

**STANDARD
CONSTRUCTION SPECIFICATIONS
OF THE
CITY OF MARBLE FALLS, TEXAS
MARCH, 1995
REVISED JULY, 2003**

TABLE OF CONTENTS

AN ORDINANCE

GENERAL PROVISIONS

- Item 1 – Trenching and Backfilling
- Item 2 – Concrete
- Item 3 – Water System
- Item 4 – Wastewater System
- Item 5 – Storm Drainage
- Item 6 – Pipe
- Item 7 – Water Valves
- Item 8 – Concrete Encasement and Encasement Pipe
- Item 9 – Jacking or Boring Pipe
- Item 10 – Bulkheads
- Item 11 – Adjusting Structures
- Item 12 – Manholes
- Item 13 – Frames, Grates, Rings and Covers
- Item 14 – Finish Grading, Topsoil and Revegetation
- Item 15 – Trench Safety Systems
- Item 16 – Streets, Walks and Driveways

STANDARD DETAILS

A N O R D I N A N C E

AN ORDINANCE ADOPTING THE STANDARD CONSTRUCTION SPECIFICATIONS OF THE CITY OF MARBLE FALLS, TEXAS, DATED MARCH 1995, REVISED OCTOBER, 2002 AND ANY SUBSEQUENT REVISIONS THERETO.

WHEREAS: The City Council of the City of Marble Falls, Texas, seeks to establish reasonable construction specifications to ensure that the installation of public infrastructure is of a quality acceptable to the City, AND

WHEREAS: The City Council of the City of Marble Falls, Texas, has caused to be prepared this ordinance calling for the implementation of certain construction specifications so as to implement and enforce certain necessary standards for the entire jurisdiction of the City of Marble Falls, Texas, AND

WHEREAS: The City Council of the City of Marble Falls, Texas, has set forth said construction specifications in the form of an ordinance, herein referred to as the STANDARD CONSTRUCTION SPECIFICATIONS OF THE CITY OF MARBLE FALLS, TEXAS,

NOW THEREFORE: BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF MARBLE FALLS, TEXAS, as follows:

The attached STANDARD CONSTRUCTION SPECIFICATIONS OF THE CITY OF MARBLE FALLS, dated March 1995, Revised October, 2002 and any subsequent revisions thereto are included as a part of this ordinance. All facilities constructed within the existing public right-of-way and utility easements, or newly dedicated right-of-way and utility easements shall conform to the applicable provisions of these Standard Construction Specifications of the City of Marble Falls, including any subsequent revisions.

Considering the fact that existing ordinances cover construction operations as performed by Plumbers within the City limits, this ordinance shall not be construed to include plumbing operations when such operations are being conducted from a point two (2) feet behind the curb line, or future curb line, to and including the plumbing for the building line, or future curb line, to and including the plumbing for the building to be served. However, when a plumbing contractor exceeds these limits his operations shall be deemed those of a contractor and in this case shall be governed by these specifications and this ordinance.

This ordinance shall not be construed to include a person, individual partnership, or corporation which constructs or contracts to construct a building which will receive service from City owned utility lines and appurtenances, said persons being included under existing ordinances.

In the event any section, sub-section, sentence, clause or phrase of this ordinance shall be declared or adjudged invalid or unconstitutional, such adjudication shall in no means affect any other sections, sub-sections, sentences, clauses or phrase of this ordinance, but all the rest hereof shall be in full force and effect just as though the section, sub-section, sentence, clause or phrase so declared are adjudged invalid or unconstitutional was not originally a part hereof.

All ordinances or part of ordinances inconsistent or in conflict with the provisions of this ordinance shall be void and the same are hereby repealed.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF MARBLE FALLS, TEXAS this _____ day of _____, _____, at which meeting a quorum was present.

Nona Fox, Mayor

Attest:

Christina Laine, City Secretary

GENERAL PROVISIONS

1. **DEFINITIONS:** The following definitions of terms as used in the Technical Specifications and elsewhere shall apply.

City shall refer to the governing body of the City of Marble Falls or to the office or employees to which or to whom appropriate authority has been delegated.

City Manager shall refer to the City Manager or to his designated representative.

City Engineer or Engineer shall refer to the City's Public Works Director, Maintenance Director or Director of Utilities or to a representative designated by the City Manager. The City's Public Works Director, Maintenance Director or Director of Utilities may or may not be a registered professional engineer.

Approved – where the word “approved” or the phrase “as approved” appears in the Standard Specifications, it shall be construed to refer to approval by the City Engineer or the City Manager.

City Inspector or Inspector shall refer to the City Engineer or any duly authorized representative of the Engineer who is performing field inspection of the work.

Developer, Sub-Divider, or Contractor – these terms shall be construed as referring to the individual(s) or firm(s) alike who are responsible for the work within the public right-of-way and is not intended to differentiate between the individuals or firms for the purpose of settling responsibility.

Public Right-of-Way for the purpose of these specifications shall include all publicly owned or controlled property within the property lines established by approved plats, deeds, or easements.

2. **Applicability:** These standards are intended to apply primarily to the design and construction of new developments, subdivisions, or additions to the City of Marble Falls. However, they may be used also for contract work directly with the City for work within previously developed areas, as applicable and as stipulated in the Contract.
3. **Plans and Procedures:** Prior to initiation of any construction work in connection with any planned development, subdivision or addition within the City or proposed for annexation, the developer shall submit plats, plans, drainage studies, and other data for approval as required by the current Subdivision Ordinance, these specifications and any current revisions thereto, and any other applicable Ordinances or Standards in effect at the time of application. Prior to final approval and acceptance of the plat, plans shall be stamped with a licensed engineer's seal and shall include as a minimum plans and profiles of streets, drainage facilities, gravity sewer lines and water lines 12 inch and larger in diameter. Plans shall also include locations, sizes, and other pertinent data for water lines, force mains, lift stations, and off-site work required to connect to existing facilities. The amount of detail required shall be commensurate with the size and complexity of the project. However, all plans will be required to conform to all applicable provisions of these Standard Specifications.

4. CONSTRUCTION PROCEDURES:

A. Contractor's Public Responsibility

- (1) The Contractor shall at all times conduct the work in such manner as to insure the least possible obstruction to public traffic and protect the safety of the public. Public safety and convenience and provisions therefore made necessary by the work shall be the direct responsibility of the Contractor and shall be performed at his entire expense. Materials placed on the site, or materials excavated and the construction materials or equipment used shall be located so as to cause as little obstruction to the public as possible. The Contractor shall at all times conduct his operations and the use of construction machinery, so as not to damage or destroy improvements, trees and shrubs located adjacent to the site of the work. Whenever any such damage may be done, the Contractor shall immediately satisfy all claims of the property owners.
- (2) The Contractor shall at all times conduct the work in such manner as to insure no damage to existing utilities or other facilities. However, in the event that damage is done to existing utilities, the Contractor shall repair and replace them immediately and at his entire expense. In the event public facilities are damaged which cannot be replaced or repaired by the Contractor, the contractor shall inform the City or the Utility Company involved and will reimburse them for the replacing or repairing of the item damaged. This reimbursement shall be a prerequisite to any acceptance of the construction which was responsible for the damage.
- (3) The Contractor shall save harmless the City from his operations, shall provide bonds, insurance, etc., as required by law.
- (4) Contractor shall be an Equal Opportunity Employer and comply with all applicable regulations.

5.

B. QUALITY CONTROL:

- (1) Materials – The Contractor shall furnish such evidence as may be requested by the City Engineer that materials furnished for incorporation in the work comply with the requirements of these Standard Specifications. Manufacturer's Certifications, certified copies of independent laboratory tests, shop drawings, catalog literature, or similar data will normally be considered sufficient. Any materials not meeting specification requirements shall be removed from the site.

(2) Construction:

- (a) If work is being performed as a part of a new subdivision the City shall determine the need for laboratory and field testing to assure that materials and construction complies with the requirements of the plans and specifications. Generally, laboratory and field testing requirements will not exceed those set out below for other than new subdivisions. All costs shall be paid by the subdivider. Should test results indicate failure to comply, the subdivider shall also pay for additional tests required to assure compliance.
- (b) If work being performed is not a part of a new subdivision, the Contractor shall be responsible for the cost of tests required to assure compliance with the specifications on the following basis:
- (1) A modified Proctor Density test for each type of material to be used in all types of construction where density requirements are specified. Sampling locations shall be selected at intervals not to exceed three hundred (300) feet.
 - (2) One field density test on "street subgrade" for each type of material in each section, however short that section may be; in the case of a street more than four-hundred (400) linear feet in length, there shall be required one (1) for each four-hundred (400) linear feet of street constructed. All locations for tests shall be determined by the City inspector. Areas where failures occurred will be retested.
 - (3) Where materials such as flexible base, sub-base, portland cement concrete and hot-mix asphaltic concrete are used, sufficient tests as determined by the City inspector will be made to assure compliance to specification requirements. Other materials may be accepted on the basis of manufacturer's literature and grade markings at the option of the City Engineer.
 - (4) One field density test on "utility trench backfill" within proposed pavement sections shall be required and one (1) for each two hundred (200) feet per 8" lift of backfill material of utility trench constructed.
 - (5) All tests required by these specifications will be conducted by a commercial testing laboratory operating under the supervision of a registered professional engineer.

- (6) Each project shall have a "Subsurface Investigation and Pavement Design Report" prepared by a qualified geotechnical engineering firm. The plans and specifications shall comply with the geotechnical engineering firm's report for the street design.
- (3) Supervision and Inspection: The developer or Contractor is responsible for compliance with the approved plans and the applicable provisions of these Standard Construction Specifications and shall furnish sufficient supervision to insure that the work is accomplished in a satisfactory manner. The City Engineer will inspect the work sufficiently to satisfy himself that the work does comply with all requirements. It shall be the Contractor's responsibility to keep the Engineer advised of scheduled work and to notify the Engineer when work is ready for inspection or acceptance, and no work or increments thereof will be accepted without inspection unless the requirement for inspection is waived by the Engineer.
- (4) Reference Specifications and Standards: When specifications and standards such as ASTM, AASHO, AWWA, ASA, and other association standards are referenced in the specifications, it shall be interpreted to refer to the latest or current issue of the standard or specification.
- (5) Standard Details: The Standard drawing details bound in the back of these specifications shall be considered an extension of the plans and these specifications and any reference to the plans, specifications, and/or details shall be construed as including these details and drawings.
- (6) Warranty: Notwithstanding any certificate or other indication of acceptance which may have been given by the City Engineer, if any materials, equipment or any workmanship which does not comply with the requirements of this Contract shall be discovered within one (1) year after final completion of construction of the project, and acceptance by the Owner, the Contractor shall replace such defective materials or remedy any such defective workmanship within ten (10) days after notice in writing of the existence thereof shall have been given by the City or Engineer. In the event of failure by the Contractor to replace any such defective materials or equipment or to remedy defective workmanship as herein provided, the City may replace such defective materials or equipment or remedy such workmanship as the case may be and in such event the Contractor shall pay to the City the cost and expense thereof.

- (7) Bridges, Culverts and Special Drainage Structures: Requirements for design and construction of bridges, culverts, and special drainage structures are not included herein, and shall be subject to the approval of the City Engineer in all instances.**
- (8) Protection of Existing Utilities: Existing utilities are indicated on the City maps from available information. The Contractor is advised that any reference to or indication of existing utilities on these maps is solely for the City's general information and is not to be construed as indicating the exact location or number of said utilities. The locations shown on the maps relative to existing utilities are based upon the best record and/or field information available. It shall be the Contractor's responsibility to verify the location of adjacent and conflicting utilities and to take all necessary precautions in order to protect all utilities encountered.**
- (9) Order of Work: Unless otherwise approved by the City Engineer, all rough grading for streets shall be accomplished prior to the installation of any underground utility systems. All utilities shall be completed prior to the subgrade preparation, construction of curb and gutter, and construction of the base course for the streets.**

TECHNICAL SPECIFICATIONS

ITEM 1 – TRENCHING AND BACKFILLING

1. GENERAL:

All excavation, trenching and backfilling for utility lines and appurtenant structures shall conform to the requirements of this specification and to the applicable typical details attached to these specifications. The inspector shall have the right to limit the amount of trench opened in advance or left open after pipe laying.

2. EXCAVATION:

Trench excavation shall be to the lines and grades shown on the plans or standard details or as required by the specifications for the line work to be installed therein. The City inspector may direct or authorize deviations where appropriate at his discretion. Excavation for structures shall be sufficient to accommodate forms, where required. Overdepth excavation shall be avoided. All excavation, regardless of the materials encountered, shall be unclassified so far as payment is concerned.

3. METHODS OF EXCAVATION:

Excavation may be performed with any type of trenching or excavating equipment which is capable of cutting properly aligned trenches in whatever materials are encountered. All excavation shall be by open cut unless specifically required to be bored. Blasting will be permitted only when or where specifically approved by the City Manager in writing, and only in the manner specifically approved. Blasting shall conform to all Federal and State laws and Municipal Ordinances. When necessary to prevent caving or unduly hazardous working conditions, trench walls shall be sheathed and braced or shall be layed back from a point six (6) inches above the pipe. Where sheathing and bracing are used, sheathing shall remain in place until the pipe has been installed, tested for leaks and defects, repaired if necessary, and the earth backfill completed to a depth of two (2) feet unless ordered by the Public Works Department to be left in place (see also section on Trench Safety).

If trenching for utilities indicates seepage of ground water into the area under the road bed, subsurface drainage as approved by the Public Works Department shall be installed.

4. EXCAVATED MATERIALS:

All excavated material shall be piled in such a manner that it will not endanger the work in progress and will avoid blocking sidewalks and driveways or obstructing traffic. Driveways must be immediately cleared to permit free access. Gutters and drainage channels shall be kept clear, or other means of securing proper drainage shall be provided.

5. DEWATERING:

Where ground water is encountered, the water table shall be lowered so that all necessary work may be carried on in the dry. The water shall be kept down until the unit or section under construction is completed. No water shall be allowed to flow through or over unset concrete or through the completed line.

6. **USE OF WASHED GRAVEL:**

Where ground water is encountered, four (4) inches of washed gravel will be placed the full width of the trench in lieu of the granular embedment upon which the pipe will rest. The Public Works Department will direct the Contractor when and where to place washed gravel.

7. **EXISTING STRUCTURES:**

At the expense of the Contractor, all existing structures, improvements and utilities shall be adequately protected from damage that may occur due to construction operations. Where construction comes in close proximity to existing structures or utilities, or if it becomes necessary to move services, poles, guy wires, pipelines or other obstructions, the Contractor shall notify and cooperate with the utility or structure owner.

8. **EXCAVATION:**

(A) Procedure:

Excavate as indicated or specified line and grade.

Excavate by open cut with trenching machine or backhoe. Do not use excavated material composed of large chunks or clods for backfill, but dispose of such material and provide other suitable material for backfill without additional expense.

During excavation, pile material suitable for backfilling in an orderly manner far enough from the bank of the trench to avoid overloading, slides or cave-ins.

Remove from site all excavated materials not required or suitable for backfill. Loading and transportation of waste material shall be included in contract price and no additional payment will be made.

Grade as necessary to prevent surface water from flowing into trenches or other excavations.

(B) Trench Excavation:

Cut banks of pipe trench as nearly vertical as practical in the pipe zone without violating the requirements for the trench safety system. Remove stones as necessary to avoid point-hearing. Overexcavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe.

Dig the trench the proper width as shown. If the trench width below the top of pipe is wider than specified in this section or shown on the plans, then the Contractor shall install higher class of pipe and/or improved bedding as determined by the Public Works Department. No additional payment will be made.

Accurately grade the trench bottom to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except where necessary to excavate for bell holes and for proper sealing of pipe joints. Dig bell holes and depressions for joints after the trench bottom has been graded. Make bell holes and depressions for joints no deeper, longer or wider than needed to make the joint properly.

If any excavation is carried beyond the lines and grades required or authorized, the Contractor shall, at his own expense, fill such space with concrete or other suitable material as directed by the Engineer. No additional payment will be made.

The excavation of trench shall not advance more than 100 feet ahead of the completed pipe work except where specifically authorized by the Public Works Department.

(C) Sheeting and Bracing:

Install, in trenches and other excavations with vertical sides, sheeting and bracing necessary to support the sides. Sheeting and bracing shall be so installed as to place no undue or damaging strain on uncompleted work. Any damage resulting from settlement or lack of bracing shall be repaired by the Contractor at his own expense.

The sides of all trenches shall be securely held by bracing and sheeting which may be removed in units when the level of backfilling has reached the elevation necessary to properly protect the work and adjacent property.

When sheeting or shoring cannot be safely removed, it shall be left in place. Timber left in place shall be cut off at least 2 feet below the surface.

(D) Pipe Zone:

The pipe zone is defined as including the pipe bedding, backfill to one-half the pipe diameter (to the springline) and the initial backfill to 12 inches above the top of the pipe.

9. **BACKFILL:**

Backfill shall be of three types: Select bedding, Select Backfill and Common Backfill.

(A) Select Bedding:

Select bedding shall be used under, around, and over all utility lines in accordance with the standard detail for "Trench and Embedment Detail". Select Bedding shall be defined as follows:

(1) Sand or Mixed Sand and Pea Gravel

Free flowing sand or mixed sand and pea gravel that is free of stone, organic material or clay and which material shall not form mud or muck when wet. This material may be an inferior grade or "pit-run" sand not normally considered satisfactory for construction purposes, and it may be used directly from pits without processing. No fine granular material will be installed by the Contractor without the Public Works Department's approval.

(2) Pipe Bedding Stone

a). Pipe bedding stone shall be clean, well graded gravel, crushed gravel or crushed limestone free of mud, clay, vegetation or other deleterious material conforming to ASTM C33 for stone quality. Size graduation shall conform to ASTM C33 No. 57 or No. 67 or the following:

b).	<u>Sieve Size</u>	<u>Percent Retained by Weight</u>
	1- 1/2"	0
	1"	0-10
	1/2"	40-85
	#4	90-100
	#8	95-100

(3) Pea Gravel

Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C33. Size shall be as follows:

	<u>Sieve Size</u>	<u>Percent Retained by Weight</u>
	3/4"	0
	1/2"	0-25
	1/4"	90-100

Compaction of Select Bedding by flooding will not be permitted.

"Crusherfines" do not constitute approved Select Bedding material.

Crushed stone or gravel shall not be used with polyethylene film wrap.

Accurately grade the bottom of the trench 6 inches below the elevation of the normal pipe installation and limit clear space on either side of the pipe as shown on the drawings. Place and compact 6 inches of select bedding material in the trench before the pipe is laid. Install the pipe and place additional bedding material to 12-inches above the top of pipe.

Water in Excavation:

The Contractor shall, at all times, take such precautions as are necessary to keep the work free from ground or surface water. Pumps of adequate capacity or other approved method shall be provided to remove water from the excavation in such a manner that it will not interfere with the progress of the work or the proper placing of other work. Water shall be discharged to a stream or storm sewer as designated by the Public Works Department. Ground or surface water will not be allowed to drain into or be pumped into an existing sanitary sewer system. If the work includes connection to an existing sanitary sewer, a temporary watertight plug must be installed and maintained within the pipe for the duration of the contract and bedding material interrupted in a manner approved by the Engineer to isolate new construction from the existing system. All costs of handling the water shall be included in the bid item and no additional payment shall be made.

(B) Select Backfill in Streets and Drives

Select backfill shall be used for the total depth immediately below the base material and above the select bedding material of streets or other areas to be paved. Select backfill shall be of generally granular type material such as base material, road gravel, sand or sandy gravel, free of trash and spongy or otherwise objectionable material (approved by the Public Works Department) and shall have a Plasticity Index of not more than ten (10). Select backfill shall contain no rock larger than three (3) inches in its greatest dimension. Not more than fifty (50) percent of the

material shall rock, and more than ten (10) percent shall be as large as three (3) inches. Not more than twenty-five (25) percent shall be clay or clay lumps.

- (1) In the pipe zone, deposit bedding material in layers 6 inches or thinner. Compact each layer to 95 percent of AASHTO Density, Test Method T-99.
- (2) Above the pipe zone, select backfill soil material to be deposited in 12-inch layers, each layer compacted to 95 percent AASHTO Density, Test Method T-99. Place compacted soil material to within 0.5 feet of finished pavement surface.

(C) **Common Backfill:**

In areas outside of streets and drives, trench backfill above select bedding material may be accomplished with the use of excavated material if the material is suitable for compaction and contains only an occasional rock up to five (5) inches in its greatest dimension.

- (1) In the pipe zone, place bedding material evenly and carefully around and over pipe in layers no thicker than 6 inches. Compact with mechanical hand tampers to 95 percent AASHTO Density, Test Method T-99, until there is a cover of not less than 1 foot over utility lines. Use selected backfill material of optimum moisture content. Take special care not to damage pipe wrapping or coating.
- (2) Above the pipe zone, deposit select backfill in 12-inch layers. Compact each layer to 90 percent AASHTO Density, Test Method T-99.
- (3) All forms, lumber, trash and debris shall be removed from manholes and other structures. Backfill shall be placed symmetrically on all sides in layers no thicker than 8 inches. Each layer shall be compacted to 90 percent AASHTO Density, Text Method T-99.

10. PAVEMENT REPAIR:

Existing pavement shall be precut, sawed or scored so as to result in an event, straight cut. After completion of the trench backfill, and upon approval of the Engineer, on all paved streets other than gravel streets, the Contractor shall cut and excavate the surface and base of the streets back on each side of the trench to form a shoulder for the new base and surfacing. The base, if stone, shall then be replaced in three (3) inch layers tamped in place. On gravel streets, six (6) inches of road gravel shall be rolled in place to serve as a wearing surface. All cutbacks shall be to a neat, straight line, and the paving cut shall be made with a concrete saw and shall be parallel to the center line of the pipe. Where excess surfacing has been removed beyond the nominal limits of the ditch, such areas shall be kept to a minimum, and where excess of such areas shall be cut parallel to the pipe. All stone or gravel base or surface course shall be compacted to ninety-five (95) percent of AASHTO Density, Test Method T-99.

In all paved streets the trench shall be finished in a workmanlike manner with the same type of roadway which was removed so that the underlying courses, as well as the wearing surface, shall conform to the remainder of the roadway and shall be equal in every respect to the improvements existing prior to excavation.

TECHNICAL SPECIFICATIONS

ITEM 2 – CONCRETE

1. DESCRIPTION:

The requirements of this item shall govern for all concrete for structures, curb and gutter, and incidentals or miscellaneous construction.

Concrete shall be composed of Normal Portland Cement or High Early Strength Cement, coarse aggregate, fine aggregate and water proportioned and mixed as hereinafter provided in these specifications.

2. MATERIALS:

- (A) Only one brand of cement shall be used in any one (1) structure, except by written permission of the Public Works Department. When such permission is granted and more than one (1) brand is used in one (1) structure, the resulting concrete shall be uniform in color.

Portland Cement shall meet the requirements of the current Standard Specifications for Portland Cement of the ASTM Designation C-150, Type I, for Normal Portland Cement, Type III for High Early Strength Portland Cement and Type II will have a maximum of five (5) percent tricalcium aluminate for exposure to sewage.

All cement shall be sampled and tested in accordance with the current Standard Methods of Sampling and Testing Portland Cement of the ASTM Designation C-183, C-184, C-188, C-190 and C-191.

(B) Mixing Water

Water for use with cement shall be clean and free from injurious amounts of oil; acid, alkali, salt, organic matter or other deleterious substances and meeting the requirements of ASTM C94. Water from doubtful sources shall not be used until tested and approved.

Water which is suitable for drinking or for ordinary household use may be accepted for use without being tested.

(C) Coarse Aggregate

Coarse aggregate shall consist of gravel or crushed stone meeting the requirements of the current ASTM Specifications C-33.

When tested by the Standard Method for Testing for Abrasion of Coarse Aggregate by use of the Los Angeles Testing Machine, ASTM Designation C-131, coarse aggregate shall have a percentage of wear of not more than forty (40).

Coarse aggregate for Class F concrete shall have a minimum of fifty (50) percent calcium carbonate equivalent.

When tested by approved methods, the coarse aggregate shall conform to the following grading requirements:

Maximum Size Aggregate

1 1/2"

Retained on 1 1/2" screen	0 to 5%
Retained on 3/4" screen	25 to 60%
Retained on 1/4" screen	95 to 100%

1"

Retained on 1" screen	0 to 5%
Retained on 1/2" screen	25 to 60%
Retained on 1/4" screen	95 to 100%

(D) Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof, conforming to the current ASTM Specification C-33.

When tested in accordance with the Standard Method of Test of Organic Impurities in Sands for Concrete, ASTM Designation C-40, the fine aggregate shall not show a color darker than the standard color.

When tested by approved methods, the fine aggregate shall conform to the following grading requirements.

Retained on 3/8" screen	0%
Retained on 1/4" screen	0 to 5%
Retained on 20 mesh sieve	15 to 50%
Retained on 100 mesh sieve	85 to 100%

(E) Concrete Admixtures

- (1) Water Reducing Agent shall conform to ASTM C-494 Type A, and shall have a dosage as recommended by the manufacturer. Admix shall be Pozzoloth by Master Builders Co.; WRDA by W.R. Grace; PSI by Gifford Hill & Company or approved equal.
- (2) Set Retarding Agent: When, in the opinion of the Engineer, the ambient or concrete temperature requires the use of a set retarding admixture, such admix shall conform to ASTM C-494, Type D. Admixtures shall be PSI-R by Gifford Hill; Daratard by W.R. Grace, or approved equal.
- (3) Air Entaining Admixture shall be used where specified or directed to improve workability and increase resistance to freeze and thawing, and scaling. The admix shall comply with ASTM C 260 and shall be used in accordance with manufacturer's recommendations. Products shall be Air-Tite by Gifford Hill; Daravair by W.R. Grace; MB-VR by Master Builders, or approved equal.

The total air content of the concrete shall be three percent to six (6) percent.

(F) Curing and Sealing Compound

All concrete shall be cured and sealed with a continuous acrylic membrane forming compound meeting the requirements of ASTM C-309. Curing compound shall be applied as soon as practical after placement of concrete and shall be used in accordance with the manufacturer's recommendations: Products shall be Sealco 309 by Gifford-Hill; Horn Clear Seal by W.R. Grace and Company, or an approved equal.

(G) Bonding Agent

Bonding agent shall be a liquid polymer latex compound such as Daraweld-C manufactured by W.R. Grace and Company or an approved equal.

(H) Fiber

(1) Add steel or polypropylene fibers only when called for on the plans or approved by the Public Works Department:

(2) Polypropylene Fiber:

- a). Ratio: 1.5 pounds of fiber per cubic yard of concrete.
- b). Physical Properties:
 1. Material: Polypropylene.
 2. Length: 3/4 inch.
 3. Specific Gravity: 0.91.
 4. Absorption: None.
 5. Tensile Strength: 70-110 Ksi.
 6. Modulus of Elasticity: 500 Ksi.
 7. Melt Point: 140 degrees F (60 degrees C).
 8. Flash Point: 932 degrees F (500 degrees C).
 9. Density: 3.pounds/cubic yard.
- c). Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.

(3) Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A820.

- a). Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
- b). Physical Properties
 1. Material: Steel.
 2. Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1.
 3. Specific Gravity: 7.8.
 4. Tensile Strength: 40-400 ksi.
 5. Young's Modulus: 29,000 ksi.
 6. Minimum Average Tensile Strength: 50,000 psi.

7. Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to an angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking.

(I) Formwork Materials

- (1) Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair the finished surface of concrete. Use 545 lumber for facing or sheathing. Forms for bottoms of caps: At least 2-inch (nominal) lumber, or $3\frac{1}{4}$ -inch form plywood backed adequately to prevent misalignment. General use: Provide lumber of 1-inch nominal thickness or form plywood of approved thickness.
- (2) Formwork for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of $1\frac{1}{4}$ -inch minimum thickness, preferably oiled at the mill.
- (3) Chamfer Strips and Similar Moldings: Redwood, cypress or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.
- (4) Form Ties: Metal or fiberglass of approved type with tie holes not larger than $\frac{7}{8}$ inch in diameter. Do not use wire ties or snap ties.
- (5) Metal Forms: Clean and in good condition, free from dents and rust, grease or other foreign material that tend to disfigure or discolor concrete in a gage and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present a smooth surface and which line up properly.

(J) Production Methods

Use either ready-mixed concrete conforming to requirements of ASTM C94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685.

(K) Reinforcing Steel

- (1) Bar Steel: All bar reinforcement shall be open hearth new billet steel of structural, intermediate, or hard grade. New billet steel shall conform to the requirements of the latest Standard Specification for Billet-Steel Concrete Reinforcement Bars, ASTM Designation A615, A767 or A775, grade 40 or grade 60.

Unless otherwise shown on the plans, all reinforcing bars shall be deformed bars. Twisted bars are not considered as deformed bars and will not be used. The form of deformed bars shall be such as to provide a net sectional area at all points equivalent to that of the plain round bars of equal nominal size.

- (2) Wire Fabric: Wire for fabric reinforcement shall be cold-drawn from rods hot rolled from open hearth billets. Wire shall conform to the requirements of the latest Standard Specification for Drawn Wire for Concrete Reinforcement, ASTM Designation A-185 or A884.

(3) Wire: ASTM A82. Use 16½ gauge minimum for tie wire, unless otherwise indicated.

(L) Premolded Expansion Joint Filler shall conform to the requirements of ASTM Designation D-994 or other as approved by City Engineer.

3. EQUIPMENT:

The Contractor shall obtain the Inspector's approval of all concrete mixing, handling and transporting equipment before any pour of concrete is commenced. Such approval will not relieve the Contractor of his responsibility for providing adequate equipment to carry on satisfactorily the project operations.

4. BATCHING AND MIXING:

All batching and mixing of concrete materials shall conform to ACI 304-73 "Recommended Practice for Measuring, Mixing and Placing Concrete". All materials shall be measured separately and accurately and batches shall be uniform. The coarse and fine aggregate shall be measured or weighed, loose and separately.

When transit mix concrete is used, the delivery of concrete shall be continuous at regular and uniform intervals, without stoppages or interruptions. Transit mix concrete shall not be placed in the job after a period of forty-five (45) minutes after the cement has been placed in the mixer.

5. CONSISTENCY:

In general, the consistency of concrete mixtures shall be such that:

- (A) The mortar will cling to the coarse aggregate.
- (B) The aggregate will not segregate in the concrete when it is transported to the place of deposit.
- (C) The concrete and mortar will show no free water when removed from the mixer.
- (D) The surface of the finished concrete will be free from a surface film of "laitance".

Any concrete mix failing to meet the above outlined consistency requirements, although meeting the slump requirements will be considered unsatisfactory, and the mix shall be changed to correct such unsatisfactory conditions.

6. CLASSIFICATION AND PROPORTIONS:

Concrete shall be proportioned as determined by the Inspector. The total volume of materials in the concrete mixture shall be so regulated that the cement content per cubic yard of concrete shall not be less than the minimum specified for that class of concrete.

- (A) The concrete shall be uniform and workable and the minimum cement content, maximum water content, and the maximum slump for the various classes of mixes shall conform to the following:

Class	Min. Cement Bags/C.Y.	Max. Size Coarse Ag. (Inches)	Max. Water Gals./Bag (Net)	Max. Slump (Inches)
A	5.5	1 ½	6 ¾	5
B	5.0	1 ½	7	4
C	6.0	1	6 ¼	5
D	6.5	1 ½	6 ¼	5
E	3.0	1 ½	6 ¼	4
F	6.0	1 ½	5 ½	4

The maximum amount of coarse aggregate (dry loose volume) per cubic foot of finished concrete shall not exceed zero-point-eighty-two (0.82) cubic feet.

The maximum amount of water, as set forth in the table above, is based upon the assumption that the aggregates are in a saturated, surface dry condition.

- (B) It shall be the responsibility of the Contractor to furnish the mix design, using a Coarse Aggregate Factor acceptable to the City, for the class (es) of concrete specified. The mix shall be designed by a certified testing laboratory to conform with the requirements contained herein and in accordance with ASTM C1077. The Contractor shall perform, at his own expense, the work required to substantiate the design, and testing of concrete strength. Complete concrete design data shall be submitted to the City for approval.

The concrete mix will be designed with the intention of producing concrete which will have compressive or flexural strength equal to or greater than the following when using current ASTM Designation C-39 and C-293.

Class of Concrete	Compressive Strength (Pounds per Square Inch)		Flexural Strength (Pounds Per Square Inch)	
	7-Day	28-Day	4-Day	7-Day
A	2,000	3,000	400	500
B	1,700	2,500	350	425
C	2,000	3,000	400	500
D	2,000	3,000	400	500
E	1,000	1,500	150	250
F	2,700	4,000		

- (C) The following class of concrete will be used as shown, unless otherwise specified:

Class Use

- A Formed Structures, such as: Walls, Decks, Structural Foundations, Floor Slabs, Paving, Culverts, Storm Sewer Manholes and Inlets, except Water Retaining Walls and Structures exposed to sewage.

- B Unformed Structures, such as: Riprap, Sidewalks, Curb and Gutter, Gutter, Valleys, Exposed Encasement or as noted on Plans.
- C Drilled Shafts and Thin Wall Sections, Formed Septum Walls.
- D Railings, Stairs and Unformed Foundation Seals.
- E Confined Cradling, Blocking, Backfill, Unexposed Encasement Below Grade, or Backfill.
- F Structures Exposed to Sewage and Water Retaining Walls.

In order to obtain a more workable mix and denser concrete, there shall be added as a part of the concrete for Class "A" and Class "F" concrete a cement dispersing or water reducing agent conforming to ASTM Specification C-494, Type A. The agent shall be added in accordance with the manufacturer's recommendations.

The quantity of water to be used shall be determined by the Engineer and shall be such as to give a mixture containing the minimum amount of water consistent with the required workability. The quantity of water shall be varied only by the Engineer.

7. QUALITY OF CONCRETE:

Quality of Concrete: During the progress of the work the Inspector may cast test cylinders or beams for testing to maintain a check on the compressive or flexural strength of the concrete actually placed.

Test beams or cylinders shall be required for each fifty (50) cubic yards or portion thereof, placed each day. On small structures, such as manholes, inlets, culverts, wing-walls, etc., the Inspector may vary the number for small placements to tests for each twenty-five (25) cubic-yards placed over a several-day period.

8. GENERAL CONSTRUCTION REQUIREMENT FOR CONCRETE STRUCTURES:

- (A) Prior to starting work the Contractor shall inform the Inspector as to the methods of construction and the amount and character of equipment he proposes to use, the adequacy of which shall be subject to the approval of the Inspector.
- (B) Forms and falsework to be used in the construction of the various units of a structure shall be in accordance with all governing safety requirements and shall be the responsibility of the Contractor.
- (C) Approval by the Inspector of *construction* methods, equipment, or form and falsework plans will not relieve the Contractor of responsibility for the safety or correctness of methods used, adequacy of equipment, or from carrying out the work in full accordance with the contract.

9. CONCRETE DELIVERY:

The rate of delivery of transit mixed concrete shall be so arranged that a cold joint is not allowed to form between loads. Concrete shall be hauled in vehicles so

constructed and operated to provide constant agitation during transportation. Concrete improperly mixed shall not be placed in the structure.

The transit mixer shall be of an approved revolving drum or revolving blade type so constructed as to produce a thoroughly mixed concrete with a uniform distribution of the materials throughout the mass and shall be equipped with a discharge mechanism which will insure the discharging of the mixed concrete without segregation.

The mixer drum shall be water-tight when closed and shall be equipped with a locking device which will automatically prevent the discharging of the mixer prior to receiving the required number of revolutions.

The entire quantity of mixing water shall be accurately measured and controlled. Each batch shall be mixed to the consistency as described in paragraph 5 above. Any additional mixing shall be done at a slower speed specified by the manufacturer for agitation and shall be continuous until the batch is discharged.

10. CONCRETE JOINTS:

Construction joints shall be placed as shown on the plans unless otherwise specifically authorized by the Engineer, in which case the joints shall be so placed and formed as to least impair the strength and appearance of the structure. All construction joints shall be made on horizontal and vertical planes and formed with mortises or keys made in the concrete unless shown otherwise on the plans.

11. FORMS:

Nominal one (1) inch lumber surfaced to a uniform width and thickness will be permitted for general use on the various portions of structures, if backed by a sufficient number of studs and wales.

Forms shall be mortar tight, and of sufficient strength to prevent bulging between supports. Forms shall be maintained to the lines designated until the concrete is sufficiently hardened to permit form removal and until the minimum time for forms to remain in place has elapsed in accordance with ACI Standard 318-71 "Building Code Requirements for Reinforced Concrete (AS1318-71)".

Where corners occur, suitable chamfer strips shall be placed at the angle of the forms to round off or level them. All forms shall be constructed so as to permit removal without injuring the concrete. At the time of placing concrete, the forms shall be clean and entirely free of all chips, dirt, sawdust, and other extraneous matter.

For thin wall sections and other locations where access to the bottom of the forms by other methods would be cumbersome and inadequate, clean-out opening shall be provided.

Only spreaders approved by the Inspector shall be used.

Metal form ties of an approved type shall be used to hold forms in place. Such ties shall be of a type especially designed for use in connection with concrete work, and they shall have provision to permit ease of removal of the metal as hereinafter specified. The use of metal form ties of a type that are encased in paper or other

materials to allow the removal of the complete tie, leaving a hole through the concrete structure, will not be permitted. Metal ties shall be held in place by devices attached to walls. Each device shall be capable of developing the strength of the tie.

All cavities produced by the removal of metal ties shall be carefully cleaned and completely filled with retempered sand cement mortar mixed in proportion of one to three, and the concrete shall be left smooth and even.

12. PLACING CONCRETE:

(A) General

The Contractor shall give the Inspector at least twenty-four (24) hours advance notice that he intends to pour concrete in any unit of the structure. The mixing of concrete and placing of same in the forms shall not be commenced until the Engineer has given his approval. No concrete shall be placed in any unit prior to completion of the form work and the placement of the reinforcing and other steel.

Where the Contractor's operations involve the placing of concrete from above directly into an excavated area or through the completion of forms, all concrete so placed shall be deposited through a vertical sheet metal or other approved pipe or tremie not less than six (6) inches nor more than ten (10) inches in diameter. The pipe shall be made in sections so that the outlet may be adjusted to proper heights during placing operations.

Concrete shall be placed in continuous horizontal layers approximately (12) inches in thickness. The rate of delivery shall be so arranged that a cold joint is not allowed to form between loads. The Contractor shall avoid unauthorized construction joints by placing required portions of abutments, piers, walls, floors, slabs columns or superstructures in one continuous operation. As a safety precaution, openings in the forms shall be provided for the removal of laitance and other foreign material.

All concrete shall be well compacted and the mortar flushed to the surface of the forms of continuous working with concrete spading implements and mechanical vibrators of an approved type. Vibrators of the type which operate by attachment to forms or reinforcement will not be permitted. The vibrators shall be applied to the concrete immediately after deposit and shall be moved throughout the mass, thoroughly working the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms until it has been reduced to a plastic mass. The mechanical vibrator shall not be operated so that it will penetrate or disturb layers placed previously which have become partially set or hardened. The vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures, but shall not be done to an extent that will cause segregation. Vibration shall be supplemented by hand spading to insure the flushing of mortar to the surface of all forms.

(B) Foundation and Footings

Concrete shall not be placed in footings until the depth and character of the foundation has been inspected and permission has been given to proceed.

Concrete in deep foundations shall be placed in a manner that will avoid separation of the aggregates or displacement of the reinforcement. Suitable chutes or vertical pipes shall be provided.

When footings can be placed in dry foundation pits without the use of cofferdams or caissons, forms may be omitted, if desired by the Contractor and approved by the Engineer, and the entire excavation filled with concrete to the elevation of the top of the footing.

(C) Weather Conditions for Placement

No concrete shall be placed when the atmospheric temperature is at or below forty (40) degrees F (taken in the shade away from artificial heat) unless permission is given or in cases where the temperature drops below forty (40) degrees F after the concreting operations have been started.

The Contractor shall furnish sufficient canvas and frame work or other type of housing to enclose and protect the structure in such a way that the air around the forms and fresh concrete can be kept at a temperature not less than fifty (50) degrees F for a period of five (5) days after the concrete is placed.

Sufficient heating apparatus such as stoves, salamanders, or steam equipment and fuel to furnish all required heat shall be supplied.

(D) Installation of Premolded Expansion Joint Filler shall be made where indicated, and the filler shall extend through the entire section of the structure.

13. **FINISHING:**

(A) Slabs, Valve Vault, Tops, Etc.

As soon as concrete placing operations have been completed for a slab section of sufficient width to permit finishing operations, the concrete shall be approximately leveled and then struck, off, tamped, and screeded using a longitudinal screed. The screed shall be of a design adaptable to the use intended, shall have provisions for vertical adjustment, and shall be sufficiently rigid to hold true to shape during use.

The initial strike off shall leave the concrete surface at an elevation slightly above grade so that, when consolidation and finishing operations are completed, the surface of the slab will be at the grade elevation shown on the plans with proper allowance for finished camber when required.

Tamping and screeding operations shall be continued until the concrete is properly consolidated and the surface voids are eliminated. The surface shall then be brought to a smooth true alignment by means of longitudinal screeding, floating, betting, and/or other methods approved by the Engineer. When templates are used, they shall be of such design as to permit early removal in order to avoid construction joints and to permit satisfactory finishing at and adjacent to the site of the template.

While the concrete is still plastic, the surface shall be straightedged by the use of a standard ten (10) foot metal straightedge. Deviations in excess of permissible variations shall be corrected. The final surface finish of the slab

shall be done after the initial straightedging, and corrective adjusting, if required, is completed, as specified hereinafter.

(B) Formed Surfaces

Immediately after forms are removed, the formed surfaces shall be finished as follows:

- (1) Any honeycomb areas shall be chipped out to firm concrete and thoroughly cleaned of chips and particles of broken concrete. A bonding agent shall then be applied to the entire surface of the cavity, and the cavity packed with a relatively dry mortar of the same sand-cement ratio as the concrete mix used in the structure. The mortar shall be thoroughly compacted to insure complete filling of the cavity and the surface struck off to match the surrounding concrete.
- (2) Exterior surfaces that will be more than one (1) foot below grade will require no further finish.
- (3) Exterior surfaces to be exposed to view and to a point one (1) foot below finish grade, and interior exposed surfaces, shall be finished as follows:

All fins, form marks or offsets, and other protrusions shall be removed and surface voids shall be filled or pointed with grout. After the pointing has dried sufficiently to permit rubbing, all surfaces shall be wetted and given a surface rubbing with a No. 16 Carborundum stone or an abrasive of equal quality. The rubbing shall be continued sufficiently to bring the surface to a paste, to remove all form marks and projections, and to produce a smooth dense surface without pits or irregularities. The material that has been ground to a paste shall be carefully spread or brushed uniformly over the surface and allowed to take a set. The use of cement to form a surface will not be permitted.

(C) Floor and Slab Finishes

Finish treatment of floors and slabs to be provided after the initial treatment specified under "A" above shall be as follows:

(1) Sidewalks

The sidewalk shall be floated with a steel trowel to provide a smooth, burnished surface. After floating and before the finish has set, the surfaces shall be lightly brushed with a fine brush to remove the surface.

(2) Concrete Valleys, Driveways, Vault Tops and Floors, Etc.

After the initial treatment specified in "A" above, and after the surface has become firm, the surface shall be given a single floating with a wood float to provide a uniform surface.

(3) Other slab surfaces shall be finished with one of the above finishes, or not finished, as otherwise specified or as approved by the City Inspector.

14. CURING CONCRETE:

Immediately after finishing, all upper non-formed surfaces shall be covered with a continuous, uniform, water impermeable coating. Immediately after removal of the side and end forms of non-exposed surfaces, and after required finishing of exposed surfaces, the formed surfaces of all concrete shall receive a like coating. The solution shall be applied under pressure with a spray nozzle in such a manner as to cover the entire exposed surface thoroughly and completely with a uniform film.

The rate of application shall be such as to insure complete coverage, but the area covered shall not exceed two hundred (200) square feet per gallon of curing compound.

The coating shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from that of the natural concrete at the conclusion of the curing period. It shall, however, contain a fugitive dye of color strength to render the film distinctly visible on the concrete for a period of at least four (4) hours after application.

Under normal conditions, the curing compound, after application, shall dry to touch within one (1) hour and shall dry thoroughly and completely within four (4) hours. When thoroughly dry, it shall provide a continuous flexible membrane free from cracks or pinholes and will not disintegrate, check, peel, or crack during the required curing period. If for any reason the seal is broken during the curing period, it shall be immediately repaired with additional sealing solution.

TECHNICAL SPECIFICATIONS

ITEM 3 – WATER SYSTEM

1. GENERAL:

The Contractor shall be responsible for furnishing all materials and accomplishing all work necessary for the construction of new water lines in accordance with approved plans and in conformance with the following requirements. He shall also be responsible for the construction of service lines from the main to the meter box location behind the curb. The Contractor shall make all required connections to existing lines. All plans and specifications shall conform to the current Rules and Regulations for Public Water Systems of the Texas Commission on Environmental Quality (TCEQ) and to these Specifications as they may be amended. Water lines shall not be located closer than nine (9) feet from sewer lines. Where water lines cross sewer lines, the water line shall crossover the sewer line, if possible with minimum separation distance as required by TNRCC. All work will be subject to inspection by an authorized representative of the City and no work will be accepted until all construction, testing, flushing, and disinfection has been completed in accordance with the applicable plans and these specifications and to the satisfaction of the Public Works Department. Any work found not to be acceptable shall be removed and replaced at the Contractor's expense. The Contractor shall notify the Public Works Department prior to starting work and prior to covering any water lines in place.

2. WATER SYSTEM REQUIREMENTS:

Refer to the following standard specification items herein for additional water system requirements:

<u>ITEM</u>	<u>DESCRIPTION</u>
6	Pipe
8	Concrete encasement and encasement pipe
9	Jacking or boring pipe
10	Bulkheads
11	Adjusting Structures
12	Manholes
13	Frames, grates, rings and covers
14	Finish grading, topsoil and revegetation
15	Trench safety systems

3. **MATERIALS:**

Approved materials for water line construction shall conform to requirements specified below. All materials shall be designed for 150 psi working pressure unless water distribution system pressures dictate higher classifications of water pipe. All new water lines shall be a minimum of eight (8) inches in diameter. Pipe for water lines shall be Polyvinyl Chloride (PVC) or Ductile Iron.

- (A) Polyvinyl Chloride Water Pipe – Pipe shall be C-900 or C-905. Refer to standard specification Item 6, "Pipe".
- (B) Ductile Iron Water Pipe – Refer to standard specification Item 6, "Pipe".
- (C) Gate Valves – Gate valves shall be resilient wedge type open left (counter clockwise) with adjustable cast iron box and cover in raised letters with cast on cover. All tees, crosses and connections shall have gate valves at locations determined by the City. For tees, there shall be two valves and for crosses there shall be two valves and for crosses there shall be 3 valves. Approved manufacturers are Mueller, Crow, M & H and American. Refer to standard specification Item 7, "Water Valves".
- (D) Fire Hydrants – Fire hydrants shall be either Mueller Centurion, Clow Medallion or American Darling having a dry barrel and a six (6) inch inlet with a five and one-quarter (5 1/4) inch main valve opening. with one (1) pumper connection and two (2) hose nozzles, and shall conform to the requirements of AWWA Specification C502 except that the barrels shall have a frangible section at the ground level for break off upon impact. Hydrants shall open by turning counterclockwise. Barrels shall be for thirty-six (36) inch bury. Extensions shall be provided where necessary to attain the proper height setting of hydrants. The inlet shall be a mechanical joint.

Any fire hydrant placed inside the City shall be placed on block corners or near the center of the block in such a manner as to place all of every lot within a radius of 500 feet of a fire hydrant in residential areas and within a radius of 300 feet in commercial or industrial areas. Hydrant should be placed so that the bottom flange of the body will be a minimum of three (3) inches above finish elevation and a nine (9) inch maximum. Refer to standard specification Item 7, "Water Valves".

- (E) Service Lines: Materials for service lines from mains to the meter box shall be as specified below. Short single services shall be a minimum of one (1) inch and short double services a minimum of two (2) inches. Long single services shall be a minimum of two (2) inch from main to 2"x1" brass 90° bend and one (1) inch from 90° bend to meter. Long double services shall be a minimum of two (2) inch from main to 2"x1" brass tee and one (1) inch from tee to each meter.
 - (1) One inch service tubing shall be copper conforming to ASTM Specification B88, Type K.
 - (2) Fittings for copper tubing shall be brass conforming to ASTM B62. Couplings for copper tubing shall be flare type. All fittings shall have threads conforming to the following:

Coupling ends to be connected to iron pipe shall have thread dimensions conforming to Table 3 of ASA B2.1, American Standard Pipe Threads.

- (3) Two inch service pipe shall be PVC, Schedule 80 (200 PSI).
 - (4) Corporation Cocks (stops) shall be Ford B11-677-QT67 or equivalent, having a male threaded inlet and a compression outlet.
 - (5) Curb or Meter Stops: For single service connections, curb stops shall be Jones J-1965 W (with lockwing head) or equivalent.
- (F) Hydrostatic pressure test – Refer to standard specification Item 6, "Pipe".
- (G) Disinfection – Refer to standard specification Item 6, "Pipe".

4. EXCAVATION, TRENCHING AND BACKFILL:

Excavation, Trenching, and Backfill, including pipe bedding, shall conform to the applicable provisions of Item 1, Trenching and Backfill, and to the applicable Trenching and Backfill details. Walls of trenches shall be vertical to a minimum distance of twelve (12) inches above the top of the pipe. Minimum depth of cover shall be three (3) feet over the top of the pipe, except that minimum cover on top of service lines shall be at least eighteen (18) inches below the top of subgrade.

5. PIPE HANDLING:

Handling of pipe during unloading, stockpiling, and distribution along the trench shall be done in such a manner that the pipe or coating is not damaged by handling equipment which may cause cuts or indentations in the pipe or coating. Slings shall be used to handle all pipe and fittings; no hooks will be permitted.

Plastic pipe shall be stored on flat surfaces to avoid deformation of the pipe. Particular care shall be exercised during cold weather to avoid severe impact which may damage the pipe. Care should be exercised at all times to prevent entrance of dirt and foreign matter into the pipe.

All pipe, fittings, valves, hydrants and accessories should be carefully lowered into the trench using suitable equipment in such manner as to prevent damage to pipe and accessory items. Pipe and accessories should never be dropped or dumped into the trench.

Pipe and accessories should be inspected for defects and cleanliness prior to lowering into the trench. Any defective damaged or unsound material should be repaired or replaced and all foreign matter or dirt should be removed from the interior of the pipe and accessories before lowering into the trench.

Any unsound or damaged pipe, fittings, or specials shall be rejected and removed from the site unless, in the opinion of the Inspector, it is suitable for repair. Pipe or fittings approved for repair shall be repaired in accordance with the recommendations of the Inspector and the manufacturer of the pipe.

6. INSTALLATION:

The pipe shall be kept clean during the laying operation and free of all dirt and trash and, at the close of each operating day, the open end of the pipe shall be effectively sealed against the entrance of all objects and, especially, water. Pipe shall be laid to the lines and grades shown on the plans or otherwise approved. Horizontal and vertical curves may be effected by offsetting of the pipe joints where the radius of the curve exceeds the minimum radius recommended by the manufacturer of the pipe. Where the curve radius is less than the acceptable minimum for offsetting the pipe joints, bends shall be installed.

All pipe and fittings shall be laid on specified bedding so as to be uniformly supported along its entire length. No "blocking up" of pipe or joints will be permitted. Bell holes to allow making the exterior joint shall be provided.

~~Any~~ One pipe shall be installed in accordance with the pipe manufacturer's published recommendations.

7. SETTING FITTINGS:

The Contractor shall furnish and install all fittings at the points shown on the drawings, and as directed. Before installing any fittings, care shall be taken to see that all foreign material is removed from the interior. Fittings shall be placed in the lines as shown on the plans or directed by the Engineer and shall be firmly supported and anchored in accordance with the recommendations of the manufacturer of the pipe.

8. INSTALLATION OF GATE VALVES:

Valves shall be carefully handled and lowered into position by mechanical equipment in such a manner as to prevent damage to any part of the valve. The valve shall be placed in the proper position and held securely until all connections have been made.

Where valves are to be placed in a concrete structure the floor shall be completed before installing the valve. The valve shall be securely blocked so that its weight is carried by the floor rather than being supported by the connected piping.

Valves sixteen (16) inches and larger, which are not housed in structures shall be supported on concrete bases as detailed on the plans. Valves fourteen (14) inches and smaller, not housed in structures shall be supported on the same material as that supporting the connecting pipe. An adjustable cast iron valve box and cover shall be provided for all buried valves fourteen (14) inches and smaller, and all sixteen (16) inch valves installed in streets (including bypass valves), with stem extension when depth exceeds three (3) feet. The valve shall be set with the stem in a truly vertical position with the box correctly centered over the operating nut.

When the valve box is in position and the top of the box adjusted to the proper elevation, select backfill material shall be firmly tamped around the outside.

9. SETTING FIRE HYDRANTS:

The hydrant shall set truly vertical and be securely braced and blocked with concrete. It shall be set on a block of concrete at least one (1) foot square and six (6) inches thick placed on well compacted or undisturbed soil surrounded by a minimum of seven (7) cu. ft. of clean gravel or stone to permit free draining of the hydrant.

The six (6) inch fire hydrant lead shall be of such length as is necessary to reach from the main to the hydrant location, and at such depth as to permit the pipe being installed in a horizontal position, and the barrel of the fire hydrant being in a vertical position. The bury depth may vary, and care must be taken to select and install the proper length of fire hydrant extension as required.

A six (6) inch gate valve shall be installed in the six (6) inch hydrant lead between the fire hydrant and the main where shown on the plans.

After installation is complete, the Contractor shall apply two (2) coats of bright OSHA yellow machinery enamel, Sherwin Williams or approved equal.

10. INSTALLATION OF TWO INCH (2) AND SMALLER PVC LINES:

Fittings for two (2) inch PVC pipe shall be PVC of the same pressure class. Gate valves shall be bronze for two (2) inch diameter pipe and gate valves under two (2) inch shall be bronze body, as hereinbefore specified. All joints shall be compression type. Pipe ends shall be lubricated in accordance with the manufacturer's recommendation and pushed in to the proper depth as indicated by the reference mark on the pipe. Pipe may be jointed in the trench or above ground prior to placing in the trench. Bedding shall be used where rock is encountered in the trench or when directed by the Engineer. Pipe laid in earth trenches without rock need not have bedding if the backfill material is free of rock. Pipe shall be "snaked" in the trench when temperatures exceed seventy (70) degrees F to allow for contraction due to cooling, and the pipe should preferably be filled with water before backfilling.

11. WASTEWATER LINE CROSSINGS:

Whenever wastewater mains, laterals or service lines are encountered by trenching operations, the sewer pipe shall be replaced with one eighteen (18) foot joint of PVC pipe centered in the trench. The PVC pipe shall have solid bearing on undisturbed earth; at least eighteen (18) inches back from the face of the trench. The jointing and connection of the cast iron pipe to clay, PVC or concrete pipe shall be done in accordance with City standards. Upon completion of the joints they shall be completely surrounded with thoroughly compacted moist backfill.

12. CONCRETE BLOCKING AND CRADLE:

Concrete blocking (Class "E" Concrete) shall be placed at bends, tees, crosses and plugs in the pipe lines. The concrete blocking shall be placed so as to rest against firm, undisturbed trench walls, normal to the thrust. The supporting area for each block shall be at least as great as that indicated on the plans and/or standard details and shall be sufficient to withstand the thrust, including water hammer which may develop. Each block shall rest on a firm, undisturbed foundation or trench bottom. When tie downs are required, concrete shall be Class "A" or "B" and constructed as detailed and/or noted on the plans. Concrete cradle shall be Class

"E" concrete and shall be installed where shown on the plans in accordance with the standard details. Restrained joints may be used in lieu of concrete blocking, when approved by the Public Works Department.

13. INSTALLATION OF SERVICE LINES:

Service lines shall be of copper pipe as herein specified. Connections to water mains shall be made by tapping for cast iron pipe, and by the use of Jones #1979 bronze fitting.

Corporation stops shall be installed in all taps or service saddles with the lines connected to the corporation stop. Service lines shall be installed a minimum of eighteen (18) inches below subgrade and a minimum of twenty four (24) inches below finished grade without sharp bends or changes of direction. Particular care shall be taken to avoid kinking or excessive bending of either copper or plastic pipe during installation and the pipe shall be laid from side to side in the trench to provide for expansion and contraction. Lines shall extend to approximately two (2) feet in back of and one (1) foot below the top of the back face of the curb. Curb stops, meter couplings, and "U" branch connections shall be provided on the end of the line for future connection to the meter. Service lines in earth-trenches without rock will not require bedding. Where trenches are partially or entirely in rock, or where the backfill material contains rock, bedding a minimum of four (4) inches under and over the pipe shall be required. The curb shall be marked by an imprinted letter "W", three (3) inches in height, at the point where the service pipe passes under the curb.

Pressure testing and sterilization of service lines is not required, but prior to backfilling, the lines shall be filled under normal working pressure and observed for leaks. Backfill will not be placed over pipe until approved by the City Inspector.

When tapping into the City water main the tapping sleeve shall be a **stainless steel** wrap-around, either the Smith-Blair #663 (formerly Rockwell) or the Romac SST model.

The Contractor shall also furnish the City with the extracated piece of pipe from the tap known as the coupon.

14. CLEAN-UP:

Upon completion of the installation of the water lines, distribution systems and appurtenances, all debris and surplus materials resulting from the work shall be removed.

TECHNICAL SPECIFICATIONS

ITEM 4 – WASTEWATER SYSTEM

1. **GENERAL:**

This item includes the construction of both gravity sewers and force mains. Insofar as possible sewer systems shall consist of gravity lines and the use of lift stations and force mains shall be avoided. Design of sewer systems shall conform to the requirements of the Texas Commission on Environmental Quality (TCEQ). Design Criteria for Sewer Systems Construction shall conform to the requirements of these specifications. The Developer shall provide with his plat the plans and profiles for review of all sewer line work proposed and shall construct the sewer system in accordance with the approved plans. All plans shall contain the seal of a licensed registered engineer.

2. **ALIGNMENT AND GRADES:**

Sewers shall be laid in straight alignment and a uniform grade between manholes. If fittings have to be used a manhole must be placed for access. All lines shall be located a minimum of nine (9) feet horizontally from water lines, and where sewers cross water lines, they shall be constructed of pressure pipe for a distance of nine (9) feet on either side of the water line.

A minimum of 8 inch pipe shall be required. Wherever practiceable wastewater lines shall be 5 feet to 6½ feet deep in invert wherever practiceable. Crossings shall be under water lines where possible. Minimum grades as per Texas Natural Resource Conservation Commission requirements shall be:

Pipe I.D. in Inches	Fall in Feet Per 100 Ft.
6"	0.50
8"	0.33
10"	0.25
12"	0.20
15"	0.15
18"	0.11

3. Refer to the following standard specification items herein for additional wastewater system requirements:

<u>ITEM</u>	<u>DESCRIPTION</u>
6	Pipe
8	Concrete encasement and encasement pipe
9	Jacking or boring pipe
10	Bulkheads
11	Adjusting Structures
12	Manholes
13	Frames, grates, rings and covers
14	Finish grading, topsoil and revegetation
15	Trench safety systems

4. **MATERIALS:**

(A) Gravity Pipe

Gravity sewer pipe shall be one of the following materials.

- (1) SDR 26-PVC Gravity Sewer Pipe: PVC a sewer pipe and fittings shall conform to the requirements of current ASTM Specification D-3034-SDR 26, and shall be equipped with joints meeting the requirements of current ASTM Specification D-3212.
- (2) Corrugated PVC or T-1 Wall Gravity Sewer Pipe, 15 Inch through 48 Inch: Corrugated or T-1 Wall wastewater pipe shall conform to ASTM F679.

(B) Pressure Pipe

Pressure Pipe for force mains and water line crossings shall be:

- (1) Ductile Iron Pipe and fittings shall conform to the requirements for Class 150 pipe for water lines as specified under Item 3, "Water System" Specifications.
- (2) PVC Pressure Pipe and fittings shall be C-900, SDR 18, pipe conforming to ASTM Designations D1784 and D2241.

(C) Concrete shall conform to the requirements of Item 2, "Concrete", of these specifications.

(D) Manholes shall be forty-eight (48) inch inside diameter reinforced concrete, precast or monolithic, cast-in-place, or when so approved, may be preformed fiberglass. Manholes shall be placed at all sewer line intersection, grade breaks, angle points, and at intervals not to exceed four hundred (400) feet along the line.

- (1) Precast Concrete manholes shall consist of precast riser, concentric cones, and grade rings supported on a cast-in-place concrete base. For water containment construction, precast reinforced concrete manhole sections shall be of the bell and spigot or tongue and groove design meeting the requirements of ASTM C-478, having a wall thickness equal to that of ASTM C-76 wall "B", using a trapped type preformed O-Ring rubber gasket conforming to the requirements of ASTM C-443. Risers shall be in standard lengths of one (1) through six (6) feet in increments of one (1) foot. Manhole steps shall be installed by the pipe manufacturer where attention shall be given to a safe structural tie. Vertical center line of steps shall be marked on the outside of each manhole section.
 - (2) Monolithic concrete manholes shall be poured on the job site in forms as approved by the Engineer. These manholes shall be poured from Class "F" (4000#) concrete to provide a formed wall thickness of at least six (6) inches.
 - (3) Fiberglass Manholes shall consist of a preformed riser with an integral cone supported on a reinforced cast-in-place concrete base. They shall be manufactured in accordance with ASTM Specification X-23.2.10 or the latest draft thereof, and shall be designed for H-20 wheel load.
- (E) Manhole Frames and Covers: Grey iron manhole frames and covers shall be Western Iron Works #42 or approved equal. Covers shall be provided with pick slots for those manholes equipped with thirty (30) inch diameter cover. The word "Sewer" shall be cast in each cover. N
 - (F) Non-Metal Manhole Steps: Non-metal steps shall be of solid glass fiber or other non-corrosive manhole steps. Only non-metallic manhole steps will be used in sanitary sewer manholes.
 - (G) Cleanouts: Cleanouts shall be standard castings with covers, Western Iron Works #60 or an approved equal.

5. EXCAVATION, TRENCHING AND BACKFILLING:

Excavation, trenching and backfilling shall conform to the requirements of Item 1 of these specifications.

6. PIPE LAYING:

All pipe shall be lowered into the trench by suitable mechanical equipment; no pipe shall be rolled or dumped into the trench. All dirt and trash shall be removed from the pipe while suspended.

Previous to being lowered into the trench, each pipe shall be carefully inspected, and those not meeting specifications shall be rejected, and either destroyed or removed from the job. All pipe shall be laid to the line and grade shown on the plans.

- (A) The pipe and specials shall be so laid in the trench that after the project is completed, the interior surface shall conform accurately to the grade and alignment indicated on the plans. All pipe shall be carefully adjusted to fit

snugly in cradling or embedment so that the entire length bears on cradling or embedment materials. Pipe shall be laid with the bell (or groove) end upgrade, unless otherwise approved by the Engineer.

- (B) Before laying, the interior of the bell shall be carefully wiped smooth and clean and the annular space shall be kept free from dirt, stones, or water. All water must be kept out of the bell hole during laying.
- (C) Pipe shall be installed and joints made up in complete conformance with the instructions and recommendations regarding proper installation and assembly furnished by the manufacturer.
- (D) Pipe shall be installed in accordance with the most current revision of ASTM Specification D-2321, "Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe", available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103. In addition, written recommendations of the pipe manufacturer shall be followed, where these recommendations do not conflict with ASTM D-2321.
- (E) When work is suspended on the line for any reason, the end of the line shall be properly plugged to prevent water, trash, dirt, or rodents from entering.

7. SERVICE CONNECTIONS:

Unless otherwise shown or approved by the Public Works Department, a sewer service connection shall be installed to serve each lot in the area served by the sewer main.

Standard sewer service connections shall be installed in trenches down to twelve (12) feet deep, and deep-cut service connections shall be installed in trenches greater than twelve (12) feet deep. Installation of sewer service connections will consist of such wyes, bends, etc., as may be required by the Standard Details. The four (4) inch tap on main for service line shall be a ninety (90) degree "T" or Wye layed with the line, or it shall be made on pipe in place by installing a tapping saddle on the pipe over a four (4) inch hole cut in the pipe. Pipe saddles shall be completely encased in concrete. Wyes, forty-five (45) degree tapping saddle with direction of flow. No taps in manhole unless approved.

Service lines shall extend from the sanitary sewer lateral in the street to a point at least two (2) feet behind the curb, unless otherwise shown.

The end of the services shall be plugged with a precast plug or other suitable means, meeting the approval of the Engineer. The curb shall be marked by an imprinted letter "S", three (3) inches in height, at the point where the service pipe passes under the curb.

All completed service lines must have a clean-out.

8. MANHOLE CONSTRUCTION:

Sewer line manholes shall be constructed in accordance with the plans, specifications, and standard details and approval of the Engineer. They shall be

provided with cast iron manhole ring and covers. Non-corrosive manhole steps shall be installed as shown on the plans or as directed by the Engineer.

Sewer pipe shall be laid through the manhole where possible, prior to concreting floor slab, so that full depth of pipe is embedded in concrete to form the flow channel. Where pipe cannot be used through manholes due to direction of flow, the flow channel to top of pipe shall be formed with concrete and troweled with a steel trowel to a smooth even finish. The slab shall be sloped one (1) inch per foot to flow channel and troweled to a smooth even finish. After concrete has set, the top half of the pipe between the walls of the manhole shall be broken out and the edges pointed up.

- (A) **Cast-In-Place Manholes:** The walls and base of cast-in-place manholes shall be poured monolithically.

The earthen pit shall be widened and deepened at the bottom to allow a sufficient spread of base concrete matching the dimensions shown on the detail in the plans. The walls shall be constructed using form sections which can be disconnected and removed both inside and outside after the concrete has cured.

Precast cover grade rings shall be used to bring the manhole to finish grade. The grade rings and cast iron frame and cover shall be mortared around the outside flush with the outside wall of the cast-in-place section.

- (B) **Precast Manholes:** The Class "B" concrete base shall be poured around the sewer pipe to the shape and dimensions shown on the plans. The first section of reinforced precast concrete pipe shall be set on the base and grouted in place. The required sections of precast pipe shall be placed to bring the manhole up to grade. Precast pipe joints shall be "O" ring. Precast concrete grade rings shall be used to bring the manhole to finished grade. The grade rings and cast iron frame and cover shall be mortared around the outside flush with the outside wall of the precast manhole cone.

- (C) **Fiberglass Manholes** shall be installed in accordance with the manufacturer's recommended procedures as found in Owens-Corning Fiberglass Publication No. 5-PS-6455-C, "Fiberglass Flowtite Manholes".

- (D) **Drop manholes** shall be constructed with ductile iron pipe drops in locations as shown and as shown in the standard details.

9. **CONNECTION TO EXISTING LINES:**

Where possible, connection to an existing line shall be made without interruption of flow of sewage in the existing line.

10. **BYPASSING OF SEWAGE:**

Sewage shall not be bypassed from existing lines unless absolutely necessary. Before any sewage may be bypassed from an existing sanitary sewer to accomplish any of the work required on the project, written permission to make such bypass must be obtained from the City's Engineer. A request for permission to effect such bypass shall be made in writing at least two (2) days prior to the time needed. The request shall contain full details as to the manner in which

bypassing is to be accomplished, and the minimum and maximum time bypass is to remain in service. In general, bypassing will not be approved unless it is absolutely essential to accomplish the work, and all costs incurred by the City in taking proper health and sanitation precautions as a result of an approved bypass shall be paid by the Contractor.

11. TESTING:

Refer to standard specifications Item 6, "Pipe".

12. CLEAN-UP:

Upon completion of the installation of the wastewater lines, manholes and appurtenances, all debris and surplus materials resulting from the work shall be removed.

TECHNICAL SPECIFICATIONS

ITEM 5 – STORM DRAINAGE

1. GENERAL:

This item includes the construction of underground storm drainage facilities, particularly for new developments. The use of open channels shall be limited to major drainage facilities in open pipe areas. Storm drainage facilities shall include inlets, manholes, pipe drains, culverts, headwalls, and pipe underdrains. All except underdrains shall be designed to convey the runoff from a one hundred (100) year storm from the area served by the storm drain, including any contributing areas, without any significant ponding in streets or overflows onto adjacent property. All storm drains shall discharge into larger collector drains or outfall into natural major drainageways or streams within the same drainage area in such a manner as to not endanger downstream property or facilities from increased or concentrated flows caused by the storm drainage facility. Design of all storm drainage facilities must be approved by the Public Works Department. Materials and construction methods shall conform to requirements specified hereinafter.

2. EXCAVATION, TRENCHING, AND BACKFILLING:

Excavation, trenching and backfilling shall conform to the applicable requirements of Item 1, "Trenching and Backfilling" of these specifications except for bedding as specified below.

3. CONCRETE:

Concrete shall conform to the requirements of Item 2, "Concrete", of these specifications. Concrete for structures such as inlets, manholes, and headwalls shall be Class A.

4. STORM DRAIN LINES AND CULVERTS:

Storm drain lines and culverts materials and construction shall conform to Items 464 and 465 of the Texas Department of Transportation (TxDOT) Standard Specifications except as provided above. Pipe jointing materials shall be rubber gaskets or cold applied preformed plastic gaskets unless otherwise approved by the Public Works Department. Bedding shall be Class B. Pipe shall be precast reinforced concrete unless otherwise approved.

5. MANHOLES AND INLETS:

Manholes and Inlets shall conform to Items 470 and 471 of the TxDOT Standard Specifications.

6. PIPE UNDERDRAINS:

Pipe Underdrains shall conform to Items 510 of the TxDOT Standard Specifications, of the type pipe approved for use.

7. CLEAN-UP:

Upon completion of the installation of the storm drainage lines, manholes and appurtenances, all debris and surplus materials resulting from the work shall be removed.

TECHNICAL SPECIFICATIONS

ITEM 6 - PIPE

1. **GENERAL:**

This item shall consist of furnishing and installing all pipe and/or materials for constructing pipe mains, sewers, laterals, stubs, inlet leads, service connections and culverts, including all applicable Work such as excavating, bedding, jointing, backfilling materials, tests, concrete trench cap, concrete cap and encasement, etc.

2. **MATERIALS:**

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

(A) Concrete

Concrete shall conform to Item 2, "Concrete".

(B) Coarse Aggregate

Coarse aggregate shall conform to Item 2, "Concrete" or one of the following:

(1) Pipe Bedding Stone

Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C 33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or the following Table:

SIEVE SIZE	% RETAINED BY WEIGHT
1 - 1/2"	0
1"	0 - 10
1/2"	40 - 85
#4	90 - 100
#8	95 - 100

(2) Foundation Rock

Foundation rock shall be well graded coarse aggregate ranging in size from 2 to 8 inches.

(C) Fine Aggregate

(1) Concrete and Mortar Sand

Fine aggregate shall conform to Item No. 2, "Concrete".

(2) Bedding Sand

Sand for use as pipe bedding shall be clean, granular and homogeneous material composed mainly of mineral matter, free of mud, silt, clay lumps or clods, vegetation or debris. The material removed by decantation TxDOT Test Method Tex-406-A, plus the weight of any clay lumps, shall not exceed 4.5 percent by weight.

The resistivity shall not be less than 3000 ohms-cm as determined by TxDOT Test Method Tex-129-E. Size gradation of sand for bedding shall be as follows:

GRADATION TABLE	
SIEVE SIZE	% RETAINED BY WEIGHT
1/4"	0
#60	75 - 100
#100	95 - 100

(3) Stone Screenings

Stone screenings shall be free of mud, clay, vegetation or other debris, and shall conform to the following Table:

SIEVE SIZE	% PASSING
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

All screenings shall be the result of a rock crushing operation.

(D) Pea Gravel

Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be as follows:

SIEVE SIZE	% RETAINED BY WEIGHT
3/4"	0
1/2"	0 - 25
1/4"	90 - 100

(E) Select Backfill or Borrow

This material shall consist of borrow or suitable material excavated from the trench. It shall be free of stones or rocks over 8 inches and shall have a plasticity index of less than 20. The moisture content at the time of compaction shall be within 2 percent of optimum as determined by TxDOT Test Method Tex-114-E. Sandy loam borrow will not be allowed unless shown on the Drawings or authorized by the Public Works Department.

All suitable materials from excavation operations not required for backfilling the trench may be placed in embankments, if applicable. All unsuitable materials that cannot be made suitable shall be considered surplus excavated materials. The Contractor may, if approved by the engineer, modify unsuitable materials to make them suitable for use. Modification may include drying, removal or crushing of over-size material, and lime or cement treatment.

(F) Cement Stabilized Backfill

When indicated or directed by the Drawings, all backfill shall be with cement-stabilized backfill rather than the usual materials. The cement and aggregates shall be thoroughly dry mixed with no water added to the mixture except as may be directed by the Public Works Department.

(G) Pipe

General

Fire line leads and fire hydrant leads shall be ductile iron. Domestic water services shall not be supplied from fire service leads, unless the domestic and fire connections are on separately valved branches with an approved backflow prevention device in the fire service branch. All wastewater force mains shall be constructed of ductile iron pipe Pressure Class 250 minimum for pipe greater than 12-inch size and Pressure Class 350 for pipe 12-inch size and smaller. Wastewater pipe shall have a corrosion resistant interior lining acceptable to the Public Works Department.

All water pipe within utility easements on private property shall be Ductile Iron Pipe, Pressure Class 350 minimum for pipe 12-inch size and smaller and Pressure Class 250 minimum for pipe greater than 12-inch size wrapped as indicated.

Approved service clamps or saddles shall be used when tapping ductile iron pipe 12 inch size and smaller. All service tubing (3/4 inch thru 2 inches) installed in utility easements on private property shall be 150 PSI annealed seamless Type K copper tubing with no sweat or soldered joints.

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the Public Works Department at the pipe manufacturing plant and at the project site prior to and during installation. All water distribution pipe and fittings shall be listed in the Fire Protection Equipment Directory published by the Underwriter's Laboratories, Inc., or shall be Factory Mutual approved for fire service.

