CITY OF COPPERAS COVE

DEPARTMENT OF PUBLIC WORKS
AND ENGINEERING DEPARTMENT

STANDARD SPECIFICATIONS

Revised April 2018

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General Statements

1. These specifications and associated details were created with the intent of standardizing the infrastructure for the City of Copperas Cove. In the event of a conflict between these specifications and state and/or federal regulations, the state and/or federal regulations shall govern.
2. Please note that the Standard Details are numbered so that they correspond to the primary specification to which they are related.
3. The City of Copperas Cove reserves the right to limit the purchase of specific items and appurtenances to those in these specifications, provided the items conform to the provisions herein. The intent is to reduce the amount of various manufacturers' replacement parts that the City's maintenance department must keep on hand.
4. The "Measurement" and "Payment" sections included in these Standard Specifications are for projects bid out by the City of Copperas Cove, such as Capital Improvement Projects, repair projects, etc. Permanent improvements for developments that will subsequently be accepted by the City do not have to use these sections, but the remaining sections of the specifications still apply.

Specifications 100-199: General

100 - Mobilization

A. Description

This item shall govern the mobilization of personnel, equipment, and supplies at the project site in preparation for beginning work on other contract items. Mobilization shall include, but is not limited to, the movement of equipment, personnel, material, supplies, etc., to the project site and the establishment of office and other facilities necessary prior to beginning the work. Examples of inclusive material are those typical of payment aspects designated as large “EA” items (such as manholes, fire hydrants, water valves, etc.), or “LF” items such as (water or sewer main piping).

B. Measurement

Measurement of the Item, Mobilization, as specified herein, will be by the “Lump Sum,” as the work progresses.

C. Payments

Partial payments of the “Lump Sum” bid for mobilization will be as follows: (The adjusted contract amount for construction items, as used below, is defined as the total contract amount, less the lump sum bid for Mobilization and Preparing Right-Of-Way).

a. When 1% of the adjusted contract amount for construction items is earned, 50% of the “Lump Sum” bid or 5% of the total contract, whichever is less, will be paid.

b. When 5% of the adjusted contract amount for construction items is earned, 75% of the “Lump Sum” bid or 10% of the total contract amount, whichever is less, will be deducted from the above amount.

c. When 10% of the adjusted contract amount for construction items is earned, 90% of the “Lump Sum” bid or 15% of the total contract amount, whichever is less, will be paid. Previous payments under this item will be deducted from the above amount.

d. Upon completion of all work under this contract, payment for the remainder of the “Lump Sum” bid for Mobilization will be made.

NOTES: Cost for Insurance and Bond is inclusive to cost of Mobilization.

e. Payment shall be made by the Inspector for approved materials stored on the project site that are deemed necessary and required for the “PROJECT WORK” in accordance with all contract documents.

110 - Right of Way Preparation

A. Description

This item shall govern preparing the right-of-way for construction operations by removing and disposing of obstructions from the right-of-way and from designated easements where removal of such obstructions is not otherwise provided for in the contract documents.

Such obstructions shall be considered to include: trees and other vegetation, existing fencing, topsoil removal and stockpile, and other debris, as well as the installation and removal of tree protection, where called for in the drawings. This item shall also include obstructions specifically included in the project-specific provisions, specifications, and drawings.

Unless shown otherwise in the contract documents, all fences along the right-of-way which are damaged or removed temporarily by the Contractor shall be replaced by the Contractor to an equal or better condition, at no additional cost to the City.

B. Construction Methods

Areas designated in the contract documents shall be cleared of all obstructions, vegetation, abandoned structures, etc., as defined above, except trees or shrubs specifically designated by the engineer for preservation. Trees and shrubs designated for preservation shall be carefully trimmed as directed and shall be protected from scarring, barking, or other injuries during construction operations. Exposed ends of pruned limbs shall be treated with an approved pruning material.

Unless otherwise indicated in the contract documents, all underground obstructions shall be removed to the following depths:

a. In areas to receive embankment, 2 feet below starting grade.

b. In areas to be excavated, 2 feet below the lowest elevation of the excavation;

c. All other areas, 2 feet below finished grade.

Holes remaining after removal of obstructions shall be backfilled and tamped as directed by the Inspector, and the entire area shall be bladed to prevent ponding of water and to provide drainage. In areas that are to be immediately excavated, backfilling and blading may be eliminated, if approved by the Inspector. Areas to be used as borrow sites and material sources shall have obstructions removed to the complete extent necessary to prevent such objectionable matter from becoming mixed with the material to be used in the construction.

Material to be removed will be designated as “salvageable” or “non-salvageable” in the contract documents prior to bidding by the Contractor. All “salvageable” material will remain the property of the CITY and will be stored at the site as directed by the Inspector. All “non-salvageable” materials and debris removed shall become the property of the Contractor and shall be removed from the site and shall be disposed of properly.

All asphaltic material shall be disposed of or recycled at the facility authorized to accept the asphalt for such purposes and applicable to appropriate guidelines and regulations.

C. Measurement

Preparing Right-of-Way for new construction will be measured by the “Lump Sum.”

D. Payment

This item will be paid for at the contract “Lump Sum” price bid for Preparing Right-of-Way, which price shall be full compensation for work herein specified, including the furnishing of all materials, equipment, tools, labor, and incidentals necessary to complete the work. 10% of the payment will be withheld until final construction payment.

E. Notes

Additional requirements: Adherence to City Tree Protection Requirements, Section 170.

120 - Trench Excavation & Backfill

A. Description

This item shall govern all excavation, trenching, and backfilling for utility lines and appurtenant structures, which shall conform to the requirements of this specification and to the applicable typical details attached to these specifications. The amount of trench open in advance or left open after pipe laying shall be limited to the length that can be backfilled within the same day.

B. 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. Over-depth excavation shall be avoided. All excavation, regardless of the materials encountered, shall be unclassified so far as payment is concerned.

a. 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 laid back from a point six (6) inches above the pipe. If trenching for utilities indicates seepage of ground water into the area under the road bed, subsurface drainage, as approved by the City Engineer, shall be installed.

b. 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.

c. 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.

C. 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 City Engineer will direct the Contractor when and where to place washed gravel.

D. Backfill

Backfill shall be of three types: Granular embedment, Select Backfill, and Trench Backfill

a. Granular Embedment

Granular Embedment shall be used under, around, and over all utility lines in accordance with the standard details for utility trenches, except that service lines in soil not containing rock may be installed without embedment. Granular embedment shall be defined as 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 Engineer's approval.

Granular embedment shall be replaced to a grade slightly higher than required for the grade. Wedging or blocking up of pipe will not be permitted. Each pipe section shall have a uniform bearing on the embedment for the length of the pipe, except for immediately at the joint. Embedment under either water or sewer lines shall amount to at least four (4) inches in earth cut and six (6) inches in rock cut. Granular embedment over the pipe shall be at least twelve (12) inches.

Where sand of a quality meeting the requirements for granular embedment material is encountered in the trench excavation, it may be stockpiled and used in lieu of material from other sources. Compaction of granular embedment by flooding will not be permitted.

"Crusherfines" do not constitute approved embedment material.

b. Select Backfill

Select backfill shall be used for a depth of twelve (12) inches immediately below the base 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, and shall have a Plasticity Index less than twenty (20). 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 be rock, and not 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. Select backfill shall be compacted to not less than ninety-five (95) percent of Modified Proctor Density, ASTM Designation D1557, in layers of not over four (4) inches in thickness. Compaction method shall be approved by City Engineer.

c. Other Trench Backfill:

In areas outside of streets, drives, and in streets below select backfill material, etc., trench backfill above embedment material may be accomplished by the use of excavated material if the material is suitable for compaction and contains only an occasional rock up to eight (8) inches in greatest dimension.

Trench backfill in areas outside of streets, drives, etc., will not be tested for density, but the material shall be compacted and the entire area left in a neat and orderly condition with excess material mounding over the trench. After a suitable length of time to permit settling, the trench surface shall be brought to a smooth grade.

Trench backfill in streets below select backfill shall be compacted to ninety-five (95) percent modified Proctor Density.

Trench backfill outside of streets shall be compacted to ninety (90) percent modified Proctor Density.

E. 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.

F. Payment

Payment for this item shall be subsidiary to the item to which it relates. Payment shall include all labor, material, equipment to accomplish this item.

121 - Trench Safety Systems

A. 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. 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.

B. 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 Rule published in the Federal Register (59 FR 40730) on August 9, 1994. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652. Legislation that has been enacted by the Texas Legislature (H.B. No. 662, H.B. 665 and Texas Health and Safety Code, Title 9, Ch. 756, Sub. C. Trench Safety) 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 registered professional engineer” (1926-652(b)(4) and 1926-652(c)(4)), the “registered professional engineer” shall be a Professional Engineer Registered in the State of Texas.

C. Safety Program

The Contractor shall submit a safety program and trench design specifically for the construction of trench excavation. Trench design shall be signed by a Professional Engineer licensed in the State of Texas.

The trench safety program shall be in accordance with OSHA standards governing the presence and activities of individuals working in and around trench excavation.

D. 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.

E. Measurement

This item shall be measured by the “Lump Sum”.

F. Payment

This item will be paid for at the contract "Lump Sum" price bid for Trench Safety Systems, which price shall be full compensation for work herein specified, including the furnishing of all materials, equipment, tools, labor, and incidentals necessary to complete the work. 10% of the payment will be withheld until final construction payment.

122 - Pavement Restoration

A. Description

This item shall govern the restoration of pavement after the construction of a utility within a roadway.

B. Materials

Materials for pavement restoration shall be in accordance with Section 500 – Streets, Walks, and Driveways, of these specifications.

C. Construction

Existing pavement shall be precut, sawed or scored so as to result in an even, 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 for a minimum of 12" on each side of the trench wall. 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 Modified Proctor Density, ASTM Designation D1557.

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. Asphalt shall be installed such that after rolling and compaction the restored area will be level with the existing surface.

D. Measurement

Street restoration shall be measured by the square foot of surface replaced.

E. Payment

Payment for Pavement Restoration shall be paid for at the contract unit price bid for each square foot of surface replaced. Payment shall include all equipment, labor, material, tools, and incidentals necessary for the complete replacement as called for in the plans and details.

130 - Encasement Pipes, Jacking & Boring

A. Description

This item shall govern the installation of water or sanitary sewer lines through a casing piping using boring and/or jacking technologies to avoid disturbance to surface features.

B. Submittals

Contractor shall submit manufacturer's product data, instructions, and recommendations.

C. Materials

1) Encasement Pipe

All carrier pipes installed by boring or jacking shall be placed in an encasement pipe.

The minimum nominal size of the casing shall be large enough to accommodate the outside diameter of the bells of the carrier (main) pipe plus two (2) inches, unless otherwise required by the railroad and/or TxDOT. All casing pipes exposed to the atmosphere must be painted per the standard specifications.

Casing shall be steel with a minimum thickness of:

a) 1/4-inch for casings up to and including 18-inch nominal diameter
b) 3/8-inch for casings greater than 18-inch and up to and including 24-inch nominal diameter
c) 1/2-inch for casings greater than 24-inch and up to and including 42-inch nominal diameter.
d) Larger casings shall have their thickness determined by the engineer of record.

2) Joints

All joints for the carrier pipe shall be mechanically restrained within the limits of the encasement pipe. This includes pressure and gravity pipelines.

3) Spacers

Casing spacers shall be provided for all boring/jacking operations. The casing spacers shall have stainless steel bands and fasteners with reinforced plastic runners. The size, length, number, and location of the spacers shall be per the manufacturer's recommendation. Approved spacing manufacturers are Phoenix (Cascade Manufacturing Co.), Advanced Products and Systems, Inc., or pre-approved equal. All metal hardware shall be stainless steel, acceptable for use in sewage environments.

4) Annular Space

The annular spaces on the outside of the encasement pipe shall be filled by pressure grouting for the entire length before the carrier pipe is set in place.

5) Encasement Ends

The ends of the encasement pipe will be sealed with a boot or seal wrap to prevent migration of adjacent backfill into the encasement pipe. End seals shall be made from 1/8" thick neoprene rubber, Advanced Products and Systems, Inc. Model AWN, or pre-approved equal.

Waterline bores under State highways or large creeks/rivers (generally defined as bores in excess of 100 feet) shall have isolation valves provided on both sides of the bore.

D. Construction

1) Jacking

Suitable pits or trenches shall be excavated for the purpose of boring and jacking. Such pits and trenches shall be securely sheeted and braced in accordance with all laws and regulations. Boring and jacking operations shall not interfere with the operations of railroads, streets, highways, or other facilities.

The casing to be jacked shall be set on guides for support and to direct the casing in the appropriate line and grade. Material shall be excavated just ahead of the casing and the material removed through the pipe. The casing shall be forced through the opening created in this manner.

Generally, the line shall be jacked from the downstream end. Permissible lateral or vertical variation in the position of the pipe from line and grade will be as determined by the Engineer.

Any pipe that is damaged in jacking operations shall be removed and replaced at the Contractor's expense. Jacking pits/trenches shall be backfilled immediately upon completion of jacking operations. Jacking pits/trenches in streets shall be backfilled with twelve (12) inches of flowable fill or cement-stabilized backfill immediately below the subgrade.

2) Boring

Boring operations may include a pilot hole which shall be bored the length of the crossing and used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings, and shall be disposed of in an appropriate manner. Variation in line and grade shall apply as specified under "Jacking".

3) Joints

The casing shall be supported using the spacers at distances as recommended by the manufacturer. The joints for water pipe shall be restrained in accordance with manufacturer recommendations and using restraints appropriate to the pressure requirements.

E. Measurement

This item shall be measured by the linear foot of boring or tunnel as measured from face to face of the jacking pits.

F. Payment

The work performed and materials furnished as specified, shall be paid for at the contract unit price bid per linear foot of jacking, and tunneling. Such price shall include the boring, casing, carrier pipe, casing spacers, end seals, grout, labor, tools, equipment, and incidentals necessary to complete the work, including excavation, backfill, grouting, restoration to original ground conditions, and disposal of surplus materials necessary to install a complete casing with the carrier pipe inserted to the grade, alignment, and length as specified on the plans.

140 - Fencing

A. Description

This item shall govern furnishing and installing fencing and gates at locations shown on the Drawings or directed by the Engineer or designated representative, including all posts, bracing and accessories as specified in this Item and as indicated on the Drawings. Reference to TxDOT requirements.

B. Materials

a. Chain Link Fencing

Chain link fencing shall conform to the requirements of TxDOT Item 550 – Chain Link Fence.

b. Woven Wire Fencing

Woven wire fencing shall be either galvanized steel wire fencing or aluminum-coated steel wire fencing conforming to the following requirements:

1. Galvanized steel wire fencing shall conform to ASTM A116, Class 1.
2. Aluminum-coated steel wire fencing shall consist of aluminum-coated steel wire conforming to the requirement for galvanized steel wire fencing, except the wire shall be aluminum coated. The wire shall not have less than 0.40-ounce coating of aluminum alloy per square foot of uncoated surface in accordance with ASTM A491

c. Wire Fencing

Wire fencing shall conform to the requirements of TxDOT Item 552 – Wire Fence.

d. Wood Fencing

Wood for wood fencing shall be Wolmanized pine, cedar or as indicated on the Drawings. The timber shall be sound and free from all decay, shakes, splits or any other defects, which would make it structurally unsuitable for the intended purpose.

e. Mowing Strip

When called out in the drawings, a mowing strip shall be Class A concrete. It shall be 24 inches wide and a minimum of four (4) inches thick. Three number three (#3) bars shall be evenly spaced and supported along the full length of the mow strip, and a number three (#3) bar shall be cross-tied every four (4) feet. Fence posts shall be installed in center of mow strip.

C. Construction Methods

a. Chain Link Fence

The Chain Link Fence shall be erected to lines and grades established by the Engineer or designated representative in accordance with the details indicated on the Drawings. The fence shall be true to line, taut and shall comply with the best practice for fence construction of this type.

Construction of the chain link fence shall also be governed by TxDOT Item 550 – Chain Link Fence.

b. Wire Fencing

Wire fencing shall be governed by TxDOT Item 552 – Wire Fence.

c. Wood Fencing Material

After all posts have been permanently positioned and anchorages firmly set, stringers shall be placed and boards secured to the stringers. Other techniques utilizing modular precut panels may be used, when indicated on the Drawings.

D. Removal and Relocation of Existing Fences

This item shall govern the removal and relocation of existing fence, gates and hardware to a new alignment at the location in conformance to the typical details indicated on the Drawings or as directed by the Engineer or designated representative.

1. Removal of Existing Material

The existing boards, fabric, posts, wire, rails, braces, hardware, gates and miscellaneous items shall be carefully removed, bundled, rolled and stockpiled as indicated on the Drawings for installation at the new fence assignment. The removal and handling shall be such that the fence materials may be reused in the relocated fence, if indicated by the project drawings, provisions, and/or specifications.

a. Removal of Fabric and Wire

Fabric and wire of all types shall be carefully untied or disassembled from the posts and other appurtenances and shall be rolled in bundles of a size that will allow handling with ordinary equipment.

b. Removal of Posts

Posts shall be carefully removed from the ground and the concrete footing removed. The concrete shall be disposed of off-site. Post holes shall be filled with suitable embankment material and thoroughly compacted.

c. Removal of Boards

Boards of all types shall be carefully disassembled from the rails and other appurtenances to facilitate removal in panels. Excess material removed shall be disposed of as indicated below.

d. Storage of Materials

Storage of all salvageable materials that will be reinstalled at a new location shall be stored on-site or at such other locations as the Contractor may elect, subject to approval by the Engineer or designated representative. Security and maintenance of the salvageable materials shall be the responsibility of the Contractor.

e. Excess Materials

Materials, that are damaged, unsuitable for reinstallation or unnecessary for completion of the scope of the fence work in the new alignment shall be considered as excess but shall be offered to the Owner before removal from the site by the Contractor.

2. New Materials

   New materials that are required to complete the fence at the location indicated on the Drawings shall be of equal quality to the existing materials. Used materials from other projects or from the Contractor's own used material stocks will not be allowed. The new materials to be furnished will be those necessary to replace items from the existing fence which were damaged during removal operations or which for other reasons cannot be reused.

3. Construction Methods

   The removed fence shall be installed at the new assignment in accordance with the typical details indicated on the Drawings and shall comply with these specifications and the best practices for fence construction of the specified type.

E. Fencing for Excavations

This item to consist of temporary safety fencing supported on posts and constructed of materials as indicated and removed when excavation is backfilled.

1. Materials

   A. Fabric to be four (4) feet in width, made of high density polyethylene resin, extruded and stretched to provide a highly visible international orange, non-fading fence which will remain flexible from -60 F to 200 F, and be inert to most chemicals and acid. Pattern may vary from diamond to circular with a minimum weight per foot of 0.4 lbs./Ft., a 4-foot width minimum tensile yield strength (horizontal) of 2000 psi, ultimate tensile strength of 2680 psi (horizontal) and a maximum opening no greater than 2 inches.

   B. Posts

      Steel pipe, tee posts, U posts or 2" x 4” timber posts, 5½ feet in length minimum, spaced no more than 8 feet on centers. Fabric to be secured to post by bands or wire ties.

2. Construction Methods

Prior to commencing construction suitable "Barricades, signs and traffic handling" devices to be installed to protect workers and public. Safety fencing to be erected to lines and grades indicated. Excavations within 750 ft. of schools or day care centers require special attention by Contractor to secure entry while work is in progress. Fence to be installed prior to excavation and maintained until excavation is backfilled. Fence to be placed a minimum of 4 feet from edge of excavation. Posts to be driven in ground a minimum of 18 inches. At completion of each day's work, safety fencing to be pulled taut, and entry secured. When safety fence is no longer needed, Contractor to remove fence and posts and patch any damage to surfaces.

F. Measurement

All fence-related items shall be measured by the linear foot, except for gates, which will be measured by each gate.

G. Payment

The work performed and materials furnished as specified, shall be paid for at the contract unit price bid per linear foot of fencing. Gates shall be paid for at the contract unit price per each gate. Such price shall include all labor, tools, equipment, and incidentals necessary to complete the work as specified on the plans.

150 - Soil Decompaction

This item shall govern the materials and construction methods for decompacting soil to allow for water infiltration for root growth and drainage of storm water.

A. Definitions

1. Air tillage, fertilizer, mulch (AFM), is a soil decompaction and amendment process for trees involving decompaction with a pneumatic air tool while simultaneously incorporating organic matter and fertilizer into the soil.
2. Critical Root Zone: also called the root protection zone. This zone is defined as an area on the ground, generally circular, corresponding to the dripline of the tree.
3. Compacted soil: High density soil lacking structure and porosity and characterized by restricted water infiltration and percolation (drainage), and limited root penetration.
4. Permanent Wilting Point: Water content of a soil when most plants growing in that soil wilt and fail to recover their turgor upon rewetting.

Table 150.1

Soil type	Permanent wilt point v/v	Field capacity v/v
Sand, Loamy sand, Sandy loam	5 - 8%	12 - 18%
Loam, Sandy clay, Sandy clay loam	14 - 25%	27 - 36%
Clay loam, Silt loam	11 - 22%	31 - 36%
Silty clay, Silty clay loam	22 - 27%	38 - 41%

Source: 015639 Tree and Plant Protection Specification (www.isa-arbor.com)

5. Planting Soil: Approved topsoil and topsoil mix in accordance with ASTM D5268 “Standard Specification for Topsoil Used for Landscaping Purposes.”
6. Scarify: Loosening and roughening the surface of soil and sub soil prior to adding additional soil on top.
7. Soil Ripping: Loosening the soil by dragging a ripping shank or chisel through the soil to the depths and spacing specified.
8. Soil Tilling: Loosening the surface of the soil to the depths specified with a rotary tine tilling machine, roto tiller, or spade tiller.
9. Surface Soil Compaction: A maximum of six (6) inches deep and the result of traffic, light grading, or other impacts.
10. Subsoil or Deep Soil Compaction: Deeper than six (6) inches, and may be the result of previous grading, filling and dynamic or static compaction forces.
11. Topsoil: Naturally produced and harvested soil from the upper layers of the soil.
12. Vertical Mulching: A soil decompaction method for tree root zones involving drilling or air spading a series of shallow holes in the root zone and filling them with compost or other materials.

B. Materials

The Contractor shall be responsible for supplying all supplies and equipment in sufficient quantities so as to perform soil decompaction as necessary without delaying construction progress.

1. Compost: Blended and ground leaf, wood and other plant based material, composted for a minimum of nine (9) months and at temperatures sufficient to break down all woody

fibers, seeds and leaf structures, free of toxic material at levels that are harmful to plants or humans. Source material shall be yard waste trimmings blended with other plants or other materials designed to produce compost high in fungal material. Non-vegetal source materials may be acceptable upon approval by the Owner. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.

A. Compost shall be commercially prepared compost and meet US Compost Council STA/TMECC criteria or as modified in this section for "Compost as a Landscape Backfill Mix Component".

http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf

B. Mulch (hardwood): Mulch shall be coarse-ground and derived from hardwood (e.g., oak, elm) trees and woody brush sources. No more that 25% of the total volume shall be fine particles and no more than 20% of total volume shall be large pieces, where fine particles are defined as less than 3/8 inch in size and large pieces are defined as either larger than 1½ inch in diameter or longer than eight (8) inches. The mulch shall be free from foreign materials.

