

TECHNICAL/REQUIREMENTS

DIVISION III - SANITARY SEWER AND STORM DRAIN

III.1 TRENCH EXCAVATION, PIPE ZONE, AND BACKFILL

III.1.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for trench excavation, trench foundation stabilization, pipe zone materials and construction, trench backfill, embankments and surface removal and replacement.

III.1.B.00 DEFINITIONS

III.1.B.01 UNCLASSIFIED TRENCH EXCAVATION

Unclassified trench excavation is defined as all excavation within the trench regardless of the type, nature, or condition of the materials encountered. The Contractor shall assume full responsibility to estimate the kind and extent of various materials encountered in order to accomplish the work.

III.1.B.02 CLASSIFIED TRENCH EXCAVATION

III.1.B.02.1 ROCK EXCAVATION

Rock excavation shall be understood to mean solid sandstone, limestone, granite, basalt, or other solid rock of equal hardness, in ledges, bedded deposits, or unstratified masses that, in the Engineer's opinion, will require the use of systematic drilling and blasting or special equipment for removal. Boulders less than ½ cubic yard in volume will not be classified as rock. Cemented gravel (conglomerate), shale, clay, and other sedimentary materials will be classified as rock when, in the Engineer's opinion, systematic drilling and blasting or special equipment is required for removal. Loam, sand, gravel, clay or other such material stratified between the layers of rock will not be classified as rock.

III.1.B.02.2 COMMON EXCAVATION

Common excavation is defined as the removal of all material not classified as Rock Excavation. Where the type of excavation is not specifically designated, the excavation shall be understood to mean common excavation.

III.1.B.03 BORROW EXCAVATION

Borrow material is defined as material obtained from borrow sources lying outside of, separated from, and independent of planned excavation occurring within the project limits.

III.1.B.04 TRENCH FOUNDATION

Trench foundation is defined as the bottom of the trench on which the pipe bedding

is to lay and is responsible for the support of the pipe.

III.1.B.05 UNSUITABLE MATERIALS

Unsuitable materials are those materials which, in the opinion of the Engineer, are unsuitable in their natural state as a trench foundation material.

III.1.B.06 OVEREXCAVATION

Overexcavation is defined as the removal of unsuitable materials in the bottom and/or sides of a trench excavation and replacing with specified materials.

III.1.B.07 PIPE ZONE

III.1.B.07.1 GENERAL

The pipe zone is defined as the full width of the trench from the bottom of the bedding to a point 8-inch above the top outside surface of the bell of the pipe.

III.1.B.07.2 PIPE BEDDING

Pipe bedding is defined as the furnishing and placing of specified materials on the trench foundation so as to uniformly support the entire length of the pipe. The total bedding depth shall be as hereinafter specified.

III.1.B.07.3 HAUNCH AREA

The haunch area is defined as that portion of the pipe zone from the top of the bedding to the springline of the pipe.

III.1.B.07.4 INITIAL BACKFILL

The initial backfill area is defined as that portion of the pipe zone from the springline of the pipe to a point 8-inch above the top outside surface of the bell of the pipe.

III.1.B.08 TRENCH BACKFILL

Trench backfill is defined as the furnishing, placing and compacting of material in the trench between the top of the pipe zone material and the bottom of the pavement base rock, ground surface, or other surface material as specified or directed.

III.1.C.00 MATERIALS

III.1.C.01 WATER

Water used in all work must be reasonably clean and free of oil, salts, acid, alkali, sugar, vegetative matter, silts, and any other substances which would be deleterious to the quality of the material to which it is applied or with which it is mixed. Whenever City water is to be used, the Contractor shall obtain a meter from the City Utilities Division.

III.1.C.02 EXPLOSIVES

Explosives are to be fresh, stable materials manufactured to the standards of the "Institute of Makers of Explosives", and shall conform to ORS Chapter 480 or any other applicable state law or administrative rule.

III.1.C.03 AGGREGATE FOR OVEREXCAVATION

1. Approved Quarry Rock - 3-inch largest material allowed meeting the requirements of Section II.3.C.01, AGGREGATE.
2. Other aggregate material as specifically approved and directed by the Engineer.

III.1.C.04 PIPE ZONE

Pipe zone material shall be 1-inch-0 or ¾-inch-0 crushed aggregate meeting the requirements of Section II.3.C.01, AGGREGATE.

III.1.C.04.1 TRACER WIRE

Use 12-gauge stranded or solid copper insulated high molecular weight polyethylene (HMW-PE) tracer wire. The HMW-PE insulated cover shall be green and a minimum 45 mil thick. The wire shall be UL rated for 140 °F.

III.1.C.05 TRENCH BACKFILL

III.1.C.05.1 NATIVE MATERIAL

Any native material to be used as a backfill material shall consist of earth, sand, gravel, rock or combination thereof, free of humus, organic matter, vegetative matter, frozen material, clods, sticks and other deleterious debris and containing no stone having a dimension greater than 3-inch.

III.1.C.05.2 (Deleted)

III.1.C.05.3 CRUSHED AGGREGATE

Crushed aggregate shall be 1-inch-0 or ¾-inch-0 and shall conform to the requirements of Section II.3.C.01, AGGREGATE

III.1.C.05.4 TOPSOIL

The imported topsoil shall be fertile, loamy, natural surface soil consisting of sands, silts, clays and organic matter in combination and free from substances toxic to plant growth, noxious weeds, roots, refuse, sticks and lumps. The minimum and maximum Ph value shall be 5 and 8 respectively.

Imported topsoil shall contain a minimum of 3% and a maximum of 20% organic matter as determined by loss on ignition of samples oven dried to constant weight at 212⁰ F.

Topsoil shall have a grading analysis as follows:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieve	
1	100	
1/4-inch	97-100	
No. 10	80-100	
<hr/>		
Material	Particle Size	
Sand	Passing No. 10 Sieve	
Silt	Passing No. 10 Sieve & Retained on No. 20 Sieve	
Clay	Passing No. 200 Sieve	
<hr/>		
Material	Minimum	Maximum
Sand	20%	75%
Silt	10%	60%
Clay	5%	30%

III.1.C.05.5 CONTROLLED DENSITY FILL (C.D.F.)

C.D.F. shall be composed of a mixture of Portland cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, free-flowing and excavatable material which will result in a hardened, dense, non-settling fill. This mixture shall be batched and mixed in accordance with ASTM C94.

Materials and testing shall conform to the following:

Portland Cement: ASTM C150, Type I or II.
 Fly Ash: Class F or Class C., ASTM C618.
 Aggregates: ASTM C33.
 Water: Potable.
 Admixtures: AASHTO M 194 or ASTM C494 or ASTM C260.
 Testing: ASTM D 4832

C.D.F. shall be proportioned to be a flowable, non-segregating, self consolidating, low-shrink slurry with unconfined compressive strength at 28 days of 80 psi minimum, 150 psi maximum. The maximum density shall be 130 pcf.

The Contractor and its supplier shall determine the materials and portions used to meet the requirements of these specifications. The Contractor shall make daily checks of the aggregate gradation and adjust the mix design as required to meet these specifications. The

C.D.F. mix shall be modified as necessary to meet the flow, pump, and set time requirements for each individual pour.

The Contractor shall submit a mix design for C.D.F. and trial lab and field data, with 6-inch x 12-inch cylinder breaks performed at 7, 14, and 28 days. The approval of a mix design shall be a conditional acceptance. Final acceptance will be based on tests conducted on field samples and conformance with these specifications.

The construction of any bulkheads and form work necessary to confine or backfill with C.D.F. is incidental to these bid items.

III.1.D.00 CONSTRUCTION/WORKMANSHIP

III.1.D.01 PRESERVATION OF EXISTING IMPROVEMENTS

The Contractor shall conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, survey monumentation and other facilities, which are to remain in place will not be damaged. The Contractor shall furnish and install shoring or whatever means necessary to support material carrying existing facilities, or to support the facilities themselves, and to maintain such support until no longer needed.

The Contractor shall notify the Engineer immediately upon the discovery by the Contractor of any existing utilities of which existence or location had previously been unknown. These utilities include, but are not limited to, sewer service laterals, storm drain laterals, roof drains below curb level, drain tiles, water services, etc. The Engineer shall then examine the situation and make a decision to hook up, repair, abandon, or other. Failure of the Contractor to immediately notify the Engineer of existing utilities shall in no way relieve the Contractor of their responsibility to notify the Engineer of the situation and to have the Engineer make a decision concerning the situation.

The Contractor shall protect temporary pavements, facilities, utilities, and installations until they are no longer required. When temporary supports and other protective means are no longer required, the Contractor shall remove and dispose of as directed.

III.1.D.01.1 CONFLICTS OF PROPOSED SANITARY SEWERS AND STORM DRAINS

The Contractor shall construct all sanitary sewer service laterals and storm drain service laterals to avoid conflict with other proposed improvements. Service laterals constructed by the Contractor and found to be in conflict with other existing or proposed improvements shall, at the direction of the Engineer, be reconstructed by the Contractor at no cost to the City.

III.1.D.02 PAVEMENT CUTTING AND REMOVAL

Existing pavement along both sides of the trench shall be initially saw cut or jack hammered to facilitate excavation. Final cuts prior to paving shall be made by saw-cut unless otherwise specifically directed. For trenches, the cuts shall be made a minimum of 6-inches wider than the undisturbed base width for each side of the trench. Cuts shall be clean, vertical cuts and within a tolerance of 1-inch of specified line. Depths of the cuts shall be sufficient to permit the removal of the pavement between or alongside them without damage to pavement or structures to

be left in place. Pavement lying within the limits of said cutting shall be removed and disposed of in conformance with the applicable requirements of II.1.D.03, DISPOSAL OF EXCESS MATERIAL, as shall also any adjoining areas damaged by the cutting and removal operations.

III.1.D.03 TRENCH EXCAVATION

III.1.D.03.1 LIMITS OF EXCAVATION

III.1.D.03.1.a TRENCH WIDTH

It is the intent of these Specifications that the trench width at the surface of the ground be kept to a minimum necessary to install the pipe in a safe manner but not less than 24-inch in a paved street surface. In all cases, trenches must be of sufficient width to allow for shoring and permit proper joining of the pipe and backfilling of material along the sides of the pipe. Normally, the trench width shall be a minimum of 18-inch wider than the O.D. of the pipe.

Unless otherwise specified or directed by the Engineer, the maximum width of the trench shall not exceed the O.D. of the pipe plus 30-inch. If the maximum width as specified is exceeded by the Contractor without written authorization, the Contractor will be required, at the expense of the Contractor, to provide pipe of a higher strength designation as directed by the Engineer.

All trenches shall be excavated with vertical walls unless otherwise specified.

III.1.D.03.1.b TRENCH GRADE

The Contractor shall excavate the trench to the lines and grades shown on the Plans or as directed by the Engineer, with proper allowance for pipe thickness, pipe bedding and any foundation stabilization as required. The foundation upon which the bedding is to be placed shall be firm, undisturbed and true to grade within 0.1-foot. The Contractor shall not excavate below the foundation grade without prior approval by the Engineer. Any excavation below the foundation grade not specifically approved by the Engineer shall be brought to grade with approved aggregate; the cost of such work and materials to be borne solely by the Contractor.

III.1.D.03.2 UNCLASSIFIED TRENCH EXCAVATION

The Contractor shall excavate, remove and dispose of all formations, natural or man-made, irrespective of nature or conditions, encountered within the excavation limits, excepting those items as specified in Section III.1.D.01, PRESERVATION OF EXISTING IMPROVEMENTS.

III.1.D.03.3 ROCK EXCAVATION

Rock excavation shall be confined to those areas as specified in Section III.1.B.02.1, ROCK EXCAVATION, and shall be in accordance with the required excavation limits as specified in Section III.1.D.03.1, LIMITS OF EXCAVATION.

Before rock removal by systematic drilling and blasting or other methods will be permitted, the materials shall be exposed by removing the common material above it or by

predrilling. The Contractor shall keep a drilling log for each hole drilled that shall include the location of the drill hole and relative elevation and type of rock or other materials drilled. The Engineer shall then be notified, after which the Engineer, along with the Contractor, will measure the amount of material to be removed and will record the information.

If systematic drilling and blasting is to be used, the Contractor shall secure a City of Corvallis blasting permit and shall comply with all provisions of said permit. The use and security of the explosives shall be in conformance with the applicable provisions of General Requirements Section II. 7, LEGAL RESPONSIBILITIES. The Contractor shall be responsible for any and all damage to below surface, surface, and/or above surface and/or any injury to persons resulting from the blasting, or accidental or premature explosions that may occur in connection with the use of the explosives. Adequate warning to all affected persons shall always be given. Procedures, safety precautions, and time of blasting shall be submitted to the Engineer prior to blasting. The explosives shall be in conformance with Section III.1.C.02, EXPLOSIVES.

III.1.D.03.4 COMMON EXCAVATION

The Contractor shall excavate, remove, and dispose of all formations and materials, natural or man-made, irrespective of nature or conditions, encountered within the excavation limits, excepting those items specified in Section III.1.D.03.03, ROCK EXCAVATION, and Section III.1.D.01, PRESERVATION OF EXISTING IMPROVEMENTS.

