

ARTICLE 12

STORM SEWERS

12.1 GENERAL

12.1.1 DESCRIPTION

The work covered by this specification consists of furnishing all labor, equipment, tools, materials necessary to install storm sewer pipe and appurtenances as shown on the plans and as specified herein. The term "Storm Sewer" as used in these specifications also applies to "Culverts" and all provisions apply unless noted otherwise.

12.1.2 PLANS AND DATA

Profiles of the ground or a detailed utility plan shall be shown on the plans for the work. The Contractor must satisfy himself regarding the character of the material to be excavated and the work to be done.

12.1.3 SITE INVESTIGATION

Contractor acknowledges the nature and location of the work, the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, uncertainties of weather, physical conditions at the site, the character/quality of surface and subsurface materials to be encountered, the character of equipment and facilities needed prior to and during the work, and all other matters which can in any way affect the work or the cost thereof under this contract. Failure by Contractor to acquaint himself with all the available information concerning these conditions will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the work.

12.2 MATERIALS

12.2.1 PIPE MATERIALS

Acceptable storm drain construction materials to be used for all public infrastructure include ASTM C76 Class III reinforced concrete pipe (RCP) and High Performance (HP) Storm Polypropylene Pipe manufactured by Advanced Drainage System, Inc. (or approved equal). Approved HP Storm Polypropylene Pipe diameters range in size from 15" to 60". Other materials may be considered on a case-by-case basis for private development projects that will not be publicly maintained. **Only the type of pipe designated on construction documents will be allowed.**

Acceptable storm drain construction materials to be used for private development projects include ASTM C76 Class III reinforced concrete pipe (RCP), High Density Polyethylene (HDPE) with smooth interior, High Performance (HP) Storm Polypropylene Pipe manufactured by Advanced Drainage System, Inc. (or approved equal), or Polyvinyl Chloride (PVC). **Only the type of pipe designated on construction documents will be allowed.**

For pipes sizes larger than 60 inches in diameter, **only RCP will be allowed.**

When plastic pipe with flared end sections is to be installed, the end section shall be steel or reinforced concrete as approved by the Engineer. Concrete collars will be required to join

reinforced concrete flared end section to the plastic pipe. Plastic flared end sections are not acceptable.

12.2.2 REINFORCED CONCRETE PIPE (RCP)

Concrete pipe shall be made using Type I/II cement or a 7-sack mix design and shall be a minimum of Class III unless shown otherwise on the drawings, and shall conform to the following AASHTO / ASTM designation:

	AASHTO	ASTM
Storm Drain and Sewer Pipe (RCP)	M 170	C76
Precast Manhole Sections	M 199	C 478
Arch Pipe	M 206	C 506
Elliptical Pipe	M 207	C 507
Joints, Using Rubber Gaskets	M 315	C 473
Precast Reinforced Concrete Box Sections	M 259	C 1577 or C 1433
Joints, Using Rubber Gaskets (Box Culverts)		C 1677
Joints, Using Mastic Gaskets		C 1990

Prior to pipe laying operations, the Contractor shall submit a letter from the pipe manufacturer certifying that the minimum areas of steel (RCP) and concrete strengths are in compliance with the applicable AASHTO specification and strength classification. The pipe manufacturer's facility shall be certified annually by the American Concrete Pipe Association. Representatives from the City shall be allowed full access to the facility to observe all phases of the pipe manufacturing process and to review all records pertaining to pipe testing. The City reserves the right to reject pipe based upon visual observations of apparent defects or departures from the tolerance standards.

Joints for storm drains or manholes shall be either bell and spigot or tongue and groove. Jointing material for concrete pipe shall be a preformed, flexible plastic sealing compound which conforms to Federal Specification SS-S-00210 (GSA-FS6) "Sealing Compound Preformed Plastic for Expansion Joints and Pipe Joints". The sealant shall be made of top-grade vulcanized butyl rubber which is compressible and has a tacky surface for adherence to the joint. The material shall be capable of being installed in the temperature range from zero to one-hundred degrees Fahrenheit (0 - 100°F).

12.2.3 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

High density polyethylene pipe shall have a smooth interior wall (Type S) and shall conform to AASHTO M 294. Joints shall be a gasketed bell and spigot fitting. Acceptable products are "N-12 WT IB" as manufactured by Advanced Drainage Systems, Inc. or an approved equal. The joining of pipe shall be in strict conformance with the manufacturer's recommendations or the Contract Documents, whichever is more stringent. Only pipe diameters 15" through 36" will be allowed. Installation of High-Density Polyethylene pipe (HDPE) must meet the following conditions described below:

- (a) Where there are discrepancies between HDPE pipe installation specifications and City of Pueblo Standard Specifications, the more stringent specifications will apply.
- (b) Where HDPE pipe enters a manhole, flowable fill must be used to ensure proper support beneath the pipe. Flowable fill must be installed to the spring line of the highest HDPE pipe and within the area of manhole excavation.

- (c) Upon completion of installation and backfill, the contractor must demonstrate that the pipe has not deflected more than 5% of the pipe diameter, including manufacturing tolerances.
- (d) HDPE pipe may not be used in Public Right-of-Way or adjacent to a street that has classification as a Collector or higher designation.
- (e) The maximum allowable height of backfill as measured from the top of pipe to finished grade shall be limited to ten feet (10').

12.2.4 HIGH PERFORMANCE POLYPROPYLENE PIPE (HPPP)

Only pipe diameters 15" through 60" pipe will be allowed. High Performance Polypropylene Pipe supplied shall be smooth interior with annular exterior corrugation meeting the requirements of ASTM F2881 for respective diameters.

Pipe shall be joined using bell & spigot joints, meeting the requirements of ASTM F2881. The join shall be watertight according to the requirements of ASTM 3212. Gaskets shall meet the requirements of ASTM F477.

Fittings shall conform to ASTM F2881. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM 3212. Gaskets shall meet the requirements of ASTM F477.

All High Performance Polypropylene Pipe storm sewer shall be installed in accordance with ASTM D2321. Please refer to the HPPP Storm Trench Installation Detail for all other installation requirements.

