STANDARD CONSTRUCTION SPECIFICATIONS

CITY OF CAÑON CITY

PREPARED BY CITY OF CAÑON CITY,

ENGINEERING DEPARTMENT

Approved December 15, 2025 (Resolution No. 23 Series of 2025)

SECTION 00010

TABLE OF CONTENTS

END OF SECTION

CONTRACTOR REQUIREMENTS

SECTION 00710

GENERAL CONDITIONS & REQUIREMENTS

PART 1

1.1 SUMMARY

A. Section Includes:

1. General Contractor Licensing Provisions.
2. Affirmative Action.
3. Excavation Permit.
4. Fees.
5. Bonding and Insurance.
6. Warranty.
    a. Product Requirements
    b. Products.
    c. Product delivery requirements.
    d. Product storage and handling requirements.
    e. Product options.
    f. Product substitution procedures.

B. Related Documents:

1. City of Cañon City Municipal Code – Chapter 5.12.
2 City of Cañon City Municipal Code – Chapter 12.12.
3. City of Cañon City Municipal Code – Chapter 13.04.
4. City of Cañon City Municipal Code – Chapter 8.70.
5. City of Cañon City – Related Codes and Ordinances.
6. Colorado Revised Statutes 24-34-301 to 308.

1.2 CONTRACTOR LICENSING

A. No person, firm, corporation, partnership, utility company, special district or other entity, unless specifically exempted herein, shall engage in the business of contractor, either general or limited, within the City of Cañon City, unless a contractor license is applied for and issued for the current year to said subject.

B. Refer to City of Cañon City Municipal Code, Chapter 5.12, Building Contractors.

1.3 NONDISCRIMINATION AND AFFIRMATIVE ACTION

A. The Contractor agrees to comply, and require all subcontractors to comply, with all provisions of the Colorado Antidiscrimination Act of 1957, as amended, C.R.S. 24-34-301 to 308, as amended, and all provisions of any other federal or state statute regarding equal employment opportunity in the performance of services rendered in accordance with this document.

1.4 PERMIT REQUIRED

A. No person, firm, corporation, partnership, utility company, special district or other entity, unless specifically exempted herein, shall close a portion of the street or sidewalk, excavate, install or repair underground utilities, install fill, construct or rebuild any pavement, concrete, curb, gutter or sidewalk in any street, alley, or Rights of Way within the City of Cañon City without first obtaining a permit from the City of Cañon City.

B. Refer to City of Cañon City Municipal Code, Chapter 12.12.

1.5 FEE SCHEDULE

A. Fees for excavation permits, inspections, tests and costs of concrete and pavement replacements:

1. Permit Fee: $70.00
2. Inspection Fee (per site visit): $100.00
3. Compaction Tests (per test): $70.00
4. Pavement and Concrete replacement costs:

Asphalt pavement < 5” Thick (design)	$15.00 / SFT
Asphalt pavement > 5” Thick (Design)	$25.00 / SFT
Reinforced Concrete Pavement	$35.00 / SFT
Curb & Gutter (install only)	$50.00 / FT
Curb & Gutter (Remove & replace)	$80.00 / FT
Concrete Flatwork, 4 inches thick	$15.00 / SFT
Concrete Flatwork, 6 inches thick	$20.00 / SFT
Concrete Flatwork, 8 inches thick	$25.00 / SFT

B. Fees for installation and testing of water mains, services, and appurtenances:

1. Standby and Inspection Fee: $100.00 / HR
   (work other than main installation)
2. Inspection of main installation: $1.00 / FT
3. Pressure test and Sampling (per test): $120.00 + $0.15 / FT

4. 3” and above- Contractor will be responsible for fees associated with hiring a third party to conduct any tap. The water department will have discretion on whether a water main may be tapped live and methods used to conduct any water tap.

5. Private Fire Hydrants

Testing and Flushing	$100.00 / EA
Private Fire Hydrant Painting	$56.00 / EA
Private Fire Hydrant Repair	$100.00 / EA + Parts
Water Modeling Fee	Fees vary based on size and complexity of project. Applicant shall cover full cost of water modeling required.

C. Fees – Street Damage Restoration Fee (SDRF):

Surface Damage Restoration Fee (SDRF) is established to encourage proactive repair of underlying roadway utilities ahead of street improvement projects to avoid the need to cut roads after significant improvements have been made.

These fees are established in addition to any other fees assigned in Section 1.5

Fees decrease based on the age of the street and are heavily weighted against newer streets to discourage cuts to those streets in the first years after an improvement.

1. Arterial/Collector Street Classification:

Street Age: 0-5 years	$15.00/SF
Steet Age >5 years and <-15 years	Max fee adjusted by the decimal form of the PCI.

Example – for a 12-year-old road with a PCI of 75: $15.00/SF X .75 PCI = $11.25 / SF

2. SDRF Fee Local Street Classification:

Street Age: 0-5 years	$12.00/SF
Steet Age >5 years and <-15 years	Max fee adjusted by the decimal form of the PCI.

3. Chip Seal Damage Fee (Chip Seal Age: 5 years old or less):

< 2500 SF	$550.00
>2500-<5000 SF	$1,100.00
>Greater than 5000 SF	$0.44/SF

a. All road cuts made while road is in the moratorium period shall have the calculated SDRF fee doubled.

b. SDRF Area will be calculated by multiplying the length of the pavement cut by the width of the pavement cut.

i. All pavement cuts must be square or rectangular patches with all edges perpendicular or parallel to traffic. No irregular shaped patches allowed.

ii. All pavement cuts on collector and arterial roadways must encompass the full lane width impacted. No partial lane cuts will be allowed.

4. Excavations in roads that the City plans to resurface or reconstruct within the following 3 years are exempt from the SDRF.

5. Multiplication Factors. Several situations with unique circumstances warranty differing multiplication factors be applied against the SDRF fees. Fees will only be subject to one (1) reduction factor and they cannot be compounded. Any patches subject to the escalating factor are only subject to that multiplier.

a. Reconstructed or newly constructed streets and paved alley ways shall be considered to have a moratorium on pavement cutting for the first 5 years. Any road cuts permitted on these streets shall have an escalating multiplier of 2 applied to the above calculated values.

b. Roads for which the previous repair was an overlay or milling and resurfacing shall be considered to have a moratorium on pavement cutting for the first 2 years. SDRF fees for cuts during the mortarium period shall be calculated as a new road. After the 2-year moratorium period, overlayed roads will be subject to SDRF in an amount of 50% the calculated values.

c. Reconstructed or newly constructed streets shall be considered to have a moratorium on pavement cutting for the first 5 years. Any road cuts permitted on these streets shall have an escalating multiplier of 2 applied to the above calculated values.

7. SDRF will be reduced by 25% if flow-fill is used to back fill trench.

8. Any inspection or testing made on any Saturday, Sunday, or holiday, or between the hours of 3:30 p.m. and 7 a.m. of any day shall require a fee of 50% higher than the fee otherwise established.

9. Some or all fees may be waived for Contractors working for the City on capital improvement projects.

10. Permit Fees for larger new developments with multiple lots and larger projects:

a. Wet Utilities (Water, storm, sewer, etc.) $70.00 X (# of residential lots/services) + $700.00 x (# of Non-residential lots/services)

b. Dry Utilities (Phone, cable, electric, etc.) $70.00 X (# of residential lots/services) + $700.00 x (# of Non-residential lots/services)

c. Paving $70.00 X (# of residential lots/services) + $700.00 x (# of Non-residential lots/services)

d. Curb and Gutter $70.00 X (# of residential lots/services) + $700.00 x (# of Non-residential lots/services)

e. Total (If all elements are appliable) $280.00 X (# of residential lots/services) + $2,800.00 x (# of Non-residential lots/services)

Each new development/project will be responsible to provide their own inspections and testing for all public infrastructure; including but not limited to (trench inspections, subgrade inspections, aggregate gradation testing, density testing, concrete testing, asphalt testing) testing and inspections shall be completed by a qualified third party and all results and reports shall be provided to the city prior to placement of new work over previous work. The third-party firm shall be required to provide a monthly summary of test results including deviations from specifications and steps taken to mitigate those deviations. A final summary report of all the work testing and conformance to specifications shall be provided prior to final acceptance of the project by the City

Where deemed necessary in the best interests of the city the developer will be responsible to provide water modeling to support large-scale development projects. The fees for this service will be assessed on a case-by-case basis in working with the selected engineer that provides water modeling services to the City.

It is at the City's discretion on which developments/projects are large enough or qualify to be considered in this manner.

1.6 BOND AND INSURANCE REQUIRED

A. As required per City of Cañon City Municipal Code – Chapter 5.12 & 12.12.

B. The limits of liability for the insurance required for work in the right-of-way shall provide coverage for not less than the following amounts or greater where required by law:

C. Certificates of Insurance shall be submitted to the City prior to commencement of work and shall name the City of Cañon City as an additional insured. All insurance policies shall remain in effect for the duration of the project or license period and shall provide for at least 30 days' written notice to the City prior to cancellation or material modification

1. CAPITAL PROJECTS

Comprehensive General Liability:

Bodily Injury

$1,000,000 Each Occurrence

$2,000,000	Annual Aggregate, Products and Completed Operation

Property Damage:

$1,000,000	Each Occurrence
$1,000,000	Annual Aggregate

Property Damage Liability insurance will provide explosion, collapse and underground coverage where applicable

(4) Personal injury with employment exclusion deleted

$1,000,000	Annual Aggregate

Comprehensive Automobile Liability:

Bodily Injury

$1,000,000	Each Person
$2,000,000	Each Accident

Property Damage:

$1,000,000	Each Occurrence

Umbrella Liability or Excess Liability:

$1,000,000	Each Occurrence
$1,000,000	Annual Aggregate

Worker's Compensation:

State:	Statutory
Applicable Federal (e.g. Longshoreman's):	Statutory
Employer's liability	$200,000

2. ROW LICENSE:

Comprehensive General Liability

Bodily Injury

$1,000,000	Each Occurrence
$2,000,000	Annual Aggregate, Products and Completed Operation

Property Damage:

$1,000,000	Each Occurrence
$1,000,000	Annual Aggregate

Property Damage Liability insurance will provide explosion, collapse and underground coverages where applicable

Personal injury with employment exclusion deleted

$1,000,000	Annual Aggregate

3. SURETY BOND REQUIREMENTS:

   a. A Performance Bond shall be required for all Right-of-Way (ROW) Licenses that include excavation. The Performance Bond shall be in accordance with CCMC Chapter 12.12:

   b. A Performance Bond shall not be required for Right-of-Way Licenses that exclude excavation.

4. GENERAL PROVISIONS:

   a. The City reserves the right to require higher limits of insurance or bonding where deemed appropriate based on the nature of the project or work performed.

   b. Contractors and licensees are responsible for ensuring that all subcontractors meet the same insurance and bonding requirements.

   c. Any subcontractor performing work within the public right-of-way (ROW) shall be required to obtain a valid City of Cañon City Right-of-Way License prior to commencing work. The prime contractor shall ensure that all subcontractors are properly licensed, bonded, and insured in accordance with these specifications. Failure of a subcontractor to obtain and maintain a current ROW license shall constitute a violation subject to enforcement and may result in suspension or revocation of the prime contractor's license or permit.

   d. Failure to maintain required insurance and bonding shall be considered a material breach and may result in suspension or revocation of the permit or license.

1.7 WARRANTY AND CORRECTION PERIOD

A. If within two years after the date of Substantial Completion, or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the City of Cañon City, any Work is found to be defective, Contractor shall promptly without cost to City of Cañon City and in accordance with City of Cañon City's written instructions: (i) correct such defective Work, or, if it has been rejected by City of Cañon City, remove it from the site and replace it with Work that is not defective, and (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom.

B. For areas in which Ordinary Backfill, Section 02060, was installed, such warranty period is extended to 5 years.

1.8 MORATORIUM PERIOD

A. Cutting of streets within the moratorium period for any reason is highly discouraged.

B. Overlaid streets shall not be cut for two years from the time the street was overlaid.

C. New or reconstructed streets shall not be cut for five years from the time the street was constructed or reconstructed.

D. Acceptance will be based on the compensation of the percent value established at the time of acceptance based on the following schedules:

1. HMA / PCC PAVEMENT THICKNESS

Thickness	Percent Reduction
> 95% Specified Thickness	0%
<95% and ≤ >90% Specified Thickness	25%
< 90% Specified Thickness	NA*

* If the overall average of core thicknesses or an area represented by one or more cores is less than 90% of the plan thickness the area must be corrected by the contractor at their expense.

2. ASPHALT OVERLAY THICKNESS

Thickness	Percent Reduction
> 88% Specified Thickness	0%
> 63% and ≤ 88% Specified Thickness	25%

3. HMA DENSITY

Density/Strength	Percent Reduction
≥ 92%	0%
< 92% but ≥ 91%	2%
≥ 90% and < 91%	5%
≥ 89% and < 90%	10%
≥ 87% and < 89%	25%
≥ 85% and < 87%	50%
≤ 85% or less	N/A*

* If the overall average of core densities or an area represented by one or more cores is less than 85% of the plan density, the area must be corrected by the contractor at their expense.

4. PORTLAND CEMENT CONCRETE

Pay Factors. The pay factor for concrete which is allowed to remain in place at a reduced price shall be determined according to Table 601-3 and shall be applied to the unit price bid.

If deviations occur in air content and strength within the same batch, the pay factor for the batch shall be the product of the individual pay factors.

Table 601-3 PAY FACTORS

Percent Total Air		Strength		
Deviations From Specified Air (%)	**Pay Factor (%)**	**Below Specified Strength (psi) [< 4500 psi Concrete]**	**Pay Factor (%)**	**Below Specified Strength (psi) [≥ 4500 psi Concrete]**
0.0-0.2	98	1-100	98	1-100
0.3-0.4	96	101-200	96	101-200
0.5-0.6	92	201-300	92	201-300
0.7-0.8	84	301-400	84	301-400
0.9-1.0	75	401-500	75	401-500
Over 1.0	**Reject**	Over 500	Reject	
			65	501-600
		54	601-700	
		42	701-800	
		29	801-900	
		15	901-1000	
		Reject	Over 1000	

E. PRODUCT REQUIREMENTS

1. PRODUCTS

a. Furnish products of qualified manufacturers suitable for intended use.

b. Furnish products of each type by single manufacturer unless specified otherwise.

c. Do not use materials and equipment removed from existing premises, except as specifically permitted by City.

d. Furnish interchangeable components from same manufacturer for components being replaced.

F. PRODUCT DELIVERY REQUIREMENTS
   1. Transport and handle products in accordance with manufacturer's instructions.
   2. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
   3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

G. PRODUCT STORAGE AND HANDLING REQUIREMENTS
   1. Store and protect products in accordance with manufacturers' instructions.
   2. Store with seals and labels intact and legible.
   3. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
   4. For exterior storage of fabricated products, place on sloped supports above ground.
   5. Provide off-site storage and protection when site does not permit on-site storage or protection.
   6. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
   7. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
   8. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
   9. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

H. PRODUCT OPTIONS
   1. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
   2. Products Specified by Naming One or More Manufacturers: products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
   3. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

I. PRODUCT SUBMITTALS
   1. Submittal required for each product to the City Engineer for review and approval. .
   2. Product submittals are required for all construction related to subdivisions, new utility main installation, and all water mains and any other project the City deems is significant enough to warrant or as required by Specifications.

J. PRODUCT SUBSTITUTION PROCEDURES

1. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
2. Document each request with complete data substantiating compliance of proposed Substitution with Specifications.
3. A request constitutes a representation that Contractor:
    a. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
    b. Will provide same warranty for Substitution as for specified product.
    c. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to City.
    d. Waives claims for additional costs or time extension which may subsequently become apparent.
    e. Will reimburse Engineer for review or redesign services associated with re-approval by City.
4. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Specifications or prior agreements and requirements.
5. Substitution Submittal Procedure:
    a. Submit substitution request for consideration. Limit each request to one proposed Substitution.
    b. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
    c. Engineer will notify Contractor in writing of decision to accept or reject request.

END OF SECTION

DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01100

SUMMARY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Scope.

B. Definitions.

C. Authority of City.

D. Work by City.

E. Plan Approval and Revision.

F. Contractor Responsibility.

G. Contractor's Use of Site.

H. Work sequence.

1.2 SCOPE

A. Specifications and requirements set forth to be used in the design and construction or repair of water mains, streets, pavements, curb and gutter, sidewalks, storm sewers, culverts, and installation of utilities or any other work performed within the public right of way for approval and acceptance by the City of Cañon City.

B. Excavation and restoration standards are required to preserve the integrity, operational safety, and function of the City rights-of-way.

1.3 DEFINITIONS

A. City: Shall mean the City of Cañon City, Colorado and personnel with the authority to act on behalf of the City of Cañon City.

B. Engineer: Shall mean the City Engineer of the City of Cañon City, Colorado and authorized representatives acting on behalf of the City or the City Engineer, including but not limited to inspectors in the field.

C. Public Works Inspector: Shall mean the Public Works Inspector of the City of Cañon City, Colorado and authorized representatives acting on behalf of the City or the Public Works Inspector.

D. Right-of-Way (ROW or R-O-W): Shall mean the area on, below, or above a public roadway, highway, street, alley, pathway, bicycle lane and public sidewalk in which the City has an interest, including other dedicated rights of ways for travel purposes and utility easements of the City.

E. Contractor: Shall mean a person, partnership, or corporation duly licensed in the City of Cañon City in accordance with the requirements of the laws and codes of the City of Cañon City.

F. Excavate: Shall mean to dig into or in any way remove or physically disturb or penetrate any part of a right of way.

G. Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, maintenance procedures, and other management practice to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, waste disposal, or drainage from material storage.

1.4 AUTHORITY OF CITY

A. City shall have authority to ascertain that all construction of facilities is equal to or better than the minimum construction requirements set forth in these specifications.

B. City and Engineer have authority to assign an inspector to check any and all work, including materials to be incorporated in the work, excavation, bedding, backfill, and all construction methods and practice.

C. Inspectors are assigned to assist the Contractor to comply with these specifications and have the authority to reject defective or inferior materials and workmanship and to suspend work until the conditions in question are corrected.

D. City Engineer shall have the authority to make final determinations on issues that are not defined or not clearly defined within this specification and any other project documents. The City Administrator shall serve as a point of appeal for any decisions by the City Engineer that are not accepted at the initial level.

E. Deviations may be requested on a case-by-case basis in writing. Deviations must be requested in advance of work to be performed with supporting documents. Cost alone cannot be the sole reason for the deviation request. Approval of requested deviation is at the discretion of the Engineer.

F. The City Engineer shall have the authority to administratively update these specifications upon review and approval by the City Administrator for any changes that do not impact fees.

1.5 WORK BY CITY

A. Work includes:

1. Approval of plans, means, and methods of construction.
2. Installation of tapping saddles, corporation stops and tapping of water mains.
3. Blowing off and testing of chlorine residual for new water mains.
4. Pressure testing of water mains to be accepted by the City.

5. Operating existing valves and appurtenances in existing system required for construction, including filling and flushing mains to be accepted by the City.
6. Notifying public of water interruption due to construction 24 hours prior to shut off.

1.6 PLAN APPROVAL AND REVISION

A. Plans shall be submitted for all development projects identified in Title 17 (Unified Development Code), all new utility main installations or replacements, all street reconstructions, and any other project the City deems is significant enough to warrant.

B. Plans shall be signed and sealed by an actively licensed Colorado Professional Engineer.

1.7 MINIMUM CONSTRUCTION DRAWING REQUIRMENTS

These are the expected standards for elements to include on a set of plans for a city construction project that requires a permit. Additions or reductions to these minimums can be required based on the specific scope of work in the opinion of the City Engineer.

A. All sheets shall be formatted for ANSI D (22" x 34"), with a 1" = 50' scale or other scale as appropriate for the specific design

B. All plans shall be submitted in PDF format, or if requested by the engineering AutoCAD (DWG) format.

C. Specific Minimum Sheets as follows:

1. Title Sheet
2. Vicinity Map with North Arrow
3. Legend
4. Name and Stamp for Engineer
5. Project Name / Numbers
6. Horizontal and Vertical Datums Utilized
11. Note Sheets
12. Project specific and city standard notes as applicable to the project
13. Typical Cross Sections
14. Existing and Proposed pavement sections with all dimensions, slopes, rights-of-way, materials, pay items, and stationing identified
15. Plan Sheets (Separate Removal, Construction, Utility, Sheets May Be Required/Utilized if Necessary)
16. Existing and Proposed Utilities (New Utilities located at preferred locations per standard detail or as otherwise approved by City Engineer)
17. Existing and Proposed Structures / Features (Pavements, sidewalks, curbs, drainage, etc....)

18. Existing and Proposed Right-of-Way
19. Existing and Proposed Property Lines
20. Existing and Proposed Easements
21. Existing and Proposed Contours (can be provided via a separate grading plan)
22. Existing and Proposed Centerline Alignment with Stationing and Horizontal Curvature Data
23. Labels as necessary for clarity
24. North Arrow
25. Pay Item designations
26. Start/Stop of all work items
27. Profile Sheets (Separate Profile Sheets for Road and Utility May Be Required/Utilized if Necessary)
    a. Existing and Proposed profile at Centerline
    b. Existing and Proposed profile at Curb or Ditches (Identify Independent Curb/Ditch Profiles)
    c. Existing and Proposed utility profiles both longitudinal and transverse to centerline
28. Stationing with Labels and Elevations
29. Hydraulic Grade Line for Storm Drainage Features
30. Drainage Structure Number, Station, Offset, Rim Elev, Casting, Invert Elev, Sump Elev, etc....
31. Vertical Curvature Information
32. Subsurface Utility Engineering (SUE)
    a. Plan and profile views of SUE conflicts in accordance with the applicable state statutory requirements.
    b. Soil Erosion and Sedimentation Control (SESC)
    c. Plan and profile views of all SESC elements as necessary to obtain the state permits and maintain compliance with all state regulations.
33. Traffic Sheets
    a. Plan View Layout showing Method of Handling Traffic
    b. Plan View Layout showing existing and proposed pavement marking and signing features with detail.
34. Detail Sheets

a. Intersection grading sheets showing tie points/elevations, radii, sidewalk ADA details, signage, drainage patterns, and other information as necessary to convey the intent of the design

b. City Standard Details

c. CDOT or Other Incorporated Standard Details

The Engineer shall return the plans with either a stamp of approval or a letter designating necessary revisions required for approval.

No work shall proceed on that portion of the project requiring revisions until such revisions have been submitted and approved.

Minor revisions may be made by written permission from the Engineer.

Upon completion of the project a set of As-Builts drawings signed and sealed by a Colorado Professional Engineer shall be provided to the City. Contractor shall be responsible to develop the As-Built drawings.

1.8 CONTRACTOR RESPONSIBILITY

A. Contractor shall be responsible to read and fully comply with all the provisions of these specifications.

B. Contractor shall perform work in a manner subject to current Occupational Safety and Health Administration and State of Colorado safety requirements. It shall be the responsibility of the Contractor to fully comply with these regulations.

C. Contractor shall provide adequate construction signing, flagmen, barricades, etc., to warn vehicular and pedestrian traffic of work in progress and divert traffic as may be required during the course of the construction per approve traffic plan. All signing shall conform to the Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices (MUTCD). Contractor shall notify the respective local emergency response agencies 24 hours in advance of the closure of any street.

D. Contractor shall notify the City of Cañon City Water Distribution Supervisor at least 72 hours prior to a planned water service interruption.

E. Contractor shall notify the City Engineer at least 72 hours prior to any work within the right-of-way or lane restrictions.

F. Contractors or Owners for non-publicly financed capital projects shall pay City for all expenses required of City personnel due to inspection and testing of construction activities unless otherwise stipulated in the development agreement.

G. Contractor shall protect all existing facilities and utilities within the work area and shall be liable for any damage to any such facilities and utilities due to Contractor's activities. Any damage shall be repaired to the satisfaction of the Engineer and the Utility Owner.

1.9 CONTRACTOR'S USE OF SITE

A. Limit use of site to allow:

1. City occupancy.
2. Work by City.
3. Use of site by the public.

1.10 WORK SEQUENCE

A. Construct Work in stages to accommodate City’s occupancy requirements during construction period. Coordinate construction schedule and operations with Engineer.

PRODUCTS

Not Used.

EXECUTION

Not Used.

END OF SECTION

SECTION 01700

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Contractor Responsibilities.

B. Construction Facilities.

C. Construction schedule, testing, and inspections.

D. Control of vehicular and pedestrian traffic.

E. Protection of Utilities.

F. Discovery of historical items.

G. Construction site erosion.

H. Cleaning & site maintenance.

I. Protecting installed construction.

J. Closeout procedures.

1.2 CONTRACTOR RESPONSIBILITIES

A. Contractor shall obtain a ROW permit with the City of Cañon City prior to the beginning of any work operations within the City rights of way including work that does not require a license but requires use of the right of way to complete.

B. Contractor shall be a licensed, insured, and bonded contractor with the City of Cañon City.

C. Contractor shall assume responsibility for disposing of removed vegetation, tree material, soil, asphalt, concrete, and other surplus materials at an acceptable site at Contractor's expense.

D. Contractor shall assume responsibility for performing all work in a workmanlike manner with due care being taken to avoid unnecessary damage to property. Contractor shall be responsible for all damage resulting from carelessness or work performed in an irresponsible or unworkmanlike manner.

E. Contractor shall obtain all utility locates prior to excavating and shall be liable for all damages to existing structures and utilities and shall save the City harmless for any liability or expense for injuries, damages, or repairs.

F. Contractor shall perform all work not covered in the Specifications to applicable industry standards.

G. Contractor shall conform to all applicable State and local Codes and Ordinances.

H. Contractor shall provide all construction surveying and/or staking as deemed necessary to complete the project as intended per the Specifications and approved plans

1.3 CONSTRUCTION FACILITIES

A. Provide and place all traffic control signs, barricades, and devices during the total construction time of the work, including time for concrete curing. Temporary fencing or other adequate measures to control pedestrian access to construction area shall be maintained.

B. Contractor's construction activities are restricted to the area within the City rights of way and City owned property boundaries as near as practical and within any specified construction easements within private property, which are obtained by the City or the Contractor. Access must be maintained for property owners and residents and their business patrons to and from private property within the site.

C. Protect all private and public property located within the construction site. All property disturbed by Contractor during construction will, at Contractor's expense, be repaired or replaced and left in as good a condition as originally found.

D. All temporary utilities such as electricity, sanitation services (when practical these facilities should be located outside of the public way and screened from public view), heating, or other services required for construction and other facilities such as safety equipment, fire extinguishers, warning signs, lights, or special equipment shall be supplied as needed by the Contractor at his expense.

E. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment. Protect site from puddling or uncontrolled running water. Provide sumps, water barriers as required to protect site from soil erosion and other potential damage to work, such as storm water accumulating on site from upstream.

F. Contractor shall be responsible to provide the City written permission for the use of any non-publicly owned property utilized during the completion of a project. This includes yard and material storage areas.

1.4 CONSTRUCTION SCHEDULE, TESTING, AND INSPECTIONS

A. At least 72 hours prior to the start of any work, Contractor shall furnish a submittal of construction schedule to facilitate scheduling required inspections according to the specifications and to minimize the Contractor's wait time.

B. Reports will be submitted by independent firm or City representative to Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements. Testing does not relieve Contractor from performing Work to requirements.

C. Retesting required because of non-conformance to specified requirements shall be performed by the Engineer or their designated representative and will be done at Contractor's expense.

D. Contractor shall be responsible for supplying the City of Cañon City, at the Contractor's expense, with suitable soils tests from a licensed independent soils testing laboratory, with gradation and proctor density data for any material used in the work for backfill.

E. Contractor shall be responsible for obtaining three soil tests of the existing sub grade material from a licensed independent soil testing laboratory, with gradation, Proctor density data, and shrink/swell measurements prior to pavement installation. for concrete pavement installation. Any materials found with swell results above 2% shall require pre-treatment. Additional testing shall be repeated at the direction of the Public Works Inspector or Engineer at Contractor's expense if necessary to reflect changing soil conditions.

F. Contractor may (or as required in other portions of the specification), at its expense, employ the services of an independent testing service to test the base course and pavement during and after installation.

G. On publicly led projects the City will employ an independent inspection laboratory to take random core samples of finished HMA pavement to be measured for thickness and density or finished PCC pavement for thickness & strength. Final acceptance will be based on the average thickness and density/strength determined by the core samples.

1.5 CONTROL OF VEHICULAR AND PEDESTRIAN TRAFFIC

A. Contractor shall be permitted to close the roadways to traffic during construction activities, if it is necessary. Contractor shall provide the Engineer with a minimum of 7 calendar days' notice prior to closing of any arterial & collector streets and 72 hours' notice for local streets. An approved Traffic Control plan shall be required in advance should an arterial or collector road need to be closed

B. Contractor shall accommodate adjacent property owners and businesses by providing access and parking within the street right-of-way as near to properties as possible, except during paving operations when residents will be expected to walk.

C. Contractor shall be fully responsible for providing qualified personnel to provide and place all traffic control signs and devices during the total construction time of the project.

D. Contractor shall provide traffic control that shall conform to the intent and instructions provided by the Engineer, the City of Cañon City Public Works Department and the Manual of Uniform Traffic Control Devices (MUTCD).

E. Contractor shall submit a prepared traffic control plan prepared by a Certified Traffic Control Supervisor and tentative schedule for arterial and collector streets to the Engineer for approval prior to the start of any work on the project site, unless otherwise required by the Engineer or Public Works Inspector.

F. Contractor is responsible for notifying Police Department, Fire District, Dispatch Center, School District and all emergency and ambulance service providers of any street closures or blockages, due to construction, prior to beginning any such activity. Contractor shall also maintain the means at all times to provide emergency access routes to all properties located along the construction site when needed.

G. Contractor required to notify affected property owners of street closures 72 hours in advance of project star

1.6 PROTECTION OF UTILITIES

A. The Contractor shall protect all public utilities encountered. These may include telephone lines, culverts, buried cables, power lines, water lines, sewer lines, irrigation laterals, gas lines and other overhead and underground utilities.

B. Before any excavation or work is begun in the vicinity of the above-named utilities, each utility company or department concerned must be notified in advance of such work, and such work shall not be done until an authorized representative of the utility concerned is on the premises.

C. The Contractor shall be held liable for all damages to any and all public utilities encountered on this project, which damages are due to the Contractor's operations. Such damages shall include all physical damages to utilities and also all damages due to the interruption of service of such utilities, when such damages and interruptions are caused by the Contractor's operations.

D. Where alterations or moving of utilities is not required to permit construction of the work, the Contractor shall take such measures as the utility entity may direct to properly protect these utilities throughout his construction activities and shall cooperate at all times with the proper authorities and/or Owner in maintaining service of the above-named utilities affected by the work.

E. The cost of damages due to the Contractor's operations, the cost of moving water or sewer service lines and the cost of protecting the utilities, where alteration or moving is not required to permit construction of the work, shall be paid for by the Contractor.

F. Should any pipelines, water lines, gas mains, electrical conduits, sewer pipes, overhead wiring, telephone lines, buried cables, power lines, or any other such utilities not specifically mentioned and provided for elsewhere as a part of this document, have to be moved, repaired, reconditioned or revised due to construction, or moved temporarily to permit construction of work, the party or parties owning and operating such utilities shall perform the actual work of moving, repairing, reconditioning or revising such utilities, unless other agreements are reached with the utility companies involved.

1.7 DISCOVERY OF ARCHAEOLOGICAL AND OTHER HISTORICAL ITEMS

A. In the event of an archaeological find during any phase of construction, the following procedure will be followed:

B. Construction shall be halted, with as little disruption to the site as possible.

C. The Contractor shall notify the City who shall contact the State Historic Preservation Officer

D. The State Historic Preservation Officer may decide to have an archaeologist inspect the site and make recommendations about steps needed to protect the site, before construction is resumed.

E. The entire event should be handled as expediently as possible in order to hold the loss in construction time to a minimum while still protecting archaeological find.

1.8 CONSTRUCTION SITE EROSION AND SEDIMENT CONTROL MEASURES

A. See Section 02374.

B. Contractors and subcontractors must implement Best Management Practices (BMPs) to reduce pollutants in any storm water runoff from construction activities that result in a land disturbance of greater than or equal to one acre. Reduction of pollutants in storm water discharges from construction activity disturbing less than one acre must be included in the program if that construction activity is part of a larger common plan of development or sale that would disturb one acre or more. Contractors are further required to control construction site waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality. These activities must be in compliance with all applicable State and local laws and regulations.

C. Where appropriate, the Contractor's efforts shall reflect the following engineering principles:

D. When appropriate, land grading and excavating should be kept at a minimum to reduce the possibility of creating runoff and erosion problems that require extensive control measures.

E. Whenever possible, topsoil should be removed and stockpiled before grading begins.

F. Land exposure should be minimized in terms of area and time.

G. Exposed areas subject to erosion should be covered as quickly as possible by means of mulching or vegetation.

H. Natural vegetation should be retained whenever feasible

I. Early completion of stabilized drainage system (temporary or permanent) will substantially reduce erosion potential.

J. Appropriate structural or agronomic practices to control runoff and sedimentation should be provided during and after construction.

K. Roadways and parking lots should be paved or otherwise stabilized as soon as feasible.

L. Clearing and grading should not be started until a firm construction schedule is known and can be effectively coordinated with the grading and clearing activity

1.9 CLEANING & SITE MAINTENANCE

A. Public streets within the work site must be cleaned and swept on a daily basis or otherwise, according to the discretion of the Engineer. Anytime during the course of the Work, Contractor shall, at the discretion of the Engineer, wash, sprinkle, or wet down streets or alleys, including areas affected by work detours and construction traffic.

B. Clean-up of site shall be completed prior to requesting final inspection.

C. Clean debris from right of way and drainage systems on a routine basis, or otherwise as directed by the Engineer.

D. Clean site; sweep paved areas, rake clean landscaped surfaces; provide access at all driveways and cross streets as needed during construction to maintain the site and provide access.

E. Remove waste and surplus materials, rubbish, and construction facilities from site prior to requesting final inspection.

1.10 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Prohibit traffic on newly paved surfaces.

D. Prohibit traffic from landscaped areas.

E. Contractor is responsible to repair damage that occurs due to inadequate protection.

1.11 RESTORATION

A. All excavations and improvements not otherwise specified shall be completely restored within a period of twenty-one days subsequent to acceptance of backfill and compaction unless otherwise approved by the Engineer.

B. If restoration is not complete by the end of the required time, the City will schedule to complete the restoration at Contractor's expense, after a nine-day advance notice to Contractor.

C. The cost of such restoration by the City will be double the replacement cost plus an additional inspection fee and compaction fee as outlined in Section 00710.

Restoration during times of inclement weather may be delayed at the direction of the Public Works Inspector. Temporary measures may be implemented, including but not limited to a cold asphalt patch to be replaced when weather permits.

1.12 CLOSEOUT PROCEDURES

A. Contact City for final inspection. Complete any corrections from punch list.

B. Provide submittals required by City to Engineer.

C. Pay any outstanding inspection and permit fees.

D. Provide as-built plans required by City to Engineer:

1. As-built plans shall be submitted for all projects that were originally reviewed and approved by the City Engineer.

2. PDF Copies shall be submitted for any As-Built Plans or AutoCAD at the request of the Engineer.

3. As-Built plans shall consist of a full set of the original approved construction drawings sealed by the engineer of record inclusive of all necessary updates and changes.

4. Captured changes shall include at a minimum:

a. Changes to drainage patterns

b. Changes to underground feature layout and alignment

c. Final Rim/Invert elevations

d. Changes to the roadway alignment

e. Major changes to the roadway profile

f. Changes to the project typical pavement sections

g. Other items as requested by the Engineer

PRODUCTS

Not Used.

EXECUTION

Not Used.

END OF SECTION

DIVISION 2 – SITE CONSTRUCTION

SECTION 02060

AGGREGATE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Coarse aggregate materials.
2. Fine aggregate materials.
3. Blended aggregate materials.
4. Rip Rap

B. Related Sections:

1. Section 02320 - Backfill.
2. Section 02324 - Trenching.
3. Section 02512 - Water Distribution.
4. Section 02630 - Storm Drainage.
5. Section 02721 - Aggregate Base Course.
6. Section 02740 - Flexible Pavement.
7. Section 02750 - Rigid Pavement.
8. Section 03300 - Cast-in-Place Concrete.

1.2 REFERENCES

A. Colorado Department of Transportation:

1. Current CDOT Standard Specifications for Road and Bridge Construction.

B. American Association of State Highway and Transportation Officials:

1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
2. AASHTO T-24- Unconfined Compressive Strength of Drilled Core Specimen

C. American Society for Testing and Materials:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM C535- Abrasion Resistance by Los Angeles Machine
5. Municipal Government Engineers Pavement Council – Current Specifications

1.3 SUBMITTALS

A. Materials Source: Submit name of imported materials suppliers.

B. Copies of all Proctor density curves and test results showing exact location of sample collection and test sites must be furnished to Engineer.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with City of Cañon City standard.

C. Maintain one copy of each document on site.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

A. Coarse Aggregate Type Class 6 (Road Base) per the current CDOT Standard Specifications for Construction.

B. Coarse Aggregate Type A1: No. 67 (Gravel) per the current CDOT Standard Specifications for Construction.

2.2 FINE AGGREGATE MATERIALS

A. Fine Aggregate Type A2 (Sand) per the current CDOT Standard Specifications for Construction

2.3 BLENDED AGGREGATE MATERIALS

A. For use only as directed by Engineer. Also, see 1.9 Special Considerations, Section 00710 and 2.1 Fill Materials, Section 02324.

B. Blended Aggregate Type A3 (Ordinary Backfill or Select Borrow Material):

C. Ordinary Backfill - on-site material that has been excavated from the trench, which may actually contain soil, except for rubbish, frozen material, broken pavement, large stones, or other consolidated material greater than 3 inches in diameter, organic muck, or other materials

considered deleterious by Engineer. Expansive clays of a plastic nature will not be considered suitable.

D. Select Borrow Material - well-graded mixture of sound mineral aggregate containing sufficient, proper bonding material which may include recycled materials, within the following limits:

Sieve Size	Percent Passing
No. 4	100
No. 10	80
No. 200	5 to 15

2.4 RIP RAP

A. Rip Rap shall consist of hard, dense, and durable stone, angular in shape and resistant to weathering. Rounded stone or boulders shall not be used as rip rap material. The stone shall have a specific gravity of at least 2.5. Each piece shall have its greatest dimension not greater than three times its least dimension. Rip rap shall conform to Current CDOT Standard Specifications for Road and Bridge Construction,

2.5 SOURCE QUALITY CONTROL

A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D698.

B. Fine Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D698.

C. Blended Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D698.

D. Rip Rap – Testing and Analysis: ASTM C 535 LA Abrasion and AASHTO T-24.

E. When tests indicate materials do not meet specified requirements, change material and retest.

F. Testing shall use the Standard Proctor method. Alternatives such as Modified Proctor or Relative Density based on necessity due to material type may be used with the permission of the Engineer so long as the necessary conversion data, testing, and information has been completed and submitted prior commencement of the work.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate aggregate materials from on-site locations indicated when directed by Engineer as specified in Section 02315 and Section 02324.

B. Stockpile excavated material meeting requirements for aggregate materials when directed by Engineer.

C. Remove excess excavated materials, not intended for reuse, from site.

3.2 STOCKPILING

A. Stockpile materials on site at locations designated by Engineer.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

E. Stockpile unsuitable or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

F. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 02222

DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolishing designated structures within City rights of way.
2. Protecting items designated to remain.
3. Removing demolished materials.

B. Related Sections:

1. Section 02060 - Aggregate.
2. Section 02315 - Excavation.
3. Section 02320 - Backfill.

1.2 QUALITY ASSURANCE

A. Conform to applicable code for demolition of structures, safety of adjacent structures, dust control, runoff control, and disposal.

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

D. Perform Work in accordance with the City of Cañon City standards.

1.3 QUALIFICATIONS

A. Demolition Firm: Company specializing in performing work of this section with documented experience.

1.4 PRE-DEMOLITION MEETINGS

A. Convene minimum one day prior to commencing work of this section.

1.5 SCHEDULING

A. Schedule Work to precede site excavation work and new construction.

B. Describe demolition removal procedures and schedule.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Document condition of adjacent structures indicated to remain.

B. Make arrangements with adjacent property owners and Engineer to survey existing surrounding structures and property.

3.2 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location of utilities.

C. Do not close or obstruct roadways, sidewalks, or hydrants without permission.

D. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.

E. Protect existing landscaping materials, trees, appurtenances, structures, and fences indicated to remain.

F. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

3.3 DEMOLITION REQUIREMENTS

A. Use of explosives is not permitted.

B. Conduct demolition to minimize interference with adjacent structures. Cease operations immediately when adjacent structures appear to be in danger. Notify authority having jurisdiction and Engineer. Do not resume operations until directed.

C. Conduct operations with minimum interference to public or private accesses. Maintain egress and access for adjacent property at all times.

D. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

E. Sprinkle Work with water to minimize dust. Provide hoses and water connections required for this purpose.

F. Provide other equipment as necessary to complete demolition work including, but not limited to, steel and concrete cutting equipment, pneumatic concrete breakers, anchoring devices, excavation, loading, lifting, and public safety equipment.

3.4 DEMOLITION

A. Remove designated structures within area of new construction.

B. Remove materials to be re-installed or retained in manner to prevent damage. Store and protect in accordance with requirements of Section 01600.

C. Backfill areas excavated due to demolition, in accordance with Section 02320.

D. Rough grade and compact areas affected by demolition to maintain site grades and contours. Grading shall not negatively impact adjacent properties.

E. Continuously clean-up and remove demolished materials from site. Do not allow materials to accumulate on site.

F. Do not burn or bury materials on site. Leave site in clean condition.

END OF SECTION

SECTION 02315

EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating for curb and gutter.
2. Excavating for paving, roads, and parking areas.
3. Excavating for slabs-on-grade, including cross-pans.
4. Excavating for site structures.
5. Excavating for sidewalks.

B. Related Sections:

1. Section 02721 - Aggregate Base Course.
2. Section 02740 - Flexible Pavement.
3. Section 02750 - Rigid Pavement.
4. Section 03300 - Cast-in-Place Concrete.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with City of Cañon City Standards.

B. Perform work to local utility standards when working within 2 feet of utility lines.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location of utilities.

C. Perform utility potholing to positively identify size, depth and alignment of buried utilities. In accordance with the current sub-surface utility regulations.

D. Identify required lines, levels, contours, and datum.

E. Notify utility companies to remove and relocate utilities.

F. Protect utilities indicated to remain from damage.

G. Protect plant life, lawns, landscaping, driveways, and other features that are to remain.

H. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.2 EXCAVATION

A. Excavate subsoil to accommodate slabs-on-grade, paving, sidewalks, curb and gutter, cross-pans, culvert, drain inlets and construction operations.

B. Remove old concrete, pavement, and related debris and dispose of in an approved disposal site. Interior sections to be removed shall be saw-cut at sufficient depth at control joints, or where designated, to avoid breaking, disturbing, or chipping adjacent concrete or pavement. Saw-cut, remove, and replace the existing asphalt pavement a minimum of 1-foot from the curb and gutter unless the pavement is determined to be in "sound" condition as determined by the Engineer.

C. Exposed edges of existing sidewalk shall be ramped as necessary to provide a reasonably safe and accessible walkway if excavation is to be left open for any length of time prior to reconstruction.

D. Remove all disturbed load bearing soil, which no longer has its original bearing capacity.

E. Grade top perimeter of excavation to prevent surface water from draining into excavation.

F. Trim excavation. Remove loose matter.

G. Remove lumped subsoil, roots, stumps, loose dirt, broken asphalt or concrete, boulders, and large rock.

H. Notify Engineer of unexpected subsurface conditions.

I. Correct areas over-excavated with material as directed by Engineer.

J. Remove excess and unsuitable material from site.

K. Repair or replace items indicated to remain damaged by excavation.

3.3 FIELD QUALITY CONTROL

A. Request visual inspection of bearing surfaces by Engineer or Public Works Inspector before installing subsequent work.

3.4 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 02320

BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backfilling site structures to subgrade elevations.
2. Fill under structures.
3. Fill for over-excavation.

B. Related Sections:

1. Section 02060 – Aggregate
2. Section 02315 - Excavation.
3. Section 02324 – Trenching
4. Section 02512 – Water Distribution
5. Section 02630 – Storm Drainage
6. Section 03300 – Cast-in-Place Concrete

1.2 REFERENCES

A. Colorado Department of Transportation:

1. Current CDOT Standard Specifications for Road and Bridge Construction.

B. American Society for Testing and Materials:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
4. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
5. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material Cylindrical Test Specimens
6. ASTM D6103 - Standard Test Method for Flow Consistency of Controlled Low Strength Material
7.

1.3 SUBMITTALS

A. Materials Source: Submit name of imported materials suppliers.

B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Road Base: Type Class 6 as specified in Section 02060.

B. Ordinary Backfill: Type A3 as specified in Section 02060, only as directed by Engineer.

C. Stabilizing Material: Minimum of 1 ½ inch, uniformly graded, clean rock, or as directed by Engineer.

D. Rip Rap: Stone Size; d50=12" minimum or larger as directed by Engineer.

Structural Backfill: Flow Fill / CLSM (Controlled Low Strength Material): Structural Backfill that meets the requirements of Current CDOT Standard Specifications for Road and Bridge Construction, A mix design submittal indicating the product meets CDOT requirements shall be provided for review and approval by the Engineer prior to placement.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify subgrade is suitable for placement of backfill.

B. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material

3.3 BACKFILLING

A. Backfill areas to contours and elevations with unfrozen materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Place aggregate in maximum 8 inch layers and compact to 95 percent, maximum dry density, ASTM D698, Standard Proctor, except for the top 4 feet of trench, which shall be compacted to 97 percent, maximum dry density, ASTM D698, Standard Proctor. Lift size may be

increased when it is demonstrated that compaction requirements can be met using other methods. The Engineer will make final determination on the thickness of each lift in the field.

D. Use smaller mechanical tamping equipment in areas inaccessible to compaction equipment.

E. Place fill material in continuous layers and compact in accordance with schedule at end of this section.

F. Employ placement method that does not disturb or damage other work.

G. Maintain optimum moisture content of backfill materials to attain required compaction density.

H. Backfill against supported walls. Do not backfill against unsupported walls.

I. Backfill simultaneously on each side of unsupported walls until supports are in place.

J. Make gradual grade changes. Blend slope into level areas.

K. Remove surplus backfill materials from site.

L. Leave fill material stockpile areas free of excess fill materials.

M. Rip rap shall be placed and stacked in manner that creates a stable slope that will not impede flow of water.

3.4 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

A. Compaction Testing: In accordance with ASTM D698.

B. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

C. Compaction Testing for Bedding and Backfill:

1. Contractor is required to hire an independent, licensed engineer experienced in soil analysis and evaluation to perform required compaction tests in accordance with ASTM D698. Furnish copies of all Proctor curves and test results showing exact location of sample collection and test sites to Engineer. Engineer shall be informed prior to testing and he may designate areas of testing.

2. Performed by City personnel or Contractor at option of Engineer in accordance with ASTM D698.

3. Testing is to be done at various elevations in trench, which may require excavation by Contractor after backfill is installed.

4. Frequency of Compaction Tests will be specified by Engineer in field but shall be no less than every 200 feet at every 1 foot of depth of the backfill or anytime the means and methods of compaction change.

5. For trenches greater than 4 feet in depth, compaction effort shall be visually observed based on an initial test to determine a best means and methods of compaction that can subsequently be used for trench side observation. A new initial test shall be performed, whenever backfill materials or means and methods of compaction change.

6. Testing shall use the Standard Proctor method. Alternatives such as Modified Proctor or Relative Density based on necessity due to material type may be used with the permission of the Engineer so long as the necessary conversion data, testing, and information has been completed and submitted prior commencement of the work.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.6 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

B. All areas showing signs of settlement shall be filled and maintained by Contractor during all construction phases and for a period of two years following the date of final acceptance, except areas where Ordinary Backfill, Section 02060, was installed, for which the period is extended to 5 years.

C. When Contractor is notified by the City or Engineer that any backfill is hazardous, the condition shall be corrected at once.

