

**PART 00400 - DRAINAGE AND SEWERS****Section 00401 - Video and Electronic Inspection of Sewers****Description**

**00401.00 Scope** - This work consists of the cleaning and inspection of sewers using video and related electronic equipment. The work may include locating live connections, documenting existing conditions and providing information about sewer conditions that may require repair work.

**00401.01 Abbreviations:**

**CCTV** - Closed Circuit Television  
**CD-ROM** - Compact Disc Read Only Memory  
**DVD** - Digital Video Disc or Digital Versatile Disc  
**MPEG** - Moving Pictures Expert Group  
**SVCD** - Super Video Compact Disc  
**VCD** - Video Compact Disc

**Equipment****00401.20 Mainline Inspection Equipment:**

**(a) Camera and Lighting** - Use a digital color video camera equipped with high-intensity lighting that is appropriate for the sewer pipe size and material type and that is capable of operating in 100% humidity conditions with ability to pan and tilt in all directions (360°).

The lighting and camera shall provide a clear, in-focus color picture of the sewer for a length of three pipe diameters. The camera lighting shall be free from shadows or hot spots. The camera lighting shall be fixed in intensity prior to commencing the inspection and adjusted during the inspection as needed to optimize the image quality displayed on the video monitor.

**(b) Footage Meter** - The recorded video shall have an information banner that displays a footage meter displaying footage in tenths of feet and indicating the camera's position from its starting point. The banner area shall not obstruct the forward camera view. The footage information on the recorded video shall correspond to the footage references in the written video inspection log.

**(c) Reference Device** - For concrete pipe, the video camera shall have a 1 inch steel reference ball suspended with a chain, or other approved reference device, mounted approximately one foot in front of the camera lens. The device shall maintain continuous contact with the pipe invert to serve as a depth reference as the camera travels in the pipe. The reference device shall be clearly visible at all times yet be positioned so as not to obstruct more than 10% of the forward camera view. The reference device is to be stopped at every joint to allow for comparison of the device to the joint width.

**00401.21 Lateral Inspection Equipment:**

(a) **Push Camera** - A portable camera system that can be manually extended into lateral sewers for inspection purposes. The push camera shall have imaging capabilities similar to the camera used to inspect sewer mains.

(b) **Lateral Launch Camera** - A secondary camera component of a mainline sewer video inspection system that can be launched into a lateral connection while inspecting main line sewers. The lateral launch camera must be capable of inspecting the length of the lateral from the mainline connection to beyond the edge of the right-of-way. The lateral launch camera shall have imaging capabilities similar to the mainline camera.

(c) **Electronic Location Device** - A radio transmitter designed to travel inside a non-metallic pipe that can be detected from the surface and determine the horizontal and vertical position of the sewers below ground.

**Labor**

**00401.30 Video Personnel Qualifications** - Perform video inspection work with experienced personnel trained or certified in using remotely operated video equipment to recognize, locate and accurately document sewer breaks, obstacles, bellies, defects, and service connections.

**Construction**

**00401.40 General Video Inspection:**

(a) **Notice and Access** - Provide notice a minimum of 48 hours before beginning cleaning or video inspection. Do not proceed with cleaning or video work without prior approval of the Traffic Control Plan according to Section 00225 and Sewer Diversion Plan according to Section 00490 and as directed. Allow access to the video truck at all times to observe the video monitor and all other operations.

(b) **Cleaning** - Install a screen to catch debris at the downstream end of the pipe run. Clean the sewer pipe of obstructions that will impede video inspection. Avoid causing damage to pipe while completing the cleaning operation. Remove and properly dispose of solid debris resulting from the cleaning operation. Do not move the debris from manhole section to manhole section.

(c) **Inspection** - After cleaning, pre-charge the sewer with clean water to assist in locating bellies and deformations of the pipe. Control the flow into the segment to be inspected. Perform continuous video inspection as soon as possible after cleaning the pipe. Video inspect sewers one segment at a time. Do not move the camera at a speed greater than 30 feet per minute. Move the camera through the line in either direction stopping, panning or tilting as necessary to permit proper documentation of the sewer's condition including the location of all lateral connections, additional connections to the mainline and other characteristics.

Use tractors, manual winches, power winches, video cable, powered rewinds, or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions and that allow the camera to be maintained at the approximate center of the pipe at all times. If, during the inspection operation, the camera will not pass through the entire pipe run, set up equipment so that the inspection can be performed from the opposite manhole. If, on second try, the camera fails to pass through the entire manhole section, ask for direction.

**(d) Narrative and Extent of Inspection** - Provide a running narrative description on each video inspection recording. Include the following minimum information in the narrative: the beginning and the end of the video, the site location, manhole identifications, the total footage of the sewer inspected, the company name, the operator's name and the date and time.

Make note of all joints, lateral connections, and other noteworthy features within the sewer.

**(e) Footage Metering** - Before beginning video inspection, restore the footage meter to zero beginning from the middle of the manhole or provide a means to convert the meter reading to accurate aboveground distances. Provide accurate on-screen distance measurements in the video recording.

**(f) Recording Format, Storage Box and Labeling** - Record using high-quality video media such as DVD, CD-ROM or other approved media. Submit recordings playable on consumer DVD players and Microsoft Windows-based personal computers at resolutions of 352x240 or higher. Submit DVD recordings in standard MPEG-1 or MPEG-2 format. Submit CD-ROM recordings in standard VCD or SVCD format. Recordings shall be submitted in a plastic protective box, labeled to indicate the project number and name, date of inspection, sewer segment number, Contractor's name and whether it is a pre-construction or post-construction video. Label both copies of the video media and the boxes.

**(g) Continuity, Image and Audio** - Record video continuously, without editing or starts and stops, in color from the beginning to the end of each sewer segment. The sewer image shall be free of visual distortions and appear level and centered in the sewer being inspected. The audio portion of the composite video recording shall be sufficiently free from electrical interference and background noise to provide complete clarity of the narrative description.

**(h) Video Inspection Logs** - Provide one copy of all pre- and post-inspection video inspection logs and video recordings promptly after completing the inspection. Provide print location records that clearly show the location in relation to an adjacent manhole for each feature observed during inspection. Include other points of significance such as locations of building sewers, unusual conditions, roots, location and depth of pipe sags, all connections, pipe material and size, and broken pipe.

(i) **Disposition of Report** - Deliver the video inspection recordings of each sewer segment immediately after such work is completed. All accepted video recordings, operator logs, and any related information become the property of the City.

**00401.41 Pre-Construction Video Inspection:**

(a) **Mainline Inspection** - Clean and complete video inspection of all existing mainline sewers and positively locate each service connection to the mainline sewer.

(b) **Lateral Inspection and Field Location** - Locate and video inspect each lateral from its mainline connection to the edge of the right-of-way or to a distance as specified or directed. Use an electronic location device such as the Aqua-Tronics Snooper to verify the path of the lateral. Use marker paint to record the alignment of the lateral on the ground. Indicate where the lateral connects to a building connection.

For open-trench work, inspect laterals using a hand-held push camera. Have a hand-held push camera and a locator device on site for the project duration, whether or not it is used to complete the service lateral inspection.

For trenchless work in mains with a diameter of 18 inches and less, use a side launch lateral camera or another approved method. The Engineer must be present to view inspection as it is performed. For mains larger than 18 inches, use an approved method.

Record all information about its condition, service status (e.g. live or abandoned), length, distances to surface features, fittings and any obstructions.

**Finishing and Clean-up**

**00401.70 Post-Construction Video Inspection:**

(a) **Inspection of Completed Work** - Video inspect all completed work according to 00401.40. Provide the original copy of the post-construction video recording.

(b) **Corrections to Deficiencies in Work** - Each delivered video recording will be reviewed and any deficiencies noted. A written notice will be issued to correct any identified deficiencies. Correct any identified deficiencies within 48 hours after receiving notification. Re-perform the video inspection of the sewer and submit the new video recordings for review and acceptance at no additional cost to the City.

**Measurement**

**00401.80 Measurement** - The quantities of all video inspection will be measured on the unit basis as follows:

(a) **Video Inspection of Mainline Sewers** - Measure a mainline sewer from center of manhole to center of manhole.

**(b) Video inspection of Lateral Sewers** - Measurement of "live" lateral sewers connected to the mainline will be measured on the unit (Each) basis. Multiple private lateral sewers connected at the mainline by means of a single existing connection will each be counted if the existing alignment is fully documented.

**Payment**

**00401.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<b>Pay Item</b>	<b>Unit of Measurement</b>
(a) Video Inspection of Sewers, Mainline .....	Foot
(b) Video Inspection of Sewers, Lateral Launch Camera .....	Each
(c) Video Inspection of Sewers, Push Camera .....	Each
(d) Video Inspection of Sewers, Special .....	Foot or Each



Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for providing a hand-held push camera and locator device on site at all times.

No separate or additional payment will be made for:

- excavation
- restoration work

**Section 00405 - Trench Excavation, Bedding and Backfill**

**Description**

**00405.00 Scope** - This work consists of excavating trenches, constructing trench foundations, and placing bedding, pipe zone material and backfill.

**00405.01 General** - Excavate, backfill and dispose of excess excavated materials in connection with minor structures and conduits such as subsurface drain, culvert, siphon, irrigation and storm and sanitary sewer pipe, and potable water pipe.

Trench excavation does not include earthwork covered under any other section, or any earthwork that may be specifically included and provided for as Incidental work in the Specifications for other pay items of the Contract. Dispose of excess excavated materials and perform other matters not covered in this Section according to Section 00330.

**00405.02 Definitions:**

**Boulder Excavation** - The removal of pieces of boulders larger than 1 cubic yard in volume that requires drilling and blasting or other approved splitting and breaking methods, or necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench.

**Common Excavation** - The removal of all material not classified as boulder, concrete or rock excavation.

**Concrete Excavation** - The removal of pieces of concrete larger than 1 cubic yard in volume that requires drilling and blasting or other approved splitting and breaking methods, or a necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench. Concrete Excavation includes materials composed of Portland cement that are not identified in another Bid item other than manholes, structures, sewer pipe, or other appurtenances all of which are classified as Common Excavation.

**Discharge Concentration** - The tested non-water concentration of sampled wastewater before discharge.

**Exploratory Excavation** - The removal and replacement of material from locations shown on the Plans, or as directed, for the purpose of investigating underground conditions and identifying potential utility conflict between existing and proposed facilities.

**Flexible Pipe** - For the purpose of these Specifications, potable water pipes and pipes constructed of PVC, fiber reinforced plastic, ductile iron, steel, concrete cylinder, and high density polyethylene are considered flexible pipes.

**Gravel** - Rounded fragments of rock.

**Pipe Bedding** - Furnishing, placing and compacting specified materials on the trench foundation so as to uniformly support the barrel of the pipe.

**Pipe Zone** - The area from the bottom of the bedding to a point 12 inches, minimum, above the top outside of the pipe barrel for the full width of the trench.

**Pothole Excavation** - Pothole excavation is the removal and replacement of all materials via coring, vacuum extraction, or similar method, not classified as Exploratory Excavation, for the purposes of locating an underground utility and to investigate underground conditions.

**Prior day Total Pumped Discharge** - The total wastewater flow discharged at each sample location during the preceding workday.

**Rigid Pipe** - For the purpose of these Specifications, pipes constructed of concrete or clay are considered rigid pipes.

**Rock Excavation** - Rock Excavation indicates a method of removal and not a geologic formation. Rock Excavation is the removal of all materials which, by demonstration, cannot be excavated with equipment weighing at least 50,000 pounds and having at least 140 net horsepower equipped with a ripper or similar approved equipment without prior systematic drilling and blasting or breaking with power-operated rock excavation tools. The Engineer may waive the demonstration if the material encountered is well defined rock.

**Sewers, Pipes and Mains** - Conduits of circular or other geometric shapes, used to convey liquids or gases, or other material.

**Standard Proctor** - A laboratory test used to determine the optimum water for a given compaction energy for a given soil.

**Surface Removal** - The removal of surface material such as topsoil, sod, pavement, sidewalks, or gravel which requires different equipment or methods than those used for trench excavation.

**Trench Backfill** - Furnishing, placing, and compacting material in the trench, between the top of the pipe zone material and the bottom of the pavement base rock, ground surface or surface material.

**Trench Excavation** - The removal of all material encountered in the trench to the depths as shown or as directed. Trench excavation is classified as common, boulder, concrete, or rock excavation.

**Trench Foundation** - The bottom of the trench on which the pipe bedding is to lie and which provides support for the pipe.

**Trench Foundation Stabilization** - Trench foundation stabilization is removal of unsuitable material in the bottom of a trench or other excavation and replacement with specified material for support of a pipe, main, conduit, structure, or appurtenances.

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**Wastewater Discharge** – Delivery of water, wastewater or uncontaminated waterborne waste comprised of rainwater, process wastewater, non-storm or ground water originating from construction site activities.

**00405.03 Lines, Grades, and Cross Sections** - Excavate trenches to the lines, depths, grades and cross sections shown on the plans or as established. Variations will be permitted only when necessary to ensure firm foundations and when such variations will not be detrimental to the work.

**00405.04 Compaction and Density Measurement** - In-place density of soil and aggregate will be determined in accordance with ASTM D 2922 and D 3017, or ASTM D6938, or AASHTO T 310 (Density and Moisture content of Soil and Soil-Aggregates by Nuclear Methods).

Maximum laboratory density and optimum moisture content will be determined in accordance with ASTM D 698, or AASHTO T 99 (Standard Proctor); or in accordance with ASTM D 1557, or AASHTO T 180 (Modified Proctor), as specified, using Method A or D. Coarse particle correction shall be made in accordance with, and to the limits defined in AASHTO T 224 (Correction for Coarse Particles in the Soil Compaction Test).

### Materials

**00405.10 General** - Trench backfill shall be classified as either native backfill material or imported granular backfill material. Native backfill shall not be used for trenches within the public right-of-way unless pre-approved prior to permitting or beginning of excavation.

**00405.11 Trench Foundation Stabilization** - Use trench foundation stabilization material consisting of 6" - 3/4" aggregate, or as directed. The material shall be free from clay or organic material and shall be well graded from coarse to fine.

**00405.12 Bedding** - Furnish one of the following bedding materials as prescribed below for the particular type of facility to be constructed:

**(a) Sewer Pipe:**

- Commercially available 1" - 0 or 3/4" - 0 crushed aggregate.
- A continuous cradle of concrete conforming to Section 00440.

**(b) Water Pipe** – Bedding material and pipe zone material shall be the same unless otherwise directed.

- 1" - 0 or 3/4" - 0 aggregate conforming to 02630.10
- Medium sand conforming to 00405.14(c).
- Fine sand conforming to 00405.14(c).

**00405.13 Pipe Zone Material** - For flexible pipes, backfill the pipe zone with bedding material as described in 00405.12.



For rigid pipes, unless otherwise directed, use either:

- 1" - 0 or 3/4" - 0 base aggregate conforming to 02630.10 or
- Commercially available 1" - 0 or 3/4" - 0 aggregate
- Medium sand in accordance with 00405.14(c).
- Fine sand in accordance with 00405.14(c).

**00405.14 Trench Backfill** - Use the following materials where shown or required:

- Outside of the public right-of-way, use approved selected native backfill material (Class A) or imported granular backfill material (Class B, C, or D).
- Within the public right-of-way, use imported granular backfill material (Class B, C, or D).
- Within paved areas in a public right-of-way with a trench width of 12 inches or less use Controlled Low-Strength Material (CLSM) for backfill material (Class E).

Place and compact backfill as shown.

**(a) Class A Backfill** - Use approved native material excavated from within limits of the project, free from vegetation and other deleterious material, and containing no frozen ground. Maximum particle size shall be 3 inches. If the Engineer determines native material is not suitable, use another class of backfill as directed.

**(b) Class B Backfill** - Use granular material consisting of aggregate meeting the requirements of Section 00640.

**(c) Class C Backfill** - When specified, use sand consisting of granular material, naturally produced or produced from crushed gravel, or dredge sand that is reasonably free of organic material, mica, clay, fly ash and other deleterious substances.

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The grading of sand shall be as follows:

Sieve Size	Percentage Passing by Weight		
	Coarse Sand	Medium Sand	Fine Sand
1"	100	100	100
3/8"	95-100	95-100	---
#4	80-100	70-95	90-100
#30	10-30	10-45	---
#100	---	2-10	2-10
#200	0-8	0-7	0-4
Sand Equivalent	50 min.	50 min.	50 min.

When using sand as imported granular trench backfill material, material shall be able to stand on a minimum 60 degrees angle from horizontal following compaction to specified density unless otherwise approved. Specified density will be a minimum of 95% of Standard Proctor maximum density.

**(d) Class D Backfill** - Use pit run or bar run material, well graded from coarse to fine. The maximum dimension shall be 3 inches. Material shall be free from organic material. Classification will be determined according to requirements of ASTM D 2487.

**(e) Class E Backfill** - Use Controlled Low-Strength Material conforming to Section 00442.

Do not use CLSM as a replacement course for paved sections, unless a pavement section design is submitted and approved.

When excavation exposes existing metal pipes, provide adequate protection to separate the pipe from direct contact with the CLSM. Re-establish the original pipe zone bedding and backfill around the pipe, or, at the direction of the Engineer, provide pipe protection, such as pipe coating, tape wrap or casing, according to the Engineer's requirements.

**(f) Class F Backfill** - Use impervious backfill material of the following soil types as defined by ASTM D 2487 or as approved.

SC: Clayey sands, sand-silt mixtures

GC: Clayey gravels, gravel-sand-clay mixtures

CL: Inorganic clays of low to medium plasticity, gravelly/sand/silt/lean clays

**00405.15 Quality Control** - Provide quality control according to Section 00165.

**00405.16 Temporary Plating** - Temporary plating shall conform to Section 00275.

### Labor

**00405.30 Quality Control Personnel** - Provide certified technicians in the following fields when required by Section 00165:

- CEBT
- CAgT
- CDT

### Construction

**00405.40 General** - Excavate, remove and dispose of all formations and materials, natural or man-made, irrespective of nature or conditions, encountered within limits defined or as specified in the Contract Documents, necessary for construction of the project. Perform all excavation and backfilling according to the following requirements:

**(a) Limitation on Commencement** - Do not commence excavation until the undisturbed or existing ground has been measured and the measurements have been approved by the Engineer.

**(b) Natural Stream Protection** - Hold to a minimum excavation in, or adjacent to, natural streambeds. Comply with 00290.30(a). Restore the streambed according to 00405.46(f).

**(c) Partial Embankment Construction for Exposed Pipe** - Construct partial embankment according to 00330.42(c)(6) and the plans, before excavating trenches. Place compacted fill to a minimum depth of 3 feet above top of pipe before other trenches are excavated for installation.

**(d) Temporary Handling of Water or Other Conditions** - Provide temporary measures according to 00405.43.

**00405.41 Trench Excavation** - Excavate trenches according to the following:

**(a) Within Paved Areas to Be Preserved** - Excavate trenches for pipe installation by the open excavation method, unless otherwise directed. Do not disturb the adjoining pavement more than necessary.

**(1) Preservation of Existing Improvements** - Conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other improvements, which are to remain in place will not be damaged. Furnish and install cribbing and shoring or whatever means necessary to support material around existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed, at no expense to City.

Use hand excavation methods when normal methods cannot be utilized without endangering existing or new structures or other facilities. When the precise location of subsurface structures is unknown, locate such structures by hand excavation prior to utilizing mechanical excavation equipment.

Protect temporary facilities, until they are no longer required, and when temporary supports and other protective means are no longer required, remove and dispose of as directed.

**(2) Limits of Excavation** - Excavate to the depths and widths designated as shown, allowing for forms, shoring, working space, gravel or sand base, and finish topsoil where required. Do not excavate deeper than elevation shown without approval.

**(b) Open Trench Limit** - The length of trench excavated in advance of a pipe laying operation shall be kept to a minimum, and in no case shall it exceed 100 feet unless otherwise authorized. Related resurfacing shall be completed within 800 feet of the associated open trench limit for each main pipe laying operation. The Engineer will have sole discretion to consider two or more main pipe laying operations as one if they are adjacent or cause a disturbance to the same neighborhood. If the unfinished trench or restoration exceeds 800 feet in length, the main pipe construction operation shall be suspended and not resumed until authorized.

**(1) Unfinished trench** - A section of trench will be considered unfinished for the purpose of establishing work limits, until all the following have been completed:

- Surface removal
- Excavation
- Main line and service lateral construction
- Backfilling
- Backfill compaction
- Gravel road restoration
- Pavement base construction
- Portland cement concrete paving
- Asphaltic concrete paving
- Sidewalk and driveway construction
- Landscaping
- Property restoration
- Cleanup operations
- Pipe acceptance testing

**(2) Cleanup** - Cleanup of the construction area shall include all work necessary to allow use of the construction area for normal use. Perform temporary resurfacing per Section 00495.

**(c) Trench Width** - Keep the trench width at the ground surface to the minimum necessary to install the pipe in a safe manner. In all cases, make trenches of sufficient width to allow for shoring and to permit proper jointing of the pipe and backfilling of material along the sides of the pipe. Refer to the following table for minimum trench widths for various diameter pipes.

<b>Minimum Trench Width</b>	
<b>Size of Sewer Pipe</b>	<b>Width of Sewer Trench</b>
6 to 10 inches	30 inches
12 to 21 inches	OD plus 18 inches
24 to 36 inches	OD plus 22 inches
42 to 54 inches	OD plus 42 inches
60 inches and larger	OD plus 46 inches
<b>Minimum Trench Width</b>	
<b>Size of Water Pipe</b>	<b>Width of Water Pipe Trench</b>
6 to 16 inches	OD plus 18 inches
24 inches or larger	OD plus 24 inches

Make excavations for manholes and other structures wide enough to provide a minimum of 12 inches between the structure surface and the sides of the excavation. Do not exceed the right-of-way easement, or permit limits without prior approval.

Do not exceed any maximum trench width. If there is a maximum width shown and said width is exceeded without authorization, provide pipe of a higher strength designation, a higher class of bedding, or both, as directed at no additional cost to the City. Excavate all trenches with vertical walls unless otherwise specified.

**(d) Trench Grade** - Excavate trenches to the lines and grades shown or as established, with proper allowance for pipe thickness, pipe bedding and trench foundation stabilization. Place pipe bedding on a firm, undisturbed, foundation, true to grade. If the trench is excavated below grade without authorization, restore to grade with material of the type specified for pipe bedding or trench foundation stabilization as directed at no cost to the City. Place the material over the full width of the trench, in compacted layers not exceeding 6 inches.

**(e) Disposal of Excavated Material** - Materials removed under this Section that are not used on the Project become the property of the Contractor at the point of origin. Dispose of materials according to 00310.43 unless special site(s) are specified in the Special Provisions.

Make arrangements for and dispose of all excess material not required elsewhere on the Project in an approved manner, at no cost to the City, and according to 00310.43(d).

**(1) Reprocessing or Recycling Requested** - Subject to approval, the Contractor is requested, but not required, to reprocess materials that are created by excavation or demolition and would otherwise be unsuitable for reuse on the site. Contractor is also requested, but not required, to recycle materials that are created by excavation or demolition and are suitable for reuse on the site. Recycling may be possible at the sites listed in the Special Provisions. It is the responsibility of the Contractor to verify the information in the Special Provisions. This information may change without notification to the City.

**(2) Disposal on Pre-designated Sites** - City will secure all necessary disposal permits for required work performed unless otherwise specified.

**(3) Sites Provided by Contractor** - Dispose of all excess material not required for pre-designated sites. Within the City limits, do not deposit excess excavated material on an unimproved dedicated street area without approval and a valid street use permit from the City of Portland. Do not deposit excess excavated material on any private property without approval and a valid fill permit.

**(4) Temporary Placement of Usable Excavated Materials** - Place excavated material that is suitable for use in embankment or backfill, and not excess material, only within construction easements, rights-of-way, or other approved working area. Place in a manner that will not cause an inconvenience to the public. Provide unobstructed access to all fire hydrants, water valves, and meters, and leave clearance to enable free flow of stormwater in all gutters, conduits, and natural watercourses. Submit a copy of the written approval from each property owner prior to stockpiling material on private property.

**(f) Trench Protection** - Install and maintain shielding, shoring, sheeting, bracing, and trench support systems, hereinafter called "shoring", to prevent caving and to protect adjacent structures, property, utilities, workers, and the public. Remove shoring during backfilling in a manner that will not damage adjacent structures, property, utilities, or the pipe, permit voids in the backfill, or disturb the compacted pipe bedding material between the pipe and the undisturbed trench wall. Maintain design information for shoring onsite at all times. Make this information available for the Engineer's review upon request. A utility protection plan is required as outlined in 00406.41(a)(17).

**(1) Engineered Systems** - Engineered Shoring is required for temporary earth support systems for trenches or excavations greater than 20 feet deep including bore pits, jacking pits, receiving pits, and shafts. Engineered Shoring is also required for areas subject to vibration, groundwater, utility crossings, or where required on the Drawings. Submit the following for each area where Engineered Shoring is required:

- Detailed construction sequence descriptions. The sequence shall detail installation, excavation, maintenance, backfill, and removal requirements.

- Design calculations. Calculations shall be prepared and sealed by a State of Oregon licensed Professional Engineer and include design criteria, analysis assumptions, construction sequence requirements, and detailed design for each system and structural element of the proposed shoring system.
- Drawings shall be prepared and sealed by a State of Oregon licensed Professional Engineer. Drawings shall present an explicit representation of the character, extent, and details of the proposed shoring in relation to the project site.

Working Drawings shall show the following:

- Details, arrangement and method of assembly, method of disassembly of the proposed system and sequence of construction.
- Method of pre-loading the bracing and pre-load values.
- Full excavation depth.
- Loads on the support system for various stages of excavation, bracing, and / or tieback installation and removal and concrete placement.
- Expected equipment loads.
- Maximum design load to be carried by the various members of the support system.
- The depth below the main excavation to which the support system is to be installed.
- Existing utilities and facilities: After checking locations by field investigation, revise drawings to show actual locations of facilities and excavation supports, interference with proposed work, and measures proposed to overcome such interference.
- Allowable shoring deflections and proposed method of monitoring shoring movements.
- Equipment used for installation.

**(2) Other Systems** - Shoring systems using tabulated data may be substituted for those approved in the initial submittal (not including Engineered Shoring). Tabulated data for the substituted systems shall be provided to the Contractor's competent person and the Engineer before installation. If shoring system is changed, re-submit tabulated data for the proposed new system. The shoring system submittal shall address, at a minimum, the following items:

- Pipe installation
- Manhole installation
- Structure installation
- Support and protection of existing utilities
- Lateral connections

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- Miters
- Other non-linear areas

**(g) Existing Abandoned Facilities** - Remove and dispose of existing abandoned pipe, structures and other facilities as necessary to construct the trench according to 00310.41(c).

**00405.42 Rock Excavation** - Where rock excavation is required, remove the rock to provide the minimum clearances shown. Excavate and remove the overburden and expose the rock to allow the Engineer to measure the rock prior to removal.

**00405.43 Dewatering** - Promptly remove and dispose of all excess water entering the trench from the time the trench is being prepared for the pipe laying until the backfill at the pipe zone has been completed. Dispose of the water in an approved manner without damage to adjacent property.

Control groundwater to prevent softening of the bottom of excavations or formation of "quick" conditions or "boils". Design and operate dewatering systems to prevent removal of the natural soils and so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

When dewatering near a river, lake, or stream, conform to the requirements of 00290.30(a) and Section 00280. When the presence of water or other conditions in the excavated area would be detrimental to the purpose of the work, obtain approval of the Engineer for the temporary measures required to correct or care for the condition.

If water or other conditions encountered require permanent correction or care not anticipated by the Contract and not due to the Contractor's neglect or method of operation, perform the work according to 00140.60.

At all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages. Have available at all times competent workmen for operation of the pumping equipment. Control surface runoff to prevent entry or collection of water in excavations. Keep all excavations free of water when concrete is being deposited or during placement of backfill.

Before dewatering is started, submit to the Engineer a Discharge Plan in accordance with 00405.49. Open and cased sumps shall not be used as primary dewatering for excavations deeper than 3 feet below static water table unless authorized.

Release ground water to its static level in such a manner as to maintain the undisturbed state of natural foundation soils. Prevent disturbance of compacted backfill and flotation or movement of structures, water mains, sewers, and other utilities.



**00405.44 Trench Foundation Stabilization** - Make the full length and width of completed trench bottoms firm. Do not place bedding material before the trench foundation is inspected and approved. If bell and spigot pipe is used, recess the trench bottom to accommodate the bell.

When, in the judgment of the Engineer, the existing material in the bottom of the trench is unsuitable for supporting the pipe, excavate below grade, as directed. Replace the excavated material with imported trench foundation stabilization material conforming to 00405.11. Place the backfill material in 6 inch layers and compact according to 00330.43. Place the backfill material to the elevation established.