III.1.D.03.5 OVEREXCAVATION

In the event that material exists in the trench foundation which, in the opinion of the Engineer, is unsuitable as a foundation material, the material shall be removed by the Contractor to the lines and grades as directed by the Engineer. The overexcavation shall be replaced with suitable aggregate materials as directed by the Engineer as identified in Section III.1.C.03, AGGREGATE FOR OVEREXCAVATION, and compacted as specified in Section III.1.D.08, COMPACTION AND DENSITY.

III.1.D.03.6 TEMPORARY LOCATION OF EXCAVATED MATERIALS

Excavated material suitable for backfill, when specified, shall be piled only within the construction easement, right-of-way, or other approved working areas, outside of tree preservation areas and shall be piled in a manner which will cause a minimum of inconvenience to the public as well as prevent erodible material from entering the storm drainage system. All materials excavated from trenches and piled adjacent to the trench or in a roadway or public thoroughfare shall be piled and maintained so that the toe of the slope of the material is at least 2-foot from the edge of the trench unless otherwise required by State, Federal, or local regulations. The Engineer may, at their option, require a copy of written approval from each property owner prior to stockpiling material on private property. Unless otherwise directed by the Engineer, all streets and roadways shall be kept open. Free access shall be provided to all utility appurtenances and clearance shall be allowed to enable the free flow of storm water in all gutters, conduits, and natural watercourses.

III.1.D.03.7 DISPOSAL OF EXCESS MATERIAL

Unless otherwise specified, all excavated materials shall be removed from the project site and shall be disposed of by the Contractor in a manner satisfactory to the Engineer and in compliance with Federal, State, and local laws and ordinances. Unless otherwise specified, the material will become the property of the Contractor.

III.1.D.04 SHORING

Shoring will be required when necessary to prevent caving and to protect adjacent structures, property, workers, and the public.

All shoring of trenches shall conform to the safety requirements of the Federal, State, and local laws, ordinances and codes concerning such. The most stringent of these requirements shall apply.

Unless otherwise specified, the Contractor shall provide all necessary material, labor and equipment necessary for the shoring and its installation. The method of shoring shall be of the Contractor's choice insomuch that it conforms with all of the aforementioned laws, ordinances and codes. Damages resulting from improper shoring or failure to shore shall be the sole responsibility of the Contractor.

Shoring shall not be removed until after the pipe has been placed and backfilling of the pipe zone has been completed. Shoring shall be removed as the trench backfilling operation progresses along the trench. The shoring shall be removed in a manner that will not damage the pipe or permit voids in the backfill, or change grade and alignment of the pipeline. When, in the opinion of the Engineer, the withdrawal of the shoring from the trench will result in damage to adjacent utilities or property, the Engineer may order all or a portion of the shoring to remain in place.

The use of horizontal strutting below the barrel of the pipe or the use of the pipe as support for trench bracing will not be permitted.

III.1.D.05 DEWATERING

The Contractor shall provide and maintain ample means and devices with which to promptly remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe and until the backfill at the pipe zone has been completed. The Contractor shall dispose of the water in a suitable manner without damage to adjacent property.

Ground water shall be controlled to prevent softening of the bottom of excavations or formation of "quick" conditions or "boils". Dewatering systems shall be designed and operated so as to prevent removal of the natural soils and so that the ground water level outside of the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

III.1.D.06 PIPE ZONE

III.1.D.06.1 PIPE BEDDING

Pipe bedding consists of leveling the bottom of the trench or the top of the foundation material and the placing of the bedding material. The bedding material shall be 3/4-inch-0 crushed aggregate as specified in Section III.1.C.04, PIPE ZONE, and shall be placed to a compacted minimum depth of 4-inch for pipe 12-inch in diameter or less, 6-inch for pipe 15-inch to 36-inch in diameter, and 8-inch for pipe 42-inch and greater. The bedding material shall be placed so that the pipe is uniformly supported along its entire length. Compaction of the bedding material shall be in conformance with Section III.1.D.08, COMPACTION AND DENSITY.

III.1.D.06.2 HAUNCH AREA AND INITIAL BACKFILL

The Contractor shall place the haunch area and initial backfill material around the pipe and to the upper limits of the pipe zone as specified in Section III.1.B.07, PIPE ZONE. The material shall be 3/4-inch-0 crushed aggregate as specified in Section III.1.C.04, PIPE ZONE. Material shall be compacted in conformance with Section III.1.D.08, COMPACTION AND DENSITY. The Contractor shall prevent the pipe from movement either horizontally or vertically during placement and compaction of the pipe zone material. Whenever the vertical distance between any point on the top surface of the pipe and the subgrade of the street is less than 1-foot, a concrete cap shall be constructed over that portion of pipe as specified in Standard Detail 202, CONCRETE CAP AND ENCASEMENT DETAIL.

III.1.D.07 TRENCH BACKFILL

III.1.D.07.1 GENERAL

The Contractor shall proceed with the backfilling operation as soon as practicable after the pipe installation and the placing and compacting of the pipe zone material. Unless otherwise approved by the Engineer, trenches shall not be left open overnight. The material shall be as hereinafter specified in Section III.1.D.07.2, BACKFILL CLASSIFICATIONS, and as shown on the Plans.

Prior to backfilling, all form lumber and debris shall be removed from the trench. The backfill shall be placed so that there is no horizontal or vertical movement of the pipe and no damage to the pipe. Any movement or damage to the pipe shall be immediately corrected by the Contractor all at the Contractor's expense.

Compaction of the backfill material shall be accomplished by the Contractor in lifts of appropriate thickness and shall conform to the requirements of Section III.1.D.08, COMPACTION AND DENSITY.

III.1.D.07.1.a TRACER WIRE

Install tracer wire in all trenches for sanitary and storm sewers. Place the tracer wire directly over the pipe centerline and on top of the pipe zone material. Place a branch tracer wire over each pipe connected to the main sewer.

Make tracer wire splices using a solderless connection kit that effectively moisture seals two or more conductors for direct burial and securely join the wires both mechanically and electrically. Insulate splices to be moisture and waterproof. Splices wrapped with tape will not be accepted as waterproof. Have all splice kits approved

prior to installation.

Test all tracer wire with locating equipment prior to acceptance.

III.1.D.07.2 BACKFILL CLASSIFICATIONS

III.1.D.07.2.a CLASS A BACKFILL

Class A backfill shall consist of native material as specified in Section

III.1.C.05.1, NATIVE MATERIAL. Unless otherwise specified or directed by the Engineer, the material shall conform to the requirements of Section III.1.D.08, COMPACTION AND DENSITY.

When specified, natural settlement will be allowed. The Contractor shall make an estimate of the amount of settlement expected and shall place a windrow of material over the trench to allow for natural settlement. If at any time after the backfilling operation during the warranty period the trench settles to a

point that the stockpiled material over the trench is below the surrounding ground level, additional material shall be added by the Contractor to bring the top of the trench flush with the existing ground all at the expense of the Contractor.

Unless otherwise specified or directed by the Engineer, Class A backfill shall be permitted in areas outside of public rights-of-way excepting those areas under paved driveways, sidewalks and parking lots and areas where the Engineer has determined that the existing soil is an unsuitable backfill material.

III.1.D.07.2.b CLASS B BACKFILL

Class B backfill shall consist of 1-inch-0 or ¾-inch-0 crushed aggregate as specified in Section III.1.C.05.3, CRUSHED AGGREGATE. Unless otherwise specified or directed by the Engineer, the material shall be compacted and shall be in conformance with the requirements of Section III.1.D.08, COMPACTION AND DENSITY.

Unless otherwise specified or directed by the Engineer, Class B backfill shall be required in all public rights-of-way, in areas outside of public rights-of-way under driveways, sidewalks and parking lots, in areas where the Engineer has determined that the existing soil is an unsuitable backfill material, and in other areas specified on the Plans or as directed by the Engineer.

III.1.D.07.2.c CLASS C BACKFILL

The Class C backfill classification is herein reserved for special types of backfill. The Class C backfill when specified shall be unique for each project and shall be described and specified in the Special Provisions for each project when it is used. Use of steel plates to protect C.D.F. is required in all traffic areas.

III.1.D.08 COMPACTION AND DENSITY

Unless otherwise specified, mechanical compaction of all pipe zone material and trench backfill material is required. The materials shall be compacted according to the pipe manufacturer's recommendations and in lifts of appropriate thickness for the type of equipment being used, to a density of 95% of the maximum relative density as determined by AASHTO T99. Compaction tests shall be required at 3-foot depth intervals. The method of compaction shall be modified as necessary to protect the pipe. At the option of the Engineer, backfill density tests may be taken at any time and location.

Compaction by water flooding or water jetting will not be allowed at any time.

Any subsequent settlement of the trench during the warranty period shall be considered to be the result of improper compaction and shall be promptly corrected by the Contractor all at the expense of the Contractor.

III.1.D.09 SURFACE REPLACEMENT

III.1.D.09.1 TOPSOIL

Where trenches have crossed lawns, garden areas, pasture lands, cultivated lands, or other areas on which reasonable topsoil conditions exist, the Contractor shall replace the top 12-inch of the trench backfill with material equal to or better than the existing topsoil material in accordance with Section III.1.C.05.4, TOPSOIL.

III.1.D.09.2 PAVEMENT, CURB, AND SIDEWALK REPLACEMENT

Replacement of pavement, curb and sidewalks shall be in conformance with the applicable requirements of Section II.7, PAVEMENT REMOVAL AND REPAIR.

III.1.E.00 TESTING

III.1.E.01 COMPACTION AND DENSITY

Unless otherwise directed by the Engineer, the specified density requirements as determined by AASHTO T99 and as specified in Section III.1.D.08, COMPACTION AND DENSITY shall be tested by the Engineer using a nuclear density-moisture gauge.

III.1.E.02 LINE AND GRADE

The line and grade as specified or as determined by the Engineer shall not deviate more than ½-inch for line and 1/4-inch for grade. The Contractor shall use whatever line and grade control they choose, however, when requested by the Engineer, the Contractor shall provide the Engineer with the appropriate grade check information that the Engineer requires.

III.1.E.03 TV INSPECTION

The City will complete a TV inspection of completed pipelines 1 time only (at the City's expense on public contracts; at the Developer's expense on private contracts). This TV inspection is presumed to be the final TV inspection for acceptance of the completed work. In addition, 1 TV inspection at the end of the warranty period will be provided by the City.

The Contractor shall notify the Engineer, in writing, 5 working days prior to the requested TV inspection date. The results of mandrel, pressure, and backfill density tests shall be submitted prior to or concurrent with the TV inspection request. The Contractor shall allow the City a minimum of 5 working days to complete TV inspection work. The 5 working days shall be working days following the requested date on the notification. The Contractor shall allow 1 additional working day to complete the inspection for each 500 lineal feet of pipe over 2,000 lineal feet. The Contractor shall construct no improvements over sewers/drains until they are inspected and accepted. A TV inspection will be scheduled for separate completed sections of the project to allow paving only if approved by the Engineer (i.e. manhole to manhole).

In the event that TV inspections cannot be completed due to improperly cleaned or an incomplete system, or because of inadequate site access, or when repairs are required to be verified, the contractor will be responsible for the cost of additional TV inspections. The schedule for completing TV inspections, when additional inspections are required, will be at the convenience of the City.

The Contractor shall be responsible for dewatering the trenches as specified in Section III.1.D.05, DEWATERING. The contractor shall be responsible for all costs for cleaning construction related to new and existing pipes soiled with debris from the Contractor's operations.

III.1.F.00 MEASUREMENT AND PAYMENT

III.1.F.01 MEASUREMENT

III.1.F.01.1 TRENCH EXCAVATION

III.1.F.01.1.a UNCLASSIFIED AND COMMON EXCAVATION

When listed in the Proposal as a pay item, unclassified and common excavation shall be measured on a lineal foot basis to the nearest foot. The length of the trench shall be measured from centerline to centerline of the manholes, fittings, or to the end of the pipe, whichever is applicable, along the centerline of the trench. No consideration will be given for the depth or width of the trench.

III.1.F.01.1.b ROCK EXCAVATION

Quantities for rock excavation will be measured on an cubic yard basis to the nearest 0.25 cubic yard in original position prior to excavation and shall be based on profile and cross-sectional measurements to the nearest 0.1-foot. The quantity measured for payment will include only material excavated within the specified excavation limits. The following pay limits will be used for rock excavation when the rock extends at least to these limits.

Size of Pipe	Pay Width of Trench	Pay Depth Below Pipe
Less than 15-inch	2.5-foot	6-inch
15-inch-36-inch (inclusive)	O.D. plus 18-inch	6-inch

Greater than 36-inch	O.D. plus 24-inch	8-inch
----------------------	-------------------	--------

Any additional excavation outside of these limits, unless specifically authorized by the Engineer, shall be considered as having been for the Contractor's benefit and will

be considered as incidental to the work. The quantity for payment will be that amount as approved by the Engineer.

III.1.F.01.1.c OVEREXCAVATION

When specified, quantities for overexcavation will be measured on a cubic yard basis. The measurement will be based on cross-sections of compacted material in place in the designated overexcavation areas and to the lines and grades as specified.

When specified, quantities for overexcavation will be measured on a per ton basis to the nearest 0.1 ton of the aggregate backfill. Material receipts showing certified scale weights will be required from the Contractor.