12.2.5 BEDDING FOR PIPE

- (a) CLASS "B" BEDDING – Suitable material for RCP shall be Class "B" bedding a well-graded crushed stone. When tested by means of laboratory sieves it shall conform to the following requirements: (AASHTO M43, NO. 67 gradation)

SIEVE SIZE	PERCENT PASSING
1 in.	100
¾ in.	90
3/8 in.	20 – 55
No. 4	0 – 10
No. 8	0 – 5

When crushed gravel or stone is used, at least 50 percent, by weight, of the particles retained on the No. 4 sieve and above shall have at least two (2) fractured faces.

- (b) CLASS I OR II BEDDING – Suitable material for HDPE and HPPP shall be Class I or II. The contractor shall provide documentation for material specification to engineer. Fill shall be placed in six (6)-inch lifts with a minimum compaction of 95% per the city standards for both cohesive and cohesion less soils. Unless otherwise noted by the engineer, minimum bedding thickness shall be 6" for all pipe sizes. The

middle 1/3 beneath the pipe invert shall be loosely placed. See ADS's "109 Classes of Embedment and Backfill Materials Detail" for bedding specifications.

12.2.6 TRENCH STABILIZATION MATERIAL

Backfill for unstable subgrade conditions shall be select material as approved by the Engineer. Contractor shall submit a sample and sieve analysis for City Engineer's review and approval prior to delivery of the materials to the site.

12.2.7 CONCRETE MANHOLES

Unless otherwise specified on the plans, or approved by the City Engineer, manholes shall be constructed of precast concrete barrels and cones with cast-in-place concrete bases. Bases may be precast if placed on six inches (6") of compacted gravel bedding extending a minimum of twelve inches (12") around the base or the width of the excavation-whichever is greater. In the event severe groundwater conditions are encountered, the thickness of the gravel bedding below the manhole base shall be increased to twelve inches (12"). Alternate construction methods may be required as approved by the Engineer on a case-by-case basis. The concrete channel and bench within precast bases shall be poured on site after the storm sewer pipe is set to grade. Where possible, manhole channel shall be storm sewer pipe with the upper portion removed. Precast concrete barrels and cones shall conform to ASTM C478 Standard Specifications except that the wall thickness may be either wall A or wall B as described in ASTM C76

Standard Specifications. Provide eccentric cones for all manholes greater than six feet (6') deep, and flat lids for manholes six feet (6') deep or less as shown on the drawings. Manholes shall conform to the Standard Details shown on the plans. Concrete used in the construction of all storm sewer structures shall conform to those portions of ARTICLE 4 – CONCRETE and ARTICLE 5 – STRUCTURAL CONCRETE, which are applicable.

All joints in the manhole barrel, cone, grade adjustment rings, and flat top sections shall be sealed with a preformed flexible plastic sealing compound conforming to Federal Specification SS-S-00210 (GSA-FS6). All joint surfaces shall be cleaned prior to applying the sealant. The outside of the manhole joints shall be wrapped with a butyl adhesive tape sealant that conforms to Federal Specification SS-S-00210 (GSA-FS6). The eccentric cone section shall be situated so that the slope of the cone section is pointing toward the downstream direction.

All pipe penetrations shall be an approved flexible connection, mechanical seal, water stop, or non-shrink grout to reduce infiltration and exfiltration. When grouting is necessary at a water stop connection, non-shrink grout shall be used.

Manholes are required whenever there is a change in size, direction, elevation, grade, or where there is a junction of two or more drains. A manhole may be required at the beginning and the end of the curved section of storm drain. The maximum spacing between manholes is 500 feet for pipes with a vertical dimension of 42 inches and larger, and 400 feet for pipes with a diameter of less than 42 inches. The required manhole size shall be in accordance with values shown below:

Storm Drain Diameter (inches)	Manhole Diameter (feet)
15 to 18	4
>18 to <42	5
42 to 54	6
Larger than 54	Appropriate manhole size from CDOT Standard Plan No. M-604-20

Larger manhole diameters or a junction structure may be required when large diameter pipe alignments are not straight through manholes or when more than one storm drain line goes through the manhole. A special structure is required for 42-inch or larger pipe when the angle of deflection is more than 45 degrees.

12.2.8 INLETS

Inlets (Catch Basins) shall be constructed of cast-in-place concrete in accordance with the standard detail of the type and size shown on the drawings. Precast concrete inlets may be used when approved by the Engineer with the added requirements shown on the "Pre-Cast Inlet Detail". Shop drawings for all precast inlets must be submitted to the Engineer for approval prior to installation. If differing site conditions require modifications to the precast inlet, the cost to modify or replace the inlet will be borne solely by the contractor. Inlets fabricated prior to the completion of the inlet piping will be at the contractor's risk.

The standard inlets permitted for use in the city are provided in the below:

Standard Inlet Types in City of Pueblo	
Inlet Type	Use Permitted
CDOT Type R Curb Opening	All street types
Slotted Inlet Parallel to Flow	Streets or open areas
CDOT Type D	Streets or open areas
CDOT Type C Grate	All streets with a roadside or median ditch
CDOT/Denver 13 Valley Grate	Alleys or drives with a valley gutter (private areas only)
Denver No. 16 Combination	All street types

The City may consider other inlet types for retrofit projects if the applicant demonstrates that the City's standard inlet types are unsuitable. The use of inlet types that are not listed in the Table above will require a variance.

Further guidance and requirements are provided in the *City of Pueblo Drainage Criteria Manual, April 2023*.

12.2.9 MANHOLE RING AND COVER ADJUSTMENT

- (a) **CONCRETE GRADE RINGS.** Reinforced concrete grade rings may be used in the adjustment of manhole rings. Grade rings shall have a minimum thickness of two inches (2") and maximum thickness of six inches (6"). Total adjustment height shall not exceed the tolerances as shown on the Standard Details.
- (b) **HIGH DENSITY POLYETHYLENE (HDPE) GRADE RINGS.** High Density Polyethylene grade rings may be used in the adjustment of manhole rings. Grade rings shall be rated for HS-20 loading. Total adjustment height shall not exceed the tolerances as shown on the Standard Details.

12.2.10 CASTINGS AND MANHOLE RING & COVERS

Iron castings shall conform to the requirements of AASHTO M306. Gray iron used in the casting shall conform to AASHTO M105, Class 35B, unless otherwise specified.