C. Construction Methods

1. General. Before initiation of decompaction activities, all required erosion control and environmental measures shall be in place as indicated on the drawings, and the depth(s) and location(s) of underground utilities shall be verified. The surface of the subgrade shall be shaped in general conformity with the typical sections, lines, and grades indicated on the drawings by the removal of existing material or by the addition of approved material as established by the Engineer.

   This specification covers decompaction of (1) surface soils (0 - 6 inches) and/or (2) subsoil (below 7 inches) as show on the drawings. Requirements for decompaction of soils within the critical root zones of existing trees are also described.

2. The following are general threshold levels of compaction as determined by three compaction testing methods, including the bulk density method, standard proctor method, and penetration resistance method.

   Compaction levels that are detrimental to root growth are dependent on soil type, which typically varies from site to site.

   Excellent to Good Compaction: Good rooting anticipated, but increasing settlement expected as compaction is reduced and/or in soil with a high organic matter content.

   Fair Compaction: Root growth is limited with fewer, shorter and slower growing roots.

   Poor Compaction: Roots not likely to grow but may penetrate soil when soil is above field capacity.

Table 150.2 Comparison of Compaction limits by various methods			
COMPACTION RATING	**BULK DENSITY (g/cm ^{3})**	**STANDARD PROCTOR (%)**	**PENETRATION RESISTANCE (PSI) [1]**
Excellent	<1.10 to	75 - 85%	75 - 125 [2]
Good	<1.60		126 - 175
Fair	1.39 to 1.69	>85%	176 - 225
Poor	>1.47 to >1.80		>225

[1] Acceptable test methods include ASTM D3441 Standard Test Method for Mechanical Cone Penetration or methods described in references such as Methods for Soil Analysis, Part 1, Physical and Mineralogical Methods, 2nd ed., EA Klute, ed. (Soil Science Society of America: Madison, WI 1986).

[2] Penetration resistance method: Below 75 psi soil becomes increasingly unstable and will settle excessively.

3. All soil management activities including amendment and/or decompaction must occur at a soil moisture content between 5 - 20% measured at the depth of the work.

4. Compacted Surface Soil (0 - 6 inches): Tilling. Surface tilling shall not be considered adequate to reduce compaction at depths seven (7) inches or greater below finished grade.

   A. After rough grading and removing all plants and debris from the surface, till top six (6) inches with a roto tiller, spade tiller, or other equipment approved by the Engineer. Spread three (3) inches of compost on the surface of the tilled soil.

   B. Till the compost into the loosened soil. Smooth out grades with a drag rake or drag slip. An even bed, with limited irregularities, lumps or soil clods shall be prepared. Clods or rocks larger than two (2) inches shall be removed.

5. Compacted Subsoil (7 - 24 inches): Soil Ripping

   A. After rough grading and removing all plants and debris from the surface, loosen the soil by dragging a ripping shank or chisel through the soil to depths of twenty-four (24) inches maximum. Shank spacing shall be as specified by the Engineer.

   B. At least three (3) separate series or patterns of movement are required.

      i. The first series or pattern of passes is applied lengthwise, parallel with the longest spread of the site; gradually progressing across the site's width, with each successive pass.
      ii. The second series runs obliquely, crossing the first series at an angle of about 45 degrees.
      iii. The third series runs at right angle or 90 degrees to the first series.

   C. Spread three (3) inches of compost or other specified amendment over the ripped area and till the material into the top six (6) inches of the soil surface using a roto-tiller or other approved method. An even bed, with limited irregularities, lumps or soil clods shall be prepared. Clods or rocks larger than 2" shall be removed.

6. Compacted Subsoil (7 - 24 inches): Subsoiling

   A. Drag a ripping shank or chisel thru the soil to depths of twenty-four (24) inches maximum. Shank spacing shall be as specified by the Engineer. Do not disturb soil or plants in the areas between subsoiled trenches.

B. Fill subsoiled trenches with compost to create a uniform surface grade

7. Compacted Soil within the critical root zone of existing established trees: Full AFM or Vertical Mulching.

   Two techniques are described based on tree location relative to the floodplain and potential for adverse erosion.

   Under no circumstances should decompaction work be done in the critical root zone, unless indicated on the plans.

   A. Remove the tops of all plants to be removed from the root zone. Remove sod with a walk behind sod cutter. Do not grub out the roots of plants to be removed.

   B. Prior to beginning work, the proposed area shall be sufficiently wetted twenty-four (24) hours in advance to minimize dust to the greatest extent possible.

   C. Use a pneumatic air tool such as an air knife or air spade.

   D. Method 1 - Full AFM: In a location outside the floodplain and on slopes of 3:1 or less, use a pneumatic air tool to loosen the top nine (9) to twelve (12) inches of the soil in the entire dripline. In cases where nine (9) to twelve (12) inches is not attainable (i.e., shallow soil), apply aeration to the depth of soil present. Surface roots may move and separate from soil during this process but the bark on roots should not be broken. Make chemical adjustment as recommended by the soil test. Add three (3) inches of compost over the soil immediately after aeration. Use a pneumatic air tool to mix the compost into the top six (6) to eight (8) inches of the loosened soil. Apply a minimum of three (3) inches of shredded hardwood mulch across the entire treatment area, but kept back one (1) foot from the trunk.

   E. Method 2 - Vertical Mulching: This technique is suitable for a floodplain or other location subject to adverse erosion. Use a pneumatic air tool to make one (1) inch minimum diameter holes to a depth of ten (10) to twelve (12) inches with holes three (3) feet on center from the half critical root zone (CRZ) to the dripline. Funnel compost into the holes. Apply three (3) inches of shredded hardwood mulch across the entire treatment area, but kept back one (1) foot from the trunk.

   F. Work in sections such that the entire process - including any proposed irrigation - can be completed in one day for each section. Apply ten (10) gallons of water per inch in diameter of DBH over the loosened soil at the completion of each day's work except during precipitation events of half inch or greater. During drought or other prolonged dry periods, continue to provide supplemental water for one (1) to three (3) weeks minimum after treatment.

8. Protection of Decompacted Soils: After any decompaction activities have taken place do not pass motorized equipment or stockpile construction materials or equipment on previously decompacted soil.

   The Contractor shall protect decompacted soil from damage including contamination and re-compaction due to other soil installation, planting operations, and operations by other Contractors. Maintain protection of decompacted areas until project acceptance.

Utilize fencing and matting as required or directed to protect the finished soil work. Treat, repair or replace damaged decompacted soil immediately.

9. Repair of Re-compacted Soils: After decompaction has taken place, any soil that becomes re-compacted to a density greater than 225 psi shall be decompacted again.

   A. Loosen compacted soil and replace soil that has become contaminated as determined by the Engineer. Re-compacted and/or contaminated soil shall be loosened or replaced at no expense to the Owner.

   B. Where modified existing soil has become compacted or contaminated and needs to be replaced, provide imported soil that is of similar composition, depth and density as the soil that was removed.

D. Payment

Payment for this item shall be subsidiary to the Right-of-Way Preparation item.

160 - Tree Protection

A. Description

This item shall govern the proper care, protection and treatment of trees and other vegetation in the vicinity of the proposed construction. Tree Protection shall be provided where indicated on the drawings.

B. Materials

1. Protective Fencing

   Protective fencing is designated as the materials used to protect the root zones of trees as illustrated in the Standard Details.

   a. High visibility plastic construction/safety fencing.

      The fabric shall be 4 feet in width and made of high density polyethylene resin, extruded and stretched to provide a highly visible international orange, non-fading fence. The fabric shall remain flexible from -60°F to 200°F and shall be inert to most chemicals and acid. The fabric pattern may vary from diamond to circular with a minimum unit weight of 0.4 lbs./foot.

      The fabric shall have a 4-foot width minimum tensile yield strength (Horizontal) of 2000 psi, ultimate tensile strength of 2680 psi (Horizontal) and a maximum opening no greater than 2 inches.

   b. T-posts.

      The fencing materials, shall be supported T-posts that are a minimum of 5½ feet in height and spaced no more than 10 feet on centers. The fabric shall be secured to post by bands or wire ties.

2. Trunk Protection Recommendation

   When trees are near a roadway or construction area, tree trunk protection is recommended and shall consist of any 2 x 4-inch or 2 x 6-inch planking or plastic strapping that is attached in a manner that does not damage the tree.

3. Fertilizer

   Humate/nutrient solutions with mycorrhizae components or soil injection at recommended rates are to be used when appropriate. Construction which will be completed in less than 90 days may use materials at half the recommended rates. Alternative organic fertilizer materials are acceptable when approved by the City of Copperas Cove.

C. Construction Methods

1. Protective Fencing

   All individual or groups of trees, shrubs, and natural areas shown to be protected on the drawings or identified to be protected by the City of Copperas Cove, shall be protected during construction with temporary fencing as indicated on the drawings.

   Protective fences shall be installed prior to the start of any site preparation work (clearing, grubbing, or grading), and shall be maintained in functioning condition throughout all phases of the construction project.

2. Pruning and Repair of Damage

   A minimum clearance height of eight (8) feet above the street level should be provided and maintained for all existing trees if adjacent to a sidewalk. However, if the limbs of trees overhang the curb line or edge of travel lane of any street, a minimum clearance height of fourteen (14) feet is required.

3. Tree Removal

   All trees to be removed shall be performed in a manner that does not damage the canopies, trunks or root systems of remaining trees and that protects all existing facilities, improvements and vegetation. All tree material shall be removed from the site or used as wood chips or mulch.

   When a tree or shrub is scheduled for removal, it shall be cut to a maximum depth of 12 inches below the surrounding grade (the tree(s) should be removed at grade, and with hand saws, in situations where other tree root systems are present which are to be preserved). When applicable, after tree removal, soil shall be placed in the hole to a depth matching the existing grade.

4. Final Cleanup

   All temporary tree and shrub preservation and protection measures shall be removed when the construction has been completed and any mulch applications shall be removed or reduced to no more than 3 inches depth.

5. Oak Wilt Prevention Policy

   A. Purpose and Scope

      The purpose of this Oak Wilt Prevention Policy is to identify measures that city staff and city-hired contractors and their sub-contractors, who perform the services of removing or trimming trees, will take to prevent the spread of oak wilt.

B. Definitions

Oak Wilt Disease: A tree disease caused by the fungus, Ceratocystis fagacearum. The fungus infects the vascular system of a tree. The vascular system contains vessels which transport moisture throughout the tree. The vessels of an infected tree effectively become blocked by the infection of the fungus, and cannot transport adequate moisture to sustain a healthy or living tree. In most cases, the end result is tree mortality.

C. Prevention Policy

a. Prior to beginning field work, all city staff associated with projects involving potential contact with oak trees shall be made aware of the city's official Oak Wilt Policy by receiving and reading a written copy of this policy. Staff receiving a written copy of the policy shall include, but not limited to, project managers, equipment operators responsible for removing or trimming trees, or operators using heavy equipment which could cause wounding of susceptible oaks in the use of the equipment. In addition, individual city departments will provide a written copy of the Oak Wilt Policy to contractors participating in city projects in areas where oak trees are present before initiating field work.

b. When possible, city staff and contractors should avoid trimming, pruning, or wounding Live Oaks and Red Oaks (Spanish, Shumard, Texas Red, and Blackjack oaks) from February through June.

c. At all times and irrespective of limb size, all cuts and wounds to oak trees shall be dressed immediately using a non-phytotoxic tree wound dressing. Stump cuts and damaged roots (both above and below ground) shall also be dressed.

d. Disinfection of pruning tools, saws, and related equipment is mandatory during the trimming or pruning of oak trees. Disinfection of tree removal and trimming equipment shall occur before work begins in a project area, between work in individual oak trees, and again prior to leaving a project area. Acceptable disinfectants include either aerosol disinfectant or a 10 percent bleach-water solution.

D. Disposal Policy

1. Chipping or shredding the wood from infected trees to use as mulch is an acceptable means of recycling the wood. Chipping or shredding allows the wood to dry out quickly, thereby killing the fungus.

2. Burning diseased wood is an acceptable means of disposal. Burning diseased logs will kill the fungus, and the fungus will not spread with the smoke.

3. Logs from diseased Red Oaks, that are not chipped, shredded, or burned shall be disposed of at a landfill.

4. Firewood from diseased Red Oak trees shall not be stored near healthy trees where fungal spores or insects that carry the spores have the potential to spread the fungus to healthy trees. It is recommended to store oak firewood under a sheet of clear plastic, tightly sealing the edges of plastic with soil or bricks. Doing so will prevent any spore carrying beetles from escaping and will solarize and heat the stored firewood to speed the drying process. It is also recommended to use clear plastic, as black plastic will reveal any escape holes to the beetles.

5. In situations where diseased Red Oak trees are identified and are not accessible for chipping, shredding, or removal, the trunk of the diseased tree should be girdled, and the stem treated with an appropriate herbicide to deaden the tree and hasten the desiccation and drying of the wood below the minimum moisture content that could support the development of fungal spores.

D. **Payment**

Payment for this item shall be subsidiary to the Right-of-Way Preparation item.

170 - Protective Coatings

A. Description

This item shall govern the application of protective coatings for wastewater systems, where indicated on the drawings or required by the location, such as force main termination manholes, lift station wet wells, exposed lift station piping, etc.

B. Coating Systems

Table below shows categories of item to be coated and options of coating system to use.

Table 170.1	
Item to be Coated	**Coating System**
New or existing above ground and non-submerged metallic piping and valves (non-galvanized)	1, 2, or 3
New or existing submerged structural steel and piping (when exposed from dewatering, non-galvanized)	3 or 4
Concrete structures	5, 6, or 7

1. Polyurethane Three-Coat System.
   A. Surface Preparation.
      i. Protection. Vehicles, equipment, structures, or other nearby surfaces not to be coated, shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.
      ii. Initial Cleaning. If necessary, surfaces shall be decontaminated by high-pressure water blasting, steam cleaning, or by any other method, to remove all oils, greases, scum and surface contaminants.
      iii. Abrasive Blast Cleaning for External Coating. Surfaces shall be cleaned as per SSPC Standard SP-10, "Commercial Blast Cleaning."
      iv. Cleaning of Adjacent Areas: After abrasive blasting is completed, areas adjacent to the work area shall be cleaned of dirt, blasting residues and other debris to prevent wind-blown contamination of the prepared substrate or freshly applied coatings.
      v. Final Cleaning Before Application of Primer: Just prior to primer application, surfaces to be coated shall be power vacuumed to remove all dust and blasting residues. Transitions into adjacent areas not to be coated shall be neatly taped off or otherwise protected. Steel surfaces must be absolutely dry and dust-free prior to and during application of the primer.
   B. Three Coat Application. The total dry film thickness (DFT) after 5 days shall be 9 to 13 mils for metallic surfaces.
      i. First Coat. First coat with zinc rich epoxy or organic zinc primer @ 3 to 4mils DFT.
      ii. Second Coat. Second coat with chemical resistant epoxy @ 4 to 6 mils DFT.
      iii. Third Coat. Third coat with UV stable polyurethane topcoat @ 2 to 3 mils DFT.
2. Premium Epoxy Coating System.
   A. Surface Preparation.
      i. Protection. Vehicles, equipment, structures, or other nearby surfaces not to be coated, shall be protected from blasting products and overspray throughout all

surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.

ii. Initial Cleaning. If necessary, surfaces shall be decontaminated by high pressure water blasting, steam cleaning or by any other method to remove all oils, greases, scum and surface contaminants.

iii. Decontamination. Surfaces previously exposed to salts or other chemical services shall be decontaminated by high pressure fresh water blasting, steam cleaning or by any method to remove all surface contaminants and eliminate or reduce subsurface contaminants to an acceptable level. If detergents are used, they shall be completely rinsed with plenty of fresh water.

iv. Abrasive Blast Cleaning for External Coating.

1. Surfaces shall be cleaned as per SSPC Standard SP-10, "Commercial Blast Cleaning."
2. Immersed surfaces to receive an external coating shall be abrasive blasted per SSPC Standard No. SP 10, "Near-White Blast Cleaning" with a 1 1/2 to 2 mil (37.5-50 micron) surface profile. Blast or grind irregular surfaces to same condition as flat surfaces. Sharp edges shall be ground down and rounded.

v. Cleaning of Adjacent Areas. After abrasive blasting is completed, areas adjacent to the work area shall be cleaned of dirt, blasting residues and other debris to prevent wind-blown contamination of the prepared substrate or freshly applied coatings.

vi. Final Cleaning Before Application. Just prior to application, surfaces to be coated shall be power vacuumed to remove all dust and blasting residues. Transitions into adjacent areas not to be coated shall be neatly taped off or otherwise protected. Steel surfaces must be absolutely dry and dust-free prior to and during application of the coating.

vii. Concrete surfaces to be coated that are subject to immersion conditions shall be abrasive blast cleaned per ASTM D4259, Abrading Concrete, to provide a minimum height profile of 5 to 8 mils. Blasting must produce an even profile, free of loose aggregate, weak matrix, crusts, dusting and other contaminants.

B. Two Coat (Primer-less) Application (to be used only on indoor applications). The total dry film thickness (DFT) after 5 days shall be 40 mils for concrete, masonry or immersed metallic surfaces.

i. First Coat. First coat with flake-filled premium epoxy @ 20 mils dry film thickness.

ii. Second Coat. Second coat with flake-filled premium epoxy @ 20 mils dry film thickness.

C. Three Coat Application (required for outdoor applications). The total dry film thickness (DFT) after 5 days shall be 9 to 13 mils for metallic surfaces.

i. First Coat. First coat with zinc rich epoxy or organic zinc primer @ 3 to 4 mils dry film thickness.

ii. Second Coat. Second coat with chemical resistant epoxy @ 4 to 6 mils dry film thickness.

iii. Third Coat. Second coat with UV stable polyurethane topcoat @ 2 to 3 mils dry film thickness.

3. Fusion Bonded Epoxy Coating
   A. Surface Preparation. In accordance with coating manufacturer's recommendations.
   B. Application. In accordance with coating manufacturer's recommendations.
4. Coal Tar Epoxy
   A. Surface Preparation
      i. Protection. Vehicles, equipment, structures, or other nearby surfaces not to be coated, shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.
      ii. Initial Cleaning. If necessary, surfaces shall be decontaminated by high pressure water blasting, steam cleaning or by any other method to remove all oils, greases, scum and surface contaminants.
      iii. Decontamination. Surfaces previously exposed to salts or other chemical services shall be decontaminated by high pressure fresh water blasting, steam cleaning or by any method to remove all surface contaminants and eliminate or reduce subsurface contaminants to an acceptable level. If detergents are used, they shall be completely rinsed with plenty of fresh water.
      iv. Abrasive Blast Cleaning per SSPC Standard No. SP 10, "Near-White Blast Cleaning" with a 1 1/2 to 2 mil (37.5-50 micron) surface profile. Blast or grind irregular surfaces to same condition as flat surfaces. Sharp edges shall be ground down and rounded. If flash rust develops, all traces shall be removed by abrasive sweep blast before priming.
      v. Cleaning of Adjacent Areas. After abrasive blasting is completed, areas adjacent to the work area shall be cleaned of dirt, blasting residues and other debris to prevent wind-blown contamination of the prepared substrate or freshly applied coatings.
      vi. Final Cleaning Before Application of Coating. Just prior to primer application, surfaces to be coated shall be power vacuumed to remove all dust and blasting residues. Transitions into adjacent areas not to be coated shall be neatly taped off or otherwise protected. Steel surfaces must be absolutely dry and dust-free prior to and during application of the primer.
   B. Application. The total dry film thickness after 5 days shall be 20 mils.
      i. One Coat (Primer-less). 20 mils dry film thickness.
5. Raven 405 System.
   A. Surface Preparation.
      i. Protection. Vehicles, equipment, structures or other nearby surfaces not to be coated shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.
      ii. New Concrete.
         1. Concrete should be floated free of sharp edges, ridges or depressions. All structural cracks shall be repaired, voids filled and slopes reestablished.

New concrete must be allowed to cure for a minimum of 28 days prior to applying a protective lining system. This usually is sufficient time to allow for shrinkage and for new concrete pours to dissipate a sufficient amount of moisture.

2. Moisture Testing. New concrete should be installed over a moisture barrier to eliminate moisture transmission through the concrete floor. Prior to the application of materials, the moisture content must be determined using a suitable Moisture Detection System such as that manufactured by Sealflex Industries, 2925 College Ave., #B4, Costa Mesa, CA (714-708-0850). An average value exceeding 3.0 lbs./1000 ft^2/24-hour period is unacceptable and will require additional cure time, the application of a surface penetrating vapor barrier or other corrective measures. Retest after taking corrective measure to ensure an average value below 3.0 pounds.
3. All concrete structures to receive lining system must be properly designed and capable of withstanding imposed loads. Surfaces must be dry, firm, free of laitance, form release agents, standing water and have attained 3000 psi compressive strength or be structurally sound as determined by Engineer. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse.
4. Abrasive blast to expose fine aggregate, using a shot-blasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #5 comparator, minimum. (Note: ICRI = International Concrete Repair Institute.)

iii. Old Concrete.

1. All concrete structures to receive lining system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface of concrete by chemical cleaning. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse. Surfaces must be firm, free of standing water, laitance, form release agents, and be structurally sound as determined by Engineer.
2. Abrasive blast to expose fine aggregate. Use a shot-blasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #5 comparator, minimum. (Note: ICRI = International Concrete Repair Institute.)

B. Application.

i. 100% solids, solvent-free epoxy grout that can be troweled or sprayed and specifically formulated for optimum epoxy top-coating compatibility. The epoxy grout manufacturer shall provide instructions for epoxy top-coating procedures.

1. Cementitious repair materials shall be troweled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive

the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.

2. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the Engineer and protective coating applicator. Repair materials must be compatible with the specified epoxy coating and shall be applied and cured in accordance with the manufacturer's recommendations.
3. For lift station applications, apply coating on all wall, floor and ceiling surfaces. For all other applications, apply coating from top of structure to one (1)-foot below minimum water surface elevation.

ii. Raven Lining Systems' Raven 405 coating system

1. Raven Lining Systems' Raven 405 coating system - a 100% solids, solvent-free two-component epoxy resin system thixotropic in nature and filled with select fillers to minimize permeability and provide sag resistance
2. Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating.
3. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.
4. Installation. Specified surfaces shall be coated by spray application of Raven 405 0 moisture tolerant, solvent-free, 100% solids, epoxy protective coating. Spray application shall be to the following wet film thickness: 100 mils minimum thickness

iii. Contractor Prequalification.

1. Raven Lining Systems' certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.
2. Certification by Raven Lining Systems that the equipment to be used for applying the products has been approved and Applicator personnel have been trained and certified for proper use of the equipment
3. Two (2) years' experience and five (5) recent references of projects of similar size and scope and Applicator must provide references indicating successful application on underground concrete or masonry substrates of a minimum 5,000 sf of Raven Lining Systems' 100% solids, high-build solvent-free epoxy coating by heated, plural component spray application.

6. SewerGard No. 210S System.

A. Surface Preparation.

i. Protection. Vehicles, equipment, structures or other nearby surfaces not to be coated shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.

ii. New Concrete.

1. Concrete should be floated free of sharp edges, ridges or depressions. All structural cracks shall be repaired, voids filled and slopes reestablished. New concrete must be allowed to cure for a minimum of 28 days prior to

applying a protective lining system. This usually is sufficient time to allow for shrinkage and for new concrete pours to dissipate a sufficient amount of moisture.

