Standard Specifications

City of Fairburn

2008

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SECTION 02112 - ROUTE CLEARING

PART l - GENERAL

DESCRIPTION OF WORK:

The extent of route clearing is that minimum degree of clearing necessary to install utilities and appurtenances, and such additional clearing as shown on the Drawings.

Route clearing operations include, but are not limited to, the following:

Protection of existing trees and other vegetation.

Removal of trees and other vegetation.

Clearing.

Removing above-grade improvements.

Removing underground improvements.

Restoring damaged improvements.

Protecting above-grade and underground improvements.

JOB CONDITIONS:

Protection of Existing Improvements:

Provide barricades, coverings, or other types of protection necessary to prevent unnecessary damage to existing improvements.

Protect improvements on adjoining properties as well as those on the project site. Restore improvements damaged by this work to their original condition, as acceptable to the City's or other parties or authorities having jurisdiction. Replace property line monuments (such as iron pins) removed or disturbed by clearing operations.

Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip lines, excess foot or vehicular traffic, or parking of vehicles or equipment within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing.

Provide protection for ornamental tree roots over l-l/2 inches diameter that are cut during any construction operation. Coat the cut faces with an emulsified asphalt, or other acceptable coating, especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots of ornamental trees with wet burlap to prevent roots from drying out; provide earth cover as soon as possible.

Repair or replace unnecessarily damaged trees and vegetation, as determined by the City, resulting from any construction operation, in a manner acceptable to the City. Tree damage repair shall be performed by a qualified nurseryman. Replace unnecessarily damaged trees, which cannot be repaired and restored to full-growth status, as determined by the tree surgeon.

Protection of Adjacent Property:

Protect improvements, trees and vegetation on adjoining property as well as those on property requiring route clearing work.

Execute work so as not to create a nuisance to persons utilizing adjacent property.

Use work methods and provide temporary facilities as necessary to prevent washing, erosion, siltation or dust damage, or hazard to persons and property, within and off the work area.

PART 2 - PRODUCTS

Not applicable to work of this section.

PART 3 - EXECUTION

CLEARING:

Remove vegetation, trees, lawns, shrubbery, gardens and other plant growth to the minimum practicable extent. Limit clearing to a single lane work route without provision for construction vehicles to pass utility operation. Accurately determine limitations of construction easement or right-of-way, and keep construction activity within such limits.

Remove lawn sod by cutting into maximum size, which can be handled without tearing, stripping sod and underlying topsoil, and stockpiling for use in restoring the surface area. Water sod and otherwise maintain sod in viable, growing condition.

Remove above-grade structures only where specifically authorized.

Remove conflicting fences and provide effective temporary measures to prevent stock, cattle or other domestic animals from wandering to other lands. Reconstruct fences promptly.

Remove abandoned underground facilities such as utilities and structures, walls, footings, basements, wells, septic tanks, cisterns, underground pipe, and other items which conflict with construction.

HOLES AND DEPRESSIONS:

Fill holes, depressions and voids created or exposed by clearing operations with non-organic soil material, unless further excavation or earthwork is indicated.

Place fill material in horizontal layers not exceeding six inches loose depth, and thoroughly compact to a density at least equal to adjacent original ground.

DISPOSAL OF WASTE MATERIALS:

Disposal General Requirements:

Accomplish disposal of cleared matter daily so as to maintain site in a safe and neat condition throughout the contract period.

The City may remove merchantable timber, buildings or other items of value from the work site before the Contractor begins operations, and no assurance exists that any such material will be on the work site when the Contractor begins work.

Burning of cleared materials on the work site is not permitted.

On-Site Disposal:

Unless the City requests complete removal, cut tree trunks and limbs, over two inches in diameter, into 24-inch lengths and neatly stack within work limits having the same property ownership as that on which the tree originally grew.

On undeveloped property, distribute brush, trees and limbs less than two inches in diameter, within the work area from which cut, in such a way as not to be objectionable to the property of the City. On developed property, remove all such clearing waste and properly dispose of it off-site.

END SECTION 02112

SECTION 02204 - TRENCHING AND BACKFILLING

PART l - GENERAL

DESCRIPTION OF WORK:

The extent of trenching and backfilling is shown on the Drawings.

Trenching and backfilling operations include, but are not limited to, all earthwork associated with installation, modification, or abandonment of underground utilities and appurtenances, and restoration of damaged improvements.

Related work specified elsewhere includes, but is not limited to, the following:

Route Clearing, Section 02112

QUALITY ASSURANCE:

Codes and Standards: Perform trenching and backfilling work in compliance with applicable requirements of governing authorities having jurisdiction where such requirements exceed those specified in this section.

Sampling and Testing:

Provide quality control testing during construction as necessary to assure the entire earthwork including all fill layers, sub grades, and bases meets contract requirements. Remove and reconstruct, or otherwise correct work, which falls below specified density or is outside other specified limits.

Employ, at Contractor's expense, an independent testing laboratory to perform quality control testing during trenching and backfilling operations.

The City may perform sampling, surveying, inspection or testing activity during construction for his use, but such activity does not relieve the Contractor from the City's responsibility to achieve specified results.

SITE INFORMATION:

Verify existing site grades to be substantially consistent with grades shown on the Drawings before commencing work. Report any significant conflict in grades to the City before proceeding.

Subsurface conditions presented, if any, are not intended as representations or warrants of continuity of such conditions between soil borings or pits. It is expressly understood that the Contractor is solely responsible for interpretations or conclusions drawn there from. Data are made available for the convenience of the Contractor who may perform additional test borings and other exploratory operations at Contractor's expense, provided such operations are acceptable to the City.

Existing Utilities: Locate all existing underground utilities in the areas of work including verification of nature and exact location of any utility indicated on Drawings. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

Should unexpected piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with the City and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by the City or others, except when permitted in writing by the City and then only after acceptable temporary utility services have been provided.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

Traffic Control: Schedule and conduct Work in a manner, which will minimize inconvenience to vehicular and pedestrian traffic. Provide flaggers, barricades, warning signs, warning lights, and other warning means as appropriate. When flaggers are utilized, individuals must meet local and state requirements. Maintain traffic on all roads and streets which must be crossed by trenching and making two separate cuts so that at least one traffic lane is open at all times. All traffic controls during construction must conform to Part VI of the Manual on Uniform Traffic Control Devices, ANSI D6.1e.

PART 2 - PRODUCTS

RIP RAP STABILIZATION:

Stone Rip-Rap: Individual stones not less than 6 inches thick or 12 inches wide, not more than 2 cubic feet in volume and of proper shape to bring structures to accurate lines, shapes and elevations. Provide stone free of rounded, or worn surfaces and also free of segregation, seams, cracks, pyrite intrusions and other defects tending to reduce weather resistance.

PART 3 - EXECUTION

PROTECTION OF PERSONS AND PROPERTY:

Prior to commencing other work, accurately locate above and below ground utilities and structures, which may be affected by the Work, using whatever means be appropriate. Mark the location of existing utilities and structures, not otherwise readily visible, with flagging, stakes, barricades, or other suitable means.

Barricade open excavations and post warning lights for safety of persons. Operate warning lights during hours from dusk to dawn each day.

Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations, from damage caused by settlement, lateral movement, undermining, washout and other hazards.

Take precautions and provide necessary bracing and shoring to guard against movement or settlement of existing improvements or new construction. Contractor is entirely responsible for strength and adequacy of bracing and shoring, and for safety and support of construction from damage or injury caused by the lack thereof or by movement or settlement.

Use work methods and provide temporary facilities as necessary to prevent washing, erosion, siltation or dust damage, or hazard to persons and property, within and outside the work area.

Place excavated material compactly alongside of the trench, and keep such material trimmed up so as to present the least practicable inconvenience to the public. Where necessitated by traffic conditions, remove from the roadway the first material excavated from a working length of trench so that further excavation is immediately used for backfilling, and thereby avoid stockpiling of material upon the roadway. Afterward, return first excavated material if needed for final backfilling.

Maintain all streets, sidewalks, crossings, fire hydrants, water and gas valves, fire alarm boxes, and other utilities accessible for their intended use except while the work is steadily advancing in the immediate vicinity of each such facility.

Keep every drain, gutter, culvert, sewer, and surface drainage route encountered, open for both temporary and permanent flow unless other effective provision for drainage is made.

Do not permit any hazardous condition to result from trenching and backfilling operations.

USE OF EXPLOSIVES:

Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction.

Use explosives only as legally permitted and when other work methods are impractical.

Do not permit explosives on the project site other than during the least practicable use period.

Assume sole responsibility for handling, storage, and use of any explosive materials.

TRENCHING:

Trenching consists of removal and disposal of material encountered to obtain required sub grade elevations, usually, but not necessarily limited to that incidental to installation or modification of underground pipelines and appurtenances.

Rock excavation consists of removal and disposal of natural material encountered that cannot be excavated without continuous and systematic drilling and blasting or continuous use of a ripper or other special equipment. Intermittent drilling or blasting performed to increase production and unnecessary for excavation of material encountered will not be classified as rock excavation.

Stability of Excavation: Slope sides of excavations to comply with Subpart P of Part 1926 of the Occupational Safety and Health Act as amended. Should any provision of a governing local code be more stringent than the preceding national standard, follow the local code. Shore and brace or use trench box where sloping is not possible either because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

Shoring and Bracing: Provide portable trench boxes and materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

Maintain shoring and bracing and/or portable trench boxes in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

Provide trench boxes and/or shoring and bracing to comply with Subpart P of Part 1926 of the Occupational Safety and Health Act as amended. Should any provision of a governing local code be more stringent than the preceding national standard, follow the local code.

Dewatering: Perform earthwork in a manner to prevent surface water and minimize subsurface or ground water from flowing into excavations, and to prevent water from flooding project work and surrounding area.

Do not allow water to accumulate in excavations. Remove water using dewatering methods, which will prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of sub grades and foundations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Limit opening of additional trench length to that which can be dewatered with available equipment or methods.

Do not use trench as temporary drainage ditch.

Material Storage: Locate and retain materials away from edge of trench.

Dispose of excess soil material and waste materials, such as unsatisfactory excavated soil material, trash and debris, as specified hereinafter.

Excavating: Do not extend excavation below or wider than that, which is necessary to construct work except as otherwise provided herein. Repair any unauthorized trenching as necessary to obtain an adequate sub grade as determined by the City.

Limit open trench excavation to a maximum of 300 feet ahead of completed backfill.

Where specific utility system elevations or depths are indicated on the Drawings or elsewhere herein, accurately conform with such requirements. Otherwise, achieve a minimum earth and/or pavement cover of 30 inches above top of underground utilities being constructed unless a greater cover is made necessary by easement or permit requirement, by maintaining a minimum clearance of l8 inches below any existing or proposed structure or channel, or by achieving proper alignment with existing or proposed facilities.

Maintain a horizontal separation of at least 10 feet between sanitary sewers and any existing or proposed water main. A sewer may be laid closer than 10 feet to a water main if it is laid in a separate trench or it is laid in the same trench with the water main located at one side on a bench of undisturbed earth.

Maintain a vertical separation of at least 18 inches between the crown of sanitary sewers and the invert of existing or proposed water mains with the sewer located below the water main. Where a vertical separation of 18 inches cannot be provided and the water main cannot be relocated to provide adequate clearance, center one full length of water main over the sewer so that both joints of the water main will be as far from the sewer as possible.

Confine trench width from an elevation of one foot above top of underground pipe to the trench bottom, to that minimum which is necessary to pipe laying operations, but do not exceed maximum trench width determined by pipe foundation requirements.

Remove rock, masonry and concrete material to a distance of at least six inches from all parts of pipe and appurtenances being installed. Backfill and thoroughly compact, to proper trench bottom elevation, with select excavated material.

Do not mix excavated rock, masonry or concrete with backfill material placed within two feet of installed pipe, or within one foot of finished grade.

Pavement Removal: Remove all pavement, including curb and gutter, sidewalk and the like, which must be disturbed by trenching operations.

Saw cut edges of bituminous pavement. For concrete pavement, saw cut edges or remove and replace to nearest joint.

At sidewalks, curbs and gutters, and the like, remove entire width of damaged sections.

Extend pavement removal to the width required to accomplish trenching operations without damage to edge of remaining pavement. Correct any edge damage, which occurs as requested by the City.

Removal of Unsatisfactory Soil Materials: To the extent required, over-excavate those soil materials, which are unsatisfactory in the opinion of the City and backfill with approved materials.

COMPACTION:

General: Control soil compaction during construction providing minimum percentage of density specified for each area classification.

Percentage of Maximum Density Requirements: Achieve not less than the following percentages of maximum density of soil material compacted at optimum moisture content, for each layer of soil material-in-place as determined by ASTM D 698 (Standard Proctor) test procedures:

Rights-of-Way: Conform with the more stringent requirements of the permit issuing authority and the requirements herein.

Roadways: Under and within five feet horizontal distance of traffic using surfaces, compact each layer of backfill and fill material to 95 percent of maximum dry density.

Walkways: Under and within two feet horizontal distance of paved walks, compact top six inches of sub grade and each layer of backfill and fill material to 95 percent of maximum dry density.

Driveways and Parking Lots: Under and within two feet horizontal distance of traffic using surfaces, compact each layer of backfill and fill material to 95 percent of maximum dry density.

Lawn or Unpaved Areas: Compact each layer of backfill or fill material to 85 percent of maximum dry density.

