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Groundwater Underdrains

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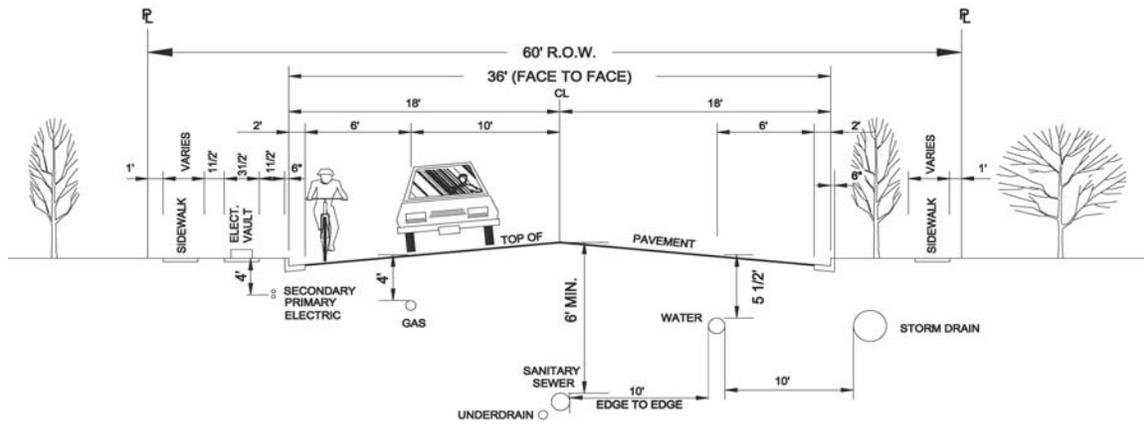
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**STANDARD SPECIFICATIONS FOR
THE INSTALLATION OF SANITARY SEWER MAINS AND SERVICES**

CHAPTER 13

GROUNDWATER UNDERDRAINS



**TYPICAL CROSS SECTION
UTILITIES LOCATION
N.T.S.**

This chapter is to be read in conjunction with the current version of the City of Colorado Springs Subdivision Policy Manual (www.springsgov.com – City Engineering) and City Code Chapter 3.9 – Groundwater Underdrains.

13.01 General.

When required, these standards establish design criteria for groundwater underdrains **within a public right-of-way or public drainage easement.**

The purpose of the underdrain system is to provide a method for conveying subterranean groundwater from around a structure/building foundation via gravity to an acceptable discharge point in a drainage channel or storm drain. All new residential developments within the City of Colorado Springs shall install a gravity underdrain system, unless a variance is given by the City of Colorado Springs, Engineering Division. Foundation perimeter drains, whether inside or outside the foundation walls, shall be connected by gravity to the underdrain main line via an underdrain service line.

Only subterranean groundwater may be discharged into the underdrain system. No person(s) shall make connection of sources of surface runoff to an underdrain or building drain which in turn is connected directly or indirectly to an underdrain system. No person shall discharge or cause to be discharged any stormwater, surface water, roof runoff, cooling water, domestic or industrial wastewater, or industrial process waters of any kind to the underdrain system. No person shall contribute or cause to be contributed, directly or indirectly, any pollutant or wastewater to the underdrain system.

Residential - Separate and independent underdrain service line taps shall be provided for every structurally independent single-family detached dwelling unit unless a variance from this requirement has been granted by the City of Colorado Springs. Single family residential dwelling units include duplexes and triplexes.

Non-Residential - A non-single family residential construction shall only connect to an underdrain main within a public right of way subsequent to obtaining a State of Colorado General Permit for Discharges Associated with Subterranean Dewatering or Well Development. The property owner is responsible for permit compliance and renewal. Each non-residential underdrain tap connecting to a public underdrain main or to the stormwater system will also require a revocable permit issued by the City of Colorado Springs. The number and size of underdrain service line taps required to serve non-residential buildings will be as reviewed and approved by the City of Colorado Springs Engineering Division.

13.02 Location.

When co-located with the sanitary sewer, groundwater underdrain mains shall be located parallel to the sanitary sewer pipeline, on the south and west side of the sanitary sewer line with sufficient separation to allow proper compaction and consolidation of bedding and backfill material. All public underdrain mains and outfalls shall be within a public right of way or public drainage easement. (Reference Wastewater Construction Drawing C-5-6)

Unsurfaced Areas. All surface cuts shall be, as a minimum required, restored to a condition equal to that prior to construction. All streets shall be restored in accordance with the regulations and requirements of the agency having control or jurisdiction over the street, roadway or right-of-way. An access drive shall be constructed within a thirty (30') foot wide easement with a sixteen (16') foot wide all weather surface such as asphalt paving, concrete paving or an adequate gravel base. The sixteen (16') foot drive shall be designed to carry HS-20 loading and compacted to City of Colorado Springs, Engineering Standards. A turnaround per Spring Utilities standards is required when the back-up distance for any maintenance vehicle exceeds one (100') hundred feet in length. (Reference Water Construction Detail A 7-3) The maximum grade allowed at any point on the access road is 10%, with a maximum cross-slope for the access road of 2%.

13.03 Sizing Criteria.

The size and extent of groundwater underdrains shall be established by a Professional Engineer, registered in the State of Colorado. The minimum size of a main line groundwater underdrain system shall be six (6") inches and three (3") inches in diameter for the service line. The City of Colorado Springs/Utilities can request a copy of the site geologic hazards report from the engineer to determine if a different size or type of pipe is to be used on a project due to site conditions. The design shall include consideration of existing and potential future upstream and downstream connected underdrain mains within the drainage area.

13.04 Approval.

The underdrain system concept plan shall be included on the Development Plan and on the master utility facilities plan. The City's Engineering Division shall approve the proposed outfalls. Refer to section 13.08 if a variance is requested to the requirement for installation of an underdrain system.

The groundwater underdrain utility system plan, showing the underdrain system within the Subdivision and outfall locations, shall be submitted to Springs Utilities along with the sanitary sewer plan and profiles for approval. Springs Utilities will review the proposed groundwater underdrain system design and location in compliance with these standards and specifications, and inspect the installation. Groundwater underdrain main lines that extend outside of street right-of-way for outfall must be located within a public drainage easement dedicated to the City of Colorado Springs.

Underdrain Review statement (to be added to the proposed construction plans)

Review by City Engineering Division is for approval of discharge points to open drainage or storm sewer.

Reviewed by

Date

Review by Springs Utilities is for compliance with the standards and specifications.

Reviewed by

Date

Note:

Springs Utilities will inspect the groundwater underdrain installations and all taps. Neither the City nor Springs Utilities will be responsible for maintenance or repair of underdrain service lines.

13.05 Design and Construction.

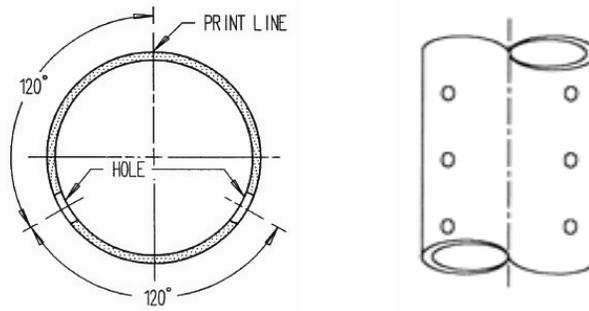
The Master Development Drainage Plan shall identify potential outfalls which shall be installed as frequently as practicable. The wastewater plan submittal shall include the proposed groundwater underdrain system for approval prior to construction. Such plans (wastewater plan and profiles) shall include alignments, the size of pipe, whether passive or active, trench dams, inspection pits, service line stub outs, tracer wire and test point locations, inverts at system connection points and inspection pits, grade (minimum grade shall be no flatter than 0.5%), easements, and outfalls. Restraint pipe is to be used for pipe on slopes greater than ten (10 %) percent, and is to be shown on the plan and profile sheet when constructed parallel to the sanitary sewer line, with the approval of Springs Utilities.