**00405.45 Pipe Bedding** - Spread the bedding smoothly to the proper grade so that the pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the joint. Bedding under the pipe shall provide a firm, unyielding support along the entire pipe length.

**(a) Bedding for Rigid Sewer Pipe** - Construct bedding in conformance with drawings to approximate limits for various classes of bedding as shown. The Engineer may change bedding classifications and limits thereof as necessary during construction.

Place bedding full width of the excavated trench from the bottom of trench or top of foundation stabilization material to the top of bedding.

**(1) Class A Bedding** - Class A bedding consists of a pipe cradle of Portland cement concrete as shown. When a flexible joint cannot be located within 18 inches of the outside wall of a structure, install reinforcing steel into the concrete bedding. Provide #5 rebar at 6 inches O.C. longitudinally up to the pipe springline. Bottom of trench shall be fully compacted before placement of pipe or cradle. Place concrete in such a manner that no dirt, water, or foreign material becomes mixed with the concrete. Allow concrete sufficient time to reach initial set before any additional backfill material is placed in the trench.

**(2) Class B Bedding** - Class B bedding consists of leveling the bottom of trench or top of foundation material and placing bedding material to the horizontal centerline (springline) of the pipe. Use bedding material as specified herein and as shown. Place first lift to provide minimum depth of bedding material. Spread smoothly to proper grade and compact bedding to minimum 90% of Standard Proctor maximum density or as directed so that the pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Place subsequent lifts of not more than 6 inches thickness up to the horizontal centerline of the pipe. Bring lifts up together on both sides of pipe and carefully work under pipe haunches using appropriate methods to ensure the bedding material is compacted as specified.

**(3) Class C Bedding** - Class C bedding shall conform to requirements for Class B bedding except that bedding material shall be placed only to approximately the lower quadrant of pipe as shown.

**(b) Bedding for Flexible Sewer Pipe (Class D Bedding)** - Unless otherwise specified, bed flexible sewer pipe in 3/4" - 0 aggregate placed a minimum of 4 inches under the pipe, between the sides of the pipe and the undisturbed trench walls, and to the top of the pipe zone which is 12 inches above the top of the pipe.

Spread the first lift of material so that the pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Install subsequent lifts of not more than 6 inch thickness to the top of the pipe zone. Compact to 95% of Standard Proctor maximum density.

Bring lifts up together on both sides of pipe and carefully work under pipe haunches by using appropriate methods to ensure bedding material is compacted as specified.

**(c) Bedding for Water Pipe** - Place uniform bedding to a minimum thickness of 6 inches below the outside bottom of the pipe or conduit and compact as directed.

**00405.46 Backfilling** - Backfill with material conforming to the details shown, or as directed.

**(a) General** - Begin backfilling when:

- The foundation has been prepared, if required
- The bedding has been prepared
- The drainage facilities and fittings are installed
- The installation has been inspected and approved

Thoroughly tamp and compact all trench backfill with machine or pneumatic operated tampers of a size and type that will obtain the required density.

Backfill either to the top of the trench, the surrounding ground level, or the upper limit of excavation, as directed. Dispose of excess excavated material not used in backfill work according to 00330.41(a)(4) and (a)(5).

**(b) Pipe Zone** - Place 1" - 0, 3/4" - 0, or sand if approved, in the pipe zone in layers not greater than 6 inches thick and in a manner that equalizes pressure on the structure and minimizes stress. Place specified pipe zone backfill carefully around the pipe. Do not allow sharp, heavy pieces of material to drop directly onto or contact the pipe. Prevent pipe from movement both horizontally and vertically.

As required under the haunches of pipe and in areas not accessible to mechanical tampers or to testing, compact with hand methods to ensure intimate contact between the backfill material and the pipe or structure. Provide thorough compaction.

Ponding or jetting will not be permitted within the pipe zone.

**(1) Sewer Pipes** - Compact pipe zone backfill to a minimum of 95% of Standard Proctor maximum density or as specified.

**(2) Water Pipes** - Backfill and compact to a total depth of 12 inches above the pipe.

**(c) Trench Backfill** - Condition backfill material to within 2% of optimum moisture content required for compaction, as determined by ASTM D 698 throughout each lift of the fill.

**(1) General** - Use Class B trench backfill unless otherwise specified or approved.

The Engineer may sample excavated material to determine the suitability of the Class A material for use as backfill. If the material is approved, the Contractor may elect to use the material in place of the specified backfill. Prevent excavated material from becoming saturated beyond the critical moisture limits, and replace any saturated Class A material with Class B, C or D material, as specified, at no additional cost to the City.

**(2) Class A, B, C, or D Backfill** - Backfill trench above the pipe zone to the specified grade, or as shown on the Plans, in lifts of 8 inch loose depth to 3 feet loose depth depending on compaction equipment and material, unless water settling combined with mechanical compaction is allowed as provided herein. Compact all trench backfill to a minimum of 95% of Standard Proctor maximum density in paved areas and in street rights-of-ways or 90% in other areas, or as specified, with mechanical vibrating or impact tampers. Then place and compact aggregate base material or topsoil as specified.

When the backfilling is complete, finish the surface area as specified. In paved or graveled areas, maintain the surface of the trench backfill level with the existing grade with 3/4" - 0 or 1" - 0 aggregate material, or asphalt concrete if directed, until final pavement replacement is complete and accepted.

- Maintain all temporary trench surfaces in a safe condition, to the satisfaction of the City. Maintain backfilled trench surfaces between any two successive manholes until the following operations have been completed and approved.
- Service connections installed, backfilled, and compacted, including water settling when required.
- Valves, valve boxes, and hydrants installed.
- Construction of manholes and appurtenances.
- Hydrostatic or air testing.
- Flushing and disinfection.
- Cleanup and restoration of all physical features.

- Utilities restored to their original condition or better.
- All work between the two manholes has been completed.

**(3) Class E Backfill** - Backfill the trench above the pipe zone with CLSM. If the CLSM is to be used as a temporary surfacing, backfill the CLSM to the top of the trench and strike it off to provide a smooth surface. If the CLSM is not to be used as a temporary surfacing, backfill the CLSM up to the bottom of the proposed resurfacing. No compaction of CLSM is allowed. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed, if it has hardened sufficiently to prevent rutting.

**(4) Density Testing** - Test for density according to 00405.04. Excavate test pits in the backfill as directed to demonstrate that the specified compaction has been obtained for the entire depth of the backfill. At the option of the Engineer, density tests may be taken in a lift of compacted backfill immediately before placing the next lift. In general, 1 successful test for the entire backfill depth and 3 successful tests at lesser depths per 400 linear feet of pipe installed will be required. Additional successful tests at lateral crossings at various depths may also be required.

**a. Un-testable Backfill** - All materials and areas which are not susceptible to testing for density, as determined by the Engineer, shall be compacted in place by whatever equipment and method is practicable or specified, and as approved. Compaction shall be performed at such moisture content as is required to produce well filled, dense and firm material in place showing no appreciable deflection or reaction under the compacting equipment used.

**b. Inadequate Density** - If required compaction density has not been obtained, remove the backfill from trench, replace with approved backfill, and recompact to the specified density. Then, should routine field densities taken during the course of construction show the specified compaction is not being obtained because of changes in soil types or for any other reason, modify the backfill compaction procedure. In no case will excavation and pipe-laying operations be allowed to proceed until the specified compaction is attained. The Engineer will have the right to require changes in methods to accommodate changes in soil conditions.

**c. Subsequent Settlement** - Any subsequent settlement of trench and adjacent pavement areas during the maintenance warranty period shall be considered to be the result of improper compaction and shall be promptly corrected.

**(d) Ponding or Jetting of Backfill Materials** - Ponding or jetting will not be permitted within roadbed limits. Ponding or jetting will be permitted outside roadbeds when approved by the Engineer in writing.

Use Class C or D trench backfill material at the Contractor's expense. Provide drainage at the bottom of the trench to remove water from the jetting operation. Compact to the density and deflection requirements of 00405.46(c)(2).

Furnish equipment that provides a minimum gauge pressure of 35 psi at the discharge nozzle. Use a rigid pipe that will reach within 1 foot of the bottom of the backfill. Insert the pipe at intervals not exceeding 4 feet throughout the entire width and length of the trench backfill.

Push backfill material onto the slope of backfill previously placed and allow to slide down into the trench. Do not push backfill into the trench in such a way as to permit free fall of material until at least 2 feet of cover is provided over the top of pipe. Under no circumstances allow sharp, heavy pieces of material to drop directly onto the pipe or tamped material around the pipe. Do not use backfill material of consolidated masses larger than 1/2 cubic foot. The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of pipeline to be designated. Said test section shall not exceed 200 feet in length.

Determine procedures and provide the quantity of water required in every case to effect complete water settlement of backfilled materials. Do not, under any circumstances, insert the jetting pipe closer than 2 feet above top of pipeline.

**(e) Temporary Trench Plating** - Install temporary plating according to Section 00275.

**(f) Restoration of Streambeds** - Comply with 00290.30(a) and Section 00280. Upon completion of the work:

- Restore the streambed to its former condition of resistance to scour.
- Remove all matter that has come into the stream due to the Contractor's activities.
- Backfill under-crossing of water-courses with approved Class F impervious material in the top 2 feet of stream bed and 2 feet into stream banks.
- Compact to a minimum of 95% of maximum density as determined by ASTM D 698-78 (delete paragraph 5.1).

**00405.48 Surface Removal:**

**(a) General** - For trench resurfacing see Section 00495.

**(b) Topsoil** - Where trenches cross lawns, garden areas, pastures, cultivated fields or other areas on which topsoil exists, remove the topsoil to a minimum 12 inch depth and place the material in a stockpile. Do not mix the topsoil with other excavated material. After the trench has been backfilled, replace the topsoil.

In lieu of stockpiling the topsoil, approved imported topsoil may be substituted, to a depth specified or approved, at no cost to the City.

Maintain the finished grade of the topsoil level with the area adjacent to the trench until final acceptance by the Engineer, and repair damage to adjacent topsoil caused by the Contractor's operations. Remove all rock, gravel, clay and other foreign materials from the surface. Regrade and add topsoil as required.

**(c) Pavement, Curb, Driveways, and Sidewalk** - Use saws to cut portland cement concrete pavement, curbs, driveways and sidewalks, regardless of thickness. In bituminous pavement, when no pavement overlay will occur, sawcut the pavement along each edge of the area to be removed. In any case, a jackhammer shall not be used to remove asphaltic pavement if there is concrete pavement underneath.

Sawcut Portland cement concrete pavement to a minimum of 75% of total depth. Saw curbs and sidewalks to a minimum depth of 4 inches. Subsequent removal may be accomplished by using a jackhammer or other approved method. Full depth cut by pavement saw can be made at the option of the Contractor at no additional cost to the City. Use of any machine utilizing a falling or swinging weight will not be permitted.

Upon completion of backfill and just prior to pavement re-surfacing, saw the surfacing on both sides of the trench a minimum of 6 inches wider than each top of the trench. In areas of any undermined or damaged surfacing, re-saw to a width outside these areas. When sawcutting, follow lines parallel to the pipe centerline. All slurry developed during the sawcutting process is to be removed using a vacuum continuously during operation.

In removing pavements, curbs, driveways and similar structures, all cuts where an abutting structure or a part of a structure is to be left in place shall be clean, smooth, vertical cuts made with a concrete saw or other approved cutting device to lines as established.

**(d) Minimum Width** - Where the width changes in areas of asphalt pavement re-surfacing, cut the transition between the different widths at 45°. When the pipe line changes direction, or there is a connecting pipe line that requires the sawcut alignment to change at an angle greater than 60°, make a minimum 24 inch transition sawcut. If there is damaged or undermined surfacing at the transition point, make the transition sawcut beyond the damaged or undermined surfacing. Make the transition sawcut angle half the angle change in the direction of the pipeline or connecting line.

If the asphalt surfacing is to be overlaid, the second sawcut will only be required to firm subgrade.

A second sawcut for concrete sidewalks, driveways and pavements will not be required unless needed to reach firm subgrade.

Remove and dispose of pavement lying within the limits of the cuts and from any adjoining areas damaged by the cutting and removal operations according to Section 00310.

When trenching within improved streets, sidewalks, driveways or other improved areas to be restored or protected, the pavement, walk, or drive shall be removed 6 inches wider on each side than the remaining trench width, unless otherwise specified.

Remove all loose, undermined or damaged pavements. If the edge of the pavement replacement (not the trench) is less than 2 feet from the edge of another patch, curb, or construction joint, the pavement between the two shall be replaced. If there is more than one edge within the 2 foot zone, remove pavement to the far edge or as directed.

If at least one edge of the trench resurfacing falls within a marked bike lane, replace the top surface of pavement within the entire bike lane. Fully restore all striping and pavement markings to their original layout and material, or as directed. Sawcut, remove, and replace any concrete not scheduled for removal that has been damaged by construction activities.

**00405.49 Discharge of Construction-Generated Wastewater** - Manage discharge of construction-generated wastewater into a public sewer, public sump or body of surface water for a duration of 6 months or less. Plans to discharge wastewater for a duration exceeding 6 months will be required to undergo a more intensive application, review and operations process. Plans shall cover all work necessary to design, permit, provide, operate, maintain, monitor, restore and remove all machinery, appliances and equipment required to perform this work.

**(a) Discharge Permit** - Apply for and obtain a wastewater Discharge Permit(s) from BES before discharging any wastewater into a public sewer, public sump or body of surface water. Do not begin discharge until BES or the State of Oregon has reviewed the Discharge Permit application and has issued written authorization to proceed including any specific conditions that apply. Obtain from the Engineer a *Construction Dewatering Permit Application* form. All applications shall include a copy of the proposed discharge plan and, if applicable, a copy of the project environmental site assessment.

The approved Discharge Permit may restrict discharge of wastewater to a quantity containing less than a specified maximum daily load for a distinct set of parameters such as Total Dissolved Solids (TDS) or Total Suspended Solids (TSS). Any specified daily load limits will apply to the project as a whole and not to individual discharge location(s) unless otherwise specified. Limits specified by the Discharge Permit will be determined based on likely site pollutants or pollutants of concern for the receiving system. Design, operate, and maintain a containment and discharge system to control the flow rate, solids or other pollutants in accordance with limitations specified by the applicable Discharge Permit.

**(b) Discharge Plan (DP)** - Prepare and submit a DP for completing the Work.

- Describe the proposed discharge system including: wastewater source and character, collection method, equipment, and pipelines including capacity, installation details, power supply and standby equipment, monitoring facilities and procedure, storage facilities, and measuring systems proposed to safely deliver the wastewater to the approved discharge location(s).
- Clearly describe the equipment and method proposed to accurately log and record daily total flow rates and volumes and monitor pollutant loads or concentrations discharged to the receiving system.
- Provide above ground storage to temporarily hold all wastewater for sampling and pretreatment before discharge, unless otherwise directed.
- Pipe all wastewater discharge(s) to the identified discharge location(s). Follow the approved DP without variance unless non-compliance with the Discharge Permit requires DP modification. If sampling and testing should indicate contaminant concentrations exceed Discharge Permit limitations, immediately stop discharging wastewater and modify the DP to provide additional storage or pretreatment to meet these limitations. Submit all proposed modifications for review.
- Before initiating wastewater discharge at approved discharge locations(s), test the entire system under planned operating conditions. The Engineer will observe all startup tests and review the system for use. Correct all identified deficiencies and review with Engineer before initiating wastewater discharge.
- Discharge wastewater only at the approved discharge location(s) shown or as otherwise permitted. Each discharge location will have a specified maximum discharge rate in gallons per minute (gpm). The receiving public sewer(s), public sump(s) or water body(s) capacity will determine the maximum Permitted discharge rate(s). Do not exceed specified flow rates at any time during the performance of the Work.
- Refer to the Contract Documents for information regarding project-specific discharge location(s) and maximum discharge rate(s).

**(c) Discharge Plan Modifications** - Upon discovery or receipt of notice that any discharge exceeds Discharge Permit limitations, immediately stop all discharge, modify the process described in the DP and submit a DP modification proposal for review. If breakdown, accident, acts of God, or any other condition cause the release of any pollutant, excessive solids load or wastewater volume:



- Immediately take action to stop, contain, and correct the problem.
- Immediately notify the Engineer and contact the BES Duty Officer.
- Within 5 calendar days after such a non-compliance event, submit a detailed written report describing the breakdown, the actual quantity of resultant wastewater discharged, the corrective action taken, the steps taken to prevent recurrence, proposed DP modifications, if necessary, and any other pertinent information.

Implement all approved corrective measures and retest the discharge system before restarting any operations. The Engineer will observe all retesting and review the system for use. If necessary, modify discharge operations during unusually severe weather conditions or as directed.

**(d) Design and Construction** - Design and select materials and equipment for implementing the DP in a manner that will yield compliance with the Discharge Permit. Incorporate equipment or procedures to record total daily discharges:

- Install properly sized totalizing flow meters on all pumps to accurately log the total daily discharge volume. Do not install flow meters closer than 4 feet from any bend in the pump discharge line.
- As an alternative, record the total number and volume of all storage tanks filled throughout a workday. Calculate average flow rate by recording the time, in minutes, to empty each tank after it has been filled and the contents have been sampled. Make sure there is adequate number of storage facilities on site to assure that none of the wastewater is directly discharged without being held for sampling.

Install and maintain fittings for sampling purposes in all of the discharge line(s). Locate fittings downstream of storage facilities but upstream from the approved disposal location(s). Fittings shall be fully accessible and provide the Engineer opportunity to safely obtain one liter samples of wastewater. Detail sampling locations in the DP.

**(e) Operation** - Give 1 calendar day notice before initiating discharge operations. Record daily total amount of wastewater discharged at all location(s). Submit a weekly report to the Engineer summarizing discharge rates and volumes at each location(s) for the previous 7 calendar days. Submit this information on a *City of Portland Discharge Report Form*. A sample of this Form is in the project's Special Provisions. If not, a sample will be provided upon request.

From time to time, the Engineer will collect and analyze representative samples from all discharge location(s). Samples will be taken downstream from any storage or treatment facility. Sampling will continue throughout wastewater discharge. Samples will be taken on random occasions and frequency will change without notice. Provide the previous day total discharge at each sample location(s). The Engineer will report sample analyses to the Contractor within 72 hours after sample results are available. During this time, do not modify the discharge method or its operation without approval.

00405.70

Retain all records relating to the Discharge Permit for a minimum of 3 years after Acceptance and Final Payment. Extend this retention throughout the course of any unresolved litigation pertaining to the discharge of pollutants, or when the BES or other regulatory authority, such as the DEQ or EPA, requests this information.

Pretreat all wastewater containing solids or pollutant concentrations exceeding the specified maximum Daily Load limit(s). Dispose of all wastewater in such manner as to prevent injury to public or private property or nuisance or menace to the public. Control the entry or collection of surface runoff to prevent contamination of discharged wastewater. Pipe all wastewater from the site to the approved discharge point(s). Do not convey any wastewater in open ditches or trenches. Protect all pipe outlets to avoid damage at the discharge location.

**(f) Enforcement** - The Discharge Permittee will be solely responsible for any civil penalties that may be assessed for any gross violation of the Discharge Permit or Discharge Authorization conditions.

### Finishing and Cleaning Up

**00405.70 General** - Clean roadway surfaces with restrictions and methods detailed in 00280.64(a) and 00280.65.

### Measurement

**00405.80 Trench Excavation** - Volume for trench excavation and backfill will be measured and computed on the following bases for length, width, and depth of trench

**(a) Length** - Length for calculating excavation and backfill volume for pipe will be the entire horizontal distance measured along centerline of trench, including measurement through valves, fittings, couplings, manholes, or structures, except that measurement through such structures will be deducted if the Contract contains a separate measurement provision for trench excavation and backfill that is applicable to those structures.

Length of service line pipes will be measured horizontally along the centerline of the trench from the centerline of the mainline pipe to the end of the service line pipe, including all fittings. Measurement will be from center-to-center of valves, fittings, couplings, manholes, structures, or end of pipe, whichever is applicable.

**(b) Width** - Width for calculating excavation and backfill volume for pipe will be based on the diameter of the pipe barrel or width of the conduit, as follows:

<b>Size of Sewer Pipe</b>	<b>Pay Width of Sewer Trench</b>
6 to 10 inches	30 inches
12 to 21 inches	OD plus 18 inches
24 to 36 inches	OD plus 22 inches
42 to 54 inches	OD plus 42 inches
60 inches and larger	OD plus 46 inches
<b>Size of Water Pipe</b>	<b>Width of Water Pipe Trench</b>
6 to 16 inches	OD plus 18 inches
24 inches or larger	OD plus 24 inches

**(c) Depth:**

**(1) Sewer Pipe** - Depth for calculating excavation volume for pipes will be measured vertically from the invert of the pipe to original grade or new road subgrade whichever is lower. No measurement will be made for the extra excavation required for placement of pipe bedding. Backfill for pipe will be measured from the top of the pipe zone to the original ground or bottom of the new road subgrade whichever is less.

**(2) Water Pipe** - Depth is measured to the bottom of the pipe zone bedding.

**(d) Concrete Roadbed** - Concrete roadbed encountered in trench excavation shall be defined as trench excavation and measured accordingly.

**(e) Exploratory Excavation** - Exploratory excavation will be the measured on a volume basis.

**(f) Pothole Excavation** - Pothole excavation will be measured on an each basis for each location shown or specifically directed.

**00405.81 Sawcutting** - Sawcutting will not be measured separately.

**00405.82 Rock, Concrete, and Boulder Excavation:**

**(a) Rock Excavation** - Rock excavation will be measured on the volume basis. Measurement will be of the actual dimensions of rock removed within the following limits:

**(1) Length** - The length will be the horizontal distance measured along the centerline of the trench. The measurement will exclude manholes and other structures, which will be measured separately.

**(2) Width** - The width for payment of trench Rock Excavation will conform to the applicable provisions of 00405.80. There will be no additional measurement for additional trench width or restoration resulting from this work.

**(3) Depth** - Depth will be the vertical distance from the top of rock, to the bottom of rock, or a depth that is 6 inches below the sewer pipe, whichever is less. Measure depth at intervals of 25 feet along the trench centerline beginning at the first location where rock starts. Use the average depth between measuring points for computing the rock depth.

Compute the excavated material volume for manholes and other structures using the depth as determined using the method described in the previous paragraph, and multiplied by an area within a line parallel with, and 12 inches outside of, the actual dimensions of the manhole or structure.

The following will not be measured for payment:

- Soft or disintegrated rock
- Hardpan or cemented gravel that can be removed with a hand pick or power-operated excavator or shovel
- Loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere
- Rock outside of the minimum limits of measurement allowed, which may fall into the excavation

**(b) Concrete/Boulder Excavation** - Measurement will be on the volume basis for material that complies with definition of trench Concrete/Boulder Excavation in 00405.02. When approved, additional payment for trench Concrete/Boulder Excavation will be made for depths greater than 6 inches below the specified sewer invert. There will be no measurement of additional trench width, or restoration for trench Concrete/Boulder Excavation outside the limits defined in 00405.82(b).

**00405.83 Trench Protection** - Shoring, mobile trench shields, over-break and other trench protection measures will be considered incidental work.

**(a) Shoring, Sheet piling and Bracing** - When the item "Engineered Shoring" is not included in the Contract Schedule of Items, providing shoring, sheet piling and bracing of trenches and other trench protection measures will be considered incidental work. When the item "Engineered Shoring" is included in the Contract Schedule of Items, measurement will be made on a lump sum basis.

**(b) Dewatering** - When the item "Dewatering" is not included in the Contract Schedule of Items, the cost to collect excess water and remove it from all excavations will be considered incidental to the Work. When the item "Dewatering" is included in the Contract Schedule of Items, measurement will be made on a lump sum basis.

**(c) Construction Generated Wastewater Discharge** - When the item "Construction Generated Wastewater Discharge" is not included in the Contract Schedule of Items, the cost to collect, convey, store and dispose of the wastewater, including permitting, will be considered incidental to the Work. When the pay item "Construction Generated Wastewater Discharge" is included in the Contract Schedule of Items, measurement will be made on a lump sum basis.

**00405.84 Trench Foundation Stabilization** - Trench foundation removed and replaced with trench foundation stabilization material according to 00405.44 will be measured on a volume basis, as directed.

**(a) Volume Basis** - Trench foundation stabilization will be measured on the volume basis, computed using the following dimensions:

**(1) Length** - Length will be the feet of trench foundation used in the trench.

**(2) Width** - Width shall conform to pay limits for trench excavation and backfill set forth in 00405.80(b).

**(3) Depth** - The depth will be the vertical distance from the bottom of the pipe bedding to the bottom of the excavated unsuitable material. The depth will be measured at intervals of 25 feet, or as directed, along the centerline of the trench and the average depth between points will be used for the volume computation.

**(b) Extra Work Basis** - When not listed in the Contract Schedule of Items, trench foundation stabilization will be paid for as Extra Work.

**00405.85 Pipe Bedding:**

**(a) Sewer Pipe** - No measurement will be made for pipe bedding conforming to 00405.12, including the reinforcement in Class A bedding.

**(b) Water Pipe** - Measurement for pipe bedding will be made according to 00405.86(b).

**00405.86 Pipe Zone Material:**

**(a) Sewer Pipe** - No measurement will be made for pipe zone material conforming to 00405.13.

**(b) Water Pipe** - Measurement for Water Pipe Zone Material will be on the volume basis and exclude the volume of the pipe measured using the outside pipe diameter.

**00405.87 Trench Backfill Material:**

**(a) Trench Backfill Material** - Measurement of trench backfill material above the pipe zone will be made on the volume basis. Volume will be calculated from the following length, width, and depth for granular trench backfill:

00405.88

- Length and width will conform to pay limits for trench excavation and backfill set forth in 00405.80(a) and (b).
- Depth of granular backfill will be the actual vertical depth placed from the top of the pipe zone to the top of the trench, road subgrade, or as directed.

Measurement of the volume in cubic yards will be determined by using the pay limits contained above.

**(b) CLSM Backfill** - Measurement of CLSM backfill material will be made on the volume basis. The volume will be computed as set forth in 00405.87(a) above.

**00405.88 Imported Topsoil** - Imported topsoil will be measured according to Section 1040.

**Payment**

**00405.90 Payment** - The accepted quantities of trench work will be paid at the Contract price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Trench Excavation, _____	Foot or Cubic Yard
(b) Exploratory Excavation	Cubic Yard
(c) Pothole Excavation	Each
(d) Trench Foundation Stabilization	Cubic Yard
(e) Trench Backfill, Class _____	Cubic Yard
(f) Engineered Shoring	Lump Sum
(g) Dewatering	Lump Sum
(h) Construction-Generated Wastewater Discharge	Lump Sum
(i) Water Pipe Zone Bedding and Backfill	Cubic Yard

For item (a), the type of excavation will be inserted in the blank (Common, Rock, Boulder or Concrete). This work includes any additional excavation required for installation of manholes, inlets, pipe or other structures in rock or concrete. Other than as provided in 00405.82(a) and (b), such additional excavation is considered incidental to the work and no separate or additional payment will be made.

Item (b), includes pavement restoration. All other exploratory excavation work performed by the Contractor for its sole use is considered incidental to the work with no additional payment.

Under item (c), If another method is used than described, no additional payment will be made. All other pothole excavation work performed by the Contractor for its sole use is considered incidental to the work with no additional payment.

Payment for item (d) includes removal of unsuitable material and replacement as necessary to provide a stable foundation for the pipe.

For item (e), the class of backfill will be inserted in the blank according to 00405.14.

Item (f) includes designing, providing, constructing, maintaining, and removing the shoring system.

Item (h) includes all costs to collect excess water and remove it from all excavations and all costs to permit, collect, convey, store and dispose of the wastewater, including mobilization, construction, operation, disassembly, and demobilization of the collection, storage, and disposal system.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

**00405.91 Imported Topsoil** - Imported topsoil will be paid for according to Section 01040.

**00405.92 Incidental Basis** - When there is no pay item in the Contract Schedule of Items for trench excavation or trench backfill, perform the work as incidental work for which no separate payment will be made.

Bedding, pipe zone material, and trench sawcutting are incidental work for which no separate payment will be made.

Excavation, bedding, and backfill for pipes 4 inches or less in diameter will be incidental to the pipe pay item(s), and no separate payment will be made.



**Section 00406 - Tunneling, Boring and Jacking**

**Description**

**00406.00 Scope** - This work consists of tunneling, boring, or jacking casings or carrier pipes or other conduits without excavating the overlying surface.