3.7 SCHEDULE

A. Fill Behind Abutment and Wing Walls:

1. Fill Type Class 6, from bottom of excavation to top of walls, compact uniformly to 97 percent of maximum density.

B. Fill Wing Walls (ditch side):

1. Fill Rip Rap, from ditch bottom to top of adjacent disturbed soil, stacked tight and stable.

C. Fill Under Footings, Inlets, Manholes, Vaults, and other Concrete Structures:

1. Fill Flow Fill, 18 inch thick to required elevations for the width of the footing.

2. See Section 02630.

D. Fill Under and Around Cast in Place Concrete:

1. See Section 03300.

E. Fill Over and Around Utilities:

1. See Section 02324, 02512, 02630

F. Fill to Correct Over-excavation and Unstable Subgrades:

1. Flow Fill, flush to required elevation, or material as directed by Engineer compacted uniformly to 97 percent of maximum density.

3.8 SPECIAL CONSIDERATIONS

A. Backfill Specification- Trench Work Performed by, or on behalf of through contract, Governmental Utilities: Ordinary Backfill, as defined in Section 02060, may be used above the pipe zone and up to within 24 inches of the gravel surface in unpaved alleys. All Ordinary Backfill installation and compaction shall be subject to the terms and conditions of current City of Cañon City Standard Construction Specifications, specifically Sections 02060, 02320, and 02324.

END OF SECTION

SECTION 02324

TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for site utility lines including domestic water lines.
2. Compacted fill from top of utility bedding to top of trench.
3. Backfilling and compaction of trenches.

B. Related Sections:

1. Section 00710 – General Conditions & Requirements
2. Section 02060 – Aggregate
3. Section 02446 – Horizontal Directional Drilling
4. Section 02512 – Water Distribution
5. Section 02740 – Flexible Pavement
6. Section 02750 – Rigid Pavement
7. Section 03300 – Cast-in-Place Concrete

1.2 REFERENCES

A. Colorado Department of Transportation:

1. Current CDOT Standard Specifications for Road and Bridge Construction.

B. American Society for Testing and Materials:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb f/ft3 (600 kN-m/m3)).
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb f/ft3 (2,700 kN-m/m3)).

5. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
6. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material Cylindrical Test Specimens
7. ASTM D6103 - Standard Test Method for Flow Consistency of Controlled Low Strength Material
8. Environmental Protection Agency (EPA)
9. International Building Code (IBC)
10. Occupational Safety and Health Administration (OSHA)

1.3 DEFINITIONS

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

1.4 SUBMITTALS

A. Obtain City of Cañon City Excavation Permit prior to any excavation.

B. Excavation Protection Plan: as required by applicable codes, laws, and standards.

C. Materials Source: Submit name of imported fill materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with City of Cañon City and industry standards.

B. Maintain one copy of each required document on site.

C. Any imported material must be free of hazardous and organic wastes, “clean” as defined by EPA, and approved for its intended use by the City or project Geotechnical Engineer.

1.6 QUALIFICATIONS

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

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to work.

1.8 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

B. Verify locations, types, and sizes of existing facilities that will be integrated with project Work.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Road Base: Type Class 6 as specified in Section 02060.

B. Stabilizing Material: Minimum of 1 ½ inch, uniformly graded, clean rock, or as directed by Engineer.

C. Blended Aggregate: Type A3 as specified in Section 02060. This backfill shall be allowed under new streets in approved subdivisions. The project geotechnical engineer shall design all backfill. The developer's engineer shall provide oversight of installation and compaction including compaction testing. Native soil shall be allowed for the top 2 feet of trench backfill when trench is under an open drainage/irrigation channel for the purpose of sealing the channel and minimizing leakage.

D. Flow-Fill: Structural Backfill that meets the requirements of Current CDOT Standard Spec

PART 3 EXECUTION

3.9 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.

1. Engineering the reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

2. Use staking for alignment and elevation of water mains to establish lines and grades.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.

C. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities indicated to remain.

E. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

F. Prior to excavation in paved areas, the pavement shall be cut in such a manner as to effect a smooth, straight edge and a vertical face 6 inches minimum beyond the trench wall.

3.2 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. Maintain service to existing pipelines and utilities indicated on Drawings during construction.

C. Backfill will be placed and compacted so as to prevent future settlement or damage to existing utilities, structures, and new work.

D. Any excavations improperly backfilled or where settlement occurs will be reopened to the depth required then refilled with approved materials and compacted, as well as the surface restored to the required grade and condition, at no additional cost to the City.

E. 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 Engineer or utility owner, will be borne by the Contractor at no additional expense to the City.

3.3 TRENCHING

A. Excavate subsoil by open cut to the depth required, unless written permission is given by Engineer to do otherwise, for utilities at the required locations.

B. Remove lumped subsoil, boulders, organic material, and rock as well as all mud and muck encountered.

C. When rock or hard clay is encountered, the trench shall be over-excavated 6 inches.

D. Excavation performed within 24 inches of existing utility service shall be done in accordance with utility's requirements.

E. Do not advance open trench more than 200 feet ahead of installed pipe, unless Engineer determines a shorter length is necessary for the safety of the public.

F. Cut trenches to the width necessary to permit the pipe to be laid, jointed properly, inspected, and backfilled properly. No trench shall have a width of less than the diameter of the pipe plus 12 inches. The maximum clear trench width, measured 1 foot above the top of the pipe barrel shall not be greater than that shown in the following table unless otherwise specified:

Pipe Diameter (in)	Minimum Trench Width (in)	Maximum Trench Width (in)
6	18	26
8	20	28
10	24	30
12	24	32
16	32	36
20	36	44
24	42	48
30	48	56
36	54	64

G. 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
4. When maximum trench widths are exceeded and Engineer determines that the design load limits of the pipe are exceeded, the Contractor will be required to either cradle the pipe in concrete or to use a pipe of a stronger class.

G. Dewatering

1. All dewatering activities in accordance with all federal, state, and local regulations regarding site drainage, dewatering, and erosion and sediment control including permitting requirements
2. Remove water or materials that interfere with Work. Contractor shall provide and maintain at all times ample means and devices to promptly and properly dispose of all water entering trench excavation. Water shall be disposed of in a suitable manner without damage to adjacent property or without a menace to public health and convenience. Unless authorized, in writing, trench water shall not be allowed to enter any water or sewer lines. Protect pipeline against damage from water in the event of a storm or pump failure.
3. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary to these purposes, lower water level in advance of excavation, utilizing wells, wellpoints, jet educators, or similar positive methods
4. Keep each excavation dry during subgrade preparation and continually thereafter until the structure to be built or the pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result
5. Dewater excavations which extend to or below groundwater by lowering and keeping the groundwater level beneath such excavation at least 12 inches below the bottom of the excavation
6. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head
7. Dewatering to surface waterways requires 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.
8. Contractor will be solely responsible for the design, installation, operation, maintenance, and any failure of any component of the system

9. Dewatering will be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted
10. 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 support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance
11. 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 Owner
12. 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
13. Remove dewatering equipment from the site, including related temporary electrical service
14. Wells will be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction
15. Excavate trenches to depth indicated on Drawings. The trench shall be excavated to a depth below the established grade equal to 1/8 the outside diameter of the pipe, but not less than 4 inches. Provide uniform and continuous bearing and support for bedding material and pipe. A continuous trough shall be excavated to receive the bottom quadrant of the pipe barrel and bell ends. Excavate adequate space for required restraints, valves, and fittings prior to placing pipe in trench.
16. Do not interfere with the bearing soil of foundations of existing structures.
17. When Project conditions permit, slope side walls of excavation starting 1 foot above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.
18. When subsurface materials at bottom of trench are loose, soft, or otherwise unsuitable, excavate to greater depth as directed by Engineer until suitable material is encountered. It shall be replaced, as directed by Engineer, with approved backfill material and methods to provide a suitable foundation for the pipe, which may include 1 ½ inch clean rock.
19. Trim excavation. Remove loose matter.
20. Correct areas over-excavated with compacted backfill as specified for authorized excavation as directed by Engineer.
21. Remove excess subsoil, not intended for reuse, from site. Top soil shall be removed and piled separately for use in finish grading the site. Excavated material that is suitable for

backfilling shall be piled in an orderly manner, a sufficient distance from the trench to avoid over-loading and to prevent slides or cave-ins.

22. Boring, Tunneling, and Jacking:
    a. Reference Section 02446 for Horizontal Directional Drilling requirements.
    b. Written permission by Engineer is required prior to commencing work.
    c. Tunneling will not be permitted for distances greater than 10 feet
    d. Tunneling will not be allowed under curb and gutter, walks, cross pans or pavement.
    e. When jacking is required, only persons experienced in such work, using suitable equipment, shall perform the operation.
    f. Flow-fill shall be used as backfill under any structure that has had material excavated from beneath them, been jacked, or for any tunnel.

3.4 SHEETING AND SHORING

A. All sheeting, shoring, and bracing shall be in accordance with OSHA and IBC requirements.

B. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

C. If sheet pile cut off walls are required, submit design calculations, stamped by a Colorado licensed Professional Engineer

D. Contractor will be solely responsible for proper design, installation, operation, maintenance, and any failure of any system component

E. Engineer review of Contractor's design and data does not relieve the Contractor from full responsibility for errors or from the entire responsibility for complete and adequate design and performance of the sheeting, shoring and bracing system

F. Design, furnish, build, maintain and subsequently remove, to extent required a system of temporary supports for 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 rights-of-way, or as otherwise specified or indicated in the 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, maintain shape and position under all circumstances.

G. 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.

H. 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.

I. Contractor will make their own assessment of existing conditions including adjacent property, the possible effects of their 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.

J. Do not pull trench sheeting before backfilling.

K. 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.

L. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment is completed.

M. Contractor shall repair all damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil at no additional cost to the City.

N. Contractor shall repair any damage to new and existing Work from settlement, water, earth pressure, or other causes resulting from inadequate sheeting, shoring, or bracing at no additional cost to the City.

3.6 BEDDING

A. Bedding installation and material shall be in accordance with the utility's specifications. All water lines shall be bedded using coarse aggregate or fine aggregate as specified in Section 02060 – Aggregate.

3.7 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen, non-organic, or otherwise suitable fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place fill material in continuous layers and compact in accordance with City of Cañon City Standard Detail. Flow-fill may be used from 4 inches above the pipe barrel to the top of the trench.

D. 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.

E. Compact backfill material to 95 percent, maximum dry density, ASTM D698, Standard Proctor, except for the top 4 feet of the trench, which shall be compacted to 97 percent, maximum dry density, ASTM D698, Standard Proctor.

F. Lifts will not exceed 8 inches in depth unless a sheep's foot compactor or a hydraulic plate compactor (headshaker) mounted on excavation equipment of adequate size is used. Lift size may be increased by using this compaction equipment when it is demonstrated that compaction requirements can be met. Engineer will make final determination on the thickness of each lift in the field. Only equipment designed for the purposes of compaction shall be used.

G. Employ placement method that does not disturb or damage utilities in trench, and other existing structures or facilities.

H. Maintain optimum moisture content, plus or minus (+) 2 percent, of fill materials to attain required compaction density.

I. Do not leave more than 25 feet of trench open at end of working day.

J. Protection of trench backfill:

1. Protect open trench to prevent danger to the public.

2. Where trenches are constructed in ditches or other water courses, protect backfill from erosion.

3. Install ditch checks where the ditch grade exceeds 1 percent.

a. Minimum depth: 2 feet below the original ditch or water course bottom for the full bottom width

b. Minimum width: 18 inches into the side slopes

c. Minimum thickness: 12 inches

3.8 SURFACE RESTORATION

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, all areas being graded on site.

B. Slope grades to direct water away from buildings and prevent ponds from forming where not intended.

C. Pavement (either asphalt or concrete), curb and gutter, sidewalks, drainage culverts, headwalls, etc., or other improved surfaces that have been removed during the course of work shall be restored to a condition as equal to or better than that prior to removal and to the same elevation and alignment.

D. The subgrade for all restored surfaces shall be thoroughly compacted by mechanical or hand tampers weighing not less 20 pounds, by vibratory rollers, or by other means of compaction approved by Engineer.

E. Surface restoration shall be per current applicable City of Cañon City Specifications and Standard and subject to review by Engineer.

F. Where excavation occurs in paved areas, the pavement shall be repaired as required in Sections 00710, 02740, 02750, and 03300.

3.9 FIELD QUALITY CONTROL

A. Compaction Testing: In accordance with ASTM D698.

B. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest. Contractor shall be responsible for all costs associated with retesting of the Work.

C. Compaction Testing for Bedding and Backfill:

1. Contractor is required to hire an independent, licensed engineer experienced in soil analysis and evaluation to perform required compaction tests in accordance with ASTM D698. Copies of all Proctor curves and test results showing exact location of sample collection and test sites must be furnished to Engineer. Engineer shall be informed prior to testing and he may designate areas of testing.

2. Performed by City personnel or Contractor at option of Engineer in accordance with ASTM D698.

3. Testing is to be done at various elevations in trench, which may require excavation by Contractor after backfill is installed.

4. Frequency of Compaction Tests will be specified by Engineer in field but shall be no less than every 200 feet at every 1 foot of depth of the trench or anytime the means and methods of compaction change.

5. For trenches greater than 4 feet in depth, compaction effort shall be visually observed based on an initial test to determine a best means and methods of compaction that can subsequently be used for trench side observation. A new initial test shall be performed whenever backfill materials or means and methods of compaction change.

6. Testing shall use the Standard Proctor method. Alternatives such as Modified Proctor or Relative Density based on necessity due to material type may be used with the permission of the Engineer so long as the necessary conversion data, testing, and information has been completed and submitted prior commencement of the work.

3.10 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

B. All areas showing signs of settlement shall be filled and maintained by Contractor during all construction phases and for a period of 2 years following the date of final acceptance.

C. When Contractor is notified by the City or Engineer that any backfill is hazardous, the condition shall be corrected at once.

END OF SECTION

SECTION 02374

EROSION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. All Erosion Control, Construction Best Management Practices (BMPs), and Post Construction BMPs materials, methods, and installation shall be in accordance with:

1. City of Cañon City Grading, Erosion, & Sedimentation Control (GESC) Plan Manual.
2. Mile High Flood District (MHFD) Criteria Manuals
3. Current CDOT Standard Specifications for Road and Bridge Construction, Section 208
4. Current CDOT M&S Standard Plans

1.2 SUBMITTALS

A. Proprietary products may be submitted for approval on a case-by-case basis.

PRODUCTS

See Summary.

EXECUTION

See Summary.

END OF SECTION

SECTION 02446

HORIZONTAL DIRECTIONAL DRILLING

GENERAL

1.1 SECTION INCLUDES

A. This section presents requirements for trenchless excavation and installation of pipe. The Contractor shall perform; but is not limited to the following tasks:

1. Provide an alignment design for the installation with surface activity outside of the right-of-way as much as practical.
2. Transport all suitable equipment, labor, and materials to and from the job site.
3. Prepare the site including entry and exit pits as defined on the Drawings and as specified herein.
4. Install the Carrier pipe using Horizontal Directional Drilling including drilling the pilot hole and reaming a suitable diameter hole for the installation of the Carrier pipe into the borehole.
5. Cleanup and perform final restoration of all work areas.
6. Install the proposed Carrier pipes as indicated on the Construction Drawings. The selected materials must meet all project requirements and be approved by the Engineer.
7. Arrange and conduct at least one project kick-off meeting with the City, the engineer, and any of the Contractor's subcontractors prior to the initiation of the project.

1.2 RELATED SECTIONS

A. Section 02315 – Excavation

B. Section 02374 – Erosion Controls

C. Section 02512 – Water Distribution

D. Section 03300 – Cast-in-Place Concrete

1.3 DEFINITIONS

A. BACK REAMER: A tool designed to enlarge a pilot hole. Typically employed by attaching to the drill string once it exits the ground (surface to surface installation).

B. BORE OR BOREHOLE: The elongated cavity created through the drilling process. Often the borehole is not a void, but rather a hole filled with drilling fluids and native soil/formation.

C. BORE-TRACKING EQUIPMENT: Methods and systems generally defined as a walkover or non-walkover. To be specified by the project Engineer and used to measure and track the bore path line and grade. The bore path is monitored during the pilot bore by taking periodic reading of the inclination and azimuth of the probe located with the drive bit. Readings can be compared to the construction drawings to determine the accuracy of the bore path relative to proposed line and grades.

D. CARRIER PIPE: Pipe carrying water as specified in Section 02512 – Water Distribution

E. BORE PIT: An excavated area for entry, exit, slurry sump pits or any other excavation. It will also be used to manage, control and track the progress of the bore and recirculate drilling fluid.

F. DEFLECTION: The amount of flex exhibited by the drill rods. The drill head is typically steered by pushing it into the formation without rotation and within the drill steel tolerable limits.

G. DIMENSION RATIO (DR): The ratio of pipe diameter to wall thickness; DR = D/t where D is the outside diameter and t is the pipe wall thickness.

H. DRILLING FLUIDS: Fluids consisting of water, bentonite and any approved additives such as environmentally safe polymers, lubricants, and viscosifiers.

I. DRY HOLE: A condition that occurs when the drilling tools advance beyond the drilling mud. Typically caused by trying to drill or ream too fast.

J. FILTER CAKE: the wall cake that forms from the platelets in bentonite-based drilling mud. Filter cake is the barrier between the borehole and the formation, this can help protect from lost circulation.

K. HORIZONTAL DIRECTIONAL DRILLING (HDD): A method of installing buried piping by controlled (guided within specified limits) horizontal boring

L. INADVERTENT FLUID RELEASE (IFR): during normal drilling and reaming operations, drilling fluid travels up the borehole into a pit. When the borehole becomes obstructed or the pressure becomes too great inside the borehole, the ground fractures and fluid escapes to the surface. Also known as hydrofracture or frac-out

M. MUD SWIVEL: The fitting at the top of the drill string that enables the flow of drilling mud into the drill rods while simultaneously permitting them to rotate.

N. PILOT HOLE: The initial, controlled drilled horizontal opening used to guide the enlargement to the design size and eventual installation of the Carrier Pipe.

O. PITCH: The deviation angle from a horizontal plane is measured as pitch. When the drill is directed downward, the pitch is negative. When it is directed toward the surface, the pitch is positive.

P. PULLBACK: The pipe installation process where a swivel/pulling head connected behind the reamer and/or product pipe is pulled into place.

Q. REAMING: The enlargement of the initial pilot hole in one or more passes to accommodate the desired Carrier Pipe diameter.

R. GOVERNING AGENCY: Agency which owns and/or operates the property in which the trenchless work will be conducted.

1.4 REFERENCES

A. Manual of Uniform Traffic Control Devices (MUTCD)

B. Horizontal Earth Boring and Pipe Jacking Manual No. 2, latest revision

C. American Association of State Highway and Transportation Officials (AASHTO):

1. T 180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

D. American Society for Testing and Materials (ASTM):

1. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))
2. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
3. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
4. D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
5. D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
6. D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
7. D2464 – Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
8. D2466 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
9. D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
10. D2683 – Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
11. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
12. D2855 – Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

13. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
14. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
15. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
16. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
17. D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
18. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
19. F1056 – Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings
20. F1962 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings

E. American Water Works Association (AWWA):
   1. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
   2. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
   3. C901 – Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service
   4. C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission

F. North America Society for Trenchless Technology (NASTT):
   1. Horizontal Directional Drilling Good Practices Guidelines

G. National Utility Contractors Association (NUCA):
   1. Horizontal Directional Drilling Good Practices Guidelines

H. Plastics Pipe Institute (PPI):
   1. TR-46 – Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High-Density Polyethylene Pipe

I. Manual of Uniform Traffic Control Devices (MUTCD)

J. Horizontal Earth Boring and Pipe Jacking Manual No. 2, latest revision

1.5 GENERAL

A. The Contractor shall be responsible for the HDD design, construction and performance of the trenchless excavation and installation of the Carrier pipeline for this project.

B. This is a performance specification. Minimum design requirements are presented herein. It is the Contractor's responsibility to develop and implement the design to fulfill the specified design requirements specified by the City necessary for completion of the work.

1.6 DESIGN REQUIREMENTS

A. Contractor to design Carrier pipe wall thickness based on worst condition of any anticipated loads during or after construction. Specified thickness for pipe Carriers are the minimum required regardless of the Contractor design. However, thicker wall may be required based on the design by the Contractor based upon the superimposed loads and not upon the loads which may be placed on the pipe as a result of drilling operations

B. Provide increased pipe strength necessary to withstand drilling and installation loads

C. Contractor shall obtain and comply with necessary permit for work within City right-of-way as necessary

D. If a pipe must be used for HDD having an inside diameter less than a 6-inch DR11 HDPE PE4710, the nominal pipe size shall be increased such that the average inside diameter is greater than or equal to 5.35 inches.

1.7 QUALITY ASSURANCE

A. Perform Work according to following:

1. NUCA HDD Good Practices Guidelines
2. ASTM F1962
3. PPI TR-46

B. Experience: Actively engaged in horizontal directional drilling under water crossings for minimum of three years

C. Field supervisory personnel: Experienced in the performance of work and tasks as stated herein for minimum of five years

D. Submit and meet the following qualifications:

1. List of previous completed projects in which the drilling (HDD) Contractor has completed at least three installations of at least 4-inch nominal diameter plastic pipes with a minimum length of 500 feet each within the past 5 years. Include project name, contract amount, length, diameter, and soil conditions for the drill; and three project references, with project descriptions, and current name and phone number for the references. Qualifying projects must have been completed by the bidding HDD company and/or project manager.

2. Names and experience resumes for key field personnel. Key staff shall demonstrate on their resumes that they meet the following qualifications:
    a. Driller: Minimum five years' experience as a horizontal directional driller and have completed at least three crossing projects of similar length, size, pipe material, and subsurface conditions within the past five years
    b. Superintendent: Minimum three years' experience as a superintendent and have a minimum of three similar HDD project experience.
3. Name and experience resume for guidance system personnel
4. Name and experience resume for drill fluid control personnel
5. Certifications for qualified fusion technician. The pipe fusing technician must have a current certification from the manufacturer of the proposed pipe fusing equipment to be used.
6. All personnel employed by the Contractor in the work shall be experienced and competent in their respective tasks, and shall work only under the direct control of a suitably experienced Superintendent specified as herein
7. Horizontal directional drill rig with a minimum of 60,000 lbs of Thrust / Pullback force

1.8 SUBMITTALS

A. Working Drawings and written procedure describing in detail proposed method and entire operation for information only including, but not limited to:
    1. Size, capacity, and arrangement of equipment
    2. Location and size of drilling and receiving pits
    3. Dewatering and methods of removing spoils material
    4. Method of installing detection wire and pipe
    5. Type, location and method of installing locator station
    6. Method of fusion pipe segment and type of equipment
    7. Type of cutting head
    8. Method of monitoring and controlling line and grade
    9. Detection of surface movement
    10. Bentonite drilling mud for information only:
        a. Products information, material specifications, and handling procedures
        b. Material safety data sheet and special precautions required
        c. Method of mixing and application

1.9 PROJECT CONDITIONS

A. Complete HDD so as not to interfere with, interrupt, or endanger surface and activity thereon

B. Do not use HDD in rock stratum or subsoil consisting of boulders and underground obstructions that impede the process

C. Follow applicable local, state and federal ordinances, codes, statutes, rules, and regulations

1.10 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of pipe elevations

B. Identify and describe unexpected variations in and/or discovery of uncharted utilities

1.11 REGULATORY REQUIREMENTS

A. Contractor, not City, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities

B. Contractor shall obtain and pay for bonds or indemnity required by the permits for protection

1.12 DELIVERY STORAGE ANF HANDLING

A. Coordinate storage of materials with City and Engineer

B. Provide temporary end caps and closures on piping and fittings until pipe is installed

C. Protect pipe from entry of foreign materials and water by installing temporary covers, completing sections of Work, and isolating parts of completed system

D. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage

E. Use shipping braces between layers of stacked pipe

F. Stack piping lengths no more than three layers high

G. Store field joint materials in original shipping containers in dry area indoors

H. Support pipes with nylon slings during handling

PART 2 PRODUCTS

2.2 HORIZONTAL DIRECTIONAL DRILLING

A. Performance and Design Criteria:

1. Drilling Steering System: Remote with continuous electronic monitoring of boring depth and location

2. Directional Change Capability: 90 degrees with 35-foot radius curve

3. Minimum distance for single bores and between boring pits:

Pipe Size	Boring Distance
1 to 1-1/2 inch	400 feet
2 to 2-1/2 inch	350 feet
3 to 6 inch	300 feet
6 to 12 inch	250 feet

4. Ratio of Reaming Diameter to Pipe Outside Diameter:
    a. Nominal Pipe Diameter of 6 Inches and Smaller: Maximum of 1.5
    b. Nominal Pipe Diameter Larger than 6 Inches: Submit recommended ratio and reaming procedures for review

2.2 WATER SOURCE

A. Potable and non-potable water is not available on site. Contractor to provide water at their expense.

2.3 UNDERGROUND PIPE MARKERS

A. Tracer Wire: Electronic detection materials for nonconductive piping products
    1. Unshielded 10 AWG THWN-insulated copper wire
    2. Conductive tape

2.4 MATERIALS

A. Drilling Fluid:
    1. Liquid bentonite clay slurry; totally inert with no environmental risk
B. Piping and Locator Station: As specified in Division 2 specifications

2.5 MIXES

A. Grout: As specified in Section 03300

PART 3 EXECUTION

3.1 EXAMINTATION

A. Verify size, depth, type, and location of existing piping system prior to making connections

3.2 PREPARATION

A. Call local utility line information service not less than three working days before performing Work

B. Request underground utilities to be located and marked within and surrounding construction areas

C. Maintain access to existing facilities and services indicated to remain; modify pipe installation indicated on Drawings to maintain access to existing facilities

D. Locate and identify utilities indicated to remain and protect from damage

E. Notify utility companies to remove or relocate utilities

F. Identify required lines, levels, contours, and data locations

G. Protect plant life, lawns, rock outcroppings, and other features remaining as portion of final landscaping

H. Protect benchmarks such as existing structures, fences, and survey control points from excavating equipment and vehicular traffic

I. Provide equipment to guard against electrocution and alarm system on drilling equipment capable of detecting electrical current as it approaches electric lines

3.3 OPERATION

A. General

1. Determine drilling length and equipment pull strength for type of soil encountered
2. Provide method to control line and grade
    a. Provide and maintain instrumentation that accurately locates pilot hole
    b. Drill pilot hole along path following Drawings to these tolerances:
        i. Vertical alignment plus or minus 0.5 foot. Vertical path of pilot hole must not establish new high points not shown on Drawings.
        ii. Horizontal alignment plus or minus 1.0 foot
    c. Include electronic monitoring of horizontal and vertical drilling head location. Obtain accuracy range within 1 inch of actual position of pipeline. Record position readings at maximum of 10 foot intervals.
    d. At completion of pilot hole drilling, furnish tabulations of horizontal and vertical alignment to Engineer.
3. When water is encountered.
    a. Provide and maintain dewatering system of sufficient capacity to remove water
    b. Keep excavation free of water until backfill operation is in progress

c. Perform dewatering in manner that removal of soils particles are held to minimum

d. Dewater into sediment trap following Section 02374 and Stormwater Management Plan

4. Maintain close observation to detect settlement or displacement of surface and adjacent facilities

a. Notify Engineer immediately if settlement or displacement is detected

b. Maintain safe conditions and prevent damage

B. Drilling Operation

1. Drilling Fluids

a. Maintain drilling fluid in bore hole to increase stability of surrounding soil and reduce drag on pulled pipe

b. Dispose of drilling fluid and other spoils at location following laws, ordinances, rules, and regulations of local jurisdiction

c. Transport excess fluids and other spoils to disposal site, at no additional cost to the City

d. Minimize drilling fluid at locations other than entry and exit points. Immediately clean up any drilling fluids that inadvertently surface.

e. Provide clean water for drilling, at no cost to the City, at Engineer's requirement

2. Pilot Hole Drilling

a. Angle entry hole so that curvature of pilot hole does not exceed allowable bending radius of pipe.

b. Be able to make a turn of up to 90 degrees and maintain curvature not to exceed allowable bending radius of pipe

c. Alignment Adjustment and Restarts

i. Follow pipeline alignment on Drawings within tolerances specified herein. Before adjustments, notify Engineer for approval.

ii. Notify Engineer when forward motion of operation is stopped by an obstruction

iii. Abandon in place with drilling fluid, unless Engineer directs otherwise

iv. Upon Engineer's approval, attempt second installation at approved location

v. Withdrawals, abandonments, and restarts are at no additional cost to the City when HDD is provided as an option of installation of pipe

vi. Exercise caution including, but not limited to, locating utilities, drilling downholes (test pits) to observe drill stems or reamer assembly to clear other existing utilities at locations following Drawings

vii. Keep the number of boring pits to a minimum, no closer than following distances, unless otherwise approved by Engineer

viii. Equipment must be capable of boring 250 feet for 4-inch diameter pipe

3.4 INSTALLATION

A. Dewatering:
   1. Intercept and divert surface drainage, precipitation, and groundwater away from excavation using dikes, curb walls, ditches, pipes, sumps, or other approved means.
   2. Develop and maintain substantially dry subgrade during drilling and pipe installation.
   3. Comply with Colorado Department of Public Health and Environment requirements for discharging water to watercourse, preventing stream degradation, and controlling erosion and sediment.

B. Excavation:
   1. Excavate subsoil as specified in Section 02315
   2. Excavate approach trenches and pits according as Site conditions require; minimize number of access pits.
   3. Provide sump areas to contain drilling fluids
   4. Install excavation supports as specified in Section 02315
   5. Restore areas after completion of drilling and pipe installation

C. Drilling:
   1. Drill pilot bore with vertical and horizontal alignment as indicated on Drawings
   2. Survey entire drill path and mark entry and exit locations with stakes. If a magnetic guidance system is used, survey drill path for surface geomagnetic variations or anomalies.
   3. Guide drill remotely from ground surface to maintain alignment by monitoring signals transmitted from drill bit.
      a. Monitor depth, pitch, and position.
      b. Adjust drill head orientation to maintain correct alignment.
   4. Inject drilling fluid into bore to stabilize hole, remove cuttings, and lubricate drill bit and pipe.
   5. Continuously monitor drilling fluid pumping rate, pressure, viscosity, and density while drilling pilot bore, back reaming, and installing pipe to ensure adequate removal of soil cuttings and stabilization of bore.
   6. Provide relief holes when required to relieve excess pressure.
   7. Minimize heaving during pullback.

D. Verification of Accuracy:

1. Calibrate and verify electronic monitor accuracy during first 50 feet of bore in presence of Architect/Engineer before proceeding with other drilling.
2. Excavate minimum of four test pits spaced along first 50 feet of bore to verify required accuracy.
3. If required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy.

E. After completing pilot bore, remove drill bit.

F. Drilling Obstructions:
1. If obstructions are encountered during drilling, notify Engineer immediately. Do not proceed around obstruction without Engineer's approval.
2. For conditions requiring more than 3 feet of deviation in horizontal alignment, submit revised Shop Drawings to Engineer for approval before resuming Work.
3. Maintain adjusted bore alignment within easement or right-of-way.

G. Pipe:
1. Install reamer and pipe pulling head; select reamer with minimum bore diameter required for pipe installation.
2. Attach pipe to pipe pulling head and pull reamer and pipe to entry pit along pilot bore.
3. Inject drilling fluid through reamer to stabilize bore and lubricate pipe.
4. Install piping with horizontal and vertical alignment as shown on Drawings
5. Protect and support pipe being pulled into bore such that pipe moves freely and is not damaged during installation.
6. Do not exceed pipe manufacturer's recommended pullback forces.
7. Tracer Wire:
   a. Install trace wire continuous with each bore.
   b. Splice trace wire only at intermediate bore pits.
   c. Tape or insulate trace wire to prevent corrosion and maintain integrity of pipe detection.
   d. Terminate trace wire for each pipe run at structures along pipe system.
   e. Provide extra length of trace wire at each structure such that trace wire can be pulled 3 feet out top of structure for connection to detection equipment.
   f. Test trace wire for continuity for each bore before acceptance.
8. Provide sufficient length of pipe to extend past termination point to allow connection to other pipe sections
9. Allow minimum of 24 hours for stabilization after installing pipe before making connections to pipe.

10. Mark location and depth of bore with spray paint on paved surfaces and on wooden stakes on non-paved surfaces at 25-foot intervals.

H. Slurry Removal and Disposal:
   1. Contain excess drilling fluids at entry and exit points until recycled or removed from Site; provide recovery system to remove drilling spoils from access pits.
   2. Drilling Spoils:
      a. Remove, transport, and legally dispose of drilling spoils.
      b. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.
      c. When drilling in suspected contaminated soil, test drilling fluid for contamination before disposal.
   3. If drilling fluid leaks to surface, immediately contain leak and barricade area from vehicular and pedestrian travel before resuming drilling operations.
   4. Complete cleanup of drilling fluid at end of each working day.

3.5 TOLERANCES

A. Maximum Variation from Horizontal Position: 12 inches

B. Maximum Variation from Vertical Elevation: 2 inches

C. Minimum Horizontal and Vertical Clearance from Other Utilities: 12 inches

D. Deviation:
   1. When pipe installation deviates beyond specified tolerances, abandon bore, remove installed pipe, rebore, and reinstall pipe in correct alignment.
   2. Fill abandoned bores greater than 3 inches in diameter with grout

3.6 FIELD QUALITY ASSURANCE

A. Perform field testing of pipe following Section 02512 – Water Distribution

3.7 CLEANING

A. Upon completion of drilling and pipe installation, remove drilling spoils, debris, and unacceptable material from approach trenches and pits. Clean up excess slurry from ground.

B. Restore approach trenches and pits to original condition.

C. Remove temporary facilities for drilling operations.

END OF SECTION

SECTION 02512

WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for site water lines including domestic water lines.
2. Valves.
3. Hydrants.
4. Pipe markers.
5. Precast concrete vault.
6. Bedding and cover materials.
7. Water System Accessories.

B. Related Sections:

1. Section 01600- Product Requirements
2. Section 02060- Aggregate
3. Section 02320- Backfill
4. Section 02324 - Trenching: Execution requirements for trenching required by this section.
5. Section 02446- Horizontal Directional Drilling
6. Section 02676- Disinfection of Water System

1.2 REFERENCES

A. The standards and documents listed below may apply to the materials and practices in this specification. In the event of a conflict, the requirements of this specification prevail. Unless otherwise specified, references to documents shall mean the latest published edition of the referenced document in effect at the project bid date.

B. Colorado Department of Transportation:

1. Current CDOT Standard Specifications for Road and Bridge Construction.

C. American Society for Testing and Materials:

1. ASTM A536 – Standard Specification for Ductile Iron Castings.
2. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
3. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN- m/m3)).
5. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
6. ASTM F 585 – Standard Guide for Insertion of Flexible Polyethylene Pipe Into Existing Sewers
7. ASTM F 714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
8. ASTM F 905 – Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
9. ASTM F 1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Fittings
10. ASTM F 1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
11. ASTM F 1962 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings
12. ASTM F 2164 – Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
13. ASTM F2206 – Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
14. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
15. ASTM F 2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
16. ASTM D 2683 – Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter- Controlled Polyethylene Pipe and Tubing
17. ASTM D 2737 – Standard Specification for Polyethylene (PE) Plastic Tubing
18. ASTM D 2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
19. ASTM F 2880 – Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3⁄4 in. to 65 in.

20. ASTM F 3124 – Standard Practice for Data Recording the Procedure Used to Produce Heat Butt Fusion Joints
21. ASTM D 3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
22. ASTM D 3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
23. ASTM D 3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

D. American Water Works Association:
1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 – Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch for Water and Other Liquids.
4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
6. AWWA C153 – Ductile-Iron Compact Fittings, 3-inch through 16-inch, for Water and Other Liquids.
7. AWWA C205 – Cement-Mortar Protective Lining and Coating for Steel Water Pipe- 4-inch and larger- shop applied.
8. AWWA C207 – Steel Pipe Flanges for Waterworks Service – Sizes 4-inch through 144-inch.
9. AWWA C502 - Dry-Barrel Fire Hydrants.
10. AWWA C504 - Rubber-Sealed Butterfly Valves.
11. AWWA C515 - Resilient-Seated Gate Valves for Water-Supply Service.
12. ASTM C500 – Metal-Seated Gate Valves for Water Supply Service
13. ASTM C509 – Resilient-Seated Gate Valves for Water Supply Service
14. AWWA C550 – Protective Interior Coatings for Valves and Hydrants
15. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
16. AWWA C605 – Underground installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
17. AWWA C651 – Disinfecting Water Mains.

18. AWWA C800- Underground Service Line Valves and Fittings
19. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
20. AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission
21. AWWA M55 – Manual of Water Supply Practices, PE Pipe–Design and Installation

E. Underwriters Laboratoires Inc.1. UL 246 - Hydrants for Fire - Protection Service.

F. National Fire Protection Agency (NFPA)

G. Occupational Safety and Health Administration (OSHA)

H. NSF International:
1. Standard 60 – Drinking Water Treatment Chemicals – Health Effects
2. Standard 61 – Drinking Water System Components – Health Effects

I. Surface Preparation Standards (SSPC)

J. National Association of Corrosion Engineers (NACE):
1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems

K. 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. Material Handling Guide

L. Ductile Iron Pipe Research Association (DIPRA):

M. Thrust Restraint Design for Ductile Iron Pipe

N. American Railway Engineering and Maintenance-Of-Way Association (AREMA)

O. International Plumbing Code (IPC)

P. International Code Council (ICC)

1.3 SUBMITTALS

A. Product Data: Submit data on pipe materials, pipe fittings and couplings, valves, joint restraint system, affidavits of compliance for protective shop coatings and linings, and accessories
1. Provide sufficient data on features, pipe, joints, gasket material, lubricant and accessories to verify compliance with specifications

2. Provide manufacturer catalog information on castings, grating, and accessories to indicate compliance with specifications of precast vault

B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements and applicable standards.

C. Shop Drawings:

1. Provide drawings with pipe and structure details, design standards, reinforcement, dimensions, layout fabrication and assembly drawings and shall include, but not limited to, the following:
   a. Layout of pipe drawings
   b. Pipe and joint details
   c. Restrained joint locations
   d. Specials, fittings, and coupling details
   e. Specification data sheets
   f. Certificates of compliance with applicable standard and specification and testing certificates
2. Provide additional detailed information including elevations, fittings, specialty materials or fabrications for special or custom features, structures, junctions and/or pipes
3. Specifications, data sheets and affidavits of compliance for coatings and linings
4. Provide pipe-laying and installation schedule
5. Provide sufficient data to verify compliance with the specifications and to illustrate construction and assembly of precast vault

D. Design Data: Include calculations prepared by precast manufacturer indicating design loads and material requirements for reinforcement

E. Test Reports: Submit all shop test, field test and disinfection test reports in accordance with specified requirements.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in design and manufacturing of products specified herein for a minimum period of 5 years

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents “AS BUILTS”: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with City of Cañon City standards, AWWA C651, and the Colorado Department of Public Health and Environment (CDPHE), and Fremont County requirements.

B. Contractor shall conduct visual inspection before installation

C. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational water lines

D. Maintain one copy of each document on site.

E. Manufacturer's name and pressure rating marked on valve body.

F. Pipe: Acceptance of DI pipe that has cracks within the cement lining or PVC pipe that is "sunburned" shall be accepted at the Engineer's discretion.

1.7 REGULATORY REQUIREMENTS

A. Conform to all State and local municipal codes and ordinances, laws and regulations

B. Conform to AWWA C651, as appropriate, and CDPHE Design Criteria for Potable Water Systems for performing the work of this Section

C. In case of apparent conflict, State and local requirements govern over these specifications

D. In absence of State and local regulations, International Plumbing Code applies

E. NFPA Compliance: Install fire water systems in accordance with NFPA 24 "Standard for the Installation of Private Fire Service Mains and Their Appurtenances"

F. UL Compliance: Provide fire hydrants that comply with UL 246 "Hydrants for Fire-Protection Service," and are listed by UL.

G. Contractor, not City, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Pipes, fittings, valves, and accessories shall be loaded and unloaded or otherwise handled in such a manner as to minimize the possibility of damage prior to installation. All materials shall be stored at the construction site in such a way as to prevent damage and to assure they are kept as clean as possible prior to installation.

C. Delivery

1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and direct sunlight

D. Storage

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 5 feet

E. Storage: Use the following precautions for valves, during storage:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage
    a. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary

F. Handling
1. Handle so as 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

G. Preparation for Transport: Prepare valves, for shipping as follows: Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends, flange faces, and weld ends. Set valves in best position for handling. Set valves closed to prevent rattling

H. Deliver and store valves and accessories in shipping containers with labeling in place in accordance with AWWA C500

I. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation

J. Seal valve ends to prevent entry of foreign materials into valve body

K. 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
6. Store rubber gaskets in cool dark location
7. Store all material on wood pallets or timbers

L. Adequately tag or otherwise mark all piping, fittings, and valves as to size per AWWA C509 and C900

M. 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 and at no additional cost to the City

N. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the City

O. 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.

1.9 JOB CONDITIONS

A. Section 01600 – Product Requirements: Requirements for transporting, handling, storing, and protecting products

B. All work which requires the interruption of active water service lines must be completed as quickly as possible in order to minimize inconvenience to customers and risk to the City and coordinated as specified in Division 1

C. Underground Obstructions

1. Underground Obstructions known to Engineer are shown on Drawings
    a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered
    b. Contractor shall field locate and verify all obstructions where or not shown on the Drawings
2. Notify each utility owner 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 Engineer and City in case of a conflict
    b. In case of a conflict, the proposed work may be changed by Engineer
4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances

D. Verify existing system operation, pressures, and valve settings (open or closed) prior to construction

1.10 ENVIRONMENTAL REQUIREMENTS

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

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

A. AWWA C151 and C104, Pressure Class 350, exceptions by Engineer may include Class 51 or 52.

B. Fittings: Ductile iron, compact, AWWA C153. Fittings shall have a pressure rating no less than that of adjoining pipe.

1. Approved Manufacturers:

a. Tyler Union

b. Star

c. Sigma

d. Sip

e. Or Engineer's accepted substitution

C. Joints: AWWA C110, C111, and C153, rubber gasket, mechanical joint restraints ("Mega-lug", retainer gland) for all connections to valves and fittings. Shall have a pressure rating no less than that of adjoining pipe

1. Gaskets shall be neoprene or other synthetic rubber (SBR). Natural rubber is not acceptable.

D. Jackets: AWWA C105 polyethylene jacket, half lapped, 8 mil (0.008 inch), polyethylene tape.

E. Coatings & Linings: AWWA C104, cement-mortar lining, bituminous seal coating.

F. Size:

1. Except for permanent cul-de-sacs of less than 500 feet in length, the minimum size of any new water main within the distribution system shall be eight (8) inches in diameter.

2. In streets that have a permanent cul-de-sac less than 500 feet in length, the Engineer may authorize a water main that is six (6) inches in diameter.

3. In location where the Engineer determines that a water main must be larger than eight (8) inches in diameter, the water main shall be of such size as specified by the Engineer or according to the City's Master Plan.

4. Larger sizes shall be required as needed to provide proper distribution flow, pressure, and fire protection.

G. Use/Location: Shall be polyethylene encased to AWWA C105 at all locations north of Arkansas River and south of Arkansas River when aggressive or "hot" soils are shown to exist.

2.2 COPPER TUBING: ATSM B88, TYPE K, ANNEALED

A. Fittings: Flared.

B. Joints: Flared.

C. Size: ¾ inch minimum.

D. 1 ½ inch – 2 inch If approved by the water superintendent, service lines can be rigid copper w/ silver solder connections or DR9 CTS blue Poly with the proper stiffener. Mueller 110 Compression or Ford Grip joint may also be used after tubing has been re-rounded.

2.3 PVC PIPE

A. AWWA C900 (DR-14, DR18, DR-21, & DR-25)

B. Marking: Identification markings on pipe shall conform to AWWA C900

C. Fittings: AWWA C111, cast iron, wrapped. Fittings shall have a pressure rating no less than that of adjoining pipe.

D. Joints: ASTM D3139 compression gasket ring, AWWA C153 and C900, mechanical joint restraints ("Mega-lug") for all connections to valves and fittings.

E. Jackets: Fittings and valves only, AWWA C105 polyethylene jacket, half lapped, 8 mil (0.008 inch), polyethylene tape.

F. Size:

1. Except for permanent cul-de-sacs of less than 500 feet in length, the minimum size of any new water main within the distribution system shall be eight (8) inches in diameter.

2. In streets that have a permanent cul-de-sac less than 500 feet in length, the Engineer may authorize a water main that is six (6) inches in diameter.

3. In location where the Engineer determines that a water main must be larger than eight (8) inches in diameter, the water main shall be of such size as specified by the Engineer or according to the City's Master Plan.

4. Larger sizes shall be required as needed to provide proper distribution flow, pressure, and fire protection.

G. Thickness: DR-18 for sizes 6 inch – 12 inch or DR-14 when static pressure exceeds 100 psi, DR-25 for sizes greater than 12 inch or DR-18 when static pressure exceeds 100 psi.

H. Use/Location: Allowed for use in entire system.

2.4 HDPE PIPE

A. ASTM D3350 and AWWA C901 or AWWA C906

B. Pipe:

1. Pipe shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum cell classification of 445474C. The polyethylene compound

shall be suitably protected against degradation by ultraviolet light by means of carbon black of not less than 2 percent. The manufacture of the HDPE resin shall certify the cell classification indicated.

C. Pipe sizes 3" and large shall have a manufacturing standard of ASTM F 714, while pipe smaller than 3" shall be manufactured to the dimensional requirements listed in ASTM D 3035. Dimension Ratio (DR) and Outside Diameter (IPS/DIPS) shall be as specified on plans.

D. Pipe shall meet AWWA C901 (1/2" to 3") or AWWA C906 (4" to 63") and shall be listed as meeting NSF-61. Pipe shall have a manufacturing standard of ASTM F714 and be manufactured by an ISO 9001 certified manufacturer.

E. All pipes and fittings shall be suitable for use as pressure conduits and have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe and/or fitting

F. When required by the owner, pipe shall be color coded for the intended service. The color coding shall be permanently co-extruded stripes on the pipe outside surface as part of the pipe's manufacturing process. Color coding shall be as follows:

1. Sewer – green
2. Potable Water – blue
3. Non-Potable Water – purple

G. Fittings:

1. All fittings shall be PE 4710 HDPE, minimum Cell Classification of 445574C/E as determined by ASTM D3350 and approved for use by AWWA.
2. All fittings shall be of the same base resin as the pipe.
3. All fittings shall have a working pressure rating equal to the pipe unless otherwise specified in the plans.
4. All fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.
5. Butt Fusion Fittings: Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted in 2.1.A. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans or accepted by owner/engineer. All fittings shall meet the requirements of AWWA C901 or C906.
    a. Molded fittings shall comply with the requirements of ASTM D3261.
6. All fabricated elbows, tees, reducing tees and end caps shall be produced and meet the requirements of ASTM F2206, as manufactured by ISCO Industries, Inc or other approved manufacturer holding an ISO 9001 quality system certificate. Each fitting will be marked per ASTM F2206 section 10 including the nominal size and fitting EDR, which will meet or exceed the pipe DR identified for the project. Fabricated fittings shall be manufactured and pressure tested using an approved data logger to record fusion pressure and

temperature and shall be stamped with unique joint number that corresponds to the joint report. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained for a minimum of 5 years as part of the quality control and will be available upon request of owner. Test results to validate ASTM F2206 section 7.3 and 9 shall be provided to owner or owner's representative upon request.

7. Socket fittings shall meet ASTM D2683.
8. Electrofusion Fittings: Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted in 2.1.A. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans. For potable water systems, all electrofusion fittings shall have AWWA approval.
9. Bolted Connections: Flanges and MJ Adapters shall be fused onto the pipe and have a minimum pressure rating equal to or greater than the pipe unless otherwise specified on the plans.
10. Metallic back-up rings (Van-Stone style lap joint flanges) shall have a radius on the inside diameter of the bore so as to be compatible with HDPE Flanges. Back up rings shall have bolt pattern that will mate with AWWA C207 Class D (generically known as 150-pound patterns).
11. Flange assemblies shall be assembled and torqued according to PPI TN-38, "Bolt Torque for Polyethylene Flanged Joints."
12. Where shown on the drawings, 4" and larger transitions to mechanical joint fittings and valves shall be accomplished using a MJ Adapter with kit. The D.I./HDPE mechanical joint adaptor shall consist of an HDPE mechanical joint transition fitting, rubber gasket, a mechanical joint backup drive ring, and Corten mechanical joint tee bolts.
13. Mechanical Fittings: The use of mechanical coupling and saddles shall be approved by the owner or engineer prior to installation. Mechanical Fittings shall be designed for use and compatible with HDPE pipe, including SS stiffeners when required by manufacturer. Mechanical fittings shall have a pressure rating equal to or greater than the pipe.