(1) Iron Pipe

Iron pipe shall be ductile iron pipe meeting all requirements of standards as follows:

-For push-on and mechanical joint pipe: AWWA C-151

-For flanged pipe: AWWA C-115

Barrels shall have a nominal thickness required by Table 1 of AWWA C-115, which thickness corresponds to Special Class 53 in sizes through 54 inch, and Class 350 in 60 and 64-inch sizes. Flanges shall be ductile iron (gray iron is not acceptable); they shall be as shown in ANSI/AWWA C115/A21.15 and shall conform to dimensions shown in Table 2 and Figure 1 of AWWA C115. These flanges are the same in all respects as flanges shown in ANSI/AWWA C110/A21.10 for fittings. Flanges shall be fabricated and attached to the pipe barrels by U.S. fabricators using flanges and pipe barrels of U.S. manufacture.

-Linings and Coating:

Interior surfaces of all iron water pipe shall be cement-mortar lined and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater line and force main pipe shall be coated with a non-corrosive lining material. Pipe exteriors shall be coated as required by the applicable pipe specification. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the Public Works Department, only one type and brand of pipe lining shall be used on a given project.

Except as described above for flanged pipe (Thickness Class 53) and where not otherwise indicated, ductile iron pipe shall be minimum Class 250 as defined by ANSI/AWWA C150/A21.50-current; all ductile iron pipe and flanges shall meet the following minimum physical requirements:

Grade 60-42-10:

- Minimum tensile strength: 60,000 PSI (414 mPa).
- Minimum yield strength: 42,000 PSI (290 mPa).
- Minimum elongation: 10 percent.

The flanges for AWWA C115 pipe may be also be made from:

Grade 70-50-05:

- Minimum tensile strength: 70,000 PSI (483 map).
- Minimum yield strength: 50,000 PSI (345 mPa).
- Minimum elongation: 5 percent.

a). Ductile Iron Fittings:

Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:

- Sizes 4 inch through 24 inch: AWWA C-110 or AWWA C-153
- Sizes larger than 24 inch: AWWA C-110.
- Lining and Coating:

Interior surfaces or all iron water pipe fittings shall be lined with cement- mortar and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater and force main fittings shall be coated with a non-corrosive lining material acceptable to Owner. Fitting exteriors shall be coated as required by the applicable pipe specification.

b). Joint Materials

Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C-111.

Joining of slip joint iron pipe shall, without exception, be accomplished with the natural or synthetic rubber gaskets of the manufacturer of that particular pipe being used. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.

Gaskets for flanged joints shall be continuous full face gaskets, of 1/8 inch minimum thickness of natural or synthetic rubber, cloth-reinforced rubber or neoprene material, preferably of deformed cross section design and shall meet all applicable requirements of ANSI/AWWA A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.

Tee-head bolts, nuts and washers for mechanical joints shall be high strength, low alloy, corrosion resistant steel stock equal to "COR-TEN A" having UNC Class 2 rolled threads or alloyed ductile iron conforming to ASTM A 536; either shall be fabricated in accordance with ANSI/AWWA A21.11/C-111.

Hex head bolts and nuts shall satisfy the chemical and mechanical requirements of ASTM A449 SAE Grade 5 plain, and shall be fabricated in accordance with ASTM B 18.2 with UNC Class 2 rolled threads.

Either Tee-Head or Hex-Head bolts, nuts and washers as required, shall be protected with bonded fluoro-polymer corrosion resistant coating where specifically required by the Engineer.

All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate literature to facilitate such identification; painted markings are not acceptable.

c). Polyethylene Film Wrap

All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4-mil (minimum) cross laminated high-density polyethylene conforming to AWWA C-105, with all edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling.

d). Marking

Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal diameter of openings and the number of degrees for bends. Painted markings are not acceptable. **All pipe joints and fittings shall be manufactured in the United States of America.**

(2) Concrete

a). General

Pipe shall conform to ASTM C 76 for Circular Pipe. Concrete pipe smaller than 12 inches in diameter shall conform to ASTM C 14, Extra Strength. All pipe shall be machine made or cast by a process which will provide uniform placement of the concrete in the form and compaction by mechanical devices, which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete shall not be acceptable for use in precast pipe. The pipe shall be Class III or the class indicated. Storm sewer pipe shall be of the tongue and groove or O-ring joint design. Wastewater pipe shall be of the O-ring joint design; it shall be acceptably lined for corrosion protection.

b). Marking

Each joint of pipe shall be marked with the pipe class, the date of manufacture, the manufacturer's name or trade mark, diameter of pipe and orientation, if required.

Pipe marking shall be waterproof and conform to ASTM C 76.

c). Minimum Age for Shipment

Pipe shall be considered ready for shipment when it conforms to the tests specified in ASTM C 76.

d). Joint Materials

When constructing storm sewers, the Contractor shall have the option of making joints with either of the following materials:

1. Mortar

Mortar for joints shall meet the requirements set forth below in "Mortar".

2. Cold Applied Preformed Plastic Gaskets

Cold Applied Plastic Gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross section. The size of the plastic gasket joint sealer shall be in accordance with the manufacturer's recommendations and sufficient to obtain squeeze-out around the joint. The gasket joint sealer shall be protected by a suitable removable wrapper that may be removed longitudinally without disturbing the joint sealer to facilitate application.

The chemical composition of the gasket joint sealing compound as shipped shall meet the following requirements:

Composition (% by weight)	Test Method	Typical Analysis
Bitumen (petroleum plastic content)	ASTM D 4	50 – 70
Ash-inert Mineral Water	Tex-526-C	30 – 50
Volatile Matter (at 325 F)	Tex-506-C	2.0 Maximum

The gasket joint sealing compound when immersed for 30 days at ambient room temperature separately in 5 percent solution of caustic potash, a mixture of 5 percent hydrochloric acid, a 5 percent solution of sulfuric acid and a saturated H₂S solution shall show no visible deterioration.

The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

Property	Test Method	Typical Analysis	
		Minimum	Maximum
Specific Gravity at 77 F	ASTM D 71	1.20	1.35
Ductility at 77F (cm) Minimum	Tex-503-C	5.0	
Softening point	Tex-505-C	275 F	
Penetration:			
32 F (300 g) 60 sec	Tex-502-C	75	
77 F (150 g) 5 sec	Tex-502-C	50	120
115 F (150 g) 5 sec	Tex-502-C		150
Flashpoint C.O.C. F	Tex-504-C	600 F	
Fire Point C.O.C. F	Tex-504-C	625 F	

When constructing wastewater lines, the Contractor shall use O-ring gasket joints conforming to ASTM C 443. Just before making a joint, the ends of the pipe shall be clean, dry, free of blisters or foreign matter and shall be wire brushed. For O-ring joints, the gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound to facilitate assembly of the joint. The rubber O-ring gasket shall be stretched uniformly in the joint. Wedge seal type ("Forsheda" pre-lubricated) gaskets may be used if joint details submitted are approved; installation of such gaskets shall be in strict accordance with the manufacturer's recommendations, and shall be the sole element depended upon to make the joint flexible and watertight.

In wastewater lines no horizontal or vertical angles in the alignment of pipes shall be permitted unless indicated. The spigot shall be centered in the bell, the pipe pushed uniformly home and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint.

e). Bends

When horizontal or vertical angles in the alignment of storm sewers are indicated, the bend or angle shall be constructed by cutting on a bias one or both pipes as may be required for the alignment indicated. The pipe cut shall be sufficiently long to allow exposing the reinforcement, which shall be bent, welded and incorporated into the pipe bend and reinforced concrete collar to maintain the structural integrity. The collar shall be 6 inches minimum, reinforced with #4 bars on a 1 foot center both directions. Builder's hardware cloth may be used on the outside of the joint to aid in holding cementing materials in place. Plywood, fiberboard or other materials placed on the inside of the pipe as formwork shall be removed as soon as the joint materials have obtained initial set, after which the inside surface of the pipe joint shall be finished smooth and true to the line and grade established. The Contractor may use prefabricated bends meeting the specification requirements in lieu of field fabricated bends. All bends shall be watertight, have a smooth flow line and be equal or greater in strength to the adjacent pipe.

Horizontal or vertical changes in alignment in wastewater lines shall be accomplished by use of manholes. With the Public Works Department's approval, horizontal changes in alignment may be made by the "Joint Deflection" method. Joint deflection is limited by regulations of the Texas Commission on Environmental Quality (TCEQ) to 80 percent of the maximum recommended by the manufacturer; such deflection may not exceed 5 degrees at any joint. Changes in alignment using pipe flexure shall not be allowed.

f). Sulfide and Corrosion Control

All concrete pipe used for wastewater installations shall be protected from sulfide and corrosion damage by using limestone aggregate.

(3) Concrete Steel Cylinder (CSC) Pipe

a). General Requirements

The Contractor shall submit to the Engineer for approval along with other required data a tabulated layout schedule with reference to the stationing and grade lines to be used.

The manufacturer shall furnish all fittings and special pieces required for closures, bends, branches, manholes, air valves, blow offs and connections to main line valves and other fittings as indicated.

Each pipe length, fitting and special joint shall have plainly marked on the bell end of the pipe, the head condition for which it is designed. In addition, marking shall be required to indicate the location of each pipe length or special joint in the line and such markings will be referenced to the layout schedules and drawings and submitted for approval.

Concrete steel cylinder fittings shall be tested as required by the applicable AWWA Standards.

b). Design and Inspection

Where not otherwise indicated, concrete steel cylinder pipe shall be Class 150, designed to withstand a vacuum of not less than 28 feet of water. Valve reducers, tees and outlets from a pipe run shall be designed and fabricated so that all stresses are carried by the steel forming the fitting or outlet.

Concrete steel cylinder pipe shall meet one of the following specifications:

AWWA C-301 - Any Size

AWWA C-303 - 24-inch maximum size

All pipe flanges shall conform to AWWA C-207, requirements for standard steel flanges of pressure classes corresponding to the pipe class.

Pipe to be installed in a tunnel or encasement shall be manufactured with 1 inch thick by 24-inch wide skid bands of mechanically impacted mortar in addition to the normal coating.

All concrete steel cylinder fittings shall be constructed of steel plate of adequate strength to withstand both internal pressure and external loading. Rod reinforcing shall not be used to figure the required steel area. The fittings shall have a concrete lining and 1 inch minimum coating of cement mortar, except that centrifugally spun lining need not be reinforced.

Minimum lining thickness shall be 1/2 inch for 16-inch pipe and 3/4 inch for sizes larger than 16-inch pipe. Where it is impractical to place such concrete protection on interior surfaces of small outlets, 2 coats of "Bitumastic Tank Solution" shall be applied.

No fitting shall be made by cutting of standard pipe, except that outlets of less than 75 percent of the pipe diameter may be placed in a standard pipe. Beveled spigots may be placed on standard pipe.

c). Joint Materials

Joints shall be of the rubber gasket type conforming to the applicable standards. The inside and outside recesses between the bell and spigot shall be completely filled with Cement Grout in accordance with the pipe manufacturer's recommendations. Grout materials for jointing such pipe, unless otherwise indicated, shall be as described herein.

(4) In Place Pipe Rehabilitation

a). In Place Sliplining With or Without Pipe Destruction/Replacement.

This item shall consist of installing a high-density polyethylene pipe, by use of a pipe insertion machine into an existing line.

1. Material Requirements

The polyethylene pipe shall meet the following specifications:

ASTM F 714

Plastic Pipe Institute PE3408

Unless otherwise specified, the Contractor shall furnish the polyethylene pipe in accordance with the following table:

Depth of Cover in Feet	SDR of Pipe
0 - 16	17
Greater than 16	11

2. Functional Requirements

The polyethylene pipe shall be assembled and joined at the site using the thermal butt fusion method. All equipment and procedures shall be in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.

The complete joint shall be in true alignment and have a uniform double roll back bead resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. Joints shall be made smooth on the inside by removal of the projecting weld bead using appropriate equipment; maximum projection of the weld bead on the exterior of the pipe shall be approximately 3/16 inch. The fused joint shall be watertight and shall have a tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Public Works Department or his/her representative prior to placement. All defective joints shall be cut out and replaced.

Any section of the pipe with a gash, abrasion, nick or scar greater in depth than 10 percent of the wall thickness, or containing concentrated ridges, discolorization, excessive spot roughness, pitting, variable wall thickness, or any other defect of manufacturing or handling as determined by the Public Works Department or his/her representative, shall be discarded and removed from the site.

Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp with a minimum length of one and one half times the nominal inside pipe diameter. The butt gap between pipe ends shall not exceed 1/10 of the nominal inside diameter of the pipe.

3. Installation Procedure

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements.

The Contractor shall provide for the flow of water and wastewater around the section or sections of pipe designated for rehabilitation including active services in the rehabilitation section. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall

take all necessary steps to prevent flooding of any private property and shall be liable for damages incurred by the flooding. No sewage or water shall be allowed to drain into earthen sump pits.

New polyethylene pipe shall be inserted immediately behind the expansion and insertion equipment in accordance with the manufacturer's procedures. The expansion and insertion equipment shall be equipped with all controls necessary to place the pipe on proper line and grade according to the Drawings.

The Contractor shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes and to protect the pipe from damage during installation.

Lubrication may be used as recommended by the pipe manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit.

All active service connections shall be identified by video inspection or other means and connected to the new main in accordance with the plan details.

Upon commencement, insertion, from manhole to manhole, shall be continuous without interruption except as approved by the Public Works Department.

The installed pipe shall be allowed the manufacturer's recommended amount of time to provide for complete shrinkage or relaxation of the pipe prior to any connection of service lines, sealing of the annular space where the pipe enters the manhole, or backfilling of the insertion pit. Sufficient excess length of pipe shall be allowed to provide for this shrinkage.

The pipe bedding in the insertion pit shall be either pea gravel or pipe bedding stone. Bedding and backfill shall conform to the specification requirements of Paragraph 2. **Materials** contained herein.

The relaxed pipe shall be cut so that it projects 4 inches inside of the manhole and any annular space shall be sealed. Sealing shall be with material approved by the Engineer. The sealant shall completely fill the void between the pipe and the manhole wall and shall extend 3 inches beyond the annulus on the inside wall of the manhole. The sealant shall form a smooth transition from the pipe onto the manhole. The complete joint shall be uniform and watertight. A concrete invert shall be poured in place and shaped to form a smooth flow channel through the manhole.

b) Cured Resin Pipe Lining

This method of rehabilitation shall consist of the insertion of a resin-impregnated flexible tube into an existing pipe by the inversion method given in ASTM F 1216 or by a comparable approved method.

1. Material Requirements

Certified copies of all test reports on the properties of the selected resin and on the initial structural properties of the CIPP system—and later, on the field samples from designated inversion lengths as required by Section 8 of ASTM F 1216—shall be submitted to the Owner's Engineer. All testing costs are incidental to, and shall be included in, the unit price bid for CIPP.

The Cured in Place Pipe (CIPP) system shall have minimum initial structural properties as follows:

Flexural Strength (ASTM D 790)	4,500 PSI
Tensile Strength (ASTM D 638)	2,500 PSI
Flexural Modulus (ASTM D790)	250,000 PSI

The results of tests by an independent laboratory, of specimens taken by the Contractor as required by Section 8 of ASTM F 1216 and to demonstrate compliance with the above minimum values, shall be made available to the Public Works Department at the completion of testing.

2. Installation Procedure

Insertion of a resin-impregnated flexible tube into an existing pipe shall be by an inversion method as given in ASTM F 1216 and the manufacturer's recommendations.

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements.

Measures shall be taken to reduce atmospheric styrene concentration to an acceptable level at all times during the cured in place pipe installation procedure. The percent lower explosive limit, temperature and styrene concentration shall be measured and recorded for each inversion taken to ensure the following conditions are met:

Percent Lower Explosive Limit (LEL) shall not exceed 2% using an atmospheric monitor calibrated within at least six (6) months of the day reading is taken. The LEL shall be measured at the top of the downstream manhole adjacent to the section of pipe being lined.

No process water shall be discharged until cooled to below 100 degrees Fahrenheit in accordance with Section 7.1 of ASTM F 1216.

Atmospheric styrene levels shall not exceed 50 ppm as measured by a Drager Tube 67 23 301 Styrene 10/a five feet above and within 3 feet downwind of the downstream manhole adjacent to the section of pipe being lined.

Contractor shall be responsible for satisfactorily resolving customer complaints involving styrene odors.

Any necessary repairs to the pipeline shall be performed by the Contractor. Inspection of pipeline by the Contractor shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television. The interior of the pipe shall be carefully inspected to determine the location of any conditions which may prevent proper installation into the pipe and these conditions shall be corrected. A videotape and log shall be made by the Contractor and provided to the Owner upon completion of the project.

The Contractor shall provide for the flow of water and wastewater around the section or sections of pipe designated for rehabilitation, including active services in the rehabilitation section. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall take all necessary steps to prevent flooding of any private property and shall be liable for any damages incurred by the flooding. No sewage or water shall be allowed to drain into earthen sump pits.

The Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated fiber-felt tube shall be vacuum impregnated prior to installation. The Contractor shall allow the Public Works Department to inspect the materials and "wet out" procedure. The quantities of the liquid thermosetting materials shall be per manufacturer's standards to provide the wall thickness specified.

Water for the Work shall be metered and furnished by the Contractor. The wet out fiber-felt tube shall be inserted through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated manhole.

Any defect which will affect, in the foreseeable future, or warranty period, the integrity or strength of the pipe liner shall be repaired at the Contractor's expense, in a manner satisfactory to the Public Works Department.

If, due to broken or misaligned pipe at a manhole wall, the pipe liner fails to make a tight seal, the Contractor shall apply a seal at that point. The seal shall be of a resin mixture compatible with pipe liner.

After the pipe liner has been cured in place, and allowed to cool down and normalize to ambient temperature, the Contractor shall connect new services or reconnect existing service piping as designated and identified in the proposal. After the Work is completed, the Contractor shall provide the Public Works Department with a videotape showing both the before and after conditions including the restored connections.

(5) Copper Tubing

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 and rated at 150 PSI working pressure. The tubing shall be homogenous throughout and free from cracks, holes, crimping, foreign inclusions or other defects. It shall be uniform in density and other physical properties.

Nominal Tube Size, inches	Outside Diameter, inches		Wall Thickness, inches	
	Average	Tolerance	Average	Tolerance
3/4	0.875	± 0.003	0.065	± 0.0045
1	1.125	± 0.0035	0.065	± 0.0045
1 1/4	1.375	± 0.004	0.065	± 0.0045
1 1/2	1.625	± 0.0045	0.072	± 0.005
2	2.125	± 0.005	0.083	± 0.007

(6) Service Connection Fittings

Refer to the Standard Details for specific service connection fittings allowed.

(7) Brass Goods

All brass valves, couplings, bends, connections, nipples and miscellaneous brass pipe fittings and accessories used in meter connections, service lines, air release piping assemblies, and wherever needed in the water distribution system, shall conform to these specifications.

Unless otherwise noted, the goods described herein shall be fabricated of standard Red Brass (Waterworks Brass) meeting ASTM B62 or B584, alloy 83600, consisting of 85 percent copper and 5 percent each of tin, lead and zinc.

Exposed threads shall be covered with plastic caps or sheeting to protect the threads.

Brass goods of each type and class shall be compatible with other fittings in common usage for similar purposes. Where not otherwise indicated, all such materials shall meet the following requirements:

Inlet threads of corporation valves shall be AWWA iron pipe (IP) thread (male); outlets of service saddles shall be tapped with AWWA IP thread (female). AWWA IP threads shall conform to ANSI/ASME B1.20.1 as required by AWWA C800 for "General Purpose (Inch) Pipe Threads". For 3/4" and 1" sizes only, corporation valve inlet threads, and the internal threads of saddles may be the AWWA taper thread conforming to AWWA C800 Figure 1 and Table 6. External threads of corporation valve inlet must be compatible with internal threads of the service saddle.

Connections of all new tubing, and of tubing repairs wherever possible, shall be by flared fittings. Flare connections - and compression connections when permitted - shall be designed to provide a seal and to retain the tubing, without slippage, at a working water pressure of 150 psig.

Flanges shall conform to ANSI B16.1, Class 125, as to dimensions, drillings, etc. Copper tubing, when used, shall be Type K tubing having dimensions and weights given in Table A.1 of AWWA C800.

Brass pipe shall conform to the weights and dimensions for Extra Strong pipe given in Table A.2 of AWWA C800.

All fittings shall be suitable for use at hydrostatic working pressures up to 150 psig (hydrostatic testing of installed systems is at 200 psig).

(8) Polyvinyl Chloride Water Pipe

a). General

All polyvinyl chloride (PVC) water pipe shall be of the rigid (UNPLASTICIZED) type and must bear the National Sanitation Foundation seal of approval for potable water pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe in 4, 6, 8 and 12 inch nominal sizes shall be pressure rated at 200 PSI (SDR-14) or 150 PSI (SDR-18) as indicated on Plans. Pipe in 14 inch and larger nominal sizes shall be pressure rated at 235 PSI (SDR 18) or 165 PSI (SDR 25) as indicated on Plans.

Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells with rubber gasket joints. The wall thickness of each pipe bell and joint coupling must be greater than the standard pipe barrel thickness. Clearance must be provided in every gasket joint for both lateral pipe deflection and for linear expansion and contraction. Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all fire hydrants, valves and AWWA C110 fittings; such support shall be provided for AWWA C153 fittings when required by the Public Works Department.

b). Applicable Specifications

Except as modified or supplemented herein, PVC pipe shall meet the following standards:

AWWA C-900, SDR 18 or SDR 14 for PVC Pressure Pipe in 4, 6, 8 and 12 inch nominal sizes, having Cast Iron Pipe size outside diameters. AWWA C-905, SDR 25 or SDR 18 for PVC pressure pipe in 14 inch and larger nominal sizes, having cast iron pipe size outside diameters.

Fittings used with PVC Pressure pipe shall be AWWA C-110 or AWWA C-153 compact ductile iron fittings. All ductile iron fittings shall be manufactured in the United States of America.

Standard sizes, dimensions and tolerances for AWWA C-900 pipe shall be as follows:

AWWA C-900 PIPE			SDR-18		SDR-14	
Nominal Size (inches)	Outside Diameter, inches		Wall Thickness, inches		Wall Thickness, inches	
	Avg.	Tolerance	Min.	Tolerance	Min.	Tolerance
4	4.800	+ 0.009	0.267	+ 0.032	0.343	+ 0.041
6	6.900	+ 0.011	0.383	+ 0.046	0.493	+ 0.059
8	9.050	+ 0.015	0.503	+ 0.060	0.646	+ 0.078
12	13.200	+ 0.015	0.733	+ 0.088	0.943	+ 0.113

All pipe 4 inches and larger must be approved Underwriter's Laboratories for use in buried water supply and fire protection systems.

c). **Material Requirements**

All pipe and fittings shall be made from clean, virgin, NSF approved, Class 12454B PVC. Clean reworked materials generated from the manufacturers own production may be used within the current limits of the referenced AWWA C-900.

d). **Marking**

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

Nominal pipe size and OD base (e.g., 4 CIP\$).

Type of plastic material (e.g., PVC 12454B).

Standard Dimension Ratio and the pressure rating in PSI for water at 73 F (e.g., SDR 18, 150 PSI).

AWWA designation with which the pipe complies (e.g., AWWA C -900).

Manufacturer's name or code and the National Sanitation Foundation (NSF) mark.

e). **Tracer Tape**

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer's requirements. The tape shall be minimal six (6) inches in width and be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

(9) **Polyvinyl Chloride (PVC) Pipe (Nonpressure) and Fittings**

a). **General**

Where PVC sewer or wastewater pipe is indicated, it shall conform to ASTM D 3034. Cell Class shall be as required by applicable ASTM pipe specification; pipe stiffness shall be 115 PSI minimum for pipe to 15" size, or 72 PSI minimum for larger pipe.

b). Joint Material

PVC pipe and fitting shall have elastomeric gasket joints conforming to ASTM D 3212; gaskets to ASTM F 477.

c). Pipe Markings

Permanent marking on the pipe shall include the following at intervals of not more than 5 feet:

Manufacturer's name and/or trademark.

Nominal pipe size.

PVC cell classification per ASTM D 1784.

ASTM designation and legend:

For pipe 6 inch to 12-inch size: ASTM D 3034, SDR-26 PVC sewer pipe.

For pipe 15 inches and larger: ASTM F 679. T-1 wall PVC or corrugated PVC sewer pipe.

d). Fitting Markings

Fittings shall be clearly marked as follows:

Manufacturer's name or trademark,

Nominal size,

The material designation "PVC",

PSM, and

The designation, "Specification D3034".

e). Tracer Tape

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer's requirements. The tape shall be minimum six (6) inches in width and be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

(10) Steel Pipe

a). Standard Weight

ASTM A 53, Schedule 40.

b). Extra Heavy Weight

Seamless ASTM A 53, Schedule 80.

c). Encasement Pipe

Welded or Seamless pipepiles ASTM A-252, Grade 2.

d). Fittings

Nipples and fittings extra strong Federal Specification WW -N 351 or WW-P 521.

e). Coatings

Black or galvanized as indicated.

(11) Welded Steel Pipe and Fittings for Water -Pipe

a). General Reference Standards Specification.

Specifications of the American Water Works Association (AWWA) listed below shall apply to this Section.

C-200 Steel Water Pipe 6 inches and larger.

C-205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 inches and larger, Shop Applied .

C-206 Field Welding of Steel Water Pipe.

C-207 Steel Pipe Flanges for Waterworks Services, Sizes 4 inches through 144 inches.

C-208 Dimensions for Steel Water Pipe Fittings.

C-602 Cement-Mortar Lining of Water Pipelines, 4 inches and larger in Place.

b). Submittals

Furnish Shop Drawings, product data, design calculations and test reports as described below:

1. Certified copies of mill tests confirming the type of materials used in steel plates, mill pipe flanges and bolts and nuts to show compliance with the requirements of the applicable standards.
2. Complete and dimensional working drawings of all pipe layouts. Shop Drawings shall include the grade of material, size, wall thickness of the pipe and fittings, type and location of fittings and the type and limits of the lining and coating systems of the pipe and fittings.
3. Product data to show compliance of all couplings, supports, fittings, coatings and related items.

c). Job Conditions

1. The internal design pressure of all steel pipe and fittings shall be as indicated.
2. The interior of all steel pipe for potable water, 4 inches and larger, shall be cement-mortar lined.

d). Manufacturing

1. Description

Pipe shall comply with AWWA C-200.

A. Circumferential deflection of all pipe in-place shall not exceed 2.0 percent of pipe diameter.

B. Diameter

Nominal pipe diameter shall be the inside diameter of lining or pipe barrel, unless otherwise designated in Job Conditions.

2. Wall Thickness

A. Steel pipe wall thickness shall be designed for the internal and external loads specified in this section. The cylinder thickness needed to resist internal pressure shall be based on an allowable stress in the steel equal to 1/2 the minimum yield stress of the material used.

e). Fittings

1. Welded

Fabricated steel fittings shall be of the same material as pipe and shall comply with AWWA C-208.

f). Flanges

1. Flanges shall comply with the requirements of AWWA C-207, Class D or Class E. The class shall be based on operating conditions and mating flanges of valves and equipment.

2. Gaskets shall be cloth-inserted rubber, 1/8 inch thick.

3. Flanges shall be flat faced with a serrated finish.

g). Pipe Joints

1. Lap Joints for Field Welding

A. Lap joints for field welding shall conform to AWWA C-206. This item applies only to pipes 72 inches in diameter and larger.

B. The bell ends shall be formed by pressing on a hydraulic expander or a plug die. After forming, the minimum radius of curvature of the bell end at any point shall not be less than 15 times the thickness of the steel shell. Bell ends shall be formed in a manner to avoid impairment of the physical properties of the steel shell. Joints shall permit a lap at least 1 1/2 inches when assembled. The longitudinal or spiral weld on the inside of the bell end and the outside of the spigot end on each section of pipe shall be ground flush with the plate surface. The inside edge of the bell and the outside edge of

the spigot shall be scarfed or lightly ground to remove the sharp edges or burrs.

2. Bell and Spigot Joints with O-Ring Gasket

A. Bell and spigot joints with rubber gasket shall conform to AWWA C-200.

B. The bell and spigot ends shall be so designed that when the joint is assembled, it will be self-centered and the gasket will be confined to an annular space in such manner that movement of the pipe or hydrostatic pressure cannot displace it. Compression of the gasket when the joint is completed shall not be dependent upon water pressure in the pipe and shall be adequate to ensure a watertight seal when subjected to the specified conditions of service. Bell and spigot ends shall be welded on preformed shapes. The bell and spigot ends shall conform to the reviewed Shop Drawings.

h). Interior and Exterior Protective Surface Coatings

1. Exterior Surface to be mortar coated shall conform to AWWA C -205 for shop application and AWWA C-602 for field application. Pipe materials shall be the product of an organization, which has had not less than 5 years successful experience manufacturing pipe materials, and the design and manufacture of the pipe, including all materials, shall be the product of one company.

2. All surfaces except as noted in c and d below shall receive shop application of mortar lining and coating.

3. Field Welded Joints. After installation, clean, line and coat unlined or uncoated ends adjacent to welded field joints, including the weld proper, as specified for pipe adjacent to the weld.

4. Machined Surfaces. Shop coat machined surfaces with a rust preventative compound. After jointing surfaces, remaining exposed surfaces shall be coated per a) and b) above.

(12) Corrugated Metal Pipe

a). General

Pipe shall be corrugated continuous lock or welded seam helically corrugated pipe. Corrugated metal pipe may be galvanized steel, aluminized steel or aluminum conforming to the following:

Galvanized Steel	AASHTO M 218
Aluminized Steel	AASHTO M 274
Aluminum	AASHTO M 197

Where reference is made herein to gage of metal, the reference is to U.S. Standard Gage for uncoated sheets. Tables in AASHTO M 218 and AASHTO M 274 list thickness for coated sheets in inches. The Tables in AASHTO M 197 list thickness in inches for clad aluminum sheets.

Sampling and testing of metal sheets and coils used for corrugated metal pipe shall be in accordance with TXDOT Test Method Tex-708-I.

Damaged spelter coating shall be repaired by thoroughly wire brushing the damaged area and removing all loose, cracked or weld-burned spelter coating. The cleaned area shall be painted with a zinc dust-zinc oxide paint conforming to Federal Specifications TT-P 641b. Damaged pipe shall be rejected and removed from the project.

Damaged aluminized coating shall be repaired in accordance with the manufacturer's recommendations.

The following information shall be clearly marked on each section of pipe:

Thickness and corrugations
Trade Mark of the manufacturer
Specification compliance

b). Fabrication

1. Steel Pipe

Galvanized or aluminized steel pipe shall be full circle or arch pipe conforming to AASHTO M 36, Type I or Type II as indicated.

It may be fabricated with circumferential corrugations; lap joint construction with riveted or spot welded seams or it may be fabricated with helical corrugations with continuous helical lock seam or ultra high frequency resistance butt-welded seams.

2. Aluminum Pipe

Pipe shall conform to AASHTO M 196, Type I, circular pipe or Type II, pipe arch as indicated. It may be fabricated with circumferential corrugations; lap joint construction with riveted or spot welded seams or it may be fabricated with helical corrugations with a continuous helical lock seam.

Portions of aluminum pipe that are to be in contact with high chloride concrete or metal other than aluminum, shall be insulated from these materials by a coating of bituminous material. The coating applied to the pipe or pipe arch to provide insulation between the aluminum and other material shall extend a minimum distance of 1 foot beyond the area of contact.

c). Selection of Gages

The pipe diameter, permissible corrugations and required gauges for circular pipe shall be as indicated on the drawings.

For pipe arch, the span, rise, gage, corrugation size and coating thickness shall be as shown on the drawings. A tolerance of plus or minus 1 inch or 2 percent of equivalent circular diameter, whichever is greater, will be permissible in span and rise, with all dimensions measured from the inside crests of the corrugations.

d). Joint Material

Except as otherwise indicated, coupling bands and other hardware for galvanized or aluminized steel pipe shall conform to AASHTO M 36 for steel pipe and AASHTO M 196 for aluminum pipe. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of soil material during the life of the installation.

Coupling bands shall be not more than 3 nominal sheet thickness lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inch for steel or 0.048 inch for aluminum.

Coupling bands shall be made of the same base metal and coating (metallic or otherwise) as the pipe.

Coupling bands shall lap equally on each of the pipes being connected to form a tightly closed joint after installation.

Pipes furnished with circumferential corrugations shall be field jointed with corrugated locking bands. This includes pipe with helical corrugations, which has reformed circumferential corrugations on the ends. The locking bands shall securely fit into at least one full circumferential corrugation on each of the pipe ends being coupled. The minimum width of the corrugated locking bands shall be as shown below for the corrugation which corresponds to the end circumferential corrugations on the pipes being joined:

10 1/2 inches wide for 2 2/3 inches x 1/2-inch corrugations.

12 inches wide for 3 inches x 1 inch or 5 inches x 1-inch corrugations.

Helical pipe without circumferential end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe, which was installed with no circumferential end corrugations. In this event pipe furnished with helical corrugations at the ends shall be field jointed with either helically corrugated bands or with bands with projections or dimples. The minimum width of helically corrugated bands shall conform to the following:

12 inches wide for pipe diameters up to and including 72 inches.

14 inches wide for 1 inch deep helical end corrugations.

Bands with projections shall have circumferential rows of projections with one projection for each corrugation. The width of bands with projections shall be not less than the following:

12 inches wide for pipe diameters up to and including 72 inches.

The bands shall have 2 circumferential rows of projections.

16 1/4 inches wide for pipe diameters of 78 inches and greater.

The bands shall have 4 circumferential rows of projections.

Unless otherwise indicated, all bolts for coupling bands shall be 1/2-inch diameter. Bands 12 inches wide or less shall have a minimum of 2 bolts and bands greater than 12 inches wide shall have a minimum of 3 bolts.

Galvanized bolts may be hot dip galvanized conforming to AASHTO M 232, mechanically galvanized to provide the same requirements as AASHTO M 232 or electro-galvanized per ASTM A 164 Type RS.

e). Additional Coatings or Linings

1. Bituminous Coated

Bituminous Coated pipe or pipe arch shall be as indicated both as to base metal and fabrication and in addition shall be coated inside and out with a bituminous coating which shall meet the performance requirements set forth herein. The bituminous coating shall be 99.5 percent soluble in carbon bisulphide. The pipe shall be uniformly coated inside and out to a minimum thickness of 0.05 inch, measured on the crests of the corrugations.

The bituminous coating shall adhere to the metal tenaciously, shall not chip off in handling and shall protect the pipe from deterioration as evidenced by samples prepared from the coating material successfully meeting the Shock Test and Flow Test in accordance with Test Method Tex-522-C.

2. Paved Invert

Where a Paved Invert is indicated, the pipe or pipe arch, in addition to the fully coated treatment described above, shall receive additional bituminous material of the same specification as above, applied to the bottom quarter of the circumference to form a smooth pavement with a minimum thickness of 1/8 inch above the crests of the corrugations.

3. Cement Lined

A. General

Except as modified herein, pipe shall conform to AASHTO M 36 for lock seam or welded helically corrugated steel pipe. Pipe shall be of full circle and shall be fabricated with two annular corrugations for purposes of joining pipes together with band couplers. Lock seams shall develop the seam strength as required in Table 3 of AASHTO M 36. Concrete lining shall conform to the following:

Composition: Concrete for the lining shall be composed of cement, fine aggregate and water that are well mixed and of such consistency as to produce a dense, homogeneous, non-segregated lining.

Cement: Portland Cement shall conform to AASHTO M 85.

Aggregate: Aggregates shall conform to AASHTO M 6 except that the requirements for gradation and uniformity of gradation shall not apply.

Mixture: The aggregates shall be sized, graded, proportioned and thoroughly mixed with such proportions of cement and water as will produce a homogenous concrete mixture of such quality that the pipe will conform to the design requirements indicated. In no case, however, shall the proportions of Portland Cement, blended cement or Portland Cement plus pozzolanic admixture be less than 470 lb/cu. yd of concrete.

Thickness: The lining shall have a minimum thickness of 1/8 inch above the crest of the corrugations.

Lining Procedures: The lining shall be plant applied by a machine traveling through a stationary pipe. The rate of travel of the machine and the rate of concrete placement shall be mechanically regulated so as to produce a homogenous nonsegregated lining throughout.

Surface Finish: The lining machine shall also mechanically trowel the concrete lining as the unit moves through the pipe.

Certification: Furnish manufacturer's standard certification of compliance upon request of the purchaser.

Joints: Pipe shall be joined together with coupling bands made from steel sheets to an indicated thickness of 0.064 inch (12 ga.). Coupling bands shall be formed with two corrugations that are spaced to provide seating in the third corrugation of each pipe end without creating more than 1/2 inch \pm annular space between pipe ends when joined together.

Bands shall be drawn together by two 1/2 inch galvanized bolts through the use of a bar and strap suitably welded to the band.

When O-ring gaskets are indicated they shall be placed in the first corrugation of each pipe and shall be compressed by tightening the coupling band. Rubber O-ring gaskets shall conform to Section 5.9, ASTM C 361.

B. Causes for Rejection

Pipe shall be subject to rejection on account of failure to conform to any of the indications. Individual sections of pipe may be rejected because of any of the following:

Damaged ends, where such damage would prevent making satisfactory joint.

Defects that indicate poor workmanship and could not be easily repaired in the field.

Severe dents or bends in the metal itself.

If concrete lining is broken out, pipe may be rejected or at the discretion of the Public Works Department, repaired in the field in accordance with the manufacturer's recommendation.

Hairline cracks or contraction cracks in the concrete lining are to be expected and does not constitute cause for rejection.

4. Fiber Bonded

Where fiber bonded pipe is indicated, the pipe or pipe arch shall be formed from sheets whose base metal shall be as indicated. In addition, the sheets shall have been coated with a layer of fibers, applied in sheet form by pressing them into a molten metallic bonding. If a paved invert is indicated it shall be in accordance with the procedure outlined above. The test for spelter coating above is waived for fiber bonded pipe.

f). Slotted Drain Storm Sewers

The pipes for the slotted drain and slotted drain outfall shall be helically corrugated, lock seam or welded seam pipe. Materials and fabrication shall be in accordance with the above. The metal thickness shall be a minimum 16 gage.

The chimney assemblies shall be constructed of 3/16 inch welded plate or machine formed 14 gage galvanized steel sheets. The height of the chimney required shall be as indicated. Metal for the welded plate slot shall meet the requirements of ASTM A 36 and the completed plate slot shall be galvanized after fabrication in accordance with ASTM A 123.

Weld areas and the heat affected zones where the slot is welded to the corrugated pipe shall be thoroughly cleaned and painted with a good quality asphalt base aluminum paint.

g). Mortar

Mortar shall be composed of 1 part Type I Portland Cement and 2 parts clean, sharp mortar sand suitably graded for the purpose and conforming in other respects to the provisions for fine aggregate of Item 2, "Concrete". Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight of the total dry mix.

3. **CONSTRUCTION METHODS:**

(A) General

Prior to commencing this Work, all erosion control and tree protection measures required shall be in place and all utilities located and protected.

The Contractor shall conduct his Work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of all existing utilities. If at any time the Contractor damages the utilities in place through his operations, the Contractor shall immediately notify the owner of the utility to make the necessary repairs. When active wastewater sewer lines are cut in the trenching operations, temporary flumes shall be provided

across the trench while open and the lines shall be restored when the backfilling has progressed to the original bedding lines of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the Contractor may proceed with his Work with a minimum of delay and expense. The Contractor shall cooperate with all utility owners concerned in effecting any utility adjustments necessary and shall not hold the City liable for any expense due to delay or additional Work because of conflicts arising from existing utilities.

The Contractor shall do all trenching in accordance with the provisions and the directions of the Public Works Department as to the amount of trench left unfilled at any time. All excavation and backfilling shall be accomplished as indicated and in compliance with State Statutes.

Where excavation for a pipe line is required in an existing City street, a street cut permit is required and control of traffic shall be as indicated in accordance with the Texas Manual on Uniform Traffic Control Devices.

Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impractical, a deviation from line and grade will be ordered by the Public Works Department and the change shall be made in the manner directed.

Adequate temporary support, protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the Work shall be furnished by the Contractor, at his expense and as approved by the Public Works Department.

Where traffic must cross open trenches, the Contractor shall provide suitable bridges. For trenches less than 2 feet in width, sheet steel plates having a minimum thickness of 1/2 inch shall be used. For trenches up to 4 feet in width, sheet steel plates having a minimum thickness of 3/4 inches shall be used. In all cases, the plates shall overlay the top of the trench a minimum of 18 inches on both sides and secured by asphalt. Adequate provisions shall be made for the flow of sewers; drains and watercourses encountered during construction and any structures, which may have been disturbed, shall be satisfactorily restored upon completion of Work.

When rainfall or runoff is occurring or is forecast by the U.S. Weather Service, the Contractor shall not perform or attempt any excavation or other earth moving Work in or near the flood plain of any stream or watercourse or on slopes subject to erosion or runoff, unless given specific approval by the Public Works Department. When such conditions delay the Work, an extension of time for working day contracts will be allowed in accordance with "General Conditions".

(B) Water Line/New Wastewater Line Separation

Installation of new water or wastewater lines shall conform to the following:

Where feasible, water and wastewater lines shall be no closer to each other than 9 feet between outside diameters in all directions and shall be in separate trenches.

If the 9 foot separation cannot be achieved, any portion of a new gravity wastewater line within 9 feet in any direction (between OD's) of a potable water line, shall be in a separate trench and constructed of ductile iron, AWWA C -900 (SDR-18) 150 PSI rated PVC in sizes 12 inch, or AWWA C -905 (SDR-25) 165 PSI rated PVC in sizes larger than 12 inches.

If the lines are parallel, they shall not be closer than 4 feet horizontally or 2 feet vertically between OD's with the wastewater lower than the water line. If the lines cross, they may be no closer than 6 inches vertically between OD's with the sewer below the water line and one standard 20 foot length of ductile iron, AWWA C -900 (SDR-18) 150 PSI rated PVC in sizes to 12 inch, or AWWA C -905 (SDR-25) 165 PSI rated PVC in sizes larger than 12 inches shall be centered at the point of crossing the water line.

Unless wastewater manholes and the connection to the sewer can be made completely watertight and tested for no leakage, they must be installed so as to provide a minimum of 9 feet of horizontal clearance from an existing or proposed water line.

(C) Utility and Storm Sewer Crossings

When the Contractor installs a pipe that crosses under a utility structure or storm sewer and the top of the pipe is within 18 inches of the bottom of the utility structure, the pipe shall be encased as specified in Item 8, "Concrete Encasement and Encasement Pipe", for a distance of at least 1 foot on either side of the ditch line of the utility structure or the storm sewer. Unless otherwise specified by the Engineer, concrete encasement will not be required for ductile iron, AWWA C -900 (SDR-18) 150 PSI rated PVC in sizes to 12 inch, or AWWA C -905 (SDR-25) 165 PSI rated PVC in sizes larger than 12 inches. When the Contractor installs a pipe that crosses over a utility structure or storm sewer and the top of the utility structure or storm sewer is within 18 inches of the bottom of the pipe, the pipe shall be either ductile iron, AWWA C -900 (SDR-18) 150 PSI rated PVC in sizes to 12 inch, or AWWA C -905 (SDR-25) 165 PSI rated PVC in sizes larger than 12 inches, unless otherwise specified by the Engineer.

Where trenches wider than 12 inches cross under existing wastewater lines, the sewer lines shall be replaced with one 20 foot joint of ductile iron, AWWA C -900 (SDR-18) 150 PSI rated PVC in sizes to 12 inch, or AWWA C -905 (SDR-25) 165 PSI rated PVC in sizes larger than 12 inches, centered over the trench.

(D) Trench Excavation

Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes conforming to Item 15, "Trench Safety Systems" and with a trench width and depth described below. When pipe is to be constructed in fill above the natural ground, Contractor shall construct embankment to an elevation not less than one foot above the top of the pipe, after which trench is excavated. Required vertical sides shall be sheeted and braced as indicated to maintain the sides of the required vertical excavation throughout the construction period. Adequacy of the design of sheeting and bracing shall be the responsibility of the Contractor's design professional. The Contractor shall be responsible for

installation as indicated. After the pipe has been laid and the backfill placed and compacted to 12 inches above the top of the pipe, any sheeting, shoring and bracing required may be removed with special care to insure that the pipe is not disturbed. As each piece of sheeting is removed, the space left by its removal must be thoroughly filled and compacted with suitable material and provisions made to prevent the sides of the trench from caving until the backfill has been completed. Any sheeting left in place will not be paid for and shall be considered subsidiary to the pipe item bid.

(E) Trench Width

Trenches for water and wastewater lines shall have a clear width on each side beyond the outside surfaces of the pipe bell or coupling of not less than 6 inches nor more than 12 inches.

Trenches for Storm Sewers up to 42 inches shall have a width of 1 foot on each side beyond the outside surfaces of the pipe. Pipes more than 42 inches shall have a trench width not to exceed 18 inches on each side beyond the outside surfaces of the pipe.

If the trench width within the pipe zone exceeds this maximum, the entire pipe zone shall be refilled with approved backfill material, thoroughly compacted to a minimum of 95 percent of maximum density as determined by TxDOT Test Method Tex -114-E and then re-excavated to the proper grade and dimensions. Excavation along curves and bends shall be so oriented that the trench and pipe are approximately centered on the centerline of the curve, using short lengths of pipe and/or bend fittings if necessary.

For all utilities to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than 1 foot above the top of the utility after which excavation for the utility shall be made.

(F) Trench Depth and Depth of Cover

All pipe and in-line appurtenances shall be laid to the grades indicated. The depth of cover shall be measured from the established finish grade, natural ground surface, subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

- (1) Where not otherwise indicated, all water piping shall be laid to the following minimum depths:
 - a). Water piping installed in undisturbed ground in easements of undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 36 inches of cover.
 - b). Water piping installed in existing streets, roads or other traffic areas shall be laid with at least 48 inches of cover below finish grade.
 - c). Unless approved by the Public Works Department, installation of water piping in proposed new streets will not be permitted until paving and drainage plans have been approved and the roadway traffic areas excavated to the specified or standard paving subgrade, with all parkways and sidewalk areas graded according to any applicable provisions of the drainage plans or sloped upward from the curb line to the right of way line

at a minimum slope of 1/4 inch per foot. Piping and appurtenances installed in such proposed streets shall be laid with at least 36 inches of cover below the actual subgrade.

- (2) Where not otherwise indicated, all wastewater piping shall be laid to the following minimum depths:
 - a). Wastewater piping installed in natural ground in easements or other undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 42 inches of cover.
 - b). Wastewater piping installed in existing streets, roads or other traffic areas shall be laid with at least 66 inches of cover.
 - c). Wastewater piping installed in such proposed streets shall be laid with at least 48 inches of cover below the actual subgrade.

(G) Classification of Excavation

Excavation will not be considered or paid for as a separate item of Work, so excavated material will not be classified as to type or measured as to quantity. Full payment for all excavation required for the construction shall be included in the various unit or lump sum Contract prices for the various items of Work installed, complete in place. No extra compensation, special treatment or other consideration will be allowed due to rock, pavement, caving, sheeting and bracing, falling or rising water, working under and in the proximity of trees or any other handicaps to excavation.

(H) Dewatering Excavation

Underground piped utilities shall not be constructed or the pipe laid in the presence of water. All water shall be removed from the excavation prior to the pipe placing operation to insure a dry firm granular bed on which to place the underground piped utilities and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point installation as conditions warrant.

In the event that the excavation cannot be dewatered to the point where the pipe bedding is free of mud, a seal shall be used in the bottom of the excavation. Such seal shall consist of Class B concrete, conforming to Item 2, "Concrete", with a minimum depth of 3 inches.

(I) Trench Conditions

Before attempting to lay pipe, all water, slush, debris, loose material, etc., encountered in the trench must be pumped or bailed out and the trench must be kept clean and dry while the pipe is laid and backfilled. Where needed, sump pits shall be dug adjoining the trench and pumped as necessary to keep the excavation dewatered.

Backfilling shall closely follow pipe laying so that no pipe is left exposed and unattended after initial assembly. All open ends, outlets or other openings in the pipe shall be protected from damage and shall be properly plugged and blocked watertight to prevent the entrance of trench water, dirt, etc. The interior of the pipeline shall at all times be kept clean, dry and unobstructed.

Where the soil encountered at established footing grade is a quicksand, saturated or unstable material, the following procedure shall be used unless other methods are indicated:

All unstable soils shall be removed to a depth of a minimum 2 feet below bottom of piped utility or as required to stabilize the trench foundation. Such excavation shall be carried out for the entire trench width.

All unstable soil so removed shall be replaced with a concrete seal, foundation rock or coarse aggregate materials placed across the entire trench width in uniform layers not to exceed 6 inches, loose measure and compacted by mechanical tamping or other means which shall provide a stable foundation for the utility.

Forms, sheathing and bracing, pumping, additional excavation and backfill required in unstable trench conditions shall be subsidiary to pipe bid.

(J) Blasting

All blasting shall require a "Blasting" permit from the City, though permit approval may be denied by the City.

(K) Removing Old Structures

When out of service masonry structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth of 1 foot below the bottom of the trench. When abandoned inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new sewers, such manholes and inlets within the construction limits shall be removed completely to a depth 1 foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided above. Where the trench cuts through storm or wastewater sewers which are known to be abandoned, these sewers shall be cut flush with the sides of the trench and blocked with a concrete plug in a manner satisfactory to the Public Works Department. When old structures are encountered, which are not visible from the existing surface and are still in service, they shall be protected and adjusted as required to the finished grade.

(L) Lines and Grades

Any damage to Grades, Lines and Levels by the Contractor shall be re-established at the Contractor's expense. The Contractor shall furnish copies of all field notes and "cut sheets" to the Public Works Department.

The location of the lines and grades indicated may be changed only by direction of the Engineer and it is understood that the Contractor will be paid on the basis of his unit Contract prices bid for such Work actually performed and shall make no claim for damages or loss of anticipated profits due to the change of location or grade.

The Contractor shall furnish, at his expense, all necessary batter boards or electronic devices for controlling the Work. Batter boards shall be of adequate size material and shall be supported substantially. The boards and all location stakes must be protected from possible damage or change of location. The Contractor shall furnish good, sound twilled lines for use in achieving lines and grades and the necessary plummets and graduated poles.

The Contractor shall submit to the Engineer at least 6 copies of any layout Drawings from the pipe manufacturer for review and approval. The Contractor shall submit the layout Drawings at least 30 days in advance of any actual construction of the project. The Engineer will forward all comments of the review to the Contractor for revision. Revisions shall be made and forwarded to the Engineer for his acceptance. Prior to commencement of the Project, reviewed layout Drawings will be sent to the Contractor marked for construction.

Should the Contractor's procedures not produce a finished pipe placed to grade and alignment, the pipe shall be removed and relayed and the Contractors procedures modified to the satisfaction of the Engineer. No additional compensation shall be paid for the removal and relaying of pipe required above.

(M) Surplus Excavated Materials

Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the Public Works Department and shall become the property of the Contractor to dispose of off site at a permitted fill site, without liability to the City or any individual. Such surplus material shall be removed from the Work site promptly following the completion of the portion of the utility involved.

(N) Pipe Bedding Envelope

Pipe shall be installed in a continuous bedding envelope of the type shown on the drawings or as described herein. The envelope shall extend the full trench width, to a depth of 6 inches below the pipe and shall rise at least to the spring line of storm water pipe and to 12 inches above water and wastewater pipe.

(1) Standard Bedding Materials

USE / PIPE MATERIAL	Cement Stabilized Backfill	Natural or Mfd Sand	Pea Gravel	PIPE BEDDING STONE			
				Uncrushed Gravel	Crushed Gravel	Crushed Stone	Stone Screenings
WATER							
Welded Steel	X					X	
Service Tubing 3/4" to 2-1/2"		X	X				X
WATER and WASTEWATER							
Up to 15 Inch ID		X	X	X	X	X	X
Larger Than 15 Inch ID			X	X	X	X	
STORMWATER							
Concrete		X	X	X	X	X	X
Metal		X	X	X			X

(2) General requirements and limitations governing bedding selection.

- a). Crushed gravel or crushed stone shall not be used with polyethylene tubing or polyethylene film wrap.
- b). Uncrushed gravel may be used with polyethylene film wrap in trenches up to 6 feet deep and in deeper trenches where ample trench width, a

tremmie, or conditions will allow controlled placement of the gravel without damaging the polyethylene wrap.

- c). Bedding shall be placed in lifts not exceeding 8 inches loose thickness and compacted thoroughly to provide uniform support for the pipe barrel and to fill all voids around the pipe.
- d). Pea Gravel or bedding stone shall be used in blasted trenches.

(3) Requirements to prevent particle migration.

Bedding material shall be compatible with the materials in the trench bottom, walls and backfill so that particle migration from, into or through the bedding is minimized. The Public Works Department may require one or more of the following measures to minimize particle migration: use of impervious cut-off collars; selected bedding materials, such as pea gravel or bedding stone mixed with sand; filter fabric envelopment of the bedding; cement stabilized backfill; or other approved materials or methods. Measures to minimize particle migration will be shown on the Drawings or designated by the Engineer, and, unless provisions for payment are provided in the contract documents, the cost of these measures shall be agreed by change order. The following limitations shall apply.

- a). Sand, alone, shall not be used in watercourses, in trenches where groundwater is present, or in trenches with grades greater than 5 percent.
- b). Pea gravel or bedding stone, alone, shall not be used in the street right-of-way within 5 feet of subgrade elevation in trenches that are 3 feet or wider.
- c). Each gravel or bedding stone, alone, shall not be used where the trench bottom, sides, or backfill is composed of non-cementitious, silty or sandy soils having plasticity indices less than 20, as determined by the Engineer.

(O) Laying Pipe

No pipe shall be installed in the trench until excavation has been completed, the bottom of the trench graded and the trench completed as indicated.

Laying of corrugated metal pipes on the prepared foundation shall be started at the outlet end with the separate sections firmly joined together, with outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Any metal in joints, which is not protected by galvanizing, shall be coated with suitable asphaltum paint. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without damaging the pipe or disturbing the prepared foundation and the sides of the trench. Any pipe which is not in alignment or which shows any undue settlement after laying or damage, shall be taken up and re-laid without extra compensation.

Multiple installations of corrugated pipe or arches shall be laid with the centerlines of individual barrels parallel. When not otherwise indicated, clear distances of 2 feet between outer surfaces of adjacent pipes shall be maintained.

No debris shall remain in the drainways or drainage structures.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. Unless otherwise indicated, all materials shall be delivered to the project by the manufacturer or agent and unloaded as directed by the Contractor. Each piece shall be placed facing the proper direction near to where it will be installed.

The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times and stored in a manner that will protect them from damage. Stockpiled materials shall be stacked so as to minimize entrance of foreign matter.

The interior of all pipeline components shall be clean, dry and unobstructed when installed.

Piping materials shall not be skidded or rolled against other pipe, etc. and under no circumstances shall pipe, fittings or other accessories be dropped or jolted.

During handling and placement, materials shall be carefully observed and inspected and any damaged, defective or unsound materials shall be marked, rejected and removed from the job site. Minor damage shall be marked and repaired in a manner satisfactory to the Public Works Department. Joints, which have been placed, but not joined, backfilled, etc., shall be protected in a manner satisfactory to the Public Works Department.

(P) Assembling of Pipe

Angular spacing of all joints shall meet the manufacturer's recommendations for the pipe and accessories being used. Side outlets shall be rotated so that the operating stems of valves shall be vertical when the valves are installed. Pressure pipe shall be laid with bell ends facing the direction of pipe installation. Pipe end bells shall be placed upgrade for all wastewater lines.

Orientation marks, when applicable, shall be in their proper position before pipe is seated.

Before joining any pipe, all foreign matter, lumps, blisters, excess coal tar coating, oil or grease shall be removed from the ends of each pipe and the pipe ends shall then be wire brushed and wiped clean and dry. Pipe ends shall be kept clean until joints are made.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing or other materials shall be placed in the pipe.

(Q) Joints

(1) Mortar (Storm Drain joints only)

Pipe ends shall be clean, free of asphalt or other contaminants, which will inhibit the bond of the mortar to the pipe. The pipe ends shall be moistened immediately prior to placing the mortar in the joint.

(2) Cold Applied Preformed Plastic Gaskets (Storm Drain joints only)

The pipe ends shall be clean and the joint material applied to the dry pipe. In cold weather, the joint material shall be heated to facilitate the seal of the joint.

(3) O-Ring and Push-on Joints

Just before making a joint the ends of the pipe shall be clean, dry, free of any foreign matter, lump blisters, excessive coal tar coating and grease or oil and shall be wire brushed. The gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound (Flax Soap) to facilitate telescoping the joints. The rubber gasket if not factory installed shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the groove. The spigot shall be centered in the bell, the pipe pushed home uniformly and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint. Care should be taken to prevent dirt or foreign matter from entering the joint space.

(4) Bolted Joints

All flanged, mechanical or other bolted joints shall be joined with nuts and bolts and be coated as indicated above in Iron Pipe.

(R) Pressure Pipe Laying

(1) Grout for Concrete Steel Cylinder Pipe (CSC) and Welded Steel Pipe

Aggregate, cement, etc., shall be as indicated in "Mortar" herein.

Grout shall be poured into the recess between the bell and spigot on the outside of the pipe and contained by a joint wrapper ("diaper") recommended by the pipe manufacturer. The wrapper shall have a minimum width of 7 inches for 30 inch and smaller and 9 inches for larger pipe, secured to the pipe by "Band Iron" steel straps. The grout shall be poured in one continuous operation in such manner that after shrinkage and curing the joint recess shall be completely filled.

Mortar for the inside recess shall be of the consistency of plaster. The inside recess between the bell and spigot shall be filled with mortar after the pipe joint on either side of the recess has been backfilled and well tamped with no less than one pipe joint installed ahead of the pipe forming the recess. The mortar shall completely fill the recess and shall be trowelled and packed into place and finished off smooth with the inside of the pipe.

The Contractor shall inspect the joint after the mortar has set and make repairs of any pockets, cracks or other defects caused by shrinkage to the satisfaction of the Public Works Department. The inside surface shall be cleared of any mortar droppings, cement, water, slurry, etc., before they have become set and shall be cleared of any other foreign matter. The inside surface of the pipe shall be left clean and smooth.

Pipe shall be handled at all times with wide non abrasive slings, belts or other equipment designed to prevent damage to the coating and all such equipment shall be kept in such repair that its continued use is not injurious to the coating. The use of tongs, bare pinch-bars, chain slings, rope slings without canvas covers, canvas or composition belt slings with protruding rivets, pipe hooks without proper padding or any other handling equipment, which the Public

Works Department deems to be injurious to the coating, shall not be permitted. The spacing of pipe supports required to handle the pipe shall be adequate to prevent cracking or damage to the cement mortar lining.

(S) Placing Pipe in Tunnels

Piping installed as a carrier pipe in a tunnel, encasement pipe, etc., shall have uniform alignment, grade, bearing and conform to the reviewed Shop Drawings. All necessary casing spacers, bedding material, grout cradle or paving, bracing, blocking, etc., as stipulated by the Contract or as may be required to provide and maintain the required pipe alignment and grade, shall be provided by the Contractor at no cost except as provided by the Bid Items. This shall include casing spacers acceptable to the Owner attached to the carrier pipe in accordance with the manufacturer's recommendations. The insertion pushing forces shall not exceed the pipe manufacturer's recommendation. Such carrier piping shall have flexible bolted or gasketed push-on joints or Concrete Steel Cylinder pipe installed as follows:

(1) 21 Inch Pipe and Smaller

Prior to placing the pipe in the tunnel, the inside joint recess at the bell shall be buttered with cement mortar.

After the joint is engaged, the excess mortar shall be smoothed by pulling a tight fitting swab through the joint. Cement mortar protection shall then be placed in the normal manner to the exterior of the joint and allowed to harden sufficiently to avoid dislodgment during installation. If time is of the essence, a quick setting compound may be used.

(2) 24 Inch Pipe and Larger

Each length of pipe shall be pushed into the tunnel as single units. A flexible mastic sealer shall be applied to the exterior of the joint prior to joint engagement. The surfaces receiving the mastic sealer shall be cleaned and primed in accordance with the manufacturer's recommendation. Sufficient quantities of the mastic sealer shall be applied to assure complete protection of all steel in the joint area. The interior of the joint shall be filled with cement mortar in the normal manner after the pipe is in its final position within the tunnel.

(T) Temporary Pipe Plugs, Caps, Bulkheads and Trench Caps

Temporary plugs, caps or plywood bulkheads shall be installed to close all openings of the pipe and fittings when pipeline construction is not in progress.

All temporary end plugs or caps shall be secured to the pipe as provided under Item 10, "Bulkheads".

Trench caps shall be reinforced Class B concrete as indicated.

(U) Corrosion Control

(1) Protective Covering

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other iron or steel components buried and in contact with earth or backfill shall

be wrapped with 8-mil (minimum) polyethylene film meeting ANSI/AWWA C - 105 to provide a continuous wrap.

(V) Pipe Anchorage, Support and Protection

Pressure pipeline tees, plugs, caps and bends exceeding 22-1/2 degrees; other bends as directed shall be securely anchored by suitable concrete thrust blocking or by approved metal harness. Unless otherwise indicated, on 24 inch or larger piping, all bends greater than 11 1/4 degrees shall be anchored as described herein.

Storm sewers on steep grades shall be lugged as indicated.

(1) Concrete Thrust Blocking

Concrete for use as reaction or thrust blocking shall be Class B conforming to Item 2, "Concrete".

Concrete blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as indicated or directed by the Public Works Department. The blocking shall, unless otherwise indicated, be so placed that the pipe, fittings and joints will be accessible for repair.

The trench shall be excavated at least 6 inches outside the outermost projections of the pipe or appurtenance and the trench walls shaped or undercut according to the detail Drawings or as required to provide adequate space and bearing area for the concrete.

The pipe and fittings shall be adequately weighted and laterally braced to prevent floating, shifting or straining of the pipeline while the concrete is being placed and taking initial set. The Contractor shall be solely responsible for the sufficiency of such restraints.

(2) Metal Thrust Restraint

Fabricated thrust restraint systems such as those described below may be approved for use instead of concrete blocking. To obtain approval, the project Drawings must include sufficient drawings, notes, schedules, etc., to assure that the proposed restraints as installed will be adequate to prevent undesirable movement of the piping components. Such restraint systems may only be used where and as specifically detailed and scheduled on approved Drawings.

a). Thrust Harness

A metal thrust harness of tie rods, pipe clamps or lugs, turnbuckles, etc., may be approved. All carbon steel components of such systems, including nuts and washers, shall be hot-dip galvanized; all other members shall be cast ductile iron. After installation, the entire assembly shall be wrapped with 8-mil polyethylene film, overlapped and taped in place with duct tape to form a continuous protective wrap.

b). Restrained Joints

Piping or fitting systems utilizing integral mechanically restrained joints may be approved. All components of such systems shall be standard manufactured products fabricated from cast ductile iron, hot-dip

galvanized steel, brass or other corrosion resistant materials and the entire assembly shall be protected with a continuous film wrap as described for 1. above.

Location, configuration and description of such products shall be specifically detailed on the Plans. (Add-on attachments such as retainer glands, all-thread rods, etc., are not acceptable.)

(3) Concrete Encasement, Cradles, Caps and Seals

When trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 30 inches of cover, Contractor shall notify Public Works Department. Public Works Department may require Contractor to install a concrete seal, cradle, cap, encasement or other appropriate action.

All concrete cap, etc., shall be continuous and begin and end within 6 inches of pipe joints. Concrete cap, cradle and encasement shall conform to the Standard Details. The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

(4) Anchorage Bulkheads

Concrete bulkheads keyed into the undisturbed earth shall be placed as indicated to support and anchor the pipe and/or backfill against end thrust, slippage on slopes, etc. Concrete material and placement shall be Class A, Item 2, "Concrete".

(5) Trench Caps, Concrete Rip-Rap and Shaped Retards

Where called for by the Contract or as directed by the Public Works Department, concrete trench caps, concrete rip-rap and/or shaped retards shall be placed as detailed by the Drawings as protection against erosion. Concrete material and placement shall be Class A, Item 2, "Concrete".

(W) Wastewater Connections

(1) Connections to Mains 12 Inches and Smaller

All branch connections of new main lines shall be made by use of manholes.

Service stubs shall be installed as indicated. Minimum grade shall be 1 percent downward to main and minimum cover shall be 4 1/2 feet at the curb. Standard plugs shall be installed in the dead end before backfilling.

Where a service connection to a main 12 inches or smaller is indicated, a wye, tee or double wye shall be installed.

Where a service connection to a main 15 inches or larger is indicated, a field tap may be made with the pipes installed crown to crown. The tap should be made conforming to the pipe manufacturer's recommendations with the Public Works Department's approval.

Where not otherwise indicated, (wastewater) service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

(2) Connections to the Existing System

Unless otherwise specified by the Engineer, all connections made to existing mains shall be made at manholes with the crown of the inlet pipe installed at the same elevation as the crown of the existing pipe. Service stubs installed on the existing system shall be installed by use of tapping saddles unless otherwise approved by the Public Works Department. Extreme care shall be exercised to prevent material from depositing in the existing pipe as the taps are being made.

When connections to existing mains are made, a temporary plug approved by the Public Works Department must be installed downstream in the manhole to prevent water and debris from entering the existing system before Final Completion. These plugs shall be removed after the castings are adjusted to finish grade or prior to Final Completion.

(X) Water System Connections

The Contractor shall, at his expense, make all necessary connections of new piping or accessories to the existing water system. To minimize any inconvenience from outages, the Contractor shall schedule all such connections in advance and such schedule must be approved by the Public Works Department before beginning any Work.

(1) Shutoffs

The City will make all shutoffs on existing water mains. The Contractor shall be required to notify the Public Works Department's field representative on the job at least 72 hours prior to the desired time for any shutoff. The Public Works Department's field representative will notify any affected utility customers at least 24 hours prior to the shutoff. The Public Works Department will make the shutoff after ensuring that all appropriate measures have been taken to protect the water system, customers and employees.

The Public Works Department will operate all valves to fill existing mains. Where a newly constructed main has not been placed in service and has only one connection to the public water supply, the Contractor may operate one valve to fill the main after approval has been obtained from the Public Works Department. The operation of the valve is to be conducted under the immediate supervision of the Public Works Department field representative.

Water for the Work shall be metered and furnished by the Contractor.

(2) Wet Connections to Existing Water System

The Contractor shall make all wet connections called for by the Contract or required to complete the Work. Two connections to an existing line performed during the same shutout, at the same time and at a distance less than 50 linear feet apart, will be considered one wet connection. Two connections to an existing line performed during the same shutout, at the same time and at a distance equal to, or greater than 50 linear feet will be considered two wet connections. A wet connection shall include draining and cutting into existing piping and connecting a new pipeline or other extension into the existing pressure piping, forming an addition to the water transmission and distribution network.

The Contract price for wet connections shall be full payment for all necessary shutoffs, excavation, removing plugs and fittings, pumping water to drain the lines, cutting in new fittings, blocking and anchoring piping, bedding and backfilling, placing the lines and service and all site cleanup.

No water containing detectable amounts of chlorine may be drained, released or discharged until specific planning and appropriate preparations to handle, dilute and dispose of such chlorinated water are approved in advance by the Public Works Department and the disposal operations will be witnessed by an authorized representative from the Public Works Department.

(3) Pressure Taps to Existing Water System

The Contractor shall make all pressure taps called for by the Drawings or required to complete the Work. A pressure tap shall consist of connecting new piping to the existing water system by drilling into the existing pipe while it is carrying water under normal pressure without taking the existing piping out of service.

The Contractor shall, at his expense, perform all necessary excavation, furnish and install the tapping sleeve, valve and accessories, provide the tapping machine, drill the tap and shall block, anchor and backfill the piping, valve and all accessories, place the new piping in service and perform all site cleanup. **All tapping sleeves shall be constructed of stainless steel full circle gasket and sleeve (wrap-around), either Smith – Blair #663 (formally Rockwell) or the Romac SST model.**

If a private Contractor makes the tap, a Public Works Department Inspector must be present. "Size on size" taps will not be permitted, unless made by use of an approved full circle gasket **stainless steel** tapping sleeve. Concrete blocking shall be placed behind and under all tapping sleeves 24 hours prior to making the wet tap.

(4) Service Connections

Service connection taps into PVC or AC pipe or into CI or DI pipe 12 inches or smaller shall be made using either a service clamp or saddle or a tapping sleeve as recommended by the pipe manufacturer and as approved by the Public Works Department. Direct tapping of these pipes will not be permitted.

All water service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

Precautions should be taken to ensure that the tapping saddle or sleeve is placed on the pipe straight to prevent any binding or deformation of the PVC pipe. The mounting chain or U-bolt strap must be tight.

Tapping shall be performed with a sharp shell type cutter so designed that it will smoothly penetrate heavy walled PVC DR14 and 200 PSI AC and will retain and extract the coupon from the pipe.

(Y) Backfilling

(1) General

Special emphasis is placed upon the need to obtain uniform density throughout the backfill material. The maximum lift of backfill shall be determined by the compaction equipment selected and in no case shall it exceed 18 inches, loose measurement.

No heavy equipment, which might damage pipe, will be allowed over the pipe until sufficient cover has been placed and compacted. All internal pipe bracing installed or recommended by the manufacturer shall be kept in place until the pipe bedding and trench backfill have been completed over the braced pipe section. Testing of the completed backfill in streets and under and around structures shall meet the specified density requirements. Initial testing shall be at Contractor's expense.

(2) General Corrugated Metal Pipe

After the corrugated metal pipe structure has been completely assembled on the proper line and grade and headwalls constructed where indicated; selected material free from rocks over 8 inches in size from excavation or borrow, as approved by the Public Works Department, shall be placed along both sides of the completed structures equally, in uniform layers not exceeding 6 inches in depth (loose measurement), sprinkled if required and thoroughly compacted between adjacent structures and between the structures and the sides of the trench.

Backfill material shall be compacted to the same density requirements as indicated for the adjoining sections of embankment in accordance with the governing specifications thereof. Above the 3/4 point of the structure, the fill shall be placed uniformly on each side of the pipe in layers not to exceed 12 inches, loose measure.

Prior to adding each new layer of loose backfill material, until a minimum of 12 inches of cover is obtained over the crown of the pipe, an inspection will be made of the inside periphery of the corrugated metal structure to determine if any floating, local or unequal deformation has occurred as a result of improper construction methods.

(3) Backfill Materials

The Public Works Department may approve any of the following well graded materials:

- a). Select backfill under streets and drives.
- b). Common backfill in open areas.
- c). Sand
- d). Rock cuttings
- e). Foundation Rock
- f). Blasted material with fines and rock
- g). Cement stabilized material
- h). Borrow

Within the 100-year flood plain, sand will not be permitted for backfilling. The Engineer will approve the topsoil for areas to be seeded or sodded.

(4) Backfill in Street Right of Way

Placement of backfill under existing or future pavement structures and within 2 feet of any structures shall be compacted to the required density using any method, type and size of equipment, which will give the required compaction without damaging the pipe or bedding. Placement of backfill greater than 2 feet beyond structures in Right of Way shall conform to (g) below. The depth of layers, prior to compaction, shall depend upon the type of sprinkling and compacting equipment used and the test results thereby obtained. Prior to and in conjunction with the compaction operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept level to insure uniform compaction over the entire layer. Testing for density shall be in accordance with Test Method Tex-114-E and Test Method Tex-115-E.

Each layer of backfill must provide the density as required herein. Swelling soils (soils with plasticity index of 20 or more) shall be sprinkled as required to provide not less than optimum moisture nor more than 2 percent over optimum moisture content and compacted to the extent necessary to provide not less than 95 percent nor more than 102 percent of the density as determined in accordance with Test Method Tex-114-E. Non-swelling soils (soils with plasticity index less than 20) shall be sprinkled as required and compacted to the extent necessary to provide not less than 95 percent of the density as determined in accordance with Test Method Tex-114-E.

After each layer of backfill is complete, tests may be ordered by the Public Works Department at the **Contractor's expense**. If the material fails to meet the density indicated, the course shall be reworked as necessary to obtain the indicated compaction and the compaction method shall be altered on subsequent Work to obtain indicated density.

At any time, the Public Works Department may order proof rolling to test the uniformity of compaction of the backfill layers. All irregularities, depressions, weak or soft spots that develop shall be corrected immediately by the Contractor.

Should the backfill, due to any reason, lose the required stability, density or finish before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent backfill layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than 4 percent below the optimum of compaction ratio density. Backfill shall be placed from the top of the bedding material to the existing grade, base course, subgrade or as indicated. The remainder of the street backfill shall be Flexible Base, Concrete or Hot Mix Asphalt Concrete as indicated or to be replaced in kind to the surface removed to construct the pipe.

(5) Backfill in County Street or State Highway Right of Way

All Work within the right of way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the County when their requirements are more stringent. Prior to the start of construction, the Contractor shall be responsible for contacting the appropriate TxDOT office or County Commissioner's Precinct Office and for coordinating his activities

with the operating procedures in effect for utility cut permits and pavement repair under their jurisdiction. Approval for all completed Work in the State or County right of way shall be obtained from the appropriate Official prior to final payment by the Owner.

(6) Backfill in Railroad Right of Way

All Work within the railroad right of way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the Railroad Owner when their requirements are more stringent. Approval for all completed Work in the railroad right of way shall be obtained from the Railroad prior to Final Completion.

(7) Backfill in Easements

Where not otherwise indicated, Contractor may select whatever methods and procedures may be necessary to restore entire Work area to a safe, useful and geologically stable condition with a minimum density of 85 percent or a density superior to that prior to construction.

In and near flood plain of all streams and watercourses, under or adjacent to utilities, structures, etc. all backfill shall be compacted to a density of not less than 95 percent conforming to TxDOT Test Method Tex-114-E, unless otherwise directed by Public Works Department.

All soil areas disturbed by construction shall be covered with top soil and seeded conforming to Item 14, "Finish Grading, Topsoil and Revegetation". All turf, drainways and drainage structures shall be constructed or replaced to their original condition or better. No debris shall remain in the drainways or drainage structures.

(Z) Quality Testing for Installed Pipe

(1) Wastewater Pipe Acceptance Testing

After construction is complete, Public Works Department will determine whether the pipeline is to be tested for infiltration, exfiltration or by the low-pressure air test method. In addition, plastic pipe 18 inches and larger in diameter shall be deflection tested.

Wastewater pipe installed in the City of Marble Falls and its ETJ areas shall be tested for exfiltration or infiltration as described below in "Exfiltration Test" and "Infiltration Test" or by acceptable low pressure air test, as described below. At the conclusion of either test series, the Work shall be further tested for pipeline settlement and also for deflection as described below. The Contractor shall be solely responsible for making proper repairs to those elements, which do not pass these test requirements.