**00406.01 Definitions:**

**Annular Space** - The void between the outside diameter of a carrier pipe or conduit and the inside surface of the tunnel liner or casing previously installed by tunneling, boring or jacking.

**Backfill Space** - The void created between the extreme outer limit of excavation and either the outside diameter of a casing or pipe being jacked into place or a tunnel liner being erected.

**Boring and Jacking** - A trenchless method of underground pipe construction wherein a pipe or series of pipe sections is pushed into place while excavation is performed at the head of the pipe string.

- **Manned Tunneling and Boring and Jacking** - Boring and jacking where the excavation size and method allows the stationing of a worker within the casing or direct-jacked pipe without stopping or removing the excavation equipment.
- **Unmanned Boring and Jacking** - Boring and jacking operation where the excavation size or method precludes the stationing of a worker within the casing or direct-jacked pipe without first stopping or removing the excavation equipment.

**Boring Equipment** - Tunnel boring machine, which includes: the boring head, mechanical shield, digger head, or other excavation equipment located at face of a jacked pipe or casing, including all excavation support and muck handling equipment and equipment used for any pipe insertion, placement, and backfill.

**Carrier Pipe** - A permanent material-carrying pipe or conduit installed either by direct jacking or by insertion into a casing pipe or primary tunnel support liner.

**Casing** - A pipe or other conduit that is jacked into place in a boring and jacking operation, provides initial ground support for pipe insertion, and, in the case of direct-jacked pipe, may also be the carrier pipe furnishing its own permanent ground support.

**Direct-Jacked Pipe** - Pipe installed by boring and jacking that serves as a casing or carrier pipe.

**Full Face Control** - Complete support and control of the excavation face at all times for all loading conditions throughout the course of a tunneling or boring and jacking operation.



**Jacking** - All methods by which a direct-jacked pipe is pushed into place behind or ahead of an excavation face.

**Micro-tunneling** - A remote-controlled boring and jacking operation to install a pipe or casing headed by a remotely operated tunnel boring machine. Micro-tunneling operations are not covered by these Specifications.

**Muck** - All material of whatever nature that is excavated, removed, and disposed of during the course of a tunneling or boring and jacking operation.

**Permitter** - The owner of land, or other facilities with prior rights, under which a conduit is to be tunneled, bored or jacked.

**Pipe Lubricant** - A substance applied in order to fill the backfill space and minimize friction between a jacked conduit and the outer limit of excavation.

**Pipe Ramming** - A special case of boring and jacking where a pipe string is jacked forward without excavation at the head of the string. Muck is removed after jacking is completed or only as needed to limit jacking force. Pipe ramming operations are not covered by these Specifications.

**Tunneling** - All methods by which an underground opening is first excavated before lining materials or pipe or conduit are brought in and placed.

**00406.02 Responsibility for Methods and Equipment** - Unless otherwise specified, select the methods and equipment used in tunneling and boring and jacking. Information on the proposed method and equipment shall be submitted as specified herein and accepted prior to the start of the work. Acceptance will not relieve the Contractor of the responsibility for making a satisfactory installation meeting the criteria set forth herein.

**00406.03 Safety** - Conduct operations in strict accord with all applicable requirements of the U.S. Department of Labor, OSHA, all Federal, State and local safety codes and statutes, and these Specifications. The Contractor is fully responsible and obligated to use procedures that assure the safety of all workers and equipment involved in the project, other project personnel, the public, and the adjacent property, whether public or private.

### **Materials**

**00406.10 Inserted Pipe** - Conform to 00406.12 Casing for the strength, class and type specified or shown.

**00406.11 Direct-Jacked Pipe** - At the Contractor's option, either select pipe from available standard classes and types, or design and fabricate pipe to specifically suit the methods and equipment chosen for jacking the pipe into place. The design of direct-jacked pipe must be based upon the superimposed loads and not upon the loads that may be placed upon the pipe as a result of the jacking operations. Any increase in pipe strength needed to withstand jacking loads is the responsibility of the Contractor and shall be provided at no additional cost to the City.

**(a) Pipe Loading** - Pipe selection or design shall take into account the loading criteria defined in the Plans and geotechnical data referenced in the Contract Documents. Such criteria shall include but not be limited to: long-term earth and hydrostatic loads, construction loads such as erection and jacking forces, surcharges from stockpiles and construction equipment, rigging and handling loads, and loads from all other sources.

**(b) Pipe Design** - Determine the design criteria for longitudinal or axial loading on the pipe and joints based on the selected methods and equipment. Be responsible for design of the pipe and pipe joints to carry the thrusts of the jacking equipment without damage or distortion. If used, propulsion jacks on the shield shall be configured so that the thrust is uniformly distributed and will not cause pipe damage or distortion.

**(c) Maximum Bearing Stresses** - Thrust jack configuration and concrete strengths for concrete pipe and yield strength of steel for steel pipe shall be coordinated. The maximum bearing stresses imposed upon the pipe by the jacking effort shall:

- (1) not exceed 33% of the ultimate strength (28-day) of the concrete for concrete pipe or
- (2) not exceed 33% of the yield strength of the steel for steel pipe.

**(d) Injection Nipples** - Equip 36 inch and larger direct-jacked pipe with nipples for lubricant injection or pressure grouting on 10 foot centers located at the crown and on each side 60° above invert.

**(e) Cushioning Material** - When approved for use, place cushioning material in the joints between successive pipes to provide uniform thrust distribution across the pipe joint. The initial thickness of the cushioning material shall not exceed the joint gap allowance determined from the approved pipe joint design.

**00406.12 Casing Pipe** - Use smooth welded steel pipe or other pre-approved pipe material for casing in bored and jacked applications where specified or approved. Provide casing of a size to permit proper construction to the required lines and grades of the carrier pipe to be inserted and allow filling the backfill space with the specified material. Provide casing of such strength as to withstand all boring and jacking loads.

**(a) Wall Thickness** - Use casing of adequate strength and wall thickness for all loads which may be imposed including ground and hydrostatic loads, jacking thrust, slurry and grout pressures, external loads such as construction equipment, stockpiles, railroads, highway traffic, and any other loads that may be anticipated. Submit details of selected casing along with design calculations in accordance with submittal requirements herein. Identify and provide any additional wall thickness needed to comply with additional requirements of the Permittee without additional cost to the City. Use a gauge or wall thickness corresponding to the size of casing selected from the following for the type of pipe being installed:

For Sewer and Stormwater Pipe use this table as a minimum for casing wall thickness

Diameter in Inches	Smooth Steel Pipe Wall Thickness
0-24	0.250" per ASTM A 53 Grade B or ASTM A 252 Grade 2
24-36	0.313" per ASTM A 53 Grade B or ASTM A 252 Grade 2
Over 36	As Specified

For all Domestic Water Pipe use this table as a minimum for casing wall thickness

This chart is for smooth steel casing pipes with a minimum yield strength of 35,000 psi

Diameter of Casing Pipe	Smooth Steel Pipe Minimum Wall Thickness
12" or less	1/4" (0.2500")
Over 12" - 18"	5/16" (0.3125")
Over 18" - 22"	3/8" (0.3750")
Over 22" - 28"	7/16" (0.4375")
Over 28" - 34"	1/2" (0.5000")
Over 34" - 42"	9/16" (0.5625")
Over 42" - 48"	5/8" (0.6250")
Larger than 48"	Casing pipes larger than 48" diameter or with any portion deeper than 20 feet shall be submitted for approval

For wall thicknesses less than those prescribed above, provide complete structural calculations demonstrating the adequacy of the submitted casing and wall thickness. Such calculations shall be stamped by a structural or geotechnical Engineer licensed to practice in the State of Oregon.

**(b) Liner Plate Casing** - Construct steel casing of hot-dipped galvanized steel standard offset tunnel liner plate with gauge and section modulus per inch of width as approved. Plates shall meet ASTM 139 Grade BB requirements. Fabricate each plate from a single piece of steel plate and provide flanges for both circumferential and longitudinal joints. Provide a sufficient number of bolt holes in joints to fully develop the design strength of the individual liner plates. Locate boltholes so that all liner plates with the same curvature are interchangeable and can be easily moved from place to place in the tunnel.

**(c) Injection Nipples** - Equip casing with nipples for lubricant injection and pressure grouting on 10 foot centers, at obstructions encountered, and at voids encountered. For pipes 36 inches to 42 inches place grout port at crown. For casings 48 inches and larger, place grout ports at the crown and on each side, 60° from crown.

**00406.13 Grout** - If specified for filling the annular space between inserted pipe and casing or tunnel liner, provide flowable, non-shrinking, non-expanding manufactured grout that will take a permanent set. Grout shall be recommended by the manufacturer for the particular application. Submit details of grout before use.

00406.14

**00406.14 Lubricant** - Lubricant for backfill space lubrication of initial casing shall be a non-toxic bentonite or polymer material at the Contractor's discretion. Lubricant shall be of a composition and consistency to reduce skin friction between the outer wall of casing and the excavated surface.

**00406.15 Cradles, Spacers, and Isolators for Inserted Sewer and Stormwater Pipe** - Where pipe or conduit is to be inserted into a tunnel or bored and jacked casing, provide spacers or isolators around the carrier pipe as specified or approved. Spacers and isolators shall be manufactured from pressure treated wood, polyethylene, or other suitable synthetic material and sized appropriately for the casing material. Bands shall be manufactured from stainless steel, steel, polyethylene or other suitable material as recommended by manufacturer for intended application.

**00406.16 Cradles, Spacers, and Isolators for Inserted Domestic Water Pipe** - Where pipe or conduit is to be inserted into a tunnel or bored and jacked casing, pipe shall be supported by casing spacers at no more than 10 feet between spacers or otherwise shown on the plans. Each spacer shall be 12 inches wide and manufactured of minimum 14 gauge Type 304 stainless steel. All nuts and bolts shall be corrosion resistant and compatible with the respective band. Each spacer shall have a minimum of 4 runners manufactured of a high molecular weight polymer plastic. The runner supports shall be of adequate height to position the carrier pipe in center of casing with a minimum top clearance of 1/2 inch. All casing spacers for use with larger than 36 inch diameter carrier pipe shall be factory designed taking in consideration the weight of the carrier pipe filled with water. All calculations and drawings shall be submitted for approval.

**00406.17 Casing End Seals** - Casing end seals shall be used to completely close both ends of the casing. These end seals shall be pull on (seamless) or wrap around with stainless steel straps for securing to the carrier pipe and the casing. End seals shall be constructed of specially compounded synthetic rubber a minimum thickness of 1/8 inch.

**00406.18 Cathodic Protection** - Where cathodic protection is used on the carrier pipe, an above ground test box constructed specifically for this purpose will be provided. Install casing vent pipe if shown on the plans. Test box will have test wires attached to casing wall and carrier pipe as shown on the cathodic protection details or as directed.

### Equipment

**00406.20 Excavating Equipment for Unmanned Boring and Jacking** - The boring head for such operations shall be designed to securely anchor to the leading section of the pipe string to prevent any wobble or any deviation in alignment during the boring operation. The boring head shall also be removable, and capable of excavating a small distance outside the outer diameter of the casing. In addition, the boring head shall be steerable to the extent necessary to conform to line and grade requirements herein.

**00406.21 Excavating Equipment for Manned Tunneling and Boring and Jacking** - Excavating equipment for such boring and jacking and for tunneling shall be steerable with full-face control capability. All machinery and moving parts such as shove jacks, breasting plates, breasting jacks, cutting equipment, excavating equipment, and the like, shall be new or refurbished to like new condition. All air and hydraulic lines and connections shall be new or like new, and shall be capable of withstanding maximum service pressures. All electrical wiring and insulation shall be new or like new and of explosion proof type electric Class 1, Group D, Division 1 of National Electrical Code. All electrical motors, accessories, and installations and electrical equipment inside the excavated volume shall conform to Class I, Division 2 requirements of Subpart K, OSHA Standards 29 CFR 1926, current revision.

**00406.22 Jacking Equipment** - Mount main jacks in a jacking reaction frame located in the jacking shaft or pit. Main jacks shall advance pipe or casing by pushing a successive string of connected conduit sections toward a receiving shaft or pit. Determine necessary jacking force in advance and design complete jacking system before submitting for review. The main thrust jacking system shall develop a uniform distribution of jacking forces on the end of the casing or direct-jacked pipe by the use of appropriate thruster rings and cushioning material. Use intermediate jacking stations at the Contractor's discretion as approved.

**00406.23 Pipe Lubrication Equipment** - If lubrication is needed to keep jacking forces within the thrust capacity of jacks, use pumping equipment and accessories that are suitable for the intended purpose: to inject lubricant through injection nipples. The lubricant shall be of a composition and consistency to reduce skin friction between the initial support conduit and the excavated surface during jacking operations.

**00406.24 Line and Grade Monitoring** - Use a laser and target system, water levels, surveys or other approved methods to continuously monitor line and grade during manned boring or tunneling operations. For unmanned boring, check line and grade daily, every 40 feet or at intervals proposed in accepted submittal. Calibrate monitoring equipment before the beginning of each operation and check again at the beginning of each shift during the operation. Maintain monitoring equipment and keep it in good working condition at all times. Mount laser or other continuous monitoring equipment independently of any jacking frame, backup plate, or reaction bulkhead in such a manner as to keep it completely stable during operations.

**00406.25 Grouting Equipment** - Use positive displacement pumping equipment equipped with a colloidal mixer of a type normally used to grout backfill space behind tunnel liner, jacked casing, or direct-jacked pipe, as applicable. Monitor grouting pressure at all times during grouting and limit pressure so as to have no detrimental effects on the liner or conduit. Calibrate all gauges and other equipment prior to their use on the project.

**Labor**

**00406.30 General** - Supervisors shall have a minimum of 5 years experience in tunneling or boring and jacking operations.

**Construction**

**00406.41 Required Submittals** - Submit a complete construction plan showing details of the proposed methods of construction and the sequence of operations to be performed. Submit the plan at least 30 calendar days prior to materials and equipment purchase, or prior to mobilization if the equipment is already owned. A Professional Engineer registered in the State of Oregon shall stamp all structural or geotechnical designs. These submittal requirements are not intended to limit submittals, but to provide the minimum of details that must be included for each size and location of each contracted boring and jacking operation.

**(a) Boring and Jacking Submittals** - Submit details of the following for approval before beginning the boring and jacking operation:

**(1) General** - Show subsurface excavation and face control at point of excavation, muck removal and disposal, pipe installation methods, details of jacking system including intermediate jacking systems, if used, and shaft or pit location, construction, shoring and bracing designs, including dewatering schemes whenever necessary.

**(2) Boring and Jacking Contractor** - Submit names and contact information of Contractor or subcontractor actually performing the Work along with qualifications for performing the Work including references and experience on similar past projects.

**(3) Sequence of Work and Construction** - Submit drawings and written description identifying details of the proposed sequence of work and construction operations to be performed as required by the method of excavation. The drawings and descriptions shall be sufficiently detailed to demonstrate whether the proposed materials and procedures will meet the requirements of the Contract Documents. Show site constraints and staging. Include proposed contingency plans for any critical or particularly dangerous phases of boring and jacking operation.

**(4) Boring Equipment** - Submit detailed drawings of boring equipment including dimensional data and proposed overcut, excavation method, head or shield operation and steering, arrangement of components and face control method. Provide technical specifications of the boring equipment and trailing equipment including performance capabilities (include any modifications) and experience record with proposed equipment. Describe method of steering, if any, and methods of minimizing over excavation and loss of ground, especially when excavating cobbles and boulders.

**(5) Jacking System** - Submit jacking system drawings and details showing jack set up, backstop for jack thrust, bearing block, or other means of furnishing reaction for the jacking frame, intermediate jacking stations, if used, and thrust and other performance capabilities of all jacking system components. Show details of method by which jacking thrust is transferred to the conduit being jacked and methods of protecting conduit from damage due to thrust. Provide description of any cushioning material to be used and show detail of placement between successive sections. Furnish data on maximum available thrust of the system.

**(6) Jacked Pipe** - Submit anticipated jacking loads and design calculations for direct-jacked pipe or casing per the design criteria set forth in the Contract Documents. The design calculations shall take into account maximum ground and hydrostatic loads, jacking thrust, slurry and grout pressures, external loads such as construction equipment, stockpiles, railroads, highway traffic, and any other anticipated loads. Show and describe all anticipated loads. Provide structural details of the pipe or casing proposed to be jacked, particularly reinforcing and cushioning at the joints. Show details of joining casing sections by welding or other joining methods.

**(7) Shafts** - Submit plans showing shaft or pit locations, layout, dimensions, surface construction, excavation equipment, excavated material disposal, and their locations and layout with respect to the shafts or pits. Submit scale drawings, details, and design calculations for shaft shoring and bracing stamped by a professional structural or geotechnical Engineer licensed to practice in the State of Oregon.

**(8) Maintaining Line and Grade** - Submit details and description of proposed guidance equipment, method of line and grade control, and proposed frequency of line and grade checking. In case of deviation, include proposed method of bringing actual boring and jacking alignment and elevation back onto specified line and grade.

**(9) Backfill Space Lubrication** - Submit proposed method of furnishing backfill space lubrication, if any. Include anticipated lubricant, lubricant injection rates and volumes, injection equipment, pumping procedures and capacities, methods of introducing lubricant into backfill space, proposed water-based non-toxic lubricant mix and other pertinent system components.

**(10) Muck Removal** - Submit details of muck removal system and disposal plan including equipment to be used. Provide details for handling and disposal of any contaminated media anticipated or encountered. Indicate sites for cleanup of trucks and other vehicles to prevent dirt nuisance or contamination of adjacent property.

**(11) Grouting Annular Space and Backfill Space Fill** - Submit details of annular and backfill space grouting methods to be used including equipment and placement, sequence of operations, schedule, pumping procedures, sand or grout mix, plug and insertion points, and method of

monitoring and controlling fill pressure for each of the required filling operations.

**(12) Support Systems** - Submit layout and details of all support equipment including ventilation system, lighting layout, and electrical system and emergency backup systems. Show air quality monitoring systems, procedures, frequencies, redundancies, and record keeping to be used.

**(13) Tees and Wyes** - If tees or wyes are to be constructed, submit drawing and details of typical pipe fitting connection and installation.

**(14) Modification of Existing Facilities** - Submit a design for any part of the existing sewer system that must be changed or new structures that may be required because of the particular method or procedure used by the Contractor (Manholes, headwalls, vaults, etc.).

**(15) Inserted Pipe** - If a carrier pipe or other conduit is to be placed in a previously bored and jacked casing, submit placement method, equipment, backfill material, and details of bracing to prevent pipe shifting and flotation.

**(16) Dewatering Equipment** - When groundwater is known to exist or is expected to be encountered, submit a dewatering plan showing location, size, and layout of pumps, wells, piping, appurtenant equipment, and points of discharge and disposal to be used to keep excavations free of water. Conform to dewatering requirements set forth elsewhere in these Specifications.

**(17) Utility Protection Plan** - Submit, for approval, a utility protection plan before starting work. The plan will be created from the same scale and details as the construction drawings. The following items must be included in the plan:

- Location of all utilities impacted by construction by type, size and status of use.
- Methods employed by the Contractor to locate each and every utility.
- List of utility owners and 24-hour emergency contact numbers
- Methods planned by the Contractor to support utilities while in full operation.
- Hours of planned shutdown of utilities if required.
- Special support details approved by the owner/operator of all high pressure gas lines
- Correspondence confirmation from all utilities that proposed plan meets their approval



- If impacted utility requires support during construction, the support system must be designed and stamped by a registered engineer licensed in the State of Oregon.
- Other conditions may apply depending on field conditions.

**(b) Tunneling Submittals** - Submit details of the following for review before beginning the tunnel construction:

**(1) General** - Submit a complete construction plan showing details of the proposed methods of construction and the sequence of operations to be performed. Submit at least 30 calendar days prior to materials and equipment purchase, or prior to mobilization if the equipment is already owned. A professional engineer registered in the State of Oregon shall stamp all structural or geotechnical designs. These submittal requirements are not intended to limit submittals, but to provide the minimum of details that must be included for each size and location of each contracted boring and jacking operation.

**(2) Tunneling Contractor** - Submit names and contact information of Contractor or subcontractor actually performing the Work along with qualifications for performing the Work including references.

**(3) Sequence of Work and Construction** - Submit drawings and written description identifying details of the proposed sequence of work and construction operations to be performed as required by the method of excavation. The drawings and descriptions shall be sufficiently detailed to demonstrate whether the proposed materials and procedures will meet the requirements of the Contract Documents. Show site constraints and staging. Include proposed contingency plans for any critical or particularly dangerous phases of tunneling.

**(4) Tunneling Equipment** - Submit drawings of tunneling equipment and dimensional data including proposed overcut, excavation method, head or shield operation and steering, arrangement of components and face control method. Provide technical specifications of tunneling equipment and trailing equipment including performance capabilities (include any modifications) and experience record with proposed equipment. Describe methods of minimizing over excavation and loss of ground, especially when excavating cobbles and boulders.

**(5) Primary Liner System** - Submit scale drawings, details, and dimensional data for primary liner and components thereof. Show sequence of installation, bracing to prevent shifting or rotation, and laydown areas for required materials. Drawings, details, and design calculations for primary liner system shall be stamped by a professional engineer licensed to practice in the State of Oregon.

**(6) Shafts** - Submit plans showing shaft or pit locations, layout, dimensions, surface construction, excavation equipment, excavated material disposal, and their locations and layout with respect to the shafts or pits. Submit scale drawings, details, and design calculations for shaft shoring and bracing stamped by a professional structural or geotechnical engineer licensed to practice in the State of Oregon.

**(7) Maintaining Line and Grade** - Submit details and description of proposed guidance equipment, method of line and grade control, and frequency of line and grade checking. Include method of bringing tunnel back onto specified line and grade in case of deviation.

**(8) Muck Removal** - Submit details of muck removal system and disposal plan including equipment to be used. Provide details for handling and disposal of any contaminated media anticipated or encountered. Indicate sites for cleanup of trucks and other vehicles to prevent dirt nuisance or contamination of adjacent property.

**(9) Grouting Annular Space and Backfill Space** - Submit details of backfill and annular space grouting methods to be used including equipment and placement, pumping procedures, grout mix, plug and insertion points, and method of monitoring and controlling grout pressure for each of the required grouting operations.

**(10) Support Systems** - Submit layout and details of all support equipment including ventilation system, lighting layout, and electrical system and emergency backup systems. Show air quality monitoring systems, procedures, frequencies, redundancies, and record keeping to be used.

**(11) Tees and Wyes** - If tees or wyes are to be constructed, submit drawing and details of typical pipe fitting connection and installation.

**(12) Modification of Existing Facilities** - Submit a design for any part of the existing sewer or water system that must be changed or new structures that may be required because of the particular method or procedure used by the Contractor (Manholes, headwalls, vaults, etc.). Submit drawings, details, and design calculations for shaft shoring and bracing stamped by a registered professional engineer licensed to practice in the state of Oregon.

**(13) Inserted Pipe** - If a pipe or other conduit is to be placed in a previously tunneled casing, submit details of bracing to prevent pipe shifting and flotation, backfill material, placement method and equipment.

**(14) Dewatering Equipment** - When groundwater is known to exist or is expected to be encountered, submit a dewatering plan showing location, size, and layout of pumps, wells, piping, appurtenant equipment, and points of discharge and disposal to be used to keep excavations free of water. Conform to dewatering requirements set forth elsewhere in these Specifications.

**(15) Settlement Monitoring** - Submit details of the settlement-monitoring plan intended to be used. The minimum number of settlement measuring points shall be at least at quarter stations along the centerline of the boring and jacking alignment. Settlement points at either side of the centerline points shall also be installed as needed.

**00406.42 Alternate of Boring and Jacking or Tunneling** - Boring and jacking or tunneling may be allowed in lieu of each other or in lieu of specified open trench installation; however approval must first be obtained. Unless specified, the Engineer retains sole discretion to reject the substitute method without rejecting other methods. Approval will in no way relieve the Contractor of the responsibility for making a satisfactory installation meeting the requirements set forth herein.

**00406.43 Excavation** - Excavation for work under this Section is unclassified and includes whatever materials are encountered to the depths shown on the Plans or as required. Estimate the kind and extent of the various materials that will be encountered in the excavation based on experience with nearby work, surface investigation, any subsurface investigation that may have been performed, and any applicable geotechnical data that may be available.

**(a) Establishing Line and Grade** - The Engineer will provide the survey control points indicated on the Plans or other survey points as may be agreed. Check these survey control points in the field before commencing excavation and report any errors or discrepancies. When all survey control points are found to be correct, use them to establish and maintain all reference lines and grades for the construction of the pipe or conduit. Install all direct-jacked pipe, casing, tunnel liner, or inserted pipe to true line and grade. Should any deviation from true line and grade occur, modify the installation operation to correct the deviation at no additional cost to the City. Unless otherwise shown or specified, the Contractor will be permitted a deviation from the specified line and grade equal to 1/2 inch for line and 1/4 inch for grade per 100 feet of centerline length.

**(b) Jacking Procedure:**

**(1) Cradle** - Construct a concrete cradle in the jacking shaft true to line and grade and conforming to the outside radius of the pipe. The cradle shall be of such dimensions as to uniformly support the pipe under the lower 60° sector measured on the outside of the pipe. The curved surface shall be formed or accurately screeded to the proper dimensions. It shall be reinforced with not less than 0.3 % of longitudinal steel and not less than 0.5% of transverse steel with respect to the cross-sectional area of the cradle. The transverse steel shall be bent equal to the radius of the outside of the pipe plus 2 inches and shall extend to within 1 inch of every surface of the cradle.

**(2) Concrete Base Slab** - In lieu of the concrete cradle specified above, and subject to the approval of details by the Engineer, set steel rails in a concrete base slab parallel to the longitudinal axis of the pipe and to true line and grade for jacking pipe support.

**(3) Gasket Integrity** - Verify that pipe gaskets are in place and that the joints are watertight. After each section of pipe has been set into position in the jacking shaft and assembled with previously installed pipe, test pipe joint as specified. Remove and reinstall any pipe with a defective joint.

**(4) Pipe End Protection** - For either concrete or steel pipe, properly protect the driving ends of pipe being jacked against spalling and other damage. Similarly protect intermediate joints by installing sufficient bearing shims to properly distribute the jacking stresses. Remove any section of pipe showing signs of failure and replace it with a new section of pipe or with a cast-in-place section adequate to carry the loads imposed upon it at no additional cost to the City.

**(c) Excavation Limits** - Carry out all excavation entirely within the boring or tunneling equipment. No excavation in advance thereof will be permitted. Make every effort to avoid any loss of earth outside the equipment.

**(d) Working Conditions** - At all times, maintain clean working conditions inside the boring and jacking or tunneling operation and associated shafts. Remove all muck, debris, material spills, unusable supports and other material not required for the operation as excavation progresses. Do not allow such material to accumulate within the tunnel, casing, conduit, pipe, or shafts.

**(e) Excavation Records and Control** - Maintain a log of soil excavated versus face advance during the tunneling or jacking operation. The log shall be sufficiently accurate and up-to-date to quickly alert the operator of the face controlling equipment of over excavation and creation of voids. Make the log available to the Engineer at all times and submit a copy at the end of each shift. If at any time more soil is removed than calculated based on the forward progress, stop excavation and increase the rate of advance for the operation. When jacking pressures require it, resume excavation at the minimum necessary to maintain the minimum rate of advance necessary to prevent the casing or tunneling equipment from "freezing" in place. Determine the cause of overbreaks and correct it before continuing. Immediately report all such cases of overbreaks to the Engineer.

**(f) Settlement Monitoring** - Take initial settlement readings before shafts or pits are excavated, and record all readings as a base line for comparison to subsequent readings. Take readings at the same time each day of tunneling operations. Submit a copy of all readings at the end of each day. Any settlement in excess of 0.25 inch shall be corrected by the contractor to the satisfaction of the City at the Contractor's expense.

**(g) Settlement** - Execute all work of excavating, lining, boring, jacking, grouting, and constructing the conduit so that settlement is minimized. The completed direct-jacked pipe, casing, or tunnel liner shall have full bearing against earth with no voids or pockets left in any portion of the work. Promptly fill the backfill space between the tunnel liner, direct-jacked pipe, or casing and the excavated surface with specified backfill material, as approved. Provide full breasting of excavation face when operations stop for more than 2 hours or sooner as site conditions dictate.

**(h) Protection of Adjacent Property** - Before beginning construction at any location, adequately protect existing structures, utilities, trees, shrubs and other objects in accordance with General Requirements provisions regarding protection and restoration of property. Assume all costs for repair of, or compensation for, damage to adjacent facilities due to negligence or lack of adequate protection. Tunnel or install direct-jacked pipe or casing under railroad embankments, highways or streets so as to minimize the interference with the operation of the railroad, highway, or streets.