Castings shall be boldly filleted at angles and the risers shall be sharp and perfect. Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes or other defects in positions affecting their strength for services intended. The ring and covers for manholes and all storm sewer appurtenances shall be straight and shall fit properly together so that traffic will not cause them to rattle. Rough spots, which prevent a suitable fitting, shall be removed by grinding. Manhole castings shall be Neenah R-1706, Deeter 1258, East Jordan Ironworks 2430 or approved equal. The informational logo "No Dumping / Drains to River" shall be cast on the covers. Other castings shall be as shown on the Standard Details. See City Standard Details for additional information.

12.2.11 RIPRAP

Riprap shall consist of hard, dense, sound, rough fractured stone as nearly cubical as practicable. Thin slab type stones and flaking rock shall not be used. The stone shall have a specific gravity of at least 2.5. Concrete rubble is not acceptable for use as rip rap unless approved by the Engineer.

Stones shall be well graded in order that the voids can be filled. At least fifty percent (50%) of the mass shall be stones equal to or larger than the stone size called for on the plans. Stone size shall not be larger than the thickness of the riprap layer.

Riprap shall be placed to conform to the plan details. The larger size stones composing the riprap material shall be placed first and roughly arranged in close contact. The spaces between the larger stones shall then be filled with smaller stone of suitable size, so placed as to leave the surface evenly stepped, conforming to the contour required. The material may be machine placed with sufficient hand work to accomplish requirements of this specification.

Excavation for riprap shall be made to a neat line. Allowance will not be made for work outside of the neat line.

All riprap shall require filter fabric as specified in section 12.2.12 FILTER FABRIC.

12.2.12 FILTER MATERIAL

Class A filter material shall consist of free draining sand, gravel, or crushed stone. The material shall be uniformly graded from coarse to fine and shall meet the following gradation requirements:

SIEVE SIZE	PERCENT PASSING
3"	100
3/4"	20-90
No. 4	0-20
No. 200	0-3

12.2.13 FILTER FABRIC

Filter fabric shall be a nonwoven polypropylene material conforming to the minimum performance specifications outlined below and designed for use under riprap. Acceptable products are Supac 4NP manufactured by Phillips 66, 0401T manufactured by Advanced Drainage Systems, Inc., or an approved equal.

Min. Thickness (mils) ASTM D1777	40
Min. Grab Strength (md/cd, %) ASTM D4632	50
Min. Grab Elongation (md/cd, %) ASTM D4632	50
Min. Burst Strength (psi) ASTM D3786	155
Min. Puncture Strength (lbf) ASTM D4833	55
Min. Permeability (cm/sec) ASTM D4491	0.2
Max. A.O.S. (Std. Sieve) ASTM D4751	35

12.2.14 TRACER WIRE

Refer to Standard Detail Drawings SD31 thru SD36.

12.3 CONSTRUCTION REQUIREMENTS

12.3.1 WATER LINE AND SANITARY SEWER CROSSINGS

Where storm sewer mains cross water mains, sanitary sewers or other non-potable lines, the storm sewer pipe shall be a minimum of eighteen inches (18") clear distance vertically below the water main or sanitary sewer. If this clear distance is not feasible, the crossing utility section must be designed and constructed so as to protect the water main or sanitary sewer. Minimum protection shall consist of the installation of an impervious and structural sewer. For example:

(a) **REINFORCED CONCRETE ENCASEMENT.** The sanitary sewer pipe shall be reinforced with a reinforced concrete encasement. The encasement shall be at least six inches (6") thick and extend a distance of ten feet (10') either side of the water main or storm sewer. See Section 11.3.11 - PIPE BEDDING LIMITS, REINFORCED CONCRETE ENCASEMENT.

(b) **JOINT CENTERING.** The sewer shall be constructed such that one length of pipe, at least eighteen feet (18') long, shall be centered over the water main or storm sewer. Joints between the sewer pipe and special length pipe (18' section of pipe) shall be encased in a concrete collar at least six inches (6") thick and extending at least six inches (6") either side of the joint.

In all cases, proper soil compaction, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of either pipe.

12.3.2 RAILROAD AND HIGHWAY CROSSINGS

At all railroad and highway crossings extreme care shall be exercised to safeguard life and property. All storm sewer work under and adjacent to railroads and highways shall be accomplished to the satisfaction of a representative of the railroad company and/or Colorado Department of Transportation (CDOT) and the Engineer. The Contractor shall obtain at his own expense all permits, bonds, and insurances necessary for the execution of his work, and/or required by the appropriate railroad or CDOT. Contractor shall submit a plan for approval for crossing railroads or highways unless otherwise shown on drawings.

12.3.3 EXCAVATION - GENERAL

All excavation for storm sewer and/or manhole construction will be considered as unclassified excavation. Excavation shall conform to ARTICLE 7 – EARTHWORK, Section 7.3.2 General Excavation.

12.3.4 TRENCH EXCAVATION - WIDTH AND DEPTH

The width of the trench shall provide adequate space for workers to place, join the pipe, and bed the pipe properly.

The minimum width of the trench from a plane six inches (6") below the pipe to a plane twelve inches (12") above the pipe shall be a minimum of nine inches (9") clear on each side from the undisturbed edge of the trench wall to the outside diameter of the pipe. This minimum trench width shall also be used for measurement of trenches in rock.

In order to protect the pipe from external loads in excess of those used in the design of the pipe, it is necessary to limit the width of the lower portion of the trench below an elevation 12 inches above the top of the installed pipe to 6" below the invert of the pipe. The trench from a plane six inches (6") below the pipe to a plane twelve inches (12") above the pipe shall be excavated so the trench walls are as close to vertical as possible. The maximum trench width within this zone will not be limited but shall be kept as narrow as possible.

When using a movable trench support, care shall be exercised not to disturb the pipe location, jointing and bedding material. Any voids left in the bedding material by support removal shall be carefully filled with additional bedding material and properly tamped. The width and slope of the trench from a plane twelve inches (12") above the pipe to the top of the ground shall be determined by the Contractor. Considering factors shall include, but not be limited to; all safety requirements; type of material being excavated; equipment used; widths of dedicated right-of-ways; and adjacent structures, property, and utilities.

The trench bottom shall be constructed to provide a firm, stable and uniform support for the full length of the pipe. Except in ledge rock, water bearing earth, or where a special pipe bedding is called for in the contract documents, the rough excavation of trenches shall extend no less than six inches (6") below the bottom of the pipe.

