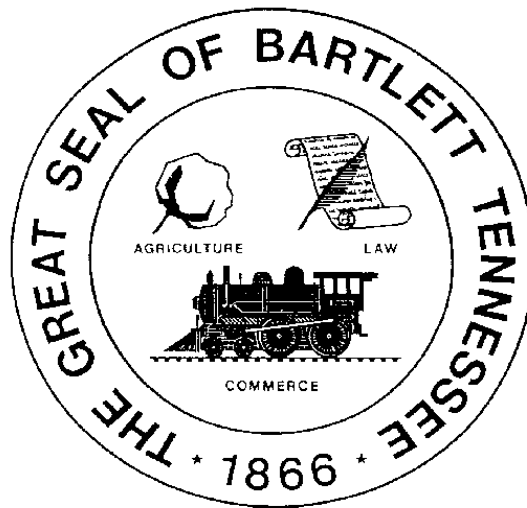


City of Bartlett

Shelby County, Tennessee

Technical Specifications



Prepared by:

City of Bartlett
Department of Engineering and Utilities
6382 Stage Road
Bartlett TN 38134-3739

John Horne, Director

February 1, 2023

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CITY OF BARTLETT

TECHNICAL SPECIFICATIONS

These specifications list the minimum acceptable standards for processes, material, construction and workmanship in municipal construction for subdivisions, commercial properties and capital improvement projects in the City of Bartlett, Tennessee and are current as of the date of publication. Additions, deletions or other changes to these specifications may occur in contract documents and request for bids. To insure you have the most current edition and changes, or you have any questions concerning these standards, contact the City of Bartlett Department of Engineering and Utilities, 901-385-6499. The City of Bartlett accepts no responsibility for use of specifications that are not the most current and will reject plans or submittals using outdated or incorrect specifications.

Submittals for approval of items not listed in these specifications or on the list of approved items should be sent to the City of Bartlett Department of Engineering and Utilities, 6382 Stage Road, Bartlett TN 38134-3739. Submittals should include all information necessary to determine if the item meets the minimum standards to constitute an acceptable alternative to an approved item.

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Section 1: Construction Stakes, Lines and Grades

- 1.1. Terms.** In the context of these specifications, the word “Engineer” is to mean the City of Bartlett Engineer or his duly assigned designee. The word “Department” is used to mean the City of Bartlett Engineering Department.
- 1.2. License Requirements.** All work performed in the City of Bartlett shall be done by a State of Tennessee licensed Professional Engineer and/or licensed surveyor.
- 1.3. Staking.** All staking shall be performed by qualified engineering or surveying personnel who are trained, experienced and skilled in construction layout and staking of the type required under the contract and who are acceptable to the Engineer.
 - 1.3.1. The personnel shall perform this staking under the direct supervision of a Tennessee licensed professional engineer with background experience in the direction of such work and is acceptable to the Engineer.
 - 1.3.2. A certified listing of all personnel to be used in the performance of the lines and grades on the project shall be submitted to the Engineer before any staking commences.
- 1.4. Unacceptable Personnel.** The contractor shall not engage the services of any persons who are or have been, during the period of the contract, in the employment of the City of Bartlett Engineering Department (except regularly retired employees) without the written consent of the Engineer. In addition, the contractor shall not engage the services of any firm or any principal officer or employee of a firm that participated in the development of a project that will be constructed under the proposed contract with the City of Bartlett.
- 1.5. Control Points.** The engineer will locate and reference the control points, i.e., PIs and PTs, as indicated on the contract plans, along the paper-located centerline or the survey baseline for the project mainline only (ramps, side roads, etc. shall be the responsibility of the contractor) and establish benchmarks for the proper layout of the work. The contractor shall be required to make all calculations involved and to furnish and place all layout stakes including those required for the location of public utility service lines (water lines, sewer lines, gas lines, etc.), utility fixtures, and right-of-way, as shown on the plans or directed by the engineer.
 - 1.5.1. The contractor shall be responsible for the placement and preservation of adequate ties to all control points, whether established by the contractor or found on the project, which are necessary for accurate re-establishment of all base lines or center lines shown on the plans.
 - 1.5.2. The contractor shall provide right-of-way or slope stakes, ditch or stream bed grades, or other essential survey staking as directed by the Engineer.
- 1.6. Accuracy Assurance.** Dimensional details, including elevations, shown on the plans shall be checked by the contractor to assure accuracy of the required layout. Any errors and apparent discrepancies found in previous surveys or in either the specifications or the special provisions shall be called to the Engineer’s attention by the contractor for correction or interpretation prior to proceeding with the work.
 - 1.6.1. All stakes, references and batter boards, including original, additional or replacement, which may be required for the construction operations shall be furnished, set and properly referenced by the contractor.
 - 1.6.2. The contractor shall be solely and completely responsible for the accuracy of the line and grade of all features of the work.

Section 1: Construction Stakes, Lines and Grades

- 1.6.3. When requested by the Engineer, the contractor shall provide safe facilities for convenient access by the Department to control points, batter boards and references.
- 1.6.4. The Engineer may check the control of work, as established by the contractor, at any time during the progress of work. The contractor will be informed of the results of these checks but the City, by so doing, in no way relieves the contractor of the responsibility for the accuracy of the layout work.
 - 1.6.4.1. The contractor shall correct or replace, as required, any deficient layout and construction work which may have resulted from inaccuracies in layout operations or of a failure to report inaccuracies found in work done by the Department or others.
 - 1.6.4.2. If, as a result of these inaccuracies, the Department is required to make further studies, redesign, or both, all expenses incurred by the Department due to such inaccuracies may be deducted from monies due the contractor.
- 1.7. **Data.** The contractor shall furnish to the Engineer copies of all data used in establishing line and grade for all features of work, including but not limited to, the data used in setting and referencing all stakes and layout marking used by the contractor.
- 1.8. **Work.** The contractor shall furnish all necessary personnel, engineering equipment and supplies, materials, transportation, and work incidental to the accurate and satisfactory completion of the work.
- 1.9. **Basis of Payment.** Partial payments for construction stakes, lines and grades shall be made based on the actual percentages of contract estimate. Ten percent of contract completion shall equate to a 10% payment of this item, 20% to 20% and so on, with 80% contract completion equating to 100% payment for this item. The City of Bartlett reserves to itself the right for making all measurements and surveys that involve the determination of final pay quantities, including original and final cross-sections, for all earthwork.

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2.1 General.

- 2.1.1 Do all necessary clearing, grubbing, excavating, filling and compacting to provide the finished lines, grades and cross sections indicated and required for the project involved.
- 2.1.2 Subgrade preparation for paving, excavation and backfill for concrete work and underground utilities are specified elsewhere.
- 2.1.3 The contractor shall install and maintain the erosion control measures as shown on the Erosion Control Plan or as directed by the Engineer. Erosion prevention and sediment control (EPSC) design shall be consistent with the current edition of the Tennessee Department of Environment and Conservation (TDEC) Erosion and Sediment Control Handbook and meet or exceed the requirements of the current State of Tennessee General National Pollution Discharge Elimination System (NPDES) Permit for Discharges of Stormwater Associated with Construction Activities (commonly referred to as the construction general permit (CGP)).
 - 2.1.3.1 The contractor shall sign the Notice of Intent (NOI) as required by the TDEC.
 - 2.1.3.2 The contractor shall install erosion prevention and sediment control measures as indicated on the applicable portions of the Erosion Control Plan prior to the commencement of earth disturbing activities.
 - 2.1.3.3 The contractor shall monitor and maintain erosion prevention and sediment control measures and complete all reports required by the TDEC CGP.

2.2 Clearing and Grubbing.

- 2.2.1 Clearing shall consist of felling and cutting trees, the trimming of trees left standing and the satisfactory removal and disposal of all trees, logs, downed timber, hedges, shrubs, brush, growing corn, weeds, grass, cornstalks, other herbaceous vegetation and rubbish.
- 2.2.2 Grubbing shall consist of the removal and disposal of stumps, hedges and roots.
- 2.2.3 Clearing and grubbing shall be performed in areas within the slope limits of embankments, in areas to be excavated and in other areas as designated on the drawings.
 - 2.2.3.1 Down timber and logs shall be cleared from all areas within the slope limits of embankments, areas to be excavated and areas designated on the drawings.
 - 2.2.3.2 Hedges or shrubs shall be pulled or grubbed from all areas within the slope limits of embankments, areas to be excavated and areas designated on the drawings.
 - 2.2.3.3 Trees, stumps, shrubs, bushes and roots shall be pulled or grubbed in all areas within the slope limits of embankments and areas to be excavated.

Section 2: Grading, Excavating, Seeding and Planting Screens

- 2.2.3.4 Trees, stumps, shrubs, bushes and roots as designated on the drawings shall be removed below the elevation of subgrade unless otherwise directed by the City Engineer.
- 2.2.3.5 All areas within the slope limits of embankments and areas to be excavated shall be cleared or stripped of any organic substances, rubbish or similar unsuitable materials. Areas designated on the drawings shall be cleared or stripped as above when noted on the drawings or directed by the City Engineer.
- 2.2.4. All dead branches and all live branches designated by the City Engineer for removal shall be trimmed out of individual trees and groups of trees left standing.
 - 2.2.4.1. All limbs and branches required to be trimmed shall be neatly cut to the bole of the tree or to the main branches.
 - 2.2.4.2. Cuts greater than one and one half (1½) inches in diameter shall be painted with an approved tree-wound paint.
- 2.2.5. Trees, shrubs and other vegetation to be left standing shall be protected from damage during clearing and other construction operations by methods subject to the approval of the City Engineer.
 - 2.2.5.1. Clearing and grubbing operations shall be performed in such a manner as to prevent damage to structures, trees, shrubs and other vegetation to be left standing and to provide for the safety of employees and others.
 - 2.2.5.2. In the event that any tree or shrub designated to be left standing is damaged, such plants shall be repaired immediately or replaced as directed by the City Engineer in accordance with standard horticultural practice at the contractor's expense and at no expense to the city.
- 2.2.6. Cleared and grubbed material shall generally be disposed of away from the construction site.
 - 2.2.6.1. Combustible material may be disposed of by burning on site when approved by the City Engineer and upon acquiring the necessary permits.
 - 2.2.6.2. Disposal of cleared and grubbed material shall be performed in a manner consistent with applicable laws.