(2) Exfiltration Test

Water for the Work shall be metered and furnished by the Contractor.

The pipeline shall be completely filled with water for its complete length or by sections as determined by the Public Works Department. If tested for its

complete length, the maximum head at any point shall not exceed 25 feet unless otherwise indicated. If tested in sections, the manholes in the test section shall be completely filled with water. After the pipeline has been filled and allowed to stand for 24 hours, the amount of exfiltration shall be calculated. Any amount in excess of 200 gallons per inch of inside pipe diameter per mile per day shall be cause for rejection.

For portions of lines located within the 25-year flood plain, the minimum head during testing shall not be less than 2 feet and the leakage rate shall not exceed 10 gallons per inch of inside pipe diameter per mile per day. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the flood plain as indicated on Drawings.

(3) Infiltration Test

When the pipe placed in easements is completed, the upper portion of the trench backfill shall be removed to a depth of not less than 18 inches below the finished surface and width equal to the original trench width. The trench shall then be flooded with water until it is completely saturated and water stands in the ditch a minimum of 12 inches deep. In cases of steep terrain, earthen dikes shall be used to assure that water will stand over the trench. After it is apparent that the trench is completely saturated, the main shall then be inspected **at the Contractor's expense** with closed-circuit television for infiltration. Any section of the main or any service stub that indicates infiltration above the maximum quantity specified shall be cause for rejection.

This procedure shall not be used for pipes installed in areas where the Plasticity Index (P.I.) of the surrounding material is 20 or higher or where the backfill material has a P.I. of 20 or more.

For portions of lines located within the 25-year flood plain, the total infiltration as determined by water test, must be at a rate not greater than 10 gallons per inch of pipe diameter per mile of pipe per 24 hours at a minimum test head of two feet. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the flood plain as indicated on Drawings.

If the quantity of infiltration exceeds the maximum quantity specified, remedial action must be undertaken in order to reduce the infiltration to an amount within the limits specified.

(4) Pipeline Settlement Test

During the infiltration test or after the exfiltration test, the pipe will be TV inspected for possible settlement. When air testing has been used, water shall be flowed into the pipe to permit meaningful observations. Any pipe settlement which causes excessive ponding of water in the pipe shall be cause for rejection. Excessive ponding shall be defined as a golf ball (1-5/8" dia.) submerged at any point along the line.

(5) Low Pressure Air Test of Plastic Gravity Flow Wastewater Lines

a). General

Wastewater lines, at the discretion of the Public Works Department, shall be air tested between manholes. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses, which could cause an erroneous, test result. Manholes shall be plugged so they are isolated from the pipe and cannot be included in the test.

All plugs used to close the sewer for the air test shall be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure. Release all pressure before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 PSI or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. (Inject the air at the upper plug if possible.) Use only qualified personnel to conduct the test.

b). Ground Water

Since the presence of ground water will affect the test results, test holes shall be dug to the pipe zone at intervals of not more than 100 feet and the average height of ground water above the pipe (if any) shall be determined before starting the test.

c). Test Procedure

The Public Works Department may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10 PSI and an accuracy of 0.0625 PSI. (One ounce per square inch.) All air used shall pass through a single control panel. Clean the sewer to be tested and remove all debris where indicated. Wet the sewer prior to testing. The average back pressure of any groundwater shall be determined (0.433 PSI) for each foot of average water depth (if any) above the sewer.

Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the pipe. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the pipe. Compare the time recorded with the specification time for the size and length of pipe as given in the following table:

Table For Low Pressure Air Testing of Plastic Pipe:

Minimum Specified Time Required For 1.0 psig Pressure Drop For Size and Length of Pipe Indicated								
Diameter of Pipe, (in.)	Specification Time (min: sec) for length shown							
	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

NOTES: 1. Specification times are as given in UNI-B-6 RECOMMENDED PRACTICE FOR LOW-PRESSURE TESTING OF INSTALLED PIPE -by Uni-Bell PVC Pipe Association, 2655 Villa Creek Dr., Ste. 155, Dallas Texas 75234.

Any drop in pressure, from 3.5 psig to 2.5 psig (adjusted for groundwater level), in a time less than that required by the above table shall be cause for rejection. When the line tested includes more than one size pipe, the minimum time shall be that given for the largest size pipe included.

Test procedure for wastewater pipe located in the 25-year flood plain.

Low-pressure air tests must conform to the procedure described in ASTM C-924 or other equivalent procedures. For safety reasons, air testing of pipe sections will be limited to line sizes of 36 inches inside diameter or less. Lines that are 36 inches or larger inside diameter may be air tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch to 2.5 pounds per square inch gauge during a joint test, regardless of pipe size, shall be twenty (20) seconds.

For sections of pipe less than 36-inch inside diameter, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge must be computed by the following equation:

$$T = 0.0850 (D)(K)/(Q), \text{ where}$$

T = time for pressure to drop 1.0 pounds per square inch gauge in seconds;

K = $0.000419(D)(L)$, but not less than 1.0

D = nominal inside diameter in inches;

L = length of line of same pipe size in feet; and

Q = rate of loss, assume 0.0015 cubic feet per minute per square foot (ft³/min/ft sq) of internal surface area.

Any drop in pressure, from 3.5 psig to 2.5 psig, in a time less than that required by the above formula shall be cause for rejection. When the line tested includes more than one size of pipe, the minimum time shall be that calculated for the largest size pipe included.

Manholes must be tested separately and independently. All manholes must be hydrostatically tested with a maximum loss allowance of 0.025 gallon per foot diameter per foot of head per hour.

When lines are air tested, manholes are to be tested separately by exfiltration or vacuum method (see Standard Specification Item 12, "Manholes").

(6) Deflection Test

Deflection tests shall be performed by the Contractor on all flexible and semi-rigid wastewater pipes. The tests shall be conducted after the final backfill has been in place at least 30 days. Testing for in-place deflection shall be with a pipe mandrel or rigid ball sized at 95% of the inside diameter of the pipe. A second test of flexible and semi-rigid wastewater pipes 18 inch size and larger, also with a pipe mandrel or ball sized at 95% of the inside diameter of the pipe, shall be conducted by the Contractor 30 days prior to expiration of his warranty on the Work.

Contractor shall submit his proposed pipe mandrels or testing balls to the Public Works Department or his designated representative for concurrence prior to testing the line.

Test(s) must be performed without mechanical pulling devices and must be witnessed by the Public Works Department or their designated representative.

Any deficiencies noted shall be corrected by the Contractor and the test(s) shall be redone.

(AA) Pressure Pipe Hydrostatic Testing

After the pipe has been installed and backfilled and all service laterals, fire hydrants and other appurtenances installed and connected, a pressure test, followed by a leakage test, will be conducted by the Contractor. The Contractor will furnish the pump and gauges for the tests. The Public Works Department shall be present to witness the tests. The specified test pressures will be based on the elevation of the lowest point of the line or section under test. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points.

All drain hydrant and fire hydrant leads, with the main 6-inch gate valve open, the hydrant valve seats closed and nozzle caps open, shall be included in the test.

(1) Pressure Test

The entire project or each valved section shall be tested, at a pressure of 200 PSI for a sufficient period (approximately 10 minutes) to discover all leaking or

defective materials. Repairs shall be made by the Contractor to correct any leaking or defective materials.

(2) Pressure Pipe Leakage Test

A leakage test will follow the pressure test and be conducted on the entire project or each valved section. The leakage test shall be at 150 PSI for at least 1 hour.

a). Allowable Leakage

Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe to maintain the specified leakage test pressure (see above, "Pressure Pipe Leakage Test") after the air in the pipeline has been expelled and the pipe has been filled with water .

No pipe installation will be accepted if the leakage exceeds 25 gallons/24 hours/mile of pipe/inch nominal pipe diameter.

$$\frac{(25 \text{ gpd })}{(\text{in.} - \text{mi.})}$$

b). Location and Correction of Leakage

If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the indicated allowance.

All visible leakage in pipe shall also be corrected by Contractor at his own expense.

(BB) Disinfection of Potable Water Lines

(1) Preventing Contamination

The Contractor shall protect all piping materials from contamination during storage, handling and installation. Prior to disinfection, the pipeline interior shall be clean, dry and unobstructed. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day 's work.

(2) Cleaning

Prior to disinfection the Contractor shall clean the pipeline to remove foreign matter. For pipelines 16" in diameter or smaller, cleaning shall consist of flushing the pipeline. For pipelines greater than 16" in diameter, cleaning shall be performed by operating hydrants and blow-offs located at low points in the pipeline, or by mechanical means (sweeping or pigging. Water for the Work shall be metered and furnished by the Contractor.

(3) Procedure and Dosage

The Contractor, at its expense, will supply the test gauges and the Sodium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 5 percent to fifteen percent available chlorine, and will submit for approval a written plan for the disinfection process. Calcium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 65 percent available chlorine by weight, may be used in granular form or in 5 g tablets for 16" diameter or

smaller lines. The Contractor, at its expense, shall provide all other equipment, supplies and the necessary labor to perform the disinfection under the general supervision of the City.

One connection to the existing system will be allowed with a valve arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The valve shall be kept closed and locked in a valve box with the lid painted red. No other connection shall be made until the disinfection of the new line is complete and the water samples have met the established criteria. The valve shall remain closed at all times except when filling or flushing the line and must be manned during these operations. Backflow prevention in the form of a reduced pressure backflow assembly must be provided if the valve is left unattended. The new pipeline shall be filled completely with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has a minimum concentration of 50 mg/liter available chlorine.

The disinfecting solution shall be retained in the piping for at least 24 hours and all valves, hydrants, services, stubs, etc. shall be operated so as to disinfect all their parts. After this retention period, the water shall contain no less than 25 mg/liter chlorine throughout the treated section of the pipeline.

For pipelines larger than 16" in diameter, the Contractor may use the AWWA C - 651 "Slug Method" for disinfecting the pipeline. Chlorine shall be fed at a constant rate and at a sufficient concentration at one end of the pipeline to develop a slug of chlorinated water having not less than 100 mg/liter of free chlorine. The Contractor shall move the slug through the main so that all interior surfaces are exposed to the slug for at least three (3) hours. The chlorine concentration in the slug shall be measured as it moves through the pipeline. If the chlorine concentration drops below 50 mg/liter, the Contractor shall stop the slug and feed additional chlorine to the head of the slug to restore the chlorine concentration to at least 100 mg/liter before proceeding. As the slug flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

Unless otherwise indicated, all quantities specified herein refer to measurements required by the testing procedures included in the current edition of "Standard Methods". The chlorine concentration at each step in the disinfection procedure shall be verified by chlorine residual determinations.

(4) Final Flushing

The heavily chlorinated water shall then be carefully flushed from the potable water line until the chlorine concentration is no higher than the residual generally prevailing in the existing distribution system. Proper planning and appropriate preparations in handling, diluting, if necessary, and disposing of this strong chlorine solution is necessary to insure that there is no injury or damage to the public, the water system or the environment. The plans and preparations of the Contractor must be approved by the City before flushing of the line may begin. Additionally the flushing must be witnessed by an authorized representative of the City.

Approval for discharge of the diluted chlorine water or heavily chlorinated water into the wastewater system must be obtained from the Public Works Department. The line flushing operations shall be regulated by the Contractor so as not to overload the wastewater system. The City shall designate its own representative to oversee the work.

Daily notice of line discharging must be reported to the Public Works Department.

(5) Bacteriological Testing

After final flushing of the strong disinfecting solution, one (1) set of water samples from the line will be tested for bacteriological quality by the City and must be found free of coliform organisms before the pipeline may be placed in service. Each set shall consist of one (1) sample that is drawn from the end of the main and additional samples that are collected at intervals of not more than 1000 feet along the pipeline. All stubs shall be tested before connections are made to existing systems.

The Contractor, at its expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

Samples for bacteriological analysis will only be collected from suitable sampling taps in sterile bottles treated with sodium thiosulfate. Samples shall not be drawn from hoses or unregulated sources. The City, at its expense, will furnish the sterile sample bottles and may, at its discretion, collect the test samples with City personnel.

If the initial disinfection fails to produce acceptable sample test results, the disinfection procedure shall be repeated at the Contractor's expense. Before the piping may be placed in service, two (2) consecutive sets of acceptable test results must be obtained.

An acceptable test sample is one in which: (1) the chlorine level is similar to the level of the existing distribution system; (2) there is no free chlorine and (3) total coliform organisms are absent. An invalid sample is one, which has excessive free chlorine, silt or non-coliform growth as defined in the current issue of the "Standards Methods." If unacceptable sample results are obtained for any pipe, the Contractor may, with the concurrence of the Inspector, for one time only flush the lines and then collect a second series of test samples for testing by the City. After this flushing sequence is completed, any pipe with one or more failed samples must be disinfected again in accordance with the approved disinfection procedure followed by appropriate sampling and testing of the water.

(CC) Cleanup and Restoration

It shall be the Contractor's responsibility to keep the construction site neat, clean and orderly at all times. Cleanup shall be vigorous and continuous to minimize traffic hazards or obstructions along the streets and to driveways. Trenching, backfill, pavement repair (as necessary), and cleanup shall be coordinated as directed by the

City. The Public Works Department will regulate the amount of open ditch and may halt additional trenching if cleanup is not adequate to allow for orderly traffic flow and access.

Materials at the site shall be stored in a neat and orderly manner so as not to obstruct pedestrian or vehicular traffic. All damaged material shall be removed from the construction site immediately and disposed of in a proper manner. All surplus excavated materials become the property of the Contractor for disposal at his expense. After trenching, the Contractor shall immediately remove all excavated materials unsuitable for or in excess of, backfill requirements. Immediately following the pipe laying Work as it progresses, the Contractor shall backfill, grade and compact all excavations as provided elsewhere and shall immediately clean up and remove all unused soil, waste and debris and restore all surfaces and improvements to a condition equal or superior to that before construction began and to an appearance which complements the surroundings. The Contractor shall grade and dress the top 6 inches of earth surfaces with soil or other material similar and equal to the surrounding, fill and smooth any visible tracks or ruts, replace and re-establish all damaged or disturbed turf or other vegetation and otherwise make every effort to encourage the return of the entire surface and all improvements to a pleasant appearance and useful condition appropriate and complementary to the surroundings and equal or similar to that before construction began.

Permanent pavement replacement, if necessary, shall begin immediately after all testing of each segment of piping is satisfactorily completed.

TECHNICAL SPECIFICATIONS

ITEM 7 – WATER VALVES

1. GENERAL:

This item shall govern the valves furnished and installed as indicated on the Drawings. Unless otherwise indicated on the Drawings, all valves 4 inches (102 mm) and larger shall be AWWA-type valves of suitable design and fully equipped for service buried in the earth, without need for further modification and shall be wrapped with 8-mil (0.2 mm) polyethylene film with all edges and laps securely taped to provide a continuous wrap. Where not indicated, the Contractor may use valves with any type end-joint allowed for fittings of the pipe class being used. Unless otherwise indicated on the Drawings, all valve stems shall be adjusted to situate the operating nut not more than 24 inches (0.6 meters) below the proposed ground or paving surface of the finished project.

This specification is applicable for projects or work involving either inch-pounds or SI units. Within the text, inch-pound units are given preference followed by SI units shown within parentheses.

2. MATERIALS:

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is of the kind and quality that satisfies the specified functions and quality.

(A) Samples, Inspection and Testing Requirements:

All tests and inspections called for by the applicable standards shall be performed by the manufacturer. Upon request, results of these tests shall be made available to the purchaser.

(B) Other Requirements:

Each submittal shall be accompanied by:

- (1) Complete data covering:
 - a). the operator, including type and size, model number, etc.,
 - b). the manufacturer's name and address of his nearest service facility,
 - c). the number of turns to fully open or close the valve.
- (2) detailed instructions for calibrating the limit stops for open and closed positions, and
- (3) any other information that may be necessary to operate and maintain the operator.
- (4) Complete dimensional data and installation instructions for the valve assembly as it is to be installed, including the operator.
- (5) Complete replacement parts lists and drawings, identifying every part for both the valve and operator.

3. VALVES:

(A) Iron-Body Gate Valves

Unless otherwise indicated, Iron Body Gate Valves, 4" and larger (102 mm to 305 mm), including Tapping Valves, shall conform to AWWA C509 or C515, "Resilient Seated Gate Valves for Water and Sewerage Systems".

- (1) Stem Seals: All valves shall have approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body.
- (2) Operation: All valves shall have non-rising stems with a 2" (50 mm) square operating nut, or with a spoke type handwheel when so ordered, turning clockwise to close.
- (3) Gearing: Gate valves in 16 inch (406 mm) and larger sizes shall be geared and, when necessary for proper bury depth and cover, shall be the horizontal bevel-geared type enclosed in a lubricated gear case.
- (4) Valve Ends: Valve ends shall be push-on, flanged or mechanical joint, as indicated or approved.

Tapping valves shall have inlet flanges conforming to MSS SP-60, with boltholes drilled per ANSI B16.1 Class 125. Seat rings and body casting shall be over-sized as required to accommodate full size cutters; the outlet end shall be constructed and drilled to allow the drilling machine adapter to be attached directly to the valve.

- (5) Gear Case: All geared valves shall have enclosed gear cases of the extended type, attached to the valve bonnet in a manner that makes it possible to replace the stem seal without disassembly and without disturbing the gears, bearing or gear lubricant. Gear cases shall be designed and fabricated with an opening to atmosphere so that water leakage past the stem seal does not enter the gear case.
- (6) Valve Body: Gate valves in 16 inch (406 mm) and larger sizes installed in the horizontal position shall have bronze rollers, tracks, scrapers, etc.

(B) Butterfly Valves:

Unless otherwise indicated, all valves shall conform to the current "AWWA" Standard C-504, "Rubber-Seated Butterfly Valves", Class 150B, except as modified or supplemented herein.

(1) Functional Requirements

- a). Valves shall be the short body design and shall have flanged connections on both ends unless otherwise called for.
- b). Valves shall be of such design that the valve discs will not vibrate or flutter when operated in a throttled position. Valve discs shall be secured to the shafts by means of keys or pins so arranged that the valve discs can be readily removed without damage thereto. All keys and pins used in securing valve discs to shafts shall be stainless steel or monel. Valve

discs shall be stainless steel or ductile iron, ASTM A 536, Grade 65-45-12 (448-310-12); seating edge shall be stainless steel or other corrosion resistant material.

- c). Valve shafts shall be constructed of wrought stainless steel or monel. The ends of the shaft shall be permanently marked to indicate the position of the disc on the shaft.
- d). All buried valves shall have approved manufacturer's O-ring type or split V type "Chevron" shaft seals. When O-ring seals are used, there shall be at least two O-rings in contact with the valve shaft where it penetrates the valve body.

On 24 inch (635 mm) and larger valves, the seat shall be completely replaceable and/or adjustable with common hand tools without disassembling the valve from the pipeline.

Rubber seats located on the valve disc shall be mechanically secured with stainless steel retainer rings and fasteners.

- e). Unless otherwise indicated, valves shall be provided with manual operators with vertical stems and 2 inches (50 mm) square operating nut turning clockwise to close and equipped with a valve disc position indicator. All keys or pins shall be stainless steel or monel. Buried valves shall have the valve stems extended or adjusted to locate the top of the operating nut no more than 24 inches (0.6 meter) below finish grade.
- f). Unless otherwise indicated, motorized butterfly valves shall be equipped with 230/460 volt, 3-phase reversing motor operators, extended as required to locate the center line of the operator shaft approximately 4 feet to 4 feet, 6 inches (1.2 to 1.4 meters) above finish grade. Operators shall be equipped with cast iron or malleable iron manual override hand wheel with a valve position indicator, local push button controls, lighted status/position indicator, torque and travel limit switches and all switches, relays and controls (except external power and signal wiring) necessary for both local and remote operation.

(2) Performance Requirements

- a). Unless otherwise indicated, valve operators shall be sized to seat, unseat, open and close the valve with 150 psi (1 megapascal) shutoff pressure differential across the disk and allow a flow velocity of 16 feet (4.9 meters) per second past the disc in either direction.
- b). Motorized valve motors shall be capable of producing at least 140 percent of the torque required to operate the valves under conditions of maximum non-shock shutoff pressure without exceeding a permissible temperature rise of 131⁰F over 104⁰F ambient (55 degrees Celsius over 40 degrees Celsius ambient); they shall have a duty rating of not less than 15 minutes and shall be capable of operating the valve through 4 1/2 cycles against full unbalanced pressure without exceeding the permissible temperature rise. Motors shall be suitable for operating the valve under maximum differential pressure when voltage to motor

terminals is 80 percent of nominal voltage. Motor bearings shall be permanently lubricated and sealed.

(C) Ball Valves:

Ball valves shall be brass, bronze, stainless steel or PVC as indicated on the Drawings or Details or as approved by the Engineer or designated representative.

(D) Air-Vacuum Release Valves

- (1) Valves shall be combination air-release, air-vacuum units having small and large orifice units contained and operating within a single body or assembled unit.

The small orifice system shall automatically release small volumes of air while the pipe is operating under normal conditions. The large air-vacuum orifice system shall automatically exhaust large volumes of air while the pipe is being filled and shall permit immediate re-entry of air while being drained.

Valves shall be rated for at least 150-psi (1 megapascal) {maximum} normal service pressure.

- (2) Material Requirements

Valve exterior bodies and covers shall be cast iron.

Internal bushings, hinge pins, float guide and retaining screws, pins, etc., shall be stainless steel or bronze.

Orifice seats shall be Buna-N rubber.

Floats shall be stainless steel, rated at 1000 psi (6.9 megapascals).

E) Fire Hydrants

All fire hydrants shall be Dry Barrel, Traffic Model (break-away), Post Type having Compression Type Main Valves with 5 1/4" (133 mm) opening, closing with line pressure.

Fire hydrants shall be either Mueller Centurion, Clow Medallion or American Darling.

- (1) Applicable Specifications

AWWA C-502 current: "AWWA Standard for Dry-Barrel Fire Hydrants".

NFPA 1963: "National (American) Standard Fire Hose Coupling Screw Thread" and City of Austin 4 inch (102 mm) Fire Hose Connection Standard (Available upon request from Standards Committee Secretary at 322-2806).

ANSI A-21.11 current: "American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings".

- (2) Functional Requirements

Design Working Pressure shall be 200 psi (1.38 megapascals) and a test pressure of 400 psi (2.76 megapascals).

Inlet shall be side connection hub end for mechanical joint (ANSI A-21.11-current). Shoe shall be rigidly designed to prevent breakage.

Lower Barrel shall be rigid to assure above ground break at traffic feature. Bury length of hydrant shall be four (4) feet (1.2 meters) minimum, five (5) feet (1.5 meters) maximum (hydrant lead pipe may be elbowed up from main using restrained joints; flanged joints in lead pipes are not allowed). Flange type connections between hydrant shoe, barrel sections and bonnet shall have minimum of 6 corrosion resistant bolts.

Hydrant Main Valve shall be 5 1/4 inch (133 mm) I.D. Valve stem design shall meet requirements of AWWA C502, with Operating Nut turning clockwise to close. Operating Nut shall be pentagonal, 1 1/2 inch (38 mm) point to flat at base, and 1 7/16 inches (36.5 mm) at top and 1 inch (25 mm) minimum height. Seat ring shall be bronze (bronze to bronze threading), and shall be removable with light weight stem wrench. Valve mechanisms shall be flushed with each operation of valve; there shall be a minimum of two (2) drain ports.

Traffic Feature shall have replaceable breakaway ferrous metal stem coupling held to stem by readily removable type 302 or 304 stainless steel fastenings. Breakaway flange or frangible lugs shall be designed to assure aboveground break. Breakaway or frangible bolts will not be acceptable.

Outlet Nozzles shall be located approximately 18 inches (450 mm) above ground. Each hydrant shall have two (2) 2 1/2 inch (63.5 mm) nozzles 180 degrees apart with National (American) Standard Fire Hose Coupling Screw Thread NFPA 1963 and one (1) 4 inch (102 mm) pumper nozzle with City of Austin standard thread—six (6) threads per inch (25 mm) "Higbee" cut, 4.8590 inch (123.4 mm) O.D., 4.6425 inch (117.9 mm) root diameter. Nozzles shall be threaded or cam-locked, O-ring sealed, and shall have type 302 or 304 stainless steel locking devices. Nozzle caps (without chains) and cap gaskets shall be furnished on the hydrant. The cap nut shall have the same configuration as the operating nut.

Hydrants shall be Dry-Top Construction, factory lubricated oil or grease with the lubricant plug readily accessible. The system shall be described for City approval.

A blue reflective delineator of a type approved by the Public Works Department shall be placed 2 to 3 feet (0.6 to 0.9 meters) offset from the centerline of paved streets, on the side of and in line with, all newly installed fire hydrants.

Hydrant shall have double O-ring seals in a bronze stem sheath housing to assure separation of lubricant from water and shall have a weather cap or seal, or both, as approved by the Owner, to provide complete weather protection.

(3) Material Requirements

All below ground bolts shall be corrosion resistant. The hydrant valve shall be Neoprene, 90 durometer minimum. The seat ring, drain ring, operating nut and nozzles shall be bronze, AWWA C-502 current, containing not over 16 percent zinc. Break-away stem coupling shall be of ferrous material; its retaining pins, bolts, nuts, etc. of type 302 or 304 stainless steel.

Coatings shall be durable and applied to clean surfaces. Exterior surfaces above ground shall receive a coating of the type and color per City standards. The coating shall be applied according to coating manufacturer's specifications. Other exposed ferrous metal shall receive asphalt-based varnish, or approved equal, applied according to the coating manufacturer's specifications.

4. CONSTRUCTION METHODS:

(A) Setting Valves, Drains and Air Releases

Unless otherwise indicated, main line valves, drain valves and piping, air and vacuum release assemblies and other miscellaneous accessories shall be set and jointed in the manner described for cleaning, laying, and jointing pipe.

Unless otherwise indicated, valves shall be set at the locations shown on the Drawings and such that their location does not conflict with other appurtenances such as curb ramps. Valves shall be installed so that the tops of operating stems will be at the proper elevation required for the piping at the location indicated above. Valve boxes and valve stem casings shall be firmly supported and maintained, centered and aligned plumb over the valve or operating stem, with the top of the box or casing installed flush with the finished ground or pavement in existing streets, and installed with the top of the box or casing approximately 6 inches (150 mm) below the standard street subgrade in streets which are excavated for paving construction or where such excavation is scheduled or elsewhere as directed by the Public Works Department or designated representative.

Drainage branches or air blowoffs shall not be connected to any sanitary sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system. Every drain line and every air release line shall have a full sized independent gate valve flanged directly to the main. Flap-valves, shear gates, etc., will not be accepted.

(B) Setting Fire Hydrants:

Fire hydrants shall be located in a manner to provide accessibility and in such a manner that the possibility of damage from vehicles or conflict with pedestrian travel will be minimized. Unless otherwise directed, the setting of any hydrant shall conform to the following:

Hydrants between curb and sidewalk on public streets, shall be installed as shown on Standard Fire Hydrant Detail, with outermost point of large nozzle cap 6" to 18" (150 mm to 450 mm) behind back of curb. Where walk abuts curb, and in other public areas or in commercial areas, dimension from gutter face of curb to outermost part of any nozzle cap shall be not less than 3 feet (0.9 meters), nor more than 6 feet (1.8 meters), except that no part of a hydrant or its nozzle caps shall be within 6 inches (150 mm) of any sidewalk or pedestrian ramp. Any fire hydrant placed near a street corner shall be no less than 20 feet (6 meters) from the curb line point of tangency. Fire hydrants shall not be installed within nine feet (2.75 meters) vertically or horizontally of any sanitary sewer line regardless of construction.

All hydrants shall stand plumb; those near curbs shall have the 4 inch (102 mm) nozzle facing the curb and perpendicular to it. The hydrant bury mark shall be located at ground or other finish grade; nozzles of all new hydrants shall be

approximately 18 inches (450 mm) above grade. Lower barrel length shall not exceed 5 feet (1.5 meters). Barrel extensions are not permitted unless approved by the Engineer or designated representative. Each hydrant shall be connected to the main by 6 inch (152 mm) ductile iron pipe; a 6 inch (152 mm) gate valve shall be installed in the line for individual shutoff of each new hydrant.

Below each hydrant, a drainage pit 2 feet (0.6 meter) in diameter and 2 feet (0.6 meter) deep shall be excavated and filled with compacted coarse gravel or broken stone mixed with coarse sand under and around the bowl of the hydrant, except where thrust blocking is located and to a level 6 inches (150 mm) above the hydrant drain opening.

The hydrant drainage pit shall not be connected to a sanitary sewer. The drain gravel shall be covered with filter fabric to prevent blockage of voids in the gravel by migration of backfill material. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust blocking (taking care not to obstruct the hydrant drain holes), or the hydrant shall be tied to the pipe with approved metal harness rods and clamps. The fire line shall be provided with joint restraint from the main line to the fire hydrant. Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

Fire hydrants on mains under construction shall be securely wrapped with a poly wrap bag or envelope taped into place. When the mains are accepted and placed in service the bag shall be removed.

(C) Plugging Dead Ends:

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses and spigot ends shall be capped. All end plugs or caps shall be secured to the pipe conforming to Standard Specification Item 6, "Pipe".

(D) Protective Covering:

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel component shall be coal tar coated and shall be wrapped with standard minimum 8-mil (0.2 mm) low density polyethylene film or a minimum 4-mil (0.1 mm) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105-current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling.

(E) Valve Box, Casing and Cover:

Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A 48, Class 30B. Testing shall be verified by the manufacturer at the time of shipment. Each casting shall have cast upon it a distinct mark identifying the manufacturer and the country of origin.

TECHNICAL SPECIFICATIONS

ITEM 8 – CONCRETE ENCASUREMENT AND ENCASUREMENT PIPE

1. GENERAL:

This item shall govern the furnishing of materials and the methods of constructing a Portland cement concrete encasement or encasement pipe.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

2. SUBMITTALS:

The submittal requirements of this specification item include:

- (A) Type, of pipe, construction methods and sequence,
- (B) Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- (C) Proposed proportioning of materials for the mortar mix.

3. MATERIALS:

- (A) Portland Cement Concrete

The Portland cement concrete shall conform to Class B Concrete, Item 2, "Concrete".

- (B) Pipe

Portland Cement concrete pipe shall conform to ASTM C-76, Class III or better.

Corrugated Metal Pipe (CMP) shall conform to Standard Specification Item 6, "Pipe".

Steel Pipe shall conform to ASTM A134 with a minimum thickness of 3/8 inch (9.5 mm) for pipe with a diameter of 16 inches (400 mm) and greater.

- (C) Grout

Grout shall consist of not less than 6 sacks Portland cement per cubic yard (335 kilograms Portland cement per cubic meter) and clean washed sand mixed with water. The grout shall have a consistency such that the grout will flow into and completely fill all voids. If allowed by the Public Works Department or designated representative, an air entraining admixture may be added to facilitate placement.

4. CONSTRUCTION METHODS:

When indicated on the Drawings or acceptable to Public Works Department or designated representative, concrete encasement shall be placed to protect the pipe. Pipe or bedding shall not be placed where:

- (1) the top of the pipe would have less than 30 inches (60 mm) of cover,
- (2) the ground water invades the trench, or

(3) the trench bottom is of unstable material.

If either of these conditions is encountered, the Public Works Department or designated representative shall be notified and may direct the Contractor to:

- (1) encase the pipe with concrete,
- (2) change pipe material, or
- (3) use a higher strength class of pipe.

Concrete encasement shall extend from 6 inches (150 mm) below to 6 inches (150 mm) above the outer projections of the pipe over the entire width of the trench.

The ends of the encasement pipe shall be bulkheaded (refer to Standard Specification Item 10 - Bulkheads) with concrete blocks, bricks or stones, dry-stacked without mortar, sufficient to prevent the intrusion of trench backfill material into the encasement, but fitted loosely enough to facilitate the escape of water from the encasement should carrier pipe leakage or failure occur.

TECHNICAL SPECIFICATIONS

ITEM 9 – JACKING OR BORING PIPE

1. **GENERAL:**

This item shall govern furnishing and installing of encasement pipe by methods of jacking or boring as indicated on the Drawings and in conformity with this specification. This item shall also include, but not be limited to other construction activities such as traffic control measures, excavation, removal of all materials encountered in jacking or boring pipe operations, disposal of all material not required in the work, grouting, bulkhead installation, backfilling and re-vegetation.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

2. **SUBMITTALS:**

The submittal requirements for this specification item shall include:

- (A) Shop drawings identifying proposed jacking or boring method complete in assembled position
- (B) Trench Safety Plan including pits, trenches and sheeting or bracing if necessary,
- (C) Design for jacking or boring head,
- (D) Installation of jacking or boring supports or back stop,
- (E) Arrangement and position of jacks and pipe guides, and
- (F) Grouting plan,

3. **MATERIALS:**

- (A) Pipe

Carrier pipe and encasement pipe shall conform to Standard Specification Item 8, "Concrete Encasement and Encasement Pipe" and Item 6, "Pipe" and shall be size, type materials, thickness and class indicated on the Drawings, unless otherwise specified.

- (B) Grout

Grout for void areas shall consist of 1 part Portland cement and 4 parts fine, clean sand mixed with water.

4. **CONSTRUCTION METHODS:**

- (A) General

The Contractor is responsible for:

- (1) Adequacy of jacking and boring operations,

- (2) Installation of support systems as indicated on the Drawings,
- (3) Provision of encasement and carrier pipe, and
- (4) Execution of work involving the jacking operation, the wet or dry method of boring and the installation of encasement pipe simultaneously.

The Contractor shall have sole responsibility for the safety of the jacking and boring operations and for persons engaged in the work. The Contractor's attention is directed to the Construction Industry Occupational Safety and Health Administration (OSHA) Standards (29 FR 1926/1920) as published in U.S. Department of Labor publication OSHA 2207, latest revision, with particular attention to Subpart S. The Contractor shall conform to the requirements in accordance with Standard Specification Item 15, "Trench Safety System" and shall provide an appropriate Trench Safety Plan.

When the grade of the pipe at the jacking or boring end is below the ground surface, suitable pits or trenches shall be excavated to provide sufficient room to conduct the jacking or boring operations and for placement of end joints of the pipe. In order to provide a safe and stable work area, the excavated area shall be securely sheeted and braced to prevent earth caving in accordance with the Trench Safety Plan.

The location of the work pit and associated traffic control measures required for the jacking or boring operations shall conform to the requirements of the TxDOT Manual on Uniform Traffic Control Devices.

Where installation of pipe is required under railroad embankments, highways, streets, or other facilities by jacking or boring methods, construction shall be undertaken in such a manner that it will not interfere with operation of any railroad, street, highway, utility or other facility and shall not weaken or damage any embankment or structure. All appropriate permits shall be acquired prior to the initiation of the work.

During construction operations, and until the work pits are backfilled and fill material compacted, traffic barricades and warning lights to safeguard traffic and pedestrians shall be furnished and maintained by the Contractor. The Contractor shall submit the proposed pit location and traffic control plan for review by the Engineer or designated representative. The Review by the Engineer or designated representative, however, will not relieve the Contractor from his responsibility to obtain specified results in a safe, workmanlike manner.

When grade of pipe at jacking or boring end is below ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking or boring operations and for joining pipe. Work shall be securely sheeted and braced as indicated on the Trench Safety Plan to prevent earth caving and to provide a safe and stable work area.

The pipe shall be jacked or bored from the low or downstream end, if possible. Minor lateral or vertical variation in the final position of pipe from line and grade established by Engineer or designated representative will be permitted at the discretion of Engineer or designated representative provided that such variation is regular and occurs only in one direction and that the final grade of the flow line conforms to the specified direction.

When conforming to details indicated on the drawings, but the bottom of the work pit is unstable or excessively wet or the installation of water and wastewater pipe will result in less than 30 inches (750 mm) of cover, the Contractor shall notify the Engineer or designated representative. The Engineer or designated representative may require the Contractor to install a concrete seal, cradle, cap or encasement or other appropriate action.

Immediately after jacking or boring is complete and the encasement pipe is accurately positioned and approved for line and grade, the clear space between the pipe and the surrounding excavated material shall be completely filled by pressure grouting for entire length of installation.

After placement of the carrier pipe is complete, the ends of the encasement pipe shall be bulkheaded with brick, concrete blocks or stones of sufficient mass to prevent the intrusion of backfill, etc. into the encasement pipe. The bulkhead shall also be provided with sufficient number and placement of weep holes to facilitate the escape of the contents of carrier pipe should failure occur.

As soon as possible after the carrier pipe(s) and bulkheads are completed, the work pits or trenches, which are excavated to facilitate these operations, shall be backfilled. The backfill in the street ROW shall be compacted to not less than 95 percent of the maximum density conforming to TxDOT Test Method Tex-114-E, "Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil". Field density measurements will be made in accordance with TxDOT Test Method Tex-115-E, "Field Method for Determination of In-Place Density of Soils and Base Materials".

Where the characteristics of soil, size or size of proposed pipe dictate that tunneling is more satisfactory than jacking or boring, a tunneling method may be submitted for acceptance by Engineer or designated representative.

(B) Jacking

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating the jacks, an even pressure shall be applied to all jacks used so that the pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The complete jacking assembly shall be placed in order to line up with the direction and grade of the pipe. In general, the embankment material shall be excavated just ahead of the pipe, the material removed through the pipe and the pipe forced through embankment by jacking, into the space thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of no more than 2 inches (50 mm) may be provided for the upper half of the pipe. This clearance shall be tapered to zero at the point where excavation conforms to contour of pipe.

The distance that excavation shall extend beyond the end of the pipe depends on the character of material encountered, but it shall not exceed 2 feet (0.6 meter) in any case. This distance shall be decreased, when directed by the Engineer or

designated representative, if the character of the material being excavated makes it desirable to keep the advance closer to the end of the pipe.

The Contractor may use a cutting edge of steel plate around head end of the pipe extending a short distance beyond the end of pipe with inside angles or lugs to keep cutting edge from slipping back onto the pipe.

When jacking of the pipe is begun, all operations shall be carried on without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at its entire expense.

(C) Boring

The boring shall proceed from a work pit provided for the boring equipment and workmen. Excavation for the work pits and the installation of shoring shall be as outlined in the Trench Safety Plan. The location of the pit shall be approved by the Engineer or designated representative. The boring shall be done mechanically using either a pilot hole or the augur method.

In the pilot hole method an approximate 2 inch (50 mm) pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored.

When the augur method is used, a steel encasement pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation shall be used. Augurs shall be of sufficient diameter to convey the excavated material to the work pit.

Excavated material will be removed from the working pit and disposed of properly. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Water jetting will not be permitted.

In unstable soil formations, a gel-forming colloidal drilling fluid, that consists of at least 10 percent of high grade carefully processed bentonite, may be used to consolidate the drill cuttings, seal the walls of the hole and furnish lubrication to facilitate removal of the cuttings from the bore.

(D) Joints

If reinforced concrete pipe is used, the joints shall be in accordance with TxDOT Specification Item 464, "Reinforced Concrete Pipe".

TECHNICAL SPECIFICATIONS

ITEM 10 - BULKHEADS

1. GENERAL:

This item shall govern furnishing and installing plywood or end caps as a temporary utility plug at locations indicated on the Drawings or as directed by the Engineer or designated representative. The work will be placed in conjunction with installation of a pipe where a continuation of the utility system will be performed later.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

2. SUBMITTALS:

The submittal requirements of this specification item include the type (wood, plastic, rubber, etc.) and application (pipe characteristics and location) of bulkheads.

3. MATERIAL:

Plywood shall be construction grade, 3/4 inch (19 mm) thick and need not be new or treated. End caps may be plastic, vitrified clay pipe, rubber or concrete.

4. CONSTRUCTION METHODS:

After installation of the utility requiring temporary bulkheading, an end cap or a section of plywood, having dimensions at least 6 inches (150 mm) in excess of the outside pipe diameter shall be attached to the exposed bell or spigot and backfilled immediately after installation. Care shall be exercised to prevent the backfill material from entering the pipe.

Bulkheads used with staged construction shall be sound, reasonably free of knots and warps and have a 3 inch (75 mm) nominal thickness.

TECHNICAL SPECIFICATIONS

ITEM 11 – ADJUSTING STRUCTURES

1. GENERAL:

This item shall govern the removal and replacement of surfacing, furnishing of materials, adjusting and/or repositioning existing structures, valve boxes, pull boxes, survey monument boxes and water meters in accordance with these specifications to the locations or elevations indicated on the Drawings or as directed by the Engineer or designated representative. This item shall also govern any pumping, bailing and drainage required to complete the Work and Standard Specification Item 15, "Trench Safety Systems" for trench walls when indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses

2. SUBMITTALS:

The submittal requirements of this specification item include:

- (A) Aggregate type, gradations and physical characteristics for the Portland cement concrete mix.
- (B) Proposed proportioning of materials for the mortar mix.
- (C) Type structures and proposed adjustment technique (lowering, raising, lateral displacement).
- (D) Type structure, repair technique and materials to be furnished (new replacement or reuse of existing) Type of mixing plant and associated equipment including chart indicating the calibration of each cold bin

3. MATERIALS:

Precast reinforced concrete rings and castings in good condition, which are removed from the structures to be adjusted, may be reused with the written approval of the Engineer or designated representative. Additional materials required shall conform to the details indicated on the Drawings.

(A) Portland Cement Concrete

The Portland cement concrete shall be Class A conforming to Standard Specification Item 2, "Concrete".

(B) Mortar

Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand, by volume based on dry materials. Sufficient water will be added to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item 2, "Concrete".

4. **CONSTRUCTION METHODS:**

All adjustments shall be completed prior to the placement of the final surface.

Pull box and valve box components scheduled for reuse shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at its own expense.

If the adjustment involves slight lowering or raising a valve box or survey monument box, the outside shell of a slip or screw casing shall be excavated to its full length and adjusted to the proposed grade. Pipe castings shall be excavated to the depth required to cut from or weld a section to the casing as may be needed to adjust the ring to the proposed elevation. The ring shall be welded to the casing prior to pouring concrete around the casing.

If the adjustment involves a vertical (lowering or raising) or a horizontal reassignment of a water meter and the property owner's cut off valve, this work shall be completed in accordance with Standard Installation Details included herein.

After the adjustments have been completed and cured, structures within the paved area shall be paved as indicated on the Drawings.

TECHNICAL SPECIFICATIONS

ITEM 12 - MANHOLES

1. GENERAL:

This item shall govern construction of manholes, complete in place, and the materials used therein, including excavation, installation, backfilling and surface restoration. It shall also include furnishing and installing rings, covers, and appurtenances, as well as any pumping and drainage necessary to complete the work. Wastewater manholes shall be 'acceptance tested' by the Contractor.

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work are of the kind and quality that satisfies the specified functions and quality as specified or presented in the Drawings.

2. SUBMITTALS:

The submittal requirements of this specification item include:

- (A) Type, size and manufacturer of manhole (diameter of water or wastewater manhole), structure (precast, cast in place; Standard, Tee, etc), and materials and equipment to be furnished (brick, concrete, seals, rings, covers, etc.)
- (B) Aggregate types, gradations and physical characteristics for the Portland cement concrete mix.
- (C) Proposed proportioning of materials for the mortar mix.
- (D) Proposed Acceptance testing procedure and associated test equipment and materials Type structures and proposed adjustment technique (lowering, raising, lateral displacement).
- (E) Proposed product for coating the interior surface of new and/or existing wastewater manholes.

Submittal of test Records is required and shall include as a minimum the following items. The test records shall also be included as part of the Project records turned in with the acceptance package.

- Name of the manhole manufacturer
- Interior surface coating type and application method for Wastewater Manholes
- Model and manufacturer of vacuum tester
- Date tested/date re-tested
- Passed/failed and state what was done to correct the problem
- Test Method Used
- Location/station of manhole
- Precast/cast-in- place bottom
- Any repairs made to the joints.

3. MATERIALS AND COMPONENTS:

(A) Concrete and Cement Stabilized Sand

All concrete shall conform to Standard Specification Item 2, "Concrete". The cast in place concrete shall be Class A, and the precast concrete manhole base sections, riser sections and appurtenances shall conform to the requirements of ASTM C478/C478M, "Standard Specification for Precast Reinforced Concrete Manhole" with Class I concrete. All interior surfaces of wastewater manholes shall receive a coating by an application method acceptable to the Engineer or designated representative or shall be otherwise acceptably protected from the acidic effects of municipal wastewater. Concrete for backfill of over-excavated areas shall be Class A or Class J as indicated on the Drawings. Cement stabilized sand for bedding or backfilling, when indicated or required on the Drawings, shall contain 2 bags of Portland Cement per cubic yard (112 kilograms of Portland cement per cubic meter). The sand shall meet the requirements for "Fine Aggregate" in Standard Specification Item 2, "Concrete".

(B) Mortar

The mortar shall be composed of one part Portland cement, one part masonry cement (or 1/4 part hydrated lime), and sand equal to 2-1/2 to 3 times the sum of the volumes of the cements and lime used. The sand shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item 2, "Concrete".

(C) Reinforcement

The reinforcing steel shall conform to the requirements of Standard Specification Item 2, "Concrete". Secondary, non-structural steel in cast-in-place stormwater manholes may be replaced by collated fibrillated polypropylene fibers, if approved by the Engineer or designated representative.

(D) Brick

The brick for ring adjustment courses and for stormwater manholes shall be of first quality, sound, hard burned, perfectly shaped brick conforming to the requirements of ASTM C 62, Grade SW, or concrete brick meeting the requirements of ASTM C 55, Grade N-1.

(E) Rings and Covers

Rings and covers shall conform to the requirements of Standard Specification Item 13, "Frames, Grates, Rings and Covers".

(1) Replacement Rings and Covers, 30 in. (763 mm) Diameter Lids.

This ring and cover shall be used for the replacement of broken rings and covers, minor manhole adjustment, or as otherwise directed by the Engineer or designated representative.

(2) Rings and Covers, 32 in. (813 mm) Diameter Lids.

This ring and cover shall be used for all new manhole construction, except as otherwise directed by the Engineer or designated representative.

(F) Bulkheads.

Bulkheads shall meet the requirements of Standard Specification Item 10, "Bulkheads"

(G) Precast Base Sections, Riser Sections, and Cones.

Precast concrete base sections, riser sections, and cones shall conform to the requirements of ASTM C 478. The width of the invert shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped with a minimum depth of three fourths of the largest pipe diameter. The invert shall have a minimum difference of 0.10 feet (30 mm) between the inlet and outlet. Where lines enter the manhole up to 24 inches (610 mm) above the flowline of the outlet, the invert shall be filleted to prevent splashing and solids deposition. A drop pipe shall be provided for a sewer entering a manhole at more than 24 inches (610 mm) above the flowline of the outlet.

Joints for wastewater base sections, riser sections, and cones shall conform to the requirements of ASTM C 443. Additionally, joint dimensions for 48-inch (1.22 meters) inside diameter wastewater manhole sections and cones shall comply with City of Austin Standard Detail No. 506S-12, "O-Ring Joint Detail Precast Manhole Section" or City of Austin Standard Detail No. 506S-13, "Wedge Seal Joint Detail, Precast Manhole Section". Precast bases for 48 inch (1.22 meters) inside diameter manholes shall have preformed inverts. Inserts acceptable to the Engineer or designated representative shall be embedded in the concrete wall of the manhole sections to facilitate handling; however, through-wall holes for lifting will not be permitted. Any voids between the pipe and boot shall be filled to the springline with a product recommended by the manhole manufacturer to prevent solids collection.

(H) Precast Junction Boxes.

Precast junction boxes shall be allowed only where indicated on the Drawings or acceptable to the Engineer or designated representative. Joints for wastewater junction boxes shall conform to the requirements of ASTM C 443.

(I) Pipe-to-Manhole/Junction Box Assemblies

Precast bases and precast junction boxes shall have flexible, resilient and non-corrosive boot connectors or ring waterstops acceptable to the Engineer or designated representative conforming to the requirements of ASTM C 923 on all wastewater pipe connections.

(J) Precast Flat-Slab Transition/Junction Box Lids.

Precast slab transitions and lids shall be designed to safely resist pressures resulting from loads which might result from any combination of forces imposed by an HS-20 loading as defined by the American Association of State Highway and Transportation Officials (AASHTO). The joints of precast slab transitions and of lids for wastewater applications shall conform to the requirements of ASTM C443.

(K) Precast-Prefabricated Tee Manholes.

Tee manholes shall be allowed only where indicated on the Drawings or as directed by the Engineer or designated representative. The main pipe section shall conform to the requirements of Standard Specification Item 6, "Pipe". The vertical manhole

portion (tee) above the main pipe shall conform to the requirements of the precast components.

The manhole tee shall have a minimum inside diameter of 48 inches (1.22 meters) and shall rise vertically centered or tangent to the main pipe, as indicated on the Drawings or as directed by the Engineer or designated representative. An access hole less than 48-inches (1.22 meters) in diameter shall be cut into the main pipe to allow a ledge for support of access ladders.

(L) Precast Grade Rings

Rings shall be reinforced Class A or I concrete.

(1) Precast Grade Rings, 24-1/2 inches (622 mm) Inside Diameter:

This adjustment ring shall be used only for adjusting existing manholes with 24 inch (610 mm) lids and for Wastewater Access Device. Inside to outside diameter dimension of ring shall be 6 inches (152 mm) with a thickness of 3 inches to 6 inches (76 mm to 152 mm).

(2) Precast Grade Rings, 35 inches (889 mm) Inside Diameter:

This adjustment ring shall be used for all new manhole construction with 32 inches (813 mm) lids. Inside to outside diameter dimension of ring shall be 6 inches (152 mm) with a thickness of 4 inches to 6 inches (102 mm to 152 mm).

(M) New Manhole Construction and Minor Manhole Adjustment:

For new manhole construction, the maximum vertical allowable ring adjustment, including the depth of the ring casting, shall be limited to 18 inches (450 mm). For adjustments of existing manholes that fall within the limits of overlay and street reconstruction projects, the maximum vertical allowable, including the depth of the ring casting, shall be limited to two feet (600 mm). All other existing manholes shall have a maximum allowable ring adjustment, including the depth of the ring casting, of one foot (300 mm). All manholes not located in paved areas shall have bolted covers.

(N) Waterproofing Joint Materials.

O-rings and wedge seals for the joints of all wastewater manholes, and for stormwater manholes when indicated on the Drawings, shall conform to the requirements of ASTM C443. Cold applied preformed plastic gaskets for stormwater manholes shall be as specified in Standard Specification Item 6, "Pipe". The connections between reinforced concrete wastewater manhole structures and pipes shall meet the requirements of ASTM C923.

(O) Interior Surface Coatings for Wastewater Manholes

The interior surfaces of all wastewater manholes shall be coated with a product as specified on the Drawings, designated in writing by the Engineer or designated representative or included on the approved Standard Products List (SPL) numbers WW-511 for new manholes and WW-511A for existing manholes.

(P) Abandonment of Existing Manholes

When designated on the Drawings for abandonment, existing manholes shall be removed to a level not less than four feet (1.2 meters) below grade. The inlets and

outlets shall be securely plugged and the structure filled with flowable fill or as directed by the Engineer or designated representative.

4. CONSTRUCTION:

All manholes shall have a minimum inside diameter of 48 inches (1.22 meters). Manhole base section or junction box dimension shall be appropriately increased to accommodate all converging pipe. A minimum horizontal clearance of 12 inches (300 mm) shall be maintained between adjacent pipes. Pipe ends within the base section or junction box walls shall not be relied upon to support overlying manhole dead and live load weights. All wastewater branch connections to new or existing mains shall be made at manholes with the influent pipe crown installed at the elevation of the effluent pipe crown. Where lines enter the manhole up to 24 inches (600 mm) above the flowline of the outlet, the invert shall be sloped upward to receive the flow, thus preventing splashing or solids deposition. Where the springline of an influent pipe is 24 inches (600 mm) or more above the springline of the effluent pipe, a drop manhole shall be used. Construction of extensions to existing systems shall require placement of bulkheads at locations indicated or directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, stormwater manholes shall have eccentric cones; wastewater manholes shall have concentric cones, except on manholes over large mains where an eccentric cone shall be situated to provide access to an invert ledge. Eccentric cones may be used where conflicts with other utilities dictate. Flat-slab tops may be used where clearance problems exist.

Manholes shall be founded at the established elevations on uniformly stable subgrade. Unstable subgrade shall be over-excavated a minimum of 12 inches (300 mm) and replaced with a material acceptable to the Engineer or designated representative. Precast base units shall be founded and leveled on a 6 inch (150 mm) coarse aggregate bedding. A pipe section with a prefabricated tee manhole and half the length of the adjoining pipe sections on each side shall be founded on a minimum of 6 inch (150 mm) unreinforced Class A concrete (Standard Specification Item 2, "Concrete"). The cast-in-place concrete cradle shall be placed against undisturbed trench walls up to the pipe's springline.

All adjustments shall be completed prior to the placement of the final surface.

Manhole components to be reused shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at its expense.

If the adjustment involves lowering the top of a manhole, a sufficient depth of precast concrete rings or brick courses shall be removed to permit reconstruction. The mortar shall be cleaned from the top surface remaining in place and from all brick or concrete rings to be reused and the manhole rebuilt to the required elevation. The manhole ring and cover shall then be installed with the top surface conforming to the proposed grade.

If the adjustment involves raising the elevation of the top of the manhole, the top of brick or concrete ring shall be cleaned and built up vertically to the new elevation, using new or salvaged concrete rings or bricks and the ring and cover installed with the top surface conforming to the proposed grade.

Cast-in-place foundations shall have a minimum depth of 12 inches (300 mm) at the invert flowline. The widths of all manhole inverts shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped with a minimum depth of three fourths of the largest

pipe diameter. The invert shall have a minimum fall of 0.10 of a foot (30 mm) between the inlet and outlet. The lowermost riser section may be set in the Portland cement concrete, while still green, after which the foundation shall be cured a minimum of 24 hours prior to proceeding with construction of the manhole up to 12 feet (3 2/3 meters) in depth. The foundation shall be cured an additional 24 hours prior to continuing construction above the 12 foot (3 2/3 meters) level. Manhole depth shall be measured from the invert flowline to the finish surface elevation.

Wastewater manholes having cast in place foundations may be constructed over existing wastewater pipes, except polyvinyl chloride (PVC), and the top half of the pipe removed to facilitate invert construction. The manhole bottom shall rise from the springline elevation of the pipe, approximately one inch for each 12 inches (80 mm per meter) of run (8%). Wastewater manholes with lines larger than 18 inches (450 mm) shall require precast bases; manholes constructed over in-service mains however, may be built on cast-in-place foundations if the flow cannot be interrupted. Precast and cast-in-place wastewater junction boxes shall be allowed only where indicated on the Drawings or acceptable to the Engineer or designated representative. The floors of stormwater manholes also, shall rise outwardly from the springline on a slope of 1:12 or 80 mm per meter (8%).

Wastewater lines, except reinforced concrete pipe, set in cast-in-place foundations, shall require a waterstop seal or gasket acceptable to the Engineer or designated representative around the outside perimeter of the pipe. It shall be approximately centered under the manhole section wall.

Cast-in-place stormwater manholes, junction boxes and flat-slab transitions shall be reinforced, Class A concrete (Standard Specification Item 2, "Concrete"). All structural concrete work shall conform to Standard Specification Item 2, "Concrete". Forms will be required for all cast-in-place walls above the foundation. Where the surrounding material can be trimmed to a smooth vertical face, outside forms may be omitted.

Backfilling for manholes shall conform to the density requirements of Standard Specification Item 6, "Pipe". Manhole construction in roadways may be staged to facilitate base construction. Manholes constructed to interim elevations shall be covered with steel plates of sufficient thickness to support vehicular traffic. Steel plates on wastewater manholes shall be set in mortar to minimize inflow. Manholes shall be completed to finish elevation prior to placement of the roadway's finish surface. The excavation for completion of manhole construction shall be backfilled with cement stabilized sand with 2 sacks of cement per cubic yard (112 kilograms of cement per cubic meter) up to the bottom of Portland Cement pavement slabs or to within 2 inches (50 mm) of finish elevation of asphaltic concrete pavements. The cement stabilized sand shall be a minimum of 12 inches (300 mm) thick.

After rings and covers are set to grade, the inside and outside of the concrete rings shall be wiped with mortar so placed as to form a durable water-tight joint smooth and even with the manhole cone section. No grouting shall be performed when the atmospheric temperature is at or below 40°F (5°C), and when necessary, because of a sudden drop in temperature, joints shall be protected against freezing for at least 24 hours.

5. ACCEPTANCE TESTING OF WASTEWATER MANHOLES

Manholes shall be tested separately and independently of the wastewater lines.

(A) Test by the Vacuum Method:

A vacuum test shall be performed by the Contractor prior to backfilling those manholes that fall within the right-of-way that require detouring of vehicular traffic. A second vacuum test will not be required after backfilling and compaction is complete unless there is evidence that the manhole has been damaged or disturbed subsequent to the initial vacuum test.

For manhole installations which do not require detouring of vehicular traffic, the vacuum method is recommended and may be used by the Contractor prior to backfilling the manhole to insure proper installation so that defects may be located and repaired; however, a vacuum test shall be performed after backfilling, and compaction are complete. Testing after backfill and compaction are complete will be the basis for acceptance of the manhole.

(1) Equipment:

- a). The manhole vacuum tester shall be a device approved for use by the Engineer or designated representative.
- b). Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.

(2) Procedures - applicable to new 4'-0" (1.22 meter) diameter manholes.

- a). Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before installation or unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.
- b). After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots shall be blocked to prevent their movement during the vacuum test.
- c). The vacuum test head shall be placed on the top of the cone section or, inside of the top of the manhole cone section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches (254 mm) of mercury [(-5 psig) {-35 kPa}] has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.
- d). The manhole shall have passed the test if the vacuum does not drop below 9 inches (229 mm) of mercury [(-4.5 psig){-31 kPa}] within three (3) minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the three (3) minutes during which the valve was closed.

- e). When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to the Engineer or designated representative), testing of individual joints shall be performed as directed by the Engineer or designated representative.

(B) Test by the Exfiltration Method:

At the discretion of the Engineer or designated representative, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Paragraph 5. A above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the Engineer or designated representative. All backfilling and compaction shall be completed prior to the commencement of testing.

The procedures for the test shall include the following:

- (1) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.
- (2) After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer.
- (3) Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.
- (4) At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour (60 minutes). The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1 hour test time is 0.025 gallons per diameter foot, per foot of manhole depth (1.0 liter per diameter in meters, per meter of manhole depth). For a 4 foot (1.22 meter) diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone) of 0.05 inches per foot (4 mm per meter) of manhole depth or 0.5 inches for a 10 foot (12.5 mm for a 3 meter) deep manhole.

(C) Failure to Pass the Test - Records of Tests.

If the manhole fails to pass the initial test method as described in (A) Test by the Vacuum Method and, if allowed, (B) Test by the Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, the Contractor shall consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available

to the Engineer or designated representative at the close of each working day, or as otherwise directed by the Engineer or designated representative. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

(D) Inspection.

The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The inspection shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of Engineer or designated representative.

TECHNICAL SPECIFICATIONS

ITEM 13 – FRAMES, GRATES, RINGS AND COVERS

1. GENERAL:

This item shall govern furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

2. SUBMITTALS:

The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of frames, grates, rings, covers, height adjustment insert and nuts and bolts required for completion of the work.

3. MATERIALS:

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is the kind and quality that satisfies the specified functions and quality.

(A) Welded Steel

Welded steel grates and frames shall conform to the number; size, dimensions and details indicated on the Drawings and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of ASTM A 36/A 36M, "Specification for Structural Steel".

(B) Castings

Castings, whether Carbon-Steel, Gray Cast Iron or Ductile Iron shall conform to the shape and dimensions indicated on the Drawings and shall be clean substantial castings, free from sand or blowholes or other defects. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth. Runners, risers, fins and other cast on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. Pairs of machined castings shall be matchmarked to facilitate subsequent identification at installation with the exception of water and wastewater manhole and valve castings. These manhole and valve castings shall be fabricated with such draft, tolerances, bolt hole spacing, etc., that all rings and covers of a particular type or class are interchangeable and match-marking will not be required.

Steel castings shall conform to ASTM A 27/27M, "Specifications for Steel Castings, Carbon, for General Application". Grade 70-36 (480-250) shall be furnished unless otherwise specified on the Drawings.

Cast iron castings shall conform to ASTM A 48, "Specification for Gray Iron Castings", Class 30.

Ductile Iron castings shall conform to ASTM A 536, "Specification for Ductile Iron Castings". Grade 60-40-18 (415-275-125) shall be used unless otherwise indicated on the Drawings.

(C) Manhole Cover Riser Rings

Height-adjustment inserts for wastewater manhole rings, which are used for raising standard manhole covers, shall be used as required.

(D) Nuts and Bolts

Nuts and bolts shall be hex head 5/8" x 2.5" (16 mm x 63.5 mm) #11 National Coarse Thread, Type 316 stainless steel. For bolted manhole covers, a thin film of an approved "Anti-freeze" compound, approved by the Engineer or designated representative, shall be applied to all bolts.

(E) Mortar

Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand and sufficient water to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements in Standard Specification Item 2, "Concrete".

4. CONSTRUCTION METHODS:

Frames, grates, rings and covers shall be constructed of the specified materials in accordance with the details indicated on the Drawings or in the City of Marble Falls Standard Details. The Frames, grates, rings and covers shall be placed carefully to the lines or grades indicated on the Drawings or as directed by the Engineer or designated representative.

All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1. Welded frames, grates, rings and covers shall be given 1 coat of a commercial grade red lead oil paint and 2 coats of commercial grade aluminum paint. All coats shall be a minimum of 1.5 mils (0.4 mm), dry.

Painting of gray iron castings will not be required, except when used in conjunction with structural steel shapes.

TECHNICAL SPECIFICATIONS

ITEM 14 – FINISH GRADING, TOPSOIL AND REVEGETATION

1. GENERAL:

Section includes:

- (A) Finish grade subsoil behind curbs and disturbed areas.
- (B) Place, level, and compact topsoil
- (C) Protection:
 - (1) Protect features remaining as final work.
 - (2) Protect structures, fences, sidewalks, paving, and curbs.

2. PRODUCTS

Materials

(A) Topsoil:

Reuse existing soil excavated and stockpiled, if it meets the minimum specifications herein, for finish grading behind curbs and disturbed areas.

(B) Topsoil:

Imported, friable loam; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4 percent and a maximum of 25 percent organic matter.

(C) Provide imported topsoil if quantity of reused topsoil is insufficient to complete the work.

3. EXECUTION

(A) Inspection

- (1) Verify site conditions and note irregularities affecting work of this Section.
- (2) Verify subsoil has been contoured.
- (3) Beginning work of this Section means acceptance of existing conditions.

(B) Subsoil Preparation:

- (1) Eliminate uneven areas and low spots. Remove debris, roots, branches, weeds, stones, in excess of ½ inch in size.
- (2) Scarify common fill or subsoil to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

- (3) Prepare to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- (4) Subsoil backfill behind the curb shall be compacted to obtain a minimum of 95% maximum density (TEX 113-E) to within 3" of top of curb. Next, topsoil shall be placed.

(C) Placing Topsoil:

- (1) Place topsoil in areas where hydromulching is scheduled. In street rights-of-way, topsoil shall be placed a minimum of 10 feet behind curb or greater to blend slopes into level areas. Then apply hydromulch.
- (2) Use topsoil in relatively dry state. Place during dry weather.
- (3) Fine grade topsoil eliminating rough or low areas. Maintain levels, profiles, and contours of subgrade.
- (4) Remove stone, roots, grass, weeds, debris, and foreign material while spreading.
- (5) Manually spread topsoil around building, sidewalks, curbs and site structures to prevent damage.
- (6) Lightly compact placed topsoil.
- (7) Remove surplus subsoil and topsoil from site.
- (8) Leave stockpile area and site clean and raked, ready to receive hydromulch.

(D) Tolerances

- (1) Top of Topsoil: Plus or minus ½ inch of required grade.

TECHNICAL SPECIFICATIONS

ITEM 15 – TRENCH SAFETY SYSTEMS

1. DESCRIPTION:

This item shall govern for the Trench Safety Systems required for all trench excavation and including all additional excavation and backfill necessitated by the safety system. A trench shall be defined as a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than fifteen (15) feet. Trench Safety Systems include, but are not limited to, sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

2. CONSTRUCTION METHODS:

Trench safety systems shall be accomplished in accordance with the detailed specifications set out in the provisions of Excavations, Trenching, and Shoring Federal Occupational Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Proposed Rules published in the Federal Register (Vol. 52, No. 72) on Wednesday, April 15, 1987. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-653. Legislation that has been enacted by the Texas Legislature (H.B. No. 662 and H.B. 665 and any subsequent) with regard to Trench Safety Systems is hereby incorporated, by reference, into these specifications.

If the Contractor elects to use a trench protective system that, in the Proposed Rules, requires "design by a qualified person or a qualified Engineer", (for example see 1926-652 (b) (3) and 1926.652 (c) (4), "a qualified person or a qualified engineer" shall be a Professional Engineer registered in the State of Texas.

In accordance with the Laws of the State of Texas and the U.S. Occupational Safety and Health Administration regulations, all trenches over 5 feet in depth in either hard and compact or soft and unstable soil shall be sloped, shored, sheeted, braced or otherwise supported. Furthermore, all trenches less than 5 feet in depth shall also be effectively protected when hazardous ground movement may be expected. Trench safety systems to be utilized for projects within the City shall be provided by the contractor prior to commencement of any excavation exceeding 5 feet in depth.

In accordance with the U.S. Occupational Safety and Health Administration regulations, when employees are required to be in trenches 4 feet deep or more, adequate means of exit, such as a ladder or steps, must be provided and located so as to require no more than 25 feet of lateral travel.

If trench safety system details were not provided in the plans because trenches were anticipated to be less than 5 feet or more in depth or trenches less than 5 feet in depth are in an area where hazardous ground movement is expected, all construction shall cease, the trenched area shall be barricaded and the City Engineer notified immediately. Construction shall not resume until appropriate trench safety system details, as designed by a registered professional engineer in the State of Texas are submitted to and accepted by the City, and, a bid item for implementation of trench safety systems is added to the contract by change order.

3. **SAFETY PROGRAM:**

The Contractor shall submit a safety program specifically for the construction of trench excavation.

The trench safety program shall be in accordance with OSHA standards governing the presence and activities of individuals working in and around trench excavation.

4. **INSPECTION:**

The Contractor shall make daily inspections of the Trench Safety Systems to ensure that the systems meet OSHA requirements. Daily inspection is to be made by a competent person provided by the Contractor with actual experience in trench safety systems.

If evidence of possible cave-ins, or slides, is apparent, all work in the trench shall cease until the necessary precautions have been taken by the Contractor to safeguard personnel entering the trench. It is the sole duty, responsibility and prerogative of the Contractor, not the Owner or the Engineer, to determine the specific applicability of the designed trench safety systems to each field condition encountered on the project. The Contractor shall maintain a permanent record of daily inspections.

5. **INDEMNIFICATION:**

The Contractor shall indemnify and hold harmless the City, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgments or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this contract.

The Contractor acknowledges and agrees that this indemnity provision provides indemnity for the City in case the City is negligent either by act or omission in providing for trench safety, including, but not limited to, inspections, failure to issue stop work orders, and the hiring of the Contractor.

TECHNICAL SPECIFICATIONS

ITEM 16 - STREETS, WALK, AND DRIVEWAYS

1. GENERAL:

This item includes the construction of all street, curb and gutter, sidewalk, and driveway construction within public right-of-way. It does not include walk and driveway construction beyond the right-of-way property line. The provisions of these specifications are intended to apply primarily to new developments and to new streets within existing platted or annexed areas, and the developer shall provide complete plans, including profiles, of the proposed work for approval prior to initiating any work in the area. Street design shall conform to the requirements of the current Subdivision Ordinance and to these technical specifications. All streets shall have curb and gutter and bituminous surfacing, and all street construction shall conform to the requirements of this item of the Standard Specifications.

2. STREET CLASSIFICATION AND PAVEMENT STRUCTURE REQUIREMENTS:

(A) All streets shall be classified as either Residential (local, minor, and major), Collector (minor or major), or Others. The classifications shall be as specified in the criteria found in the Subdivision Ordinance and/or as approved by the City. "Others" shall refer to streets shown by the City, City Engineer, or a Registered Professional Engineer, based on acceptable engineering practices, that loading or traffic count requirements exceed those provided for the street classifications.

(1) Residential

- | | | |
|-------------------|---|------------------------------------------------------|
| ROW | - | See Subdivision Regulations in Subdivision Ordinance |
| Asphaltic Surface | - | 1 ½" hot-mix asphaltic concrete |
| Flexible Base | - | See Pavement Thickness Design Chart |
| Pavement Width | - | See Subdivision Ordinance |

(2) Collector

- | | | |
|-------------------|---|----------------------------------------------------------------|
| ROW | - | See Subdivision Ordinance Regulations in Subdivision Ordinance |
| Asphaltic Surface | - | 2" hot-mix asphaltic concrete |
| Flexible Base | - | See Pavement Thickness Design Chart |
| Pavement Width | - | See Subdivision Ordinance |

(3) Other

- | | | |
|-------------------|---|-------------------------------------|
| ROW | - | As approved by City |
| Asphaltic Surface | - | 2" hot-mix asphaltic concrete |
| Flexible Base | - | See Pavement Thickness Design Chart |
| Pavement Width | - | As approved by City |

Axle Frequency
Loading

- Number of 18000, pound equivalent axle load repetitions which street will experience if its design life exceeds 150,000.

3. ALIGNMENT AND GRADES:

(A) Alignment

Street and curb alignment shall consist of uniform straight line tangents connected by true circular horizontal curves. Compound curves may be used where necessary to achieve the desired alignment. Extensions of existing streets shall match the existing street centerline without abrupt offsets, and any widening shall be accomplished equally on both sides with horizontal curves in the curb line. Requirements of the current Subdivision Ordinance shall also be complied with in establishing the street alignment. At intersections, curbs shall have a minimum radius of fifteen (15) feet to the back of the curb. Larger radii at these points are permissible if desired. Curb returns at driveway approaches shall have five (5) foot radius to the back of the curb.

(B) Grades

Streets and curbs shall be on uniform straight-line grades with any changes of grade made on a true calculated parabolic vertical curve. Abrupt changes of grade without vertical curves will not be permitted. Vertical curves may be successive without an intervening tangent grade where necessary; but shall not be compounded. Uniform grades shall not be less than zero point thirty (0.30) percent and shall not exceed ten (10) percent without approval. Grades for sidewalks shall be exactly that of the curb, which is adjacent. Elevations for sidewalks shall be one (1) inch above the elevation of the adjacent curb, with the sidewalk also having a fall of one quarter (1/4) inch per foot toward the street. Valley gutters shall have a minimum of zero point thirty (0.30) percent grade truly uniform.

(C) Standard Details

All streets, curb and gutter, sidewalks, and driveways shall conform to the standard plans and details appended to these Standard Specifications.

(D) Construction Tolerances

Maximum allowable deviations from alignments and grades shown on the plans shall be:

(1) Alignment

Variations from the true alignment shall not exceed zero point zero five (0.05) feet combined amount in any one hundred (100) foot distance.

(2) Grade:

a). Subgrade - ± 0.05 feet

b). Finished Base Course - ± 0.03 feet without abrupt changes.

c). Finished Pavement Surface - \pm 0.02 feet

d). Curbs - For grades of:

Over 1.0%	-	0.02 ft.
0.5 to 1.0%	-	0.01 ft.
Under 0.5%	-	0.00

Regardless of the allowable tolerances indicated for curbs, all curb and gutter shall be constructed to proper grade to drain freely and any gutter constructed with water pockets shall be torn out and properly replaced at the Contractor's expense.

Any variation in alignments, grades, plans or sections as herein required shall only be by written consent of the City Engineer.

4. **QUALITY CONTROL:**

Attention is invited to the Quality Control provisions of the General Provisions of these Standard Specifications. All work under this item will be subject to these quality control requirements.

5. **MATERIALS:**

Materials for the various features of work under this item of these specifications shall meet the following requirements:

- (A) Concrete shall conform to the requirements of Item 2, "Concrete".
- (B) Lime for subgrade stabilization shall conform to the requirements of Item 264 of the Texas Department of Transportation (TxDOT) Standard Specifications, for Type A or Type B.
- (C) Flexible Base Material shall be obtained from approved sources and shall be crushed limestone consisting of durable particles mixed with approved binding materials. The material shall be subject to approval of the City Engineer at the source. The processed material when properly slaked and tested by standard laboratory methods shall meet the following requirements:

Retained on 1 $\frac{3}{4}$ inch sieve	0%
Retained on No. 4 sieve	45 to 75%
Retained on No. 40 sieve	60 to 85%

The material when tested by "The Wet Ball Method for Determining the Disintegration of Flexible Base Materials" according to the latest procedures of the TxDOT shall not develop more than fifty (50) percent soil binder prior to rolling.

Materials passing the No. 4 sieve shall be known as "Binder". The portion of material passing the No. 40 sieve shall be known as "Soil Binder" and shall meet the following requirements:

The liquid limit shall not exceed 40 when tested in accordance with AASHO designation T89-49.

The plastic limit shall be determined by testing in accordance with AASHO designation T90-49.

The plasticity index shall not exceed 12 or be less than 4 when calculated in accordance with AASHO designation T91-49.

The preparation of samples for testing according to AASHO designations T89-49, T90-49, and T91-49 shall be according to AASHO designation T146-49 "Wet Preparation of Disturbed Soil Samples for Test".

Materials retained on the No. 4 sieve shall have a per cent wear of not more than 45 when tested according to AASHO designation T96-49 "Abrasion of Coarse Aggregate by use of the Los Angeles Abrasion Machine".

(D) Bituminous Materials

All-bituminous materials shall conform to the TxDOT Standard Specification Item 300, types and grades as indicated below:

Tact Coat	-	RC-2, or a slow or medium setting emulsion.
Prime Coat	-	MC-30 or MC-70
Asphalt for Hot-Mix Asphaltic Concrete	-	AC-5
Asphalt for 2-Course Surface Treatment	-	RC-2

(E) Paving Mixes and Aggregates shall conform to the Standard Specification items of the TxDOT as listed below:

Hot Mix Asphaltic Concrete	-	Item 340, Type "D"
Aggregate for Surface Treatment	-	Item 302, Type B, Grade 3 for first course and Grade 4 for second course.

(F) Where more than one (1) type or grade of material is given, the City Engineer shall determine the type of grade to be used for the project.