Correction of a trench grade that is too low shall be done by compacting select material of the types designated by the Engineer, over the entire width of the trench to 95% of AASHTO T99. Such work required due to over excavation will not be included for payment.

Trench excavation shall meet the requirements of ARTICLE 7 – EARTHWORK, SECTION 7.3.2(5) TRENCH EXCAVATION.

12.3.5 HANDLING EXCAVATED MATERIAL

The material excavated from trenches that is suitable for backfill shall be kept so as not to significantly alter drainage flow patterns, endanger the work and to be of as little inconvenience as possible to the traveling public and the occupants of the abutting properties. Free access must be maintained at all times to driveways, fire hydrants, water valves, gas valves, existing manholes, etc., in the vicinity of the work.

Where lines are located in alleys or in any other case where the Contractor proposes to deposit material on private property, written permission shall be obtained from the owner of the property prior to placing any material on the property. The Contractor shall be held responsible for any damage to private property.

Materials encountered during clearing of the right-of-way and excavation of the trench such as rubbish, organic material, abandoned foundations and any other material which are not satisfactory for use as backfill in the opinion of the Engineer, shall be removed from the site and disposed of by the Contractor at his own expense.

12.3.6 UNSTABLE SUBGRADE

Where unstable subgrade conditions are encountered, as determined by the Engineer, the Contractor may be required to excavate below subgrade elevation and backfill the unstable area with material as per Section 12.2.6 - TRENCH STABILIZATION MATERIAL. The material approved by the Engineer shall be used to an elevation six inches (6") below the bottom of the pipe. The extra depth of excavation and backfill shall be as ordered by the Engineer, and only when ordered by the Engineer.

If the unstable condition is a result of the Contractor not properly protecting his work from surface water infiltration, or from sewer or water lines damaged or broken by the Contractor, the cost shall be borne by the Contractor. If the unstable soil condition is the result of ground water infiltration and other causes beyond the control of the Contractor, the extra foundation material ordered by the Engineer will be paid for.

Unstable subgrade shall meet the requirements of ARTICLE 7 – EARTHWORK, SECTION 7.3.2(5)(c) REMOVAL OF UNSTABLE MATERIAL.

12.3.7 TRENCHES IN ROCK

Rock will be defined as any naturally occurring or manmade material in such a form that it cannot be readily removed using the equivalent of a 165hp/40,000lb operating weight track-type tractor (bulldozer) with a ripper or a 188hp/63,000lb operating weight hydraulic excavator (crawler mounted backhoe) with “rock teeth” without a significant loss of production. It also includes boulders exceeding one-half (½) cubic yard in volume.

Whenever rock material is encountered in an excavation, the Contractor shall immediately notify the Engineer for field verification. The Engineer shall measure and document the limits of the rock prior to excavation. Any rock removed prior to notification will not be considered for payment. After rock has been measured, trenching shall continue by such means as may be necessary, to a depth of six inches (6") below the outside bottom of the pipe, and to a width in conformance to Section 12.3.4 - TRENCH EXCAVATION - WIDTH & DEPTH.

Blasting for rock excavation will only be allowed with the written permission from the Engineer and Fire Chief. The Contractor shall exercise the utmost care to protect the public from harm and to avoid property damage. Blasting shall be done by a State licensed blaster. The Contractor shall comply with all laws, ordinances, insurance, bonding, and applicable safety code requirements and regulations and shall be responsible for all damage caused by the blasting operations. Signals warning persons of danger shall be given before any blast.

Blasting shall be controlled as not to make any excavation unduly large or irregular. Excessive blasting or overshooting shall not be permitted. The Engineer shall have authority to order any method of blasting discontinued which leads to overshooting or is dangerous to the public or destructive to property or to natural features. Approved blasting blankets shall be used for all blasting.

12.3.8 QUICKSAND AND GROUNDWATER INFILTRATION

Should running sand, quicksand or groundwater be encountered, the work shall be pushed with utmost vigor. Groundwater encountered in trench or manhole excavations shall be drained to sumps, through sub-drains, or by other methods to keep the water level below the bottom of the bell of the pipe while joints are being made. Dispose of the water in a manner to prevent damage to adjacent property. Drainage of groundwater through any sanitary sewer pipeline is prohibited. Drainage of ground water during construction through any storm sewer pipeline will be allowed. All dewatering and trench stabilization methods and type of equipment used shall be approved by the Engineer and in compliance with the City's MS4 permit.

If dewatering and trench stabilization is required as a result of the Contractor not properly protecting his work from surface water infiltration, or from sewer or water lines damaged or broken by the Contractor, the cost shall be borne by the Contractor. In the event such work is required through no fault of the Contractor, it shall be considered extra work and a price shall be negotiated.

12.3.9 EXCAVATION FOR STRUCTURES

Excavation for manholes, inlets, vaults, and miscellaneous structures shall consist of the removal of all material necessary for construction of the work in conformity with the plans and these specifications.

If rock is encountered, the excavation shall be done in such a manner as to allow the rock to be exposed and prepared for receiving the concrete. All loose and disintegrated rock or thin strata shall be stripped to a clean bed acceptable to the Engineer and in conformance to all applicable items as described in Section 12.3.7 - TRENCHES IN ROCK.

Whenever the footing is to rest on any excavated surface other than rock, special care shall be

taken not to disturb the bottom of the excavation (subgrade), and the final finishing of the surface shall not be done until just before the footing is to be placed. Correction of any over excavated areas shall be at the Contractor's sole expense.

Whenever the subgrade soil is not sufficiently firm, the Contractor is to furnish and compact, according to the direction of the Engineer, select material, as may be required and in conformance to all applicable items as described in Section 12.3.6 - UNSTABLE SUBGRADE.

After each excavation is completed, the Contractor shall notify the Engineer, who shall make an inspection of the depth of the excavation and character of the foundation material. No concrete shall be placed until after the Engineer has approved the depth of the excavation and character of the foundation material.

An Excavation Permit is required for any underground work within the City of Pueblo. The "no-fee" permit shall be obtained from the City Streets Division at 211 E. "D" Street. Any work placed without benefit of this permit will not be paid for.