The trench may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe, the typical minimum curve radius for 6 inch PVC pipe shall be 150 feet, 8 inch is 200 feet and 12 inch is 300 feet, reference manufacturer's recommendations for larger size pipes. Mechanical means should not be employed to accomplish these radii. It is the intent that the workers should accomplish this manually in the trench. On 6-inch to 12-inch pipe, the curve should be accomplished by bending the pipe rather than deflecting the joints. There shall be no deflection in the joints upon completion to avoid over-stressing the bell and prevent possible breakage and/or leaks.

To avoid deflecting the joints while achieving curvature, it is recommended that the joints be sufficiently braced or backfilled and compacted to keep them stationary. Abrupt changes in direction may be accomplished with fittings or manholes.

1. Main line

- a. The type and size of underdrain pipe to be used shall be as specified on the drawings. The minimum size of an underdrain main shall be six (6") inches.
- b. Perforated and non-perforated polyvinyl chloride (PVC) plastic pipe shall conform to the requirements of ASTM D 3034.
- c. Filter cloth for underdrain trenches shall be Mirafi 160N, or equal that conforms to the requirements of AASHTO M 21313 as approved by Springs Utilities, as shown on Wastewater Construction Drawing C 5-6.
- d. Passive sections (non-perforated) shall be constructed of SCH 40 PVC. Active sections (perforated) shall be constructed of perforated PVC pipe SDR 35 or SCH 40. The perforations on the pipe shall be located at approximately the 4 o'clock and 8 o'clock positions (120 degrees apart) the pipe shall be installed with the perforations in the down position.



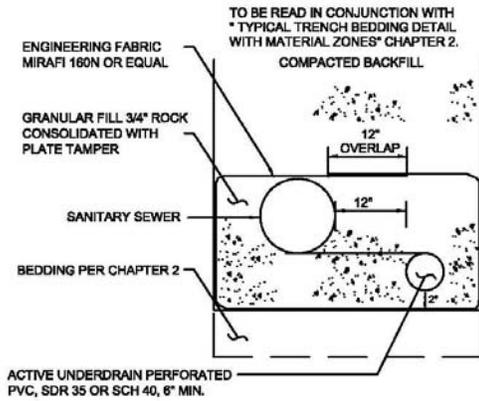
Perforated Pipe hole configuration

The pipe sections shall be joined securely with the appropriate coupling bands or fittings, the trench shall be an approved granular fill, 3/4" rock and consolidated using vibratory methods acceptable to the Springs Utilities Inspector, and wrapped with engineering fabric, Mirafi 160N or equivalent approved by Springs Utilities. The groundwater underdrain pipe shall be located at the bottom of the sanitary sewer pipeline, to allow for service connections, as shown on Figure 1 and 1A – Alternate Underdrain Trench details.

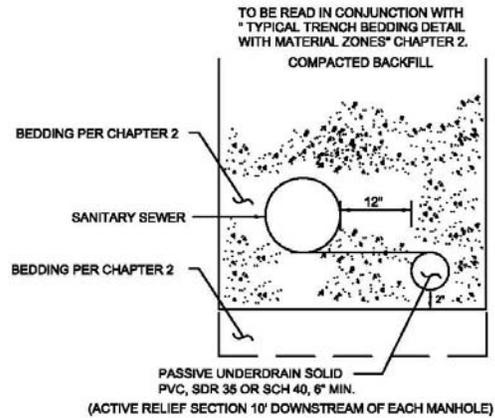
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ALTERNATE 1

- NOTE:
 * POINT OF DISCHARGE TO PUBLIC SYSTEM REQUIRED.
 * UNDERDRAIN SERVICE LINE CONNECTIONS SHALL BE 3" SCH 40.



ACTIVE UNDERDRAIN PIPE



PASSIVE UNDERDRAIN PIPE

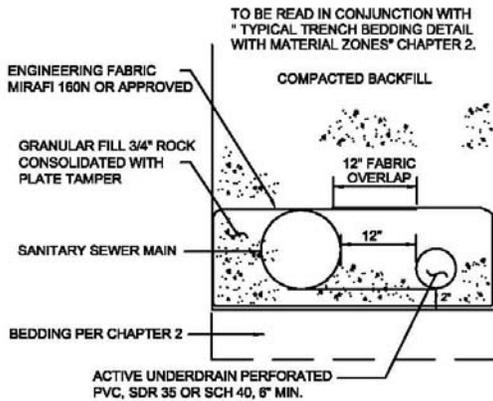
GENERAL NOTES:

1. MINIMUM UNDERDRAIN SIZE OF MAINLINE PIPE TO BE SIX (6") INCHES.
2. TO BE READ IN CONJUNCTION WITH WASTEWATER CHAPTER 13 - UNDERDRAINS
3. UNDERDRAIN TO BE LOCATED ON THE SOUTH AND WEST OF THE SANITARY SEWER LINE, OPPOSITE TO THE WATERLINE LOCATION.

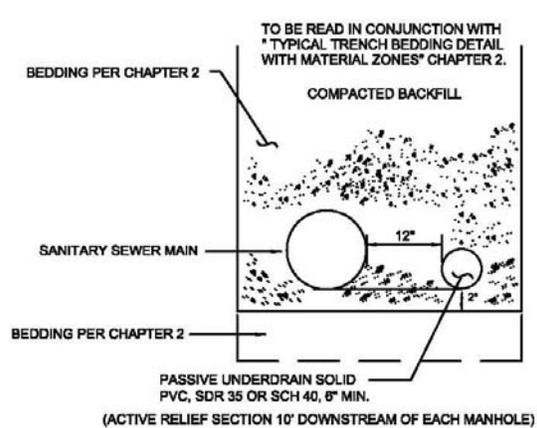
Figure 1 - Alternate 1 Underdrain Trench details

ALTERNATE 2

- NOTE:
 * POINT OF DISCHARGE TO PUBLIC SYSTEM REQUIRED.
 * UNDERDRAIN SERVICE LINE CONNECTIONS SHALL BE 3" SCH 40.