Spoil Areas: Compact each layer of backfill or fill material to 85 percent of maximum dry density.

Moisture Control: Where a layer of soil material is too dry to achieve required compaction, uniformly apply water to layer in such manner as to prevent excessive free water from appearing on surface during or subsequent to compaction operations.

Remove, dry and replace, or scarify and air dry in place, soil material that is too wet to achieve required compaction.

BACKFILL AND FILL:

General: Place acceptable soil material in uniform layers, to required elevations. Backfill excavations as promptly as work permits.

Backfill and Fill Materials: Use acceptable trench excavated soil material, free of stumps, trees, roots, muck, trash and other objectionable matter.

Placement and Compaction: Place backfill and fill materials in layers not more than eight inches in loose depth. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Commence backfill and fill operations close behind utility laying operations. Take care to prevent wedging action of backfill or fill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.

GRADING:

General: Uniformly grade areas within limits of earthwork, including adjacent transition areas. Smooth and compact finished surface within specified tolerances, with uniform levels or slopes between points where elevations are shown, or between such points and existing grades, or between existing grades.

Grading Outside Structures: Grade finished areas adjacent to structures to drain away from structures (except drainage inlets), and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:

> Grassed or Landscaped Areas: Finish areas to within not more than 0.l0 feet above or below the required elevations.
>
> Walks and Pavements: Shape surface of areas under walks and pavements to line, grade and cross-section, with finish surface not more than l/2 inch above or below the required sub grade elevation.
>
> Compaction: After grading, compact sub grade surfaces to the depth and percentage of maximum density for each area classification.

RIP RAP SURFACE STABILIZATION:

General:

Prior to placing rip rap, bring ground surface to correct line and grades. At Contractor's option, provide either soil cement bag rip rap or stone rip rap at all stream crossings, and/or at locations indicated on Drawings.

Stone Rip Rap:

Hand place stone rip rap into final position to form a compact layer not less than 6 inches in-place thickness. Use well graded stone sizes to eliminate void spaces between stones. Place stones neatly and anchor units to be free of tendency to slip out of position. Place rip rap so that no more than 3 inches variation exists above or below the required plane.

MAINTENANCE:

Protection of Graded Areas: Protect newly graded areas from traffic and erosion, and keep free of trash and debris.

Repair and re-establish grades in settled, eroded, and rutted areas to specified compaction and tolerances.

Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction, adverse weather, traffic, or other cause, scarify surface, re-shape, and compact to required density prior to further construction.

DISPOSAL OF EXCESS AND WASTE MATERIALS:

Disposal of Excess Excavation: Transport excess excavated material, including unsatisfactory soil material, to any designated spoil areas, and spread as specified; otherwise remove from the project work area and legally dispose of such material which cannot be acceptably distributed within project work area.

Disposal of Waste Material: Remove trash, debris, and waste materials from the project work area and legally dispose of such material.

RESTORATION:

Plan and execute total work so as to minimize damage to property. Restore all surface materials, shrubbery, fences, lawns, walls, structures and other improvements to a condition no less desirable than that, which existed before construction operations began.

Conduct all construction operations such that upon completion of any part of the work, the contour and topography of the construction area has not been substantially altered. No alteration of previously established storm drainage patterns will be permitted unless such alteration can be proven to the City's satisfaction to substantially improve the drainage pattern.

Where necessary to temporarily remove or damage improvements of any significance, take professional quality photographs of such improvements before disturbing them. Make copies of such photographs available to the City on request.

Restore work area and accomplish site cleanup immediately after backfilling and fill operations.

Replace property line monuments, which were damaged, removed or disturbed by trenching and backfilling operations.

END SECTION 02204

SECTION 02408 – TUNNELING AND CASED BORES

PART l - GENERAL

DESCRIPTION OF WORK:

Tunneling pertains to the installation of carrier pipe or tunnel liner below ground by means other than open cut excavation. The extent of tunneling is shown on the Drawings.

Tunnel liner sizes indicated on the Drawings and elsewhere in the Contract Documents are minimum nominal diameters. Use appropriate size and type of tunnel liner and construction methods as necessary to provide a complete tunnel liner installation.

Related Work Specified Elsewhere:

Route Clearing, Section 02112

Trenching and Backfilling, Section 02204

Water System, Section 02710

Sanitary Sewer System, Section 02720

Storm Sewer System, Section 02770

JOB CONDITIONS:

Traffic Control:

Schedule and conduct Work in a manner, which will minimize inconvenience to vehicular and pedestrian traffic. Provide flagmen, barricades, warning signs, warning lights, and other warning means as appropriate. Maintain traffic on all roads and streets, which must be crossed by utility lines. All traffic controls during construction must conform to Part VI of the Manual on Uniform Traffic Control Devices, ANSI D6.1e.

Weather Limitations:

Conduct all operations during weather conditions appropriate to the work being performed.

QUALITY ASSURANCE:

Codes and Standards:

Comply with applicable provisions of the following, unless otherwise indicated:

AASHTO, Standard Specifications for Highway Bridges, Section 16 "Specification for Steel Tunnel Plates".

AISC, "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" including, the Commentary.

AREA, Manual for Railway Engineering, Section 4.12 "Specification for Steel Tunnel Liner Plates."

PART 2 - PRODUCTS

CARRIER PIPE:

Where carrier pipe is installed without tunnel liner by tunneling methods, conform with carrier pipe material specifications unless otherwise indicated.

PIPE CASING:

Where pipe casing is installed using jacking or boring construction methods, comply with the following material specifications for steel pipe casing:

Steel Pipe Casing:

Steel Pipe Tunnel Liner, 4 Inches and Smaller: Conform to ASTM A53 material specifications. Use galvanized steel, Schedule 40 minimum, with threaded couplings.

Steel Pipe Tunnel Liner, Larger Than 4 Inches: Conform to ASTM A53 or Al39 material specifications, except hydrostatic testing is not required. Join pipe sections with full strength, continuous welds in accordance with procedures approved by the American Welding Society to obtain a watertight seal.

Unless otherwise indicated on the Drawings, use pipe meeting the following thickness requirements:

Nominal Diameter Inches	Minimum Wall Thickness Inches
l2 or Smaller	0.l88
16	0.282
l8	0.3l3
20	0.344
24	0.407

26	0.438
30	0.469
36	0.532
42	0.563

Reinforced Concrete Pipe Casing:

Conform to ASTM C76, Class V material specifications for withstanding in-place vertical loads. Provide additional reinforcement or strength required to withstand jacking pressure. Except for end closures, provide pipe in eight-foot minimum lengths. Use self-centering tongue and groove joints such that outside of tunnel liner is uniform in diameter at all locations. Seal pipe joints with butyl-based sealant manufactured for that purpose.

SECTIONAL PLATE TUNNEL LINER:

Where carrier pipe is installed in tunnel liner and mining methods are utilized, comply with the following specifications:

Materials:

Fabricate tunnel liner sections of corrugated steel plate especially manufactured for tunnel liner service. Design liner sections and fasteners in consideration of tunnel location shown on the Drawings. For liner plate design purposes, use soil, wheel, and surcharge loads of sufficient magnitude to insure a safe liner plate system in actual use conditions.

Provide tunnel liner plate having a minimum thickness of 0.l79 inches and liner plate fasteners having a minimum diameter of 0.625 inches.

Fabrication:

General: Tunnel diameters shown on the Drawings are in terms of the required minimum clear inside diameter of the erected liner plate tunnel. Fabricate liner plate sections so as to allow complete installation from within the tunnel, and with alternate liner plate rings in the erected tunnel containing two threaded grout holes in the vicinity of the tunnel invert and two grout bleed holes in the vicinity of the tunnel crown.

Galvanized Coating: After tunnel liner plate sections have been formed, punched, etc., hot dip galvanize plate sections with at least a two ounce coating of spelter per square foot total for both sides. Galvanized liner plates must not be warped, and the spelter coating must be free from defects such as blisters, flux, abrasion, poor adhesion and uncoated spots.

Bituminous Coating: After galvanizing, fully coat both sides of liner plate sections with an asphaltic bituminous coating not less than 0.05 inch thick and conforming to AASHTO N 190 for bituminous protected corrugated metal pipe.

VENT PIPING:

Conform to ASTM A53 or Al20 material specifications. Use two-inch minimum Schedule 80 steel pipe with butt-welded joints for vent construction.

Provide enamel primer and two coats exterior enamel paint in color(s) selected by the City for above grade piping.

ACCESSORIES:

Grout: One part Portland Cement; two parts masonry lime; four parts mortar sand; two percent of an approved admixture of Bentonite, Septamin Stearex, or Hydrocide Liquid; and where required, a retardant. Use sufficient mixing water that will produce a workable mixture of grout capable of being pumped into the voids created by the tunneling.

Concrete: Use 2000 PSI compressive strength concrete:

Clay Brick: ASTM C 32, Grade MS or ASTM C32 sewer and manhole brick or ASTM C216 facing brick, Grade MW or SW, of nominal size 8 x 2-l/4 x 3-3/4 inches. Color and texture as selected by Contractor.

Concrete Brick: ASTM C 55, Grade P-II, of nominal size 8 x 2-l/4 x 3-3/4 inches; gray-white concrete color with smooth formed natural texture.

Mortar Materials:

Cement: Portland Cement ASTM C 150, Type I or II.

Sand: ASTM C 144, well screened, clean, hard sharp, siliceous, free from loam, silt and other impurities. Provide the following grain size distribution:

#10 sieve, passing 95-100 percent

#50 sieve, passing 15-40 percent

#l00 sieve, passing 0-10 percent

Removal by decantation 0-5 percent

Water: Clean, fresh, free from oil, acid, organic matter and other deleterious substances.
Mortar Mix Proportions: Provide mortar mixed in the proportion of one part cement to three parts sand with only enough water to allow good workability of the mix. Hydrated lime may be added in amounts not exceeding 10 percent of the cement weight.

PART 3 - EXECUTION

INSPECTION:

Examine areas and conditions under which tunneling is to be done, and notify the City in writing, of conditions detrimental to proper and timely completion of Work.

GENERAL:

Carry out Work in a safe manner, taking all necessary precautions and measures necessary to maintain a stable construction system, which does not weaken existing earth or structures nor cause settlement of the over passing roadway or railway section.

When tunneling operations are carried out under railroad tracks, highways, streets, or any other existing thoroughfare, perform operations in such manner as not to interfere with nor in any way endanger the normal operation of such thoroughfares.

Complete all tunneling work at one particular location before starting work at another location.

EXCAVATION:

The following requirements are supplemental to the excavation section(s) of these specifications.

When required, excavate suitable pits or trenches for tunneling operations. Provide all necessary bracing, sheeting and/or other temporary means to insure safety of persons and property.

Maintain excavation free from water, mud and debris, which will interfere with an efficient tunneling operation. Neatly dry-excavate material of whatever nature encountered within the tunnel. Do not use sluicing or jetting excavation techniques.

Limit excavation to the minimum diameter required for tunnel liner installation.

Pressure grout all excessive voids, which may develop about the tunnel liner exterior.

Promptly backfill all pits and trenches.

JACKING:

When installing tunnel liner by jacking method, use guide rails or other jacking frame structure to effectively maintain tunnel liner at proper line and grade. Force tunnel liner into place with suitable jacks, which apply uniform pressure around the tunnel liner end section. Excavate at the lead end of the tunnel as the jacking operation progresses, but do not excavate more than two feet in front of tunnel liner. Reduce the two feet distance where material character results in excess

loss of soil. Remove excavated material through the tunnel liner. Once jacking is begun, continue operation without interruption to prevent the pipe from becoming firmly set in the embankment.

Perform tunneling such that the final tunnel liner position is within the following limits:

Lateral Alignment: Within two percent of tunnel liner length.

Vertical Elevation: Within one percent of tunnel liner vertical grade, provided that the final grade of flow line is in the direction indicated on the Drawings.

BORING:

Mechanically bore by use of a cutting head on a continuous auger. Install tunnel liner in hole by jacking or other suitable methods. Accomplish boring of hole and tunnel liner installation simultaneously. Do not permit boring to proceed more than one foot in front of tunnel liner.

Conduct initial boring using a pilot hole approximately 2 inches in diameter for the entire installation length. Verify required line and grade and use pilot hole as the centerline of the larger hole to be bored. If rock is encountered in pilot hole, withdraw equipment and relocate tunnel location. Conduct pilot hole installation in revised location and repeat procedure. No extra payment will be considered for pilot hole installations that encounter rock and must be abandoned.

Perform tunneling such that the final tunnel liner position is within the following limits:

Lateral Alignment: Within two percent of tunnel liner length.

Vertical Elevation: Within one percent of tunnel liner vertical grade, provided that the final grade of flow line is in the direction indicated on the Drawings.

MINING:

When installing tunnel liner by mining methods, handle, maintain, and install liner plate sections in such manner as to avoid damage to plates and surface coating thereon. Install liner plates immediately after excavated material is removed from the tunnel. Do not permit liner plate installation to fall more than 24 inches behind the tunnel working face. Do not leave more than 12 inches of unlined tunnel at the end of the day's operation.

Provide all necessary bracing bulkheads and/or shields required to insure safety of persons and property. Provide well-braced, temporary bulkhead against excavation face during each cessation of work while the heading is within 20 feet of railroad tracks or roadway pavement.