H. Detectable Marker Tape: Plastic marker tape shall be 5 mil minimum thickness with a solid aluminum core of .35mil minimum thickness and a minimum width of 2". The background of the tape shall be colored based on pipe service with black lettering continuously printed. Marker tape shall have a minimum 35 lbs./inch tensile strength. The installation of the tape shall be at 18 inches below finish grade.

I. Tracer Wire: All HDPE pipe 4" and greater shall be installed with an extra high-strength, copper clad steel tracer wire as specified in Section 02512, under PIPE MARKERS. This wire shall be continuous and brought up in the valve boxes at the ends of each line segment with splices made only by methods per the equipment manufacturer's recommendation. All miscellaneous splicing components shall be furnished and installed by the Contractor.

J. Fusion Equipment Requirements:

1. Butt fusion equipment must be in satisfactory working order and the hydraulic system must be leak free. Heater plates shall be free from scrapes, gouges, and have a consistent clean coated surface. The pressure gage and thermometer should be checked for accuracy. When requested by the owner, records showing a maintenance service/inspection within 3 months prior to use for this project shall be provided.

2. Electrofusion Processors shall be maintained and calibrated per manufacturer's requirements and recommendations.

K. Approved Suppliers:

1. All Pipe, Fittings, and Fusion Equipment shall be provided by one supplier. Approved suppliers are ISCO Industries, Inc. or approved equal.

2.5 GATE VALVES

A. Valves: Manufactured/cast. to meet or exceed the requirements of AWWA C515, or latest revision, and in accordance with the following specifications:

1. Gate valves shall be resilient wedge/seat gate with cast iron or ductile iron body in compliance with ASTM A536/A126 CL B, corrosion resistant material, with non-rising stem and rubber encapsulated wedge.

B. Coatings: All valves shall have epoxy coating both internally to AWWA C550 and NSF 61, and externally to AWWA C116.

1. Minimum 8 mils dry film thickness

2. Fusion bonded epoxy applied to all ferrous metal surfaces after cleaning surfaces of grease, dirt and moisture, and performing near-white blast cleaning following SSPC-SP10

3. Do not coat fasteners or machined surfaces subject to contact and relative movement against other surfaces during operation of valve or other surfaces where such coating would compromise proper installation or functionality of valve

C. Valve Stems: Valve stems are used to raise the wedge using a 2" square-operating nut. Valve stems shall be stainless steel. The stem shall be non-rising and be sealed with "O" ring packing. Non-adjustable elastomeric stem seals shall be provided. Adjustable packing glands are not permitted.

1. Provide valve stem extensions as necessary for proper valve operation with a 7-foot key with tee handle

2. Provide one (1) key to City prior to project closeout

2.6 BUTTERFLY VALVES

A. Valves: Manufactured/cast to meet or exceed the requirements of AWWA C504, or latest revision, and in accordance with the following specifications:

1. Butterfly valves shall be of the rubber-seat type, cast iron or ductile iron body manufactured in accordance with ASTM A126 CL B/A536 and conform to AWWA C504 in terms of laying lengths and minimum body shell thickness. Valve discs shall be Cast or Ductile Iron to ASTM A126/A536 and shall rotate ninety (90) degrees from the fully open position to the tight shut position and have a positive stop. Valve Operators: Valve operators shall be designed to hold the valve disc in any intermediate position between fully closed and fully opened without creeping or fluttering. All valves shall be equipped with a two-inch (2") operating nut.

B. Coatings: All valves shall have epoxy coating both internally to AWWA C550 and NSF 61, and externally to AWWA C116.
   1. Coat interior and exterior ferrous surfaces of valve with epoxy suitable for potable water conditions: in accordance with AWWA C550 and coating manufacturer's recommendations
   2. Provide three coats of two component, high-build epoxy with minimum dry film thickness of 12 mils

C. Extension stems
   1. Provide for buried valves with operating nuts more than 4.5 feet below grade
   2. Non-rising stems
      a. Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
      b. Connected to the valve by a flexible socket coupling
      c. All other connections pinned
      d. Extend stem to within 6-inch of grade
      e. Provide spacers to center stem in valve box
      f. Provide wrench nut

D. Approved Manufacturers:
   1. DeZurik
   2. Mueller/Pratt
   3. AVK
   4. Or Engineer's accepted substitution

L. Shall be 12 inches or larger.

M. Shall have cast iron or ductile iron body.

N. Shall be open left.

O. Shall have a non-rising stem.

P. Shall have a two-inch (2") square nut.

Q. Shall be tested bi-directionally. Test results shall be provided at the time of delivery.

R. Accessories: Manufactured in U.S.A., unless accepted by the Engineer.

2.7 HYDRANTS

A. Approved Hydrants:

1. Centurion 200 manufactured by Mueller Company
2. 2780 manufactured by American AVK
3. Or Engineer's accepted substitution

B. All fire hydrants shall be designed and manufactured in strict compliance with the latest version of AWWA C502. Two-piece modern style fire hydrant is preferred of the approved listed models above. Fire hydrants shall meet all test requirements and be listed by Underwriters Laboratories Inc and have Factory Mutual Research approval. All references made in this Specification are to the above standards unless otherwise noted. The manufacturing facility for the hydrant must have current ISO 9001 certification. All brass alloys in the hydrant exposed to the Potable Water shall comply to UNS designations for Hydrant Components and shall be Lead Free in accordance with NSF/ANSI 372 in the open position effective January 5, Mueller Super Centurion A-403 Colorado Springs Utilities Water Line Extension & Service Standards – 2023 4-57 2015 for all new installations and repair pieces. Fire hydrants shall be rated for a minimum working pressure of 250 psi.

C. Shall be of the traffic "break-away" type with safety stem coupling, frangible bolts, or safety flange that permits full rotation of the nozzle section. The break-flange segments shall be located under the upper barrel flange to prevent the segments from falling into the lower barrel when the hydrant is struck

D. Shall have a stainless-steel upper stem. Hydrant shall have one breakaway flange and stem coupling located 3-inches above finished grade.

E. All hydrants shall be supplied with a 6" MJ base or vertical shoe. Mechanical joints shall comply with AWWA C111.

F. Trench depth shall be 4 foot, 6 inches, unless otherwise specified.

G. Hydrants with a bury depth beyond 6' 06" must use a vertical shoe.

H. If approved, hydrant extensions shall be fabricated in multiples of 6 inches with rod and coupling to increase barrel length. Maximum of one extension per hydrant.

I. Main valve opening of the hydrant shall not be less than 5 ¼".

1. The main valve and drain shall be of one-piece construction and completely encapsulated with EPDM.
2. The EPDM shall be permanently vulcanized to the main valve.
3. The main valve shall provide complete closing of the drains after 4 to 5 turns.

4. During initial stages of opening, the drains shall momentarily flush outward to remove any debris in the drain ports, in order to provide complete draining upon closing of the hydrant main valve.
5. The drain ring assembly shall be replaceable without removing the hydrant from the connecting pipe or having to dig.
6. Valve facings shall be of non-toxic materials suitable for potable water service.

J. Hydrant nozzles shall consist of two (2), 2 ½" hose nozzles and one (1), 5" pumper nozzle. Threads on all nozzles shall be national standard. Nozzles not using a mechanical lock-in device shall not be accepted

K. Operation nut and nozzle cap wrench nuts shall be national standard 1- 1/2" pentagon. Nozzle cap shall be chained to hydrant. Operating nuts shall be one-piece bronze design with upper and lower anti-friction washers for ease of operation. A protective weather shield shall be installed over the operating nut.

L. Hydrants using the breakaway coupling on the hydrant rod as a wrench attachment to disassemble the internal valve parts shall not be accepted. The hydrant bonnet assembly shall consist of a top weather seal or cap and shall be provided with a grease/oil reservoir and lubrication system that automatically circulates lubricant to all operating stem threads and bearing surfaces each time the hydrant is operated. The system shall be completely sealed form the waterway and external contaminants by means of O-rings.
    1. The reservoir shall be filled with NSF/FDA approved food grade grease or oil at the manufacturer’s facility.
    2. Valve stem seals shall have no less than two O-rings below the thrust nut and two O-rings above the thrust nut.
    3. O-ring and gaskets shall be made of an NBR rubber to help prevent the effects of permeation.

M. An arrow shall be on the hydrant bonnet with the word "open" to designate all hydrants to open left.

N. All hydrants shall be red in color, with reflective silver/white caps.

O. Protective Coatings
    1. All ferrous parts except the lower barrel and those parts made of stainless steel shall be fusion bonded epoxy coated yellow
    2. All epoxy coatings shall meet the requirements of ANSI/AWWA C550 (latest edition).
    3. The lower barrel shall be bitumen coated both internally and externally.
    4. A bury line shall be marked on the lower barrel below the break flange to indicate proper installation depth. Bury depth will be clearly stenciled on the standpipe section.

P. Warranty. Hydrants shall be warranted by the manufacturer against defects in materials or workmanship for a period of 10 years from the date of manufacture. No Fire Hydrant, more

than 2 years old from the date of manufacture, shall be accepted into the Water Distribution System.

2.8 BRASS FITTINGS

A. All fittings and valves shall be manufactured in the U.S.A. in accordance with AWWA C800 and meet the following:

1. Any brass part of the fitting or valve in contact with potable water shall be made of a "No-Lead Brass", defined for this specification as UNS Copper Alloy No. C89520 or C89833 in accordance with the chemical and mechanical requirements of ASTM B584 and AWWA C800. This "No- Lead Brass" alloy shall not contain more than nine one hundredths of one percent (0.09% or less) total lead content by weight.

2. Any Brass part of the fitting or valve not in contact with potable water shall be made of 85-5-5-5 brass as defined for this specification as UNS Copper Alloy C83600 per ASTM B62, ASTM B584 and AWWA C-800

3. All brass fittings and valves shall be certified by an ANSI accredited test lab per NSF/ANSI Standard 61, Drinking Water Components – Health Effects, Section 8 or NSF/ANSI Standard 372, Drinking Water System Components – Lead Content. Proof of certification is required.

4. Brass fittings and valves shall comply with the United States Of America Safe Drinking Water Act, and the U.S. Environmental Protection Agency.

5. All brass fittings and valves shall have the manufacturer's name or trademark permanently stamped or cast on it. Another marking identifying the "no lead" brass alloy, e.g., 'NL', shall be cast or permanently stamped on the fitting or valve.

2.9 UNDERGROUND PIPE MARKERS

A. Provide tracer wire for all pipe regardless of pipe material.

B. Tracer Wire: shall be a #12 AWG (0.0808" diameter) fully annealed, high carbon 1055 grade steel, high strength solid copper clad steel conductor (HS-CCS), insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts.

1. HS-CCS conductor must be at 21% conductivity for locating purposes.

2. Break load of 452 lbs.

3. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities.

4. Manufacturers supplying copper clad steel tracer wire must have available detailed performance data including 5 years of underground testing in terms of durability related to damage of protective insulation and effects of potential corrosion of the specific copper clad steel used. Origin of copper clad steel manufacturer is required and steel core must be

manufactured in the United States. If manufacturer has not completed 5 year corrosion testing, a 5-year warranty must be provided.

5. Tracer wire shall be Copperhead® High Strength HS- CCS HDPE 30 mil or pre-approved equal.

C. Tracer Wire Test Stations:

1. Part #: 3WB-01
2. Max voltage: 50V
3. Size: 1.138” x 1.617”
4. Color: Blue only
5. Wire Type: copper-clad steel; solid copper
6. Wire Range: min 14-AWG / max 10-AWG
7. Sealant Temp: -45˚F to 400˚F
8. Lug: tin plated high conductivity aluminum
9. Screws: zinc plated steel
10. Housing: high impact polypropylene
11. Sealant: non-hardening viscous dielectric silicone

2.10 SURFACE PIPE MARKERS

A. Marking Posts: Marking posts shall be installed per manufacturer’s instructions above the water main, in rural unpaved areas to be determined by Engineer, every 200 feet and at every valve and bend.

1. The posts shall be “Rhino 3-Rail” or approved equal.
2. The posts shall be blue in color and have UV stable, all-weather decals affixed that are marked with the international “No-Dig” symbol and have a highly visible white and blue warning that reads “WARNING WATER PIPELINE, BEFORE DIGGING IN THIS AREA CALL CITY OF CANON CITY WATER 719-269-9022”.
3. Decals shall measure 2-7/8” X 14”.

2.11 PRECAST CONCRETE VAULT

A. Furnish materials in accordance with City of Cañon City standards.

B. Product Description: Pre-cast vault designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories per City of Cañon City Standard Detail W-5C.

2.12 AIR & VACUUM VALVE VAULT

A. Refer to City of Cañon City Standard Detail W-7

2.13 BEDDING MATERIALS

A. Bedding installation and material shall be in accordance with the utility's specifications. All water lines shall be bedded using coarse aggregate or fine aggregate as specified in Section 02060 – Aggregate.

2.14 FLOW-FILL: AS SPECIFIED IN SECTION 02320 ACCESSORIES

A. Concrete for Thrust Restraints, Cradles, Valve Blocking, and Encasements:
   1. Refer to City of Cañon City Standard Detail W-4 for restraint sizing.
   2. Concrete: compressive strength of 3000 psi in 28 days with maximum water to cement ratio of 0.63 by weight
   3. Provide where indicated on Drawings. Suitably support and block pipe and anchor against flotation

2.15 BELL JOINT RESTRAINTS

A. Restraint at push-on pipe joints for ductile iron pipe (AWWA C151) and PVC pipe (AWWA C900) shall be manufactured of ductile iron conforming to ASTM A536. The restraint devices shall be coated using MEGA- BOND™.
   1. A split serrated ring, with a sufficient number of heat-treated Tru-Dual inserts for gripping both ductile iron pipe and PVC pipe, shall be utilized behind the pipe bell.
   2. A split serrated ring, with a sufficient number of heat-treated Tru-Dual inserts for gripping both ductile iron pipe and PVC pipe, shall be used to grip the spigot, plain end pipe.
   3. A sufficient number of bolts shall be used to connect the bell ring and the gripping ring.
   4. The restraint shall be the Series 1500TD, as manufactured by EBAA Iron, Inc., or approved equal.

2.16 MECHANICAL JOINT RESTRAINTS

A. PVC: Mechanical joint restraint shall be incorporated into the design of the follower gland. The restraint mechanism shall consist of a plurality of individual actuated gripping surfaces to maximize restraint capability. Glands shall be manufactured of ductile iron conforming to ASTM A536. The gland shall be such that it can replace the standardized mechanical joint gland and can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest version. Twist off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices. The restraining glands shall have a pressure rating equal to that of the pipe on which it us used. The restraining glands shall have been tested to ASTM F1674-96, be listed by Underwriters Laboratories, and be approved by Factory Mutual. The restraint shall be the EBBA Iron Series

2000PV or approved equal. Pressure rating shall be consistent with pipe pressure rating. Restraint coatings shall be consistent with manufacturer's standard.

1. Approved manufacturers.
    a. Tyler Union series 1500/200
    b. EBAA series 2000 pv
    c. Ford series 1500
    d. Sigma One Lok SLCE
    e. Star Stargrip series 4000
    f. SIP EZ Grip
    g. Or Engineer's accepted substitution

B. DUCTILE IRON PIPE: Restraint for standardized mechanical joints shall be incorporated in the design of the follower gland and shall impart multiple wedging actions against the pipe, increasing its resistance as the pressure increases. The assembled joint shall maintain its flexibility after burial and shall maintain its integrity by a controlled and limited expansion of each joint during the wedging action. Restraining glands shall be manufactured of high strength ductile iron conforming to the requirements of ASTM A536 Grade 60-42-10. Wedges shall be contoured to provide exact fit on the pipe, and shall be manufactured of ductile iron, heat treated to a hardness of 370 BHN minimum. Dimensions of the glands shall be such that they can be used with the standardized mechanical joint bell and Tee head bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist off nuts shall be incorporated in the design of the wedge activation screws to ensure proper torque. Nuts and bolts shall be torqued to requirements of manufacturer. The mechanical joint restraining device shall have a water working pressure rating of 250 psi minimum with a safety factor of at least 2:1 against separation when tested in a dead-end situation and shall be EBBA Iron Series 1100 Megalug Mechanical Joint Restraint or approved equal.

1. Pipe with grooved or shouldered joints for any restrained joint shall have wall thickness increased to provide the minimum wall thickness in accordance with AWWA C606
2. Approved manufacturers.
    a. Tyler Union series 1000/1500
    b. EBAA series 1100
    c. Ford series 1400
    d. Sigma One Lok SLDE
    e. Star Stargrip series 3000
    f. SIP EZ Grip
    g. Or Engineer's accepted substitution

2.17 BOLTS

A. Blue bolts

B. General: T-Head bolts are utilized to bolt together all pipe, fittings and appurtenances

C. Size(s): Varies depending on fitting being installed, Bolts are generally 3/4 or 5/8 inch in diameter and length varies

D. Material: Bolts shall be manufactured from high strength, low alloy steel in accordance with ANSI/AWWA C111/A21.11.

E. Specifications: All Tee Head bolts and nuts shall be coated with a corrosion resistant XYLAN 1424 Polytetrafluoroethylene (PTFE) Dry-Film protective coating/lubricant or fluoropolymer coating. Bolt strength shall be equal to minimum ASTM A307.

2.18 TAPPING SLEEVES

A. Shall be constructed from 304 Stainless Steel; including shell, sidebars, lugs, bolts, nuts, and washers.

B. Gasket shall be full circle and formed from a SBR rubber compounded for water service in accordance with ASTM D 2000 MAA 610.

C. Flange or MJ outlet shall be stainless steel AWWA C228; and Class D ANSI 150# flange drilling pattern with gasket.

D. Shell cutters shall have an outside diameter one-half inch (½") less than the nominal size of valve or fitting, unless otherwise specified.

E. Approved tapping Sleeves:

1. Romac "SST III"
2. Mueller H304 Stainless Steel
3. JCM #432 or #439
4. Or Engineer's accepted substitution

2.19 VALVE BOXES

A. Three-piece cast iron (complying with ASTM A48, Class 20A), 5 ¼ inch diameter screw type, No. 564S recommended (or others for varying depth). Minimum thickness of 3/16 inch. Box, cover, and base coated with dipping in asphalt varnish. Provide extension piece to permit 6-inch adjustment above finish grade.

B. "WATER" shall be cast in valve box covers

C. Bonnet required for valves 12 inches or larger.

2.20 TAPPING SADDLES

A. Saddles shall meet or exceed ASTM A536, B633 and A563. Saddle shall meet AWWA C800 and be NSF 61 certified. PVC saddle connections shall have 2 stainless steel straps.

B. The body shall be made of Ductile Iron conforming to ASTM A536. The inlet shall be an AWWA taper ("CC") thread. The body shall be coated with fusion bonded flexi epoxy or nylon.

C. Approved Manufacturers.

1. Romac 202NS
2. Mueller DR2S
3. JCM 406
4. Ford FCD 202
5. Or Engineer's accepted substitution

2.21 CORPORATIONS

A. Ball type, CC threaded X flared. Compression may be allowed for 1-1/2" and 2".

B. Ford, Mueller, or Engineer's accepted substitution

2.22 CURB STOPS

A. Flared connections with threaded inlet and outlet matching service pipe material. Compression may be allowed for 1-1/2" and 2".

B. Ford, Mueller, Or Engineer's accepted substitution

2.23 VALVE BLOCKING

A. Solid concrete blocks, 4-inch x 8-inch x 16-inch minimum.

2.24 MECHANICAL COUPLINGS

A. General: All mechanical couplings shall be of a gasketed, sleeve-type, with diameter to properly fit the pipe. Tolerance on pipe and coupling, together with proper bolt and gasket arrangements, shall be sufficient to ensure permanent watertight joints under all conditions.

B. Materials: Materials used in the manufacture of couplings shall be Ductile Iron or Steel in accordance to AWWA C111 and AWWA C219. Specifications: Steel couplings shall meet or exceed ASTM A283/A283M, Grade C for Carbon steel, or ASTM A666. Ductile Iron shall meet or exceed ASTM A536 Grade 65-45-12. Gaskets shall meet the requirements of ASTM D2000. External Coating. The manufacturer may supply either an asphaltic coating or a fusion bonded epoxy coating outside the fitting per AWWA C 110. Fusion bonded epoxy coating where used shall be in accordance with ANSI/AWWA C116/A21.16. Stainless steel bolts and nuts required.

C. Approved Manufacturer(s):

1. Romac 501, XR 501, 400, Macro, and Alpha series
2. JCM 241, 242
3. Hymax couplings
4. Powerseal 3501,3506 series
5. Or Engineer's accepted substitution
    a. Wrench nut shall be constructed of ductile iron. Wrench nut shall have four flats at stem connection to assure even distribution of operating input torque to the stem.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify connections and municipal utility water main size, location, and invert as indicated on Drawings. Report any discrepancies to City and Engineer.

C. Carefully examine pipe and fittings for cracks, damage to linings, and other defects prior to installation

D. Remove all defective piping from site and replace

E. Examine areas for weak or structural defects or deviations beyond allowable tolerances for piping clearances that adversely affect excavation and quality of Work

F. Start installation only when conditions are satisfactory

G. Verify items provided by other sections of Work are properly sized and located

H. Verify that built-in items are in proper location, ready for roughing into Work

I. Verify excavation for vault is correct

3.2 PERFORMANCE – GENERAL

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

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 of site will be the responsibility of the Contractor

D. Contractor to verify quantities to perform all earthwork required, including but not limited to, additional import or export required to handle compaction, pavement subgrade preparation, and pipe bedding

E. Contractor shall take precautions to limit the removal of or damage to existing pavements, multi-use paths sidewalks, curbs, lawns, shrubbery, trees, hedges, walls, fences, buildings, or other existing improvements to the least practicable amounts and shall replace or restore such improvements to their original location and condition after the excavation has been backfilled and compacted

3.3 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Excavation and backfill operations shall 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 shall 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 shall be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the City

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 shall be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, shall be borne by the Contractor at no additional expense to the City

3.4 SITE PREPARATION

A. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris

B. Remove all waste materials from site and dispose. Stockpile all acceptable grubbings for reuse in revegetation areas.

C. 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

3.5 DEWATERING

A. Comply with CDPHE Dewatering Requirements

B. Dewatering discharge to surface waterways requires CDPHE dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, if necessary

3.6 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Thoroughly clean pipe and fittings of foreign matter before installation. Remove scale and dirt, on inside and outside, before assembly

C. Prepare pipe connections to equipment with flanges or unions. Clean joint contact surfaces with wire brush is necessary, wipe clean, and keep clean until jointing is complete.

D. Cut ends of metallic pipe, recoat with coating approved for potable water service and compatible with manufacturer's coatings.

E. Shape trench and place bedding as specified in Section 02320 and 02324 and as shown on the drawings. Do not disturb trench bottom during excavation. Hand trim excavation for accurate placement of pipe to elevations indicated

1. Dig bell or coupling holes
2. Do not support pipe on blocks or mounds of earth
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
5. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent
6. Backfill in accordance with Sections 02320 and 02324

3.7 FUSION AND JOINING

A. Fusion Joining Requirements:

1. All HDPE pipes shall be joined to itself by the heat fusion process which produces homogeneous, seal, leak tight joints. Tie-ins between sections of HDPE pipe shall be made by butt fusion whenever possible.
2. Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. A record or certificate of training for the fusion operator must be provided that documents training to the fundamentals of ASTM F 2620. Consideration should be given to and provisions made for adverse weather conditions, such as temperatures below freezing, precipitation, or wind, which is accepted by the owner/engineer.
3. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers' recommended procedure. Other sources of electrofusion joining information are ASTM F 1290, PPI TN 34, and PPI Municipal Advisory Board (MAB) Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician shall be demonstrated by evidence electrofusion training within the past year on the equipment to be utilized for this project.

B. Fusion Operators:

1. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The employer is responsible for documenting all training and qualification records for that individual, including compliance to any code

requirements for fusion/bonder operators. Fusion/bonder operators must have a current certification.

2. All HDPE fusion equipment operators shall be qualified to the procedure used to perform pipe joining. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.

C. Butt Fusion Equipment:

1. For 6” and larger pipe sizes, the pipe butt fusion machine shall be a hydraulic fusion machine capable of butt fusing HDPE pipe. The carriage must be removable from the chassis for in-ditch use. The machine must be compatible with an approved electronic data recording device. Accessories will include all butt fusion inserts for the specified range of pipe sizes, a pyrometer kit for checking the surface temperature of the heater, extension cord of appropriate gauge (25' minimum), and hydraulic extension hoses (minimum of four). The butt fusion machine will be Engineer approved.

3.8 PRECAST CONCRETE VAULT PREPARATION

A. Verify items provided by other section of Work are properly sized and located

B. Verify built-in items are in proper location, ready for roughing into Work

C. Verify excavation for concrete vault is correct

D. Excavation, Backfill, Subgrade Compaction: Refer to Sections 02315 and 02320 for requirements

E. Rock Subbase

1. Remove water and place 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 Engineer and backfill to grade with 1-1/2 inch minus rock and compact

3.9 PLACING PRECAST SECTIONS

A. Thoroughly clean joints of sections to place gasket material

B. Place gasket material on base or lower section to ensure watertight fit between lower precast section and upper precast section

C. Fill inside and outside of joint completely with non-shrink grout and trowel smooth

D. Cure non-shrink grout using approved methods as recommended by manufacturer

3.10 PREFORMED GASKETS

A. Remove and replace vault 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

3.11 BORING

A. A qualified contractor shall perform boring with proper boring equipment.

B. Water pipe shall be installed through a steel sleeve under irrigation canals, railroads, creeks, waterways, and other structures designated by the Engineer.

C. Steel sleeve shall be of Standard Weight, Schedule 30 steel, with a diameter adequate to receive the pipe bells and insulators.

D. Corrosion resistant coated casing insulators with steel bands and glass reinforced plastic runners shall be installed and centered within the sleeve according to the manufacturer’s instructions at the maximum allowed spacing.

E. Rubber end seals with stainless steel bands, clamps, and screws shall be installed on both ends of the sleeve

3.12 INSTALLATION- BEDDING

A. Excavate pipe trench in accordance with Section 02324 for Work of this Section.

B. Minimum support for the pipe shall be directed by the Engineer to meet conditions in the field. No pipe shall be installed when the Engineer has determined that the trench conditions are unsuitable.

C. Prior to placing concrete for cradles or encasements, temporary supports consisting of concrete blocks shall be used to support the pipe in place. Not more than two supports shall be used for each pipe length, one on either end. Inspection by Engineer is required prior to placement of concrete.

D. Place bedding material at trench bottom per City of Cañon City Standard Detail W-3, level fill materials under pipe in one continuous layer not less than 4 inches compacted depth up to 6 inches above the top of the pipe; compact to 92 percent, maximum dry density, ASTM D698, Standard Proctor.

E. Place fill material in accordance with Section 02324.

F. Bedding installation and material shall be in accordance with the utility’s specifications. All water lines shall be bedded using coarse aggregate or fine aggregate as specified in Section 02060 – Aggregate.

3.13 INSTALLATION - PIPE

A. Inspect pipe and accessories for defects before lowering into trench.

B. Utilize implements, tools and facilities as recommended by the manufacturer if required to remove debris

C. Replace any defective, damaged or unsound pipe.

D. Do not bend pipe

E. Carefully lower pipe and fittings into trench in such a manner as to prevent damage to the water main materials and protective coatings and linings.

F. Install as specified or in accordance with the manufacturer's recommendations. Prevent foreign material from entering pipe or joint space while it is installed. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected. During installation, no debris, tools, clothing, or other materials shall be placed in the pipe. At times when installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or as directed by the Engineer. Do not lay pipe in water. Maintain groundwater level a minimum of 12 inches below pipe to be installed. Do not lay pipe under unsuitable weather or trench condition. If water is in trench, the plug shall remain in place until the trench is pumped completely dry.

G. Joint to form true and smooth line. Remove any pipe not making a good fit.

H. Deflect pipe at joints.

I. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system

J. Protect pipe from floatation or movement until completely backfilled and put into service. Remove and re-lay any pipe which has floated.

K. Install PVC Pipe in accordance with AWWA M23 and AWWA C605

L. Install Ductile Iron Pipe in accordance with AWWA C600

M. Install Ductile Iron Fittings in accordance with AWWA M41. Do not deflect PVC pipe at connection to ductile iron fittings

N. Install HDPE Pipe as specified in Section 02517

O. Maintain horizontal separation of water main from sewer piping a minimum of 10 feet and 18 inches of vertical separation between water main and storm or sanitary sewer lines in accordance with the CDPHE.. At no time shall a bell or spigot PVC pipe joint be located within 5 feet of the centerline of a sanitary sewer pipe trench.

P. When water pipeline crosses a sanitary service, perform work in accordance with City of Cañon City Standard Detail W-6. The Contractor shall physically locate the centerline of the existing sewer main and center of a full pipe joint (nominal joint length of 20 linear feet) across the sewer main (+/- 1-foot from the center of the joint). Crossings shall likely require the Contractor to cut and re-bevel the end of the previously laid pipe joint to fit. New water main shall be installed a

minimum of 6- inches above the top of the existing sewer main pipe. The water main shall be blocked on both sides of the sewer pipe with concrete blocks resting on undisturbed native soil. Bedding and backfill materials within 3-feet either side of the intersection of water and sewer pipe shall be lightly compacted (less than 95% Standard Proctor density) until the water main is backfilled to approximately 6-inches above the top of the pipe, at which point normal compaction shall begin.

Q. Cutting Pipe

1. Cut pipe to measurement taken at the site, not from the drawings
2. Cut pipe neatly without damage to pipe
3. Cut smooth, straight, and at right angles to pipe axis
4. Dress and bevel end of cut pipe to remove roughness and sharp corners
5. Cut pipe with saw or abrasive wheel
6. Follow state and federal safety regulations pertaining to cutting asbestos concrete pipe as necessary

R. Water mains shall be installed so that a continuous loop is provided for an alternate source of supply where deemed practical by the City. Route pipe as indicated on plan and profile drawings.

S. Water mains shall be placed under traveled portion of roadway if possible. Provide staking for alignment and elevation of water mains a minimum of 50 feet apart and for location of hydrants.

T. Install pipe with a minimum of 3 ½ feet and a maximum of 7 feet of cover from top of the pipe to the final finished grade of street. Maintain a minimum of 3 feet of cover over pipe at all times during construction. Add additional soil in areas of future fill to provide minimal cover at all times. Report any variations from plan to City and Engineer.

1. Provide air release valve at all high points and blow-offs or hydrant at all low points. Coordinate locations and details with Engineer.
2. Where minimum depth cannot be maintained, provide a minimum of 2 inch of specified insulation board per 1 foot of cover not provided. Contractor must have City and Engineer approval prior to installation.
3. Place insulation board over bedding material for the width of the trench

U. If for any reason, minimum and maximum cover cannot be maintained over existing installed water mains or water service lines; the mains and service lines so affected shall be relocated at the expense of the developer/owner.

V. Mechanical Joint Fittings:

1. Install ductile iron piping and fittings per AWWA C600 and PVC piping and fittings per AWWA 605.
2. All fittings and valves used north of the Arkansas River shall be wrapped/encased with polyethylene jacket per AWWA C105.

3. There shall be a minimum of 18 inches of pipe between all valves and fittings.
4. Remove all oil, grit, excess coating, and foreign material from inside the fitting. Slip the follower gland on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell end. Place the rubber gasket on the spigot end with the thick edges toward the gland. Push the entire section of pipe forward to seat the spigot in the socket end of the fitting. Thoroughly lubricate gaskets and install in accordance with manufacturer's instructions. Press the gasket into place within the socket. If an effective seal is not obtained, disassemble joint, clean thoroughly, and reassemble. Move the follower gland along the pipe into position for bolting. Install flange and mechanical joint pieces so the mechanical joint holes, as well as the flange holes, straddle the top centerline for horizontal piping, or the side centerline for vertical piping. Insert all the bolts and "finger" tighten nuts. Tighten nuts spaced 180 degrees apart alternately in order to produce an equal pressure on all parts of the gland. Do not over tighten bolts to compensate for poor installation. Tighten all nuts with a torque limiting wrench according to the following torques:

Bolt Size (inch)	Torque (ft-lb)
5/8	40-60
3/4	60-90
1	70-100
1 ½	90-120

W. Push-On Joint Pipe:

1. Remove all oil, grit, excess coating, and foreign material from inside of bell and outside of spigot.
2. For PVC pipe, Contractor to ensure that pipe is not inserted into the bell ends beyond the push line. Utilize EBAA Mega-Stop bell protection, or approved substitution, if necessary, to ensure previously laid pipe joints are not impacted by ongoing installation
3. Flex the circular rubber gasket inward and insert in the recess of the bell. Apply a thin film of gasket lubricant to the inside surface of the gasket and the spigot end of the pipe immediately before completing the joint.
4. Install the spigot end of pipe in bell without letting it contact the ground. Push the joint together. Pipe that is not furnished with a depth mark shall be marked prior to assembly to assure that spigot is installed to the proper depth.
5. Field cut spigot ends shall be filed and ground smooth and angled to resemble the original manufactured end.
6. Install restrained joints following manufacturer's recommendations

X. Water mains shall be designed to be restrained mechanically without the use of thrust blocks when at all possible:

1. Design of number and placement of mechanical joint restraints shall be by a licensed professional engineer.

2. Install “Mega-Lug” fittings or retainer glands on all fittings and valves. Form and place concrete for thrust restraints at elbow or change of direction of pipe main in addition to mechanical restraints only at the Engineer’s direction or as shown on Drawings.
3. At a minimum, install a bell joint restraint when a bell end is within 14 feet of a fitting or valve. Also, the last section of pipe at a dead end shall have a bell joint restraint, in addition to adequate blocking, if the section is less than 14 feet. Pipe sizes larger than 8-inch diameter will have different requirements.
4. A closed valve that will be pressure tested against shall be considered as a dead end. Payment for Bell joint restraints shall be incidental to the cost of the sleeve or pipe installed.
5. Locking gaskets (if available) may be substituted for bell joint restraints where applicable with the Engineer’s approval.
6. Route pipe in straight line at a constant depth. When pipe is laid on a grade of 10 percent or greater, the laying shall start at the lower elevation and shall proceed uphill with the bell ends of the pipe uphill.

Y. Install pipe to allow for expansion and contraction without stressing pipe or joints per pipe specifications.

Z. Concrete Thrust Restraints (when applicable):

1. Concrete thrust restraints shall be necessary when connecting to existing water mains. Thrust blocks shall be constructed at bends and fittings that require support due to unbalanced line thrust. Care shall be taken to ensure that outlets, cover bolts, nuts, clamps, and other fittings are accessible. A bond breaker shall be placed between the pipe and the thrust block to aid in future removal. If a large thrust block is to be placed, it shall be separated into sections by a suitable material. Bearing surface areas are minimum areas to bear against the undisturbed trench wall. If the soil bearing capacity is insufficient to provide adequate support, then the minimum bearing area shall be increased to a size that shall ensure support restraint. In every instance, the thrust block shall bear against undisturbed earth. Before placing concrete, equipment used in the mixing and transport shall be cleaned. Debris, water, or ice shall be removed from the area to be occupied by concrete. Concrete shall not be placed on frozen subgrade. Concrete shall be placed only in the presence of the City or Engineer unless inspection is waived prior to the placement
2. Form and place concrete for pipe thrust restraints at change of pipe direction when required by Engineer or not otherwise restrained. Forming for concrete thrust blocks and anchors shall be done by bulkheading around the shape of the thrust block or anchor with wood, burlap sacks, or reinforced paper sacks that are filled with sand or earth. Sacks shall be constructed of a size easily handled when full and left in place in the trench. Wood forms shall be removed before backfilling. Horizontal struts or braces required for trench shoring shall not remain in concrete thrust blocks. Prior to placing concrete, the forms and ditch bank will be inspected and approved by City or Engineer. When concrete is deposited against the ground without the use of forms, the ground shall be thoroughly moistened or other provisions made to prevent the ground from drawing water in from the concrete

3. Place concrete to permit full access to pipe and pipe accessories against undisturbed trench wall.
4. Use plastic “bond breaker” between concrete restraint and pipe or fitting.
5. Allow concrete restraint to cure for 12 hours before continuing backfill operations. Backfill may be placed over thrust blocks once the surface has set sufficiently and they are able to resist the weight of the backfill. However, tamping or compacting shall not be allowed above the thrust block for a minimum of 24 hours after placement.
6. Per City of Cañon City Standard Detail W-4.

AA. 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

BB. Install tracer wire continuously to the top of PVC pipe taped at maximum 500 LF intervals to keep it on top of pipe during backfill operations; coordinate with Section 02324. Bring tracer wire to surface at every hydrant location or at locations indicated by Engineer.
1. Tape tracer wire to top of pipe using PVC tape every 4 feet along the pipe, and on each side of fitting. Tape: minimum 2 inches wide and wrapping full circumference of pipe
2. Install identification /warning marker tape in fill area of trench above all water lines

CC. Install access fittings to permit disinfection of water system, subject to approval by Engineer

DD. Backfill trench in accordance with Section 02324 and per City of Cañon City Standard Detail W-3.

EE. Direct Burial HDPE Pipe:
1. Buried HDPE pipe and fittings shall be installed in accordance with ASTM D 2321 or ASTM D 2774 for pressure systems and AWWA Manual of Water Supply Practices M55 Chapter 8. The Design Window identified in AWWA M55 Chapter 5 (page 65 of 2006 version) shall be considered acceptable design and installation conditions.
2. Unless required by the owner’s engineer, no thrust blocks shall be placed in the HDPE pipe system since the fused system is fully restrained.
3. Trenchless or Pull-in Installation Methods
4. For Horizontal Directional Drilling (HDD), refer to ASTM F1962, PPI TR-46, PPI PE Handbook (Chapter 12) and www.PPIBoreAid.com. See Section 02446, Horizontal Directional Drilling, for HDD Specifications.
5. For pipe bursting, refer to PPI PE Handbook (Chapter 16)

3.14 INSTALLATION - VALVES AND HYDRANTS

A. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards

B. Install valves and accessories in accordance with the manufacturer's recommendations and in accordance with referenced standards and specifications

C. Install valves at locations indicated on Drawings. Install a minimum of one valve every two blocks in residential areas and every block in business or high-density areas.

D. Set valves on blocking placed on subsoil.

1. Valves up to and including 8 inch: install solid concrete blocks, 4-inch x 8- inch x 16-inch minimum.

2. Valves 10 & 12 inch: blocks under 10-inch and 12-inch butterfly valves shall be pre-cast concrete 3-foot wide X 3-foot wide and 6-inches thick. The blocks shall be constructed with concrete of a compressive strength of

3. 3500 psi at 28 days and reinforcement of #4, grade 40 deformed bar at 12- inch o.c. each way. Smaller blocks will be stacked tightly onto the pre-cast block up to the bottom of the valve operator nut of all butterfly valves.

4. Flow-fill in addition to blocking shall be installed a minimum of 8 inches under valve up to the spring line of the pipe.

5. Valves greater than 12 inch: blocks under valves shall be pre-cast concrete 4-foot wide X 4-foot wide and 6-inches thick. The blocks shall be constructed with concrete of a compressive strength of 3500 psi at 28 days and reinforcement of #4, grade 40 deformed bar at 12-inch o.c. each way. Flow-fill in addition to blocking shall be installed a minimum of 8 inches under valve up to the spring line of the pipe.

6. The Engineer may specify for valves of all sizes cast-in-place concrete blocking.

E. Center and plumb valve box over valve. Set box cover flush with finished grade. Backfill and compact under and around valve boxes to ensure no vertical loads are transmitted to valve operators or bonnets. Extend stem to within 6 inches of final grade. Provide spacers to center stem in valve box

F. Provide concrete collar for installations within landscaped areas

G. Protect valve box and cover during paving operations and clean any excess concrete, or asphalt, or road base from valve box and cover to ensure visibility and proper operation

H. Install hydrants at locations indicated on Plans and as required by the Fire District. Comply with AWWA M17 for fire hydrant installation. Install with gate valve and provisions for drainage.

I. When a drainage ditch deeper than 2 feet exists between a hydrant and the roadway, a culvert of appropriate size of at least 10 feet in length shall be installed centered on the hydrant per Specifications.

J. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.

K. Set hydrants to grade, with nozzles at least 16 inches above ground.

L. Connect hydrant to water main with a 6-inch branch line (using the least amount of joints possible) controlled by an independent 6-inch gate valve. Locate control valve per Detail.

M. Provide drainage pit 12 inches square by 12 inches deep (in clay or other impervious soil, pit shall be 36 inches square by 36 inches deep) filled with 1 ½ inch washed gravel with a waterproof barrier on top between pit and backfill. Encase elbow of hydrant in gravel to 12 inches above drain opening.

N. Install hydrant and blow-off assemblies in accordance with City of Cañon City Standard Details W-1 and W-2. A hydrant or blow-off assembly must be installed at all dead ends on water mains.

3.15 INSTALLATION - METERS

A. Install Work in accordance with City of Cañon City standards and Standard Details W-5A, W-5B, and W-5C.

3.16 SERVICE CONNECTIONS

A. City of Cañon City Water Department personnel will perform the installation of taps on the water main. All required shoring and safety measures shall be in place prior to City personnel entering the trench to make the taps. The Contractor shall perform excavation, backfill, compaction, and maintenance of trenches for the water main taps and service lines. Direct taps are not permitted.

B. Where it is required to reconnect the existing tap to the new water main, the Contractor shall extend the existing service line to the new main. Where the Contractor encounters existing galvanized steel or lead pipe water service lines, the Contractor shall completely replace such lines with type K copper tubing of equal diameter or larger (3/4 inch minimum). This work shall include miscellaneous fittings for connection to the existing curb stop or water meter, or coupling connection at the edge of the street R-O-W, as approved by the Engineer.

C. No service line splices are be allowed to be installed under a newly constructed, reconstructed, or over-layed street.

D. Service lines shall be placed with a minimum of 3 ½ feet and a maximum of 7 feet of cover from the top of line to the final finished grade of street.

E. If for any reason, minimum and maximum cover cannot be maintained over existing installed water mains or water service lines; the mains and service lines so affected shall be relocated at the expense of the developer/owner.

F. The Contractor is encouraged to use small diameter boring equipment wherever practical for installation of service lines.

G. Taps will never be made on PVC water mains until such lines have been isolated and depressurized.

H. Tapping saddles are not required on ductile iron water mains.

I. Taps will not be made until the water main has been tested and accepted.

J. Taps will be placed in the top quadrant of the water main at a 45 degree angle no closer than 18 inches to another tap, fitting, valve, or a spigot/bell end of pipe.

K. A minimum of 1 foot of new pipe must be installed on the outside of a new pit on the customer side.

L. Saddle nuts shall be tightened evenly with the following torque:

Bolt Size (inch)	Torque (ft-lb)
5/16	10-12
1/2	25-30
5/8	50-60

3.17 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Reference Section 02676 – Disinfection of Water Systems

3.18 FILLING AND FLUSHING DOMESTIC WATER PIPING SYSTEM

A. It may be necessary to install temporary blow-offs to facilitate blowing off and disinfecting the new water mains before the mains can be tied into the City water system. The Contractor shall furnish all materials, labor, and equipment to install and remove the temporary blow-offs. For each blow-off, the Contractor shall install the required assembly per Standard Detail W-2 or an approved method and assembly approved by the Engineer (as the blow-off is temporary).

B. Taps shall be made to expel air in locations at high points where no hydrant or blow- off is installed. The Engineer shall specify the size and number of taps. Such taps shall be plugged when testing is complete. Permanent high points in the water main shall have air and vacuum valves and vaults installed.

C. All dead end portions of the main that are to be tied into existing mains after completion shall be fitted with temporary blocking of sufficient strength to withstand required test pressures.

D. Filling and flushing of mains shall be performed by City of Cañon City Water Department personnel.

E. All backfill operations shall be complete and all permanent concrete thrust blocks in place for a minimum of 24 hours prior to any filling or flushing operations.

F. Following chlorination, all treated water shall be flushed from the pipeline until, upon test by City personnel, the water is proved comparable in quality to the water served to the public from the existing system.

3.19 EXISTING MAIN ABANDONMENT

A. Existing water mains indicated by the Engineer shall be abandoned as directed. Where mains are to be abandoned and removed to a fitting or valve, cut and plug main at fitting or valve.

B. Existing water valves shall be removed if necessary to install the new main or can be left in place. Valves left in place shall have their valve boxes removed and the resulting void filled with flow fill.

C. Pipe, fittings, and other appurtenances that are removed, but are not required to be salvaged become property of Contractor

D. Remove and dispose of offsite

E. Existing fire hydrants to be abandoned shall be removed as a whole assembly by disconnecting it at the lateral without damage to the assembly or surrounding structures and landscape. The hydrant shall be salvaged by delivering it to the Water Department yard if directed, otherwise shall be disposed of at Contractor's expense.

F. ERECTION TOLERANCES

G. Establish invert elevations and slopes as shown on Drawings

H. Respect pipe manufacturer's tolerances of horizontal and vertical deflection

3.20 FIELD QUALITY CONTROL

A. Engineer and City personnel will perform Field inspecting and testing unless otherwise indicated. Contractor shall have a Certified Class 3 Water Distribution Technician on site any time any existing water main is cut open. The Contractor shall be billed for this service if provided by City personnel.

B. A coliform bacteria sample shall be taken by City personnel after flushing is complete and delivered by the Contractor to a certified laboratory. Pressure testing shall be scheduled upon receipt of a negative coliform bacteria test result.

C. Valve Testing
   1. Conduct pressure and leakage tests on all newly installed valves
   2. Furnish all necessary equipment and material and make all connections to the pipe, as required. The Engineer shall monitor the tests.

D. Pressure test system:
   1. After completion of pipeline installation, including backfill, but prior to final connection to existing system, the City will conduct, in presence of Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600 & AWWA C605.

2. The Contractor shall accept full responsibility for testing against any existing valves, fire hydrants, or other appurtenances.
3. The City will provide equipment required to perform leakage and hydrostatic pressure tests.
4. Test Pressure: Not less than 150 psi or 1.5 times in excess of maximum static pressure, whichever is greater.
5. Conduct hydrostatic test for at least two-hour duration.
6. Pressure shall not vary by more than 5 psi during the hydrostatic pressure test.
7. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks installed and plug pipe openings.
8. The City personnel will slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
9. Examine exposed piping, fittings, valves, hydrants, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.

The specified test pressure for the leakage test is the same as for the pressure test (See Table I) and the test should be conducted for at least 2 hours in duration. Leakage is defined as the quantity of water that must be supplied into the main in order to maintain the water pressure within 5 psi of the specified test pressure after the pipe has been filled with water and air expelled. No pipe installation will be acceptable if the leakage is greater than that determined by the following formulas:

For PVC or DIP pipe,

$$\frac{L = S \times D \times \sqrt{P}}{133{,}200}$$

where,

L allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P= average test pressure during the leakage test, in pounds per square inch

The above equation is based on a leakage rate of 10.5 gallons per day per mile per inch of nominal diameter of pipe. Leakage values determined by the above formula for 1000 feet of pipe are presented in Table 2. These values are similar to those presented in AWWA C605 and DIPRA (DIPRA, 2003).