**(i) Cleanup** - Provide surface drainage as required during construction to protect the Work and to avoid nuisance to adjoining property. Conduct operations in such a manner that trucks and other vehicles and equipment do not create a dirt nuisance in adjacent and nearby streets. Conform to erosion control requirements set forth elsewhere in these Specifications.

**(j) Continuity of Jacking Operations** - Once commenced, perform boring and jacking operations on each project workday without interruption until the direct-jacked pipe or casing has been jacked between the specified limits. This requirement may be modified if the Contractor submits for prior approval methods and details that will preclude the "freezing" or seizure of the casing and ensure that the excavation face is stable at all times.

**(k) Voids and Loss of Ground** - Should loss of ground occur during tunneling or boring and jacking operations, backfill all voids promptly. Fill all remaining voids before completion of operations. Such filling or backfilling shall be with grout unless otherwise approved. Surface settlement or excessive muck volume will be conclusive evidence that voids exist.

**(l) Lubrication** - Maintain an envelope of pipe lubrication around the exterior of the pipe during the boring and jacking operation to reduce the exterior conduit wall friction and to reduce the possibility of the pipe "freezing" or seizure in place. Utilize lubrication immediately upon start of jacking and maintain use continuously until jacking is completed. Calculate backfill space volume and measure grout injected to ensure adequate lubrication is being utilized. Provide copies of calculation of backfill space volume and amount of injected pipe lubrication to the Engineer on a shift-by-shift basis.

**00406.44 Jacking Steel Casing** - Join sections of steel casing by welding the joints with a continuous circumferential weld or by other approved means. Provide joints that are capable of resisting the boring and jacking forces without failure. Provide casing of such strength as to withstand the boring and jacking loads and of such diameter to allow filling the backfill space with the specified material. Unless otherwise specified, the size and wall thickness of the casing to accommodate the final pipe shall be at the Contractor's option.

00406.45

**00406.45 Installing Steel Liner Plates** - Install bolt-together steel liner plates when specified or otherwise selected for use. Install plates progressively as excavation proceeds. Do not excavate more than 24 inches past the end of the last-placed liner plate. Install an additional full section of the liner before resuming excavation. In sandy and running ground environment, inject grout at pressures not exceeding overburden pressure to fill voids behind the liner as excavation proceeds. At a minimum, place grout at the end of each shift as close to the heading as possible using grout stops as necessary. Start grouting in the lower holes moving upward as the annular space is filled. Whenever necessary, install additional threaded nipples filling each hole or where grout interconnection with adjacent holes occurs.

**00406.46 Pressure Grouting After Jacking or Tunneling:**

**(a) Procedure** - In all cases, pressure grout backfill space and voids outside casing or primary liner after it is in position through bored holes or injection nipples provided. Start grouting at one end through a side hole and pump grout until grout appears in the grout hole at the crown. Then start grouting through the opposite side hole until grout appears at the hole in the crown. Next grout through the hole at the crown until grout appears in the next set of holes along the pipe. Plug the holes at the starting point and move to the next set of holes and repeat grouting sequence until full length of jacked pipe has been grouted. Once commenced, grouting shall be completed without stopping.

**(b) Documentation** - During grouting operations, maintain complete records at all times. Record grout mixes, grout pressures, amount of grout takes, injection rates, weather conditions and temperature including start and stop times and interval before restarting operations. Submit all requested data daily.

**00406.47 Inserting Pipe** - Where pipe or conduit is to be inserted into a tunnel or bored and jacked casing, provide cradles under the barrel of each pipe unless otherwise specified or approved. Join the pipe and slide into the pipe or casing. The pipe barrel shall bear continuously on casing spacers. Conform to applicable pipe installation requirements of Section 00445, including hydrostatic or air testing and tolerances for line and grade.

**00406.48 Backfilling Pipe** - Completely fill the annular space between the inserted pipe and the primary tunnel liner or jacked casing with approved backfill material in such a manner as to prevent pipe shifting or flotation. Pour or pump the fill from the two ends and from intermediate points as necessary. Complete grouting in a continuous operation without stopping. Perform sand filling using a gunite machine or other approved equipment. Installed pipe must conform to pipe deflection testing requirements set forth in Section 00445.

## Measurement

### 00406.80 Measurement:

**(a) Installation** - Completed and acceptable pipe installed by tunneling or boring and jacking will be measured either on a lump sum basis or linear foot basis, as shown on the Bid. Linear foot measurement will be from end to end along the centerline of the final tunnel liner or direct-jacked or inserted pipe or conduit between portals or will be the length shown on the Plans, whichever is less.

**(b) Contractor Convenience** - Tunneling or boring and jacking extensions beyond the limits shown will be considered to be for the Contractor's convenience unless ordered in writing. If approved, measurement of such extensions will be made as if the open trench method of construction had been used.

**00406.81 Tunneling, Boring and Jacking in Lieu of Open Trench** - Where tunneling or boring and jacking is approved in lieu of open trench construction, measurement will be made as though the open trench method had been used. Such measurement will include all the pay items that would have been applicable if the open trench construction method had been used. No additional measurement will be made for any pay item that would not have been applicable.

**00406.82 Separate Item Basis** - If the Special Provisions or Contract Schedule of items indicate a unit basis of payment, measurement of quantities will be made on the length basis from end to end along the centerline, or from center to center of manholes, inlets, other structures, or portals as applicable.

## Payment

**00406.90 Payment** - Payment will include full compensation for all excavation, shafts, portals, jacking pits, pipe, conduits, pipe bedding, tunnel stabilization, backfill, lubricant, grouting pipe, casing and all appurtenances as approved, complete in place, except for tees and wyes.

**(a) Optional Use of Casing** - Where casing is used at the option of the Contractor in lieu of direct-jacked pipe, the casing and the backfill between the pipe and the casing will be included in the pay item for boring and jacking as applicable, and no separate payment will be made therefore.

**(b) Casing or Tunnel Liner** - There will be no separate payment for casing or tunnel liner used to install pipe or for backfill between inserted pipe and the casing or liner. If tunneling, boring and jacking, or open trench excavation is used at the Contractor's option in lieu of another specified method, payment will be made as originally bid.

**00406.91 Lump Sum Basis** - The accepted quantities of tunneling or boring and jacking work done on a lump sum basis will be paid as follows:

**Pay Item** **Unit of Measurement**

- (a) Tunneling ..... Lump Sum
- (b) Boring and Jacking ..... Lump Sum

Item (a) applies to all excavation, shafts, portals, jacking pits, pipe, conduits, pipe bedding, tunnel stabilization, backfill, lubricant, grouting pipe, casing and all approved appurtenances.

Item (b) applies to all excavation, shafts, portals, pipe, conduits, pipe bedding, backfill, lubricant, grouting pipe casing, and all approved appurtenances

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, materials and incidentals necessary to complete the work as specified.

**00406.92 Separate Unit Basis** - The accepted quantities of tunneling or boring and jacking work done on a unit basis will be paid for at the Contract unit price per unit of measurement for the following items:

**Pay Item** **Unit of Measurement**

- (a) Tunneling ..... Foot
- (b) Boring and Jacking ..... Foot
- (c) Tees, \_\_\_\_ inch ..... Each
- (d) Wyes, \_\_\_\_ inch ..... Each

Item (a) applies to all excavation, shafts, portals, jacking pits, pipe, conduits, pipe bedding, tunnel stabilization, backfill, lubricant, grouting pipe, casing and all approved appurtenances.

Item (b) applies to all excavation, shafts, portals, pipe, conduits, pipe bedding, backfill, lubricant, grouting pipe casing, and all approved appurtenances

For items (c) and (d), the nominal size will be inserted in the blank.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

**00406.93 Incidental Basis** - When neither the Special Provisions or Contract Schedule of Items indicate separate payment for tees and wyes under this section, the work is considered incidental and no separate payment will be made.

**(a) Installation** - Completed and acceptable pipe installed by tunneling or boring and jacking will be paid either on a lump sum basis or linear foot basis, as shown in the Contract Schedule of Items. Linear foot measurement will be from end to end along the centerline of the final tunnel liner or direct-jacked or inserted pipe or conduit between portals or will be the length shown on the Plans, whichever is less.



**(b) Contractor Convenience** - Tunneling or boring and jacking extensions beyond the limits shown will be considered to be for the Contractor's convenience unless ordered in writing. If approved, payment of such extensions will be made as if the open trench method of construction had been used.



**Section 00412 - Pipe Bursting**

**Description**

**00412.00 Scope** - This work consists of furnishing and installing HDPE pipe in gravity sewer pipe by the pipe bursting method.

**Materials**

**00412.10 Pipe** - Furnish high molecular weight, high-density polyethylene pipe and fittings that are made from virgin grade material, to the diameter as specified, and to tolerances meeting ASTM F714. The minimum ratio of orthogonal diameters prior to installation shall be 0.95.

**(a) Markings** - Pipe materials shall be legibly marked by the pipe manufacturer with the following information:

- Name and trademark of manufacturer
- Nominal pipe size
- Dimension ratio
- The letters PE followed by the polyethylene grade per ASTM D1248, followed by the Hydrostatic Design Basis in hundreds of psi
- Manufacturing Standard Reference
- A production code from which the date and place of manufacture can be determined

Pipe material shall be listed by the Plastic Pipe Institute (PPI) with a designation of PE 3608 or 4710 and have a minimum cell classification of 345464C as described in ASTM D3350. Pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material pipe. Pipe (excluding black colored pipe) stored outside shall not be recycled. Pipe and fittings shall be made in conformance with ASTM F714 and ASTM D3261 as modified for the specified material. The material shall have a long-term hydrostatic strength (LTHS) of 1,600 psi when tested and analyzed in accordance with ASTM D2837. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects and be uniform in density and other physical properties. Any pipe not meeting these criteria will be rejected.

**(b) Pipe Color** - Pipe shall be:

- Black or gray only.
- Homogeneous throughout.

**(c) Dimension Ratio (DR)** - Pipe shall conform to the following:

- Nominal Size: 8 to 18 inches
- Minimum Strength DR: 17

**00412.11 Service Connections** - New lateral service connections to the sewer main shall be accomplished either by Inserta-Tee®, electrofusion saddle type fittings, or approved equal. The service connection shall be specifically designed for connection to the HDPE sewer main being installed.

**00412.12 Contractor Submittals:****(a) Shop Drawings** - Provide the following:

- Submit catalog cuts, specifications, dimensioned drawings, installation details and sketches, and other pertinent information for the HDPE pipe installation work.
- Verify with the pipe manufacturer all connection details.
- Submit detail drawings and a written description of the construction procedure and sequence including locations for initiating bypass and receiving bypass of the sewage flow for host sewer and sewer laterals, install new house sewer and service laterals, and disconnection and reconnection of the sewer service lateral connections.
- Submit method of bursting, including listed equipment by size, make, model and manufacturer.

**(b) Certification** - Furnish a certified affidavit of compliance for all HDPE pipe and fittings furnished confirming that the materials supplied fully conform to the requirements specified herein.

**(c) Diversion of flow** - Submit a complete plan for a diversion of flow in accordance with Section 00490.

**(d) Fusion Weld** - Perform trial fusion welds in the field and submit samples to the Engineer for review prior to installation of the pipe. All full penetration welds shall provide a homogeneous material across the entire cross section of the weld. The fusion machine employed for the trial welds shall be the same machine that will be utilized for the complete project installation work.

**00412.15 Quality Assurance** - Quality assurance of the pipe and fittings shall include certified laboratory data confirming that said tests have been performed on a sample of the pipe provided this contract, or on pipe from the production run. Tests must show that satisfactory results were obtained prior to any installation of said pipe.

### Labor

**00412.30 Qualifications** - The pipe bursting contractor shall be a licensed installer of the selected pipe bursting system. The contractor must be satisfactorily trained by the pipe bursting system manufacturer and certified in writing as such.

Pipe bursting insertion equipment shall be operated only by technicians who have a minimum of 3 years experience in the installation of the polyethylene pipe, using pipe bursting technology as specified herein. The technician's experience and references shall be documented in the HDPE pipe submittal.

Polyethylene pipe joining shall be performed by personnel trained in the use of butt-fusion equipment by the specific manufacturer of fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the polyethylene pipe. Training shall be performed by a qualified and certified representative of the equipment and pipe manufacturer.

Fusion joining and other procedures necessary for correct assembly of the polyethylene pipe shall be done only by personnel trained in those skills to the satisfaction of the Engineer and the pipe supplier.

**00412.31 Certified Operators** - Fusion equipment shall be operated only by technicians who have been certified by the pipe manufacturer or supplier and who have a minimum of 2 years experience of fusion welding 8 inches or larger diameter pipelines. The technician's experience and verifiable references shall be documented in the HDPE pipe submittal.

### Construction

**00412.40 General** - Identify and locate all sewer service connections according to Section 00401. An original copy of the post-television inspection video tape shall be provided to the Engineer for final approval.

**00412.41 Preparation** - All work shall be performed as specified herein and supervised by personnel experienced in the installation of pipe using the pipe bursting system.

Receiving/insertion pits shall be located to suit the pipe bursting operation without impacting the surrounding area of facilities. Restore at contractor's expense those pit areas where new manholes are not being installed. This includes providing a new manhole if an existing manhole is removed or damaged.

Identify and inform the Engineer of all pipe types and material encountered during the preparation phase. Upon commencement, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the Engineer. Upon completion of the insertion and installation of the new pipe, expedite the reconnection of lateral service connections so as to minimize any inconvenience to the customers.

Excavate, expose, and isolate all sewer service connections prior to the start of any pipe bursting operation and pipe insertion. Determine if any tee connections are live and in mortar, concrete, or reinforced concrete.

If existing manholes are used as pits, remove all inverts and benches and channels to permit access for installation equipment as appropriate. When installing through an existing manhole, enlarge the input and output pipe as appropriate to accommodate the maximum OD size of the bursting device.

**00412.42 Handling and Storage** - Exercise special care during the unloading, handling, and storage of all polyethylene pipes to ensure that the pipe is not cut, gouged, scored, or otherwise damaged. Remove any pipe segment that has cuts in the pipe wall exceeding 10% of the wall thickness. Store pipe in a manner such that it is not deformed axially or circumferentially. After the unloading of pipe material at the project site and before installation, inspect all pipes to verify their condition with the Engineer. Submit a pipe condition inspection report for review and approval prior to installation.

Polyethylene pipe without an ultraviolet inhibitor shall be protected against the outside elements.

**00412.43 Diversion of Flow** - Furnish, install, maintain and operate a bypass pumping system as needed in accordance with the diversion of flow specifications outlined in Section 00490.

**00412.45 Sags In Line** - The Engineer will identify any sag in the existing sewer greater than 1/2 inch and show on the plans. Take necessary means to eliminate these sags by the system of pipe replacement, digging a sag elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert or by other measures that shall be acceptable to the Engineer. Elimination of these existing sags shall be considered incidental to the pipe bursting bid item and no separate payment will be made.

Any sag found in a new pipe installed by pipe bursting that did not exist before installation of the new pipe shall be eliminated to the satisfaction of the Engineer at no additional cost to the City.

**00412.46 Point Repairs** - Repair the pipe where point repairs are identified on the Drawings. If not shown, point repairs will constitute extra work when approved by the Engineer. The work shall include verifying the location of the point repair, locating all interfering utilities, temporary flow bypassing, traffic control; excavation, haul off of all material, shoring, dewatering, pipe repairs or replacement, connections to existing pipe, backfilling, and surface restoration.

00412.47

**00412.47 Pipe Joining** - Sections of polyethylene pipe shall be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. Fusion equipment used in the joining procedure shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, fusion temperature, alignment, and fusion pressure. Electrofusion may be used for field closures as necessary when appropriate fusion equipment can be utilized in a trench type environment.

A fire-retardant bag or suitable enclosure shall be used with the heater plate to facilitate control of the heating process and to protect the heater plate surfaces from dirt and other debris when not in use. The heater plate surfaces shall be cleaned regularly as needed to prevent accumulation of fusion welding residues or other substances that may result in faulty pipe joining.

Butt fusion shall conform to ASTM D2657 and pipe manufacturer's criteria for the type of joining. Joint strength shall be equal to that of the adjacent pipe. All fusion of pipe shall be in accordance with Section 00445.

After achieving the proper melt pattern, the pipe ends shall be brought together in a firm, rapid motion applying sufficient pressure to form a pipe bead (1/8 inch to 3/16 inch in height) around and inside the entire circumference of the pipe.

The inside and outside of pipe ends shall be cleaned with a cotton or non-synthetic cloth to remove dirt, water, grease, and other foreign materials. The pipe ends shall be cut square and carefully aligned just prior to heating.

Make all connections to concrete manholes, structures and pipelines using slip-on sanded adaptors. Rejoin ends of the pipeline in accordance with the manufacturer's recommendation. Render the inside surface of the pipe free of cuts, gouges, or scratches. Remove fusion beads on the inside of butt welds with an inside rotary cutter or other approved method. Unless otherwise directed or approved, bead removal shall restore the inside diameter to that of the rest of the pipe. Use only tools and methods recommended by pipe manufacturer when cutting or machining the pipe.

**00412.48 Pipe Installation** - Excavate, expose, and isolate all sewer service connections prior to the start of any pipe bursting operation and pipe insertion. If the existing service connections are encased in mortar, concrete, or reinforced concrete, remove the encasement.

Install the pipe by utilizing a constant tension system with a static, hydraulic or pneumatic bursting device that breaks away the existing pipe. The void created by the bursting device shall be sufficient in size to accommodate the HDPE pipe, which shall be installed immediately after the void has been formed. Provide adequately designed pipe bursting equipment to accomplish the replacement of the existing pipe under all adverse conditions.

All noise related to construction activities shall comply with 00290.30(d).

At no time shall the bursting device or the installation process put any undue stress on the existing surface. Manhole benches and channels shall be reconstructed after the new pipe is in-place.

Secure the pipe to concrete structures or manholes after the pipe has been installed along the length of sewer replaced. Use a sanded coupler adapter, as supplied by the pipe manufacturer around the pipe exterior, and grouted into the structure wall to create a watertight seal. The new pipe shall extend 12 inches inside of the manhole opening. The structure or manhole connections shall be made a minimum of 12 hours after pipe insertion.

**00412.49 Low Pressure Air Testing** - Low pressure air testing shall comply with 00445.72.

**00412.50 Service Connections** - Successfully test the installed pipe prior to reconnecting sewer services. Sewer service connections shall be connected to the new pipe and installed in a hole that shall be drilled the full inside diameter of the outlet or as recommended by the connection manufacturer.

**Finishing and Cleanup**

**00412.70 Flushing** - Prior to final acceptance and final inspection of the pipe by the Engineer, flush and clean all parts of the system by removing all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the pipe.

**00412.71 Final Video Inspection** - Provide Post-Construction Video Inspection according to Section 00401.

**Measurement**

**00412.80 Measurement** - The quantity of the pipe replaced by pipe bursting will be measured on a linear foot basis, for each pipe size, from center to center of manholes or other structures, as applicable.

Service connections will be measured on a unit basis, per each, by actual count, regardless of size. There will be no measurement of excavation and backfill or the required testing.

**Payment**

**00412.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<b>Pay Item</b>	<b>Unit of Measurement</b>
(a) HDPE Pipe-burst Installation. ____ Inch.....	Foot
(b) Service Connections .....	Each

Item (a) the nominal size of the new HDPE pipe will be inserted in the blank.

00412.90

Item (b) includes all required work to excavate for, backfill, and install service connections.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Resurfacing work will be paid for according to Section 00495.

No separate or additional payment will be made for surface restoration for pits, CCTV inspection (pre and post) pipe cleaning (pre and post), sag elimination, point repairs, leak testing, and acceptance testing.





**Section 00415 – Vegetated Stormwater Facilities**

**Description**

**00415.00 Scope** - This work consists of constructing stormwater planters, swales or curb extensions to the lines and grades shown or established. The work includes furnishing and constructing connections to other drainage structures or systems, and installation and maintenance of the entire facility, as necessary, for a complete installation.

**00415.01 Definitions:**

**Stormwater Curb Extension** - A stormwater facility that protrudes into the roadway. The facility is often used to retrofit existing developed roadway by removing a portion of the existing pavement and roadbed. Then a curb is constructed closer to the roadway centerline in order to install a landscaped depression that collects, filters, infiltrates, and conveys stormwater. A stormwater curb extension may also be constructed with new roadway development. Existing sidewalks, plantings strips and curbs may or may not be modified. Plantings are surrounded by vertical curbs or walls on all sides.

**Stormwater Planter** - A stormwater facility with a relatively flat landscaped reservoir used to collect, filter, infiltrate and convey stormwater. Plantings are surrounded by vertical curbs or walls on all sides.

**Stormwater Swale** - A stormwater facility with a landscaped depression used to collect, filter, infiltrate, and convey stormwater. Plantings are located on gradually sloping areas between the roadway curbing and sidewalk.

**Materials**

**00415.10 Materials** - Furnish materials meeting the following requirements:

- Coir Filter Fabric.....00280.10(v)
- Commercial Grade Concrete ..... 00440
- Controlled Low Strength Material (CLSM) ..... 00442
- Geomembrane Liner..... 00350
- Mulches ..... 01040.20
- Open Graded Aggregates .....02690.20(g)
- Perforated Corrugated Polyethylene Pipe ..... 02410.60
- Plantings..... 01040
- Topsoil, Stormwater Facility.....01040.14(d)

**00415.11 Plastic Sheeting** - Use minimum 30 mil thick polyvinyl chloride or HDPE sheeting.

**00415.12 Ballast Aggregates** - Furnish ballast aggregates of 4" - 2" as shown. Use clean, hard, durable aggregates, reasonably well graded from the maximum to minimum size.

**00415.13 Ballast Aggregates Acceptance** - The material will be accepted by visual inspection by the Engineer.

### Construction

**00415.40 General** - Construct the planters or swales as shown or as directed. A facility table, including finish elevations and dimensions, will be provided by the Engineer.

The length of open excavation in advance of concrete or soil placement operations shall be kept to a minimum, and in no case shall it exceed two blocks at one time unless otherwise approved. If the unfinished excavation or restoration exceeds approved limits, the associated construction operation shall be suspended and not resumed until authorized.

**00415.41 Earthwork** - Excavate according to Section 00330 and to the depths, widths, and cross-sections shown, specified, or directed. Facility bottoms, temporary construction benches, and final soil surfaces shall be without ruts or other surface imperfections capable of channeling water flows.

**00415.42 Existing and Proposed Utility Services** - When encountered during construction, utility lines must be relocated by the utility owner. Coordinate this work with the Engineer and each facility per 00150.55(c).

Wherever existing utility service trenches are encountered adjacent to a facility during excavation and construction, provide a watertight seal along the utility trench wall whenever granular material is present in the exposed portion of the trench. The seal shall be by means of a native soil, imported clay or bentonite plug as approved. Taking care not to over-excavate, carefully remove the granular material at least 6 inches into the rock trench wall and firmly pack the resulting space with native soil, imported clay, or bentonite as directed

**00415.43 Plastic Sheeting of Geomembrane Liner** - Install as shown or directed.

**00415.44 Retaining Walls, Concrete Curbs, Walks and Other Concrete Structures** - Install as shown or directed. Remove all concrete overspill and debris from facility prior to aggregate or topsoil placement.

**00415.45 Material Placement** - After construction of the concrete elements, install materials as shown or directed.

**00415.46 Facility Erosion Control** - Temporary erosion control measures are required until permanent stabilization methods are functional. Install as shown or directed, and in accordance with Section 00280.

**00415.47 Finish Grading** - Grade slopes in a uniform manner as shown or directed. Bring grading conflicts to the Engineer prior to proceeding with the work. Round any abrupt changes in the surfaces and feather grades gradually to meet existing contours. Minor adjustments to the grading and contouring shown are anticipated to meet site conditions. Hand grading and final refinement of the finish grade shall be as directed. The Engineer will have final approval of all grading and contouring.

**00415.48 Protection of the Facility** - During all phases of construction, the facility must be protected from foot or equipment traffic that is unrelated to the construction of the facility. Under no circumstances should materials and equipment be stored in the facility. If an excavated area is to be left open overnight, secure the area to ensure public safety by installing temporary fencing and traffic control measures as directed.

Facilities shall be kept clean and shall not be used as erosion or sediment control structures during construction.

**Facility Maintenance and Establishment**

**00415.60 Maintenance and Establishment Period** - During the 2 year warranty period, the facilities are to be inspected and cleaned at least every 6 months, as sediment or debris accumulation necessitates. In this same period, refresh or restore topsoil and plantings in accordance with good horticultural practices under prevailing conditions. At the end of the warranty period, and prior to final inspection and acceptance by the City, perform a final clean-out of the facility.

**Measurement**

**00415.80 Measurement** - The quantities of facilities constructed under this Section will be measured on the area basis, in place:

**Area Basis** - Measurement will be on the ground surface by the square foot. The limits of measurement will be the back of curb, edge of sidewalk, or other asphalt or concrete structure surrounding the facility. If a facility does not have an edge on a side, the limit of measurement will be the top of slope of the facility.

**Payment**

**00415.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

<b>Pay Item</b>	<b>Unit of Measurement</b>
(a) Stormwater Curb Extensions.....	Square Foot
(b) Stormwater Planters.....	Square Foot
(c) Stormwater Swales.....	Square Foot

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

When earthwork is included as separate pay items, payment will be made according to 00330.90 through 00330.94 as appropriate.

When earthwork is not included as separate pay items, no separate or additional payment will be made for earthwork.

00415.90

| Pipe outside of the defined facility area will be paid for according to Section 00445.

| Inlets will be paid for according to Section 00470.

| Connection to existing structures will be paid for according to Section 00490.

| Retaining walls will be paid for according to Section 00596.

| Pavement and base aggregate will be paid for according to Sections 00640 and 00744.

| Concrete curbs, walks and other miscellaneous concrete structures will be paid for according to Section 00759.

## Section 00430 - Subsurface Drains

### Description

**00430.00 Scope** - This work consists of constructing subsurface drains to the lines and grades shown or established using drain pipe, special filter material or granular drain material, and drainage geotextile.

**00430.01 Definitions** - The terms used in designating drain pipe or when referring to them on the plans are as follows:

**Aluminum** - The base metal for aluminum sheets.

**Concrete, Steel, Aluminum, Polyethylene, Polyvinyl Chloride** - The basic material of the pipe.

**Drain Pipe** - Perforated pipe of specified material.

**Metal** - Aluminum and steel.

**Steel** - The base metal for galvanized or aluminum coated sheets.

**Subsurface Drain** - Drainage system beneath the base, usually with a perforated drain pipe, to collect and drain groundwater.

**00430.02 Contractor's Options** - If the Contractor has an option of using different kinds of pipe, the option and its limitations will be shown on the plans or on a "Pipe Data" sheet of the plans.

The limiting factors and requirements shown on the plans or on the Pipe Data sheet are minimums. The Contractor may substitute stronger, larger, and higher quality material at any installation site, provided the substitution meets the approval of the Engineer and is made at no additional cost to the City.

**00430.03 Size Determination** - The nominal size of pipe will be determined according to AASHTO tolerances for pipe dimensions for the appropriate kind or class of pipe.

### Materials

**00430.10 Materials** - Furnish materials meeting the following requirements:

00430.11

Commercial Grade Concrete .....	00440
Delineators.....	00840
Drainage Geotextile .....	02320
Perforated Concrete Pipe.....	02410.10
Perforated Corrugated Aluminum Alloy Pipe.....	02420.50
Perforated Corrugated Polyethylene Pipe.....	02410.60
Perforated Corrugated Steel Pipe .....	02420.30
Perforated Polyvinyl Chloride Pipe.....	02410.70
Protective Coatings.....	02420.20
Special Filter Materials.....	02610.10

Furnish wire mesh that is commercial quality 1/4 inch galvanized metal screening.

**00430.11 Granular Drain Backfill Material** - Furnish granular drain backfill material of 1 1/2" - 3/4", 1 1/4" - 3/4", or 3/4" - 1/2" crushed or uncrushed rock or gravel meeting the requirements of 02690.20(d) and the following gradation requirements:

Sieve Size	Percent Passing (by weight)		
	Designated Sizes (inch)		
	1 1/2" - 3/4"	1 1/4" - 3/4"	3/4" - 1/2"
2"	100		
1 1/2"	95 - 100	100	
1 1/4"	-	90 - 100	
1"	-	-	100
3/4"	0 - 15	0 - 15	90 - 100
1/2"	0 - 2	0 - 2	0 - 15
1/4"	-	-	0 - 3

**Construction**

**00430.40 General** - Excavate trench, prepare bedding, backfill, except as noted in 00430.46, according to Section 00405 and dispose of excavated materials according to Section 00330. If required, place geotextile according to Section 00350 before backfilling.

Install a Type W-1 delineator at each outlet protection block as shown.