2.3 Earth Excavation.

- 2.3.1 Earth excavation shall consist of all the excavation, removal and satisfactory disposal of all material regardless of its nature encountered within the area to be graded and/or in a borrow area except for rock excavation as defined herein.
- 2.3.2 Rock excavation shall consist of the excavation, removal and satisfactory disposal of:
 - 2.3.2.1 All boulders and rocks which occur on the surface of the earth or in the sub-surface deposits mixed with the earth, sand or gravel, when in the opinion of the City Engineer, their size, number or location prevents them from being handled in a manner normal to the excavation

Section 2: Grading, Excavating, Seeding and Planting Screens

operation being conducted in the area where the boulders and rocks occur.

- 2.3.2.2 Granite, trap, quartzite, chert, limestone, hard sandstone, hard shale or slate, or similar materials, in natural ledges or displaced masses, which, in the opinion of the City Engineer, it is not possible to excavate and remove without resorting to the continuous use of pneumatic tools, or to continuous drilling and blasting.
- 2.3.3 Excavation of materials shall be performed to the lines, elevations and cross sections as shown on the drawings and as herein specified. Excavated materials that are suitable shall be used in the construction of embankments so far as possible and no such material shall be wasted without authority from the City Engineer.
- 2.3.4 Excavation operations shall be conducted so that material outside the limits of slopes will not be removed or loosened.
 - 2.3.4.1 In the event that such material is removed or loosened, it shall be replaced as directed by the City Engineer.
 - 2.3.4.2 The cost of such replacement will be totally borne by the contractor.
- 2.3.5 Care shall be taken not to excavate material below the elevations and lines indicated on the drawings.
 - 2.3.5.1 If material is excavated below the elevations and lines indicated on the drawings, the contractor shall, as directed by the City Engineer, construct embankments to the said elevations and lines.
 - 2.3.5.2 In the case of ditches and waterways, place stone or broken Portland cement concrete in the ditches and waterways.
 - 2.3.5.3 The cost of all work shall be totally borne by the contractor.
- 2.3.6 Excavated area shall be continuously maintained such that the surface shall be smooth and have sufficient slope to allow water to drain from the surface. If the contractor fails to maintain partly finished work in a satisfactory manner, excavation shall be discontinued, if so ordered by the City Engineer, until the work is in a satisfactory condition.
- 2.3.7 All lots shall be laid out so as to provide positive drainage directly to the street at a rate of not less than 3.3 percent slope. In cases where this requirement prevents coordination of lot draining and the general storm drainage pattern, a written waiver may be granted on an individual lot basis by the City Engineer.
- 2.3.8 All areas in excavation will be proof rolled prior to any building or placing of base.
 - 2.3.8.1 Prior to placement of any architectural or engineered fill, the area to receive fill will be proof rolled in the presence of the City Engineer or his approved representative with a pneumatic tired dual wheel tandem axle truck with a gross weight as indicated in [Table 1, Compaction Requirements](#).

Section 2: Grading, Excavating, Seeding and Planting Screens

2.3.8.1.1 Proof rolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire's tracks covering the entire area being proof rolled.

2.3.8.1.2 All soft spots will be cut out and repaired prior to any fill being placed on the surface of the sub base.

2.3.8.2 All areas in either cut or fill will be proof rolled prior to any building or placing of base material for roads or parking lots in the presence of the City Engineer or his designated representative with a pneumatic tired dual wheel tandem axle truck with a gross weight as indicated in *Table 1, Compaction Requirements*.

2.3.8.2.1 Proof rolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire's tracks covering the entire area being proof rolled.

2.3.8.2.2 All soft spots will be cut out and repaired prior to any building or placing of base material for roads or parking lots.

Compaction Requirements			
Type of Fill	Std. Proctor ASTM	Mod. Proctor ASTM	Proof Rolling Gross WT. Lbs.
Compacted fill under buildings and structures	98%	95%	50,000
Compacted fill under roadway base or other areas to be paved	98%	95%	40,000
Roadway base	98%	95%	50,000
Compacted fill in levees and dikes	98%	95%	50,000
Compacted fill in over lot areas	95%	90%	40,000
All compactor test costs shall be borne by the contractor. Locations or number of tests are to be indicated on the construction plans as approved by the Engineering Department or as directed by the City Engineer.			
<i>Table 1, Compaction Requirements</i>			

2.4 Removal of Existing Obstructions. All obstructions such as fences, walls, foundations, buildings, accumulated rubbish of whatever nature and existing structures shall be removed from the grade site and disposed of in a manner consistent with existing laws and codes or as directed by the City Engineer.

2.4.1 Existing structures, buildings, walls and foundations which are not to remain in service shall be removed to at least one (1) foot in any direction from all new structures and shall be removed to at least one (1) foot below the proposed elevation of subgrade or finished ground surface, whichever is lower, except as such items are specifically noted on the drawings to remain in place.

2.4.2 Concrete and other materials removed from existing structures, buildings, walls, foundations or other obstructions shall be broken up in to sizes suitable for use as rip-rap, embankment fill or for other satisfactory disposal as directed by the City Engineer.

2.5 Protection of Sewer Lines, Utility Structures and Drainage Facilities. Existing utility lines which are to be retained, as well as utility lines constructed during excavation operations, shall be protected from damage during excavation and filling operations and, if damaged, shall be repaired by the contractor at his expense.

Section 2: Grading, Excavating, Seeding and Planting Screens

- 2.5.1 In the event that existing utility lines are encountered at such locations or elevations that they must be relocated to avoid conflict with the new work, and where such relocation is not included as part of the proposed work, then the necessary relocation may be conducted by “others” or by the contractor as directed by the City Engineer. Such work, when ordered by the City Engineer and performed by the contractor, shall be paid for in accordance with the provisions set forth in section [2.17 Measurement and Payment](#).
- 2.5.2 If it is necessary to interrupt natural drainage of the surface or the flow of artificial drains, the contractor shall provide temporary drainage facilities, at his expense, that will prevent damage to public or private interests.
 - 2.5.2.1 As the work progress permits, the contractor will restore the original drains at his expense.
 - 2.5.2.2 The contractor shall be liable for all damages which may result from his neglect to provide for either natural or artificial drainage which the work may have interrupted.
- 2.6 Removal and Disposal of Surplus, Unstable and Unsuitable Materials.**
 - 2.6.1 Prior to starting of soil excavation:
 - 2.6.1.1 Existing oiled earth or bituminous surfaces may be broken into pieces not exceeding six (6) inches in the largest diameter and embedded in embankments with the approval of the City Engineer.
 - 2.6.1.2 Existing Portland cement pavement, bituminous concrete pavement and existing sidewalks shall be removed from the site and disposed of in a suitable manner consistent with existing laws by the contractor.
 - 2.6.2 Stones and boulders encountered in excavation shall, whenever possible, be removed and placed in embankments.
 - 2.6.2.1 Stones and boulders not placed in embankments shall be disposed of in a manner consistent with existing laws or as directed by the City Engineer.
 - 2.6.2.2 No stones, boulders or bituminous concrete pavement over three (3) inches in diameter shall be used for backfill in trenches.
 - 2.6.3 Unstable material is soil material of such a nature that, in the opinion of the City Engineer, it cannot be properly consolidated in embankments or material that will not be made to function to satisfy the project conditions.
 - 2.6.3.1 Unstable materials shown on the drawings shall be removed and disposed of as directed by the City Engineer and in a manner consistent with existing laws.
 - 2.6.3.1.1 The horizontal and vertical limits of unstable material to be removed as shown on the drawings are an approximation only.

Section 2: Grading, Excavating, Seeding and Planting Screens

- 2.6.3.1.2 All material of the same soil type will be removed to the limit of its existence regardless of the actual limits and the limits shown on the drawings.
 - 2.6.3.2 Where unstable material not shown on the drawings is encountered at or below the elevation of the finished grade or at or below the original ground line on which embankment is to be constructed, the City Engineer may direct the contractor to, and the contractor shall when so directed, remove and dispose of the unstable material as specified by the City Engineer and in a manner consistent with existing laws. Payment for such material ordered removed and replaced shall be in accordance with the provisions set forth in section [2.17 Measurement and Payment](#).
- 2.6.4 Surplus excavated material shall be disposed of in the following locations, as noted on the drawings, or as directed by the City Engineer.
 - 2.6.4.1 Used to widen embankments or flatten slopes. Surplus material disposed of in this manner will not be required to be rolled unless widening is made at the same time the embankment is constructed.
 - 2.6.4.2 Disposed of within and/or adjacent to the job site.
 - 2.6.4.3 Disposed of within a waste area noted on the drawings.
 - 2.6.4.4 Disposed of outside the limits of the job site at a location chosen by the contractor and approved by the City Engineer in a manner consistent with existing laws and at the contractor's expense.
- 2.7 Top Soil Removal and Conservation.** Top soil shall be removed from areas to be graded and spread on areas previously graded and prepared to receive the top soil or shall be removed, transported and deposited in storage piles for use at such time as the graded area are ready for such placement.
 - 2.7.1 Top soil shall be stripped to the surface of the sub soil.
 - 2.7.2 Top soil shall be free of sub soil, stones and other undesirable material.
- 2.8 Borrow.** When the quantity of material required for earth fill is not available within the limits of the job site, the contractor shall provide sufficient material to construct the embankments to the lines, elevations and cross sections as shown on the drawings from borrow areas.
 - 2.8.1 Borrow material shall be provided which meets the requirements and conditions of earth fill in which it is to be deposited.
 - 2.8.2 Unless borrow areas are specifically shown on the drawings as provided by the City, they shall be provided by the contractor and at his expense.
 - 2.8.2.1 The contractor shall obtain from the property owner of said borrow the right to excavate material.
 - 2.8.2.2 The contractor shall pay all royalties and other charges involved.
 - 2.8.2.3 The contractor shall pay all expenses in developing the source, including cost of right-of-way required for hauling the material.

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2.8.2.4 Borrow areas selected by the contractor and the materials contained therein shall be approved by the City Engineer prior to placing any such materials excavated from the borrow pit.

2.8.2.5 The contractor shall notify the City Engineer at least ten (10) days in advance of the opening of any borrow pit to permit any necessary elevations or measurements to be taken or any desired material test to be made.

2.8.3 Procedures and requirements specified herein for other excavations are also applicable to excavation from borrow areas.