12.3.10 PIPE BEDDING LIMITS

Unless stated otherwise on the plans or details or ordered by the Engineer, RCP pipe shall be bedded in accordance with Class "B" bedding as described below and HPPP & HDPE pipe shall be bedded in accordance with Class "I" or "II" bedding as described below. All classes of bedding shall be properly tamped around the lower half of the pipe (haunches) and horizontally away from the pipe in both directions to the undisturbed trench walls.

- (a) CLASS "B" CRADLE BEDDING. The sewer pipe shall be set on a minimum of six inches (6") of Class "B" bedding material carefully shaped to fit the lower part of the conduit exterior for a width of at least 60% of the pipe breadth and for the entire pipe length. After setting the sewer pipe, Class "B" bedding shall be added and properly tamped around the lower half of the pipe (haunches) for the full width of the trench, and the bedding shall be consolidated carefully without disturbing the pipe alignment or grade. Additional Class "B" bedding material shall be added up to the spring line of the pipe.
- (b) CLASS I or II BEDDING. The storm sewer pipe shall be set on a minimum of six inches (6") of Class "I" or "II" bedding material carefully shaped to fit the lower part of the conduit exterior for a width of at least 60% of the pipe breadth and for the entire pipe length. After setting the storm sewer pipe, Class "I" or "II" bedding shall be added and properly tamped around the lower half of the pipe (haunches) for the full width of the trench, and the bedding shall be consolidated carefully without disturbing the pipe alignment or grade. Additional Class "I" or "II" bedding material shall be added up to a minimum of twelve inches (12") above the top of the pipe for the full width of the trench.

12.3.11 PIPE LAYING

Before any pipe laying shall occur cutsheets shall be submitted to the Stormwater Utility Division for approval. No pipe laying shall occur prior to cutsheet approval. Cutsheets shall match the approved subdivision construction drawings on file with the City. See below for further cutsheet requirements:

- a) 25 ft stake intervals

- b) Stationing matching approved plans
- c) Field Stationing
- d) Grade
- e) Cut/Fill
- f) Slope
- g) Description of pipe section

Pipe shall be protected during handling against impact shocks and free fall. Proper methods shall be used for handling and placing pipe to avoid spalling or breaking and to avoid unnecessary disturbance of the bedding surface in the trench bottom. Pipe shall be kept clean at all times and no pipe shall be used in the work which does not conform to these specifications. Pipes shall be laid to a true line and at uniform rates of grade between manholes and/or inlets as shown on the plans. The laying of the pipe in prepared trenches shall commence at the lowest point with the spigot ends pointing in the direction of flow. No pipe shall be laid in water or when trench conditions are unsuitable for such work.

The Contractor shall take every precaution necessary to prevent dirt, debris or surface water from entering the existing lines or new construction.

The Contractor shall submit a plan for handling existing storm sewer flows while rehabilitating the pipe at the pre-construction meeting for approval by the City. The bypass plan must be designed in accordance with the approved traffic control plans and identify the location of any pumping equipment, temporary discharge piping, pumping and discharge manholes, redundant pumps and piping, the location of nearby waterways or drainages, and the method for diverting runoff around the site. The Contractor shall be responsible to obtain all existing flow measurements in the storm sewer to determine a bypass plan. Precautions must be taken to ensure that storm sewer flow control operations do not cause damage to property being served by the storm sewers involved. Bypass pumping will not be allowed during nonworking hours unless authorized by the Engineer. When 24-hour pumping operations have been approved by the Engineer in residential areas, attenuated pumps will be required to minimize noise disturbance. The Contractor shall provide 100% redundancy on any 24-hour pumping operation, near any waterways or any site deemed necessary by the Engineer. Bypass piping shall be placed in trenches and covered with temporary pavement or metal traffic covers when traffic conditions dictate the need for protection of the piping unless otherwise directed by the Engineer. The Engineer may specify additional design requirements based on specific site conditions.

Each bypass pumping system shall be hydrostatically tested using potable water prior to use. Unless otherwise indicated, water for testing bypass pipelines shall be furnished by the Contractor. The bypass pumping system may require air release valves to release air that may become trapped in the bypass system piping. The bypass pumping system shall be filled at a rate which will not cause any surges or exceed the rate at which air can be released through the air valves. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. Once the system has been successfully filled and all air purged, the piping system exclusive of the pump(s) shall be pressurized to 150% of the calculated working pressure, or 40 psi, whichever is greater, measured at the lowest point along the alignment, and hydrostatically tested for a minimum of 30 minutes. During the test, the entire system shall be visually inspected for leaks and monitored for pressure drop. Any leaks encountered shall be repaired at the Contractors cost, and the hydrostatic pressure test restarted until the system successfully passes the test. Potable water used during the test shall be discharged to the stormwater system at a controlled rate to prevent surcharging of the

stormwater system.

If the City must provide personnel and equipment to minimize damages, in the event of any failure of the Contractor's storm sewer flow control operations, the Contractor shall be liable for all costs incurred by the City. The Contractor will be charged \$550 per hour that the City of Pueblo crews are onsite, which will be deducted from the amount of the Contractor's final payment.

- a) **ALIGNMENT.** All pipe shall be laid to the lines and grades given by the Engineer with joints close and even, butting all around. They shall be carefully centered and shall not deviate more than one inch (1") from line so that when laid will form a storm sewer with a uniform invert and a straight alignment unless a specified curve alignment is shown on the plans.

The grade of the pipe shall be obtained by the use of batter boards and a "top line," batter boards with a double string line having a minimum of four feet (4') separation, a laser beam, or by the use of surveying instruments approved by the Engineer. The grade shall not be obtained by placing a carpenter's level on individual pipes.

If batter boards are used, the Contractor shall at all times where pipe laying is in progress, maintain batter boards for a distance covering at least three grade stakes. The elevation of the batter boards shall be determined from the depth of cut as given by the Engineer, and the Contractor shall keep on each crew a person whose duty it shall be to see that the batter boards are in proper place at all times. It is not intended that these requirements shall make it necessary for the Contractor to keep a person especially for this purpose, but to provide that a competent person shall be with each crew at all times whose duty it shall be to attend to the placing of the batter boards and the giving of grades to the pipe layer.