III.1.F.01.2 PIPE ZONE

When listed in the Proposal as a separate pay item and when specified, quantities for pipe zone material and placement will be measured on a lineal foot basis to the nearest foot. The length will be measured from centerline to centerline of the manholes or to the end of the pipe, whichever is applicable, along the centerline of the trench. No consideration will be given for the depth of the bedding or the width of the trench.

When specified, quantities for pipe zone material and placement will be measured on a per ton basis to the nearest 0.1 ton for the specified amount of aggregate required. Material receipts showing certified scale weights will be required from the Contractor.

III.1.F.01.3 TRENCH BACKFILL

III.1.F.01.3.a CLASS A BACKFILL

When listed in the Proposal as a pay item, quantities for Class A backfill will be measured on a lineal foot basis to the nearest foot. The length will be measured from centerline to centerline of the manholes or to the end of the pipe, whichever is applicable, along the centerline of the trench. No consideration will be given for the depth of the trench or the width of the trench.

III.1.F.01.3.b CLASS B BACKFILL

When listed in the Proposal as a pay item and when specified, quantities for Class B backfill will be measured on a lineal foot basis to the nearest foot. The length will be measured from centerline to centerline of the manholes or to the end of the pipe, whichever is applicable, along the centerline of the trench. No consideration will be given for the depth of the trench or the width of the trench.

When specified, quantities for Class B backfill will be measured on

a per ton basis to the nearest 0.1 ton for the specified amount of aggregate required. Material receipts showing certified scale weights will be required from the Contractor.

III.1.F.01.3.c CLASS C BACKFILL

When listed in the Proposal as a pay item, quantities for Class C backfill will be measured in accordance with the procedure outlined in the Special Provisions for the project where Class C backfill is specified.

III.1.F.02 PAYMENT

III.1.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to trench excavation, pipe zone and backfill construction performed on the Contract work under Section III.1, TRENCH EXCAVATION, PIPE ZONE, AND BACKFILL, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

III.1.F.02.2 PAY ITEMS

Pay Item	Unit of Measure
Unclassified Trench Excavation	Lineal Feet
Common Trench Excavation	Lineal Feet
Rock Excavation	Cubic Yards
Overexcavation	Cubic Yards or Tons
Pipe Zone	Lineal Feet or Tons
Trench Backfill (Class A)	Lineal Feet
Trench Backfill (Class B)	Lineal Feet or Tons

III.2 GRAVITY STORM DRAINS

III.2.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of gravity storm drain facilities.

III.2.B.00 DEFINITIONS

III.2.C.00 MATERIALS

III.2.C.01 GENERAL

The use of all pipe and fitting shall conform to the size, strength, material and joint type as specified herein, on the Plans and/or in the Proposal unless otherwise specified. Each piece of pipe shall be clearly identified as to its strength, class, and date of manufacture. If requested by the Engineer, the manufacturer or fabricator shall furnish appropriate certification, based on the manufacturer's routine quality control tests, that the materials in the pipe and fittings meet the requirements as specified herein.

It is not intended that the materials listed herein are to be considered equal or generally interchangeable for all applications. The Engineer shall determine the materials suitable for the project and so specify. Unless otherwise specified, the same type of material shall be used throughout a project and all fittings shall match the material and strength of the pipe being used.

The City of Corvallis Stormwater Design Standards contain details for stormwater facilities. The Stormwater Design Standards are located on the City of Corvallis web site at

<https://archives.corvallisoregon.gov/internal/ElectronicFile.aspx?dbid=0&docid=919001>

III.2.C.02 CONCRETE PIPE

III.2.C.02.1 NONREINFORCED CONCRETE PIPE

When specified, or allowed as an alternate for storm drain construction, nonreinforced concrete pipe shall conform to the requirements of ASTM C14, and the class as specified. The pipe shall have either a tongue and groove or bell and spigot joint system.

III.2.C.02.2 REINFORCED CONCRETE PIPE

When specified, or allowed as an alternate for storm drain construction, reinforced concrete pipe shall conform to the requirements of ASTM C76, and the class as specified, or ASTM C655 at the Contractor's option. The pipe shall have either a tongue and groove or bell and spigot joint system.

III.2.C.02.3 CAST-IN-PLACE CONCRETE PIPE

When specified, or allowed as an alternate for storm drain construction, the following requirements for cast-in-place concrete pipe shall be met.

III.2.C.02.3.a CONCRETE PROPERTIES

The Portland cement concrete materials and properties shall be in conformance with the applicable requirements of Section II.5, PORTLAND CEMENT CONCRETE (PCC) PAVEMENT, except as hereinafter modified:

1. The slump of the concrete shall not exceed 2-inch according to the requirements of AASHTO T119.
2. The maximum size of coarse aggregate to be used shall not exceed 1-inch for pipe sizes of 48-inch or less and 1 ½-inch for pipe sizes greater than 48-inch.

3. The Portland cement concrete shall be so proportioned as to provide a 28 day minimum ultimate compressive strength of 3,000 psi according to the applicable provisions of AASHTO T22 and AASHTO T23.

III.2.C.02.3.b PIPE DIMENSIONS

The minimum wall thickness of cast-in-place concrete pipe, at any point shall be 1/12 of the nominal internal diameter of the pipe plus 1-inch, but in no case less than 2-inch.

The internal diameter of the pipe at any point shall not be less than 95% of the specified nominal diameter, and the average of any 4 measurements of the internal diameter made at 45⁰ intervals shall not be less than the specified nominal diameter.

III.2.C.03 CORRUGATED ALUMINUM ALLOY PIPE

When specified, or allowed as an alternate for storm drain pipe construction, corrugated aluminum alloy pipe shall conform to the requirements of AASHTO M196, M197, M211 and M219.

When perforated corrugated aluminum alloy pipe is specified, it shall conform to the requirements of AASHTO M197.

III.2.C.04 POLYVINYL CHLORIDE PIPE (PVC)

When specified, or allowed as an alternate for storm drain pipe construction, polyvinyl chloride (PVC) pipe shall conform to the requirements of ASTM D3034 or ASTM F-679 or F-794. The fittings shall conform to the applicable portions of ASTM D1785, ASTM D2729, ASTM D2466, ASTM D2467, ASTM D3034, or ASTM F-789. The minimum SDR shall be 35 and the minimum pipe stiffness shall be 46 psi.

When perforated polyvinyl chloride pipe is specified, it shall conform to the requirements of ASTM D3034 and D2729. Unless otherwise specified, the perforations shall consist of 2 rows of 2-inch by 1/4-inch slots transverse to the axis of the pipe and 120⁰ apart.

III.2.C.05 FITTINGS

Unless otherwise specified or directed by the Engineer, all fittings used in new construction will be manufactured, with the exception of concrete lines 21-inch and larger for which the fittings may be field fabricated.

Construction connections to existing facilities shall conform to Section III.2.C.06, CONNECTIONS TO EXISTING PIPE. Gaskets will be installed at all fittings and joints.

When pipe repairs necessitate the use of couplings, a ROMAC style 501 coupling, or approved equal, will be used for pipes 12-inch and smaller and a ROMAC style 400 coupling, or approved equal, will be used for pipes larger than 12-inch.

III.2.C.06 CONNECTIONS TO EXISTING PIPE

4-inch and 6-inch connections to existing PVC and preformed concrete pipes will

be accomplished using a ROMAC “CB” style tapping saddle with stainless steel straps, or Insert-a-Tee, or approved equal.

Connections larger than 6-inch will be made through the construction of a standard manhole unless otherwise specified by the Engineer.

III.2.C.07 CEMENT MORTAR

Cement mortar shall conform to the requirements of ASTM C387, or be proportioned one part type II Portland cement to two parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages by weight of cement: hydrated lime, 10%; diatomaceous earth or other inert materials, 5%. Consistency of mortar shall be such that it will adhere readily to the pipe. Mortar mixed for longer than 30 minutes shall not be used.

III.2.C.08 FILTER MATERIAL

Unless otherwise specified, filter material for subsurface (french) drains shall be 1/2-inch minimum particle size pea gravel or concrete aggregate as specified herein at the Contractor's choice.

III.2.C.09 DRAINAGE GEOTEXTILE FABRIC

The fabric shall be composed of a polymeric yarn or fiber oriented into a stable network which retains its relative structure during handling, placement, and design service life. The fabric shall be free of any chemical treatment or coating which might significantly reduce permeability. The selvage of fabric shall be such that the outer fibers are prevented from pulling away from the fabric.

Both woven and nonwoven fabrics are acceptable. Slit film or slit tape fabrics will not be permitted.

Geotextile Fabric Property	Test Method
Grab tensile strength, lbs.	ASTM D 1682 Modified 80 min
Grab elongation, percent	ASTM D 1682 Modified 15 min
Burst strength (Diaphragm method), psi	ASTM D 3786 Modified 130 min
Puncture strength, lbs.	ASTM D 3787 Modified 80 min
AOS (Apparent Opening Size), U.S. Std. sieve	OSHD TM 815 50-100
Water permeability, cm./sec.	ASTM D 4491 0.01 min

III.2.D.00 CONSTRUCTION/WORKMANSHIP

III.2.D.01 TRENCH EXCAVATION, PIPE ZONE AND BACKFILL

Trench excavation, pipe zone and backfill shall conform to the applicable requirements of Section III.1, TRENCH EXCAVATION, PIPE ZONE AND BACKFILL.

III.2.D.02 PIPE LAYING AND JOINTING OF PIPE AND FITTINGS

III.2.D.02.1 GENERAL

All pipe installation shall be in accordance with the manufacturer's recommendations unless otherwise directed by the Engineer.

All pipe and fittings should be inspected by the Contractor prior to lowering them into the trench to insure no cracked, broken, or otherwise defective materials are used. The Contractor should use only approved implements, tools and facilities for the safe and proper protection of the work. The pipe should be lowered into the trench in such a manner as to avoid any physical damage to the pipe. At no time shall pipe be dropped into the trench.

Normally pipe laying shall begin at the downstream end of the pipeline with the spigot or tongue ends pointing in the direction of flow. The pipe shall be placed in such a manner as to insure solid bearing between the pipe and the full cross sectional area of the bedding for the full length of pipe including the joints.

During and following the laying operations, the pipe shall be protected from the entry of any foreign material. Any foreign material which has entered the pipeline shall be removed by the Contractor at the direction of the Engineer all at the expense of the Contractor.

When cutting or machining of pipe is necessary, the tools and methods shall be used as recommended by the pipe manufacturer.

Any pipes which are to be stubbed out for future use or for connections by others shall be mechanically plugged. No glue-on or solvent weld plugs will be allowed.

III.2.D.02.2 LINE AND GRADE

The line and grade as specified or as determined by the Engineer shall not deviate more than ½-inch for line and 1/4-inch for grade. The Contractor shall use whatever line and grade control they choose, however, when requested by the Engineer, the Contractor shall provide the Engineer with the appropriate grade check information that the Engineer requires.

III.2.D.02.3 PRECAST CONCRETE PIPE

Unless otherwise specified, precast concrete pipe as specified shall be gasketed. Use rubber gaskets for bell and spigot pipe conforming to ASTM C443. Use captive gasket in groove design for 24-inch diameter and larger pipe. Mortar for tongue and groove pipe shall conform to Section III.2.C.07, CEMENT MORTAR.

III.2.D.02.4 CAST-IN-PLACE CONCRETE PIPE

III.2.D.02.4.a METHOD OF PLACEMENT

The pipe shall be constructed in 1 or 2 placements. The concrete shall be vibrated, rammed, tamped, or worked with suitable compacting equipment.

III.2.D.02.4.b HORIZONTAL JOINTS

When the two-placement method is used, construction joints shall occur at approximately the horizontal diameter between the upper and lower placements, and all construction joints shall be cleaned of dirt, foreign matter, and loose or defective concrete before the top placement is made. The top placement shall always be made before the concrete of the lower placement has undergone initial set and shall be tamped or vibrated to secure intermixing and consolidation of the first and second placements.

III.2.D.02.4.c STOPPAGE JOINTS

When placement is stopped for such period that initial set takes place, a stoppage joint shall be formed. Before resuming placement, an excavation shall be made along the side and bottom of the joint to permit casting of a concrete collar around the outside of the joint. This collar shall have a minimum thickness of 1 1/4 times the wall thickness of the pipe and shall lap the entire joint by at least two times the wall thickness. Immediately before resuming concrete placement the surfaces to be bonded shall be cleaned of all coatings, foreign materials, and loose or defective concrete, and thoroughly wetted and coated with a layer of bonding mortar approximately 1/4-inch thick. In lieu of the bonding mortar, neat cement paste mortar approximately 1/4-inch thick may be thoroughly scrubbed onto the wet surface of the previously placed concrete.

III.2.D.02.4.d FINISH

Except for the form offsets, the interior surface of the pipe shall be equivalent to or better than a wood float finish. All extraneous concrete shall be removed from the interior surface.

III.2.D.02.4.e CURING AND BACKFILL

The Contractor shall be responsible for proper curing of the concrete and backfilling the trench to an even grade. Curing shall be performed in such a manner as to prevent the premature drying of the concrete. Final backfill, and compaction where required, shall not be started until the pipe has developed sufficient strength to support the loads to be imposed and shall conform to requirements as outlined in these standard specifications.