2. Moisture Testing. New concrete should be installed over a moisture barrier to eliminate moisture transmission through the concrete floor. Prior to the application of materials, the moisture content must be determined using a suitable Moisture Detection System such as that manufactured by Sealflex Industries, 2925 College Ave., #B4, Costa Mesa, CA (714-708-0850). An average value exceeding 3.0 lbs./1000 ft2/24-hour period is unacceptable and will require additional cure time, the application of a surface penetrating vapor barrier or other corrective measures. Retest after taking corrective measure to ensure an average value below 3.0 pounds.
3. All concrete structures to receive lining system must be properly designed and capable of withstanding imposed loads. Surfaces must be dry, firm, free of laitance, form release agents, standing water and have attained 3000 psi compressive strength or be structurally sound as determined by Engineer. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse.
4. Abrasive blast to expose fine aggregate, using a shot-blasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #3-5 comparators. (Note: ICRI = International Concrete Repair Institute.)

iii. Old Concrete.

1. All concrete structures to receive lining system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface of concrete by chemical cleaning. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse. Surfaces must be firm, free of standing water, laitance, form release agents, and be structurally sound as determined by Engineer.
2. Abrasive blast to expose fine aggregate. Use a shot-blasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #3-5 comparators. (Note: ICRI = International Concrete Repair Institute.)

B. Application.

i. Epoxy Filler Compound No. 209. Used for filling bug holes, static cracks and joints and for general concrete patching.

1. Mixing. Add contents of hardener to liquid and mix with a slow-speed paddle or “Jiffy” mixer for 1 minute until thoroughly blended. Add the powder gradually while mixing with same slow-speed mixer to obtain a uniform consistency. Mix only complete batches. Material which has begun to set must be discarded. Do not try to re-temper the material.

2. Installation. To maximize working time, spread mixed No. 209 onto a plasterer's hawk upon completion of the mixing. Apply No. 209 to concrete with a smooth plasterer's rubber float. After application, excess material must be removed by using the edge of the float or squeegee.
3. For lift station applications, apply coating on all wall, floor and ceiling surfaces. For all other applications, apply coating from top of structure to one (1)-foot below minimum water surface elevation.

ii. SewerGard No. 210S. Corrosion-resistant, spray-applied epoxy lining.

1. No. 210S is a two-component product, packaged in premeasured containers consisting of liquid and hardener.
2. Remix contents of liquid component for a minimum of 2 minutes with a "Jiffy" type mixer.
3. Remix contents of the hardener by shaking; then add to liquid and mix for a minimum of 3 minutes until thoroughly blended.
4. Mix only complete batches. Material which has begun to set must be discarded. Do not try to re-temper the material.
5. Installation. SewerGard No. 210S is applied by spray method to a thickness of 60 mils. Theoretical coverage is 90.5 square feet per unit at 60 mil thickness. Coverage is theoretical and will vary depending upon surface conditions, porosity, application techniques and project specifics.

iii. Contractor Prequalification.

1. Sauereisen No. 210S System Applicators. Each applicator who is to apply the No. 210S system must be tested prior to proceeding with the installation of materials, in order to determine qualification and skill. This prequalification test will be conducted to ensure that the materials will be applied in a manner that will produce a strong, uniform, well-bonded, holiday-free lining.
2. No. F-120/209. A 3' x 5' concrete panel will be used for each applicator. The surface of the concrete must be properly prepared for the applicator as outlined in this specification. The applicator must show competency in applying both products per the specification in regards to mixing, application techniques, cleanup and safety precautions.
3. The No. 210S must be applied in one coat to a minimum 60-mil thickness and must be uniform in appearance and thickness. SewerGlaze must be applied in one coat to a minimum thickness of 8 mils and must be uniform in appearance and thickness. The applicator must show competency in spray applying epoxy systems, including but not limited to mixing, application techniques, cleanup and safety precautions.

7. Chesterton ARC 791 System

A. Surface Preparation.

i. All surface preparation shall be the responsibility of the coating installer and shall be fully responsible for all aspects of preparation of substrate. Repairs, cracks, joints blasting, cleaning and testing.

ii. All surfaces to receive coating shall be dry abrasive blasted to minimum profile equal to ICRI CSP #6.
iii. All terminations (walls, floors, gates, pipe, and doors etc. shall be keyed in to prohibit corrosion at seams and under coating gas migration.
iv. All leaking cracks shall be injected with suitable manufacturer approved urethane leak stop material by the certified coating applicator.
v. All active cracks shall be treated as an expansion joint as detailed in ARC procedural guide and addressed by the certified coating applicator.
vi. When required rebar replacement and manufacturer approved concrete repair mortar shall be applied by certified coating installer.

B. Application.
i. Concrete repair mortar shall be manufactured and/or approved by coatings manufacturer and/or supplied by same. All repair materials/mortar shall be installed by coatings Manufacture, Certified applicator.
ii. Do not apply under conditions that are unsuitable for the production of good results. Do not begin application of coatings in areas where other trades are working, or where construction activities result in airborne dust or other debris. Do not apply coatings in conditions which do not conform to the recommendations of coating manufacturer.
iii. Coatings shall only be applied when conditions fall within the parameters listed in manufacturer's printed data.
iv. Applicator's Qualifications
1. Must be qualified in this line of work and have at least ten (10) years documented experience in concrete repair/restoration.
2. Must have a minimum of ten (10) years documented experience in the application of the protective coatings specified herein.
3. Must have a minimum of ten (10) years of documented successful installations of the specified products, on structures and/or equipment similar to this project.
4. Submit a list of (5) recent projects of the same structures and names and contact information of references.
5. Applicator must be Manufacturer certified for 5 years prior to bid submission.
6. Applicator must have minimum (5) years' experience with installation of concrete repair mortar and rebar replacement.
7. Applicator must have NACE ll certified inspector on staff at all times to conduct all testing as required in section (1.02 C) of specifications.
8. Applicator must use own employees for all work, no subcontractors shall be permitted.
v. Primer ARC 797
1. Two component primer.
2. Primer must be chemically unique from the top coat matrix.
3. Primer must provide a recoat window of not less than 2 hours at 77°F.

4. Primer shall be hydrophobic, moisture insensitive, have a low viscosity and be able to bond to wet concrete.

vi. Trowel-on ARC 791 Quartz-Reinforced Composite Coating

1. Mixing:
   a. Material temperatures shall be between 70 and 90°F to facilitate mixing and application.
   b. Premix Part A to disperse pigments.
   c. Thoroughly mix Part A and Part B in a suitable pail, using a slow speed mixer.
   d. Transfer the blended resins to a mortar mixer and gradually add the quartz reinforcement.
   e. Mix for 3 minutes or until uniformly blended.
2. Apply trowel-on quartz-reinforced composite shortly after application of primer while primer is still wet or tacky. This is normally within approximately 4 hours of primer application.
3. If the area to be coated is not wet or tacky, re-prime the area.
4. Minimum application temperature is 50°F, recommended application temperature is 77°F.
5. Apply single coat at 250 mils dry film thickness (DFT).
6. Horizontal surfaces (floors):
   a. Distribute over floor surface using screed guides and rigid bar, or screed box, not exceeding 4 feet wide.
   b. Rough screed a minimum of 0.25 inches and finish the surface using steel trowels.
   c. Large horizontal areas may be power troweled to achieve the required flatness and finish.
7. Vertical surfaces:
   a. Apply to vertical surfaces using a hawk and trowel, pressing the top coat firmly onto the surface to promote contact with the primer.
   b. Finish the surface to the desired texture with a trowel.
8. Remove all trowel marks and unevenness before the end of the "Working Time".
9. Curing Schedule:

Table 170.2

	50°F	**60°F**	**77°F**	**90°F**
Foot Traffic	16 hrs.	9 hrs.	6 hrs.	4.5 hrs.
Light Load	24 hrs.	19 hrs.	11 hrs.	8.5 hrs.
Full Load	72 hrs.	42 hrs.	24 hrs.	19 hrs.
Full Chemical	19 days	13 days	7 days	5 days

Note: Cure times are based on substrate temperature and thickness of 0.25 inches. Thicker films will cure more rapidly.

   a. Provide adequate lighting at any location that coatings are being applied or testing is performed. Illumination shall be of sufficient

intensity to achieve good results. Provide explosion-proof lighting when required.

b. Temporary ladders and scaffolds shall conform to applicable safety requirements. Erect temporary scaffolds where needed to cover large areas. Provide ladders or scaffolding during testing procedures.

C. Quality Control

i. The cured composite must meet the following physical requirements:
   1. Compressive Strength (ASTM C579): 9.320 psi
   2. Tensile Strength (ASTM C307): 2,850 psi
   3. Flexural Strength (ASTM C580): 5,500 psi
   4. Flexural Modulus of elasticity (ASTM C 580) 1.87 X 106 psi.

ii. Composite shall be able to hold a minimum of 0.25 inches thick on vertical surfaces without sag at temperatures of up to 80°F.

iii. Composite must have a working time of at least 45 minutes at 77°F.

iv. Maximum service temperature:
   1. Continuous: 150°F
   2. Intermittent: 200°F

v. Protective coatings shall be applied under quality control procedures that include the following test procedures certified by NACE Level ll inspector.

vi. Pre-Installation Testing
   1. Surface profile test using Elcometer 224 surface profile gage or equal, to ANSI/NACE/ICRI standards for specified substrate. CSP 9 for trowel applied,
   2. pH testing for acidification of concrete (ASTM D 4262) Utilize WTW 3310 pH meter or approved equal.
   3. Chloride testing for soluble salts using Hedon Automated Soluable Salt Meter or approved equal.
   4. Ultraviolet light testing for hydrocarbon residues shall be conducted on all surfaces to be coated.
   5. Moisture vapor transmission testing (ASTM D 4263) not to exceed 5 lbs./1000 Sq. Ft./24hrs. Must use Elcometer 7410 Moisture Meter or approved equal.

vii. Post-Installation Testing
   1. Delamination detection shall be conducted on all surfaces using an Albion 875-1 delamination detection tool.
   2. High voltage spark testing on all coated surfaces for pinhole/holiday free verification (100 volts/mil) must use Tinker & Rasor Model AP/W, or approved equal.
   3. Dolly pull off adhesion testing shall be performed only when delamination is detected using DeFelsko PosiTest AT-A pull off adhesion tester, or approved equal. (1 dolly per 750 sq. ft.)
   4. Cured coating shall have thickness confirmed must use Elcometer NDT CG70ABDL Ultrasonic Thickness Gauge or approved equal.

8. Con Shield
    A. Application
        i. Antimicrobial additive, Con Shield®, shall be used to render the concrete uninhabitable for bacteria growth.
        ii. The liquid antibacterial additive shall be an EPA registered material.
        iii. The amount to be used shall be as recommended by the manufacturer. This amount shall be included in the total water content of concrete mix design.
        iv. The additive shall be added into the concrete mix water to ensure even distribution of the additive throughout the concrete mixture.
        v. The antibacterial shall be used by factory certified precast concrete plants. Acceptance from the precast manufacturer shall be in the form of a letter of certification stating that the correct amount and mixing procedure were followed.

Surface Preparation

b. Coating Execution
    1. Work Conditions
        A. Weather. No coating or painting shall be applied: 1) when the surrounding air temperature or the temperature of the surface to be coated or painted is below 50 F; 2) to wet or damp surfaces or in rain, snow, fog or mist; 3) when the temperature is less than 5 F above the dew point; 4) when it is expected the air temperature will drop below 50 F or less than 5 F above the dew point within 8 hours after application of coating or paint. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric tables. If preceding conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions. The weather conditions shall be adhered to unless otherwise specified under individual coating systems.
        B. Surface. If surfaces to be painted cannot be put in proper condition for painting by customary cleaning and abrasive operations, promptly notify Owner’s Inspector. Contractor shall assume responsibility for and rectify any unsatisfactory finish resulting from application to an unsatisfactory surface. Do not apply paint to a wet or damp surface.
        C. Equipment. The Contractor's coating and painting equipment shall be designed for application of the materials specified and shall be maintained in good working order comparable to that described in printed instructions of the coating manufacturer. Clean equipment thoroughly before and after use with the appropriate cleaning solution indicated by the coating manufacturer. All gauges and controls on spray equipment shall be in proper working order at all times and the gauges must be operational and readable.
        D. Warnings. Display caution signs in necessary areas advising of spray painting and warning against open flames.

2. Surface Preparation
   A. Solvent Cleaning. Remove oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action, in accordance with SSPC SP 1.
   B. Grinding. Remove weld splatter and rough edges and grind rough welds so that all surfaces are in proper condition to receive the specified coating. Prepare all welds that will be immersed as per NACE RP0178, Designation D.
   C. Abrasive Blast Cleaning.
      i. Use a source that provides compressed air, free of detrimental amounts of water and oil. The compressor shall, as a minimum, be capable of delivering a pressure at the blast nozzle of at least 90 psig; the blast nozzle shall be of the venturi type.
      ii. Abrasively clean only those areas that can be primed the same day or before any rust starts to form, whichever occurs first. Areas which are not painted the same day must be cleaned again on the day the prime coat is applied. Remove the abrasive material from surface by brush or industrial vacuum.
   D. Power Tool Cleaning. Metalwork in which SP 6 or SP 10 cannot be accomplished shall be cleaned in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal, providing an angular profile.
   E. Shop Priming. Where metalwork, equipment, valves and the like are shop primed, the primer used must be compatible with the coating system to be applied in the field. All information shall be furnished regarding the shop prime coat and, if not compatible with succeeding coats, the shop prime coat shall be removed by abrasive blast cleaning.
   F. Unknown or Non-Compatible Materials. Items coated with an unknown paint system, or a primer or system which is not compatible with the specified system, shall be blast cleaned and recoated with the specified coating system at the job site. When abrasive blast cleaning is not feasible, the Contractor shall notify the Owner's Inspector and request permission to apply a barrier coat over the unknown or non-compatible material. The proposed barrier coat must be recommended in writing by the paint system manufacturer and is subject to review by the Engineer. Following application of the barrier coat, if permitted, the specified coating system shall be applied. Minimum dry film thickness shall be increased an amount equal to the barrier coat and unknown or non-compatible coats.

B. Coating Application
   1. Manufacturer's Representative. The coating manufacturer will be responsible, through an authorized representative, to provide technical assistance to the paint contractor as needed.
   2. Workmen. Employ workmen skilled in structural steel, piping, and mechanical equipment painting.
   3. Materials.
      A. Coating materials, abrasive, and equipment used in painting and abrasive cleaning are subject to inspection at any time by the Owner's Inspector.

B. Remove blasting material and dust from the surface to be painted before paint application is begun.

4. General Application Requirements.
   A. Prepare all surfaces to receive materials as required herein or as required by the coatings manufacturer. Clean surfaces to remove all foreign matter. Roughen surface as recommended by the coating manufacturer for proper adhesion of coating to the substrate.
   B. Items to be attached to similar or dissimilar materials shall be back coated as specified for the exposed surfaces of those items. Mask or protect finished surfaces in area being coated. Remove, replace, and protect finished items adjacent to surfaces to be coated. Reinstall items when painting is complete.
   C. Mix and apply materials in accordance with the manufacturer's printed instructions. Allow each succeeding coat to dry in accordance with manufacturer's printed instructions.
   D. Include painting of engaged and free-standing columns or similar items when painting walls.
   E. Do not paint code required labels, (Underwriters Laboratories, Inc., Factory Mutual, or the like) or any equipment identification, performance ratings, name, or nomenclature plates. Remove any paint inadvertently applied to such items.
   F. Protect adjacent walls, floors, and ceilings against splash or overspray. Remove materials from surfaces not designated to receive such materials.
   G. Remove waste rags and coating debris on a daily basis. Keep storage spaces and work areas neat and clean.
5. Paint Coating Methods.
   A. Stripe coat all welds. Apply stripe coat by brush and scrub into all weld areas; then apply prime coat to entire surface, including weld areas, by spray, roller or method selected.
   B. Coat areas with a uniform film, free of sags, runs, or brush marks. Where multiple coats of paint are specified, apply each coat in a different color which complements the following coat and is different than the preceding coat. Each coat must be free of shadows and uniform in appearance.
   C. Except where otherwise specified, thin paint only as necessary for workability of coating material in accordance with manufacturer's printed instructions. Use only an appropriate thinner as recommended by the paint manufacturer.
   D. When paint is being applied to interior of wet well or any other closed areas, provide adequate ventilation.
   E. Comply with recommendations of the paint manufacturer in regard to drying time for each coat, technique of spray application, ventilation, paint thinning, and safety precautions. The Contractor must fully inform all members of his field crew of these recommendations.
   F. Where inspection shows that the specified thickness is not developed, apply additional coats in accordance with the manufacturer's surface preparation and cure schedule requirements to produce the required film thickness.

G. Repair and recoat improper applications as recommended by the manufacturer or as required by the Owner's Inspector.
H. Factory finished items shall be protected against damage during transit, storage and erection. Damaged areas must be refinished as the original so that at the end of the project the finish on all items will be in like new condition. The following items shall receive final finish at the factory.
    i. Electrical panels (to be factory painted ANSI No. 61 gray).
    ii. Light fixtures.
    iii. Pressure gauges.
    iv. Instrumentation.
    v. Similar equipment with standard factory finish, subject to Owner's review.
I. The following items shall not be painted unless otherwise specified:
    i. Aluminum, brass, bronze, chrome, copper, stainless or galvanized steel.
    ii. Nameplates or serial numbers.
    iii. Grease fittings.
    iv. Valve operator stems.
    v. Buried or encased piping or conduit.
    vi. Concrete floors and slabs not exposed to wastewater.
    vii. Glass.
J. Cleaning. Upon completion of the work, remove all staging and scaffolding. Dispose of all used sand, containers and rubbish in a suitable manner. Remove paint spots, oil or stains on adjacent surfaces. Leave the entire job clean and acceptable.

C. Coating Inspection and Testing
1. Inspection.
    A. The Contractor shall provide OSHA approved staging, scaffolding and lighting as required to facilitate proper inspection.
    B. Surface preparation, coating application and repairs are subject to inspection by Owner's Inspector. The standards published by the Steel Structures Painting Council, especially SSPC VISL 635, Pictorial Surface, will be used as guides for acceptance or rejection of the cleaning, painting or coating application. Particular attention will be given hard to reach areas, bolted connections, supports, anchor bolts and threaded joints.
    C. A magnetic type dry film thickness gauge and an electrical holiday detector will be used to determine the acceptability of the paint application. Calibration of the magnetic thickness gauge will be done on the site using the U.S. Department of Commerce, Bureau of Standard Film Thickness Calibration Standards.
    D. Give sufficient notice in advance of coating applications such that Owner's Inspector can perform the following:
        i. Examination and approval of surface preparation prior to any coating.
        ii. Examination and approval of each coat prior to application of the next coat.
        iii. Inspection of the completed coating for runs, overspray, roughness, and any evidence of improper application.
        iv. Direction or observation of testing.
2. Testing.

A. The following tests will be conducted:
    i. Dry film thickness will be tested after each coat of interior and exterior paint has been applied and after final coat of the exterior system has been applied.
    ii. A test shall be made for every 25 square feet of surface area and at other locations specified by the Owner's Inspector.
    iii. All paint systems will be tested for holidays after the final coat has been applied.
B. Should any paint system fail to pass a test, Contractor will remove defective coating system, reapply and subsequently retest the coating system.

C. Payment

Payment for Protective coatings shall be considered subsidiary to the item on which the coating is to be applied.

Specifications 200-299: Concrete

200 - Concrete

A. 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.

B. Materials

a. Cement

Only one brand of cement shall be used in any one (1) structure, except by written permission of the City Engineer. 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, II or III. If the cement could be exposed to sewage, ASTM C-150 Type V shall be used.

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-188, 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. 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.

Unless otherwise indicated, use following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.

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 Fine Aggregates for Concrete, ASTM Designation C-40, the fine aggregate shall not show a color darker than the standard color.

Unless otherwise indicated, use following ASTM standard sizes: 3/8"; No. 4, No. 16, and No. 100. Maximum size: Not larger than 1/5 of narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.

e. Concrete Admixtures

Admixtures shall be manufactured by a company on the TxDOT approved manufacturer list.

1. Water Reducing Agent shall conform to ASTM C-494 Type A, and shall have a dosage as recommended by the manufacturer.

2. Water Reducing and Retarding Agent: When, in the opinion of the Engineer, the ambient or concrete temperature requires the use of a water reducing and retarding admixture, such admix shall conform to ASTM C-494, Type D.

3. Air Entraining 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.

   The total air content of the concrete shall be three (3) 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 those on the TxDOT approved Manufacturer's list.

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. 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 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement, ASTM Designation A-615.

   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 Carbon-Steel Wire and Welded-Wire Reinforcement, Plain and Deformed, for Concrete, ASTM Designation A-1064.

i. Pre-molded Expansion Joint Filler

Pre-molded Expansion Joint Filler shall conform to the requirements of ASTM Designation D-994 or other as approved by City Engineer.

C. 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.

D. Batching and Mixing

All batching and mixing of concrete materials shall conform to ACI 304-73 "Recommended Practice for Measuring, Mixing, Transporting, 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. Discharge of the concrete delivered by truck mixers shall be within the times listed below. Concrete may be discharged after these times provided the concrete temperature and slump meet the requirements of this section.

Table 200.1

Fresh Concrete Temperature, °F	Max Time After Batching for Concrete Not Containing Admixtures, min.	Max Time After Batching for Concrete Containing Admixtures, min.
90 and above	45	75
75 ≤ T < 90	60	90
T < 75	90	120

Note: Admixtures are those identified in TxDOT Item 421 as Type B and D. Concrete must contain at least the minimum manufacturer's recommended dosage of Type B or D admixture.

E. 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.

F. Concrete Classification

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 TxDOT 421, or latest revision thereof, Class A, B or S. The design strength of each class is shown below. The max water to cement ratio, acceptable coarse aggregate grades, and acceptable slump range shall be per TxDOT 421.

Table 200.2	
Class	**Design strength f'_c (psi)**
A	3,000
B	2,000
S	4,000

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. 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.

c. The following class of concrete will be used as shown, unless otherwise specified:

Table 200.3	
Class	**Use**
A	Curb, gutter, curb &gutter, conc. Retards, sidewalks, driveways, back-up walls, anchors, non-reinforced drilled shafts
B	Riprap, traffic signal controller foundations, small roadside signs, and anchors, concrete encasement
S	Bridge slabs, top slabs of direct traffic culverts, approach slabs

In order to obtain a more workable mix and denser concrete, there shall be added as a part of the concrete for Class A concrete a cement dispersing or water reducing agent conforming to ASTM Specification C-494. 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.

G. Quality of Concrete

During the process 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.

H. 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.

I. 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 ensure 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 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.

J. Construction 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.

K. 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 (ASI318-71)."

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 openings 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 re-tempered sand cement mortar mixed in proportion of one to three, and the concrete shall be left smooth and even.

L. Placing Concrete

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 twelve (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 ensure the flushing of mortar to the surface of all forms.

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.

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 of 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.

Installation of Pre-Molded Expansion Joint Filler shall be made where indicated, and the filler shall extend through the entire section of the structure.

M. Finishing

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, belting, 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 straight-edged 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 straight-edging, and corrective adjusting, if required, is completed, as specified hereinafter.

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 ensure 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 rest. The use of cement to form a surface will not be permitted.

Floor and Slab Finishes: Finish treatment of floors and slabs to be provided after the initial treatment specified under “A” above and 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 cement film, leaving a fine grained, smooth but sand texture.

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.

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 ensure 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.