Pressure grout voids between excavated tunnel bore and liner plate at least daily as tunnel excavation and liner plate installation proceeds. In addition, do not extend liner plate installation more than 10 feet without placing grout. Introduce grout through all grout holes in tunnel liner plate at or near tunnel invert, continue grouting until grout mixture bleeds through grout holes located at tunnel crown. Use grouting pressure sufficient to fill all voids.

Perform tunneling such that the final tunnel liner position is within 0.2 feet of specified position, both laterally and vertically.

ABANDONMENT:

Should it become necessary to abandon a tunnel for any reason, pressure grout the abandoned hole to prevent damage to surrounding earth and structures. When the tunnel liner is retained, fill entire tunnel with grout and pressure grout any voids about the tunnel liner exterior.

TUNNEL LOCATIONS:

Locate tunnels as indicated on the Drawings.

To facilitate construction, changes in tunnel location may be permitted. Proposed changes must be submitted by the Contractor. Changes in location must be acceptable to the City, and any utility company or public agency having jurisdiction over the location.

END SEALS:

Seal ends of tunnel liner to prevent debris and moisture from entering the annular space between the carrier pipe and tunnel liner. For pipe tunnel liner, provide end seal consisting of flexible synthetic rubber boot conforming to ASTM C-923 or Link Seal penetration seal with insulating plastic plate, galvanized bolts and nuts, and EPDM rubber element manufactured by Thunderline Corporation.

VENTS:

Construct vents for tunnel liners as indicated on the Drawings or as required by any utility company or public agency having jurisdiction over the location.

END SECTION 02408

SECTION 02710 - WATER SYSTEM

PART l - GENERAL

DESCRIPTION OF WORK:

The extent of water system is shown on the Drawings.

Water system work includes, but is not limited to, the following:

Foundation preparation.

Furnishing and laying water pipe.

Furnishing and installing water line appurtenances.

Furnishing and laying services and accessories.

Cleaning and sterilizing constructed work.

Testing constructed work.

Related Work Specified Elsewhere:

Route Clearing, Section 02112

Trenching and Backfilling, Section 02204

Tunneling, Section 02408

JOB CONDITIONS:

Traffic Control:

Schedule and conduct Work in a manner, which will minimize inconvenience to vehicular and pedestrian traffic. Provide flagmen, barricades, warning signs, warning lights, and other warning means as appropriate. Maintain traffic on all roads and streets which must be crossed by water lines and making two separate cuts so that at least one traffic lane is open at all times. All traffic controls during construction must conform to Part VI of the Manual on Uniform Traffic Control Devices, ANSI D6.1e.

Connection to Existing Pipe work:

Where it is required that connection be made to existing pipe work, expose existing piping and determine the exact fittings and/or other appurtenances necessary to make the connection. Connections to existing pipe work indicated on drawings (if any) are shown only for the purpose of illustrating the general type of connection desired, and no assurance exists that such illustration can be followed precisely.

Weather Limitations:

Conduct all operations during weather conditions appropriate to the work being performed.

QUALITY ASSURANCE:

Manufacturer:

Furnish manufactured items, fittings, valves, and service components, from manufacturers having regularly produced such items as specified herein which have proven satisfactory in actual service, over at least a two-year period, as determined by the City.

Imperfections:

Irregardless of tolerances permitted by industry standards specified herein, the City may reject pipe or appurtenances at the manufacturing plant or project site, which have cracks, chips, blisters, lack of smooth interior or exterior surface, evidence of structural weakness, porosity, joint defect, significant variation from theoretical shape, or other imperfection which might, in the opinion of the City, contribute to a reduced functional capability, accelerated deterioration, or reduced structural strength.

Repairs:

Do not use patched or repaired pipe or appurtenances

PART 2 - PRODUCTS

MATERIALS:

Provide all materials, products and accessories required for complete, properly functioning system. Use only those pipe, fitting and accessory materials that are free of qualities, which impart taste, odor or toxicity to potable water.

DUCTILE IRON PIPING SYSTEMS:

Ductile Iron Piping System Type l (DIPW-l): (Sizes 6-inch and Larger)

Pipe: For pipe with push-on joints or mechanical joints, provide ductile cast iron pipe conforming with ANSI/AWWA C151/A2l.5l for pressure class not less than required by Table 51.3 for minimum 250 PSIG rated working pressure, laying condition 2, and depth of cover for actual installation. For pipe with flanged joints or grooved joints, provide ductile iron cast pipe conforming with ANSI/AWWA C115/A21.15 for thickness class 53 in Table 15.1 for minimum 250 PSIG rated working pressure.

Pipe Lining: Provide standard cement mortar pipe lining complying with ANSI/AWWA C104/A21.4, and standard asphaltic coating over lining and pipe exterior. Do not use any material which imparts taste or odor to potable water, or which is toxic to humans.

Fittings: Use gray or ductile iron fittings complying with ANSI/AWWA C110/A2l.l0 and C111/A2l.ll for minimum 250 PSI working pressure rating, lined and coated same as connecting pipe. At Contractor's option, ductile iron compact fittings complying with ANSI/AWWA C153/A21.53 for a minimum 350 psi working pressure rating, lined and coated same as connecting pipe may be used for pipe with push-on joints or mechanical joint.

Joints: For pipe, fittings and valves, use the following joint types indicated for the specified locations, unless otherwise specified or shown.

Flanged Joint (FJ): ANSI/AWWA C115/A21.15 ductile iron flanged joint complying with ANSI Bl6.l for class 125 pound drilling, unless class 250 pound drilling is indicated on Drawings or is required for connecting valves. Use corrosion resistant alloy steel bolts and nuts, and rubber gaskets complying with Appendix A to ANSI/AWWA C115/A21.15. Provide flanged joints for normally visible piping, unless noted otherwise.

Mechanical Joint (MJ): Mechanical joint complying with ANSI/AWWA C111/A2l.ll. Use corrosion resistant alloy steel bolts and nuts. Provide mechanical joints for direct burial piping or concealed piping within structures, for piping installed in tunnel liner, or, at Contractor option, for direct burial piping outside structures.

Push-On Joint (POJ): Push-on type joint complying with ANSI/AWWA C111/A21.ll. Provide push-on joints for direct burial piping outside structures.

Restrained Joint (RJ): Factory fabricated joint restraint system to resist pressurized pipe thrust forces. For push-on type joint, use boltless system of rubber gasket embedded with equally spaced stainless steel segments to grip the pipe, with allowance for joint deflection, and rated for 250 psi working pressure. For mechanical joint, use assembly of ductile iron retainer gland and corrosion resistant alloy steel bolts and nuts having a minimum 250 psi working pressure rating and permitting joint deflection. Provide restrained joints where indicated on the Drawings and, at Contractor option, for direct burial piping thrust restraint in lieu of concrete and metal tie rods and bands.

COPPER PIPING SYSTEMS:

Copper Tubing System (CuTW):

Tubing: Copper tubing complying with ASTM B88, Type K suitable for working pressures up to 200 psig at 200F water temperature. For underground direct burial installations, use soft annealed or hard drawn tubing and for all other installation use hard drawn tubing.

Fittings: For hard drawn tubing, use solder or brazing type wrought copper or cast bronze pressure fittings complying with ANSI Bl6.22 or Bl6.l8. For soft annealed tubing use solder or brazing type wrought copper or cast bronze pressure fittings complying with ANSI Bl6.22 or Bl6.l8 or flare type cast bronze fittings complying with ANSI Bl6.26.