6. **EXCAVATION, FILL, AND GRADING:**

All excavation, construction of fills or embankments and grading within the, public right-of-way shall conform to the following requirements. All completed work shall conform to the plans and applicable Standard Details and shall be accomplished as specified hereinafter.

- (A) Excavation shall be in accordance with the lines, grades, and typical sections as shown on the plans or established by the Engineer. Unless otherwise shown on the plans or established by the Engineer, street excavation will be made to the subgrade.
- (B) Embankments (Fills): Prior to placing fill material, the area on which the fill is to be placed shall be cleared of all trees, brush, stumps, and other obstructions.

Embankments shall be constructed of suitable materials approved by the Engineer and shall be placed in successive horizontal layers of not more than eight (8) inches in depth, loose measurement, for the full width of the embankment and in such lengths as designated. Stumps, trees, rubbish, vegetation or other unsuitable materials shall not be placed in embankments. All construction traffic shall be uniformly distributed over the entire surface of each layer of the embankment.

A "Maintainer", or a "Blade Grader" weighing at least three (3) tons, with a blade at least ten (10) feet in length shall be kept in operation on the embankment for the purpose of uniformly mixing, spreading, pulverizing, and consolidating the embankment material.

After a layer of embankment material has been placed and bladed, it shall be sprinkled, if directed, in the quantity as determined by the Engineer, and rolled-to-compaction with a tamping roller, of approved type.

Embankment placed over and adjacent to pipes, culverts, and other structures shall be of suitable materials, and shall be placed in successive horizontal layers of not more than eight (8) inches in depth, loose measurement, and each layer uniformly mixed, pulverized and thoroughly compacted to the satisfaction of the Engineer, by the use of rakes, hand tamps, and/or other approved methods.

Special care shall be taken to prevent any wedging action against the structure. This method of consolidation and compaction shall be used for such distances along embankment adjacent to structures as may be necessary and in other areas where blading and rolling would be impractical.

Where a large portion of the materials excavated consist of rock, the rock may be used in the construction of the embankment as hereinafter specified.

The maximum dimension of any rock used shall not exceed fifty (50) percent of the height of the embankment and in no case shall any rock over twenty-four (24) inches in its maximum dimension be placed in the embankment. When the greater portion of the embankment is to compose of materials other than rock, the embankment shall be constructed as required in the preceding paragraphs, and the rock shall be carefully distributed throughout the embankments and

filled around with earth or other approved fine material so that the interstices between the large particles are filled and a dense, compacted, uniform embankment is secured.

The upper eight (8) inches of all embankments shall be composed of soil without objectionable quantities of rock.

All embankments shall be compacted for the full depth to a density of ninety (90) percent of maximum density as determined by the modified Proctor method, ASTM Designation D1557.

7. PROVISIONS FOR DRAINAGE:

If it is necessary in the prosecution of the work to interrupt the natural drainage of the surface, or the the flow of artificial drains the Contractor shall provide temporary drainage facilities that will prevent damage to public or private interests, and shall restore the original drains as soon as the work will permit. The Contractor shall be held liable for all damages which may result from neglect to provide for either natural or artificial drainage which his work may have interrupted.

If excavation of road materials indicates seepage of ground water into the area under the road bed subsurface drainage as approved by the City Engineer shall be installed.

If permanent underground drainage facilities or off-street drainage facilities are required, they shall conform to Item 5, Storm Drainage, of these Standard Specifications.

8. SUBGRADE SAMPLING PROCEDURE:

- (A) Each project shall have a "Subsurface Investigation and Pavement Design Report" prepared by a qualified geotechnical engineering firm. The plans and specifications shall comply with the geotechnical engineering firm's report for the street design.
- (B) Samples shall be obtained of the predominant subgrade materials from the street right-of-way.
- (C) Sampling locations shall be selected at intervals not to exceed three-hundred (300) feet and for each type of subgrade material.
- (D) Each sample shall consist of approximately two (2) pounds of material and should be properly identified as to sampling location and sampling depth interval.
- (E) The sample shall be representative of the twelve (12) inches below subgrade elevation. It should be cautioned that the top twelve (12) inches of the natural soil profile is not necessarily representative of the subgrade.
- (F) Notations shall be made of any fill areas, soft ground conditions, groundwater, or other unusual situations, which may influence the pavement design. Sampling should not be from previously backfilled trenches.

9. **LABORATORY TESTING PROCEDURE:**

- (A) All samples of subgrade materials shall be visually examined in the laboratory for the initial soil classification and color description.
- (B) Samples, which visually appear to be similar, shall be grouped together. This process is very important since subsequent testing is performed on these grouped samples.
- (C) Representative samples from each of these groups shall be tested for the following properties:

Liquid Limit (LL)

Plastic Limit (PL)

Plasticity Index (PI)

Percentage Passing No. 200 Mesh Sieve Optimum Moisture Content
Modified Proctor Density

- (D) All samples shall be stored until the project is complete. These samples may be useful during construction as an aid in identifying the various subgrade groups.

10. **SUBGRADE GROUP CLASSIFICATION PROCEDURE:**

- (A) Plot the results of the Atterberg Limits tests (LL and PI) on the "Subgrade Classification Chart", Table II, to obtain the subgrade group.
- (B) The resulting subgrade group may be up-graded one (1) group if less than forty (40) percent of the material passes the No. 200 mesh sieve. This applies only to groups III through VII.

11. **PAVEMENT THICKNESS DESIGN PROCEDURE:**

- (A) Each street must be assigned one of the traffic classifications as indicated below:

Residential Street (local, minor, and major)

Collector Street (minor and major)

Others (approved by City)

The City Engineering Department must be consulted to aid in these traffic classifications.

- (B) The appropriate "Pavement Thickness Design Chart" (see Tables III through V) selected on the basis of the traffic classification can then be used with the subgrade classification group to determine the total required pavement thickness.

- (C) The pavement section will consist of hot-mix asphaltic concrete surface (thickness as indicated on "Pavement Thickness Design Chart") overlying a crushed limestone base material.
- (D) For pavements designed for Subgrade groups IV through VII, a select sub-base layer may be substituted for a portion of the base layer. The select sub-base material must be classified using the subgrade classification procedure and a subgrade group assigned to the sub-base material. The pavement thickness required above the sub-base material is determined using the design charts and the group classification.
- (E) A six (6) inch thickness of lime-stabilized subgrade may be substituted for eight (8) inches of crushed limestone base material for pavements designed in Subgrade groups IV through VII. The quantity of hydrated lime may be selected from the table below:

Subgrade Group No.	Pounds of Lime to be Applied per Square Yard: <u>Six (6) Inch Compacted Thickness</u>
IV	20 pounds per square yard
V	22 pounds per square yard
VI	25 pounds per square yard
VII	28 pounds per square yard

12. SUBGRADE PREPARATION:

- (A) If subgrade consists of fill material or natural, non-lime-stabilized material the top six (6) inches shall be compacted as required to ninety-five (95) percent modified Proctor Density.
- (B) Lime Stabilized Subgrade should be constructed in accordance with TxDOT Item 260, Lime Treatment for Materials In-Place using the quantity of hydrated lime required by the design procedure. Hydrated lime should meet the requirements of TxDOT Item 264. The well-mixed and cured soil-lime mixture should be compacted to a minimum of ninety-five (95) percent of ASTM D1557 maximum density at optimum moisture content.

Approved lime-stabilization procedures follow.

The existing subgrade shall be pulverized to a depth of six (6) inches and shall be treated with lime and water either in the form of a slurry or the materials may be applied to the subgrade separately.

The lime and moisture are to be uniformly mixed with the subgrade by the use of an approved pulvi-mixer. The section will then be brought to proper crown and grade. In the event that all clods and lumps are not sufficiently broken up by the pulvi-mixer, the soil-lime mixture shall be allowed to cure from two (2) to four (4) days as directed by the City Engineer. During the curing period, the material shall be kept moist as directed. After the curing is completed, the final

mixing shall begin. The mixture (exclusive of all plus half (1/2) inch non-slaking aggregates) when properly mixed shall meet the following requirements when dry screened on a dry weight basis.

Passing 2" Screen	100%
Passing 1/2" Screen, Minimum	60%

Water shall be added during the mixing of soil and lime to attain the optimum moisture content to ninety-five (95) percent maximum density as determined by the modified Proctor method, ASTM Designation D1557.

After compaction is completed, the surface shall be shaped, water added as needed and finish rolled as directed with a pneumatic or other suitable roller sufficiently light to prevent cracking.

The completed section shall be moist cured until such time as the first course of base material is placed and compacted.

13. FLEXIBLE BASE COURSE:

Prior to placing the flexible base material on the subgrade, the surface of the subgrade shall be bladed and rolled, as necessary and to the extent directed in order to place the subgrade in an acceptable condition to receive the base material. The surface of the subgrade shall be smooth and conform to line and grade as established and in conformity with the typical section as shown on the plans. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work.

Where the base course exceeds six (6) inches in thickness, it shall be constructed in two (2) or more courses of equal thickness as indicated on the typical section.

Immediately before placing the base course material, the subgrade shall be checked as to conformity with grade and section. The surface of the subgrade shall not show deviations in excess on one quarter (1/4) inch of five (5) feet, nor one-half (1/2) inch in sixteen (16) feet longitudinally.

The base course material shall be delivered in approved vehicles of a uniform capacity, and the required amount of specified material shall be delivered to secure the proper thickness of completed base course. Material deposited on the subgrade shall be spread and shaped the same day. All material shall be moved at least once from the original position in which it is deposited. The material shall be sprinkled, if directed, and shall then be bladed and shaped to conform to the typical section as shown on the plans. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material as directed by the Engineer. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and applied in the amount directed by the Engineer. Such binder shall be carefully incorporated with the other approved methods. The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter specified. After each section of flexible base is completed, tests as necessary will be made. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with typical sections shown on the

plans and to the established lines and grades. On the surface where pavement is to be placed, any deviation in excess of one-fourth (1/4) inch in cross-section.

The base material shall be compacted at optimum moisture content to ninety -five (95) percent modified Proctor Density as determined by ASTM Designation D1557.

14. BITUMINOUS SURFACES:

All streets shall have a surface treatment of Hot Mix Asphaltic Concrete (HMAC) of the minimum thickness shown in the geotechnical engineering firm's Subsurface Investigation and Pavement Design Report.

(A) Construction of HMAC Pavement

Prime coat, tack coat, and HMAC surface course or courses shall be placed in accordance with the following:

(1) Prime Coat

All base courses to receive asphaltic concrete pavement shall be cleaned and primed with uniform application of asphaltic material as specified above. The priming material shall be applied with a self-propelled pressure distributor sprayer, except in places impossible to use a sprayer, at a rate of zero point fifteen (0.15) to zero point three (0.3.) gallons per square yard of surface as determined by the Engineer. Subsequent application of pavement course shall not be laid until the primed surfaces have cured long enough to evaporate the volatiles. Alternate methods of application at the same coverage rates shall be used where the pressure distributor sprayer cannot be used.

(2) Tack Coat

When required to obtain a satisfactory bond between courses or between the prime coat and surface course, a tack coat shall be applied prior to placing the next course. Tack coat material shall be as specified under "Materials" above. The course to which the tack coat is applied shall be swept clean before the tack is applied. The asphalt tack coat material shall be applied uniformly with a sprayer at a maximum coverage of zero point ten (0.10) gallons per square yard of surface as directed by the Engineer. The surface of curbs, gutters, vertical faces of existing pavements, and all structures in actual contact with asphalt mixes shall be painted with a thin, complete coating of asphaltic tack coat material to provide a closely bonded, water-tight joint.

(3) Hot Mix Asphaltic Concrete

Construction methods shall conform to the requirements of Item 340 of the TxDOT 1972 Standard Specifications for Construction of Highways, Streets and Bridges. Materials shall be as specified above under "Materials".

The compacted thickness or depth of the asphaltic concrete surface course shall be as shown on the plans or Standard Details. Where the plans require a depth or thickness of the surface course greater than two (2) inches, it shall be accomplished by constructed multiple courses of approximately equal depth.

All asphaltic concrete material shall be placed and rolled during daylight hours. The mixture shall be at a temperature between two-hundred twenty five (225) degrees F and three-hundred twenty five (325) degrees F when placed.

During the application of asphaltic material, care shall be taken to prevent splattering on adjacent pavement, curbs, gutters, and other structures.

a). Joints

The placing of the mixture shall be as continuous as possible, and the roller shall pass over the unprotected edge of the freshly laid mixture only when the laying is discontinued for such length of time as will permit chilling or cooling of the mixture. In every case when resuming the work, the material previously laid shall be cut back to produce a slightly beveled edge for the full depth of the course. The material cut away shall be removed from the site of the work. Fresh mixture shall be laid against the fresh cut. Construction joints shall be either parallel axis or at right angles to the longitudinal axis of the work.

b). Compaction

The edges of the pavement along curbs, headers, manholes, valve boxes, and similar structures, and all places not accessible to the roller, or such areas where proper compaction cannot be obtained with the roller, shall be compacted with lightly oiled hand operated vibrating rollers, mechanical tamps, or hand tamped.

Each separate course after final compaction shall have a density of not less than ninety-two (92) percent nor more than ninety-five (95) percent of the density developed in the laboratory test method, ASTM D1188, "Test for Bulk Specific Gravity of Compacted Bituminous Mixtures, Using Paraffin-Coated Specimens".

c). Testing

The surface of the pavement, after final compaction, shall be smooth and true to the established line, grade, and cross section, and shall have no deviation in excess of one eighth (1/8) inch per foot from the nearest point of contact when tested with a sixteen (16) foot straight-edge placed parallel to the centering of the roadway. The maximum ordinate measured from the face of the straight-edge shall not exceed one-quarter (1/4) inch at any point. All areas not complying with this requirement shall be corrected.

When required by the City Engineer, the completed pavement shall be sampled and tested for thickness and density.

The testing agency will cut cores from the pavement at locations selected by the Engineer in order to determine if the specified thickness, stability, and density have been obtained. If any core indicates a deficient thickness, the Contractor may cut additional cores at his own expense in order to define the area of deficiency. The Contractor shall remove and repair the areas of deficient thickness, stability, or density, designated by the Engineer at no extra cost.

15. CURB AND GUTTER, SIDEWALKS, AND DRIVEWAYS:

Construction of curb and gutter, concrete valleys, sidewalks, and driveway approaches shall conform to the following requirements. Concrete shall be Class B as specified under Item 2, "Concrete", of these Standard Specifications. No concrete shall be placed until the forms have been checked and approved by the City Inspector. Dimensions and conformation shall comply with the Standard Details appended to these specifications. Grades, alignment, and tolerances shall be as hereinbefore specified.

Forms shall be of wood or metal, of a section satisfactory to the Engineer, straight, free of warp and of a depth equal to the depth of the concrete face. They shall be securely staked to line and grade, and maintained in a true position during the depositing of concrete. Thin plywood, steel, or other similar material may be used to form short radius curb returns at driveways. The reinforcing steel, if required, shall be placed in position as shown on the typical sections. Care shall be exercised to keep all steel in its proper location.

(A) Curb and Gutter

The length of curb and gutter placed in any one day shall be limited to the amount which can be furnished in daylight hours. The concrete shall be of sufficiently dry consistency when placed to permit shaping of the curb without a face form. The concrete shall be spaded along the forms to eliminate honeycomb and the gutter section shall be consolidated by tamping. The top section of curb and gutter shall be formed by a template or "mule" fabricated to match the contour of the curb and gutter. The lip of the gutter shall be "turned down" while necessary to match the adjacent grade of valley gutters.

When the concrete has set sufficiently, the top surface shall be finished uniformly with a wood float, and then tooled transversely at five (5) foot intervals and longitudinally at the gutter lip and the back of the curb with a quarter (1/4) inch radius edging tool. Expansion joints with half (1/2) inch thick premolded expansion joint filler shall be installed at ends of curb returns, at cold joints between pours, and at other locations required by the Standard Details or as directed by the City Engineer.

As an option to the method described above, the concrete may be struck off one-quarter (1/4) inch to half (1/2) inch low, and a mortar topping of the same sand-cement ratio placed to fill the curb and gutter section. Finishing shall then be accomplished as specified above with a full-section mule, wood float, and

edging. Topping must be placed while the base concrete is still plastic and prior to initial set. The face of the curb shall be marked where water and sewer service lines cross under the curb with the letters "W" or "S", as appropriate, and as specified under Item 3, Water System, and Item 4, Wastewater System, of these specifications. The letters shall be three (3) inches high and shall be imprinted while the concrete is sufficiently plastic to receive a legible impression.

Completed curb and gutter shall be coated immediately with a curing compound as specified under Item 2, "Concrete". Immediately following the removal of forms, the formed surfaces shall have all honeycomb neatly patched and the surface treated with curing compound.

Backfill shall not be placed against the curb face for at least five (5) days, and the backfill shall not be compacted in a manner that will cause lateral displacement of the curb. Care shall also be exercised to prevent scarring or defacing of the exposed surfaces with equipment used for backfilling and grading.

(B) Concrete Valleys

Concrete Valleys shall be constructed in accordance with the Standard Details and to the grades indicated on the plans. Transitions to and from the standard curb and gutter sections at each end shall be such that water will not be trapped in the gutter section. The structure shall be monolithic with the curb and gutter at either end. Valleys shall have a wood float finish with transverse tooled joints as shown in the details. Steel reinforcement shall be provided as shown.

(C) Sidewalks and Drive Approaches

Sidewalks and drive approaches shall conform to the Standard Details appended to these specifications. The subgrade shall be compacted uniformly to the approximate density of the surrounding undisturbed material, and a one (1) inch sand cushion provided on the subgrade. Wire mesh reinforcement shall be provided in both sidewalks and drive approaches. Wire mesh shall be 6 x 6 - 10 / 10 for sidewalks and 6 x 6 - 6 / 6 for driveways. Expansion joints shall be installed at the intersection of drives and walks, where cold joints occur, and where walks or drives abut other concrete structures. Walks and drives shall have a light brush finish as specified under Item 2, "Concrete", of these specifications. The edges shall be tooled with a one-quarter (1/4) inch radius edging tool, and walks shall also be tooled transversely at five (5) foot intervals. This pattern shall be continued through the drive approach apron. Curing compound shall be applied to the surface immediately after finishing is completed.

CITY OF MARBLE FALLS

TABLE I
FLEXIBLE PAVEMENT DESIGN PROCEDURE
SUBGRADE CLASSIFICATION GROUPS

Soil Classification Tests

<u>Group No.</u>	<u>Liquid Limit</u>	<u>Plasticity Index</u>	<u>Typical Material Description</u>
I	< 35	5 – 15	limestone, weathered limestone, or severely weathered limestone
II	30 – 40	10 – 25	sandy clays, silty clays, or severely weathered limestone
III	40 – 50	15 – 30	sandy clays, silty clays, or severely weathered limestone
IV	50 – 60	20 – 35	clay or silty clay
V	60 – 70	25 – 40	clay
VI	70 – 80	35 – 50	clay
VII	> 80	40 – 60	clay

Graphical representation of these subgrade groups are shown on following Table II. Values which plot on the borderline between two (2) groups should be assigned the group number of the poorer soil group. Soils which have less than forty (40) percent passing the No. 200 mesh sieve and which would plot in Groups III through VII may be up-graded to the next better group.

TABLE II
 CITY OF MARBLE FALLS
 PAVEMENT DESIGN PROCEDURE
 SUBGRADE CLASSIFICATION PROCEDURE

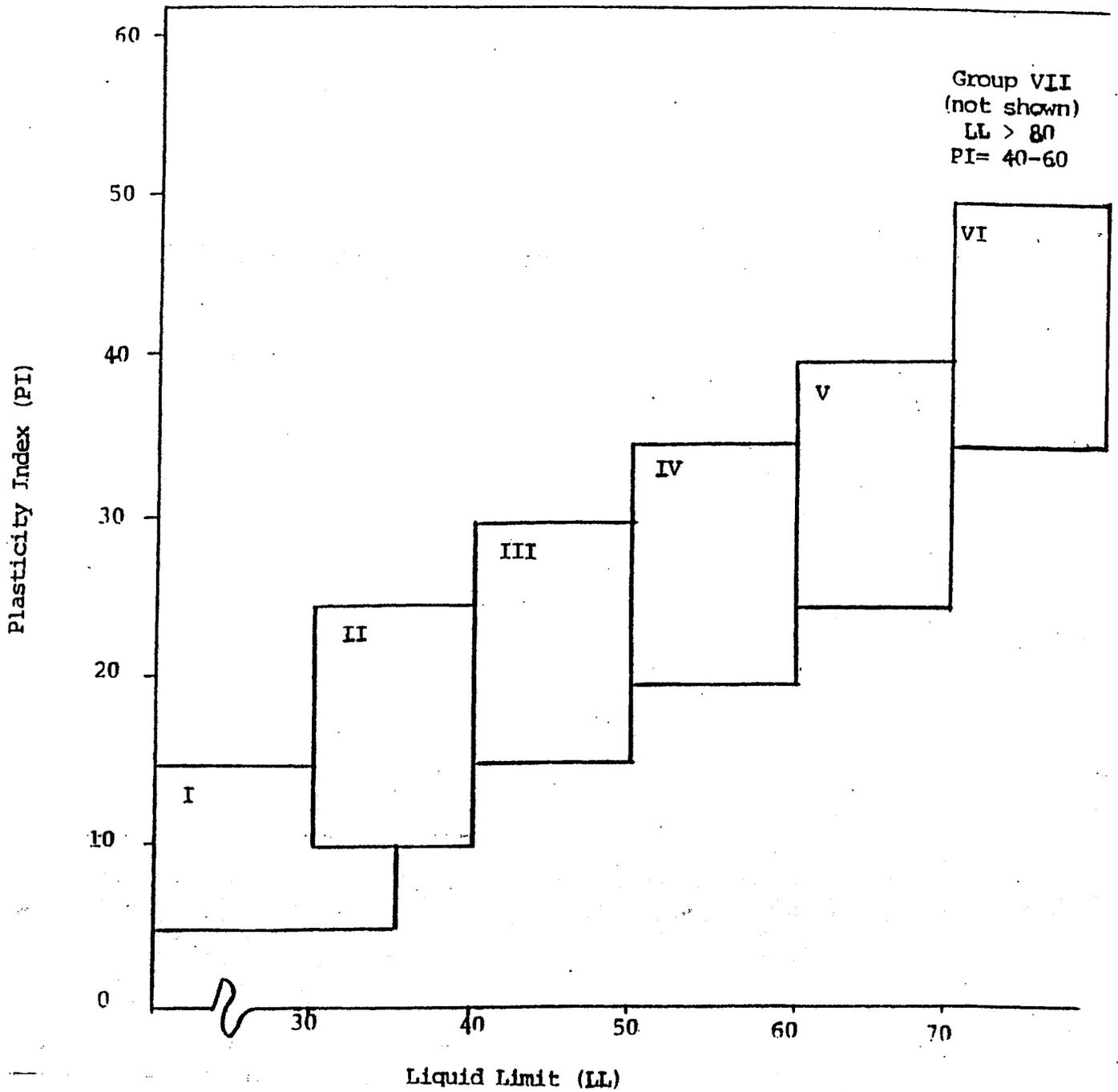
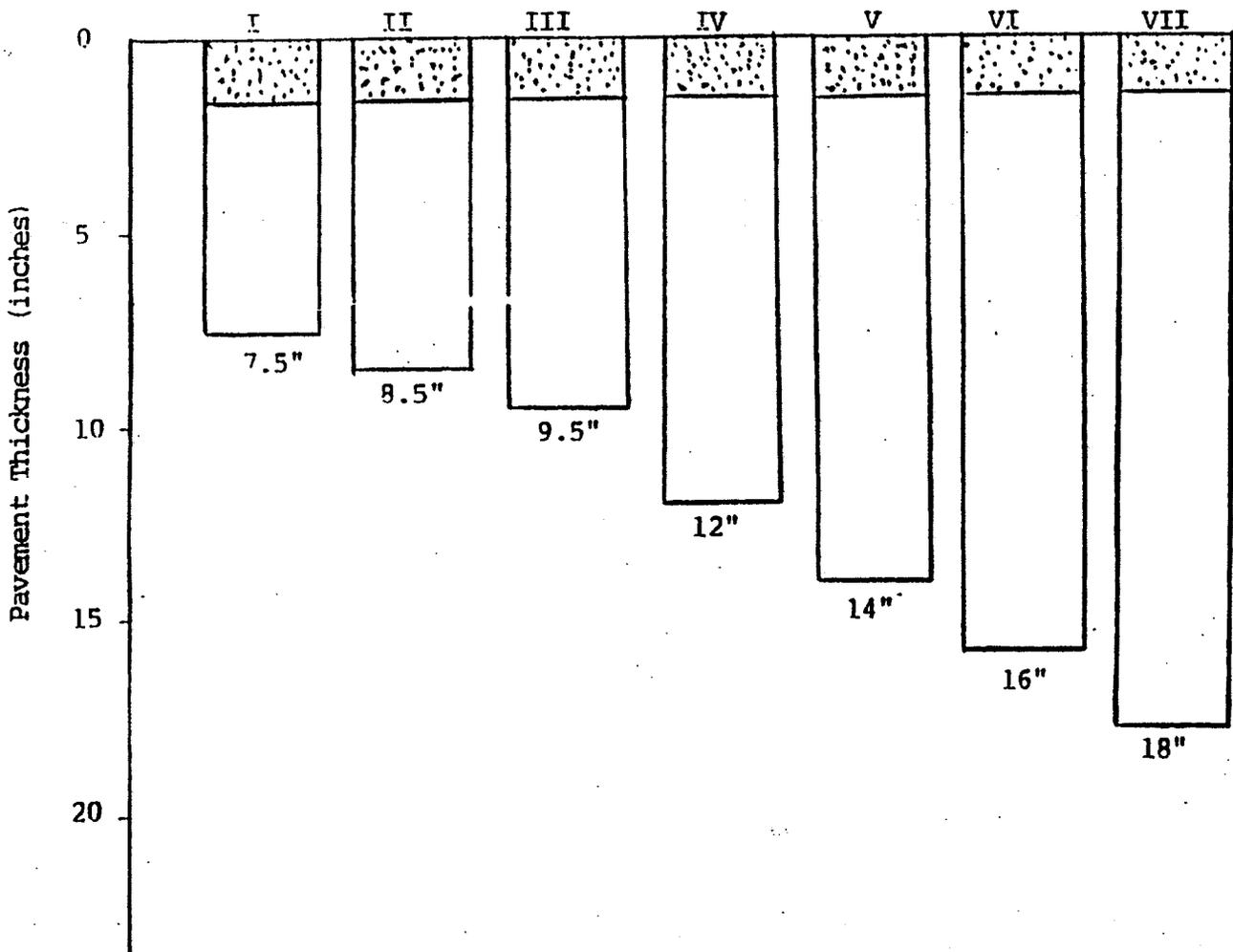


TABLE III

CITY OF MARBLE FALLS
PAVEMENT THICKNESS DESIGN CHART
RESIDENTIAL OR MINOR STREETS

Subgrade Classification Group



Minimum surface course thickness = 1.5 inches

TABLE IV

CITY OF MARBLE FALLS
PAVEMENT THICKNESS DESIGN CHART
COLLECTOR OR MAJOR STREETS

Subgrade Classification Group

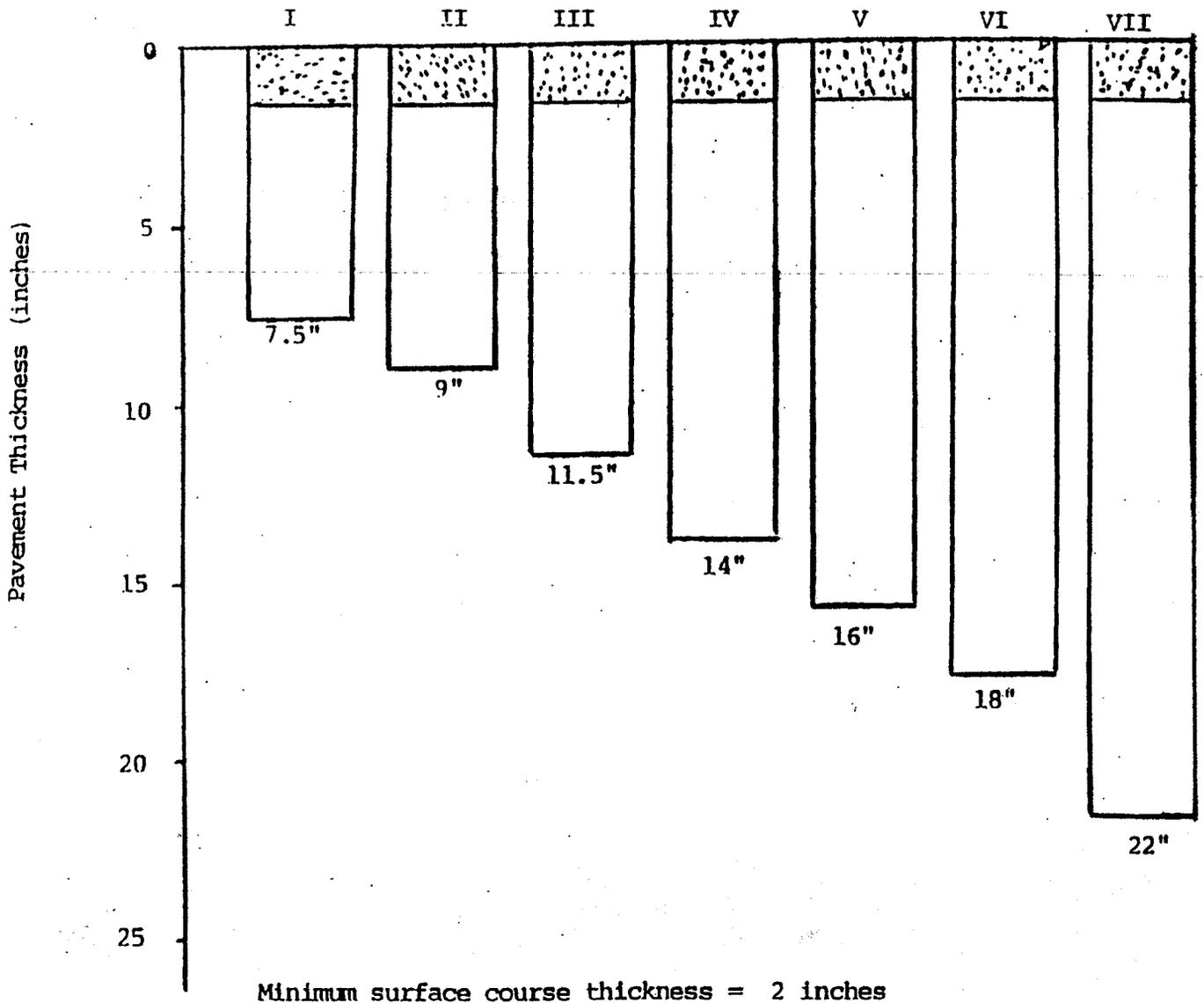
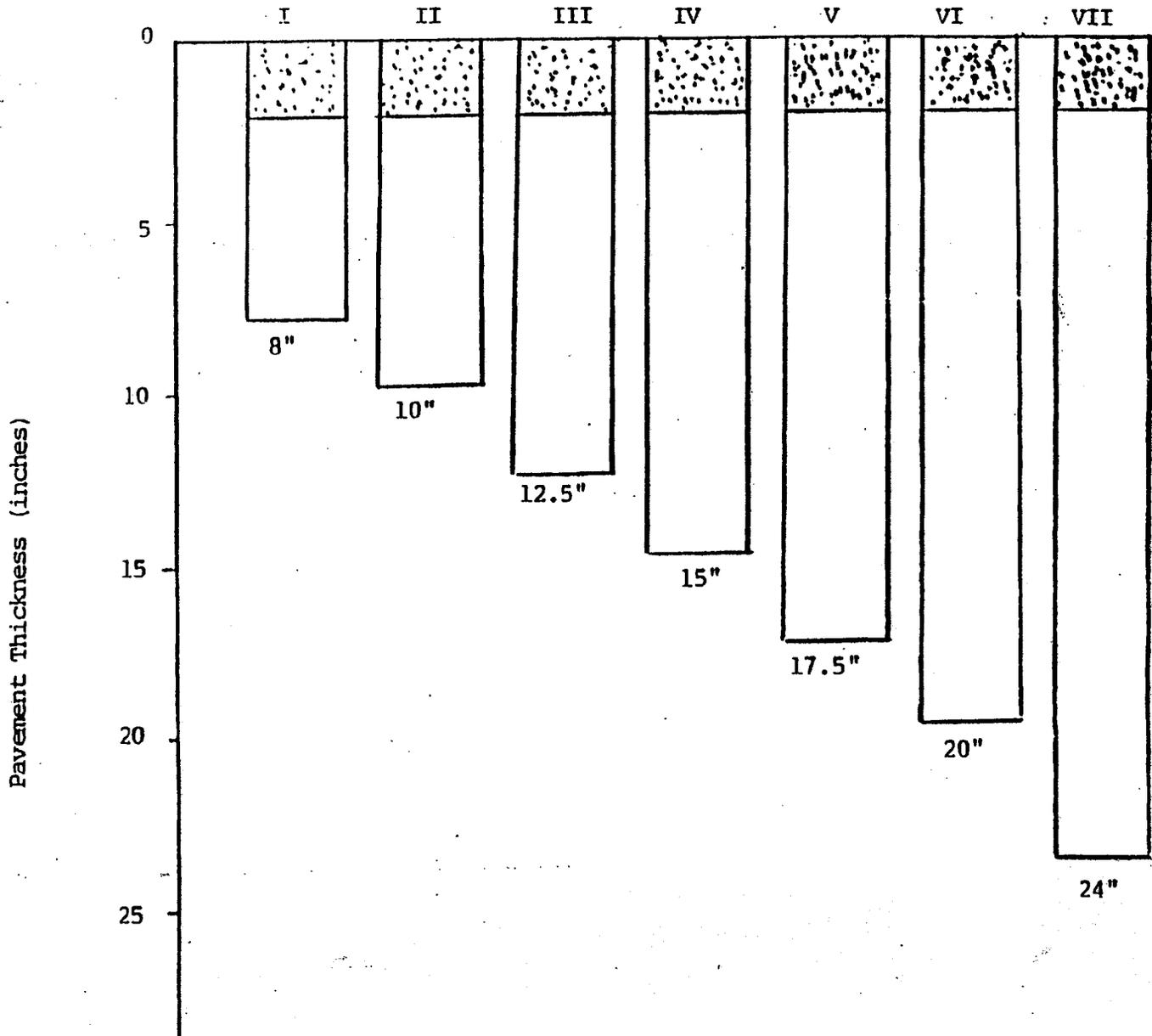


TABLE V

CITY OF MARBLE FALLS
PAVEMENT THICKNESS DESIGN CHART
OTHER STREETS

Subgrade Classification Group



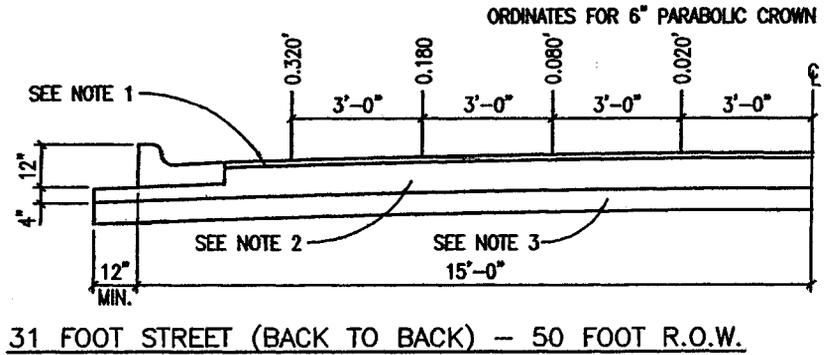
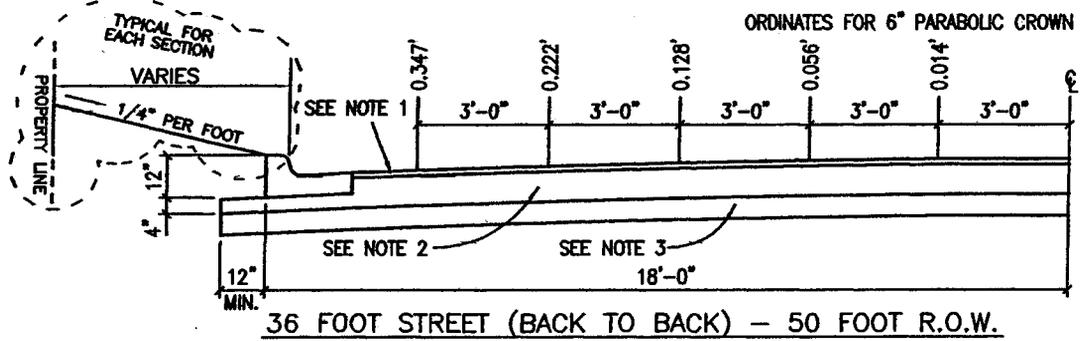
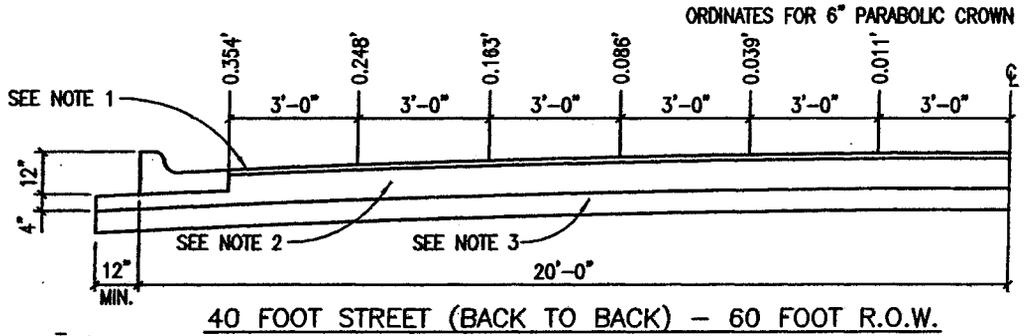
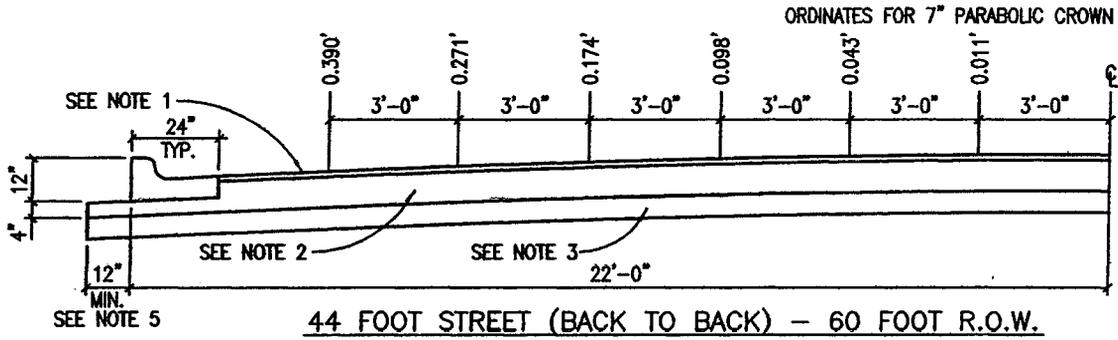
Minimum surface course thickness = 2.0 inches

STANDARD DETAILS

City of Marble Falls

Street and Drainage Details and Construction Standards

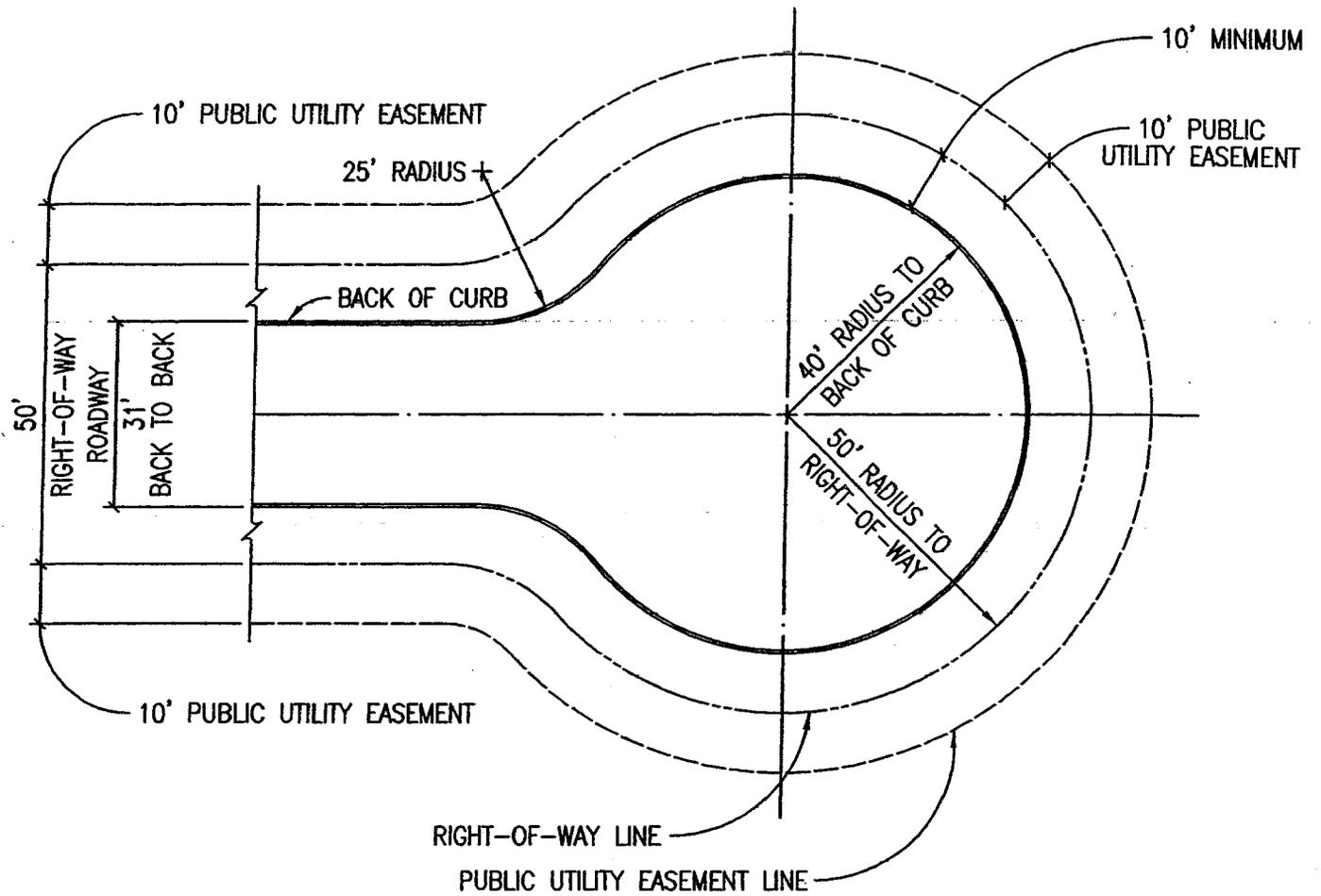
<u>Detail #</u>	
SD01	Typical Half Cross-Sections for H.M.A.C. Surfaced Streets
SD02	Concrete Valley Gutter Detail
SD03	Typical "Single Family" and "Two Family" Cul-de-sac Plan
SD04	Typical "Non-Single Family or Non-Two Family" Cul-de-sac Plan
SD05	Curb and Gutter Details
SD06	Mountable Curb and Gutter Details
SD07	Ribbon Curb Details
SD08	Curb Inlet Detail
SD09	Curb Inlet-Typical Section
SD10	Standard Storm Sewer Manhole Cover (24")
SD11	Standard Storm Sewer Manhole Frame (24")
SD12	Standard Storm Sewer Manhole Set (38" Cover)
SD13	Sidewalk Section and Joint Detail
SD14	Sidewalk Ramp Details
SD15	Concrete Driveway Approach Type "A"
SD16	Concrete Driveway Approach Type "B"
SD17	Concrete Dip Driveway Approach
SD18	Rural Residential Driveway Approach with Culvert Pipe
SD19	Rural Non-Residential Driveway Approach with Culvert Pipe
SD20	Typical Concrete Rip-Rap at Pipe
SD21	Half-Section Concrete Lined Ditch Step
SD22	Typical Pilot Channel Section
SD23	Concrete Rip-Rap at Pipe
SD24	Curb Inlet Protection Detail
SD25	Standard Barricade
SD26	Standard Street Sign Detail
SD27	Energy Dissipator Detail



NOTES:

1. 1 1/2" HOT MIX ASPHALTIC CONCRETE.
2. FLEXIBLE BASE COURSE; VARIES IN THICKNESS FROM MINIMUM 8".
3. 6" LIME STABILIZED SUBGRADE OR SELECT SUBBASE MATERIAL AS REQUIRED.
4. COMBINED THICKNESS OF FLEXIBLE BASE COURSE, TREATED SUBGRADE OR SUBBASE SHALL BE AS REQUIRED TO SUPPORT TRAFFIC LOADS AND VOLUME ON SUBGRADE.
5. GEOTECHNICAL REPORT MAY REQUIRE BASE MATERIAL GREATER THAN 12" BEHIND CURB.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
TYPICAL HALF CROSS-SECTIONS FOR H.M.A.C. SURFACED STREETS		Detail No. SD01.DWG



NOTE:

1. CUL-DE-SAC SHALL BE CONSTRUCTED WITH A 7-INCH CROWN, GIVING A 1.5% CROSS SLOPE.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

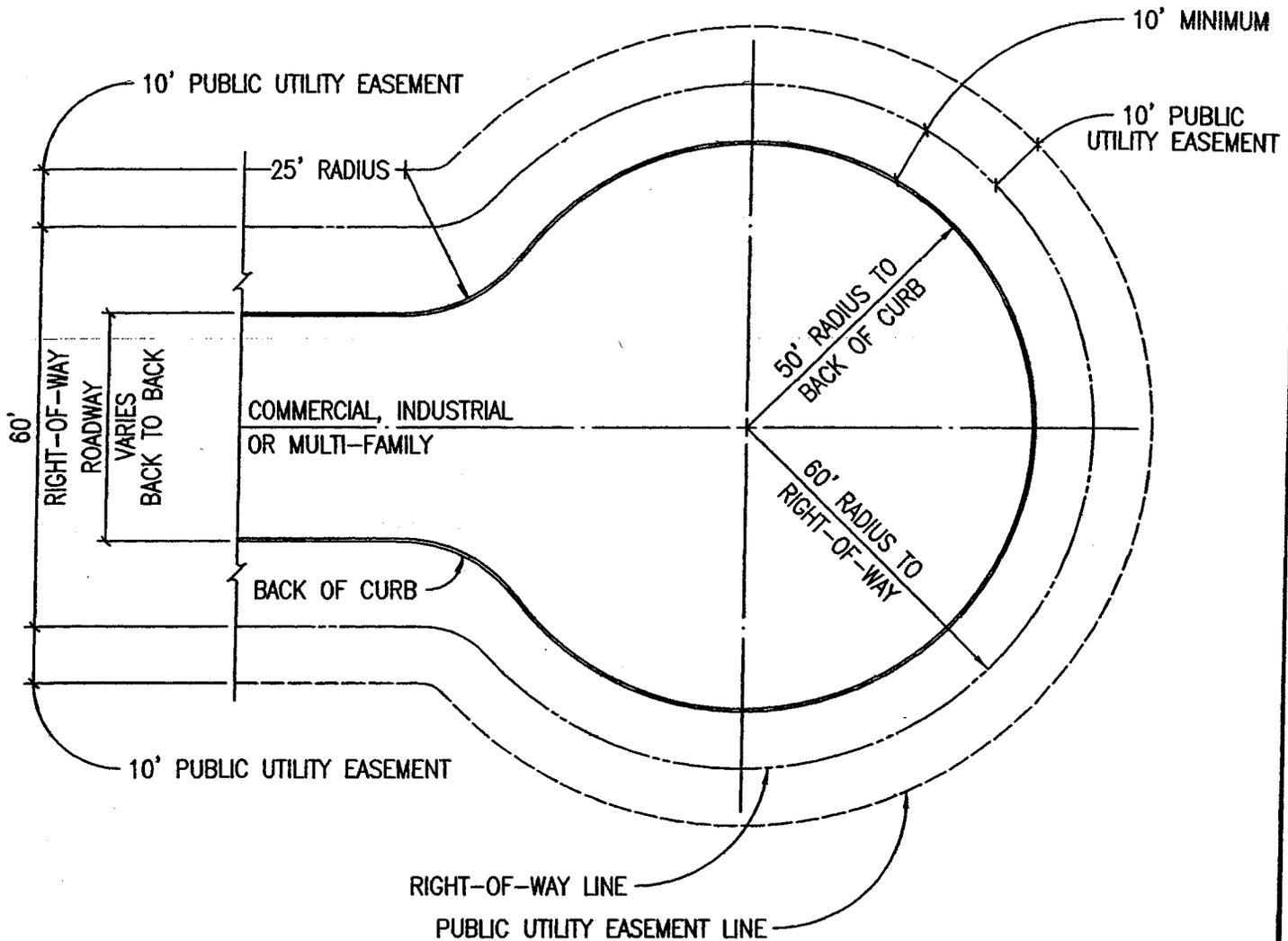
Approved _____

Date _____

Drawn by:
SDK

TYPICAL "SINGLE FAMILY" &
"TWO FAMILY" CUL-DE-SAC PLAN

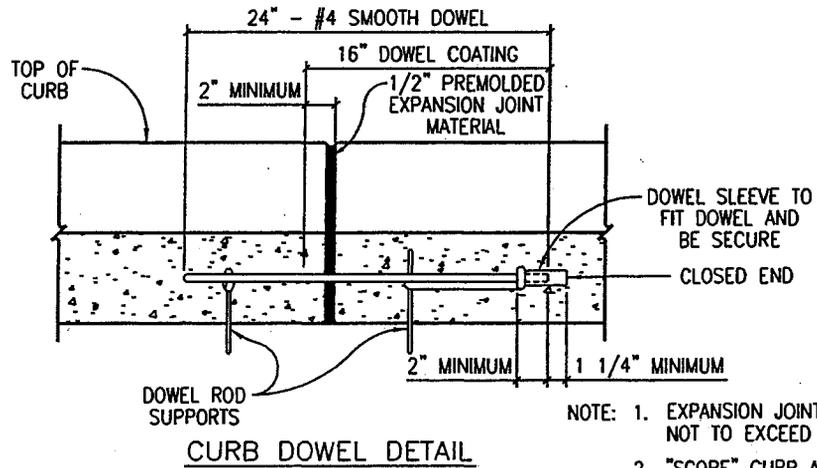
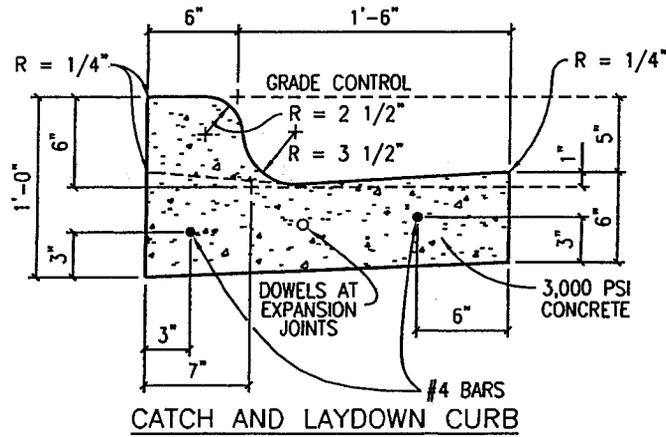
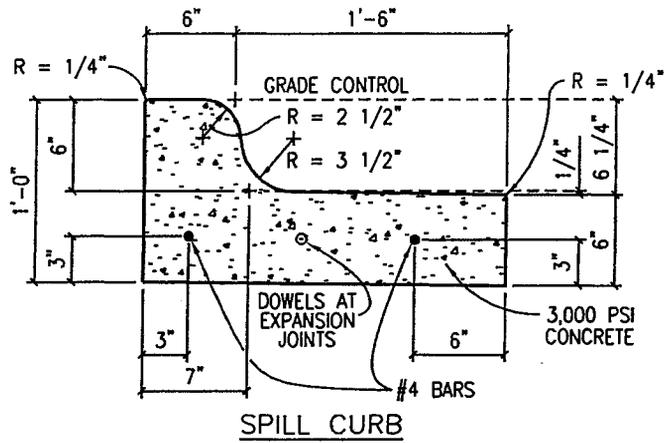
Detail No.
SD03.DWG



NOTE:

1. CUL-DE-SAC SHALL BE CONSTRUCTED WITH A 9-INCH CROWN, GIVING A 1.5% CROSS SLOPE.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Drawn by: SDK
	Date _____	
TYPICAL "NON-SINGLE FAMILY OR NON-TWO FAMILY" CUL-DE-SAC PLAN		Detail No. SD04.DWG



- NOTE: 1. EXPANSION JOINT INTERVALS NOT TO EXCEED 40'-0".
 2. "SCORE" CURB AT 10'-0" INTERVALS.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

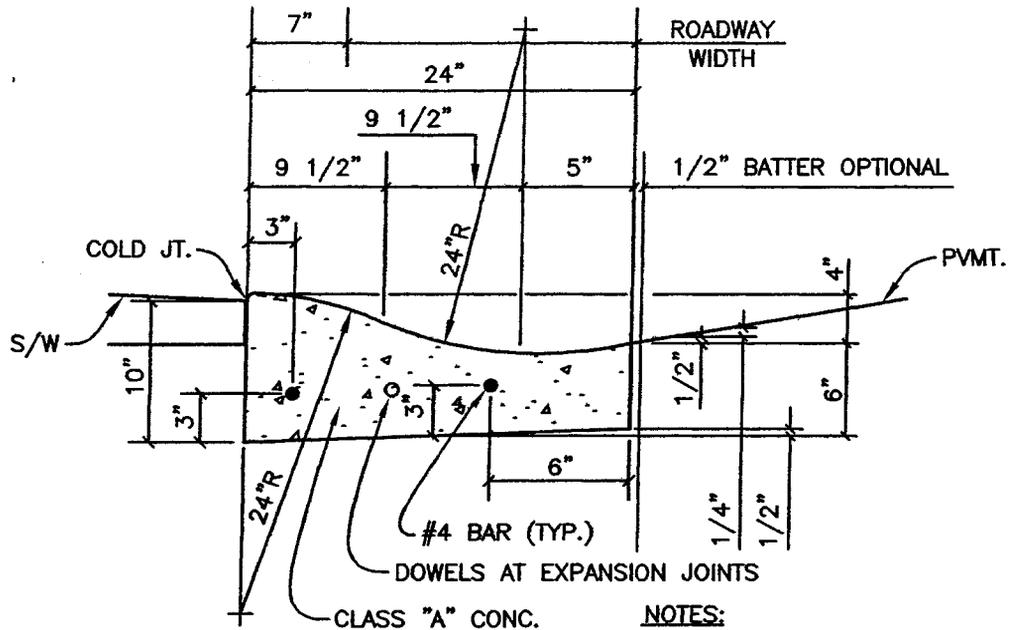
Approved _____

Date _____

Drawn by:
SDK

CURB AND GUTTER DETAILS

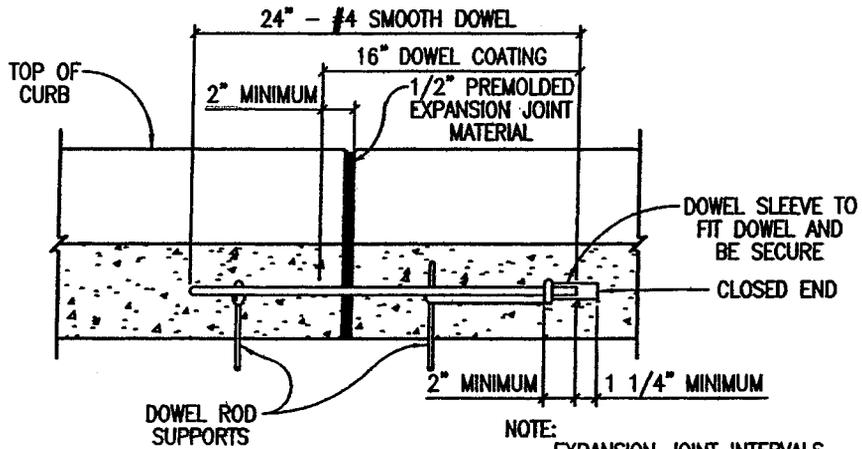
Detail No.
SD05.DWG



MOUNTABLE CURB

NOTES:

1. ALL WORK AND MATERIAL SHALL CONFORM TO ASTM A615, A615M, C309, AND D1752. BROOM FINISH EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAX.
3. EXPANSION JOINTS AS PER STD. ASTM D-1752.



CURB DOWEL DETAIL

NOTE: EXPANSION JOINT INTERVALS NOT TO EXCEED 40'-0".

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

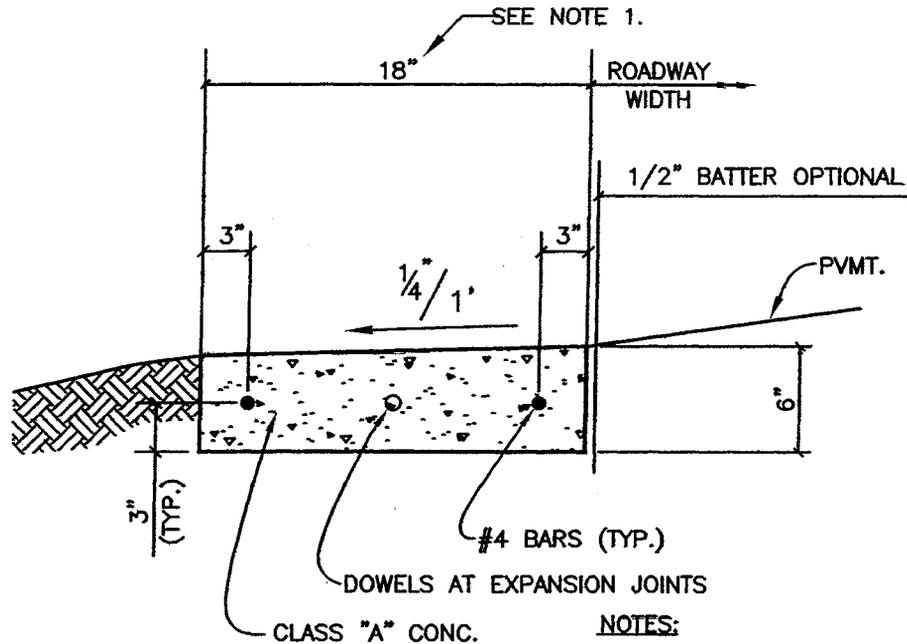
Approved _____

Date _____

Drawn by:
SDK

MOUNTABLE CURB AND GUTTER DETAILS

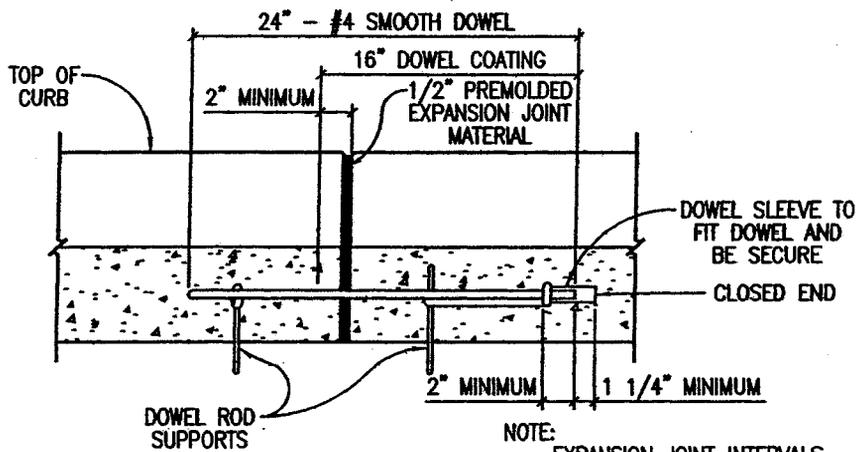
Detail No.
SD06.DWG



RIBBON CURB

NOTES:

1. ALL WORK AND MATERIAL SHALL CONFORM TO ASTM A615, A615M, C309, AND D1752. BROOM FINISH EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAX.
3. EXPANSION JOINTS AS PER STD. ASTM D-1752.



CURB DOWEL DETAIL

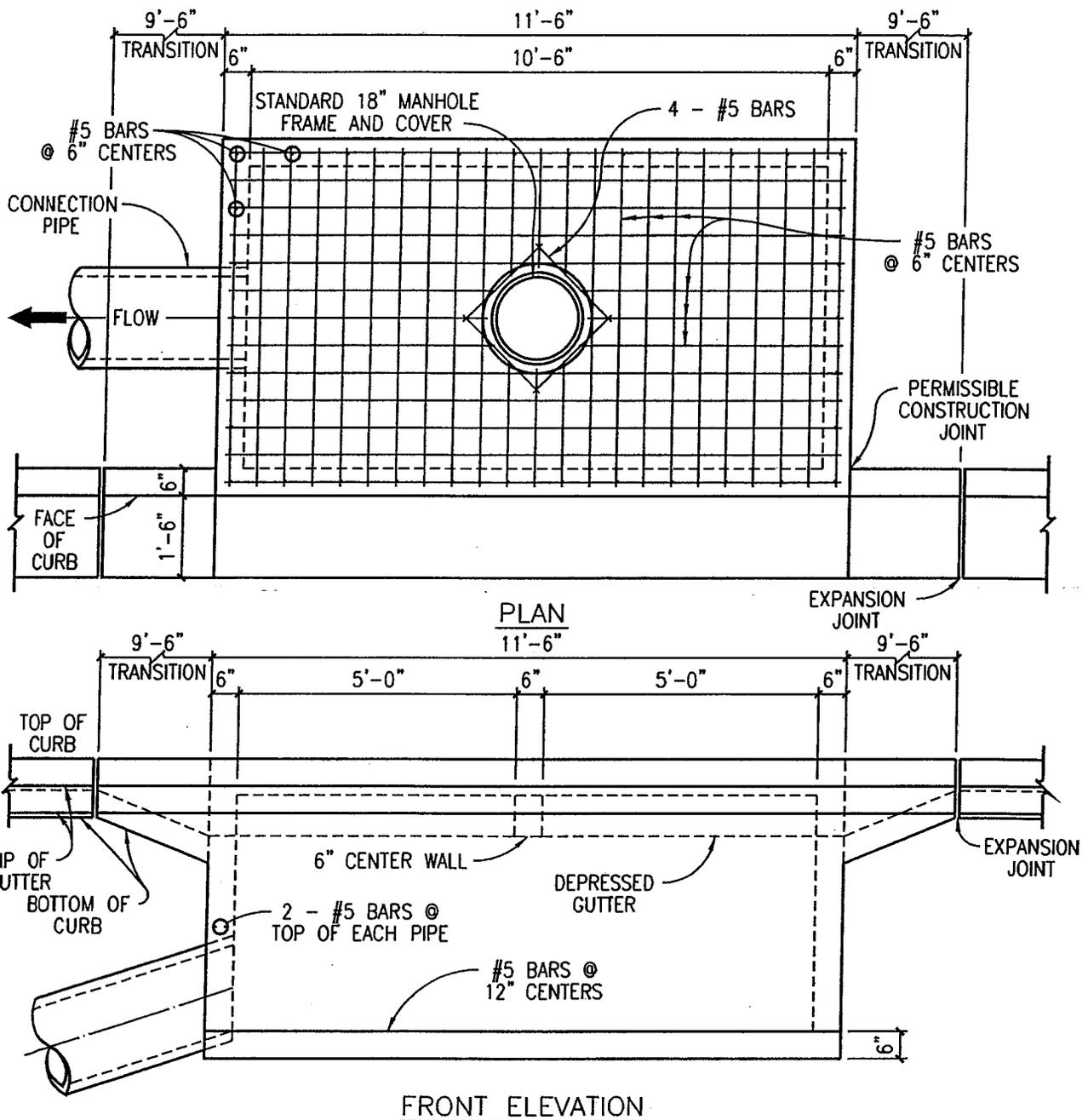
NOTE: EXPANSION JOINT INTERVALS NOT TO EXCEED 40'-0".

NOTE:

1. WIDTH OF RIBBON CURB MAY BE 24" WIDE IF SHOWN ON DRAWINGS.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____	Date _____	Drawn by: SDK
RIBBON CURB DETAILS			Detail No. SD07.DWG

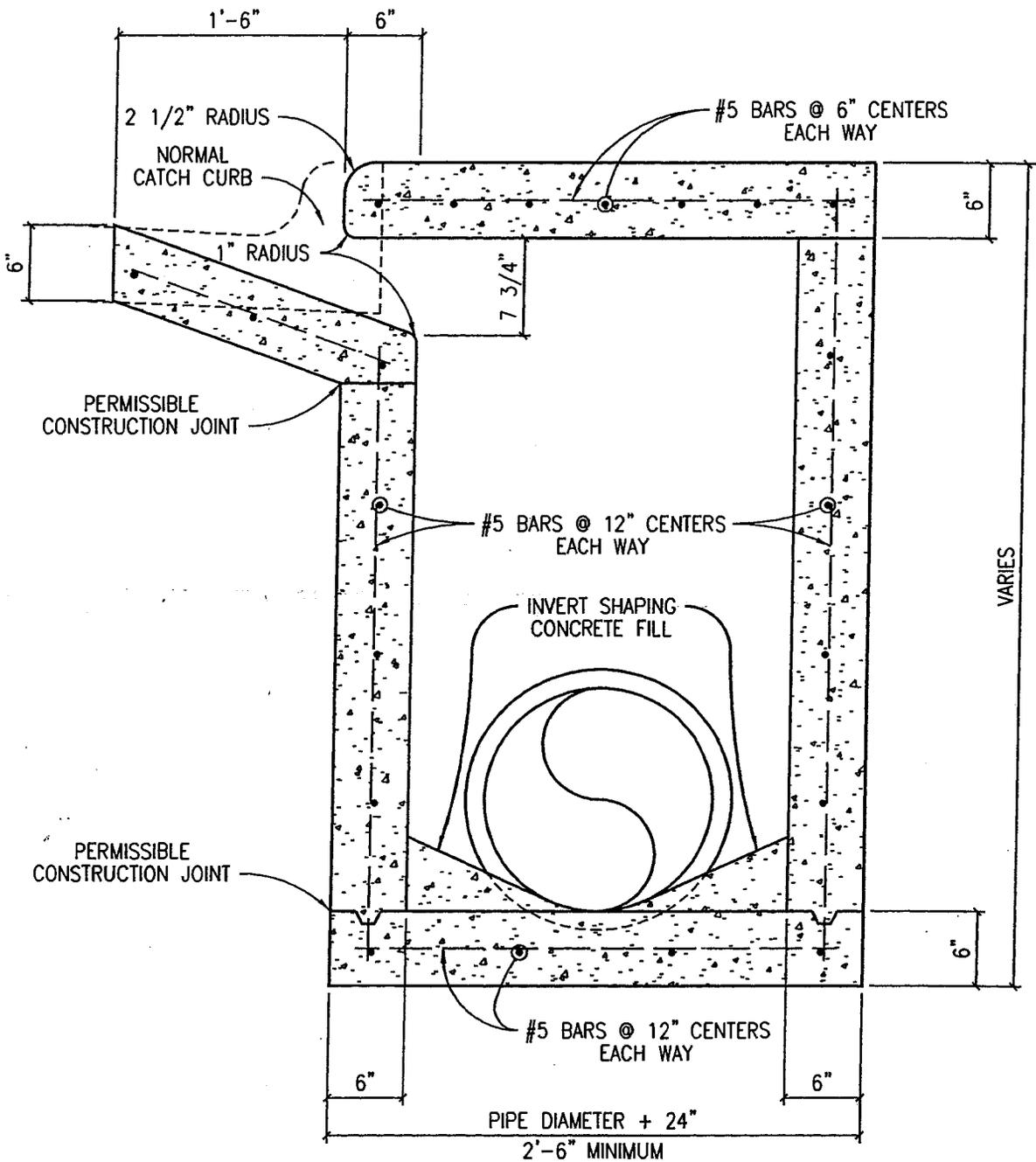


NOTES:

1. ALL CONCRETE SHALL BE MINIMUM 5 SACK CONCRETE WITH A 28 DAY COMPRESSIVE STRENGTH OF 3,000 P.S.I. MINIMUM.
2. STORM SEWER PIPE MATERIAL TO BE R.C.P. (CLASS III). STORM SEWER MATERIAL MAY BE H.D.P.E. PIPE (A.D.S. (N-12) OR HANCOR (SURE-LOK), ONLY WHEN SPECIFICALLY APPROVED BY THE CITY ENGINEER.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____	Date _____	Drawn by: SDK
CURB INLET DETAIL			Detail No. SD08.DWG



NOTES:

1. ALL CONCRETE SHALL BE MINIMUM 5 SACK CONCRETE WITH A 28 DAY COMPRESSIVE STRENGTH OF 3,000 P.S.I. MINIMUM.
2. STORM SEWER PIPE MATERIAL TO BE R.C.P. (CLASS III). STORM SEWER MATERIAL MAY BE H.D.P.E. PIPE (A.D.S. (N-12) OR HANCOR (SURE-LOK), ONLY WHEN SPECIFICALLY APPROVED BY THE CITY ENGINEER.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

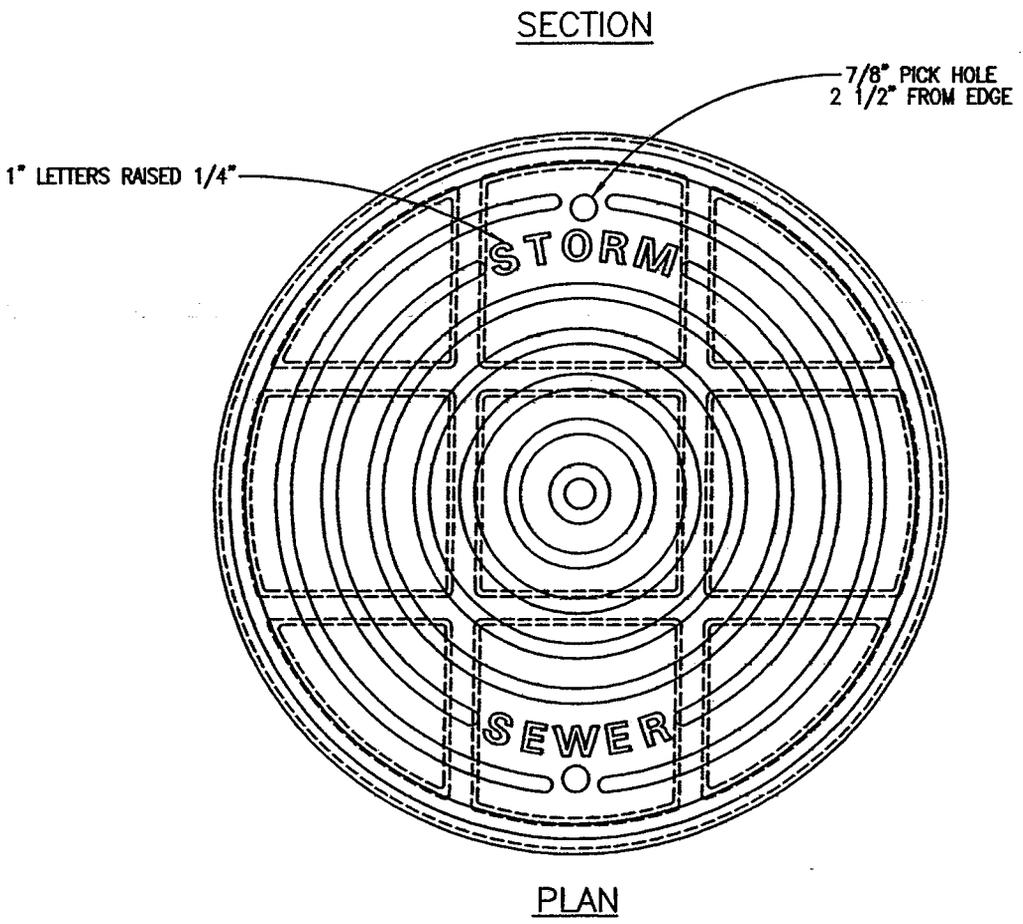
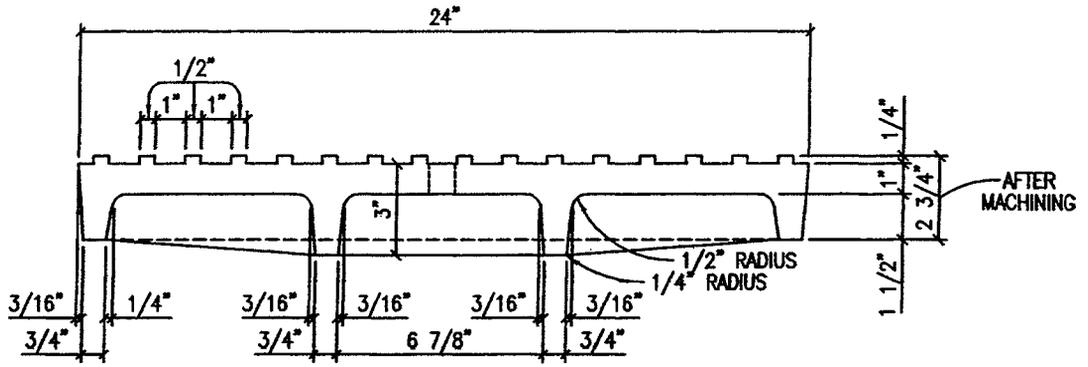
Approved _____

Date _____

Drawn by:
SDK

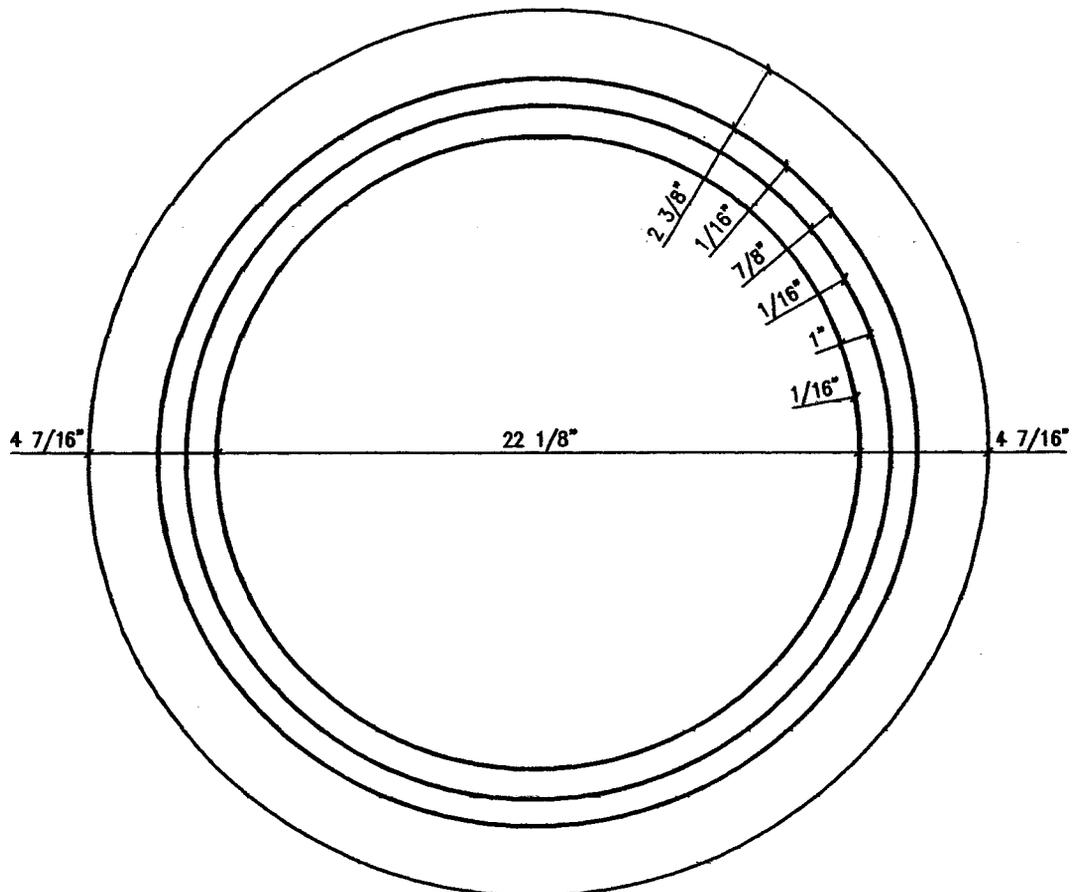
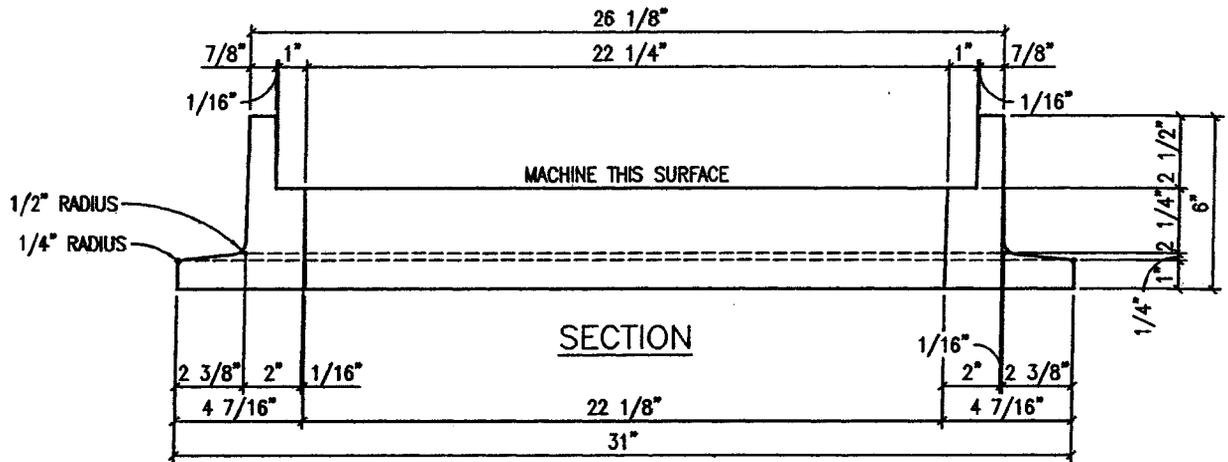
CURB INLET-TYPICAL SECTION

Detail No.
SD09.DWG



NOTE:
1. REQUIRED FOR USE IN STORM SEWER STRUCTURES HAVING A DEPTH OF 4- FEET OR LESS.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Drawn by: SDK
	Date _____	
STANDARD STORM SEWER MANHOLE COVER (24")		Detail No. SD10.DWG



CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

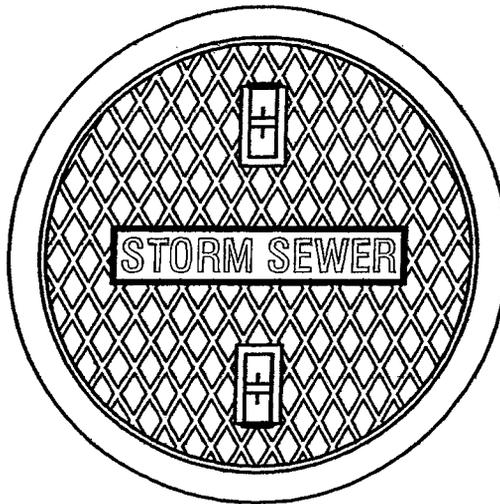
Approved _____

Date _____

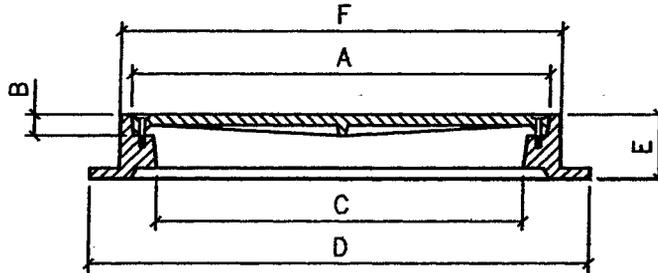
Drawn by:
SDK

STANDARD STORM SEWER
MANHOLE FRAME (24")

Detail No.
SD11.DWG



PLAN



SECTION

NOTES:

1. REQUIRED FOR USE IN STORM SEWER STRUCTURES HAVING A DEPTH OF GREATER THAN 4- FEET.
2. STORM SEWER MANHOLE FRAME AND COVER TO BE EAST JORDAN IRON WORKS, INC. V-1600-5, OR APPROVED EQUAL.
3. COVER TO BE TYPE 36 MARKED "STORM SEWER".
4. LID SHALL HAVE A TYPE 4 STAINLESS STEEL PICK BAR. REFER TO DETAIL #WW11 FOR PICK BAR DETAIL.