**00430.41 Foundations in Unyielding Material** - Excavate rock, hardpan or other unyielding materials a minimum of 3 inches below established grade of the pipe exterior to place special filter material or drain backfill material.

**00430.42 Laying Pipe** - Lay the pipe according to Section 00445. Place pipe with perforations down unless otherwise directed.

**00430.43 Joining Pipe** - Fasten pipes together with appropriate coupling fittings or bands as specified for the type of pipe used. Close upstream end of pipe with plugs suitable to prevent entry of soil materials.

**00430.44 Contact Surfaces, Aluminum to Concrete** - Coat aluminum pipe and aluminum coated steel pipe that contact portland cement concrete with asphalt mastic according to Section 00445.

**00430.45 Inspection** - The installation will be inspected after the pipe is laid and joined and before backfilling. Remove and reinstall or replace any pipe found to be out of alignment, unduly settled or damaged.

**00430.46 Backfilling:**

**(a) Special Filter Material** - After the pipe is installed and inspected, place up to 12 inches of uncompacted special filter material above the top of the pipe. Above this, place approved backfill material or special filter material, as directed, and compact according to Section 00405.

**(b) Granular Drain Backfill Material** - Drainage geotextile is required when using granular drain backfill material. Place granular drain backfill material according to (a) above and as shown.

**Measurement**

**00430.80 Measurement** - The quantities of subsurface drain pipes of the various kinds, types and sizes will be measured, with no deduction for fittings and special sections, along the pipe flow line from end to end of pipe.

The quantities of subsurface drain outlets will be measured on the unit basis.

**Payment**

**00430.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) _____ Inch Drain Pipe .....	Foot
(b) Subsurface Drain Outlets .....	Each

In item (a), the nominal diameter of pipe will be inserted in the blank.

Item (b) includes furnishing and installing pipe, constructing outlet protection blocks, connecting pipe to inlets, and excavating and disposing of excess materials.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Delineators will be paid for according to 00840.90.

Trench resurfacing will be paid for according to 00495.90.

00430.90

No separate or additional payment will be made for:

- trench excavation
- trench backfill
- special filter material
- drainage geotextile
- granular drain backfill
- fittings
- special pipe sections





**Section 00440 - Commercial Grade Concrete**

**Description**

**00440.00 Scope** - This work consists of furnishing, placing and finishing commercial grade concrete (CGC).

**Materials**

**00440.10 Materials** - Furnish materials meeting the following requirements:

	Admixtures.....	02040
	Aggregates.....	02690
	Bonding Agents.....	02070
	Cement.....	02010
	Curing Materials.....	02050
	Grout.....	02080
	Modifiers.....	02030
	Water.....	02020



**00440.11 Proportioning** - Furnish in writing to the Engineer, the proportions by weight of the following materials before using CGC:

- air entraining admixtures
- cement
- each size of aggregate
- fly ash
- GGBF slag
- other admixtures
- water

**00440.12 Properties of CGC** - Furnish a workable mixture of CGC that is uniform in composition and consistency, and has the following characteristics:

- **Entrained Air** - 4.0% to 7.0%
- **Slump** - 5 inches or less
- **Compressive Strength** - Minimum 3,000 psi at 28 days
- **Temperature** - Minimum 50 °F to maximum 90 °F

**00440.13 Field-Mixed Concrete** - CGC may be field mixed for work items listed in 00440.14(a).

**00440.14 Acceptance Sampling and Testing:**

**(a) General** - Acceptance sampling and testing will be based on samples obtained at the site of placement from the discharge of the delivery vehicle. All sampling and testing shall be performed by a QCT.

00440.15

CGC mixture may be accepted visually for the following items of work:

<b>Work Item</b>	<b>Section</b>
Electrical Conduit Backfill .....	00960
Fence Post Footings .....	01050
Guardrail Anchors .....	00810
Irrigation System Thrust Blocks.....	01120
Mailbox Support Footings.....	01070
Outlet Protection Blocks .....	00430
Square Tube Sign Support Footings .....	00930

(b) **Delivery Tickets** - Send a delivery ticket with each load recording the source, day, time of batch, size of load and quantity of individual constituents in the load. A delivery ticket will not be required for field-mixed concrete.

(c) **Plastic CGC** - Acceptance of plastic CGC will be based on tests performed by the QCT according to the MFTP and 00440.12.

(d) **Hardened CGC** - Acceptance of the hardened CGC will be according to 00440.12. Cast one set of cylinders per 20 cubic yards, with a maximum of one set per day.

**00440.15 Quality Control** - Provide quality control according to Section 00165.

**00440.16 Pre-Approved Mix Designs** - Contact the Project Manager for a list of pre-approved CGC Mixes.

**Labor**

**00440.30 Quality Control Personnel** - Provide certified technicians in the following fields:

- CSTT
- QCT

**Construction**

**00440.40 General:**

(a) **Mixing** - Mix CGC to the extent that ensures a uniform distribution of materials throughout the mixture.

(b) **Placing** - Place CGC according to the appropriate Sections in which CGC is required and the following:

- Place using the best common practices to avoid segregation.
- Vibrate and spade to achieve a dense homogeneous concrete, free of voids and rock pockets.
- Place within 90 minutes after batching and mixing.

(c) **Forms** - Provide forms for CGC according to the appropriate Sections in which CGC is required and best common practices. Place to the lines and grades shown or directed.

(d) **Weather** - Do not place CGC when the air temperature is below 35 °F without approval.

Protect from freezing if the air temperature is expected to drop below 35 °F during the first 5 calendar days after CGC placement.

(e) **Curing** - Cure CGC by covering with burlap, canvas, sand or other acceptable material, and keep moist for a minimum of 7 calendar days.

Curing compounds may be used except on concrete surfaces or reinforcement that will come in contact with adjacent concrete pours. Use compounds according to the following:

Section	Item	Type 1 or 1-D Clear	Type 2 White-Pigmented
00480	drainage curbs	*	*
00599	slope paving curbs, and berm paving	Yes	No
00759	walks, sidewalk ramps, driveways, surfacings, curbs, and islands	*	*

\* Use Type 2 except when the Engineer requires Type 1 or 1-D

Apply curing compounds at a rate of not be less than 1 gallon per 150 square feet.

**00440.41 General Surface Finish** - Give concrete surfaces a general surface finish, according to 00540.53(a), in addition to the finish specified for a particular item of work.

**00440.42 Replacement or Price Reduction** - Remove concrete represented by cylinders that fail to meet the minimum strength requirement and replace at no additional cost to the City. If the Engineer determines that the low-strength concrete is suitable for the purpose intended, the Contractor may accept a price reduction established by the Engineer instead of removal and replacement.

**Measurement**

**00440.80 Measurement** - No measurement of quantities will be made for CGC.

00440.90

**Payment**

**00440.90 Payment** - No separate or additional payment will be made for CGC. Payment will be included in payment made for the appropriate items under which this work is required.



**Section 00442 - Controlled Low Strength Materials**

**Description**

**00442.00 Scope** - This work consists of furnishing and placing Controlled Low-Strength Materials (CLSM).

**00442.01 Definition:**

**Controlled Low-Strength Material** - A highly flowable lean concrete mix; a mixture of fly ash, cement, fine aggregates, water and admixtures, if necessary.

**Materials**

**00442.10 Materials** - Furnish materials meeting the following requirements and as modified in the Special Provisions:

Admixtures .....	02040
Fly Ash .....	02030.10
Portland Cement .....	02010.10

**00442.11 Fine Aggregates** - Furnish fine aggregates that are commercial quality concrete sand.

**00442.12 Proportioning of CLSM Mixture** - Furnish the following, to the Engineer, prior to using any CLSM on the Project:

- Written certification of proposed CLSM materials proportions and compressive strength.
- 28-day cylinder reports from a trial CLSM batch based on above certification. Include evidence that compressive strength requirements for specific applications are met.

**00442.13 Compressive Strength** - CLSM shall attain a 28-day compressive strength of 100 psi - 200 psi.

**00442.14 Acceptance** - Acceptance will be based on the Engineer's review and approval of written certification and trial batch cylinder reports as required by 00442.12.

**Measurement**

**00442.80 Measurement** - No measurement of quantities of CLSM will be made for CLSM.

**Payment**

**00442.90 Payment** - No separate or additional payment will be made for CLSM. Payment will be included in payment made for the appropriate items under which this work is required.

**Section 00445 - Sanitary, Storm and Culvert Pipe**

**Description**

**00445.00 Scope** - This work consists of constructing and or/reconstructing culverts, gravity and pressure sewers, service laterals, underdrains, inlet leads, stubouts, and associated joints, fittings, and other accessories.

Install pipes in the kinds, sizes and lengths and at the locations shown on the plans or as directed to the lines and grades established. The work includes furnishing and constructing joints and connections to other drainage structures or systems, as necessary, for complete installations.

**00445.01 Definitions** - The following terms have the meanings presented below when used in this Section:

**Concrete, Ductile Iron, PVC, and HDPE** - The basic material of the pipe

**Concrete Block** - Encasements, thrust blocks, anchor blocks, plugs and cutoff diaphragms

**Culvert Pipe** - Typically, a concrete, ductile iron, PVC, or HDPE pipe passing under a roadway

**DR (Dimension Ratio)** - The pipe average outside diameter divided by its minimum wall thickness

**Flexible Pipe** - Pipes constructed of ductile iron, PVC, steel and HDPE. For the purposes of these specifications, all potable water pipes are considered to be flexible pipes.

**HDPE** - High Density Polyethylene

**Joint** - The place where the ends of sections or modified sections of pipe contact one another

**Metal Pipe** - Ductile Iron

**Pavement** - Pavement as defined in Section 00110, as well as driveways, curbs, gutters, walks, dikes, walls and other similar asphalt or portland cement concrete structures

**Pipe** - All pipe, regardless of kind, size, shape or use

**Plain Concrete** - Non-reinforced concrete

**PVC** - Polyvinyl Chloride

**Rigid Pipe** - Pipes, other than potable water pipes, constructed of concrete and clay

**Sanitary and Storm Sewer Pipe** - Typically, concrete, PVC, solid wall HDPE or ductile iron pipe.

**SDR (Standard Dimensional Ratio)** - Same as DR

**Section** - The individual pieces in which the furnished pipe is manufactured.

#### **Materials**

**00445.10 General** - Furnish appropriate manufacturer or fabricator certification, based on the manufacturer's quality control tests, that the materials used in the production of the pipe meet these Specifications. Materials and strength shall be as specified for the particular kind of pipe and fittings required.

Use flexible elastomeric gasket joints on all pipes and fittings unless joining pipe by butt fusion. Furnish caps or plugs with each fitting, outlet or stub as required, with the same type gasket or joint as the pipe.

Each pipe shall be clearly marked to identify its class and date of manufacture.

Use the same material for all pipe and fittings for both the sewer mainline and any service laterals located between two consecutive manholes, unless otherwise approved. Use 6 inch pipe for residential service laterals when not otherwise specified.

Provide tee or wye fittings in the sewer main for service laterals and catch basins or inlet connections. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

Cap or plug all fittings that are terminal ends or for future use and provide with gaskets of the same material as used in the pipe joint. Fit with an approved mechanical stopper, or install an integrally cast knockout plug. The cap or plug shall be capable of withstanding test pressures without leaking and, when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

00445.11

**00445.11 Materials** - Furnish materials meeting the following requirements:

Corrugated or Spiral Rib Aluminum Alloy Pipe.....	02420.40
Corrugated or Spiral Rib Steel Pipe and Pipe Arches.....	02420.10
Commercial Grade Concrete in blocks .....	00440
Ductile Iron Pipe.....	02420.11
Electronic Location and Visual Identification of Sewers .....	00446
Metal Reinforcement in Blocks.....	02510.10
Nonreinforced Concrete Pipe.....	02410.10
Polyvinyl Chloride (PVC) Pipe.....	02410.70
Protective Coatings.....	02420.20
Reinforced Concrete Pipe.....	02410.10
Rubber Gaskets .....	02440.40
Solid Wall High Density Polyethylene (HDPE) pipe ..	02410.60

**(a) Pipe Anchors** - Use pipe anchors conforming to the details as shown.

**(b) Cleanouts** - Use materials conforming to the details as shown.

**(c) Electronic Location and Visual Identification of Sewers** - Use materials in accordance to Section 00446.

**(d) Fittings for Concrete Pipe** - Where fittings are fabricated by inserting a stub into a hole cut in concrete pipe, grout with a non-shrink grout. Coat surfaces to receive grout with an epoxy bonding agent prior to grouting. Fitting stubs shall not protrude inside of the sewer pipe.

**(e) Fittings for HDPE Pipe** - HDPE fittings shall be molded or fabricated. Manufacture all HDPE fittings from the same cell class of material as the mainline pipe. Fittings shall be manufactured in accordance with ASTM D 3261-97. Butt fusion outlets shall be manufactured to the same outside diameter or externally reinforced wall thickness, tolerances and the internal pressure service equivalent as the mating pipe.

**(1) Fittings for Gravity HDPE Pipe** - For gravity HDPE pipe, fittings shall have a DR of the same or greater strength than the pipe.

**(2) Fittings for Pressure HDPE Pipe** - All HDPE fittings used in pressure pipeline applications shall be pressure rated the same as or greater than the pressure rating of the pipe. Mitered HDPE fittings used in pressure applications shall be manufactured using the butt fusion process from pipe of the same size and a minimum of one Standard Dimension Ratio heavier than the main pipe.

Use Type 316 stainless steel stiffeners where plain ends of pipe are used in conjunction with mechanical fittings that rely on compressing the outside pipe diameter. Also use stainless steel stiffeners whenever mechanical restraints provide restraint to a HDPE pipe system.



**(f) Flanges for HDPE Pipe** - Where approved, use flanged connections to mechanically connect HDPE pipe to HDPE pipe and fittings. Use HDPE pipe flanges with Type 316 stainless steel backing rings. All nuts, washers and bolts for flanges shall be Type 316 stainless steel. Connection hardware shall develop the full strength of the flanged joint. Suitable gaskets are required when joining to non-polyethylene materials.

**(g) Flexible Couplings for HDPE Pipe** - Use flexible couplings for joining HDPE pipe to HDPE pipe and fittings. Flexible couplings shall be specifically designed for the application, and shall have a pressure rating equal to or greater than the main pipe.

**(h) HDPE Laterals** - Tee and wye fittings to connect service laterals shall be either molded butt fusion HDPE fittings or molded saddle fusion HDPE fittings. In situations where laterals exceed the sizes available in molded fittings, fabricated HDPE fittings will be allowed only with approval.

**(i) Joints for HDPE Pipe** - HDPE pipe and fittings shall be joined by the butt fusion process set forth in ASTM D 3261-97 and ASTM D 2657-97. The butt fusion procedure shall also conform to the manufacturer's specific recommendations. The tensile strength at yield of the butt fusion joints shall be not less than that of the pipe.

**(j) Service Lateral 2 Inch x 4 Inch Markers** - Use materials conforming to Section 00446.

**(k) Flexible Closure Collar Couplings** - Do not use flexible closure collar couplings unless specified or approved. Couplings shall incorporate full length and full diameter shear bands. All metal parts shall be stainless steel. Couplings shall be of the type produced by "Fernco" or "Mission" or approved equal.

### Labor

**00445.30 General** - Perform all pipe fusion using a competent operator that has been trained, as certified by the supplier or manufacturer of the pipe.

**(a) Welder Qualifications for Fusing HDPE Pipe** - The operator shall have a minimum of 2 years experience in fusing those sizes of pipe shown. A representative of the supplier shall field review and approve the procedure used for the first 4 fusion joints.

**(b) Training Sessions** - Provide training sessions on the proper procedures for testing, assembly and installation of HDPE pipe and associated hardware. Address polyethylene fusion machine operation instructions in detail. General construction personnel with the responsibility of assembly, fabrication, handling, installation, and testing of pipe shall attend training. Quality control personnel and polyethylene fusion machine operators shall also attend training sessions. Submit a list of those authorized to perform polyethylene fusion before any installation or work on HDPE pipe.

00445.40

Make all training sessions available to the Engineer at no additional cost to the City. Schedule training sessions at a date and time agreeable to both parties.

### Construction

**00445.40 General** - Construct culvert, sanitary sewer, and storm sewer, pipe according to the following:

**(a) Trench Work** - Excavate trench, prepare bedding, pipe zone material and trench backfill, and dispose of excavated material according to Section 00405.

**(b) Line and Grade** - The Engineer will establish centerline and grade control prior to the start of construction.

Do not deviate from the specified line and grade more than 1/2 inch for line and 1/4 inch for grade, provided such variation does not result in a level or reverse sloping invert. Measure for grade at the pipe invert.

Establish line and grade with an approved pipe laser, or other approved method, by transferring the cut information from the offset stakes starting with 0+00 at a downstream manhole or structure, then, at intervals of 0+10, 0+25, and 0+50 and continuing at 50 foot intervals, maximum, thereafter.

All other methods of establishing line and grade for pipe shall transfer the cut information from the offset stakes at maximum intervals of 25 feet. Submit all other alternate methods, other than lasers, for approval before beginning work.

Lay sewer service lateral pipe in a straight line and at a uniform grade between the tee or wye and the end stake established by the Engineer. Where minimum slopes are used, lay the pipe by means of a builder's level of good quality and not less than 24 inches in length. Minimum slope shall be 1/4 inch per foot unless otherwise approved but in no case less than 1/8 inch per foot.

**(c) Pipe Distribution and Handling** - Unload pipe only by approved means.

Inspect the pipe and fittings prior to lowering into the trench to ensure no cracked, broken or otherwise defective materials are used. Clean the ends of the pipe thoroughly, remove foreign matter and dirt from the inside of the pipe, and keep the pipe clean during laying and joining.

Do not distribute more than one day's supply of material in advance of pipe laying unless otherwise approved. Do not unload pipe of any size by dropping to the ground. Do not drop or dump pipe into trenches. Lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. Remove all damaged pipe from the jobsite.

**(d) Concrete Closure Collars** - Use concrete closure collars only when approved, and only to make connections between dissimilar pipe or where standard rubber gasketed joints or transition couplings are not available. Place the collars using an approved commercial concrete bonding agent applied to all surfaces in contact with the collar. Where concrete closure collars are necessary to join PVC pipe, first prepare the PVC surface for bonding to the concrete by applying a dense coating of clean mortar sand to the pipe using PVC solvent cement. After the cement has cured, apply an approved commercial concrete bonding agent to the sand surface prior to placement of the concrete.

**(e) Installation of Sanitary Sewer Service Tees and Wyes** - Install tees, wyes and service lateral fittings as shown or as staked in the field. Provide a compacted aggregate base of pipe bedding material under all tees, wyes and lateral fittings extending to the springline of the fittings.

Provide ends of all service laterals and fittings with an approved watertight plug, or cap suitably braced to prevent blow off during hydrostatic or air tests. The plug or cap shall be removable and provide a socket suitable for making a flexible joint lateral connection or extension.

The maximum deflection permissible with any one fitting, except a service lateral tee, shall not exceed 45°; accomplish the deflection with standard bends.

Connect a service lateral to a manhole or structure only when approved. Make the connection so a standard pipe joint is located not more than 18 inches from the manhole or structure.

**(f) Pipe Anchors** - Construct metal or concrete pipe anchors as specified or as shown.

**00445.41 Installing Pipe Under Railroad** - Prior to beginning any under-track work, submit plans of construction, and details of the methods and equipment proposed to be used, to the Engineer for submittal to the Railroad. Do not begin under-track work until Railroad approval is obtained.

Within the limits indicated on the plans, do not install the pipe under the railroad tracks by the open trench method. Within these limits install the pipe by tunneling, jacking, boring or similar methods, approved by the Railroad, as the Contractor elects, according to Section 00406. Install the pipe to the lines and grades established and backfill completely all voids around the installation with specified material, to the satisfaction of the Railroad.

**00445.43 Placing and Joining Pipe:**

**(a) General** - Begin pipe laying at the downstream end of the pipe line and proceed up grade with spigot or tongue ends pointing in the direction of flow. Assemble joints in accordance with the recommendations of the manufacturer for the type of joint used. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

Take care to properly align the pipe before joints are forced entirely home. All pipe joints shall be in the "home" position, where the least gap (if any) exists when the pipe components that are fitted together as tightly as the approved joint design permits. After installation, prevent movement from any cause including uplift or floating.

Prevent excavated or other foreign material from getting into the pipe. Plug or close off pipes that are stubbed off for future connection. When cutting or machining of the pipe is necessary, use only the tools and methods recommended by the pipe manufacturer. All field joints shall:

- Provide equal or greater strength than the adjoining pipe.
- Fit close and tight.
- Provide a smooth and uniform interior surface.
- Secure and hold adjoining sections to each other.
- Fasten securely to adjoining structures and special sections.

**(b) Concrete Pipe:**

**(1) Elliptical Reinforced Pipe** - Lay elliptical reinforced pipe so that the top or bottom marks are not more than 5° from vertical.

**(2) Flexible Joints at Structures** - Provide 36 inch or smaller sewer pipes entering or leaving manholes or other structures with flexible joints within 18 inches of the exterior wall. Pipes larger than 36 inch shall have a flexible joint within a distance from the exterior wall equal to 1/2 the inside pipe diameter. If the flexible joint exceeds the specified distance from the exterior wall, Class A bedding, in Section 00405, may be used as a substitute. Do not substitute Class A bedding without first receiving the City's approval. Class A bedding, shall extend from the structure to the back of the pipe bell. Also provide a #4 rebar mat with 3 longitudinal bars minimum, cross-tied on 12 inch centers beneath the pipe and extended into the structure wall or base or as directed.

**(3) Joint Gap** - Repair all joint gaps that exceed the normal "home" position gap by more than 1/4 inch. In cases where a joint gap exists but does not exceed the normal "home" position gap by more than 1/4 inch, the Engineer may require repair of the joint if, in the Engineer's judgment, these gaps detract significantly from the integrity of the joint based on soil conditions and the intended use of the pipe.

**(4) Multiple Excessive Joint Gaps** - When three or more joint gaps exceed the allowable joint gap or when three or more corrections of defective work occur within any manhole-to-manhole section, properly relay all pipe between first and last defect to reduce the total defects to two per manhole-to-manhole section. Complete this work at no additional cost to the City. Work required in repairing or re-laying is included as part of Contractor's construction work limits.

**(5) Excessive Joint Gap** - Should a joint gap in the completed line exceed the allowable joint gap determined in accordance with the MSPCP and these Specifications or should visible leakage exist at the joint, construct a reinforced concrete closure collar around the joint or re-lay the pipe as approved at no additional cost to the City. Repaired joints will be subject to joint testing requirements.

**(c) PVC Pipe** - Install PVC pipe and fittings in conformance with the manufacturer's recommendations.

Cut the pipe in a neat manner, at right angles to the axis of the pipe, and dress the cut end.

**(1) Connections to Manholes** - Make connections to manholes with an approved manhole adapter grouted into the manhole wall or cast-in-place with the manhole base. If the joint at the coupling meets the requirement of a flexible joint as determined by the Engineer, no additional flexible joint within 18 inches of the manhole wall will be required.

**(2) Service Lateral Connections to Mainline** - Connect service laterals to mainline PVC sewer pipe with full line tees and standard wyes and eighth bends.

**(3) Perforated PVC Pipe** - Install perforated PVC pipe according to Section 00430.

**(d) HDPE Pipe** - Install solid wall HDPE pipe and fittings in conformance with the manufacturer's recommendations.

Assemble and join solid wall HDPE pipe at the site using the thermal butt-fusion method or approved coupler to provide a leak proof joint. Threaded or solvent-cement joints are not permitted. All equipment and procedures used shall be in strict compliance with the manufacturer's recommendations. Use personnel certified as fusion technicians by the manufacturer of the pipe or fusing equipment to accomplish the fusing.

Join HDPE pipe by the thermal butt fusion method prescribed in ASTM D 2657-97 and ASTM D 3261-97, and also in accordance with the procedures established by the pipe manufacturer, including fusion pressure, temperatures and cycle times when specified. Pay particular attention to use of proper interface pressures and heater plate temperatures. The tensile strength at yield of the butt-fused joints shall not be less than that of the pipe.

Only personnel possessing appropriate qualifications and certifications shall join pipe. If necessary, clear, grade and surface joining sites to provide enough space for pipe storage and fusion equipment. Render the site free of rocks, stumps and debris that could cut, scar, or gouge the pipe. Provide a shelter over the joining operation during adverse weather conditions. Prevent water from coming into contact with the fusion heater plate. Perform all joining above ground unless otherwise approved.

Assemble lengths of pipe into suitable installation lengths. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier. Prior to attempting fusion on polyethylene pipe, qualified joining personnel shall obtain and use correct fusion temperature, interface pressure, and cycle time information for the particular HDPE material being joined. The selected fusion equipment shall conform to pipe manufacturer equipment recommendations.

Fused joints on gravity pipelines do not require electronic data recording, unless directed. Fused joints on pressure pipelines shall be monitored and documented with an electronic data recording system. Use the data recording system to monitor the following information:

**(1) Data Recording System Record Data**

- Date and Time
- Joint Number
- Job Number
- Employee Number
- Machine ID
- Machine Model
- Piston Area
- Pipe Material
- Pipe Size

**Interface Pressures**

- Heat
- Soak
- Fuse
- Cool

**Recommended Gauge Pressure**

- Heat
- Soak
- Fuse
- Cool

**Recorded Data**

- Drag Pressure
- Data logger Probe Temperature
- External Probe Temperature

The data recording system shall be McElroy Datalogger or approved equal. At the start of each shift, provide the Engineer with copies of the fusion graphs for the previous shift's fusions. Cut out and remove any joints determined to be outside the acceptable parameters a minimum of 12 inches from the joint and rejoin using the thermal butt fusion process.

Install fittings, couplings and fuse joints to make a complete HDPE pipe system. During shipping, delivering, and installing, handle and store the pipe, fittings, and accessories according to manufacturer's recommendations and in such a manner as to ensure a sound, undamaged condition upon incorporation into the Work. Provide adequate storage for all site-delivered materials and fusion equipment. Protect and maintain all such material and equipment.

Follow manufacturer's recommendations when hauling, unloading, and stringing pipe. Take all necessary precautions to prevent damage to the pipe. Do not push or pull pipe and fittings over sharp projections. Do not drop pipe or allow other objects to be dropped on it.

Inspect the pipe for defects before installation. Remove any pipe from the site that shows kinks, buckles, cuts, gouges, or any other damage that may affect the performance of the pipe and replace it with new identical pipe. Remove all sections of pipe with cuts, gouges, or scratches on the outside surface of the pipe that exceed 10% of the wall thickness of the pipe. Whether found before or after installation, replace defective material with sound identical material without additional cost to the City.

Lower pipe and accessories into the trench by means of derrick, ropes, belt slings, or other suitable hoisting equipment. Unless otherwise directed, complete all joints before placing butt-fused polyethylene pipe in the trench. Do not under any circumstances drop or dump any pipeline materials into the trench. Before backfilling, render the full length of each section of pipe resting solidly upon pipe bedding material. Pipe that has the bedding grade disturbed after placement shall be taken up and reinstalled.

Do not perform pipe fusion in water or when trench conditions are unsuitable for the Work. Join all butt-fused joints above ground and not in the trench unless otherwise approved. If so approved, water shall be kept out of the trench until joining is completed.

When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substance will enter pipe or fittings. Pipe ends left for future connections shall be plugged or capped.

Polyethylene pipe shall be brought to within 5 °F of ambient earth temperature prior to cutting to length for placement of fittings. All HDPE pipe shall be at the temperature of the surrounding soil at the time it is backfilled and completed.

Make all connections to concrete manholes, structures and pipelines using slip-on sanded adaptors. Rejoin ends of the pipeline in accordance with

the manufacturer's recommendation. Render the inside surface of the pipe free of cuts, gouges, or scratches. Remove fusion beads on the inside of butt welds with an inside rotary cutter or other approved method. Unless otherwise directed or approved, bead removal shall restore the inside diameter of the rest of the pipe. Use only tools and methods recommended by pipe manufacturer when cutting or machining the pipe.

(2) **Bolt Up Procedure for Flanged HDPE** - Submit manufacturer's bolt up procedure.

(e) **Field-Fabricated Fittings:**

(1) **Fittings** - Field fabricate tee or wye fittings for required connection when shown or approved. Field-fabricated connections shall be free of visible leakage. Make all field-fabricated tee or wye fittings equal to or better than approved manufacturer supplied tee or wye fittings and provide a flexible joint at the point of connection to the tee or wye. Do not allow the tee or wye to protrude past the inside wall surface of the sewer main. Finish the inside wall surface to provide a smooth, uniform area for uninhibited flow.