Joints: Soldered, silver brazed or flared as appropriate and suitable for the following conditions:

```
Maximum working pressure:          150 psig

Service temperature:               100 F
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NON-METALLIC PIPING SYSTEMS:

Polyvinyl Chloride Piping System Type l (PVCPW-l): (2-1/2" to 4" Diameters Only)

Pipe: Non-toxic, polyvinyl chloride compound meeting ASTM Dl784, Class l2454-A or B material specification, and further meeting requirements of the National Sanitation Foundation. Must conform with requirements of ASTM D224l for pressure rated pipe of the following class(es):

Class 200 (SDR 21)

Furnish pipe with each section continuously and permanently marked with the following identifying data:

Nominal size and outside diameter.

Material code designation.

Dimension ratio number (SDR or DR).

Pressure class.

ASTM or AWWA specification designation.

Manufacturer's name or trademark and production record code.

National Sanitation Foundation Seal (NSF) verifying suitability of pipe material for potable-water service.

Fittings (PVC): Manufactured from same material compound as pipe, and in such configuration as necessary to achieve long term water pressure rating not less than the connecting pipe nor less than l60 PSI at 73 F with a safety factor of 2.5:l.

Fittings: Gray or ductile iron fittings complying with ANSI A2l.l0 or A2l.ll for minimum 250 PSI pressure rating. At Contractor's option, ductile iron compact fittings complying with ANSI A21.53 for minimum 350 psi pressure rating may be used. Provide cement mortar interior lining complying with ANSI A2l.4, and manufacturer's standard bituminous coating over lining and fitting exterior. Do not use any lining or coating which imparts taste or odor to potable water, or which is toxic to humans.

Joints (PVC Pipe): Unless otherwise required, use flexible elastomeric seals conforming to ASTM D3139 and ASTM F477. Provide compatible gaskets or adapters as required when joining to different type pipe material.

Joints (PVC Fittings): Unless otherwise required, use flexible elastomeric seals conforming to ASTM D3139 and ASTM F477.

Joints (Gray or D.I. Fittings): Comply with ANSI A21.11 and unless otherwise required, use at Contractor's option push-on type joint or mechanical joint utilizing corrosion resistant alloy bolts. Provide gaskets or adapters compatible with connecting pipe as required.

Polyethylene or Polybutylene Tubing System Type 1 (PETW-1):

Tubing: Flexible polybutylene or polybutylene tubing complying with AWWA C902, suitable for working pressures up to l60 PSIG at 73F water temperature and having a SDR not greater than 13.

Furnish tubing continuously and permanently marked with the following identifying data:

Nominal size and outside diameter.

Material code designation.

Dimension ratio number (SDR or DR).

Pressure class.

ASTM or AWWA specification designation.

Manufacturer's name or trademark and production record code.

National Sanitation Foundation Seal (NSF) verifying suitability of pipe material for potable water service.

Fittings and Adapters: Brass or bronze, and of the type and size required by the installation.

Joints: Metal to plastic tubing-compression type with stainless steel insert.

VALVES:

Gate Valves:

Gate Valve Type 1 (GVW-1):

Cast iron, resilient seated, AWWA C509 gate valves, rate for 200 psig working pressure, with counterclockwise opening, manual operator unless another type operator is shown or specified. Provide gate valves with the following features depending upon installed location of valve:

> Direct burial locations: Mechanical joint ends, non-rising stem, O-ring seals and square wrench operating nut. Provide one operating wrench for each 10 valves furnished, or fraction thereof. Where depth of valve is too great for operation by standard wrench, provide suitable, permanently installed valve stem extension and guide. For each valve, furnish two piece, cast iron or plastic roadway valve box with 5 1/4 inch minimum shaft size, cast iron top ring and drop type lid with "stay-put" features, and extensions as necessary to adjust top to finished grade.
>
> All except direct burial locations: Flanged ends, non-rising stem, O-ring seals, and operating hand wheel.

Gate Valve Type 2 (GVW-2):

Bronze body, threaded ends, complying with FS WW-V-54d, rising stem, hand wheel operator, solid disc, rate for 200 PSIG working pressure.

Check Valves (CV/WL):

Iron body, bronze mounted, full opening check valves with flanged ends and outside weight and lever. Provide l25 psig flanges suitable for l75 psig working pressure. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

> M & H Valve Company
>
> Clow Corporation
>
> Mueller Company

Detector Check Valve (DCVW):

Iron body, full opening detector check valve with flanged ends and by-pass meter. Provide unit, which is suitable for 175 psig working pressure. In addition to detector check valve, furnish gate valve on each side of check valve and on either side of meter. Complete assembly is to be UL listed and suitable for fire main service. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

Hersey Corporation

Mueller Company

Tapping Sleeves and Valves (TSVW):

Mechanical joint split sleeve and gate valve assembly suitable for working pressures up to 200 PSI. Use split sleeve having flanged valve connection. Furnish gate valve and valve box complying with preceding gate valve specification except provide one valve end flanged as required for attachment to tapping sleeves.

At Contractor's option use stainless steel tapping sleeve and gate valve assembly suitable for working pressures up to 150 psig and testing pressures up to 225 psig. Fabricate sleeve unit, including shell, lugs, nuts, bolts, flange and test plug, from 18-8 stainless steel. Provide sleeve lining gasket and flange gasket of styrene butadiene rubber suitable for potable water service. Furnish gate valve complying with preceding gate valve specification except provide one valve end flanged as required for attachment to tapping sleeve. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

Clow Corporation

Ford Meter Box Company, Inc.

JCM Industries, Inc.

Romac Industries, Inc.

Flexible Coupling (FCW):

Bolted couplings utilizing plain pipe ends, and suitable for not less than 150 psig working pressure while permitting angular flexibility without longitudinal restraint of connecting pipe. Fabricate body of welded rolled high strength steel of cylindrical shape with malleable or ductile iron flanges, coupling gaskets of molded synthetic rubber and bolts of corrosion resistant steel alloy. Use couplings compatible with pipe and fittings shown on Drawings. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

Dresser (Style 38)

Smith-Blair, Inc. (Type 411)

Fire Hydrants (FH):

Post style, l50 PSI working pressure, traffic model ("breakable"), compression type, and dry barrel fire hydrant complying with AWWA C502. Furnish hydrants with one 4 l/2 inch pumper connection and two 2 l/2 inch hose connections conforming with National Standard Fire-Hose Coupling Screw Thread. Supply cast iron cap and cap to hydrant securing chain for each connection. Provide cast iron body with harnessing lugs for optional reaction bracing, and with 6-inch size inlet connection compatible with connecting pipe. Shop paint hydrant above grade with red enamel. Apply one field finish coat of bright red enamel to hydrant barrel. Select depth of bury appropriate to actual hydrant installation (42 inches minimum unless otherwise indicated). Provide positive shut-off main valve whose minimum orifice diameter is at least 4 l/4 inches, and whose operation is accomplished by means of counter-clockwise opening stem fitted with National Standard pentagon operating nut. Utilize O-ring stem seals. Furnish one operating wrench for each l0 hydrants furnished, or fraction thereof.

Water Meter Type l (WM-l):

Cold water meter suitable for l50 PSIG working pressure, complying with AWWA C700. Use bronze, split style main case, or one-piece bronze main case with cast iron bottom cap. Use bronze or brass couplings for connecting pipe or tubing, and brass, bronze composition, or stainless steel external nuts, bolts, and washers. Include vulcanized hard rubber nutating disc, non-ferrous strainer to protect meter from damage by any solid particles contained in the water, and hermetically sealed, easily read register with l00 equal part test index circle and pointer. Use register, which is removable, without breaking water seal or interrupting customer service.

Provide reading in U. S. gallons.

Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

Badger Meter, Inc.

Neptune Meter Company

Water Meter Type 2 (WM-2):

Current type cold-water meter suitable for 150 PSIG working pressure and complying with AWWA C701. Use flanged, cast iron or bronze main case with bronze top cover and register housing. Use brass, bronze composition or stainless steel external nuts, bolts, and washers. Provide non-ferrous strainer to protect meter from damage by any solid particles contained in the water. Use hermetically sealed register, which is removable without breaking water seal or interrupting customer service. Use easily read register with 100 equal part test index circle and pointer.

Provide register reading in U.S. gallons.
Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

Badger Meter, Inc.

Neptune Meter Company

Backflow Preventers (BFP):

Reduced pressure type suitable for l50 PSIG working pressure and complying with ASSE l0l3 and AWWA C506 specifications. Use flanged cast iron body with bronze trim. Furnish complete unit including preventer, strainer, and test cocks.

Pipe Detection Tape:

Metal core enclosed 3 inch wide protective plastic jacket which can be readily detected by electronic pipe locator instruments in general use. Provide blue color jacket with block letters reading "Buried Water Line Below".

Coarse Granular Material For Pipe Bedding:

Crushed stone, crushed gravel, natural gravel, crushed shell, or similar material complying with ASTM C33, and having No. 67 gradation (3/4 inch to No. 4 sieve).

SERVICE SYSTEM COMPONENTS:

Corporation Stops: Cast brass or bronze with end threads conforming with AWWA C800, and consisting of precision tapered, and individually lapped, key and body surfaces. Shop test each stop for leak proof shutoff at specified working pressure. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

Mueller Company

Hays Manufacturing Company

Service Saddles For Ferrous Pipe: Extra heavy, hot dipped galvanized malleable iron bodies with galvanized or cadmium plated double straps and nuts, retained neoprene gasket, and outlet threads mating those of corporation stops used. Provide assemblies suitable for 500 psig cold water working pressure. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

Mueller Company

Smith-Blair

Service Saddles For Non-Ferrous Pipe: Heavy cast bronze or waterworks brass body and straps, bronze, brass or stainless steel screws or nuts and bolts, retained O-rings seal, and outlet threads mating those of the corporation stop used. Provide assemblies suitable for 200 psig cold water working pressure. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include but are not limited to, the following:

Mueller Company

Ford Meter Box Company

Clow Corporation

McDonald Manufacturing Company

Curb Stops: Brass or bronze body with resilient plug, permanently non-grease lubricated, and with end connections appropriate to connecting tubing or pipe. Use stops rated not less than l75 psig working pressure at l80F.

Meter Boxes: High density, reinforced plastic body with one-piece cast iron lid, unless otherwise indicated on the Drawings. Provide box of size and height appropriate to installation of meter and accessories required.

ANCHORAGE/SUPPORT MATERIALS:

Non-direct Burial Locations:

Piping Anchorage/Support: Factory fabricated hangers and supports conforming to Manufacturers Standardization Society (MSS) SP-58.

Metal Tie Rods, Bands and Accessories: 18-8 stainless steel or other acceptable corrosion resistant components which when combined as a system resist applied thrust at test and working pressures, with suitable allowance for water hammer.

Direct Burial Locations:

Concrete: Concrete conforming to ASTM C94 having a minimum compressive strength of 2,000 psi at 28 days.

Metal Tie Rods, Bands and Accessories: 18-8 stainless steel or other acceptable corrosion resistant components which when combined as a system resist applied thrust at test and working pressures, with suitable allowance for water hammer.

PART 3 - EXECUTION

GENERAL:

The Drawings are generally schematic, and it is required that the Contractor extend and/or modify construction details, as approved by the City, when field conditions necessitate such changes to achieve a safe and properly functioning system.

Construct and, if necessary, reconstruct water system work as necessary to obtain system free of breaks or excessive leakage.

Unless otherwise indicated, lay and join pipe in trenches and on foundations complying with methods proposed by the pipe manufacturer in writing and approved by the City. Methods will not be approved which are likely to result in lower quality of installation than that afforded by requirements contained in the following articles.

Install PVC pipe with rubber ring joints in accordance with ASTM D2774.

Install ductile iron pipe in accordance with AWWA C600.

PIPE FOUNDATION AND LAYING:

Clean interior of pipe and all joints before laying. When pipe-laying activity is not in actual progress, tightly cover open ends of pipe. Avoid permitting dirt, mud, or other material from entering pipe at any time.

Avoid damage or shock in handling pipe and accessories. Inspect each length of pipe and reject any defective piece. Carefully protect pipe in place from damage or displacement until backfilling operations are complete.

Cut pipe in a manner to avoid damage to pipe or lining, leaving a smooth end at right angles to pipe axis. Smooth and bevel edges of cut pipe for push-on, gasket type joints.

Lay pipe at depth dictated by field conditions, but with distance from top of pipe to finished grade not less than 42 inches unless otherwise shown or specified.

Found pipe on firm soil or coarse granular material in flat bottom trench with entire pipe barrel bearing uniformly on trench bottom, except for an approximately l8 inch gap at pipe balance point for sling removal. Hand excavate and backfill as required to provide uniform and continuous bearing and support for the pipe. Do not support pipe on hubs or end bells. Consolidate soil under and around pipe up to pipe centerline by tamping.

Join pipe with bells facing direction in which laying operation is progressing. Lay pipe upgrade wherever line grade exceeds l0 percent.

Control geometric position of pipe to ensure that pipe and fittings accurately conform with grade and alignment requirements. Lay pipe in a straight line or with uniform sweeping horizontal and vertical curves for proper alignment. Do not exceed manufacturer's recommended maximum joint deflection.

Prevent water from accumulating or running in trench during pipe laying operations or before the trench has been backfilled.

Adjust pipe depth or alignment to accommodate valve, hydrant or fitting setting, and as necessary to meet tie-in requirements or to avoid obstructions.

SERVICE TUBING INSTALLATION:

At roads, paved drives, retaining walls, and other paved areas, install service tubing by pushing, pulling, or auguring techniques. Do not cut any paved surface without written authorization of City.

At all other locations, install service tubing by trenching and backfilling, unless otherwise noted.

Lay tubing at depth dictated by field conditions, but with not less than l8 inches cover.

Bed tubing on firm soil. Remove any rocks, masonry, or any other objectionable material, which could damage tubing.

Lay tubing in compliance with manufacturer's recommendations.

Restore ground surface to original condition. Replace or repair any damaged improvements.

PIPE CONNECTIONS:

Make all pipe connections with standard factory fabricated fittings except where special connection details (if any) are shown on Drawings.

INSTALLING WATER PIPE IN TUNNEL LINER:

Tunnel Liner, 4 Inches or Smaller:

Insert water tubing into tunnel liner using methods, which prevent damage to tubing.

Tunnel Liner, 6 Inches to 42 Inches:

Insert water pipe concentrically into tunnel liner by securing hardwood blocks radially or PVC coated steel spacer around water pipe at no more than l0 foot longitudinal intervals. Use steel banding for securing wood blocks in place.