TABLE 2 - ALLOWABLE LEAKAGE (gaVhr) FOR 1000 FT OF GASKETED PVC OR DIP PIPE

Nominal psi Pipe Size	Average Test Pressure in Pipeline,													
(in)	50	75	100	125	150	175	200	225	250	275	300	350	400	450
2	0.10	0.12	0.14	0.15	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.25	0.27	0.29
3	0.14	0.18	0.20	0.23	0.25	0.27	0.29	0.30	0.32	0.34	0.35	0.38	0.41	0.43
4	0.19	0.23	0.27	0.30	0.33	0.36	0.38	0.41	0.43	0.45	0.47	0.51	0.54	0.57
6	0.29	0.35	0.41	0.45	0.50	0.54	0.57	0.61	0.64	0.67	0.70	0.76	0.81	0.86
8	0.38	0.47	0.54	0.60	0.66	0.72	0.76	0.81	0.85	0.90	0.94	I.OJ	1.08	1.15
10	0.48	0.59	0.68	0.76	0.83	0.89	0.96	1.01	1.07	1.12	1.!7	1.26	1.35	1.43
12	0.57	0.70	0.81	0.91	0.99	1.07	1.15	1.22	1.28	1.34	1.40	1.52	1.62	1.72
14	0.67	0.82	0.95	1.06	1.!6	1.25	1.34	1.42	1.50	1.57	1.64	1.77	1.89	2.01
16	0.76	0.94	1.08	1.21	1.32	1.43	1.53	1.62	1.71	1.79	1.87	2.02	2.16	2.29
18	0.86	1.05	1.22	1.36	1.49	1.61	1.72	1.82	1.92	2.02	2.1!	2.28	2.43	2.58
20	0.96	1.!7	1.35	1.51	1.66	1.79	1.91	2.03	2.14	2.24	2.34	2.53	2.70	2.87
24	1.15	1.40	1.62	1.81	1.99	2.15	2.29	2.43	2.56	2.69	2.81	3.03	3.24	3.44
30	1.43	1.76	2.03	2.27	2.48	2.68	2.87	3.04	3.21	3.36	3.51	3.79	4.05	4.30
36	1.72	2.11	2.43	2.72	2.98	3.22	3.44	3.65	3.85	4.03	4.21	4.55	4.86	5.16
42	2.01	2.46	2.84	3.17	3.48	3.75	4.01	4.26	4.49	4.71	4.92	5.31	5.68	6.02
48	2.29	2.81	3.24	3.63	3.97	4.29	4.59	4.86	5.13	5.38	5.62	6.07	6.49	6.88
54	2.58	3.16	3.65	4.08	4.47	4.83	5.16	5,47	5.77	6.05	6.32	6.83	7.30	7.74
60	2.87	3.51	4.05	4.53	4.97	5.36	5.73	6.08	6.41	6.72	7.02	7.58	8.11	8.60
64	3.06	3.75	4.32	4.83	5.30	5.72	6.12	6.49	6.84	7.17	7.49	8.09	8.65	9.17

Note: The allowable leakage for test sections with different diameters is the sum of the computed leakage for each pipe size.

10. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

E. Compaction testing for bedding and backfill in accordance with Section 02324.

F. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

G. The pipeline may be placed in operation after all required cleaning, testing, and inspection have been completed and written permission has been granted by the Engineer. Final acceptance of the pipeline system shall take place a period of 2 years from the date written permission is given. During this 2 year period, any defects in the system resulting from defective materials, poor workmanship, or any other cause attributable to the Contractor shall be corrected at his expense and to the satisfaction of the Engineer. Should the Contractor fail to respond within 48 hours after written notification of any deficiency, the City may complete the work and bill the Contractor. In emergency situations, the City shall take whatever steps necessary to correct the problem.

END OF SECTION

SECTION 02517

HIGH DENSITY POLYETHYLENE (HDPE) PIPE, FITTINGS AND JOINING/FUSION

PART 1 GENERAL

1.1 SUMMARY

A. SCOPE OF WORK

1. This specification covers the material (pipe and fittings), joining methods and general installation practice for high density polyethylene pipe (HDPE) piping systems for water and wastewater utility use as indicated on the Drawings.

B. SUBMITTALS

1. Submit product data to the Engineer for review in accordance with the Section 01600, Product Requirements, for all pipe, fittings, and appurtenances.

2. Contractor shall also submit the following to the Engineer for approval:

a. Certified dimensional as-built drawings/profile of all installed pipe, specials and fittings.

b. Details of fittings and specials such as elbows, tees, outlets, connections, test bulkheads, nozzles or other special items where shown on the Construction Drawings. All connections to jointed gasketed pipe materials, valves or fire hydrants must be restrained and supported independently to withstand the pressure transients, soil settlement, and external loading conditions.

c. The Supplier of the material shall submit, through the Contractor, a Certificate of Compliance that the HDPE pipe and fittings furnished for this project are City of Cañon City Water Superintendent approved materials that meet or exceed the standards set forth in this specification. The Contractor shall submit these certificates to the Engineer prior to installation of the pipe materials.

d. Provide a statement that personnel responsible for fusing the pipe have been trained and qualified.

e. For items that do not meet all of the requirements of this specification, the bid/submittal shall include a written description of the deviations, along with data that show the magnitude and the justification for the deviation from the specification. The decision to accept material deviating from this specification shall be the responsibility of the specifying engineer and must be approved in writing.

1.2 REFERENCE DOCUMENTS AND STANDARDS

A. The standards and documents listed below may apply to the materials and practices in this specification. In the event of a conflict, the requirements of this specification prevail. Unless otherwise specified, references to documents shall mean the latest published edition of the referenced document in effect at the project bid date.

B. ANSI/AWWA

1. ANSI/AWWA C901 – Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm) for Water Service
2. ANSI/AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission
3. ANSI/AWWA C651 – Standard for Disinfecting Water Mains
4. AWWA M55 – Manual of Water Supply Practices, PE Pipe–Design and Installation
5. Plastics Pipe Institute, PPI
6. PPI Handbook of Polyethylene Pipe – 2009 (2ndEdition)
7. PPI Municipal Advisory Board (MAB) Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe
8. PPI Material Handling Guide for HDPE Pipe and Fittings
9. PPI TR-33 Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe
10. PPI TR-34 Disinfection of Newly Constructed Polyethylene Water Mains
11. PPI TR-38 Bolt Torque for Polyethylene Flanged Joints
12. PPI TN-42 Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects
13. PPI TR-46 Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe

C. ASTM

1. ASTM F 585 – Standard Guide for Insertion of Flexible Polyethylene Pipe Into Existing Sewers
2. ASTM F 714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
3. ASTM F 905 – Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
4. ASTM F 1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Fittings
5. ASTM F 1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings

6. ASTM F 1962 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings
7. ASTM F 2164 – Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
8. ASTM F2206 – Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
9. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
10. ASTM F 2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

D. ASTM D 2683 – Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter- Controlled Polyethylene Pipe and Tubing
1. ASTM D 2737 – Standard Specification for Polyethylene (PE) Plastic Tubing
2. ASTM D 2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
3. ASTM F 2880 – Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3⁄4 in. to 65 in.
4. ASTM F 3124 – Standard Practice for Data Recording the Procedure Used to Produce Heat Butt Fusion Joints
5. ASTM D 3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
6. ASTM D 3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
7. ASTM D 3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

1.3 PRODUCTS

A. HIGH DENSITY POLYETHYLENE MATERIALS
1. Resin and Material Requirements

All material shall be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D 3350 with a minimum cell classification of 445474C. HDPE pipe and fittings shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. HDPE products shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

B. HDPE PIPE

1. Pipe shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2.01.A. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black of not less than 2 percent. The manufacture of the HDPE resin shall certify the cell classification indicated.

2. Pipe sizes 3" and large shall have a manufacturing standard of ASTM F 714, while pipe smaller than 3" shall be manufactured to the dimensional requirements listed in ASTM D 3035. Dimension Ratio (DR) and Outside Diameter (IPS/DIPS) shall be as specified on plans.

3. Pipe shall meet AWWA C901 (1/2" to 3") or AWWA C906 (4" to 63") and shall be listed as meeting NSF-61.

4. When required by the owner, pipe shall be color coded for the intended service. The color coding shall be permanently co-extruded stripes on the pipe outside surface as part of the pipe's manufacturing process. Color coding shall be as follows:

    a. Sewer – green

    b. Water – blue

    c. Reclaim – purple

C. HDPE FITTINGS

1. Butt Fusion Fittings: Fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2.1.A. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans or accepted by owner/engineer. All fittings shall meet the requirements of AWWA C901 or C906.

    a. Molded fittings shall comply with the requirements of ASTM D 3261.

    b. All fabricated elbows, tees, reducing tees and end caps shall be produced and meet the requirements of ASTM F 2206, as manufactured by ISCO Industries, Inc or other approved manufacturer holding an ISO 9001 quality system certificate. Each fitting will be marked per ASTM F 2206 section 10 including the nominal size and fitting EDR, which will meet or exceed the pipe DR identified for the project. Fabricated fittings shall be manufactured and pressure tested using an approved data logger to record fusion pressure and temperature and shall be stamped with unique joint number that corresponds to the joint report. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained for a minimum of 5 years as part of the quality control and will be available upon request of owner. Test results to validate ASTM F 2206 section 7.3 and 9 shall be provided to owner or owner's representative upon request.

    c. Socket fittings shall meet ASTM D 2683.

2. Electrofusion Fittings: Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted in 2.1.A. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans. For potable water systems, all electrofusion fittings shall have AWWA approval.

3. Bolted Connections: Flanges and MJ Adapters shall be fused onto the pipe and have a minimum pressure rating equal to or greater than the pipe unless otherwise specified on the plans.

    a. Metallic back-up rings (Van-Stone style lap joint flanges) shall have a radius on the inside diameter of the bore so as to be compatible with HDPE Flanges. Back up rings shall have bolt pattern that will mate with AWWA C207 Class D (generically known as 150-pound patterns).

    b. Flange assemblies shall be assembled and torqued according to PPI TN-38, "Bolt Torque for Polyethylene Flanged Joints."

    c. Where shown on the drawings, 4" and larger transitions to mechanical joint fittings and valves shall be accomplished using a MJ Adapter with kit. The D.I./HDPE mechanical joint adaptor shall consist of an HDPE mechanical joint transition fitting, rubber gasket, a mechanical joint backup drive ring, and Corten mechanical joint tee bolts.

    d. Mechanical Fittings: The use of mechanical coupling and saddles shall be approved by the owner or engineer prior to installation. Mechanical Fittings shall be designed for use and compatible with HDPE pipe, including SS stiffeners when required by manufacturer. Mechanical fittings shall have a pressure rating equal to or greater than the pipe.

4. Fusion Equipment Requirements
    a. Butt fusion equipment must be in satisfactory working order and the hydraulic system must be leak free. Heater plates shall be free from scrapes, gouges, and have a consistent clean coated surface. The pressure gage and thermometer should be checked for accuracy. When requested by the owner, records showing a maintenance service/inspection within 3 months prior to use for this project shall be provided.

    b. Electrofusion Processors shall be maintained and calibrated per manufacturers' requirements and recommendations.

5. Approved Suppliers

    a. All Pipe, Fittings, and Fusion Equipment shall be provided by one supplier. Approved suppliers are ISCO Industries, Inc. or approved equal.

D. PIPELINE LOCATING MATERIALS
1. Detectable Marker Tape: Plastic marker tape shall be 5 mil minimum thickness with a solid aluminum core of .35mil minimum thickness and a minimum width of 2". The background

of the tape shall be colored based on pipe service with black lettering continuously printed. Marker tape shall have a minimum 35 lbs./inch tensile strength. The installation of the tape shall be at 18 inches below finish grade.

2. Tracer Wire: All HDPE pipe 4" and greater shall be installed with an extra high-strength, copper clad steel tracer wire as specified in Section 02512, under PIPE MARKERS. This wire shall be continuous and brought up in the valve boxes at the ends of each line segment with splices made only by methods per the equipment manufacturer's recommendation. All miscellaneous splicing components shall be furnished and installed by the Contractor.

1.4 EXECUTION

A. GENERAL

1. All HDPE pipe and fittings shall be cut, joined, and installed in accordance with the manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with polyethylene pipe systems. All pipe shall be pressure class 250 DR9 unless approved by the Water Superintendent.

1.5 TRANSPORTATION, UNLOADING, HANDLING, AND STORAGE

A. The manufacturer shall package product in a manner designed to deliver the pipe and fittings to the project neatly, intact and without physical damage. During transportation each pipe shall rest on suitable pads, strips skids, or blocks securely wedged or tied in place.

B. During loading, transportation, and unloading, every precaution should be taken to prevent damage to the pipe. The handling of the pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Cuts or gouges that reduce the wall thickness by more than 10% are not acceptable and must be cut out and discarded.

C. Handle the pipe in accordance with the PPI Handbook of Polyethylene Pipe (2nd Edition), Chapter 2. All pipe and accessories shall be loaded and unloaded by lifting with hoists or by skidding in order to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be rolled or skidded against pipe on the ground. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or interior of the pipe. All pipe and fittings shall be subjected to visual inspection at time of delivery and before they are lowered into the trench to be laid.

D. Materials, if stored, shall be kept safe from damage and shall not be stacked higher than the limits recommended by the manufacturer. The bottom tiers shall be kept off the ground on timbers, rails, or concrete. Pipe shall not be stored close to heat sources. The contractor shall be responsible for all security, damage and loss of pipe, excluding Acts of God.

E. The interior of the pipe as well as all sealing surfaces of mating components (i.e. flange faces) shall be kept free from dirt or foreign matter at all times. The open ends of all sections of joined and/or installed pipe (not in service) shall be plugged to prevent insects, animals, or foreign material from entering the pipe line or pipe section. The practice of stuffing cloth or paper in the open ends of the pipe will not be permitted. Use waterproof nightcaps to prevent

the entrance of any type of natural precipitation into the carrier or containment pipe and will be secured to the pipe in such a manner that the wind cannot blow them loose. Where possible, the pipe shall be raised and supported at a suitable distance from the open end such that the open end will be below the level of the pipe at the point of support.

1.6 RECEIPT INSPECTION

A. All pipe and fittings shall be subjected to visual inspection at time of delivery and before they are installed or lowered into the trench to be laid. Defective, damaged, or unsound pipe will be rejected. Cuts, punctures, or gouges that penetrate or reduce the wall thickness by 10% or more are not acceptable and must be removed and discarded.

1.7 FUSION AND JOINING

A. Fusion Joining Requirements:

1. All HDPE pipes shall be joined to itself by the heat fusion process which produces homogeneous, seal, leak tight joints. Tie-ins between sections of HDPE pipe shall be made by butt fusion whenever possible.

2. Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. A record or certificate of training for the fusion operator must be provided that documents training to the fundamentals of ASTM F 2620. Consideration should be given to and provisions made for adverse weather conditions, such as temperatures below freezing, precipitation, or wind, which is accepted by the owner/engineer.

3. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers' recommended procedure. Other sources of electrofusion joining information are ASTM F 1290, PPI TN 34, and PPI Municipal Advisory Board (MAB) Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician shall be demonstrated by evidence electrofusion training within the past year on the equipment to be utilized for this project.

4. Fusion Operators:

a. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The employer is responsible for documenting all training and qualification records for that individual, including compliance to any code requirements for fusion/bonder operators. Fusion/bonder operators must have a current certification.

b. All HDPE fusion equipment operators shall be qualified to the procedure used to perform pipe joining. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.

5. Butt Fusion Equipment:

    a. For 6” and larger pipe sizes, the pipe butt fusion machine shall be a hydraulic fusion machine capable of butt fusing HDPE pipe. The carriage must be removable from the chassis for in-ditch use. The machine must be compatible with an approved electronic data recording device. Accessories will include all butt fusion inserts for the specified range of pipe sizes, a pyrometer kit for checking the surface temperature of the heater, extension cord of appropriate gauge (25' minimum), and hydraulic extension hoses (minimum of four). The butt fusion machine will be Engineer approved.

1.8 INSTALLATION

A. Direct Burial

1. Buried HDPE pipe and fittings shall be installed in accordance with ASTM D 2321 or ASTM D 2774 for pressure systems and AWWA Manual of Water Supply Practices M55 Chapter 8. The Design Window identified in AWWA M55 Chapter 5 (page 65 of 2006 version) shall be considered acceptable design and installation conditions.

2. Unless required by the owner’s engineer, no thrust blocks shall be placed in the HDPE pipe system since the fused system is fully restrained.

3. Trenchless or Pull-in Installation Methods

4. For Horizontal Directional Drilling (HDD), refer to ASTM F1962, PPI TR-46, PPI PE Handbook (Chapter 12) and See Section 02446, Horizontal Directional Drilling, for HDD Specifications.

5. For pipe bursting, refer to PPI PE Handbook (Chapter 16)

B. Appurtenances

1. All appurtenances (tees, elbows, services, valves, air relief valves, fire hydrants, etc.), must be independently supported and shall not rely on the pipeline and its connections for this support. Excessive stresses may be encountered when appurtenances are inadequately supported.

2. Hydrant Assemblies shall be installed, and field tested according to the requirements of AWWA M17.

3. Installation of Tracer Wire. When tracer wire is required, the Contractor shall install along the entire section of pipeline per City of Cañon City Standard Construction Specifications and manufacturer’s requirements. The tracer wire shall be installed simultaneously with the polyethylene piping system. Tracer wire shall be installed by the Contractor and securely attached to the top of the pipe. of the pipe. Tracer wire shall be properly spliced at each end connection and each service connection. Care should be taken to adequately wrap and protect wire at all splice locations. No bare tracer wire shall be accepted. Provide magnesium alloy anode for cathodic protection that conforms to the requirements of ASTM B843.

1.9 FLUSHING, CLEANING, AND DISINFECTING

A. All mains shall be cleaned and flushed to remove all dirt, sand, debris and foreign matter.

B. Disinfection:

C. Cleaning and disinfecting of potable water systems shall be in accordance with AWWA C651 and AWWA M55 Chapter 9, and PPI Handbook of Polyethylene Pipe Chapter 2 (2nd Edition). The disinfection chemicals should be limited to less than 12% active chlorine. The duration of the disinfection should not exceed 24 hours. Chlorine tablets and powders are not permitted. Upon completion, the system should be thoroughly flushed with fresh water, and sampled to verify the disinfectant chlorine level has been reduced to potable drinking water concentrations in all service water tubing and branch lateral pipes.

1.10 TESTING AND LEAKAGE

A. The contractor shall ensure testing can be accomplished in a safe manner, including protection of personnel, equipment, and public in the event of a failure during testing. The contractor shall restrain pipe, components, and test equipment as required. All pumps, valves, temporary connections, meters, gauges and other measuring devices shall be furnished, installed and operated by the Contractor and all such equipment and devices and their installation shall be approved by the Owner's Engineer.

B. The test pressure shall be 1.5 times the operating pressure, based on the lowest point in elevation in the test section.

C. Test pressures require consideration of thermal conditions. Polyethylene piping materials are typically pressure rated at 73°F (23°C) and PE piping at temperatures greater than 80°F (26°C) require reduced test pressures. (Note that higher pipe temperatures should consider both ambient temperatures and radiant solar heating of exposed black HDPE pipe) Guidance for elevated temperatures can be found in the appendix of Chapter 3 (Material Properties) of the PPI Handbook of PE Pipe.

D. Pressure Pipelines-Pressure testing shall be conducted in accordance with requirements and recommendations of ASTM F 2164 (Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure), AWWA M55 Chapter 9, and PPI Handbook of Polyethylene Pipe Chapter 2 (2nd Edition). Pneumatic (compressed air) leakage testing of HDPE pressure piping is prohibited for safety reasons.

1. The section of pipe to be tested shall be filled with potable or generally clean water (uncontaminated river/lake water) approved by the Owner/Engineer. While the system is being filled with water, air shall be carefully and completely exhausted.

2. If the Contractor elects to perform hydrostatic testing against valves in an existing distribution system, it does so at his own risk and will bear the cost of any damages to the existing valve, piping system, private or public property, or the new pipeline under test.

3. The test procedure for HDPE pipe consists of two steps: 1) the initial phase or expansion phase and 2) the test phase. During the initial/expansion phase, sufficient make-up water

shall be added hourly for 3 hours to return to the test pressure. During the test phase, the expansion phase pressure is reduced by 10 psi to test phase pressure and monitored for at least one hour (3 hours maximum).

4. Under no circumstances shall the total time under test exceed eight (8) hours. If the test is not completed due to leakage, equipment failure or any other reason, depressurize the test section and permit the system to "relax" for eight (8) hours prior to the next testing sequence.
5. In accordance with section 9.8 of ASTM F 2164, the pipe shall pass if the final pressure is within 5% of the test phase pressure for the testing period (3 hours maximum). If the test section fails this test, the Contractor shall repair or replace all defective materials and/or workmanship at no additional cost to the Owner.

END OF SECTION

SECTION 02630

STORM DRAINAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storm drainage piping including irrigation lines within City rights of way.
2. Accessories.
3. Catch basins.
4. Cleanouts.
5. Manholes.
6. Head Walls.
7. Bedding and cover materials.

B. Related Sections:

1. Section 02060 – Aggregate.
2. Section 02324 – Trenching.
3. Section 03300 - Cast-in-Place Concrete.

1.2 REFERENCES

A. City of Cañon City Grading, Erosion, & Sediment (GESC) Plan Manual.

B. Mile High Flood District (MHFD) Criteria Manuals.

C. City of Cañon City Illicit Discharge Detection & Elimination (IDDE) Manual.

D. Colorado Department of Transportation:

1. Current CDOT Standard Specifications for Road and Bridge Construction.
2. CDOT M & S Standards 2012.

E. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
3. ACI 305 - Hot Weather Concreting.
4. ACI 306 - Cold Weather Concreting.

5. ACI 318 - Building Code Requirements for Structural Concrete.

F. Concrete Reinforcing Steel Institute:

1. CRSI Manual of Standard Practice.

G. American Society for Testing and Materials:

1. ASTM C76- Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
2. ASTM C443- Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
3. ASTM C478- Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
4. ASTM C923- Standard Specification for resilient Connectors Between Reinforced Concrete Manhole Structures.
5. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
6. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
7. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

1.3 SUBMITTALS

A. Product Data: Submit data indicating pipe, pipe accessories, and shop drawings for inlet boxes, manhole covers, steps, and grates.

B. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:

1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Current CDOT Standard Specifications for Road and Bridge Construction, CDOT M&S Standards 2012, and City of Cañon City Standards.

B. Maintain one copy of each document on site.

C. Video Inspection, at Engineer's discretion, shall be required per Engineer's inspection criteria for all new storm sewer installed. COORDINATION

D. Design the Work to incorporate existing storm sewers systems and City's Master Drainage Plan.

E. All erosion, sediment, and illicit discharge control shall be in accordance with applicable Federal, State, and City regulations including the City of Cañon City GESC & IDDE Manuals.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Pipe: ASTM C76; mesh or bar reinforcement; inside nominal diameter of 12-inches minimum, bell and spigot ends.

1. Fittings: Reinforced concrete.
2. Joints: ASTM C443, rubber compression gasket

B. Corrugated Steel Pipe: Nominal diameter of 12-inches minimum, 12 gauge; helical lock seam; galvanized steel.

1. Fittings: Corrugated steel.
2. Joints: Corrugated steel pipe coupling bands, galvanized steel, 0.052 inches thick x 10 inches wide; connected with two neoprene "O" ring gaskets and two galvanized steel bolts.

C. Plastic Pipe: ASTM D3350, High Density Polyethylene (HDPE) material, corrugated, smooth wall interior, inside nominal diameters of 12-inches minimum, bell and spigot style ends.

1. Fittings: Same material and manufacturer.
2. Joints: rubber O-ring gasket, silt tight.

D. Plastic Irrigation Pipe (P.I.P.): Soil Conservation Service Specification SCS 430-DD; DR51(80PSI) minimum

1. Fittings: Same material and manufacturer.
2. Joint design tested to the requirements of ASTM D 3139 with rubber gaskets that conform to ASTM F477.
3. P.I.P. shall not be placed in the ROW in locations that are subject to vehicular traffic or where improvements will be constructed over the pipe (sidewalks, ramps, driveways, etc.) and shall only be used for irrigation purposes.
4. Size: P.I.P pipe shale be sized to match the existing upstream and downstream pipe locations. Existing open ditches shall have pipe sized based on flow requirements and other existing site conditions.

2.2 ACCESSORIES

A. Pipe and Structure Grout: Specified in Section 03300.

1. Rip Rap Grout: 70 percent sand, 30 percent 3/8 inch aggregate, 6-9 inch slump, 5-8 percent entrained air, minimum compressive strength 3500 psi.

2. Reinforcement: Specified in Section 03300.

2.3 CATCH BASINS/INLETS AND CLEAN OUTS

A. Inlet Box & Grate:

1. Construction: Pre-cast, HS-20 loading.

2. Grate & Frame: HS-20 loading – heavy duty, bicycle safe.

3. Nominal Minimum Inside Dimension: 2 x 2 foot.

B. Type R Inlet:

1. Construction: Pre-cast, according to CDOT M & S Standards 2012.Nominal Minimum Inside Dimension: 3.5 x 3.5 foot.

C. Concrete Clean Out:

1. Construction: Cast-in-place, HS-20 loading.

2. Lid: Approved 3/8” inch steel cut to fit.

3. Nominal Minimum Inside Diameter: 2 x 2 foot.

2.4 MANHOLE

A. Construction: Pre-cast, ASTM C478, HS-20 loading.

B. Lid: Neenah R-1706-1.

1. Steps: Aluminum or gray iron and cast in place when concrete is cast and be 9 ¼ inch x 12 ½ inch. As an alternate, steps may be polypropylene (M.A. Industries PS2-PFS or equal) and can be press fit into preformed holes.

2. Nominal Minimum Inside Diameter: for manholes 6 feet or less in depth - 4 foot, for manholes greater than 6 feet in depth - 6 foot.

3. Manhole Sections: Reinforced pre-cast concrete as specified in Drawings in accordance with ASTM C478 with gaskets in accordance with ASTM C923.

2.5 HEAD WALL

A. Concrete: Specified in Section 03300.

B. Reinforcement: Specified in Section 03300.

2.6 PRE-CAST CONCRETE

A. Provide all units shown in Plans and as needed for a complete and proper installation.

B. Design Criteria- Design units in accordance with:

1. ACI 304 and 318.
2. CRSI Manual of Standard Practice.
3. Applicable ASTM Standards.

2.7 BEDDING AND COVER MATERIALS

A. Bedding: Flow Fill as specified in Section 02320 or uniformly graded rock wrapped in drainage fabric or Fill Type Class 6 as specified in Section 02060, see City of Cañon City Standard Detail W-3.

B. Cover and Backfill: Fill Type Class 6 as specified in Section 02060 or Flow Fill as specified in Section 02320.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify trench cut and excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

A. Remove old culvert, and related debris and dispose of.

B. Hand trim excavations to required elevations. Correct over excavation with material as directed by Engineer.

C. Remove large stones or other hard matter, which could damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 02324 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth.

C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

A. Per City of Cañon City Standard Detail.

B. Install pipe, fittings, and accessories as indicated in accordance with ASTM D2321 with the exception that minimum cover shall be 1 foot. Seal joints watertight.

C. Place pipe on minimum 4-inch-deep bed of Type Class 6 aggregate.

D. Lay pipe to slope gradients noted on drawings with maximum variation from indicated slope of 1/8 inch in 10 feet.

E. Install aggregate at sides and over top of pipe as indicated. Install top cover to minimum compacted thickness of 12 inches, compact to 97 percent according to ASTM D698.

3.5 INSTALLATION - CATCH BASINS, CLEANOUTS, AND MANHOLES

A. Lift pre-cast structures at lifting points designated by manufacturer.

B. When lowering manholes and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

C. Form bottom of excavation clean and smooth to correct elevation, install and compact bedding material. Flow fill can be used in place of bedding material, as specified in Section 02320.

D. Form and place Cast-In-Place Concrete base pad, with provision for storm sewer pipe end sections according Section 03300.

E. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

F. Set pre-cast structures bearing firmly and fully on bedding.

G. Move pre-cast boxes into position in a manner that is not detrimental to the construction of concrete or reinforcement.

H. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.

I. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

J. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

K. Mount grate/lid and frame level in grout, secured to top section to elevation indicated.

L. Install aggregate at sides and around box as indicated on Drawings. Compact to 97 percent according to ASTM D698.

M. Grout flow line inverts and pipe connections the full wall width.

N. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.

O. Pipes stubbed into boxes shall be saw-cut to length such that ends do not protrude into the interior of the box in excess of 4 inches.

P. Manholes shall be placed a minimum of every 500 feet and at connections under the traveled roadway.

Q. Cleanouts shall be placed a minimum of every 50 feet and at connections outside the traveled roadway.

3.6 HEAD WALL

A. Install required reinforcement as indicated.

B. Form and place concrete to the dimensions indicated according to Section 03300.

3.7 FIELD QUALITY CONTROL

A. Request inspection prior to and immediately after placing aggregate cover over pipe.

B. Compaction Testing: In accordance with ASTM D698.

C. When tests indicate work does not meet specified requirements, remove work, replace and retest.

3.8 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.

2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION

SECTION 02676

DISINFECTION OF WATER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disinfection of potable water piping, potable water storage facilities, treatment unit equipment and piping, pumping equipment and piping; testing and reporting results

1.2 RELATED SECTIONS

A. Section 01600 – Product Requirements

B. Section 01700 – Execution Requirements

C. Section 02512 – Water Distribution

1.3 REFERENCES

A. American Water Works Association (AWWA):
   1. B300 – Standard for Hypochlorites
   2. B301 – Standard for Liquid Chlorine
   3. C651 – Disinfecting Water Mains
   4. C652 – Disinfection of Water Storage Facilities
   5. C653 – Disinfection of Water Treatment Plants

B. National Sanitation Foundation (NSF):
   1. Standard 60 – Drinking Water Treatment Chemicals – Health Effects

1.4 SUBMITTALS

A. Test Reports: Indicate results comparative to specified requirements

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01600 and Section 01700

B. Disinfection report; record:
   1. Type and form of disinfectant used
   2. Date and time of disinfectant injection start and time of completion
   3. Test locations

4. Initial and 24-hour disinfectant residuals (quantity in treated water) in parts per million (ppm) or milligram per liter (mg/L) for each outlet tested
5. Date and time of flushing start and completion
6. Disinfectant residual after flushing in ppm for each outlet tested

C. Bacteriological (Bac-T) report; record:
1. Date issued, project name, and testing laboratory name, address, and telephone number
2. Time and date of water sample collection
3. Name of person collecting samples
4. Test locations
5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested
6. Coliform bacteria test results for each outlet tested
7. Bacteriologist's signature and authority

1.6 QUALITY ASSURANCE

A. Perform work in accordance with AWWA C651, C652, C653, and the Colorado Department of Public Health and Environment (CDPHE)

1.7 REGULATORY REQUIREMENTS

A. Conform to AWWA C651, C652, C653, as appropriate, and CDPHE regulations for performing the work of this Section

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Calcium and sodium hypochlorite shall conform to AWWA B300 and B301

B. Store hypochlorite in a cool, dark place away from flammable materials

PART 3 EXECUTION

3.1 CLEANING

A. Verify that piping, equipment and/or tanks have been cleaned and inspected

B. Verify that piping has been successfully pressure tested and flushed

C. Perform scheduling and disinfection activity with start-up, testing, adjusting, demonstration procedures, including coordination with related systems

D. Contractors work in tank is to be completed using “clean procedures”. Clean procedures require Contractor personnel to only have controlled access into tank wearing appropriate personal protective equipment and sanitized rubber boots prior to entry. No debris, foreign

objects or materials to remain in tank after work is completed. Disinfection and filling of tank will then be completed by the Contractor

3.2 DISINFECTION

A. Provide and attach required equipment to perform the work of this Section

B. Tablet, continuous, or slug disinfection may be followed according to AWWA C651

C. The preferred method is continuous disinfection, summarized as follows:

1. Inject treatment disinfectant, free chlorine in liquid form into piping system to obtain 50 to 80 ppm residual

2. Bleed water from outlets to ensure distribution and test for disinfectant residual

3. Maintain disinfectant in system for 24 hours

4. If final disinfectant residual tests less than 25 ppm, repeat treatment

5. Flush, circulate and clean until residual equal to that of incoming potable water or 1.0 mg/L is achieved

D. Replace permanent system devices removed for disinfection

3.3 FINAL FLUSHING

A. Maintain a flushing velocity of 2.5 feet per second in piping

B. Collect chlorinated water for proper disposal and/or dechlorinate to less than 0.1 ppm free chlorine prior to discharge in accordance with State, County, and local regulations

C. Contractor to provide and pay for flushing water

3.4 FIELD QUALITY CONTROL

A. After final flush, and before main or equipment is placed in service, collect water samples from representative points along the main or from the equipment and field test for chlorine residual

B. Chlorine residual shall be within 50 percent of the chlorine residual prevailing in the source

C. If initial disinfection fails to provide satisfactory samples, repeat disinfection until satisfactory samples have been obtained

3.5 TESTING AND ACCEPTANCE

A. The Contractor will perform Bac-T sampling and testing after pipes have been disinfected and flushed as specified in Section 02512

B. If any portion of the piping, equipment or tanks fails Bacteriological testing, the Contractor is responsible for repeating disinfection procedures until Bac-T test passes

C. Contractor shall provide and pay for services of a certified laboratory to complete Bac-T testing

D. Submit test reports per Section 01600 and Section 01700

END OF SECTION

SECTION 02721

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aggregate base course.

B. Related Sections:

1. Section 02060 – Aggregate Materials.
2. Section 02315 – Excavation.
3. Section 02740 – Flexible Pavement.
4. Section 02750 – Rigid Pavement.
5. Section 03300 – Cast-in-Place Concrete.

1.2 REFERENCES

A. Colorado Department of Transportation:

1. Current CDOT Standard Specifications for Road and Bridge Construction.

B. American Society for Testing and Materials:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

1.3 SUBMITTALS

1. Materials Source: Submit name of imported materials suppliers.
2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform work in accordance with Current CDOT Standard Specifications for Road and Bridge Construction and City of Cañon City standard.

C. Maintain one copy of each document on site.

D. Obtain materials from same source throughout.

PART 2 PRODUCTS

2.2 MATERIALS

A. Aggregate Base Course: Type Class 6 as specified in Section 02060 or as specified by design engineer and approved by the City.

B. Geotextile Fabric:

1. Shall be a non-woven, spun-bonded, continuous filament, polypropylene geotextile fabric meeting the following minimum standards:

TEST METHOD	*PROPERTY*	*MINIMUM VALUE*
ASTM D-4751	Apparent Opening Size	140 US Sieve
ASTM D-4491	Permittivity	0.10 Sec^{-1}
ASTM D-4491	Water Flow Rate	15 g/min/sf
ASTM D-4632	Grab Tensile Strength	240 lbs
ASTM D-4533	Trapezoidal Tear	79 lbs
ASTM D-4632	Elongation @ Break	50%

2. Geotextile fabric shall be approved by the Engineer. Additionally, other physical properties may be used by the Engineer to evaluate the geotextile including, but not limited to, CBR puncture testing, Mullen Burst testing, permeability, and puncture strength.

3. Approved Fabrics

a. Typar 3601G.

b. US Fabric SF65

c. Other fabrics will be considered when supported by a Geotechnical Engineering Report.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate has been inspected, gradients and elevations are correct and is dry.

3.2 PREPARATION

A. Scarify sub grade 6-inches minimum and compact to 97 percent Standard Proctor.

B. Compact disturbed load-bearing soil to 97 percent Standard Proctor prior to placement of fabric or base course material.

C. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

D. Do not place fill on soft, muddy, or frozen surfaces.

3.3 GEOTEXTILE FABRIC PLACEMENT

A. Install fabric on native sub grade below aggregate base course.

B. The fabric shall be unrolled parallel to the alignment of the roadway.

C. Folds and wrinkles not associated with roadway curves shall be removed prior to covering fabric.

D. The fabric shall be pinned, stapled, or secured in place by small piles of fill prior to covering to prevent movement.

E. Mechanical equipment shall not be allowed to operate on the surface to the fabric.

F. Minimum overlap along fabric seams shall be as specified by the design engineer but not less than 2 foot longitudinally and 3 feet transversally.

3.4 AGGREGATE PLACEMENT

A. Place aggregate in maximum 8-inch layers and compact to 97 percent, maximum dry density, ASTM D698, Standard Proctor. Lift size may be increased when it is demonstrated that compaction requirements can be met using other methods. The Engineer will make final determination on the thickness of each lift in the field.

B. Level and contour surfaces to elevations and gradients indicated.

C. Maintain optimum moisture content, plus or minus (+) 2 percent, of fill materials to attain required compaction density.

D. Use adequate hand operated mechanical tamping equipment in areas inaccessible to larger compaction equipment.

3.5 TOLERANCES

A. Maximum Variation From Thickness: 1/2 inch.

B. Maximum Variation From Elevation: 1/4 inch.

3.6 FIELD QUALITY CONTROL

A. Compaction Testing: In accordance with ASTM D698.

B. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest

C. Compaction Testing for Bedding and Backfill:

1. Contractor is required to hire an independent, licensed engineer experienced in soil analysis and evaluation to perform required compaction tests in accordance with ASTM D698. Copies of all Proctor curves and test results showing exact location of sample

collection and test sites must be furnished to Engineer. Engineer shall be informed prior to testing and he may designate areas of testing.

2. Performed by City personnel or Contractor at option of Engineer in accordance with ASTM D698.
3. Testing is to be done at various elevations in trench, which may require excavation by Contractor after backfill is installed.
4. Frequency of Compaction Tests will be specified by Engineer in field but shall be no less than every 200 feet at every 1 foot of depth of the backfill or anytime the means and methods of compaction change.
5. Testing shall use the Standard Proctor method. Alternatives such as Modified Proctor or Relative Density based on necessity due to material type may be used with the permission of the Engineer so long as the necessary conversion data, testing, and information has been completed and submitted prior commencement of the work.

3.7 SCHEDULES

A. Under Curb and Gutter, Cross Pans, Driveway Aprons, and Asphalt Patch:

1. Compact placed aggregate materials uniformly, 6 inches thick, over sub grade.
2. Exclude Class 6 base course material installed for all curb & gutter tied to concrete pavement. Subgrade treatment for the attached curb & gutter shall be the same as for the concrete pavement.
3. Design engineer shall verify minimum requirements are adequate based on site conditions and propose changes to Engineer accordingly for approval.

B. Under Sidewalk:

1. Compact placed aggregate materials uniformly, 4 inches thick, over sub grade.
2. Compact placed aggregate materials uniformly, 6 inches thick in driveways and under sidewalk adjacent to mountable curb and gutter, over sub grade.
3. Design engineer shall verify minimum requirements are adequate based on site conditions and propose necessary changes to Engineer accordingly for approval.

C. Under Asphalt Pavement:

1. Compact placed aggregate materials uniformly, 8 inches thick minimum, over geotextile fabric.
2. Design engineer shall verify minimum requirements are adequate based on site conditions and propose necessary changes to Engineer accordingly for approval.

D. Under Concrete Pavement:

1. Compact placed aggregate materials uniformly, to thickness indicated by Engineer if required, over subgrade.

2. Design engineer shall verify minimum requirements are adequate based on site conditions and propose necessary changes to Engineer accordingly for approval.

END OF SECTION

SECTION 02740

FLEXIBLE PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hot Mix Asphalt (HMA) pavement.
   2. Hot Mix Asphalt (HMA) pavement overlay.
   3. Infrared patch repair.

B. Related Sections:
   1. Section 02315 – Excavation.
   2. Section 02721 – Aggregate Base Course.

1.2 REFERENCES

A. Colorado Department of Transportation:
   1. Current CDOT Standard Specifications for Road and Bridge Construction.

B. American Society for Testing and Materials:
   1. ASTM D276- Standard Test Methods for Identification of Fibers in Textiles.
   2. ASTM D3776- Standard Test Method for Mass Unit Area (Weight) of Fabric.
   3. ASTM D4632- Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

C. American Association of State Highway and Transportation Officials:
   1. AASHTO M140- Standard Specification for Emulsified Asphalt.
   2. AASHTO M208- Standard Specification for Cationic Emulsified Asphalt.
   3. Municipal Government Engineers Pavement Council – Current Specifications

1.3 PERFORMANCE REQUIREMENTS

A. Paving: Designed for residential streets, 92-96 percent maximum density.

1.4 SUBMITTALS

A. Product Data: Submit product information and mix design.

B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Current CDOT Standard Specifications for Road and Bridge Construction and City of Cañon City Standards.

B. Mixing Plant: Conform to Current CDOT Standard Specifications for Road and Bridge Construction.

C. Obtain materials from same source throughout.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with documented experience.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt when ambient air or base surface temperature is less than the temperatures indicated in Table 401-3, CDOT Standard Specifications for Road and Bridge Construction.

PART 2 PRODUCTS

2.1 MATERIALS

A. Hot Mix Asphalt Pavement (HMA): Asphaltic cement binder- PG 64-22, uniformly mixed, well-graded aggregate- Grading SX for collector or arterial streets as determined by Engineer, ½ Inch or Grading S for local streets, Current CDOT Standard Specifications for Road and Bridge Construction, Aggregate for Wearing Course Mix: ½ inch or Grading S maximum well-graded aggregate as determined by Engineer.

B. Tack Coat: Emulsified asphalt with the same asphaltic cement as pavement mix, SSI or equal. In accordance with requirements of AASHTO M140 or M208.

2.2 SOURCE QUALITY CONTROL AND TESTS

A. Submit proposed mix design with aggregate gradation and mix proportioning for review prior to beginning of Work. Design shall not be dated prior than three years before work start date.

B. Thickness and density shall be determined by calculating the average of the results of core samples taken by an independent testing laboratory. At least one core sample shall be taken per 200 linear feet of street paved.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify compacted aggregate base course is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

C. Verify manhole frames and valve boxes are installed in correct position and elevation.

3.2 BASE COURSE

A. Fine grade and compact aggregate base course to maximum material density per Section 2721.

3.3 PREPARATION – EXISTING PAVEMENT

A. Remove additional pavement to a painted lane stripe, gutter pan, an existing pavement patch, or an edge of the pavement if such street feature is within the two feet of the second cut.

B. All pavement cuts must be square or rectangular patches with all edges perpendicular or parallel to traffic. No irregular shaped patches allowed.

C. All pavement cuts on collector and arterial roadways must encompass the full lane width impacted. No partial lane cuts will be allowed.

D. Existing adjacent pavement shall be cut square and vertical after placement of base course and prior to placement of new pavement. Milled edges are acceptable so long as the milled face is vertical and the edge is generally straight with a deviation of +/- 1 inch for every 10 feet.

E. Existing pavement shall be rotomilled where indicated and cleaned free of all dirt, water, oil, dust, vegetation, and debris prior to placement of overlay.

3.4 PREPARATION - TACK COAT

A. Apply tack coat in accordance with Current CDOT Standard Specifications for Road and Bridge Construction, Section 407.

B. Apply tack coat on all adjacent asphalt and concrete contact surfaces at uniform rate.

C. Apply tack coat to contact surfaces of curbs, gutters, and cross-pans.

D. Coat surfaces of manhole and valve box lids with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.5 PLACING ASPHALT PAVEMENT

A. Install Work in accordance with Current CDOT Standard Specifications for Road and Bridge Construction, Section 401 & 403.

B. The pavement shall be installed in lifts not exceeding 3 inches in compacted depth.

C. Place asphalt within 24 hours of applying primer or tack coat. If surface of asphalt has visible evidence of sediment or mud remnants, the surface shall be tacked prior to placement of additional asphalt mats.

D. Place asphalt with a self-contained, self-propelled paving machine of sufficient width. Hand placement, without separation, is permissible for small patches.

E. Large surface aggregate shall be raked and struck off to leave a smooth, finely graded surface.

F. The asphalt material shall be placed to the grade and thickness required for compaction after rolling such that the final grade is ¼ inch above all adjacent asphalt and concrete edges.

G. Compact pavement by rolling to 92 percent or greater density using the number, weight, and type of rollers required providing the maximum density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

H. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.6 TOLERANCES

A. Flatness: Maximum variation of 3/16 inch measured with 10-foot straight edge.

B. Scheduled Compacted Thickness: Within 1/2 inch.

C. Variation from Indicated Elevation: Within 1/4 inch.

3.7 PROTECTION OF FINISHED WORK

A. Immediately after placement, protect pavement from mechanical injury.

3.8 SCHEDULES

A. HMA patch: Final replacement thickness shall be in accordance with the original Pavement Design Report for the facility or equal to the existing section, whichever is greater, but must be a minimum of 4” compacted thickness. HMA pavement: 4-inch minimum compacted thickness. Design engineer shall verify minimum requirements are adequate based on site conditions and propose necessary changes to Engineer accordingly for approval.

B. HMA pavement overlay: Single course of 2-inch minimum compacted thickness.

C. Streets having no outlet shall be no longer than 500 feet and shall end in a cul-de-sac with a minimum radius of 45 feet center to curb flowline.

3.9 ACCEPTANCE/COMPENSATION FOR NON-CONFORMING IN-PLACE PAVEMENT

A. Consideration shall be given at the discretion of the City on a case-by-case basis to accept pavement that has been installed and has some functional value but does not meet the minimum specification.

B. Thickness and Density shall be determined by calculating the average of the results of core samples taken by an independent testing laboratory at the Developer’s expense. At least one core sample shall be taken per 200 linear feet of street paved.

END OF SECTION

SECTION 02750

RIGID PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portland Cement Concrete (PCC) pavement.

B. Related Sections:

1. Section 02315 – Excavation.
2. Section 02721 – Aggregate Base Course.
3. Section 03300 – Cast-in-Place Concrete.

1.2 REFERENCES

A. Colorado Department of Transportation:

1. Current CDOT Standard Specifications for Road and Bridge Construction.

B. American Concrete Pavement Association (ACPA):

1. Municipal Concrete Pavement Manual.

C. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
3. ACI 305 - Hot Weather Concreting.
4. ACI 306 - Cold Weather Concreting.
5. ACI 318 - Building Code Requirements for Structural Concrete.

D. American Association of State Highway and Transportation Officials:

1. AASHTO M31- Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

E. American Society for Testing and Materials:

1. ASTM C39- Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
2. ASTM C78- Standard Test Method for Flexural Strength of Concrete.
3. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

4. ASTM C1107- Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
5. ASTM D5893- Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
6. Municipal Government Engineers Pavement Council – Current Specifications

1.3 PERFORMANCE REQUIREMENTS

A. Paving: Designed for parking, residential streets, and main street arteries.

B. Concrete Pavement: Required compressive strength shall be 4200 psi at 28 days per ASTM C39. Required flexural strength (modulus of rupture) shall be 600 psi at 28 days per ASTM C78, third-point loading.

C. Surface Tolerances: Surface deviation shall not be in excess of 3/16 inch 10 feet.

D. Thickness Tolerances: Thickness shall not be 1/2 inch more or less than that specified for an average of no more than 30 percent of the area of the slab.

E. Elevation Tolerances: Variation from indicated elevation within 1/4 inch.

F. Cracking: All cracking shall occur within cut or hand-tooled joints.

1.4 SUBMITTALS

A. Product Data: Submit data on joint filler, admixtures, and curing compounds.

B. Concrete Mix Design: Submit current mix design with aggregate gradation, cylinder compression test results, and mix proportioning prior to beginning work. Design shall not be dated prior to three years before start date, which is indicated on the Notice to Proceed.

C. Delivery Tickets: Submit concrete delivery tickets, indicating mix I.D. number, time water was added, elapsed time from when water was added and concrete placed, and amount of additional water added.

D. Work Schedule: Submit schedule to allow at least 24 hours' notice of work to be performed or concrete poured to allow for appropriate schedules for testing and inspection.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI, ACPA, Section 03300, and the City of Cañon City standards.

B. Maintain one copy of each document on site.

C. Obtain cementitious and aggregate materials from same source throughout.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with documented experience.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F unless approved by Engineer, or surface is wet or frozen.

B. Concrete placed in cold weather conditions shall be done in accordance with ACI 306.

C. Conform to ACI 305 when concreting during hot weather.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Form Materials: As specified in Section 03300.

2.2 REINFORCEMENT

A. Reinforcing Joint Steel: AASHTO M31; 40 ksi yield grade; #4; deformed billet steel bars; 24 inches long.

B. Reinforcing (Transverse Construction Joint) Steel: AASHTO M31; 40 ksi yield grade; #5; smooth billet steel bars; 12 inches long; lubricated one end.

2.3 CONCRETE MATERIALS

A. Concrete Materials: As specified in Section 03300

2.4 ACCESSORIES

A. Bonding Agent: Two component, moisture insensitive epoxy.

B. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 in 48 hours and 7,000 psi in 28 days.

C. Curing Compound: membrane forming, ASTM C309.

D. Joint Sealers: Crafco Roadsaver Silicone (SL) Sealant Part No. 34903 installed with approved

2.5 CONCRETE MIX

A. Concrete Mix and Delivery: As specified in Section 03300.

PART 3 EXECUTION

3.1 EXAMINATION

A. Per Section 03300.

3.2 SUBBASE

A. Aggregate Subbase: Fine grade and compact to 97% Standard Proctor.

3.3 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole, catch basin, and valve box frames with oil to prevent bond with concrete pavement.

C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.4 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Only one half of the street width shall be formed and placed at a time, with a longitudinal

3.5 REINFORCEMENT

A. Place reinforcement as indicated. Do not deviate from required position.

B. Place reinforcement to achieve pavement and curb alignment as detailed.

C. Place, support, and secure reinforcement against displacement.

D. Provide doweled joints as indicated at interruptions of concrete (construction joint), at curb and gutter, and all longitudinal joints.