ACTIVE UNDERDRAIN PIPE



PASSIVE UNDERDRAIN PIPE

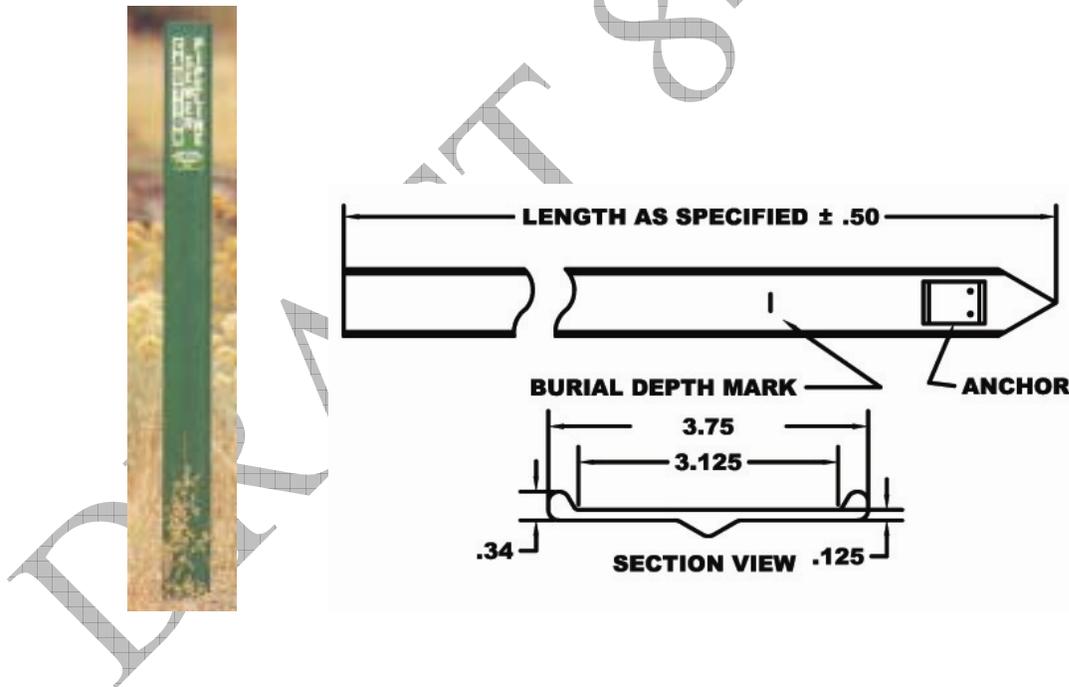
GENERAL NOTES:

1. MINIMUM UNDERDRAIN SIZE OF MAINLINE PIPE TO BE SIX (6") INCHES.
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3. UNDERDRAIN TO BE LOCATED ON THE SOUTH AND WEST OF THE SANITARY SEWER LINE, OPPOSITE TO THE WATERLINE LOCATION.

Figure 1A – Alternate 2 Underdrain Trench details

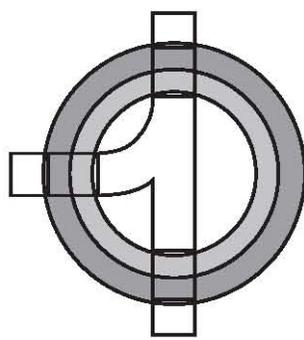
- e. Tracer wire shall be installed with the wastewater main line in compliance with the requirements of Chapter 6 of the Wastewater Line Extension and Service Standards, latest edition. Tracer wire will be brought to accessible points such as inspection pits and accessible outfall locations. If the underdrain is not in the same trench as the sanitary sewer line, a separate tracer wire shall be installed with the underdrain.
- g. Passive mains shall be laid with solid pipe with one ten (10') foot section of active pipe downstream of each manhole or inspection pit with a trench dam, as shown on Figure 2A, C and D – Underdrain Inspection Pit.
- h. Underdrain (Utility) Line Markers. Underdrain line markers are to be placed at all test points or inspection pits installed at underdrain outfalls where the installation is not in a paved surface or as designated by the inspector. Line markers are to be installed with Colorado Springs Utilities decal and telephone number. (See manufacturer's specifications for correct installation.)

Carsonite (Utility Marker) composite post or Colorado Springs Utilities approved equal - 66" long, 3.75" wide, with a three rail design, color - GREEN

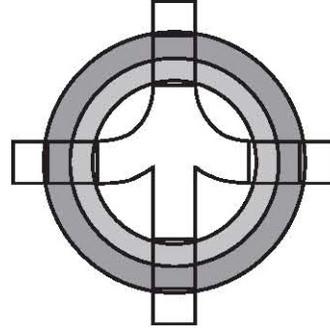


2. Inspection Pit

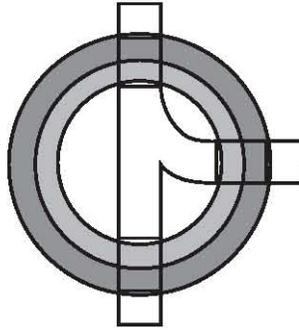
Inspection pits shall be constructed outside a sanitary sewer manhole as shown on Figures 2, 2A thru D – Underdrain Inspection Pit. Inspection pits shall be installed as necessary to allow inspection and maintenance access to the main with at least one chamber within each straight run of main. Inspection pits shall have no more than a four hundred (400') foot straight run of main upstream or downstream to either another inspection pit or the end of a straight run main section. The inspection chamber shall be a zero sump chamber to allow for easy camera access for inspection.



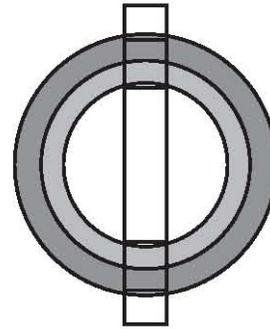
Minimum 24" Base Unit



Minimum 24" Base Unit



Minimum 24" Base Unit



Either 24" or 15" Base unit

Alternate configurations for inlets into Inspection pit

Composite Pit lid covers.

Pit covers shall be nonmetallic in nature and shall be of a polymer construction. Covers shall be tested in accordance to the procedures outlined in AASHTO M306. Pit lids shall be certified to HS-20 loading. Cover to include attachment for magnet unit beneath the lid. Lid shall be marked with the word "**UNDERDRAIN**" in the center of lid.