(2) **Connection to Sewer Main** - Fabricate fittings by inserting a pipe stub into a hole cut in the sewer main and grout with a non-shrink grout. Coat surfaces to receive grout with an epoxy-bonding agent before grouting. Submit fabrication details of fittings for approval before fabrication. The Engineer may require steel reinforcement at no additional cost to the City. If approved, use a pre-manufactured pipe connector in lieu of tees for field-fabricated connections on sewer reconstruction projects.

(f) **Inspection** - After the pipe is laid and joined, and before any backfilling over it, the installation will be inspected. Re-lay or replace any pipe found to be out of alignment, unduly settled, to have excessive joint gap, or to be damaged.

(g) **Service Lateral 2 Inch x4 Inch Markers** - Install 2 inch x 4 inch markers at the end of each new service lateral not connected to a building sewer as shown or as directed by the Engineer and according to Section 00446.

(h) **Disconnection and Reconnection of Existing Service Laterals** - Disconnect existing service laterals from the existing sewer and reconnect to new sewer as shown or directed. Locate all existing service laterals and utilities before beginning work.

(i) **Deep Connection Risers** - Construct Deep Connection Risers as shown or directed, and conforming to the Standard Drawings.

(j) **Culverts** - Remove and replace culverts in conformance with all applicable requirements of this section and Section 00405 Trench Excavation, Bedding and Backfill.

**00445.45 Backfilling** - After the pipe is installed and inspected, backfill pipe zone and trench according to Section 00405.



**00445.46 Concrete Blocks** - When called for by the plans or directed, construct concrete blocks, with commercial grade concrete according to Section 00440.

**00445.48 Electronic Location and Visual Identification of Sewers** - Install facilities for electronic location and visual identification of sewers as shown or directed, according to Section 00446.

#### **Finishing, Clean Up and Testing**

**00445.70 General** - After laying and joining pipe for sanitary sewers, storm sewers and culverts, and backfilling trenches, test the installations for water tightness, including inlet and outlet connections, to the Engineer's satisfaction. Perform video inspection, deflection, and hydrostatic testing and low-pressure air testing as required.

**00445.71 Requirements Prior to Tests:**

**(a) General** - All sanitary, storm and culvert gravity systems, siphon and irrigation systems and appurtenances shall successfully pass a hydrostatic or air test prior to acceptance and shall be free of visible infiltration of water. Test manholes as specified in Section 00470.

On pipe 42 inches in diameter and larger, individual joints may be tested by an approved joint testing device. All details of the testing procedure shall meet the approval of the Engineer.

Hydrostatically test all pressure sewers and fittings in accordance with Section 01140 unless otherwise specified.

Make all arrangements for furnishing clean, potable water from an approved source for testing purposes. Perform the tests and provide personnel, hoses, tank trucks, plugs and other necessary equipment to complete the tests at no additional cost to the City. The method, equipment and personnel are subject to approval. A permit from the PWB or other water district is required if a hydrant is used.

**(b) Plugging Tees, Wyes, Stubs and Service Connections** - Plug all wyes, tees, stubs and service connections with gasketed caps or plugs securely fastened or blocked to withstand test pressures.

**(c) Testing Equipment** - Furnish all necessary testing equipment and perform the tests in a manner that provides observable and accurate measurements of either air or water leakage under the specified conditions. Calibrate and certify gauges at the direction of the Engineer. Provide the certification with the gauge.

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**(d) Cleaning** - Before final testing, final manhole-to-manhole inspection and Acceptance of Work flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.

During the final manhole-to-manhole inspection, if any foreign matter is still present in the system, flush and clean the sections and portions as required. Do not allow debris to flow into downstream system. Keep all connecting piping clean and free of debris that is generated from construction activities.

**00445.72 Pipe Testing :**

**(a) General** - Perform the tests in a manner satisfactory to the Engineer. Provide testing equipment that gives observable and accurate measurements of either air or water leakage under the specified test conditions. Calibrate the gauges for air testing with a standardized test gauge furnished by the Engineer. The Engineer will observe the calibration. Notify the Engineer before each field air test.

Test a section of constructed sewer for Acceptance only after completing all service laterals, manholes, backfilling and compaction between the stations to be tested. Unless otherwise approved, do not allow testing of completed sections of sewer between manholes to lag more than one completed section behind the work in progress. The Engineer may require testing of manhole-to-manhole sections as they are completed in order to expedite the Acceptance of Work for those completed sections of sewer and allow connections before the whole system is completed.

**(1) Safety Precautions** - Only qualified personnel will be permitted to conduct the test. All plugs used to close the system for the testing shall be capable of resisting the expected internal pressures. Securely brace plugs, if necessary.

**(2) Ground Water** - The presence of ground water can affect the results of the test. Determine the average height of groundwater over the lines immediately before starting the test, using an approved method.

**(3) Infiltration** - Infiltration of ground water in any amount is unacceptable. Correct such failures occurring within the warranty period in an approved manner at no additional cost to the City.

**(4) Coatings** - Do not internally or externally coat a sewer with any type of substance in an attempt to improve its performance when performing an air or hydrostatic test.

**(b) Hydrostatic Testing** - Sewer pipe and joints shall sustain a maximum allowable loss by leakage of 0.04 gallons per hour per inch diameter per 100 feet when field-tested by either infiltration or exfiltration methods, regardless of pipe material used.

Testing of HDPE sewers shall conform to pressure or hydrostatic acceptance testing set forth elsewhere in these specifications.

For test purposes, the hydrostatic head shall exceed the maximum estimated ground water level in the section being tested by at least 72 inches and in no case shall it be less than 72 inches above the sewer crown of the highest section in the test section, including service laterals. In all cases, determine the height of the water table at the time of the test by exploratory holes or other approved method. The Engineer will make the final decision regarding the test height for the water in the sewer section to be tested. The length of sewer tested by exfiltration will be limited so that the pressure on the invert of the lower end of the section will not exceed 16 feet of water column. Make an allowance of 0.05 gallons per hour per foot diameter per foot of head above the manhole invert for each manhole included in a test section. If the test produces more than the allowable leakage, test manholes and sewer lines separately.

The Engineer will account for all service lateral footage included in the test section and subject to the specified minimum hydrostatic head in computing allowable leakage rate.

The sewer test section may be filled 24 hours before the time of exfiltration testing to permit normal water absorption into the pipe wall to take place.

Use air testing when the elevation of any sewer test section between manholes cannot meet the above criteria.

**(c) Air Testing** - At any time, the Engineer may require a calibration check of the test instrumentation. All air used shall pass through a single control panel.

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

The pressure gauge used in air testing shall have minimum divisions of 0.1 psi and an accuracy of 0.1 psi. All air testing shall be by the Time Pressure Drop Method. The test procedure is as follows:

- (1) The Contractor may wet the lines prior to testing. Clean the sewer to be tested; remove all debris. Plug all sewer outlets with suitable temporary test plugs. Brace each plug securely.
- (2) Determine the average height of the groundwater over the line. The test pressures required shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.

- (3) Add air slowly to the section of system being tested until the internal air pressure is raised to 4 psi greater than the average back pressure due to groundwater.
- (4) After the 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.
- (5) After the temperature stabilization period, disconnect the air supply.
- (6) Record the time in seconds that is required for the internal air pressure to drop from 3.5 to 2.5 psi greater than the average backpressure due to groundwater.

The tested section will be acceptable if the time recorded in (6) above is not less than the time in seconds (T) computed by the formula:

$$T = K/C$$

Where:

- K = the sum of the computations  $(0.011 d^2L)$  for each size of pipe and its length in the section
- C = the sum of the computations  $(0.0003882 dL)$  for each size of pipe and its length in the section, except that the minimum value for C shall be 1
- d = inside diameter of the pipe in inches
- L = length of pipe in feet

If the sewer fails to meet these requirements, determine the reason for leakage and repair or replace all defective materials or workmanship, all at no additional cost to the City.

**(d) Individual Joint Testing:**

The following requirements are for air testing of 42 inch or larger sewers:

- (1) **General** - The Contractor may test each individual joint for leakage using a pneumatic joint testing apparatus. The method, equipment and personnel used in individual joint testing shall be as approved. The Engineer may, at any time, require a calibration check of the instrumentation used. The pressure gauge used shall have minimum divisions of 0.1 psi and have an accuracy of 0.1 psi. All air used shall pass through a single control panel.

Submit necessary joint and joint tester data necessary for computing the combined annular test volume.

Perform testing of individual sewer joints as sewer pipe laying progresses. Conduct a joint test immediately after constructing and backfilling each mainline sewer pipe section.

At the sole discretion of the Engineer upon the satisfactory installation and testing of the first ten successive pipe joints of each sewer size, the Contractor may elect to test joints at no greater than one work day intervals instead of making tests after laying each pipe section.

**(2) Method** - All air testing shall be by the Time Pressure Drop Method. Clean the sewer and remove all debris before beginning the air test. The sewer may be wet if desired. The test procedure is as follows:

- a. Determine the average height of the groundwater over the line. The test pressures required below shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.
- b. Add air slowly to the section being tested until the internal air pressure is raised to 4 psi greater than the average backpressure due to ground water.

**(3) Acceptance** - The allowable minimum time for a drop in pressure from 3.5 to 2.5 psi greater than the average back pressure of any ground water shall be the time per unit volume "T" in seconds, from the following table, multiplied by the combined annular volume of the joint and joint tester "V<sub>y</sub>" in cubic inches. (Minimum Time = T \* V<sub>y</sub>)

**TIME PER UNIT VOLUME TABLE**

Pipe Inside Diameter (Inches)	Time per Unit Volume (Sec. per Cu. In.)
36.....	0.0109
42.....	0.0093
48.....	0.0082
54.....	0.0073
60.....	0.0065
66.....	0.0059
72.....	0.0054
78.....	0.0050
84.....	0.0047

**(4) Repairs** - If a joint does not meet the test time established herein, construct a reinforced concrete closure collar around the joint or reassemble the joint as approved at no additional cost to the City.

**00445.73 Deflection Testing** - In addition to the hydrostatic or air test, perform a deflection test on all sewers and culverts constructed of PVC, HDPE or other flexible pipe material. The test shall be completed not less than 30 days nor more than 60 days after the trench backfill and compaction have been completed, unless otherwise approved. Conduct the test by pulling an approved solid pointed mandrel through the completed sewer. The diameter of the mandrel shall be 95% of the inside pipe diameter unless otherwise specified. Conduct testing on a manhole-to-manhole basis. Before testing, completely flush the sewer with water, clean, and remove all debris.

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**00445.75 Repairs:**

(a) **General** - Locate and repair any sections failing to pass the required tests and inspections. Repeat the specified tests and inspections on those sections at no expense to the City.

(b) **Correcting Pipe Defects** - Repair or replace, in an approved manner, any section of sewer not meeting the air or hydrostatic test requirements, deflection test requirements, joint testing, which has visible leakage, or is noted as deficient in video inspection. Internal pipe repairs are not acceptable. Rounding of pipe is not an approved repair method.

(c) **Visible Infiltration of Groundwater** - Following a successful hydrostatic or air test, visible infiltration of ground water in any section will be considered evidence that the original test was in error or that failure of the section has occurred. Correct such failures and retest the repaired sections, at no expense to the City.

**Measurement**

**00445.80 Measurement** - Trench excavation, bedding, pipe zone material, trench backfill and acceptance testing for pipes will be measured according to Section 00405.

**00445.81 Pipes and Appurtenances** - The quantities of pipe of the various kinds, types and sizes, complete and in place, will be determined by the length and depth of installation as follows:

(a) **Pipes** - Measurement of all installed conduit, pipes, sanitary and storm sewers, including culverts, pressure sewer and pipe stubouts from manholes, will be made on a linear foot basis for the various classes, types and sizes of pipe in the Proposal. For pipe on a grade less than 15%, except service laterals, measure the pipe length horizontally from center-to-center of manholes or to the end of the pipe, whichever is applicable. For pipe on a grade of 15% or more, measure the pipe length on the slope distance from center-to-center of manholes or to the end of the pipe, whichever is applicable. No deductions will be made for fittings or for structures.

Service laterals will be measured on the linear foot basis for the type and size of pipe installed as shown in the Proposal. Length will be measured as total length of pipe installed, commencing at the point of connection to a tee, wye, manhole or pipe as applicable and terminating at the end of the pipe, including all fittings, measured along the pipe centerline.

Disconnecting and reconnecting an existing service lateral will be measured on the same basis as for service lateral pipe, and the footage required to complete an installation will be included in the total footage for service lateral pipe as shown in the Proposal.

Inlet lead pipes will be measured on the linear foot basis for the type and size of pipe installed as shown in the Proposal. Length will be measured along the pipe centerline in place from face of structure to face of structure of manholes,

inlets, or to the end(s) of pipe, whichever is applicable, and rounded to the nearest foot.

**(b) Tee and Wye Fittings** - Tee and wye fittings will be measured on the unit basis per each by actual count of units in place. No deduction will be made from measurement of pipe for the length of the fitting. Pipe plugs, stoppers and other fittings required to accomplish the work will be incidental to this item.

**(c) Metal Pipe Anchors** - There will be no separate measurement for metal pipe anchors.

**(d) Concrete Pipe Anchors** - Concrete pipe anchors will be measured on the unit basis, per each, by actual count of units in place.

**(e) Concrete Closure Collars** - Concrete closure collars will be measured on the unit basis, per each.

**(f) Cleanouts** - Terminal cleanouts and service lateral cleanouts will be measured on the unit basis, per each, by actual count of units in place.

**(g) Deep Connection Risers** - Deep connection risers will be measured on the unit basis, per each, by actual count of units in place.

**(h) Field Fabricated Connections** - Field fabricated connections will be measured on the unit basis, per each, by actual count of units in place.

**(i) Concrete in Blocks** - The quantities of concrete used in blocks will be measured in place on the volume basis as shown.

**(j) Reinforcement** - The quantities of reinforcement used in blocks will be incidental to concrete blocks and no measurement will be made.

**(k) Service Lateral 2 Inch x 4 Inch Markers** - Service lateral 2 inch x 4 inch markers will be measured according to Section 00446.

**00445.82 Acceptance Testing** - No measurement will be made of required air, hydrostatic and deflection acceptance testing.

**00445.83 Installation Under Pavement** - Pipe installed under pavement will be measured according to 00445.81. Trench resurfacing will be measured according to Section 00495.

**00445.84 Installation Under Railroad** - There will be no measurement of materials (except for pipe) for the lump sum pay item "Pipe Under Railroad". Pipe installed under railroads will be measured according to 00445.81.

**00445.85 Special Sections** - In addition to measurement of inlet lead pipe in 00445.81(a), a pay quantity allowance of 2 feet of the larger diameter pipe will be made for each special factory-fabricated section of pipe incorporated into the work as elbows, bends or reducers.

**Payment**

**00445.90 General** - The Contract unit price for each pay item reflects plan requirements or the Contractor's choice from the applicable options listed on the Pipe Data Sheets (if shown).

**00445.91 Payment** - The accepted quantities of pipe and related work items performed under this Section will be paid for at the Contract price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) _____ inch Pipe, _____, Bedding Type _____	..... Foot
(b) Pipe Tees or Wyes, _____ x _____ inch	..... Each
(c) Concrete Pipe Anchors	..... Each
(d) Concrete Closure Collars	..... Each
(e) Terminal Cleanout	..... Each
(f) Service Lateral Cleanout	..... Each
(g) Deep Connection Risers	..... Each
(h) Field Fabricated Connections	..... Each
(i) Concrete in Blocks	..... Cubic Yard

In item (a), the nominal pipe diameter will be inserted in the first blank. The type and design standard of pipe will be inserted in the second blank. The appropriate pipe zone bedding type will be inserted in the third blank.

Items (b) through (h) include pipe plugs, stoppers and other fittings required to accomplish the work.

For item (b) the tee or wye will be a compatible pipe type and class as indicated in 00445.91(a) or as specified. The nominal size will be inserted in the first blank and the lateral size inserted in the second blank.

Payment for a service lateral connection to a new manhole will be made under item (b) for a tee of the same inside diameter as the service lateral.

Payment will be payment in full for furnishing and placing all materials, and for furnish all equipment, labor, and incidentals necessary to complete the work as specified.

Payment for service lateral 2 inch x 4 inch markers will be according to Section 00446.

There will be no separate payment for metal pipe anchors. Payment will be included in payment for the appropriate pipe pay item.

The accepted quantities of reinforcement will be paid for on the weight or lump sum basis according to 00530.90. If there is no item provided in the Contract Schedule of Items for "Reinforcement in Blocks" the cost will be considered incidental with payment for reinforcement included in the item "Concrete in Blocks".



Payment for pipes will include bedding, pipe and pipe zone material, compaction, joint materials, joining, fittings, and pipe acceptance testing.

Payment for trench excavation and trench backfill will be as specified in Section 00405.

Payment for facilities for electronic location and visual identification of sewers will be as specified in Section 00446.

Payment for connections to existing manholes will be as specified in Section 00490.

Payment for perforated pipe will be according to Section 00430.

**00445.92 Acceptance Testing** - All work and material involved in testing of sanitary sewers, storm sewers, and culverts as specified will be considered incidental and included in payment made for the applicable pipe pay item.

**00445.93 Installation Under Pavement** - There will be no separate payment for the additional work involved in placing pipe under pavement. Payment for trench resurfacing will be according to Section 00495.

**00445.94 Installation Under Railroads** - Payment for the additional work involved in placing pipe under existing railroad tracks as specified within the limits indicated on the plans, will be made at the Contract lump sum amount for the pay item "Installing \_\_\_\_\_ inch Pipe Under Railroad". The nominal diameter of pipe will be inserted.

Payment will be payment in full for furnishing all equipment, labor, and Incidentals necessary to complete the installation as specified. Payment for the pipe will be made according to 00445.91. Payment for resurfacing will be according to Section 00495.

**00445.95 Incidental Basis** - When neither the Special Provisions nor Contract Schedule of Items indicates separate payment for work under this Section, perform the work as Incidental work for which no separate payment will be made.



**Section 00446 - Electronic Location and Visual Identification of Sewers**

**Description**

**00446.00 Scope** - This work consists of providing facilities or systems for electronic location and visual identification of sewers (ELVIS) including restoration of pre-existing ELVIS facilities or systems disturbed by construction or restoration work.

**Materials**

**00446.10 Electronic Locating Materials** - Furnish materials meeting the following requirements:

**(a) Marker Balls** - Use Omni Marker Model 162, or approved equal. Marker balls shall:

- Be green in color, maximum 4.5 inches in diameter, and made with exterior material of HDPE
- Be locatable with standard electronic marker locating devices at a depth up to 5 feet
- Produce a spherical RF field regardless of orientation
- Contain no floating or movable parts, and no batteries or active components

**(b) Tracer Wire** - Use Copperhead Reinforced Tracer wire manufactured by Copperhead Industries, LLC or approved equal. Tracer wire shall be direct burial #12 AWG solid, annealed copper-clad carbon steel high strength tracer wire, 380 pounds average tensile breaking load, with 30 mil high molecular weight high density green polyethylene jacket complying with ASTM D 1248, 30 volt rating.

**(c) Underground Detectable Marking Tape** - Use Terra Tape® Sentry Line® Detectable Underground warning tape manufactured by Reef Industries, Inc. or approved equal. Marking tape shall consist of material impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil.

Marking tape shall be reinforced in a tri-layer laminate consisting of coated woven scrim, a solid foil core, and a clear encapsulating film. The marking tape shall be made of a solid foil core encased between a HDPE scrim coated with 100% virgin polyolefin pigmented resins and a clear protective film that allows full view of the foil to ensure continuity. The solid core must provide detectability utilizing either the inductive or conductive modes using a pipe and cable locator. The ink used to print the material must be permanent and not subject to removal by normal handling or upon burial.

The width of the tape shall be 6 inches. The tape for water mains shall be blue and imprinted continuously over its entire length in permanent black ink with the words "Caution - Water" for force mains. The tape for sewer force mains shall be green and imprinted continuously over its entire length in permanent black ink the words "Caution - Sewer Line."

**(d) Ground Wire** - Use #12 AWG bare solid copper wire.

**(e) Tracer Wire Connectors** - Use the following direct-bury connectors as shown:

- **Direct-bury lug connectors** – Use DRYCONN® DIRECT BURY LUG connectors by King Innovations, or approved equal.
- **Direct-bury twist connectors** - Use 3M DBY Direct Bury Splice Kit 09053 connectors or approved equal.

Connectors shall be waterproof, corrosion proof and suitable for #12 AWG solid core wire be pre-filled with silicone and suitable for use with low voltage tracer lines of less than 50 volts. Lug connectors shall have a waterproof plastic housing that encases the silicone pre-filled lug terminals. Twist connectors shall have a waterproof epoxy-filled packaging that encases the silicone pre-filled twist connectors.

**(f) Locator Station** - Use FlangeFink® locator stations manufactured by Cott Manufacturing or approved equal. Locator station shall be Lexan® polycarbonate, green in color, with terminals suitable for #12 AWG leads. Use single (2 lead) locator stations with 2 terminals, 1 for ground wire and 1 for tracer wire, when only 1 tracer wire is terminated in manhole. Use multi-lead locator stations with the appropriate number of terminals when 2 or more tracer wire leads are terminated in manhole.

**00446.11 Visual Identification Materials** - Use materials conforming to the following requirements:

**(a) Tracer Wire Locate Boxes** – Use Carson Industries L Series model 708 with green locking type cover marked "Sewer Locate Wire", or approved equal. Tracer wire locate boxes shall be made from polyolefin, with a green cover marked "Sewer Locate Wire". Cover shall be locking type with a nominal 6 inch opening.

**(b) Cleanouts** - Use materials conforming to the Standard Drawings and Section 00445.

**(c) Manholes and Inlets** – Use materials conforming to the Standard Drawings and Section 00470.

**(d) Service Lateral Plastic or Copper Markers** – Use markers of the type that requires installation to be recessed below grade. Either plastic or copper markers may be used. In new concrete, use "new construction" markers; in existing concrete use "retrofit" markers and use adhesive recommended by the manufacturer. Use the following materials as shown:

**(1) Plastic Pavement Markers** - Use A-TAG pavement markers by Rhino Marking and Protective Systems or approved equal. Plastic markers shall be UV stabilized and fade resistant, be of a material meeting or exceeding a tensile strength of 3,500 psi, and meet test requirements as outlined in ASTM G53, Standard Practice for Light and Water Exposure of Nonmetallic Material. Markers shall be green in color, with the words, "WARNING, SEWER PIPELINE, Call Before You Dig", molded to the top of marker.

**(2) Copper Pavement Markers** – Use Berntsen Concrete Marker Item # BP2 or approved equal. Copper markers shall be made from copper material chosen by manufacturer, and shall have the words "Sewer Lateral" stamped on the top.

**(e) Service Lateral 2 Inch x4 Inch Markers** - Use new, pressure-treated 2 inch x 4 inch lumber, utility grade or better, conforming to Sections 02130 and 02190.

### Construction

**00446.40 General** - Install ELVIS facilities as shown or directed according to the following requirements for all new and reconstructed sewers:

**00446.41 Electronic Locating Facility Installation:**

**(a) Marker Balls** - Install marker balls according to manufacturer's recommendations and as shown or directed and according to the following requirements:

- Install marker balls directly above the pipe alignment at a depth no less than 3 feet and no more than 4.5 feet below final surface grade.
- Install marker balls during trench backfill operations by placing the marker ball in compacted backfill. Cover marker ball with a minimum of 6 inches of backfill and compact backfill before continuing trench backfill operations.
- Install markers balls with trenchless pipe installations by core-drilling hole of a minimal diameter needed to allow clearance for placement of marker ball. Backfill with approved trench backfill, pavement base and pavement, as applicable.
- Install marker balls directly above connection points, termination points and all fitting locations, and at a minimum spacing of 50 feet on sewers with a straight horizontal alignment except on mainline sewers between two visible manholes.
- Install marker balls at a minimum spacing of 25 feet directly above sewer mains or pressure lines installed on a radius.
- Install marker balls on new or reconstructed sewer service laterals, directly above the centerline of the end of the lateral at the curb line or as directed.

- Install marker balls directly above every alignment change along pressure lines, sewer mains and service laterals.
- Install marker balls directly above manholes for manholes with buried covers.

**(b) Tracer Wire and Terminal Appurtenances** - Restore pre-existing tracer wire systems disturbed by adjacent work as shown or directed directly over the pipe centerline and on top of the pipe zone in all sewer trenches, including mainline sewers, service laterals and storm sewer inlet leads. Connect mainline and service lateral tracer wires using either an approved direct-bury lug connector or direct-bury twist connector. Extend tracer wire to locator stations in manholes, locator boxes, storm inlets, or other visually identifiable terminal appurtenances, allowing for access with electronic locating equipment, as shown or directed and according to the following requirements:

**(1) Locator Stations** – Install locator stations as shown within manholes. Mount locator station to manhole wall within 18 inches of manhole rim with 2 stainless steel expansion anchors. Drill a minimum 3/8 inch diameter hole through the manhole wall within 18 inches of the finish grade of the manhole rim. Extend the tracer wire from the pipe trench in one continuous piece up the outside of the manhole and through the hole and into a locator station, and attach to one of the lugs in the locator station. When multiple tracer wires are terminated in manhole install a multi-lead locator station. Extend a ground wire from the locator station through a minimum 3/8 inch diameter hole in the manhole wall. Install ground wire approximately 3 feet deep, and extend from the outside manhole wall a minimum of 3 feet horizontally in any direction. Seal all holes drilled in manhole walls with silicone sealant.

**(2) Storm Inlet Tracer Wire Termination** - Terminate tracer wire inside inlet and directly over storm outlet pipe by placing tracer wire as follows: Drill a minimum 3/8 inch diameter hole through inlet wall to pass tracer wire through to inside inlet wall. Seal hole with silicon sealer or material approved. Leave 6 inches of coiled tracer wire along inside of inlet wall approximately 3 inches below the inlet frame and grate or as directed.

**(3) Service Lateral Tracer Wire Termination** - Terminate tracer wire at ends of service laterals as shown or directed, as follows:

**a. Termination in Tracer Wire Locate Boxes** - Extend the tracer wire in one continuous piece up vertically from the pipe trench and into the bottom of the locate box. Leave 18 inches of coiled tracer wire inside locate box.

**b. Termination at 2 Inch x 4 Inch Markers** - Extend tracer wire in one continuous piece directly up service lateral 2 inch x 4 inch markers and leave 18 inches of tracer wire wrapped around the exposed top end of 2 inch x 4 inch marker.

**(c) Underground Detectable Marking Tape** – Bury all underground detectable warning tape for both water and sewer force mains 24 inches below

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finished grade directly over center of pipeline unless otherwise shown or as directed.

**00446.42 Visual Identification Facilities** - Provide facilities for visual identification of sewers as shown or directed and as follows:

**(a) Manholes, Terminal Cleanouts and Storm Inlets** - Install manholes or storm inlets at ends of sewers as shown and according to Section 00470. Install terminal cleanouts at ends of sewers as shown and according to Section 00445.

**(b) Lateral Cleanouts** - Install lateral cleanouts as shown or directed and according to Section 00445. Install lateral cleanouts as close to property line as practical at approved locations.

**(c) Tracer Wire Locate Boxes** - Restore pre-existing tracer wire locate boxes directly over service laterals at property line, service boundary, or other location as shown or directed.

**(d) Service Lateral Plastic or Copper Markers** - Install plastic or copper markers in the concrete curb directly over the centerline of all new and reconstructed service laterals, as shown or directed. Either plastic or copper markers may be used. If there is not suitable concrete curb for marker placement, then install a lateral cleanout as shown or directed according to Section 00445.

**(e) Service Lateral 2 Inch x 4 Inch Markers** - Place a 2 inch x 4 inch marker at the end of each new service lateral not connected to a building sewer. Omit markers only as approved. Block the capped or plugged service lateral end with a wood block against undisturbed earth and install the marker. Extend the marker from the blocked service lateral invert to at least 12 inches above the existing or proposed finish ground surface. Install marker in one piece. No splicing will be accepted.

Paint the exposed portion of the marker after its installation with quality quick drying enamel white paint for a storm only sewer and green paint for a sanitary or combined sewer. After the paint has dried, use black, quick drying enamel and neatly indicate the distance from the ground surface to the top of the service lateral in feet and inches.

Do not disturb the position and location of the marker during the backfilling operation. If the marker is broken, moved out of location, or vertical alignment is changed during the backfilling operation, reopen the trench and replace the marker.

#### Finishing and Testing

**00446.70 General** - Test all installed marker balls and tracer wire and appurtenances with locating equipment before acceptance. Replace all marker balls and tracer wire that cannot be located with the testing equipment and retest until all defects are corrected. Document the GPS coordinates for each marker ball.

**Measurement**

**00446.80 Measurement** - No measurement of quantities will be made for electronic location and visual identification of sewers.