2.9 Fill Areas.

2.9.1 Prior to placement of any architectural or engineered fill, the area to receive fill shall be proof rolled in the presence of the City Engineer or his approved representative with a pneumatic tired dual wheel tandem axle truck with a gross weight as indicated in [Table 1, Compaction Requirements](#).

2.9.1.1 Proof rolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire's tracks covering the entire area being proof rolled.

2.9.1.2 All soft spots shall be cut out and repaired prior to any fill being placed on the surface of the sub base.

2.9.2 All areas in either cut or fill will be proof rolled prior to any building or placing of base material for roads or parking lots in the presence of the City Engineer or his designated representative with a pneumatic tired dual wheel tandem axle truck with a gross weight as indicated in [Table 1, Compaction Requirements](#).

2.9.2.1 Proof rolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire's tracks covering the entire area being proof rolled.

2.9.2.2 All soft spots will be cut out and repaired prior to any fill being placed on the surface of the sub base.

2.9.3 The construction of earth fill shall consist of the preparation of the site and the placement and compacting of excavated materials, including earth, stone, gravel or other materials of acceptable quality as specified herein and to the lines, elevations and cross sections as shown on the drawings. Fill areas shall be inspected by a qualified soil testing laboratory to insure they are properly constructed and footings will bear in them.

2.9.4 Before earth fill is placed, all clearing and grubbing, top soil removal and conservation, and removal and disposal of unstable and unsuitable material shall be performed as specified in the applicable sections of these specifications on the area which is to receive the fill material. A qualified soils testing laboratory shall inspect the site and give a written recommendation before construction of the fill is approved.

2.9.5 The surfaces upon which earth fill is to be constructed shall, if directed by the soil testing laboratory, be loosened by scarifying, disking, or other approved methods to provide bond between existing ground and the embankment. Wherever an embankment is to be constructed on or against a slope steeper than four (4) feet

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horizontal to one (1) foot vertical rise (4 to 1 slope), the existing embankment will be continuously benched as the construction to the new embankment progresses.

- 2.9.6 Snow and ice, if present, shall be removed from the area to be covered. Embankments shall not be constructed on frozen ground nor shall frozen materials be deposited in fill locations.
- 2.9.7 All earth fill shall be placed by depositing excavated materials which have been approved by the soil testing laboratory in horizontal layers not to exceed six (6) inches loose thickness.
 - 2.9.7.1 The moisture content of the materials shall be equal to or slightly above the optimum moisture content.
 - 2.9.7.2 So far as practical, each layer shall extend the full width.
 - 2.9.7.3 The material shall be leveled before compaction by means of equipment approved by the soils testing laboratory.
 - 2.9.7.4 The surface of the material shall be continuously maintained smooth and have sufficient slope to allow water to drain from the surface.
 - 2.9.7.5 If the contractor fails to maintain partly finished work in a satisfactory manner, construction shall be discontinued, if so ordered by the City Engineer, until the work is in a satisfactory condition.
 - 2.9.7.6 The paths of the hauling equipment shall be distributed over the width of the work.
- 2.9.8 After each layer is leveled and before the next layer is deposited, the entire area of each layer shall be compacted to the compaction requirements listed in Table 1 or to the compaction requirements otherwise noted on the drawings.
 - 2.9.8.1 The determination that the compacted fill material meets the compacted requirements shall be performed by the soils testing laboratory by the Standard Methods of Test, AASHTO.
 - 2.9.8.2 The contractor shall provide the qualified testing laboratory with sufficient opportunity to perform this determination test before proceeding with additional layers of materials.
- 2.9.9 If the moisture content of the deposited material is such that the compaction requirements cannot be obtained without drying or wetting the material, the contractor shall dry the material by disking, harrowing or other approved method, or wet the material uniformly with the application of water, whichever is necessary.
- 2.9.10 In the construction of levee embankments and where fill materials from excavation and borrow have decidedly different values of permeability when compacted, the more impervious materials shall be placed in the river side face of the embankment.
- 2.9.11 Materials used in fill area may contain stones smaller than six (6) inches in diameter and such stones shall be interspersed through the soil.

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- 2.9.11.1 If these stones interfere with the compaction of the embankment, they shall be removed and otherwise disposed of.
- 2.9.11.2 Stones larger than three (3) inches in diameter will not be permitted in the uppermost one (1) foot of embankment.

2.10 Shoulder Construction.

2.10.1 **Adjacent to Rigid Surfaces (Portland cement concrete pavement, bituminous surface, Portland cement base, curb, gutter, or curb and gutter).** After the rigid surface has been constructed, the placing of earth for the shoulder shall be completed and the earth compacted, shaped and finished to the lines, elevations and cross sections shown on the drawings.

2.10.2 **Adjacent to Non-rigid Surfaces (gravel or crushed stone base or surface, any bituminous surface not constructed on a Portland cement concrete course).**

2.10.2.1 **Shoulder elevation at or near surface elevation of surface or base course.**

2.10.2.1.1 The earth for the shoulder shall be roughed in before the material for the base or surface course is deposited.

2.10.2.1.2 The edge of the shoulder abutting the base or surface course shall be constructed as nearly vertical as possible.

2.10.2.1.3 The earth shall be placed so that it will be possible to retain and compact the edges of the base or surface course against the shoulder.

2.10.2.1.4 After the base or surface course is constructed, the balance of the earthwork required to complete the shoulders shall be performed.

2.10.2.1.5 Shoulders shall be compacted, shaped and finished to the lines, elevations and cross sections shown on the drawings.

2.10.2.2 **Shoulder elevation below the surface elevation of the surface course.**

2.10.2.2.1 The earthwork required to complete the shoulders shall be performed before the surface course is constructed.

2.10.2.2.2 The shoulders shall be compacted, shaped and finished to the lines, elevations and cross sections shown on the drawings.

2.10.3 The contractor shall perform shoulder construction operations in a manner such that the finished pavement, base or surface course, curb, gutter, curb and gutter or any structure will not be damaged. Any damage occurring shall be either repaired or removed and replaced by the contractor at his expense.

2.10.4 The shoulders shall be rolled with an approved pneumatic tire roller unless otherwise directed by the City Engineer.

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2.11 Finishing.

2.11.1 Excavation and Embankments (including all earth areas disturbed by the construction work).

- 2.11.1.1 Shall be shaped, trimmed, smoothed and finished uniformly to lines, elevations and cross sections shown on the drawings or as directed by the City Engineer.
- 2.11.1.2 The degree of finish for grading shall be that ordinarily obtainable through the use of a blade grader or similar equipment operated under favorable conditions and by skilled workmen.
- 2.11.1.3 Other methods, including hand methods, will be required in the event satisfactory finishing is not otherwise obtainable.

2.11.2 Surface Elevations.

- 2.11.2.1 Areas on which base and or surface courses are to be constructed shall be constructed so the average surface area elevation of earth shall not be higher than the average elevation of the subgrade and shall not be lower than 0.15 feet below this elevation.
- 2.11.2.2 All other surfaces shall not vary in elevation more than 0.15 feet above or below the elevation or cross section as shown on the drawings or as established by the City Engineer.

2.11.3 Drainage. All earth surfaces shall be shaped and finished so that proper drainage is assured.

2.11.4 Proof Rolling.

- 2.11.4.1 Prior to placement of any architectural or engineered fill, the area to receive fill shall be proof rolled in the presence of the City Engineer or his approved representative with a pneumatic tired dual wheel tandem axle truck with a gross weight as indicated in [Table 1, Compaction Requirements](#).
 - 2.11.4.1.1 Proof rolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire's tracks covering the entire area being proof rolled.
 - 2.11.4.1.2 All soft spots shall be cut out and repaired prior to any fill being placed on the surface of the sub base.
- 2.11.4.2 All areas in either cut or fill shall be proof rolled prior to any building or placing of base material for roads or parking lots in the presence of the City Engineer or his designated representative with a pneumatic tired dual wheel tandem axle truck with a gross weight as indicated in [Table 1, Compaction Requirements](#).
 - 2.11.4.2.1 Proof rolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire's tracks covering the entire area being proof rolled.

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2.11.4.2.2 All soft spots shall be cut out and repaired prior to any building or placing of base material for roads or parking lots.

2.12 Placing of Top Soil. Top soil shall be placed after areas to be covered have been shaped, trimmed and finished.

2.12.1 If the surface which is to receive the top soil is hardened or crusted, it shall be raked or otherwise broken upon as to provide sufficient bond with the top soil to be placed thereon.

2.12.2 Top soil shall be spread over the area and to the depth indicated on the drawings and finished in accordance with section [2.11 Finishing](#).

2.13 Protection of Graded Areas. Newly graded areas shall be protected from traffic and erosion by using barricades and straw coverings. Any settlement or washing away that may occur is to be corrected by the contractor, at his expense, prior to final acceptance. Such repairs shall begin within 24 hours after notification by the City Engineer.

2.13.1 After excavation, filling, grading, and backfilling are completed, all areas of disturbed ground shall have fertilizer, seed and mulch applied in accordance with sections **2.13.3 Liming and Fertilizer**, **2.13.4 Seeding**, **2.13.5 Mulching** or **2.15 Sodding**.

2.13.2 When work has ceased for 14 days, all areas of disturbed ground shall have fertilizer, seed and mulch applied in accordance with the provisions in sections **2.13.3 Liming and Fertilizer**, **2.13.4 Seeding** and **2.13.5 Mulching**.

2.13.3 Liming and fertilizing.

2.13.3.1 Lime shall be standard agricultural type containing at least 85% total carbonates.

2.13.3.2 Fertilizer shall be 6-12-12 grade commercial type containing 6% nitrogen, 12% phosphorus (P_2O_5) and 12% potassium (K_2O) or as determined by the results of any soil analysis performed for the project.

2.13.3.3 Before seeding, apply lime and fertilizer at the following rates and uniformly incorporate it into the soil at least three (3) inches by disking, harrowing or other approved method.

2.13.3.3.1 Lime: 4,000 pounds per acre (92 pounds per 1,000 square feet).

2.13.3.3.2 Fertilizer: 100 pounds per acre (2.3 pounds per 1,000 square feet). For projects that are subject to the Tennessee General NPDES Permit for Discharges of Stormwater Associated with Construction Activities, use the application rate as determined by the results of the soil analysis performed for the project.