N. Flowable Fill

Flowable fill is a concrete material suitable as a backfill for utility trenches, abandoned pipes, manholes and valves. It is a heavy material and will exert a high fluid pressure against any forms, embankment, or wall used to contain the backfill.

a. Materials

1. Cement. Furnish hydraulic cement that meets the requirements of TxDOT's DMS-4600, "Hydraulic Cement," TxDOT's Hydraulic Cement Quality Monitoring Program (HCQMP), and ASTM C-150 Type I Portland Cement. Sources not on the HCQMP or other sources to be used in combination with an approved source will require approval before use.
2. Fly Ash. Furnish fly ash conforming to TxDOT DMS-4610, "Fly Ash."
3. Chemical Admixtures. Furnish chemical admixtures conforming to TxDOT DMS-4640, "Chemical Admixtures for Concrete."
4. Fine Aggregate. Provide fine aggregate that will stay in suspension in the mortar to the extent required for proper flow and that meets the gradation requirements of Table 1. Test fine aggregate gradation in accordance with TxDOT standard laboratory test procedure Tex-401-A. Plasticity Index (PI) must not exceed 6 when tested in accordance with TxDOT standard laboratory test procedure Tex-106-A.
5. Mixing Water. Potable water, free of oils, acids, alkalis, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

b. Construction Methods

1. Submit a construction method and plan, including mix design and shrinkage characteristics of the mix, for approval. Provide a means of filling the entire void area, and be able to demonstrate that this has been accomplished. Prevent the movement of any inserted

structure from its designated location. If voids are found in the fill or if any of the requirements are not met as shown on the plans, remove and replace or correct the problem without additional cost to the OWNER.

Unless otherwise shown on the plans, furnish a mix meeting the following requirements.

A. Strength. The compressive strength range, when tested in accordance with TxDOT standard laboratory test procedure Tex-418-A, must be between the following strength values unless otherwise directed by the Engineer or shown on the plans:
   i. Low Strength. Between 80 psi and 150 psi at 28 days.
   ii. High Strength. Greater than 500 psi at 28 days. For emergency repairs, strength shall be greater than 50 psi at 2 hours.
   iii. Two specimens are required for a strength test, and the compressive strength is defined as the average of the breaking strength of the 2 cylinders.

B. Consistency. Design the mix to be placed without consolidation and to fill all intended voids. Fill an open-ended, 3-inch diameter by 6-inch-high cylinder to the top to test the consistency. Immediately pull the cylinder straight up. The correct consistency of the mix must produce a minimum 8-inch diameter circular spread with no segregation.
   i. When necessary, use specialty type admixtures to enhance the flowability, reduce shrinkage, and reduce segregation by maintaining solids in suspension. All admixtures must be used and proportioned in accordance with the manufacturer's recommendations.
   ii. Mix the flowable fill using a central-mixed concrete plant, ready-mix concrete truck, pug mill, or other approved method.
   iii. Furnish all labor, equipment, tools, containers, and molds required for sampling, making, transporting, curing, removal, and disposal of test specimens. Furnish test molds meeting the requirements of TxDOT standard laboratory test procedure Tex-447-A. Transport, strip, and cure the test specimens as scheduled at the designated location. Cure test specimens in accordance with TxDOT standard laboratory test procedure Tex-447-A. The Engineer will sample, make, and test all specimens. Dispose of used, broken specimens in an approved location and manner. The frequency of job control testing will be at the direction of the Engineer.

C. Shrinkage and Bleeding. Limit shrinkage to 0.5% or less based upon the results from ASTM C 827, "Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures."

210 - Concrete Encasement, Cradles, Saddles, and Collars

A. Description

This item shall govern the placement of concrete encasements, cradles, saddles, collars on either existing or proposed water/sewer mains, when specified in the contract documents, or as directed by the Engineer or Inspector.

B. Materials

All concrete shall conform to the provisions of Section 200, “Concrete,” or as noted otherwise in the contract documents.

C. Construction

1. Concrete Encasement: When concrete encasement is shown in the contract documents, or when directed by the Engineer or Inspector, the trench shall be excavated and fine graded to a depth conforming to details and sections shown therein. The main shall be supported by precast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement shall then be placed to a depth and width conforming to the details and sections shown in the contract documents or per standard drawings.

2. Concrete Cradles: When concrete cradles are shown in the contract documents or when called for by the Engineer or Inspector, the trench shall be prepared and the main supported in the same manner as described in 1 above. Straps/Tie Downs shall be a minimum of No. 4 diameter rebar.

3. Concrete Saddles: When shown in the contract documents or when directed by the Engineer or Inspector, the main to receive concrete saddles shall be backfilled in accordance with Section 120, "Trench Excavation & Backfill" to the spring line and concrete placed for a depth and width conforming to details and sections shown in the contract documents.

4. Concrete Collars: When shown in the contract documents or when directed by the Engineer or Inspector, concrete collars shall be constructed in accordance with details and sections shown in the contract documents.

D. Measurement

Concrete Encasement, Cradles, Saddles, and Collars will be measured by the cubic yard of accepted work, complete in place. Reinforcing, if required by the Engineer or Inspector, shall not be measured for payment.

E. Payment

Concrete Encasement, Cradles, Saddles and Collars will be paid for at the unit price bid per cubic yard, which price shall be full compensation for furnishing and placing all materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work. Payment for concrete encasement shall consist of 6 inches of concrete around the pipe where required (as per Standard Details), minus manholes, structures, etc.

220 - Concrete Vaults

A. Description

Reinforced concrete vaults shall be cast-in-place and shall include reinforcing steel, forms, finishing, curing, and all other appurtenant work required to provide a complete and functional structure.

All cast-in-place concrete shall be accurately formed and properly placed and finished as shown in the contract documents.

The Contractor shall inform the Engineer at least 24 hours in advance, of time and location at which he/she intends to place concrete in order for inspection of forms, reinforcing steel placement, and other preparatory work.

Precast vaults conforming to the Standard Drawings and Specifications shall be acceptable as a substitute to the cast-in-place vaults or as approved by the Engineer.

B. Materials

Concrete used shall be transit mix and shall have a 28-day compressive strength of 3,000 psi with a maximum slump of 6 inches and a minimum slump of 3 inches. The use of admixtures shall not be permitted unless approved by the Engineer. Cement shall conform to the general requirements contained in Section 200 - Concrete and the latest provision of ASTM Specifications C150 and C156 or most applicable approved equal provision.

C. Construction

a. Forms: Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown in the contract documents.

Surfaces which will be exposed to view when construction is completed shall be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard. The forms shall produce finished surfaces that are free from off-sets, ridges, waves, and concave or convex areas.

Plywood or lined forms will not be required for surfaces which are normally submerged or not ordinarily exposed to view. Other types of forms, such as steel or unlined wooden forms, may be used for surfaces which are not restricted to plywood or lined forms and may be used as backing for form linings.

Before concrete is placed, a film of light form oil shall be applied to the forms.

Forms shall be substantial and sufficiently tight to prevent leakage of mortar. Forms shall be thoroughly cleaned, braced, or tied to maintain the desired position, shape, and alignment during and after concrete placement.

Form ties shall be corrosion resistant and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment.

b. Form Removal: Forms shall be removed after 24 hours, provided that the exposed surfaces can be immediately and effectively sealed to prevent loss of moisture. Otherwise, the forms

shall remain in place for 48 hours. Precautions shall be taken in form removal to avoid surface gouging, corner or edge breaking, and other damage to the concrete.

c. Reinforcing Steel: Reinforcing steel shall be accurately formed and shall be free from loose rust, scale, and contaminants which reduce bond. Unless otherwise shown in the contract documents, bar reinforcement shall be deformed and conform to requirements of Section 200, Concrete.

d. Reinforcing Steel Placement: Reinforcing steel shall be accurately positioned on supports, spaces, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips. All bars shall be shop fabricated and bent cold.

e. Concrete Placement: Concrete shall be placed as nearly as practicable in its final position to avoid segregation due to re-handling. When the concrete pour has commenced, it shall be carried on as a continuous operation until the placing of the panel or section is completed as a whole. All concrete shall be thoroughly compacted by suitable means during pouring operations and shall be thoroughly worked around reinforcement bars and into the corners of the forms. Mechanical vibration or other acceptable means shall be used to completely embed the reinforcement and eliminate honeycomb. Finished surfaces shall be brought to proper grade, struck off, and completed in a workmanlike manner. No honeycombing, rough spots or protruding stones shall be left exposed.

f. Curing: Concrete shall be protected from loss of moisture for at least 7 days after placement. Curing of concrete shall be by methods which will keep the concrete surfaces adequately wet during the specified curing period.

1. Water Curing: Water saturation of concrete surfaces shall begin as quickly as possible after the initial set of the concrete. The rate of water application shall be regulated to provide complete surface coverage with a minimum of runoff.

2. Membrane Curing: Chlorinated, rubber-type, membrane curing compound may be used in lieu of water curing on concrete which will not be covered later with mortar or additional concrete.

Membrane curing compound shall be spray applied at coverage of not more than 300 square feet per gallon. If forms are removed before the end of the specified curing period, curing compound shall be immediately applied to the formed surfaces before they dry out.

Curing compound shall be suitably protected against abrasion during the curing period.

g. Finishing Surfaces: Fins and other surface projections shall be removed from all formed surfaces. All exposed exterior surfaces shall have a rubbed finish. The floor surface shall be brush finished, unless otherwise specified.

h. Repairing Defective Concrete: Defects in formed concrete surfaces shall be repaired to the satisfaction of the Engineer within 24 hours, and defective concrete shall be replaced within 48 hours after the forms have been removed. All concrete which is honeycombed or otherwise

defective shall be cut out and removed to sound concrete with edges square cut to avoid feathering.

Concrete repair work shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured.

i. Painting: All exposed metallic surfaces such as the cover plate, hinges, handles, and other exposed hardware, shall be primed and painted with one coat of primer and one coat of aluminum paint of approved and compatible quality.

j. Backfill: The Contractor shall cover the openings at each end of the vault with ¼ inch plywood placed outside the vault. Selected backfill (consisting of job excavated materials, finely divided and free from debris, organic material and stones larger than two inches in greatest dimension) shall be placed in uniform layers not exceeding eight inches in un-compacted thickness and shall be carefully compacted around the sides of the vault until level with the surrounding ground.

D. Measurement

Reinforced concrete vaults shall be measured by the unit of the various sizes.

E. Payment

Payment for reinforced concrete vaults will be made at the unit price for each size vault installed.

Specifications 300 – 399: Water

300 - Water General

This section presents the criteria, standards and regulations related to the design of water distribution systems for general development service within the City of Copperas Cove water service area.

Designs for water system construction and improvements shall conform to the most recent edition of Rules and Regulations for Public Water Systems as published by the Texas Commission on Environmental Quality (TCEQ).

Waterline Designations are as follows:

a. Transmission water lines are generally lines conveying water from pumping facilities to reservoirs or lines conveying water directly between pumping facilities or directly between reservoirs. Such lines may not be tapped for any purpose without special approval.

b. Distribution water lines are generally lines providing local distribution of water and from which individual user service taps are made. Distribution lines stem from transmission lines or from other local distribution lines.

c. Service water lines are lines providing service from the distribution line directly to the individual's meter.

310 - Water Main Pipe

A. Description

This item shall govern the installation and material for water main pipe.

B. Pipe Material

a. General

Pipe materials other than those identified in this section may be proposed, but shall meet appropriate American Water Works Association Standards (AWWA) and bear the National Science Foundation (NSF) approval for use in potable water systems. Acceptance of alternative pipe material is subject to Public Works Director and City Engineer approval.

The following table summarizes the acceptable pipe materials and their uses:

Table 310.1

Pipe Material	Use	Pipe Size	Classification
Copper Tubing	Service lines	< 2”	Type K
Polyethylene	Service lines	< 2”	SDR 9 – 200psi
PVC	Service lines	2” – 3”	Schedule 80
PVC	Distribution, service lines	4” – 12”	C900 DR 18
Ductile Iron	Fire hydrant lead, distribution	6”	C151 Cl 350
Ductile Iron	Distribution line	8” – 12”	C151 Cl 350
Ductile Iron	Transmission line	16” – 60”	C151 Cl 250
Concrete Steel Cylinder	Transmission line	16” – 60”	C301
PVC	Transmission line	14” – 42”	C905 DR 18

b. Copper Tubing

Copper Tubing shall be of the type commercially known as type “K” soft and shall conform to NSF standard 61, ASTM B-88, or latest revisions thereof.

c. Polyethylene

Polyethylene shall be High Density Polyethylene shall be manufactured in accordance with ASTM F714 and ASTM D3035, and shall be of the material designation PE3408.

Both Fittings and pipe shall carry the same pressure rating. Piping shall have a 200-psi rating (SDR 9).

d. PVC

<u>For Pipe 4” through 12”:</u>

Dimensions, tolerances, and markings shall be in conformance with AWWA C900 (or latest revision thereof).

All pipes shall be Class 150 (DR 18).

Gaskets shall be designed with a retainer ring that shall be installed at the manufacturer. Gasket shall be in conformance with ASTM F477.

Approved Manufacturers: PW Eagle, J-M Manufacturing, Certainteed Corporation, Diamond Plastics, North American Pipe, Vinyltech, JM Eagle, Northern Pipe Products, Underground Solutions, Pipelife Jet Stream.

For Pipe 16" through 42":
Dimensions, tolerances, and markings shall be in conformance with AWWA C905 (or latest revision thereof).

All pipes shall have a pressure rating of 235 PSI (DR 18) or have the highest pressure rating available for each size of pipe.

Gaskets shall be designed with a retainer ring that shall be installed at the manufacturer. The dimensions and design of the gasket shall meet requirements provided in ASTM D3919 and ASTM D2122. Gasket shall also be in conformance with ASTM F477.

Approved Manufacturers: Diamond Plastics, North American Pipe, JM Eagle, Northern Pipe Products.

e. Ductile Iron

Dimensions, tolerances, and markings for each nominal pipe size shall be in accordance with AWWA Standard C151 (or latest revision thereof).

All pipes shall be lined with cement mortar in accordance with AWWA C104 (or latest revision thereof).

Exterior coating shall consist of asphaltic material applied in accordance with AWWA Standard C151 (or latest revision thereof).

Rubber gaskets shall conform with AWWA Standard C111 (or latest revision thereof).

Approved Manufacturers: American, Griffin, US Pipe Company, Clow Water Systems, Pacific States, McWane.

All ductile iron pipe shall be wrapped with a minimum 8-mil thick polyethylene film conforming to AWWA C105 (or latest revision thereof). In highly corrosive soils, ductile iron pipe shall be double wrapped.

f. Concrete Steel Cylinder

Dimensions, material, manufacture, tolerances, and testing for each nominal pipe size shall be in accordance with AWWA Standard C301 (or latest revision thereof).

All pipe shall be AWA class 150 and shall be designed for an internal working pressure of 150 psi and minimum external load equivalent to 6 feet of earth cover. Pipe to be subjected to deeper bury, the pipe design shall be suitable for the earth loads indicated.

Each joint of pipe shall be furnished with a rubber gasket and a 12" diaper.

C. Construction

a. Embedment and Depth of Cover

Embedment material for water system construction shall conform to the City's standard details and the pipe manufacturer's recommendations, whichever is more conservative. The depth of cover to the top of the pipe shall be a minimum of three (3) feet below natural ground or the bottom of the flex base course where under pavement. If three (3) feet of cover is not achievable, a 2000 psi concrete trench cap at least 6 inches extending laterally 6 inches on both sides of the pipe zone onto undisturbed soil shall be installed. In rural areas and for pipes 16 inches in diameter and larger, the minimum depth of cover to the top of the pipe shall be four (4) feet. In no case will a minimum depth of cover of less than two (2) feet be allowed.

b. Testing

Testing of water utility improvements shall be in accordance with those procedures and standards required per TCEQ and the AWWA specifications. Refer to AWWA C605 "Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings" or AWWA C600 "Installation of Ductile Iron Water Mains and Their Appurtenances", or latest revisions thereof. All utility lines are to be hydrostatically tested at 150 psi for four hours. After the initial testing, any required repairs shall be completed and the repaired lines shall be tested at 150 psi for four hours. Leakage testing shall be performed in A State licensed/certified back flow prevention assembly tester must inspect all backflow prevention devices and the results shall be submitted to the City.

c. Disinfection

All water lines installed will be disinfected in accordance with TCEQ and AWWA standards, AWWA C651 "Disinfection Water Mains", or latest revision thereof, and witnessed by the City. Before final acceptance, the developer will provide the City with the test results after disinfection.

After disinfection, the developer will flush the system and refill with potable water and contact the City to schedule sampling for bacteria and chlorine residual testing. A sample will be taken for every 1,000 feet of waterline. The developer will repeat the disinfection and will be responsible for the cost of the bacterial sampling until bacterial limits are met. Only after the bacterial results are acceptable will the City accept the water line.

D. Measurement

Water main shall be measured horizontally per the linear foot installed.

E. Payment

Payment for water pipe shall be made at the contract unit price per linear foot complete in place. Said price shall be full compensation for furnishing all materials, including pipe, joint restraints, bedding, and thrust blocking, labor and equipment including excavation, bedding, and backfill, tools and incidentals necessary to complete the work.

311 - Water Main Fittings

A. Fittings

When Ductile Iron or PVC pipe is used, the fittings for distribution and transmission mains shall be Ductile Iron, in conformance with AWWA C110. The pressure class shall be the same as the pipe with a minimum of Class 250. Concrete Steel Cylinder (CSC) fittings shall be allowed when CSC pipe is utilized. All fittings shall have either mechanical or flanged joints.

Where required by site constraints, a ring connection may be used with prior approval from the City Engineering Department to connect the water main to another main running perpendicular to the water main. The minimum diameter of the ring connection shall be the diameter of the smaller main. If tees are used to connect the two lines, a gate valve shall be installed on the ring. If a tapping sleeve and valve is used, a gate valve is not required. The 90° bend may be rotated up or down as necessary to connect with the other main. Ebba MegaLug retainer glands shall be used at the connection of the 90° bend to the straight pipes on each side.

B. Valves

a. Valve Boxes

Cast iron valve boxes and covers shall be standard three (3) piece box and cover, consisting of base housing, extension hollow shaft and cover. The covers shall have the word “WATER” cast in raised letters in its upper surface on water mains and shall have no designation for other types of mains. Boxes furnished shall be adjustable unless shown otherwise on the plans and the extension hollow shaft shall be of sufficient diameter to admit readily standard valve wrench. Boxes shall be as manufactured by Mueller, Clow, East Jordan Ironworks, or pre-approved equal, and standard length shall be 24”-36” adjustable valve box unless pre-approved. Valve boxes will be required for every subsurface gate valve unless otherwise specified.

The valve box shall have a concrete slab around the valve box. In developed or paved areas, the slab shall be eighteen inches by eighteen inches, six inches thick. In rural or unpaved areas, the slab shall be thirty-six inches by thirty-six inches, six inches thick. The slab shall have a broom finish and shall be placed to grade. The reinforcement in the concrete slab shall be made of #4 rebar, and shall be arranged as shown in the standard details.

If a valve box extension is required, it shall be made of a two inch by two inch, quarter inch thick steel tubing extension on the valve nuts for depths deeper than five feet. The steel tubing shall be attached to the valve nut with a quarter inch fillet weld. A quarter inch thick steel support plate shall be fillet welded to the top and bottom of the nut on the top of the extension. The maximum distance between grade and the top of the extension shall be two feet.

b. Isolation Valve Types

Valves on six (6) inch to sixteen (16) inch lines shall be of the resilient "wedge" or "seated" type, in conformance with AWWA C509. Valves on mains larger than 16 inches shall be rubber-seated butterfly valves in conformance with AWWA C504. Butterfly valves on lines 24 inches and larger must be placed in a vault, direct bury of these valves is not acceptable.

c. Air Release Valves

On transmission mains or pressure plane separation, air/vacuum release valves shall be located at all significant high points. A significant high point is defined where the crown of the pipe is

greater than 1.5 times the diameter of the pipe above the flowline of the pipe in the adjacent low points.

A combination air and vacuum release valve shall be used at each location where an air release valve is required. The riser or outlet of the air release valve shall be set two feet back from the curb and four feet above the ground level. A 180° fitting shall be installed so that the air or water will release downward. The vent to the atmosphere must be covered with 16-mesh non-corrosive screen. The outlet must be covered by an enclosure.

The air release valve can be enclosed in either a pre-cast manhole or a pre-approved traffic bearing enclosure.

All metal in the valves shall be stainless steel type 303, 304, or 316 and shall be in accordance with ASTM A240 or A276. Valve shall have a test pressure rating of 300 psi and a working pressure rating of 150 psi.

Acceptable manufacturers include: Apco Valve Company, Val-Matic Mfg. Co., Powerseal Corporation, and ARI Flow Control.

C. Measurement

Valves shall be measured on the basis of one complete in place in accordance with the details, drawings, and specifications.

D. Payment

Payment for fittings shall be made at the contract price per each complete in place. Said price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work on the basis of one complete in place in accordance with the details, drawings, and specifications.

Payment for valves shall be made at the contract price per each complete in place. Said price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work on the basis of one complete in place in accordance with the details, drawings, and specifications.

312 - Water Main Thrust Restraints

A. Description

This item shall govern the thrust restraint requirements for water mains.

B. Requirements

1. Underwriter Laboratories and Factory Mutual certifications are required on all restraint systems.
2. Restraint systems for PVC to meet or exceed ASTM F1674 (or latest revision thereof).
3. Restraint systems for Ductile Iron to meet or exceed UL Standard 194 (or latest revision thereof)
4. The designer is responsible for providing, on the construction drawings, an adequate restraining system design for the waterline, including minimum length of restrained pipe required in each direction. Computer programs as distributed by EBAA Iron, Inc. and Certain TEED are available to calculate restrained joint requirements.

C. Specific Requirements

1. Restrainer for Push-on type connections:

   The pipe shall be restrained by a split retainer band, meeting or exceeding ASTM A536-80, Grade 65-45-12. The restraint system may consist of two types: Two split retainer rings or for new construction use only one split and one solid cast backup ring.

   Bolts and nuts used to attach the split retainer ring shall comply with ANSI B 18.2, SAE Grade 5. Standard MJ Fitting Tee-bolts and nuts shall be fabricated from High Strength steel conforming to AWWA C11 and AWWA C153.

2. Compression Ring Fitting Restrainer:

   Compression ring with follower gland type of restrainer may be utilized in conjunction with Mechanical Joint (MJ) bell end ductile iron pipe fittings for restraining PVC C-900 and ductile iron pipe.

   Bolts and nuts used to attach the split retainer ring shall comply with ANSI B 18.2, SAE Grade 5. Standard MJ Fitting Tee-bolts and nuts shall be fabricated from High Strength steel conforming to AWWA C11 and AWWA C153.

D. Concrete Thrust Blocking

See Section 17.5-A.4.6 of the City Code of ordinances for requirements.

E. Payment

The payment for thrust restraints and/or thrust blocking shall be subsidiary to the water pipe cost. This shall include all work, material, labor, equipment, and appurtenances to install a complete and working thrust restraint system.

320 - Fire Hydrant Materials & Installation

A. Description

This item shall govern the materials and installation of Fire Hydrant assemblies.

B. Materials

Fire Hydrants shall be either Mueller Super Centurion, Clow Medallion, AFC American Darling B84B, or preapproved equal. Hydrants shall conform to the design requirements of AWWA C502.

Hydrants shall have a dry barrel and a six (6) inch inlet with a five and one-quarter (5 ¼) inch main valve opening, with one (1) pumper connection with a nominal inside diameter of 4 inches and two (2) hose nozzles with a nominal inside diameter of 2 ½ inches, 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.