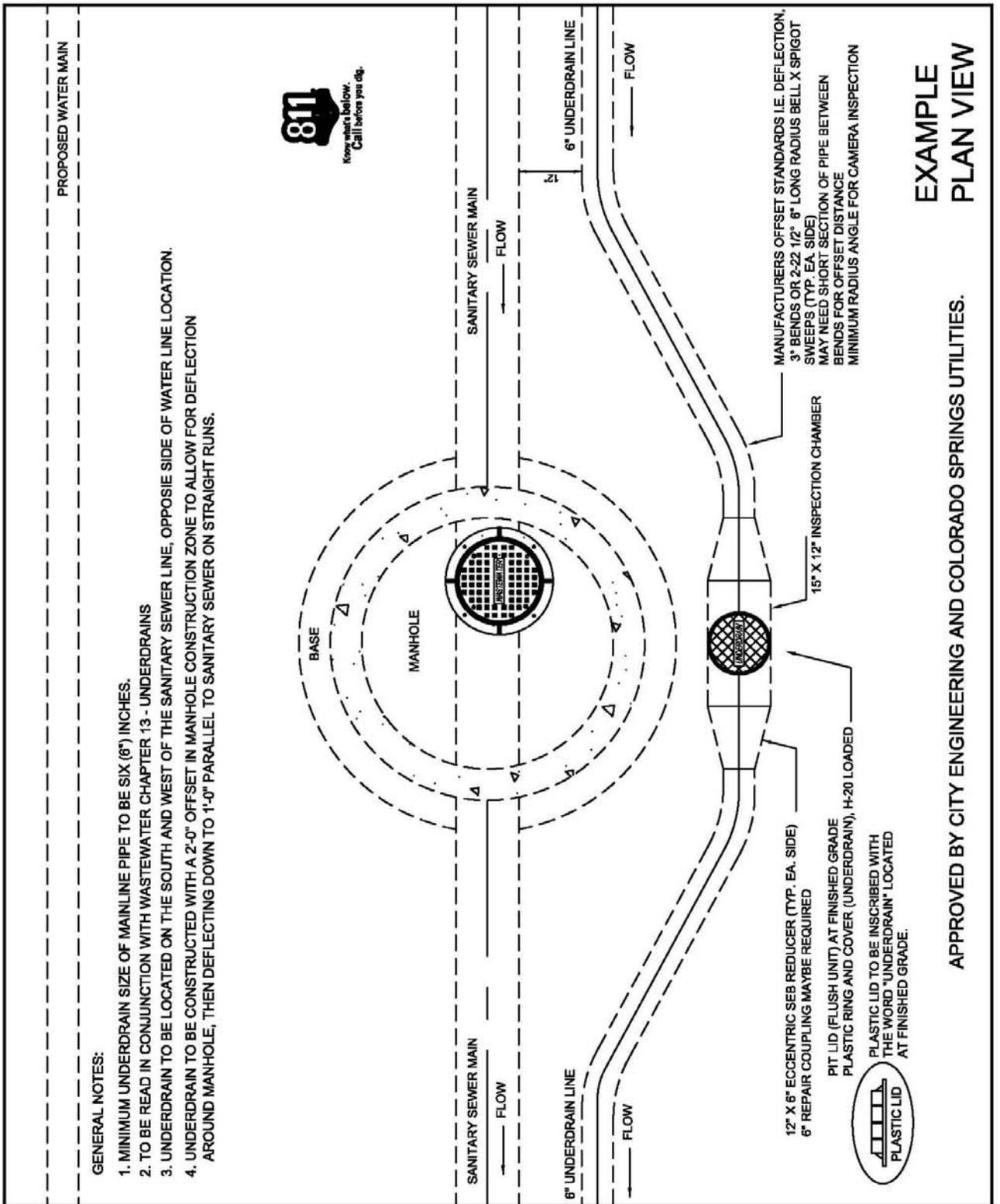


Figure 2 – Underdrain Inspection Pit

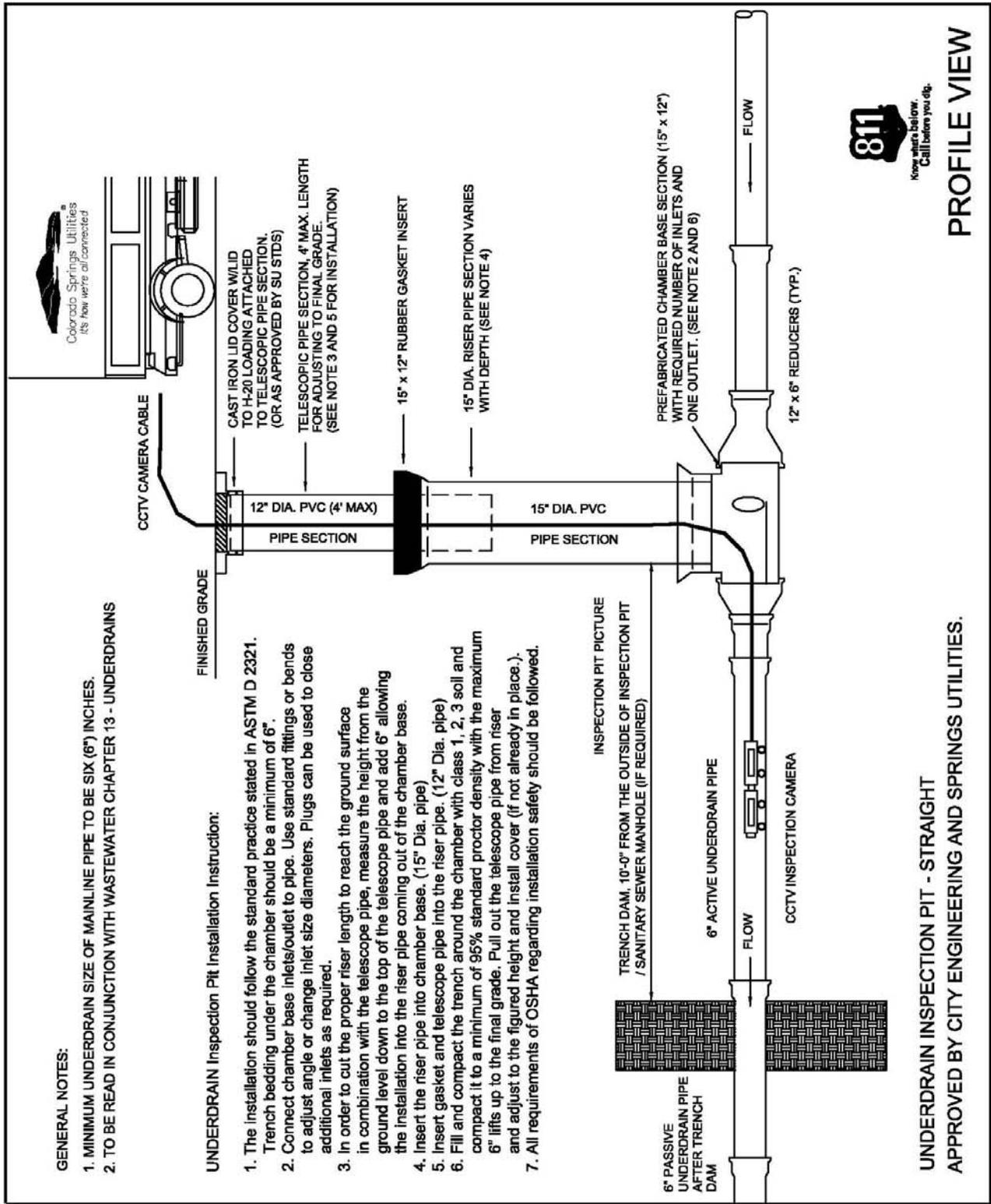


Figure 2A – Alternate 1 Underdrain Inspection Pit

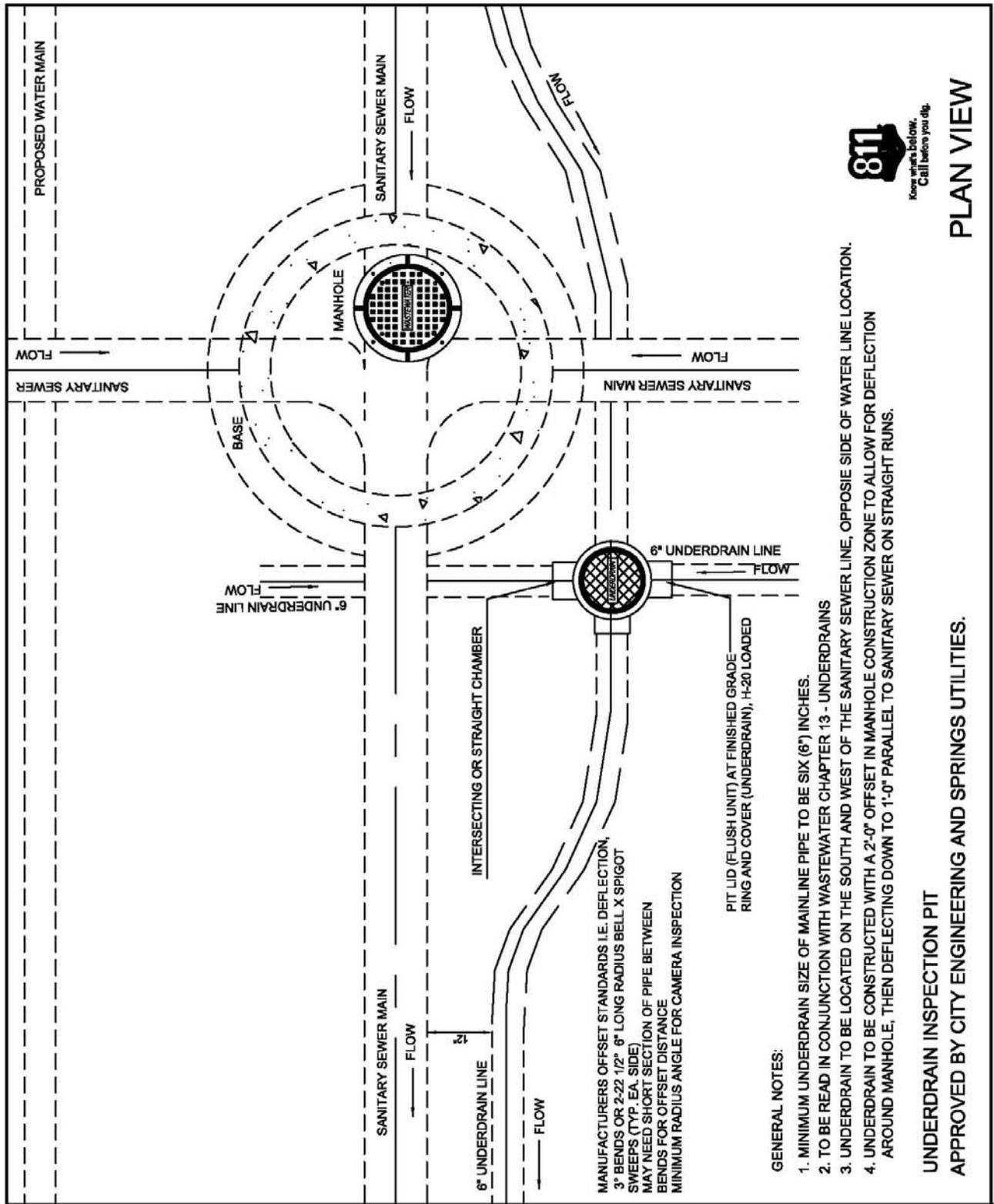


Figure 2B – Underdrain Inspection Pit

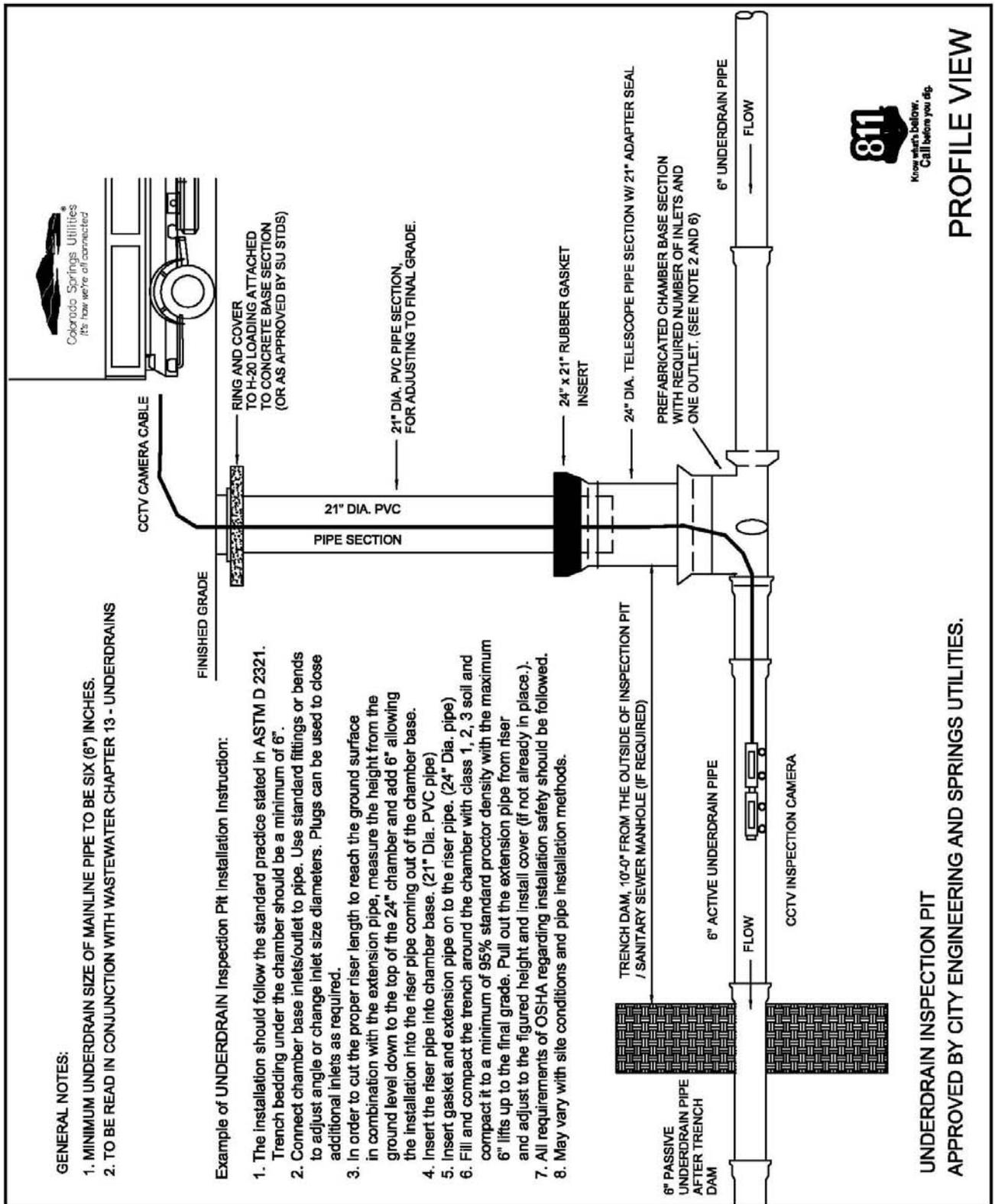


Figure 2C – Alternate 2 Underdrain Inspection Pit

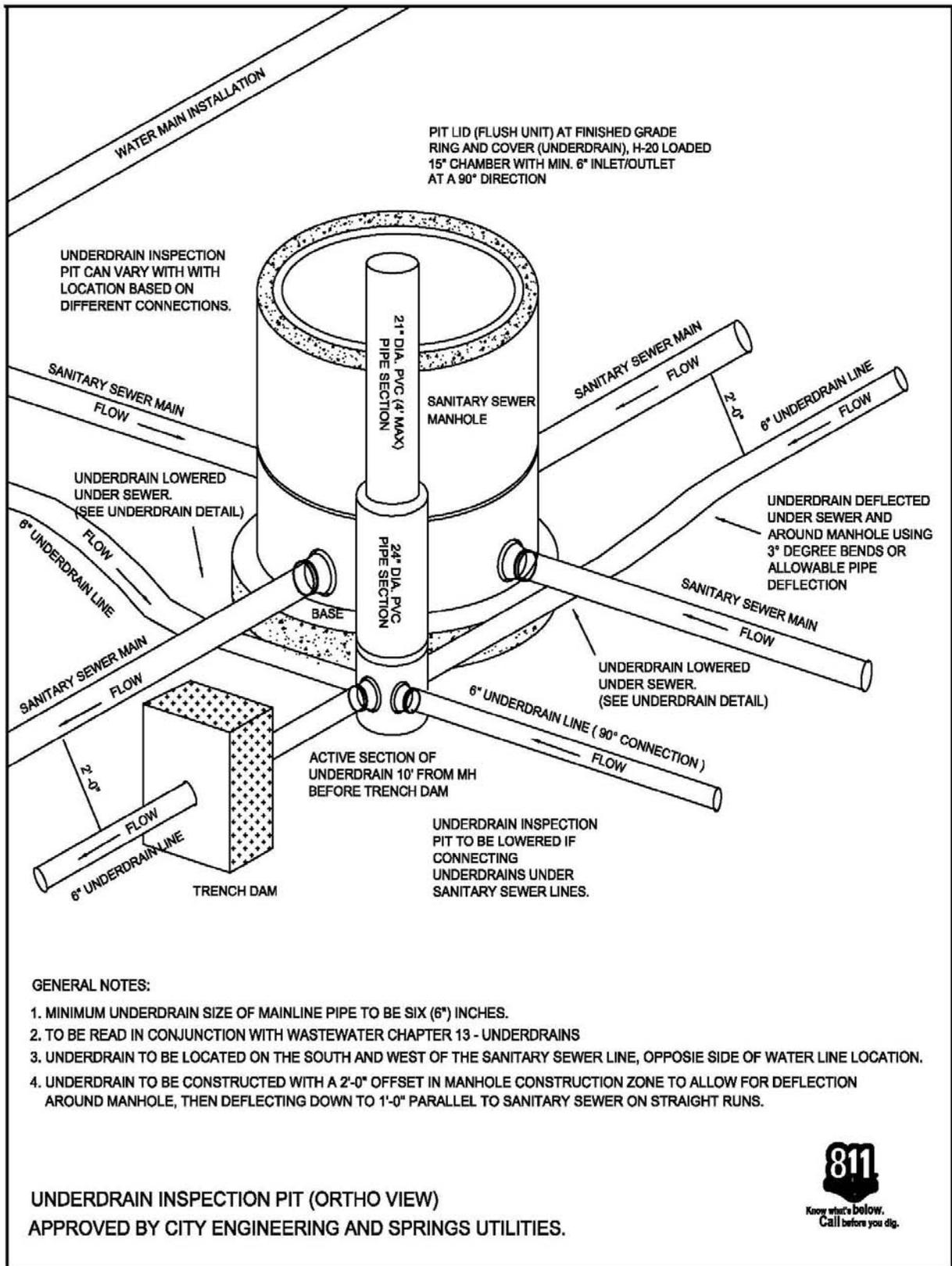


Figure 2D – Underdrain Inspection Pit

3. Service Line

Passive system shall be laid with solid pipe PVC pipe SCH 40 from the tap point at the main underdrain in the street to the perimeter drain connection point per Wastewater Construction Drawing C 5-5.

At the owner's option, an active service line may be installed from the perimeter drain connection to the property line. The active pipe section shall be wrapped with engineering fabric, Mirafi 160N or other material approved by Springs Utilities. A trench dam shall be placed at the transition from active to passive at the property line.

The developer/contractor shall extend all service taps to the property line and will be properly capped if not immediately connected to a service line. All connections shall be joined securely with appropriate bands or fittings. Taping or stuffing are not acceptable connection methods.