3.6 PLACING CONCRETE

A. Place concrete in accordance with ACI 301 and 304, and ACPA Municipal Concrete Pavement Manual.

B. Place concrete using mechanical screed, slipform or form paving type equipment, which will strike off, consolidate, and finish the pavement to the required cross section. A minimum 10 foot bull float or “bump cutter” shall be used following any paving equipment.

C. Ensure reinforcement, inserts, embedded parts, formed joints and manhole or valve box lids are not disturbed during concrete placement.

D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

E. Use a vibrator of proper speed and size to properly consolidate the concrete when screeding by hand or using a bridge deck finisher.

3.7 JOINTS

A. Place joints at 12-foot intervals maximum both directions. Align curb, gutter, and sidewalk joints when at all possible.

B. Joints shall be constructed by sawing concrete after it has set or by hand forming in the plastic concrete with an appropriate jointing tool. The transverse joints at 48 foot intervals shall be hand tooled before the concrete has set.

C. Sawing shall begin as soon as the concrete has hardened sufficiently as to not allow raveling and before uncontrolled cracking occurs. Sawing shall take place regardless of time of day or weather conditions to assure proper joints.

3.8 FINISHING

A. Paving: Heavy broom.

B. Direction of Texturing: Transverse to pavement direction.

3.9 JOINT SEALING

A. Proper cleaning and preparation of joints shall be completed prior to sealing operations, including but not limited to sandblasting per the sealant manufacturer's instructions. A clean joint shall be dry and have no visible signs of residual sealant or debris on the joint face, and will leave no residual cement powder or dust on your finger after rubbing the joint face.

B. All joints, including between pavement and curb and gutter, shall be sealed with joint sealant and backer rod.

C. Do not install sealant when temperature is below the dew point. If rain or other inclement weather occurs during joint preparation or sealing, all operations should cease and sufficient time must be allowed so that the joints are dry prior to starting or continuing the sealing operation.

D. A field adhesion test must be performed on a test section as follows:

1. Make a knife cut horizontally from one side of the joint to the other.
2. Make two vertical cuts (from horizontal cut) approximately 3-inches long, at both sides of the joint.
3. Place a mark 1-inch from the point where the 3-inch cuts stop.
4. Grasp the 2-inch piece of sealant firmly just beyond the 1-inch mark and pull at a 90-degree angle.
5. If dissimilar substrates are being sealed, check the adhesion of sealant to each substrate separately. This is accomplished by extending the vertical cut along one side of the joint, checking adhesion to the opposite side and then repeating for the other surface.
6. The adhesion test is considered passing when 1-inch of sealant is elongated to 4-inches without bond loss.

3.10 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301.

B. Provide free access to Work and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

D. Tests of concrete may be performed at random to ensure conformance with specified requirements. Engineer may request cylinder compressions, slump, aggregate sieve designation and deleterious substance tests to be performed by a qualified designee. Concrete samples for testing shall be obtained at the point of placement.

E. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.11 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, wind, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Apply curing compound to unformed surfaces immediately after finishing, at a rate not to exceed 300 SF per gallon.

D. Remove forms only after concrete has attained sufficient strength to support all dead and live loads.

E. Contractor shall provide barricading or personnel as necessary to protect freshly finished concrete from vandalism or other damage.

F. Do not permit vehicular traffic over pavement for 7 days minimum after finishing.

3.12 SCHEDULES

A. Pavement: Single course of 6-inch thickness minimum. Design engineer shall verify minimum requirements are adequate based on site conditions and propose necessary changes to Engineer accordingly for approval.

B. Street widths shall be as indicated in the Major Thoroughfare Plan or as otherwise indicated by Engineer.

C. Streets having no outlet shall be no longer than 500 feet and shall end in a cul-de-sac with a minimum radius of 45 feet center to curb flowline.

3.13 ACCEPTANCE/COMPENSATION FOR NON-CONFORMING IN-PLACE PAVEMENT

A. Consideration shall be given at the discretion of the City on a case-by-case basis to accept pavement that has been installed and has some functional value but does not meet the minimum specification.

B. Thickness and Density shall be determined by calculating the average of the results of core samples taken by an independent testing laboratory at the Developer’s expense. At least one core sample shall be taken per 200 linear feet of street paved.

END OF SECTION

SECTION 02924

SEEDING & REVEGETATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil preparation, topsoil, fertilizing, seeding, mulching, erosion control products, watering and initial care, and final inspection and acceptance.
   2. Plantings and landscaping.

1.2 REFERENCES

A. City of Cañon City Grading, Erosion, & Sedimentation Control (GESC) Plan Manual.

B. Mile High Flood District (MHFD) Criteria Manuals.

C. Current CDOT Standard Specifications for Road and Bridge Construction.

D. 2012 CDOT M&S Standard Plans

E. Erosion Control Technology Council (ECTC).
   1. Standard Specification for Rolled Erosion Control Products (RECP)
   2. Standard Specification for Hydraulic Erosion Control Products (HECP)
   3. Standard Specification for Sediment Retention Fiber Rolls (SRFR)l Products

F. American Society for Testing and Materials (ASTM).

G. National Resources Conservation Service- Colorado (NRCS)

H. Colorado State University (CSU) Extension Office

1.3 SUBMITTALS

A. Product Data: Submit product information and design.
   1. Submittals shall include seed mixes and certification of seed testing dated within 6 months prior to seeding; guaranteed analysis or manufacturers certified test results for mulches, soil amendments, compost, tackifiers, etc.; certified topsoil analysis from an independent soils laboratory prior to topsoil delivery; rolled erosion control products (RECP), and any other appurtenances. The Contractor shall also submit an irrigation plan.
   2. If specified materials are not obtainable, submit non-availability to City, together with a proposal for use of equivalent material.

B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Developer/Contractor shall have a soil sample tested by a licensed, certified soil testing company for a report that will address fertilization needs, pH balance, and agricultural chemical analysis including micronutrients and salt content data.

B. Specific fertilizer and amendments recommendations shall be provided by a licensed, certified soil-testing company.

C. All products shall be installed according to the manufacture's recommendation and/or industry accepted horticultural practices.

D. Seed, soil conditioner, mulch, and fertilizer shall not be applied during inclement weather including rain and high winds, when soil is frozen, or when moisture content of soil is too high to evenly incorporate the applied materials.

1.5 QUALIFICATIONS

A. Manufacturer/Installer: Company specializing in performing work of this section with documented experience.

PART 2 MATERIALS

2.1 QUALITY

A. All materials shall be new and without flaws or defects of any kind.

2.2 HANDLING AND STORAGE

A. Protect all materials from damage, deterioration, or loss of any kind while in transit, storage, and during installation. All materials shall be stored, transported, and applied in accordance with Federal, State, and local regulations.

2.3 TOPSOIL

A. Topsoil shall consist of loose friable, fertile, natural loam soil from the zone of major root development and be reasonably free of subsoil, refuse and other litter, stumps, woody roots, brush, noxious weed seeds and plant parts from current State and county weed lists, clay lumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter which would be detrimental to its use on the project.

2.4 SEED

A. All seed shall be furnished in containers clearly labeled to show name and address of supplier, the seed name, the lot number, net weight, origin, the percent of weed seed content, guaranteed percentage of purity and germination, pounds of pure live seed (PLS) of each species, and the total pounds of PLS in the container. All seeds shall be free from noxious weed seed in accordance with current State and local lists. Seed shall be labeled in accordance with U.S.

Department of Agriculture rules and regulations and Colorado State Seeding laws. Seed that has become wet, moldy, or otherwise damaged in transit or in storage shall not be accepted.

1. Seed Mixes
    a. Seed mixes will be approved by the Engineer depending on location, site condition, soil conditions, availability of water, and other factors. Seed mix shall be submitted to the Engineer for approval. The Engineer may require a custom seed mix based on the conditions and desired results. Seed shall be applied at a minimum rate of 15 pounds per acre (15lbs/ac).
        i. Areas deemed Critical Planting Areas (CPA's) are areas that have, or expected to have, high rates of erosion due to soil conditions and topography or sites that have physical or biological conditions that prevent establishment of vegetation with normal practices. These areas include, but not limited to, non-irrigated areas, road construction sites, banks of channels, and slopes. Species selected for planting in CPA's shall be suited to current site conditions and intended uses, and be resistant to diseases or insects common to the site or location. Unless noted seed submittal, seed rates for CPA's will be doubled.
2. Approved, preferred seed mixes (Alternative seed mixes may be submitted for approval:
    a. Saline, Alkali, and Salt (Critical Planting Area Rate)

Common Name	**Scientific/Botanical Name**	**PLS per Acre**
Alkali sacaton	*Sprorobolus airoides*	1
Western wheatgrass	*Pascopyrum smithii v. Arriba*	8
Galleta	*Pleuraphis jamesii v. Viv*	6
Blue Grama	*Bouteloua gracillis v. Hachita*	2
Alkaligrass	*Puccinellia distans*	1
Blacksamson echinacea	*Echinacea augustifolia*	1
American Vetch	*Vicia americana*	2
Cover/Nurse Crop	*Secale cereale*	4
	TOTAL	25

    b. Dry Land(Critical Planting Area Rates)

Common Name	**Scientific/Botanical Name**	**PLS per Acre**
Western wheatgrass	*Pascopyrum smithii v. Arriba or Barton*	12.4
Blue Grama	*Bouteloua gracillis v. Hachita or Lovington*	1.2
Sideoats Grama	*Bouteloua curtipendula v. Vaughn or Butte*	3.6
Indian Ricegrass	*Achnatherum hymenoides v.Paloma*	4.0
	TOTAL	21.2

    c. Wet Land- T.B.D.

2.5 FERTILIZER

A. Fertilizer (plant nutrients) shall conform to the applicable State fertilizer laws. It shall be a commercial product, uniform in composition, dry, free flowing, and be delivered to the site in the original, unopened containers each bearing the manufacturers guaranteed analysis. Fertilizer that becomes caked or otherwise damaged will not be accepted. Application rates shall be based on upon recommendations of soils laboratory and shall be reviewed by the Engineer.

2.6 SOIL CONDITIONER

A. Soil Conditioner shall consist of compost, biological nutrient or culture, or humate conditioners. Compost shall be weed free, totally organic product that has been aerobically and naturally processed in a facility permitted by the Colorado Department of Public Health and Environment (CDPHE). Soil conditioners shall generally conform to 2011 CDOT Standard Specifications for Road and Bridge Construction, Section 212.02.

2.7 SOD

A. Sod shall be nursery grown and 99 percent weed free. Species shall be approved by the Engineer. Sod that was cut more than 24 hours prior to installation shall not be used. Each load of sod shall be accompanied by a certificate from the grower stating the type of sod and the date and time of cutting.

2.8 HERBICIDE

A. Where site conditions warrant or as determined by the Engineer, an approved herbicide shall be applied in accordance with the manufacturers' label and Federal, State, and local regulations.

2.9 EROSION CONTROL PRODUCTS

A. Rolled Erosion Control Products (RECP's) shall be used in areas with slopes equal to 3:1or steeper and in swale bottoms, areas of concentrated flows, or as otherwise directed by the Engineer. RECP's shall meet the specifications of ASTM D1117, D1388, D6525, D6475, D6567, and D6818. RECPs shall meet the guidelines of the Erosion Control Technology Council (ECTC) Standard Specification for Temporary Rolled Erosion Control Products for Type 2 (12-month longevity) or Type 3 (24-month longevity) as approved by the Engineer. Applications that do not fall under the guidelines of those outlined for Type 2 and Type 3 RECPs shall be submitted to the Engineer for approval on a case-by-case basis. RECP's shall be installed according to manufacturers' requirements and in a way that is not detrimental to the seeding and germination process. A product and installation submittal shall be delivered to Engineer for approval prior to installation of RECP's.

B. Hydraulic Erosion Control Products (HECP's) shall be selected in accordance with ECTC Standard Specification for Hydraulic Erosion Control Products based on longevity, slope grade, and slope length. HECPs will be installed in accordance with this standard and the manufacturer's application instructions and machinery recommendations. Use of HECP's shall

be approved by the Engineer. A product and installation submittal shall be delivered to Engineer for approval prior to installation of HECP's

2.10 MULCH

A. Hay or Straw Mulch: Mulch shall be clean, certified weed free, long stem grass hay or cereal grain straw. At least sixty percent (60%) of the stubble, by weight, shall have fibers 10 inches (10") or longer upon the completion of the crimping process. Hay or straw mulch shall be used in areas with slopes flatter than 3:1 and shall not be used in drainage swales, areas of anticipated concentrated flows, or other special situations as identified by the Engineer. Hay or straw in a state of decomposition (discolored, brittle, rotten moldy) as to smother or retard the growth of grass or old, dry mulch which breaks during the crimping process will not be accepted. Hay or straw mulch shall be anchored into the soil a minimum of four inches (4") by a mechanical crimper. Areas that cannot be accessed by mechanical methods will be hand crimped. Crimping shall be performed on the contour. Application of tackifier to crimped mulch will be at the discretion of the Engineer.

B. Hydraulic Mulch: Hydraulic mulch material shall consist of at least ninety percent (90%) virgin wood cellulose fiber and shall be clean, free of seeds of noxious weeds or undesirable grasses, and free of any substance that might inhibit the germination or growth of vegetation. Hydraulic mulch shall be dyed (green preferred) to allow visual metering of the application. The dye shall be biodegradable and not inhibit plant growth. The wood fiber mulch shall conform to 2011 CDOT Standard Specifications for Road and Bridge Construction, Section 231.02. Tackifier shall be added to the water and wood cellulose material to form a homogenous slurry.

2.11 TACKIFIER

A. Mulch tackifier shall be applied to all areas where the mulch is not mechanically anchored or as directed by the Engineer. The tackifier shall consist of a free-flowing, non-corrosive powder produced from the natural plant gum of Plantago Insularis (Desert Indian Wheat). The powder shall possess the following properties:

Protein Content	1.6 + 0.2%
Ash Content	2.7 + 0.2%
Fiber Content	4.0 + 0.4%%
pH (1% solution)	6.5 – 8.0%
Settleable Soils	5.0%

Follow manufacturers written recommendations for application rates and procedures. The tackifier requires 12 to 18 hour drying time. Alternative tackifier agents may be used upon approval by the Engineer.

2.12 PLANTINGS

A. Plantings shall consist of trees, shrubs, and other plant material, hereinafter referred to as "plants" of the species or variety designated by the Engineer. Plants shall be in healthy condition, free of plant diseases and insect pests; with normal, well-developed branch and roots systems; and shall conform to the requirements 2011 CDOT Standard Specifications for Road and Bridge Construction, Section 214. Installation shall conform to 2011 CDOT Standard Specifications for Road and Bridge Construction, Section 214; 2012 CDOT M&S Standards; and industry approved horticulture standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify placement, techniques, and materials with Engineer.

B. All disturbed areas within the extents of the project and any disturbances outside the designated area shall be reclaimed, reseeded, mulched, or otherwise permanently stabilized according the Plans and Specifications.

C. A satisfactory stand of plantings not requiring reseeding shall be defined as a minimum of 50 grass seedlings per square foot or 70% of the prior disturbed landscaped growth.

3.2 SITE PREPARATION

A. Landscape work shall proceed as rapidly as portions of the site become available, within season limitations. Work the soil only when moisture conditions are suitable.

B. Rip existing soil on slopes 3:1 or flatter to a minimum depth of 6 inches in one direction using an agricultural ripper with tines spaced at no greater than 18 inches. Soil shall be worked until no clods of soil greater than 2 inches remain.

C. Slopes 3:1 and steeper shall be raked or otherwise worked so that the top 1inch (1") of soil is loose and friable before seeding.

D. Remove all rubble, stones and extraneous material over 2 inches in diameter.

E. Spread the amendment over the entire area to be landscaped and incorporate into the top 2 inches (2") of soil by use of a harrow or rake until a uniform mixture is obtained with no pockets of soil or amendments remaining.

F. Correct irregularities in the ground surface resulting from soil preparation operations and slope to drain. Confirm that all work is returned to final grade, per construction plans, prior to seeding.

G. Developer/Contractor shall all materials and equipment to complete the seeding and revegetation operations.

3.3 SEEDING

A. Apply seed at recommended rates.

B. Seeding shall occur after spring thaw and before consistent ground freeze. At no time will seed be sown when the surface of the ground is frozen, during periods of high wind, or at times when the moisture content of the soil is deemed excessive.

C. Seeding shall occur within 24 hours after soil preparation. All seeded areas must be mulched within 24 hours of seed application. Areas not mulched within 24 hours must be reseeded at the expense of the contractor.

D. Methods:

1. Seeding shall be accomplished by mechanical power drawn "Grass" drills equipped with agitator in the seed box, double disc opener, and depth bands followed by packer wheels. Drills shall have a depth of ½ - ¾ inch and shall be set to space the rows not more than 7 inches apart. Seed that is extremely small shall be sown from a separate hopper adjusted to the proper rate of application.

2. Areas not accessible to mechanical power-drawn seeders and slopes steeper than 3:1 may be seeded by broadcasting by hand, by mechanical spreaders, or other approved mechanical means and then cultipacked or rolled to provide good seed-to-soil contact. Broadcasting and manual spreaders will require seeding rates double that required of drill seeding. Distribute seed as evenly as possible. Rake in or otherwise cover seed with soil to a depth of one eight inch (1/8") to one quarter inch (1/4").

3. Hydraulic seeding will not be allowed unless the area to be seeded is permanently irrigated or otherwise approved by the Engineer.

3.4 MULCHING

A. Mulch shall be required for all seeded areas. Mulch must be applied within 24 hours of seeding. Areas that are not mulched within 24 hours of seeding must be reseeded the expense of the contractor.

B. Methods:

1. Hay or straw mulch shall be applied uniformly at a rate of two tons per acre (2t/ac) in accordance with Section 02924.

2. Hydraulic mulches shall be applied uniformly at a rate of one ton per acre (1t/ac) with a minimum tackifier rate of 100 pounds per acre (100lb/ac) or as recommended by the manufacturer. Hydraulic mulching shall not be done in the presence of free surface water and shall be in accordance Section 02924.

3. lopes steeper than 3:1 shall be treated with an erosion control product in accordance with Section 02924.

3.5 MAINTENANCE & WARRANTY

A. Maintenance and irrigation of seed and established plants is the responsibility of the Developer/Contractor for the full warranty period of two years. The Developer/Contractor shall be responsible for all maintenance and repairs necessary within the warranty period. At any time, during the maintenance period, that the City determines corrective work and replacement materials are necessary in accordance with the Contract, the Contractor shall take corrective measures within 10 days of notice by the City. Maintenance and repairs shall include:

1. Control of weed competition by mowing (at proper times and to proper heights to control many annual weeds).
2. Application of herbicide, when deemed necessary and directed by the Engineer, to control noxious weeds, some annual weeds, and perennial weeds.
3. Protection of seeded areas from unnecessary vehicle or pedestrian traffic until the vegetation is well established through the use of fences, barricades, signage, or other approved methods.
4. Installation and maintenance of any additional erosion control measures which are necessary for the successful establishment of vegetation.
5. Installation and maintenance of an irrigation system. The Developer/Contractor shall submit a plan for irrigation, which may include pumps, temporary sprinkler pipes, sprinklers, siphon pipes, gate pipe, etc.
6. A warranty bond in the amount of line item prices for the seeding for the two-year warranty period may be required for assurance that the seed will be grown and maintained. This warranty bond shall be received by the City prior beginning any work.

END OF SECTION

DIVISION 3 – CONCRETE

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for the following:
   1. Rigid Pavement (PCC).
   2. Curb and Gutter.
   3. Driveway Aprons.
   4. Sidewalk and Sidewalk Ramps.
   5. Cross-Pans.

B. Related Sections:
   1. Section 02060 – Aggregate Materials.
   2. Section 02315 – Excavation.
   3. Section 02721 – Aggregate Base Course.
   4. Section 02740 – Rigid Pavement.

1.2 REFERENCES

A. Colorado Department of Transportation:
   1. Current CDOT Standard Specifications for Road and Bridge Construction.
   2. 2012 CDOT M&S Standard Plans

B. Concrete Reinforcing Steel Institute:
   1. CRSI – Manual of Standard Practice.
   2. CRSI – Placing Reinforcing Bars.

C. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 304 – Measuring, Mixing, Transporting, and Placing Concrete.
   3. ACI 305 - Hot Weather Concreting.
   4. ACI 306 - Standard Specification for Cold Weather Concreting.
   5. ACI 318 - Building Code Requirements for Structural Concrete.

D. American Society for Testing and Materials:
   1. ASTM C33 - Standard Specification for Concrete Aggregates.
   2. ASTM C67 - Standard Test Methods for Sampling & Testing Brick and Structural Clay Tile.
   3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
   4. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
   5. ASTM C150 - Standard Specification for Portland Cement.
   6. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   8. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   9. ASTM C902 - Standard Specification for Pedestrian and Light Traffic Paving Brick.
   10. ASTM C936 - Standard Specification for Solid Concrete Interlocking Paving Units.
   11. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

E. 2010 Americans with Disabilities Act Accessibility Guidelines (ADAAG).

F. 2011 Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG)

G. Municipal Government Engineers Pavement Council – Current Specifications

1.3 SUBMITTALS

A. Product Data: Submit data on joint filler, admixtures, accessories and curing compounds.

B. Concrete Mix Design: Submit current mix design with aggregate gradation, cylinder compression test results, and mix proportioning prior to beginning work. Design shall not be dated prior to three years before start date, which is indicated on the Notice to Proceed.

C. Delivery Tickets: Submit concrete delivery tickets indicating mix I.D. number, time water was added, elapsed time from when water was added and concrete placed, and amounts of additional water added.

D. Work Schedule: Submit schedule to allow at least 24 hours notice of work to be performed or concrete poured to allow for appropriate schedules for testing and inspection.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Maintain one copy of each document on site.

C. Acquire cement and aggregate from one source for Work.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F unless approved by Engineer, or surface is wet or frozen.

B. Concrete placed in cold weather conditions shall be done in accordance with ACI 306.

C. Conform to ACI 305 when concreting during hot weather.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type II – Moderate, low alkali, maximum tricalcium aluminate content of 8%.

B. Aggregates: ASTM C33; 2 percent maximum soft particles.

C. Water: Clean; not detrimental to concrete; free of oils, acids, alkalis, salts, or organic materials.

2.2 ADMIXTURES

A. Furnish materials in accordance with Current CDOT Standard Specifications for Road and Bridge Construction.

B. Air Entrainment: ASTM C260.

C. Fly Ash: Substitution of 20 percent of cement material shall be allowed.

2.3 ACCESSORIES

A. Bonding Agent: Two component, moisture insensitive epoxy.

B. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 in 48 hours and 7,000 psi in 28 days.

C. Curing Compound: membrane forming, ASTM C309.

D. Detectable Warning Paver: ASTM C67, C902, C936; ADA compliant; compressive strength of 8000 psi or greater, water absorption maximum of 5%; Pavestone ADA Compliant Paver (Product No. 200), providing a minimum visual contrast of 70 percent in light reflectance between the paver and adjoining surface, i.e. Red for grey sidewalks, Pewter for red sidewalks.

E. Paver Bedding and Joint Sand: ASTM C33 for Bedding Sand; ASTM C144 for Joint Sand; c lean, non-plastic, free of deleterious or foreign material.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Expansion Joint Devices: resilient filler strip with hardness to permit plus or minus 25 percent joint movement with full recovery.

2.5 FORM MATERIALS

B. Forms shall be straight, uniform width and thickness, waterproof, free from knots, offsets, holes, dents, and other surface defects.

2.6 REINFORCEMENT

A. Reinforcing Joint Steel (Cross Pans): ASTM A615; 40 ksi yield grade, as specified; #5 as specified; deformed billet steel bars; chairs and spacers sized and shaped for strength and support reinforcement.

B. Reinforcing Joint Steel (Commercial Drive Ways and Aprons, Public Alleys and Aprons Driveway Aprons): ASTM A615; 40 ksi yield grade, as specified; #5 as specified; deformed billet steel bars; chairs and spacers sized and shaped for strength and support reinforcement.

C. Reinforcing Joint Steel (Pavement or Cross Pan Repair): ASTM A615; 60 ksi yield grade, as specified; 5 as specified; smooth billet steel bars; 12-inches long.

D. Tie Wire: 16 gage minimum; annealed type.

E. Rigid Pavement (PCC):

1. See Section 02750.

2.7 CONCRETE MIX

A. Mix concrete in accordance with ACI 301. Deliver concrete in accordance with ASTM C94.
B. General Use Concrete shall be Class B or D as outlined within the CDOT Standard Specifications for Construction.
C. Rigid Pavement (PCC) Concrete shall beClass P As outlined in the CDOT Standard Specifications for Construction. See also Section 02750.
D. Admixtures: Include admixture types and quantities indicated in concrete mix designs approved through submittal process.
    1. Admixtures shall be approved products as specified by CDOT and conform to the use and requirements outlined in the CDOT Standard Specifications for Construction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

C. The Engineer prior to concrete placement shall approve final form grades.

3.2 PREPARATION

A. Excavate and prepare base course according to Section 2315 and Section 2721.

B. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.

C. In locations where new concrete is doweled to existing work, i.e. pavement or cross pan repair, drill holes, 3/4-inch diameter, 12-inches o.c. in existing concrete, clear out holes using compressed air, fill holes with epoxy, and insert steel dowels. Coat exposed portion of dowels with grease.

D. Place expansion material and reinforcement in required locations. Locate reinforcing splices, not indicated on drawings, at point of minimum stress. Splice according to ACI 318, Class B tension splice.

E. Place any conduit and repair any cables or pipelines.

F. Place forms to straight-line grade at specified elevations. Maintain or facilitate storm water drainage with driveway, sidewalk, curb and gutter, and cross-pan grading.

G. Forms shall be placed around all concrete work. Pouring concrete directly against asphalt edge will not be allowed. Horizontal lines shall be smooth and straight. Curved forms shall be placed at uniform distance from radius point. Standard curb face shall be formed and not hand shaped.

H. Remove all loose dirt, mud, debris, and other loose materials from inside forms.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 304.

B. Notify Engineer minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Place concrete continuously between predetermined expansion, control, and construction joints.

F. All curb and gutter shall be formed and placed by machine when physically possible.

G. Do not interrupt successive placement; do not permit cold joints to occur.

H. Saw cut joints within 12 hours after placing, using 3/16 inch thick blade or hand tool; cut into 1/4 depth of slab thickness; straight and perpendicular to edges; match existing joint patterns per Engineer where applicable. Locate joints at changes in grade or line, corners, or other points of stress.

I. Screed slabs on grade to drain; sidewalks shall not have a cross slope of more than 2 percent.

3.4 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed with a broomed, uniformed finish free of visual cavities or defects. Finish edges with edging trowel.

3.5 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Apply curing compound to unformed surfaces after finishing, not to exceed 300 SF per gallon.

D. Remove forms only after concrete has attained sufficient strength to support all dead and live loads.

E. Contractor shall provide barricading or personnel as necessary to protect freshly finished concrete from vandalism or other damage.

3.6 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301.

B. Provide free access to Work and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

D. When tests indicate Work does not meet specified requirements, remove Work and replace.

E. Concrete Testing:

1. Contractor is required to hire an independent, licensed engineer experienced in concrete analysis and evaluation to perform required tests in accordance with ACI. Copies of test results showing exact location of sample collection and test sites must be furnished to Engineer. Engineer shall be informed prior to testing and he may designate areas of testing.

2. Engineer may request additional cylinder compressions, slump, aggregate sieve designation, thickness, and deleterious substance tests to be performed by a qualified designee.

3. Tests of concrete may be performed at random to ensure conformance with specified requirements.

4. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.7 PATCHING AND REPAIR

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections as directed by Engineer using specified grout and epoxy.

D. For repair of internal sections of pavement or cross pans, entire panels must be removed joint to joint by carefully saw-cutting and hammering out discarded concrete so as not to chip, crack, or otherwise damage adjacent concrete. Removal of no more than one half of or less than one third of concrete pavement panel will be allowed as long as transverse saw-cuts are continued completely to both outside edges of the pavement. If the saw-cut for the partial panel removal is longitudinal to the pavement than upon completion of curing operations but prior to opening of pavement to traffic, the pavement shall be cored with a 6-inch diameter core at the terminus of the longitudinal saw-cut to include the entire "T" joint intersection. The core shall then be removed and the remaining hole filled and repaired with non-shrink grout.

E. Pavement panels broken into three or more pieces shall be removed and replaced.

F. Pavement panels containing random and wandering cracks shall be removed and replaced.

G. Pavement panels containing a single longitudinal or transverse crack not having vertical separation and is no closer than 1 foot to but generally parallel, for the width or length of the panel, to any tooled or sawed joint, shall be routed or "vee'd" out with appropriate tools and sealed in the same manner as the pavement.

H. Concrete pavement shall be cut back a minimum of 1 foot from the trench wall. Contractor shall repair any damage due to settlement of the pavement subgrade due to operations in the trench. Voids under pavement shall be repaired by pavement removal and replacement or by drilling and injecting an approved non-shrink hydraulic cement grout into the empty spaces.

I. Concrete pavement shall be resealed in accordance with Section 02750 after repair. Old sealant must be removed by methods approved by Engineer prior to resealing.

3.8 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Engineer will determine repair or replacement of defective concrete.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.9 PEDESTRIAN ACCESS RAMPS

A. Pedestrian Access Ramps (Curb Ramps) shall be constructed win accordance with 2011 PROWAG and other standards incorporated by reference.

B. Detectable Warning and Well (Brick Pavers)

1. Detectable warnings shall be located and constructed in accordance with section R305, 2011 PROWAG.

2. Weep holes shall be cast or drilled into the well for proper drainage of the structure. Weep holes shall be ¾" (0.75 inch) diameter and fully penetrate the concrete floor of the well. Weep holes shall be spaced evenly across the lowest edge of the well with one weep hole placed in the lowest corner. The number of weep holes shall be equal to the width of the sidewalk (i.e. 4 foot wide sidewalk will have 4 weep holes).
3. Spread sand evenly in the well area defined and screed the sand to an appropriate embedment depth as directed by Engineer.
4. Screeded sand should not be disturbed. Place sufficient sand to stay ahead of the laid pavers.
5. Pavers shall be placed in a running bond pattern. Domes shall be aligned to create a square grid in the predominant direction of travel. Pavers shall be installed such that the base of the truncated dome is approximately 1/8 inch above the adjoining surface, allowing for settlement with a smooth transition between the sidewalk and detectable warning.
6. A vibrating plate compactor shall be used to embed the pavers into the sand. The size and type of compactor shall be in accordance with the paver manufacturer's recommendations, or as directed by the Engineer. Replace any pavers damaged during the compaction operations.
7. Joint spacing between paver units shall be in accordance with the manufacturer's recommendations, or as approved by the Engineer. Joints shall be filled completely with joint sand. Excess sand shall be removed by sweeping.
8. Bedding sand may be used for joint sand, requiring more effort in compaction and sweeping to fill the joints. Joint sand shall never be used for bedding sand.
9. Detectable Warning Plates (DWP)
10. DWP's shall be an integral part of the ramp and comply with 2010 ADA Standards for Accessible Design and the 2011 Proposed Accessibility guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG).
11. DWP's shall be cast gray iron conforming to either ASTM A-48 Class 30A, Gray Iron ASTM A-48 Class 35 B and /or AASHTO M 105, Class 35B Gray Iron and/or ASTM A 536 Ductile, Iron. Casting shall be of a uniform quality, free from sand holes, gas holes, cracks, shrinkage, and other defects. Casting shall be furnished uncoated. Castings shall have an integral non-slip texture on and between the truncated dome shapes.
12. DWP's shall be of the bolt-together style. All DWP shall have an integral iron anchor tab to ensure proper restraint in the concrete slab.
13. Materials
    a. DWP's shall be required to have a current CDOT Pre-Approved Product Summary and current APL listing. Products shall be approved by the Engineer prior to installation.
    b. Pre- Approved Materials
    c. EJ Co, Duralast Detectable Warning Plates

d. Standard Bolt Models 00700561, 00700571, 00700721; natural finish

e. Neenah Foundry, Detectable Warning Plates

f. Bolted Plates, Catalog #'s 4984-12B, 4984-24B, 4984-30B, 4984-36B; natural finish

g. DWP's and accessories shall be produced by a single manufacturer to the maximum extent possible. Any deviation shall be approved by the Engineer prior to installation.

14. Installation

a. DWP'S shall be installed per the manufacturer's instructions and in accordance with project specifications. Installation of DWP's will not be allowed until all submittals have been reviewed and approved by the Engineer. for construction details to be incorporated into the project.

b. DWP'S configuration shall be installed using the minimum number of plates required for the construction of the ramp.

c. DWP'S shall not be cut unless absolutely necessary to complete installation. Cut plates shall be accomplished in accordance with the manufacturer's specifications. All material, labor, coatings, and other items required to complete the installation of modified plates shall be incidental.

d. DWP'S shall be embedded to proper grade so that the top surface of the plate is flush with adjacent concrete (domes will be proud of concrete surface) and in plane with the running slope and cross slope of the ramp or landing.

e. DWP'S will be cleaned after installation to remove any excess concrete from surface, vent holes, etc.

3.10 SITE WORK

A. Backfill suitable topsoil around all new concrete adjacent to existing earth or sodded areas to conform to new elevations. Topsoil shall conform to Current CDOT Standard Specifications for Road and Bridge Construction, Section 207.02. Generally, install lightly compacted topsoil to within 1 inch of top of concrete, grade and rake out clumps to leave smooth.

B. Backfill with approved aggregate material and asphalt patch.

C. Remove all roots, wood chips, excess concrete, trash or other debris, or excess materials generated from work from the site, leaving site clean and basically complete.

3.11 SCHEDULE

A. Sidewalk:

1. Concrete 4 inches thick minimum, over base course.

2. Concrete 6 inches thick minimum, over base course: through driveways and alleys and sidewalk adjacent to mountable curb and gutter (including wings)

3. Concrete 6 inches thick minimum with reinforcement over base course: through commercial driveways and alleys

4. Minimum width:
    a. feet for repair of existing facilities of lengths equal to or less than the width of a single parcel of land;
    b. 5 feet for new construction and repairs of existing facilities longer than the width of a single parcel of land;
    c. 6 feet for high use and commercial areas.
    d. Areas with sidewalk widths less than 5 feet shall have 60 inch X 60 inch passing spaces spaced at a maximum of 200 feet installed at the time of repair or construction.

B. PCC Pavement:
    1. Concrete 6 inches thick minimum, over base course: a professional licensed engineer shall design final installed thickness.

C. Cross pan:
    1. Concrete 8 inches thick minimum with reinforcement, over base course.
    2. Minimum width: 8 feet

END OF SECTION

SECTION 10440

STREET SIGNS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Design.
   2. Appurtenances.
   3. Placement.

1.2 REFERENCES

A. Model Traffic Code for Colorado - Current Edition

B. Manual on Uniform Traffic Control Devices (MUTCD)- Current Edition Standard Highway Signs and Markings - Current Edition

C. US Department of Transportation, Federal Highway Administration (FHWA)

1.3 SUBMITTALS

A. Product Data: Submit product information and design.
B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Design and install Street Name Signs in accordance with all applicable Local, State, and Federal Standards.

1.5 QUALIFICATIONS

A. Manufacturer/Installer: Company specializing in performing work of this section with documented experience.

PART 2 PRODUCTS

2.1 MATERIALS

A. Signs - General:
   1. Blank: Aluminum Blank, 12gauge (.0808”) minimum thickness

2. Sheeting: Retroreflective (FHWA-RD-03-081) High Intensity Prismatic ASTM D4956-04 Sheeting Type III or better,
3. Color: Background and legend per MUTCD.
4. Size: Determined by Engineer.

B. Street Name Signs ("D3" MUTCD):
1. Blank: Aluminum Blank, 12gauge (.0808") minimum thickness
2. Sheeting: Retroreflective (FHWA-RD-03-081) High Intensity Prismatic ASTM D4956-04 Sheeting Type III or better,
3. Color: Green background , white legend, white border
4. Size: Varies. Refer to 2009 MUTCD, Section 2D.43
5. Design & Lettering: Refer to 2009 MUTCD, Sections 2A.13 and 2D.43

C. Appurtenances:
1. Upright Post: 12 gauge galvanized steel, square 2-inch x 2 inch, 3/8 inch diameter holes on 1 inch centers all sides
2. Anchor Base: 12-gauge galvanized steel, square 2 ¼ inch x 2 ¼ inch x 4 foot long minimum, 3/8 inch diameter holes on 1 inch centers all sides. Bolts, Nuts, and Washers: Galvanized steel

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify placement with City Engineer.

B. Verify locations of underground utilities.

3.2 INSTALLING SIGN

A. Post Installation- drive anchor base 3 ½ feet minimum into ground. Bolt upright post to anchor post, 2 bolts minimum.

B. Location and Mounting- MUTCD Part 2.

3.3 STREET NAME SCHEDULES

A. Lettering Size: 6 inch - Local Roads & Collectors Roads, 8 inch - Arterial Roads.

B. Placement per Intersection:

1. Local Roads- 1 sign assembly per intersection, placed consistently with existing installations along primary roadway.
2. Collector & Arterial Roads- 2 sign assemblies located on opposite corners diagonally across intersection.

END OF SECTION

SECTION 10450

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Design.
   2. Appurtenances.
   3. Placement.

1.2 REFERENCES

A. Model Traffic Code for Colorado 2020 Edition

B. Manual on Uniform Traffic Control Devices 11th Edition

C. Standard Highway Signs and Markings 2004 and 2012 Supplement

D. CDOT Pavement Marking Practice Guide (2020)

E. CDOT Standard Specifications for Construction (2023)

F. US Department of Transportation, Federal Highway Administration (FHWA)

1.3 SUBMITTALS

A. Product Data: Submit product information and design.

B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Design and install Pavement Markings in accordance with all applicable Local, State, and Federal Standards.

1.5 QUALIFICATIONS

A. Manufacturer/Installer: Company specializing in performing work of this section with documented experience.

PART 2 PRODUCTS

2.2 MATERIALS

A. Pavement Markings - Longitudinal:
   1. All materials must be from the CDOT Approved Products List

2. New or Resurfaced Arterial and Collector Streets shall be striped with Recessed Preformed Plastic Tape, Methyl Methacrylate, Modified Epoxy or Polyurea markings
3. New or Resurfaced Local Streets shall be striped with Recessed Preformed Plastic Tape, Methyl Methacrylate, Modified Epoxy, Polyurea, or High Build Waterborne markings
4. Repair of small segments of damaged markings may deviate from these requirements with approval of the engineer

B. Pavement Markings – Transverse (Crosswalks, Stop Bars, Symbols, etc.)
1. All materials must be from the CDOT Approved Products List
2. Preformed Plastic Tape, and Preformed Thermoplastic are required for new installations.
3. Repair of existing installations can use durable liquid products.

C. Pavement Marking – Parking Stalls
1. All materials must be from the CDOT Approved Products List
2. High Build Waterborne or better is required in all applications

D. Glass Beads
1. All materials must be from the CDOT Approved Products List
2. Application rates shall be per the CDOT Guidelines

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify placement with City Engineer prior to installation.

3.2 INSTALLING MARKINGS

A. Installation shall be per the CDOT 2023 Standard Specifications for Construction and the CDOT 2020 Pavement Marking Practice Guide

3.3 ACCEPTANCE

A. Acceptance will be conducted by the City on a random basis per the applicable CDOT guidelines and requirements.

END OF SECTION

SECTION 10900

KEYHOLE EXCAVATION

GENERAL

1.1 SUMMARY

A. Keyhole excavation coring and backfilling shall meet the following requirements:

B. Section Includes:

1. Keyhole excavations within the Public Right of Way (ROW).

2. Acceptable methods of backfill and repair of keyhole excavations.

C. Related Sections:

1. Section 0710- General Conditions and Requirements.

2. Section 02320- Backfill.

1.2 DEFINITIONS

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

B. Keyhole Excavation: Any excavation utilizing a coring device to cut a circular hole through the roadway pavement, sidewalk, or surface to allow the intact core of pavement to be extracted. Keyhole excavation also involves the removal of underlying material from the ground by the water and/or or air vacuum excavation method and includes its disposal of those materials to locate underground utilities

C. Coring Device (Core Drill): Mechanized device used in conjunction with an appropriate core drill to remove a cylinder of material. Mechanized augers with cutting teeth or other implements creating a circular hole will not be considered as an acceptable coring device.

1.3 SUBMITTALS

A. Obtain City of Cañon City Excavation Permit prior to any excavation.

B. Materials Source: Provide material submittals for products to be incorporated in the job. Mix designs must be sealed by a registered Colorado Engineer.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with City of Cañon City and industry standards.

B. Maintain one copy of each required document on site.

1.5 COORDINATION

A. Coordinate with utility owners for verification of size and type of buried utility.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. CLSM (Flow-Fill) As specified in Section 02320.
   1. Must meet current CDOT Standard Specifications for Road and Bridge Construction

PART 3 EXECUTION

3.1 GENERAL CONDITIONS

A. Variances to this specification must be approved in writing by the City Engineer.

B. In no instance shall gravel in any form be used for filling in utility locate keyholes/potholes.

C. Restoration of keyhole excavations using the required CLSM backfill material on pavement sections that have applicable SDRF fees shall not be eligible for the CLSM reduction of SDRF fees.

D. Initial locate potholes may be temporarily repaired, meeting all applicable safety requirements, for no more than fourteen (14) days unless additional time is authorized by the City in writing.

E. Use staking for alignment and elevation of water mains to establish lines and grades.

F. Pipe and conduits must be bedded with bedding sand to a minimum of 6” above the conduit or pipe or as specified by the utility owner.

G. Differential settlement or vertical displacement of any restorations of more an ¼” during the warranty period will require the permittee to repair the restoration in accordance with these specifications.

H. The permit holder is responsible for researching and locating all underground utility lines including storm sewer systems and related drainage facilities.

3.2 ASPHALT PAVEMENT SECTIONS

A. Keyhole excavation shall not be placed in the wheel path of a travel lane or within 10 feet of a crosswalk.

B. All keyholes in the pavement shall be cored with a circular coring saw with a maximum diameter of twelve (12) inches. The plug shall be carefully removed without causing damage to the plug. The plug shall be marked and stored off site until it is returned in the core hole.

C. Bore mud used during excavation shall be removed prior to backfilling.

D. Keyhole excavations shall be backfilled with controlled low strength material (CLSM) above the pipe zone in accordance with specifications prior to asphalt restoration. Native material removed shall not be used to backfill the pothole.

E. All plugs will be placed back in the corresponding hole in the original orientation at the time of restoration. The sides of the plugs shall be coated and the top sealed with permanent bonding agent. Plug shall be installed flush with the existing pavement (+/- 1/16”)

F. If the core plugs are damaged or cannot be used to fill the core hole the asphalt shall be repaired using hot mixed asphalt paving material from the City-approved list. Restoration of core locations using fresh asphalt material instead of cores will be approved if the contractor specifies this method in permit application.

G. The core holes shall be cleaned and tacked prior to placing hot mix asphalt paving material as follows:

H. Thickness of asphalt must match the existing thickness at the core location or 4” thick minimum, whichever is greater.

I. Hot rubber sealed on the surface perimeter to prevent water intrusion.

J. If the asphalt pavement is on a moratorium road, the SDRF fee calculated for the keyhole excavation shall be doubled.

3.3 CONCRETE PAVEMENT SECTIONS

A. Keyhole excavations shall avoid concrete pavement sections to the maximum extent possible. Concrete pavement sections include concrete roadways, alley ways, parking areas, and other concrete paved structures that are not classified as sidewalks, ramps, cross pans, or curb and gutter.

B. Keyhole excavation shall not be placed in the wheel path of a travel lane or within 10 feet of a crosswalk.

C. If the existing panel is broken into 3 or more pieces, the panel must be replaced in accordance with the City’s Standard Specifications. The Public Works Department reserves the right to require panel replacement in accordance with City Specifications due to existing site conditions.

D. All keyholes in the pavement shall be cored with a circular coring saw with a maximum diameter of twelve (12) inches. The plug shall be carefully removed without causing damage to the plug. Mechanized augers with cutting teeth or other methods other than coring saws to create a circular hole will not be considered as coring operations in concrete pavement sections.

E. Bore mud used during excavation shall be removed prior to backfilling excavations.

F. Keyhole excavations shall be backfilled with controlled low strength material (CLSM) above the pipe zone in accordance with specifications prior to asphalt restoration. Native material removed shall not be used to backfill the pothole.

G. All plugs will be placed back in the corresponding hole in the original orientation at the time of restoration. The sides of the plugs shall be coated and the top sealed with permanent bonding agent. Plug shall be installed flush with the existing pavement (+/- 1/16”)

H. If the core plugs are damaged or cannot be used to fill the core hole the pavement shall be repaired using a polymer modified hydraulic cement in accordance with the manufacturer's specifications. The polymer modified cement material must be listed on the CDOT approved products list. Material submittals must be approved by the City prior to work commencing. Restoration of core locations using polymer modified hydraulic cement instead of cores will be approved if the contractor specifies this method in permit application.

I. The core holes shall be prepared in accordance with the manufacturer's specification prior to placement of the material.

J. The thickness of repair must match the existing pavement thickness at the core location or 6" thick minimum, whichever is greater.

K. If the concrete pavement is on a moratorium road, the SDRF feel calculated for the keyhole excavation shall be doubled.

3.4 CONCRETE CROSS PANS, SIDEWALKS, CURB RAMPS, CURB AND GUTTER SECTIONS:

A. If a keyhole is in a cross pan, sidewalk, curb ramp, curb, or gutter, the entire panel (e.g., joint to joint) shall be removed and replaced in accordance with the City's Standard Specifications. Concrete paved parking areas shall be evaluated at the time of construction.

B. Bore mud used during excavation shall be removed prior to backfilling excavations.

C. Keyhole excavations shall be backfilled with controlled low strength material (CLSM) above the pipe zone in accordance with specifications prior to pavement restoration. Native material removed shall not be used to backfill the pothole.

D. Concrete removed adjacent to asphalt pavement shall follow the City's Standard Specifications (e.g., removal and replacement of one (1) foot of asphalt adjacent to the removed concrete) unless otherwise approved by City Engineering in writing. If the asphalt pavement is on a moratorium road, special restoration standards shall apply.

3.5 SOFT SURFACES SECTIONS (PARKWAYS, GREENSPACES, AMENITY ZONES, UNPAVED AREAS):

A. Keyhole excavation located within three (3) feet of the existing roadway shall be backfilled with controlled low strength material (CLSM). This shall include areas that are not hardscaped but subject to vehicular and pedestrian traffic such as road shoulders, trails, gravel alleys, paths, access and utility roads, and any other areas deemed necessary by the Public Works Department.

B. If keyhole excavation is in soft surfaces and is extended under (routed out) asphalt, cross pans, sidewalks, curb ramps, or curb and gutter, the contractor shall follow the backfill and repair requirements outlined above.

C. If keyhole excavation is less than two (2) feet in depth, it can be backfilled with moisture-treated and compacted soil.

D. Excavations greater than two (2) feet in depth and greater than two (2) feet away from any hard surface (e.g., sidewalk, pavement, etc.) can be filled with bentonite or comparable material approved by the Public Works Department to within two (2) feet of the soft surface (ground) and backfilled with moisture-treated, compacted fill.

E. Native material excavated by hydro/air excavating shall not be used to backfill the pothole. Native material excavated via hand or excavator may be reused to backfill the excavation to backfill, provided it is moisture-treated and compacted.

F. Restoration of keyhole excavations on landscaped areas shall be required to be restored to a condition equal to or better than existing conditions.

G. Any damaged landscaping, lawns, shrubbery, trees hedges, walls, fences, irrigation, etc. shall be replaced or restored prior to seven (7) days after the completion of the job, at the contractor's expense, and to the condition equal to or better than the existing prior to excavation.

3.6 PROTECTION OF FINISHED WORK

A. Protect all excavation locations until final restoration is complete.

B. All areas showing signs of settlement shall be repaired by the Contractor during all construction phases and for a period of 2 years following the date of final acceptance.

C. When Contractor is notified by the City or Engineer that any excavation is hazardous, the condition shall be corrected at once.