C. Construction

1) Setting Fire Hydrants

The hydrant shall be 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 4 cubic yards 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. All fittings on fire hydrant lead need to be restrained at the joints. Extensions will not be allowed.

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

Fire Hydrant shall be installed such that the final height above finished ground will allow the spanner wrench to remove the caps without repositioning.

2) Spacing

For residential zoned property or use, and as the property develops, fire hydrants shall be located at a maximum spacing of six hundred (600) feet as measured along the length of the roadway. No part of a residential structure shall be farther than five hundred (500) feet from the fire hydrant as measured by the route that a fire hose would be laid.

For non-residential zoned property or use, and as the property develops, fire hydrants shall be located at a maximum spacing of three hundred (300) feet as measured along the length of the roadway. No part of a non-residential structure shall be farther than five hundred (500) feet from the fire hydrant as measured by the route that a fire hose is laid.

Drain hydrants shall be located at all low points on transmission lines. Fire hydrants shall be located within the distances from public streets as shown in the Standard Details.

3) Cul-de-Sacs
If a fire hydrant is not required in a cul-de-sac due to distance requirements as outlined in the subdivision ordinances, a 2-inch blow off valve should be located behind the curb at the end of the line and in such a manner to allow drainage to an appropriate location.

The flushing device shall be a Kupferle 9400WC or approved equal. The fittings between the water main and the flushing device shall be copper compression fittings. A meter shall be installed between the main and the flushing device, and the meter shall be installed in a standard meter box. Erosion control and area drainage measures at the blow off discharge point must be installed to meet site drainage conditions. Also, the discharge of chlorinated water must comply with TCEQ requirements.

D. Measurements

This item shall be measured by each fire hydrant assembly installed.

E. Payment

The Payment for fire hydrants shall be made at the contract price per each complete in place. Said price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work on the basis of one complete in place in accordance with the details, drawings, and specifications.

330 - Water Service Connections

A. Description

This item shall govern the material and installation of water service connections.

B. Materials

1) Service Lines

The developer's engineer shall determine service line sizes for multi-family, commercial, or fire lines. The pipe material for these services shall be in accordance with section 310 “Water Main Pipe”.

2) Tapping Sleeves and Saddles

All tapping sleeves and saddles shall be constructed of stainless steel. Double strapped saddles shall be acceptable for taps less than four (4) inches. Taps greater than or equal to four (4) inches shall require full tapping sleeves. Requests for size on size taps with the use of a full tapping sleeve may be approved upon review by the Director of Public Works and/or City Engineer.

Approved tapping saddles include Mueller galvanized or cadmium coated, Smith-Blair #313 (formerly Rockwell) or Ford F202 service saddle for connections to cast iron or ductile iron pipe. Connections to a PVC water main shall be made with a Smith-Blair #317 service saddle.

3) Valves on Service Lines

Connections that are greater than two (2) inches shall require resilient seated or wedge type gate valves. Corporation stops are only acceptable on taps two (2) inches or smaller. This would include taps made for air release valves.

Corporation Cocks shall be Mueller H-15008, or Ford equal, which can be either CC or IP thread x compression outlet. Curb and meter stops for service connections shall be as follows: For single service connections, curb stops shall be Mueller H-14258, or Ford equal, a compression inlet with lockwing head, or a place to lock a padlock when isolating the line for service. For double service connections, “U” branch connections shall be Mueller H-15363 or Ford equal with a compression inlet. Two (2) curb stops, Mueller H-14265 shall be furnished and installed with lockwing head, or a place to lock a padlock when isolating the line for service.

4) Backflow Prevention & Pressure Reducing Valves

Backflow Prevention and Pressure Reducing Valves shall be installed in accordance with City of Copperas Cove Plumbing requirements.

5) Meter Boxes

Meter boxes may be of plastic construction when located in non-traffic areas. Steel meter boxes are required when the meter box is located in traffic areas. Owner shall install 3” meter in a concrete vault (with spring assisted lid) with appropriate sized bypass. The meter shall be located as close the main as possible, with a minimum two-foot clearance. The meter locations should be reviewed by the city inspector, and variations may be approved on a case by case basis only. Meter vaults shall be installed flush with the surrounding ground in traffic areas (vehicle and pedestrian traffic), and vaults shall be 6” above the surrounding ground for non-traffic areas.

6) Leak Detector Double Check Assembly

All new fire line services and those encountered in a construction project shall have a leak detector double check valve with a detection meter installed. The detector shall be installed in a concrete vault, and where possible, the vault shall be installed in the right of way. In commercial applications, vaults may be installed inside the building. The vault shall be manufactured by Concrete Products, Inc. or approved equal, and the door shall be spring assisted. The detector check valves must be a minimum of six inches above the floor. All test ports shall have protective caps. Upon installation, the assembly must be tested by a certified tester, and the results must be furnished to the City of Copperas Cove, Water Billing Office. Test results must be furnished to the City by the owner on an annual basis.

C. Measurement

Water service connections shall be measured on the basis of one complete in place in accordance with the details, drawings, and specifications.

D. Payment

The Payment for water service connections shall be made at the contract price per each complete in place. Said price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work on the basis of one complete in place in accordance with the details, drawings, and specifications.

340 - Blow-off Assembly

A. Description

This item shall consist of blow-off assemblies installed in accordance with these specifications and as directed by the Engineer.

B. Materials

The materials for blow-off assemblies, installation and adjustment shall conform to the specifications.

C. Construction

Blow-off assemblies shall be installed where shown on the plans and/or at locations designated by the Engineer/Owner and at the end of all dead-end mains in accordance with the Texas Administrative Code (TAC) rules to include 30 TAC § 290.44.(d)(5), (6), or latest revision thereof. All blow-off assemblies shall be joint restrained based on pressure requirements (minimally from the water main to the end of the blow off).

The blow-off assembly shall consist of the following: all galvanized iron pipe, valve, and fittings of the various sizes shown on the plans, 6-inch valve box assembly and concrete collar around the valve box. Valve box shall be raised or installed to finished grade and installed in accordance with City Standard Details.

D. Measurement

Blow-off assemblies will be measured by the unit of each such assembly of the various sizes of blow-offs installed.

E. Payment

Payment for blow-off assemblies will be made at the unit price bid for each such assembly of the various types and sizes installed in accordance with the details shown in the Standard Details. Such payment shall also include excavation, selected embedment material, anticorrosion embedment when specified, and the hauling and disposition of surplus excavated materials.

Specifications 400-499: Sanitary Sewer

400 - Sanitary Sewer General

This section presents criteria, standards and regulations related to the design of wastewater collection system facilities for general development within the City of Copperas Cove wastewater service area. The material is directed to the competent design professional and is not intended as a detailed design handbook or technical specifications.

Designs for wastewater system construction and improvements shall conform to the requirements of the Texas Commission on Environmental Quality (TCEQ). Designs for all public improvements shall conform to the Revised Subdivision Ordinance design guidelines.

410 - Manholes

A. Description

This item shall govern the installation and materials for manholes.

B. Materials

Manhole construction shall be pre-cast concrete or cast-in-place concrete. Fiberglass manholes may be used only in locations approved by the City. Manholes shall have resilient watertight pipe connections. The manhole base shall have a "U"-shaped channel to provide for a smooth flow of water and to carry the pipe slope through the manhole. The manhole invert depth shall be per the requirements of TCEQ 217. For connecting pipes of the same size, an invert drop of 0.1-ft. across the manhole is required. Connecting pipes of different size should have a crown elevation match. In situations where conservation of available head is critical for pipeline design, a waiver from these requirements may be granted to allow pipe invert elevations that provide an energy grade line match, as supported by calculations using the sizes, slopes, and design flows for the connecting pipes.

A. Pre-cast Manholes
   Pre-cast 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 connector shall be flexible seal boot resilient connector meeting the requirements of ASTM C-923. Pre-cast manholes shall be placed on a bedding six (6) inches minimum think composed of 3/8”-1” crushed rock.

B. Cast-in-Place Manholes
   Cast in place manholes will require a sealed design submitted by the contractor and approved by the city engineer.

C. Frame and Cover
   Manhole frame and cover shall be Neenah Foundry, East Jordan Ironworks, or approved equivalent. Frame and cover shall meet the requirements of TCEQ. Covers shall be provided with pick slots. The word “Sewer” shall be cast in each cover. Watertight and airtight manhole ring and cover shall be used for a manhole in the 100-yr flood plain, and anywhere else required by TCEQ 217.

D. Manholes inside a Roadway
   Manholes inside a roadway shall have a flat lid, and the manhole shall be surrounded by a five foot by five-foot, six-inch thick minimum concrete collar. The collar should have two points in direction of traffic flow, a diamond configuration. The reinforcement for the collar shall be one #4 rebar, parallel to each side and two inches above the bottom of the section. The rim elevation of the manhole shall be within one inch of the roadway elevation. This can be accomplished by using one-inch grade rings.

E. Manholes in Undeveloped Areas
   A manhole in an undeveloped area shall extend six (6) to twelve (12) inches above the surrounding grade, so that they will be visible and less likely to flood.

F. Drop Manholes
A drop manhole is required by TCEQ 217 when the upstream pipe is a specified height above the manhole invert. Please reference TCEQ 217, or latest revision thereof, for the height when a drop manhole is required. The drop pipe must be outside the manhole. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent solids deposition.

G. Installation of manhole around existing sewer pipe (doghouse manhole)
Should a manhole need to be installed around an existing sewer, the existing sewer pipe must first be exposed and an invert constructed under the pipe. The excavation must be kept free of water while the manhole is being constructed. Inverts may be formed by pouring the concrete invert (3,000 psi) and cutting out the top half of the pipe. A precast manhole section, with U-shaped cutouts for the pipe, can then be installed over the existing pipe. The voids of the cutout must then be filled with hydraulic cement. The top sections of the manhole shall be constructed per the standard manhole specification. Cast-in-place manholes will also be permitted for installation around existing sewers. The sanitary sewer pipe shall not protrude into the trough of the manhole (all pipe shall be flush with the manhole).

H. Manhole Testing
Testing of sewer manholes shall be in accordance with TCEQ requirements.

I. Manhole Lining
Manholes will be lined, at the termination points of force mains and at locations required by the City, in accordance with City specifications for protective coatings.

C. Measurement

Manholes shall be measured by each complete installation in place.

D. Payment

Manholes shall be paid by each complete installation in place. This includes excavation, backfill, compaction, concrete collar (if manhole is in the street), boot seals, watertight pipeline connections, labor, tools and equipment to install a complete and working manhole.

411 - Sanitary Sewer Gravity Pipe

A. Description

This item shall govern the materials and installation of sanitary sewer gravity pipe.

B. Materials

The material of construction for gravity sewer pipe shall be SDR 26 PVC.

PVC 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.

C. Construction

a. Regulatory Requirements

All sanitary sewer installations shall be in conformance with TCEQ's Design Criteria for Sewerage Systems (30 TAC 217 or latest revision thereof).

b. Embedment and Depth of Cover

Embedment material shall conform to the City's standard details and the pipe manufacturer's recommendations, whichever is more conservative. The depth of cover to the top of the pipe shall be a minimum of three and a half (3.5) feet below natural ground or the bottom of the flex base course where under pavement. If three and a half (3.5) feet of cover is not achievable, a 2000 psi concrete trench cap at least 6 inches extending laterally 6 inches on both sides of the pipe zone onto undisturbed soil shall be installed. In rural areas and for pipes 16 inches in diameter and larger, the minimum depth of cover to the top of the pipe shall be four (4) feet. In no case will a minimum depth of cover of less than two (2) feet be allowed.

c. Testing

Testing shall be in accordance with those procedures and standards required per TCEQ and the AWWA specifications.

D. Measurement

Sanitary sewer pipe shall be measured horizontally per the linear foot installed from center of manhole to center of manhole.

E. Payment

Payment for sanitary sewer pipe shall be made at the contract unit price per linear foot complete in place. Said price shall be full compensation for furnishing all materials, including pipe, bedding, and labor and equipment including excavation, bedding, and backfill, tools and incidentals necessary to complete the work.

412 - Sanitary Sewer Force Main

A. Description

This item shall govern the installation and material for water main pipe.

B. Pipe Material

All pipe, fittings, and joints shall meet or exceed the requirements of ASTM D2241, with the exception that solvent cement joints shall not be used. The pressure rating, size, and pressure class shall be included as part of the design drawings or documents.

Pipe shall have an integral bell and gasket seal with the locked-in type gasket conforming with ASTM F477.

Pipe joints shall also conform to ASTM D3139.

Pipe materials other than those identified in this section may be proposed, but shall meet appropriate pressure requirements and corrosion resistance for sanitary sewer force mains. Acceptance of alternative pipe material is subject to Public Works Director and City Engineer approval.

C. Construction

a. Embedment and Depth of Cover

Embedment material for shall conform to the City's standard details and the pipe manufacturer's recommendations, whichever is more conservative. The depth of cover to the top of the pipe shall be a minimum of three and a half feet below natural ground or the bottom of the flex base course where under pavement. If three and a half (3.5) feet of cover is not achievable, a 2000 psi concrete trench cap at least 6 inches extending laterally 6 inches on both sides of the pipe zone onto undisturbed soil shall be installed. In rural areas and for pipes 16 inches in diameter and larger, the minimum depth of cover to the top of the pipe shall be four (4) feet. In no case will a minimum depth of cover of less than two (2) feet be allowed.

b. Testing

Testing shall be in accordance with those procedures and standards required per TCEQ.

D. Measurement

Force Main pipe shall be measured horizontally per the linear foot installed from center of manhole to center of manhole or end of main.

E. Payment

Payment for force main pipe shall be made at the contract unit price per linear foot complete in place. Said price shall be full compensation for furnishing all materials, including pipe, joint restraints, bedding, and thrust blocking, labor and equipment including excavation, bedding, and backfill, tools and incidentals necessary to complete the work.

420 - Laterals

A. Description

This item shall govern the installation and materials for sanitary sewer service laterals.

B. Materials

Service line connections to proposed mains shall be made with wye fittings. Service line taps to existing mains shall be made using a saddle type connection designed to join the types of pipe that are to be connected. Service taps shall be watertight and shall not protrude into the sewer main. Service line taps shall be made on the top half of the main line, and the bottom lip of the connecting pipe shall not dip below the centerline of the main.

C. Construction

All lateral installations shall be in accordance with these specifications and TCEQ requirements. For sanitary sewer mains that are 12 inches in diameter and smaller, all laterals shall be individually connected using the appropriate size wye placed in line with the main line.

The minimum slope allowed for service lines is 1.0% (1/8-inch per linear foot). Grade breaks should be made with standard fittings and not exceed 45 degrees. Minimum service line depth of cover at the curb line is 36 inches. 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.

D. Measurement

Laterals shall be measured by each complete installation.

E. Payment

Payment for laterals shall be made at the contract unit price for each installation complete in place. Said price shall be full compensation for furnishing all materials, including pipe, labor and equipment including excavation, bedding, and backfill, tools and incidentals necessary to complete the work.

450 - Bypass Pumping

A. Description

The work covered by this item consists of bypass pumping operations for existing sanitary sewers less than 24-inches in diameter in order to temporarily reroute sanitary sewer flows to prevent a sanitary sewage overflow (SSO) and to provide adequate and reliable sanitary sewer flow at all times during construction.

The Contractor shall be responsible for the design of the bypass pumping plan and system. Contractor's bypass pumping system design shall be developed based upon the requirements of the Contract Documents.

The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

Pump and haul bypass systems shall not be allowed for larger sanitary sewers with significant sewage bypass flows. Contractor shall provide for temporary measures to convey sewage flows and avoid sewage spills should a storm event occur that generates sanitary sewer flows in excess of Contractor's bypass pumping system.

B. Submittals

1. All submittals shall be in accordance with Owner's requirements and shall be acknowledged by Owner prior to delivery.
2. For all projects requiring bypass pumping, the Contractor shall prepare and submit a Bypass Pumping Plan (BPP). The BPP shall be submitted a minimum of two weeks prior to commencing any portion of the proposed scope of work and shall be acknowledged by City prior to beginning Work. The BPP shall be signed and sealed by a professional engineer licensed in the State of Texas (Contractor's Engineer).
3. Contractor shall submit manufacturer's product data, instructions, recommendations, shop drawings, and necessary certifications in order for the proposed BPP to be reviewed and acknowledged.
4. The following shall be submitted as part of the BPP:

    a. A cover letter containing the following information;

        i. The project name and job number.

        ii. The name and address of the Contractor.

        iii. Contact information of the Contractor's project manager, superintendent, foreman/supervisor, safety professional, etc.

        iv. A description and location of the planned bypass pumping work to be performed; include data for stationary and pump and haul bypass systems as applicable.

    b. Emergency ("24/7") contact information for the bypass pumping subcontractor, if applicable. Make sure to include the name, cell phone number, and title of the person(s) onsite responsible for the bypass pumping operation.

c. The name, phone number, title, signature, and PE seal of the Contractor's Engineer preparing the BPP.

d. Copies of permits or other documents showing the Contractor has obtained all clearances necessary for installation and operation of the BPP.

e. If Contractor elects to use a combination of stationary bypass pumping and pump and haul for his bypass system, Contractor's BPP shall identify the quantity of flows that will be pumped and pumped and hauled for each type of bypass system along with the points where flows will be removed and reintroduced into the sanitary sewer system.

f. A description of the maximum amount of sanitary sewer flows to be bypassed by the Contractor's bypass pumping system and how the flow conditions will be monitored during system operations (including all flow measurement devices, calculations, equipment, or other sources of how data was obtained). If the bypass plan is not based on the maximum wet weather flow in the sanitary sewer, this description must include an explanation for how the contractor plans to monitor the weather for potential flows exceeding his bypass system capacity and how he will avoid having to bypass during wet weather events exceeding his bypass system capacity.

g. The date and time the bypass pumping is expected to begin and be completed. Indicate if bypass pumping will take place outside normal work hours which are between 8 am to 5 pm Mondays through Fridays (except for City observed holidays). Contractor shall reimburse City for the overtime costs required by his bypass pumping testing outside of City normal work hours.

h. The pump curves, showing operating range. This shall include the proposed system curve, addressing the pump operation in relation to the suction/discharge piping's alignment with respect to restriction and/or elevations.

i. Suction and discharge piping material(s) and capacity to be used for the bypass pumping operation, including the material(s) for any bend(s) and/or valve(s) that will be used.

j. A sketch showing the location of the pump(s) and the route of the suction, and discharge piping. If Contractor elects to use locations outside of the easements obtained by City, Contractor shall be solely responsible for obtaining the required easements and written documentation required for use of these locations. The sketch shall be dimensioned and all-inclusive showing all City manholes.

k. A Traffic Control Plan that pertains solely to the bypass pumping operations.

l. An Emergency Plan detailing procedures to be followed in the event any portion of the bypass operation fails and causes either surcharging or an actual SSO.

C. Equipment and Materials

The Contractor shall provide all necessary pumping equipment, piping and all other necessary appurtenances in order to maintain adequate and reliable sanitary sewer flow in the sanitary sewer system (including any temporary manholes) at all times during construction for stationary pumping and pump and haul bypass pumping systems. All materials, equipment, etc., must be in good condition, and should not have visible damage such as cracks, holes, foreign material, blisters, etc.

a. Plugs

Plugs must be selected and installed according to the size of the line to be plugged. Plugs shall be adequately secured and anchored to prevent plug movement or escape into the adjoining sanitary sewers should the plug fail.

b. Stationary Bypass Pumping Systems

1. High-Density Polyethylene (HDPE) is the preferred pipe material for all bypass piping. HDPE shall be used when bypass discharge pipe will be going through streams, storm water culverts, and/or environmentally sensitive areas. At other locations, flexible discharge hose that is in good condition and does not leak, may be allowed subject to it acceptably passing testing.

2. HDPE pipe must be assembled and joined using couplings, flanges or fusion welding in order to avoid joint leakage.

3. HDPE fusion welding must be performed by personnel certified as fusion technician(s) by the manufacturer of HDPE pipe and/or fusing equipment. City shall examine welds prior to use in BPP operation.

4. BPP shall indicate the proposed DR of the pipe to be used.

5. Rigid suction hose that is in good condition and does not leak may be allowed for withdrawal of flows from the suction point into the bypass pumps.

6. Pipe material other than HDPE shall be submitted to City for approval. Neither “Irrigation type” pipe nor glued PVC pipe will be permitted.

7. Any hoses or pipes that leak shall be removed and replaced with non-leaking hoses or pipes.

8. Pumps must be fully automatic self-priming units that do not require the use of foot valves or vacuum pumps to prime the system. Contractor shall provide suitable spill control and containment measures to avoid environmental contamination by pumps, fuels, or lubricants. All pumps shall be open impeller solids handling type pumps, capable of passing a minimum of 3-inch diameter solids. Contractor shall have one backup pump, equal in capacity to the largest pump in the system, connected into the bypass pumping system, and ready for operation in case any of the primary pumps fail. The backup pump shall not be used in Contractor’s calculations for determining the pumping capacity requirements for the stated flow conditions above. Sound-attenuated

pump enclosures shall be required on all projects where the bypass pumps are located within 50 feet of any residence, business, park, or other presence of people.

c. Pump and Haul Bypass Pumping Systems

Pump and haul bypass pumping systems shall use good-quality vacuum trucks, equipment, and materials from manufacturers commonly engaged in the manufacture, service, and repair of these types of sanitary sewer service trucks and equipment. All equipment shall be designed and manufactured for sanitary sewer service, shall function acceptably, be reliable, and free from leaks or other deleterious environmental impacts. All equipment proposed for use in pump and haul bypass pumping shall have been maintained per the manufacture's recommendations. Equipment service records shall be made available at City request. Any hoses or pipes that leak shall be removed and replaced with non-leaking hoses or pipes.

D. Construction

During construction, it will be the Contractor's responsibility to maintain a safe and secure environment at all times. All provisions and/or requirements of the BPP must be followed throughout the course of any bypass flow operations. Contractor must notify the City Inspections Department 72 hours prior to commencing the bypass pumping operations.

a. The Contractor shall have full time (24-hour), onsite qualified pump personnel including supervision for monitoring the entire bypass installation while it is in operation. The entire length of bypass piping shall be walked and inspected hourly to monitor for leaks. High-level alarm notification to cell phones shall not eliminate this requirement. Where bypass pumping systems exceed 1,500 feet in length or cannot be completely observed from the bypass pump location, at least one attendant shall be assigned to the pump operation, and one additional attendant shall be assigned to walk and monitor the pipeline.

b. Prior to installing any plugs, the Contractor and City shall inspect the existing pipe using a pole camera, for imperfections that might cause damage to the plug, cause the plug to not seal or function properly, or compromise the integrity of the pipe when the plug is inflated. The results of this inspection shall directly impact the planned plugging location(s). Afford City an opportunity to confirm that the location of plug(s) is acceptable.

c. Lines inserted into any manholes or structures shall be constructed with elbows, or be otherwise angled, to direct discharge along the most efficient path for entry into the downstream line without causing unnecessary turbulence of flow. The termination point of the discharge piping shall extend to the crown of the pipe housed within the manhole or structure receiving the bypassed flows.

d. Contractor shall provide continuous supply on-site fuel storage sufficient for 24- hour operation of the bypass pumping installation.

e. Contractor shall protect all components of the bypass operations from vandalism and vehicular damage by making the site secure.

f. Contractor shall minimize sanitary sewer odors by using lids, shroud covers, or any method accepted by the Inspector or Engineer.

g. Contractor shall be solely responsible for any and all damages to private and/or public property caused by, or during, the installation, operation, and/or removal of the bypass pumping system. Contractor shall be fully responsible for all damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

h. Once all work is completed and the bypass pumping operation is no longer required, the Contractor must disinfect and drain the entire BPP system in accordance with approved submittal.

i. City will not be responsible for additional traffic control measures that might be required by TxDOT, or any other public entity having jurisdiction of the project location.

k. Plug Installation

1. Safety

i. The Contractor shall be solely responsible for the safe and effective use of plugs, including the proper combination of inflatable/mechanical plugs to block the sewer flow at both the upstream and downstream ends of a sewer bypass.

ii. Inflatable plugs should be used only after receiving training as recommended by the manufacturer.

iii. An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others corrective actions should be taken prior to the equipment use.