2.13.4 Seeding.

2.13.4.1 Seeds shall be uniform mixtures of the following kinds and properties:

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Kind	Group A % by weight	Group B % by weight
Hulled Bermuda	50	20
Kentucky 31 Fescue	40	60
English Rye	10	20
Total	100	100

Table 2, Seed Groups

2.13.4.2 Time of sowing and seed mixture required:

February 1 to July 31	Use Group A Only
Month of August only	Use either Group A or Group B
September 1 to November 30	Use Group B only
December 1 to January 31	Do not sow any seed

Table 3, Seed Sowing Times

2.13.4.3 Sow 97 pounds of the required seed mixture per acre (two (2) pounds per 1,000 square feet) in two separate applications, raking the seeded areas lightly to cover seeds.

2.13.5 **Mulching.** Cover all seeded areas with a one (1) inch minimum thickness of weed-free straw or other approved mulch and wet mulch thoroughly.

2.13.6 **Watering and Maintenance.** Water and maintain the seeding until a living and growing stand of grass has been established and is acceptable to the City Engineer. Once established, vegetation shall be maintained at a height of no more than nine (9) inches until final acceptance.

2.14 **Adjustment of Utilities.** Field adjustments to any utility lines or apertures such as valves, fire hydrants, meter boxes, etc. will be accomplished by the contractor and the cost of such adjustments will be considered as incidental to the project costs. When adjustment rings are required for water valve roadway boxes, they shall be SIGMA 2600 series risers (or an approved equivalent) of the appropriate thickness to adjust the valve box top to grade. When adjustment rings are required for drain or sewer manholes, they shall be SIGMA MH-2710 or MH-2715 (or an approved equivalent) to adjust the manhole top to grade.

2.15 **Sodding.** This work shall consist of furnishing and placing sod at all locations shown on the Plans or where directed by the Engineer, and in conformity with these Specifications. Sodding is required on all slopes with a vertical rise of one or more feet in a run of three feet horizontally (3 to 1 slope). Ordinarily, the work will consist of the furnishing and placing of new sod originating from sources outside the rights-of-way and easement limits. In some cases, however, the work will include removing sod from areas where the requirements of the project would destroy existing sod, storing the sod so removed, and resetting it in areas shown on the Plans or designated by the Engineer.

2.15.1 Materials and Equipment.

2.15.1.1 **Sod.** Unless specified otherwise in drawings or contract documents, new sod shall consist of live, dense, well rooted growth of Bermuda grass, free from Johnson grass, knotgrass, and other obnoxious grasses or weeds, well suited for the intended purpose and for the soil in which it is to be planted

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2.15.1.1.1 All sod shall be cleanly cut in strips having a reasonably uniform thickness of not less than 2 inches and cut in 10 to 12 inch squares.

2.15.1.1.2 The sale or movement of sod for propagation is controlled by Tennessee Plant Pest Act of 1955, TCA 43-55 et. Seq., and the Contractor shall be responsible for obtaining all inspections, authorizations, and permits which may be required by such law and the Tennessee Department of Agriculture.

2.15.1.2 **Fertilizer.** Manufactured fertilizer shall be 15-15-15 grade commercial type containing 15% nitrogen, 15% phosphorus (P_2O_5) and 15% potassium (K_2O) unless otherwise specified on the Plans, in the Contract Documents or as determined by the results of any soil analysis performed for the project.

2.15.1.3 **Ammonia Nitrate.** Ammonium nitrate shall be a standard commercial product and shall have a minimum of 33.5% nitrogen or as determined by the results of any soil analysis for the project.

2.15.1.4 **Agricultural Limestone.** Agricultural limestone shall contain not less than 85% of calcium carbonate and magnesium carbonate combined and shall be crushed so that at least 85% will pass the No. 10 mesh sieve and 100% will pass the 3/8 inch sieve.

2.15.1.5 **Equipment.** All equipment necessary for the satisfactory performance of this work shall be on the project and approved before work will be permitted to begin

2.15.2 Construction Requirements.

2.15.2.1 **Weather Limitations.** Sod shall be set or reset only when the soil is moist and favorable to growth. No setting or resetting shall be done between December 1 and February 1, unless weather and soil conditions are considered favorable and permission is granted by the Engineer.

2.15.2.2 **Removing and Storing Sod for Resetting.** If specified, sod removed from such areas as lawns, yards and lots shall be so cut, handled, and stored that the sod can be reset in the same locations from which it was removed.

2.15.2.2.1 No exchange of sod will be permitted unless approved by the Engineer.

2.15.2.2.2 Unless reset immediately after cutting, sod shall be stacked in piles and kept moist until reset.

2.15.2.2.3 Sod shall be reset within 7 days after removal, unless otherwise specifically permitted by the Engineer.

2.15.2.2.4 Reset sod shall show vitality and growth at the time of acceptance by the City and for duration of the warranty period.

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2.15.2.3 **Sodding.** The area to be sodded shall be brought to the lines and grades shown on the Plans or as directed by the Engineer.

2.15.2.3.1 The surface of the ground to be sodded shall be loosened to a depth of not less than one inch with a rake or other device.

2.15.2.3.2 If necessary, the surface of the ground to be sodded shall be sprinkled until saturated for a minimum depth of one inch and kept moist until the sod is placed.

2.15.2.3.3 Immediately before placing the sod, fertilizer and lime shall be applied uniformly to the prepared surface of the ground.

2.15.2.3.3.1 Fertilizer shall be applied at the rate of 8 pounds of Grade 15-15-15, or equivalent per 1,000 square feet. For projects that are subject to the Tennessee General NPDES Permit for Discharges of Stormwater Associated with Construction Activities, use the application rate as determined by the results of the soil analysis performed for the project.

2.15.2.3.3.2 Agricultural limestone shall be applied at the rate of 100 pounds per 1,000 square feet.

2.15.2.3.4 Sod shall be placed as soon as practical after removal from the point of origin and shall be kept in a moist condition during the interim.

2.15.2.3.4.1 The sod shall be carefully placed by hand on the prepared ground surface with the edges in close contact and, as far as possible, in a position to break joints.

2.15.2.3.4.2 Each strip of sod laid shall be fitted and rolled using a roller of sufficient size and weight to fix the sod into place.

2.15.2.3.4.3 Immediately after placing, the sod shall be thoroughly wetted and rolled with an approved roller or hand tamped, as approved by the Engineer.

2.15.2.3.4.4 Pinning or pegging shall be required on slopes steeper than 2 to 1 to hold the sod in place or in other instances at the direction of the Engineer.

2.15.2.4 **Maintenance and Repair.** The sod shall be watered as frequently as necessary for a period of two weeks, after which, ammonium nitrate shall be applied at the rate of 3.5 pounds per 1,000 square feet and the sod given an additional watering.

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2.15.2.4.1 The contractor shall not allow any equipment or material placed on any planted area and shall erect suitable barricades and guards to prevent his equipment, labor, or the public from traveling on or over any area planted with sod.

2.15.2.4.2 Care shall include periodic watering, fertilizing and mowing necessary to maintain the vitality and appearance of the sod.

2.15.2.4.3 When mowing is required, mower blades shall be set at sufficient height to protect the vitality of the growth.

2.15.2.4.4 Sodded areas that become eroded, damaged or fail to successfully establish a stand of grass shall be repaired and/or replaced as directed by the Engineer.

2.15.2.4.5 All material and labor required to maintain and repair sodded areas shall be furnished by the contractor at no cost to the City.

2.15.2.4.6 Sod must be living at the time of final acceptance of the project and through the duration of the warranty period.

2.15.2.5 **Disposal of Surplus Material.** All surplus material will be disposed of offsite in a manner consistent with applicable laws.

2.16 Planting Screens. During preliminary plat review by the City of Bartlett Planning Commission, the contractor/developer may be directed to furnish and install prescribed planting screens prior to completion of the development. The development drawings will include the prescribed planting screen.

2.16.1 In commercial developments which require screening, the contractor/developer shall furnish as-built plans to the City Engineer prior to beginning building construction.

2.16.2 At such time the subdivision plat is given final approval for recording and the planting screen has not been installed, the contractor/developer shall furnish a construction bond to the City of Bartlett in the amount of the proposed improvements. The City Engineer shall determine the amount of the required bond.

2.17 Measurement and Payment.

2.17.1 **Clearing and Grubbing.** Paid at the unit bid price per acre.

2.17.2 **Excavation, Unclassified and Borrow.** Paid for at the unit bid price per cubic yard. Excavation will be measured in its original position using the cross section method and the volume computed by the average end area method.

2.17.3 **Fill.** Fill will not be measured and paid for directly. Payment will be included in the unit bid price for excavation.

2.17.4 **Seeding and Mulching.** Paid for at the unit bid price per acre to include liming, fertilizing, seeding, mulching and watering. No payment will be made for any

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seeding and mulching which does not produce a satisfactory and acceptable growth of grass.

- 2.17.5 **Relocation of Utilities.** Paid for at the negotiated lump sum price per complete utility relocation and return to proper operation. This item does not include adjustment of utilities which will not be paid separately but is considered incidental to the work.
- 2.17.6 **Removal and Replacement of Unsuitable Material.** Paid for at the unit bid price per cubic yard of material removed and replaced. No payment will be made for material removed outside the area indicated on the plans or as directed by the City Engineer.
- 2.17.7 **Soils Testing and Compaction.** Soil testing and compaction will not be paid for directly. Payment will be included in the unit bid price for excavation.
- 2.17.8 **Sod.** Measured and paid for at the unit bid price per square yard upon which the sod has been set to include furnishing, setting, pinning, pegging, fertilizing, watering, mowing, providing and placing agricultural limestone, and the protection, maintenance and repair of sodded areas.
- 2.17.9 **Removing, storing and resetting sod.** Measured and paid for at the unit bid price per square yard upon which the removed sod has been reset to include removing and storing the sod or turf, setting, pinning, pegging, fertilizing, watering, mowing, providing and placing agricultural limestone, and the protection, maintenance and repair of sodded areas.

3.1 General Design Information.

3.1.1 **Grades.** Before installing any sewers, calculate all proposed sewer grades.

3.1.1.1 Start all levels from established bench marks and tie in the close of the run to the point of beginning and to the inverts of all existing sewers to which the new sewer connects.

3.1.1.2 All pipe laying errors caused by failure to run levels properly shall be corrected by taking up and relaying pipe at no additional cost to the City of Bartlett.