END OF SECTION

APPENDIX

PART 1

City of Cañon City Standard Details (W & S)

W-1	Fire Hydrant
W-2	Blow-Off Assembly
W-3	Trench Backfill
W-4	Thrust Block
W-5a	Meter Pit: ¾" & 1"
W-5b	Meter Pit: 1 ½" & 2"
W-5c	Meter Vault
W-6	Sewer Crossing Detail
W-7	Air and Vacuum Valve Vault
W-8	Backflow Prevention Schematic

S-1	Curb and Gutter
S-2	Sidewalk
S-3	Sidewalk Drain Pan (Chase)
S-4	Typical Tree Radius Sidewalk Notch
S-5	Mountable Curb and Gutter with Sidewalk
S-6a	Typical Sidewalk Ramp "A"
S-6b	Typical Sidewalk Ramp "B"
S-6c	Typical Sidewalk Ramp "C"
S-6d	Sidewalk Ramp Detectable Warning
S-7	Cross Pan Detail
S-8a	Private Driveway in Right-of-Way
S-8b	Sidewalk Alley/Driveway Connection
S-9	Driveway Apron (Public Alley Ways)
S-10	H.M.A. Pavement Road Cross Section
S-11	P.C.C. Pavement Road Cross Section
S-12	P.C.C. Pavement Joint Details
S-13	P.C.C. Pavement Repair
S-14a	Standard Irrigation/Drainage Culvert
S-14b	Standard Irrigation/Drainage Culvert (less than 12" cover)
S-15	Utilities Placement & Street Dimensions
S-16	Mailbox Location
S-17	Drain Line Clean Out Box
S-18	ROW Landscaping – No Curb & Gutter

PART 2

Reference City of Cañon City Municipal Code

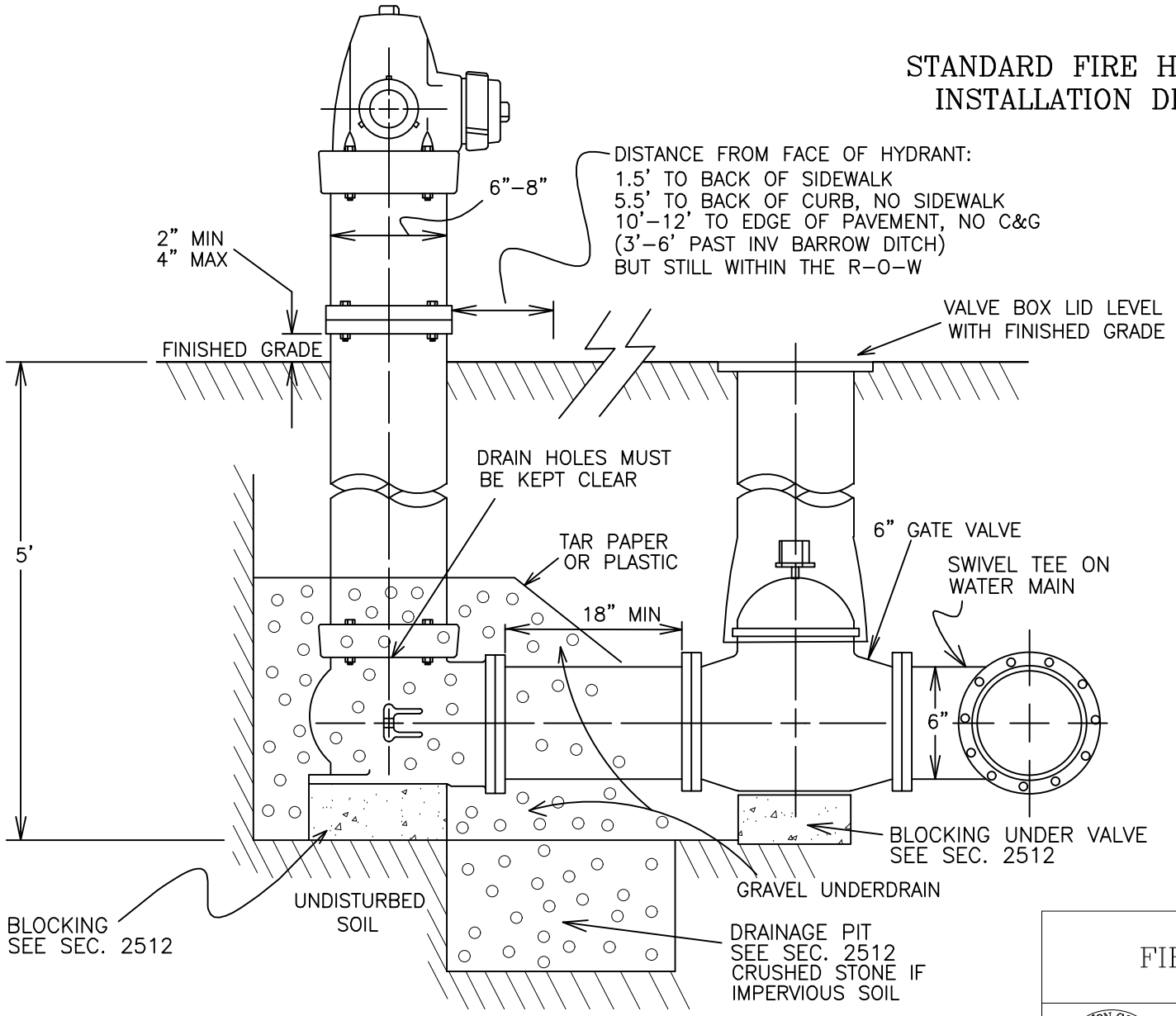
Chapter 5.12	Building Contractors
Chapter 20	Stormwater Illicit Discharges and Permit Requirements
Chapter 12.12	Work and Encroachment on City Property
Chapter 13.10	Stormwater Utility

PART 3

Reference City of Canon City Stormwater Regulations

City of Canon City GESC Manual
City of Canon City IDDE Manual

STANDARD FIRE HYDRANT INSTALLATION DETAIL



FIRE HYDRANT

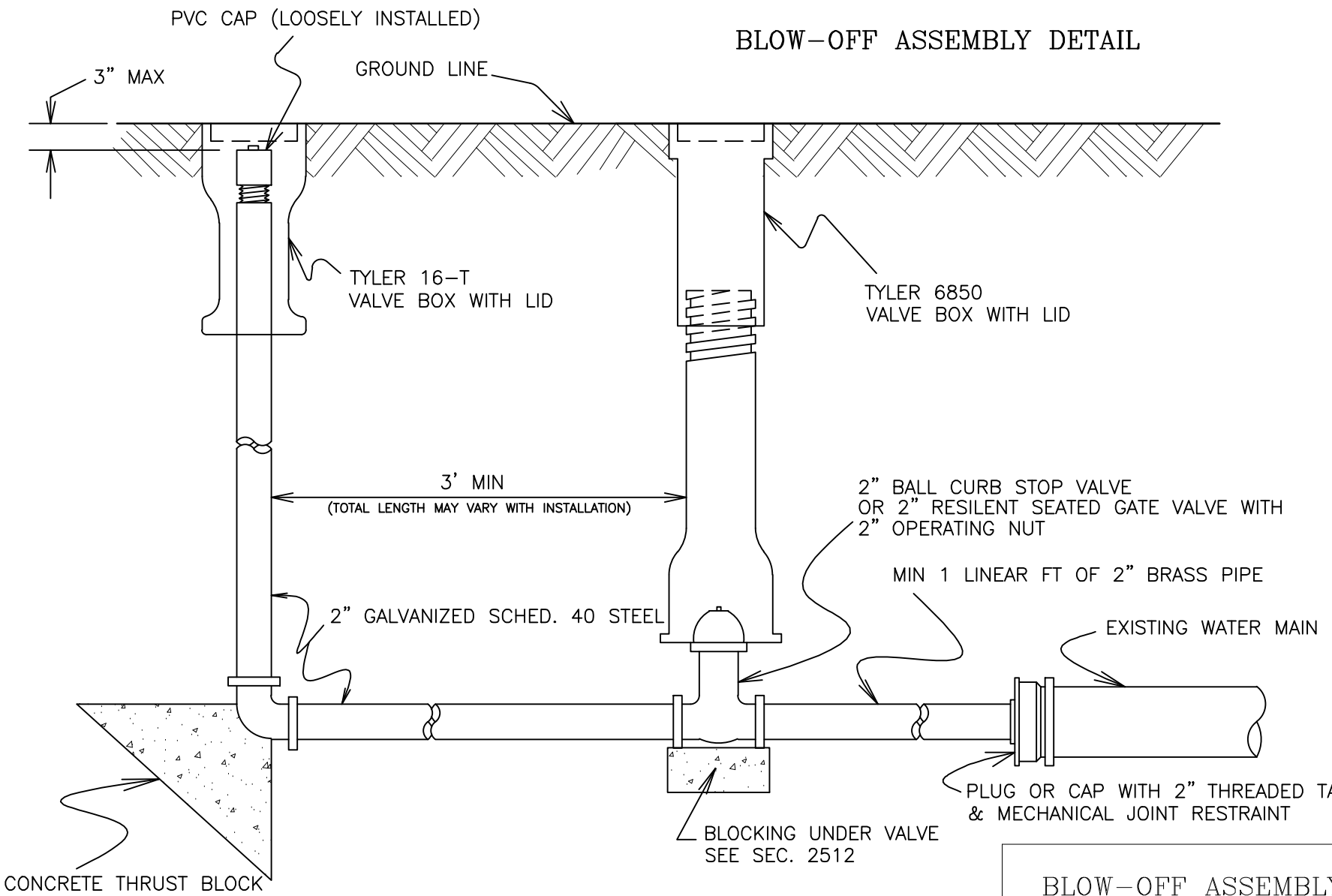
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL W–1

REVISED: MARCH 2004

W–1

BLOW-OFF ASSEMBLY DETAIL



BLOW-OFF ASSEMBLY

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

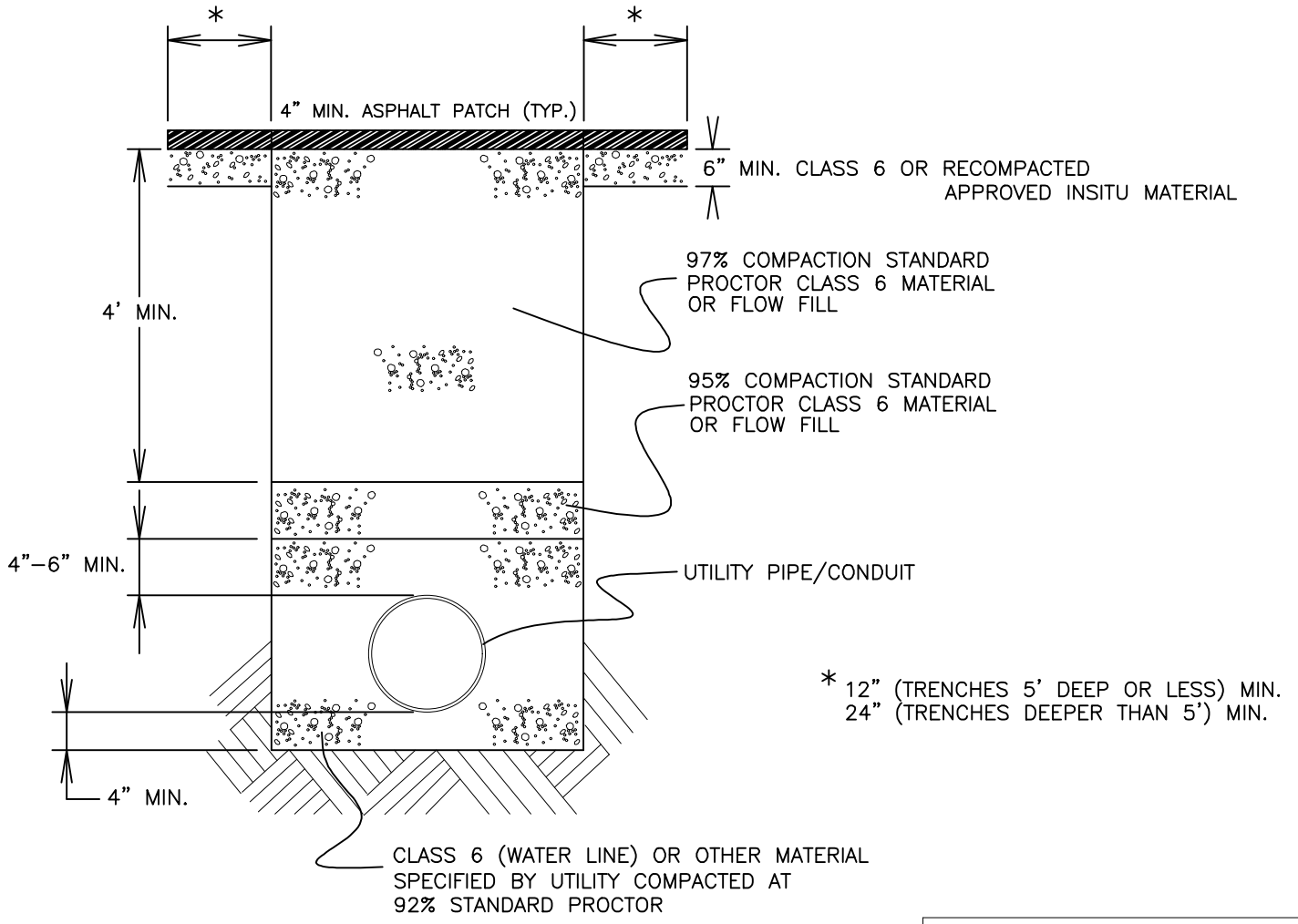
STANDARD DETAIL

W-2

REVISED: MARCH 2004

W-2

UTILITY TRENCH DETAIL



NOTE: EXCEPTION FOR LARGE NEW SUBDIVISION, SEE SECTION 02324–2.1C

TRENCH BACKFILL

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

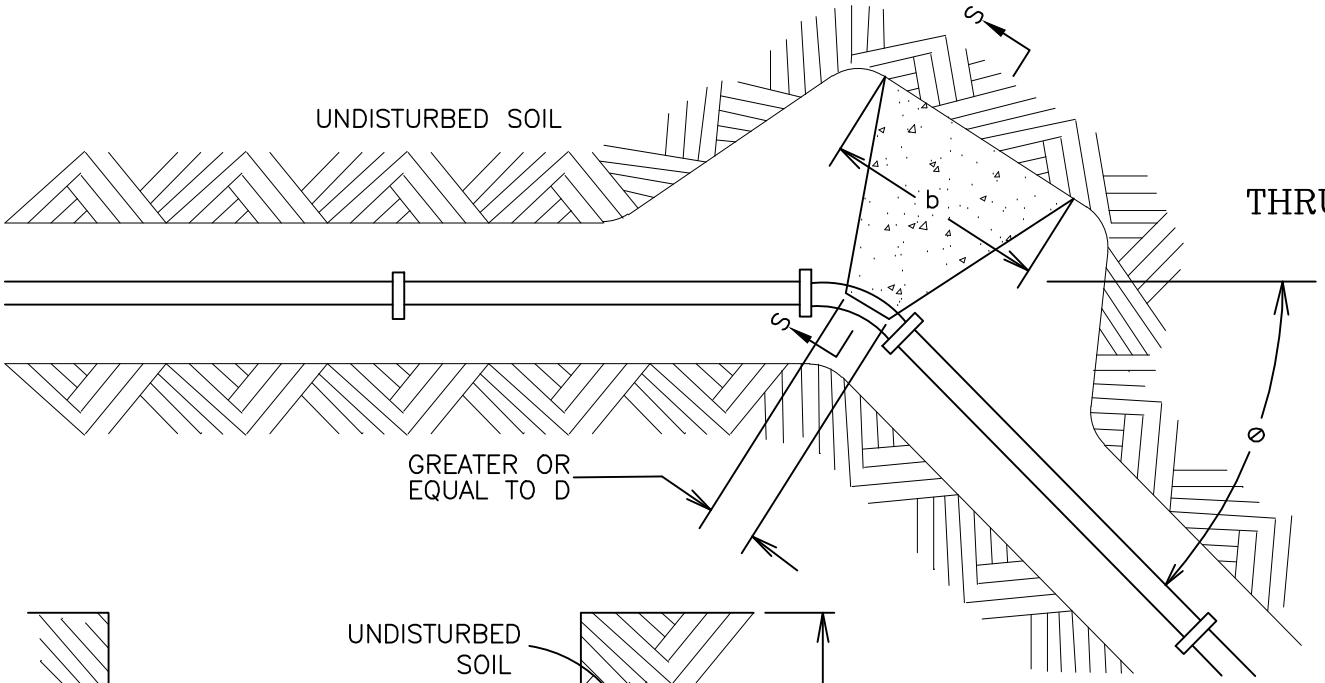
STANDARD DETAIL

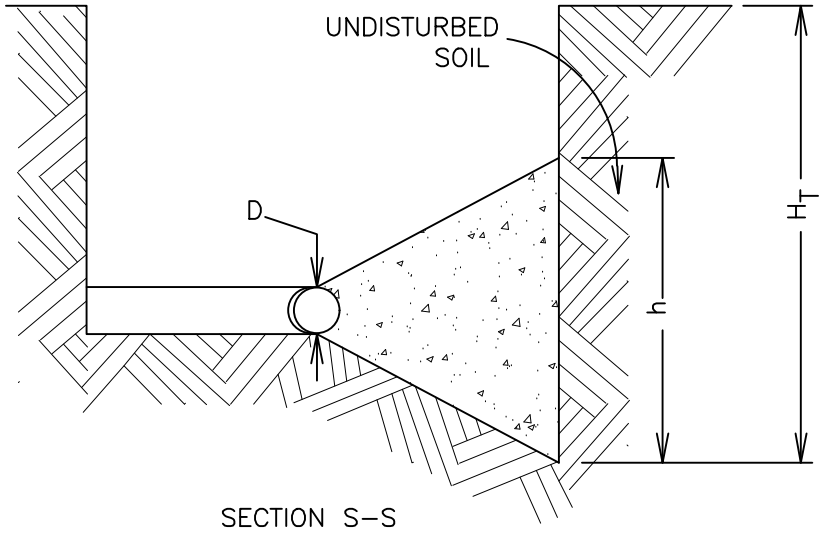
W–3

REVISED: AUGUST 2008

W–3

THRUST BLOCK DETAIL





SECTION S–S

DIA.	Ab (FT^2) FOR ∢ ∅		
	221/2°	45°	90°
4"	0.5	1.0	1.5
6"	1.0	2.0	3.5
8"	2.0	3.0	6.0
10"	2.5	5.0	9.5
12"	4.0	7.0	13.5
16"	6.5	13.0	24.0
20"	10.0	20.5	37.5
24"	15.0	29.0	54.0
30"	23.0	45.5	84.0
36"	33.5	65.5	121.0

NOTE: D = OUTSIDE DIAMETER OF PIPE

AREA, Ab = h X b

WITH $h \leq 1/2\ H_T$

& $h \geq D$ WHICHEVER IS GREATER

ALSO $h \leq b < 2h$

THRUST BLOCK

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

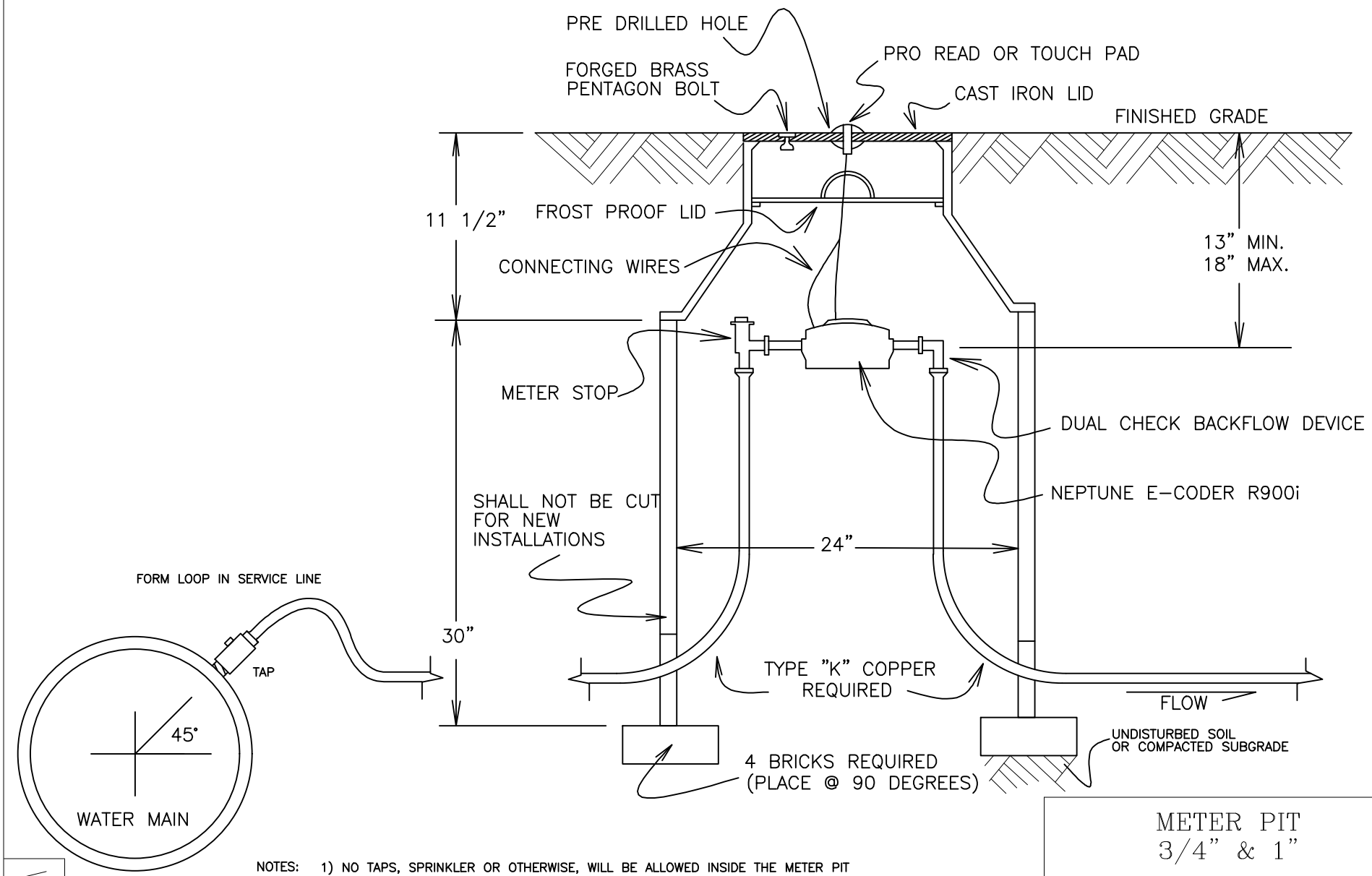
STANDARD DETAIL

W–4

REVISED: OCTOBER 2003

W–4

3/4" & 1" METER PIT INSTALLATION DETAIL



NOTES:
1) NO TAPS, SPRINKLER OR OTHERWISE, WILL BE ALLOWED INSIDE THE METER PIT
2) ANY UNIONS USED INSIDE THE METER PIT SHALL HAVE FLARED ENDS
3) IF OVER-EXCAVATED, SOIL UNDER PIT IS TO BE COMPACTED TO 97% STANDARD PROCTOR

METER PIT
3/4" & 1"

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

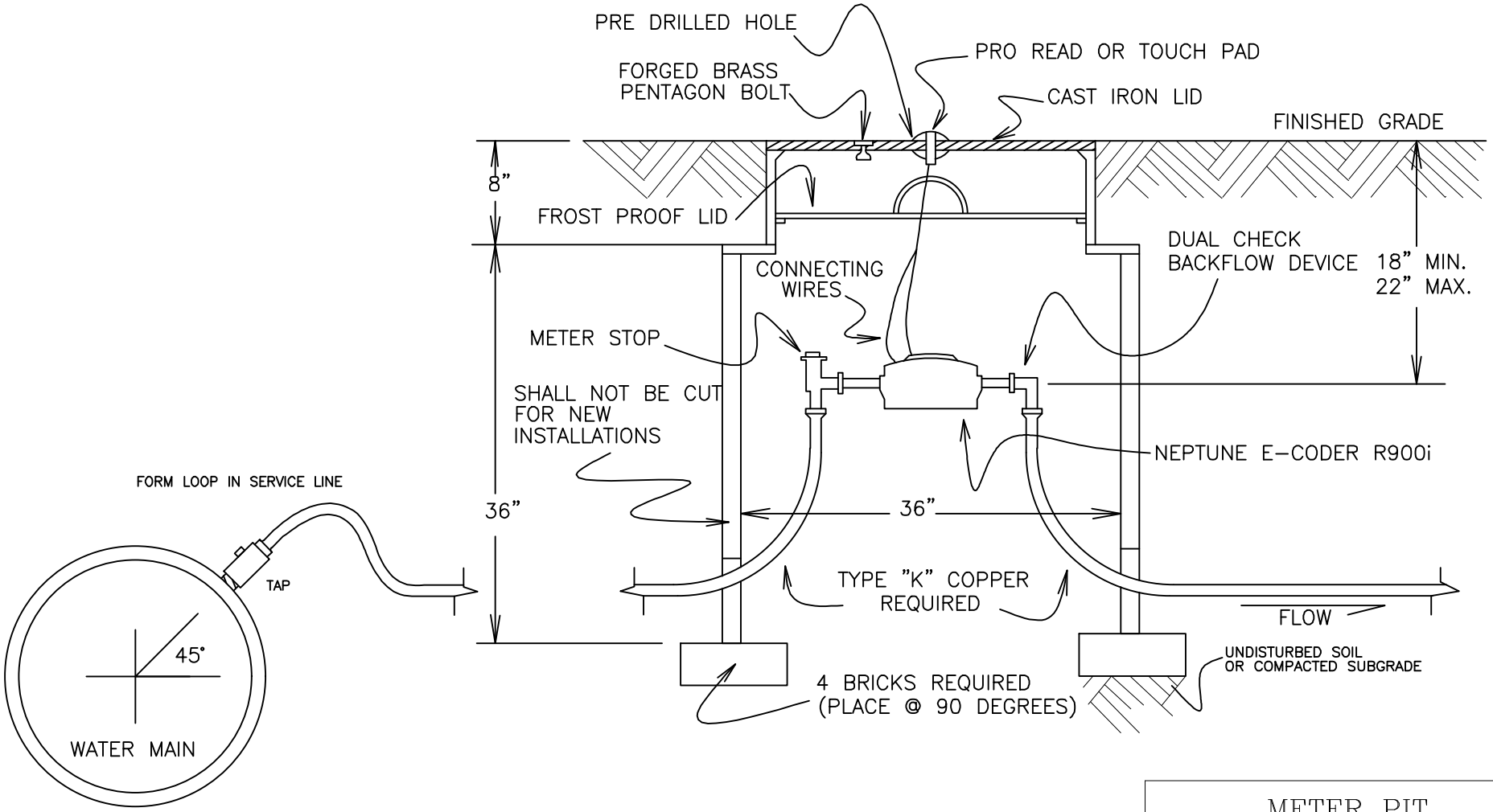
STANDARD DETAIL

REVISED: AUGUST 2017

W-5a

W-5a

1-1/2" & 2" METER PIT INSTALLATION DETAIL



NOTES:
1) NO TAPS, SPRINKLER OR OTHERWISE, WILL BE ALLOWED INSIDE THE METER PIT
2) ANY UNIONS USED INSIDE THE METER PIT SHALL HAVE FLARED ENDS
3) IF OVER-EXCAVATED, SOIL UNDER PIT IS TO BE COMPACTED TO 97% STANDARD PROCTOR

METER PIT
1-1/2" & 2"

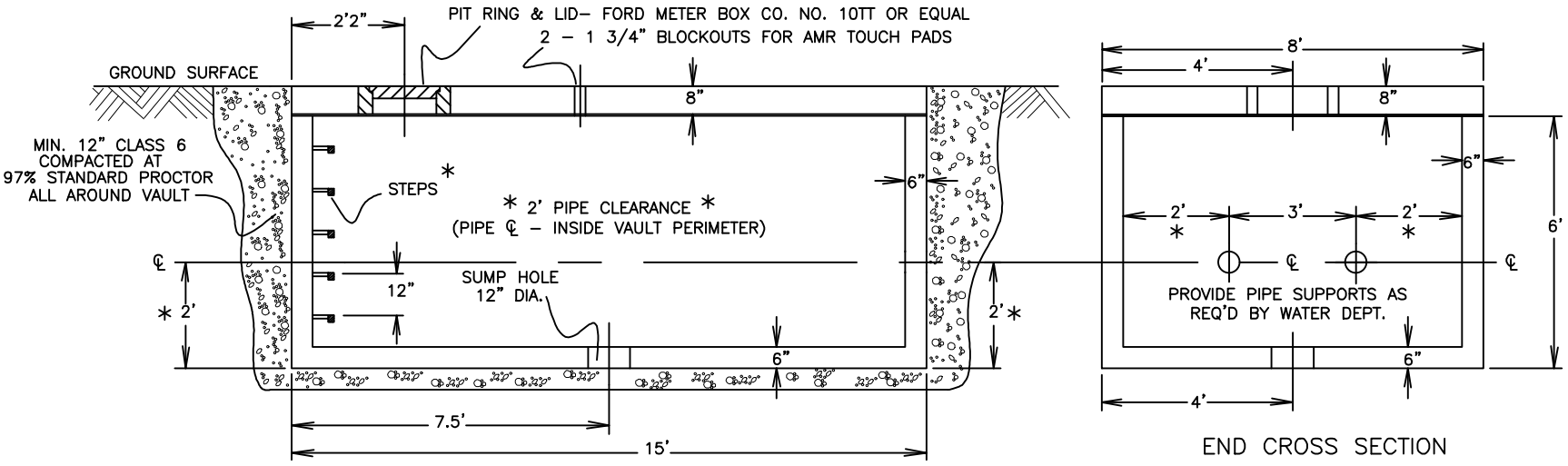
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL W-5b

REVISED: AUGUST 2017

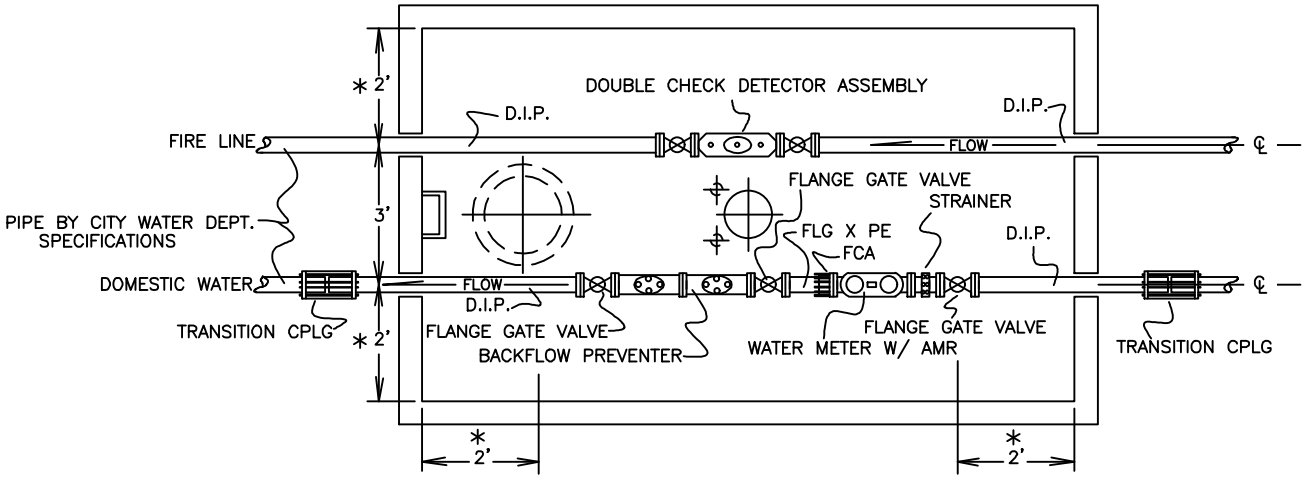
W-5b

METER VAULT INSTALLATION DETAIL



SIDE CROSS SECTION

END CROSS SECTION



PLAN VIEW

*NOTE: STEPS SHALL BE ALUMINUM OR GREY IRON AND CAST IN PLACE WHEN CONCRETE IS CAST AND BE 9 1/4" X 12 1/2". AS AN ALTERNATE, STEPS MAY BE POLYPROPYLENE (M.A. INDUSTRIES PS2–PFS OR EQUAL) AND CAN BE PRESS FIT INTO PREFORMED HOLES. THE STEPS SHALL BE NO MORE THAN 24 INCHES FROM THE TOP OF THE ACCESS, AND NO MORE THAN 18 INCHES FROM THE BENCH OF THE ACCESS.

PIPE SIZE WILL VARY AS NECESSARY AND BE SUBJECT TO APPROVAL BY THE PUBLIC WORKS DEPARTMENT.

VAULT SHALL HAVE A 2–FT MINIMUM CLEARANCE FROM INSIDE PERIMETER AND FLOOR OF METER VAULT TO PIPE AND VALVE ℄.

DESIGN OF VAULT (INCLUDING REINFORCING STEEL AND CONCRETE) SHALL BE RATED FOR HS–20 LOADING. MODIFICATIONS AS TO SIZE OF VAULT CAN BE APPROVED BY CITY ENGINEER.

W–5c

METER VAULT

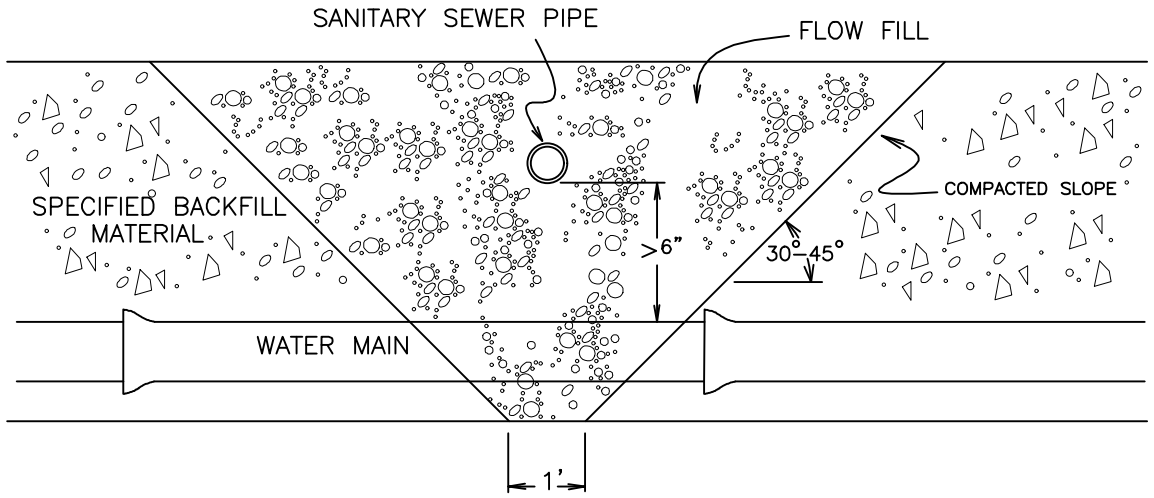
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL

REVISED: FEB 2017

W–5c

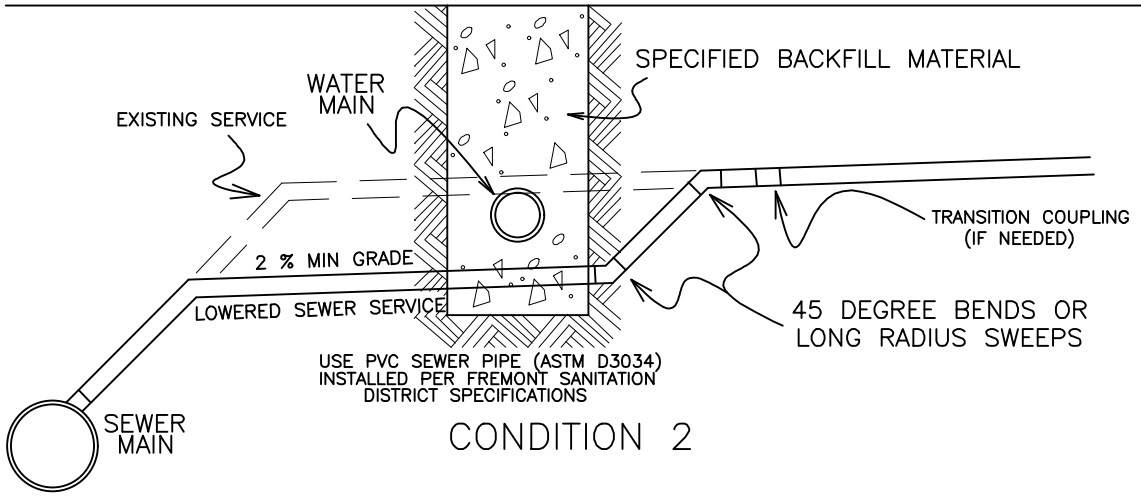
WATER AND SANITARY SEWER SERVICE CROSSING DETAIL



CONDITION 1

CONDITION 1:
WATER LINE PASSES UNDER SEWER LINE WITH GREATER THAN 6" OF CLEARANCE. FILL TRENCH, 2' ON EACH SIDE OF SEWER, WITH FLOWABLE FILL.

CONDITION 2:
WATER LINE PASSES UNDER OR OVER SEWER LINE WITHIN 6". SEWER LINE MUST BE LOWERED 6" OR GREATER BELOW THE BOTTOM OF WATER LINE IF POSSIBLE.



CONDITION 2

NOTE:
NECESSARY PRECAUTIONS SHALL BE TAKEN WHILE COMPACTING BACKFILL AROUND WATER LINE WHERE IT PASSES OVER A SEWER LINE TO PRESERVE GRADE OF SUCH LINE.

SEWER CROSSING DETAIL

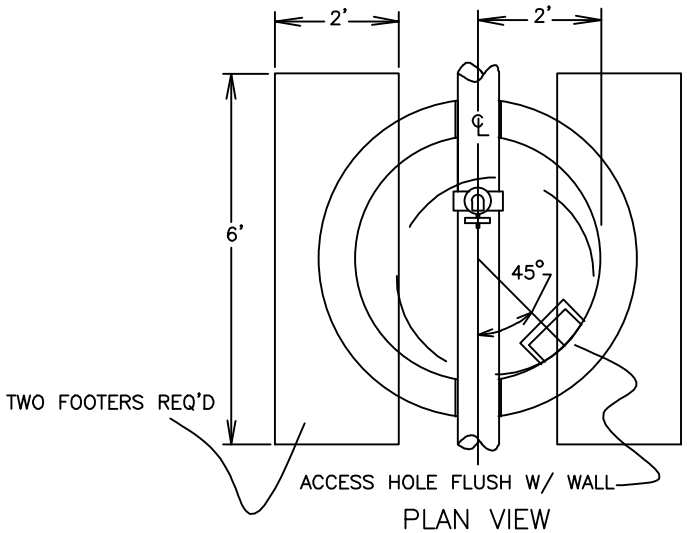
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL

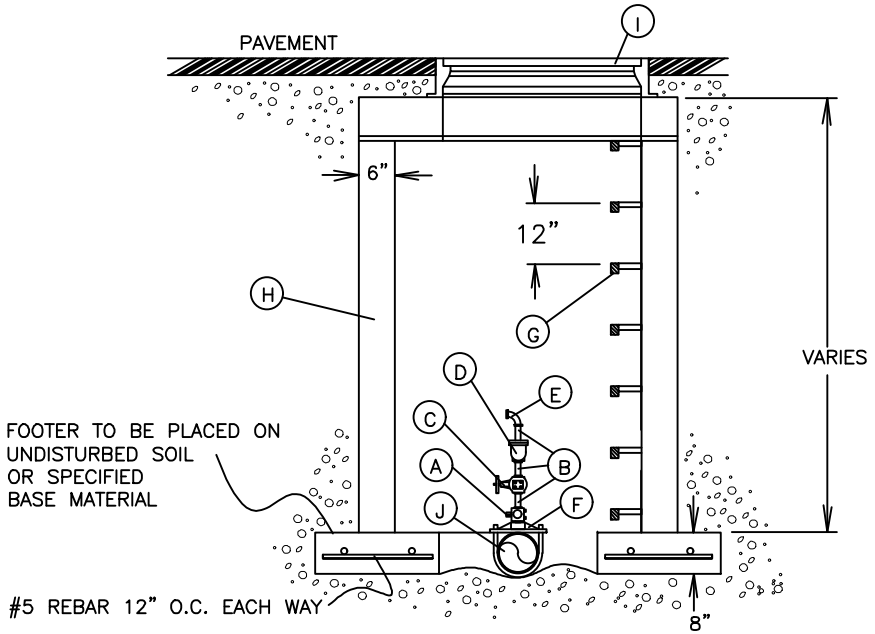
W-6

REVISED: OCTOBER 2003

AIR & VACUUM VALVE VAULT INSTALLATION DETAIL



PLAN VIEW



CROSS SECTION

LEGEND

A. 1" CORPORATION BALL VALVE TAPERED THREADS INLET W/ 1" FEMALE IRON PIPE OUTLET (MUELLER OR FORD)

B. 1" X 3" THREADED BRASS NIPPLE

C. 1" THREADED BALL VALVE WITH STANDARD OPERATING NUT

D. 1" THREADED INLET APCO OR CRISPIN AIR AND VACUUM VALVE

E. 1" X 90 DEGREE BRASS THREADED ELBOW

F. SERVICE SADDLE REQ'D FOR C-900 AND C-905 PVC PIPE

G. STEPS SHALL BE AS REQ'D PER STANDARD DETAIL W-5C

H. 4' INSIDE DIAMETER REINFORCED PRECAST CONCRETE VAULT. DESIGN OF VAULT SHALL BE RATED FOR HS-20 TRAFFIC LOADING.

I. HEAVY DUTY SINGLE 38" NOMINAL MANHOLE RING AND COVER. ADD RISERS AS NECESSARY SO LID IS LEVEL WITH PAVEMENT OR 1" ABOVE GROUND SURFACE.

J. PIPE SIZE WILL VARY. AIR VALVE ASSEMBLY LARGER THAN 1" SIZE OR FOR MAINS LARGER THAN 16" SHALL BE SPECIALLY DESIGNED AND MEET WATER DEPARTMENT REQUIREMENTS.

GENERAL NOTES

1. ALL CONCRETE WORK SHALL COMPLY TO ACI 318 SPECIFICATIONS

2. A MANHOLE VENT PIPE IS OPTIONAL– ONLY TO BE INSTALLED IF REQ'D BY WATER DEPT.

3. VAULT SHALL BE SURROUNDED BY A MIN. OF 12" CLASS 6 MATERIAL COMPACTED AT 97% STANDARD PROCTOR.

AIR AND VACUUM VALVE VAULT

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL

REVISED: MARCH 2004

W-7

W-7

LEGEND

A.* CITY WATER METER & PIT PER SPECIFICATIONS, 3/4" – 2"

B. OPTIONAL TEE – FOUNTAIN OR RESTROOM 3/4" OR 1" OUTLET

C. 12" IRRIGATION VALVE BOX W/ LOCKING LID
(SECURE HOUSING FOR QUICK COUPER BLOWOFF VALVE (QCV))

D. QUICK COUPER BLOWOFF ASSEMBLY
TEE – ELBOW – PIPE – ELBOW – QCV
(TEES PREVENT BREAKING PIPE W/ QCV KEY ENGAGEMENT)

E. CAGE OR HOT BOX – LOCKED

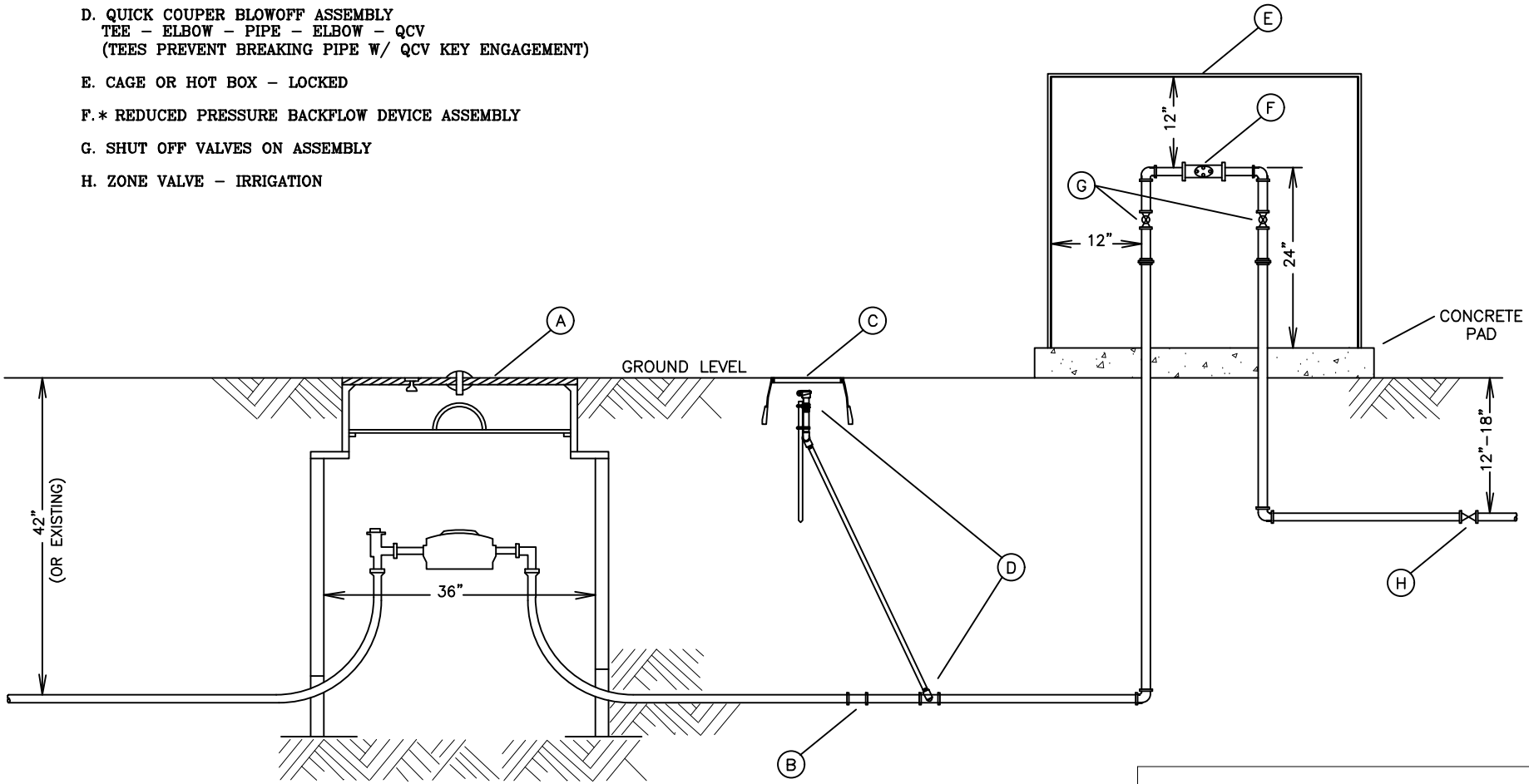
F.* REDUCED PRESSURE BACKFLOW DEVICE ASSEMBLY

G. SHUT OFF VALVES ON ASSEMBLY

H. ZONE VALVE – IRRIGATION

BACKFLOW PREVENTION SCHEMATIC

FOR CITY PARKS & CEMETARY USE ONLY



* SIZE DEPENDENT ON WATER TAP

BACKFLOW PREVENTION SCHEMATIC

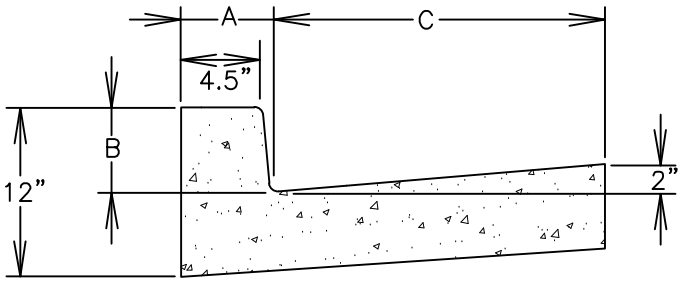
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL

REVISED: JANUARY 2017

W–8

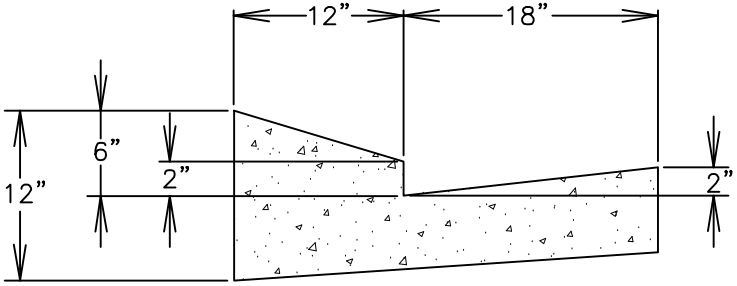
W–8



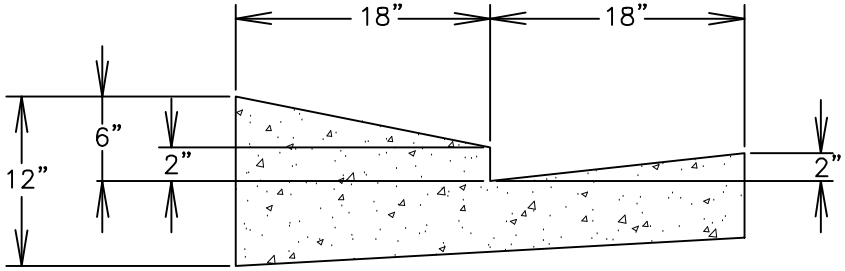
SECTION 1
CURB AND GUTTER

SECTION 1			
CURB & GUTTER	A	B	C
SECTION 1A	6"	6"	24"
SECTION 1B	6"	8.5"	28"
SECTION 1C	6"	9"	30"
CURB CUT	6"	2"	24"

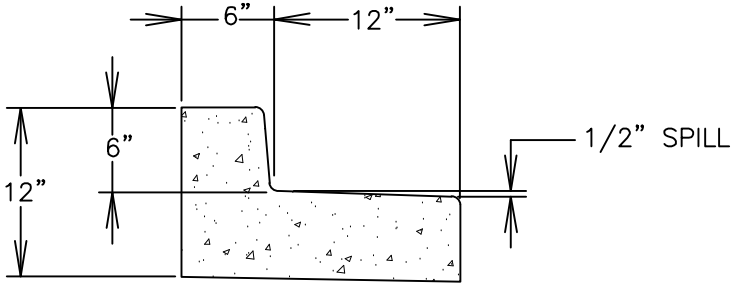
SECTION 1B & 1C TO BE USED ONLY TO REPAIR EXISTING.