2. Plugs

i. Plugs must be selected and installed in accordance with the manufacturer's recommendations.

ii. Plugs must also be selected and installed according to the size of the line to be plugged.

iii. Spare plugs – Provide spare plugs on-site ready to be installed in the event a plug fails or becomes dislodged.

iv. Plugs will be in good condition and reviewed by the Contractor for defects that might lead to failure prior to being installed. The Contractor shall sign the Plug Inspection form.

v. Plugs must be removed from the system upon completion of the work.

vi. Damages – The Contractor will be responsible for damages due to plugs being left in place or dislodged, including but not limited to:

1. Damages to City infrastructure or private property.

2. Costs associated with sanitary sewer overflows including: regulatory fines; sewage and debris cleanup; debris disposal at an appropriate landfill; disinfection of all surfaces which have contacted the sewage.

3. Costs associated with locating and retrieving lost or dislodged plugs.

E. Testing And Quality Control

Testing and quality control will be required for stationary bypass pumping and pump and haul bypass systems as indicated below. Contractor shall obtain and keep copies of all required permits on site prior to beginning Testing and throughout performance of the Work.

Contractor must prove to the Owner that the equipment, materials and all operational aspects and/or appurtenances related to the BPP are in good condition prior to commencing the bypass pumping operation. Failure to do so will result in the Contractor not being permitted to continue with any construction work requiring bypass pumping operations. Contractor must notify the City Inspections Department 48 hours prior to commencing any testing. Any flows excessively surcharging the sanitary sewer system during the test and/or during actual bypass periods will deem the BPP to be unacceptable and must be revised and resubmitted for approval. There will be no separate pay item if this condition occurs during the timeframe in which bypass pumping test and/or operations are underway during the project. No testing of the bypass pumping operation shall be conducted between Thursday and Sunday, unless approved by City. If bypass pumping will take place outside normal work hours which are between 8 am to 5 pm Mondays through Fridays (except for City observed holidays), Contractor shall reimburse City for the overtime costs required by his bypass pumping testing outside of City normal work hours.

a. Stationary Bypass Pumping Systems

Discharge piping, joints and all accessories will be required to be hydrostatic tested. All piping, joints, and accessories shall be able to withstand at least twice the anticipated pressure or a minimum of 50 psi, whichever is greater.

For any bypass operations proposed a test run of at least 2 hours must be satisfactorily performed, prior to commencing any construction work. All testing shall be performed and approved by City. Contractor shall provide both a strobe light-type high-level alarm, as well as alarm notification to their cell phones, as well as other appointed personnel to be identified by City, and ensure adequate alarm notification is attained prior to actual startup of the test period.

During the testing period, the Contractor shall install a Float Monitoring System in the upstream manhole and/or pipe to confirm that the bypass pumping flow data shown in their BPP remains applicable. The float monitoring system shall remain in the manhole and/or pipe for the duration of the bypass operation. The data collected during the test and duration of the bypass operation shall be provided to City for evaluation and recording. It will be required of the Contractor to have personnel remain onsite at the flow monitoring system in order to continuously record (every 30 minutes) the flows during both the test and actual bypass pumping periods. Contractor shall submit a copy of Testing Float Monitoring System Data log to City upon successful completion of test. Data log shall be in column format with each line entry

indicating the time, elapsed time of test, level of flow indicated in manholes, total flow being pumped by the BPP system, and any comments pertaining to the test.

b. Pump and Haul Bypass Pumping Systems

Contractor shall perform a full-scale demonstration test of his proposed pump and haul bypass system to prove that his system can be successfully used for bypass pumping at the proposed locations. Contractor's test shall use all of the equipment and staff that will operate the bypass pumping system during performance of the Work. Traffic control systems required during the Work shall be utilized during the test. Withdrawals and discharges of flow shall be from or into the manhole locations identified in the Contractor's BPP except for pump and haul system. This requirement is intended to demonstrate to City that the Contractor's proposed BPP is capable of providing satisfactory bypass pumping prior to Contractor beginning the Work, including the size and number of trucks and cycles times. Pump and haul system flow shall be disposed of in a TCEQ licensed facility and all manifests shall be kept and submitted to City. Disposal pump and haul flow in a nearby manhole is not acceptable.

c. Test Failure

Any failure of equipment, or activities associated with the bypass pumping operations contributing to either an excessive surcharge or SSO, shall be deemed a failed test. The test shall then be stopped and any necessary cleanup or reporting efforts performed. The BPP will need to be revised, resubmitted and acknowledged prior to the test initiating again. Any effort by City or other third parties to mitigate damages resulting from any surcharging or SSOs shall be the direct and sole responsibility of the Contractor. This includes any related fines, penalties, or damages to public or private property.

d. Plug Testing

Plugs shall be tested prior to use. The inflatable plug shall be placed inside of a structurally sound pipe or conduit and inflated to its operating pressure and monitored for 24 hours to observe it holds the required pressure. This testing shall be performed in accordance with the manufacturer's recommendations. Inflating a plug when it is not constrained or overinflating the plug creates a risk of being injured by pieces of the plug exploding if it fails.

F. Measurement and Payment

Measurement for the work specified herein will be by lump sum and as required by the contract documents. Payment of the "Lump Sum" bid for Bypass Pumping shall be in accordance with the following: Any effort required for multiple set-ups and operations shall be included in the lump sum price.

a. When initial set-up and operation of the bypass pumping system begins (including a successful test), 20% of the "Lump Sum" cost will be paid as applicable to the bypass system used; stationary bypass pumping or pump and haul bypass systems.

b. 60% of the "Lump Sum" cost will be paid over equal monthly payments (estimated from the BPP or other documentation approved by the Inspector) during the bypass pumping operation

as applicable to the bypass system used; stationary bypass pumping or pump and haul bypass systems.

c. 20% of the remaining “Lump Sum” cost will be paid upon an acceptable removal and/or disassembly of all components of the BPP, including site cleanup as applicable to the bypass system used; stationary bypass pumping or pump and haul bypass systems.

d. For multi-bypass pumping setups, payment will be proportional to the overall amount of the established bid line item.

e. Measurement of the work for pipe plugs shall be incidental to the work and will not have a separate pay item.

Any damages, repairs, etc., to private or public property will not be considered for any additional payment.

460 - Abandonment of Existing Mains and Manholes

A. Description

This item shall govern the abandonment of sanitary sewer mains and manholes specified in the contract documents. The sanitary sewer facility shall be abandoned in accordance with the specifications outlined herein and in conformity with the limits shown in the contract documents.

Abandoning of sanitary sewer lines and manholes shall not occur until all existing sanitary sewer services have been transferred to another line and directed by the Inspector.

B. Materials

Materials for abandonment of sanitary sewer pipe and manholes.

A manhole shall be abandoned in accordance with the detail. All existing sewer lines into the manhole shall be plugged with flowable fill material. For a brick manhole, a height of a minimum of two feet shall be removed. In paved areas, the surface around the manhole shall be replaced to match the surrounding surface per the specification and standard details. In grass areas, three inches of flowable backfill material shall be installed over gravel. Then, the remaining area shall be filled up to the surface with a minimum of six inches of top soil.

Grout material or flowable fill shall meet requirements of section 213 “Flowable Fill.”

C. Construction

Abandonment of sanitary sewer lines shall be accomplished by installing a concrete plug at each manhole penetration. Concrete plug shall be of sufficient size to prevent the flow of infiltrated groundwater. The method shall adequately provide for the removal and legal disposal of existing sewer materials in the system.

Mains to be abandoned shall be grouted only if required by the contract documents and payment as per these specifications is provided.

The concrete structure of the manhole shall be removed to a depth of 2 feet under proposed subgrade or finished ground elevation. Manhole rings and covers shall be removed and delivered to the City storage site designated by the Inspector.

D. Measurement

Grouting of abandoned manholes shall be measured on the basis of each one complete in place.

E. Payment

Payment for abandonment of manholes will be on the basis of each one complete in place. Abandonment of the sewer lines shall be subsidiary to the manhole abandonment where the line plugs are installed prior to the manhole abandonment. Said price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work. Unless otherwise shown in the contract documents, abandonment/grouting of manholes will not be a separate pay item.

Specifications 500-599: Streets, Walks, Driveways

500 – Streets General

A. 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: -/+ 0.02 feet
   d. Curbs: For grades of
      i. Over 1.0%- 0.02 ft
      ii. 0.5 to 1.0%- 0.01 ft
      iii. Under 0.5%- 0.00 ft

   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.

B. Provisions for Drainage

If it is necessary in the prosecution of the work to interrupt the natural drainage of the surface, or 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. The Contractor shall be responsible for installing necessary erosion control measures in accordance with Section 720, Best Management Practices, of these Standard Specifications.

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 these Standard Specifications and the Drainage Criteria Manual.

510 - Curb & Gutter

A. General

Construction of curb and gutter, concrete valleys, sidewalks, and driveway approaches shall conform to the following requirements. Concrete shall be Class A per section 200 “Concrete.” 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.

B. Construction

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. For curb ramp combinations, please reference TxDOT standard detail PED-12A or latest revision thereof.

B. 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” where necessary to match the adjacent grade of valley gutters.

C. 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 pre-molded 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.

D. 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 gutter shall be marked where water and sewer service lines cross under the curb with the letters “W” or “S,” as appropriate. The letters shall be three (3) inches high and shall be imprinted while the concrete is sufficiently plastic to receive a legible impression.

E. Completed curb and gutter, when required, shall be coated immediately with a curing compound as specified under Item 200, “Concrete.” Immediately following the removal of forms, the formed surfaces shall have all honeycomb neatly patched and the surface treated with curing compound.
    1. 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. Compaction testing of the backfill shall occur in accordance with the subgrade testing procedures.

C. Measurement

Curb and Gutter shall be measured by linear foot.

D. Payment

Payment for curb and gutter shall be made on the contract unit price per linear foot complete in place. Said price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.

511 - Sidewalks & Drive Approaches

A. General

This item shall govern the construction of sidewalks and drive approaches within the City.

B. Construction

1. Sidewalks and Drive Approaches shall conform to the Standard Details appended to these specifications.
2. The subgrade shall be compacted uniformly to the approximate density of the surrounding undisturbed material, and a minimum two (2) inch sand cushion provided on the subgrade.
3. Wire mesh reinforcement shall be provided in both sidewalks and drive approaches. Wire mesh shall be 6” x 6” – 10/10.
4. 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 Section 200, 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.
5. Curing compound shall be applied to the surface immediately after finishing is completed, when required by weather conditions

C. Measurement

Sidewalks and Drive Approaches shall be measured by the square foot.

D. Payment

Payment for sidewalk and drive approaches shall be made on the contract unit price per square foot complete in place. Said price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.

512 - Concrete Valleys

A. General

Concrete Valleys shall be constructed in accordance with the Standard Details and to the grades indicated on the plans.

B. Construction

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.

Concrete shall conform to the requirements of Item 200 – Concrete.

C. Measurement

Concrete Valleys shall be measured by the square foot.

D. Payment

Payment for sidewalk and drive approaches shall be made on the contract unit price per square foot complete in place. Said price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.

520 - Subgrade

A. Material

Lime for subgrade stabilization shall conform to the requirements of Item 260 of the TxDOT Standard Specifications, or the latest revision thereof.

B. Subgrade Sampling

a. Samples shall be obtained of the predominant subgrade materials from the street right-of-way.
b. Sampling must be performed in one of two methods:
    i. Subgrade physically exposed prior to sampling
        1. City Engineer or designated representative must approve subgrade sampling methods and locations prior to or during testing.
    ii. Subgrade sampled through geotechnical boring
        1. Sampling locations shall be selected at intervals not to exceed three hundred (300) feet or as selected by a licensed geotechnical engineer.

c. Each sample shall consist of approximately two (2) pounds of material and should be properly identified as to sampling location and sampling depth interval.
d. 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.
e. 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.

C. Lab Testing

f. All samples of subgrade materials shall be visually examined in the laboratory for the initial soil classification and color description.
g. 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.
h. 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
i. 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.

D. Subgrade Group Classification Procedure

a. Compare the results of the Atterberg Limits tests (LL and PI) with Table 520.1: Subgrade Classification Groups by Soil Test Results to obtain the subgrade group. Values which fall on the

borderline between two (2) groups should be assigned the group number of the poorer soil group.

b. The resulting subgrade group may be upgraded 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.

Table 520.1 Subgrade Classifications Groups by Soil Test Results			
Group No.	**Liquid Limit**	**Plasticity Index**	**Typical Material Description**
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

E. 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 Road Mixed, or latest revision thereof, using the quantity of hydrated lime required by the design procedure. Hydrated lime should meet the requirements of TxDOT Item 260. The well-mixed and cured soil-lime mixture should be compacted to a minimum of ninety-five (95) percent of ASTM D1557 or TEX-121-E maximum density at ±2% of optimum moisture content. In accordance with TEX-115-E, approved lime-stabilization procedures follow.

1. 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.
2. 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 ½” Screen, Minimum	60%

3. Water shall be added during the mixing of soil and lime to attain the optimum moisture content, within ±2%, to ninety-five (95) percent maximum density as determined by the modified Proctor method, ASTM Designation D1557 or TEX-121-E, or latest revision thereof.

4. 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.
5. The completed section shall be moist cured until such time as the first course of base material is placed and compacted.

530 - Flexible Base Course

A. Materials

Flexible Base Material shall conform to the requirements of Item 247 of the TxDOT Standard Specifications and be obtained from approved sources.

The material when tested by "Ball Mill Method for Determining the Disintegration of Flexible Base Material", or latest revision thereof, according to the latest procedures of 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:

1. The liquid limit shall the values in TxDOT 247 when tested in accordance with AASHO designation T89-49.
2. The plastic limit shall be determined by testing in accordance with AASHO designation T90-49.
3. The plasticity index shall be in accordance with TxDOT 247 and Tex 106-E.

The preparation of samples for testing according to AASHO designations T89-49, T90-49, TxDOT 247, and Tex 106-E 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 percent wear of not more than 45 when tested according to AASHO designation T96-15 "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine," or latest revision thereof.

B. Construction

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 ensure 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 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 and in length of sixteen (16) feet measured longitudinally or areas deficient by more than ½" in thickness shall be corrected by loosening, adding or removing material, reshaping and re-compacting by sprinkling and rolling. All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and re-compacting by sprinkling and rolling.

The base material shall be compacted at ±2% of optimum moisture content to ninety-eight (98) percent modified Proctor Density as determined by ASTM Designation D1557 or TEX-113-E.

In accordance with TxDOT 247.4.3.2, or latest revision thereof, the Engineer will determine roadway density and moisture content of completed sections in accordance with TEX 115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pct. below the specified density.

540 - HMAC

A. Materials

All bituminous materials shall conform to the TxDOT Standard Specification Item 300, types and grades as indicated below:

Table 540.1 Bituminous Materials Requirements	
Tack Coat	CSS-1H or SS-1H RC-250 with prior engineer approval
Prime Coat	AE-P or MC-30 If near a residential area, AE-P is required due to fumes.
Asphalt for Hot-Mix Asphaltic Concrete	AC-10
Asphalt for 2-Course Surface Treatment	AC-3 or AC-5

B. Construction Methods

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 a 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, 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 TxDOT Item 340, or latest revision thereof, Standard Specifications for Construction of Highways, Streets, and Bridges. Materials shall be as specified above.

   The compacted thickness or depth of the asphaltic concrete surface course shall be as required by City Standards in the minimum surface course thickness. 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. Complete all compaction operations in accordance with TxDOT Item 340, or latest revision thereof.

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 to or at right angles to the longitudinal axis of the work.
b. Compaction: The edges of the pavement along curbs, headers, manholes, valves 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.
   Compaction shall be in accordance with the requirements in TxDOT Item 340, or latest revision thereof, with regards to acceptable In-Place Air Voids.

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 City 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.

4. Construction of Two Course Surface Treatment: Prime coat shall be required on all base course surfaces, as specified above for HMAC pavement, prior to construction of the two (2) course surface treatment. Materials shall be as specified in TxDOT Item 316.

C. Pavement Thickness

a. Each street must be assigned one of the traffic classifications per the definitions in the ordinances. The City Engineering Department must approve these traffic classifications during the design review phase.
b. Table 540.1 Pavement Thickness Design Table can then be used with the subgrade classification group to determine the total required pavement thickness.

Table 540.1 Pavement Thickness Design Table			
Street Classification	**Subgrade Group No.**	**Min. Surface Course Thickness (in)**	**Minimum Total Pavement Thickness (in)**
Residential	I	1.5	7.5
	II	1.5	8.5
	III	1.5	9.5
	IV	1.5	12
	V	1.5	14
	VI	1.5	16
	VII	1.5	18
Collector	I	2	7.5
	II	2	9
	III	2	11.5
	IV	2	14
	V	2	16
	VI	2	18
	VII	2	22
Arterial	I	2	8
	II	2	10
	III	2	12.5
	IV	2	15
	V	2	17.5
	VI	2	20
	VII	2	24

c. The pavement section will consist of hot-mix asphaltic concrete surface (thickness as indicated in Table 540.1) 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.

550 - Railing

A. Metal Beam Guard Rail/Fence

Metal beam guard rails shall conform to TxDOT Item 540 “Metal Beam Guard Fence” and the standard details listed below, or latest revision thereof.

Texas Department of Transportation standard details for metal beam guard fence:

- GF(31)-14 Metal Beam Guard Fence
- GF(31)DAT-14 Metal Beam Guard Fence (Downstream Anchor Terminal)
- GF(31)LS-14 Metal Beam Guard Fence (Long Span)
- GF(31)TR-14 Metal Beam Guard Fence Transition (Thrie Beam Transition)
- GF(31)TL2-11 Metal Beam Guard Fence Transition (TL2)(Low Speed Transition)
- GF(31)T101-13 Metal Beam Guard Fence Transition (TL101)
- GF(31)T6-14 Metal Beam Guard Fence Transition (T6)
- GF(31)MS-11 Metal Beam Guard Fence Transition (Mow Strip)
- MBGF-11 Metal Beam Guard Fence
- MBGF(SR)-11 Metal Beam Guard Fence (Short Radius Rail)
- MBGF(TR)-11 Metal Beam Guard Fence Transition (Thrie Beam Transition)
- MBGF(TL2)-11 Metal Beam Guard Fence Transition (TL2)(Low Speed Transition)
- MBGF(T101)-11 Metal Beam Guard Fence Transition (TL101 Bridge Rail)
- MBGF(MS)-11 Metal Beam Guard Fence Transition (Mow Strip)

B. Railing

Railings shall conform to TxDOT Item 450 and TxDOT standard details, or latest revision thereof. TxDOT has standard details for Flexible Barriers (or Metal Beam Guard Fences), Steel Barriers, and Rigid Barriers (Concrete Safety Barriers), Guardrail End Treatments, Cable Barrier Systems. Construction shall be done in accordance with all applicable TxDOT details.

C. Measurement

Railings shall be measured by the linear foot, complete in place.

D. Payment

The payment for railings shall be by the linear foot, complete in place. Payment shall include all labor, tools, excavation, backfill, concrete footings, equipment, etc. necessary for the installation of a complete railing in accordance with these specifications.

560 - Traffic Control

A. General

Detours and traffic control plans shall conform to TxDOT Items 502 and 508 and the TxDOT Manual on Uniform Traffic Control Devices (MUTCD), or latest revision thereof. MUTCD Part 6 “Temporary Traffic Control” discusses rerouting traffic and provides standard details depending on the size of the road and the size of the work area.

B. Requirements

A Traffic Control Plan will be required for all work that occurs in the public Right of Way that may impact the drivability of the roadway. This includes construction that occurs on the shoulder or within the parkway of the Right of Way.

The traffic control plan will be designed, signed, and sealed by an engineer licensed in the State of Texas. The plan will be submitted for review prior to the start of construction to the City and TxDOT (if a TxDOT roadway is affected by the plan).

C. Measurement

The Traffic Control Plan and the implementation of the traffic control plan will be measured by the “Lump Sum,” as the work progresses.

D. Payment

Payment for the Traffic Control Plan and the implementation of the traffic control plan will be by the “Lump Sum,” and will include all engineering, traffic control devices, signage, labor, equipment, tools, and appurtenances necessary to implement a traffic control plan for the duration of the project.

570 - Excavation and Fill

A. General

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.

B. **Construction**

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 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 any street 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 layer of all embankments shall be composed of soil without objectionable quantities of rock within all public rights of way and easements in quantities sufficient to support and grow vegetation at the time of final stabilization.

All embankments for public improvements shall be compacted for the full depth to a density of ninety-five (95) percent of maximum density as determined by the modified Proctor method, ASTM Designation D1557.

C. Payment

Payment for this item shall be subsidiary to the structure or item that requires the embankment or excavation. Payment shall include all labor, equipment, materials, and tools required to complete the installation in accordance with these specifications and the plans.

Specifications 600-699: Storm Drainage

600 - General

This item includes the construction of underground storm drainage facilities. Storm drainage facilities include inlets, manholes, pipe drains, culverts, headwalls, and pipe underdrains. Storm drain facilities shall be designed in accordance with the latest version of the City of Copperas Cove Drainage Criteria Manual. 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 City Engineer. Materials and construction methods shall conform to requirements specified hereinafter.

610 - Storm Drain Lines and Culverts

A. General

This item governs the materials used and the constructing, furnishing and placing of storm drain lines and culverts on a prepared grade at the location shown on the Drawings.

B. Materials

Storm drain lines and culverts materials and construction shall conform to Items 460, 462, and 464 of the Texas Department of Transportation Standard Specifications, or the latest revision thereof. Pipe jointing materials shall be rubber gaskets or cold applied preformed plastic gaskets unless otherwise approved by the City Engineer. Bedding shall be Class B. Pipe shall be precast reinforced concrete unless otherwise approved.

Storm drain shall be reinforced concrete pipe (RCP), as listed in Section 17.5 Appendix C.1.2.D of the City Ordinances. For areas where the minimum cover cannot be met, a concrete cap designed by an engineer will be required for paved areas.

Storm drains crossing less than six (6) inches over or under an existing or proposed water, wastewater, or similar utility shall have concrete encasement placed in a manner to support both the storm drain and utility.

The use of High Density Polyethylene Pipe (HDPE) is allowed per Chapter 17.5 of the Subdivision Ordinance. Outfall structures shall be constructed of reinforced concrete, and the connection with the outfall structure shall be accomplished with RCP. A transition fitting from HDPE to RCP shall be made upstream of the outfall structure. If high density polyethylene pipe (HDPE) is approved, the pipe and fittings shall be manufactured in accordance with ASTM F2306 and ASTM D3350.

The use of Corrugated Metal Pipe (CMP) where properly zoned for driveway culverts shall be limited to residential driveways or areas with prior written approval by the City Engineer and Public Works Department.

C. Measurement

Storm Drain Lines and culverts shall be measured by the linear foot, from center of manhole, bend, or inlet to center of manhole, bend, inlet, or outlet.