If a method other than batter boards is used, the instrument used shall be operated continuously under the supervision of a qualified foreman or superintendent. The pipe grade shall be checked by an alternate method at fifty-foot (50') intervals and upon request of the Engineer.

- b) **VERTICAL TOLERANCE.**

In no case shall a section of pipe be accepted if it does not possess a positive grade (i.e., no flat or adverse sections). Any pipe not within 0.50% of the existing or designed slope shall be re-laid.

- c) **JOINTING PIPE.** All pipe joints shall be made in the manner and under the conditions described under the various types of joints for the work. Preparatory to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned. All pipe joints shall be watertight when completed.

(1) **HPPP & HPDE JOINTS** – Pipe shall be joined using a bell & spigot joint meeting the requirements of ASTM F2881. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477

- (i) Mechanical methods shall be employed, if necessary, to pull or push the pipe together with sufficient force to compress the gasket sufficiently to make a watertight joint.

(2) **REINFORCED CONCRETE PIPE (RCP) JOINTS** – Pipe joints shall conform with ASTM C990-09.

- (3) OTHER TYPE JOINTS - If any other type of joint is proposed to be used, it shall conform to the requirements of these specifications that apply, and the Contractor shall obtain written approval of the Engineer for its use. Connections to unlike materials must also be pre-approved, in writing, and may require Class "A" bedding (concrete cradle) at the connection joint. When joining pipe sections via a coupler, a Fernco Strong Back RC Series Repair Coupling or an approved equal shielded coupler shall be used to connect the existing to the new sewer pipe.

d) TRACER WIRE – Refer to Standard Detail Drawings SD 32 – SD 39.

12.3.12 BACKFILLING

The line, grade, joints and bedding of the storm sewer shall be inspected and approved by the Engineer before backfilling operations commence.

After the initial backfill (bedding) has been carefully placed in the pipe zone to at least one foot (1') above the top of the pipe, the remainder of the trench shall be backfilled and compacted. Depositing of the backfill material shall be done so that impact of falling material will not damage the pipe or structures.

Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or improvements installed under the contract. The Contractor shall make their own determination in this regard.

The Contractor shall employ whatever equipment and methods that are necessary to obtain the moisture and required density. All soils within the compaction limits shall be compacted to ninety-five percent (95%) of the maximum dry density as defined by AASHTO T99 (Standard Proctor). Moisture content for all compacted soils shall be within plus or minus 2% of optimum unless field observation verifies that the soils are unstable at lesser moisture contents. In those cases, the Engineer shall establish a minimum moisture content.

On all storm sewer installations, compaction tests shall be made by an approved independent testing laboratory and shall identify the location and depth of the test, the date of the test, the maximum Standard Proctor density and optimum moisture content of the soil and give the percent of compaction and moisture content of the backfill material at the test location. Compaction tests shall be made at a depth of three feet (3') above the top of the pipe and at two-foot (2') intervals in depth, up to and including the surface. Testing shall be done at a minimum of one location for every 250 feet of main line trench or fraction thereof and at every manhole or similar structure. An additional compaction test is required for each inlet pipe run and may be taken along the pipe or at the inlet at the discretion of the Engineer.

All test locations shall be randomly spaced as directed by the Engineer. These tests shall be made at the expense of the Contractor and are intended to give the Contractor and City an indication of the effectiveness of the compaction procedure and shall not relieve the Contractor of any provisions of this specification. **All Compaction tests shall be submitted and accepted by the City prior to construction of any surface improvements.**

If any compaction test should fail to meet the requirements of this section, at least two (2) additional locations shall be tested along the trench, at locations designated by the Engineer, to

determine the extent of the non-compliance. After the extent of non-compliance has been determined, that section of trench shall be re-compacted and retested at a minimum of two (2) locations as directed by the Engineer. If the failure occurs at a lateral, another lateral shall be tested in addition to the extent of non-compliance testing requirements.

In the event of settlement or subsidence of a particular excavation or any part thereof, the Contractor shall be responsible for all repaving, overlay and repair costs occasioned thereby for a period of two (2) years after the project/subdivision acceptance date.

If requested by the Contractor/Developer, and written permission is granted by the City Engineer, backfill for utility trenches may be consolidated using water induced settlement techniques (jetting/puddling). This method of trench backfill consolidation shall only be allowed in those special locations where a failure history exists for trenches using conventional engineered controlled fill. As a condition of permission to use jetting/puddling, the Contractor/Developer must agree in writing to provide a full and complete three (3) year warranty from the final acceptance date, that shall include repair of any surface amenities to the complete satisfaction of the City which may include a full width asphaltic overlay if warranted.

Where backfill for utility trenches within the roadway section are consolidated using jetting/puddling, the moisture and density requirements within the trench compaction limits stated above shall not apply; however, the compaction limits for the finished roadway subgrade as outlined under ARTICLE 7 - EARTHWORK shall apply.

12.3.13 MANHOLE CONSTRUCTION AND ADJUSTMENT

All provisions of Section 11.3.13 are applicable except that drop manholes are not required unless specified on the drawings.

Manhole bases and barrels shall be constructed of the material as specified in Section 12.2 - MATERIALS, unless otherwise specified on the plans or by the Engineer. Contractor shall wait a minimum of twenty-four (24) hours before setting manhole barrel sections, on cast-in-place bases. No backfilling shall commence around manhole bases until the concrete has either attained a compressive strength of 2,000 pounds per square inch, or seven (7) days have elapsed.

The flow channel shall be made to conform in slope and shape to that of the storm sewer pipe and wherever possible, the lower one-half of the storm sewer pipe shall be used for the invert of the open flow channel. At intersections with other lines, channels shall be formed with a sweeping curve to minimize turbulence.

Unless otherwise specified on the plans or specifications, all manhole channels shall be constructed with a minimum elevation drop as shown:

HORIZONTAL DEFLECTION ANGLE OF SEWER PIPE AT MANHOLE	MINIMUM DROP
0°	0.10'
Between 0° & 45°	0.20'
45° to 90°	0.30'

Changes in direction at intersections of sewers shall not be greater than 90 degrees.

Connection to an existing manhole shall be made so the inlet flowline is above the existing concrete manhole base. When connection to an existing manhole is allowed, the contractor shall cut into the existing manhole to install the new sewer pipe and provide a water stop and non-shrink grout for a watertight connection. A concrete channel shall be formed within the existing manhole to provide a smooth discharge from the new pipe to the existing channel.