Sewer Size	Minimum Slope used in design Calculations (feet/100)	As-Built Minimum Slope (feet/100)
8"	0.500	0.40
10"	0.350	0.30
12"	0.304	0.22
14"	0.247	0.17
15"	0.226	0.15
16"	0.206	0.14
18"	0.177	0.12
21"	0.144	0.10
24"	0.120	0.08
27"	0.051	
30"	0.045	
36"	0.035	
42"	0.028	
48"	0.024	

Table 4, Minimum Slope for Sewer Mains

3.1.2 **Slope.** All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.5 feet per second based on Kutter's formula using an "n" value of 0.013.

3.1.2.1 *Table 4, Minimum Slope for Sewer Mains* lists the minimum slopes which shall be provided, however, slopes greater than these are desirable.

3.1.2.2 When velocities greater than 15 feet per second or slopes greater than 20 percent (for 8" diameter pipe) are attained, special provisions shall be made to protect against displacement by erosion and shock. Ductile iron pipe or similar material with mechanical joints and ABS composite pipe with solvent-cement welded joints shall be used with concrete anchors.

3.1.3 **Superimposed Loads.** All sewers shall be designed to prevent damage from superimposed loads.

3.1.3.1 Proper allowance for loads on the sewer shall be made because of trench width and depth.

3.1.3.2 Trench widths shall be kept to a minimum.

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- 3.1.3.3 Backfill material up to three (3) feet above the top of pipe shall not exceed six (6) inches in diameter at its greatest dimension.
- 3.1.4 **Pipe Cover.** Unless otherwise specified or directed by the City Engineer, all sewer mains shall have a minimum cover of 30 inches.
 - 3.1.4.1 In streets and roadways, sewer mains shall have a minimum cover of four (4) feet.
 - 3.1.4.1.1 In roadways where cover is less than four (4) feet, ductile iron pipe or concrete encasement shall be used.
 - 3.1.4.1.2 In such cases, a minimum cover of six (6) inches is required.
 - 3.1.4.2 House services shall have a minimum cover of 18 inches. See section [3.12 Wyes and House Connections](#) for additional requirements.
 - 3.1.4.3 For structural reasons, ductile iron pipe, concrete encasement, or relocation shall be required when culverts or other conduits are laid such that the top of the sewer is less than 18" below the bottom of the culvert or conduit.
 - 3.1.4.4 See section [3.17 Location of Sewer in Stream](#) for special requirements for pipe cover in streams.
- 3.1.5 **Stream Crossings.** Sewer systems shall be designed to minimize the number of stream crossings. See section [3.17 Location of Sewer in Stream](#) for other design requirements.
- 3.1.6 **As-Built Sewer Plans.** At the completion of construction, as-built sewer plans are required to be provided to the Department of Engineering. As-built plans will include, as a minimum, the following information, and other information as may be requested by the City Engineer:
 - 3.1.6.1 Sewer manhole locations to include elevations of the top, both the flow in and flow out invert elevations and the upper tie-in elevation for drop connections, if applicable.
 - 3.1.6.2 Size, length and slope of sewer pipe between manholes and stub-outs.
 - 3.1.6.3 Distance of services from the property line and from the sewer main. See section [3.13 Service and Wye Record](#).

3.2 Types of Pipe.

- 3.2.1 **Polyvinyl Chloride.** Unless otherwise specified on the drawings, in these specifications or required in special locations, sanitary sewer piping for gravity sewer applications shall be polyvinyl chloride (PVC) meeting the requirements for ASTM D 3034 *Standard Specifications for Type PSM Polyvinyl Chloride Sewer Pipe and Fittings*. No second hand or used material shall be permitted. The minimum size pipe diameter shall be eight (8) inch for sewer mains and six (6) inch for sewer services.
 - 3.2.1.1 The standard dimension ratio (SDR) for nominal six (6) inch through 15 inch diameter shall be SDR 26.

- 3.2.1.2 Fittings shall be fabricated from pipe meeting the respective ASTM PVC pipe standard or molded PVC.
- 3.2.1.3 The wall thickness of the waterway and bell of molded fittings shall be no less than the respective minimum thickness for SDR 35 equivalent pipe.
- 3.2.1.4 All fittings shall be compatible with the pipe to which it is attached.
- 3.2.1.5 All joints shall be gasket, bell and spigot, push-on type conforming to ASTM D 3212 *Standard Specifications for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals*. When joining pipes of dissimilar materials (i.e., ductile to plastic), the use of a HYMAX® coupler or an approved equivalent is required.
- 3.2.1.6 Gaskets shall be part of a complete pipe section and purchased as such.
- 3.2.1.7 Lubricant shall be as recommended by the pipe manufacturer.
- 3.2.2 **Ductile Iron Pipe.** When required by the drawings, these specifications or required in special locations, all ductile iron pipe (D.I.P.) used for gravity sewer pipe shall conform to ANSI/AWWA Standard C151 with the minimum iron strength being 60/42 and the minimum pipe thickness class as indicated in [Table 5, Ductile Iron Pipe Minimum Thickness Classes](#). The minimum size pipe diameter shall be eight (8) inch for sewer mains and six (6) inch for sewer services. All pipe shall have ANSI/AWWA Standard C104 standard thickness, Protecto 401™ or an approved equivalent ceramic epoxy lining to include the first six (6) inches of the outside of the spigot end of the pipe, bituminous outside coating and ends (except the first six (6) inches of the spigot end when using Protecto 401™) as required for the types of joints specified. See [Appendix A, Standard Specification for Lining Ductile Iron Pipe for Sewer Service](#).
 - 3.2.2.1 Pipe interiors, sealing surfaces, fittings and other accessories shall be kept clean.
 - 3.2.2.2 Pipe bundles shall be stored on flat surfaces with uniform support.
 - 3.2.2.3 Protect stored pipe from prolonged exposure (six (6) months or more) to sunlight with a suitable covering (canvas or other opaque material).
 - 3.2.2.4 Provide air circulation under any covering.
 - 3.2.2.5 Gaskets shall not be exposed to oil, grease, ozone (produced by electric motors), excessive heat or direct sunlight.
 - 3.2.2.6 Fittings for D.I.P. shall be ANSI/AWWA C110 cast iron or ductile iron short body pattern, class 250, bituminous coated outside and Protecto 401™ or an approved equivalent ceramic epoxy lining inside, with ends as required for the type of joint specified.
 - 3.2.2.7 All joints shall be ANSI/AWWA Standard C111 mechanical or push on type. When joining pipes of dissimilar materials (i.e., ductile to plastic), the use of a HYMAX® coupler or an approved equivalent is required.

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3.2.2.8 Comply with the manufacturer's specific storage and handling requirements.

3.2.2.9 Upon demand by the City Engineer, the contractor shall furnish certificates of inspection made by an approved testing laboratory for any type of material used on the project.

Pipe Sizes	Wall Thickness	Minimum Thickness Class
4	0.26"	51
6	0.29"	50
8	0.27"	50
10	0.29"	50
12	0.31"	50
14	0.33"	50
16	0.34"	50
18	0.35"	50
20	0.36"	50
24	0.38"	50
30	0.39"	50
36	0.43"	50
42	0.47"	50
48	0.51"	50
54	0.57"	50

Table 5, Ductile Iron Pipe Minimum Thickness Classes

3.2.2.10 All ductile iron pipe and fittings used for sewer shall have a lining of Protecto 401™ or an approved equivalent to protect the exposed surfaces from corrosion.

3.2.2.10.1 All work shall be done in strict conformity with the applicable specifications, instructions and recommendations of the liner manufacturer.

3.2.2.10.2 The manufacturer of the lining material shall furnish an affidavit attesting to the successful use of its material as a coating for sewer pipes for a minimum period of five (5) years in sewage conditions recognized as corrosive or otherwise detrimental to concrete.

3.2.2.10.3 The pipe manufacturer shall provide to the City of Bartlett a three (3) year written warranty which covers the damage to the substrate from effects of hydrogen sulfide and delamination of the liner from the pipe.

3.2.2.10.4 The D.I.P. lining shall be Protecto 401™ ceramic epoxy lining manufactured by Induron® or an approved equivalent.

3.2.2.10.5 The lining shall be repairable at any time during the life of the pipe or structure.

3.2.2.10.6 The lining shall be a minimum of 40 mils in thickness.

3.2.2.10.7 The lining shall be applied in the full circumference of the pipe for the length of pipeline designated by the City Engineer.

3.2.2.10.8 Care shall be exercised in handling, transporting and placing lined pipe to prevent damage to the lining.

3.2.2.10.8.1 No interior hooks or slings shall be used in lifting pipe.

3.2.2.10.8.2 All handling operations shall be done with an exterior sling or with a suitable forklift.

3.2.2.10.9 No pipe with damaged lining will be accepted until the damage has been repaired to the satisfaction of the City Engineer.

3.2.2.10.10 All patches over holes or repairs to the lining shall be done in accordance with the manufacturer's recommendation.

3.2.2.10.11 Field coating at pipe joints (where necessary) shall be performed in strict conformance with the manufacturer's specifications and instructions. Cut and beveled ends of pipe shall be coated using Protecto 401™ joint compound or an approved equivalent.

3.3 Granular Drain, Pipe Embedment, Concrete Encasement, Concrete Foundation and Backfill Material.

3.3.1 **Granular Drain.** Drain rock material for trench drainage and pipe support shall be washed gravel, washed crushed rock, or washed crushed stone evenly graded from one-half ($\frac{1}{2}$) to two (2) inches in size, installed to the dimensions shown on the drawings or specified by the City Engineer.

3.3.2 **Pipe Embedment.** Granular material for pipe embedment or support shall be crushed rock, crushed stone, sand, or washed gravel with 100% passing a one-half ($\frac{1}{2}$) inch screen and 95% retained in a No. 4 sieve.

3.3.3 **Concrete Encasement.** Concrete encasement shall consist of concrete meeting the requirements in section **3.4 Concrete** and shall be used in the locations shown on the drawings, as specified in these specifications or as directed by the City Engineer. When used, concrete encasement shall be rectangular in section with a minimum thickness of six (6) inches between the outside edge of the pipe and the outside of encasement at the closest point.

3.3.4 **Concrete Foundation.** Concrete foundation shall consist of concrete meeting the requirements specified in section **3.4 Concrete**, poured the full width of the trench bottom, extending to a depth of not less than one-quarter ($\frac{1}{4}$) of the pipe diameter below the outside bottom of the pipe and no less than one-quarter ($\frac{1}{4}$) of the pipe diameter above the outside bottom of the pipe or to the dimensions directed by the City Engineer.