	DIMENSIONS						COVER		RING		SET
	A	B	C	D	E	F	CASTING #	WEIGHT	CASTING #	WEIGHT	WEIGHT
V-1600-5	38	2	36	46	6	40	41600545	365 LBS	41600510	320 LBS	685 LBS

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

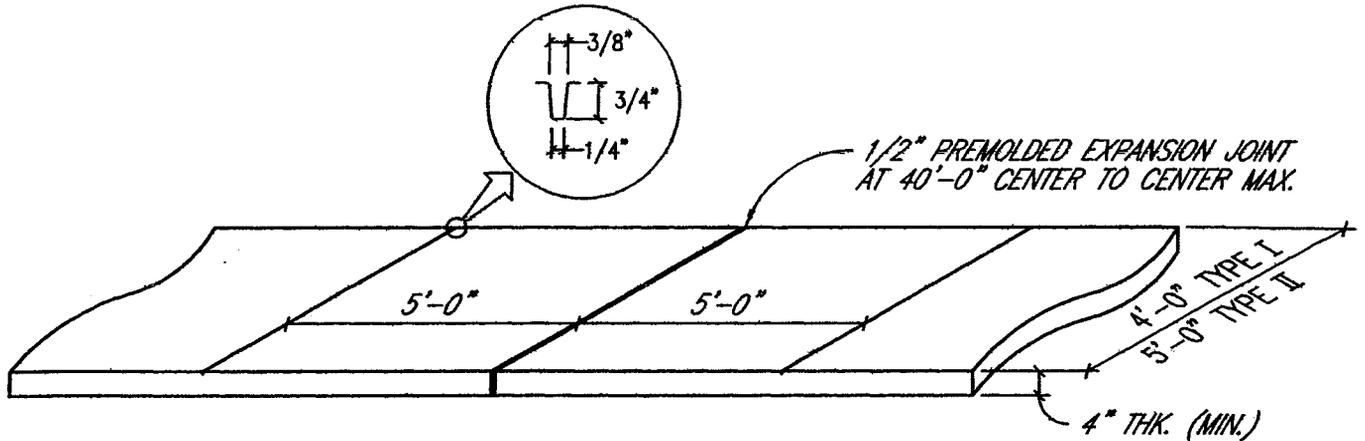
Approved _____

Date _____

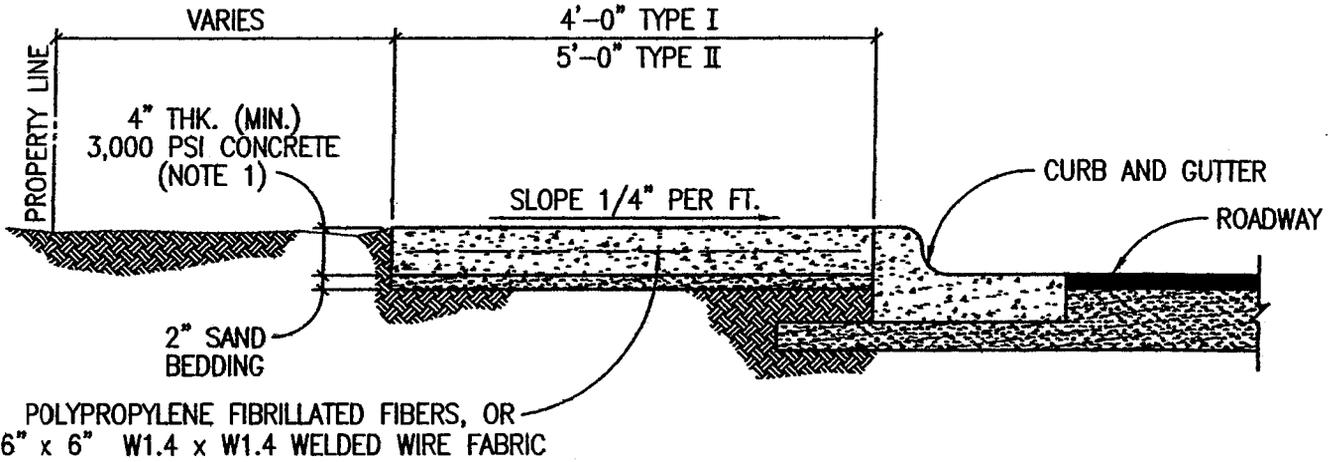
Drawn by:
SDK

**STANDARD STORM SEWER
MANHOLE SET (38")**

Detail No.
SD12.DWG



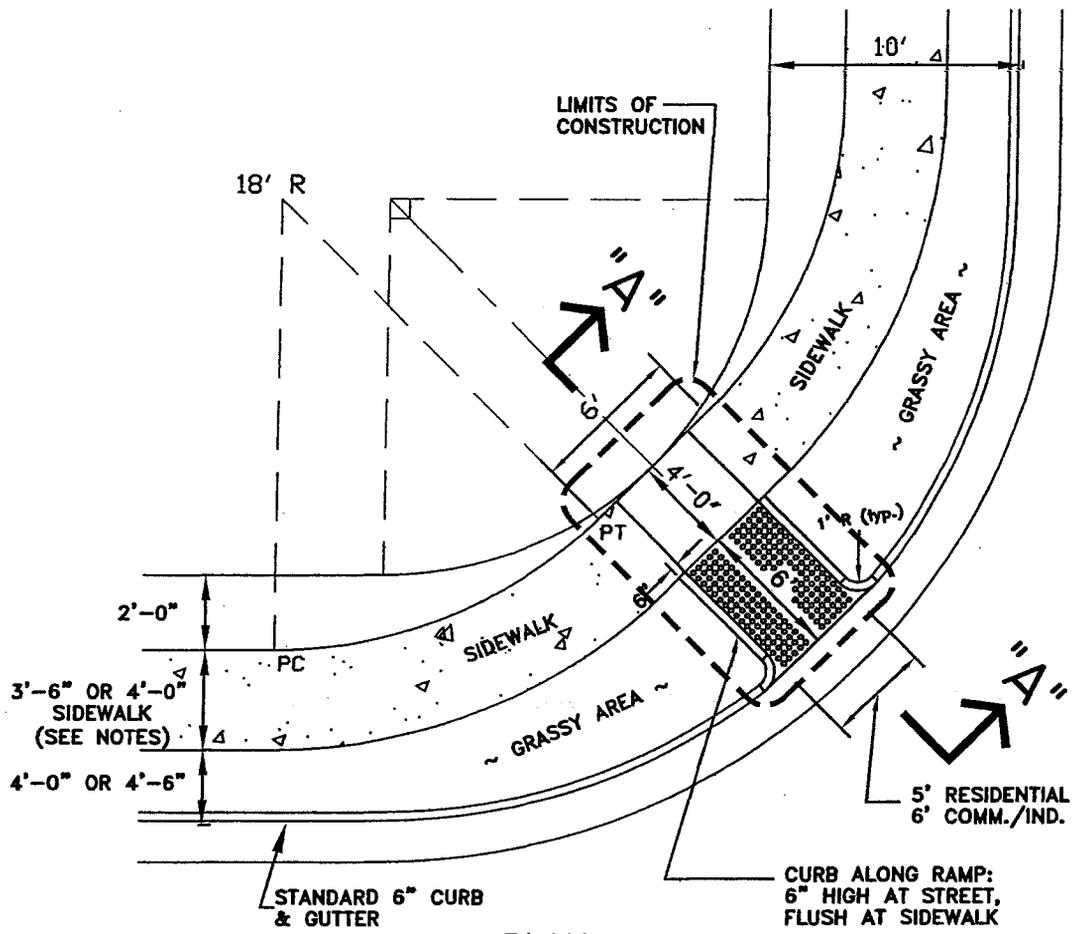
TYPE I - AS REQUIRED FOR SINGLE FAMILY, DUPLEXES AND TOWNHOUSES.
 TYPE II - AS REQUIRED FOR APARTMENTS, OFFICE AND PARKING LOTS, COMMERCIAL AND INDUSTRIAL.



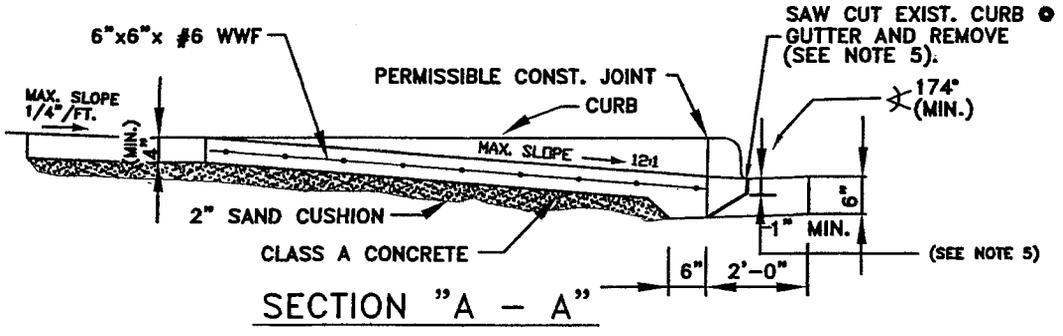
POLYPROPYLENE FIBRILLATED FIBERS, OR
 6" x 6" W1.4 x W1.4 WELDED WIRE FABRIC

1. FOR ROLLER STAMPED SIDEWALK: 4000 P.S.I. CONCRETE WITH 3/8" AGGREGATE.
2. STANDARD LOCATION OF SIDEWALK IS OFF BACK OF CURB. SPECIAL DESIGNS MAY BE APPROVED BY THE CITY ENGINEER, PRIOR TO FINAL DESIGN.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Drawn by: SDK
	Date _____	
SIDEWALK SECTION AND JOINT DETAIL		Detail No. SD13.DWG



PLAN

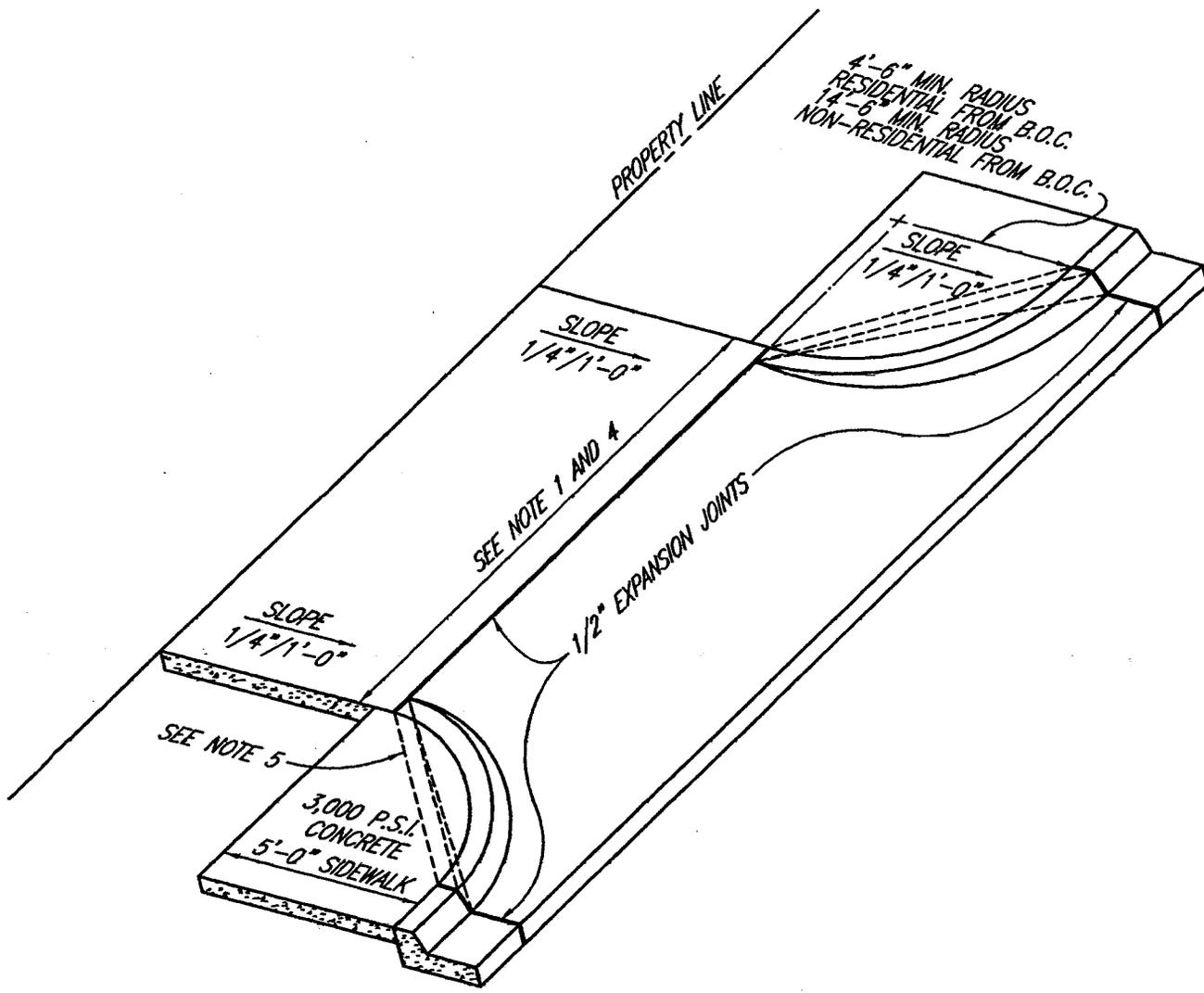


SECTION "A - A"

GENERAL NOTES:

1. THIS ITEM WILL BE MEASURED BY SQUARE FOOT OF CONCRETE PLACED AND PAID FOR UNDER 4" CONCRETE SIDEWALK.
2. SIDEWALKS SHALL BE 3'-6" WIDE (MIN.) IN RESIDENTIAL AREAS, 4'-0" WIDE (MIN.) IN OTHER AREAS. SIDEWALKS SHALL BE A MINIMUM OF 5'-0" WIDE WHEN ADJACENT TO CURB REGARDLESS OF ZONING.
3. THE RAMP SHALL HAVE A DETECTABLE WARNING AND CONTRASTING COLORED SURFACE. RAMP SHALL BE STAMPED AND DYED CONCRETE OR APPROVED EQUAL.
4. POSITION OF RAMP MAY BE ALTERED IN THE FIELD BY THE ENGINEER, BUT ONLY WITH PUBLIC WORKS DEPARTMENT APPROVAL.
5. SAW CUTTING APPLICABLE FOR INSTALLATION WHERE CURB LAYDOWN FOR RAMP NOT PROVIDED.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Date _____
SIDEWALK RAMP DETAILS		Drawn by: SDK
		Detail No. SD14.DWG

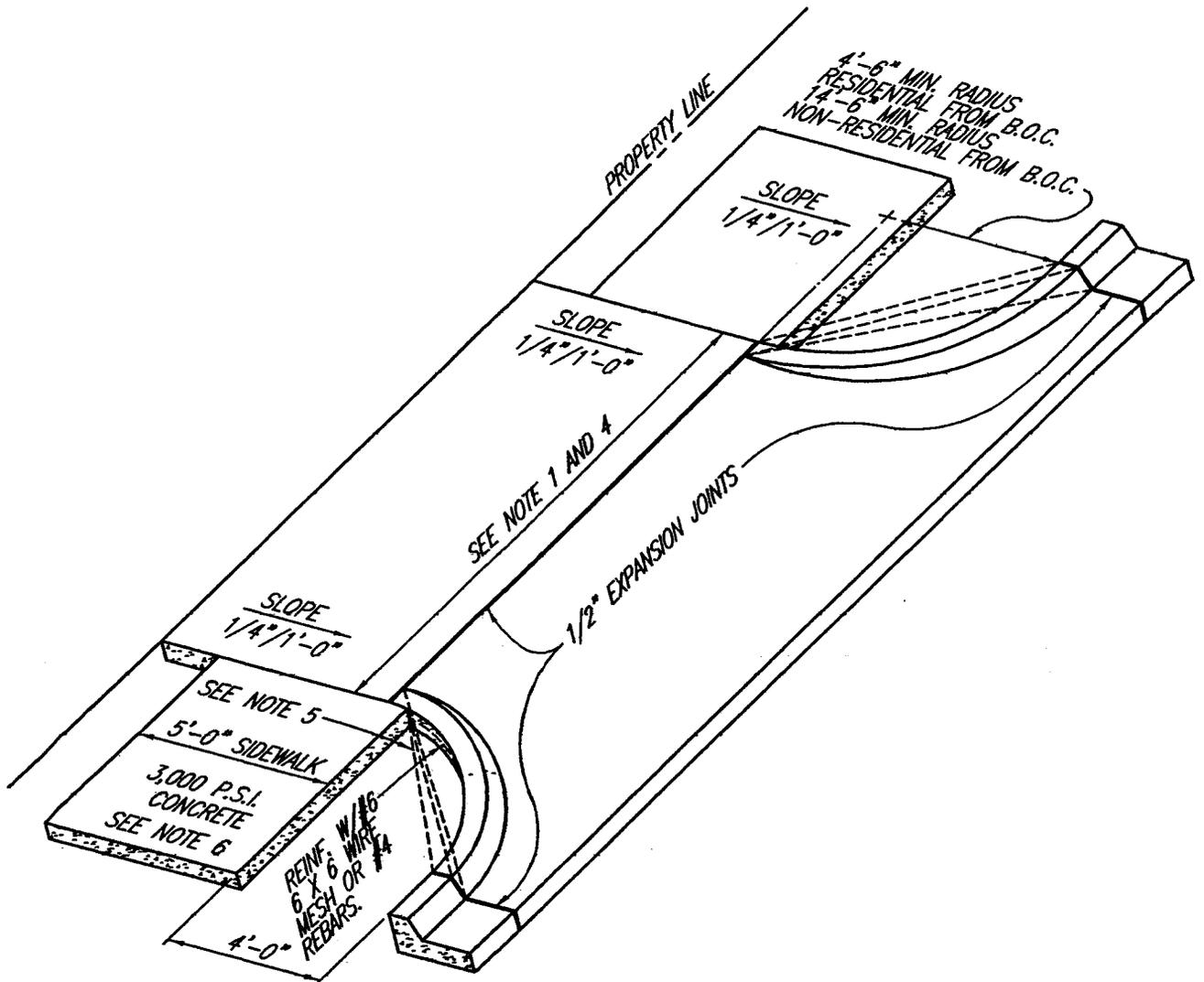


NOTES:

1. MAXIMUM WIDTH OF APPROACH SHALL BE 24'-0" FOR RESIDENTIAL, 30'-0" FOR NON-RESIDENTIAL UNDIVIDED AND 45'-0" FOR NON-RESIDENTIAL DIVIDED.
2. DRIVEWAY PERMITS TO BE ACQUIRED FROM CITY INSPECTION OFFICE.
3. SPACING OF DRIVEWAY CUTS SHALL BE AS REQUIRED BY SECTIONS 33043 - 33044 OF THE CITY'S SUBDIVISION REGULATIONS.
4. MINIMUM WIDTH OF APPROACH SHALL BE 10'-0" FOR RESIDENTIAL AND 15'-0" FOR NON-RESIDENTIAL.
5. LINEAR "RADIUS" AT CORNERS, PERMITTED FOR "SINGLE FAMILY" OR "TWO FAMILY" RESIDENTIAL DRIVEWAY APPROACH.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
CONCRETE DRIVEWAY APPROACH TYPE "A"		Detail No. SD15.DWG



NOTES:

1. MAXIMUM WIDTH OF APPROACH SHALL BE 24'-0" FOR RESIDENTIAL, 30'-0" FOR NON-RESIDENTIAL UNDIVIDED AND 45'-0" FOR NON-RESIDENTIAL DIVIDED.
2. DRIVEWAY PERMITS TO BE ACQUIRED FROM CITY INSPECTION OFFICE.
3. SPACING OF DRIVEWAY CUTS SHALL BE AS REQUIRED BY SECTIONS 33043 - 33044 OF THE CITY'S SUBDIVISION REGULATIONS.
4. MINIMUM WIDTH OF APPROACH SHALL BE 10'-0" FOR RESIDENTIAL AND 15'-0" FOR NON-RESIDENTIAL.
5. LINEAR "RADIUS" AT CORNERS, PERMITTED FOR "SINGLE FAMILY" OR "TWO FAMILY" RESIDENTIAL DRIVEWAY APPROACH.
6. SIDEWALK LOCATION TO BE APPROVED BY CITY ENGINEER PRIOR TO FINAL DESIGN.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

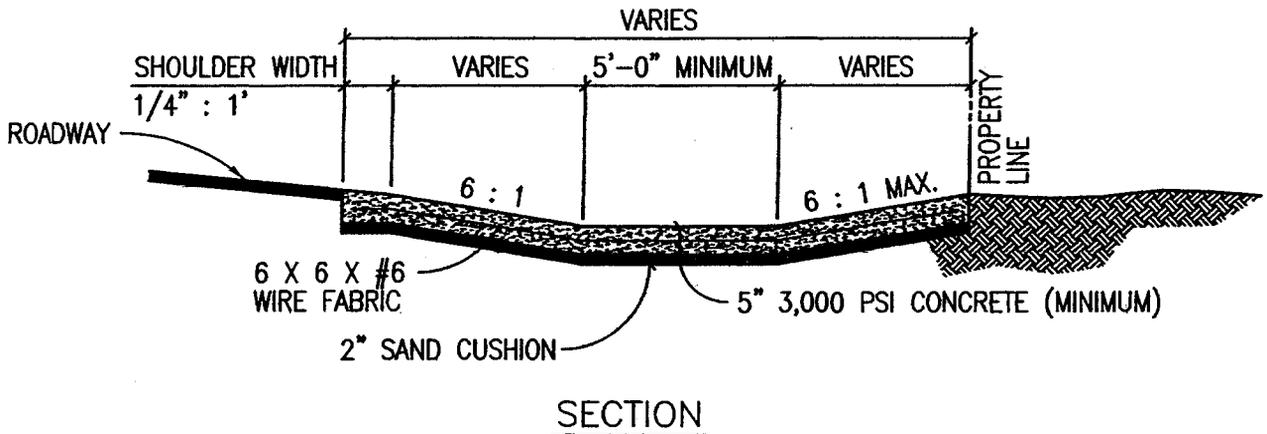
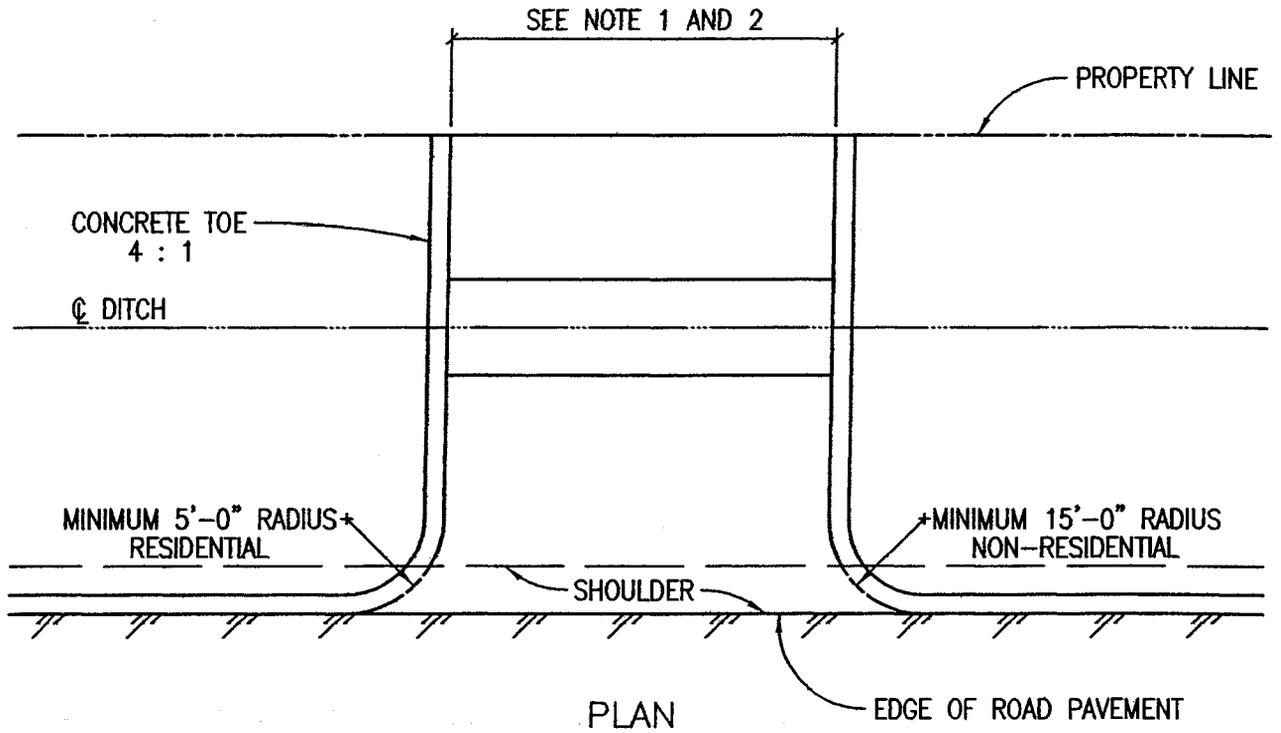
Approved _____

Date _____

Drawn by:
SDK

CONCRETE DRIVEWAY APPROACH
TYPE "B"

Detail No.
SD16.DWG



NOTES:

1. MINIMUM WIDTH OF APPROACH SHALL BE 12'-0" FOR RESIDENTIAL AND 15'-0" FOR NON-RESIDENTIAL.
2. MAXIMUM WIDTH OF APPROACH SHALL BE 24'-0" FOR RESIDENTIAL, 30'-0" FOR NON-RESIDENTIAL UNDIVIDED AND 45'-0" FOR NON-RESIDENTIAL DIVIDED.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

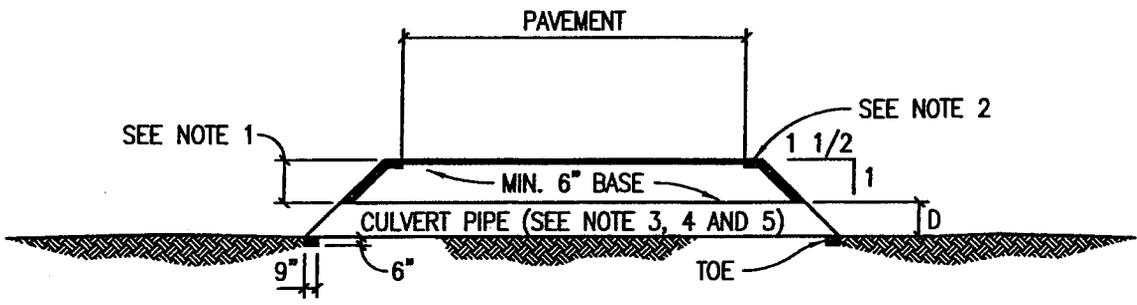
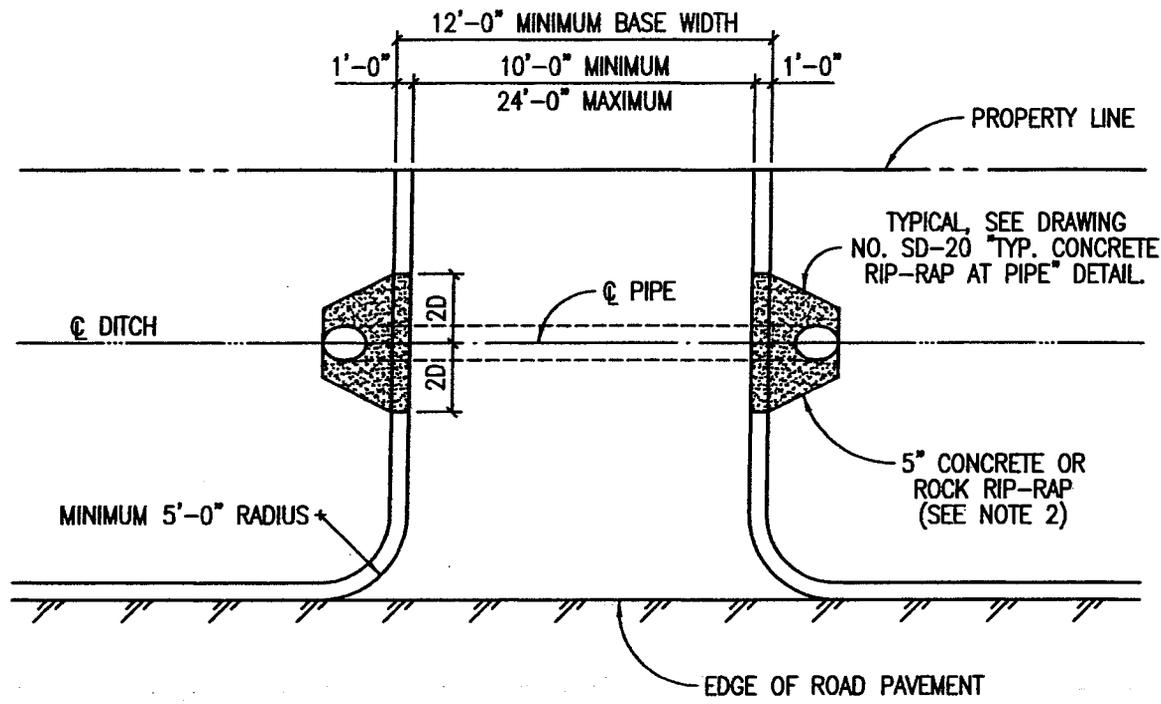
Approved _____

Date _____

Drawn by:
SDK

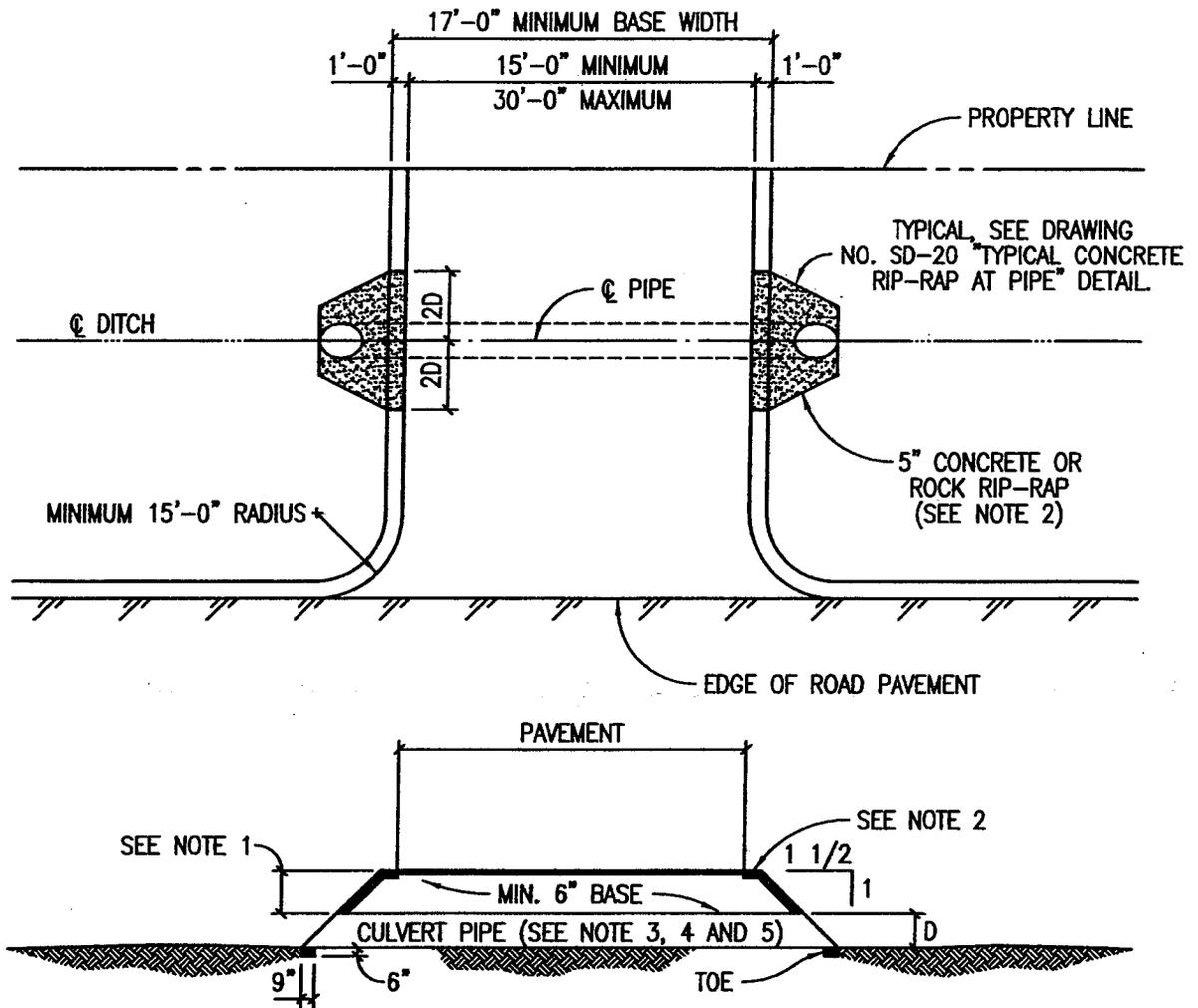
CONCRETE DIP DRIVEWAY APPROACH

Detail No.
SD17.DWG



- NOTES:
1. MINIMUM COVER OVER CULVERT PIPE SHALL BE 6" (SEE NOTE 5).
 2. 5" CONCRETE OR ROCK RIP-RAP SHALL BE INSTALLED.
 3. CULVERT PIPE TO BE MINIMUM OF 12" DIAMETER.
 4. CULVERT PIPE MATERIAL TO BE R.C.P. (CLASS III), A.D.S. "N-12" OR ALUMINIZED CORRUGATED METAL PIPE (A.C.M.P.) , AS DIRECTED BY THE ENGINEER.
 5. MINIMUM COVER OVER CULVERT PIPE SHALL PROVIDE H2O LOADING.
 6. BACKFILL AROUND CULVERT PIPE SHALL BE SELECT MATERIAL TO BE PLACED AND COMPACTED TO 95%.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Date _____
RURAL RESIDENTIAL DRIVEWAY APPROACH WITH CULVERT PIPE		Drawn by: SDK
		Detail No. SD18.DWG

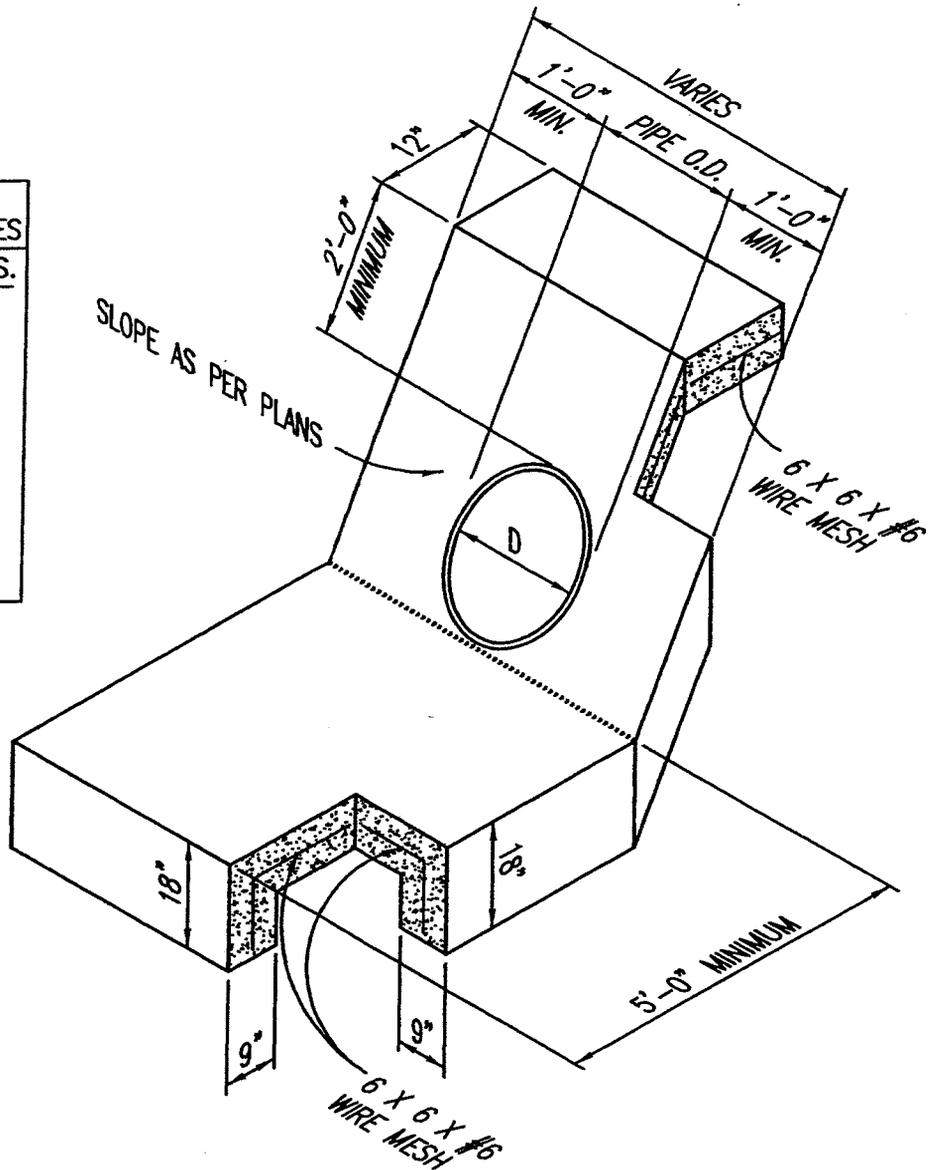


NOTES:

1. MINIMUM COVER OVER CULVERT PIPE SHALL BE 6" (SEE NOTE 5).
2. 5" CONCRETE OR ROCK RIP-RAP SHALL BE INSTALLED.
3. CULVERT PIPE TO BE MINIMUM OF 12" DIAMETER.
4. CULVERT PIPE MATERIAL TO BE R.C.P. (CLASS III), A.D.S. "N-12" OR ALUMINIZED CORRUGATED METAL PIPE (A.C.M.P.), AS DIRECTED BY THE ENGINEER.
5. MINIMUM COVER OVER CULVERT PIPE SHALL PROVIDE H2O LOADING.
6. BACKFILL AROUND CULVERT PIPE SHALL BE SELECT MATERIAL TO BE PLACED AND COMPACTED TO 95%.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
RURAL NON-RESIDENTIAL UNDIVIDED DRIVEWAY APPROACH WITH CULVERT PIPE		Detail No. SD19.DWG

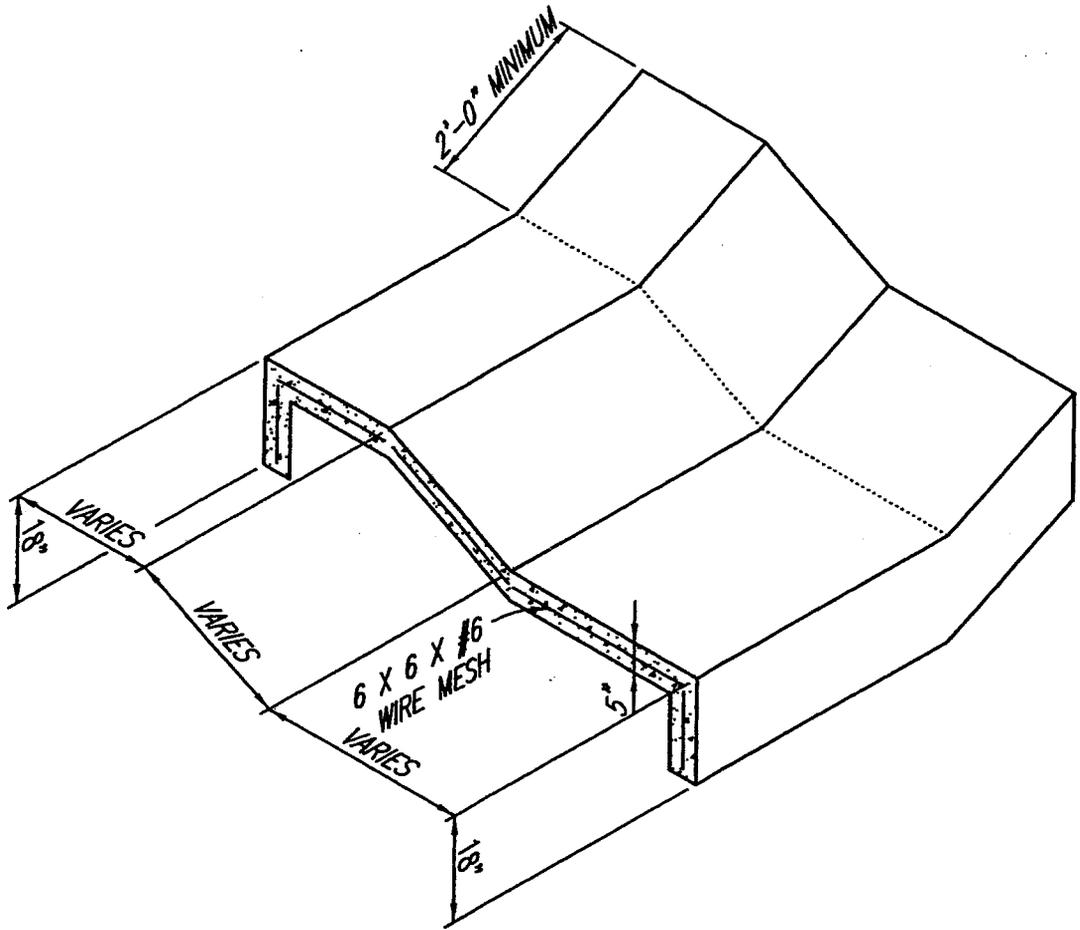
MINIMUM RIP-RAP QUANTITIES	
PIPE	SQ. YDS.
18"	6.2
24"	6.9
27"	7.8
30"	9.5
36"	10.4
42"	12.0
48"	14.3
54"	16.4



NOTES:

1. WHEN HEADWALLS AND WINGWALLS ARE REQUIRED, THEY SHALL CONFORM TO THE TxDOT STANDARDS, OR AS DIRECTED BY THE CITY.
2. ENERGY DISAPPATORS IF PIPE VELOCITY EXCESSED 5.0 F.P.S. OR AS DIRECTED BY THE CITY.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Drawn by: SDK
	Date _____	
TYPICAL CONCRETE RIP-RAP AT PIPE		Detail No. SD20.DWG



CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

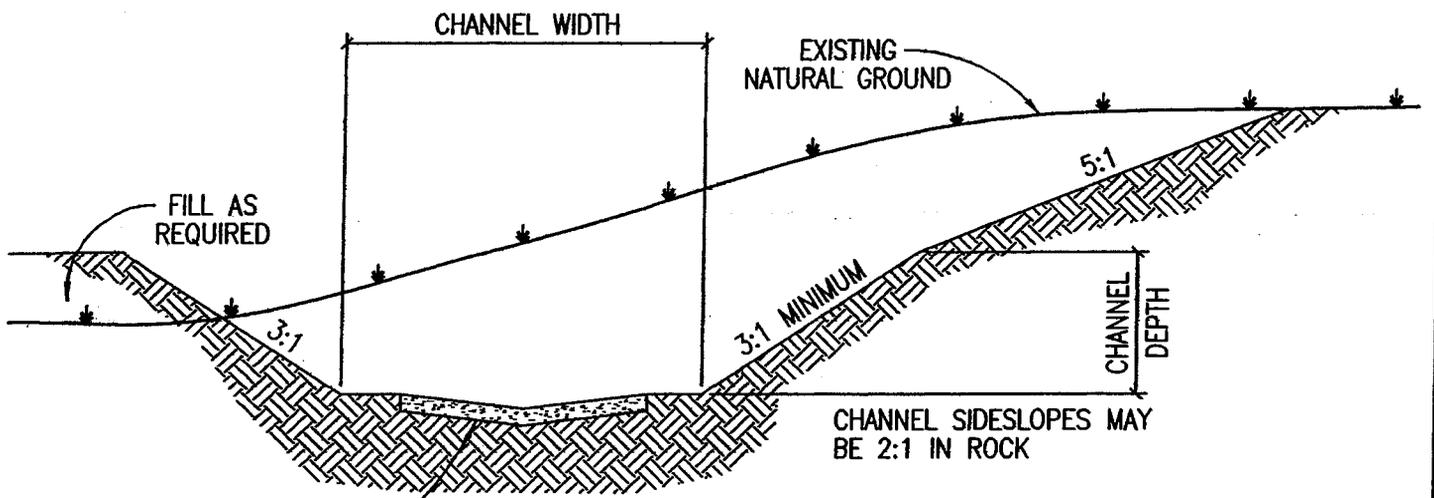
Approved _____

Date _____

Drawn by:
SDK

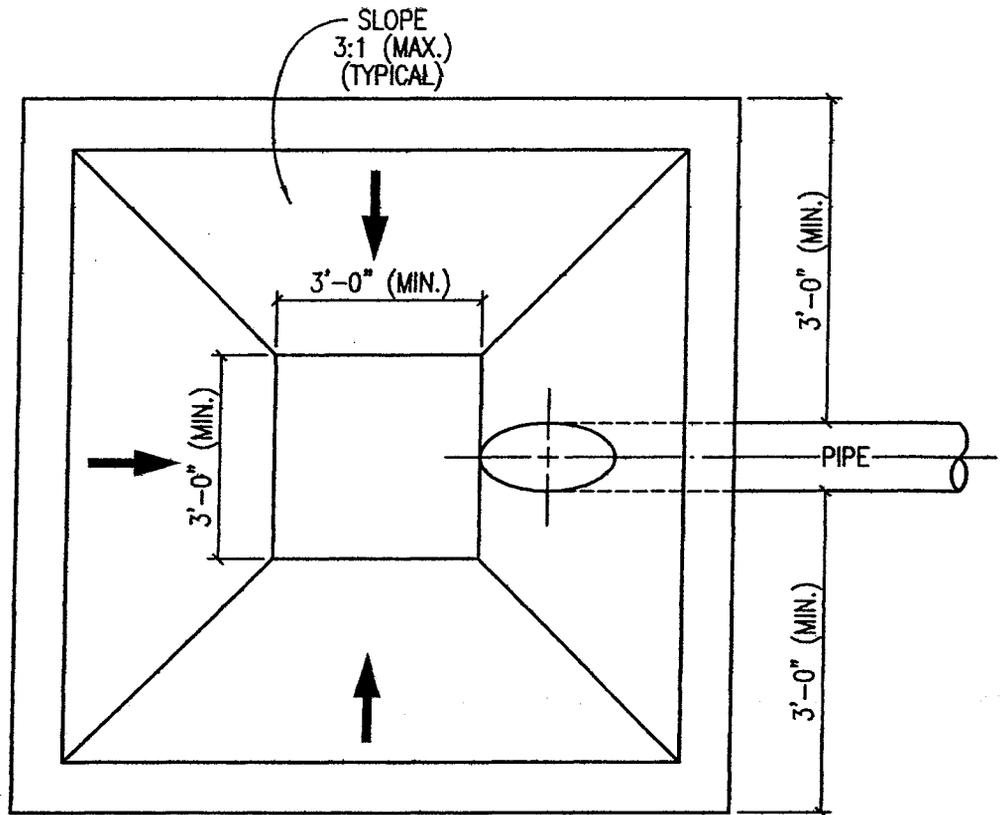
**HALF-SECTION CONCRETE
LINED DITCH STEP**

Detail No.
SD21.DWG

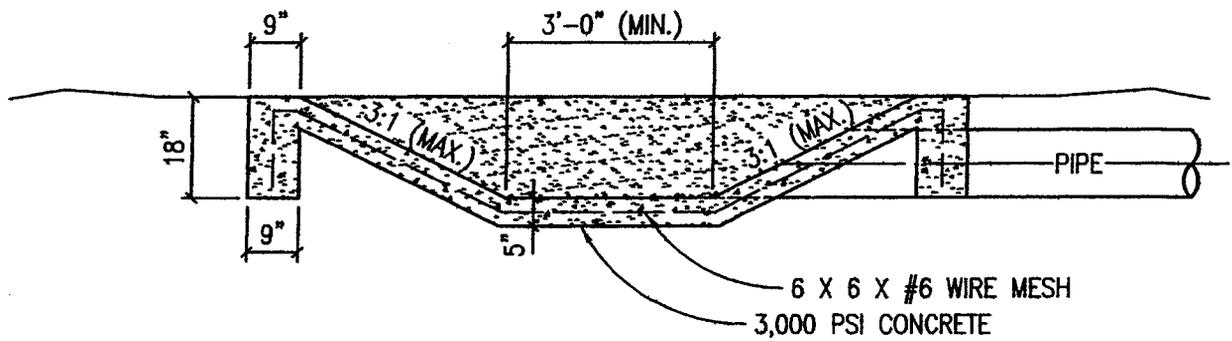


TYPICAL 6 FOOT WIDE
 CONCRETE PILOT CHANNEL
 WITH 6x6x#6 WIRE MESH
 (3000 PSI CONCRETE)

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Drawn by: SDK
	Date _____	
TYPICAL PILOT CHANNEL SECTION		Detail No. SD22.DWG



PLAN



SECTION

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

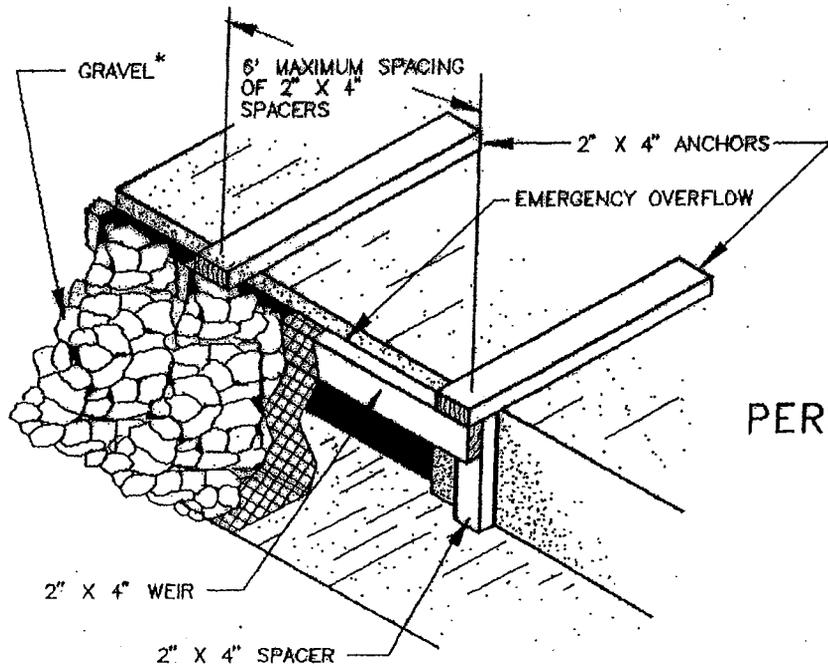
Approved _____

Date _____

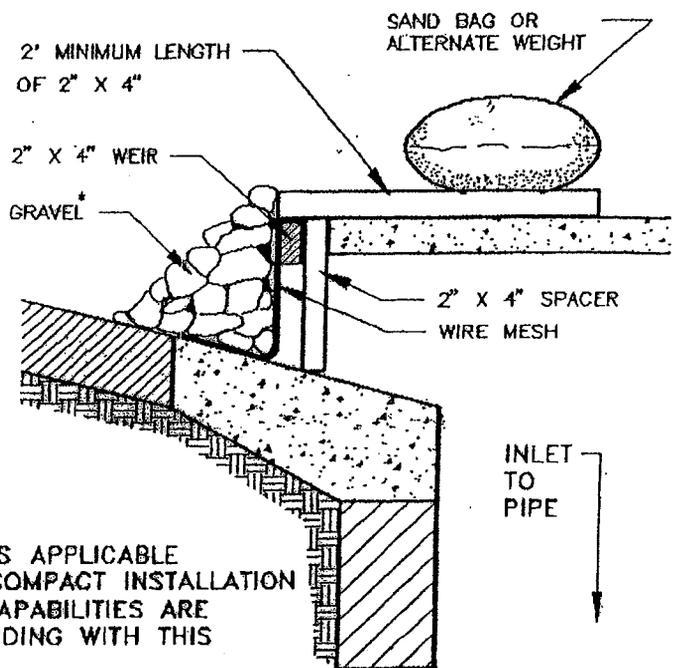
Drawn by:
SDK

CONCRETE RIP-RAP AT PIPE

Detail No.
SD23.DWG



PERSPECTIVE VIEW



SIDE ELEVATION

SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE TO CURB INLETS WHERE A STURDY, COMPACT INSTALLATION IS DESIRED. EMERGENCY OVERFLOW CAPABILITIES ARE MINIMAL, SO EXPECT SIGNIFICANT PONDING WITH THIS MEASURE.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

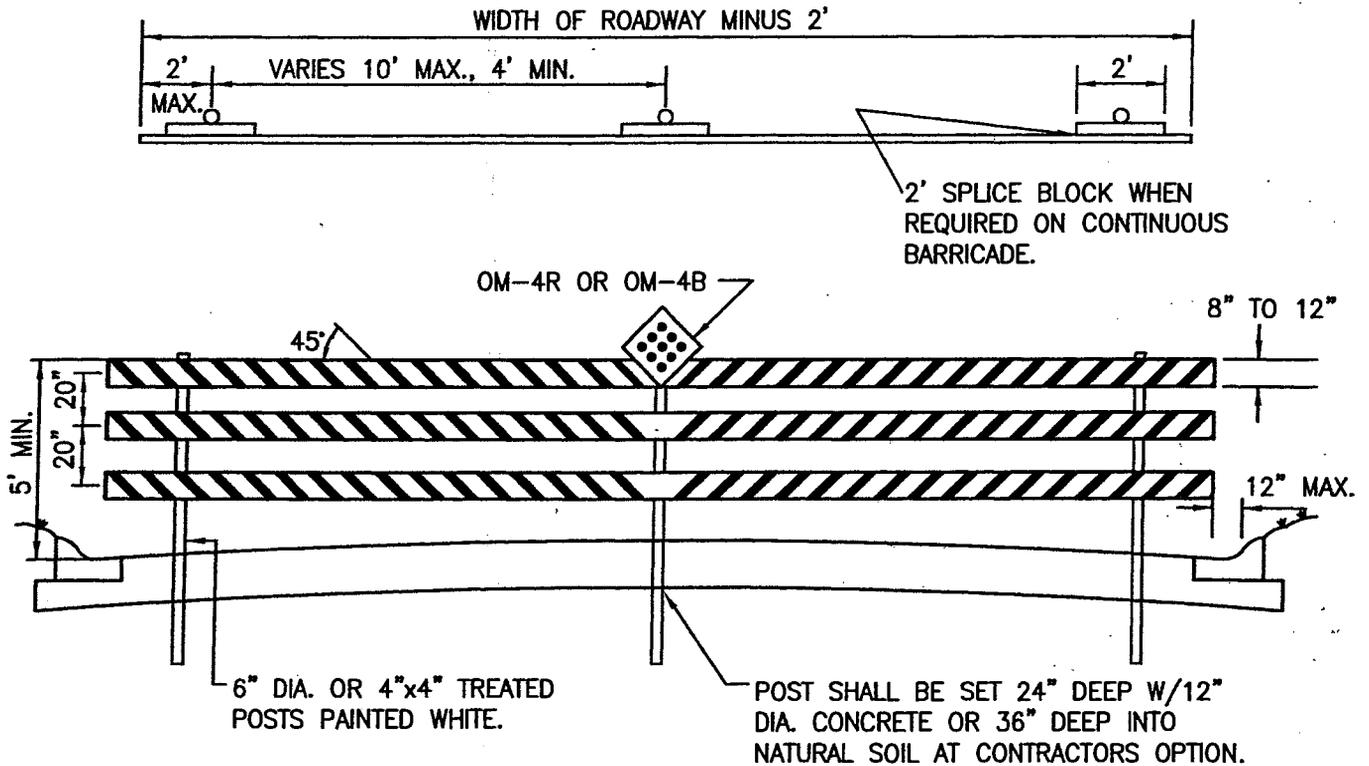
Approved _____

Date _____

Drawn by:
SDK

CURB INLET PROTECTION DETAIL

Detail No.
SD24.DWG



NOTES:

1. THE DESIGN OF THIS BARRICADE IS IN COMPLIANCE WITH THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS.
2. WIDTH OF RAIL SHALL BE A MINIMUM OF 8" AND MAY BE UP TO A MAXIMUM OF 12"; 2" NOMINAL SMOOTH LUMBER.
3. RAILS SHALL BE FASTENED TO EACH POST WITH 1/4" STEEL BOLTS WITH WASHERS ON EACH SIDE OR WITH 3-20d NAILS.
4. THE RAILS SHALL RECEIVE TWO COATS OF WHITE OIL BASE OUTSIDE PAINT, THEN SHALL HAVE 6" WIDE REFLECTORIZED RED STRIPES OF TAPE PLACED ON 45° SLOPES, DOWN AND TOWARD THE CENTER OF THE BARRICADE.
5. BARRICADES MAY BE CONSTRUCTED IN SECTIONS OR MAY BE CONTINUOUS ACROSS ROADWAY WIDTH. SPLICES ON CONTINUOUS RAIL BARRICADES SHALL BE AT POSTS AND SHALL HAVE A 2' SPLICE BLOCK ON BACK SIDE OF THE SAME MATERIAL AS RAIL.
6. 18" DIAMOND REFLECTORIZED RED PANEL OR 18" DIAMOND RED OR BLACK PANEL WITH 9-3" DIAMETER RED REFLECTORS SYMMETRICALLY PLACED AT CENTER POSTS, A MINIMUM OF 4' ABOVE GROUND SHALL BE USED FOR END OF ROAD MARKERS.

CITY OF MARBLE FALLS, TEXAS

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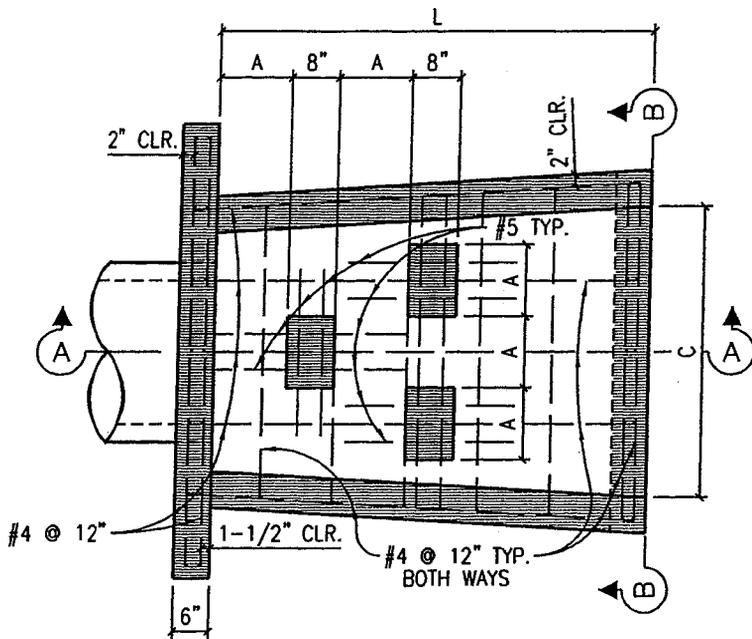
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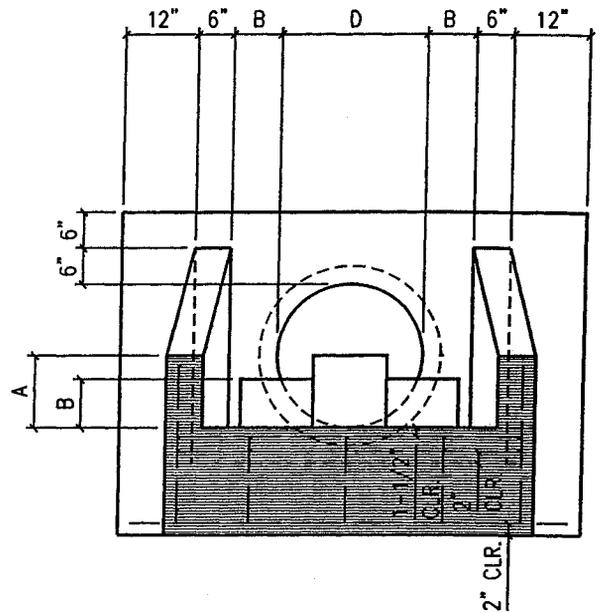
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STANDARD BARRICADE

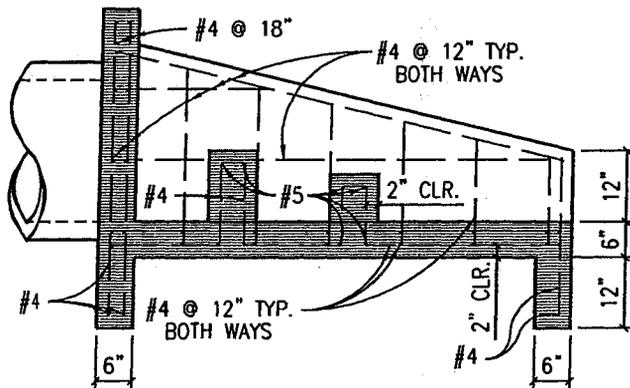
Detail No.
SD25.DWG



PLAN



SECTION B-B



SECTION A-A

DIMENSIONS IN INCHES

PIPE I.D.	18	21	24	27	30	33	36	42	48	54	60
A	9	10	12	14	15	16	18	21	24	27	30
B	6	7	8	9	10	11	12	14	16	18	20
C	32	42	48	54	60	66	72	84	96	108	120
L	54	63	72	81	90	99	108	126	144	162	180

CITY OF MARBLE FALLS, TEXAS

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SDK

ENERGY DISSIPATOR DETAIL

Detail No.
SD27.DWG

City of Marble Falls

Erosion Control Details and Construction Standards

Detail #

EC01	Temporary Erosion and Sedimentation Guidelines
EC02	Silt Fence
EC03	Rock Berm
EC04	High Service Rock Berm
EC05	Triangular Filter Dike
EC06	Stabilized Construction Entrance
EC07	Sediment Trap
EC08	Sediment Basin Baffle Design
EC09	Tree Protection – Chain Link Fence
EC10	Tree Protection – Wood Slats

GUIDELINES FOR DESIGN AND INSTALLATION OF
TEMPORARY EROSION AND SEDIMENTATION CONTROLS

TYPE OF STRUCTURE	REACH LENGTH	MAXIMUM DRAINAGE AREA	SLOPE
SILT FENCE	N/A	2 ACRES	0 - 10%
	200 FEET	2 ACRES	10 - 20%
	100 FEET	1 ACRE	20 - 30%
	50 FEET	1/2 ACRE	> 30%
TRIANGLE FILTER DIKE	100 FEET	1/2 ACRE	< 30% SLOPE
	50 FEET	1/4 ACRE	> 30% SLOPE
ROCK BERM *, **	500 FEET	< 5 ACRES	0 - 10%

* FOR ROCK BERM DESIGN WHERE PARAMETERS ARE OTHER THAN STATED, DRAINAGE AREA CALCULATIONS AND ROCK BERM DESIGN MUST BE SUBMITTED FOR REVIEW.

** HIGH SERVICE ROCK BERMS MAY BE REQUIRED IN AREAS OF ENVIRONMENTAL SIGNIFICANCE AS DETERMINED BY THE CITY OF MARBLE FALLS.

CITY OF MARBLE FALLS, TEXAS

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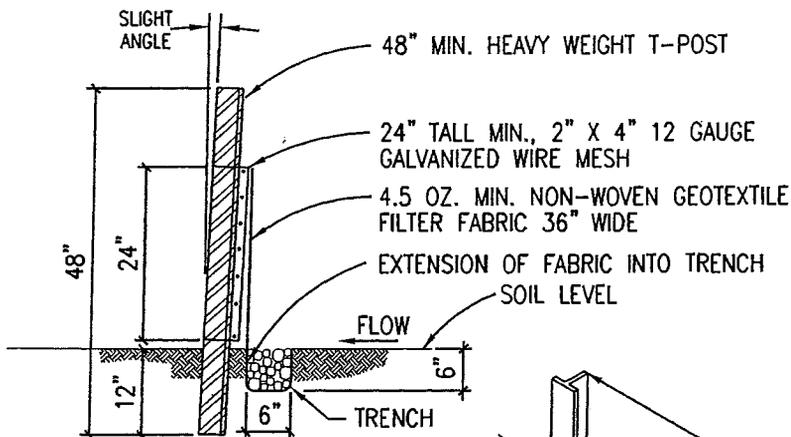
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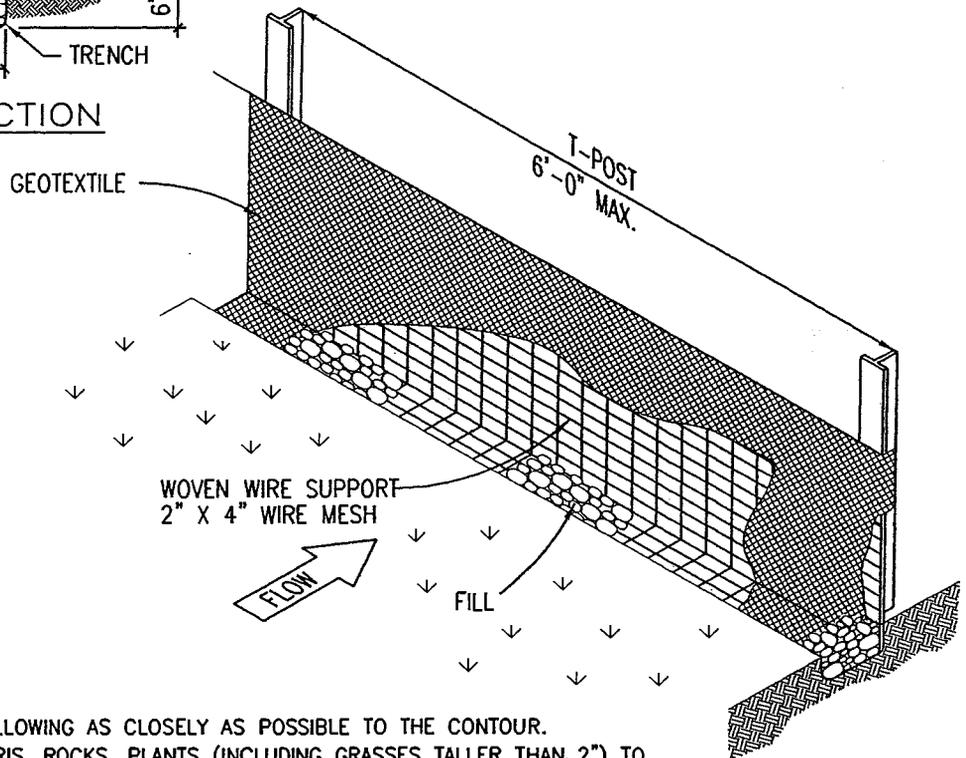
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TEMPORARY EROSION AND
SEDIMENTATION GUIDELINES

Detail No.
EC01.DWG



CROSS SECTION



INSPECTION AND MAINTENANCE GUIDELINES:

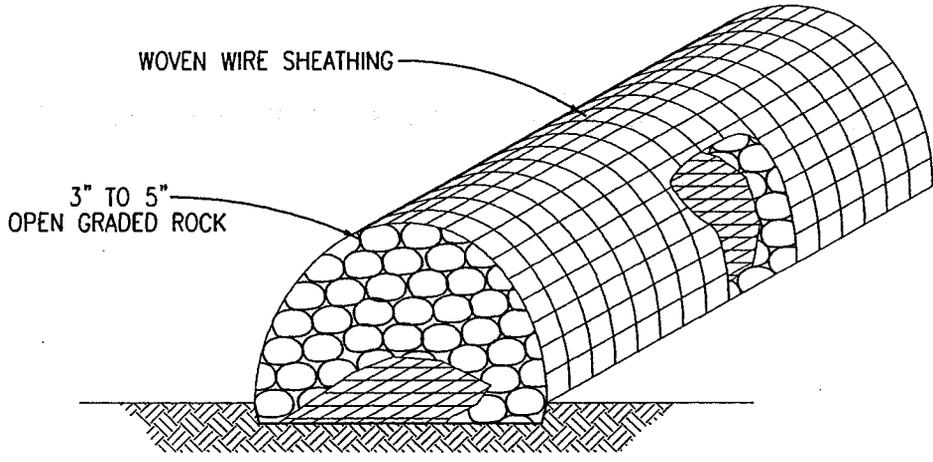
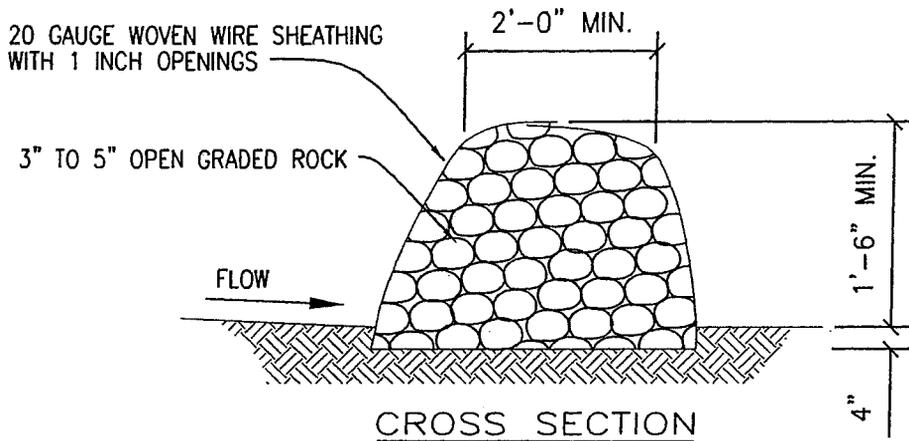
- INSPECT ALL FENCING WEEKLY, AND AFTER ANY RAINFALL EVENT.
- REMOVE SEDIMENT WHEN BUILDUP REACHES 6 INCHES.
- REPLACE ANY TORN FABRIC.
- REPLACE OR REPAIR ANY SECTIONS CRUSHED OR COLLAPSED IN THE COURSE OF CONSTRUCTION ACTMITY.