III.2.D.02.5 POLYVINYL CHLORIDE PIPE (PVC)

Installation of PVC pipe shall conform to ASTM D2321 and the manufacturer's recommended practice for installation, unless otherwise directed by the Engineer.

III.2.D.02.6 PERFORATED PIPE UNDERDRAINS (FRENCH DRAINS)

Perforated pipe shall be securely fastened together with couplings, fittings or bonds as specified by the manufacturer for the type of pipe being used. Perforated pipe shall be placed with perforations facing down. Upgrade ends of all subsurface drain pipe shall be closed with approved plugs or a standard cleanout installed as specified.

Filter material as specified in Section III.2.C.08, FILTER MATERIAL, shall be used as the pipe zone material. Unless otherwise specified or directed by the Engineer

the pipe zone material shall be completely surrounded by fabric as specified in Section III.2.C.09, DRAINAGE GEOTEXTILE FABRIC.

III.2.D.02.7 FIELD CONNECTIONS TO EXISTING PIPE

When allowed, field fabricated connections shall be made as directed by the Engineer. The field fabricated fitting or connection shall be constructed by using a tapping saddle and then grouting with a nonshrinking cement grout as approved. The pipe shall not be allowed to protrude past the inside wall surface of the pipe being connected to. The inside wall surface of the pipe being connected to shall be finished with grout at the connection to provide a smooth surface. Field connections which protrude past the inside wall surface and/or are not grouted smooth shall be removed and reconnected to meet this specification as directed by the Engineer.

Any damage to either pipes during the connection operation shall be repaired by the Contractor at the direction of the Engineer all at the expense of the Contractor. Alternate methods for connection to existing pipe other than preformed concrete or PVC shall be approved by the Engineer prior to construction.

III.2.D.03 PIPE REMOVAL

Unless otherwise specified by the Engineer all pipe permanently taken out of service shall be removed.

III.2.D.04 PIPE ABANDONMENT IN PLACE

When specified, all pipes approved for abandonment in place shall be cleaned, plugged watertight, and grouted full. The Engineer may approve plugging with gasketed mechanical plugs or non-shrink grout seals. Abandoned pipes connected to sewer manholes shall have the plugs or seals installed from the inside of the manhole and the channel reshaped with a material approved by the Engineer to conform to the standard drawings.

III.2.E.00 TESTING

III.2.E.01 GENERAL

After the completion of the storm drain installation, the trench backfilling and the compaction, each line will be inspected by the City using a closed circuit television per Section III.1.E.03 TV INSPECTION or other visual inspection methods. Any deficiencies or violations to these specifications found during these inspection shall be corrected immediately by the Contractor at the direction of the Engineer all at the expense of the Contractor.

III.2.E.02 CAST-IN-PLACE CONCRETE PIPE LOAD TEST

Load tests shall be made without disturbing the earth supporting the lower 210⁰ of pipe. The load shall be applied to a 4-foot length of pipe through a "sandbox" in such manner that carefully placed sand in the sandbox forms a bedding to a width of 0.7 the inside diameter of the pipe. The depth of the bedding above the pipe at the thinnest point shall be 1/4 the inside diameter of the pipe. The sandbox shall not be allowed to come in contact with the pipe, or sides of the trench. The sandbox shall be filled with sand which shall be clean and shall contain not less than 5% moisture and shall pass a No. 4 sieve. The upper surface of the sand shall be struck off level with a straight edge, and shall be covered with a rigid top bearing plate, the lower surface of which

is a true plane, made of heavy timbers or other rigid material capable of distributing the test load uniformly without appreciable bending. The test load shall be applied to this bearing plate by piling weights directly on the bearing plate or by moving heavy equipment of pre-determined weight onto the bearing plate. The bearing plate shall not be allowed to touch the sandbox. The sandbox shall be made of metal or dressed timber so heavy as to avoid appreciable bending by the side pressure of sand. A strip of cloth or plastic film may be attached to the inside of the sandbox on each side, along the lower edge, to prevent the escape of sand between the sandbox and pipe. The total load applied to the top of the pipe shall be at least 125% of the maximum earth load to which the pipe will be subjected, plus live load based on AASHTO H-20-44 loading with an impact factor of 2.0.

III.2.E.03 DEFLECTION TEST

Storm drains constructed of PVC pipe shall be subject to a deflection test after the trench backfill and compaction has been completed. The test shall be conducted by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be not less than 93% of the pipe diameter unless otherwise specified by the Engineer. Any sections of pipe which do not pass this test shall be located, and removed or repaired, as directed by the Engineer

III.2.F.00 MEASUREMENT AND PAYMENT

III.2.F.01 MEASUREMENT

The measurement of all specified pipe will be on a lineal foot basis for the various classes, types, and sizes of pipe actually installed. All pipe will be measured horizontally from center to center of manholes, from center of manholes to center of catch basins, or to the ends of the pipe, whichever is applicable. No deductions of pipe will be made for fittings or for structures.

III.2.F.02 PAYMENT

III.2.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to gravity storm drain construction performed on the Contract work under Section III.2 GRAVITY STORM DRAINS, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidentals necessary for all of the Contract work as specified under or covered by this Section.

All fittings connections, pipe removal, and plugging of pipe abandoned in place shall be considered as incidental to the pipe laying and no separate payment will be made for them unless otherwise specified.

All fabric involved in the construction of underdrain systems shall be considered as incidental to the pipe laying and no separate payment will be made for it.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

III.2.F.02.2 PAY ITEMS

Pay Item	Unit of Measure
Pipe (Specify type, size and class)	Lineal Feet
Grouting of Abandoned Pipe	Cubic Feet

III.3 GRAVITY SANITARY SEWERS

III.3.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of gravity sanitary sewer facilities.

The construction of pressure sewers, when specified, will be covered under the Special Provisions.

III.3.B.00 DEFINITIONS

III.3.C.00 MATERIALS

III.3.C.01 GENERAL

The use of all pipe and fittings shall conform to the size, strength, material and joint type as specified herein, on the Plans and/or in the Proposal unless otherwise specified. Each piece of pipe shall be clearly identified as to its strength, class and date of manufacture. If requested by the Engineer, the manufacturer of or fabricator shall furnish appropriate certification, based on the manufacturer's routine quality control tests, that the materials in the pipe and fittings meet the requirements as specified herein.

It is not intended that the materials listed herein are to be considered equal to or generally interchangeable for all applications. The Engineer shall determine the materials suitable for the project and so specify. Unless otherwise specified, the same type of material shall be used throughout a project and all fittings shall match the material and strength of the pipe being used.

All sanitary sewer pipe shall have rubber ring gasket joints unless otherwise specifically approved or directed. Solvent weld joints shall not be allowed.

III.3.C.02 CONCRETE PIPE

III.3.C.02.1 NONREINFORCED CONCRETE PIPE

When specified, or allowed as an alternate for sanitary sewer pipe construction, nonreinforced concrete pipe shall conform to the requirements of ASTM C14, and the class as specified. The gaskets shall conform to ASTM C443.

III.3.C.02.2 REINFORCED CONCRETE PIPE

When specified, or allowed as an alternate for sanitary sewer pipe construction, reinforced concrete pipe shall conform to the requirements of ASTM C76 and the class as specified. The gaskets shall conform to ASTM C443.

III.3.C.02.3 CAST-IN-PLACE CONCRETE PIPE

When specified, or allowed as an alternate for sanitary sewer pipe construction for lines 30-inch and larger, the following requirements for cast-in-place concrete pipe shall be met:

III.3.C.02.3.a CONCRETE PROPERTIES

The Portland cement concrete materials and properties shall be in accordance with the applicable requirements of Section II.5, PORTLAND CEMENT CONCRETE (PCC) PAVEMENT, except as hereinafter modified:

The slump of the concrete shall not exceed 2-inch according to the requirements of AASHTO T119.

The maximum size of coarse aggregate to be used shall not exceed 1-inch for pipe sizes of 48-inch or less and 1 1/2-inch for pipe sizes greater than 48-inch.

The Portland cement concrete shall be so proportioned as to provide a 28 day minimum ultimate compressive strength of 3,000 psi according to the applicable provisions of AASHTO T22 and AASHTO T23.

III.3.C.02.3.b PIPE DIMENSIONS

The minimum wall thickness of cast-in-place concrete pipe, at any point shall be 1/12 of the nominal internal diameter of the pipe plus 1-inch, but in no case less than 2-inch.

The internal diameter of the pipe at any point shall not be less than 95% of the specified nominal diameter, and the average of any four measurements of the internal diameter made at 45% intervals shall not be less than the specified nominal diameter.

III.3.C.03 POLYVINYL CHLORIDE PIPE (PVC)

When specified for sanitary sewer pipe construction, polyvinyl chloride pipe shall conform to the requirements of ASTM D3034 or F679 or F794. The fittings shall conform to the applicable portions of ASTM D1785, ASTM D2729, ASTM D2466, ASTM D2467, ASTM D3034, or ASTM F789. The minimum SDR shall be 35 and the minimum pipe stiffness shall be 46 psi. The gaskets shall conform to the requirements of ASTM F477.

When specified for certain water crossings, polyvinyl chloride pipe shall conform to the requirements of AWWA C900. The gaskets shall conform to the applicable requirements of ASTM F477 and ASTM D1869.

III.3.C.04 (Deleted)

III.3.C.05 (Deleted)

III.3.C.06 DUCTILE IRON PIPE

When specified as an alternate for sanitary sewer pipe construction, ductile iron pipe shall conform to the requirements of ANSI A21.51 or AWWA C151, with push-on joints or mechanical joints as specified, conforming to federal specification WW-P-421c and ANSI A21.11.

Ductile iron pipe shall be lined with cement mortar and seal coated in accordance with ANSI standard A21.4 and AWWA C104.

The fittings shall be mechanical or push-on of the class as specified. Mechanical joint cast iron fittings shall conform to AWWA C110 and shall be of a class at least equal to that of the adjacent pipe. Push-on joint fittings shall be gray iron with body thickness and radii of curvature conforming to ANSI A21.10.

III.3.C.07 FITTINGS

Unless otherwise specified or directed by the Engineer, all fittings used in new construction will be manufactured, with the exception of concrete lines 21-inch and larger for which the fittings may be field fabricated.

Construction connections to existing facilities shall conform to Section III.2.C.06, CONNECTIONS TO EXISTING PIPE. Gaskets will be installed at all fittings and joints.

When pipe repairs necessitate the use of couplings, a ROMAC style 501 coupling, or approved equal, will be used for pipes 12-inch and smaller and a ROMAC style 400 coupling, or approved equal, will be used for pipes larger than 12-inch.

III.3.C.08 CONNECTIONS TO EXISTING PIPE

4-inch and 6-inch connections to existing PVC and preformed concrete pipes will be accomplished using a ROMAC "CB" style tapping saddle with stainless steel straps, or Insert-a-Tee, or approved equal.

Connections larger than 6-inch will be made through the construction of a standard manhole unless otherwise specified by the Engineer.

III.3.C.09 CEMENT MORTAR

Cement mortar shall conform to the requirements of ASTM C387, or be proportioned 1 part Portland cement to 2 parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages by weight of cement: hydrated lime, 10%; diatomaceous earth or other inert materials, 5%. Consistency of mortar shall be such that it will adhere readily to the pipe. Mortar mixed longer than 30 minutes shall not be used.

III.3.C.10 MARKERS

Markers for sewer service stub outs shall be new, 1 piece Douglas Fir or cedar, 2x4s, utility grade or better. Markers for manholes and cleanouts outside of paved areas shall be 2-inch galvanized steel posts extended 36-inches above finish grade with a threaded pipe cap.

III.3.D.00 CONSTRUCTION/WORKMANSHIP

III.3.D.01 TRENCH EXCAVATION, PIPE ZONE, AND BACKFILL

Trench excavation, pipe zone, and backfill shall conform to the applicable requirements of Section III.1, TRENCH EXCAVATION, PIPE ZONE, AND BACKFILL.

III.3.D.02 PIPE LAYING AND JOINTING OF PIPE AND FITTINGS

III.3.D.02.1 GENERAL

All pipe installation shall be in accordance with the manufacturer's recommendations unless otherwise directed by the Engineer.

All pipe and fittings should be inspected by the Contractor prior to lowering them into the trench to insure no cracked, broken, or otherwise defective materials are used. The Contractor should use only approved implements, tools and facilities for the safe and proper protection of the work. The pipe should be lowered into the trench in such a manner as to avoid any physical damage to the pipe. At no time shall pipe be dropped or dumped into the trench.

Unless otherwise directed by the Engineer, pipe laying shall begin at the downstream end of the pipeline with the spigot end pointing in the direction of flow. The pipe shall be placed in such a manner as to insure solid bearing between the pipe and the full cross sectional area of the bedding for the full length of pipe including the joints.

During and following the laying operations, the pipe shall be protected from the entry of any foreign material. Any foreign material which has entered the pipeline shall be removed by the Contractor at the direction of the Engineer all at the expense of the Contractor.

When cutting or machining of pipe is necessary, the tools shall be used as recommended by the pipe manufacturer.