For vertical drops greater than 8 feet, special designs are required that address potential cavitation and energy dissipation. These situations will require special review. See Design and Construction of Urban Stormwater Management Systems (WEF and ASCE 1992) for guidelines for drop shaft structures.

All manhole ring and covers in streets to be paved shall initially be constructed to a height to top of subgrade or twelve inches (12") below the proposed finished pavement grade, whichever is less. When adjusted to a finished pavement grade, the manhole ring and cover shall be so constructed that the top of the manhole ring and cover will be flush ($\pm 1/4"$) with the replacement pavement or the grade established by the Engineer, and shall have at least one (1) four inch (4") thick precast concrete or high density polyethylene adjustment rings. Adjustment rings shall not exceed twelve inches (12") in height. High density polyethylene adjustment rings must be pre-approved by the Engineer before use and be rated for HS-20 loading.

Contractor shall salvage rings and covers removed from existing manholes. Rings and covers shall become the property of the City.

12.3.14 TESTING AND INSPECTION

Replace section 11.3.15 - TESTING AND INSPECTION with the following:

Prior to acceptance or payment, the Contractor must provide compaction test results to the City for the backfill compaction tests required in Section 12.3.12 - BACKFILLING.

All storm sewers will be inspected by closed-circuit television, by the City, after other utility installations and acceptance of all testing, but prior to construction of surface improvements over the new storm sewer unless otherwise authorized by the City. The Contractor shall thoroughly clean all storm sewers prior to televising by the City. The City requires five (5) working days advance notice for scheduling the televising and will be allowed five (5) working days to complete the television inspection.

At the City's request, deflection testing by use of a mandrel shall be completed for HPPP and HDPE storm sewer pipe by the contractor or independent agency and paid for by the contractor or owner/developer. Deflection testing shall be done prior to paving and not less than thirty days after installation. The maximum allowable deflection shall not exceed five percent (5%) during the testing. Pipes larger than 36" in diameter may be entered and deflection levels measured directly. Pipe shall be removed, replaced, and retested if maximum deflection exceeds five percent of the pipe's internal diameter.

Pipe shall be inspected by closed-circuit television by the City of Pueblo prior to the end of the two-year warranty period. Any pipe showing damage that could impact the functionality of the pipe e.g., joint disconnection, pipe cracking, gouges, warping, ponding shall be replaced by the Contractor, at their expense. A deflection test may also be performed in which case if excess of

five percent deflection is found the pipe shall be removed and replaced by the Contractor, at their expense.

Acceptance of the pipe will be granted by the Engineer only after all defects such as poor alignment, mislaid pipe, and broken or damaged pipe have been remedied, and the prescribed testing has been satisfactorily completed. Acceptance of the pipe does not relieve the Contractor of the responsibilities imposed by all other sections of these specifications.

12.3.15 CLEANING SEWERS AND APPURTENANCES

The storm sewers and all appurtenances shall be thoroughly cleaned at the Contractors expense under the direction and to the satisfaction of the Engineer before final acceptance of the work. In the event the City has to perform any cleaning, the Contractor will be charged \$550 per hour for the cost of labor, equipment, and materials.

12.3.16 REPLACING SIDEWALKS, CURB AND GUTTER, BASE COURSE, PAVING, ETC.

Where sidewalks, curb and gutter, culverts, etc., are removed within the limits of the work, the Contractor shall compact the backfill as specified under the applicable Article, and shall then replace sidewalks, curb and gutter, culverts, etc., in accordance with prevailing City Specifications for the class of work involved. Sidewalk and curb and gutter removals shall be in accordance with ARTICLE – 4 CONCRETE, Section 4.8.3. and Section 4.8.2. Where grassed areas are encountered, the Contractor shall replace all sod with sod of similar characteristics to that adjacent.

A Concrete Permit is required for all concrete work within the City of Pueblo. A “no fee” Concrete Permit shall be issued by the City Engineering Division for City funded projects. Any concrete work placed without benefit of both permit and inspection by Public Works will not be paid for.

12.3.17 STORM SEWER REHABILITATION SPECIFICATIONS

If any part of a stormwater RCP, HDPE, HPPP, or PVC main or lateral is removed or damaged to facilitate a private utility main installation or replacement, then the stormwater main or lateral must be replaced from the point of damage to the nearest inlet or manhole. If any part of a stormwater Vitrified Clay Pipe (VCP) main or lateral is removed or damaged to facilitate a private utility main installation or replacement, then the entire stormwater main or lateral must be replaced including appurtenant structures that may crumble as a result of the replacement. Metallic pipes, including corrugated metal pipes (CMPs) and cast-iron pipes (CIPs), are subject to corrosion and must be Closed-circuit television (CCTV) inspected by the Stormwater Utility Department to determine the condition of metallic pipes. The condition of the metallic pipe will determine the extent of replacement required. Deviations from this requirement must be approved in writing by the Director of Public Works. In no instance will a patch of the break or a repair sleeve in the stormwater pipe be allowed. The stormwater pipe must be installed at the same grade it was found prior to being disturbed. The Stormwater Utility Department must approve the pipe size and material and perform inspections during installation of the damaged stormwater pipe.

The City of Pueblo maintains a list of qualified contractors who have been through a vetting process and possess the qualifications to perform stormwater point repair projects. Only contractors from this list will be allowed to repair damaged stormwater infrastructure. When a point repair project arises, Stormwater Department staff will evaluate the repairs needed,

determine the unit quantities for the work required and determine which of the qualified contractors would be able to complete the repairs at the lowest cost by using the unit prices provided by each contractor in their bid. The point repair will then be offered to the contractor providing the lowest cost.

Compaction testing shall be performed in accordance with Section 12.3.13 of the City of Pueblo Standard Construction Specifications and Standard Details and testing shall be included for the bedding material.

12.3.18 GRAVEL SURFACED STREETS OR ALLEYS

When trenches are excavated in streets or alleys which have only a gravel surface, Contractor shall replace such surfacing on a compacted backfill with gravel conforming to ARTICLE 6 - AGGREGATE BASE CONSTRUCTION, CLASS 6, equal in depth to that which originally existed or a minimum thickness of two inches (2"). The surface shall conform to the street or alley grade as set by the Engineer. Where the completed surface settles below finished grade, additional gravel base course material shall be placed and compacted immediately to restore the roadbed surface to finished grade and allow drainage.