Blow sand into annular space, between water pipe and tunnel liner; starting at the longitudinal center and proceeding outward to each end. Use techniques, which assure complete filling of all voids from the liner invert up to or near the top of the water pipe.

Use water main pipe in tunnel liner with push-on joints or, at the Contractor's option, use mechanical joint type provided Contractor coordinates actual tunnel liner size to provide at least one inch clearance all around pipe joint gland outside diameter.

Restrain pipe and fittings at each end of tunnel liner in accordance with the ANCHORAGE topic in this specification section.

Tunnel Liner, 48 Inches and Larger:

Use the following procedure for installing water pipe in tunnel when adequate working room is available; otherwise follow same procedures as specified for tunnel liner, 6 inches to 42 inches.

Insert water pipe into tunnel liner after having grouted bottom of tunnel to exact grade required to support pipe in proper position.

Permanently secure water pipe in position by blocking each pipe length at top and sides with brick and mortar, followed by bedding water pipe to a depth equal to one-fourth the pipe outside diameter, with concrete.

Plug ends of tunnel with l2 inch thickness of masonry, leaving weep holes at lower end of tunnel.

VALVES, FITTINGS AND HYDRANTS:

Provide valves, fire hydrants, fittings and other appurtenances as indicated on the Drawings, specified herein, and as requested by the City. Comply with applicable provisions of AWWA C600.

Set fire hydrants plumb and with ground line index within 0.l foot of actual final ground level.

Set valves and valve boxes plumb, with valve box cover level with surface. Set lower section of valve box concentric with valve operating stem. Avoid contact at lower end of valve box with valve body or pipe.

ANCHORAGE:

Non-direct Burial Locations:

Piping Anchorage/Support: Install hangers and support in accordance with MSS SP-69 and SP-80. Install metal tie rods and bands in accordance with the requirements of AWWA C600 for thrust restraint, using components as shown in NFPA 24.

Direct Burial Locations:

Anchor all bends, valves, tees, fire hydrants, reducers and other points of unbalanced pressure as necessary to resist thrust at test and working pressures, with suitable allowance for water hammer. Also anchor piping system installed on steep slopes where gravitational force might otherwise cause piping displacement. Accomplish piping system anchorage by use of concrete reaction bracing, metal tie rods and bands, and/or restrained joint systems. When using concrete reaction bracing, pour concrete against firm earth and allow it to cure for at least five days before placing main under pressure. Position concrete blocks of sufficient size to counteract the magnitude and direction of the resultant thrust force.

Accomplish fire hydrant assembly anchorage by use of metal tie rods and bands and/or restrained joint systems. Keep joints and hydrant drain openings clear and accessible. Provide special support blocks at plastic pipes according to manufacturer's recommendation. When using bands and tie rods in conjunction with reaction bracing, provide a separate band for each tie rod. Use corrosion resistant materials throughout. When using restrained joint systems, utilize methods and place these special joints at appropriate fittings and pipe joints in accordance with manufacturer's recommendation.

Anchorage detailed on Drawings, if any, represents minimum anchorage to be installed. Field conditions may require additional anchorage, and it is the Contractor's responsibility to recognize such additional requirements and to provide appropriate additional anchorage.

SPECIAL CONSTRUCTION:

Where constructing on piers, supporting pipe on bridges, or for other special work, use safe and generally accepted construction methods to accomplish the required work.

SERVICE SADDLES:

Cast Iron and Ductile Iron Mains:

Install 3/4 and l inch size corporation stops directly into tapped holes in water main. Use service saddles for all taps larger than l inch size.

PVC Mains: (4-inches and Smaller Only)

Use service saddles for all service taps.

PIPE DETECTION TAPE:

Install pipe detection tape in trench, approximately two feet above pipe. Provide pipe detection tape for all non-ferrous water mains unless otherwise noted.

LINE CLEANING:

Avoid permitting dirt, rubbish, construction materials, etc. to enter lines and appurtenances during construction. Use whatever means are necessary to obtain a clean and internally smooth system prior to final acceptance.

Limit use of flushing water to rates and quantities, which will not interfere with, service to water customers.

WATER LEAKAGE:

General Leakage Requirements:

Make entire water line system as near watertight as practicable. Eliminate all detectable leakage regardless of test results hereinafter required.

Testing:

Furnish and use appropriate test equipment and methods. Include gage, meter, pump and connections.

Bleed all air from system prior to testing, providing any necessary corporation stops and piping installations.

Pressure test all elements of the piping system. Where piping is buried or otherwise concealed, maintain the pressure test for not less than six hours. Visible piping may be tested for a lesser time period, if approved by the City. Conduct pressure testing at 200 psi unless a lower pressure is recommended by a manufacturer of an element of the system. When a manufacturer does recommend a lower test pressure, furnish the City with a detailed written explanation before commencing test work. In no event may the lower test pressure be less than ll0 percent of the nominal working pressure of the pipe comprising the system. Measure pressure for testing referred to the elevational datum of the lowest pipe of the line section being tested.

Where possible, use methods and perform construction work in such sequence as necessary to accomplish pressure testing as work progresses. Do not pressure test more than a one-mile length of pipe at one time. Provide temporary piping and accessories if required to isolate test sections.

Makeup water, required to maintain test pressure in gallons per hour per l,000 feet of pipe under test, over the test period may not exceed the quantities shown in the following table:

Pipe Size Inches	Quantity Gal. per Hour
2	0.l6
3	0.24
4	0.32
6	0.47
8	0.63
l0	0.79
l2	0.95
l4	l.l0
l6	l.26
l8	l.42
20	l.58
24	l.89
24	l.89
30	2.37
36	2.84
42	3.3l
48	3.79

Repair all breaks, detectable leaks or other defects and retest as many times as necessary to obtain passing test.

DISINFECTING:

Chlorinate all potable water lines on completion of construction, after flushing and prior to placing in service. Use precaution to prevent backflow to supply system. Comply with AWWA C651, including Section 9 procedures on final connections to existing mains. At Contractor's option, accomplish chlorination by the tablet method, the continuous feed method, or the slug method.

Fill lines with potable water containing sufficient chlorine to show a chlorine dose of at best 25 mg/l for the tablet method, a 10 mg/l minimum residual at the end of 24 hours retention period for the continuous feed method, or a 50 mg/l minimum residual at the end of 3 hours of exposure for the slug method.

Provide and operate all equipment and provide all materials necessary for disinfecting water mains. Draw off at taps and hydrants along the line until a DPD test or approved chlorine test kit shows a strong indication of residual chlorine.

Retain chlorinated water in the system for a period of twenty-four (24) hours for either tablet method or continuous feed method. Test for specified residual. If residual is as specified or greater, flush the system with potable water, otherwise repeat entire procedure until satisfactory results are obtained. If the slug method of disinfection is used, dispose of heavily chlorinated water in a manner acceptable to Federal, state and local environmental regulatory agencies.

Demonstrate lines to be free of contamination by drawing samples there from on two successive days in the presence of the City. Deliver samples to a qualified laboratory for examination. On receipt of satisfactory test report from the foregoing laboratory, and with the approval of the City, the lines so tested are to be considered free of contamination and placed in service. In the event contamination persists, resterilize as necessary until receipt of satisfactory test report. All costs of disinfecting and bacteriological tests are to be paid by the Contractor.

END SECTION 02710

SECTION 02720 - SANITARY SEWER SYSTEM

PART 1 - GENERAL

DESCRIPTION OF WORK:

The extent of sanitary sewer system is shown on the Drawings.

Sanitary sewer system work includes, but is not limited to, the following:

Foundation preparation.

Furnishing and laying gravity sewer pipe.

Furnishing and/or constructing drainage structures and appurtenances.

Cleaning constructed work.

Testing constructed work.

Related Work Specified Elsewhere:

Route Clearing, Section 02112

Trenching and Backfilling, Section 02204

Tunneling, Section 02408

Drainage Structures and Accessories, Section 02776

JOB CONDITIONS:

Traffic Control:

Schedule and conduct Work in a manner, which will minimize inconvenience to vehicular and pedestrian traffic. Provide flagmen, barricades, warning signs, warning lights, and other warning means as appropriate. Maintain traffic on all roads and streets, which must be crossed by sewer lines.

Weather Limitations:

Conduct all operations during weather conditions appropriate to the Work being performed.

QUALITY ASSURANCE:

Manufacturer Experience:

Furnish manufactured products produced by firms generally recognized as engaged in the manufacture of products suitable for the applications of this Project, as determined by the City and which have a minimum of five (5) years experience in the production of products proposed for this Project.

Imperfections:

Regardless of tolerances permitted by industry standards specified herein, the City may reject pipe or precast structures at the manufacturing plant or project site, which have cracks, chips, blisters, lack of smooth interior or exterior surface, evidence of structural weakness, porosity, joint defect, significant variation from theoretical shape, or other imperfection which might, in the opinion of the City, contribute to a reduced functional capability, accelerated deterioration, or reduced structural strength.

Repairs: Do not use patched or repaired pipe or precast structures unless each individual length or element has been approved and marked for repair by the City at the manufacturing plant. Repairs, other than at the manufacturing plant, are not permitted.

PART 2 - PRODUCTS

Concrete Pipe (CPS):

Basic specification, nominal 18 inch size and larger: ASTM C 76, reinforced sewer pipe furnished in not less than 8 foot lengths with thickness class as determined from embedment tables for bedding class and trench width and depth for actual installation.

Identification: Stamp each length or joint of concrete pipe at the plant of manufacture, showing strength or reinforcement class, wall thickness designation, date of manufacture, and manufacturer symbol.

Joints: ASTM C 361 O-ring rubber gasket style suitable for 25 feet hydrostatic pressure head above pipe centerline with smooth and accurately formed, concrete bell and spigot surfaces.

Interior Wall Lining: Apply factory coating of heavy duty, chemically resistant epoxy resin, suitable for sewer service, over barrel and joints of pipe. Apply lining in at least 3 coats to a total minimum thickness of 20 mils, over concrete surfaces, which have been thoroughly prepared by either sand blasting or etching with acid.

Plastic Solid Wall Pipe Type 1 (PVCS):

Basic specification for pipe diameters less than 18 inches: ASTM D 3034 type PSM or ASTM D 3033 type PSP PVC bell and spigot sewer pipe with ratio of barrel outside diameter to wall thickness (SDR) no greater than 35, with pipe material meeting ASTM D 1784 12454 B or C and pipe stiffness at 5 percent deflection per ASTM D 2412, no less than 46 psi.

Basic specification for pipe diameters 18-inch through 30 inches: Provide ASTM F 679 PVC bell and spigot sewer pipe with T-1 wall thickness and pipe stiffness at 5 percent deflection per ASTM D 2412, no less than 46 psi.

For sewer depths greater than 15 feet use Ductile Iron Pipe (DIPS), and accomplish pipe material change at manholes where depth along length is greater than 15 feet.

Couplings and adaptors: Provide standard couplings and adaptors specifically designed to connect the PVC pipe to manholes or to other pipe materials. Manhole adaptors must provide a positive bond between the piping system and the mortar or concrete of the manhole structure. Protect all couplings and adaptors by fully encasing in concrete.

Joints: ASTM D 3212 elastomeric gasket system comprised of material suitable for use with domestic sewage and conforming to ASTM F 477.

Ductile Iron Pipe (DIPS):

Basic specification: For pipe with push-on joints or mechanical joints, provide ANSI/AWWA C151/A21.51 ductile iron pipe having pressure class as determined from embedment tables for bedding class and trench depth for actual installation. For pipe with flanged joints or grooved joints, provide ANSI/AWWA C115/A21.15 ductile iron pipe having minimum thickness class 53.

Coatings: Cement mortar lining per ANSI/AWWA C104/A2l.4 with standard asphaltic coating over lining and pipe exterior.

Joints: Rubber push-on type (ANSI/AWWA C111/A21.11) except where mechanical joint (ANSI/AWWA C110/A21.10 and C111/A21.11) with corrosion resistant alloy bolts, or flanged (ANSI/AWWA C115/A21.15 and ANSI B16.1, Class 125) with corrosion resistant alloy bolts and red rubber gasket joints are indicated.

Fittings: Same design strength, lining, coating and joint as connecting ductile iron pipe.

Pipe Fittings:

Use standard, factory fabricated adapters, wyes, tees, and other necessary fittings comparable to pipe with which connected.

Coarse Granular Material For Pipe Bedding:

Crushed stone, crushed gravel, natural gravel, or crushed shell meeting ASTM D 448, and having No. 67 gradation (3/4 inch to No. 4 sieve).

Fine Granular Material For Pipe Bedding:

Uniformly graded natural or manufactured sand composed of hard, durable particles with 100 percent passing a No. 4 sieve, not more than 25 percent passing a No. 100 sieve, and containing no more than 25 percent total of silt and clay.

Select Backfill Materials:

Satisfactory soil materials complying with ASTM D2487 soil classification groups GW, GP, SW, SP and free of clay lumps, rock or other material larger than 1-1/2 inches in any dimension (1/2 inch maximum size for 6 inch and smaller pipe), debris, organic material, waste, frozen materials, vegetable and other deleterious matter and not more than 5 percent passing No. 200 sieve.

Sewer System Structures: Conform with applicable provisions of the following sections:

Drainage Structures and Accessories, Section 02776

PART 3 - EXECUTION

PIPE EMBEDMENT:

Concrete Pipe Embedment:

Unless otherwise indicated, lay pipe in trenches and embedments prepared as selected by the Contractor in conformance with the bedding class, trench width and depth, and pipe size tabulated below.

Pipe Size Inches	Maximum Trench Width Ft-in.	Maximum Trench Depth in Feet							
		Class C Bedding				Class B Bedding			
		Conc. E. S.	Conc. Cl. 3	Conc. Cl. 4	Conc. Cl. 5	Conc. E. S.	Conc. Cl. 3	Conc. Cl. 4	Conc. Cl. 5
18	3-0	--	13	28	40	--	19	40	40
	3-6	--	10	17	40	--	13	27	40
	4-0	--	8	13	24	--	10	18	40
	Over 4-0	--	7	12	19	--	9	15	23
21	3-0	--	17	40	40	--	28	40	40
	3-6	--	12	22	40	--	17	40	40
	4-0	--	10	16	35	--	13	24	40

	Over 4-0	--	9	14	21	--	12	17	25
24	3-6	--	15	30	40	--	21	40	40
	4-0	--	12	20	40	--	16	31	40
	4-6	--	10	16	30	--	13	22	40
	Over 4-6	--	9	14	21	--	12	17	25
27	3-6	--	17	40	40	--	18	40	40
	4-0	--	13	24	40	--	18	40	40
	4-6	--	11	18	39	--	15	27	40
	5-0	--	10	15	27	--	13	21	40
	Over 5-0	--	9	14	21	--	12	17	25
30	4-0	--	15	29	40	--	22	40	40
	4-6	--	13	21	40	--	17	33	40
	5-0	--	11	17	33	--	14	24	40
	Over 5-0	--	9	14	21	--	12	17	25

Thermoplastic Pipe Embedment:

Unless otherwise indicated, lay pipe in trenches and embedments prepared in accordance with Class B bedding and complying with ASTM D2321. Provide trench width sufficient to place and compact embedment material, but not less than the values tabulated below. If trench width at top of pipe is greater than six pipe diameters, compact embedment material below the pipe spring line for a distance at least 2.5 pipe diameters each side of pipe for 10 inch size pipe or less and at least one pipe diameter or two feet (whichever is greater) each side of pipe for 12 inch size pipe and larger.