Any pipes which are to be stubbed out for future use or for connections by others shall be plugged. Glue-on or solvent weld plugs shall not be allowed.

III.3.D.02.2 LINE AND GRADE

The line and grade as specified or as determined by the Engineer shall not deviate more than ½-inch for line and 1/4-inch for grade. The Contractor shall use whatever line and grade control they choose, however, when requested by the Engineer, the Contractor shall provide the Engineer with the appropriate grade check information that they require.

III.3.D.02.3 CAST-IN-PLACE CONCRETE PIPE

III.3.D.02.3.a METHOD OF PLACEMENT

The pipe shall be constructed in 1 or 2 placements. The concrete shall be vibrated, rammed, tamped, or worked with suitable compacting equipment until thoroughly consolidated.

III.3.D.02.3.b HORIZONTAL JOINTS

When the two-placement method is used, construction joints shall occur at approximately the horizontal diameter between the upper and lower placements, and all construction joints shall be cleaned of dirt, foreign matter, and loose or defective concrete before the top placement is made. The top placement shall always be made before the concrete of the lower placement has undergone initial set and shall be tamped or vibrated to secure intermixing and consolidation of the first and second placements.

III.3.D.02.3.c STOPPAGE JOINTS

When placement is stopped for such period that initial set takes place, a stoppage joints shall be formed. Before resuming placement an excavation shall be made along the sides and bottom of the joint to permit casting of a concrete collar around the outside of the joint. This collar shall have a minimum thickness of 1 1/4 times the wall thickness of the pipe and shall lap the entire joint by at least two times the wall thickness. Immediately before resuming concrete placement the surfaces to be bonded shall be cleaned of all, coatings, foreign materials, and loose or defective concrete, thoroughly wetted and coated with a layer of bonding mortar approximately 1/4-inch thick. In lieu of the bonding mortar, neat cement paste mortar approximately 1/4-inch thick may be thoroughly scrubbed onto the wet surface of the previously placed concrete.

III.3.D.02.3.d FINISH

Except for the form offsets the interior surface of the pipe shall be equivalent to or better than a wood float finish. All extraneous concrete shall be removed from the interior surface.

III.3.D.02.3.e CURING AND BACKFILL

The Contractor shall be responsible for proper curing of the concrete and backfilling the trench to an even grade. Curing shall be performed in such a manner as to prevent the premature drying of the concrete. Final backfill, and compaction where required, shall not be started until the pipe has developed sufficient strength to support the loads to be imposed and shall conform to requirements as outlined in these standard specifications.

III.3.D.02.4 POLYVINYL CHLORIDE PIPE (PVC)

Installation of PVC pipe shall conform to ASTM D2321 and the manufacturer's recommended practices for installation unless otherwise directed by the Engineer.

III.3.D.02.5 SEWER SERVICE LINES, TEES, AND WYES

Tee and wye fittings and sewer service lines shall be installed as shown on Standard Detail 206,206A, and 206B. The locations shall be as shown on the Plans or as directed

by the Engineer.

Maximum deflection permissible with any 1 fitting shall not exceed 45° and shall be accomplished with long radius curves or bends.

Service lines shall be connected to manholes only when specified or directed by the Engineer. The connection shall be installed so that the standard pipe joint is located not more than 1.5-foot from the structure.

The ends of all service lines and fittings shall be provided with approved watertight plugs, caps, or stoppers, suitably braced to prevent blowoff during internal hydrostatic or air testing. Such plugs or caps shall be removable and their removal shall provide a socket suitable for making a connection or extension.

III.3.D.02.6 FIELD CONNECTIONS TO EXISTING PIPE

When allowed, field fabricated connections shall be made as directed by the Engineer. The field fabricated fitting or connection shall be constructed by using a tapping saddle and then grouting with a nonshrinking cement grout as approved. The pipe shall not be allowed to protrude past the inside wall surface of the pipe being connected to. The inside wall surface of the pipe being connected to shall be finished with grout at the connection to provide a smooth surface. Field connections which protrude past the inside wall surface and/or are not grouted smooth shall be removed and reconnected to meet this specification as directed by the Engineer.

Any damage to either pipes during the connection operation shall be repaired by the Contractor at the direction of the Engineer all at the expense of the Contractor. Alternate methods for connection to existing pipe other than preformed concrete or PVC shall be approved by the Engineer prior to construction.

III.3.D.03 CONCRETE CLOSURE COLLARS (CONCRETE ENCASEMENT)

Concrete encasement shall be used when specified and when directed by the Engineer. Concrete encasement shall be constructed in accordance with Standard Detail 202.

Concrete encasement shall be made in 1 pour and should not be made in water. After the concrete encasement has been poured and has taken its initial set, curing shall be accomplished by covering with well-moistened earth. The trench shall not be backfilled until the concrete has attained sufficient strength as determined by the Engineer.

III.3.D.04 SERVICE MARKERS

When the service line pipe is installed, a marker shall be installed by the Contractor at its end. The marker shall be installed at the full depth of the trench and to at least 12-inch above the ground surface. The top 4-inch of the marker shall be, after its installation, be painted with first-quality white, quick drying enamel. After the paint has dried, the distance from the natural ground surface to the top of the surface line pipe in feet and inches shall be painted on the white with quick-drying black enamel.

Precautions shall be taken during the backfilling operation to insure the position and location of the marker. If the marker is broken or knocked out of vertical alignment during the backfilling operation, the trench shall be reopened and the marker replaced.

III.3.D.05 PIPE REMOVAL

Unless otherwise specified by the Engineer all pipe permanently taken out of service shall be removed.

III.3.D.06 PIPE ABANDONMENT IN PLACE

When specified, all pipes approved for abandonment in place shall be cleaned, plugged watertight, and grouted full. The Engineer may approve plugging with gasketed mechanical plugs or non-shrink grout seals. Abandoned pipes connected to sewer manholes shall have the plugs or seals installed from the inside of the manhole and the channel reshaped with a material approved by the Engineer to conform to the standard drawings.

III.3.E.00 TESTING

III.3.E.01 PROOF TESTS

III.3.E.01.1 GENERAL

The intent of this requirement is to prequalify a joint system, components of which meet the joint requirements, as to the water tightness capability of that joint system. This proof test shall be understood to apply to sanitary sewers which are to be tested for water tightness prior to acceptance. Material and test equipment for proof testing shall be provided by the manufacturer. When approved, internal hydrostatic pressure may be applied by a suitable joint tester. In general each pipe material and joint assembly shall be subject to the following three proof tests at the discretion of the Engineer.

1. Pipe in Straight Alignment. No less than 3 or more than 5 pipes selected from stock by the Engineer shall be assembled accordingly to the manufacturer's installation instructions with the ends suitably plugged and restrained against internal pressure. The pipe shall be subjected to 10 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall shall be grounds for rejection of the pipe.

2. Pipe in Maximum Deflected Position. A test section shall be deflected as described hereinafter for each pipe material. The pipe shall be subjected to 10 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall shall be grounds for rejection of the pipe.

3. Joints under Differential Load. The test section shall be supported on blocks or otherwise as described hereinafter for each pipe material. There shall be no visible leakage when the stressed joint is subjected to 10 psi internal hydrostatic pressure for 10 minutes.

III.3.E.01.2 CONCRETE PIPE

For deflected position, create a position ½-inch wider than the fully compressed position, on one side of the outside perimeter.

For differential load, support so that one pipe is suspended freely between adjacent pipe, bearing only on the joints. In addition to the weight of the suspended pipe, add a

test load as given in the following table:

TEST LOADS FOR PIPES UNDER DIFFERENTIAL LOAD		
Pipe Size (inches)	Load Per Foot Laying Length up to 4-foot	Total Load for Pipe 4-foot and Over
4	650	2,600
6	1,000	4,000
8	1,300	5,200
10	1,400	5,600
12	1,500	6,000
15	1,850	7,400
18	2,200	8,800
21	2,500	10,000
24 & over	2,750	11,000

III.3.E.01.3 (Deleted)

III.3.E.01.4 DUCTILE IRON PIPE

For deflected position, create a position ½-inch wider than the fully compressed section on one side of the outside perimeter.

For differential load, support so that one of the pipes is suspended freely between adjacent pipe, bearing only on the joints. Apply a force per the following table along a longitudinal distance of 12-inch, immediately adjacent to one of the joints.

Pipe Size (Inches)	Force Pounds Inches	Pipe Size	Force Pounds
4	600	15	3700
6	900	18	4400
8	1200	21	5000
10	1500	24 & over	5500
12	1800		

III.3.E.01.5 PVC PIPE

For deflected position, join two 12 ½-foot lengths, then deflect along an arc of 720-foot radius (0.11-foot offset at the end of each length from a tangent at the joint).

For differential load, join two lengths and uniformly support for at least 2-foot on both sides of the joint with vertical load applied sufficient to deflect the joint and adjacent pipe to 95% of its initial vertical diameter.

III.3.E.02 CAST-IN PLACE CONCRETE PIPE LOAD TEST

Load tests shall be made without disturbing the earth supporting the lower 210° of pipe. The load shall be applied to a 4-foot length of pipe through a "sandbox" in such manner that carefully placed sand in the sandbox forms a bedding to a width of 0.7 the inside diameter of the pipe. The depth of the bedding above the pipe at the thinnest point shall be 1/4 the inside diameter of the pipe. The sandbox shall not be allowed to come in contact with the pipe, or sides of the trench. The sandbox shall be filled with sand which shall be clean and shall contain not less than 5% moisture and shall pass a No. 4 sieve. The upper surface of the sand shall be struck off level with a straight edge, and shall be covered with a rigid top bearing plate, the lower surface of which is a true plane, made of heavy timbers or other rigid material capable of distributing the test load uniformly without appreciable bending. The test load shall be applied to this bearing plate by piling weights directly on the bearing plate or by moving heavy equipment or pre-determined weight onto the bearing plate. The bearing plate shall not be allowed to touch the sandbox. The sandbox shall be made of metal or dressed timber so heavy as to avoid appreciable bending by the side pressure of sand. A strip of cloth or plastic film may be attached to the inside of the sandbox on each side, along the lower edge, to prevent the escape of sand between the sandbox and pipe. The total load applied to the top of the pipe shall be at least 125% of the maximum earth load to which the pipe will be subjected, plus live load based on AASHTO H-20-44 loading with an impact factor of 2.0.

The Contractor shall perform a load test for each size of pipe used or make a minimum of 2 load tests as specified. The location of said tests shall be specified and each test supervised by the Engineer. If the laboratory cured specimens do not meet the requirements, the Engineer may require the Contractor to perform additional load tests. No extra compensation shall be made for the additional load tests.

III.3.E.03 TESTING SEWERS

III.3.E.03.1 GENERAL

All new sanitary sewer main lines and appurtenances shall successfully pass an air test and all sewer service laterals shall successfully pass a hydrostatic or air test prior to acceptance. Main lines and service laterals shall be free of all visible leaks.

III.3.E.03.2 TESTING EQUIPMENT AND PROCEDURE

The Contractor shall furnish all necessary testing equipment and perform the tests in a manner satisfactory to the Engineer. Any arrangement of testing equipment which will provide observable and accurate measurements of either air or water leakage under the specified conditions will be permitted. When requested by the Engineer, gauges for air testing shall be calibrated at the start of each testing day. The calibration shall be witnessed by the Engineer.

III.3.E.03.3 TIME OF TEST

The tests of sections of constructed sanitary sewer for acceptance shall only

be made after all service connections, manholes, backfilling and compaction are completed between the stations to be tested.

The Contractor shall test the system during the normal work day, scheduling the plugging, capping and other preparatory work so as to conduct the test during daylight hours.

III.3.E.03.4 REPAIRS

The Contractor shall repair or replace, in a manner approved by the Engineer, any portion of the system not passing the air or hydrostatic test.

Infiltration of ground water, following a successful hydrostatic or air test, shall be considered as evidence that the original test was in error or that a failure in the system has occurred. The Contractor shall correct such failures occurring within the warranty period in a manner approved by the Engineer all at the expense of the Contractor.

The Contractor, in contracting to do this work, agrees that the leakage allowances as indicated herein are fair and practical.

III.3.E.03.5 HYDROSTATIC TESTING

Pipe and joints shall sustain a maximum limit of 0.3 gallons per hour per inch diameter per 100-foot when field tested by either infiltration or exfiltration methods. The hydrostatic head for test purposes shall exceed the maximum estimated ground water level in the section being tested at least 72-inch and in no case shall be less than 72-inch above the inside top of the highest section of pipe in the test section, including service connections. In every case the height of the water table at the time of the test shall be determined by the Contractor by exploratory holes or other such methods approved by the Engineer. The Engineer shall make the final decisions regarding test height for the water in the pipe section being tested. The length of the pipe tested by exfiltration shall be limited so that the pressure on the invert of the lower end of the section shall not exceed 16-foot of water column.

The pipe section may be filled 24 hours prior to the time of exfiltration testing to permit normal absorption into the pipe walls to take place.

All service connection footage, included in the test section and subjected to the minimum head specified, shall be taken into account in computing allowable leakage.

III.3.E.03.6 AIR TESTING

III.3.E.03.6.a GENERAL

After completion of the system, including service connections, and backfilling and compaction, the Contractor may, at their option, conduct a low pressure air test in lieu of the hydrostatic test required herein. The Engineer may require testing of manhole to manhole sections as they are completed in order to expedite the acceptance of the system and allow connections before the entire system is complete.