SECTION 2
MOUNTABLE CURB AND GUTTER



SECTION 3
MOUNTABLE CURB AND GUTTER



SECTION 4
6" MEDIAN CURB AND GUTTER

S-1

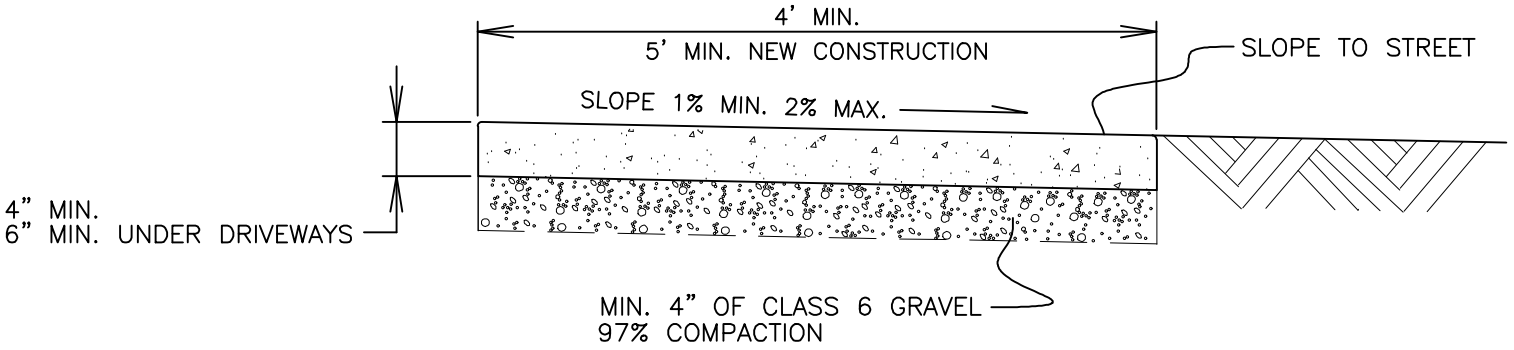
CURB AND GUTTER

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

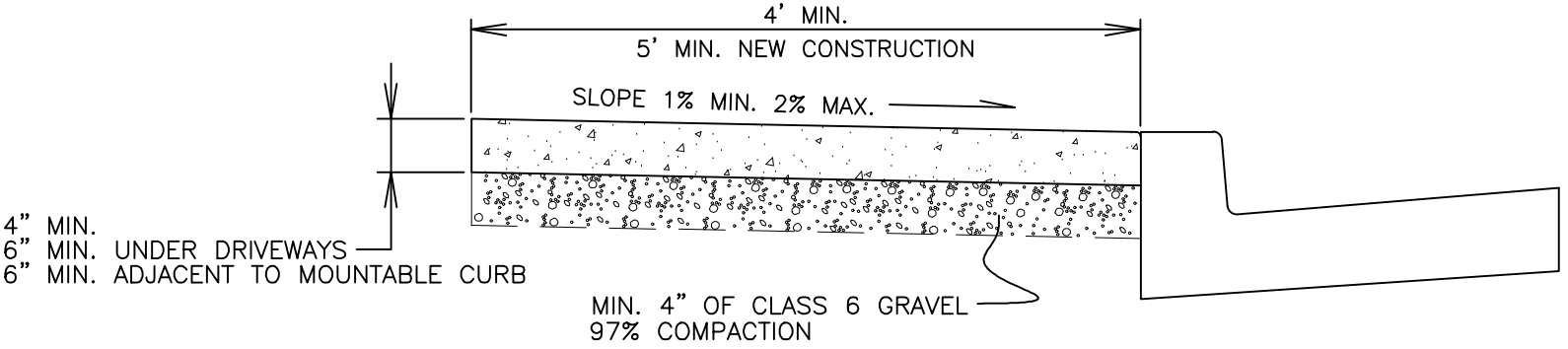
STANDARD DETAIL

S-1

REVISED: AUGUST 2008



SIDEWALK



SIDEWALK WITH CURB AND GUTTER

S-2

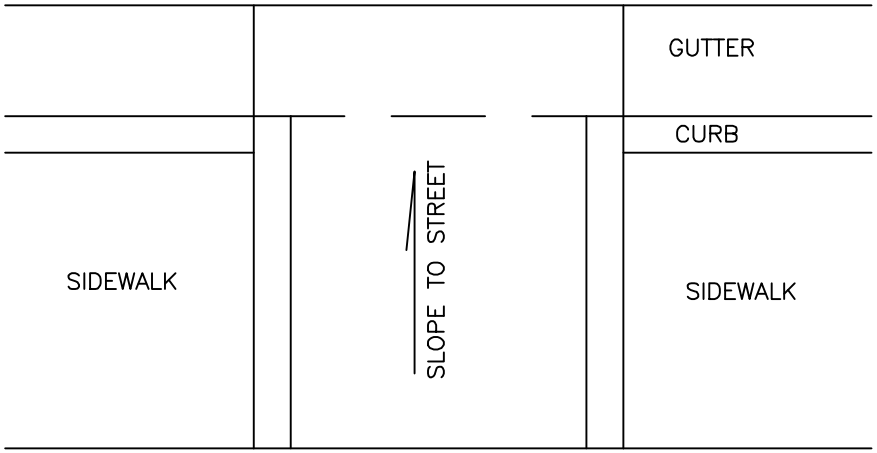
SIDEWALK

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

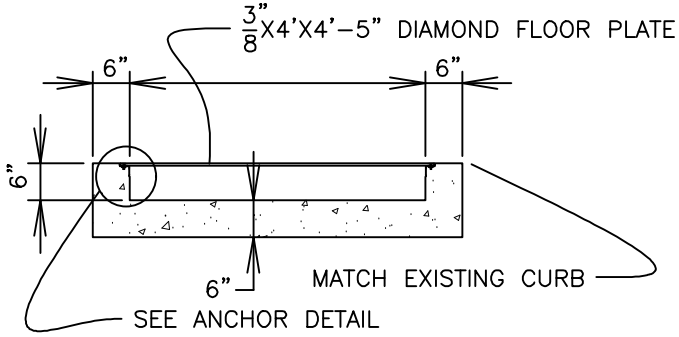
STANDARD DETAIL

S-2

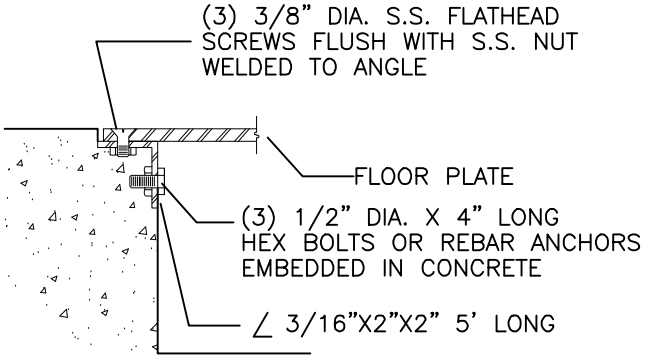
REVISED: APRIL 2005



PLAN
N.T.S



SECTION
N.T.S



ANCHOR DETAIL
N.T.S

NOTE: WIDTH OF PAN CAN VARY DEPENDING ON SIZE OF ROOF DRAIN.
WIDER DRAINS MAY REQUIRE THICKER PLATE STEEL OR ADDITIONAL SUPPORT.
R & R OF CURB & GUTTER REQUIRED, REMOVAL OF CURB HEAD IN EXISTING NOT PERMITTED.

SIDEWALK DRAIN PAN (CHASE)

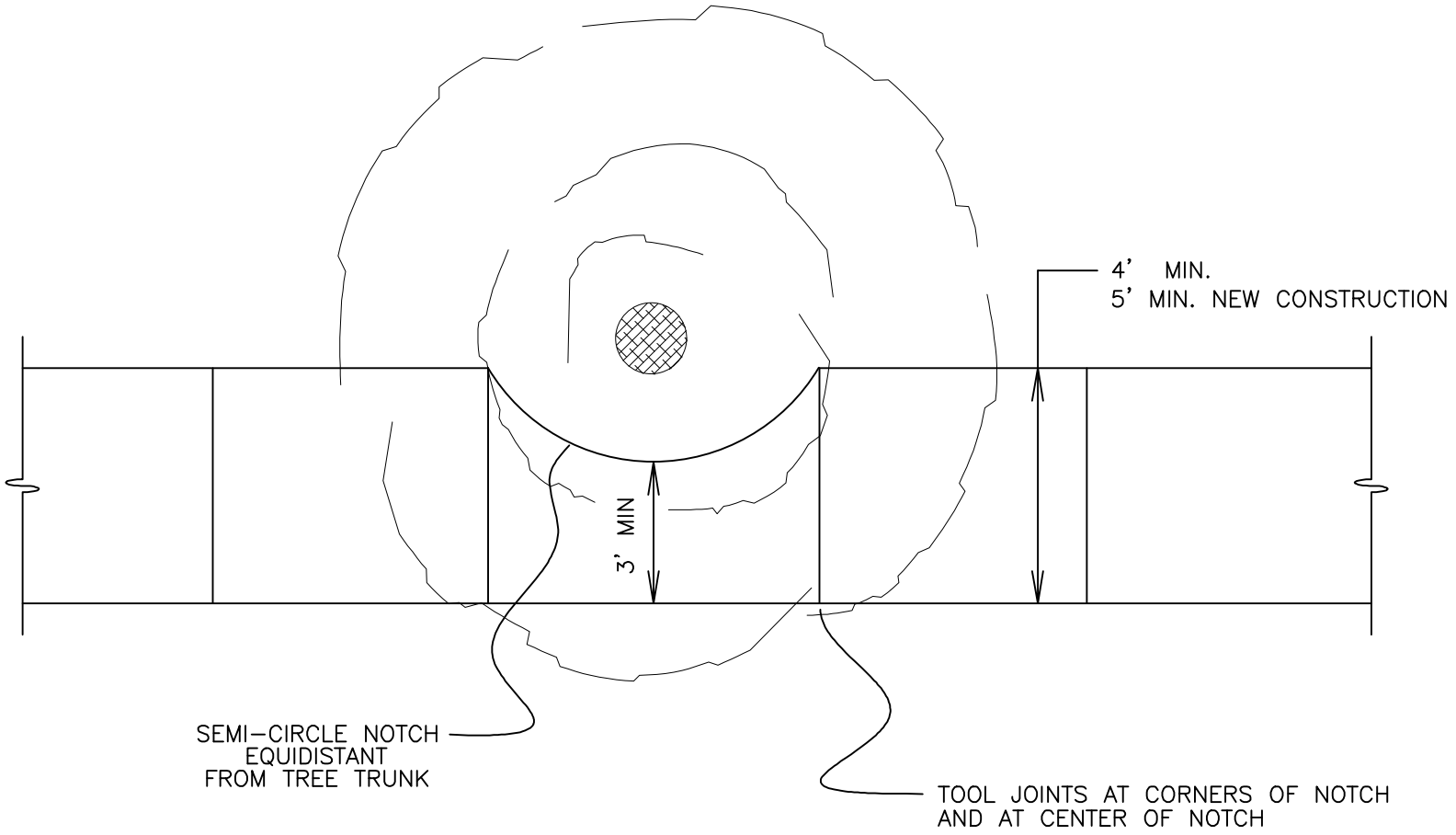
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL

S-3

REVISED: AUGUST 2008

S-3



TYPICAL TREE RADIUS SIDEWALK NOTCH

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

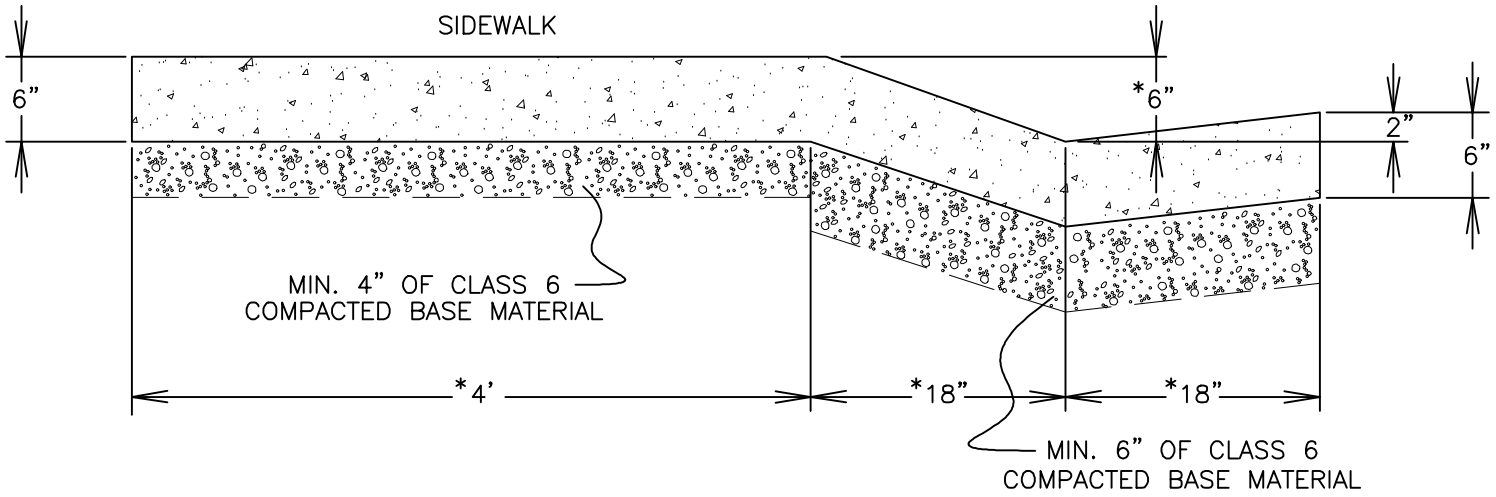
STANDARD DETAIL

S-4

REVISED: APRIL 2005

S-4

* NOTE: MATCH EXISTING DIMENSIONS



*FOR USE IN RESTORING EXISTING FACILITIES ONLY, NOT FOR NEW CONSTRUCITON.

MOUNTABLE CURB AND GUTTER WITH SIDEWALK

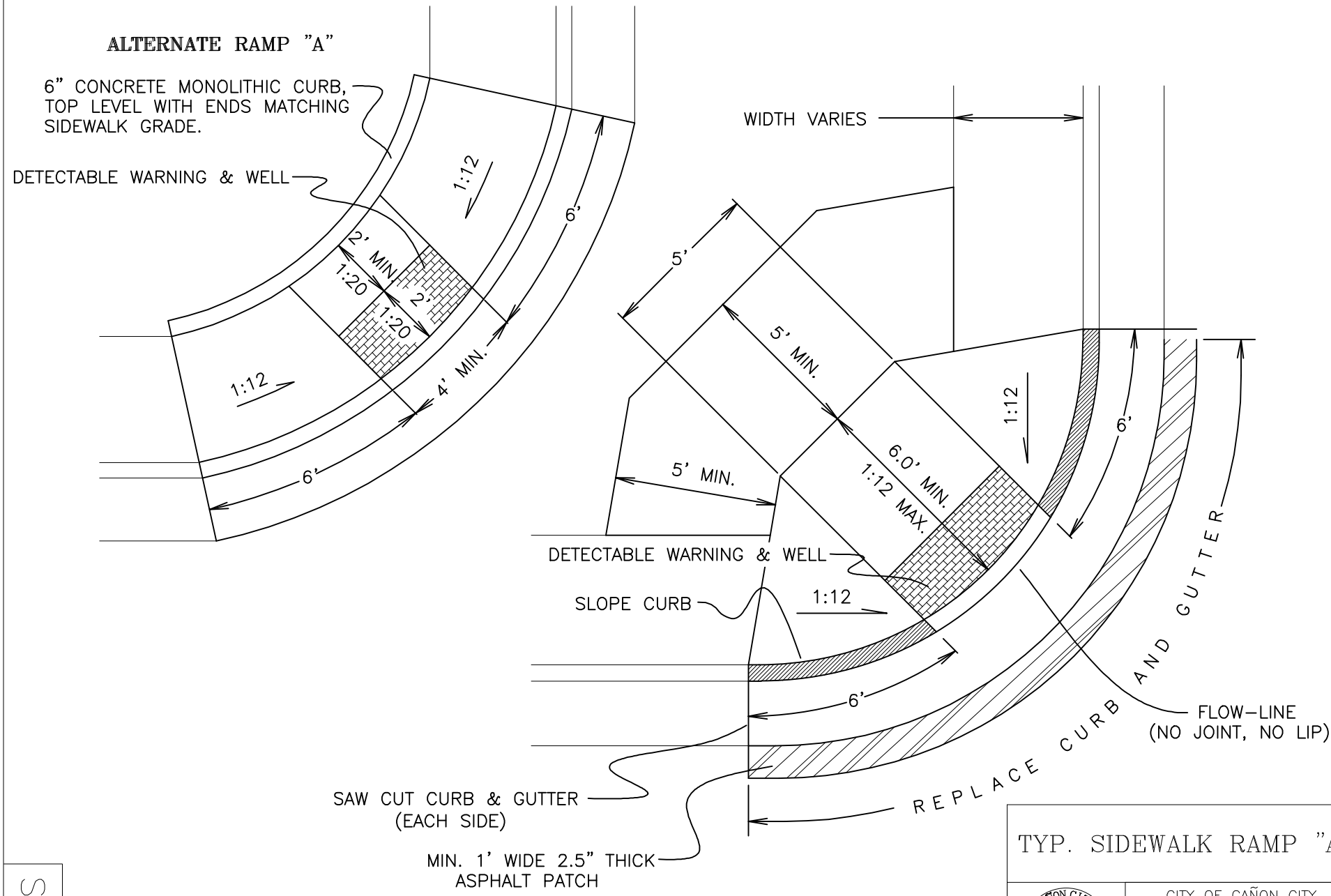
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL

S-5

REVISED: OCTOBER 2003

S-5



FOR USE IN EXISTING RETROFIT ONLY FOR EXTENUATING CIRCUMSTANCES AS DETERMINED BY CITY ENGINEER, NOT FOR NEW CONSTRUCTION

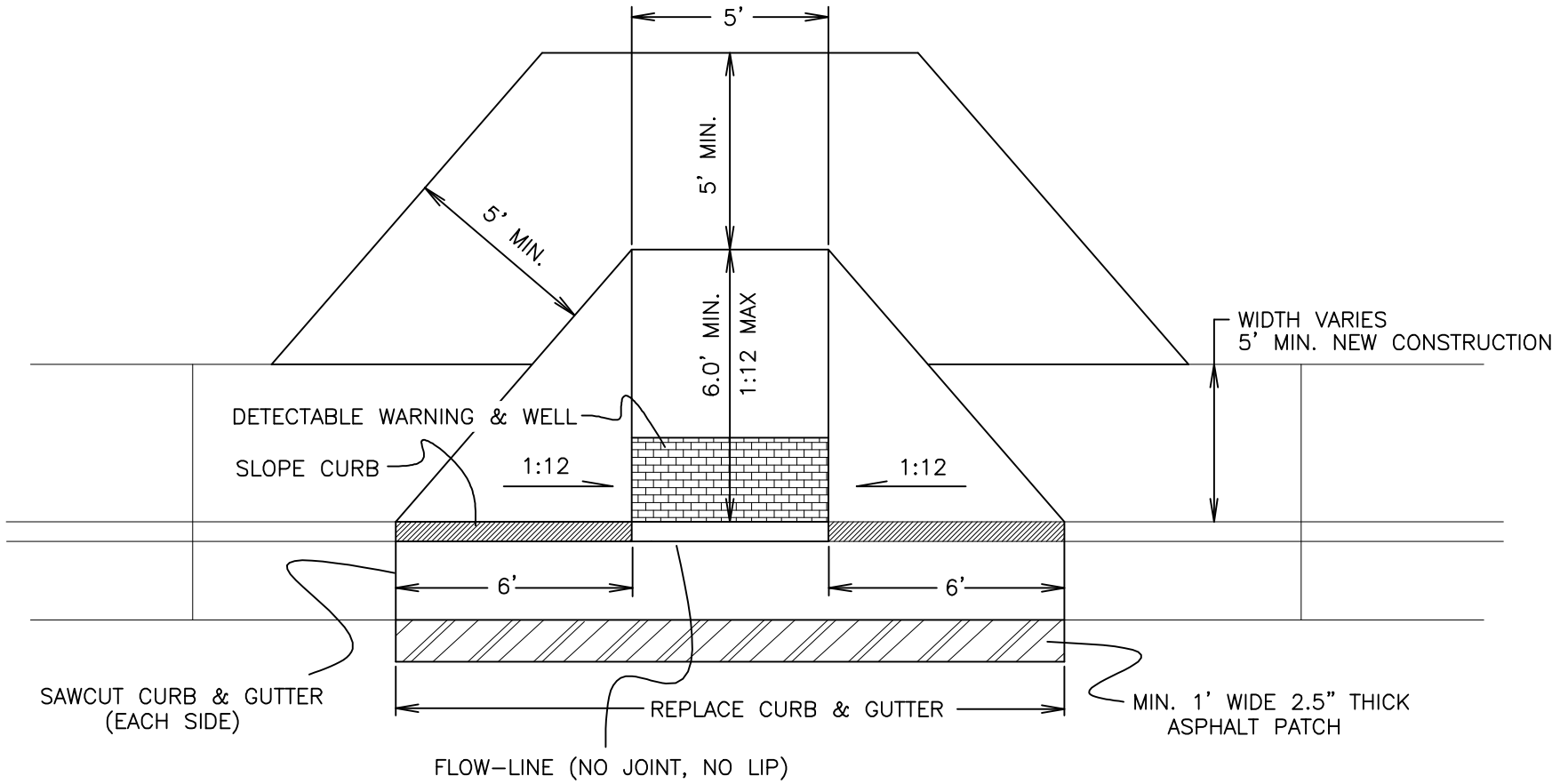
TYP. SIDEWALK RAMP "A"

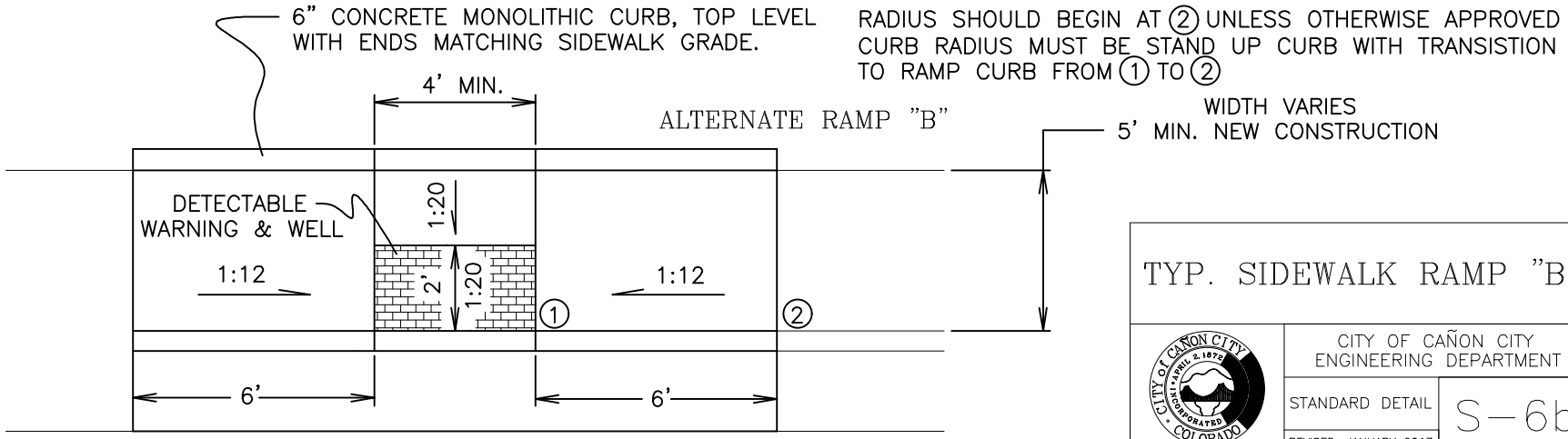
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S-6a

REVISED: AUGUST 2017

S-6a





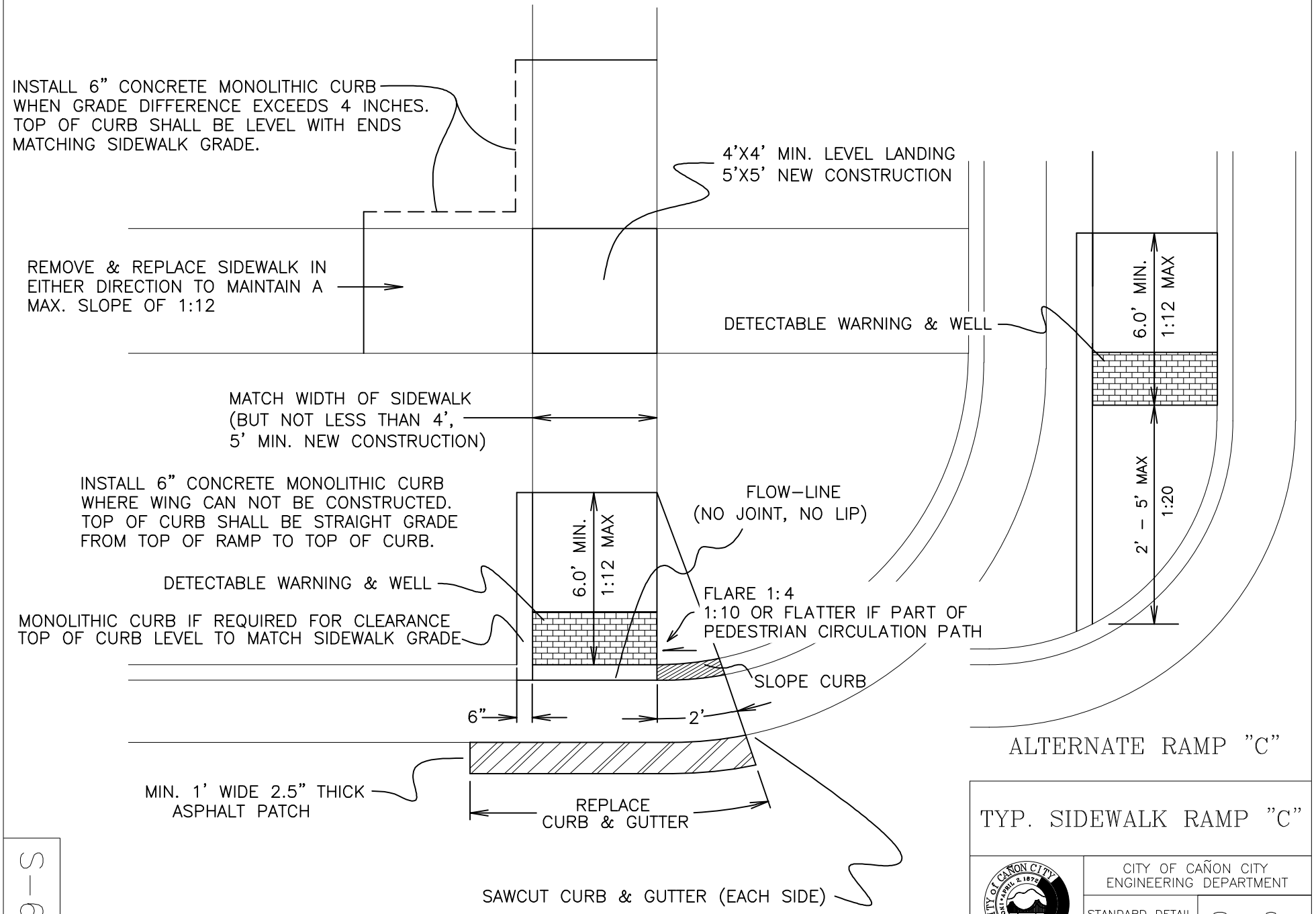
TYP. SIDEWALK RAMP "B"

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL

S-6b

REVISED: JANUARY 2017



ALTERNATE RAMP "C"

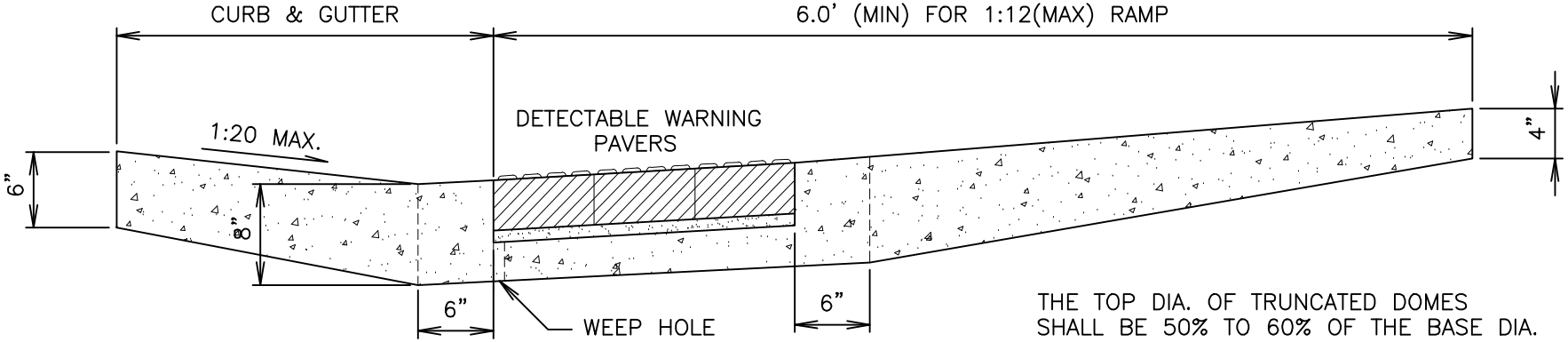
TYP. SIDEWALK RAMP "C"

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

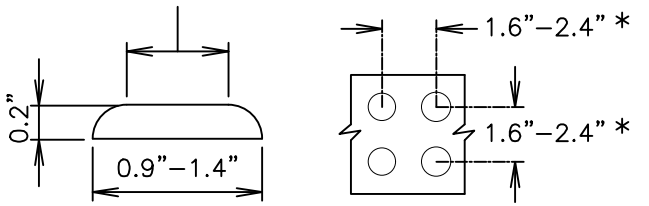
STANDARD DETAIL S-6c

REVISED: JANUARY 2017

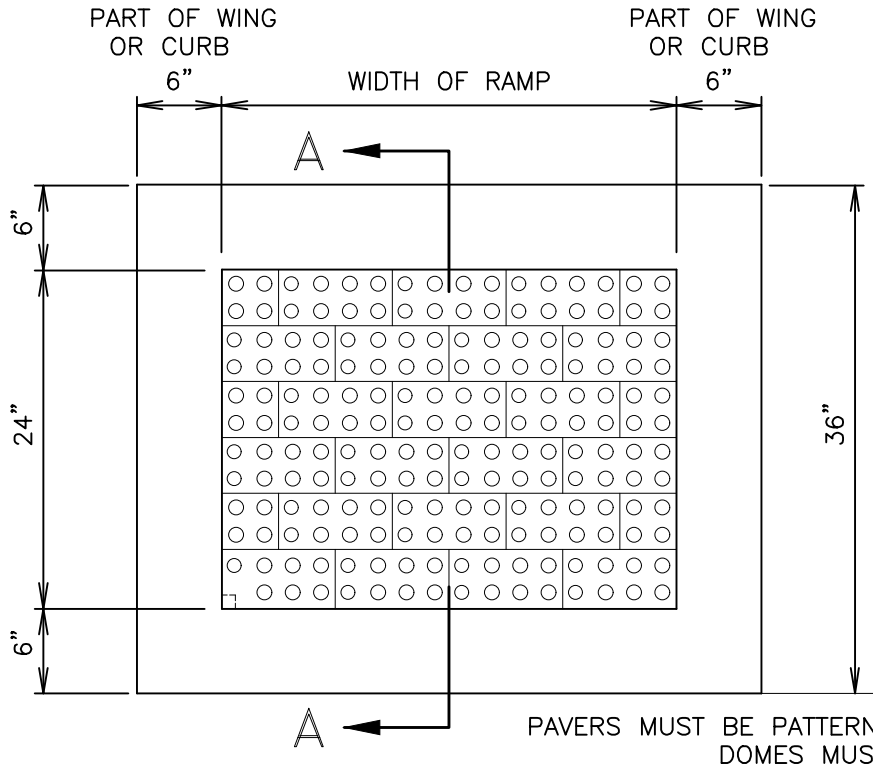
S-6c



SIDE CROSS SECTION VIEW OF DETECTABLE WARNING, WELL, CURB, AND GUTTER

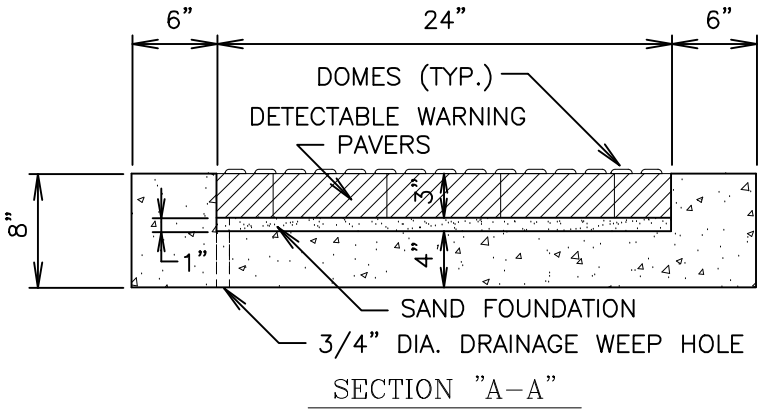


DOME AND DETECTABLE WARNING DETAILS



PLAN VIEW OF DETECTABLE WARNING AND WELL

PAVERS MUST BE PATTERNED "SOLDIERED" AS SHOWN; DOMES MUST BE ALIGNED LONGITUDINALLY AND LATERALLY.



SECTION "A–A"

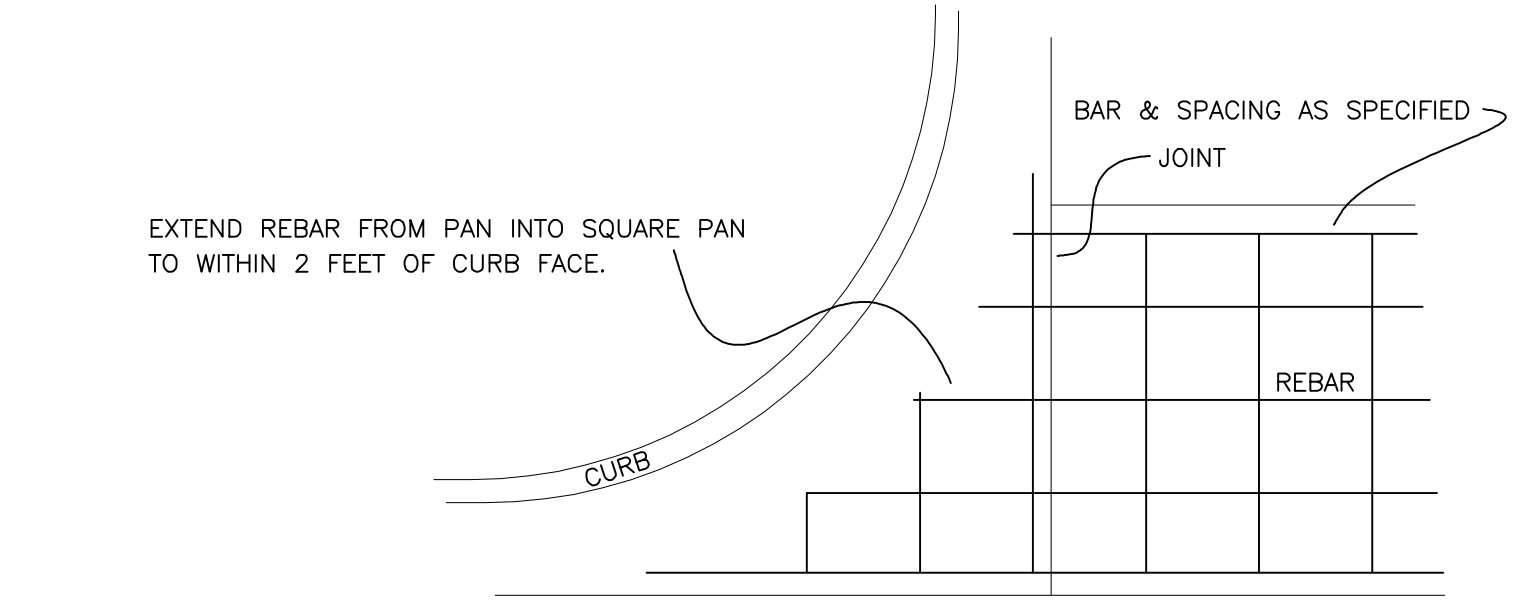
SIDEWALK RAMP DETECTABLE WARNING

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

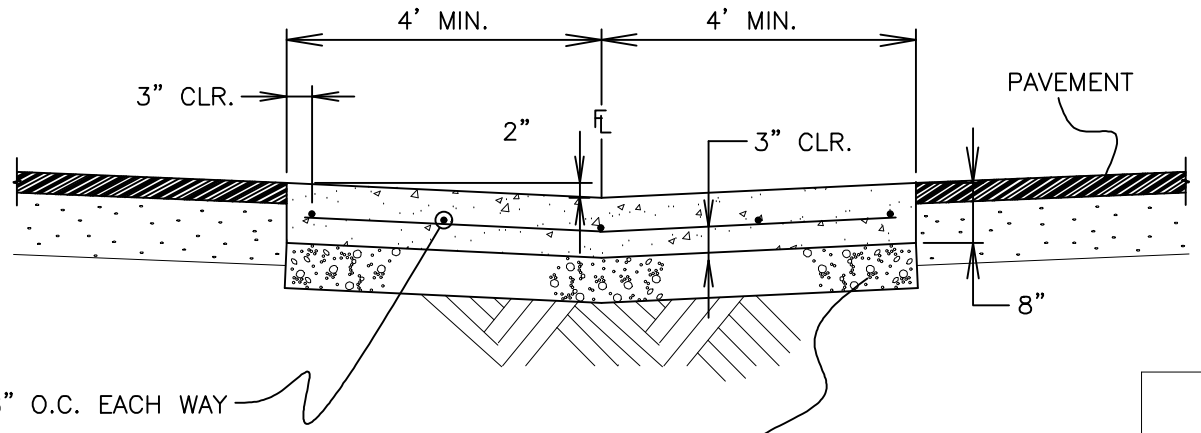
STANDARD DETAIL S–6d

REVISED: JANUARY 2017

pg–S



PAN/CURB INTERFACE TYPICAL



CROSS SECTION TYPICAL

CROSS PAN DETAIL

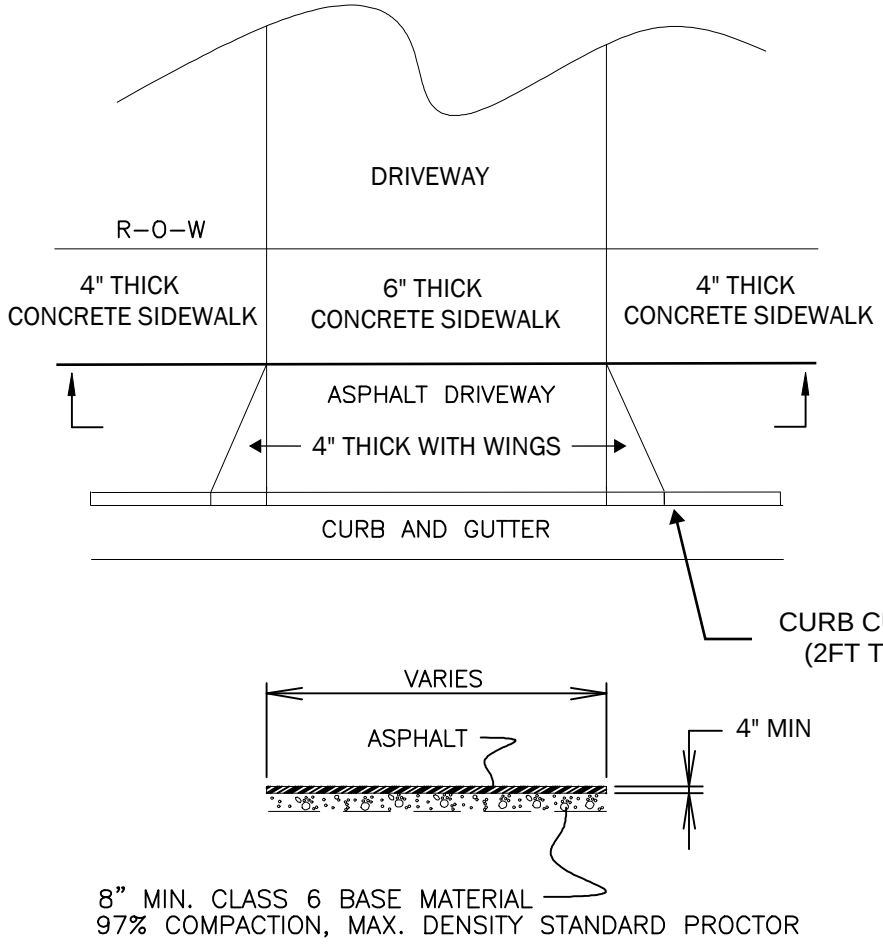
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL

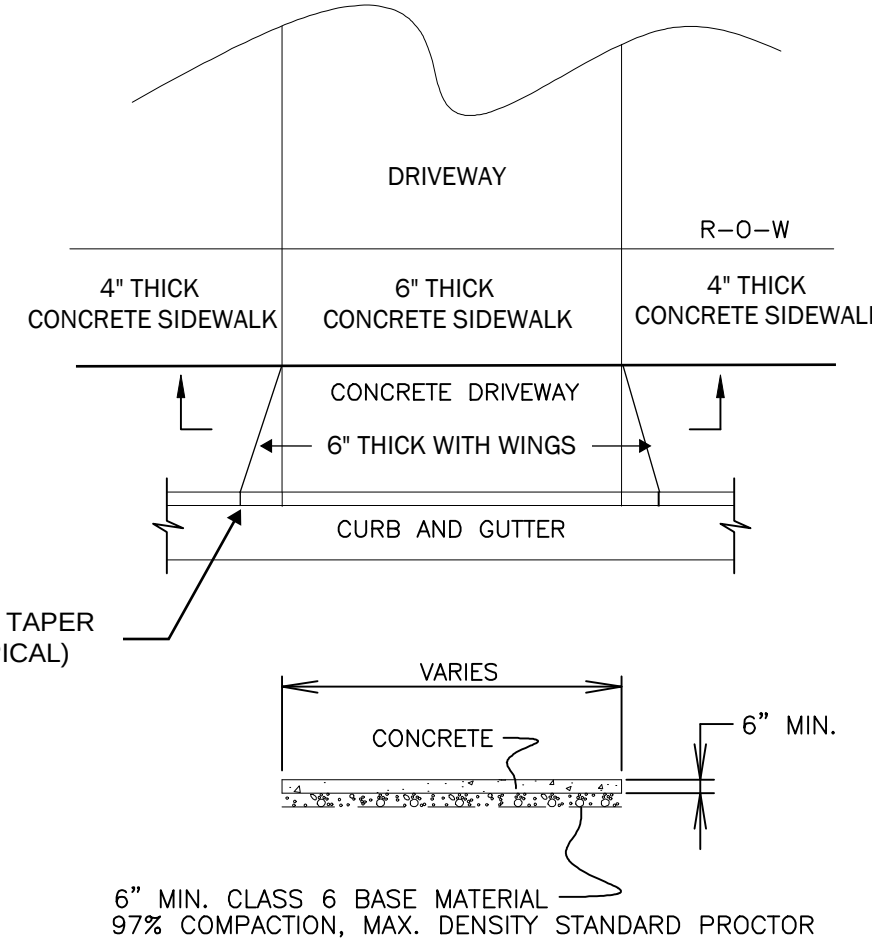
S-7

REVISED: AUGUST 2008

S-7



CROSS SECTION



CROSS SECTION

- ALL PRIVATE DRIVEWAYS MUST BE PAVED WITHIN THE RIGHT-OF WAY
- ON PRIVATELY LED PROJECTS, THE OWNER CAN CHOOSE WHETHER TO UTILIZE ASPHALT OR CONCRETE
- WHEN DRIVEWAYS ARE IMPACTED BY A CITY PROJECT THEY WILL BE REPLACED WITH EITHER ASPHALT OR CONCRETE TO MATCH EXISTING DRIVEWAY OUTSIDE THE RIGHT-OF-WAY
- IF THE EXISTING DRIVEWAY IS A MATERIAL OTHER THAN CONCRETE OR ASPHALT OUTSIDE THE RIGHT-OF-WAY, THE CITY WILL ELECT THE MATERIAL TO USE WITHIN THE RIGHT-OF-WAY
- SIDEWALK MUST BE CONCRETE. NO OTHER HARDSCAPE MATERIALS ALLOWED