**Payment**

**00446.90 Payment** - No separate or additional payment will be made for electronic location and visual identification of sewers. Payment will be included in payment made for the appropriate items under which this work is required.



**Section 00470 - Manholes, Catch Basins and Inlets**

**00470.00 Scope** - This work consists of constructing manholes, catch basins, inlets, sumps, sump and sedimentation manholes, inside drop manhole assemblies, siphon boxes, slope protectors and other similar structures. Construct the structures of commercial grade concrete, or other material, with necessary frames, covers, gratings, and other fittings and hardware.

References to manholes, sumps, sedimentation manholes, inlets, siphon boxes, slope protectors and inside drop manhole assemblies refer to standard structures of specific design and use, and are identified on the plans. The term "concrete" refers to commercial grade concrete.

**00470.01 Cast-in-Place and Precast Construction** - Concrete manholes and sumps shall be cast-in-place or precast, as shown or specified. Concrete inlets and siphon boxes may be either cast-in-place or precast. Precast concrete inlets shall not be used in the roadway.

**Materials**

**00470.10 Materials** - Furnish materials meeting the following requirements:

Aggregate Base.....	00640.10
Commercial Grade Concrete.....	00440
Concrete Drain Tile.....	02410.40
Corrugated Metal Pipe.....	02420.10, 02420.40
Couplings .....	02410.60
Geotextile .....	02320
Grout .....	02080
High Density Polyethylene (HDPE) Pipe .....	02410.60
Joint Material.....	02440.40, 02440.50, 02440.60
Metal frames, Grates, Covers, and Ladders .....	02450.30
Nonreinforced Concrete Pipe .....	02410.10
Polyethylene Pipe.....	02410.60
Polyvinyl Chloride (PVC) Pipe, Schedule 40 .....	02410.70
Polyvinyl Chloride pipe (PVC), ASTM 3034.....	2410.70
Precast Concrete Manholes, Catch Basins and Inlets.....	02450.10, 02450.20
Reinforcement .....	02510.10, 02510.40

**00470.11 Precast Concrete Manholes and Bases** - Furnish cones with the same wall thickness and reinforcement as riser sections.

All precast manholes sections, sedimentation manholes, bases, sumps and cone sections manufactured for City work must conform to the requirements of the current Manufacturing Standards for Precast Concrete Products (MSPCP) Manual published by the City's Materials Testing Laboratory. Furnish only rubber-gasket sections as specified or conforming to the Standard Plans and ASTM C478. Use only preformed rubber gaskets or mastic sealer for jointing material. Tongue and groove manhole sections must be approved and accepted before use on any project.



Prior to delivery of precast manhole sections to the job site, yard permeability tests may be required at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material to be supplied to the Project. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C497.

Precast manhole sections shall consist of circular sections in one of the following standard nominal inside diameters:

48 inch	72 inch	96 inch	120 inch	144 inch
60 inch	84 inch	108 inch	132 inch	

Heights of sections shall be multiples of 6 inches, except heights of manhole sections 72 inches through 144 inches in diameter shall be as required to fit site conditions.

**(a) Precast Concrete Bases** - Precast base sections may be used provided all details of construction are approved before shipment.

**(b) Manhole Grade Rings** - Use manhole grade rings on all manholes. Grade ring extensions are to be limited to a minimum height of 3 inches and a maximum height of 12 inches.

**(c) Manhole Steps, Polypropylene Covering, and Polyethylene Netting Encasement for Sumps** - Use only material that conforms to the requirements as shown in the Contract Drawings and Details.

**(d) Time of Installation** - Unless shown or specified otherwise, install steel reinforced polypropylene steps in all concrete manhole cones and sections before delivery to the job site.

**(e) Certification of Steps** - Manhole steps that are not on the City's list of approved manhole steps will require testing of the steps and observation of the step installation process prior to delivery. Obtain a current list of approved manhole steps from the City's Materials Testing Laboratory.

**(f) Precast Inlets and Catch Basins** - Precast units may be used in lieu of cast-in-place units when approved. Submit details of proposed units for approval. Concrete risers for extensions shall be a maximum of 6 inches in height and of the same quality as the main section. Risers shall only be used where approved.

**00470.12 Cap Screws** - Cap screws and washers for watertight manhole covers shall be stainless steel with 60,000 psi minimum tensile strength conforming to the requirements of ASTM A 453/A 453M.

**00470.13 Inside Drop Manhole Connectors** - Furnish stainless steel anchor bolts and anchor straps for inside drop pipe connections.

Provide and furnish inside drop manhole assemblies per the Contract drawings and details shown and specified.

**00470.14 Pipe and Fittings** - Furnish pipe and fittings as specified and conforming to the applicable portions of Section 00445.

**00470.15 Pipe Stubouts** - Pipe stubouts shall be the same type and strength classification as approved for use in the lateral, main or trunk sewer construction. Where there are two different classes of pipe at a manhole, the higher strength pipe will govern strength classification. Furnish watertight plugs with each stubout and adequately brace against hydrostatic or air test pressures.

**00470.16 Drain Rock Backfill** - Drain rock placed between the sump and the edge of the excavation shall be 4" - 2" aggregate with a maximum of 10% fractured faces. Drain rock shall be free from organics, frozen earth, or other deleterious material. The Engineer may inspect all potential stockpile sites prior to delivery of material.

**00470.17 Aggregate Cover** - Where sump drain rock would otherwise be in contact with the connecting pipe, provide a cover of at least 6 inches of 1" - 0 or 3/4" - 0 clean, aggregate continuously around the pipe. Use a geotextile fabric, as specified, conforming to Section 02320 as the medium between the aggregate cover and drain rock.

**00470.18 Base Drain Backfill** - Use aggregate base or selected granular backfill material that is free from silts or other fines.

**00470.19 Manhole, Inlet and Catch Basin Frames, Covers and Grates:**

**(a) Manholes** - Manhole castings shall be true to size, weight and tolerances shown. The bearing seat shall not rock when checked by the test jig. Supply all test gauges. Do not subcontract any of the work other than testing procedure, patterns, machining and cartage. The casting shall not be made by the open mold method and be free of porosity, shrink cavities, cold shuts or cracks, or any defects that would impair serviceability.

Do not repair defects by welding or by the use of "Smooth-on" or other cosmetic material. All castings shall be shot or sandblasted. Do not apply paint or other coating. Each casting shall have distinctly cast upon it the initials of the manufacturer and the year of the cast. These characters shall be minimum 1 1/4 inches in height and 1/8 inch in relief. Cast the heat number into each casting. Provide all labor and equipment for handling all castings during testing and inspection. Refer to Section 00165 for test methods and references.

**(b) Frames and Grates** - Fabricate frames and grates for inlets and catch basins from steel conforming to ASTM A7, A36 or A373 in accordance with the Standard Plans. Weld all connections. When assembled, frames and gratings shall rock no more than 1/16 of an inch. When checked by a test jig, the bearing seat of either component shall have no more than 1/16 of an inch rock.

**(c) Catch Basins** - Use metal sump catch basins from the CPL. An approved equal catch basin shall comply with Portland's plumbing code.

**00470.20 Access Doors** - Use access door from the CPL or constructed from steel or aluminum with a non-slip surface conforming to the requirements of 02484.35(a).

### Construction

#### 00470.40 General:

**(a) Excavation, Backfill and Foundation Stabilization** - Excavate and backfill according to Section 00405. When specified, or as directed, remove unsuitable material that will not support the manhole or other structure, excavate below grade and backfill with foundation stabilization material according to Section 00405.

**(b) Pipe Connections** - Place connecting pipe at the alignment and grades as shown. If not shown, inlet piping shall enter manholes at a depth of 8 feet below finish grade or 14 inches less than the depth of the manhole whichever is less. Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall. Ensure that pipe connections to the structure are completely watertight.

Grout concrete pipe connections to manholes so they are watertight, using non-shrink grout conforming to 02440.50. When grouted into the manhole section, the pipe section shall not extend more than 18 inches outside the manhole. If an approved flexible connection for concrete pipe is provided at the manhole, full or partial pipe sections may be stubbed into the manhole as required. When using flexible pipe, use approved sanded manhole adapters where pipe enters the manhole or inlet.

Connect pipe to sanitary manholes using an approved adapter specifically manufactured for the intended service. Do not use field-fabricated waterstops or improvised adapters. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout conforming to 02440.50. Connections to all manholes, sedimentation manholes, sumps, and inlets shall have a flexible joint located within 18 inches of the structure wall.

**00470.41 Precast Concrete Manholes** - Precast manhole components may be used to construct standard, sump, sedimentation and drop manholes.

**(a) Bases** - If bases are cast-in-place, consolidate the concrete by mechanical vibration. Screed off the concrete so that the first manhole section to be placed has a level, uniform bearing surface for the full circumference.

If bases are precast, carefully place the base section on the prepared bedding so it is fully and uniformly supported at true grade and alignment.

Construct the invert to match that of the sewer pipe. Where the size of the sewer pipe is changed at the manhole, construct the invert to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, break out the top to the springline of the pipe for the full width of the manhole, and completely

cover the exposed edge of the pipe with mortar. During construction divert existing flows of water or sewage away from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until initial set has been achieved. All finished surfaces shall conform to drawings as shown.

**(b) Precast Manhole Sections** - Thoroughly wet all lift holes, completely fill with nonshrink grout, and smooth and point both inside and out to ensure water tightness.

Use preformed plastic or rubber gaskets on all joints between manhole sections. Non-shrink grout is allowed on joints, and grade rings above the cone.

Set manhole covers to the finish grade of ground or street surface using manhole grade rings on all manholes. The total height of manhole grade rings between the manhole cone and manhole cover frame shall be a maximum of 12 inches. In roadways and other areas intended for traffic, a minimum of one manhole grade ring is required between the cone and manhole cover frame.

When grout is used do the following:

- Clean and wet the surfaces to be joined with water.
- Do not allow free water to come in contact with grout joints within 24 hours after the mortared joints are finished.
- Protect the completed joints against rapid drying.

**(c) Grates, Frames, Covers and Fittings** - Set metal frames for manholes on full non-shrink grout beds to prevent infiltration of surface water or groundwater between the frame and the concrete of the manhole section. If concrete is to be poured around the frames, coat the portion of the frame that will contact the concrete with hot asphalt before placing the concrete. Set frames, covers and grates true to the locations and grades established. The Type 1 grate for Type "D" inlets shall be cut in half parallel to the bars. Clean bearing surfaces and provide uniform contact. Secure all fastenings. Construct all mortared, sanitary sewer manhole necks and all riser ring joints made with non-shrink grout using an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted.

**(1) Manhole Frame and Covers** - Set frame in a bed of mortar with the mortar carried over the flange of the frame. Set frame so the top of the cover is flush with surface of adjoining pavement or ground surface unless otherwise shown or approved.

**(2) Watertight Installation** - Where a manhole cover is to be permanently buried, install a watertight manhole frame and cover only where shown or as approved. Place 2 layers of 65 pound per square smooth surfaced roll roofing or approved material over all buried covers before backfilling.

**(3) Watertight Application** - Install tamperproof or watertight manhole frames and covers where shown or as approved.

**(d) Manhole Step and Ladder Installation Requirements** - Fasten steps and ladders to the manhole walls according to the manufacturer's recommendations as shown and to all applicable safety standards, as approved. All steps within a manhole shall be of the same design, type and size. Mixing of unmatched steps within the same manhole is not acceptable. Align steps vertically. Loose steps will be cause for rejection of that manhole cone or section.

**(e) Manhole Grade Rings** - Install grade rings as shown to the approved height. Lay grade rings in mortar with sides plumb and tops level. Seal joints with mortar as specified for manhole sections. Grade rings shall be watertight.

**(f) Inside Drop Manhole Assemblies** - Construct inside drop manhole assemblies at each location shown.

**00470.42 Precast Concrete Catch Basins and Inlets** - Install precast catch basins and inlets to the specified line and grade.

**00470.43 Cast-in-Place Concrete Construction:**

**(a) General** - Construct cast-in-place catch basins and inlets, according to Section 00440. Finish all inside surfaces smooth and free of depressions or protrusions. Form exterior surfaces with steel, plywood or other approved materials. Form other surfaces with matched boards, plywood, or other approved material. Do not cast directly against trench walls, rock, or earth unless approved. Inlet depth shall be a minimum of 30 inches and a maximum of 48 inches from finish grade unless otherwise shown or approved. Do not load cast-in-place bases until approved or tests indicate the concrete can support the required load.

**(b) Cast-in-Place Catch Basins and Inlets** - Construct forms for both the inside and outside walls of cast-in- place catch basins. Forms shall be tight and well braced, with chamfered corners. Remove all water and debris prior to placing concrete. Provide and position sanded collars to be cast in proper alignment when PVC or HDPE inlet leads are used.

Consolidate the concrete immediately after placement with an approved vibrator. Limit vibration time to that necessary to produce satisfactory consolidation without causing segregation. Screed the top surface and trowel exposed surfaces to a smooth finish, free from marks or irregularities. Radius exposed edges with a steel edging tool. After forms are removed, patch any defects in the concrete with an approved mortar mix.

Immediately after removal of forms and final finishing, cure according to 00440.40(e).

**(c) Finishing/Connection for Catch Basins and Inlets** - Construct inlets in accordance with the Plans. Float finish the inside face and floor. Only use the same pipe material for the inlet lead from the inlet to a connection with another sewer or a downstream structure.

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**(d) Placing Precast Inlets** - When precast inlets are approved, set an inlet to grade at the locations shown or as approved.

**(e) Adjusting Inlet and Catch Basin Height Extensions** - When approved, construct height extensions as shown. Lay risers in mortar with sides plumb and tops to the proposed finish grade. Seal joints with mortar and trowel the interior and exterior surfaces smooth. Prevent mortar from drying out and cure by applying an approved curing compound or other approved method. All finished work shall be watertight.

**(f) Installation of Inlet and Catch Basin Frame and Grate** - Set frame and grate at the elevation shown. Frame shall be cast integral with the structure. All bearing surfaces shall be clean and provide uniform contact. Embed anchor bolts and other fastenings firmly in concrete or secure as approved.

**00470.44 Precast Sumps:**

**(a) General** - Construct precast sumps to a depth of 30 feet in conformance with the Plans. Construct precast sumps before constructing sedimentation manholes. Make all sump pipe connections as specified or approved.

**(b) Connections** - Make all sump pipe connections to the sump wall as shown. Grout all pipes into a sump wall to provide a watertight seal around pipes. Each connecting pipe shall have a flexible joint within 18 inches of the sump wall.

**(c) Depth** - Construct a sump to its full depth unless unstable or caving soil strata is encountered during construction. The Engineer will determine the need for sumps of lesser depth than shown. Do not construct a sump less than 20 feet deep.

**(d) Sump Backfill** - Use a tremie or other approved method to backfill the drain rock around the sump to prevent material from striking the netting during the backfill operation. Avoid damage to or displacement of the structure.

**00470.45 Sump and Manhole Locations:**

**(a) General** - The Engineer will establish and adjust sump and sedimentation manhole locations to minimize conflicts.

**(b) Spacing** - When constructing 2 or more sumps in an area, construct the sumps approximately 25 feet apart, or as approved. The spacing may be greater than 25 feet in order to avoid overhead wires, underground utilities or other obstacles to construction. Before beginning construction, the Engineer will determine the proper spacing at a site.

**(c) Abandoned Sump Manhole Installation** - When a sump manhole cannot be constructed to its specified minimum depth the Engineer will direct the Contractor to stop work and abandon the site. Place and compact native or imported granular material and restore the site to its preconstruction condition.

**00470.46 Sedimentation Manholes:**

(a) **General** - Construct a precast sedimentation manhole in conformance with the Plans.

(b) **Typical Location** - Unless otherwise specified or noted on the Plans, construct the sedimentation manhole 25 feet upstream from the first sump. Obtain approval before changing the location of a sedimentation manhole to avoid overhead wires, underground utilities or other obstacles.

(c) **Connections** - Connect all sedimentation manhole piping to the manhole wall as shown. Grout pipe into manhole wall to provide watertight seal.

(d) **Inspection** - To allow for inspection by the Engineer, pump all accumulated water from a sedimentation manhole.

**00470.47 Concrete Inlet Base Drains** - Provide concrete inlets with base drains leading from abutting aggregate base or selected granular backfill material.

Use concrete pipe, concrete drain tile, HDPE or PVC plastic pipe for basin drains. Place and compact backfill without damaging pipe or inlet.

**00470.48 Access Door for Manholes** - Install an access door in the sidewalk for manholes that straddle the curb face as shown or directed.

#### **Maintenance, Clean up and Testing**

**00470.70 Cleaning** - Upon completion, clean each structure of accumulated silt, debris or foreign matter of any kind and maintain clean until final acceptance of the work.

**00470.71 Sump Testing** - To ensure the optimum sump and storm sewer pipe performance, determine the in-place capacity of the sump downstream from the sedimentation manhole for each sump system. The sump system will be noted in the Special Provisions. Testing shall take place after a sump has been constructed, in conformance with the following requirements:

(a) **Filling Sump** - Fill sump with water at an initial rate of 300 gpm and record the water elevation below the sump rim after 5 minutes. Maintain initial flow rate and continue taking recordings of the water elevation at 5 minute intervals. When the water elevation stabilizes, increase the flow rate by 300 gpm, record the water elevation at the new flow rate as described in the initial process. Continue the sump test by increasing the flow rate at increments of 300 gpm until the sump has reached its maximum capacity.

Provide the Engineer with all recorded test data. The test may be completed using flow from one fire hydrant. However, a second fire hydrant may be necessary to complete the sump test.

Upon completion of each sump test, compare tested sump capacity flow rate to the minimum flow rate noted in the projects special provisions. Contact the Engineer immediately if tested flow rate is less than the minimum flow rate determined by the Engineer.

Provide water flow from fire hydrants to any sump being tested using 8 inch (nominal) diameter pipe.

Deliver clean water to the sump or sedimentation manhole for testing. The introduction of silts, sediments or gravel to sumps and sedimentation manholes shall not be permitted.

**(b) Permit Requirements** - Obtain a permit for use of fire hydrants from the permit center of the PWB prior to making any connections to a fire hydrant. The following procedures will apply in making application for issuance of a permit:

- Present 2 approved 8 inch slow opening and closing gate valves and spanner wrench for inspection and tagging, if not renting the City sump capacity tester. Rental of the City sump capacity tester includes 2 approved 8 inch gate valves, spanner wrench and 850 feet of aluminum pipe.
- Know the locations of hydrants to be used with respect to street intersections.
- Be prepared to make a monetary deposit upon issuance of the permit. Call the Permit Center ahead of the time to ascertain the minimum deposit required for use of the hydrant(s) and charges for use of the hydrant(s).

**(c) Engineer Notification** - Notify the Engineer of the estimated time of commencement of sump tests at least 2 hours prior to such commencement. The Engineer will be present during all sump capacity tests.

Based upon the results of the sump capacity test, the number or depth, of subsequently installed sumps may be modified.

The City has one sump capacity tester available on a "first come - first served" basis. The tester and pipe trailers may be rented per day for a maximum of 2 days per written application.

The Contractor is not required to use the City's sump capacity tester. However, if the tester provided by the Contractor is other than the City's, it must be approved prior to conducting sump capacity tests. Submit written details of the proposed sump capacity tester including flow measuring instrument, 8 inch piping and 8 inch gate valve specifications. The Engineer will approve or reject this submittal within 2 weeks after receipt of said submittal.

Perform sump capacity tests to determine the capacity of the sump to ascertain that the designed sump is adequate. The Engineer will determine the final number of sumps to be tested.



**00470.72 Casting Certification and Test Samples:**

**(a) General** - Certify as to the tensile strength properties and the Brinell Hardness. The Engineer reserves the right to require a tensile test bar, as per ASTM A48, for each 20 castings or heat (lot) when less than 20 castings are made from one heat (lot).

**(b) Testing** - Testing shall be performed at the option of the Engineer in accordance with one or both of the following methods:

**(1) Tensile Specimens** - Method A shall consist of testing tensile specimens in accordance with ASTM A48. Notify the Engineer at least 24 hours in advance of casting the units and bars so as to schedule time to witness the melt to permit identification of both bars and castings. Provide machined test specimens conforming to the dimensions specified for Specimen B of ASTM A48. Machining of the test specimens shall be at no additional cost to the City.

**(2) Proof Load Test** - Method B shall consist of a Proof-Load Test. The cover, while resting in its frame, shall sustain a 40,000 pound load applied through a 1 inch thick by 9 inch ASTM A36 steel plate on a 1/4 inch rubber pad centered on the manhole cover.

**(3) Proof Load Rate** - Using a calibrated testing machine, apply the specified load and hold for a period of 1 minute. Upon removal of the load, examine the test specimen for cracks and permanent deformation. Any cracks or permanent deformation will be cause for rejection.

**(4) Cost Responsibility** - The Engineer will perform all testing of the castings. Passing tests will be a City cost. Failed tests shall be at the Contractor's cost.

**(5) Test Procedure** - Test specimens will be selected by the Engineer and tested as follows:

- a. Proof-Load test 2 assembled test specimens for each 20 castings or heat when less than 20 castings.
- b. If the tested specimens of a designated lot pass the test, all of the units of that lot are considered to comply with the load requirements.
- c. If either of the tested specimens of a designated lot fails to pass the test, then test 5 additional specimens from the same lot selected by the Engineer.
- d. If the 5 additional specimens pass the load requirements of the test, then the total number of that lot to be furnished will be considered as complying with the requirements except that any of the previous test specimens that failed to meet the load test requirements will be rejected.

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If any of the 5 additional specimens fail to meet the load test requirements, then the entire lot will be rejected except for the test specimens that passed the test. All specimens that pass this test will be returned. The City will not be responsible for those that fail the test.

**00470.73 Sewer Manhole Acceptance Testing** - Field test all sanitary sewer manholes for acceptance by either hydrostatic or vacuum testing after completion of backfilling, compaction and surface restoration, including paving. If the manhole fails the test, make necessary repairs by an approved method, and retest the manhole. Repair and retest the manhole until a satisfactory test is obtained.

**(a) Hydrostatic Testing** - Perform hydrostatic testing according to ASTM C 497/C 497M. Plug all inlets and outlets and fill the manhole with water. Fill each manhole to the rim at the start of the test. Leakage in each manhole shall not exceed 0.3 gallons per hour per foot of head above the invert. Determine leakage by refilling to the rim using a calibrated container. Manholes may be filled 24 hours prior to the time of testing to permit normal absorption into the manhole walls.

**(b) Vacuum Testing** - Perform vacuum testing according to ASTM C 1244/C 1244M. Plug and brace all pipes entering the manhole. Place the test head in or on top of the manhole ring. Draw a vacuum of 10 inches of mercury on the manhole, close the valve on the vacuum line of the test head, and shut off the vacuum pump. Measure the time for the vacuum to drop to 9 inches of mercury. The manhole is acceptable if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated in the following table:

	Diameter (inches)								
	30 or less	33	36	42	48	54	60	66	72
	Depth * (feet)				Time ** (s)				
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.

#### Measurement

**00470.80 Measurement** - The quantities of manholes, sump manholes, sedimentation manholes, sumps, inlets, catch basins, siphon boxes, slope protectors, sump capacity testing, manhole inside drop assembly, and other structures will be measured on a unit basis.

The quantities of special concrete structures will be made on a lump sum basis.

**00470.81 Manholes and Inside Drop Assembly over 8 Feet Deep** - Measurement for a manhole over 8 feet deep will be from 8 feet below the top of the manhole frame and cover to the manhole invert at the center of the manhole to the nearest 0.1 of a foot.

**00470.82 Sump Manhole Greater or Less than 30 Feet Deep** - Measurement for each constructed sump greater or less than 30 feet deep, will be for each vertical foot of sump greater or less than 30 feet to the nearest 0.1 of a foot.

**00470.83 Abandoned Sump Manhole Installation** - Measurement for each partially completed sump manhole directed to be abandoned will be measured on a unit basis.

**Payment**

**00470.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Concrete Manholes, _____inch, 0-8 Ft Depth .....	Each
(b) Concrete Manholes, _____inch, Deeper than 8 Ft .....	Foot
(c) Concrete Manholes, _____ .....	Each
(d) Concrete Sumps .....	Each
(e) Concrete Inlets, Type _____ .....	Each
(f) Concrete Siphon Boxes .....	Each
(g) Concrete Diversion Boxes .....	Each
(h) Concrete Irrigation Boxes .....	Each
(i) Concrete Junction Boxes .....	Each
(j) Concrete Monument Boxes .....	Each
(k) Manhole Slope Protectors .....	Each
(l) Catch Basins, _____ .....	Each
(m) Inside Drop Assembly, _____inch .....	Each
(n) Sump Manhole, 30 Ft Depth .....	Each
(o) Sump Capacity Test .....	Each
(p) Watertight Manhole Frame and Cover .....	Each
(q) Abandon Sump Manhole .....	Each
(r) Access Doors .....	Each

In items (a), (b), and (m) the diameter of the manhole or assembly will be inserted in the blank, with a separate pay item provided for each size.

In items (c), (e) and (l) the type of structure will be inserted in the blank, with a separate pay item provided for each type.

Item (d) is for sump inlet as shown.

Under item (n), an adjustment, plus or minus, will be made if the sump manhole is not built to a depth of 30 feet. The adjustment will be calculated by dividing the sump manhole bid price by 30 feet to determine the adjustment cost per foot.

Item (o) includes any stand-by time required for the sump capacity test and evaluation.

Item (p) will be the additional cost above providing a standard manhole frame and cover.

Item (q) includes restoration of pavement base on pavement.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

| Manhole pipe stubouts will be paid for according to Section 00445.

| No separate or additional payment will be made for:

- earthwork not covered as trench or ditch excavation
- pipe connections
- rock backfill
- aggregate base backfill
- drain tile
- acceptance testing



**Section 00480 - Drainage Curbs**

**Description**

**00480.00 Scope** - This work consists of constructing mechanically extruded curbs using either commercial grade concrete (CGC) or asphalt concrete material.

Construct the curbs at the locations and to the lines, grades and dimensions shown on the plans or as directed.

**Materials**

**00480.10 Materials** - Furnish materials meeting the following requirements:

Commercial Grade Concrete.....	00440
Emulsified Asphalt.....	02710
Epoxy Bonding Agent.....	02070.10
Preformed Expansion Joint Filler.....	02440.10

**00480.11 Asphalt Concrete** - Furnish dense graded, Level 2, 1/2 inch asphalt concrete mixture meeting the requirements of Section 00744. The mixture may be varied when conditions require it, if approved. The mixture will be visually accepted.

**Construction**

**00480.40 Preparation of Base** - Clean pavements upon which drainage curbs are to be constructed so that they are free of dirt, dust, oil, grease or other extraneous matter.

**00480.41 Bonding Material Application:**

**(a) CGC Curbs** - Bond CGC curbs to underlying pavements with an epoxy bonding agent from the CPL or conforming to 00480.10. Apply according to the manufacturer's recommendations and at a rate that provides a thorough coating to the surface with all voids and depressions filled. Place the new curb on the epoxy bonding agent within 15 minutes after spreading, or before it loses its tackiness, whichever is sooner.

**(b) Asphalt Concrete Curbs** - Bond asphalt concrete curbs to underlying pavement with either:

- An epoxy bonding agent meeting the requirements of 00480.10 or from the CPL, applied in the manner specified in 00480.41(a), or
- An emulsified asphalt of the type designated by the Engineer and conforming to 00480.10. Apply emulsified asphalt at a rate of 0.05 to 0.10 gallons per square yard of curb. Place the new curb on the emulsified asphalt after the asphalt separates from the water breaks, but before it loses its tackiness.

**00480.42 Commercial Grade Concrete Curbs:**

**(a) Placing and Finishing** - Feed concrete into the extruding machine at a uniform rate and operate the machine under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete. Perform finishing work as required to present a smooth, dense surface.

Remove and replace honeycombed sections. Repair of honeycombed or other defective sections by plastering will not be permitted.

**(b) Transverse Expansion Joints** - Space expansion joints as shown. The width of the joint and thickness of the filler shall not be less than 1/2 inch. Construct each expansion joint at right angles to the curb alignment, normal to the surface of the curb and provide complete separation of new concrete.

Firmly support the adjacent portions of the curb with close fitting shields if expansion joints are sawed before the concrete has hardened.

Mortar the joint filler in place if sawing is performed after the concrete has hardened.

**(c) Transverse Contraction Joints** - Space contraction joints as shown. Form the joints by grooving, by inserting and removing plates or other devices, by inserting and leaving in place preformed expansion joint fillers or by other approved means.

Make joints no wider than 1/4 inch, and deep enough so that at least 1/3 of the cross-sectional area of the curb is severed. Tool the edges of joints. Clean unfilled grooves and fill with joint filler flush with the surface of the concrete.