The test shall be conducted at the expense of the Contractor. The Contractor shall provide all equipment and personnel for the test. The method, equipment and

personnel shall be subject to the approval of the Engineer. The Engineer may, at any time, require a calibration check of the instrumentation used. The pressure gauge used shall have minimum divisions of 0.10 psi and have an accuracy of 0.0625 psi (1 ounce per square inch). All air used shall pass through a single control panel.

All plugs used to close the sewer for the air test must be capable of resisting the internal pressures and must be securely braced, if necessary.

All air testing equipment must be placed above ground and no one shall be permitted to enter a manhole or trench where a plugged line is under pressure. All pressure must be released before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the line under test at 10 psi or to avoid excessive pressure. The Contractor shall use care to avoid the flooding of their inlet by infiltrated ground water. The Contractor shall inject the air at the upper plug if possible. Only qualified personnel shall be permitted to conduct the test.

III.3.E.03.6.b GROUND WATER

The presence of ground water will affect the results of the test. The average height of ground water over the lines must be determined immediately before starting the test. The method of checking the ground water height shall be as approved.

III.3.E.03.6.c METHOD

All air testing shall be by the Time Pressure Drop Method. The test procedures are described as follows:

1. Clean the lines to be tested and remove all debris where noted.
2. At their option, the Contractor may wet the lines prior to testing.
3. Plug all open ends with suitable test plugs. Brace each plug securely.
4. Check the average height of the ground water over the line. The test pressure required below shall be increased 0.433 psi for each foot of average water depth over the line.
5. Add air slowly to the section of system being tested until the internal air pressure is raised to 4.0 psi greater than the average back pressure of any ground water that may submerge the pipe.
6. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize adding only the amount of air required to maintain pressure.
7. After the temperature stabilization period, disconnect the air supply.

8. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psi to 2.5 psi greater than the average back pressure of any ground water that may submerge the pipe.
9. Compare the time recorded in Step 8 with the time required as determined hereinafter.

III.3.E.03.6.d ACCEPTANCE

The system shall be considered acceptable when tested as described hereinbefore, if the section under test does not lose air at a rate greater than the following limits: Test section shall not lose more than "Q" cubic feet per minute per square foot of internal surface area for any portion containing less than 625 square feet internal surface area. The total leakage from any test section shall not exceed 625 "Q" cubic feet per minute. The test times shall be computed using the following formula.

$$T = 0.085 \frac{D_1^2 L_1 + D_2^2 L_2 + \dots + D_n^2 L_n}{D_1 L_1 + D_2 L_2 + \dots + D_n L_n} \frac{K}{Q}$$

WHERE:

T = shortest time, in seconds, allowed for the air pressure to drop 1.0 psi

K = 0.000419 (D₁L₁ + D₂L₂ + ...), but not less than 1.0

Q = 0.0030 cubic feet/minute/square foot of internal surface area for concrete pipe and 0.0015 cubic foot/minute/square foot of internal surface area for all other pipe types.

D₁, D₂, etc. = Nominal diameter of the different size pipes being tested (inches).

L₁, L₂, etc. = Respective lengths of the different sizes pipes being tested (feet).

For sections of one pipe size and for sections where the service laterals can be ignored as determined by the Engineer the following tables can be used:

CONCRETE PIPE (Q = 0.0030)		
Pipe Diameter (Inches)	Test Time (Seconds)	Minimum Test Time Required (Seconds)
4	0.190L	113
6	0.427L	170
8	0.760L	227
10	1.187L	283
12	1.709L	340

15	2.671L	425
18	3.846L	510
21	5.235L	595
24	6.837L	680
27	8.653L	765
30	10.683L	850
33	12.926L	935
36	15.384L	1,020

ALL OTHER PIPE TYPES (Q = 0.0015)		
Pipe Diameter (Inches)	Test Time (Seconds)	Minimum Test Time Required (Seconds)
4	0.380L	226
6	0.854L	340
8	1.520L	454
10	2.374L	566
12	3.418L	680
15	5.342L	850
18	7.692L	1,020
21	10.470L	1,190
24	13.675L	1,360
27	17.306L	1,530
30	21.366L	1,700
33	25.852L	1,870
36	30.768L	2,040

If a line fails to meet these requirements, the Contractor shall determine at their own expense the reason for leakage and shall repair or replace all defective materials or workmanship. The repaired section shall meet the requirements of this test before being considered acceptable.

III.3.E.03.7 DEFLECTION TEST

Sanitary sewers constructed of PVC pipe shall be subject to a deflection test after the trench backfill and compaction has been completed. The test shall be conducted by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be not less than 93% of the pipe diameter unless otherwise specified by the Engineer. Any sections of pipe which do not pass this test shall be located and repaired by the Contractor at the expense of the Contractor.

III.3.E.03.8 TELEVISION INSPECTION

After the completion of the sanitary sewer installation, the trench backfilling and the compaction, each line will be inspected by the City using a closed circuit television per Section III.1.E.03, TV

INSPECTIONS.

Any deficiencies or violations to these specifications found during these inspections or any inspections during the warranty period shall be corrected immediately by the Contractor at the direction of the Engineer all at the expense of the Contractor.

III.3.F.00 MEASUREMENT AND PAYMENT

III.3.F.01 MEASUREMENT

The measurement of all specified pipe will be on a lineal foot basis for the various classes, types, and sizes of pipe actually installed. All pipe will be measured horizontally from center to center of manholes or to the ends of the pipe, whichever is applicable. No deductions will be made for fittings or structures.

III.3.F.02 PAYMENT

III.3.F.02.1 GENERAL

Payment for the following listed items which may appear in the Proposal and for other bid items which may become applicable to gravity sanitary sewers construction performed on the Contract work under Section III.3, GRAVITY SANITARY SEWERS, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, material and incidentals necessary for all of the Contract work as specified under or covered by this Section.

All fittings, connections, pipe removal and plugging of pipe abandoned in place shall be considered as incidental to the pipe laying and no separate payment will be made for them unless otherwise specified.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

III.3.F.02.2 PAY ITEMS

Pay Item	Unit
Pipe (Specify type, size and class)	Lineal Feet
Grouting of Abandoned Pipe	Cubic Feet

III.4 MANHOLES

III.4.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of manholes. All manholes shall be of concrete construction.

III.4.B.00 DEFINITIONS

III.4.C.00 MATERIALS

III.4.C.01 WATER

Water shall conform to the applicable requirements of Section, II.1.C.02, WATER.

III.4.C.02 BEDDING AGGREGATE

Bedding aggregate shall be 3/4-inch-0 crushed aggregate and shall conform to the applicable requirements of Section III.1.C.04, PIPE ZONE.

III.4.C.03 AGGREGATE FOR OVEREXCAVATION

Aggregate for overexcavation shall conform to the applicable requirements of Section III.1.C.03, AGGREGATE FOR OVEREXCAVATION.

III.4.C.04 CONCRETE

The Portland cement concrete material and properties shall conform to the applicable requirements of ASTM C94 and shall be in conformance with the applicable requirements of Section II.5, PORTLAND CEMENT CONCRETE (PCC) PAVEMENT, except as hereinafter modified:

1. The slump of the concrete shall be between 2-inch and 4-inch according to the requirements of AASHTO T119.
2. The maximum size of coarse aggregate to be used shall not exceed 1 1/2-inch.
3. The Portland cement concrete shall be so proportioned as to provide a 28 day minimum ultimate compressive strength of 3,000 psi according to applicable provisions of T22 and AASHTO T23.

III.4.C.05 FORMS

When specified, exterior and/or interior surfaces shall be formed with steel or plywood. Other surfaces shall be formed with matched boards, plywood, or other approved material.

III.4.C.06 CEMENT MORTAR

Cement mortar shall conform to the requirements of Section III.3.C.09, CEMENT MORTAR.

III.4.C.07 MANHOLES

III.4.C.07.1 PRECAST MANHOLE SECTIONS

Standard precast manhole sections shall conform to the Standard Detail 203 or 204 (18-inch cone) and to the requirements of ASTM C478. Minimum wall thickness shall be

4-inch. Cones shall have the same wall thickness and reinforcement as the riser sections. Joints shall be tongue - and - groove or keylock type. Cones shall be concentric unless otherwise specified.

Manhole size shall be as specified on Standard Detail 203 or 204 (18-inch cone) or as specified on the Plans.

III.4.C.07.2 PRECAST BASES

At the option of the Contractor, precast base sections or manhole bases may be used provided all the details of construction are approved prior to construction. Channels may be either preformed or cast in place.

III.4.C.07.3 (Deleted)

III.4.C.07.4 MANHOLE STEPS

Manhole steps shall not be installed unless otherwise specified.

III.4.C.07.5 WATER SEAL GASKET

Regardless of the pipe or manhole manufacturer's recommendations, adapters for connecting PVC pipe to new or existing manholes shall be approved commercial adapters manufactured specifically for the intended use such as Fernco CMA, Fernco Large Diameter Waterstop, Romac LCT, Tylox Manhole Adapters, Vassallo 32850, Kor-N-Seal, or approved equal. Field fabricated water stops or improvised adapters such as a gasket stretched over the pipe will not be allowed.

The manhole coupling shall be anchored and finished using an approved nonshrink grout. Standard grout is not acceptable.

All grout to be placed in contact with cured concrete shall be placed with the use of an approved commercial concrete bonding agent. Water as a bonding agent will not be approved.

Materials shall be as approved by the Engineer.

III.4.C.07.6 NON-SHRINK GROUT

Nonshrink grout shall be Sika 212, Euco N-S, Five-Star, or an equal non-metallic cementitious commercial grout exhibiting zero shrinkage per ASTM C-827 and CRD-C-621. Grout shall not be amended with cement or sand, and shall not be reconditioned with water after initial mixing. Unused grout shall be discarded after 20 minutes and shall not be used.

Nonshrink grouts shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted. The bonding agent shall be compatible with the brand of grout being used. Water as a substitute for commercial bonding agent for nonshrink grout will not be allowed in sanitary sewer construction.

III.4.C.08 MANHOLE FRAMES AND COVERS

III.4.C.08.1 METAL CASTINGS

Metal Castings shall conform to the requirements of ASTM A48, Class 30B, with the following revisions:

Tensile Strength	30,000 psi
Transverse Strength:	(1.2-inch diameter bar - 18-inch centers)
Load - Pounds	2600 - 3000
Deflection - Inches	0.22 - 0.34
Brinell Hardness	173-200

When required, the foundry shall certify as to the tensile and transverse properties and the Brinell Hardness. The City reserves the right to require a rough transverse bar (size of bar 1.2-inch diameter by 20-inch long) and/or a tensile bar as per ASTM A28 for each 20 castings or heat when less than 20 castings are made.

III.4.C.08.2 CAP SCREWS

Cap screws and washers for tamper proof and watertight manhole covers shall be stainless steel with 60,000 psi minimum tensile strength conforming to ASTM A453.

III.4.C.09 PIPE AND FITTINGS

All pipe and fittings shall conform to the applicable portions of Sections III.2, GRAVITY STORM DRAINS and III.3 GRAVITY SANITARY SEWERS.

Tees, ells, and other fittings for drop manholes shall be of the same material as the pipe in the adjacent trench unless otherwise specified.

Pipe stubouts for service connections and storm drain laterals shall conform to the applicable portion of Sections III.2, GRAVITY STORM DRAINS, and III.3, GRAVITY SANITARY SEWERS, and are to be of the same size and type as the connections.

III.4.D.00 CONSTRUCTION/WORKMANSHIP

III.4.D.01 GENERAL

III.4.D.01.1 EXCAVATION AND BACKFILL

Excavation and backfill shall conform to the applicable requirements of Section III.1, TRENCH EXCAVATION, PIPE ZONE AND BACKFILL. The backfill around the manhole and other sewer or storm drain appurtenances shall be of the same quality as the trench backfill immediately adjacent.

III.4.D.01.2 BASE ROCK

Unless otherwise specified or directed, crushed aggregate base rock thoroughly compacted to the required thickness and density shall be placed under the concrete manhole base as shown on Standard Detail 203.

III.4.D.01.3 OVEREXCAVATION

In the event that material exists which, in the opinion of the Engineer, is unsuitable as a foundation material for the manhole, the material shall be removed by the Contractor to the lines and grades as directed by the Engineer. The overexcavation shall be replaced with suitable aggregate material as specified in Section III.1.D.03.5, OVEREXCAVATION.

III.4.D.02 MANHOLES

III.4.D.02.1 GENERAL

Manholes shall be constructed according to Standard Detail 203.

Flow through existing lines will be maintained at all times. Approval from the Engineer must be obtained prior to diverting flows. The Contractor shall prevent material or debris from entering existing lines.

III.4.D.02.2 BASES

The concrete base shall be consolidated by vibrating or working as approved and shall be screeded off in such a manner such that the first manhole section to be placed has a level uniform bearing for the full circumference. Sufficient mortar shall be deposited on the concrete base to provide a watertight seal between the base and the manhole section.

If bases are precast, the base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment, and making sure that all entering pipes can be inserted on the proper grade.