D. Payment

Payment for Storm Drain Lines and culverts shall be by the price bid per linear foot, complete in place. Such payment shall include all fittings, excavation, backfill, concrete encasement (if required), labor, tools, equipment, and appurtenances necessary to have a complete and installed storm drain line or culvert.

620 - Manholes, Junction Boxes, and Inlets

A. General

This item governs the materials used and the constructing, furnishing and placing of manholes, junction boxes, and inlets at the locations shown on the Drawings.

B. Materials

Junction boxes and manholes shall be reinforced concrete, Class A concrete per section 200 – Concrete. Junction boxes in lieu of manholes shall be provided where any pipe opening exceeds thirty-seven (37) inches in diameter and where the distance from the outside surfaces of any two (2) pipes entering a manhole is less than one (1) foot, measured along the inside of the manhole.

Manholes, Junction Boxes, and Inlets shall conform to Items 465 and 471 of the Texas Department of Transportation Standard Specifications. Curb inlets shall conform to Texas Department of Transportation (TxDOT) Dallas district design standards listed below, or latest thereof.

Texas Department of Transportation Dallas district standard details:

- No. 1: Type 1 Curb Inlet for Use W/ 5” to 8” Barrier Curb – 5’, 10’, 15’, and 20’ Openings 3’6” to 10’0” Depths and 3’, 4’, and 5’ Widths
- No. 2: Type 1-C Curb Inlet on Box Culvert for Use W/ 5” to 8” Barrier Curb – 5’, 10’, 15’ and 20’ Openings
- No. 3A/3B: Type 2 Curb Inlet for Use W/ 5” to 8” Barrier Curb – 5’, 10’, 15’, and 20’ Openings
- No. 4A/4B: Type 2-C Curb Inlet on Box Culvert for Use W/ 5” to 8” Barrier Curb – 5’, 10’, 15’ and 20’ Openings
- No. 5A/5B: Type 1 Curb Inlet
- No. 6A/6B: Type 1 Curb and Grate Inlet
- No. 9A/9B: Type 2 Rail and Grate Inlet
- No. 10: Standard Recessed Storm Drainage Inlets, Curbs, and Type A Manhole Frame and Cover
- No. 14: Traffic Bearing Drop Inlet Type D Details

C. Measurement

Manholes, junction boxes, and inlets shall be measured by each complete installation in place.

D. Payment

Manholes, junction boxes, and inlets shall be paid by each complete installation in place. This includes excavation, backfill, compaction, concrete collar (if manhole is in the street), watertight pipeline connections, labor, tools and equipment to install a complete and working manhole, junction box, or inlet.

630 - Headwalls

A. General

This item governs the materials used and the constructing, furnishing and placing of headwalls at the locations shown on the Drawings.

B. Materials

Headwalls must be designed by a licensed engineer, unless TxDOT design standards, specifications and details are used. Headwalls shall be designed in accordance with TxDOT Standard Specifications, TxDOT Item 466, Concrete shall be Class A per section 200 – Concrete.

C. Measurement

Headwalls shall be measured by each complete installation in place.

D. Payment

Headwalls shall be paid by each complete installation in place. This includes excavation, backfill, compaction, watertight pipeline connections, labor, tools and equipment to install a complete and working headwall.

640 - Precast Safety End Treatments

A. General

This item governs the materials used and the constructing, furnishing and placing of Precast Safety End Treatments at the locations shown on the Drawings.

B. Materials

Precast Safety End Treatments shall be designed by a licensed engineer, unless TxDOT design standards, specification, and details are used. Precast safety end treatments shall be designed in accordance with TxDOT Standard Specifications, TxDOT Item 467.

C. Measurement

Precast safety end treatments shall be measured by each complete installation in place.

D. Payment

Precast safety end treatments shall be paid by each complete installation in place. This includes excavation, backfill, compaction, watertight pipeline connections, labor, tools and equipment to install a complete and working precast safety end treatment.

650 - Pipe Underdrains

A. General

This item governs the materials used and the constructing, furnishing and placing of Pipe Underdrains at the locations shown on the Drawings.

B. Materials

Pipe Underdrains shall conform to Items 556 of the Texas Department of Transportation Standard Specifications, of the type pipe approved for use.

C. Measurement

Pipe underdrains shall be measured by the linear foot of the complete installation in place.

D. Payment

Pipe underdrains shall be paid by the amount bid for each linear foot of the complete installation in place. This includes excavation, backfill, compaction, watertight pipeline connections, labor, tools and equipment to install a complete and working pipe underdrain system.

660 - Walls

A. General

This item governs the materials and construction of retaining walls. Refer to Building Code for Retaining Wall requirements

B. Concrete Retaining Walls

a. General

Concrete Retaining walls shall be designed in accordance with either American Association of State Highway and Transportation Officials (AASHTO) current standards or International Building Code (IBC)/American Concrete Institute (ACI) 138 or latest revisions thereof.

All forms and forming, placement of reinforcement, placement of Portland cement concrete, form removal, finishing and curing shall conform to Item 200 (Concrete) of this specification. Cast-in-place Portland cement concrete retaining walls shall be constructed in one continuous vertical pour from the top of the footing to the top of the wall unless intermediate horizontal construction joints are shown on the Drawings.

The height of the retaining wall will be determined by established grades or as directed by the Engineer or designated representative but and shall be such that water will not be trapped or ponded on private or public property.

Reinforcement for the wall shall be as indicated on the Drawings. The Contractor shall provide dowel bars of the proper size, shape and spacing, as indicated on the drawings.

Devices to release the hydrostatic head shall be installed as indicated on the drawings.

All exposed corners and edges shall be filleted with triangular chamfer strips measuring ¾ inch on each side. Exposed horizontal surfaces shall be level and flat, and exposed vertical surfaces shall be plumb and flat, unless indicated otherwise on the Drawings.

b. Vertical Control Joints

Unless indicated otherwise on the Drawings, vertical control joints shall be constructed in the retaining wall stem (the vertical portion of the wall) to create planes of weakness to control cracking. Horizontal wall reinforcement shall extend through the vertical control joints. These joints shall be constructed at abrupt changes in wall height and at a spacing not to exceed 20 feet in wall sections of uniform. The joints shall be formed by placing triangular chamfer strips to create grooves in both faces of the wall to a depth of at least ten percent of the wall thickness. Control joints shall be sealed, on the backfilled side of the retaining wall, with a non-sag low-modulus silicone sealant, or, alternatively, the joint may be covered with a waterproofing material consisting of an 18-inch wide strip of self-adhering polyethylene having a rubberized asphalt mastic, as approved by the Engineer or designated representative.

c. Vertical Expansion Joints

Vertical expansion joints shall be constructed at a spacing not to exceed 60 feet, unless indicated otherwise on the Drawings. They shall extend the full height and width of the wall, including the wall footing, and shall consist of sleeved dowels and ½-inch thick preformed bituminous fiber material. The edges and corners of the joints shall be formed by triangular chamfer strips measuring ¾ inch on each side. The concrete on the two sides of an expansion

joint shall be placed in two separate pours unless approved otherwise by the Engineer or designated representative.

d. Construction Joints
Construction joints shall be in accordance with the drawings. Wall reinforcement shall extend through the construction joint unless indicated otherwise on the Drawings.

e. Waterstops
Waterstops shall be provided in construction and expansion joints in retaining walls where water-tightness is essential to the function of the structure, as in detention, retention, or water quality ponds or flood walls.

C. Dry Stack Rock Wall

This section shall govern furnishing and placing dry stack gravity rock walls in conformance with the standard details and the Drainage Criteria Manual and as herein specified on a prepared subgrade, including the excavation and backfilling for the wall, to the height, lines, grades, details and locations indicated on the Drawings or as established by the Engineer or designated representative.

a. Materials

1. Rock

Native Rock shall be durable weathered field limestone of suitable quality to ensure permanence in the structure.

D. Mortared Rock Wall

This section shall govern the construction of mortared rock walls, as herein specified, on a prepared subgrade, including furnishing the stone, mortar and other related materials to construct walls, the excavation and backfilling the wall, removal of any old structure or portions thereof encountered, disposal of surplus excavated material and the completion Mortared Rock Walls as indicated on the Drawings or as directed by the Engineer or designated representative.

a. Materials

1. Rock: All types used shall be native limestone suitable for horizontal course type construction. The size of rock to be used for construction shall be as indicated on the Drawings, but may vary as approved by the Engineer or designated representative.
2. Portland Cement: ASTM C 150, Type I
3. Masonry Cement: ASTM C 91
4. Sand: ASTM C 144, Natural
5. Water: Free from matter that could impair suitability for use in mortar
6. Hydrated Lime: ASTM C 207, Type S
7. Mortar: Mortar shall be composed of 1-part Portland Cement, 1-part hydrated lime and 6 parts sand (by volume) and water. Mortar shall have a consistency that ensures that it can be easily spread by a trowel. An alternate mix composed of 1-part masonry cement and 3 parts sand may be used. The sand shall be measured damp and loose.

b. Construction Methods

Stone shall be laid plumb, level or true to a line. All stone shall be laid in a full bed of mortar with head joints and edge joints completely filled. The face shall be aligned or exposed as indicated on the Drawings. Exterior joints that will remain exposed shall be finished in a manner approved by the Engineer or designated representative.

In hot weather, stone work shall be kept moist until the mortar has set. No mortar work will be done when the temperature is below 40°F in the shade and all work may be suspended during freezing or undesirable weather. The mortar materials shall be mixed mechanically for not less than 5 minutes after all ingredients are in the mixer. Mortar that has begun to set or that has been mixed for more than 2 hours shall not be used.

Spalls may be used in partially filling the large voids, provided they are keyed in properly and are well coated with mortar. All finished rockwork shall be protected from damage. Chipped rockwork, that will remain exposed, shall be satisfactorily repaired or replaced.

Mortared rock walls shall consist of courses or layers of rock with the spaces between them filled with mortar and shall be constructed at such places as indicated on the Drawings or as directed by the Engineer or designated representative, in accordance with these specifications and in conformity with the lines, grades, height, depth and other details shown on the pertinent typical sections.

Excavation and concrete footings for mortared rock walls shall not be paid for directly, but shall be included in the unit price bid for mortared rock wall construction.

Prior to placing any material, the footings shall have been placed by the Contractor as part of this contract to the approved line and grade and allowed at least 36 hours curing time. The rock shall then be thoroughly wet and bedded in 1 inch of mortar placed on the footings, one against the other, with the resulting voids being completely filled with mortar. The finished surface shall be even and level.

E. Measurement

Walls shall be measured by the square footage of the front surface area of the wall. Unless shown otherwise, the area will be measured from 1 foot below the finished grade of the ground line on the face of the exterior wall to the top of the wall.

F. Payment

Payment for walls shall be as provided for under E. Measurement at the unit price bid. This payment shall be considered full compensation for all excavation, footings, leveling pads, backfill, cement stabilization (where necessary), furnishing and placing concrete, reinforcing material, filter material, drain pipe, joint material, water stop, anchorage system, and all equipment, labor, tools, and incidentals necessary for a complete and installed wall as detailed on the drawings and specifications, including these standard specifications.

Specifications 700-799: Erosion Control Measures

700 - General

This item includes the specifications for erosion control measures, including silt fencing, rock berms, curb inlet drain filters, etc.

710 - Sodding, Seeding, and Watering

A. Sodding for Erosion Control

Sodding shall be per TxDOT Item 162 “Sodding for Erosion Control” or latest revision thereof.

B. Seeding for Erosion Control

Seeding shall be per TxDOT Item 164 “Seeding for Erosion Control” or latest revision thereof.

C. Vegetative Watering

Watering shall be per TxDOT Item 168 “Vegetative Watering” or latest revision thereof.

720 - Best Management Practices

A. Silt Fence

This item shall govern the provision and placement of a silt fence fabric fence including maintenance of the fence, removal of accumulated silt, removal of the silt fence and re-vegetation of disturbed areas upon completion of the project.

a. Materials

1. Fabric

A. General: The silt fence fabric shall be of nonwoven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The silt fence fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The silt fence fabric shall be supplied in rolls a minimum of 36 inches wide.

B. Physical Requirements: The fabric shall meet the requirements presented in Table 720.1, when sampled and tested in accordance with the methods indicated herein, on the Standard Details and/or on the Drawings.

2. Posts:

A. Posts shall be steel Tee or Y-posts, not less than 4 feet in length with a minimum weight of 1.25 pounds per foot with a minimum Brinell Hardness of 143. Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A-702.

B. Wire Fence: Wire fence shall be welded wire fabric 2 in. x 4 in. 12.5 SWG, wire diameter 0.099 in (±0.005 in.).

Table 720A.1 Silt Fence Fabric Requirements

Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard	TEX-616-J [1]	5.0 minimum
Equivalent Sieve Opening Size: US Standard	CW-02215 [2]	40 to 100
Mullen Burst Strength: lbs. per sq. inch (psi)	ASTM D-3786 [3]	280 minimum
Ultraviolet Resistance; % Strength Retention	ASTM D-1682 [4]	70 minimum

[1] TxDoT Test Method Tex-616-J, "Testing of Construction Fabrics".

[2] US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".

[3] ASTM D-3786, " Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".

[4] ASTM D-1682, "Test Methods for Breaking Load and Elongation of Textile Fabrics ".

b. Construction Methods

The silt fence fabric shall be securely attached to the posts and the wire support fence with the bottom 12 inches of the material buried in a trench a minimum of 6 inches deep and 6 inches wide to prevent sediment from passing under the fence. When the silt fence is constructed on impervious material, a 12-inch flap of fabric shall be extended upstream from the bottom of the silt fence and weighted to limit particulate loss. No horizontal joints will be allowed in the silt fence fabric. Vertical joints shall be overlapped a minimum of 12 inches with the ends sewn or otherwise securely tied.

The silt fence shall be a minimum of 24 inches high. Posts shall be embedded a minimum of 12 inches in the ground, placed a maximum of 8 feet apart and set on a slight angle toward the anticipated runoff source. When directed by the Engineer or designated representative, posts shall be set at specified intervals to support concentrated loads.

* Per OSHA §1926.701, "all protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement". Caps must be large enough to dissipate the forces of impact to prevent impalement from a reasonably foreseeable fall distance. It should be noted that the use of impalement protection caps is but one method of protection; covers or wooden troughs can be another means of meeting the guarding requirement.

The silt fence shall be repaired, replaced, and/or relocated when necessary or as directed by the Engineer or designated representative. Accumulated silt shall be removed when it reaches a depth of 6 inches.

B. Stone Outlet Structure

This item shall consist of a temporary crushed stone dike installed in conjunction with and as part of a diversion dike, interceptor dike or perimeter swale. The purpose of this stone outlet structure is to provide a protected outlet for a diversion dike, interceptor dike or perimeter dike, to provide for diffusion of concentrated flow and to allow the area behind the dike to de-water. This item shall include removal of the "Stone Outlet Structure" and re-vegetation of the area.

a. Materials

1. Stone
   The stone used in construction of this stone outlet dike shall be crushed stone at least 3 inches in diameter but not over 6 inches in diameter or ½ cubic foot in volume.

2. Seeding
   Seeding for re-vegetation shall conform to section 710 “Seeding for Erosion Control”.

3. Fabric Core
   A. General: The filter fabric shall be of non-woven polypropylene, polyethylene or polyamide geo-textile with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches wide.

   B. Physical Requirements: The fabric shall meet the requirements presented in Table 720B.1, when sampled and tested in accordance with the methods indicated herein or on the Drawings.

Table 720B.1 Filter Fabric Requirements

Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard	TEX-616-J [1]	4.5 minimum
Water Flow Rate in gallons/sq. foot/minute	TEX-616-J [1]	40 maximum
Equivalent Sieve Opening Size: US Standard	CW-02215 [2]	40 minimum
Mullen Burst Strength: lbs. per sq. inch (psi)	ASTM D-3786 [3]	250 minimum
Ultraviolet Resistance; % Strength Retention	ASTM D-1682 [4]	70 minimum

[1] TxDOT Test Method Tex-616-J, "Testing of Construction Fabrics".

[2] US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".

[3] ASTM D-3786, " Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".

[4] ASTM D-1682, " Test Methods for Breaking Load and Elongation of Textile Fabrics".

b. Construction Methods

On the area over which the Stone Outlet Structure is to be placed, all clearing, grubbing and excavation operations shall be completed before placing the Stone Outlet Structure. The Stone Outlet Structure foundation soil shall be compacted to the extent necessary to provide an in-place density (TxDOT Test Method Tex-115E) not less than 95 percent of the laboratory density as determined in accordance with TxDOT Test Method Tex-114-E. The stone shall be placed, spread and shaped to the grades indicated on the Drawings and/or Standard Details. All disturbed areas shall be graded and compacted to an in-place density (TxDOT Test Method Tex-115E) not less than 85 percent of the maximum laboratory density (TxDOT Test Method Tex-114-E) and then seeded in accordance with section 710 “Seeding for Erosion Control.”

The stone outlet structure shall be inspected by the Contractor monthly and after each rainfall event with an accumulation of 1 inch or more. Stone shall be replaced when the structure ceases to function as intended due to silt accumulation among the stone, washout, construction traffic damage, etc. When the silt reaches a depth equal to 1/3 the height of the structure or six inches, whichever is less, the Contractor will remove the accumulated silt and dispose of it at a disposal site, that is approved by the Engineer or designated representative, in a manner that will ensure that additional siltation will not occur.

When indicated on the Drawings, the Stone Outlet Structure shall be removed when directed by the Engineer or designated representative and the area leveled off and protected by erosion control measures appropriate for the terrain. Stabilization shall consist of complete vegetation cover, sufficiently established to be erosion resistant.

C. Rock Berm

This item shall govern the construction of a temporary berm of open graded rock that is installed at the toe of a slope on the perimeter of a developing area. Rock berms are appropriate for use as flow diverters, energy dissipators, grade control, and level spreaders to release the water in sheet flow. This item shall also govern the removal of the "Rock Berm" and re-vegetation of the area.

a. Materials

Surplus rock excavated from utility trenches or from other excavations may be used in construction of these berms. In general, the rocks shall be sound with a minimum of 3 inches in smallest dimension and shall weigh between 10 and 30 pounds each. Seeding for re-vegetation shall conform to section 710, "Seeding for Erosion Control".

Use only open-graded rock of the size indicated on the Standard Details with most of the fines removed.

b. Construction Methods

All trees, brush, stumps and objectionable material shall be removed and disposed in a manner that will not interfere with the construction of the berm.

A trench shall be excavated to a minimum depth of 4 inches below existing grade for placement of the rock as indicated on Standard Details and the Drawings. The rocks shall be placed in interlocking layers with close joints starting at the base. Open joints shall be filled with rock-spalled materials as required to stabilize the berm.

The area upstream from the rock berm shall be maintained in a condition, which will allow sediment to be removed following the runoff from a rainfall event. After each rainfall event with an accumulation of 1 inch or more, an inspection of the rock berm will be made by the Contractor and the stone shall be replaced, when the structure ceases to function as intended because of sediment accumulation among the rocks, washout, construction traffic damage, etc.

If the sediment reaches a depth equal to 1/3 the height of the berm or 6 inches, whichever is less, the Contractor will remove the accumulated sediment and dispose of it at an approved disposal site in a manner that will not contribute to additional sedimentation. The berm will be reshaped as needed during construction.

When the site is completely stabilized, the berm will be removed and disposed of in a manner approved by the Engineer or designated representative.

The area will be re-vegetated as required by section 710, "Seeding for Erosion Control".

D. Curb Inlet Drain Filter

1. Material
   - A. Filter fabric protection shall be designed and maintained in a manner similar to a silt fence.
   - B. Where applicable, filter fabric, posts, and wire backing shall meet the material requirements specified in the silt fence design requirements.
   - C. Filter gravel shall be ¾ inch (Block and Gravel Protection) or 1-1/2 to 2 inches (Excavated Impoundment Protection) washed stone containing no fines. Angular shaped stone is preferable to rounded shapes.
2. Construction Methods
   - A. Maintain barricades, signs, and safety features around the work in accordance with all provisions of the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) when installing inlet protection on publicly traveled streets or in developed areas. Ensure that inlet protection is properly designed, installed, and maintained to avoid flooding of the roadway or adjacent properties and structures.
   - B. Maximum depth of flow shall be 8 inches or less.
   - C. Positive drainage is critical in the design of inlet protection. If overflow is not provided for at the inlet, excess flows shall be routed through established swales, streets, or other watercourses to minimize damage due to flooding.
   - D. Filter Barrier Protection – Silt Fence shall consist of nylon geotextile supported by wire mesh, W1.4 X W1.4, and galvanized steel posts set a minimum of 1-foot depth and spaced not more than 6 feet on center. A 6-inch wide trench is to be cut 6

inches deep at the toe of the fence to allow the fabric to be laid below the surface and backfilled with compacted earth or gravel. This entrenchment prevents any bypass of runoff under the fence. If the inlet is installed within a paved area, provide sufficient material overlap at the base to allow for anchorage of the fabric to the concrete inlet slab by sand bags or other means in order to prevent bypass or runoff under the fence.

3. Inspection

Inlet Protection shall be inspected regularly (at least as often as required by the TPDES Construction General Permit). When silt fences are also used and the fabric becomes clogged, it should be cleaned or, if necessary, replaced. Also, sediment should be removed when it reaches approximately one-half the height of the inlet protection device. If a sump is used, sediment should be removed when the volume of the basin is reduced by 50%. For systems using filter stone, when the filter stone becomes clogged with sediment, the stones must be pulled away from the inlet and cleaned or replaced. Dispose of clogged filter stone in an approved location.

E. Stone Outlet Sediment Trap

1. Material

Stone Outlet Sediment Traps used in situations where flows are concentrated in a drainage swale or channel are subject to the following design criteria:

1. The embankment shall be placed on geotextile fabric meeting the following minimum criteria:

1. Tensile Strength, ASTM D4632 Text Method for Grab Breaking Load and Elongation of Geotextiles, 250-lbs.

2. Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 135-lbs.

3. Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 420-psi.

4. Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 20 (max).

2. Construction Methods

Stone Outlet Sediment Traps for situations where flows are concentrated in a drainage swale or channel are subject to the following installation criteria:

A. The maximum drainage area contributing to the trap shall be 10 acres. For larger drainage areas a sediment basin shall be used.

B. The minimum storage volume shall be 1800 cubic feet per acre of disturbed land draining to the device.

C. The surface area of the design storage shall be 1% of the area draining to the device.

D. The maximum embankment height shall be 6 feet as measured from the toe of the slope on the downstream side.

E. Minimum width of the embankment at the top shall be 2 feet.

F. Embankment slope shall be 1.5:1 or flatter.

G. The embankment shall have a depressed area to serve as the outlet with a minimum width of 4 feet.

H. A six-inch minimum thickness layer of ¾ to 2 inch (1-½ inch nominal) well graded filter stone shall be placed on the face of the embankment.

I. The embankment shall be comprised of well-graded stone with a size range of 6 to 12 inches in diameter. The stone may be enclosed in wire mesh or a gabion basket and anchored to the channel bottom to prevent washing away.

J. The outlet shall be designed to have a minimum freeboard of 6" at design flow.

K. Geotextile fabric, covered with a layer of stone, shall extend past the base of the embankment on the downstream side a minimum of 2 feet.