3.3.5 **Backfill Material.** Granular material for backfill above the pipe shall be clean, natural, unwashed gravel, sand, or crushed stone with 100% passing a one (1) inch screen and 100% retained in a No. 60 sieve.

3.4 Concrete.

Limestone concrete shall be 4,000 psi ready mixed type conforming to ASTM Specification C94 and composed of Portland cement, sand, and washed coarse aggregate all conforming to applicable ASTM Specifications.

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- 3.4.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali or inorganic matter and supplied by an approved ready mix plant.
- 3.4.2 The design mix shall be the ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.
- 3.4.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

3.5 Trenching. All trenches shall be open cut unless otherwise shown on the drawings or set out elsewhere in these specifications, with the trench bottom carefully graded, formed and aligned according to the plans.

- 3.5.1 The trenches shall follow lines parallel to and equal distance from the pipe centerline.
- 3.5.2 For pipe up to and including 18 inch diameter, the width of the trenches at the top of pipe shall be such as to leave not less than six (6) inches on each side of the outside of the pipes.
- 3.5.3 For pipe over 18 inch diameter, the width of the trenches at the top of pipe shall be such as to leave not less than 12 inches on each side of the outside of the pipe.
- 3.5.4 For pipe laid in tunnels, special instructions will be issued or drawings provided in the project documents.
- 3.5.5 Where sewers are laid along or across streets or roadways or adjacent to houses or buildings, the sides of the trenches shall be vertical and protected against caving with suitable bracing and sheathing. See section [3.8 Shoring, Sheathing and Bracing](#). Before cutting any city or county road, obtain permission for each cut from the respective engineer's office.
- 3.5.6 Where sewers are laid through fields and undeveloped territory, the sides of the trenches may be sloped to prevent caving provided that the width of the trench at the top of the pipe must not exceed the trench width limits identified above.
- 3.5.7 No more than 200 feet of trench shall be opened at any time in advance of the completed sewer nor shall more than 100 feet be left unfilled except by written permission from the City Engineer. The City Engineer may limit these distances by notifying the contractor in writing.
- 3.5.8 Where a water pipe, gas pipe, drain pipe or similar structure comes within the limits of the trench, such structures shall be supported properly. The City Engineer may direct the manner in which such structures shall be supported.
- 3.5.9 The contractor shall leave a path of at least two (2) feet in width on each side of the trench, between the trench and excavated material, to allow for free passage of the engineer or inspector to permit them to perform their work in an expeditious and satisfactory manner.
- 3.5.10 The contractor shall at all times be responsible for the condition of the trenches.

- 3.5.10.1 The contractor shall maintain frequent inspections of the trenches and repair settled or sunken places as soon as they are discovered.
 - 3.5.10.2 All soft or dangerous trenches shall be marked or barricaded and lighted at night for protection of the public.
 - 3.5.11 The contractor shall maintain a top grade line for 200 feet ahead of his machine and 50 feet in the rear so the cutting may be checked at any time and any error in grade corrected.
 - 3.5.12 If the contractor carelessly or otherwise digs the trench below the required grade, he will, at his expense, refill the trench to the proper grade with sand or gravel in compacted lifts not exceeding six (6) inches.
 - 3.5.13 Placing of house service connections, construction of manholes, removal of excess excavated material, building of access bridges and general clean-up operations will be kept close behind the laying of the sewer main. The City Engineer may direct that the laying of the sewer main cease until these auxiliary operations are caught up.
- 3.6 Unsatisfactory Subgrade.** Where indicated and/or where the subgrade material will not provide a sufficiently firm foundation to support the pipes and superimposed loads or contains ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material that in the City's opinion should be removed, remove the unsatisfactory material down to the depth indicated or required. See section [3.3 Granular Drain, Pipe Embedment, Concrete Encasement, Concrete Foundation and Backfill Material](#).
- 3.6.1 Replace the unsatisfactory material with the specified drain rock, granular pipe embedment or granular backfill material.
 - 3.6.2 The City Engineer may direct the use of foundation concrete for replacement material when in his opinion a rigid subgrade is necessary. See section [3.3.4 Concrete Foundation](#) for foundation requirements.
 - 3.6.3 No material shall be used until approved by the City Engineer. Material used prior to obtaining approval or measurement by the city representative shall not be paid for.
- 3.7 Maintaining Drainage.** Provide and maintain in proper working order all necessary dewatering equipment for the removal of water from the excavation. Where the trench bottom is mucky or otherwise unstable because of ground water and in all cases where the static ground water elevation is above the bottom of the trench, lower the ground water level by using drain rock or other acceptable method as required to keep the trench free from water and the bottoms stable for pipe laying until the pipes have been installed properly and will be unaffected by submersion.
- 3.8 Shoring, Sheathing and Bracing.** Adequately shore and brace trenches and other excavations as required to protect personnel, adjacent structures and adjacent property.
- 3.8.1 Where required by conditions encountered or as required by OSHA, brace trenches and excavations with suitable close sheeting or sheet piling.
 - 3.8.2 Do all necessary cribbing up required for proper operation of trenching equipment.

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3.8.3 Repair all damage resulting from inadequate or improper shoring, sheathing and bracing.

3.8.4 Sheathing or shoring that does not extend below the pipe centerline may be removed after the trench backfill has been placed and compacted to a level one (1) foot above the top of the pipe.

3.8.4.1 Immediately after removal, fill all resulting void spaces and re-compact the backfill.

3.8.4.2 Sheathing may be left in place only where specifically approved.

3.8.4.3 Cut the tops of sheathing left in place at an approved depth below finished grade.

3.9 Pipe Embedment. Normal embedment shall be sand for pipe diameters of 15 inches or less and No. 57 stone for pipe diameters larger than 15 inches. See section [3.3 Granular Drain, Pipe Embedment, Concrete Encasement, Concrete Foundation and Backfill Material](#). For pipe installation that shall have a warranty from the manufacturer, comply with the embedment instructions provided by the pipe manufacturer.

3.9.1 Pipe shall be laid on a minimum of two (2) inches and a maximum of four (4) inches of embedment material with sufficient additional material which is accurately shaped by a template to fit the lower part of the pipe exterior for at least ten (10) percent of its overall height.

3.9.1.1 After pipe installation, embedment material shall be rammed under the haunches and tamped in layers not exceeding six (6) inches in loose thickness to approximately 12 inches above the top of the pipe.

3.9.1.2 All embedment shall be compacted to a minimum of 98% STD of maximum density as defined by laboratory standard proctor test (ASTM D 698).

3.9.1.3 The remaining depth of the trench shall be backfilled and compacted as specified in section [3.14 Backfill and Cleanup](#).

3.9.2 Earthen checks shall be installed at the midpoint between sewer manholes.

3.9.2.1 Checks are to be made from suitable material excavated from the trench and be free of sand or gravel.

3.9.2.2 Checks shall be at least five (5) feet long and no more than eight (8) feet long.

3.9.2.3 Checks shall extend the depth of the trench to include the embedment, all compacted to a minimum of 98% STD of maximum density by laboratory standard proctor test (ASTM D 698).

3.9.3 Where house connections are installed, the wye and 1/8 bend at the main will be supported by tamping sand under and around the fittings to approximately 12 inches above the top of the pipe.

3.10 Laying Sewer Pipe.

3.10.1 General Requirements.

- 3.10.1.1 Provide and use suitable equipment for safe and convenient handling of pipe, fittings, valves and other sewer piping material.
- 3.10.1.2 Provide suitable facilities and equipment for lowering the pipe into the trench without causing damage to the pipe or trench.
- 3.10.1.3 Do not drop or dump sewer piping material from transportation vehicles or into trenches.
- 3.10.1.4 Inspect each pipe and fitting for cracks and other defects prior to installation. For ductile iron pipe, suspend above ground and ring each length with a light hammer to detect cracks. Remove all defective material from the job site.
- 3.10.1.5 Lay pipe and fittings so that after installation, the interior bottom surface of the sewer will conform to the lines and grades as indicated on the previously approved drawings.
- 3.10.1.6 Spigot ends, the inside of bells, gasket grooves, gaskets, glands, bolts and nuts must be clean and free of any foreign matter before installation and prior to joining pipe.
- 3.10.1.7 Provide lasers and other necessary equipment to insure the pipe is installed to the proper line and grade.
- 3.10.1.8 Do not install any work until excavations are free of water, mud, and loose earth.
- 3.10.1.9 Do not install any work on frozen ground.
- 3.10.2 **Water and Sewer Separation.** No water pipe shall pass through or come in contact with any part of a sewer or sewer manhole.
 - 3.10.2.1 **Horizontal Separation.**
 - 3.10.2.1.1 Sewers shall be laid at least ten (10) feet horizontally from any existing or proposed water main.
 - 3.10.2.1.2 If local conditions prevent the required horizontal separation, the sewer main may be installed closer if laid in a separate trench as the water main and the elevation of the top (crown) of the sewer is at least 18" lower than the bottom (invert) of the water main.
 - 3.10.2.2 **Vertical Separation.**
 - 3.10.2.2.1 Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18" below the bottom of the water main.
 - 3.10.2.2.2 When the elevation of the sewer cannot be varied to meet the above requirement, the water main shall be relocated to provide this separation or reconstructed with mechanical joint pipe for a distance of ten (10) feet on each side of the sewer. One (1) full length of water main will be centered

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over the sewer so that both joints will be as far from the sewer as possible.

- 3.10.2.3 **Unable to Maintain Separation.** When it is impossible to obtain the proper horizontal and vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical joint ductile iron pipe and pressure tested to assure water tightness prior to backfilling. Pipe shall be centered at the point of crossing so that joints will be as far from each other as possible. When water mains must pass under sewers, provide adequate support for the sewers to prevent excessive deflection of joints or settling on and breaking the water mains.

3.10.3 Pipe Installation.

- 3.10.3.1 Lay pipe in finished trenches starting at the lowest point and proceeding upgrade without breaks from structure to structure.
- 3.10.3.2 The bell, groove or collar end of the pipe shall be upgrade.
- 3.10.3.3 Lay all pipes on stable foundations utilizing the bedding method specified or required to accommodate the conditions encountered.
- 3.10.3.4 Provide uniform full length support of the pipe barrel at every point between bell holes.
- 3.10.3.5 Provide suitable indents in the bedding to facilitate joining and prevent bells or groove ends from bearing on the trench bottom.
- 3.10.3.6 Comply with the pipe manufacturer's installation requirements.
- 3.10.3.7 Maintain the trenches water-free and as dry as practicable during bedding, laying and joining and until the work will not be adversely affected by submergence.