III.4.D.02.3 PIPE CONNECTIONS

All rigid pipes entering or leaving the manhole shall be provided with pipe joints within 1 1/2 pipe diameters, but not less than 1 1/2-foot, of the manhole structure and shall be placed on firmly compacted bedding. Special care shall be taken to see that the openings through which pipes enter the manhole are completely watertight. All flexible pipe shall be connected to manholes according to the manufacturer's recommendations.

All sanitary sewer pipe connections, including those at invert level and penetrations for drop connectors, conduits, and pass-throughs, shall conform to the requirements of Section III.4.C.07.5, WATER SEAL GASKET.

III.4.D.02.4 MANHOLE SECTIONS

Precast manhole sections shall be placed to provide vertical sides. All sanitary sewer manhole sections and cone joints shall be sealed with preformed rubber gaskets or Kent Seal, and shall be grouted on the outside of each section with an approved grout and bonding agent. Keyway of sections shall be free of debris. Kent Seal or gasket shall not be stretched and shall be uniformly placed in section keyway. Ends of Kent Seal shall not overlap and shall be cut to fit as required.

All storm drain manhole sections shall be sealed with preformed rubber gaskets or Kent Seal as specified. Grout is not required.

III.4.D.02.5 MANHOLE GRADE RINGS

Grade rings shall be installed as shown on the Standard Detail to the height directed. Grade rings shall be laid in mortar with the sides plumb and the top level. The joints shall be sealed with mortar. The extensions shall be watertight.

In general, manhole grade rings will be used on all manholes in streets or roads or in other locations where a subsequent change in existing grade may be likely. Extensions shall be limited to a maximum height of 12-inch unless otherwise directed by the Engineer. Finished grade for manhole covers shall conform to the finished street surface in streets and shall be built at least six, but not more than 12-inch above finished ground surface out of street areas, unless otherwise directed by the Engineer.

Manhole grade ring joints shall be "keylock" joint as manufactured by SPEC Industries, or an approved equal conforming to ASTM C-478, and shall be grouted or mortared using an approved commercial concrete bonding agent applied to all cured concrete surfaces. No joints or risers shall be grouted without bonding agent. Water as a bonding agent will not be approved.

III.4.D.02.6 MANHOLE FRAMES AND COVERS

Frames shall be set in a bed of mortar with the mortar carried over the flange of the frame as shown on the Standard Detail. Frames shall be set so the top of covers are flush with the surface of the adjoining pavement unless otherwise directed.

Commercial concrete bonding agent shall be applied to all cured concrete surfaces being mortared.

III.4.D.02.7 MANHOLES OVER EXISTING SEWERS

Manholes shall be constructed over existing concrete sewers after first cleaning and applying approved commercial concrete bonding agent to all surfaces of the pipe that will be in contact with the manhole. The top of the existing concrete pipe shall be cut out to the spring line for the full width of the manhole and the exposed edge of the pipe covered completely with concrete. All concrete surfaces shall be troweled smooth.

Prior to constructing a manhole over an existing PVC pipe, the pipe shall be prepared for bonding to the concrete by applying a dense coating of clean mortar sand to the pipe that will be in contact with the concrete. Sand shall be applied using PVC solvent adhesive. After curing, the sand coating shall be prepared with an approved concrete bonding agent prior to concrete placement.

Prior to severing the existing pipe with the manhole, the manhole shall be vacuum tested. Premature breakage of the existing pipe will not excuse the requirement for testing the manhole. If the existing pipe is broken the Contractor shall then plug the inverts and pump around the manhole during the test period at their own expense, as directed by the Engineer.

III.4.D.02.8 CHANNELS

Poured channels must be placed after base and pipes are installed. Poured channels will be formed concrete with special attention given to providing smooth, uniformly finished channels. Thin grout repairs will not be allowed to achieve this.

Where a full section of pipe is laid through a manhole to form the channel, the top section of the pipe shall be cut out to the spring line for the full width of the manhole and the exposed edge of the pipe covered completely with concrete. All concrete surfaces shall be troweled smooth.

III.4.D.03 DROP MANHOLES

Drop manholes shall be constructed in conformance with the Standard Detail 203A and in conformance with the requirements of Section III.4.D.02, MANHOLES.

III.4.D.04 FILLING ABANDONED MANHOLES

Manholes scheduled to be abandoned shall be cleaned and have all connecting pipes capped or plugged. Remove the manhole cone or flattop and fill the manhole barrel with crushed aggregate meeting the requirements of Section III.1.C.05.3 CRUSHED AGGREGATE and compact to 95% optimum density as determined by ASTM D 698. Break or perforate the manhole bottom to prevent the entrapment of water.

III.4.D.05 MANHOLE REMOVAL

Unless otherwise specified by the Engineer all manholes permanently taken out of service shall be removed.

III.4.E.00 TESTING

III.4.E.01 VACUUM TESTING

All new sanitary sewer manholes and existing sanitary sewer manholes penetrated by new lines shall be visually inspected and vacuum tested for leakage. A passing vacuum test will be required of all manholes with one exception. Should the contractor elect to vacuum test an existing manhole prior to making the penetration, and the manhole fails to pass the vacuum test, the manhole will be excepted from this requirement. Manholes shall be constructed to be free from any visual leakage throughout the warranty period. Required vacuum tests shall be performed after final paving in conformance with ASTM C 1244-93.

All sanitary sewer manholes shall be visually tested and vacuum tested for leakage. New manholes shall be constructed to be free from any visual leakage throughout the warranty period. The vacuum test shall be performed after final paving in conformance with ASTM C 1244-93. Additional vacuum tests may be performed prior to paving at no cost to the City.

Vacuum testing shall be done in accordance with ASTM C 1244-93. All pipes entering the manhole shall be temporarily plugged, and plugs shall be braced. The test head shall be placed in or on top of the manhole ring. A vacuum of 10-inch of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9-inch of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10-inch of mercury to 9-inch of mercury meets or

exceeds the values indicated in the table below.

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS									
	Diameter (inches)								
	30 or less	33	35	42	48	54	60	66	72
Depth* (feet)	Time (seconds)								
8 or less	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	35	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

*Depth is measured from the top of the manhole to the lowest invert.

**Test times for manhole depths between those shown in this table may be calculated by interpolation.

Repair methods for leaks identified during the testing process shall be approved by the Engineer. Surface repairs to the inside of manholes will not be allowed.

III.4.F.00 MEASUREMENT AND PAYMENT

III.4.F.01 MEASUREMENT

Measurement and payment for manholes, including standard precast concrete or monolithic concrete manholes will be made on a unit price basis for each type shown in the Proposal for manholes 6-foot deep, plus the unit price per foot shown in the Proposal for extra depth of manholes over 6-foot. No deduction will be made for depths less than 6-foot. Measurement of manhole depth will be from the top of the manhole frame and cover to the manhole invert at the center of the manhole to the nearest 1/10 of a foot. There will be no separate payment for pavement removal and replacement, excavation (including removal of an existing

manhole), backfill, foundation stabilization and/or base rock and any materials, equipment and labor necessary to reconnect all existing pipes when constructing manholes, it being understood that the cost thereof is incidental to and included in the contracted price for Standard Manhole or Manhole Drop Assembly work items.

III.4.F.02 PAYMENT

III.4.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to manhole construction performed on the Contract work under Section III.4, MANHOLES, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this section will be considered as incidental work for which no separate payment will be made.

III.4.F.02.2 PAY ITEMS

Pay Items	Unit of Measure
Standard or Drop Manhole (Specify Size) 0-6-foot Deep	Each
Additional Depth for Standard or Drop Manhole in Excess of 6-foot (Specify Size)	Foot of Depth
Filling Abandoned Manhole	Each

III.5 CATCH BASINS, INLET STRUCTURES, OUTFALL STRUCTURES

III.5.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of catch basins, pipe inlets, and pipe outfalls of the types and sizes as specified.

III.5.B.00 DEFINITIONS

III.5.C.00 MATERIALS

III.5.C.01 WATER

Water shall conform to the applicable requirements of Section III.1.C.01, WATER.

III.5.C.02 BEDDING AGGREGATE

Bedding aggregate, when required, shall be 3/4-inch-0 crushed aggregate and shall conform to the applicable requirements of Section III.1.C.04, PIPE ZONE.

III.5.C.03 AGGREGATE FOR OVEREXCAVATION

Aggregate for overexcavation shall conform to the applicable requirements of Section III.1.C.03, AGGREGATE FOR OVEREXCAVATION.

III.5.C.04 CONCRETE

The Portland cement concrete shall conform to the applicable requirements of Section III.4.C.04, CONCRETE.

III.5.C.05 FORMS

Forms shall conform to the requirements of Section III.4.C.05, FORMS.

III.5.C.06 CEMENT MORTAR

Cement mortar shall conform to the requirements of Section III.3.C.09, CEMENT MORTAR.

III.5.C.07 PRECAST CONCRETE UNITS

At the option of the Contractor, approved precast catch basin units may be substituted for cast-in-place units. Precast units shall conform to the requirements of ASTM C478. Preformed inlet/outfall units may be allowed with prior approval of the Engineer.

III.5.C.08 (Deleted)

III.5.C.09 FRAMES AND GRATES

Frames and grates shall be of steel construction and shall conform to Standard Details 208 and 208A. (change details to comply with ADA)

III.5.D.00 CONSTRUCTION/WORKMANSHIP

III.5.D.01 GENERAL

III.5.D.01.1 EXCAVATION AND BACKFILL

Excavation and backfill shall conform to the applicable requirements of Section III.1, TRENCH EXCAVATION, PIPE ZONE AND BACKFILL. The backfill around catch basins, inlets, outfalls and other storm drain appurtenances shall be of the same quality as the trench backfill immediately adjacent.

III.5.D.01.2 BASE ROCK

When specified, crushed aggregate base rock thoroughly compacted to the required thickness and density shall be placed under the catch basin base.

III.5.D.01.3 OVEREXCAVATION

In the event that material exists which, in the opinion of the Engineer, is unsuitable as a foundation material for the catch basin, the material shall be removed by the Contractor to the lines and grades as directed by the Engineer. The overexcavation shall be replaced with suitable aggregate material as specified in Section III.1.D.09, SURFACE REPLACEMENT.

III.5.D.02 CATCH BASINS

III.5.D.02.1 GENERAL

Catch basins shall be constructed as shown on Standard Details 208 and 209.

III.5.D.02.2 FORMING AND POURING

Forms should be tight and well braced. Prior to placing the concrete, the excavated area shall be free of water and debris. The forms should be moistened just prior to placing the concrete. Immediately after placing, the concrete shall be vibrated to produce satisfactory consolidation without segregation. The top surface shall be troweled to a flush, square joint for the bottom of the precast curb inlet walls or for the frame and grate of a gutter inlet as specified.

Walls and bottoms shall be poured monolithic and finished smooth. Thin grout repairs will not be allowed.

III.5.D.02.3 PRECAST CURB INLET

The precast curb inlet shall be secured and bonded to the catch basin as shown on Standard Detail 209 and as directed.

III.5.D.02.4 FRAMES AND GRATES

Frames and grates shall be installed as shown on Standard Detail 208.

III.5.D.02.5 OIL WATER SEPERATOR

When specified, oil/water separators shall be installed on all pipe inlets and shall be a Modified 4A Inlet sediment trap for concrete catch basins manufactured by Gibson Steel Basins, Eugene, Oregon or approved equal.

III.5.D.03 FIELD INLETS

Field inlets shall be constructed as shown on the Plans or as directed and shall be in conformance with Standard Detail 208A.

III.5.D.04 PIPE INLETS AND OUTFALLS

Pipe inlets and outfalls shall be constructed as shown on the plans or as directed. Inlets and outfalls for pipes 15-inch or larger shall be equipped with a locking grate. (look at adding

ODOT details and headwalls)

III.5.D.05. PIPE CONNECTIONS

Pipe connections shall conform to applicable requirements of Section III.4.D.02.3, PIPE CONNECTIONS.

III.5.D.06 FILLING ABANDONED CATCH BASINS

Catch basins scheduled to be abandoned shall be cleaned and have all connecting pipes capped or plugged. Remove the catch basin frame and fill the catch basin with crushed aggregate meeting the requirements of Section III.1.C.05.3, CRUSHED AGGREGATE and compact to 95% optimum density as determined by ASTM D69B. Break or perforate the catch basin bottom to prevent the entrapment of water.

III.5.D.07 CATCH BASIN REMOVAL

Unless otherwise specified by the Engineer all catch basins permanently taken out of service shall be removed.

III.5.E.00 TESTING

III.5.F.00 MEASUREMENT AND PAYMENT

III.5.F.01 MEASUREMENT

Measurement of catch basins inlets, and outfalls shall be based on a per each basis for each type and size specified.

III.5.F.02 PAYMENT

III.5.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to catch basin construction performed on the Contract work under Section III.5, CATCH BASINS, INLET STRUCTURES, OUTFALL STRUCTURES, pipe inlets/outlets by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

III.5.F.02.2 PAY ITEMS

Pay Item	Unit of Measure
Standard Curb Inlet Catch Basin	Each
Field Inlet	Each
Standard Gutter Inlet Catch Basin	Each
Pipe Inlet/Outfall	Each
Fill Abandoned Catch Basin	Each

III.6. CLEANOUTS

III.6.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of cleanouts.