Pipe Size, In.	Minimum Trench Width, Ft.-In.
4	1-9
6	2-0
8	2-2
10	2-4
12	2-6
15	2-9

Ductile Iron Pipe Embedment:

Unless otherwise indicated, lay pipe in trenches and embedments prepared as selected by the Contractor in conformance with the pressure class, bedding class, trench depth, and pipe size tabulated below. Provide trench width sufficient to place and compact embedment material, but not less than nominal pipe diameter plus two feet. If trench width at top of pipe is greater than six pipe diameters, compact embedment material below the pipe spring line for a distance at least

2.5 pipe diameters each side of pipe for 10 inch size pipe or less and at least one pipe diameter or two feet (whichever is greater) each side of pipe for 12 inch size pipe and larger.

	Maximum Trench Depth in Feet Class B Bedding				
Pipe Size Inches	Pressure Class 150	Pressure Class 200	Pressure Class 250	Pressure Class 300	Pressure Class 350
10	--	--	--	--	46.2
12	--	--	--	--	46.0
14	--	--	37.6	43.4	45.9
16	--	--	35.7	40.5	46.0
18	--	--	32.7	38.4	43.0
20	--	--	32.0	36.9	40.7
24	--	27.2	31.2	34.9	39.4
30	24.7	26.9	29.8	32.4	36.6

	Maximum Trench Depth in Feet Class C Bedding				
Pipe Size Inches	Pressure Class 150	Pressure Class 200	Pressure Class 250	Pressure Class 300	Pressure Class 350
8	--	--	--	--	35.1
10	--	--	--	--	29.5
12	--	--	--	--	29.2
14	--	--	25.0	27.7	29.1
16	--	--	25.5	27.8	30.2
18	--	--	24.5	28.0	30.1
20	--	--	23.9	28.1	30.0
24	--	19.6	23.1	26.5	30.5
30	17.4	19.4	22.0	24.3	28.1

Definition of Pipe Foundation Terms:

Trench depth is the vertical distance from pipe invert or flow line, to finished ground surface.

Trench width is the horizontal distance between trench walls at any point from one foot above top of pipe to trench bottom.

Class B Bedding consists of the following construction method: Bed pipe in compacted coarse granular material placed on a flat trench bottom. Thickness of granular bedding must be at least one-eighth the outside pipe diameter, but not less than 4 inches thick under pipe barrel, and extend at least halfway up the pipe barrel at the sides. Carefully place compacted select backfill material or coarse granular material above the coarse granular material up a minimum depth of

12 inches over the top of pipe. Achieve not less than 85% of maximum dry density per ASTM D698 (Standard Proctor) for all material.

Class C Bedding consists of the following construction method: Bed pipe in compacted granular material placed on a flat trench bottom. Thickness of granular material must be at least one-eighth the outside pipe diameter, but not less than 4 inches under the pipe barrel and must extend one-sixth of the outside diameter up the pipe barrel at the sides. Place compacted select backfill material or coarse granular material above the coarse granular material to a minimum depth of six inches over top of pipe. Achieve not less than 85% of maximum dry density per ASTM D698 (Standard Proctor) for all material.

PIPE LAYING:

Clean interior of pipe and all joints before laying. When pipe-laying activity is not in actual progress, tightly cover open ends of sewer. Avoid permitting mud or other material from entering sewer at all times.

Avoid damage or shock in handling pipe and accessories. Inspect each length of pipe, and reject any defective piece. Carefully protect pipe in place from damage or displacement until backfilling operations are complete.

Lay and join pipe in strict conformance with manufacturer's written recommendations as submitted to and approved by the City. Lay all pipe upgrade with spigots pointing downgrade.

Control geometric position of pipe as necessary to ensure that pipe and fittings accurately conform with required grade and alignment after sewer is completed.

Prevent water from accumulating or running in trench during pipe laying operations, and until the trench or excavation has been backfilled.

Remove and re-lay any length of pipe, which does not accurately conform with required line or grade, is crushed, or is excessively deflected.

PIPE CONNECTIONS:

Make all pipe connections with standard fittings, manholes, structures, or special construction detailed on Drawings. Locate building services and connect thereto with standard fittings as authorized.

At manholes and structures, neatly cut all connecting pipe flush with inside surface, and provide flexible pipe joint within l8 inches of outer surface. Make pipe connections to manholes and structures by laying pipe in mortar bed or concrete. Use supplemental materials and techniques as required to obtain water tightness.

Do not connect any sewage flow to new work until authorized by the City.

INSTALLING SANITARY SEWER IN TUNNEL LINER:

Tunnel Liner, 12 Inches to 42 Inches:

Insert sewer pipe concentrically into tunnel liner by securing casing spacers radially around sewer pipe at no more than l0 foot longitudinal intervals.

Blow sand into annular space between sewer pipe and tunnel liner starting at the longitudinal center and proceeding outward to each end. Use techniques, which assure complete filling of all voids.

Tunnel Liner, 48 Inches and Larger:

Use the following procedure for installing sewer pipe in tunnel when adequate working room is available, otherwise follow same procedures as specified for tunnel liner, 6 inches to 42 inches.

Insert sewer pipe into tunnel liner after having grouted bottom of tunnel to exact grade required to support pipe in proper position.

Permanently secure sewer pipe in position by blocking each pipe length at top and sides with brick and mortar, followed by bedding sewer pipe to a depth equal to one-fourth the pipe outside diameter, with concrete.

Plug ends of tunnel with 12-inch thickness of masonry, leaving weep holes at lower end of tunnel.

SEWER STRUCTURES:

Conform with applicable provisions of the following sections:

Drainage Structures and Accessories, Section 02776

WYES, TEES AND SERVICES:

Provide wyes and/or service tees at points indicated on Drawings, specified herein, and as requested by the City. If wyes or service extensions are not to be connected to a building sewer under this work, close end of pipe with removable factory fabricated plug or stopper.

When replacing an existing sewer, connect all existing service lines to the new sewer.

Service lines, unless otherwise shown on the Drawings or requested by the City, are to be run to suit field conditions at a minimum grade of 2 percent and with a minimum pipe cover of 30 inches.

Provide cleanouts in service lines at not more than 75-foot intervals and where pipe horizontal deflection exceeds 45 degrees. Unless noted otherwise, furnish cleanouts consisting of wye and 45-degree fittings, vertical pipe and threaded brass or plastic removal plug. Arrange cleanout to permit cleaning in the direction of flow.

LINE CLEANING:

Avoid permitting dirt, rubbish, surplus construction material, and other foreign matter to enter structures or pipe during construction. Use whatever means may be necessary to obtain a clean and internally smooth sewer system prior to final acceptance.

FIELD QUALITY CONTROL:

General Leakage Requirements:

Make entire sewer line system as near watertight as practicable. Eliminate all visible points of ground water infiltration, and any other significant points of leakage which can be located, regardless of test results obtained as hereinafter required.

Upon completion of pipe installation and trench backfilling to within one foot of finished grade, perform system installation acceptance tests using infiltration or exfiltration testing, or piping or joint low pressure air testing for all work constructed. Conduct final acceptance test witnessed by the City.

Installation acceptance testing is required on all new sewer line segments extending completely from manhole to manhole unless waived by the City due to unreasonable service shutdown demands.

An acceptable low-pressure air test is interpreted as an installation acceptance test in lieu of infiltration or exfiltration testing of pipelines.

Take whatever action may be necessary to permanently reduce infiltration from all water sources to less than the maximum allowable leakage limits established below for all constructed work.

System Exfiltration or Infiltration Acceptance Testing:

Infiltration testing is only applicable if the ground water table is at least two feet above the crown of the new sewer pipeline being tested. Exfiltration testing will be used when the ground water table is less than two feet above the crown of the new sewer. Perform infiltration or exfiltration acceptance testing only as permitted by the City.

System Exfiltration Testing:

Perform system exfiltration acceptance testing in accordance with ASTM C 1091 or ASTM C 969 guidelines for new sewers.

The maximum allowable leakage is 50 gallons/(inch of internal diameter)(mile of sewer)(day) when the average head of the test section is 3 feet or less. When the average head on the test section is greater than 3 feet, the allowable leakage shall be multiplied by the ratio of the square root of the average test head over the square root of the base head of 3 feet.

System Infiltration Testing:

Perform system infiltration testing in accordance with ASTM C 1091 or ASTM C 969 guidelines for new sewers.

The maximum allowable leakage limit is 50 gallons/(inch of internal diameter)(mile of sewer)(day) when the average head on the test section is 6 feet or less. When the average groundwater head on the test section is greater than 6 feet, the allowable leakage shall be increased in proportion to the ratio of the square root of the average groundwater head over the square root of the base head of 6 feet.

Air Testing:

Nominal 4 Inch to 24 Inch Pipe: After completing backfill of a sewer line section, conduct a low pressure air test depending on pipe material in accordance with ASTM C 924, ASTM C 828, ASTM F 1417, or UNI-B-6 guidelines for installation acceptance. Ductile iron pipelines shall be tested in accordance with ASTM F 1417 or UNI-B-6 requirements. Perform such tests using the following general procedures:

Temporarily plug line segment between two manholes using plugs having air tight fittings through which low pressure air can be introduced into the pipe segment being tested.

Introduce low-pressure air into the test pipe segment until the internal air pressure reaches 4.0 psig above ground water pressure, if any.

Wait at least two minutes for air temperature in the test segment to stabilize while internal air pressure remains no less than 3.5 psig above ground water pressure.

Accurately determine the elapsed time for internal pressure to drop 1.0 psig.

The air test is acceptable if elapsed time for an internal pressure drop of 1.0 psig is no less than shown in the following tables:

For Concrete Sewer Lines:

Pipe Diameter Inches	Seconds Per 100 Feet of Pipe

18	144
21	180
24 and larger	216

Air leakage time is based on pipe being damp. If pipe and joints are dry, dampen line if helpful in meeting air test time requirement.

For Thermoplastic or Ductile Iron Sewer Lines:

Pipe Diameter (inches)	Minimum Time (min:sec)	Maximum Length for Minimum Time (ft)	Minimum Time for Longer Length (sec) L = Total Length
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.218 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L
21	19:50	114	10.470 L
24	22:40	99	13.674 L

Nominal 27 Inch and Larger Pipe: After completing backfill of a sewer line section, conduct a low pressure air test on each pipe joint in the section in accordance with ASTM C 1103 for concrete pipe sewer lines or by using methods and devices acceptable to the City. Perform such tests using the following general procedures:

Properly position and completely secure test unit over pipe joint being tested.

Introduce low-pressure air into the pipe joint test area until the internal air pressure reaches 3.5 psig above ground water pressure, if any.

The joint air test is acceptable if the internal pressure drops less than 2 psi in 10 seconds.

At each manhole constructed where ground water is known to exist, install a small diameter pipe nipple through the manhole wall at the time that the sewer pipe is installed. Locate the nipple immediately above the lowest connecting sewer pipe, and grout the nipple in place concurrently with grouting the sewer pipe. Prior to placing the nipple, wrap it with a continuous length of heavy nylon chord, which can be pulled out, thus permitting removal of the nipple after test work is complete. Just before commencing the air test, attach a clear plastic tube to the nipple, and hold the tube end vertically upward. After ground water has stopped rising in the plastic tube, measure the vertical distance from water level to pipe invert in feet. Average this distance observed at manholes on each end of the test segment, and divide the average distance in feet by 2.3 to obtain the ground water pressure to be used in computing required test air pressure.

Permanently correct excessive leakage determined by air testing, and repeat operations until the City witnesses a successful test on each line segment or joint; then remove nipple through manhole wall without disturbing adjacent grout. Permanently caulk resulting hole watertight.

Deflection Testing:

Conduct internal deflection testing on all installed gravity sewer lines 6 inch size and larger, no sooner than 15 days after completion of trench backfilling. Repair or replace all defective pipe found during mandrel testing and conduct another deflection test to determine the extent and necessary repair of any additional deficiencies. After repairing all defects, perform successful mandrel testing in the presence of the Owner or the City. Mandrel testing is successful when the mandrel device can be pulled through the pipe between manholes in a continuous operation, without interruption.

Furnish mandrel test gauges sized and constructed as tabulated below:

5 PERCENT DEFLECTION MANDREL
(ASTM D 2412)

Nominal Size, In	Mandrel O.D., In	Tolerance In	Nearest 1/16"	Minimum Runner Length In	Minimum Number of Mandrel Runners
8	7.28	0.01	7-4/16	4	6
10	9.08	0.01	9-1/16	5	8
12	10.79	0.01	10-13/16	6	8
15	13.20	0.01	13-3/16	8	8
18	16.13	0.01	16-2/16	8	9

Upon request by the City, certify the accuracy of the mandrel test gauges by sliding proving rings to an accuracy of 0.05 inches over the mandrel. Use proving rings complying with ASTM F679 and ASTM D3034.

Internal Television Inspection:

Conduct internal television inspection on all installed gravity sewer lines 8 inch size and larger, after trench backfilling to within one foot of finished grade. Repair or replace all visible defects found and conduct another internal television inspection to determine the extent and necessary repair of any additional deficiencies. Repeat the inspection and correction process until the entire work shall be free from any visible defects. After repairing all visible defects, perform successful air test on each sewer segment before conducting final television inspection for the

record. Provide owner with color DVD format video record and supporting written location records of the final condition of each completed and tested sewer segment.

END SECTION 02720

SECTION 02770 - STORM SEWER SYSTEM

PART l - GENERAL

DESCRIPTION OF WORK:

The extent of storm sewer system is shown on the Drawings.

Storm sewer system work includes, but is not limited to, the following:

Foundation preparation.

Furnishing and laying gravity sewer pipe.

Furnishing and/or constructing drainage structures and appurtenances.

Cleaning constructed work.

Related Work Specified Elsewhere:

Route Clearing, Section 02112

Trenching and Backfilling, Section 02204

Tunneling, Section 02408

Drainage Structures and Accessories, Section 02776

JOB CONDITIONS:

Traffic Control:

Schedule and conduct Work in a manner, which will minimize inconvenience to vehicular and pedestrian traffic. Provide flaggers, barricades, warning signs, warning lights, and other warning means as appropriate. Maintain traffic on all roads and streets, which must be crossed by storm sewer lines. All traffic controls during construction must conform to Manual for Uniform Traffic Control Devices Guidelines.

Weather Limitations:

Conduct all operations during weather conditions appropriate to the Work being performed.

QUALITY ASSURANCE:

Manufacturer Experience:

Furnish manufactured products produced by firms generally recognized as engaged in the manufacture of products suitable for the applications of this Project, as determined by the City and which have a minimum of five (5) years experience in the production of products proposed for this Project.

Imperfections:

Regardless of tolerances permitted by industry standards specified herein, the City may reject pipe or precast structures at the manufacturing plant or project site, which have cracks, chips, blisters, lack of smooth interior or exterior surface, evidence of structural weakness, porosity, joint defect, significant variation from theoretical shape, or other imperfection which might, in the opinion of the City, contribute to a reduced functional capability, accelerated deterioration, or reduced structural strength.

Repairs:

Do not use patched or repaired pipe unless each individual length or element has been approved and marked for repair by the City at the manufacturing plant. Repairs, other than at the manufacturing plant, are not permitted.

PART 2 - PRODUCTS

Concrete Pipe (RCP):

Basic specification, nominal l5 inch size and over: ASTM C 76, reinforced sewer pipe furnished in not less than 8-foot lengths.

Identification: Stamp each length or joint of concrete pipe at the plant of manufacture, showing strength or reinforcement class, wall thickness designation, date of manufacture, and Manufacturer symbol.

Joints: At Contractor option use one of the following jointing systems. Once a system is selected, utilize system for entire project unless specified or authorized otherwise.

Cement grout type, which results in entire joint annular space being filled with grout and inside of each joint being wiped smooth. Use grout mixture consisting of not more than five gallons of water per sack of cement. Utilize cement conforming to AASHTO M85 or Ml50.

AWWA C 302 O-ring rubber gasket style in which the completed joint confines the O-ring on four sides with nominal clearance not to exceed l/l6 inch between smooth, accurately formed, bell and spigot surfaces.

Elliptical Concrete Pipe (ECPD):

Basic specification: ASTM C 507, reinforced elliptical sewer pipe furnished in not less than 8-foot lengths.

Additional Specification Requirements: Maximum absorption by standard ASTM test may not exceed 7.0 percent, and pipe must aged at manufacturing plant for not less than five days.

Identification: Stamp each length or joint of concrete elliptical pipe at the plant of manufacture, showing strength or reinforcement class, wall thickness designation, date of manufacture, manufacturer's symbol and quadrant reinforcing symbol.

Joints: At Contractor option use one of the following jointing systems. Once a system is selected, utilized system for entire project unless specified or authorized otherwise.

Cement grout type, which results in entire joint annular space being filled with grout and inside of each joint being wiped smooth. Use grout mixture consisting of not more than five gallons of water per sack of cement. Utilize cement conforming to AASHTO M85 or M150.

Preformed flexible pipe joint compound to be confined in the tongue and groove joint, meet Federal Specification SS-S-00210.

Corrugated Plastic Pipe (CPPD):

Corrugated flexible conduit with slip-on joints made of polyethylene conforming with ASTM F 405 and F 449.

Subject to compliance with requirements, firms offering products, which may be incorporated in the work, include, but are not limited to, the following:

ADS Inc.

Hancor Inc.

Bituminous Coated Corrugated Aluminum Pipe (BCCAP):

Basic specification: AASHTO M 196 with full uniform bituminous coating having minimum thickness of 0.05 inch and conforming with AASHTO M 190.

Joints: Fully bituminous coated coupling bands manufactured from base metal as pipe. Utilized bands of same manufacturer as pipe.

Pipe Fittings:

Use standard, factory fabricated adapters, wyes, tees, and other necessary fittings comparable to pipe with which connected.

Coarse Granular Material For Pipe Bedding:

Crushed stone, crushed gravel, natural gravel, or crushed shell meeting ASTM C 33, and having No. 67 gradation (3/4 inch to No. 4 sieve).

Fine Granular Material For Pipe Bedding:

Uniformly graded natural or manufactured sand composed of hard, durable particles with l00 percent passing a No. 4 sieve, not more than 25 percent passing a No. l00 sieve, and containing no more than 25 percent total of silt and clay.

Storm Sewer System Structures: Conform with applicable provisions of the following sections:

Drainage Structures and Accessories, Section 02776

PART 3 – EXECUTION

PIPE FOUNDATION:

Concrete Pipe Foundation:

Unless otherwise indicated, lay pipe in trenches and on foundations prepared as selected by the Contractor in conformance with the bedding class, trench width and depth, and pipe size tabulated below:

	Maximum	Maximum Trench Depth in Feet							
Pipe	Trench	Class C Bedding				Class B Bedding			
Size	Width	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.
Inches	Ft-in.	E. S.	Cl. 3	Cl. 4	Cl. 5	E. S.	Cl. 3	Cl. 4	Cl. 5
15	3-0	-	8	13	30	-	11	21	30
18	3-3	-	9	15	30	-	12	24	30
21	3-6	-	9	16	30	-	13	26	30
24	4-0	-	10	16	30	-	13	23	30
27	4-0	-	11	19	30	-	15	29	30
30	4-6	-	11	18	30	-	14	25	30
36	5-6	-	11	17	29	-	14	23	30
42	6-0	-	12	16	26	-	15	21	30
48	7-0	-	12	18	28	-	15	23	30
54	7-6	-	13	18	29	-	16	24	30
60	8-6	-	13	19	28	-	16	23	30
66	9-6	-	13	18	27	-	16	25	30

72	10-0	-	14	19	28	-	17	24	30

Arch Pipe Foundation:

Unless otherwise indicated, lay pipe in trenches and on foundations prepared as selected by the Contractor in conformance with the bedding class, trench width and depth, as recommended by the manufacturer's published data.

Definition of Pipe Foundation Terms:

Trench depth is the vertical distance from pipe invert or flow line to finished ground surface.

Trench width is the horizontal distance between trench walls at any point from one foot above top of pipe to trench bottom.

Class B Bedding may be achieved by either of the following two construction methods.

(l) Shaped Bottom with Tamped Backfill: Shape bottom of trench excavation to conform to a cylindrical surface with a radius at least 2 inches greater than the radius to the outside of the pipe and with a width sufficient to allow six-tenths of the width of the pipe barrel to be bedded in fine granular material fill placed in the shaped excavation. Carefully place and compact backfill at sides of pipe to a thickness of at least l2 inches above top of pipe. Limit use of this bedding method to trenches with firm bottom and sides.

(2) Compacted Coarse Granular Bedding With Tamped Backfill: Bed pipe in compacted coarse granular material placed on a flat trench bottom. Thickness of granular bedding must be at least one-fourth the outside pipe diameter, but not less than 4 inches thick under pipe barrel, and extend at least halfway up the pipe barrel at the sides. Carefully place compacted backfill above the granular material up a minimum depth of l2 inches over the top of pipe.

Class C Bedding may be achieved by either of the following two construction methods:

(l) Shaped Bottom: Bed pipe with ordinary care in an earth foundation formed in the trench bottom by a shaped excavation which fits the pipe barrel with reasonable closeness for a width of at least 50 percent of the outside pipe diameter. Place compacted fill to a minimum depth of six inches above top of pipe.

(2) Compacted Coarse Granular Bedding with a Tamped Backfill: Bed pipe in compacted granular material placed on a flat trench bottom. Thickness of granular material must be at least 4 inches under the barrel and must extend one-tenth to one-sixth of the outside diameter up the pipe barrel at the sides. Place compacted backfill above the granular material to a minimum depth of six inches over top of pipe.

PIPE LAYING:

When either bituminous coated corrugated aluminum or corrugated plastic pipe is used, pipe installation must be observed by a Georgia registered professional engineer engaged by the contractor or developer. Upon completion of the pipe installation and prior to acceptance by the City, the observing engineer is to furnish to the City a certification that the storm drainage pipe has been installed in accordance with the approved plans and these specifications. Acceptance by the City will not be considered without the engineer's certification.

Clean interior of pipe and all joints before laying. When pipe laying activity is not in actual progress, tightly cover open ends of sewer. Avoid permitting mud or other material from entering sewer at all times.

Avoid damage or shock in handling pipe and accessories. Inspect each length of pipe, and reject any defective piece. Carefully protect pipe in place from damage or displacement until backfilling operations are complete.

Lay and joint pipe in strict conformance with manufacturer's written recommendations as submitted to and approved by the City. Where cement joints are used, provide wet burlap or earth protective cover for joints immediately after initial grout set. Maintain protective cover until joint is covered by backfilling. Lay all pipe upgrade with spigots pointing downgrade.

Control geometric position of pipe as necessary to ensure that pipe and fittings accurately conform with required grade and alignment after sewer is completed.

Prevent water from accumulating or running in trench during pipe laying operations, and until the trench or excavation has been backfilled.

Remove and re-lay any length of pipe, which does not accurately conform with required line or grade, is crushed, or is excessively deflected.

PIPE CONNECTIONS:

Make all pipe connections with standard fittings, or special construction detailed on Drawings.

At manholes and structures, neatly cut all connecting pipe flush with inside surface, and provide flexible pipe joint within l8 inches of outer surface. Make pipe connections to manholes and structures by laying pipe in mortar bed or concrete. Use supplemental materials and techniques as required to obtain water tightness.

Do not connect any flow to new work until authorized by the City.

SEWER STRUCTURES:

Conform with applicable provisions of the following sections:

Drainage Structures and Accessories, Section 02776

LINE CLEANING:

Avoid permitting dirt, rubbish, surplus construction material, and other foreign matter to enter structures or pipe during construction. Use whatever means may be necessary to obtain a clean and internally smooth sewer system prior to final acceptance.

SEWER LEAKAGE:

General Leakage Requirements:

Make entire sewer line system as near watertight as practicable. Eliminate all visible points of ground water infiltration, and any other significant points of leakage, which can be located.

END SECTION 02770

SECTION 02776 - DRAINAGE STRUCTURES AND ACCESSORIES

PART l - GENERAL

DESCRIPTION OF WORK:

The extent of drainage structures is shown on the Drawings.

Related Work Specified Elsewhere:

Trenching and Backfilling, Section 02204

Sanitary Sewer System, Section 02720

Storm Sewer System, Section 02770

PART 2 - PRODUCTS

MATERIALS:

Clay Brick: ASTM C 32, Grade MS or ASTM C32 sewer and manhole brick or ASTM C216 facing brick, Grade MW or SW, of nominal size 8 x 2-l/4 x 3-3/4 inches. Color and texture as selected by Contractor.

Concrete Brick: ASTM C 55, Grade P-II, of nominal size 8 x 2-l/4 x 3-3/4 inches; gray-white concrete color with smooth formed natural texture.

Rubble Stone: Provide stone not less than 6 inches thick or l2 inches wide, and of proper shape to bring masonry structures to true lines, shapes, and elevations; smaller stones may be used to fill interior of walls. Provide stone, free of rounded, worn, weathered and scarred surfaces, and also free of segregation, seams, cracks, pyrite intrusions and other defects tending to reduce weather resistance. Select stone having not less than 65 percent wear in accordance with AASHTO T 96, and having a loss not exceeding l5 percent after five cycles of the magnesium sulfate soundness test in accordance with AASHTO T 104.

Precast Concrete Drainage Structures:

Use precast concrete drainage structures, including precast concrete pipe sections, flared end sections, adjustment rings, tapered sections, drop inlets, manholes, and other related products, which conform to the requirements of ASTM C 478 and/or C 789. Furnish structure having a minimum wall thickness of four inches or one-twelfth the interior diameter, whichever is greater. Accurately cast openings to meet specific project requirements.

Drainage Structure Steps:

Use steps conforming with applicable government safety regulations and the requirements stated below.

Provide individual steps, mortared or cast into walls and conical tops of all manholes and similar structures. Align steps so as to form a continuous ladder with steps equally spaced vertically, no more than 16 inches apart, using steps having a minimum length of 10 inches and which project a minimum clear distance of four inches from the wall. Use steps designed to prevent the foot from sliding off the end, and whose exposed parts are free of any hazardous sharp edges, burrs or projections.

Steps, fastenings and installation must be capable of supporting a single concentrated load of 300 pounds. Use designs based on imposed loads being concentrated at such points as will cause maximum stresses in the structural element being considered.

Use plastic coated steel meeting requirements of ASTM C 478, D 2146 and A 615 grade 60.

Metal Castings:

Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion or other significant defects, and having smooth surfaces free of casting sand, fins and burrs. Use component parts, which fit together uniformly, in a secure fashion. Where castings have lids or covers, make provisions for non-rocking fit.

Use one of the following casting materials:

Ductile Iron Castings: ASTM A 536, Grade 50-40-18.

Gray Iron Castings: ASTM A 48, Class 30.

Mortar Materials:

Cement: Portland Cement ASTM C 150, Type I or II.

Sand: ASTM C 144, well screened, clean, hard sharp, siliceous, free from loam, silt and other impurities. Provide the following grain size distribution:

#10 sieve, passing 95-100 percent

#50 sieve, passing 15-40 percent

#l00 sieve, passing 0-10 percent

Removal by decantation 0-5 percent

Water: Clean, fresh, free from oil, acid, organic matter and other deleterious substances.

Mortar Mix Proportions: Provide mortar mixed in the proportion of one part cement to three parts sand with only enough water to allow good workability of the mix. Hydrated lime may be added in amounts not exceeding 10 percent of the cement weight.

PART 3 - EXECUTION

Excavation and Backfill:

Conform with applicable provisions of the following:

Trenching and Backfilling, Section 02204

Pre-Cast Concrete Units:

Set precast units plumb and to exact grade on approximately three-inch thickness of compacted sand bedding.

In the event field conditions necessitate additional pipe connections for which no holes have been cast, neatly chip necessary holes, being careful not to crack portions of unit to remain. Replace any units excessively damaged as a result of field modification.

For storm sewer units constructed of more than one precast element, fill all joints solidly with mortar. Use mortar or concrete to seal joints between units and connecting pipe.

For sanitary sewer manholes, fill joints between sections with butyl based sealant especially formulated for sewer service. Use mortar or concrete to seal joints between units and connecting pipe. Supplement connecting joints with manufactured water stops or seals when recommended by pipe manufacturer or necessary to minimize leakage.

Masonry Structures:

Store cement and lime in a dry place. Store masonry units above ground on level platforms, which allow air circulation around and under stacked masonry units.

Handle and store masonry units so as to avoid damage.

Examine masonry units before installation and reject all units, which are cracked, damaged, or in any way fail to meet this Specification.

Use only clean masonry units, free of dirt and debris, which would adversely affect mortar bond. Do not use frozen materials, or materials mixed or coated with ice or frost.

Set masonry units in full mortar bed, carefully fitting units around pipe openings, etc., so as to fill all voids; completely fill any remaining voids with mortar. Do not use mortar which has been

mixed more than 45 minutes or which has been retempered. When using multi-wythe construction, make every fifth coarse a header coarse.

Do not install masonry when air temperature is below 40 F and falling.

Do not backfill against masonry structures until they are at least seven days old. In cold weather delay backfilling for a longer time to allow additional curing time for mortar.