INSTALLATION:

- LAYOUT THE SILT FENCE FOLLOWING AS CLOSELY AS POSSIBLE TO THE CONTOUR.
- CLEAR THE GROUND OF DEBRIS, ROCKS, PLANTS (INCLUDING GRASSES TALLER THAN 2") TO PROVIDE A SMOOTH FLOW APPROACH SURFACE. EXCAVATE 6" DEEP X 6" WIDE TRENCH ON UPSTREAM SIDE OF FACE PER PLANS.
- DRIVE THE HEAVY DUTY T-POST AT LEAST 12 INCHES INTO THE GROUND AND AT A SLIGHT ANGLE TOWARDS THE FLOW.
- ATTACH THE 2" X 4" 12 GAUGE WELDED WIRE MESH TO THE T-POST WITH 11 1/2 GAUGE GALVANIZED T-POST CLIPS. THE TOP OF THE WIRE TO BE 24" ABOVE GROUND LEVEL. THE WELDED WIRE MESH TO BE OVERLAPPED 6" AND TIED AT LEAST 6 TIMES WITH HOG RINGS.
- THE SILT FENCE TO BE INSTALLED WITH A SKIRT A MINIMUM OF 11" WIDE PLACED ON THE UPHILL SIDE OF THE FENCE INSIDE EXCAVATED TRENCH. THE FABRIC TO OVERLAP THE TOP OF THE WIRE BY 1".
- ANCHOR THE SILT FENCE BY BACKFILLING WITH EXCAVATED DIRT AND ROCKS (NOT LARGER THAN 2").
- GEOTEXTILE SPLICES SHOULD BE A MINIMUM OF 18" WIDE ATTACHED IN AT LEAST 6 PLACES. SPLICES IN CONCENTRATED FLOW AREAS WILL NOT BE ACCEPTED.
- SILT FENCE SHALL BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____	Date _____	Drawn by: SDK
SILT FENCE			Detail No. ECO2.DWG



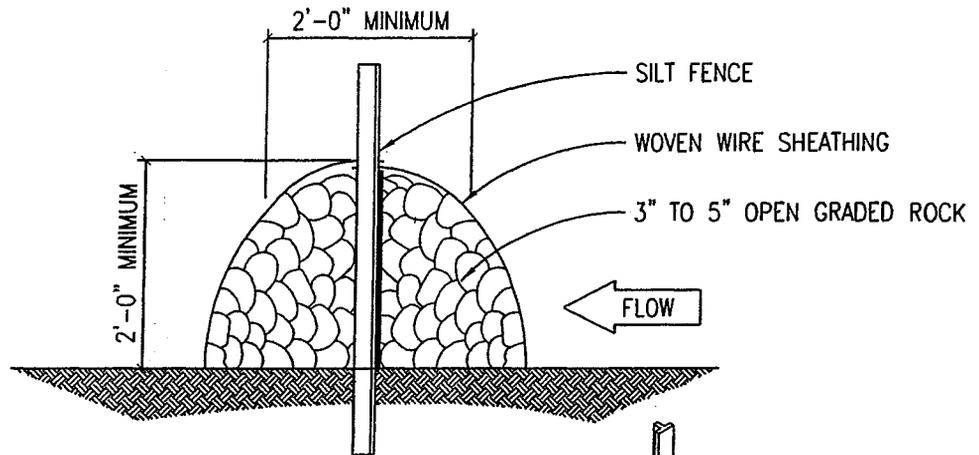
INSTALLATION:

- LAYOUT THE ROCK BERM FOLLOWING AS CLOSELY AS POSSIBLE TO THE CONTOUR.
- CLEAR THE GROUND OF DEBRIS, ROCKS OR PLANTS THAT WILL INTERFERE WITH INSTALLATION.
- PLACE WOVEN WIRE FABRIC ON THE GROUND ALONG THE PROPOSED INSTALLATION WITH ENOUGH OVERLAP TO COMPLETELY ENCIrcLE THE FINISHED SIZE OF THE BERM.
- PLACE THE ROCK ALONG THE CENTER OF THE WIRE TO THE DESIGNATED HEIGHT.
- WRAP THE STRUCTURE WITH THE PREVIOUSLY PLACED WIRE MESH SECURE ENOUGH SO THAT WHEN WALKED ACROSS THE STRUCTURE RETAINS IT'S SHAPE.
- SECURE WITH TIE WIRE.
- THE ENDS OF THE BERM SHOULD BE TIED INTO EXISTING UPSLOPE GRADE AND THE BERM SHOULD BE BURIED IN A TRENCH APPROX. 4 INCHES DEEP TO PREVENT FAILURE OF THE CONTROL.
- THE ROCK BERM SHOULD BE LEFT IN PLACE UNTIL ALL UPSTREAM AREAS ARE STABILIZED AND ACCUMULATED SILT REMOVED.

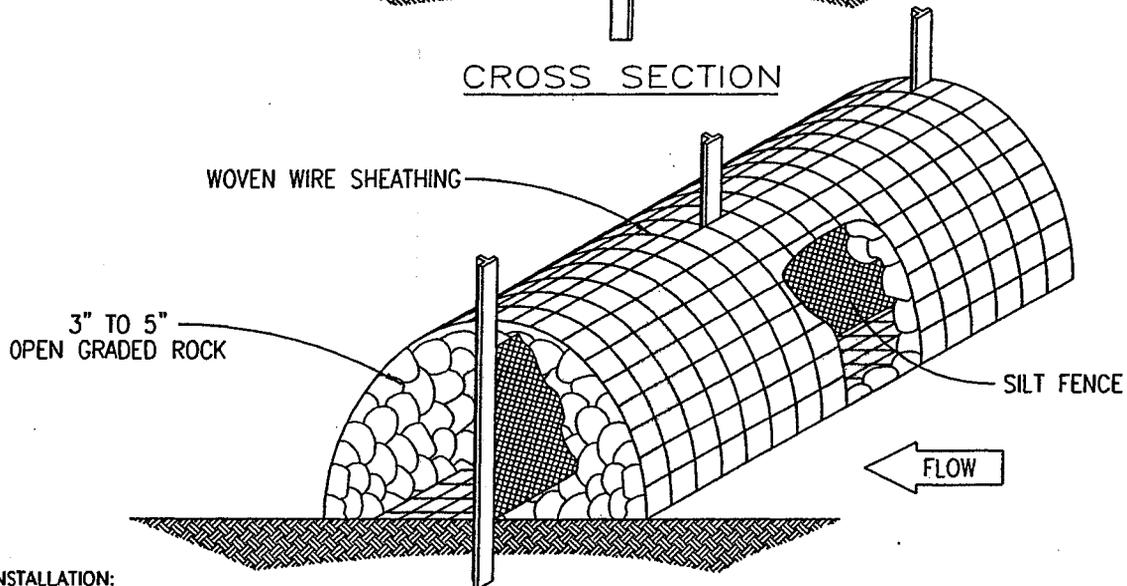
INSPECTION AND MAINTENANCE GUIDELINES:

- INSPECTION SHOULD BE MADE WEEKLY AND AFTER EACH RAINFALL EVENT BY THE RESPONSIBLE PARTY. FOR INSTALLATIONS IN STREAMBEDS, ADDITIONAL DAILY INSPECTIONS SHOULD BE MADE.
- REMOVE SEDIMENT AND OTHER DEBRIS WHEN BUILDUP REACHES 6 INCHES AND DISPOSE OF THE ACCUMULATED SILT IN AN APPROVED MANNER.
- REPAIR ANY LOOSE WIRE SHEATHING.
- THE BERM SHOULD BE RESHAPED AS NEEDED DURING INSPECTION.
- THE BERM SHOULD BE REPLACED WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT, CONSTRUCTION TRAFFIC DAMAGE, ETC.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	_____ Approved	_____ Date
ROCK BERM		Drawn by: SDK Detail No. ECO3.DWG



CROSS SECTION



INSTALLATION:

- LAYOUT THE ROCK BERM FOLLOWING AS CLOSELY AS POSSIBLE TO THE CONTOUR.
- CLEAR THE GROUND OF DEBRIS, ROCKS OR PLANTS THAT WILL INTERFERE WITH INSTALLATION.
- PLACE WOVEN WIRE FABRIC ON THE GROUND ALONG THE PROPOSED INSTALLATION WITH ENOUGH OVERLAP TO COMPLETELY ENCIRCLE THE FINISHED SIZE OF THE BERM.
- INSTALL THE SILT FENCE ALONG THE CENTER OF THE PROPOSED BERM PLACEMENT. INSTALLATION SHOULD BE AS DESCRIBED IN DRAWING NO. EC-02 "SILT FENCE DETAIL".
- PLACE THE ROCK ALONG THE CENTER OF THE WIRE AND ON BOTH SIDES OF THE SILT FENCE TO THE DESIGNATED HEIGHT.
- WRAP THE STRUCTURE WITH THE PREVIOUSLY PLACED WIRE MESH SECURE ENOUGH SO THAT WHEN WALKED ACROSS THE STRUCTURE RETAINS IT'S SHAPE.
- SECURE WITH TIE WIRE.
- THE ROCK BERM SHOULD BE LEFT IN PLACE UNTIL ALL UPSTREAM AREAS ARE STABILIZED AND ACCUMULATED SILT REMOVED.

INSPECTION AND MAINTENANCE GUIDELINES:

- INSPECTION SHOULD BE MADE WEEKLY AND AFTER EACH RAINFALL EVENT BY THE CONTRACTOR. FOR THE INSTALLATIONS IN STREAMBEDS, ADDITIONAL DAILY INSPECTIONS SHOULD BE MADE ON ROCK BERM.
- REMOVE SEDIMENT AND OTHER DEBRIS WHEN BUILDUP REACHES 6 INCHES AND DISPOSE OF THE ACCUMULATED SILT IN AN APPROVED MANNER.
- REPAIR ANY LOOSE WIRE SHEATHING.
- THE BERM SHOULD BE RESHAPED AS NEEDED DURING INSPECTION.
- THE BERM SHOULD BE REPLACES WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT, CONSTRUCTION TRAFFIC DAMAGE, ETC.

CITY OF MARBLE FALLS, TEXAS

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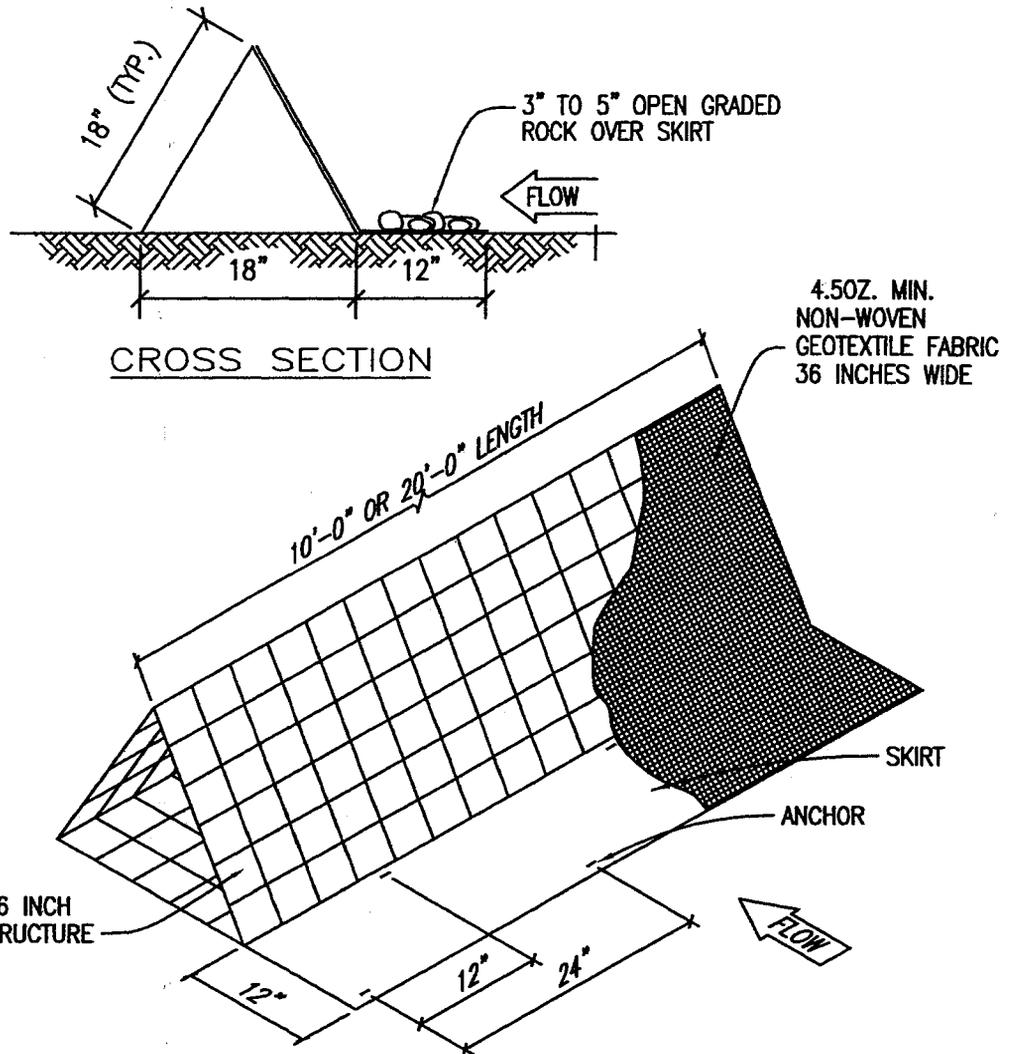
Approved _____

Date _____

Drawn by:
SDK

HIGH SERVICE ROCK BERM

Detail No.
EC04.DWG



6 GAUGE 6 INCH X 6 INCH
WELDED WIRE MESH STRUCTURE

INSTALLATION:

- LAYOUT THE FILTER DIKE FOLLOWING AS CLOSELY AS POSSIBLE TO THE CONTOUR.
- CLEAR THE GROUND OF DEBRIS, ROCKS OR PLANTS THAT WILL INTERFERE WITH INSTALLATION.
- PLACE THE FILTER DIKE SECTIONS ONE AT A TIME, WITH THE SKIRT ON THE UPHILL SIDE TOWARDS THE DIRECTION OF FLOW, ANCHORING EACH SECTION TO THE GROUND BEFORE THE NEXT SECTION IS PLACED.
- ANCHORS SHOULD BE PLACED ON 2'-0" CENTERS ALTERNATING FROM FRONT TO BACK SO THAT THERE IS ACTUALLY ONLY 1'-0" IN BETWEEN ANCHORS.
- SECURELY FASTEN THE SKIRT FROM ONE SECTION OF FILTER DIKE TO THE NEXT.
- FILTER DIKES MUST MAINTAIN CONTINUOUS CONTACT WITH THE GROUND.
- AFTER THE SITE IS COMPLETELY STABILIZED, THE DIKES AND ANY REMAINING SILT SHOULD BE REMOVED. SILT SHOULD BE DISPOSED OF IN A MANNER THAT WILL NOT CONTRIBUTE TO ADDITIONAL SILTATION.

INSPECTION AND MAINTENANCE GUIDELINES:

- INSPECTION SHOULD BE MADE WEEKLY OR AFTER EACH RAINFALL EVENT AND REPAIR OR REPLACEMENT SHOULD BE MADE PROMPTLY AS NEEDED BY THE CONTRACTOR.
- INSPECT AND REALIGN BERMS AS NEEDED TO PREVENT GAPS BETWEEN THE SECTIONS.
- ACCUMULATED SILT SHOULD BE REMOVED AFTER EACH RAINFALL EVENT, AND DISPOSED OF IN A MANNER WHICH WILL NOT CAUSE ADDITIONAL SILTATION.

CITY OF MARBLE FALLS, TEXAS

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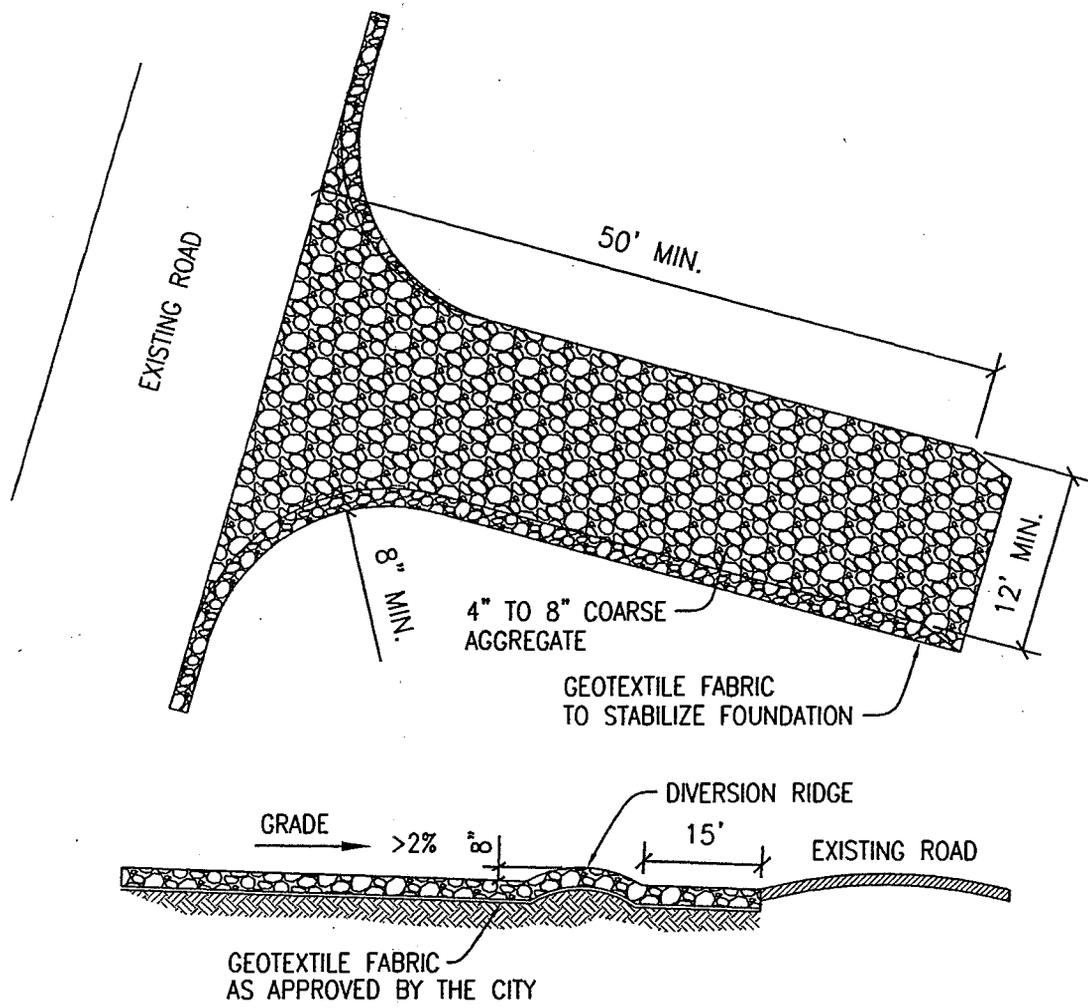
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SDK

TRIANGULAR FILTER DIKE

Detail No.
EC05.DWG



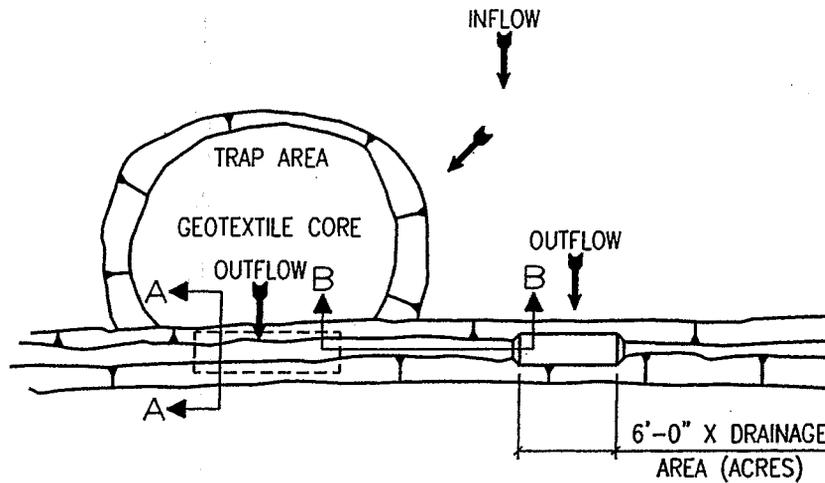
INSTALLATION:

- CLEAR THE AREA OF DEBRIS, ROCKS OR PLANTS THAT WILL INTERFERE WITH INSTALLATION.
- GRADE THE AREA FOR THE ENTRANCE TO FLOW BACK ON TO THE CONSTRUCTION SITE. RUNOFF FROM THE STABILIZED CONSTRUCTION ENTRANCE ONTO A PUBLIC STREET WILL NOT BE ACCEPTED.
- PLACE GEOTEXTILE FABRIC IF REQUIRED.
- PLACE ROCK AS REQUIRED.

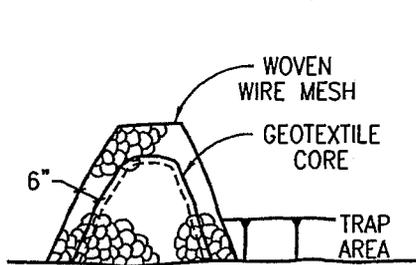
INSPECTIONS AND MAINTENANCE GUIDELINES:

- THE ENTRANCE SHOULD BE MAINTAINED IN A CONDITION, WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
- ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ON TO PUBLIC RIGHTS-OF-WAY SHOULD BE REMOVED IMMEDIATELY BY CONTRACTOR.
- WHEN NECESSARY, WHEELS SHOULD BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC RIGHTS-OF-WAY.
- WHEN WASHING IS REQUIRED, IT SHOULD BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.
- ALL SEDIMENT SHOULD BE PREVENTED FROM ENTERING ANY STORM DRAIN, DITCH OR WATER COURSE BY USING APPROVED METHODS.

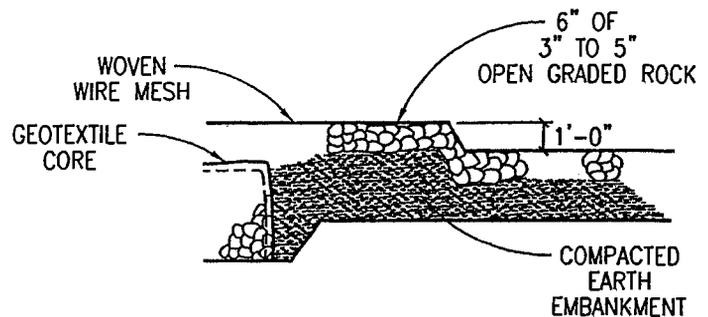
CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	_____ Approved	_____ Date
STABILIZED CONSTRUCTION ENTRANCE		Drawn by: SDK Detail No. ECO6.DWG



PLAN VIEW



SECTION A-A



SECTION B-B

INSTALLATION:

- LOCATE THE SEDIMENT TRAP SO AS TO DISTURB AS FEW TREES AS POSSIBLE.
- CLEAR AND GRUB THE AREA UNDER THE EMBANKMENT OF ALL VEGETATION AND ROOT MATS.
- LAYOUT THE WIRE MESH AND THEN THE GEOTEXTILE FABRIC.
- CONSTRUCT THE GEOTEXTILE CORE AND CORRESPONDING ROCK EMBANKMENT TO THE DESIGNATED HEIGHT AND CONFIGURATION.
- WRAP THE STRUCTURE WITH THE PREVIOUSLY PLACED WIRE MESH SECURE ENOUGH SO THAT WHEN WALKED ACROSS THE STRUCTURE RETAINS IT'S SHAPE. SECURE WITH TIE WIRE.
- PLACE THE EMBANKMENT MATERIAL IN 8 TO 12 INCH LIFTS AND MACHINE COMPACT.

INSPECTION AND MAINTENANCE GUIDELINES:

- INSPECTION SHOULD BE MADE WEEKLY AND AFTER EACH RAINFALL. CHECK THE EMBANKMENT, SPILLWAYS, AND OUTLET FOR EROSION DAMAGE AND INSPECT THE EMBANKMENT FOR PIPING AND SETTLEMENT. REPAIR SHOULD BE MADE PROMPTLY AS NEEDED BY THE CONTRACTOR.
- TRASH AND OTHER DEBRIS SHOULD BE REMOVED AND THE TRAP RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO HALF OF THE DESIGN DEPTH OF THE TRAP.
- SEDIMENT REMOVED FROM THE TRAP SHOULD BE DEPOSITED IN AN APPROVED SPOILS AREA AND IN SUCH A MANNER THAT IT WILL NOT CAUSE ADDITIONAL SILTATION.

CITY OF MARBLE FALLS, TEXAS

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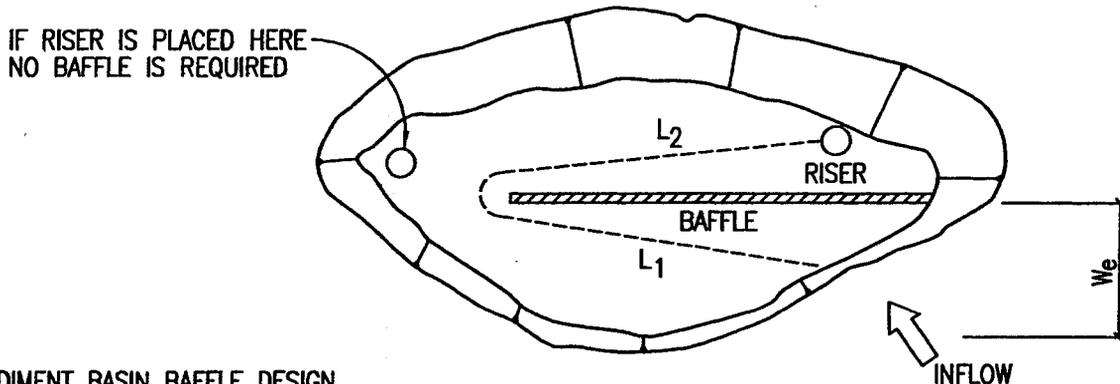
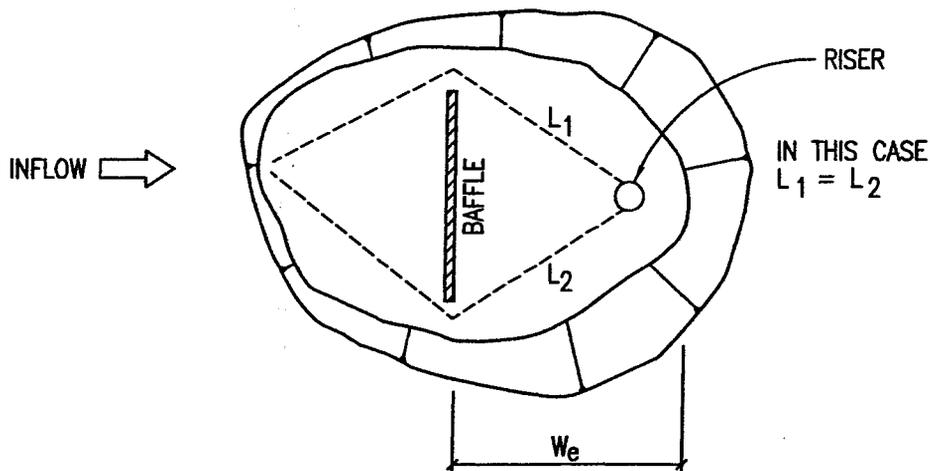
Approved _____

Date _____

Drawn by:
SDK

SEDIMENT TRAP

Detail No.
EC07.DWG



SEDIMENT BASIN BAFFLE DESIGN

$$W_e = A / (L_1 + L_2)$$

W_e = EFFECTIVE WIDTH OF BASIN

A = SURFACE AREA OF BASIN WHEN FILLED TO RISER CREST

L_1, L_2 = SHORTEST TRAVEL DISTANCE AROUND THE BAFFLE FROM INLET TO OUTLET

INSPECTION AND MAINTENANCE GUIDELINES:

- INSPECTION SHOULD BE MADE WEEKLY AND AFTER EACH RAINFALL. CHECK THE EMBANKMENT, SPILLWAYS, AND OUTLET FOR EROSION DAMAGE, AND INSPECT THE EMBANKMENT FOR PIPING AND SETTLEMENT. REPAIR SHOULD BE MADE PROMPTLY AS NEEDED BY THE CONTRACTOR.
- TRASH AND OTHER DEBRIS SHOULD BE REMOVED AFTER EACH RAINFALL TO PREVENT CLOGGING OF THE OUTLET STRUCTURE.
- ACCUMULATED SILT SHOULD BE REMOVED AND THE BASIN SHOULD BE RE-GRADED TO ITS ORIGINAL DIMENSIONS AT SUCH POINT THAT THE CAPACITY OF THE IMPOUNDMENT HAS BEEN REDUCED TO 1/2 OF ITS ORIGINAL STORAGE CAPACITY.
- THE REMOVED SEDIMENT SHOULD BE STOCKPILED OR REDISTRIBUTED IN AREAS THAT ARE PROTECTED FROM EROSION.

CITY OF MARBLE FALLS, TEXAS

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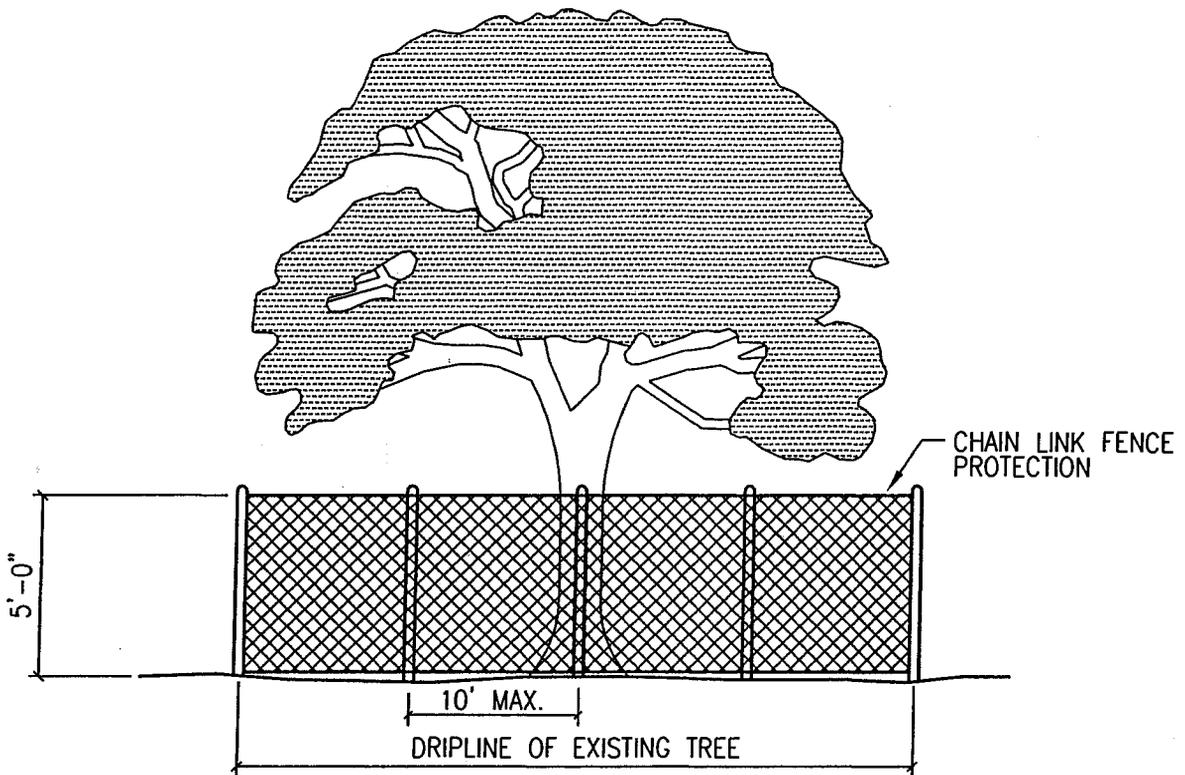
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Date _____

Drawn by:
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SEDIMENT BASIN BAFFLE DESIGN

Detail No.
EC08.DWG

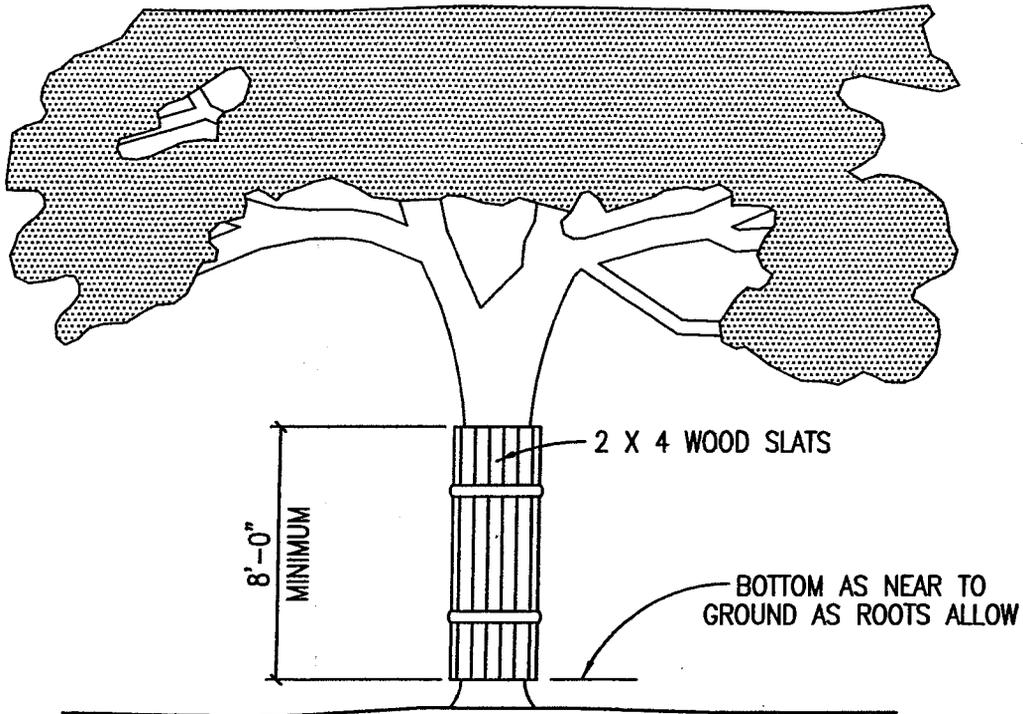


NOTES:

1. TREE PROTECTION FENCES SHALL BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY SITE PREPARATION WORK (CLEARING, GRUBBING OR GRADING).
2. FENCES SHALL COMPLETELY SURROUND THE TREE, OR CLUSTERS OF TREES; WILL BE LOCATED AT THE OUTERMOST LIMIT OF THE TREE BRANCHES (DRIPLINE), AND WILL BE MAINTAINED THROUGHOUT THE CONSTRUCTION PROJECT IN ORDER TO PREVENT THE FOLLOWING:
 - A. SOIL COMPACTION IN THE ROOT ZONE AREA RESULTING FROM VEHICULAR TRAFFIC, OR STORAGE OF EQUIPMENT OR MATERIALS.
 - B. ROOT ZONE DISTURBANCES DUE TO GRADE CHANGES (GREATER THAN SIX INCHES (6") CUT OR FILL, OR TRENCHING NOT REVIEWED AND AUTHORIZED BY THE CITY.
 - C. WOUNDS TO EXPOSED ROOTS, TRUNKS OR LIMBS BY MECHANICAL EQUIPMENT.
 - D. OTHER ACTIVITIES DETRIMENTAL TO TREES, SUCH AS CHEMICAL STORAGE, CEMENT TRUCK CLEANING AND FIRE.
3. EXCEPTIONS TO INSTALLING FENCES AT TREE DRIPLINES MAY BE PERMITTED IN THE FOLLOWING CASES:
 - A. WHERE PERMEABLE PAVING IS TO BE INSTALLED, ERECT THE FENCE AT THE OUTER LIMITS OF THE PERMEABLE PAVING AREA.
 - B. WHERE TREES ARE CLOSE TO PROPOSED BUILDINGS, ERECT THE FENCE NO CLOSER THAN SIX FEET (6'-0") TO BUILDING.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
TREE PROTECTION - CHAIN LINK FENCE		Detail No. EC09.DWG



NOTES:

1. WHERE ANY EXCEPTIONS RESULT IN A FENCE BEING CLOSER THAN FOUR FEET (4'-0") TO A TREE TRUNK; PROTECT THE TRUNK WITH STRAPPED-ON-PLANKING TO A HEIGHT OF EIGHT FEET (8'-0"), OR TO THE LIMITS OF LOWER BRANCHING IN ADDITION TO THE REDUCED FENCING PROVIDED.
2. ANY ROOTS EXPOSED BY CONSTRUCTION ACTIVITY SHALL BE PRUNED FLUSH WITH THE SOIL. BACKFILL ROOT AREAS WITH GOOD QUALITY TOP SOIL AS SOON AS POSSIBLE. IF EXPOSED ROOT AREAS ARE NOT BACKFILLED WITHIN TWO (2) DAYS, COVER THEM WITH ORGANIC MATERIAL IN A MANNER WHICH REDUCES SOIL TEMPERATURE, AND MINIMIZES WATER LOSS DUE TO EVAPORATION.
3. PRIOR EXCAVATION OR GRADE CUTTING WITHIN TREE DRIPLINE. MAKE A CLEAN CUT BETWEEN THE DISTURBED AND UNDISTURBED ROOT ZONES WITH A ROCK SAW OR SIMILAR EQUIPMENT, TO MINIMIZE DAMAGE TO REMAINING ROOTS.
4. TREES MOST HEAVILY IMPACTED BY CONSTRUCTION ACTIVITIES SHOULD BE WATERED DEEPLY ONCE A WEEK DURING PERIODS OF HOT, DRY WEATHER. TREE CROWNS SHOULD BE SPRAYED WITH WATER PERIODICALLY TO REDUCE DUST ACCUMULATION ON THE LEAVES.
5. ANY TRENCHING REQUIRED FOR THE INSTALLATION OF LANDSCAPE IRRIGATION SHALL BE PLACED AS FAR FROM EXISTING TREE TRUNKS AS POSSIBLE.
6. NO LANDSCAPE TOPSOIL DRESSING GREATER THE FOUR INCHES (4") SHALL BE PERMITTED WITHIN THE DRIPLINE OF A TREE. NO SOIL IS PERMITTED ON THE ROOT FLARE OF ANY TREE.
7. PRUNING TO PROVIDE CLEARANCE FOR STRUCTURES, VEHICULAR TRAFFIC AND EQUIPMENT SHALL TAKE PLACE BEFORE CONSTRUCTION BEGINS.

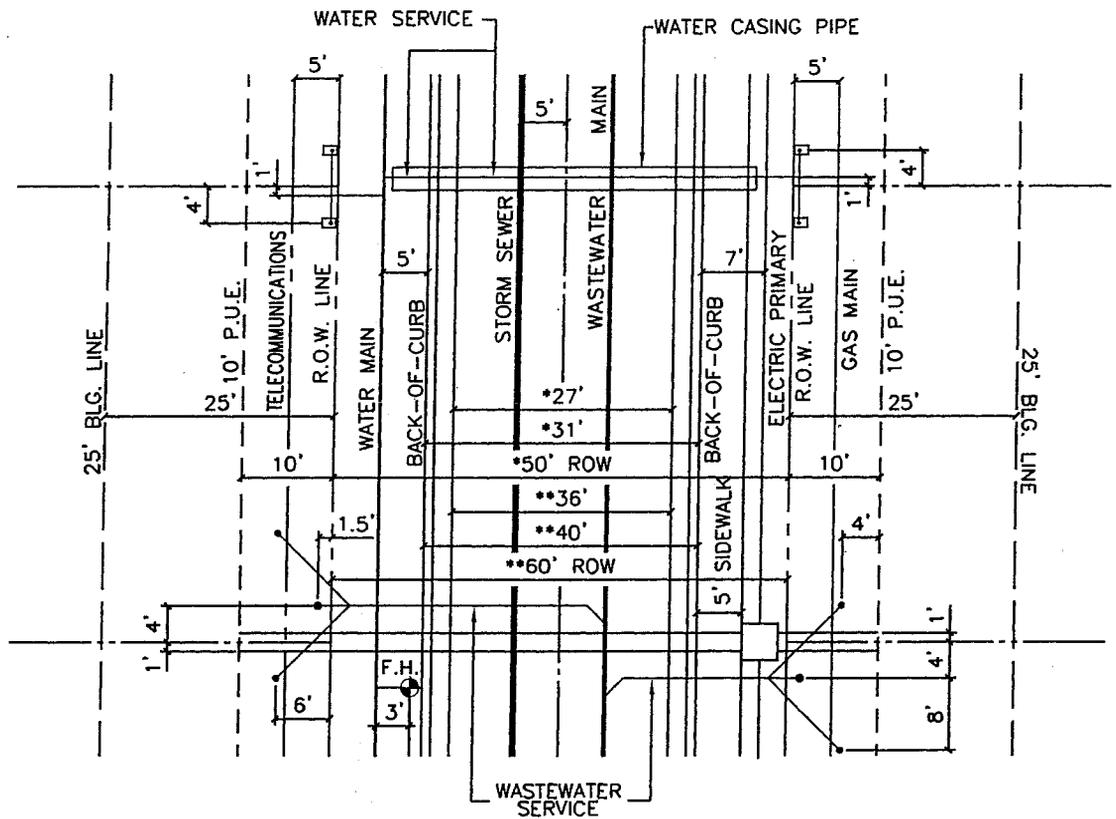
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Scale: N.T.S.	_____ Approved	_____ Date
TREE PROTECTION - WOOD SLATS		Drawn by: SDK Detail No. EC10.DWG

City of Marble Falls

Water Details and Construction Standards

Detail

W01	Typical Residential Street Layout
W01A	Road Section with Typical Utility Assignments
W02	Trench and Embedment Detail Under Non-Paved Areas
W03	Trench and Embedment Detail Under Proposed Roadway
W04	Trench and Embedment and Pavement Replacement Detail Under Existing Roadway
W05	Long Single and Double Water Service Section
W06	Short Single Water Service Plan and Section
W07	Short and Long Double Water Service Plan
W08	Typical Valve Setting
W09	Bore and Pressure Grout Under Tree
W10	Standard Blow-off
W11	Typical Fire Hydrant Installation
W12	Typical Thrust Blocks for Water and Force Mains
W13	Standard Air Release Valve for Water Main Section "X-X"
W14	Standard Air Release Valve for Water Main Section "Y-Y"
W15	Concrete Encasement Detail
W16	Inline Valve Installation
W17	Installation of P.V.C. Pipe Through Casing
W18	Concrete Trench Cap Detail
W19	Fire Hydrant Sampling Point
W20	Customer's Cut-off



MINIMUM COVER BELOW FINISH-GRADE

ELECTRIC PRIMARY	36"
ELECTRIC SECONDARY	24"
WATER	36"
WASTEWATER	48"
STORM SEWER	24"
GAS	24"
TELECOMMUNICATIONS	24"

*LOCAL RESIDENTIAL STREET

NOT TO SCALE

**RESIDENTIAL COLLECTOR STREET

NOT TO SCALE

NOTE:

1. REFER TO STANDARD DETAILS # W-01A FOR SECTION VIEWS FOR MAIN UTILITY AND COMMUNICATION LINE LOCATIONS.
2. SET EDGE OF WATER METER BOX ON PROPERTY/R.O.W. LINE.

CITY OF MARBLE FALLS, TEXAS

Scale:
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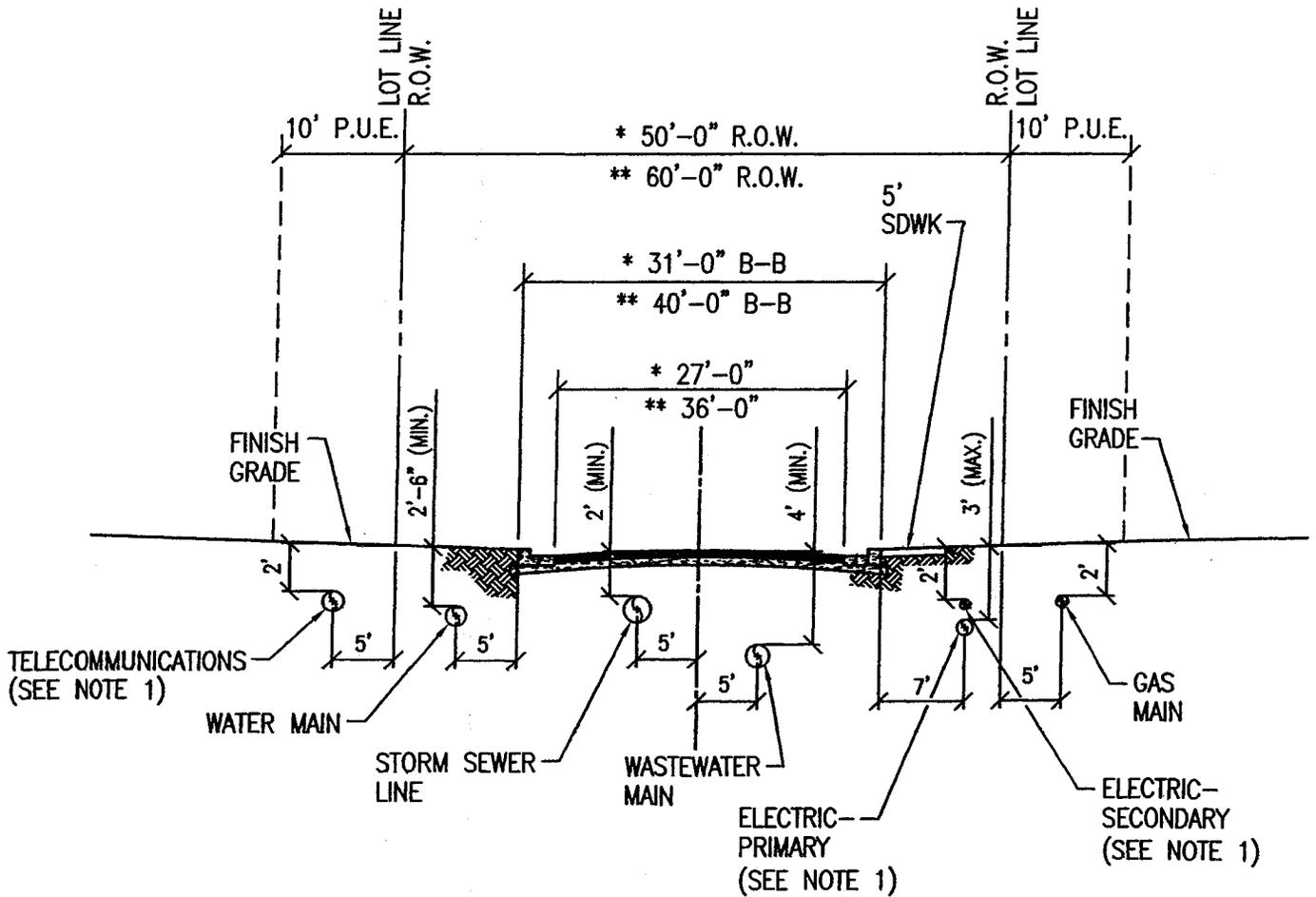
Date _____

Drawn by:
SDK

TYPICAL RESIDENTIAL STREET LAYOUT

Detail No.
W01.DWG

* LOCAL RESIDENTIAL STREET
 ** RESIDENTIAL COLLECTOR STREET



NOTE:

1. WHEN USING JOINT TRENCH FOR ELECTRIC AND TELECOMMUNICATIONS, GAS MAIN WILL BE LOCATED ON THE OPPOSITE SIDE OF THE STREET FROM THE JOINT TRENCH.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

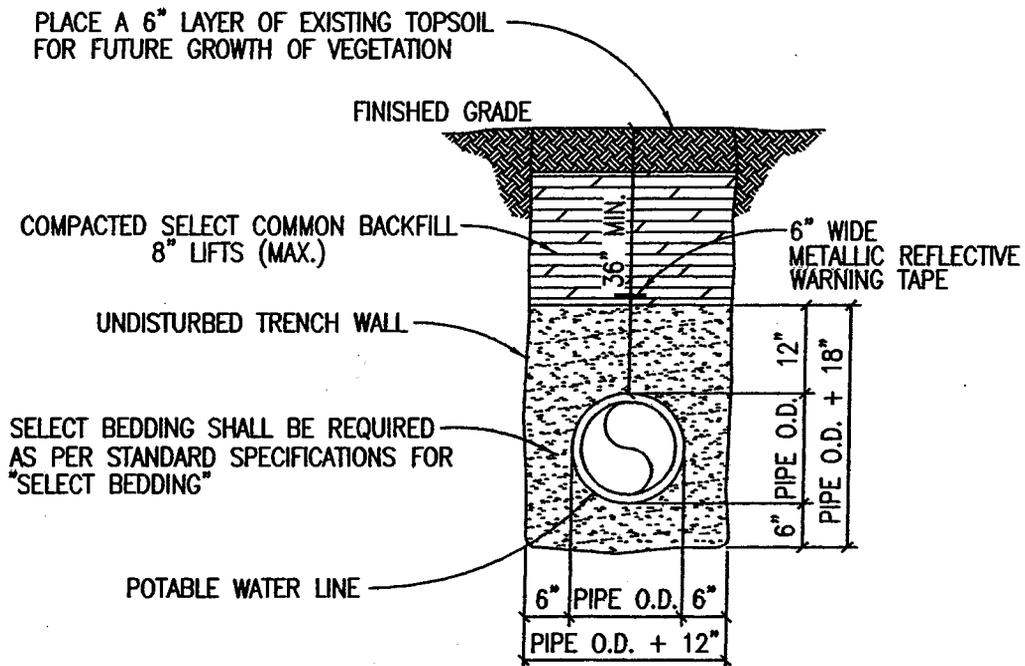
Approved _____

Date _____

Drawn by:
SDK

**ROAD SECTION WITH TYPICAL
UTILITY ASSIGNMENTS**

Detail No.
W01A.DWG



CITY OF MARBLE FALLS, TEXAS

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N.T.S.

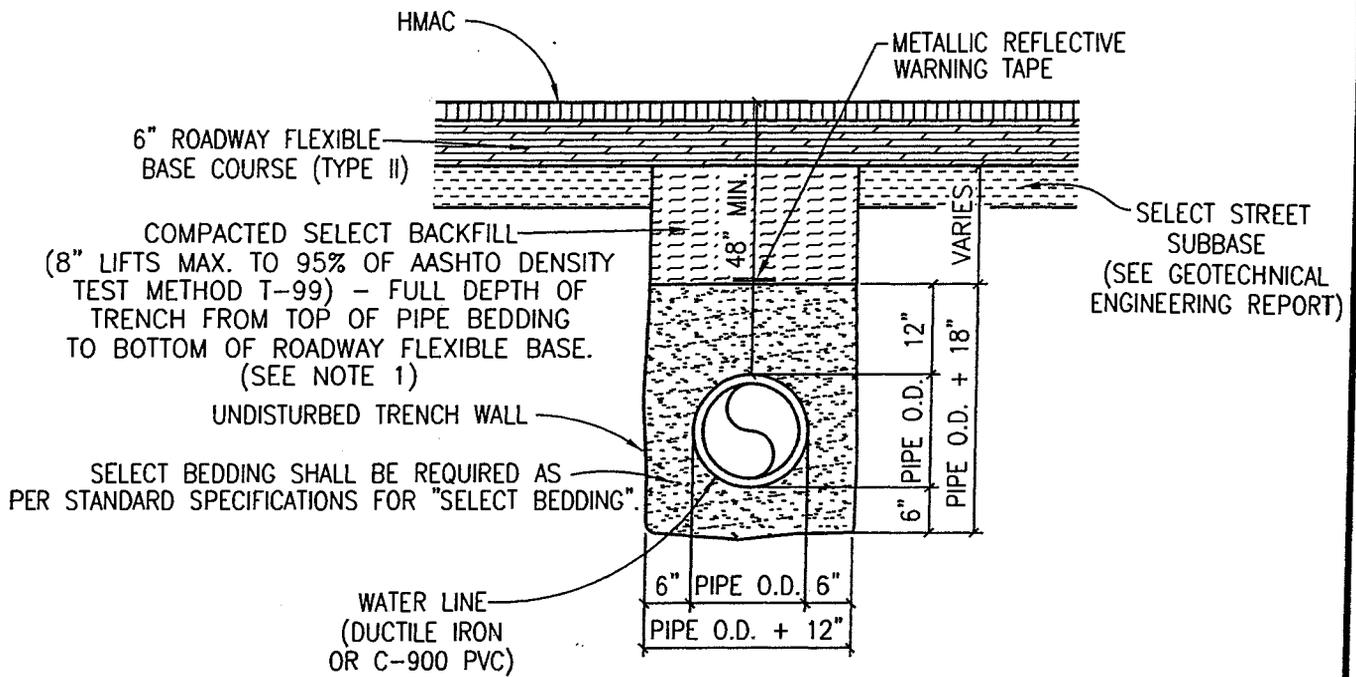
Approved _____

Date _____

Drawn by:
SDK

TRENCH AND EMBEDMENT DETAIL
UNDER NON-PAVED AREAS

Detail No.
W02.DWG

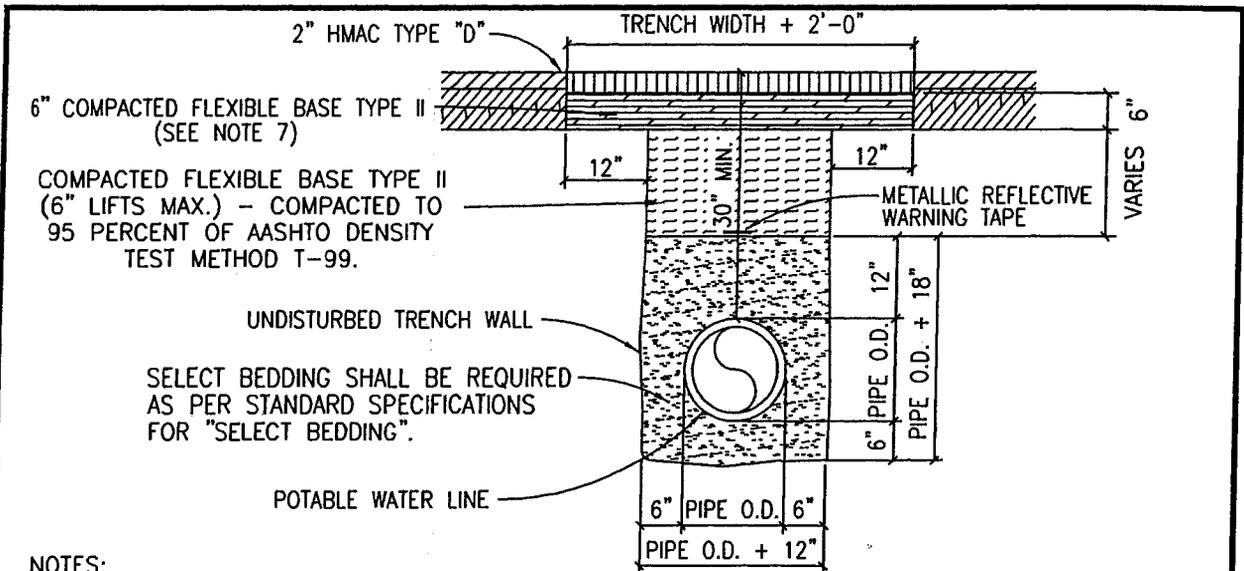


NOTES:

1. A MINIMUM OF ONE DENSITY TEST SHALL BE TAKEN EVERY TWO HUNDRED (200) FEET FOR EACH EIGHT (8) INCH LIFT OF SELECT BACKFILL. PROCTORS FOR MATERIALS USED IN BACKFILLING SHALL BE OBTAINED BY A CERTIFIED LABORATORY. DENSITY TESTS SHALL BE CONDUCTED BY A CERTIFIED LABORATORY OR THE PERMITTEE'S CONSULTANTS. THE PERCENTAGE OF MAXIMUM DENSITY REQUIRED SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF "THE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" AT THE TIME THE PERMIT WAS ISSUED. ALL DENSITY TESTS SHALL BE COMPLETED AND ACCEPTED ON EACH LAYER PRIOR TO ADDITIONAL BACKFILLING. A COPY OF ALL COMPLETED AND ACCEPTED DENSITY TESTS SHALL BE FURNISHED TO CITY OF MARBLE FALLS. BACKFILL COMPACTION SHALL BE A MINIMUM OF 95% MAXIMUM DENSITY PER TxDOT 113E SPECIFICATIONS.
2. THESE SPECIFICATIONS MAY BE SUPERSEDED BY THE GOVERNING AGENCY.
3. CONTRACTOR OR ENGINEER MAY REQUEST FOR USE OF ALTERNATE BACKFILL MATERIAL. ALTERNATE MATERIALS AND TESTING PROTOCOL MUST BE SUBMITTED TO AND APPROVED BY THE CITY ENGINEER PRIOR TO USE.
4. REFER TO GEOTECHNICAL ENGINEERING FIRM'S "PAVEMENT DESIGN REPORT" FOR SUBGRADE, FLEXIBLE BASE AND PAVEMENT REQUIREMENTS.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____	Date _____	Drawn by: SDK
TRENCH AND EMBEDMENT DETAIL UNDER PROPOSED ROADWAY			Detail No. W03.DWG



NOTES:

1. REPLACED BASE MATERIAL OVER DITCH SHALL BE TWICE THE THICKNESS OF THE ORIGINAL BASE.
2. BASE MATERIAL SHALL BE PLACED IN TWO OR THREE LAYERS AND EACH LAYER THOROUGHLY ROLLED OR TAMPED TO SPECIFIED MAXIMUM DENSITY.
3. ASPHALT CONCRETE PAVEMENT JOINTS SHALL BE MECHANICALLY SAWED.
4. SURFACE MATERIAL WILL BE CONSISTENT WITH THE EXISTING SURFACE.
5. A MINIMUM OF ONE DENSITY TEST SHALL BE TAKEN EVERY TWO HUNDRED (200) FEET FOR EACH SIX (6) INCH LIFT OF SUBGRADE AND EACH OPEN CUT CROSSING. PROCTORS FOR MATERIALS USED IN BACKFILLING SHALL BE OBTAINED BY A CERTIFIED LABORATORY. DENSITY TESTS SHALL BE CONDUCTED BY A CERTIFIED LABORATORY OR THE PERMITTEE'S CONSULTANTS. THE PERCENTAGE OF MAXIMUM DENSITY REQUIRED SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF "THE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" AT THE TIME THE PERMIT WAS ISSUED. ALL DENSITY TESTS SHALL BE COMPLETED AND ACCEPTED ON EACH LAYER PRIOR TO ADDITIONAL BACKFILLING. A COPY OF ALL COMPLETED AND ACCEPTED DENSITY TESTS SHALL BE FURNISHED TO CITY OF MARBLE FALLS.
6. THESE SPECIFICATIONS MAY BE SUPERSEDED BY THE GOVERNING AGENCY.
7. FLEXIBLE BASE TYPE II: (ROADWAY BASE)
TxDOT TYPE A - GRADE 2 OR BETTER CRUSHED LIMESTONE BASE COMPACTED TO 98% OF TxDOT 113E AT OPTIMUM MOISTURE. PROCTOR TO BE PROVIDED BY THE CONTRACTOR TO THE CITY INSPECTOR.
8. FLEXIBLE BASE TYPE II: (TRENCH BACKFILL)
TxDOT TYPE A - GRADE 2 OR BETTER CRUSHED LIMESTONE BASE COMPACTED TO 95% OF TxDOT 113E AT OPTIMUM MOISTURE. PROCTOR TO BE PROVIDED BY THE CONTRACTOR TO THE CITY INSPECTOR.
9. CONTRACTOR OR ENGINEER MAY REQUEST FOR USE OF ALTERNATE BACKFILL MATERIAL. ALTERNATE MATERIALS AND TESTING PROTOCOL MUST BE SUBMITTED TO AND APPROVED BY THE CITY ENGINEER PRIOR TO USE.

CITY OF MARBLE FALLS, TEXAS

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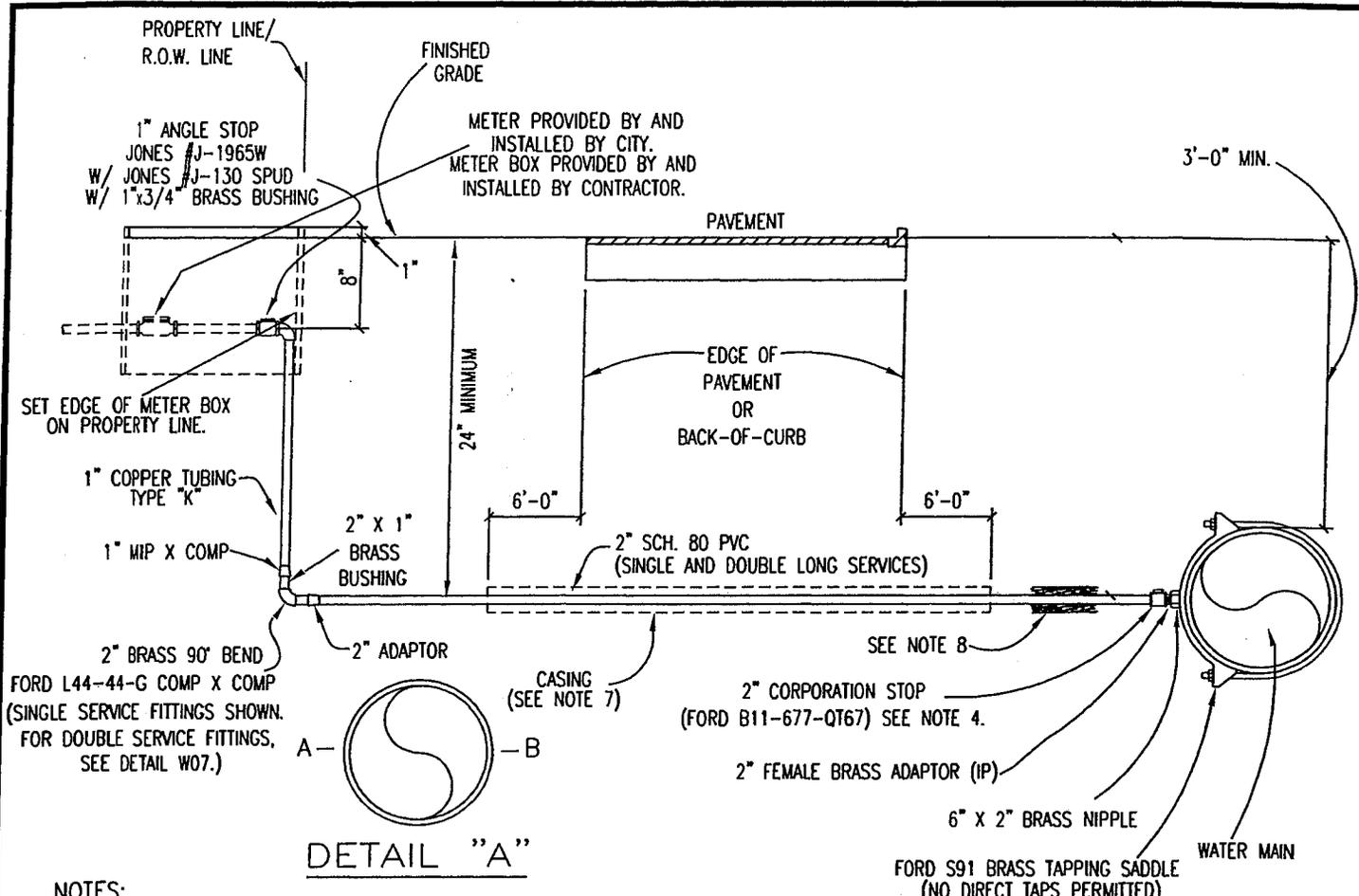
Approved _____

Date _____

Drawn by:
SDK

**TRENCH AND EMBEDMENT AND
PAVEMENT REPLACEMENT DETAIL
UNDER EXISTING ROADWAY**

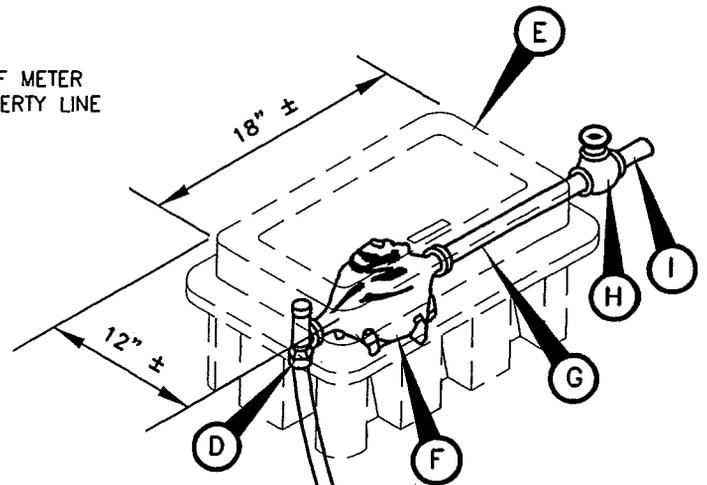
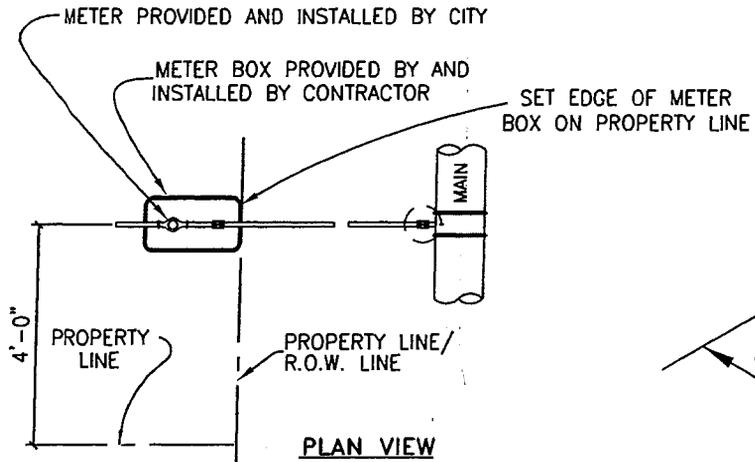
Detail No.
W04.DWG



NOTES:

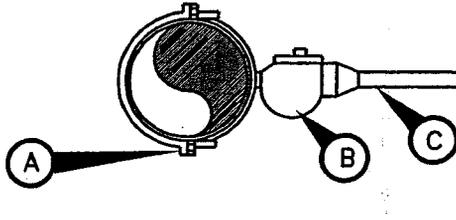
1. SUCCESSIVE TAPS INTO THE WATER MAIN SHALL BE SPACED A MINIMUM OF 18" OFFSET AND AT THE CENTERLINE AS SHOWN ON DETAIL "A".
2. THE TOP OF METER BOX SHALL BE SET 1" ABOVE FINISHED GRADE.
3. AUTHORIZED SERVICE LINE MATERIAL:
A. TYPE "K" COPPER (1" DIAMETER) FROM 2" X 1" BUSHING TO METER BOX.
B. SCHEDULE 80, P.V.C. (2" DIAMETER) - 200 PSI - FROM MAIN TO 2" X 1" BUSHING.
4. ROTATE THE CORPORATION STOP SO THAT THE OPERATING NUT IS ACTUATED FROM THE VERTICAL POSITION RATHER THAN THE HORIZONTAL.
5. SERVICE LINES SHALL BE CONTINUOUS FROM CORPORATION STOP TO 2" BRASS 90° BEND OR 2" BRASS TEE WITH NO FITTINGS IN BETWEEN.
6. SERVICE CASING SHALL NOT BE INSTALLED BY WATER JETTING UNDER ROADWAY.
7. CASING REQUIRED FOR ALL PAVEMENT CROSSINGS. 4" SDR-35 REQUIRED FOR OPEN-CUT. GALVANIZED CASING PIPE REQUIRED FOR JACK AND BORE. LIMITS OF CASING SHOULD EXTEND SIX FEET BEYOND THE EDGE OF PAVEMENT OR BACK-OF-CURB.
8. THERE SHALL BE A 6" ENVELOPE OF 3/8" ROCK OR APPROVED BEDDING SAND AROUND ALL SERVICE AND CASING PIPE. COMPACT BACKFILL ON LONG SERVICES UNDER ROADWAYS PER STANDARD DETAIL W03 OR W04.
9. ANY VARIATIONS ON FITTINGS MUST BE APPROVED BY THE MARBLE FALLS PUBLIC WORKS DEPARTMENT.
10. METER BOX TO BE SOLID BLACK PLASTIC WITH BLACK CAST IRON LID AND FLIP LID FOR METER READING. MODEL NO. 36 MANUFACTURED BY MID AMERICAN RESEARCH CHEMICAL CORPORATION OR APPROVED EQUAL.
11. CORPORATION STOPS, ANGLE STOPS AND OTHER BRASS FITTINGS SHALL BE MANUFACTURED BY JONES, FORD, McDONALD OR APPROVED EQUAL.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Date _____
LONG SINGLE AND DOUBLE WATER SERVICE SECTION		Detail No. W05.DWG



NOTES:

1. SERVICE PIPE SHALL BE COPPER TUBE SIZE. IT SHALL BE 150 psi ANNEALED SEAMLESS TYPE "K" COPPER TUBING.
2. SERVICE SADDLES SHALL BE WRAPPED COMPLETELY WITH 8 mil.POLYETHYLENE FILM.
3. TOP OF METER BOX SHALL BE SET 1 INCH ABOVE FINISHED GRADE.
4. SERVICE TUBING AND CASING PIPE SHALL BE INSTALLED WITH A 6 INCH ENVELOPE OF BEDDING SAND OR 3/8" ROCK AROUND TUBING AND CASING PIPE. COMPACT BACKFILL ON LONG SERVICES UNDER ROADWAYS PER STANDARD DETAIL W03 OR W04.
5. METER BOX TO BE SOLID BLACK PLASTIC WITH BLACK CAST IRON LID AND FLIP LID FOR METER READING. MODEL NO. 36 MANUFACTURED BY MID-AMERICAN RESEARCH CHEMICAL CORPORATION OR APPROVED EQUAL.
6. ANY VARIATIONS ON FITTINGS MUST BE APPROVED BY THE CITY ENGINEER.
7. AXIS OF METER ASSEMBLY (METER STOP, METER, PIPING AND OWNERS CUTOFF) SHALL BE 8" BELOW TOP OF BOX.
8. FACTORY MOLDED SLOTS PROVIDED IN METER BOX TO ACCOMMODATE PIPING INTO AND OUT OF BOX SHALL NOT BE MODIFIED.



SECTION VIEW

MATERIAL LIST

- A. BRASS TAPPING SADDLE - SERVICE CLAMP REQUIRED - FORD S91
- B. 1" CORPORATION STOP - SERVICE PIPE OUTLET - FORD B11-677-QT67
- C. 1" SERVICE PIPE. WATER SERVICE CASING IS REQUIRED FOR LONG SERVICE LINES CROSSING UNDER ROADWAYS. SEE DETAIL W-05, NOTE #7.
- D. ANGLE METER STOP; SERVICE PIPE INLET X SWIVEL COUPLING NUT OUTLET:
 - FOR 5/8" AND 3/4" METERS: 1" x 3/4" BRASS BUSHING
 - FOR 1" METERS: 1" x 1" BRASS BUSHING
 - JONES #J-1965 W WITH JONES J-130 SPUD
- E. PLASTIC RECTANGULAR METER BOX (SEE NOTE 5).