Tracer wire is required on any underdrain service line not located adjacent to the sewer service line and shall be in compliance with the requirements of Chapter 6 of the Wastewater Line Extension and Service Standards, latest edition. Tracer wire will be bonded to the main tracer wire and wrapped around the cleanout riser near the cap.

The owner of all structures will be responsible for repair and upkeep of their foundation underdrain drainage lines and sump pumps, if any, and the underdrain service lines from the structure to the point of connection at the public groundwater underdrain main. Any window well drains, or similar drains, that are connected to the building perimeter drain must be properly capped with a grate and fabric in order to prevent the infiltration of rocks, dirt and other debris into the perimeter drain and underdrain system.

A single cleanout for the underdrain service line must be located within five (5') feet of the foundation, Figure 3 – Underdrain Service line. Additional cleanouts must be placed at no more than one hundred (100') foot intervals on long service lines, junctions or bends. The cleanout(s) shall be installed six to twelve (6" to 12") inches below finished grade and must have a glued cap with an affixed magnet or a utility marker ball for locating purposes. Use of a backwater valve at the foundation cleanout location is at the owner's discretion.

4. Outfall

The outfall will be made into a drainage way or storm drain, per Figure 4A, B and C, at a City of Colorado Springs approved location.

The outfall run must be surveyed to assure proper slopes and alignment. Inspection pits will be located as required for mains in subsection 2 above.

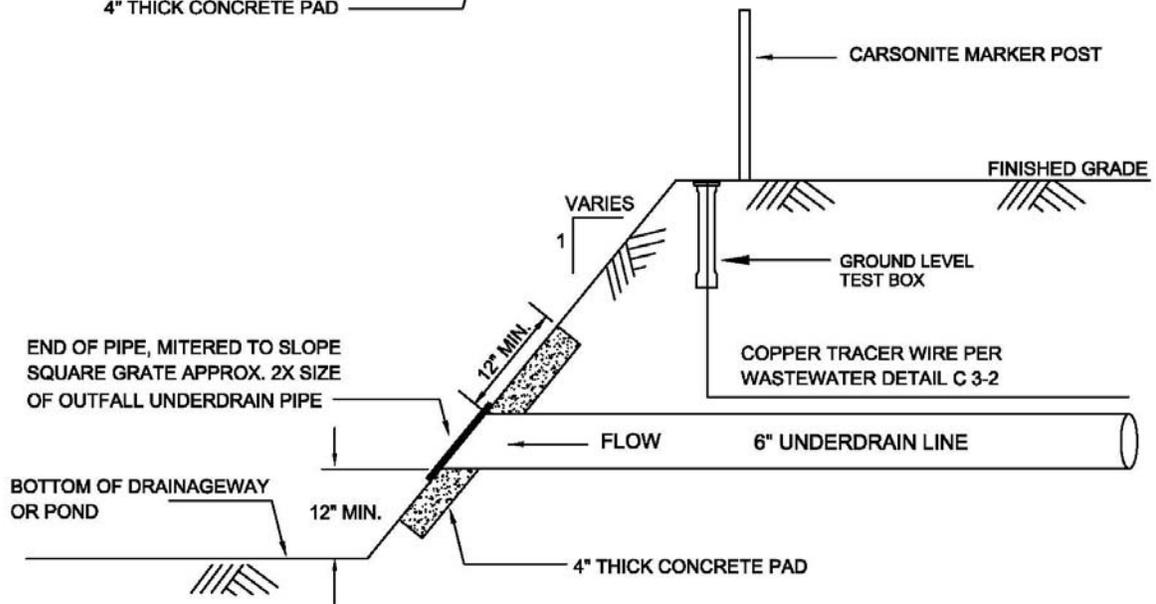
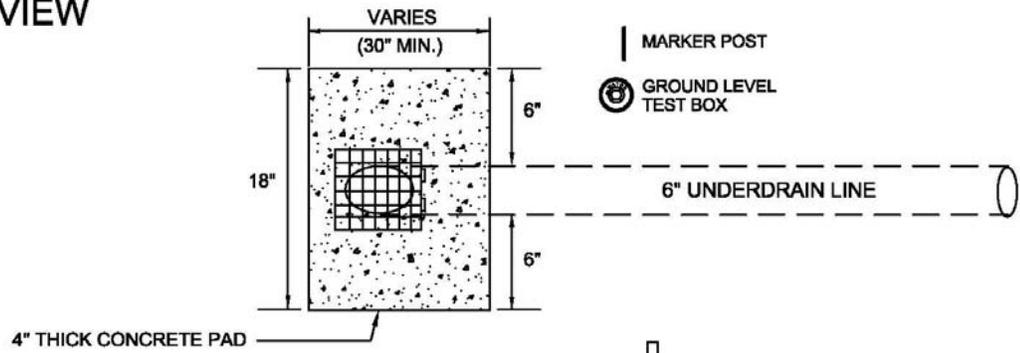
The preferred underdrain outfall into the storm drainage system is via connection into either a storm catch basin or a storm manhole per Figure 4B, located below the spring line, or at a minimum, six (6") inches above the flow-line. If the point of connection is not in a manhole or other readily accessible point, an inspection pit will be installed per Figure 1 – Underdrain Trench details.