Metal Castings:

Examine each casting before installation, and reject all castings, which are cracked, damaged or in any other way fail to meet the Specifications.

Clean castings of dirt, mud and grease before installation.

Set castings according to location and arrangement shown on the Drawings; rigidly support castings to maintain true alignment and elevation. Where castings are located in concrete or mortar construction, thoroughly work concrete or mortar around the casting so as to eliminate voids and provide solid bearing surfaces and rigid construction.

Make frames, subject to traffic, firm and stable under actual traffic conditions. When constructed in paved areas, set frames to conform with exact pavement surface including tilting frame where necessary to match pavement surface.

Sanitary Sewer Manholes:

Shape inverts and channels neatly so as to permit smooth hydraulic flow.

Saturate outside wall of each manhole with water, and plaster with a smooth, one-half inch thick minimum coat of mortar as specified under PART 2, except that the mortar shall be mixed with one part cement to two parts sand. Do not add hydrated lime to plaster mortar.

Use whatever care, materials and construction technique may be required to achieve permanent watertight joints and connections.

FIELD QUALITY CONTROL:

General Leakage Requirements:

Make all manholes as near watertight as practicable. Eliminate all visible points of ground water infiltration and any other significant points of leakage which can be located regardless of test results obtained as hereinafter required.
Upon completion of manhole installation and prior to acceptance and payment for completed work, perform manhole vacuum acceptance test for each newly installed precast concrete manhole.

Sanitary Sewer Manhole Vacuum Testing:

Where adjustment to grade using bricks and mortar is required, test manholes prior to placement of final elevation adjustment and castings.

Perform manhole vacuum tests, using the following general procedures:

Plug all lift holes with a non-shrink grout.

Temporarily plug all pipes entering the manhole and securely brace each plug to prevent them from being pulled into the manhole.

Place the vacuum testing equipment test head at the top of the manhole in accordance with the testing equipment manufacturers recommendations.

Draw a vacuum of 10 inches of mercury on the manhole and close the valve on the vacuum line of the testing equipment and shot off the vacuum pump. Measure the time for the vacuum to drop to 9 inches of mercury.

The manhole shall pass 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.

Depth	Time (Seconds) Per Manhole Diameter		
	48" Dia	60" Dia	72" Dia
0'-8'	20	26	33
8'-10'	25	33	41
10'-12'	30	39	49
12'-14'	35	46	57
14'-16'	40	52	67
16'-18'	45	59	73
18'-20'	50	65	81
20'-22'	55	72	89
22'-24'	59	78	97
24'-26'	64	85	105
26'-28'	69	91	113
28'-30'	74	98	121

If the manhole fails the initial test, permanently correct excessive leakage determined by manhole vacuum testing and repeat vacuum test until the City witnesses a successful test.

END SECTION 02776

SECTION 02930 - GRASSING

PART l - GENERAL

SUMMARY:

The extent of grassing consists of those areas, which are disturbed by operations of the Contractor and are not covered over by improvements, except where specifically noted otherwise, together with any additional areas shown on the Drawings or authorized by the City.

Types of work required include following:

Fine grading and preparing of lawn areas.

Furnishing and applying new topsoil.

Furnishing and applying soil amendments.

Furnishing and applying fertilizers.

Seeding new lawn areas.

Sodding new lawn areas.

Planting new lawn areas with sprigs.

Planting new lawn areas with plugs.

Reconditioning existing lawn areas.

Replanting unsatisfactory or damaged lawns.

Refer to earthwork sections in this Division for requirements of general excavation, filling, and grading in areas to receive grassing.

Topsoil has (or will be) stockpiled for reuse in grassing. If quantity of stockpiled topsoil is insufficient, provide additional topsoil to complete grassing.

Topsoil for grassing is not available at site. Furnish topsoil as specified under "Materials."

JOB CONDITIONS:

Planting Time: Sow lawn seed only during normal planting seasons for each type of lawn work required. Correlate planting with specified maintenance periods to provide required maintenance from date of substantial completion.

Specified work is minimum required, and any and all necessary materials and operations including reworking, must be performed to obtain specified results.

PART 2 - PRODUCTS

NEW TOPSOIL:

Provide topsoil that is fertile, friable, naturally loamy, surface soil; reasonably free of subsoil, clay lumps, brush, weeds, and other litter; and free of roots, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth.

Obtain topsoil from local sources or from areas having similar soil characteristics to that found at site of work. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.

SOIL AMENDMENTS:

Lime: Natural limestone containing at least 85 percent of total carbonates, ground to such fineness that at least 90 percent passes a 10-mesh sieve and at least 50 percent passes a 100-mesh sieve.

Provide lime in form of dolomitic limestone.

Fertilizer: Standard commercial grade fertilizer conforming to the standards of the Association of Official Agricultural Chemists. Provide either grade 4-l2-l2, 6-l2-l2 or 5-l0-l5 at Contractor's option.

Nitrogen: Standard commercial grade nitrogen conforming to state fertilizer laws. Provide in either granular or liquid form at Contractor's option.

Peat Humus: Finely divided or granular texture and with pH of 6.0 to 7.5 composed of moss peat (other than spagnum), or peat humus, or reed-sedge peat.

Sawdust or Ground Bark: Provide type that is nontoxic to plants, of uniform texture, and subject to slow decomposition when mixed with soil. Provide nitrogen-treated sawdust or ground bark, or provide untreated and mix at site with at least 0.15 lbs. of ammonium nitrate or 0.25 lbs. of ammonium sulfate per cu. ft. of loose sawdust or ground bark.

GRASS MATERIALS:

Grass Seed: Provide fresh, clean, new-crop seed complying with the tolerance for purity and germination established by the Official Seed Analysts of North America. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified below:

Common Name	Sowing Rate - lbs. per Acre	% By Wt.	Min. % Germ.	Min. % Purity	Max. % Weed Seed
Bermuda Grass, Common	8	99	70	90	2
Kentucky 3l Tall Fescue	50	98	70	95	2
Ryegrass (Temp)	40	98	70	95	2

Sod: Provide machine-cut, strongly rooted, certified turfgrass sod, at least 2 years old and free of weeds and undesirable native grasses. Provide sod capable of vigorous growth and development

Type: Bermuda grass (Cynodon dactylon).

Type: Centipedegrass (Eremochloa ophiuroides).

Sod Pad Size: Uniform thickness of 5/8 inch, plus or minus 1/4 inch, measured at time of cutting and excluding top growth and thatch. Provide in supplier's standard size of uniform length and width with maximum 5 percent allowable deviation in either length or width. Broken or torn pads with uneven ends are not acceptable.

Sod Strength: Provide sod pads capable of supporting their own weight and retaining size and shape when supplier's standard size pad is suspended vertically from a firm grasp on upper 10 percent of the pad.

MULCH AND WATER:

Antierosion Mulch: Provide clean, seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

Seed Mulch: Provide peat moss in natural, shredded, or granulated form, of fine texture, with a pH of 4.0 to 6.0 and a water-absorbing capacity of 1,100 to 2,000 percent.

Water used to produce grass is to be free of excess and harmful chemicals, acids, alkalies and all other substances, which are harmful to plant growth.

Asphalt: Homogeneous emulsified asphalt meeting ASTM D 977 which contains no agents harmful or toxic to plant growth.

PART 3 - EXECUTION

GENERAL:

Minimum Operations: These Specifications set forth minimum operations and material applications, which are acceptable. However, a satisfactory stand of grass must be obtained by using supplemental methods and/or materials as may be required.

Grassing By Private Property: Where grassing is required between curbs and sidewalks or behind sidewalks in areas adjacent to private residential or commercial property, the City may change the type of grassing specified to match any type of grass, which may be planted, and growing on the adjacent lawn. No modifications of the Contract Unit Price will be made for this substitution.

SOIL PREPARATION:

Limit preparation to areas that will be planted in immediate future.

Loosen sub grade to a minimum depth of 4 inches. Remove stones bigger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter.

Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to toxic to plant growth.

Mix soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of topsoil mixture within a few days. Either mix soil before spreading or apply soil amendments on surface of spread topsoil and mix thoroughly into top 4 inches of topsoil before planting.

Mix lime with dry soil before mixing in fertilizer.

Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to sub grade before tilling.

Spread topsoil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if material or sub grade is frozen.

Place approximately 1/2 of total amount of topsoil mixture required. Work into top of loosened sub grade to create a transition layer, and then place remainder of topsoil mixture.

Allow for sod thickness in areas to be sodded.

Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn and grass planting as follows: Till to a depth of at least 6 inches. Apply soil amendments and initial fertilizers as specified and mix thoroughly into top 4 inches of soil. Remove high areas and fill in depressions; till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.

Before preparing of unchanged areas, remove existing grass, vegetation, and turf. Dispose of such material outside of the City's property; do not turn over into soil being prepared for lawns.

Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted within immediate future. Remove trash, debris, stones larger than 1-1/2 inches diameter, and other objects that may interfere with planting or maintenance operations.

Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry off before planting lawns. Do not create muddy soil.

Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.

Lime and Fertilizer Application:

Spread lime uniformly over the ground surface at the following rate:

1,500 pounds per acre

Spread fertilizer uniformly over the ground surface at the following rate:

1,000 pounds per acre

SEEDING NEW LAWNS:

Sow seed with a spreader or a seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.

Do not use wet seed or seed that is moldy or otherwise damaged in transmit or storage.

Sow no less than the quantity of seed specified.

Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

Protect seeded slopes against erosion with jute mesh erosion netting or other similar coverings acceptable to the City.

Protect seeded areas against erosion by spreading specified lawn mulch after completion of seeding operations. Spread uniformly to form a continuous blanket at least 1-1/2 inches loose measurement over seeded areas. Spread by hand, blower, or other suitable equipment.

Anchor mulch by spraying with asphalt emulsion at the rate of 10 to 13 gallons per 1,000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean such areas where damage occurs.

Protect seeded areas against hot, dry weather or drying winds by applying specified mulch within 24 hours after completion of seeding operations. Presoak and scatter evenly to a depth of 1/8 inches to 3/16 inches thick and roll to a smooth surface. Do not mound.

HYDROSEEDING NEW LAWNS:

Mix specified seed, fertilizer, and pulverized mulch in water, using equipment specifically designed for hydro seed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

Apply slurry uniformly to all areas to be seeded. Rate of application as required to obtain specified seed sowing rate.

SODDING NEW LAWNS:

Lay sod within 24 hours of stripping. Do not lay dormant sod or if ground is frozen.

Lay sod to form solid mass with tightly fitting joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to sub grade or sod. Tamp or roll lightly to ensure contact with sub grade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering adjacent grass.

Anchor sod on slopes with wood pegs as required to prevent slippage.

Water sod with fine spray immediately after planting. During first week, water daily or more frequently as necessary to maintain moist soil to depth of 4 inches.

RECONDITIONING LAWNS:

Recondition existing lawn areas damaged by Contractor's operations including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.

Provide fertilizer, seed or sod, and soil amendments as specified for new lawns and as required to provide satisfactorily reconditioned lawn. Provide new planting soil as required to fill low spots and meet new finish grades.

Cultivate bare and compacted areas thoroughly to provide a good, deep planting bed.

Remove diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations including oil drippings, stone, gravel, and other construction materials; replace with new topsoil.

Where substantial lawn remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps, cultivate soil, fertilize, and seed. Remove weeds before seeding. If weeds are extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.

Water newly planted areas and keep moist until new grass is established.

APPLICATION OF NITROGEN:

Make two applications of nitrogen to all grassed areas using mechanical spreading equipment. Apply at a uniform rate of not less than 70 pounds per acre per application. Make both applications only when weather conditions will permit uniform and even distribution and when moisture conditions will not cause harm to grass.

Place the first application of nitrogen when young grass reaches a height of at least one inch. Make the second application of nitrogen between 30 and 45 days after the first application.

PROTECTION:

Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period until lawn is established.

MAINTENANCE:

Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.

Replant bare areas with same materials specified for lawns.

Watering: Provide and maintain temporary piping, hoses and lawn watering equipment to convey water from sources and to keep lawn areas uniformly moist as required for proper growth.

Lay out temporary lawn-watering system and arrange watering schedule to prevent puddling, water erosion, and displacement of seed or mulch (if any). Lay out temporary watering system to avoid necessity of walking over muddy or newly seeded areas.

Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height. Remove no more than 40 percent of grass leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Time initial and subsequent mowings to maintain following grass height:

Mow grass from 1-1/2 inches to 2 inches high. Do not mow to less than 1-1/2 inches.

Apply second fertilizer application after first mowing and when grass is dry.

Use fertilizer that will provide at least 1.0 lb. of actual nitrogen per 1,000 sq. ft. of lawn area.

REQUIRED COVERAGE:

Grassed areas will be considered acceptable when a viable stand of grass covers at least 98 percent of the total area with no bare spots exceeding one square foot and the ground surface is fully stabilized against erosion.

ACCEPTANCE:

When work is substantially completed, including maintenance, the City will, upon request, make an inspection to determine acceptability.

Lawn work may be inspected for acceptance in parts agreeable to the City, provided work offered for inspection is complete, including maintenance.

Replant rejected work and continue specified maintenance until reinspected by the City and found to be acceptable.

Seeded lawns will be acceptable provided requirements, including maintenance and coverage, have been met and healthy, uniform close stand of specified grass is established free of weeds, bare spots, and surface irregularities.

Sodded lawns will be acceptable provided requirements, including maintenance and coverage, have been met and required number of plugs are established as well-rooted, viable patches of grass and areas between plugs are free of weeds and other undesirable vegetation.

CLEANUP:

Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto surface of roads, walks, or other paved areas.

END SECTION 02930