3. Inspection

Stone Outlet Sediment Traps shall be inspected regularly (at least as often as required by the TPDES Construction General Permit) to check for clogging of the void spaces between stones. If the aggregate appears to be silted in such that efficiency is diminished, the stone shall be replaced. Deposited sediment shall be removed when the depth of sediment is equal to one-third of the height of the embankment as measured from the original toe of slope to the crest of the outlet, or has reached a depth of one foot, whichever is less. The removed sediment shall be stockpiled or redistributed in areas that are protected from erosion.

F. Riprap

1. Materials

A. Flexible Erosion Control Mat

Flexible erosion control matting is preferred over loose rock riprap for areas where mowing and grass maintenance is to be performed by the City. The use of grouted rock rip rap or concrete aprons is an acceptable alternative to Flexamat. Flexamat, manufacturer by Motz Enterprises, or pre-approved equal shall be used.

B. Rock

The rock shall be suitable in all respects for the purpose intended. Rock sources shall be selected well in advance of the time the rock will be required and shall be pre-approved by the Engineer. Rock used for riprap shall be hard, durable, and angular in shape and consist of clean field rock or rough unhewn quarry rock as nearly uniform in section as practicable. Neither the width nor the thickness of a single rock shall be less than one-third of its length. The rocks shall be dense, resistant to weathering and water action, and free of overburden, spoils, shale, and organic material. Shale, chalk, and limestone with shale or chalk seams shall not be acceptable. Rounded rock (river rock) shall not be acceptable.

The rock riprap material shall be provided as a gradation of larger and smaller rock sizes associated with a rock class or median diameter (D50) as specified in the drawings. Rock diameter for angular material represents the length of the intermediate axis of an

individual rock. The material gradation shall conform to table below for the class sizes corresponding to the D50. The D15, D50, D85, and D100 are the rock sizes for which 15%, 50%, 85%, and 100% of the total sample are of equal size or smaller, respectively.

Table 720F.1: Rock Riprap Gradation Table

Rock Rip Rap Class by Median Particle Dia. (D50)		D15 (in)		D50 (in)		D85 (in)		D100 (in)
Class	**Dia. (in)**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Max**
I	6	3.7	5.2	5.7	6.9	7.8	9.2	12.0
II	9	5.5	7.8	8.5	10.5	11.5	14.0	18.0
III	12	7.3	10.5	11.5	14.0	15.5	18.5	24.0
IV	15	9.2	13.0	14.5	17.5	19.5	23.0	30.0
V	18	11.0	15.5	17.0	20.5	23.5	27.5	36.0
VI	21	13.0	18.5	20.0	24.0	27.5	32.5	42.0
VII	24	14.5	21.0	23.0	27.5	31.0	37.0	48.0
VIII	30	18.5	26.0	28.5	34.5	39.0	46.0	60.0
IX	36	22.0	31.5	34.0	41.5	47.0	55.5	72.0
X	42	25.5	36.5	40.0	48.5	54.5	64.5	84.0

Reference: NCHRP Report 568.

Conversion to weight-based gradation: $W = 0.0275D^3Sg$ where W is rock size in lbs, D is diameter in inches and Sg is the specific gravity of the rock.

a. Broken Concrete
The rock used for mortar riprap may consist of broken concrete removed under the contract or obtained from other approved sources. Broken concrete shall be as nearly uniform in section as practicable and of the sizes indicated in section 720F.2.A “Dry Riprap.”

b. Concrete
Cast in place concrete shall conform to Item 200 of this specification.

c. Grout and Mortar
Grout and mortar shall consist of 1-part Portland Cement and 3 parts sand, thoroughly mixed with water. Mortar shall have a consistency such that it can be easily handled and spread by trowel. Grout shall have a consistency such that it will flow into and completely fill all joints.

d. Reinforcement
Reinforcement shall conform to Item 200 – Concrete.

e. Joints
Pre-molded expansion joint material shall conform to Item 200 – Concrete.

f. Tie Backs and Anchors
Galvanized tie backs and anchors shall be as indicated on the Drawings.

g. Filter Fabric

Filter Fabric shall conform to section 720 H “Filter Fabric” of this specification.

h. Granular Filter
Aggregate used for granular filters shall conform to section 530 “Flexible Base Course”.

i. Seed
For vegetated soil-rock riprap, the type of seed mix and application rates shall be as specified on the Drawings and within the referenced Standard Specification. If no seed mix is specified, apply according to section 710 “Seeding for Erosion Control.”

j. Soil retention blanket
Soil retention blanket shall be per section 720G “Soil Retention Blanket.”

2. Construction Methods
Prior to commencement of this work, all required erosion control and tree protection measures shall be in place and utilities located and protected. Construction equipment shall not be operated within the drip line of trees unless indicated on the Drawings. Construction materials shall not be placed under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until tree wells are constructed. Spalls and small stones used to fill open joints and voids in rock riprap shall be rocked and wedged to provide a tight fit.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material in an environmentally sound manner off the limits of the right of way at a permitted disposal site.

All blasting shall conform to the Copperas Cove Code of Ordinances. The Contractor shall comply with all laws, ordinances, and applicable safety code requirements.

Areas to be protected by rock riprap shall be free of brush, trees, stumps and other objectionable materials and be graded to a smooth compacted surface. All soft or spongy material shall be removed and replaced with appropriate material to the depths shown on the plans or as directed by the engineer. Fill Areas, unless otherwise specified will be compacted in accordance with Sections 520 or 570 of these specifications. Unacceptable subgrade conditions shall be reworked according to the Engineer's recommendations. Excavation areas shall be maintained until the riprap is placed.

a. Dry Rock Riprap
The mass of rock riprap shall be placed as to be in conformance with the required gradation mixtures, to the lines, grades and layers thickness that is shown on the drawings.

When the riprap will be placed on an erodible soil, as determined by the Engineer or designated representative, a layer of geotextile filter fabric or a granular filter layer shall be placed, prior to placement of the riprap material. In some cases multiple layers of granular filter material of varying gradations may be required. The median rock riprap size (D50), rock riprap layer thickness, filter type, when applicable the number of granular filter layers, granular filter aggregate gradations (grade/size classification), granular layer thicknesses shall be specified on the plans. The minimum granular filter layer thickness shall be 4 inches. Geotextile filter fabric shall conform to section 720 H “Filter Fabric” and be installed with

sufficient anchoring and overlap between seams according to the manufacturer's recommendations to ensure full filter barrier protection of the subgrade after riprap installation. When specified on the plans a four (4) inch minimum thickness granular cushion layer of gravel or sand may be placed over the filter fabric to prevent damage the fabric during placement of rock riprap.

Rock riprap shall be machine placed and distributed such that there will be no large accumulations of either larger or smaller sizes. Placing rock riprap by dumping into chutes or similar methods shall not be permitted. The rocks shall be placed in a single layer with close joints. The rock riprap layer thickness shall be no less than the specified maximum stone size (D100) or 1.5 times the D50, whichever produces the greater thickness. In areas exposed to flowing water the rock riprap layer thickness should be no less than 2.0 times the D50. The upright axis of the rocks shall make an angle of approximately 90 degrees with the embankment slope. The courses shall be placed from the bottom of the embankment upward, with the larger rocks being placed on the lower courses. Open joints shall be filled with spalls. Rocks shall be arranged to present a uniform finished top surface such that the variation between tops of adjacent rocks shall not exceed 3 inches. Rocks that project more than the allowable amount in the finished work shall be replaced, embedded deeper or chipped.

b. Mortared Rock Riprap
Rock for this purpose, as far as practicable, shall be selected as to size and shape in order to secure fairly large, flat-surfaced rock which may be laid with a true and even surface and a minimum of voids. Fifty percent of the mass rock shall be broad flat rocks, weighing between 100 and 150 pounds each, placed with the flat surface uppermost and parallel to the slope. The largest rock shall be placed near the base of the slope. The spaces between the larger rocks shall be filled with rocks of suitable size, leaving the surface smooth, reasonably tight and conforming to the contour required on the Drawings. In general, the rocks shall be placed with a degree of care that will ensure plane surfaces with variation from the true plane of no more than 3 inches in 4 feet. Warped and curved surfaces shall have the same general degree of accuracy as indicated for plane surfaces.

Before placing mortar, the rocks shall be wetted thoroughly and as each of the larger rocks is placed, it shall be surrounded by fresh mortar and adjacent rocks shall be shoved into contact. After the larger rocks are in place, all of the spaces or opening(s) between them shall be filled with mortar and the smaller rocks then placed by shoving them into position, forcing excess mortar to the surface and insuring that each rock is carefully and firmly embedded laterally. After the work described above has been completed, all excess mortar forced up shall be spread uniformly to completely fill all surface voids. All surface joints then shall be pointed up roughly, either with flush joints or with shallow, smooth raked joints.

c. Concrete Riprap
Concrete for riprap shall be placed as indicated on the Drawings or as directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, concrete riprap shall be reinforced using wire or bar reinforcement.

Concrete shall be Class A or as indicated otherwise on the Drawings and shall conform to section 200 “Concrete.”

When welded wire reinforcement is indicated, it shall be a minimum of 6 × 6 W1.4 × W1.4 with a minimum lap of 6 inches at all splices. At the edge of the riprap, the wire fabric shall not be less than 1 inch nor more than 3 inches from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete.

When bar reinforcement is used, the sectional area of steel in each direction shall not be less than the sectional area of the wire fabric described above. The spacing of bar reinforcement shall not exceed 18 inches in each direction and the distance from the edge of concrete to the first parallel bar shall not exceed 6 inches.

Reinforcement shall be supported properly throughout the placement to maintain its position approximately equidistant from the top and bottom surface of the slab.

Unless otherwise noted, expansion joints of the size and type indicated on the Drawings shall be provided at intervals not to exceed 40 feet and shall extend the full width and depth of the concrete. Marked joints shall be made 3/8-inch-deep at 10-foot intervals. All joints shall be perpendicular and at right angles to the forms unless otherwise indicated on the Drawings.

Slopes and bottom of the trench for toe walls shall be compacted and the entire area sprinkled before the concrete is placed.

After the concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.

Immediately following the finishing operation, the riprap shall be cured conforming to Section 200 of these specifications.

G. Soil Retention Blanket

This item shall govern the provision and placement of wood, straw or coconut fiber mat, synthetic mat, paper mat, jute mesh or other material as a soil retention blanket for erosion control on slopes or ditches or short-term or long-term protection of seeded or sodded areas indicated on the Drawings or as specified by the Engineer or designated representative.

a. Materials
   1. Soil Retention Blankets
      All soil retention blankets must be listed on TxDOT Approved Products List or approved by the Engineer or designated representative.

      The soil retention blanket shall be one (1) of the following classes and types as shown on the Drawings:

      A. Class 1. Slope Protection
         1. Type A Slopes 3:1 or flatter - Clay soils
         2. Type B Slopes 3:1 or flatter - Sandy soils

3. Type C Slopes steeper than 3:1 - Clay soils
4. Type D Slopes steeper than 3:1 - Sandy soils

B. Class 2. Flexible Channel Liner
1. Type E Short-term duration (Up to 2 years)
Shear Stress (t d) < 2.0 pound per square foot [psf]
2. Type F Short-term duration (Up to 2 years)
Shear Stress (t d) ≤ 4.0 psf
3. Type G Long-term duration (Longer than 2 years)
Shear Stress (t d) ≤ 6.0 psf
4. Type H Long-term duration (Longer than 2 years)
Shear Stress (t d) ≤ 8.0 psf

2. Fasteners
The fasteners shall conform to the recommendations of the manufacturer for the selected soil retention blanket.

b. Construction Methods
1. General
The soil retention blanket shall conform to the class and type shown on the Drawings. The Contractor has the option of selecting an approved soil retention blanket conforming to the class and type shown on the Drawings which is included on the Approved Products List published by TxDOT/TTI Hydraulics and Erosion Control Laboratory.

2. Site Preparation
Prior to placement of the soil retention blanket, the seedbed area to be covered shall be relatively free of all clods and rocks over 1 ½ inches in maximum dimension and all sticks or other foreign matter that will prevent close contact of the preparation mat with the soil surface. The area shall be smooth and free of ruts and other depressions. If the prepared seedbed becomes crusted or eroded as a result of rain or if any eroded places, ruts or depressions exist, the Contractor shall be required to rework the soil until it is smooth and to reseed or re-sod the area at the Contractor's own expense. After the area has been properly prepared, the blanket shall be laid out flat, even and smooth, without stretching or crimping the material.

3. Installation
The Soil Retention Blanket, whether installed as slope protection or as flexible channel liner in accordance with the TxDOT/TTI Approved Products List, shall be placed within 24 hours after seeding (section 710) and/or sodding (section 710) erosion control operations have been completed, or as approved by the Engineer or designated representative. The soil retention blanket shall be installed and anchored in accordance with the Manufacturer's recommendations. The Contractor shall contact the Engineer or designated representative three (3) days prior to the installation of the soil retention blanket to allow for inspection of the installation by City of Copperas Cove personnel.

H. Filter Fabric

Materials

1. General

   The fabric shall be constructed exclusively of synthetic thermoplastic fibers and may be either woven or non-woven to form a mat of uniform quality. Fabric fibers may be either continuous or discontinuous and oriented in either a random or an aligned pattern throughout the fabric. The fabric shall be mildew resistant, rot proof and shall be satisfactory for use in a wet soil and aggregate environment. The fabric shall contain ultraviolet stabilizers and shall have non-raveling edges.

2. Physical Requirements

   The fabric shall meet the requirements of Table 720H.1, when sampled and tested in accordance with the methods indicated in the table below.

   For applications such as water quality facility underdrain wrappings that require a high flow-through rate, or when specified by the engineer, the fabric shall be woven mono-filament and meet the requirements of Table 720H.2.

   All material shall be shipped with suitable wrapping to protect the fabric during shipping and storage at the job site.

2. Construction Methods

The submittal requirements shall be completed before any materials are ordered.

The "Filter Fabric" shall be installed in accordance with the manufacturer's recommendations, as indicated on the Drawings or as directed by the Engineer or designated representative. When lapping is required, it shall be in accordance with the manufacturer's recommendations. Backfilling around the Filter Fabric shall be done in such a manner that the Filter Fabric material will not be damaged during the placement.

Table 720H.1 Filter Fabric Requirements

Original Physical Properties	**Test Method**	**Requirements**
Fabric weight on an ambient temperature air-dried tension free sample, expressed in oz/ sq. yd	TxDOT Tex-616-J*	Slope Stabilization 4.0 minimum
		Gabions and Revet Mattresses 6.0 minimum
Water flow rate by falling head method, 7.9 inches to 3.9 inches on 2-inch ID cylinder with 1-inch diameter orifice, with flow rate expressed in gal/sq. ft/minute	TxDOT Tex-616-J*	80 minimum
Breaking load in either machine or cross-machine direction, expressed in pounds	ASTM D-1682 grab method G**	100 minimum
Equivalent opening size for US Standard sieves.	CW-02215	70 to 100
"Apparent elongation" at breaking load in either machine or cross-machine direction, expressed as percent	ASTM D-1682 grab method G**	100 maximum

* TxDOT Tex-616-J, "Testing of Construction Fibers

** ASTM D 1682 grab method G, "Test Methods for Breaking Load and Elongation of Textile Fabrics"* as modified by TxDOT Test Method Tex-616-J

*** CW-02215, US Army Corps of Engineers, Civil Works Construction Guide Specification "Plastic Filter Fabric".

Table 720H.2: High Flow Filter Fabric Requirements		
Property	**Test Method**	**Requirements**
Fabric Weight	>D 3776	3.0 ounces/square yard minimum
Ultraviolet (UV) Radiation Stability	D 4355	70% strength retained minimum, After 500 hours in xenon arc device
Mullen Burst Strength	D 3786	120 pound per square inch minimum
Water Flow Rate	D 4491	275 gallons/minute/square feet minimum

I. Stabilized Construction Entrance

A Stabilized Construction Entrance is required for sites in which significant truck traffic occurs on a daily basis to avoid getting tracking construction materials onto public roads.

1. Material
   A. Stone: Aggregate shall conform to the following gradation when tested using TEX 401-A:

Table 720I.1			
Sieve Size	US 8 inch	US 5 inch	US 2 inch
% Retained per sieve	0	90-100	100

   B. Filter Fabric: A layer of filter fabric shall be installed over the existing grade and underneath stone layer of stabilized construction entrance. The filter fabric will assist in removal of the construction entrance. The filter fabric shall be per the requirements in section 720H “Filter Fabric.”

2. Construction Methods
   A. Stabilized Construction Entrances are to be constructed such that drainage across the entrance is directed to a controlled, stabilized outlet on site with provisions for storage, proper filtration, and removal of wash water.
   B. The entrance must be sloped away from the paved surface so that storm water is not allowed to leave the site onto roadways.
   C. Minimum width of entrance shall be 15 feet.
   D. Stone shall be placed in a layer of at least 6-inch thickness.
   E. Prevent shortcutting of the full length of the construction entrance by installing barriers as necessary.
   F. Vehicles shall not be permitted to track or drop sediment onto paved roads, streets, or parking lots. When necessary, vehicles must be cleaned to remove sediment prior to entrance onto paved areas. When washing is required, it shall be done on a constructed wheel wash facility that drains into an approved sediment trap or sediment basin or other sedimentation/filtration device.
   G. Minimum dimensions for the entrance shall be as follows:

Table 720I.2			
Tract Area	**Average Tract Depth**	**Min. Width of Entrance**	**Min. Depth of Entrance**
< 1 Acre	100 ft.	15 ft.	20 ft.
< 5 Acres	200 ft.	20 ft.	50 ft.
> 5 Acres	> 200 ft.	25 ft.	75-100 ft.

3. Inspection

Stabilized Construction Entrances shall be inspected regularly (at least as often as required by the TPDES Construction General Permit). When sediment has substantially clogged the void area between the rocks, the aggregate mat shall be washed down or replaced. Periodic re-grading and top dressing with additional stone shall be done to keep the efficiency of the entrance from diminishing. If the stabilized construction entrance is not effectively removing sediment from wheels, then a wheel wash shall be implemented.

J. Temporary Grade Stabilization Structure

This item shall govern for construction of a temporary channel lined with Hot Mix Asphaltic Concrete, Portland Cement concrete or comparable non-erodible material. The lining shall be placed to extend from the top of a slope to the bottom of a slope and to convey surface runoff safely down-slopes without causing erosion. The removal of the entire structure and the revegetation of the area after the permanent facilities are in place shall also be included in this item.

b. Materials

1. Concrete

Portland Cement concrete shall conform to Class A, section 200 “Concrete”

2. Hot Mix Asphaltic Concrete

Asphaltic concrete shall conform to section 550 “HMAC.”

3. Riprap

Rock or broken concrete riprap for energy dissipation shall not exceed 5 pounds each and shall conform to section 720F “Riprap.”

4. Seeding

Seeding shall conform to section 710 “Seeding for Erosion Control.”

b. Construction Methods

The Contractor shall minimize the area disturbed during construction. Prior to placement of the Grade Stabilization Structure, all clearing, grubbing and subgrade preparation operations shall be completed conforming to Items 110 – Right of Way Preparation and 520 – Subgrade.

Hot Mix Asphaltic Concrete work shall conform to section 550 “HMAC.”

Concrete work shall conform to section 720F “Riprap” and all applicable concrete requirements of this specification.

At such time as the structure is no longer needed and with the approval of the Engineer or designated representative, the Contractor shall remove the entire structure and re-vegetate the disturbed area.

K. Mulch Sock

A mulch sock consists of material encased in a tube of mesh. It is used to intercept, settle, and filter sheet flow and pond runoff. Mulch socks provide an environmentally sensitive and cost-effective alternative to sediment fences.

a. Materials

1. Mulching material can be manufactured on or off the project site and may consist of shredded bark, stump grindings, and/or composted bark
2. The mulch shall have the following composition:
    1. Wood chips shall be produced from a 3-inch minus screening process (equivalent to TxDOT item 161, Compost, Section 1.6.2.B Wood Chip Requirements, or latest revision therof).
        a. Large portions of silts, clays, or fine sands are not acceptable.
        b. The pH of the mulch shall be between 5.5 and 8.5.
        c. The organic matter content shall be greater than or equal to 25% on a dry weight basis.
3. Mulch material must be free of refuse, physical contaminants, and material toxic to plant growth. It is not acceptable for the mulch material to contain ground construction debris, biosolids, manure, or recyclable material.
4. Prior to placement, a representative sample of the mulching material must be certified by the project engineer or his/her designee and accepted by the city inspector.
5. The sock material mesh opening shall be equal to or less than 3/8 inch and the material tensile strength shall be equal to or greater than 202 psi.
6. Mulch material must meet requirements in Table 720K.1 below.

Table 720K.1

Item	Requirement	Reference Specification
Particle Size	3” minus screening process	Equivalent to TXDOT item 161, Compost, Section 1.6.2.B, Wood Chip requirements
pH	5.5 - 8.5	TMECC 04. 11-A, "1.5 Slurry pH"
Organic Matter Content	≥25%, dry weight basis	TMECC 05.07-A, "Loss-On-Ignition Organic Matter Method"

b. Construction Methods

1. Install mulch socks in accordance with standard details.
2. Mulch socks should be used at the base of slopes no steeper than 2:1 and should not exceed the maximum spacing criteria provided in Tables 720K.2 and 720K.3.

Table 720K.2		
Slope	**Max. Slope Length Between Sock (ft)**	**Max. Drainage Area (sf) per 100 ft of Sock**
100:1 - 50:1	100	6,000
50:1 - 30:1	40	4,000
30:1 - 25:1	30	3,000
25:1 - 20:1	25	2,600
20:1 - 10:1	15	1,300
10:1 - 5:1	10	1,000
5:1 - 2:1	5	500

3. Place mulch socks at a 5 ft or greater distance away from the toe of the slopes to maximize space available for sediment deposition.

4. When placed on level contours, sheet flow of water should be perpendicular to the mulch sock at impact and unconcentrated.

5. Install mulch socks using rebar (#5 minimum with safety caps) a minimum of 48 inches in length placed on 2-ft centers. In order to prevent the movement or floating of the mulch sock during rain events or construction operations, install steel posts on alternating sides of the sock. Drive the posts into the ground to a minimum depth of 24 inches, leaving less than 12 inches of post above the exposed mulch sock.

6. In order to prevent water flowing around the ends of the mulch socks, point the ends of the socks up slope.

7. In order to prevent water from flowing between the gaps at adjacent ends of mulch socks, overlap the ends of adjacent mulch socks a minimum of 12 inches. Never stack mulch socks on top of one another.

8. Mulch Socks should be placed using 'smiles' and 'j-hooks'. See section 720A “Silt Fence“.

9. For steeper slopes, an additional mulch sock can be constructed on the top of the slope and within the slope area as determined by specific field conditions. Multiple mulch socks are recommended on steeper slopes.

10. Do not use mulch socks in areas of concentrated flow as they are intended to control sheet flow only.

c. Inspection and Maintenance

1. Inspect mulch socks after installation for gaps under the mulch socks and for gaps between the joints of adjacent ends of mulch socks. Contractor shall repair gaps such that no water flows under or around sock.

2. Inspect every seven days and within 24 hours of a rainfall event of 0.5 inches or greater. Replace and repair mulch socks as necessary.

3. Sediment retained by the mulch socks shall be removed when it has reached one third of the exposed height of the mulch socks.

4. Mulch socks can be vegetated or un-vegetated. Vegetated mulch socks can be left in place. The vegetation will grow in the slope, further anchoring the sock.

L. Payment

Payment for this item(s) shall be subsidiary to either the Stormwater Pollution Prevention Plan (SWPPP) and Implementation or the Erosion Control Plan and Implementation, whichever is used for the project.