3.10.4 Joining Pipes.

- 3.10.4.1 All mating surfaces of each joint and all joint material shall be clean and dry.
- 3.10.4.2 Make all joints in strict accordance with the pipe and gasket manufacturer's printed directions, using the recommended lubricants, tools, jointing methods and laying methods.
- 3.10.4.3 Taper each field cut spigot end back approximately one-eighth (1/8th) of an inch and at a 30 degree angle to prevent gasket damage.
- 3.10.4.4 Provide closely and accurately fitted water-tight joints.
- 3.10.4.5 When joining pipes of dissimilar materials (i.e., ductile to plastic), the use of a HYMAX® coupler or an approved equivalent is required.
- 3.10.4.6 As soon as possible after jointing, place sufficient backfill along each side of the pipe to prevent movement of the pipe.

3.10.5 Wye Branches.

- 3.10.5.1 As pipe laying progresses, install wye branches of the proper size in the main sewer at the locations shown in the drawings or as specified in section [3.12 Wyes and House Connections](#).
- 3.10.5.2 Materials and joint type shall be the same as those of the main sewer lines unless otherwise specified in the plans.
- 3.10.5.3 If plugs or stoppers are used, they shall be easily removable without causing damage to the wyes.

3.10.6 Protection of Pipe.

- 3.10.6.1 Keep all dirt, trash and other foreign materials cleared from the inside of pipes as it is being laid.
- 3.10.6.2 When pipe installation is not in progress, open pipe ends will be kept securely closed to prevent the entrance of water, mud or other foreign matter into the pipe.
- 3.10.6.3 Secure pipe to prevent displacement by movement of backfill, flotation or other causes.
- 3.10.6.4 Short sections of pipe will be used on each side of man holes to reduce the incidence of sheared pipe.

3.11 Manholes.

- 3.11.1 **General.** Unless otherwise specified in project documents or approved by the City Engineer, manholes shall be pre-cast concrete type constructed neatly, accurately and complete as the work progresses and when pipe installation reaches the manhole location.

- 3.11.1.1 Unless otherwise shown on the drawings or directed by the City Engineer, all manholes shall have a 48 or 60 inch inside diameter.

- 3.11.1.2 Manholes shall be installed:

- 3.11.1.2.1 At the upper end of the line.

- 3.11.1.2.2 At all changes of grade.

- 3.11.1.2.3 At all changes in pipe size.

- 3.11.1.2.4 At all changes in pipe alignment.

- 3.11.1.2.5 At all intersections of pipe.

- 3.11.1.2.6 At distances not exceeding:

- 3.11.1.2.6.1 350 feet for 15 inch or less pipe.

- 3.11.1.2.6.2 400 feet for 18 to 21 inch pipe.

- 3.11.1.2.6.3 500 feet for 24 inch or greater pipe.

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- 3.11.1.3 Manhole steps shall be Neena Special type or an approved equal.
 - 3.11.1.3.1 Steps shall be set on 16" vertical centers.
 - 3.11.1.3.2 The lowest step shall be no higher than 16" above the invert.
 - 3.11.1.3.3 The highest step shall be no more than 12" below the top with one back step at the same elevation.
- 3.11.1.4 Rims and covers shall be Memphis Tennessee Standard No. 7 cast iron type, with the covers marked "SEWER".
- 3.11.1.5 Set manhole tops as follows except where otherwise shown in the drawings or directed by the City Engineer:
 - 3.11.1.5.1 In streets, roads, highways and other paved areas, set flush with the base pavement grade.
 - 3.11.1.5.2 In undeveloped areas such as fields, woods, etc., set 18" above ground.
 - 3.11.1.5.3 In yards, set flush with existing grade.
 - 3.11.1.5.4 In all other areas, set 12" above ground.
 - 3.11.1.5.5 Protect and maintain each manhole to grade until it is accepted by the City of Bartlett.
- 3.11.1.6 Trench trace wire shall be installed through the joint between the cone section and the vertical section of the manhole riser at the time the sections are assembled.
 - 3.11.1.6.1 Trace wire shall be #14 solid copper with a vinyl covering. Stranded wire is not acceptable.
 - 3.11.1.6.2 The trace wire shall be installed in such a manner as to preclude it from being pinched by the concrete surfaces of the manhole riser and cone sections.
 - 3.11.1.6.3 The trace wire shall be wrapped around the top step in such a fashion to preclude it interfering with the use of the step, with approximately four feet of additional wire to allow it to be extended beyond the top of the manhole.
 - 3.11.1.6.4 When trace wire terminates at an existing sewer manhole, the trace wire shall be brought to finished grade at the existing sewer manhole and terminated inside a roadway valve box with approximately four (4) feet of extra wire.
 - 3.11.1.6.4.1 The cap for the roadway box shall be labeled SEWER.
 - 3.11.1.6.4.2 The roadway box shall be set flush with the finished grade. For new subdivisions, it shall be set flush with the initial asphalt surface

(base asphalt) and riser rings added at the time of final asphalt paving.

- 3.11.1.6.4.3 A concrete pad two (2) feet by two (2) feet square and six (6) inches thick shall be used to secure the roadway box regardless of location. For asphalt areas, the concrete shall be recessed below final grade enough to allow it to be covered by the final lift of asphalt. A precast concrete ring may be used for roadway boxes located in unpaved areas outside the right of way.
- 3.11.1.6.5 See section [3.14.1.4](#) for more information concerning trace wire use.
- 3.11.1.7 Remove all debris which falls into manholes during construction and prior to final acceptance by the City of Bartlett.
- 3.11.1.8 Provide short sections of pipe to extend from manhole walls to prevent pipe shear in the event of manhole settlement.
- 3.11.1.9 Connections to manholes using PVC pipe shall be made using an appropriate rubber gasket (water stop) installed in the manhole wall.
 - 3.11.1.9.1 For precast concrete manholes with precast bottoms/inverts, the rubber boot shall be installed at the time of casting.
 - 3.11.1.9.2 For precast concrete manholes without precast bottoms (doghouse style), a Fernco concrete manhole adapter, or an approved equivalent, shall be used.
 - 3.11.1.9.3 For cored manholes, the boot shall be a stainless steel wedge style Kor-N-Seal®I 106/406 series pipe-to-manhole connector, or an approved equivalent, for pipe sizes up to 15" or a Kor-N-Seal®II 206 series pipe-to-manhole connector, or an approved equivalent, for pipe sizes larger than 15".
- 3.11.1.10 Mortar for sealing around pipes and plugging lifting holes shall be non-shrinking type only, consisting of Sonneborn's "Ferrolith G", Master Builder's "Embeco", A.C. Horn's "Viro-Foil", or an approved metallic compound and suitable aggregates, mixed and applied in strict accordance with the manufacturer's printed directions.
- 3.11.1.11 Other mortar shall be one (1) part by volume of ASTM Specification C150 Type I Portland Cement, two (2) parts by volume of AASHTO Specifications M45 Mortar Sand and clean water as required to provide workable consistency. Hydrated lime may be added in an amount not more than 15% of the volume of cement in the mixture.
- 3.11.1.12 Manholes receiving force main discharges shall be given protective coatings to prevent deterioration as a result of hydrogen sulfide or other chemicals where such chemicals are present or suspected to be present because of industrial discharges or long force mains. See [Appendix B, Standard Specification for Lining Sewer Manhole](#).

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- 3.11.2 **Excavation.** Excavate to the dimensions, shapes and elevation indicated on the drawings.
- 3.11.2.1 Excavation for the manhole base shall be plumb, level, firm and clean.
- 3.11.2.2 Excavation for the manhole base shall be free of loose earth, loose rock, vegetation, mud, water, frozen earth or any other unsatisfactory materials immediately before concrete placement or pre-cast concrete placement.
- 3.11.2.3 The outside dimension of the excavation shall be at least 12 inches greater than the manhole outside diameter to facilitate manhole construction and backfilling around the structure.
- 3.11.2.4 If the contractor carelessly or otherwise excavates below the required grade or the subgrade becomes spoiled in any way, they will, at their expense, refill the excavation to the proper grade with sand or gravel tamped in place.
- 3.11.3 **Poured in Place Concrete Manholes.** Concrete for bases and other poured in place concrete items shall meet the requirements of section [3.4 Concrete](#).
- 3.11.3.1 Unless otherwise shown on the drawings or directed otherwise, bases shall be no less than eight (8) inches thick at their minimum thickness (bottom of invert for poured in place manholes).
- 3.11.3.2 Bases shall be poured at an elevation to ensure flow line elevations match the required elevations shown on the drawings and on previously approved cut sheets or as directed by the City Engineer.
- 3.11.3.3 Poured in place manholes shall have forms supported to ensure the finished manhole is plumb.
- 3.11.3.4 Steps shall be installed in conjunction with the concrete pour for poured in place manholes (see section [3.11.1.3](#)).
- 3.11.3.5 The top 36" shall be tapered and conical. Either concentric or eccentric, with its inside diameter tapering uniformly from 48" or 60" to 24" inside diameter.
- 3.11.4 **Pre-cast Concrete Manholes.** Pre-cast concrete manhole sections shall conform to ASTM Specifications C478 and shall be built to the depths indicated on the drawings or as directed by the City Engineer.
- 3.11.4.1 If a pre-cast bottom is not used, a circular concrete foundation base shall be poured using the specifications listed for poured in place concrete manholes.
- 3.11.4.2 Pre-cast bottoms shall have the rubber boots for pipe connections cast in the bottoms at time of manufacture for the size of the pipe to be used.
- 3.11.4.3 Sections shall be reinforced concrete.