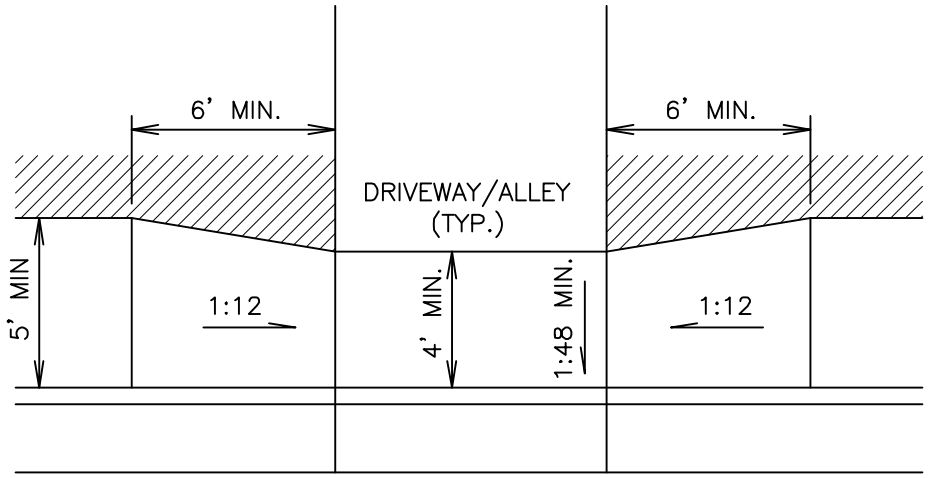
S–8a

PRIVATE DRIVEWAY IN RIGHT–OF–WAY

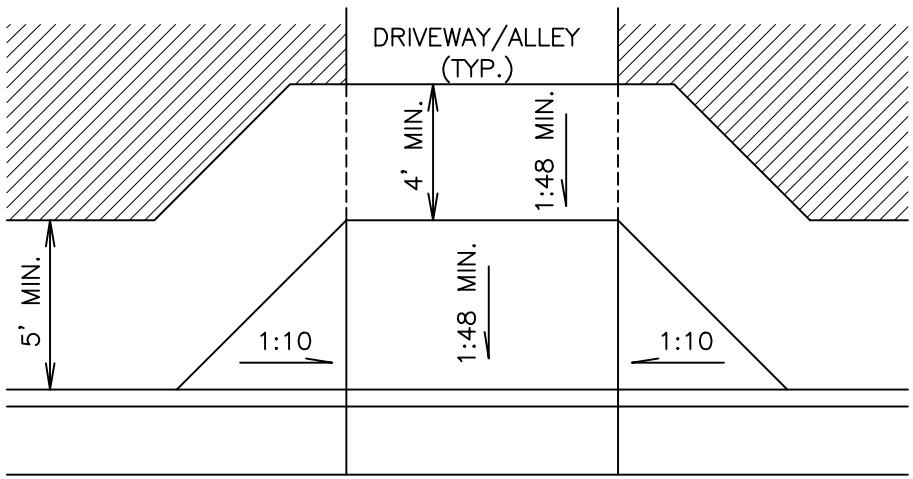
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S–8a

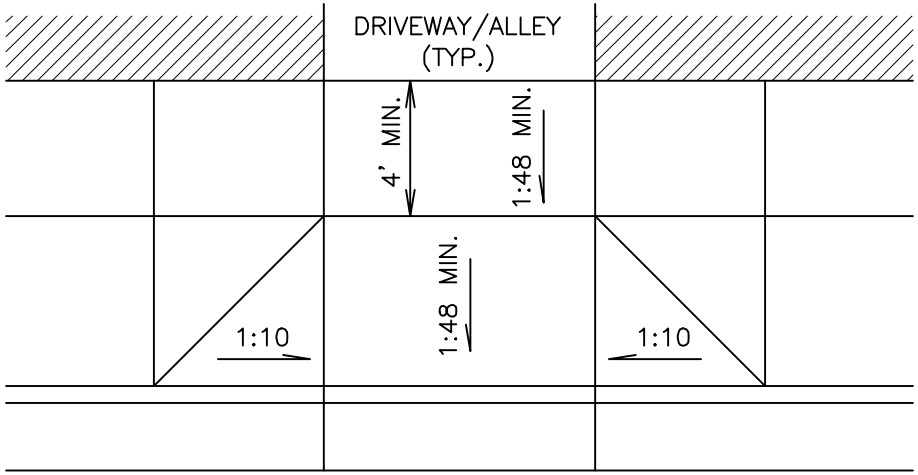
REVISED: OCTOBER 2025



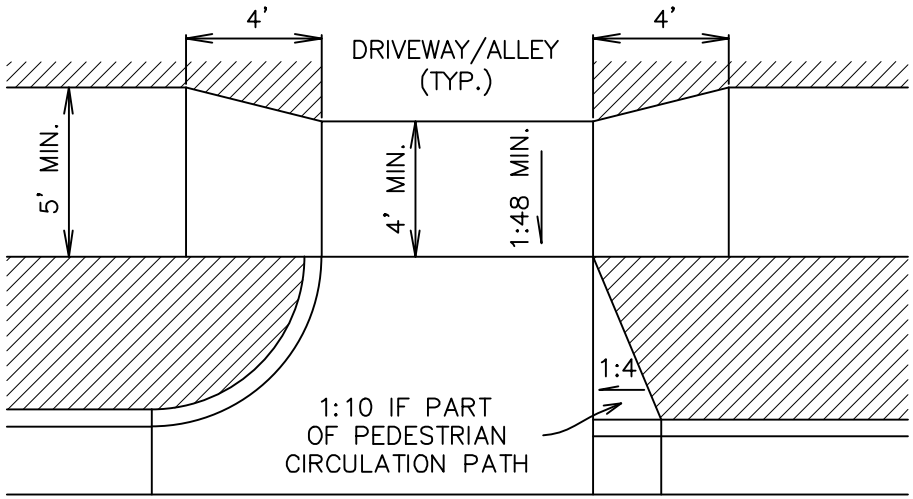
RAMP SIDEWALK



APRON OFFSET SIDEWALK



WIDE SIDEWALK



SETBACK SIDEWALK – WING OR CURB

NOTE: COMMERCIAL DRIVEWAYS AND DOWNTOWN ALLEYS SHALL HAVE DETECTABLE WARNINGS ON EACH SIDE
SIDEWALKS MUST ME REINFORCED WITH #5 GRADE 40 @ 18" O.C. EACH WAY (SEE DETAIL S-9)

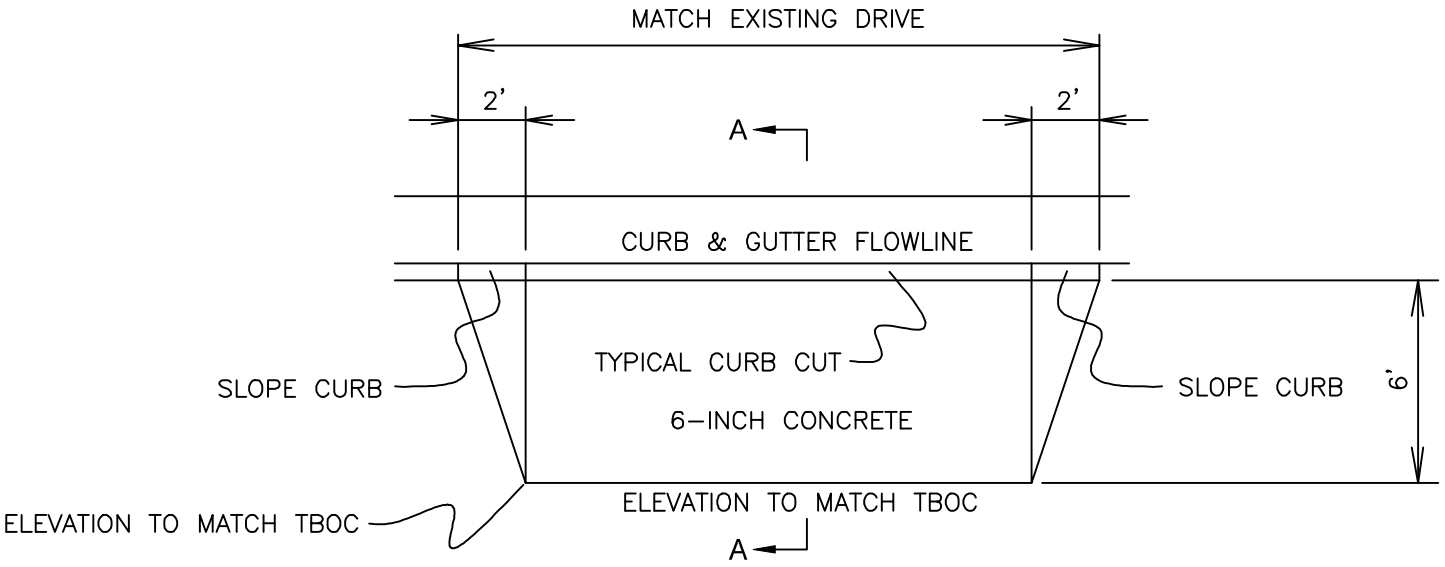
SIDEWALK ALLEY/DRIVEWAY CONNECTION

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

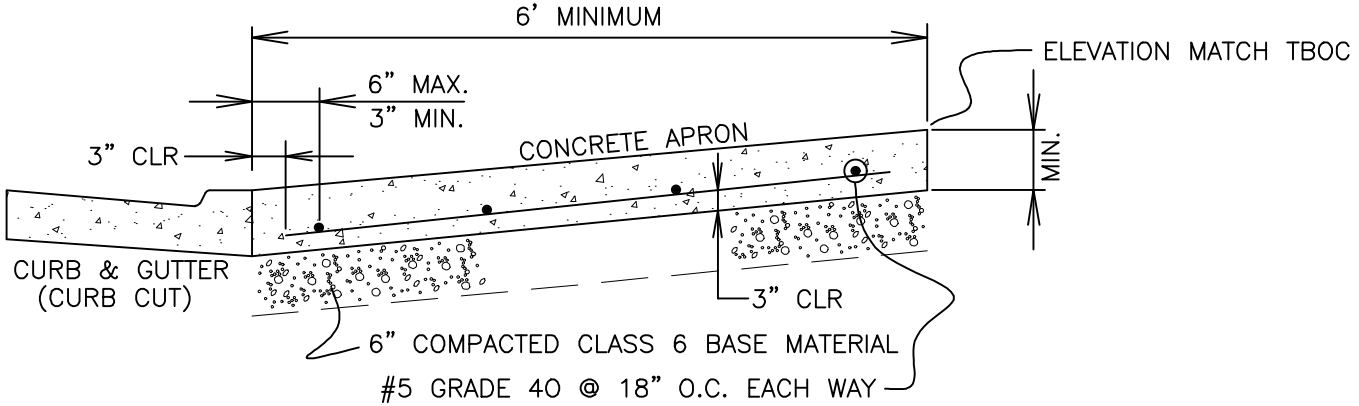
STANDARD DETAIL S-8b

REVISED: OCTOBER 2025

S-8a



TYPICAL DRIVEWAY APRON PLAN VIEW



SECTION A–A DRIVEWAY APRON

NOTE: SIDEWALK MUST BE REINFORCED AT THESE LOCATIONS

S–9

DRIVEWAY APRON (PUBLIC ALLEY WAYS)

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

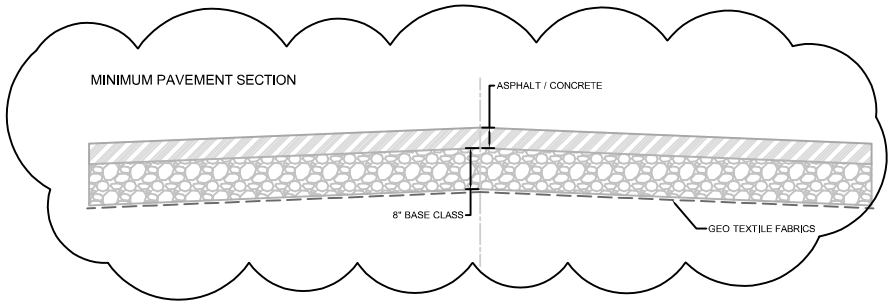
STANDARD DETAIL

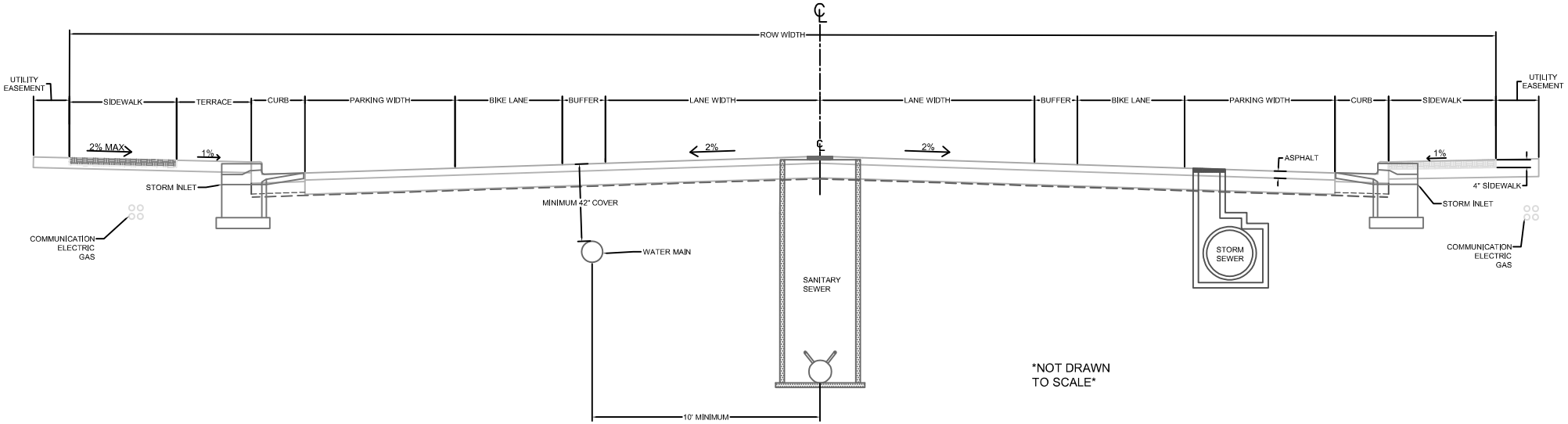
S–9

REVISED: APRIL 2005

ROADWAY CLASSIFICATION			
	LOCAL	COLLECTOR	ARTERIAL
ROW WIDTH (MIN)	60'-0"	70'-0"	80'-0"
LANE WIDTH	10'-0"	10' -11'	11' -12'
BUFFER	0' - 2'	2'-0"	2'-0"
BIKE LANE	5'-0"	5' - 7'	5' - 7'
PARKING WIDTH	7'-0"	8'-0"	N/A
CURB	2'-6"	2'-6"	2'-6"
TERRACE	0 -MAX	0 - MAX	0 - MAX
SIDEWALK (MIN)	5'-0"	5'-0"	5'-0"
UTILITY EASEMENT	10'-0"	10'-0"	10'-0"

MINIMUM PAVEMENT SECTION			
CLASSIFICATION	ASPHALT DEPTH	CONCRETE DEPTH	SUBGRADE
LOCAL	0'-4"	0'-6"	8" BASE CLASS -GEO TEXTILE -GEO GRID
COLLECTOR	0'-6"	0'-8"	
ARTERIAL	0'-7"	0'-10"	





NOT DRAWN TO SCALE

NOTES:

1. LOCAL ROADS CAN BE BUILT W/ 10' PARKING WIDTH AND ALLOW DUAL PARKING W/ YIELD CONDITION. TOTAL WIDTH = 30' MIN
2. COLLECTORS MUST BE REVIEWED AND APPROVED FOR STREET PARKING
3. WIDER SIDEWALK WIDTHS REQUIRED IN COMMERCIAL DISTRICTS OR WHERE USED AS A SHARED USE PATH
4. ROW WIDTH TO BE SPLIT EVENLY ALONG ROADWAY CENTERLINE WHENEVER POSSIBLE
5. REFER TO MULTIMODAL MASTER PLAN FOR BIKE LANE NEEDS
6. WATER METERS SHOULD BE PLACED IN UTILITY EASEMENTS AND OUTSIDE OF ANY HARDSCAPIING
7. SUBGRADE TO BE CONSTRUCTED BASED ON GEOTECHNICAL REPORT

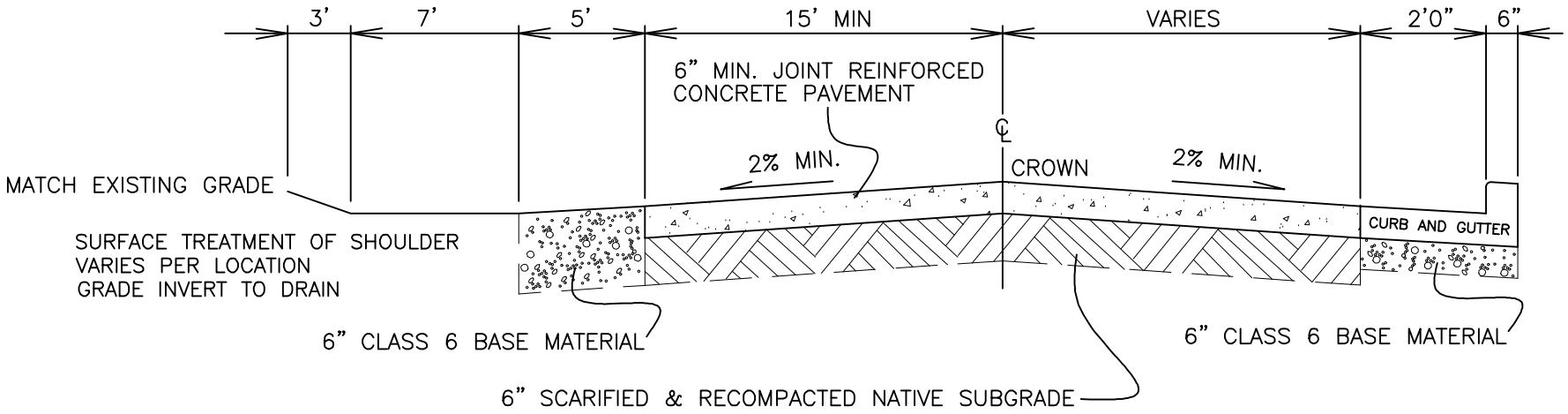
S-10

H.M.A. PAVEMENT
ROAD CROSS SECTION

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S-10

REVISED: OCTOBER 2003



*LOCAL ROAD MINIMUM
*SECTION TO BE DESIGNED/CONFIRMED BY GEOTECHNICAL ENGINEER AND APPROVED BY CITY.

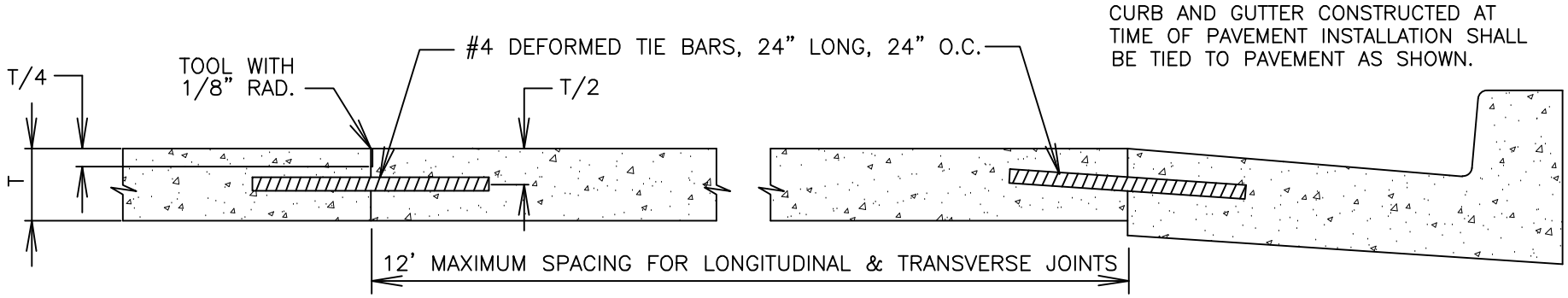
S-11

P.C.C. PAVEMENT
ROAD CROSS SECTION

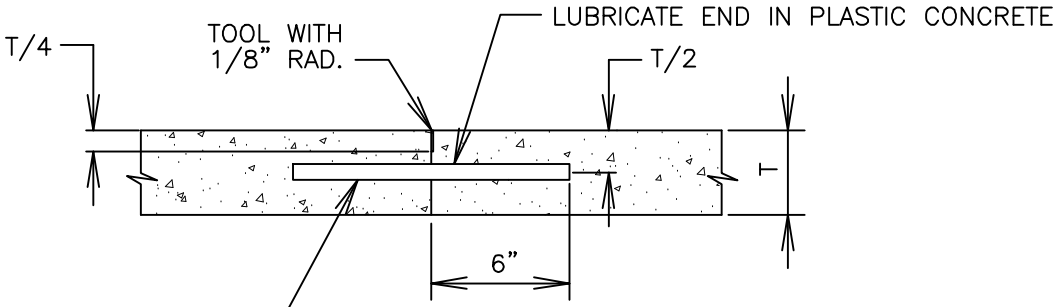
CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S-11

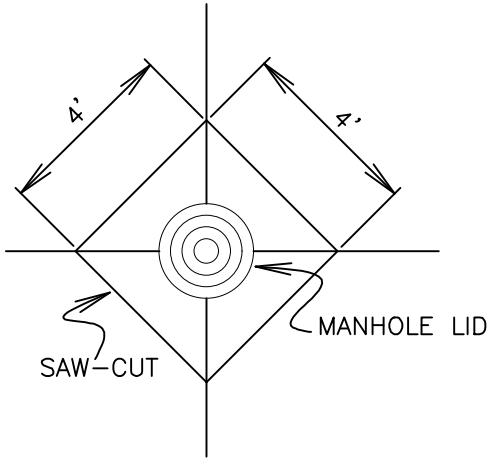
REVISED: AUGUST 2008



TYPE A–1
PRE–MOLDED OR SAWED LONGITUDINAL AND C&G JOINT



TYPE D
TRANSVERSE CONSTRUCTION JOINT



MANHOLE SAW–CUT DETAIL

*LOCAL ROAD MINIMUM
*SECTION TO BE DESIGNED/CONFIRMED BY GEOTECHNICAL ENGINEER AND APPROVED BY CITY.

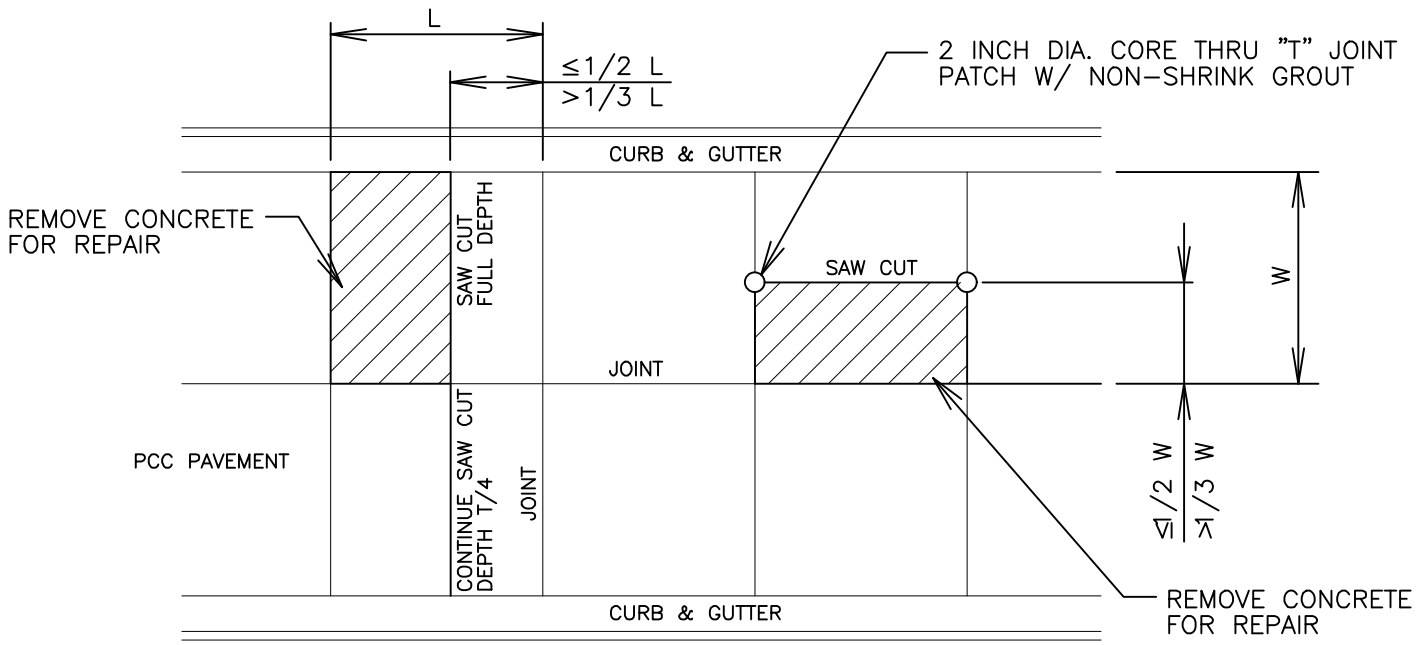
S–12

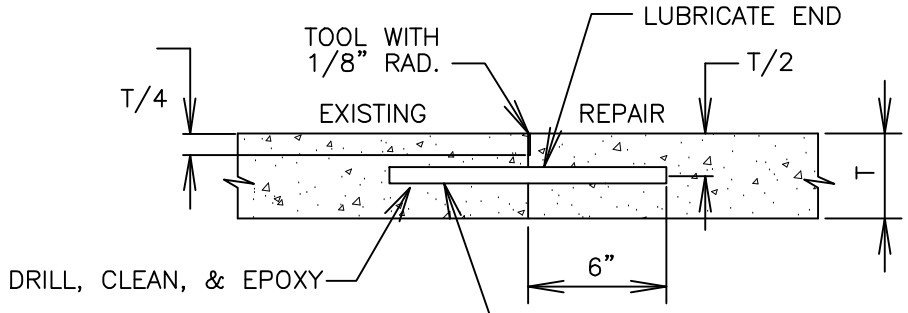
P.C.C. PAVEMENT JOINT DETAILS

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S–12

REVISED: AUGUST 2008





*OR AS DIRECTED BY ENGINEER BASED ON PAVEMENT DESIGN AND CONDITION.

12" LONG #5 SMOOTH DOWEL BARS 18" O.C.
TRANSVERSE ONLY, MATCH EXISTING PAVEMENT
FOR BAR SPACING ON LONITUDINAL JOINTS

CONCRETE REPAIR JOINT ALL SIDES

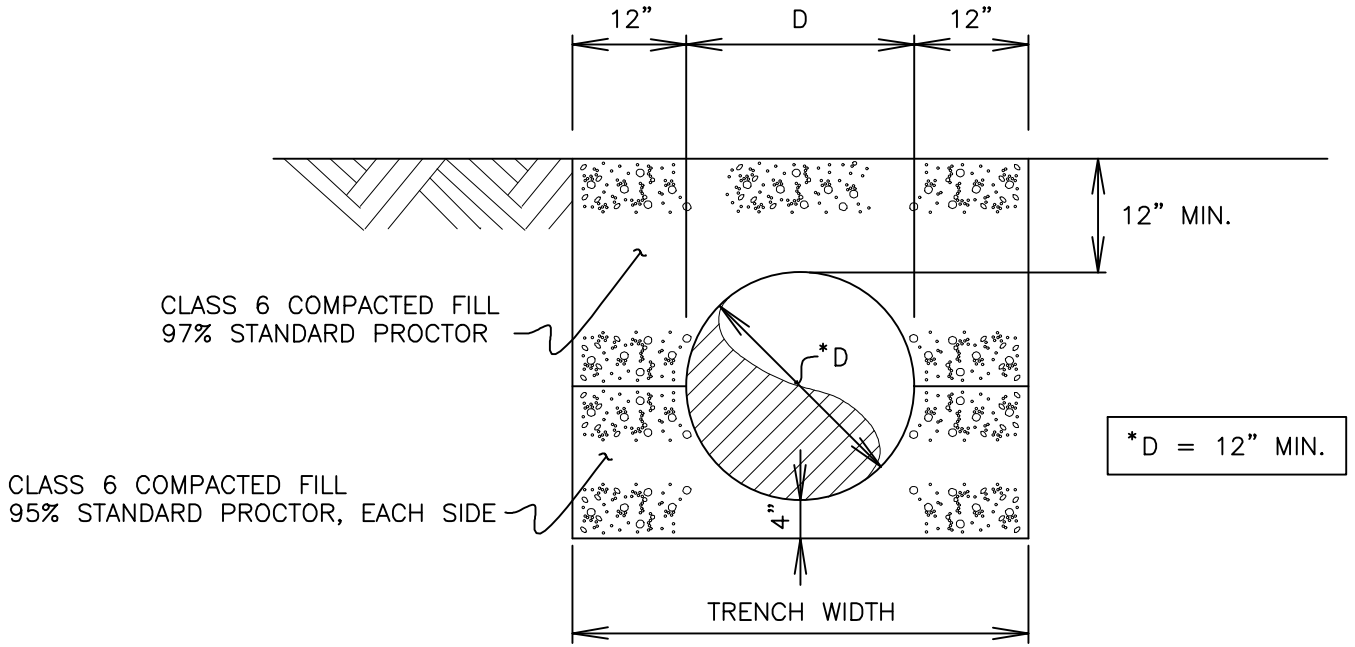
P.C.C. PAVEMENT REPAIR

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S-13

REVISED: AUGUST 2008

S-13



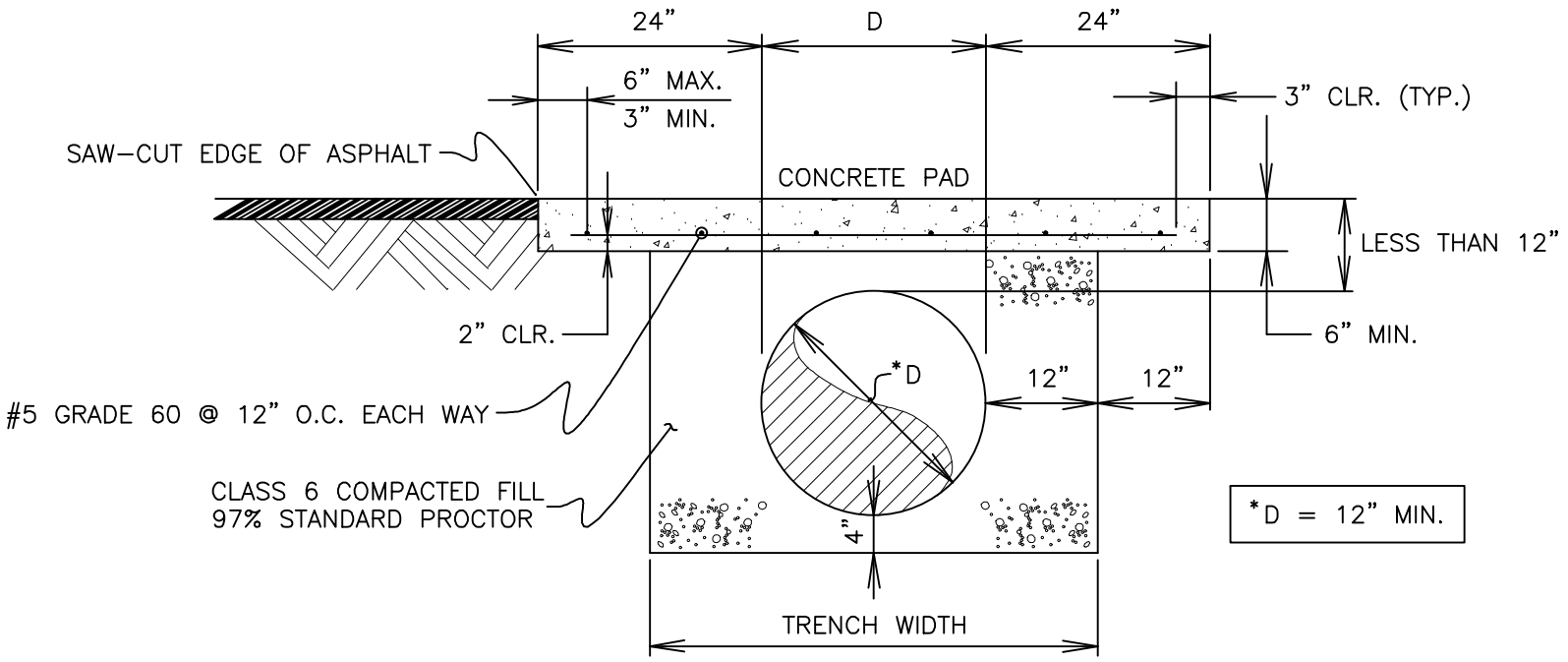
STANDARD IRRIGATION DRAINAGE CULVERT

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S-14a

REVISED: MARCH 2004

S-14a



NOTES:

1.) 1" MIN. SPACE BETWEEN PIPE AND CONCRETE PAD
2.) FOR FAMILY RESIDENCE: IF 12 GA. C.M.P. IS USED, THE FULL 12" CLASS 6 COVER OR 6" CONCRETE CAP IS NOT REQUIRED.

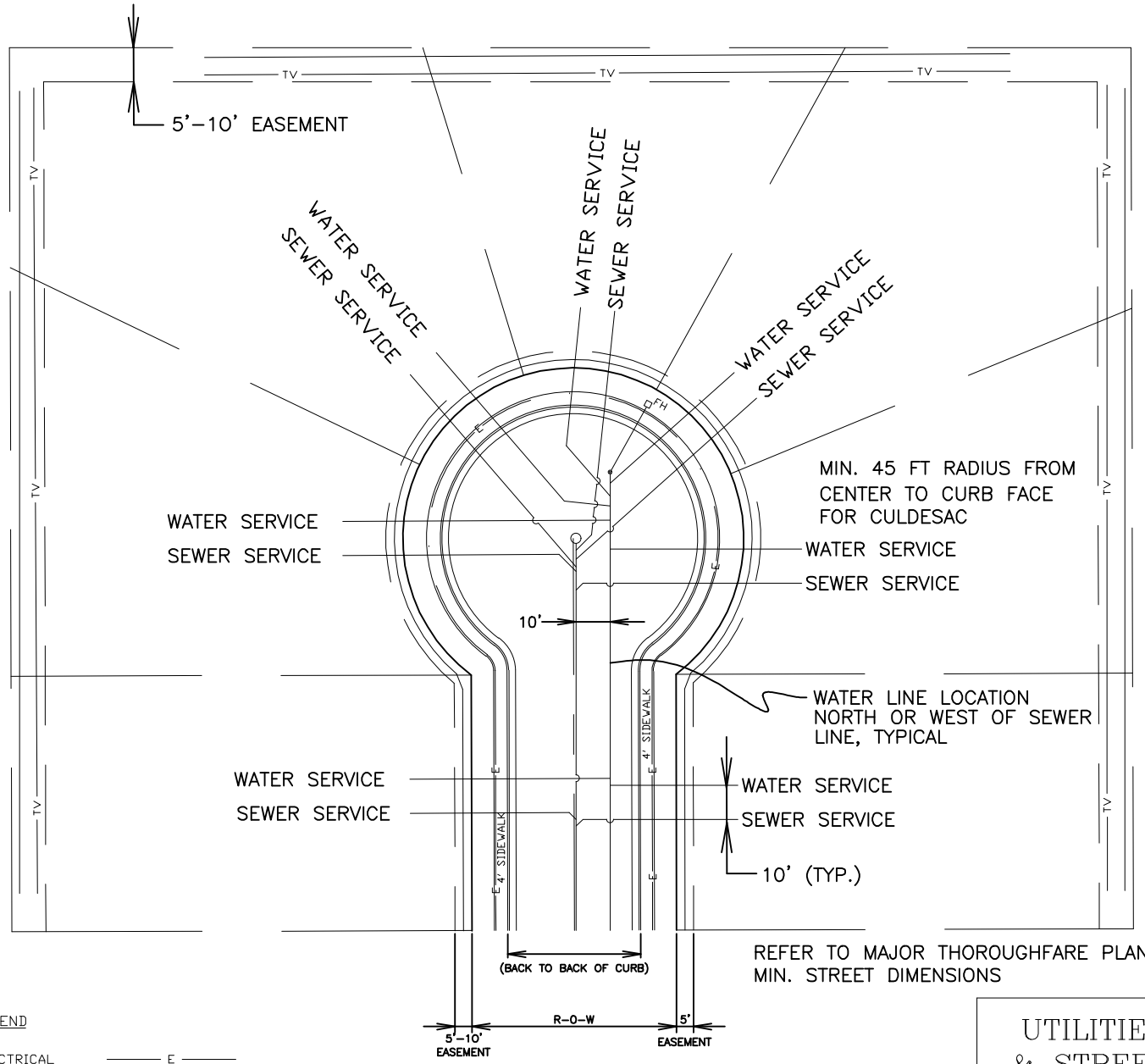
STANDARD IRRIGATION DRAINAGE CULVERT
(LESS THAN 12" COVER)

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S-14b

REVISED: MARCH 2004

S-14b



REFER TO MAJOR THOROUGHFARE PLAN FOR MIN. STREET DIMENSIONS

LEGEND

ELECTRICAL	E
GAS LINE	
SANITARY SEWER	
TELEPHONE	
TV	TV
WATER LINE	

NOTE:

TELE. & T.V. MAY BE IN SAME TRENCH WITH ELECTRICAL

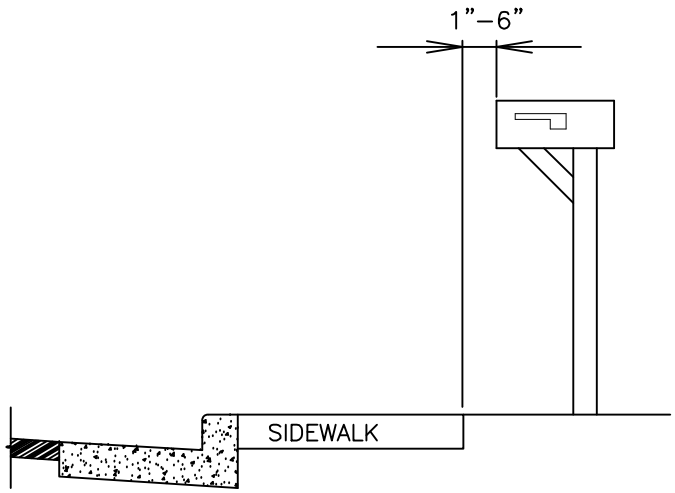
UTILITIES PLACEMENT & STREET DIMENSIONS

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

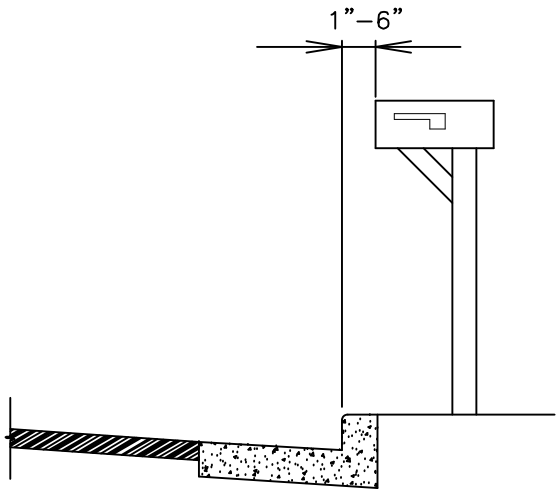
STANDARD DETAIL S–15

REVISED: AUGUST 2008

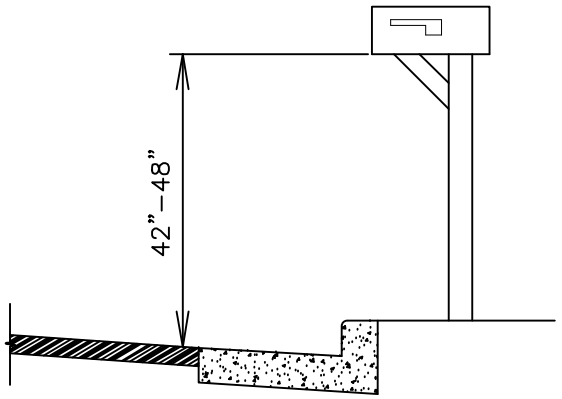
S–15



FRONT OF MAILBOX MUST BE
1–6 INCHES BACK FROM EDGE
OF SIDEWALK



FRONT OF MAILBOX MUST BE
1–6 INCHES BACK FROM EDGE
OF CURB OR SHOULDER OF ROADWAY



BOTTOM OF MAILBOX MUST BE
42–48 INCHES FROM ROADWAY
SURFACE

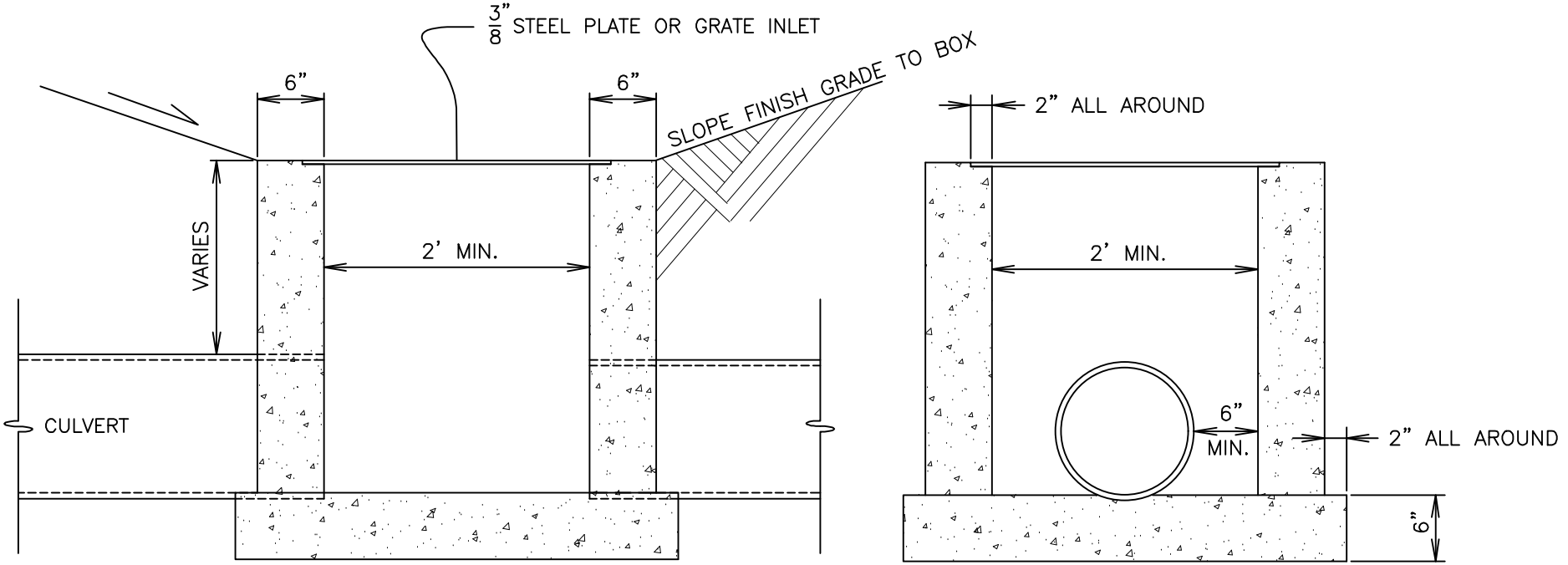
MAILBOX LOCATION

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S–16

REVISED: AUGUST 2008

S–16



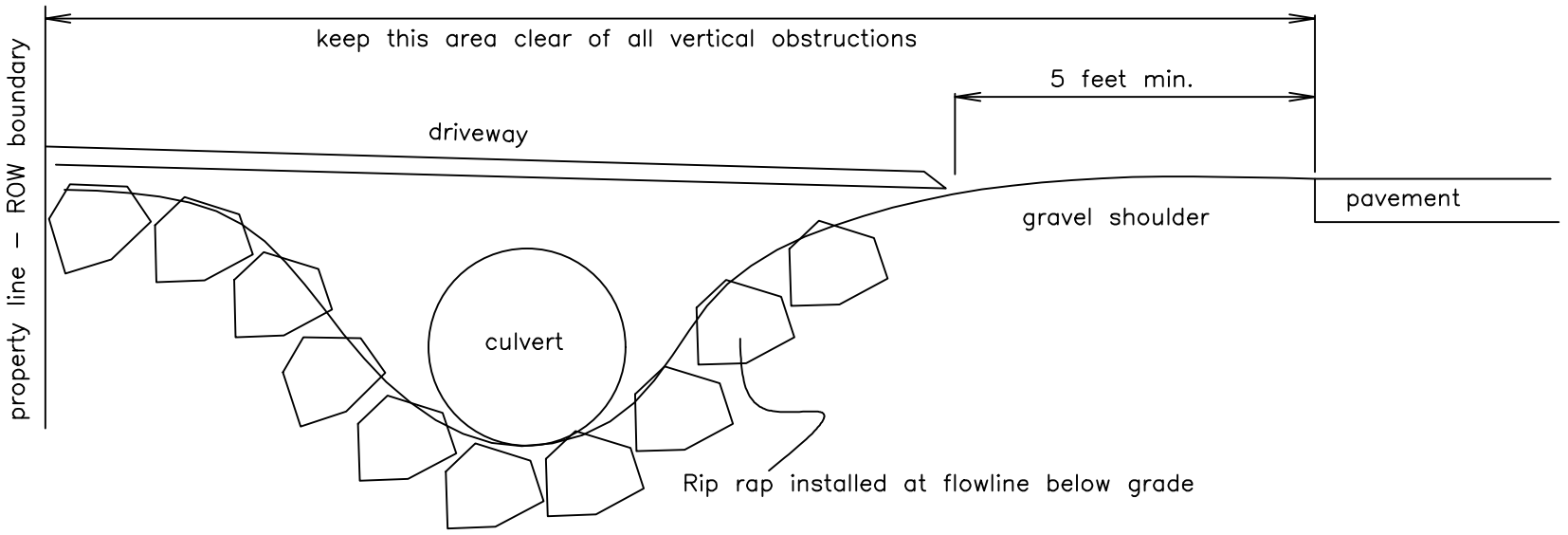
CLEANOUT SHALL BE PLACED A MIN.
OF EVERY 50 FEET.

DRAIN LINE
CLEANOUT BOX

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

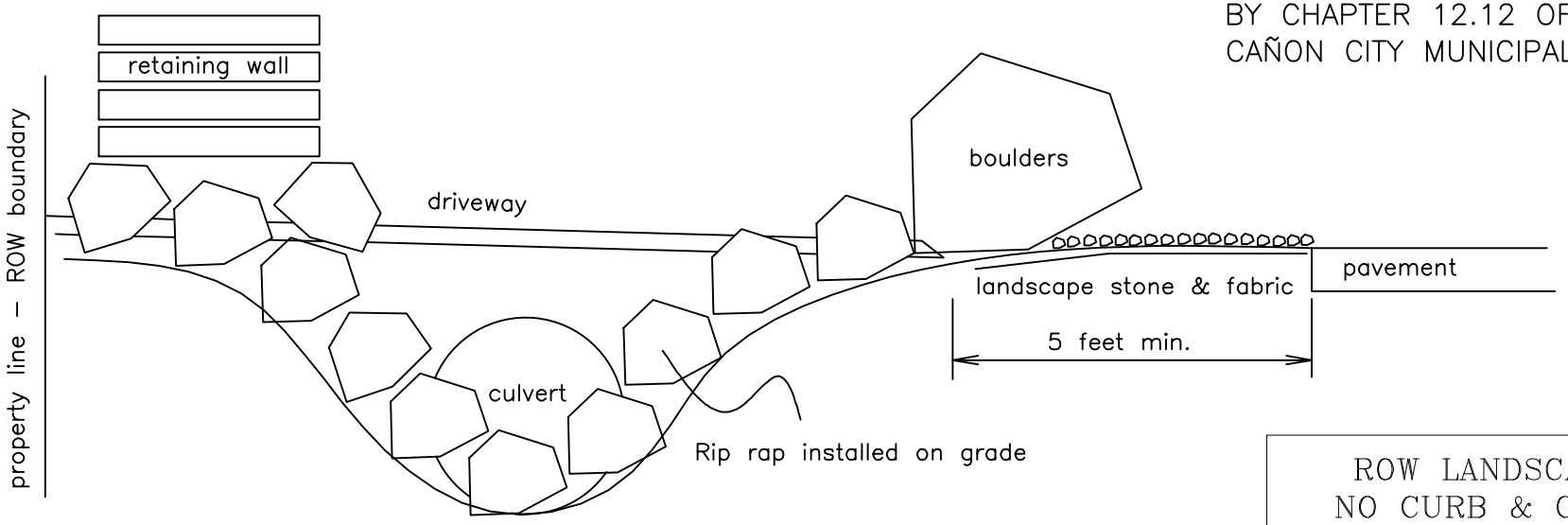
STANDARD DETAIL S-17

REVISED: AUGUST 2008



LANDSCAPING IN ROW – CORRECT
CROSS SECTION – N.T.S.

NOTE: ENCROACHMENTS IN RIGHT–OF–WAY IS GOVERNED BY CHAPTER 12.12 OF THE CAÑON CITY MUNICIPAL CODE



LANDSCAPING IN ROW – INCORRECT
CROSS SECTION – N.T.S.

ROW LANDSCAPING NO CURB & GUTTER

CITY OF CAÑON CITY
ENGINEERING DEPARTMENT

STANDARD DETAIL S–18

REVISED: AUGUST 2017

S–18