**(d) Curing** - Begin curing curbs immediately after completing machine or hand finishing of the fresh concrete, according to 00440.40(e).

**00480.43 Asphalt Concrete Curbs** - Construct asphalt concrete curbs by the mechanical extrusion method. Produce a well compacted mass of asphalt concrete with a uniform texture finish.

**00480.44 Line and Grade** - Place a 12 foot straightedge on the top or face of curb. The curb surface shall not vary more than 1/4 inch from the edge of the straightedge, except at grade changes or curves.

**Measurement**

**00480.80 Measurement** - The quantities of drainage curbs will be measured on the length basis, for each continuous run measured along the line and grade of the curb.

00480.90

**Payment**

**00480.90 Payment** - The accepted quantities of drainage curbs performed under this Section will be paid for at the Contract unit price, per foot, for the item "Drainage Curbs".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work as specified.





**Section 00490 – Work on Existing Sewers and Structures**

**Description**

**00490.00 Scope** - This work consists of joining new work to existing facilities, repairing or abandoning sewer lines and structures, adjusting existing manholes, inlets, boxes and other similar structures. Remove and dispose of pipe, manholes and catch basins that are scheduled for removal according to Section 00310.

**00490.01 Definitions:**

**Adjust** - To raise, lower or reconstruct structures to a new top elevation flush with the surrounding surface.

**Box** - Valve box, meter box, monument box or other similar structure with a removable cover.

**Bypass Pumping** - The process of pumping sanitary sewer or storm flows around a manhole or pipeline during the construction or rehabilitation of those facilities.

**Inlet** - Structure designed to receive surface water through a grate or orifice and to discharge water through pipes.

**Manhole** - Manhole, sump or similar structure designed to permit entry of sewer lines and working space for maintenance.

**Manhole Neck** - The upper portion of a manhole, having vertical walls and a uniform diameter or dimension just sufficient to receive and support the metal frame.

**Materials**

**00490.10 Materials** - Furnish materials of either existing materials in a condition suitable for reuse and meeting current design, or new materials that meet the following requirements:

- Commercial grade concrete ..... 00440
- Joint materials ..... 02440.40, 02440.50, 02440.60
- Metal frames, covers, grates and ladders ..... 02450.30
- Pipe materials ..... 00445.11
- Precast concrete sections ..... 02450.10, 02450.20
- Reinforcement ..... 02510.10

**00490.11 High Early Strength Concrete** - Furnish high early strength concrete meeting the requirements of commercial grade concrete, except it shall contain a minimum of 705 pounds per cubic yard of Type III or Type IIIA cement or an approved Type C or Type E admixture with a minimum of 592 pounds per cubic yard of Type I or Type II cement.

00490.12

**00490.12 Temporary Plating** - Temporary plating shall conform to Section 00275.

### Construction

#### **00490.40 General:**

**(a) Preparation** - Excavate and backfill according to Section 00405. Remove and dispose of old concrete and other materials according to Section 00310.

Obtain approval before reusing salvaged metal frames, covers, grates and fittings on structures to be adjusted.

When concrete is placed around frames, paint the portion of the frame that contacts the concrete with hot asphalt before the concrete is poured.

Provide high early strength concrete when shown on the plans, or when traffic is required to traverse the structure due to staging requirements. The Engineer will determine the length of curing time.

Construction of new manholes shall conform to Section 00470.

Repair, replace or restore to existing condition any manhole or similar structure backfill, inlet base drain, aggregate base or pavement disturbed or fouled by the adjustment work as directed.

#### **(b) Diversion of Flow:**

**(1)** If sewer or storm drain diversion is necessary to do the contract work, submit a "Sewer Diversion Plan" to the Engineer prior to the start of construction. The Sewer Diversion Plan shall describe the Contractor's proposed method of managing and conveying all flows during all phases of construction. The plan shall contain, at a minimum, a plan view of the diversion facilities on a site map, and the individual components including but not limited to: pump types, size and placement; diversion pipe size, type, and placement above and below ground, power supplies, method of damming the flow, and redundancy.

**(2)** The Engineer will provide the Contractor with the anticipated sewer flow rates to prepare the Sewer Diversion Plan and to size the diversion pump(s), pipe(s), and related appurtenances. Refer to the Project Special Provisions for the specific information needed to prepare a Sewer Diversion Plan.

Flow within the City sewer system can fluctuate greatly with weather conditions. The Contractor is required to have ability to divert the expected annual average maximum flow corresponding to the time when work will occur whenever flow diversion is needed to complete the project.

After the Engineer has reviewed and approved the Sewer Diversion Plan, no change is allowed. Change to any aspect of the approved Diversion Plan, including different diversion facilities or discharge location(s), shall require resubmittal and approval by the Engineer.

**(3)** No sewer diversion operation may proceed unless the Contractor has, at the work site, the following items:

**a.** Dry granular lime, or a 10% bleach solution, of sufficient quantities as determined by the Engineer, to be spread on any sewage release (defined as sewage being backed up or discharged to any unintended place or causing a threat to public health or safety) as a disinfectant. Disinfectants may not be directly applied to any surface waters, streams, creeks, or other natural or manmade surface water conveyance facilities when water is present.

**b.** Equipment to secure the area of sewerage release and isolate the public from accessing the release site. As a minimum, include barricades and caution tape.

**c.** Equipment and materials on hand to stop the release and repair the failed item.

**d.** Equipment and materials to clean and disinfect the site, rake up solid debris, and to dispose of material properly.

**(4)** When necessary, divert the flow by use of pumps to the next downstream manhole. Provide adequate pumps and piping to divert flow to downstream sewer lines. All diversion flow piping shall be buried, with leak-proof pump hoses, unless approved.

**(5)** Maintain diversion of flow during working hours and return flow to gravity during non-working hours unless otherwise approved. Be responsible for continuity of flow and uninterrupted sewer service to each facility connected to the sewer during the execution of the work. All pipe connections shall be water tight.

**(6)** If pumped diversion of flow is allowed, incorporate redundant pumps and power supplies. Have personnel on site to monitor pumped flow diversion system continuously. Personnel monitoring the pumped diversion must also be capable of starting backup system in an automatic mode capable of handling diversion flows. Back up power sources and pumps shall have the same capacity as the primary pumping equipment.

**(7)** Use generators that meet or exceed requirements imposed by local noise ordinances, and place generators so as to minimize disturbances to residential areas. When working outside the hours defined in Subsection 00290.30(d), secure a noise variance, if required, at no additional cost to the City. Comply with the more restrictive noise control requirements established for non-working hours. Contact the Office of Neighborhood Involvement, Noise Control Office.

00490.41

(8) Be responsible for all fines, cleanup, repair, property damage costs and other claim costs resulting from sewage release, including sewage entrance into buildings.

(9) Have sufficient equipment and materials at the work site to immediately cease, contain and clean up any sewage release that occurs during diversion operations. Leaking pipes and pumps shall be replaced or repaired. Immediately clean up sewage releases.

(10) Immediately notify the following agencies of any sewage release:

- a. Bureau of Environmental Services Spill Response.
- b. Bureau of Maintenance (BOM)
- c. Oregon Emergency Response System (OERS, if the spill is directly into any water body of the State).

(11) Provide these agencies and the Engineer with the following information:

- a. Release site.
- b. Date and time release started and stopped if known.
- c. Release flow rate and estimate of volume.
- d. Receiving stream or watercourse.
- e. Action taken to stop release.
- f. Cause of release.
- g. Clean-up actions

**00490.41 Manholes over Existing Sewers:**

(a) **General** - Construct manholes in accordance to Section 00470. Test all sanitary sewer manholes according to Section 00470.

Provide all rigid pipe entering or leaving a manhole with a flexible joint within 18 inches of the manhole structure. Flexible pipe may be exempt from this requirement when using an approved manhole adapter to make the connection to the manhole.

Prevent material or debris from entering the line. When required, provide all diversion facilities and perform all work necessary to maintain flow in existing lines. Obtain the Engineer's approval prior to diverting flows.

(b) **Diversion of Flow** - Before beginning work on any existing operating sewer submit a Sewer Diversion Plan in conformance with these Specifications to the Engineer. Obtain approval before beginning work. Approval will not relieve the Contractor of responsibility for maintaining adequate flow capacity at all times and adequately protecting new and existing work.

**(c) Extent of Work** - Construct manholes over existing operating sewers at locations shown on the Plans. Perform necessary excavation and construct new manholes in conformance with applicable requirements of Section 00470.

**(d) Damaged Connections** - Connect any existing or new sewers to the manhole. Replace any sewer damaged by construction operations entering or leaving a manhole at no additional cost to the City.

**(e) Interior Finishing** - After constructing the manhole, carefully break out the existing pipe within the manhole, cover the broken edges with mortar and trowel smooth as approved.

**(f) Precautions To Be Taken** - Prevent broken material or debris from entering the sewer. At all times, maintain flow through the existing sewer. After placing new concrete or mortar, protect the area for a period of 7 days.

**(g) Connection to Existing Manholes** - Carefully, break out existing manhole base and walls as approved. Grout in new sewer to provide watertight seal, and, when applicable, rework the existing base to provide smooth flow channels into and through existing manhole as specified.

**(h) Manhole Connections** - Construct openings in the existing manhole base or barrel as required. Construct connections that are watertight and that will provide a smooth flow into and through the manhole. All sanitary sewer pipe connections, including those at invert level as well as penetrations for drop connectors, conduits and carry-throughs, shall conform to the requirements of Section 00470.

**(i) Removal of Existing Pipes, Manholes & Sewer Appurtenances** - Remove from the site and dispose of existing pipelines, manholes and sewer appurtenances which lie in the line of and are to be replaced by the new construction.

**00490.42 Service Line Connections to Existing Sanitary Sewers and Facilities -**

**(a) General** - Make connections of service lines to existing sewers watertight. Make connections, where possible, to existing tees or wyes that have been previously installed and plugged. Remove the plug and make the connection according to Section 00445. Make transition couplings between dissimilar pipe materials using approved commercial adapters. Where tees or wyes for connection are absent or unusable, connect service lines with approved commercial taps. Install taps by coring without protrusion into, or damage to, the existing sewer. Support the sewer and replace bedding material, as necessary, to prevent settlement of the sewer grade.

**(b) Penetrations in Manholes** - Core-drill all openings to connect pipe up to 10 inches in diameter. Provide a minimum of 1 foot of clearance in all directions between the edge of the opening and the edge of any other adjacent opening or pipe and 6 inches of clearance from any manhole joint. Openings for pipe larger than 10 inches require Engineer's approval.

00490.43

**00490.43 Abandoning Pipe in Place** - Drain abandoned pipes and plug watertight. Plug abandoned pipes with gasketed mechanical plugs or grout seals, as directed. Where abandoned pipes connect to sewer manholes, install the plugs or seals from the inside of the manhole and reshape the channel to conform to the Standard Drawings.

Fill abandoned pipes greater than 12 inches diameter with sand, controlled low-strength material meeting the requirements of Section 00442, or other approved material.

**00490.44 Filling Abandoned Pipes, Manholes and Catch Basins:**

**(a) General** - Fill all existing manholes and structures shown to be abandoned with pea gravel or with granular material meeting the requirements of Section 02630.

Compact pea gravel until there is no reaction or yielding observed under the compactor. Compact the granular material to 90% of maximum density according to AASHTO T 99.

Remove all structures to a minimum of 2 feet below subgrade. Remove manhole or inlet frame and cover and plug all abandoned pipes with permanent plugs. Cover in-place pea gravel with 2 mats of non-woven filter fabric, extended at least 1 foot beyond the outside walls of manhole, sump, or basin. The landscaped or unimproved roadway sections shall be backfilled with approved materials meeting the requirements of 00330.13. The last one foot of backfill shall use materials as shown.

**(b) Sumps** - Remove sediment, contaminated soil, and water and properly dispose of these materials according to Section 00291. Remove top cone and first solid concrete section to a depth of approximately 8-10 feet below ground. Fill sump with CLSM meeting the requirements of Section 00442. Backfill void with approved materials meeting the requirements of 00405.14. Place geotextile meeting the requirements of 02320 on top the CLSM that extends beyond the outside of the sump and surrounding backfill.

**(c) Permanent Plugs** - Provide permanent plugs where sumps, manholes, inlets, pipes and other sewer appurtenances are removed or abandoned. Also provide plugs where shown. The minimum length of concrete plug shall be 8 inches. All plugs shall be watertight and capable of withstanding all internal and external pressures without leakage. Clean the interior surfaces of all pipes to be cut off or abandoned, as approved. For pipes greater than 12 inches in diameter, fill with CLSM or as specified. Construct a concrete plug in each end of all pipes 18 inches or less in diameter. For 21 inch and larger pipe, the plug may be constructed of common brick or concrete block. Cover the exposed face of block or brick plug with mortar.

**00490.45 Salvaging Manhole Frames, Covers and Grates** - Remove manhole frames, covers and grates scheduled for salvage and store in an approved location. Frames, grates and covers meeting Specifications may be salvaged from structures to be adjusted and may be reused in the work if of suitable size and condition. Replace, at no additional cost to the City, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.

Clean salvaged components to be reused of foreign material by methods that will not harm the components.

**(a) Existing Manhole Frames and Covers** - Manhole frames and covers removed by the Contractor are the property of the City. Notify the Engineer a minimum of 1 day before removal to arrange for pick up of the removed frames and covers, if not reused.

**00490.46 Adjusting Manholes and Structures:**

**(a) General** - Bring manholes, inlets, catch basins and other structures to the specified finished grade by methods of construction as required in Sections 00445 and 00470.

Excavation necessary for bringing a structure to grade shall center about the structure and minimize the area of disturbance, as approved. At the completion of the structure adjustment, backfill the void around the structure with crushed aggregate and thoroughly compact it before installing the finished surface.

**(b) Metal Steps and Ladders** - If existing manholes or similar structures have metal steps or metal ladders, provide new steps or new ladder extensions in the adjusted structure, in kind. Construct according to the Standard Drawings.

**(c) Concrete and Masonry Manholes** - Manholes may be raised or lowered as specified below or as shown.

**(1)** Minor adjustments of manholes are those that require adding or removing precast grade rings or metal rings as approved.

**(2)** Major adjustments of manholes are those that infringe into the cone or flat top section. Remove the cone or flat top, add or remove sections, and replace the cone or flat top. Use risers to attain desired grade. When approved, adjustment of an existing manhole to a lower grade shall comply with the following:

- a. Do not reduce the manhole cone height to a point such that the inside diameter exceeds 25 3/4 inches
- b. Do not allow the manhole form casting to rest on a manhole step.
- c. Construct a 12 inch wide, concrete collar around the frame casting from 1 1/2 inches below the top of the cone to 1 1/2 inches below the top of manhole frame casting.

- d. If the cone is cracked during reduction, restack the manhole with shorter manhole sections and a new cone.

Precast sections removed in the adjusting work may be reused in other adjusting work or in new construction provided they are in good condition and otherwise conform to the Specifications. Precast items that are not used in the work shall be disposed of according to 00290.20.

**(d) Reconstruct Manhole Base** - Conform to applicable requirements of Section 00470. Exercise caution in chipping out an existing concrete base to prevent cracking of manhole walls. Prevent any material from entering the sewer. Pour new base to a minimum of 6 inches below the lower projection of the pipe, being either the bell or barrel. Construct new channels to the elevations shown on the Plans. Conform to details for channel construction as shown. Repair any cracks that occur because of work operations with new grout to form a watertight seal, as approved.

**(e) Replace Manhole Steps** - Remove non-conforming or defective steps as follows:

Obtain approved manhole steps from the CPL or current list of City's Materials Testing Laboratory. Assure that no material created or dislodged during removal of existing or installation of new steps enters the manhole or sewer. Replace all manhole steps identified for replacement. If manhole rehabilitation is required, perform all work prior to beginning installation of steps. All steps within a manhole shall be of the same design, type and size. Mixing of unmatched steps within the same manhole is not acceptable. Align steps vertically. Spacing between steps must be as shown. Install new steps according to manufacturer's instructions or as approved.

#### **00490.47 Adjusting Catch Basins and Inlets:**

##### **(a) Cast-in-Place Concrete Catch Basins and Inlets:**

- After existing frames and grates or covers have been removed, chip away the exposed top surface to expose firm concrete. Provide at least 1 inch clearance below the frame to be placed.
- Clean the new surface by brushing and moistening with water at the time of placing new concrete.
- Provide the necessary forms to maintain existing structure dimensions in the new work.
- Place new concrete according to Section 00440 to the required grades. The frame may either be preset in the form or placed in the fresh concrete to the required grades.
- Finish the concrete top surfaces as required to match the grades required.
- Grout existing and new inside surfaces, as required, to attain a uniform surface transition.



- (b) **Precast Concrete Catch Basins and Inlets** - The entire precast structure may be reset to a new grade when the nature of the structure and conditions permit.

Precast concrete sections may be added or removed as required to obtain proper grade.

Precast structures may be raised by using precast sections provided that:

- The material conforms to the general requirements of the existing structure
- Sections are set and joined to each other and to existing sections
- Uniform bearing of bearing surfaces is assured
- Positive safeguards are made against displacement when in service.

- (c) **Catch Basin Connections** - Adjust as follows:

- Place connecting pipe at the required line and grade.
- Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall.
- Connect to the structure with a watertight joint.

Conform to applicable requirements of Section 00470. Carefully, break into existing inlet or catch basin and grout in a watertight seal between the new pipe and the inlet or catch basin wall. Plaster mortar smooth inside pipe opening. Alignment, pipe slope, and other construction details shall be as approved. Plug all abandoned pipes with permanent plugs. Slope bottom of inlet to drain to new pipe. Plaster mortar smooth all interior walls of inlet or catch basin.

- (d) **Bicycle Protection for Existing Inlet Grates** - Modify any existing inlet grate that does not have bicycle protection straps as shown or directed.

**00490.48 Adjusting Boxes, Cleanout Lids and Similar Structures** - Raise or lower boxes, lids and similar structures by one of the following methods:

- Resetting the entire structure on a firm foundation.
- Adding extensions of like material below the original structure if raising the structure to a point where it would not enclose or protect its contents.
- Placing precast box extensions, or cast-in-place concrete.
- Complete replacement of the structure with a new structure of adequate design approved by the Engineer.

**00490.49 Finish Grade** - Center a 12 foot straightedge, as far as practical, over the center of the cover of manholes and boxes. The final grade of the pavement surface and adjusted manholes and boxes shall not vary more than 1/8 inch from the finish grade and cross section at any point along the straightedge.

00490.50

**00490.50 Correction of Defects** - Perform all corrective work, including any re-inspection, necessary and provide documentation of the corrective work.

**Measurement**

**00490.80 Measurement** - The quantities of adjusted and reconstructed manholes, connection to existing manholes, filling abandoned manholes, sumps, inlets, boxes, catch basins, adjust structures to grade, reconstruct manhole base, connect pipe to existing inlets and catch basins, bicycle protection for existing grates, permanent plugs larger than 12 inches and other similar structures will be measured on the unit basis.

The quantities of manholes over existing sewers, connections to existing structures, and filling abandoned structures will be measured on the unit basis.

**00490.81 Lump Sum Basis** - Under this method, no measurement of quantities will be made.

**00490.82 Volume Basis** - Under this method, measurement on the volume basis will be within the neat line of the structure as shown.

**Payment**

**00490.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement for the following items:

	<b>Pay Item</b>	<b>Unit of Measurement</b>
(a)	Minor Adjustment of Manholes .....	Each
(b)	Major Adjustment of Manholes .....	Each
(c)	Adjusting Inlets .....	Each
(d)	Adjusting Boxes .....	Each
(e)	Adjusting Catch Basins .....	Each
(f)	Manholes over Existing Sewers .....	Each
(g)	Connection to Existing Structures .....	Each
(h)	Filling Abandoned Structures .....	Each
(i)	Existing Pipe Connection to New Manhole .....	Each
(j)	Reconstruct Manhole Base .....	Each
(k)	Permanent Plugs .....	Each
(l)	Bicycle Protection for Existing Grates .....	Each
(m)	Replace Manhole Steps .....	Each
(n)	CLSM for abandoned structures .....	Cubic Yard

Item (a) applies to manholes adjusted by adding or removing precast or metal grade rings.

Item (b) applies to manholes adjusted by:

- removing and reconstructing part or all of the cone or flat top
- removing and replacing the entire cone or flat top
- adding precast risers below the cone of precast manholes

Item (f) applies to manholes that are installed over existing sewers.

Item (h) applies to filling abandon pipes, manholes, sumps, inlets, boxes and other similar structures and includes all material and labor required to complete the work as specified.

Under item (i), any existing pipe that needs to be replaced in order to connect to a new manhole will be paid under Section 00445.

Item (k) applies to plugs larger than 12 inches.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for:

- earthwork
- backfill
- protective coatings
- replacement of sump backfill
- base drains
- aggregate bases
- pavements
- connections
- structure abandonment
- removing and disposing of existing structures and pipe
- permanent plugs 12 inches or smaller

**00490.91 Lump Sum Basis** - The accept quantities of work performed under this Section will be paid for at the Contract lump sum amount for the item "Diversion of Flow".

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

00491.00

**Section 00491 - Sump System Remediation**

**Description**

**00491.00 Scope** - This work consists of remediating a stormwater sump system damaged by the Work.

**00491.01 Definitions:**

**Sump System Site** - An area, shown on the Plans, that includes one or two sump manholes with drain rock, one sedimentation manhole and the pipe that connects these structures excluding any inlet structure and any pipe(s) between the sedimentation manhole and any inlet.

**Material**

**00491.10 Drain Rock Backfill** - Furnish clean gravel that is free of organics and is free draining. Unless otherwise directed. Use either:

- Pea Gravel as defined in 00110.20.
- 4" - 2" Aggregate with a maximum of 10% fractured faces.

Provide material that matches the character of the existing drain rock backfill. Obtain approval of material before material delivery and use.

**Construction**

**00491.40 Sump System Preservation** - When constructing sewer facilities adjacent to a sump system site, implement measures to avoid damage to any site facilities. Do not remove or abandon any sump manhole, unless identified in the Plans.

**00491.41 Sump System Site Remediation** - Remediate unavoidable damage by implementing any of the following measures:

- Remove sump drain rock that conflicts with the Work without disturbing the sump manhole. Replace the drain rock between the sump and the edge of excavation with new material. Prior to placing drain rock, protect the exposed native soil with Geotextile fabric, or other approved method. Do not disturb the exposed soil during backfill placement, or allow it to fall into the voids of the newly placed drain rock.
- Select geotextile fabric for separation purposes from Section 02320 or from the CPL and install between the drain rock and the pipe zone and trench backfill material, as shown.
- Remove and replace the sedimentation manhole according to Section 00470.

- If Work damages any portion of the pipe between the site structures remove the entire length between the structures and replace with pipe of the same material and size but not less than 10 inches in diameter according to Section 00445.
- Remove and replace any base aggregate and pavement damaged when remediating a sump system site according to Section 00495.

Obtain approval of any proposed work to these facilities.

**Measurement**

**00491.80 Measurement** - The quantities of sump system site remediation will be measured on the unit basis.

**Payment**

**00491.90 Payment** - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the item "Sump System Site Remediation".

Payment will be payment in full for furnishing and placing all materials, and furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Removing and replacing a sedimentation manhole will be paid according to Section 00470.

Removing and replacing damaged pipe between structures will be paid according to Section 00445.

Removing and replacing site pavement and aggregate base will be paid according to Section 00495.



**Section 00495 - Trench Resurfacing**

**Description**

**00495.00 Scope** - This work consists of resurfacing pipe trenches, including replacement of pavement, temporary surfacing, curbs, sidewalks, rock surfacing, topsoil, landscaping and other features removed or damaged during pipe trenching operations.

**Materials**

**00495.10 Materials** - Provide trench resurfacing materials that match existing material removed from pipe trenches, or meeting the following:

Aggregate .....	00640
Concrete Paving .....	00756
Concrete Sidewalks, Curbs and Driveway .....	00759
Control Low Strength Materials (CLSM) .....	00442
Emulsified Asphalt Concrete (EAC) .....	00735
Emulsified Asphalt Prime Coat.....	00705
Emulsified Asphalt Surfacing .....	00710
Emulsified Asphalt Tack Coat .....	00730
Minor Hot Mixed Asphalt Concrete (MHMAC).....	00744
Rock Surfacing.....	00640
Topsoil, Planting and Seeding .....	01040

Furnish sand used for edge sealing that is clean sand with no visible sign of silts or organic materials.

**00495.11 Temporary Surfacing Material** - Use MHMAC or products on the CPL.

**00495.12 Temporary Plating** - Temporary plating shall conform to Section 00275.

**Construction**

**00495.40 General** - The following construction requirements are for resurfacing trenches in various locations as shown. Refer to Section 00405 for trench surface removal requirements.

**(a) Minor Hot Mixed Asphalt Concrete (MHMAC) Paving** - Place MHMAC paving according to Section 00744.

**(b) Emulsified Asphalt Concrete (EAC) Paving** - When temporary surfacing is required prior to placing permanent surfacing, place EAC paving a minimum of 2 inch thick. The temporary paving shall be smooth with surface variations not greater than 1/2 inch from the existing surfacing. Where the temporary patch adjoins existing surfaces the joint shall not be greater than 1/4 inch high. Maintain the temporary surfacing until the permanent surfacing is placed. MHMAC mix may be used if approved.

(c) **Emulsified Asphalt Prime Coat** - Construct emulsified asphalt prime coat according to Section 00705.

(d) **Emulsified Asphalt Surfacing** - Construct emulsified asphalt surfacing treatment according to Section 00710.

(e) **Edge Sealing Tack Coat Application** - Seal all adjoining asphalt concrete pavement surfaces with an edge sealing tack coat. Place sufficient tack coat to seal the adjoining surfaces. After the tack coat has been placed, spread clean sand over the tack coat. Reapply additional tack coat and sand to cover any edges that are not completely sealed in the first application.

(f) **Aggregate Base** - Place aggregate base according to Section 00640.

(g) **Concrete Sidewalk, Curb and Driveway** - Construct concrete sidewalk, curbs and driveways according to Section 00759.

(h) **Concrete Paving** - Construct concrete paving according to Section 00756.

(i) **Rock Surfacing** - Construct rock surfacing according to Section 00640.

(j) **Topsoil** - Place topsoil according to Sections 00405 and 01040.

(k) **Landscaping** - Place landscaping according to the requirements of Section 01040.

(l) **Controlled Low Strength Material (CLSM)** - Place CLSM according to Section 00442. After the CLSM is placed and until the trench is paved, provide steel plates, or other approved covering, over the trench to allow access for vehicles, bicycles and pedestrians. Protect CLSM surface from vehicle loads for 3 days before placing MHMAC.

**00495.41 Temporary Surfacing** - Construct temporary surfacing with a minimum of 2 inches of MHMAC material or as shown.

#### Measurement

**00495.80 Measurement** - The quantities of trench resurfacing will be measured on the area basis. The length will be measured horizontally along the centerline of the installed pipe from edge to edge of the surface replaced. The width will be the trench width detailed in Section 00405 plus 12 inches as shown below. The width will be measured from edge to edge of the top of the trench.

For temporary trench resurfacing, the width will be the trench width detailed in Section 00405.

00495.90

**(a) Sewer Pipe:**

Size of Pipe	Width of Trench Resurfacing
6 to 10 inches	42 inches
12 to 21 inches	OD plus 30 inches
24 to 36 inches	OD plus 34 inches
42 to 54 inches	OD plus 54 inches
60 inches and larger	OD plus 58 inches

**(b) Water Pipe:**

Size of Pipe	Width of Trench Resurfacing
4 to 16 inches	OD plus 30 inches
24 inches and larger	OD plus 36 inches

When the pipe is installed under pavement by tunneling, boring, or jacking methods, the work will be measured for payment according to 00406.80.

**Payment**

**00495.90 Payment** - The accepted quantities of trench resurfacing will be paid at the Contract unit price, per square yard, for the following items:

Pay Item	Unit of Measurement
(a) Trench Resurfacing.....	Square Yard
(b) Temporary Trench Resurfacing .....	Square Yard
(c) Trench Resurfacing w/o Base, _____, _____ .....	Square Yard

Item (b) includes the cost to remove and dispose of the temporary surfacing when no longer needed.

Item (c) is only for the replacement of the trench surfacing material. In the first blank, indicate the resurfacing material. In the second blank, the thickness of resurfacing material. Payment for aggregate base will be paid for according to Section 00640.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for replacement of disturbed landscape items.

When the pipe is installed under pavement by tunneling, jacking, or boring methods, the work will be paid for according to 00406.90.



When the Contract Schedule of Items does not indicate payment for trench resurfacing or other work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this work is required.