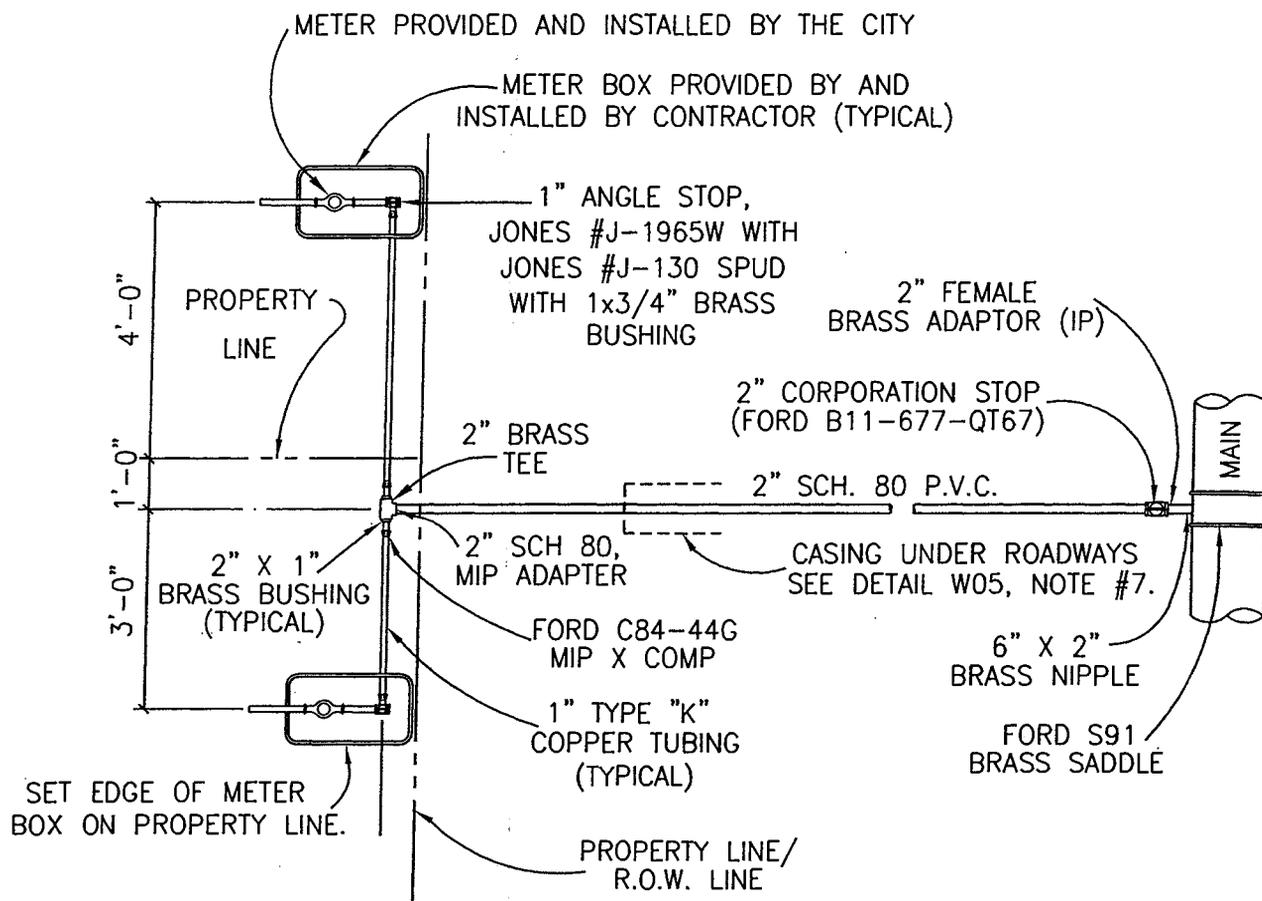
METER SIZE	LENGTH
5/8"	7 3/4"
3/4"	9"
1"	11"

NOTE: F THRU I TO BE INSTALLED UNDER SEPARATE BUILDING PERMIT.

- F. WATER METER - FURNISHED BY CITY AND INSTALLED BY CITY
- G. WATER METER COUPLING; MALE I.P.T. X SWIVEL COUPLING NUT:
 - FOR 5/8" AND 3/4" METERS: 3/4" x 8 1/2" LONG.
 - FOR 1" METERS: 1" x 8 1/2" LONG.
- H. BRONZE GATE VALVE: NON-RISING STEM 1" FEMALE I.P.T. (PROPERTY OWNERS CUT-OFF OUTSIDE METER BOX IN SEPARATE VALVE BOX CAN WITH LID AS PER STANDARDS).
- I. 1" PIPE (SCH. 40 PVC) BY PROPERTY OWNER

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
SHORT SINGLE WATER SERVICE PLAN AND SECTION		Detail No. W06.DWG



NOTES:

1. AUTHORIZED SERVICE LINE MATERIAL (2" DIAMETER):
 - A. SCHEDULE 80, P.V.C. (2" DIAMETER) CLASS 200 - MAIN LINE TO 2" TEE.
 - B. TYPE "K" COPPER (1" DIAMETER) - 2" TEE TO METER
2. ANGLE STOP SHALL BE 1" MINIMUM.
3. 1" ANGLE STOPS WITH 3/4" VALVES SHALL NOT BE PERMITTED.
4. MULTIPLE SERVICE/METER INSTALLATIONS OF MORE THAN 4 METERS PER SERVICE AND SERVICE LINES LARGER THAN 2" IN DIAMETER SHALL BE HANDLED ON AN INDIVIDUAL BASIS.
5. ANGLE STOPS 1 1/2" AND 2" IN SIZE SHALL BE PROVIDED WITH BOTH A LOCKING CAP AND METER FLANGE.
6. THERE SHALL BE A 6" ENVELOPE OF 3/8" ROCK OR APPROVED BEDDING SAND AROUND ALL SERVICE AND CASING PIPE. COMPACT BACKFILL ON LONG SERVICES UNDER ROADWAYS PER STANDARD DETAIL W03 OR W04.
7. CASING REQUIREMENTS FOR SERVICE LINES CROSSING ROADWAYS SEE DETAIL W-05, NOTE #7.
8. ANY VARIATIONS ON FITTINGS MUST BE APPROVED BY THE MARBLE FALLS PUBLIC WORKS DEPARTMENT.
9. METER BOX TO BE SOLID PLASTIC WITH BLACK CAST IRON LID AND FLIP LID FOR METER READING. MODEL NO. 36 MANUFACTURED BY MID-AMERICAN RESEARCH CHEMICAL CORPORATION OR APPROVED EQUAL.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

Approved _____

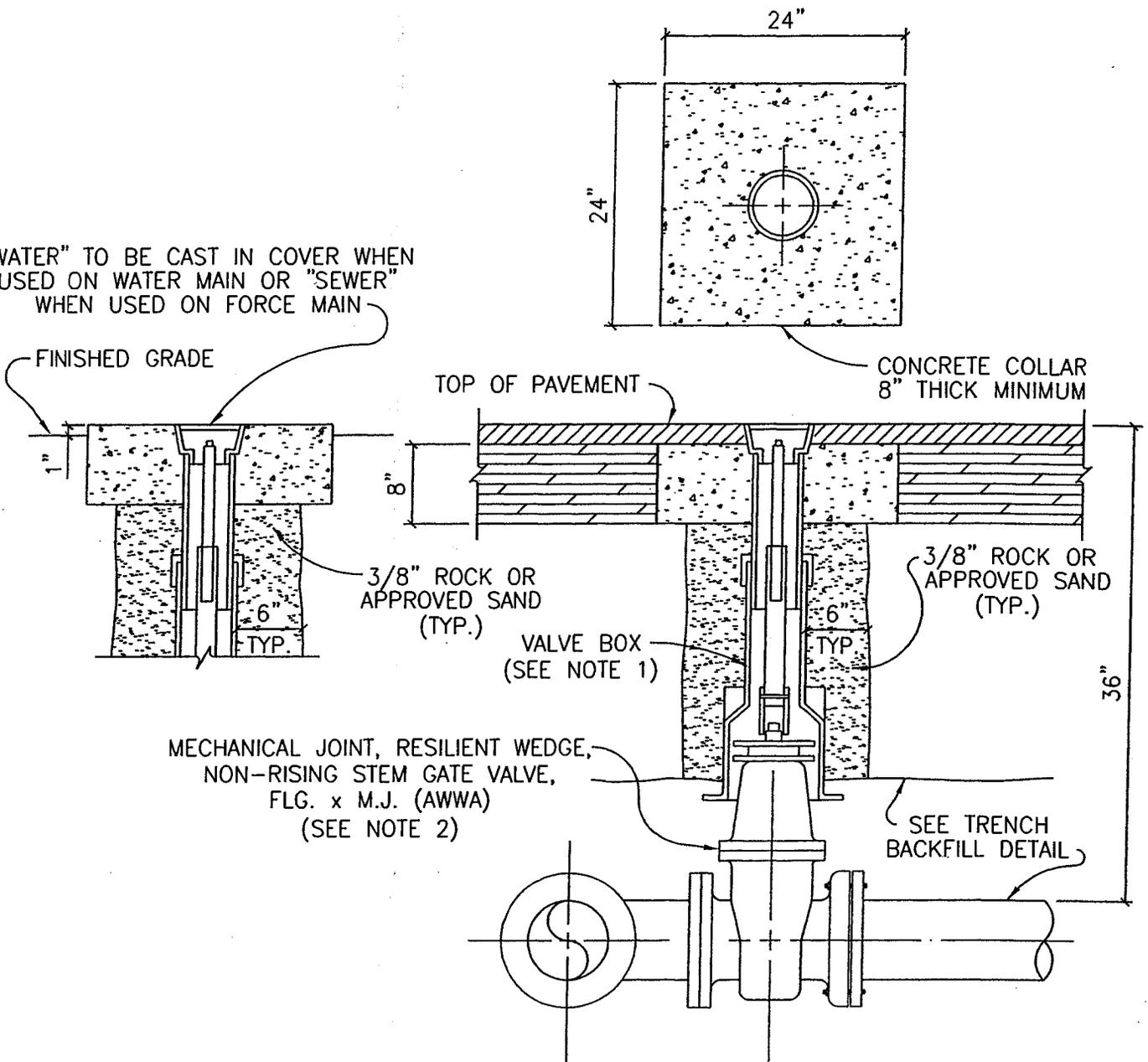
Date _____

Drawn by:
SDK

**SHORT AND LONG DOUBLE
WATER SERVICE PLAN**

Detail No.
W07.DWG

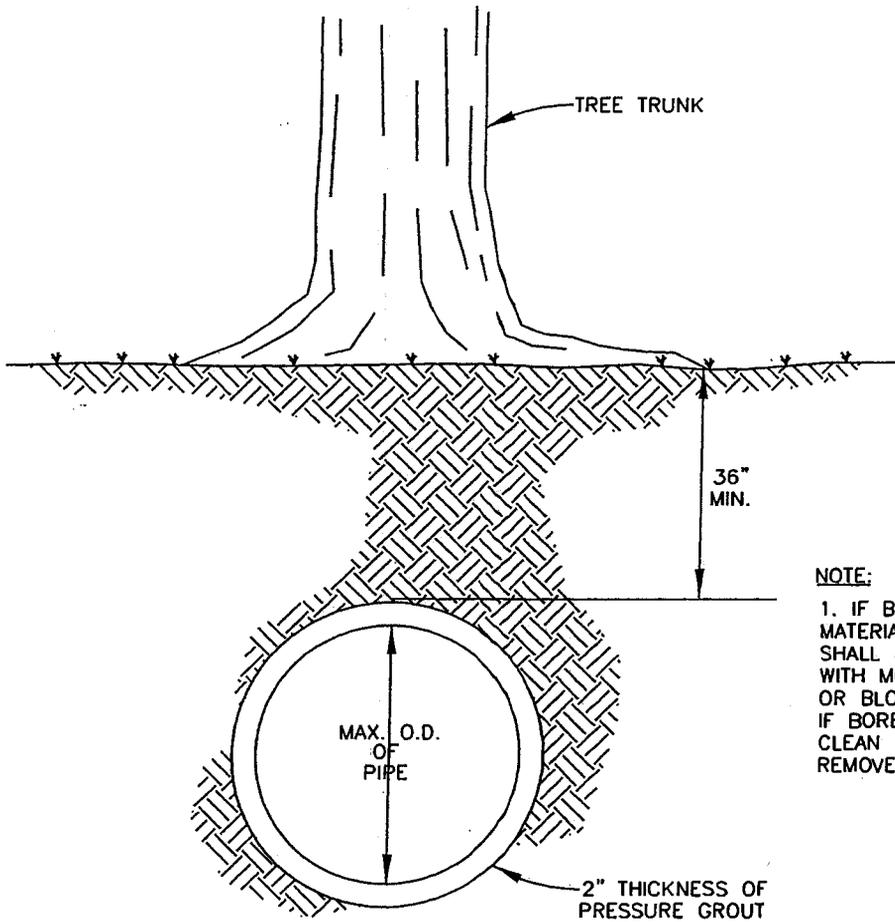
"WATER" TO BE CAST IN COVER WHEN USED ON WATER MAIN OR "SEWER" WHEN USED ON FORCE MAIN



NOTES:

1. VALVE BOX SHALL BE AMERICAN FLOW CONTROL TRENCH ADAPTER OR APPROVED EQUAL HAVING AN ADJUSTABLE RANGE OF + OR - 6 INCHES FROM INSTALLED FINISH GRADE.
2. ACCEPTABLE GATE VALVES ARE:
 - A. AMERICAN FLOW CONTROL - SERIES 2500
 - B. MUELLER - 2360 SERIES
 - C. CLOW

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Date _____
TYPICAL VALVE SETTING		Drawn by: SDK
		Detail No. W08.DWG



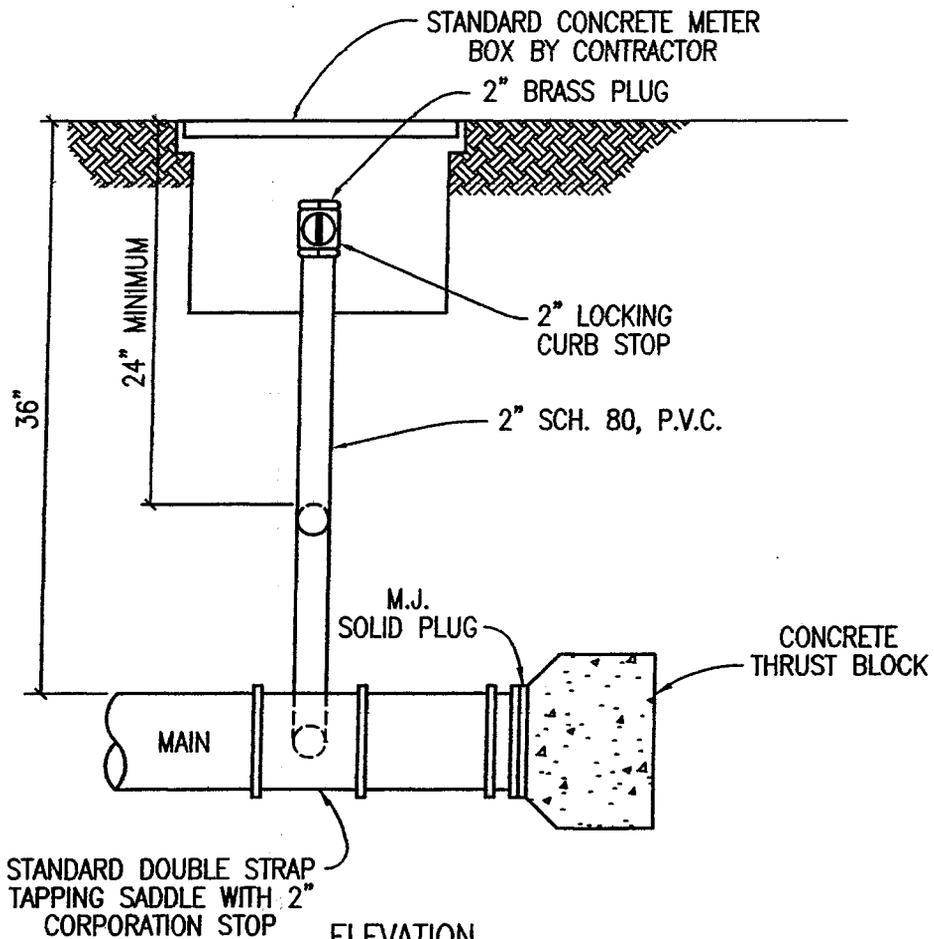
NOTE:

1. IF BORE IS THROUGH ROCK MATERIAL, BOTTOM OF PIPE BARREL SHALL BE SUPPORTED OFF BOTTOM WITH MORTAR BANDS ON C.S.C. PIPE OR BLOCKS ON D.I. OR PVC PIPE. IF BORE IS THROUGH DIRT MATERIAL, CLEAN BOTTOM OF BORE PIT TO REMOVE ROCKS, ETC.

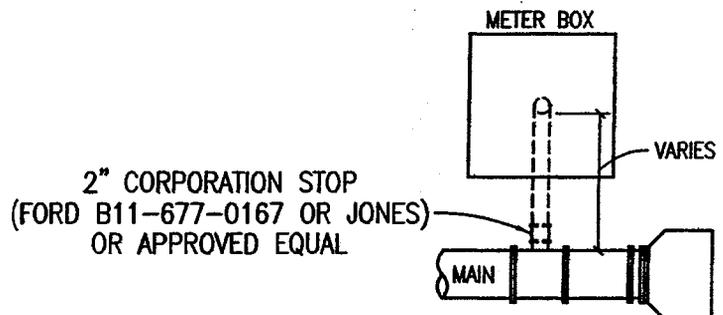
BORE & PRESSURE GROUT UNDER TREE

SCALE: N.T.S.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
BORE & PRESSURE GROUT UNDER TREE		Detail No. W09.DWG



ELEVATION

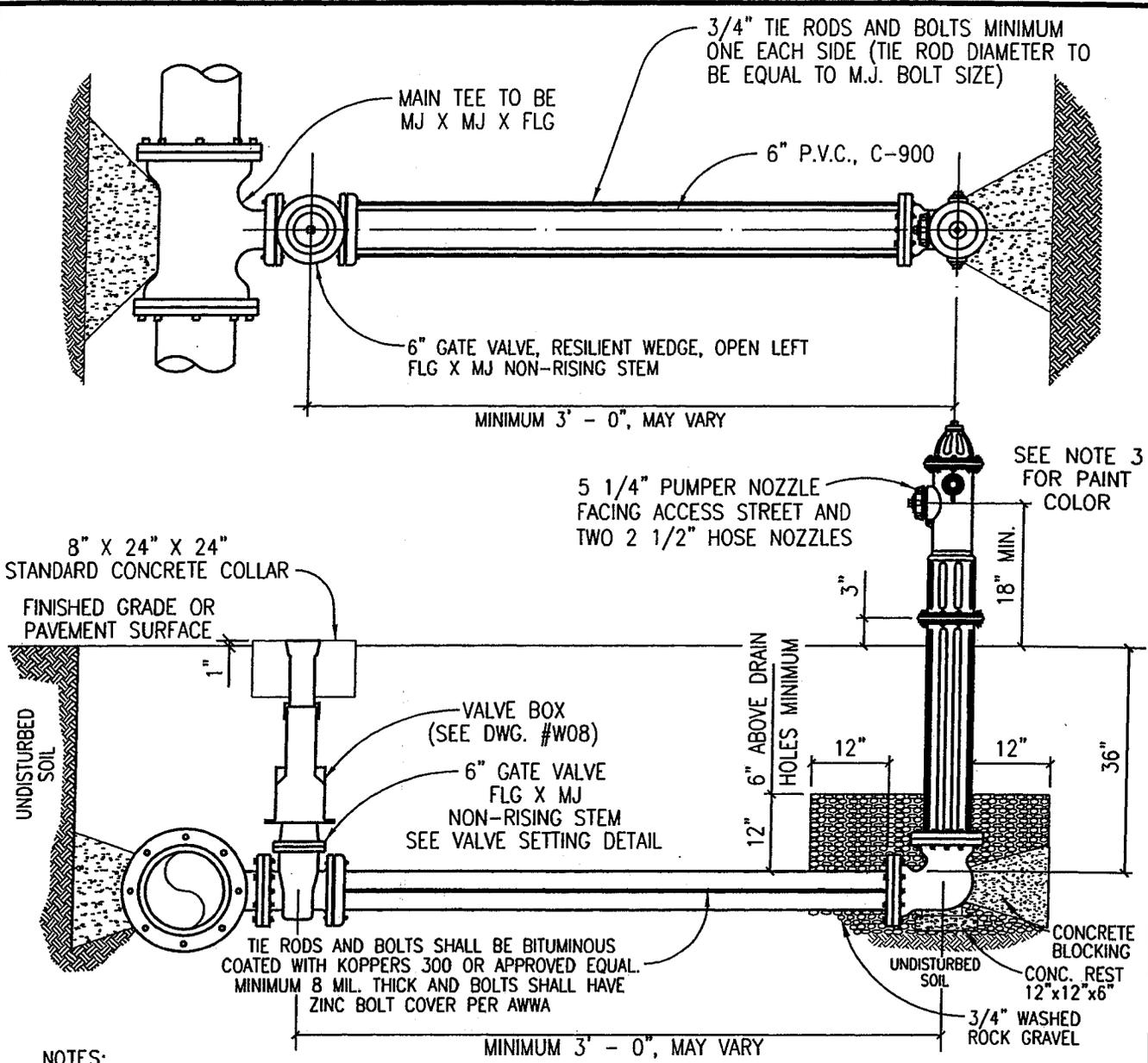


PLAN

NOTES:

1. TRAFFIC BEARING METER BOXES WILL BE REQUIRED IN ALL PAVED AREAS AND AREAS WHICH MAY BE PAVED IN THE FUTURE.
2. TUBING SHALL BE CONTINUOUS FROM CORPORATION STOP TO CURB STOP, NO FITTINGS SHALL BE PERMITTED.

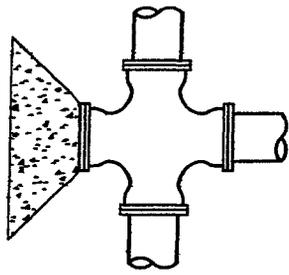
CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Date _____
STANDARD BLOW-OFF		Drawn by: SDK
		Detail No. W10.DWG



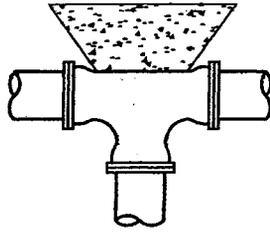
NOTES:

1. FIRE HYDRANT SHALL BE INSTALLED ON SAME SIDE OF ROAD AS WATER MAIN.
2. FIRE HYDRANT SHALL BE INSTALLED PLUMB AND TRUE.
3. ALL FIRE HYDRANT EXTERIORS SHALL BE FACTORY PRIMED AND PAINTED MARBLE FALLS STANDARD COLOR. USING A HIGH GRADE ENAMEL.
4. HEEL AND THRUST BLOCKS TO REST IN UNDISTURBED SOIL.
5. ACCEPTABLE FIRE HYDRANTS ARE:
 - A. MUELLER CENTURION
 - B. AMERICAN DARLING
 - C. CLOW MEDALLION
6. DOUBLE BLUE REFLECTOR "HYE-LITES" BRAND, MANUFACTURED BY PAVEMENT MARKERS INC. TO BE INSTALLED AT CENTERLINE OF STREET PERPENDICULAR TO HYDRANT.

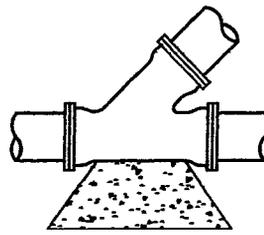
CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
TYPICAL FIRE HYDRANT INSTALLATION		Detail No. W11.DWG



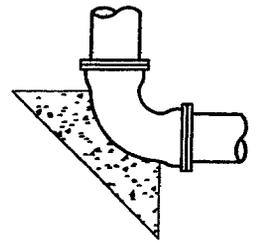
CROSS WITH PLUG



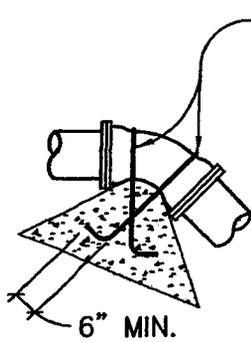
TEE



WYE

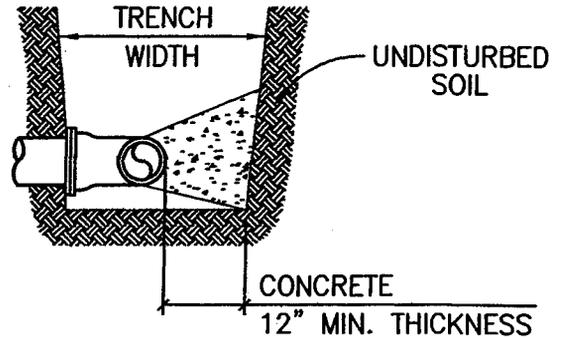


BEND



*DEADMAN

#5 REBAR MIN. 2 REQUIRED
BEND TO FIT AND PAINT
WITH 2 COATS BITUMINISTIC
PAINT BEFORE ASSEMBLY.



TYPICAL SECTION

ALL THRUST BLOCKS SHALL BE FORMED. LAID FORMS SHALL BE INSPECTED BY THE CITY OF MARBLE FALLS PRIOR TO THE POURING OF CONCRETE AND SHALL ALSO BE INSPECTED BY THE CITY OF MARBLE FALLS PRIOR TO COVERING. TYPICAL LOCATIONS WHICH REQUIRE CONCRETE REACTION (THRUST) BLOCKS, FOR PRESSURE MAINS FOUR INCHES (4") AND GREATER. CONCRETE SHALL HAVE 2500 P.S.I. MINIMUM STRENGTH AT TWENTY EIGHT (28) DAYS AND BEAR AGAINST UNDISTURBED STABLE SOILS, AREA OF CONTACT SHALL BE GOVERNED BY PIPE SIZE, MAXIMUM PRESSURE IN PIPE, AND BEARING CAPACITY OF SOIL. PROTECT FITTINGS, BOLTS, ETC. BY COVERING WITH VISQUEEN OR OTHER ACCEPTABLE MATERIAL. CONCRETE SHALL BE A MINIMUM OF TWELVE INCHES (12") THICK.

PIPE SIZE	THRUST BLOCK AREA REQUIRED	PIPE SIZE	THRUST BLOCK AREA REQUIRED	REMARKS
4"	2.0 SQ. FT.	18"	30.0 SQ. FT.	VALUES ARE FOR 90° BENDS, BASED ON 2000 P.S.F. SAFE BEARING LOAD AND PIPE PRESSURE OF 150 P.S.I. PLUS 33% SAFETY FACTOR FOR OTHER SOILS AND PRESSURES, THE AREA REQUIRED IS IN DIRECT PROPORTION.
6"	4.0 SQ. FT.	20"	37.0 SQ. FT.	
8"	6.6 SQ. FT.	24"	53.0 SQ. FT.	
10"	10.0 SQ. FT.	27"	80.0 SQ. FT.	
12"	14.0 SQ. FT.	30"	98.0 SQ. FT.	
14"	18.0 SQ. FT.	36"	127.0 SQ. FT.	
16"	24.0 SQ. FT.			

* THE ENGINEER OF RECORD SHALL CALCULATE THE SIZE OF THE DEADMAN REQUIRED AS WELL AS ANY INSTALLATION WHICH IS NOT COVERED BY THE ABOVE.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

Approved _____

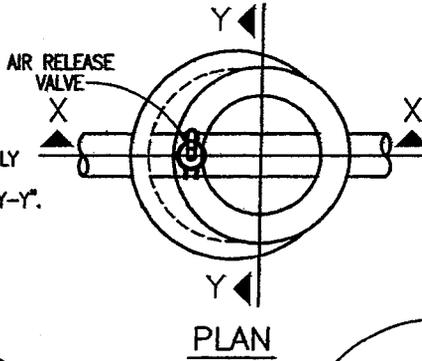
Date _____

Drawn by:
SDK

TYPICAL THRUST BLOCKS FOR
WATER AND FORCE MAINS

Detail No.
W12.DWG

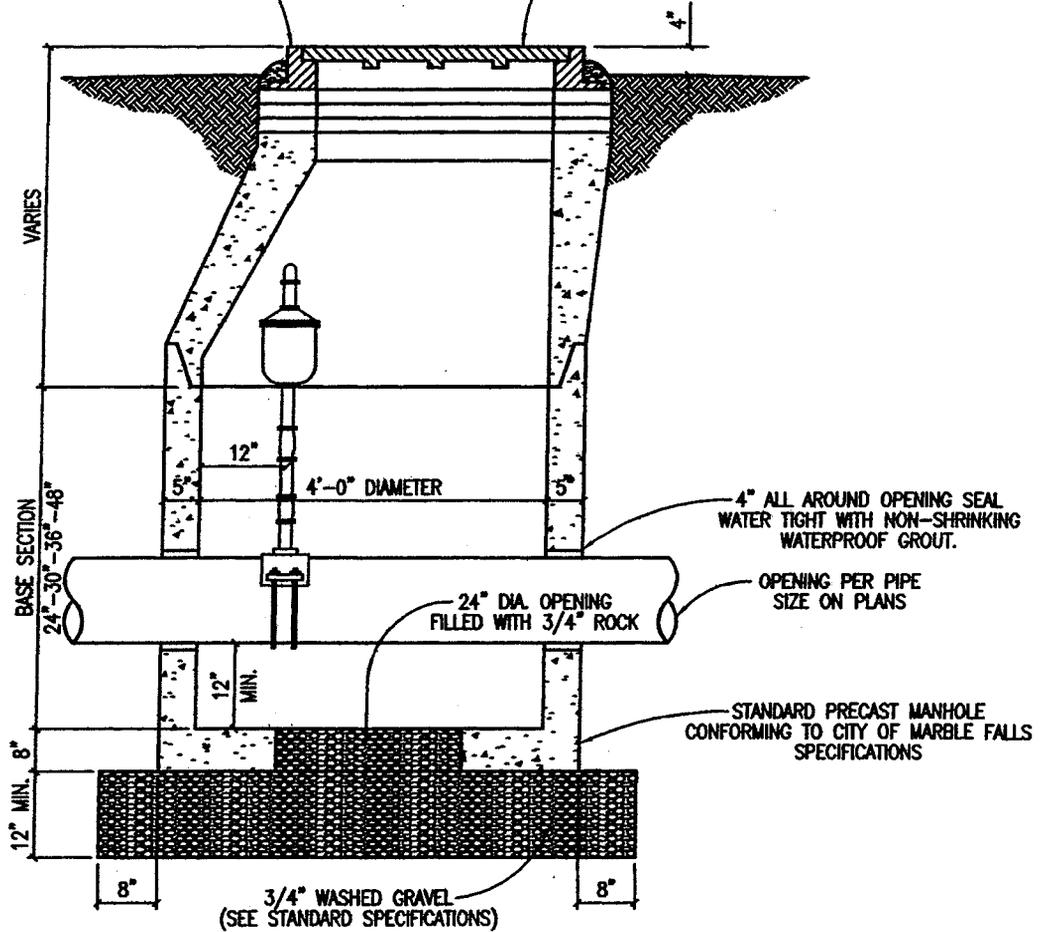
NOTE:
 PLAN VIEW SHOWN ONLY
 FOR CLARIFICATION OF
 SECTION "X-X" AND "Y-Y".



PLAN

FRAME AND COVER SHALL BE
 EAST JORDAN IRON WORKS V-1800-5
 LABELED "WATER".

ADJUST WITH GRADE RINGS
 AND MORTAR TO BRING TO 4"
 ABOVE GRADE (2 COURSES
 MIN. AND 5 COURSES MAX.).



SECTION "X-X"

CITY OF MARBLE FALLS, TEXAS

Scale:
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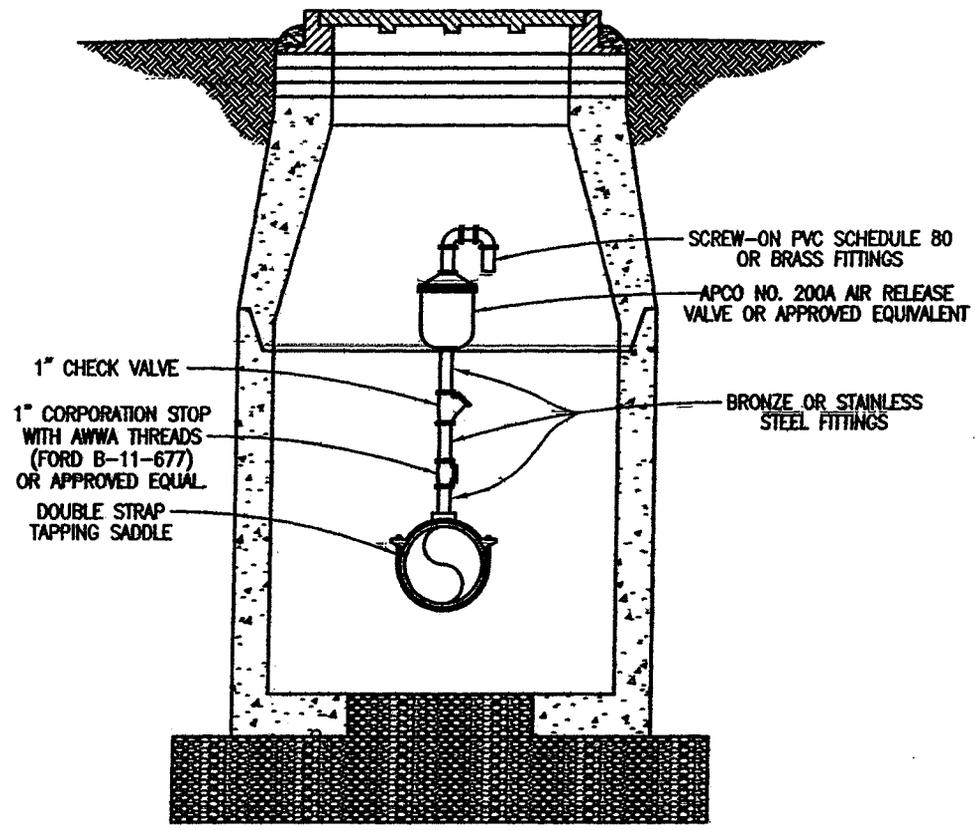
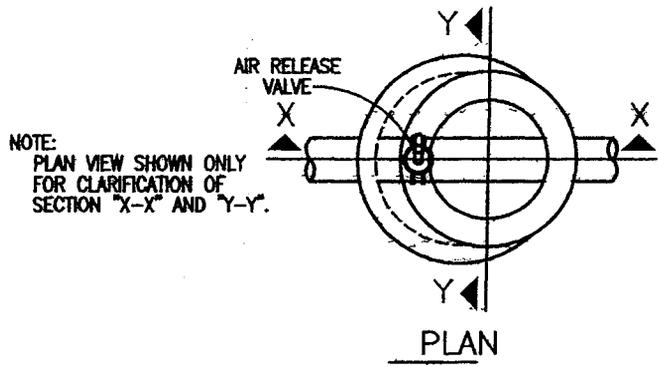
Approved _____

Date _____

Drawn by:
 SDK

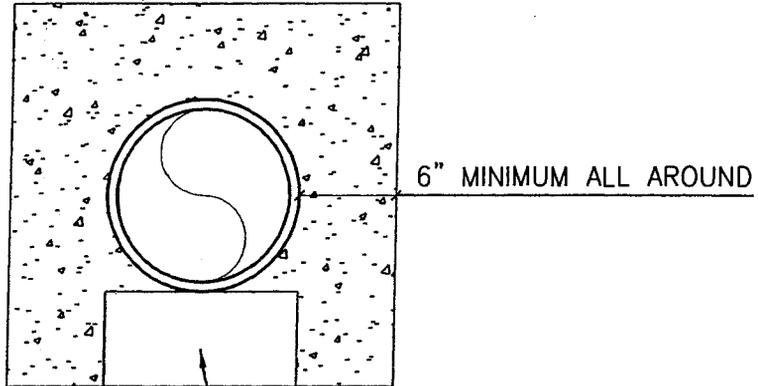
STANDARD AIR RELEASE VALVE
 FOR WATER MAIN

Detail No.
 W13.DWG



SECTION "Y-Y"

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Drawn by: SDK
	Date _____	
STANDARD AIR RELEASE VALVE FOR WATER MAIN		Detail No. W14.DWG



CONCRETE BLOCK OR BRICK SUPPORT
(MINIMUM OF TWO PER PIPE LENGTH)

NOTES:

1. ENCASEMENT TO BE CONSTRUCTED WHERE SEWER LINES PASS OVER OR UNDER A WATER MAIN WITH LESS THAN EIGHTEEN INCHES (18") CLEAR DISTANCE.
2. AT CROSSINGS, ENCASEMENT SHALL EXTEND TEN FEET (10'-0") ON EITHER SIDE OF CROSSING.
3. BEGINNING AND ENDING OF ENCASEMENTS SHALL NOT BE MORE THAN SIX INCHES (6") FROM A PIPE JOINT.
4. WHERE WATER AND SEWER LINES PARALLEL WITH LESS THAN TEN FEET (10'-0") HORIZONTAL CLEAR DISTANCE, NO ENCASEMENT IS REQUIRED IF BOTH LINES ARE 150 PSI PRESSURE PIPE.
5. RAW WATER MAINS SHALL BE 150 PSI PRESSURE RATED WHEN PARALLELING POTABLE WATER MAINS WITH LESS THAN TEN FEET (10'-0") HORIZONTAL CLEARANCE.
6. WHERE MINIMUM COVER, THIRTY INCHES (30") IS NOT AVAILABLE, ENCASEMENT WILL BE REQUIRED.
7. ALL CONCRETE ENCASEMENTS MUST BE FORMED AND INSPECTED BY THE CITY OF MARBLE FALLS INSPECTOR PRIOR TO PLACING CONCRETE AND BACKFILLING.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

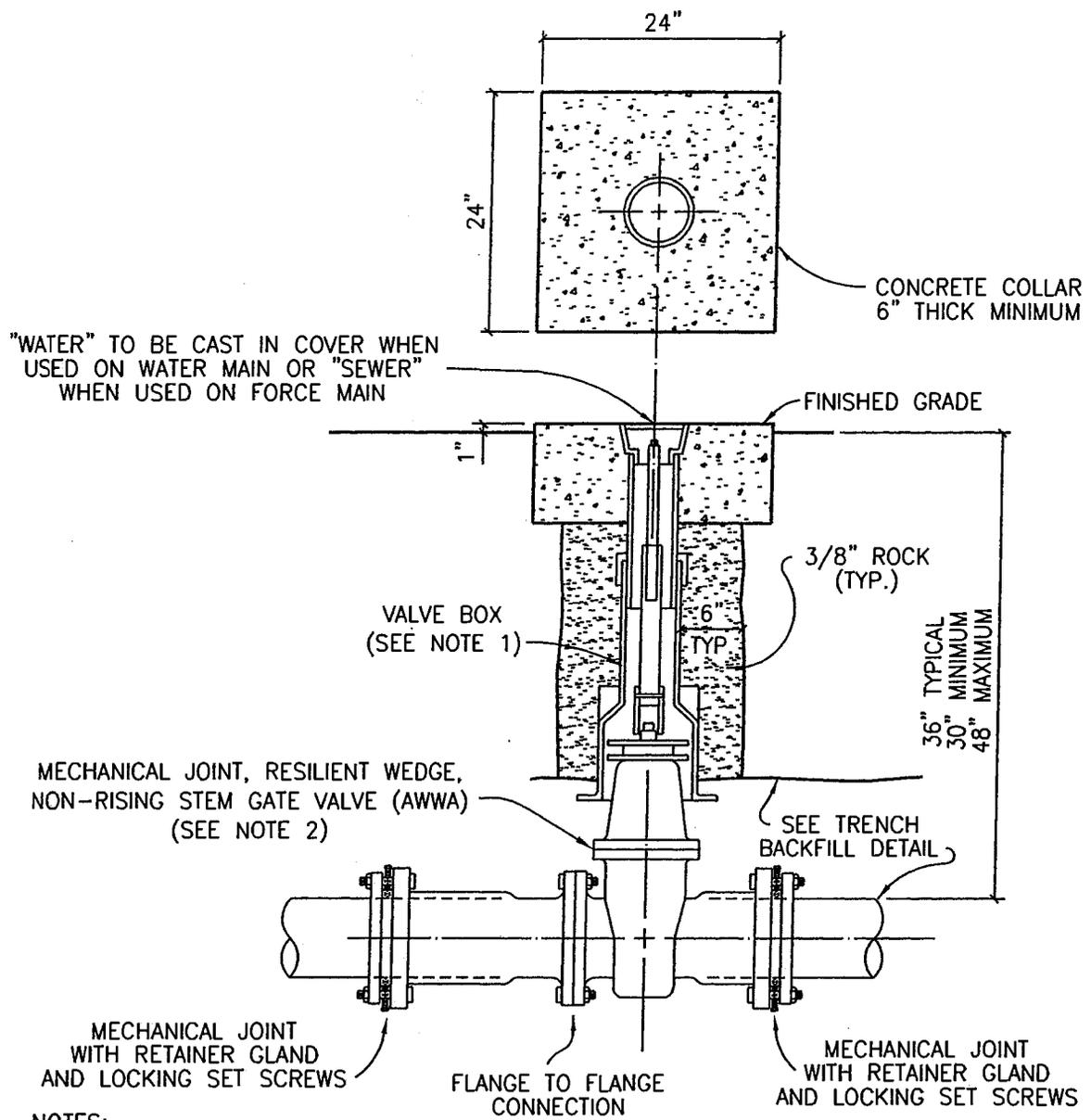
Approved _____

Date _____

Drawn by:
SDK

CONCRETE ENCASEMENT DETAIL

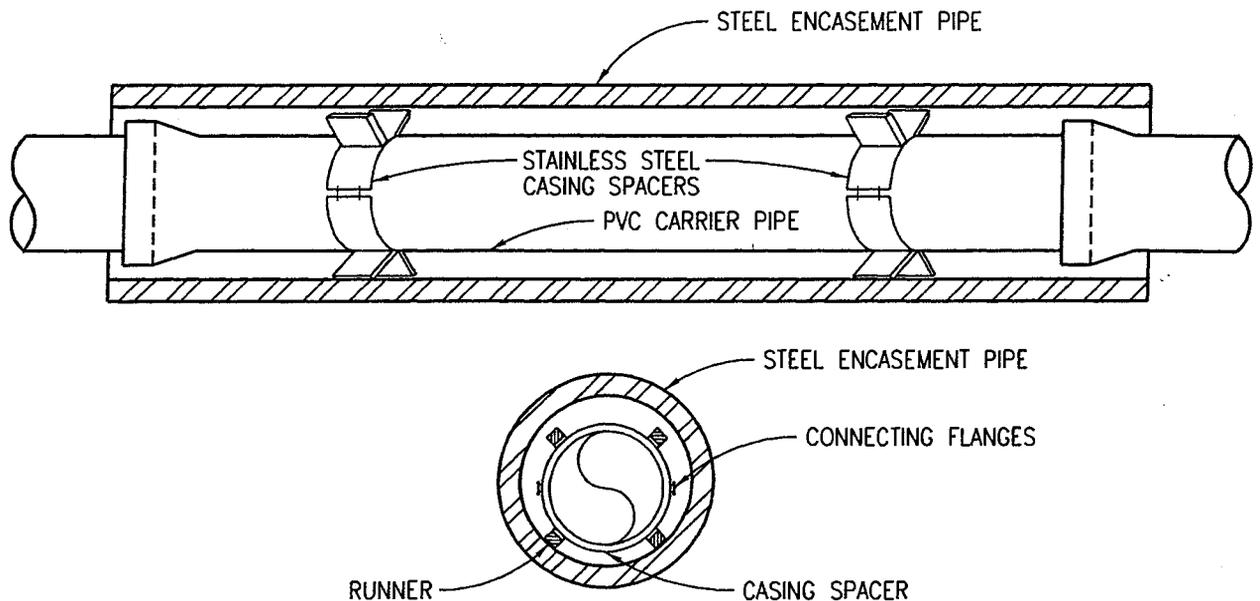
Detail No.
W15.DWG



NOTES:

1. VALVE BOX SHALL BE AMERICAN FLOW CONTROL TRENCH ADAPTER OR APPROVED EQUAL HAVING AN ADJUSTABLE RANGE OF + OR - 6 INCHES FROM INSTALLED FINISH GRADE. (SEE VALVE SETTING DETAIL, DWG. #W-08.)
2. ACCEPTABLE GATE VALVES ARE:
 - A. AMERICAN FLOW CONTROL - SERIES 2500
 - B. MUELLER - 2360 SERIES
 - C. CLOW

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Date _____
INLINE VALVE INSTALLATION		Drawn by: SDK
		Detail No. W16.DWG



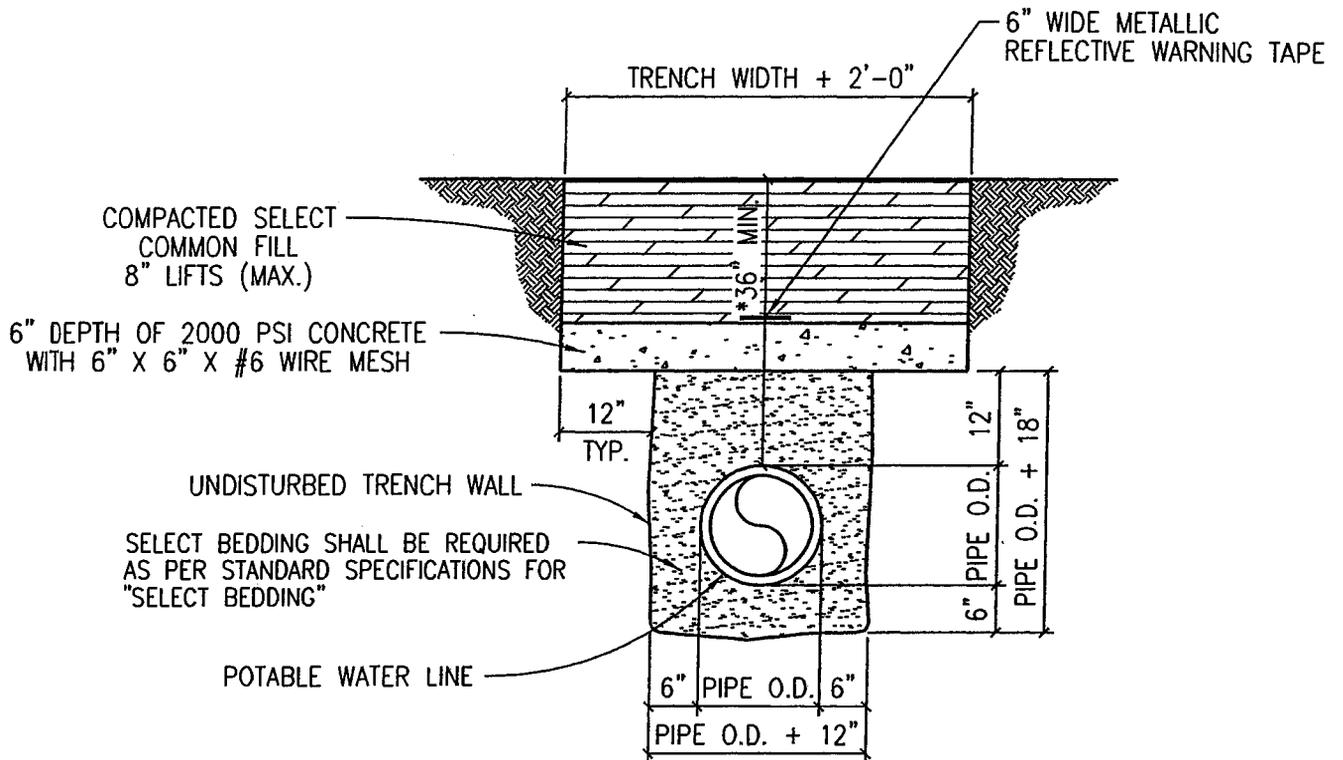
NOTES:

1. CASING SPACERS SHALL BE BOLT ON STYLE WITH A SHELL MADE IN TWO SECTIONS OF HEAVY T-304 STAINLESS STEEL. CONNECTING FLANGES SHALL BE RIBBED FOR EXTRA STRENGTH. CASING SPACERS SHALL BE MADE BY CASCADE WATERWORKS MFG. CO. OR APPROVED EQUAL.
2. CASING SPACERS SHALL HAVE RUNNERS MADE OF ULTRA HIGH MOLECULAR WEIGHT POLYMER, WITH A MINIMUM HEIGHT OF 2 INCHES.
3. DO NOT USE WEDGES BETWEEN TOP OF PVC CARRIER PIPE AND INSIDE OF CASING TO KEEP PVC FROM MOVING.
4. PRIOR TO INSERTING PVC CARRIER PIPE, ANY WATER SHOULD BE PUMPED OUT OF THE CASING PIPE SO THAT NO MORE THAN A FEW INCHES OF WATER REMAINS.
5. SPACERS WILL BE REQUIRED WITHIN AT LEAST 3 FEET FROM BOTH OPENINGS OF THE ENCASUREMENT PIPE AND SPACED NO GREATER THAN 6 FEET THROUGHOUT THE ENCASUREMENT PIPE.
6. CASING SPACERS WILL NOT BE PAID DIRECTLY BUT SHALL BE CONSIDERED SUBSIDIARY TO THE APPROPRIATE BID ITEM FOR INSTALLING PVC PIPE.
7. ENCASUREMENT PIPE SHALL BE SMOOTH STEEL 35,000 PSI YIELD STRENGTH WITH THICKNESS ACCORDING TO THE FOLLOWING TABLE:

PIPE SIZE-CARRIER (DIAMETER)	PIPE SIZE-CASING (DIAMETER)(MIN.)	MINIMUM PIPE THICKNESS (INCHES)	
6"	16"	1/4	0.2500
8"	18"	1/4	0.2500
10"	20"	5/16	0.3125
12" - 14"	24"	3/8	0.3750
16" - 18"	30"	7/16	0.4375
20"	36"	1/2	0.5000
24"	42"	1/2	0.5000
30"	48"	1/2	0.5000

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____	Date _____	Drawn by: SDK
INSTALLATION OF P.V.C. PIPE THROUGH CASING			Detail No. W17.DWG



* WHERE 30" MINIMUM COVER CAN NOT BE OBTAINED OR DUE TO POTENTIAL SURFACE LOADING THE CITY MAY REQUIRE A CAP TO BE INSTALLED.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

Approved _____

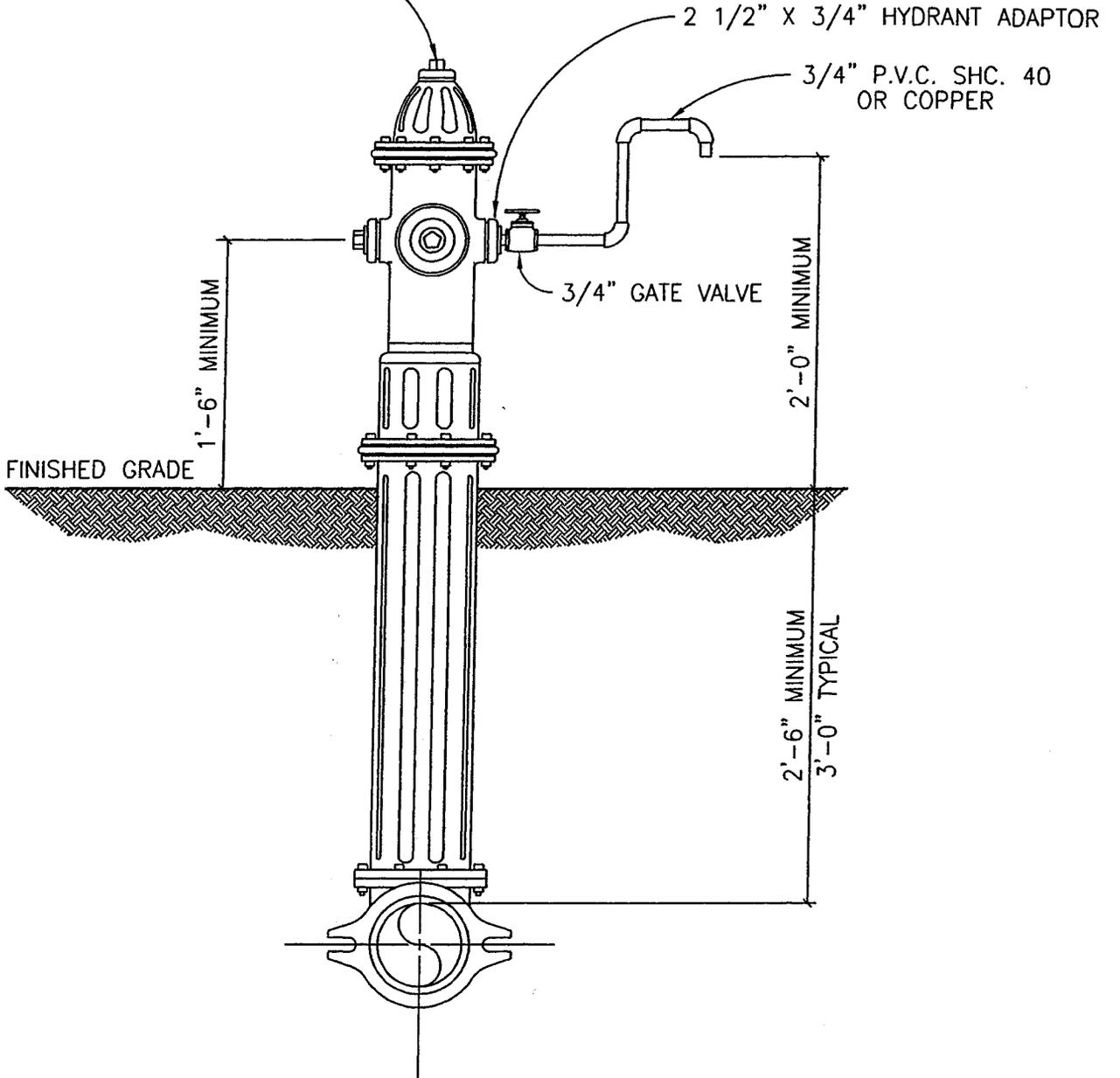
Date _____

Drawn by:
SDK

CONCRETE TRENCH CAP DETAIL

Detail No.
W18.DWG

FIRE HYDRANT AS SPECIFIED
 (REFER TO DETAIL #W-11 FOR
 ACCEPTABLE FIRE HYDRANTS)



CITY OF MARBLE FALLS, TEXAS

Scale:
 N.T.S.

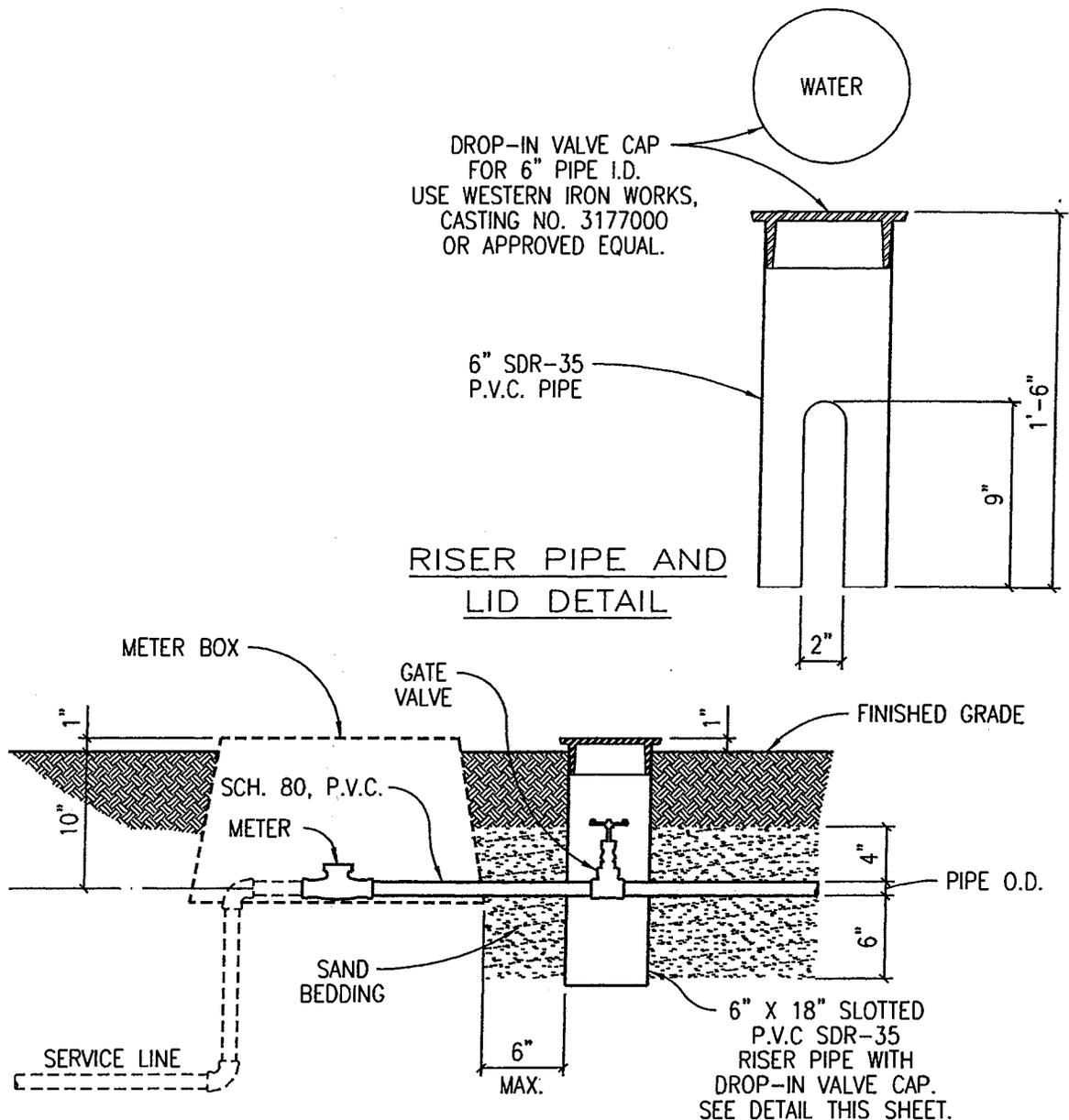
Approved _____

Date _____

Drawn by:
 SDK

FIRE HYDRANT SAMPLING POINT

Detail No.
 W19.DWG

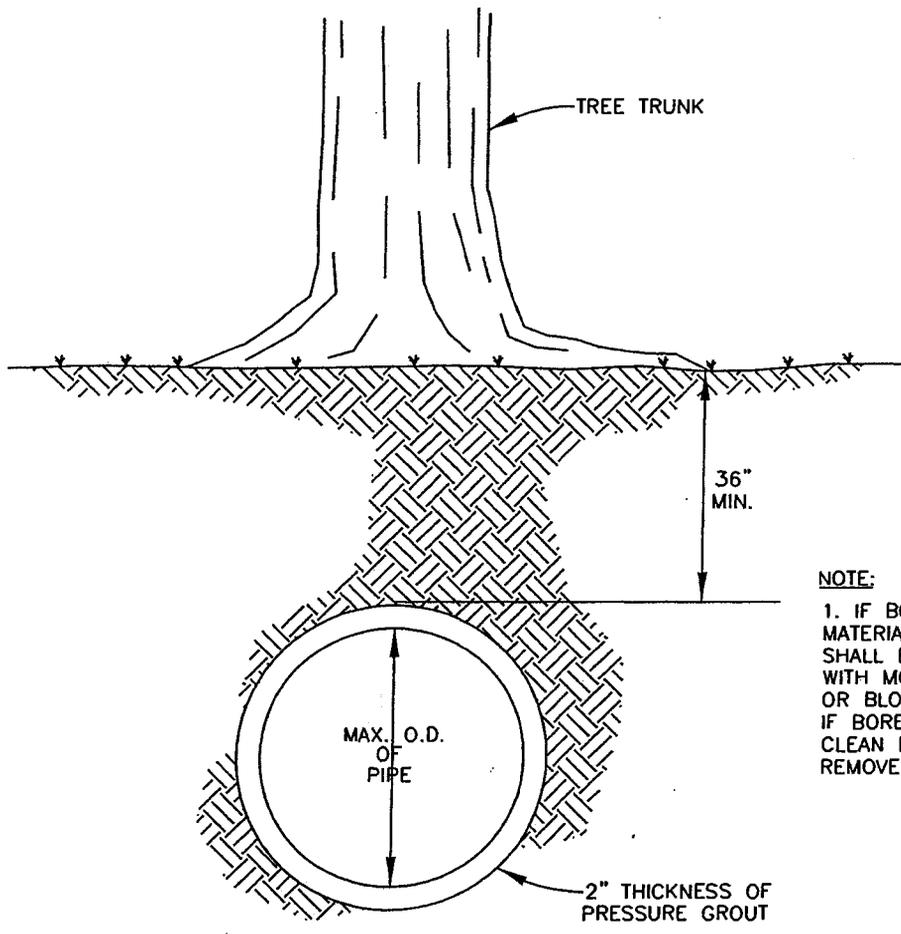


NOTES:

1. GATE VALVE SHALL BE A HAMMOND IB645, CLASS 125, BRONZE GATE, SCREWED BONNET, NON-RISING STEM, SOLID WEDGE DISC WITH THREADED ENDS OR APPROVED EQUAL.
2. DROP-IN VALVE CAP SHALL BE CAST WITH THE WORD "WATER" ON TOP.
3. USE SCHEDULE 80, M.I.P. ADAPTER AS REQUIRED.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
CUSTOMER'S CUT-OFF		Detail No. W20.DWG



NOTE:

1. IF BORE IS THROUGH ROCK MATERIAL, BOTTOM OF PIPE BARREL SHALL BE SUPPORTED OFF BOTTOM WITH MORTAR BANDS ON C.S.C. PIPE OR BLOCKS ON D.I. OR PVC PIPE. IF BORE IS THROUGH DIRT MATERIAL, CLEAN BOTTOM OF BORE PIT TO REMOVE ROCKS, ETC.

BORE & PRESSURE GROUT UNDER TREE

SCALE: N.T.S.

CITY OF MARBLE FALLS, TEXAS

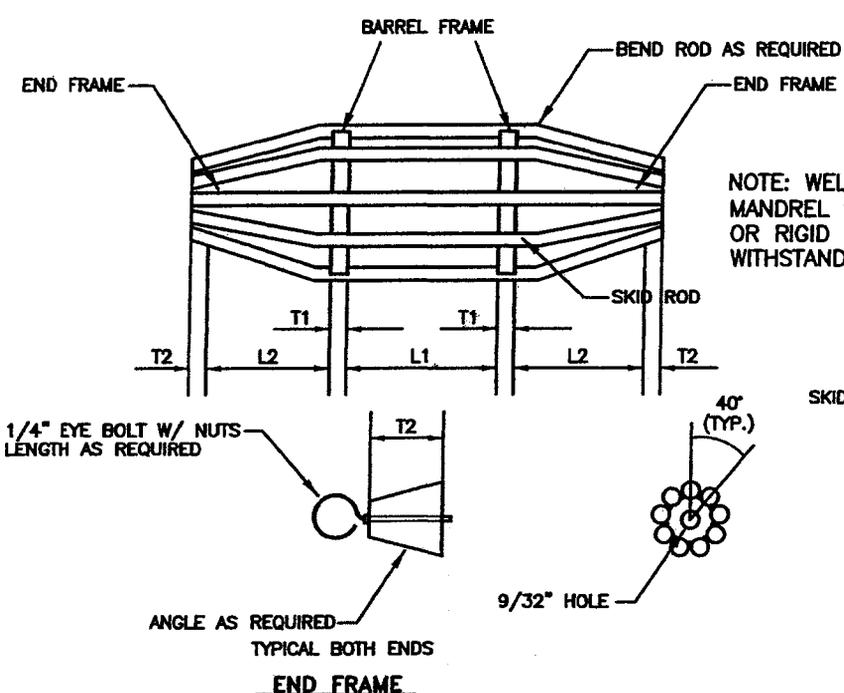
Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
BORE & PRESSURE GROUT UNDER TREE		Detail No. W21.DWG

City of Marble Falls

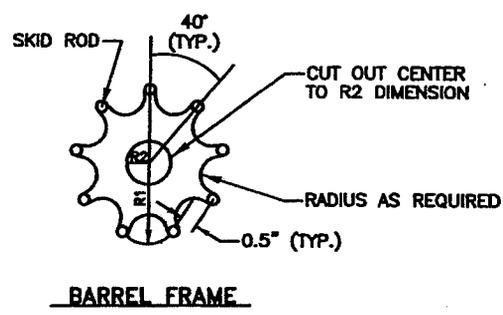
Wastewater Details and Construction Standards

Detail

WW01	Typical Mandrel Detail
WW02	Standard Manhole – Plan
WW03	Standard Manhole – Section
WW04	Drop Connection Manhole Detail
WW05	Drop Connection Precast Manhole Type “B”
WW06	Flow Patterns for Invert Channels
WW07	Concrete Apron around Manhole Ring and Cover Detail
WW08	48” X 5” to 33” X 8” X 36” Tall Eccentric Concrete Section
WW09	48” Manhole Flat Lid
WW10	Flexible “Seal Boot” Connector
WW11	Type 4 – Pickbar
WW12	Sewer Clean-Out Detail
WW13	Sewer Service Connection
WW14	Gasketed Sewer Fitting for Sewer Service Connections to Existing Mains
WW15	Standard Air Release Valve for Force Main Section “X-X”
WW16	Standard Air Release Valve for Force Main – End View Section “Y-Y”
WW17	Trench and Embedment Detail Under Non-Paved Areas
WW18	Trench and Embedment and Pavement Replacement Detail Under Existing Roadway
WW19	Trench and Embedment Detail Under Proposed Roadway
WW20	Manhole Vent for Below Ground Installation
WW21	Installation of P.V.C. Pipe through Casing



NOTE: WELD ALL RODS TO FRAME.
MANDREL SHALL BE CONSTRUCTED FROM METAL OR RIGID PLASTIC MATERIAL THAT CAN WITHSTAND 200 PSI WITHOUT BEING DEFORMED.



MANDREL DIMENSIONS - 5% DEFLECTION FOR O.D. CONTROLLED PVC PIPE*										
SIZE	TYPE	O.D. AVERAGE	MIN. WALL THICKNESS	L1	L2	R1	R2	T1	T2	ROD DIAMETER
6"	D3034 SDR35	6.275	0.180	4.50	6	2.81	0.75	0.375	1.0	0.375
8"	D3034 SDR35	8.400	0.240	5.00	6	3.75	1.25	0.375	1.0	0.375
10"	D3034 SDR35	10.500	0.300	7.50	6	4.70	1.50	0.375	1.0	0.375
12"	D3034 SDR35	12.800	0.360	9.00	6	5.65	1.75	0.375	1.0	0.375
15"	D3034 SDR35	15.300	0.437	12.25	6	6.85	2.00	0.375	1.0	0.375
18"	F679 T-1	18.791	0.535	15.50	6	8.37	2.50	0.50	1.5	0.50
21"	F679 T-1	22.047	0.632	15.75	9	9.87	3.00	0.50	1.5	0.50
24"	F679 T-1	24.803	0.711	18.00	9	11.11	3.50	0.50	1.5	0.50
27"	F679 T-1	27.953	0.801	20.25	9	12.52	4.00	0.50	1.5	0.50

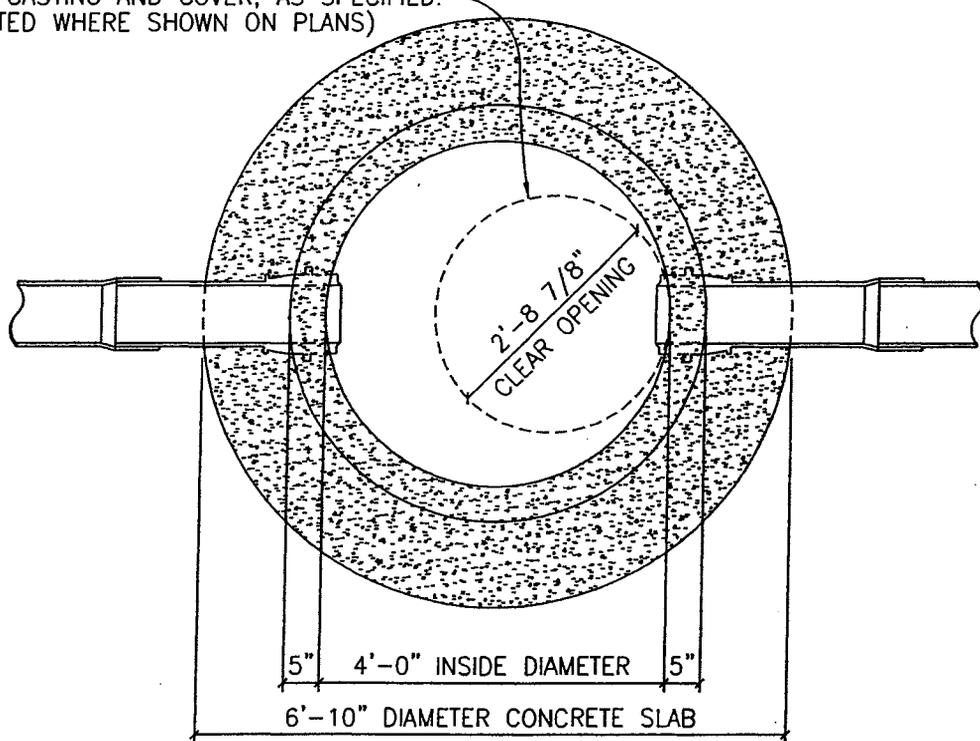
* ALL DIMENSIONS IN INCHES

TYPICAL MANDREL DETAIL

SCALE: N.T.S.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Date _____
TYPICAL MANDREL DETAIL		Drawn by: SDK
		Detail No. WW01.DWG

STANDARD CASTING AND COVER, AS SPECIFIED.
(BOLTED WHERE SHOWN ON PLANS)



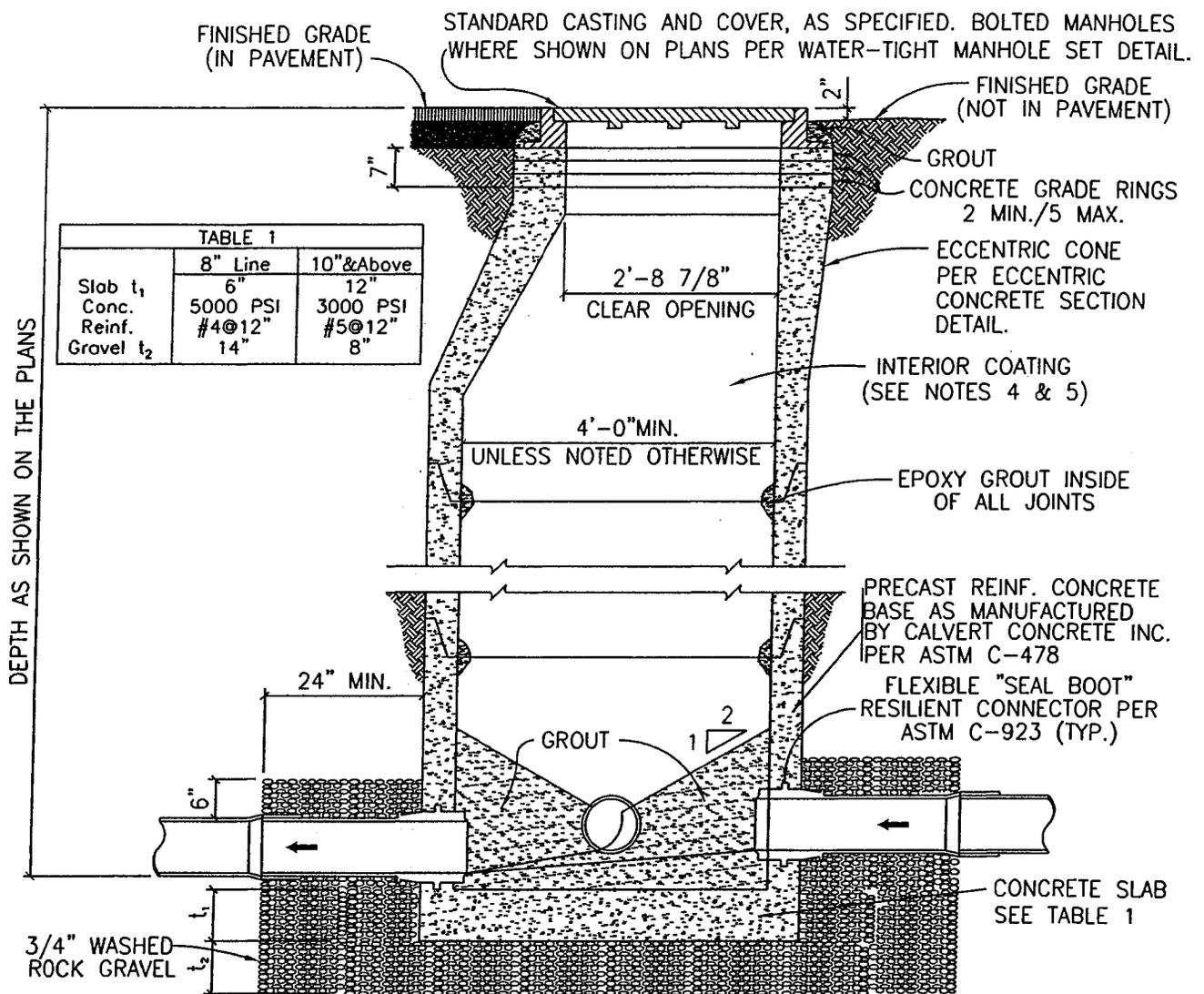
MANHOLE PLAN

NOTES:

MANHOLE DETAILS SHALL REFLECT THE CITY'S MINIMUM SPECIFICATIONS, AS STATED BELOW:

- A. ALL MANHOLES SHALL BE 48" I.D., R.C.P., CLASS III, WITH RUBBER O-RING GASKET JOINTS CONFORMING TO ASTM C478, C433 AND C76.
- B. ALL MANHOLES SHALL HAVE WATER-TIGHT FRAME AND COVER, WITH A MINIMUM 30" CLEAR OPENING, AS MANUFACTURED BY EAST JORDAN IRON WORKS (AS PER DETAIL # WW-07) OR APPROVED EQUAL.
- C. ALL MANHOLES SHALL BE CONCRETE WITH CAST IRON FRAME AND BOLTED COVER.
- D. ALL MANHOLES SHALL HAVE AN ECCENTRIC LID.
- E. MANHOLES MAY HAVE A FLAT LID, IF APPROVED BY CITY OF MARBLE FALLS, BEING 12" THICK WITH A MINIMUM 30" OPENING, AS MANUFACTURED BY CALVERT CONCRETE OR APPROVED EQUAL M.F.G. CONFORMING TO ASTM C478, 5000 P.S.I. CONCRETE, TRAFFIC BEARING, AND O-RING JOINT CONFORMING TO ASTM C443.
- F. INVERTS AND FLEXIBLE SEAL BOOTS, PER ASTM C-923, SHALL BE CAST INTO BASE SECTION.
- G. MINIMUM DROP BETWEEN INVERTS SHALL BE ONE-TENTH OF A FOOT (0.1').
- H. TWO (2") INCH GRADE RINGS WITH AN I.D. TO MATCH FRAMES CLEAR OPENING, MINIMUM OF TWO (2), MAXIMUM OF FIVE (5) GRADE RINGS REQUIRED.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	<div style="border-bottom: 1px solid black; width: 100%;"></div> Approved _____ Date _____	Drawn by: SDK
STANDARD MANHOLE - PLAN		Detail No. WW02.DWG



NOTES:

1. MANHOLES SHALL BE PRECAST ASTM C-478 BELL AND SPIGOT WITH "O" RING JOINTS.
2. SEE PLANS & MANHOLE SCHEDULE, FOR MANHOLE SIZE, LOCATION, CONFIGURATION, TYPE OF TOP SECTION, VENTING REQUIREMENTS, PIPE SIZE AND TYPES.
3. SEE SPECIFICATIONS ON MATERIALS AND CONSTRUCTION.
4. ENTIRE INTERIOR OF WASTEWATER MANHOLES AND UNDERSIDE OF FLAT TOPS TO BE "POLIBRID" COATED: 5 MIL DFT POLIBRID 672 PRIMER AND 75 MIL DFT POLIBRID 705 TOPCOAT.
5. AN 80 MIL COAT OF FOSROC EPOXY LINER HBS IS EQUIVALENT TO THE POLIBRID PRIMER / TOPCOAT.
6. ALL MANHOLE COVERS SHALL BE BOLTED AND GASKETED WHEN MANHOLES LOCATED OUT FROM PAVEMENT.
7. MANHOLES TO BE VENTED ARE IDENTIFIED ON MANHOLE SCHEDULE. REFERENCE MANHOLE VENT DETAIL.
8. MANHOLES TO BE DESIGNED TO RESIST LATERAL AND VERTICAL SOIL FORCES RESULTING FROM MANHOLE DEPTH. ADDITIONALLY, MANHOLES LOCATED IN PAVEMENT TO BE DESIGNED FOR HS-20 TRAFFIC LOADS.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

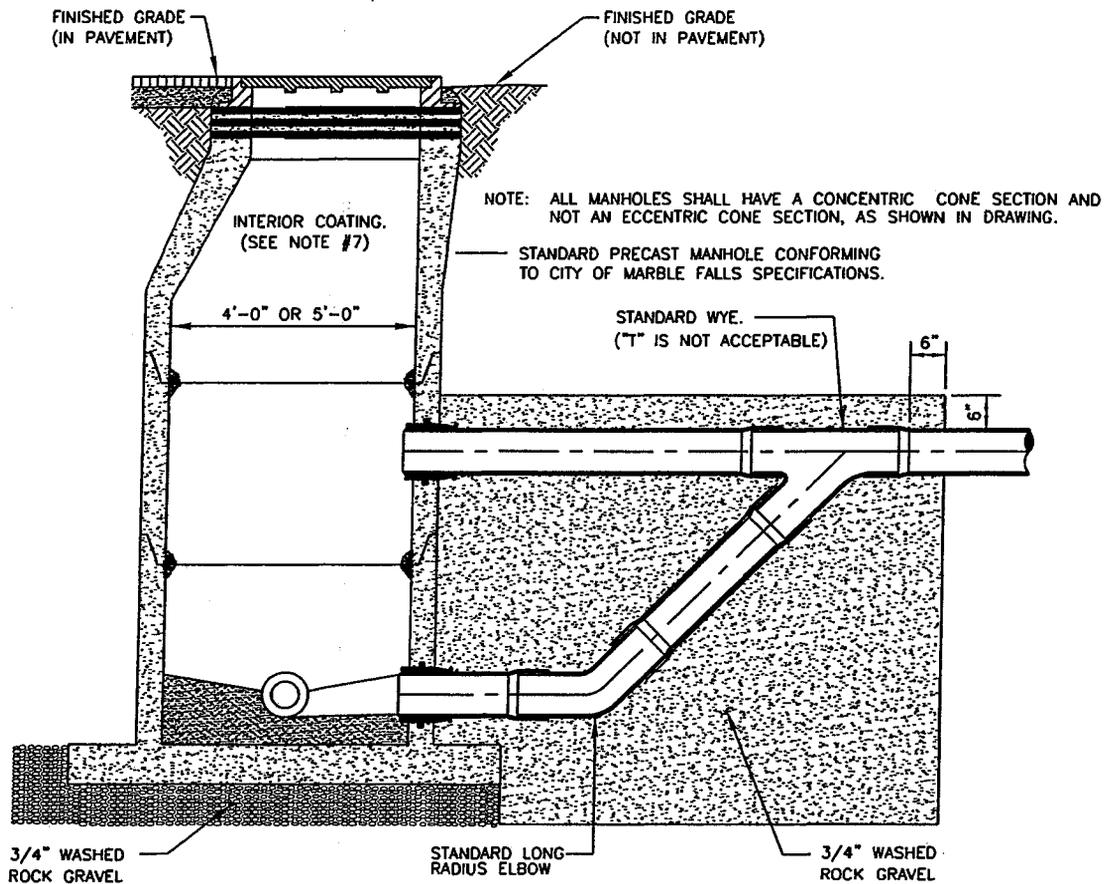
Approved _____

Drawn by:
SDK

Date _____

STANDARD MANHOLE - SECTION

Detail No.
WW03.DWG



NOTES:

1. CONCRETE ENCASEMENT FOR DROP CONNECTION TO BE POURED INTEGRALLY WITH BOTH MANHOLE SLAB AND WALL.
2. DROP CONNECTIONS SHALL BE REQUIRED WHENEVER AN INFLUENT SEWER IS LOCATED TWO FEET (2') OR MORE ABOVE THE MAIN INVERT CHANNEL.
3. A FLOW CHANNEL SHALL BE CONSTRUCTED INSIDE MANHOLE TO DIRECT INFLUENT INTO THE FLOW STREAM.
4. WHEN P.V.C. IS USED IN SANITARY SEWER LINES, SOLVENT TYPE JOINT P.V.C. FITTINGS MAY BE UTILIZED IN THE DROP ASSEMBLY ONLY.
5. MINIMUM PIPE SIZE FOR DROP IS EIGHT INCHES (8").
6. SEE STANDARD DETAIL (STANDARD MANHOLE SECTION) FOR ADDITIONAL REQUIREMENTS.
7. ENTIRE INTERIOR OF WASTEWATER MANHOLES AND UNDERSIDE OF FLAT TOPS TO HAVE 5 MIL DFT POLIBRID 672 PRIMER AND 75 MIL DFT POLIBRID 705 TOPCOAT, OR 80 MIL COAT OF "RAVEN" SELF-PRIMING EPOXY COATING 403, OR AN 80 MIL COAT OF "SPRAY WALL".