An outfall that daylights into a drainage way or other open structure must be constructed with a concrete headwall and include a hinged grate with no larger than a 1" x 1" mesh grid per Figure 4A, per City of Colorado Springs, Engineering Standards.

Multiple outfalls are encouraged for extensive underdrain systems. A permit for each proposed outfall location must be obtained from the City Engineering Division prior to final drainage plan approval.

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PLAN VIEW



PROFILE VIEW

Figure 4A – Underdrain Connection Details – Drainage way/Pond Outfall Detail



Illustration of a Pond Outfall without an outfall grate.

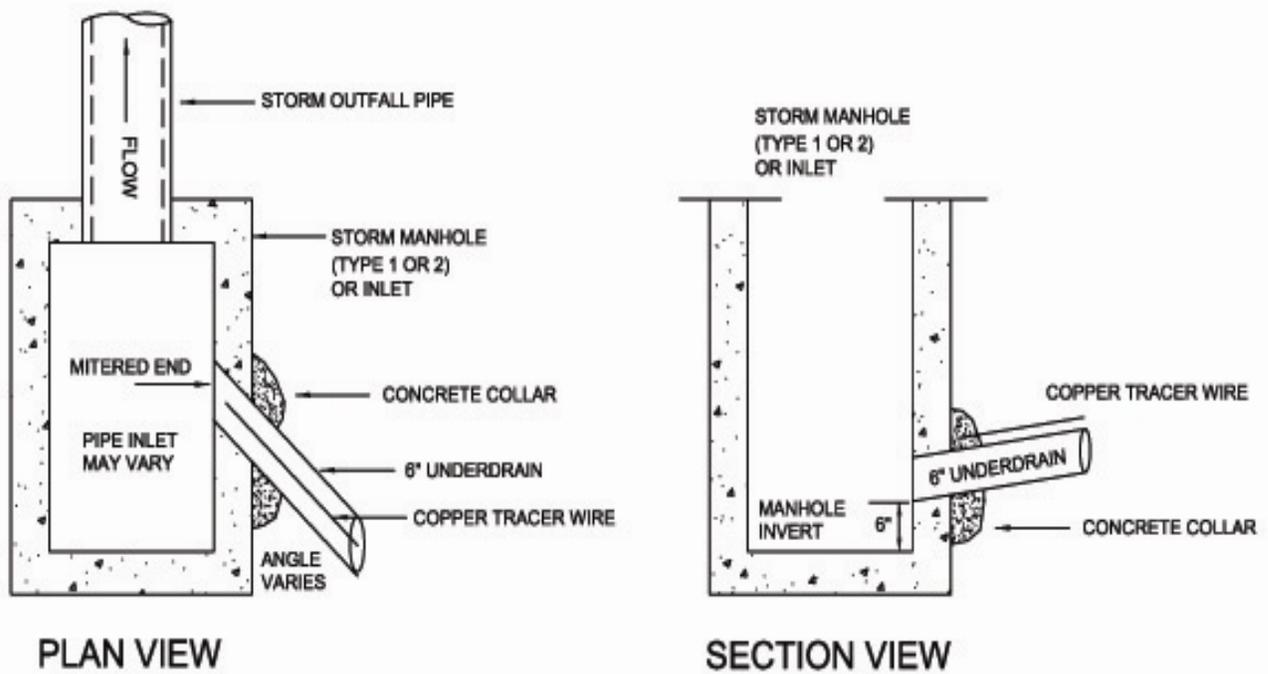


Figure 4B – Underdrain Connection Details – Inlet/Manhole Connection Detail

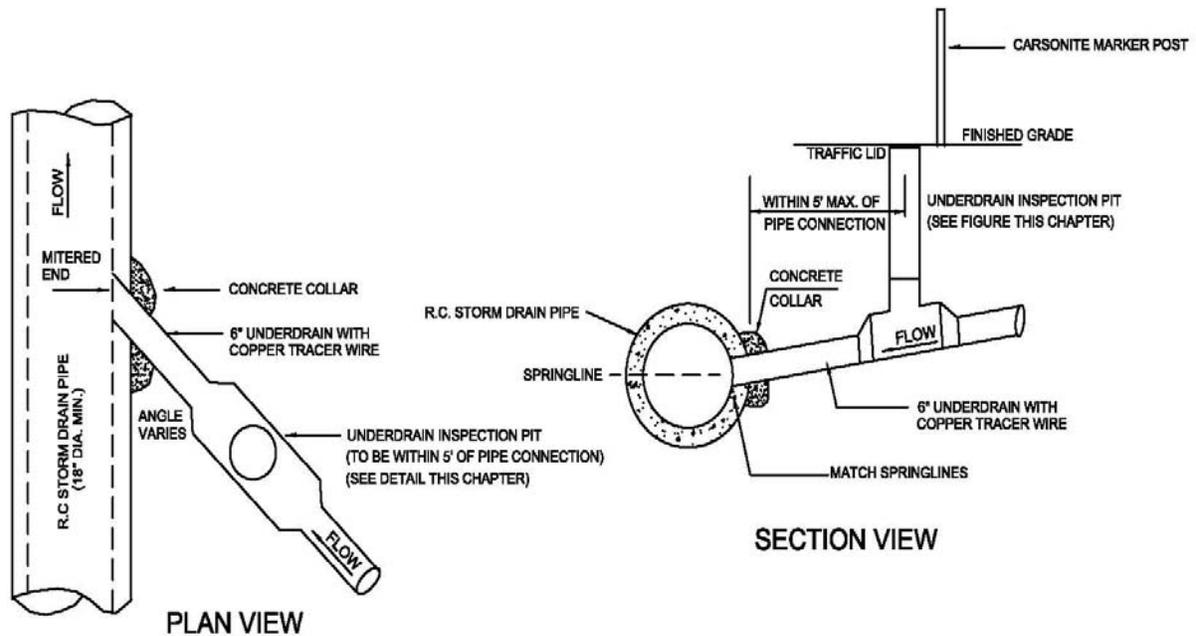


Figure 4C – Underdrain Connection Details – Storm Pipe Connection Detail

13.06 Materials

Piping Materials

Fittings for building perimeter drains:

A. Corrugated Polyethylene Pipe (Solid and Perforated)

1. Pipe Classification: AASHTO M252 Type S.
2. Material Classification: ASTM D 3350.
3. Property Description: Cell Class 324420C.
4. Perforation Size: 9/16 by 1/16 inch slots; minimum inlet area 2.4 inches per lineal foot of pipe.
5. Joint Couplings: External snap couplers with gaskets for solid wall; external snap couplers without gaskets for perforated pipe.

Fittings for building perimeter drains, underdrain service lines and mains:

B. Smooth wall Polyethylene Pipe (Solid and Perforated)

1. Pipe Classification: ASTM F 810.
2. Material Classification: ASTM D 3350.
3. Property Description: Cell Class 324420 C & E.
4. Pipe Size: 3 inch diameter for service lines and 6 inches minimum diameter for mains unless otherwise indicated.
5. Perforation Size: 1/2 inch diameter hole on 5 inch center to center, 2 rows at the 4 & 8 o'clock positions.
6. Bell-and-Spigot Joints.