III.6.B.00 DEFINITIONS

III.6.C.00 MATERIALS

III.6.C.01 CONCRETE PIPE

Concrete cleanouts shall be constructed using non-reinforced concrete pipe conforming to ASTM C14, Class 3. The gaskets shall conform to ASTM C443.

III.6.C.02 PVC PIPE

PVC cleanouts shall be constructed using pipe conforming to ASTM D3034.

III.6.C.03 CAST IRON RING AND COVER

The cast iron ring and cover shall be constructed in conformance with the appropriate ASTM Standard and in conformance with Standard Detail 206. Cleanout rings and covers shall be Brooks 1RT or 3RT, or approved equal, cast in a concrete bell.

III.6.D.00 CONSTRUCTION/WORKMANSHIP

III.6.D.01 GENERAL

The cleanouts shall be constructed in conformance with the applicable requirements of Section III.3.D.00, CONSTRUCTION/WORKMANSHIP and in conformance with Standard Detail 206.

III.6.E.00 TESTING

Testing of cleanouts shall be in conformance with the applicable requirements of Section III.3.E.00, TESTING.

III.6.F.00 MEASUREMENT AND PAYMENT

III.6.F.01 MEASUREMENT

Measurement of cleanout shall be based on a per each basis for each size specified.

III.6.F.02 PAYMENT

III.6.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to cleanout construction performed on the Contract work under Section III.6 CLEANOUTS, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidental necessary for all of the Contract work specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

III.6.F.02.2 PAY ITEMS

Pay Item	Unit of Measure
Standard Cleanout (Specify Size)	Each

III.7 TUNNELING, BORING, AND JACKING

III.7.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of sanitary sewers, storm drains, and waterlines by means of tunneling, boring, or jacking.

III.7.B.00 DEFINITIONS

III.7.B.01 TUNNELING

Tunneling shall include all methods by which the underground passageway is first excavated and by which the lining materials are brought in and placed.

III.7.B.02 BORING

Boring shall include all methods by which a conduit is pushed or pulled into place and by which the excavation method precludes the stationing of a worker within the conduit without stopping or removing the excavation equipment.

III.7.B.03 JACKING

Jacking shall include all methods by which a conduit is pushed or pulled into place

with 1 or more workers inside to excavate and assist in keeping the conduit on the required grade and alignment.

III.7.B.04 PERMITTER

Within this section, "permitter" shall designate the owner of the facility with prior rights, under which a pipe must be tunneled, bored, or jacked.

III.7.C.00 MATERIALS

III.7.C.01 PIPE BEDDING AND PIPE ZONE MATERIALS

Pipe bedding and pipe zone materials shall conform to the requirements of Section III.1.C.00, MATERIALS.

III.7.C.02 PIPE

Pipe materials shall conform to the strength, class, and type as specified. PVC pipe shall not be allowed as a carrier pipe.

III.7.C.03 CASING

Smooth steel pipe shall be used when casing is required for tunneling, boring, or jacking applications. The Contractor shall provide casing of a size to permit proper construction to the required lines and grades for the type of pipe being used. The thickness of the casing shall be as specified in the table below.

The minimum gauge or wall thickness shall correspond to the size of casing selected from the following table; however, the Contractor shall be responsible for selecting the gauge consistent with their operation and the requirements of the permitter.

Diameter (Inches)	Smooth Steel Pipe (Minimum Thickness-Inches)
0-24	1/4 ASTM A53
>24-36	5/16 AWWA C201
Over 36	As Specified

Jacked casings shall be equipped with nipples at the spring line and crown at 10-foot centers when pressure grouting is specified.

III.7.C.04 PIPE SUPPORTS AND END SEALS

All pipe supports and end seals shall be manufactured and approved by the Engineer prior to installation.

III.7.C.05 PORTLAND CEMENT CONCRETE

Portland cement concrete materials and properties shall be in conformance with

III.7.C.06 GROUT

Grout for filling the annular space between the carrier pipe and casing pipe shall be proportioned 1 part Portland cement, 5 parts sand, 7 parts pea gravel (by volume), or as approved by the Engineer.

Grout for pressure grouting outside jacked carrier or casing pipe shall be 1 part Portland cement and 3 parts sand (by volume), or as approved by the Engineer.

III.7.C.07 SAND

Sand for filling the annular space between the carrier pipe and casing pipe shall be clean, sharp and well graded so that 100% passes the No. 8 sieve, and between 10% and 35 % passes the No. 50 sieve, or as approved.

III.7.D.00 CONSTRUCTION

III.7.D.01 GENERAL

The work shall conform to all federal, state, and local laws and regulations pertaining to tunneling and specifically to the applicable standards set forth by the Oregon Occupational Safety & Health Division.

Before the start of the work, the Contractor shall submit satisfactory evidence to the Engineer that all insurance requirements called for by the permitter have been complied with. All proposed construction methods and materials shall be approved by the Engineer and permitter if applicable, prior to the start of construction. Written approval to proceed from the permitter (where applicable) shall be submitted to the Engineer prior to the start of construction by the Contractor.

III.7.D.02 EXCAVATION

Excavation shall be unclassified and shall include whatever materials are encountered to the depths as shown or as required. The Contractor shall make an estimate of the kind and extent of the various materials which will be encountered in the excavation.

III.7.D.03 TUNNELING DETAILS REQUIRED

The Contractor shall submit details of the following to the Engineer for approval before beginning the tunnel construction:

1. Tunnel shaft bracing and dimensions;
2. Tunnel supports;
3. Method of backpacking tunnel supports;
4. Bracing to prevent lining from shifting and flotation;
5. Backfill materials or pressure concrete mix design, placement method, and equipment;
6. Poling plate dimensions and details (if employed).

III.7.D.04 JACKING AND BORING DETAILS REQUIRED

The Contractor shall submit details of the following to the Engineer for approval before beginning the jacking or boring construction:

1. Jacking pit construction (including bracing and dimensions);
2. Jacking pit bracing;
3. Casing or conduit;
4. Jacking head;
5. Excavation method;
6. Tee or wye installation;
7. A substitute design for any part of the system that must be changed as a result of the jacking or boring operation (manhole, headwall, etc.);
8. Any structure that is required because of the particular method or procedure used by the Contractor;
9. If placed in a casing, bracing to prevent pipe shifting and flotation, backfilling material, method, and equipment.
10. Backfill material or pressure grout mix, placement method, and equipment.

III.7.D.05 TUNNELING

Tunneling will be permitted only where shown, specified, or approved by the Engineer.

The subgrade and bidding requirements shall be in conformance with Section III.1.D.03, TRENCH EXCAVATION, and Section III.1.D.06, PIPE ZONE.

Excavation below grade, which is made inadvertently or without authority, shall be restored to grade by backfilling with approved bedding material all at the expense of the Contractor.

III.7.D.06 ALTERNATE OF JACKING OR BORING

Jacking or boring may be allowed in lieu of the open trench method or tunneling. However, written approval by the Engineer must first be obtained. The Engineer retains the right to reject either the jacking or boring method without rejecting the other.

Approval by the Engineer shall in no way relieve the Contractor of the responsibility for making a satisfactory installation meeting the requirements set forth herein.

III.7.D.07 JACKING AND BORING

The leading section of conduit shall be equipped with a jacking head securely anchored thereto to prevent any wobble or alignment variation during the jacking or boring operation. For jacking, all excavation shall be carried out entirely within the jacking head, and no excavation in advance thereof shall be permitted. For jacking, every effort shall be made to avoid any loss of earth outside the jacking head. Excavated material shall be removed from the conduit as excavation progresses and no accumulation of such material within the conduit will be permitted.

All conduit shall be jacked or bored to the required line and grade. The method shall be modified to correct any deviation therefrom. Should any deviation from line and grade

be considered excessive in the Engineer's judgment, that portion of the conduit shall be taken up and repositioned at no expense to the owner.

Should appreciable loss of surrounding material occur during the jacking or boring operation, the voids shall be backpaked or grouted promptly before the completion of the shift. On completion, all voids shall be filled. Filling or backpaking shall be with grout or granular material as approved.

Removal of the materials from the jacked or bored hole by washing or sluicing will not be permitted.

It shall be understood that where any pipe is to be placed by jacking or boring in a tunnel or open trench, the design of such pipe is based upon the superimposed loads and not upon the loads resulting from the jacking or boring operations. Any increase in pipe strength to withstand jacking or boring loads shall be the responsibility of the Contractor.

III.7.D.08 CONCRETE PIPE AND BOX SECTIONS

The Contractor shall protect the driving ends of concrete conduit against spalling and other damage. Intermediate joints shall be similarly protected by the installation of sufficient bearing shims to properly distribute the bearing stresses. Any section of conduit showing signs of failure shall be removed and replaced with a new section of conduit or with a cast-in-place section which, in the judgment of the Engineer, is adequate to carry the loads imposed upon it.

III.7.D.09 SMOOTH STEEL CASING

Sections of smooth steel casing to be jacked or bored shall be joined by welding the joints with a continuous weld for full circumference or by other approved means. The Contractor shall provide joints which are capable of resisting the jacking or boring forces.

Pipe installed in a casing shall be braced to prevent shifting and flotation. Fill the void between the casing and carrier pipe with sand, grout, or other material as specified or approved.

If not shown or specified, the casing diameter shall be the option of the Contractor. The Contractor shall provide casing of such strength as to withstand the jacking or boring loads and of such diameter as to allow filling the void between the pipe and casing with the approved material.

III.7.D.10 GROUTING VOIDS OUTSIDE CASING

Unless otherwise specified, any void space between the tunnel and casing or liner plate shall be completely filled with approved grout. After the casing or carrier pipe has been jacked or tunneled into position, grout will be pressured through the grout holes provided to fill all voids outside the pipe. Grouting will be started at the spring line hole at one end and will be pumped in until it appears in the grout hole at the crown. Grout will then be started through the opposite spring line hole until it appears at the hole in the crown. The hole at the crown will then be grouted until grout appears in the next set of holes along the pipe. The holes at the starting point shall then be plugged. This process shall be repeated with the next set of holes and until the full length of jacked, bored, or tunneled pipe has been grouted.

III.7.D.11 PIPE SUPPORTS

Manufactured pipe supports shall be installed according to the manufacturer's recommendations.

III.7.D.12 PLACING FILL IN CASING

Unless otherwise specified, the Contractor shall completely fill the annular space between the casing, tunnel liner, or tunnel wall and the pipe with approved sand or grout to prevent pipe flotation. The Contractor shall pour or pump the fill from the two ends and such intermediate points as may be necessary. Grouting, once commenced at any one point, shall be completed without stopping using approved low pressure grouting equipment. Sand filling shall be accomplished using a gunite machine or other approved equipment.

III.7.E.00 TESTING

All testing shall be in conformance with the applicable testing procedures for sanitary sewers, storm drains, and waterlines as found in the applicable sections of these specifications.

III.7.F.00 MEASUREMENT AND PAYMENT

III.7.F.01 MEASUREMENT

III.7.F.01.1 GENERAL

Measurement and payment for tunneled, bored, and jacked pipe or conduit will be made on a lineal foot basis or lump sum basis, as specified. Measurement for tunneling, jacking, and boring will be made on a lineal foot basis along the centerline of the pipe or conduit between portals. Tunneling, jacking, and boring extensions beyond the limits shown or specified shall be considered to be for the Contractor's convenience, unless ordered in writing, and measurement and payment for said extension shall be made as if the open trench methods of construction had been used.

III.7.F.01.2 JACKING OR BORING IN LIEU OF TUNNELING

Where jacking or boring of a pipe or conduit is approved in lieu of tunneling, measurement and payment will be made as though the tunneling methods had been used and will include all the pay items that would have been applicable if the tunneling construction methods had been used.

III.7.F.01.3 TUNNELING, JACKING, OR BORING IN LIEU OF OPEN TRENCH

Where tunneling, jacking, or boring of a conduit is approved in lieu of open trench construction, measurement and payment will be made as though the open trench methods had been used and will include all the pay items that would have been applicable if the open trench construction methods had been used.

III.7.F.01.4 TUNNELING IN LIEU OF JACKING OR BORING

Where tunneling of a pipe or conduit is approved in lieu of jacking or boring, measurement and payment will be made as though the jacking or boring method had been

used and payment shall be made at the bid price for jacking or boring as applicable.

III.7.F.02 PAYMENT

III.7.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to tunneling, boring, or jacking construction performed on the Contract work under Section III.7 TUNNELING, BORING, AND JACKING, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials, and incidentals necessary for all of the Contract work as specified under or covered by this Section.

The payment shall include, but not be limited to, full compensation for all excavation, shafts, portals, jacking and boring pits, tunnel stabilization, backfill, installed pipe, lubricant, grouting of pipe, casing, and all appurtenances and all other labor, equipment, tools, and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

III.7.F.02.2 PAY ITEMS

Pay Item	Unit
Tunnel (Specify type, size, and class of carrier pipe)	Lump Sum or Lineal Feet
Jack (Specify type, size, and class of carrier pipe)	Lump Sum or Lineal Feet
Bore (Specify type, size, and class of carrier pipe)	Lump Sum or Lineal Feet