DROP MANHOLE

Scale: NTS

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

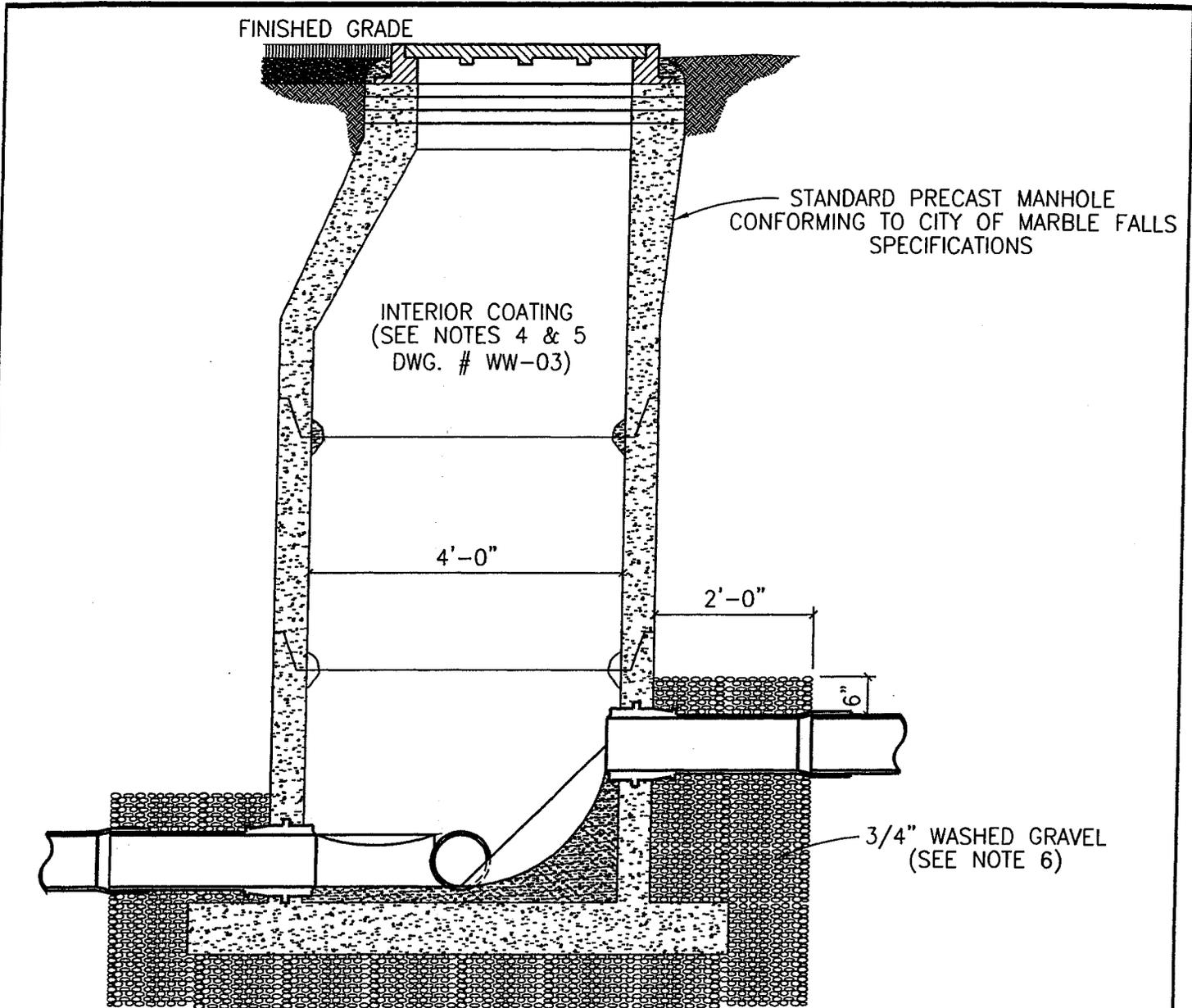
Approved _____

Date _____

Drawn by:
SDK

DROP CONNECTION MANHOLE DETAIL

Detail No.
WW04.DWG

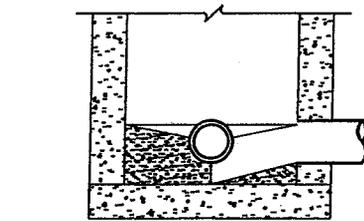
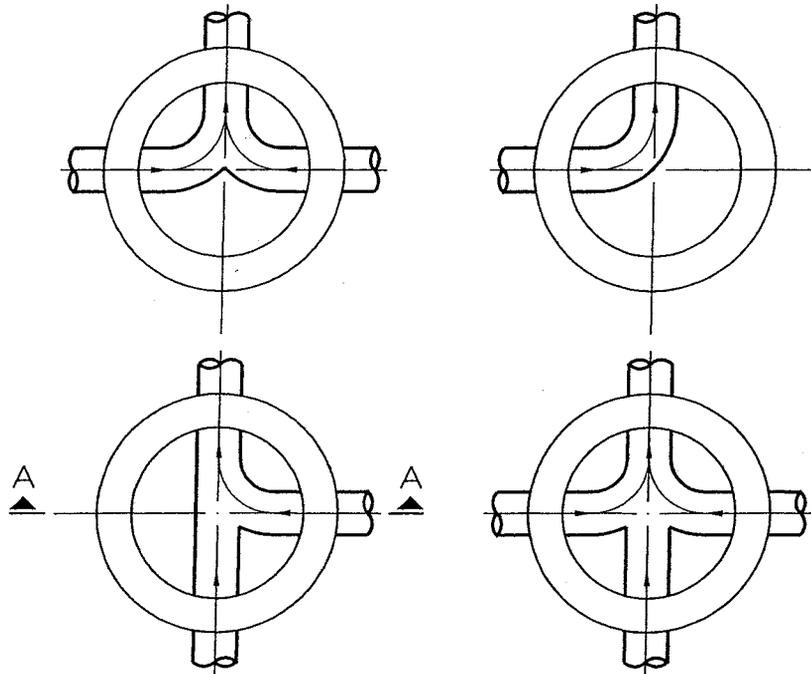


NOTES:

1. TO BE USED WHERE DROP IS SIX INCHES (6") TO TWO FEET (2'-0").
2. A FLOW CHANNEL SHALL BE CONSTRUCTED INSIDE MANHOLE TO DIRECT INFLUENT INTO FLOW STREAM.
3. CONSTRUCTION OF DROP SHALL PROVIDE AN OVERSIZED SLAB TO EXTEND UNDER THE DROP CONNECTION.
4. MINIMUM PIPE SIZE FOR DROP IS EIGHT INCHES (8").
5. SEE STANDARD DETAIL (STANDARD MANHOLE SECTION) FOR ADDITIONAL REQUIREMENTS.
6. BASE MATERIAL SHALL BE REQUIRED AS PER TYPICAL BASE SPECIFICATIONS. SEE STANDARD MANHOLE DETAIL (DWG #WW-03) FOR SPECIFICATIONS.

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	_____ Approved	_____ Date
DROP CONNECTION-PRECAST MANHOLE TYPE "B"		Drawn by: SDK Detail No. WW05.DWG

FLOW PATTERNS FOR INVERT CHANNELS



SECTION "A-A"

NOTES:

1. INVERT CHANNELS TO BE CONSTRUCTED FOR SMOOTH FLOW WITH NO OBSTRUCTIONS.
2. SPILLWAYS SHALL BE CONSTRUCTED BETWEEN PIPES WITH DIFFERENT INVERT ELEVATIONS PROVIDING FOR SMOOTH FLOW.
3. CHANNELS FOR FUTURE CONSTRUCTIONS (STUBS) SHALL BE CONSTRUCTED, FILLED WITH SAND, AND COVERED WITH 1" OF MORTAR.
4. SLOPE MANHOLE ITSELF WITH A 1:2 SLOPE FROM MANHOLE WALL TO CHANNEL.
5. INVERT SHALL BE A MINIMUM OF 1/2 THE DIAMETER OF THE LARGEST PIPE OR 4" DEEP.

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

Approved _____

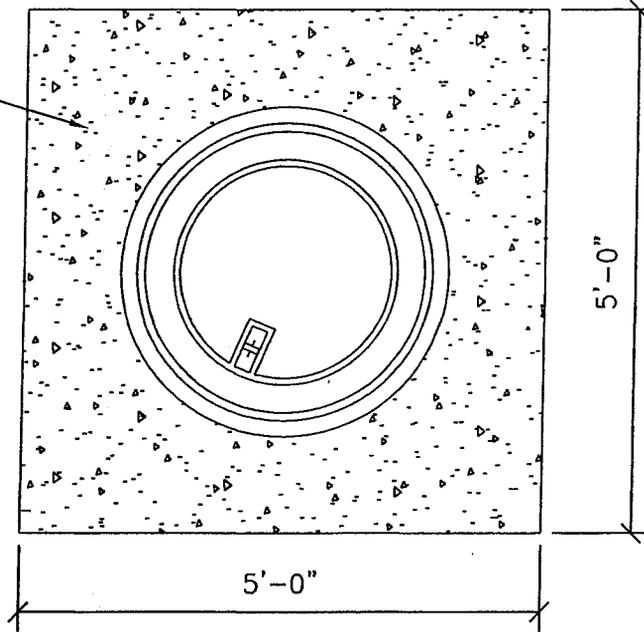
Date _____

Drawn by:
SDK

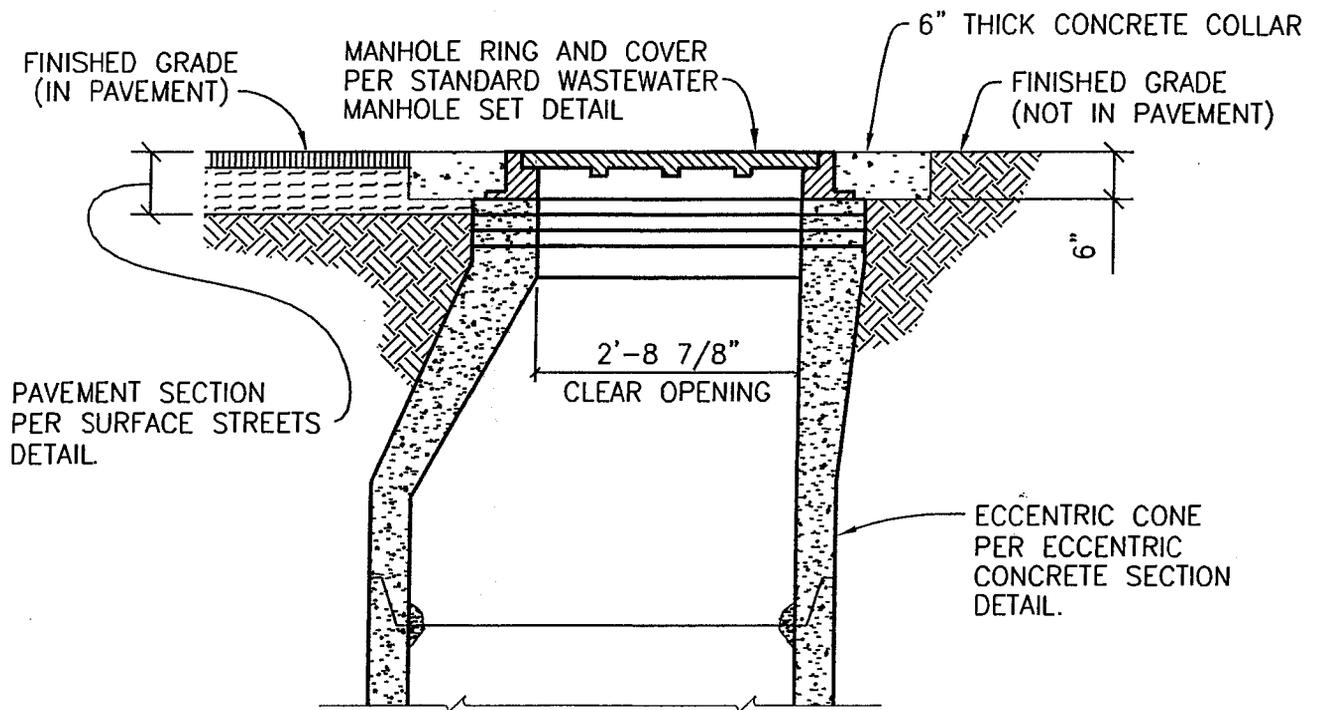
FLOW PATTERNS FOR INVERT CHANNELS

Detail No.
WW06.DWG

CONCRETE COLLAR
(MIN. 3,000 PSI) WITH
6x6x#6 WELDED WIRE
MESH OVER BACKFILL
COMPACTED TO 95%
DENSITY.



PLAN



SECTION

CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

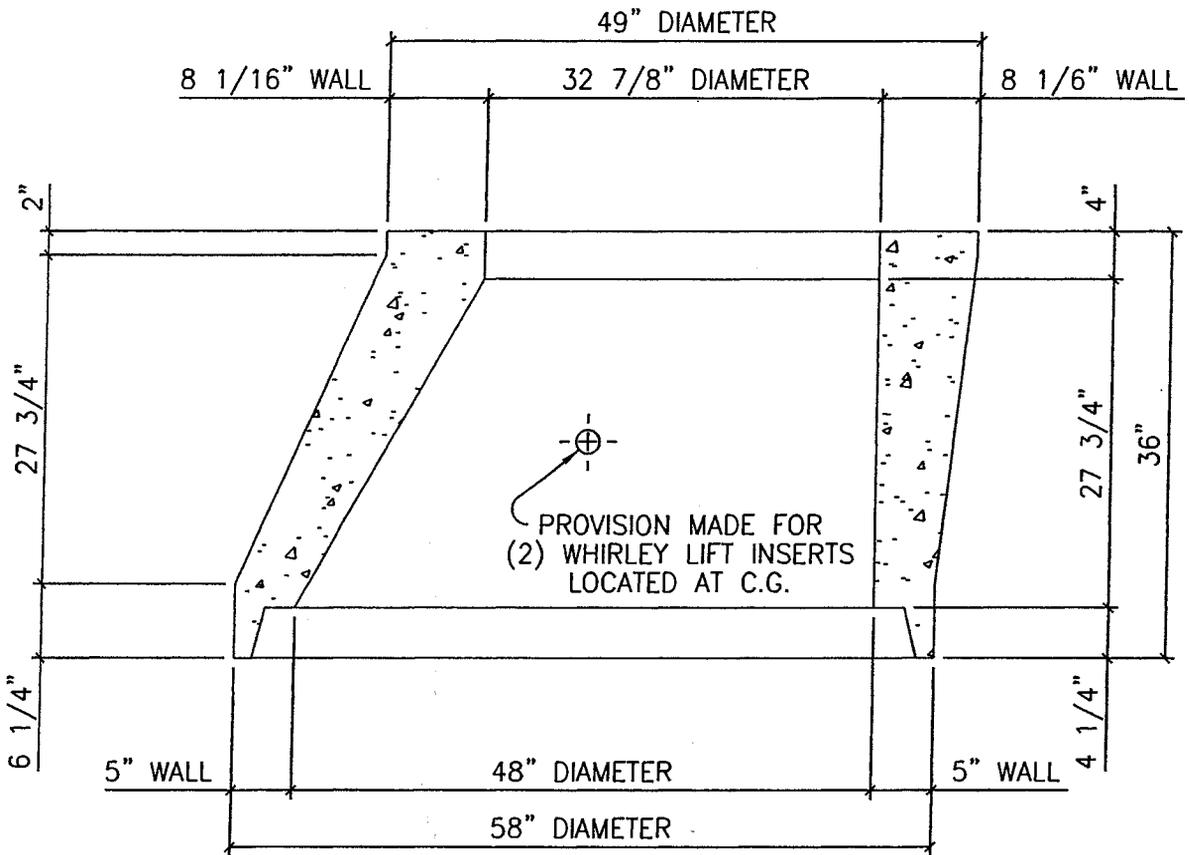
Approved _____

Date _____

Drawn by:
SDK

**CONCRETE APRON AROUND MANHOLE
RING AND COVER DETAIL**

Detail No.
WW07.DWG



CITY OF MARBLE FALLS, TEXAS

Scale:
N.T.S.

Approved _____

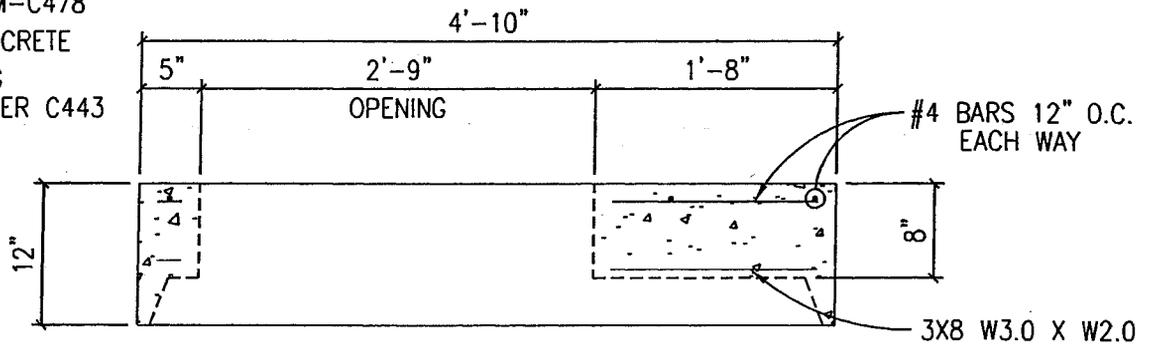
Date _____

Drawn by:
SDK

48" X 5" TO 33" X 8" X 36" TALL
ECCENTRIC CONCRETE SECTION

Detail No.
WW08.DWG

M.F.G. PER ASTM-C478
 5000 P.S.I. CONCRETE
 TRAFFIC BEARING
 O-RING JOINT PER C443

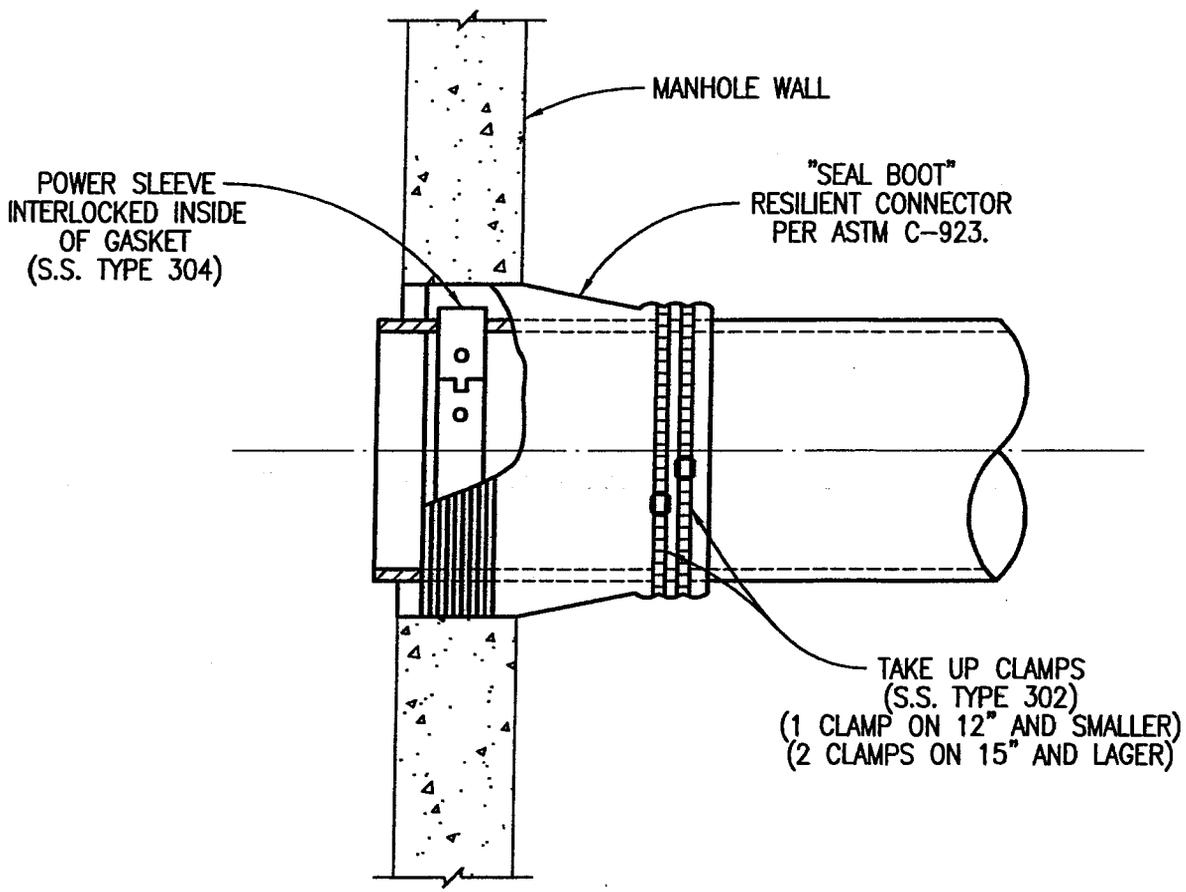


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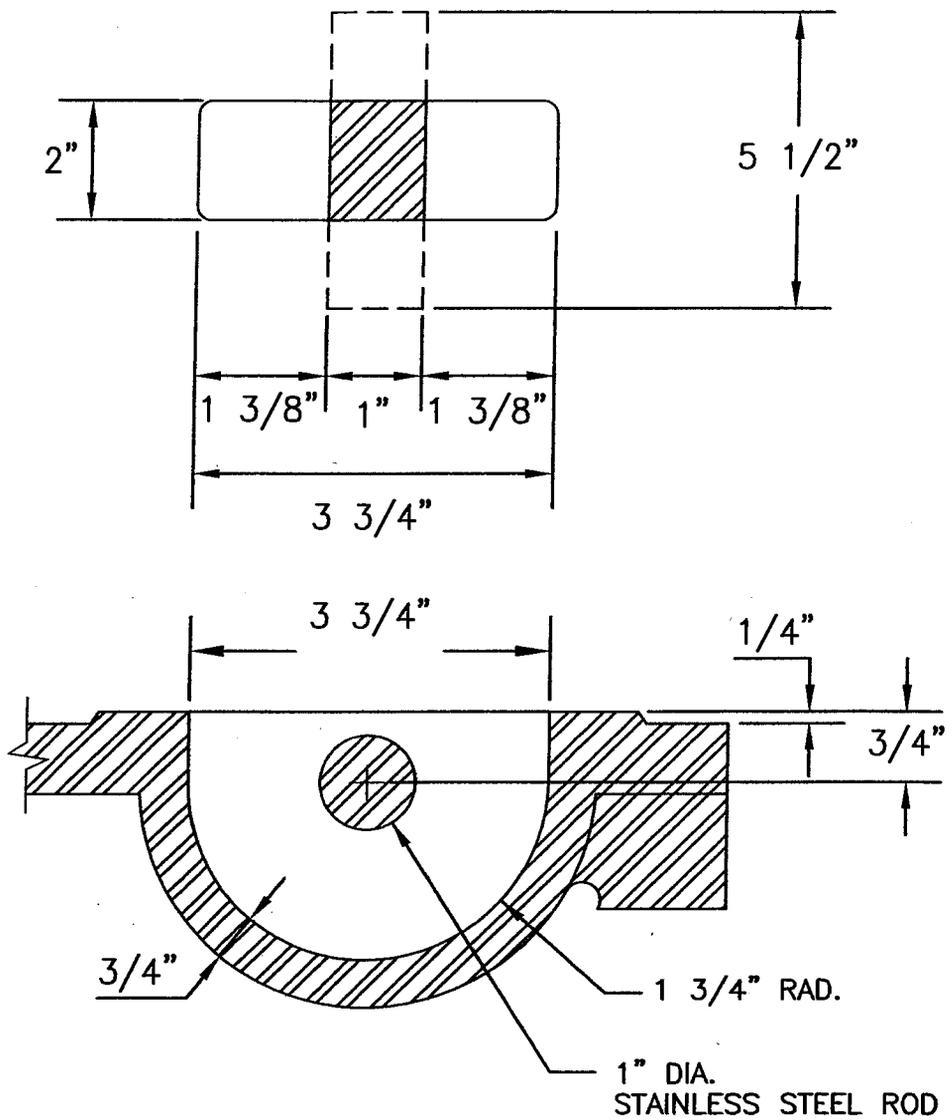
1. AVAILABLE WITH CAST IRON RING AND COVER CAST IN PLACE.
2. PERMITTED ONLY WITH WRITTEN APPROVAL FROM CITY OF MARBLE FALLS

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
48" MANHOLE FLAT LID		Detail No. WW09.DWG



CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Date _____
FLEXIBLE "SEAL BOOT" CONNECTOR		Drawn by: SDK
		Detail No. WW10.DWG



CITY OF MARBLE FALLS, TEXAS

Scale:
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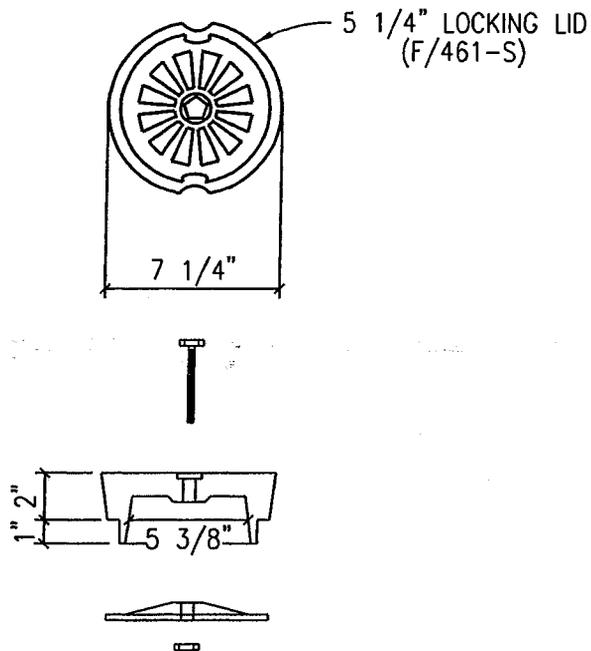
Approved _____

Date _____

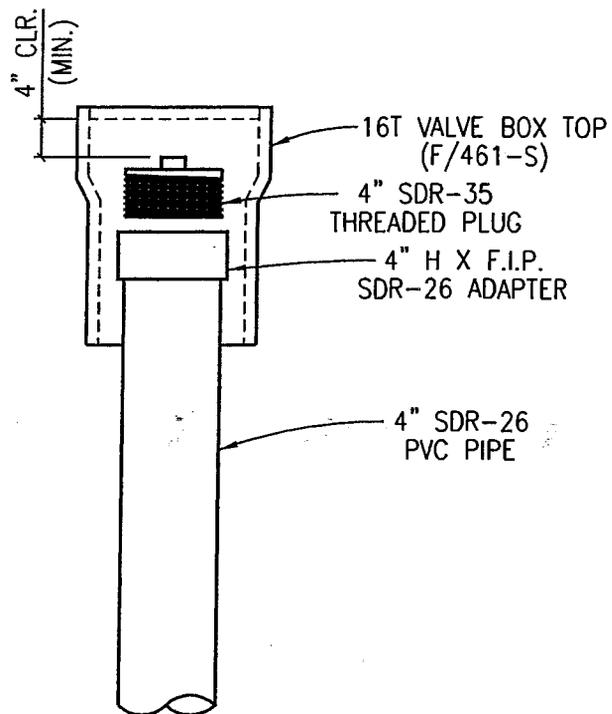
Drawn by:
SDK

TYPE 4 - PICKBAR

Detail No.
WW11.DWG

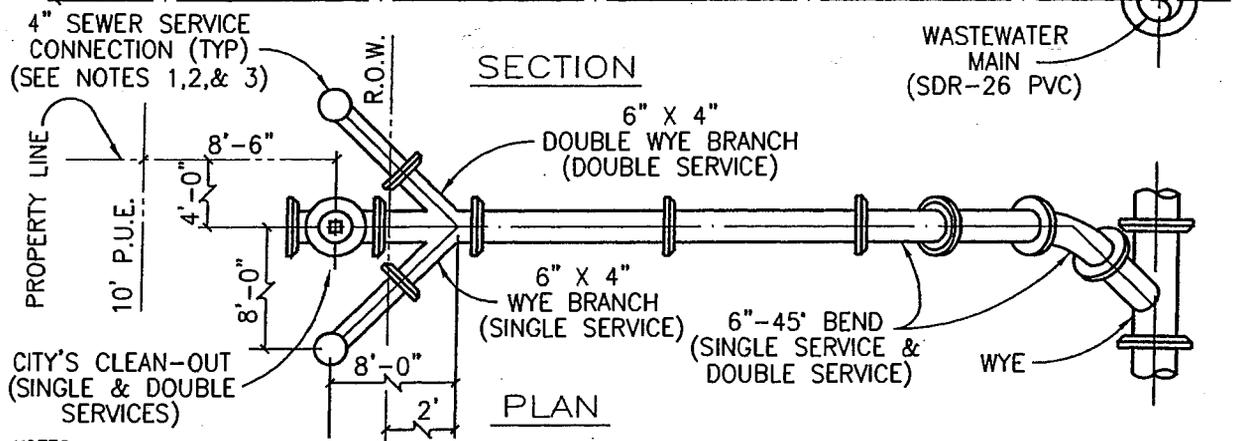
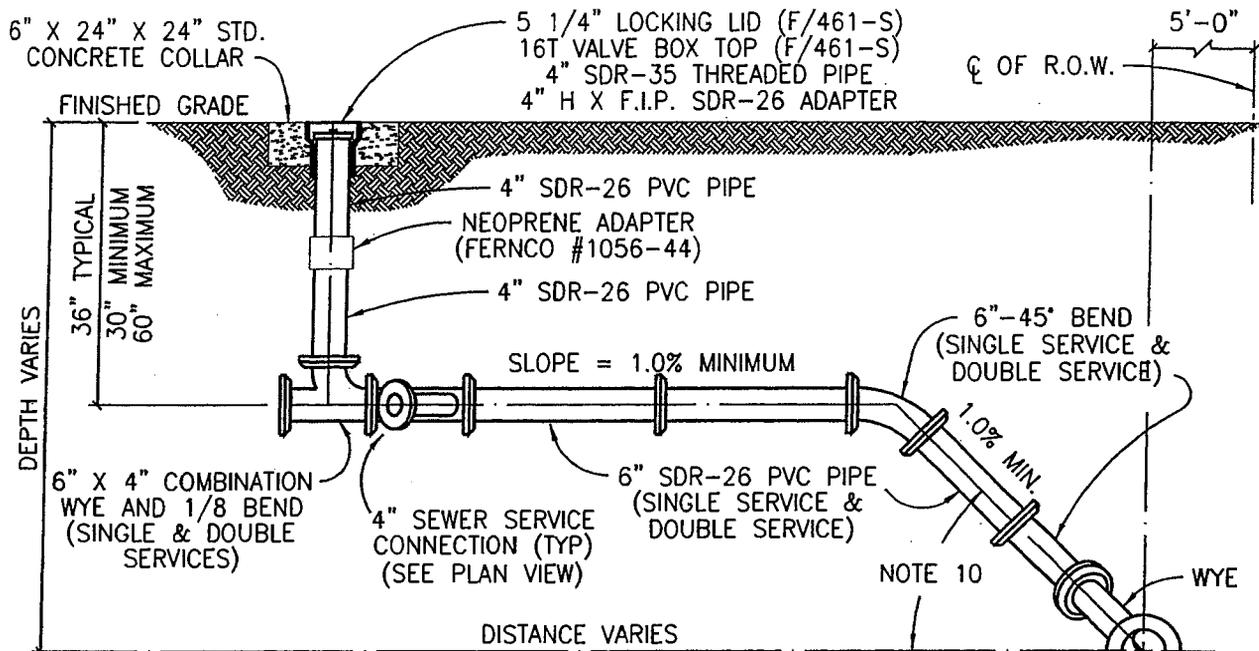


5 1/4" LOCKING LID
(F/461-S)



SEWER CLEAN-OUT
CITY OF MARBLE FALLS
(RESIDENTIAL SERVICE)

CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	_____ Approved	_____ Date
SEWER CLEAN-OUT DETAIL		Drawn by: SDK Detail No. WW12.DWG



NOTES:

1. SERVICE CONNECTION RISERS SHALL TERMINATE 6' INSIDE THE PROPERTY LINE.
2. THE END OF EACH SERVICE CONNECTION RISER SHALL BE EXTENDED 12" ABOVE FINISH GRADE.
3. EACH SERVICE CONNECTION SHALL BE PLUGGED WATER-TIGHT WITH AN APPROVED CAP OR PLUG.
4. CUT OFF BELL END WHEN USING FERCO COUPLING FOR V.C.P. (FOR EXISTING SERVICES ONLY).
5. FOR P.V.C. INSTALLATIONS, CONNECT TO EXISTING "BELL END" AND CONNECT OPPOSITE END WITH P.V.C. TO P.V.C. KNOCK ON SLEEVE.
6. SOLIDLY TAMP BACKFILL AT LEAST ONE FOOT (1'-0") ABOVE TOP OF PIPE. SERVICES UNDER PAVED AREAS SHALL BE BACKFILLED TO THE SAME SPECIFICATIONS AS SHOWN ON PAVEMENT REPLACEMENT DETAIL.
7. CONTRACTOR SHALL MARK ON A CLEAN SET OF PLANS THE FINAL STATIONING OR DISTANCE AND DIRECTION FROM MANHOLE TO EACH SERVICE LATERAL AND GIVE TO ENGINEER FOR RECORD DRAWING PURPOSES.
8. ANY DEVIATION FROM THESE METHODS SHOULD BE APPROVED BY THE CITY OF MARBLE FALLS PUBLIC WORKS DEPARTMENT.
9. SERVICE LINE MATERIAL SHALL BE P.V.C., SDR-26.
10. SEWER SERVICE SLOPE TO BE 1/8% OFF CENTERLINE OF MAIN.

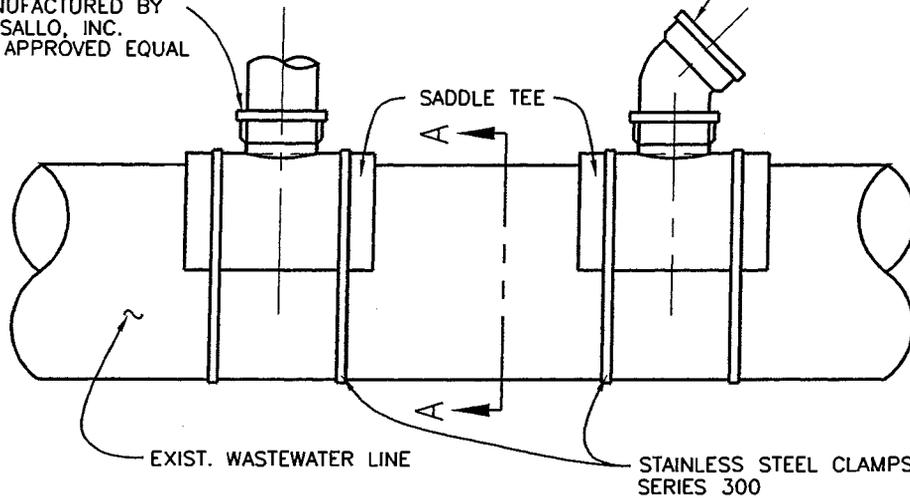
DECOR SYMBOL

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
SEWER SERVICE CONNECTION		Detail No. WW13.DWG

GASKETED SEWER FITTING
NO. 52635 (6") AS
MANUFACTURED BY
VASSALLO, INC.
OR APPROVED EQUAL

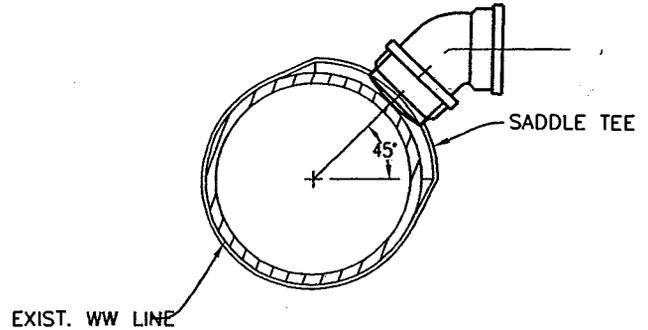
1/8 BEND-SPIGOT



PLAN VIEW

SADDLE TEE				
PART NO.	SIZE	L1	H	P
52635	8"X6"	5.625	5.659	1.448

PLASTIC TRENDS INC. - 1/8 BEND - SPIGOT					
PART NO.	SIZE	A	B	C	D
G 406	6	11.270	6.146	1.870	6.090



SECTION A-A

- NOTES: 1. FLEXIBLE SADDLE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S REQUIREMENTS.
 2. SADDLE TEE SHALL BE ORIENTATED 45° TO MAIN. (SEE SEWER SERVICE CONNECTIONS DETAIL - DWG # WW-13)
 3. EXCAVATE AROUND EXISTING 8-INCH PIPE, EXPOSING SUFFICIENT ROOM FOR S.S. CLAMPS.
 4. THOROUGHLY CLEAN AND DRY THE MATING SURFACE WITH RAG OR PAPER TOWEL MAKE SURE THEY ARE FREE OF DUST AND MOISTURE.
 5. MARK THE SIZE OF THE HOLE TO BE CUT USING THE GASKET SKIRT OR THE SADDLE ITSELF AS THE TEMPLATE.
 6. SAW OUT THE SECTION OF THE PIPE WHERE THE SADDLE WILL BE LOCATED, WITH A SABER OR KEY HOLE SAW.
 7. TEST TO MAKE SURE SADDLE FITS HOLE PROPERLY.
 8. SERVICE PIPE SHALL NOT EXTEND MORE THAN ONE-HALF INCH INTO THE MAIN.
 9. PLACE GASKET SKIRT AND SADDLE OVER OPENING AND TIGHTEN BAND CLAMPS EVENLY UNTIL SADDLE IS FIRMLY ATTACHED TO THE PIPE. APPLY PRESSURE ON THE SADDLE AGAINST THE PIPE WHILE TIGHTENING THE CLAMPS AS INDICATED ABOVE. DO NOT OVER TIGHTEN, DO NOT STRIP THREAD.
 10. REPLACE THE BEDDING AND BACKFILL IN ACCORDANCE WITH THE TRENCH EMBEDMENT DETAIL.

CITY OF MARBLE FALLS, TEXAS

Scale:
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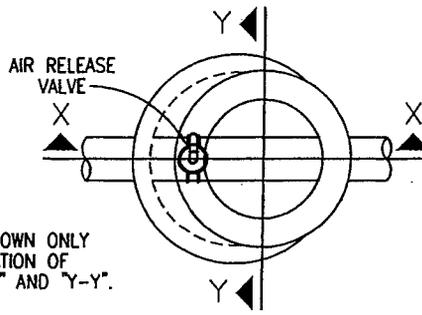
Approved _____

Date _____

Drawn by:
SDK

GASKETED SEWER FITTING FOR SEWER
SERVICE CONNECTIONS TO
EXISTING MAINS

Detail No.
WW14.DWG

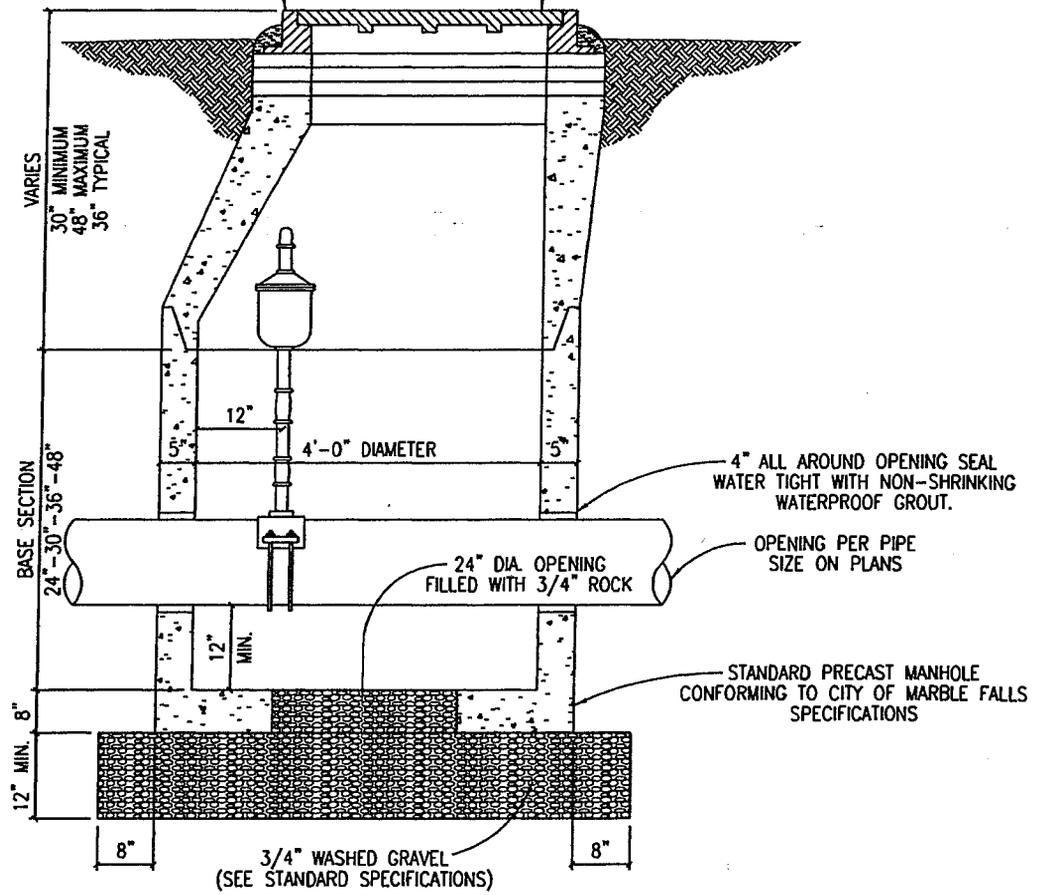


NOTE:
 PLAN VIEW SHOWN ONLY
 FOR CLARIFICATION OF
 SECTION "X-X" AND "Y-Y".

PLAN

ADJUST WITH GRADE RINGS
 AND MORTAR TO BRING TO 4"
 ABOVE GRADE (2 COURSES
 MIN. AND 5 COURSES MAX.).

FRAME AND COVER SHALL BE
 EAST JORDAN IRON WORKS
 (AS PER DETAIL #WW-07) OR
 APPROVED EQUIVALENT AND
 SHALL BE 4" ABOVE FINISH GRADE.



SECTION "X-X"

CITY OF MARBLE FALLS, TEXAS

Scale:
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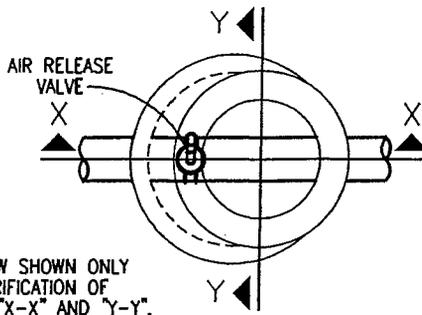
Approved _____

Date _____

Drawn by:
 SDK

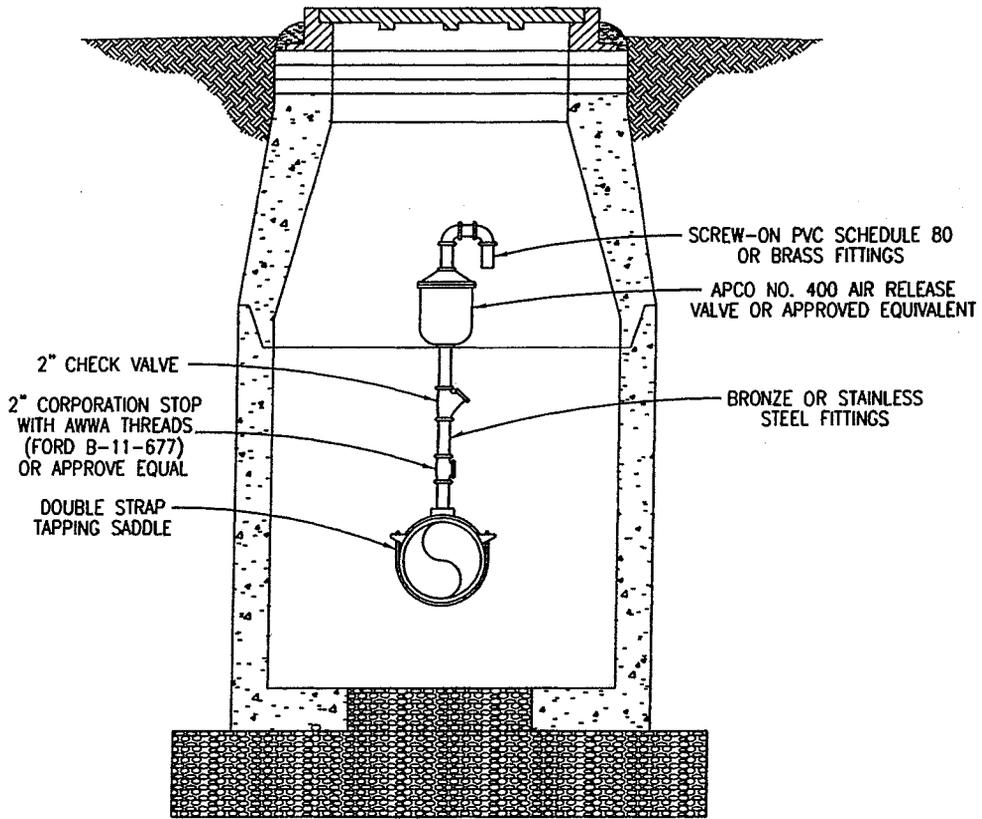
STANDARD AIR RELEASE VALVE
 FOR FORCE MAIN

Detail No.
 WW15.DWG



NOTE:
 PLAN VIEW SHOWN ONLY
 FOR CLARIFICATION OF
 SECTION "X-X" AND "Y-Y".

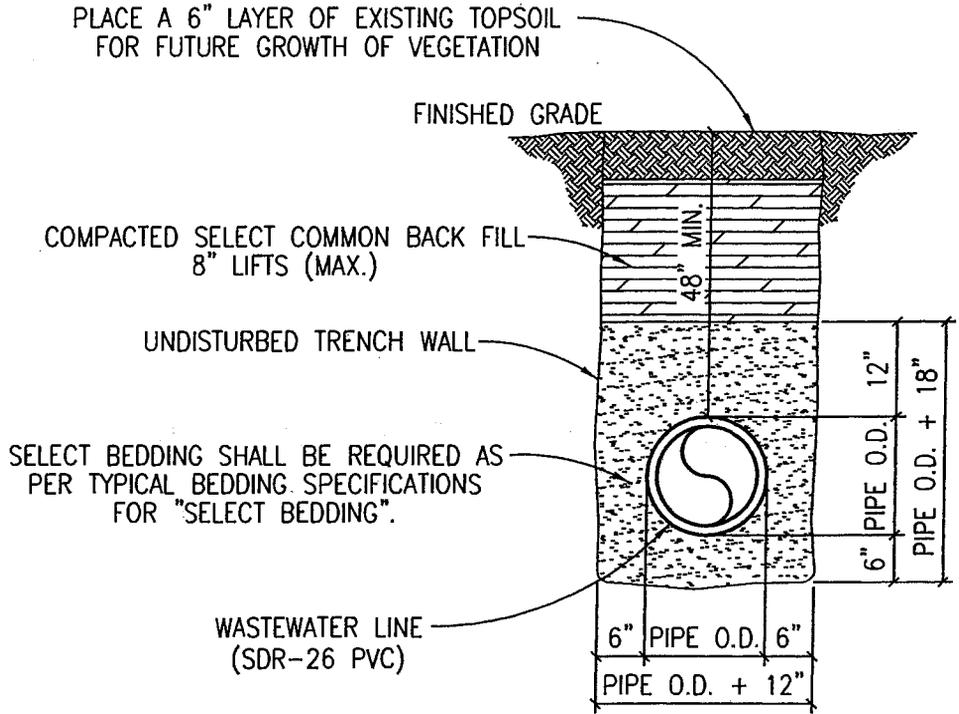
PLAN



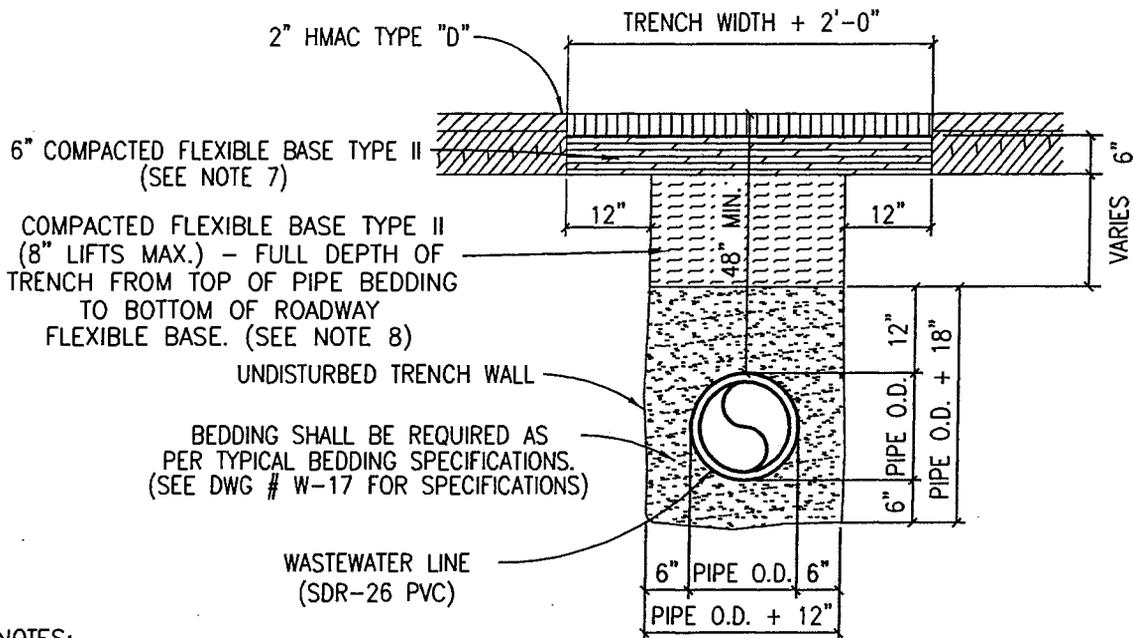
SECTION "Y-Y"

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
STANDARD AIR RELEASE VALVE FOR FORCE MAIN-END VIEW		Detail No. WW16.DWG



CITY OF MARBLE FALLS, TEXAS		
Scale: N.T.S.	Approved _____	Drawn by: SDK
	Date _____	
TRENCH AND EMBEDMENT DETAIL UNDER NON-PAVED AREAS		Detail No. WW17.DWG

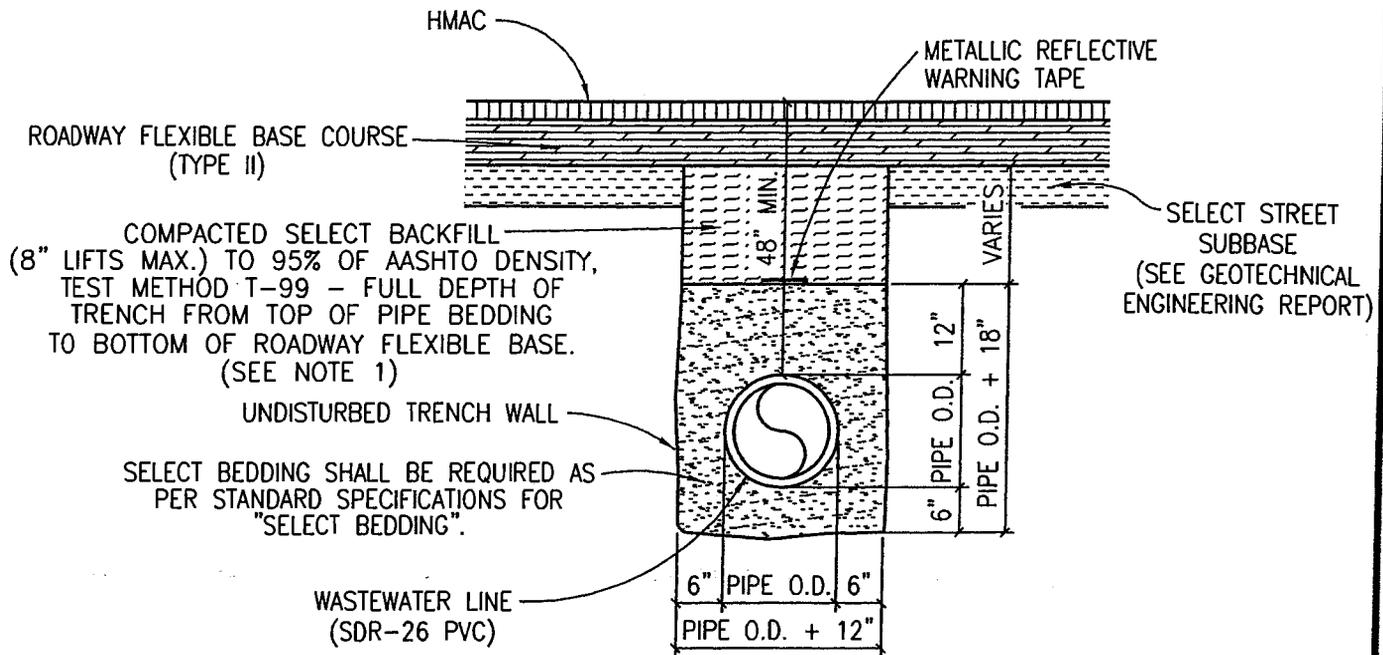


NOTES:

1. REPLACED BASE MATERIAL OVER DITCH SHALL BE TWICE THE THICKNESS OF THE ORIGINAL BASE.
2. BASE MATERIAL SHALL BE PLACED IN TWO OR THREE LAYERS AND EACH LAYER THOROUGHLY ROLLED OR TAMPED TO SPECIFIED MAXIMUM DENSITY.
3. ASPHALT CONCRETE PAVEMENT JOINTS SHALL BE MECHANICALLY SAWED.
4. SURFACE MATERIAL WILL BE CONSISTENT WITH THE EXISTING SURFACE.
5. A MINIMUM OF ONE DENSITY TEST SHALL BE TAKEN EVERY TWO HUNDRED (200) FEET FOR EACH SIX (6) INCH LIFT OF SUBGRADE AND EACH OPEN CUT CROSSING. PROCTORS FOR MATERIALS USED IN BACKFILLING SHALL BE OBTAINED BY A CERTIFIED LABORATORY. DENSITY TESTS SHALL BE CONDUCTED BY A CERTIFIED LABORATORY OR THE PERMITTEE'S CONSULTANTS. THE PERCENTAGE OF MAXIMUM DENSITY REQUIRED SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF "THE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" AT THE TIME THE PERMIT WAS ISSUED. ALL DENSITY TESTS SHALL BE COMPLETED AND ACCEPTED ON EACH LAYER PRIOR TO ADDITIONAL BACKFILLING. A COPY OF ALL COMPLETED AND ACCEPTED DENSITY TESTS SHALL BE FURNISHED TO CITY OF MARBLE FALLS.
6. THESE SPECIFICATIONS MAY BE SUPERSEDED BY THE GOVERNING AGENCY.
7. FLEXIBLE BASE TYPE II: (ROADWAY BASE)
 TxDOT TYPE A - GRADE 2 OR BETTER CRUSHED LIMESTONE BASE COMPACTED TO 98% OF TxDOT 113E AT OPTIMUM MOISTURE. PROCTOR TO BE PROVIDED BY THE CONTRACTOR TO THE CITY INSPECTOR.
8. FLEXIBLE BASE TYPE II: (TRENCH BACKFILL)
 TxDOT TYPE A - GRADE 2 OR BETTER CRUSHED LIMESTONE BASE COMPACTED TO 95% OF TxDOT 113E AT OPTIMUM MOISTURE. PROCTOR TO BE PROVIDED BY THE CONTRACTOR TO THE CITY INSPECTOR.
9. CONTRACTOR OR ENGINEER MAY REQUEST FOR USE OF ALTERNATE BACKFILL MATERIAL. ALTERNATE MATERIALS AND TESTING PROTOCOL MUST BE SUBMITTED TO AND APPROVED BY THE CITY ENGINEER PRIOR TO USE.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
TRENCH AND EMBEDMENT AND PAVEMENT REPLACEMENT DETAIL UNDER EXISTING ROADWAY		Detail No. WW18.DWG



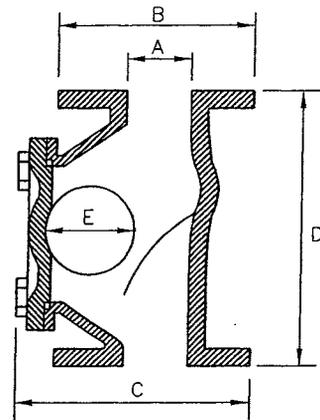
NOTES:

1. A MINIMUM OF ONE DENSITY TEST SHALL BE TAKEN EVERY TWO HUNDRED (200) FEET FOR EACH EIGHT (8) INCH LIFT OF SELECT BACKFILL. PROCTORS FOR MATERIALS USED IN BACKFILLING SHALL BE OBTAINED BY A CERTIFIED LABORATORY. DENSITY TESTS SHALL BE CONDUCTED BY A CERTIFIED LABORATORY OR THE PERMITTEE'S CONSULTANTS. THE PERCENTAGE OF MAXIMUM DENSITY REQUIRED SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF "THE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" AT THE TIME THE PERMIT WAS ISSUED. ALL DENSITY TESTS SHALL BE COMPLETED AND ACCEPTED ON EACH LAYER PRIOR TO ADDITIONAL BACKFILLING. A COPY OF ALL COMPLETED AND ACCEPTED DENSITY TESTS SHALL BE FURNISHED TO CITY OF MARBLE FALLS. BACKFILL COMPACTION SHALL BE A MINIMUM OF 95% MAXIMUM DENSITY PER TxDOT 113E SPECIFICATIONS.
2. THESE SPECIFICATIONS MAY BE SUPERSEDED BY THE GOVERNING AGENCY.
3. CONTRACTOR OR ENGINEER MAY REQUEST FOR USE OF ALTERNATE BACKFILL MATERIAL. ALTERNATE MATERIALS AND TESTING PROTOCOL MUST BE SUBMITTED TO AND APPROVED BY THE CITY ENGINEER PRIOR TO USE.
4. REFER TO GEOTECHNICAL ENGINEERING FIRM'S "PAVEMENT DESIGN" REPORT FOR SUBGRADE, FLEXIBLE BASE AND PAVEMENT REQUIREMENTS.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
TRENCH AND EMBEDMENT DETAIL UNDER PROPOSED ROADWAY		Detail No. WW19.DWG

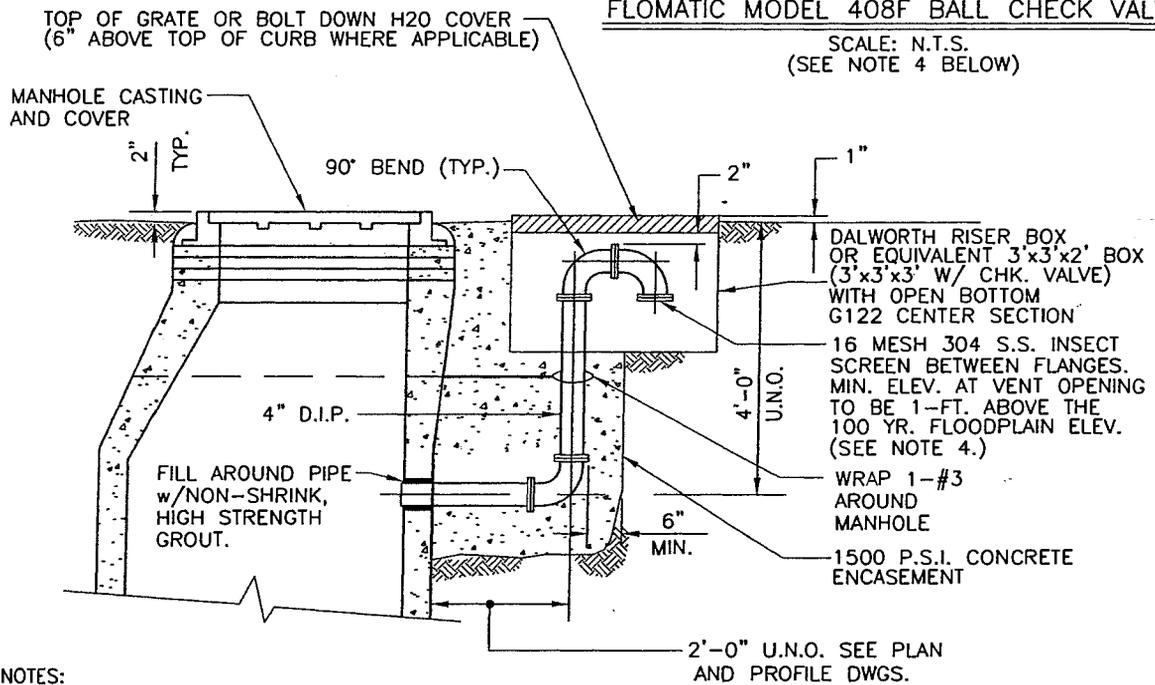
A	B	C	D	E
4"	9"	11 1/8"	12 1/4"	4 3/4"



SECTION

FLOMATIC MODEL 408F BALL CHECK VALVE

SCALE: N.T.S.
(SEE NOTE 4 BELOW)

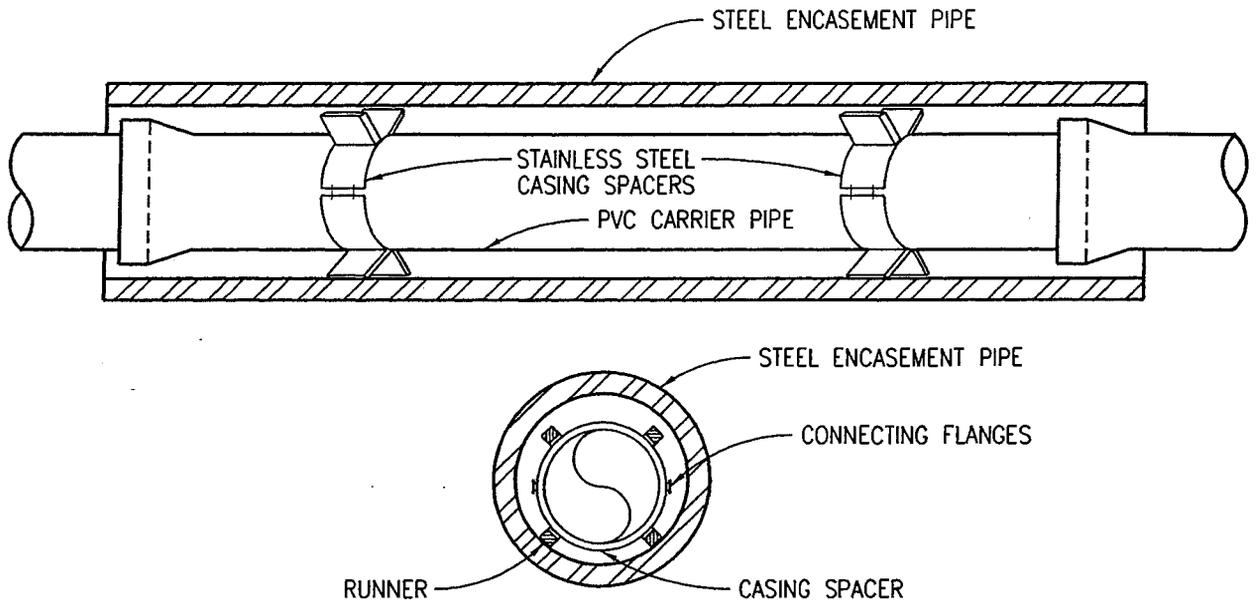


NOTES:

1. AIR INTAKE PIPE TO BE D.I.P., CLASS 53 WITH FLANGED CONNECTIONS.
2. ALL FITTINGS TO BE 150 PSIG RATED & ANSI/AWWA C110/A21.10.
3. SURFACE PREP ABOVE GROUND PIPING TO SSPC10-63, N.A.C.E. NO.2 STANDARD. APPLY EPOXY PRIMER 2-4 MIL, DFT FOLLOWED BY 2 COATS OF AMINE ADDUCT CURED, HIGH-BUILD EPOXY (TWO COMPONENT EPOXY POLYAMIDE) 8-10 MIL DFT, NON-LEAD CEDAR GREEN COLOR.
4. IF ELEVATION OF VENT OPENING IS LESS THAN 1-FT. ABOVE 100 YR. FLOODPLAIN, FLOMATIC MODEL 408F BALL CHECK VALVE OR EQUAL WITH FLOATING TYPE BALL TO BE INSTALLED AT DOWNTURNED OPENING OF VENT. (SEE DIMENSIONAL DETAIL ABOVE RIGHT). 16 MESH 304 S.S. INSECT SCREEN TO BE PLACED IN THE OPENING.

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____ Date _____	Drawn by: SDK
MANHOLE VENT FOR BELOW GROUND INSTALLATION		Detail No. WW20.DWG



NOTES:

1. CASING SPACERS SHALL BE BOLT ON STYLE WITH A SHELL MADE IN TWO SECTIONS OF HEAVY T-304 STAINLESS STEEL. CONNECTING FLANGES SHALL BE RIBBED FOR EXTRA STRENGTH. CASING SPACERS SHALL BE MADE BY CASCADE WATERWORKS MFG. CO. OR APPROVED EQUAL.
2. CASING SPACERS SHALL HAVE RUNNERS MADE OF ULTRA HIGH MOLECULAR WEIGHT POLYMER, WITH A MINIMUM HEIGHT OF 2 INCHES.
3. DO NOT USE WEDGES BETWEEN TOP OF PVC CARRIER PIPE AND INSIDE OF CASING TO KEEP PVC FROM MOVING.
4. PRIOR TO INSERTING PVC CARRIER PIPE, ANY WATER SHOULD BE PUMPED OUT OF THE CASING PIPE SO THAT NO MORE THAN A FEW INCHES OF WATER REMAINS.
5. SPACERS WILL BE REQUIRED WITHIN AT LEAST 3 FEET FROM BOTH OPENINGS OF THE ENCASEMENT PIPE AND SPACED NO GREATER THAN 6 FEET THROUGHOUT THE ENCASEMENT PIPE.
6. CASING SPACERS WILL NOT BE PAID DIRECTLY BUT SHALL BE CONSIDERED SUBSIDIARY TO THE APPROPRIATE BID ITEM FOR INSTALLING PVC PIPE.
7. ENCASEMENT PIPE SHALL BE SMOOTH STEEL 35,000 PSI YIELD STRENGTH WITH THICKNESS ACCORDING TO THE FOLLOWING TABLE:

PIPE SIZE—CARRIER (DIAMETER)	PIPE SIZE—CASING (DIAMETER)(MIN.)	MINIMUM PIPE THICKNESS (INCHES)	
6"	16"	1/4	0.2500
8"	18"	1/4	0.2500
10"	20"	5/16	0.3125
12" - 14"	24"	3/8	0.3750
16" - 18"	30"	7/16	0.4375
20"	36"	1/2	0.5000
24"	42"	1/2	0.5000
30"	48"	1/2	0.5000

CITY OF MARBLE FALLS, TEXAS

Scale: N.T.S.	Approved _____	Date _____	Drawn by: SDK
INSTALLATION OF P.V.C. PIPE THROUGH CASING			Detail No. WW21.DWG