C. PVC Pipe (Solid and Perforated)

1. Pipe Classification: ASTM D 2729.
2. Material Classification: ASTM D 1784.
3. Property Description: Cell Class 12454B, 12454C, or 13343C.
4. Pipe Size: Pipe Size: 3 inch diameter for service lines and 6 inches minimum diameter for mains unless otherwise indicated.
5. Perforation Size: 1/2 inch diameter hole on 5 inch center to center, 2 rows at the 4 & 8 o'clock positions.
6. Joints: Solvent cement or electrometric gasket.

13.07 Construction Inspection

Springs Utilities will inspect all underdrain mains, taps, stub-ins, and service lines during construction. All underdrain service lines and stub-ins must be three (3") inch diameter pipe unless otherwise approved. This is to minimize the chances that a contractor/developer will inadvertently connect the underdrain system to the sanitary sewer or the sanitary sewer to the underdrain system.

No work shall be backfilled until construction and connection have been inspected and accepted by Springs Utilities inspector. Inspection shall not constitute a guarantee of the contractor's work.

Installation

- A. Lay pipe to indicated line and grade with firm uniform bearing throughout its length.
 1. Lay pipe with a uniform pitch between high and low points.
 2. Position bells upstream.
 3. Provide sufficient clearance at each bell or coupling to allow uniform bearing along the pipe barrel. Fill excess excavation with bedding material and tamp.
 4. Install perforated pipe with perforations down.
- B. Joints:
 1. Wipe inside of sockets and outside of pipe to be jointed, clean and dry.
 2. Assemble electrometric-gasket joints in accordance with the pipe manufacturer's recommendations and ASTM D 3212.
 3. Assemble solvent-cement joints in accordance with ASTM D 2855.
 4. Assemble other joints in accordance with the pipe manufacturer's recommendations.
- C. Bends: Use two 45 degree fittings and a pup for each 90 degree turn.
- D. Branch Connections: Use standard fittings for connections at drain line intersections.

Connections

- A. Make connections to existing mains by inserting fitting with standard adapters for the particular type of pipe.
- B. Make connections to existing manholes by core drilling into the wall of the manhole approximately six (6") inches above the floor or bench, see figure 4B or storm drain, see figure 4C. (Reference Chapter 3.13 of these standards)

- C. If the pipe, manhole or other structure with which the connection is to be made has not yet been installed, the pipe shall be installed to a point directed by the Springs Utilities inspector and a plug or cap installed in the end of the pipe in a satisfactory manner.

13.08 Underdrain Variances

The City of Colorado Springs will consider variances from its underdrain requirements on a case by case basis. The impact on other property and improvements within the city will be among the considerations in granting or denying any variance. The impact on the structure will be a further consideration in granting or denying a variance for an individual structure. The City of Colorado Springs reserves the right to waive any of these requirements.

Variances for single family (including duplexes and triplexes) residential developments shall be considered only if adequate technical information is provided to indicate that the structure's perimeter drain cannot physically be connected to the development's underdrain system by gravity and that an adequate alternative solution for eliminating groundwater from around the building foundations is available and acceptable to the Regional Building Department.

Any request for a variance from the City of Colorado Springs underdrain requirements must be submitted in writing to the City of Colorado Springs along with the technical documentation and other information to support the request as indicated below. Such information shall include the following:

- a) A written request by the property owner, the signatory party on the main extension application for a development, or the signatory party on the sewer tap permit for an individual structure.
- b) A signed Request for Underdrain Variance (see Exhibit A at the end of this Chapter).

A site grading plan which shows (but not limited to) the following items:

- (1) Existing and proposed grading.
 - (2) Boring locations and identifiers.
 - (3) Location of all structures with lowest level finished floor (F.F.) elevations.
 - (4) Foundation detail showing F.F. location on typical section.
- c) A letter from the geotechnical engineer stating that foundation drains are not required or a letter explaining why the structure's foundation underdrain cannot be connected by gravity to the City of Colorado Springs underdrain system with a recommendation for an adequate alternative solution for eliminating groundwater from the building foundation.
 - d) A complete copy, including narrative, of boring logs and a boring location plan of the geotechnical report, if undertaken for the structure.

- e) Payment of the City of Colorado Springs current fee for underdrain variances.
- f) Requested variances are subject to review by an independent geotechnical firm under contract with the City of Colorado Springs for concurrence with these recommendations. The recommendation of the engineer does not constitute a guarantee of the design.
- g) Single family residential sump pumps may discharge into the underdrain service line. Non-single family residential sump pumps shall not directly or indirectly discharge into public underdrain mains.
- h) Sump pumps which discharge to the public right of way, street or sidewalk are strictly prohibited.**

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13.09 Warranty Period

Upon completion of the underdrain main and outfall construction, the City or SU will conduct a visual and CCTV inspection of the installation and direct the owner to correct any identified deficiencies. The installation will be inspected to NASSCO sanitary sewer standards. The owner will be billed for all inspection, and any necessary re-inspection, costs. Preliminary acceptance of the system will be granted after all deficiencies have been corrected. The main collection lines of the underdrain system located in the street right-of-way and within the drainage easements must be maintained by the entity which constructed them for the first two years after probationary acceptance.

At the end of the two year period, the City of Colorado Springs will either conduct a CCTV inspection of the installation or will request the owner to submit an independent third party CCTV inspection report of the underdrain system mains and request that cleaning or repairs, if necessary, be made to bring the system into compliance with the Wastewater Line Extension and Service Standards. The owner will be charged for any City inspection expenses. The main collection lines of the underdrain system will then be deeded through a bill of sale to the City of Colorado Springs for its ownership and maintenance in perpetuity (See Exhibit B at the end of this chapter). Individual lot owners will own and be responsible for maintaining the service lines up to the main tap connecting their property to the public underdrain main as well as foundation drains and any other underdrain facilities located on their property.

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EXAMPLE - Exhibit A
(Reference WS6 – downloadable file)

City of Colorado Springs - Request for Groundwater Underdrain Variance

_____ (Developer/Builder), whose address is
_____, and whose telephone number is

_____, hereby submits to City of Colorado Springs Engineering Division, 30 S. Nevada Ave., Mail Code 720, Colorado Springs, CO 80901-1575, a request for variance from the City of Colorado Springs groundwater underdrain requirements in Chapter 13, Colorado Springs Utilities, Wastewater Line Extension and Service Standards for the following reason(s):

This Request for Groundwater Underdrain Variance is for _____ construction (specify commercial slab, multi-family residential slab, or other).

Developer/Builder hereby submits for the project/structure located at _____,

the legal description for which is _____, one signed, original Groundwater Underdrain Variance Agreement and the following technical documentation to support the reason(s) for the variance request stated above:

1. A letter from a geotechnical engineer stating foundations drains are not required.
2. A copy of the geotechnical engineer's report, including narrative, of boring logs and a boring location plan.
3. A site grading plan showing existing and proposed grades, boring locations and identifiers, location of all structures with lowest level finish floor (F.F.) Elevation and a foundation detail showing F.F. Location on typical section.

If the variance request is approved by the City of Colorado Springs, the Groundwater Underdrain Variance Agreement will be signed by the City and a copy of the original returned to the Developer/Builder at the address indicated above.

Submitted this _____ day of _____.

(Name of Developer/Builder)

By: _____
(Name and Title)

APPROVED BY:

City of Colorado Springs: _____ Date: _____

EXAMPLE - Exhibit B

City of Colorado Springs - Bill of Sale for Underdrain System

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