12.3.19 CONCRETE AND ASPHALT PAVEMENT REMOVAL AND REPLACEMENT

When concrete pavement is removed, the removal shall be to an existing joint or to a sawed joint which is made prior to removal.

The final edges of asphalt removed and replaced shall be along a straight line neatly sawed to a depth which allows the pavement to be removed with no disturbance to the asphalt left in place.

The edges of pavement (either concrete or asphalt) removal and replacement shall extend one foot (1') beyond the edge of the excavation required for pipe installation. The edges of the pavement shall be clean, straight, and free from jagged intrusions and loose pieces. If the edges of the pavement are not straight, the Contractor shall saw cut back to a point where a straight edge can be maintained or overlay the asphalt patch with a minimum of 3x the nominal aggregate size asphaltic overlay extending two feet (2') beyond the edges of the asphalt patch. Concrete or asphalt removed from the trench surface shall not be used in the initial backfill, and Article 12-3-24 all pieces exceeding eight inches (8") in any dimension shall be removed from the site.

If the distance from the lip line of the curb & gutter to the trench is less than 4 feet (4'), all asphalt shall be removed from lip to the trench line.

12.3.20 ASPHALT PAVED STREETS

When trenches for public mains are excavated in existing streets having an asphalt surface, the Contractor shall replace such surfacing as follows:

- (a) Place controlled low strength materials (CLSM) (flowable fill) having a minimum thickness of one (1) foot below the hot asphalt bituminous pavement.
- (b) Place hot bituminous asphalt pavement wearing surface having a minimum compacted thickness equal to the original pavement, or four inches (4"), whichever is greater.

All the foregoing materials and methods of application shall comply with ARTICLE 6 - AGGREGATE BASE CONSTRUCTION and ARTICLE 8 - PAVEMENT.

Outside of trench areas, the Contractor shall restore damaged bituminous surfaced streets to the condition which existed prior to construction. The Contractor shall make these repairs at their own expense if the damage is a result of their operations.

12.3.21 CONCRETE PAVED STREETS

When trenches are excavated in streets constructed of concrete, the Contractor shall replace said concrete with an equivalent concrete pavement. Said concrete pavement shall have a minimum thickness conforming to ARTICLE 8 - PAVEMENT and shall be placed on six inches (6") of Class 6 base conforming to ARTICLE 6 - AGGREGATE BASE CONSTRUCTION.

Outside of trench areas, the Contractor shall restore damaged concrete surfaced streets to the condition which existed prior to construction. The Contractor shall make these repairs at his own expense if the damage is a result of his operations.

12.3.22 CONCRETE CURB AND GUTTER, SIDEWALK, DRIVEWAY, ALLEY PAN AND DIP REMOVAL

Concrete curb and gutter, sidewalks, driveways, alley pans and dips shall be removed to the limits designated by the Engineer. All joints (except expansion joints) shall be saw cut prior to removal unless otherwise directed by the Engineer. Any concrete broken or disturbed by the Contractor outside of the designated limits shall be replaced at the expense of the Contractor at no cost to the project. Sawing shall be considered incidental and subsidiary to the pipeline excavation. See ARTICLE 4 – CONCRETE for additional requirements.

12.3.23 ASPHALT OR CONCRETE UNAVAILABLE OR INCLEMENT WEATHER ON COMPLETION OF BACKFILL

Upon completion of backfill operations, if hot bituminous asphalt or concrete is unavailable or the weather is inclement, a temporary asphalt surface - cold mix or other approved material - having a two inch (2") minimum thickness shall be installed immediately on the surface of the trench, cut, or hole in an asphalt or concrete street, walk, curb and gutter, etc. before the Contractor leaves the excavation site or continues the trench to the next block, intersection, or alley, unless otherwise allowed by the Engineer. Cold mix asphalt and its placement shall be furnished at the Contractor's expense and shall not be a pay item.

As soon as hot bituminous asphalt or concrete becomes available, the temporary asphalt surface shall be removed and replaced with permanent asphalt or concrete in accordance with prevailing City construction and material specifications for the class of work involved by the Contractor. See ARTICLE 8 – PAVEMENT for additional requirements.

12.4 METHOD OF MEASUREMENT

Method of measurement for storm sewer construction shall be as follows:

- (a) Inlets and Manholes - Each inlet or manhole constructed will be counted for payment by the contract unit.
- (b) Storm Sewer Pipe - The length of storm sewer pipe of various sizes and types shall be

measured in feet along the centerline of acceptably laid storm sewer from inside of wall to inside of wall of manholes and/or inlets, or to end of pipe (excluding flared end sections).

- (c) Riprap - Shall be measured by the ton as evidenced by weight tickets or by the cubic yard as measured in the field. Method shall be determined by the bid schedule.
- (d) Flared End Section - Flared end sections shall be counted and paid for as each unit installed.

12.5 BASIS OF PAYMENT

Basis of payment for storm sewer construction shall be as follows:

- (a) Inlets and Manholes - Payment for inlets and manholes shall be full compensation to construct the complete unit in accordance with these specifications and the Standard Details. It shall include the ring and cover castings, concrete adjustment rings or brick, and all items incidental to the manhole or inlet.
- (b) Storm sewer pipe - Storm sewer pipe will be paid for at the contract unit price for the various sizes and types, installed complete in place. Said price shall include all joint materials, plugs, and other materials to construct in accordance with these specifications, and the standard details. It shall include but not be limited to all costs associated with excavation, shoring, bedding, pipe placement, backfill, compaction, water for compaction, clean-up, landscape restoration, etc. No payment will be made for pipe until backfilling, compaction tests, deflection (go-nogo) test have been accepted by the Engineer.
- (c) Riprap - Payment for this item shall be full compensation for all labor and material to furnish and install the riprap, including filter fabric and filter material, and excavation, in accordance with these specifications. Class A filter material shall be included in the bid price for riprap and not paid for separately.
- (d) Flared End Section - Payment for this item shall be full compensation for all labor and materials to furnish and install the flared end section, including excavation, backfill, coupling adapters and necessary grading to match to a channel or ditch flowline.