- 3.11.4.4 Sections shall be furnished in 16, 32 and 48 inch lengths as required to bring the manhole to the top elevations shown on the drawings or as directed by the City Engineer.
- 3.11.4.5 Each section shall have bell and spigot or tongue and groove ends.
- 3.11.4.6 Each section shall have lifting holes to facilitate handling.
- 3.11.4.7 The taper section shall be one piece 36 inch high and conical. Either concentric or eccentric, with its inside diameter tapering uniformly from 48 or 60 inch inside diameter at the bottom to 24 inch inside diameter at the top.
- 3.11.4.8 Each section shall have permanently embedded steps meeting the requirements specified in section [3.11.1.3](#).
- 3.11.4.9 Assemble manholes using 48 inch long sections and not more than one shorter section to provide the required straight height.
 - 3.11.4.9.1 Lay sections with Ram Nek or equivalent in each joint.
 - 3.11.4.9.2 Install trench trace wire between the cone section and vertical section. See [section 3.11.1.6](#).
 - 3.11.4.9.3 After all sections are installed, plug lifting holes with mortar.
 - 3.11.4.9.4 Seal around all pipe entrances and outside section joints with mortar.
- 3.11.4.10 Set rim and covers to the proper elevation using 24 inch inside diameter poured in place concrete, brick masonry, or pre-cast concrete spacers between the casting and the pre-cast taper section.
- 3.11.4.11 Where the highest step in the pre-cast taper section is more than 24 inches below the top of the manhole cover, provide a step set in the spacer section 16 inches above the highest step in the taper section.
- 3.11.5 **Backfill.** Place and compact backfill around manholes in accordance with the applicable requirements in section [3.14 Backfill and Cleanup](#). Backfill material shall be compacted sand or gravel until within two (2) feet of the proposed subgrade when manholes are in existing or planned roadways.
- 3.11.6 **Drop Connections.** Provide drop connections where indicated on the plans and in all cases where the drop through the manhole exceeds 24". See section [3.19 Force Mains](#) for drop connections associated with force main installations.
 - 3.11.6.1 Unless otherwise specified or directed by the City Engineer, all drop connections shall be inside drop connections.
 - 3.11.6.1.1 A sweep tee shall be installed on the main where the sewer enters the manhole with two openings horizontal to the sewer and the third opening (sweep) pointed down.
 - 3.11.6.1.2 The down side shall have a sufficient length of pipe to bring the discharge end of the pipe to within one foot of the invert.

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- 3.11.6.1.3 The discharge end of the pipe shall have a 22° bend to point the discharge to the out flow of the manhole.
- 3.11.6.1.4 The drop connection shall be attached to the manhole wall in such a manner as to preclude displacement. The material used for attachment shall be stainless steel straps and anchoring bolts resistant to the corrosive action of vapors or sewage installed at a maximum of four (4) foot spacing.
- 3.11.6.2 Outside drop connections shall only be used in new manhole construction and then only when specifically shown on the plans or directed by the City Engineer.
 - 3.11.6.2.1 Construct outside drops as shown in accordance with the standard detail drawing or as directed by the City Engineer.
 - 3.11.6.2.2 Outside drops shall be concrete encased.
- 3.11.6.3 Unless otherwise shown on the plans or directed by the City Engineer, PVC pipe meeting the requirements specified in [section 3.2.1](#) shall be used for all drop connections.
- 3.11.7 **Inverts.** Provide an invert in each manhole bottom as required to facilitate the in-flowing and out-flowing sewers.
 - 3.11.7.1 Inverts shall be constructed of concrete with full pipe size flow channels carefully and smoothly shaped and finished to prevent sewage splashing and turbulence.
 - 3.11.7.2 Make all changes of flow directions with the maximum practical radius curves.
 - 3.11.7.3 Where possible, lay sewer pipe through the manhole and remove the upper half of the pipe to form the invert.
 - 3.11.7.4 Invert benches shall be smooth and shall slope towards the invert on a grade of at least one (1) inch per foot.
- 3.11.8 **Connecting to Existing Sewer Manholes or Wet Wells.** Connect new sewers to existing manholes or wet wells where indicated on the drawings or as directed by the City Engineer.
 - 3.11.8.1 When a new opening is required in an existing sewer manhole or wet well, the opening shall be core drilled. [See section 3.11.1.9.3.](#)
 - 3.11.8.2 Rebuild existing inverts as required.
 - 3.11.8.3 Provide new drop connections as required.
 - 3.11.8.4 Plug all new sewer connections to existing manholes until the new sewer construction is complete and accepted by the City of Bartlett.
- 3.11.9 **Manhole Protection.** Protect and maintain each manhole to grade until it is accepted by the City.

- 3.11.9.1 Tops are to be sealed to prevent intrusion of water and mud into the manholes.
- 3.11.9.2 Pipe ends inside of the manholes shall be sealed to prevent intrusion of water or mud into the pipes.

3.12 Wyes and Service Connections.

- 3.12.1 Install wyes and house connections to serve all property having access to the sewer system:
 - 3.12.1.1 For each completed or partially constructed house or building.
 - 3.12.1.2 For each vacant lot, but at least on 100 foot MAXIMUM centers, on each side of the sewer.
 - 3.12.1.3 At any other location as required.
- 3.12.2 **Wyes.** See section [3.10.5 Wye Branches](#). Plug the branch opening of each wye which does not have a service pipe connected.
- 3.12.3 **Service Connections.** Unless otherwise shown on the plans or approved by the City Engineer, install service piping to the property line or right of way for each wye installed in the sewer system.
 - 3.12.3.1 Service pipe and fittings shall be six (6) inch diameter and of the same material and type joints as those used for the main sewer unless otherwise shown on the plans.
 - 3.12.3.2 Service pipe shall have the same bedding requirements as those used for the main sewer.
 - 3.12.3.3 Service pipe shall be laid at a minimum grade of one (1) percent or as shown on the plans.
 - 3.12.3.4 Service pipe shall be at a sufficient depth at the property line or right of way to serve the property but in no case less than 54 inches deep at the property line or right of way.
 - 3.12.3.5 Service pipes crossing under a side ditch shall have at least 18 inches minimum cover over the top of the pipe.
 - 3.12.3.6 Service pipes which must cross a side ditch exposed shall be D.I.P. meeting the requirements of [section 3.2.2](#), extending at least 22 inches into each side of the ditch. When joining pipes of dissimilar materials (i.e., ductile to plastic), the use of a HYMAX® coupler or an approved equivalent is required.
 - 3.12.3.7 Service pipes shall terminate with a sweep as shown in the standard detail drawings or as specified by the City Engineer.
- 3.12.4 When services terminate at a sewer easement in paved or concrete surfaces, the service clean-out shall be capped with a screw type fitting, the top of which is no deeper than six (6) inches below final grade.

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- 3.12.4.1 The service clean-out shall be protected by a roadway valve box, the cap being labeled SEWER.
- 3.12.4.2 The roadway box shall be set flush with finished grade.
- 3.12.4.3 A concrete pad two (2) feet by two (2) feet square and six (6) inches thick shall be used to secure the roadway box regardless of location. For asphalt areas, the concrete shall be recessed below final grade enough to allow it to be covered by the final lift of asphalt.
- 3.12.5 There shall be no additional payment for wyes, elbows, reducers, connectors, plugs, locator pipe, caps or tape used for service connections. Payment for these items shall be included in the cost of service pipe furnished and laid.
- 3.12.6 All services shall be laid by organized crews under the direct supervision of a competent foreman.
 - 3.12.6.1 Services shall be laid under conditions and in a manner that will permit each connection to be inspected by a city inspector.
 - 3.12.6.2 Haphazard and irresponsible installation of connections on holidays or after regular work hours or after other work on the project has closed due to bad weather conditions or without the knowledge or presence of a city inspector shall not be accepted.
- 3.12.7 Any sanitary sewer connections made outside the ROW or easement line, on the private side, shall be installed by a licensed and permitted contractor/plumber and inspected by the City of Bartlett Code Enforcement Department.

3.13 Service and Wye Record.

- 3.13.1 Keep an accurate record of the location of all wyes and service pipes and the length of all service pipes.
- 3.13.2 Upon completion of the sewer system, prepare and deliver to the City of Bartlett a copy of the wye and service record showing the following information:
 - 3.13.2.1 Distance in feet from each wye to the centerline of the first manhole downstream from the wye when a service pipe is not extended to the property line or right of way.
 - 3.13.2.2 Direction which each wye turns when a service pipe is not extended to the property line or right of way.
 - 3.13.2.3 Length in feet and routing of each service line.
 - 3.13.2.4 Distance in feet from the property line end of the service pipe to the centerline of the first manhole downstream from the service pipe, measured parallel to the main sewer line. When property lines are identified on curbs, this measurement may be made to the property line instead of the manhole.
- 3.13.3 The developer shall provide a coordinate list of all sewer manhole and wye locations as part of the as-built sewer plans.

3.13.4 Where curb and gutter is available, the service location shall be shown on the face of the curb with an etched "S" in three (3) inch lettering and then a black "S" stenciled over the etching in three (3) inch lettering on a white six (6) inch square background.

3.13.5 Maintain service location standpipes and stencils until the project has been accepted by the City of Bartlett.

3.14 Backfill and Cleanup. Trenches and other excavations shall not be backfilled until the City of Bartlett has approved the pipe or other work or unless specifically altered or changed in the Special Provisions of an awarded contract with the City of Bartlett. Unless specified elsewhere or directed by the City Engineer, sewer testing is not required prior to backfill.

3.14.1 **General Requirements.** General requirements apply to all backfill locations unless specifically altered or changed in the special provisions of an awarded contract with the City of Bartlett or noted otherwise in the specific requirements for the area being backfilled.

3.14.1.1 The material for backfilling, unless otherwise specified, shall be sand, earth, loam or gravel from trenches and be free of stones, broken concrete or asphalt larger than three (3) inches in diameter.

3.14.1.1.1 Before placing any backfill, all rubbish, forms, blocks, wires or other unsuitable materials shall be removed from the excavation.

3.14.1.1.2 Backfill material up to three (3) feet above the top of the pipe shall not exceed six (6) inches in diameter at its greatest dimension.

3.14.1.2 As soon as the pipe has been laid and jointed, the pipe is to be bedded in the trench and made secure against movement by backfilling to approximately 12 inches above top of pipe with the embedment material. Comply with the applicable requirements of section [3.9 Pipe Embedment](#).

3.14.1.3 Earthen checks shall be installed at the midpoint between sewer manholes.

3.14.1.3.1 Checks are to be made from suitable material excavated from the trench and be free of sand or gravel.

3.14.1.3.2 Checks shall be at least five (5) feet long and no more than eight (8) feet long.

3.14.1.3.3 Checks shall extend the depth of the trench, to include the embedment, all compacted to a minimum of 98% STD of maximum density by laboratory standard proctor test (ASTM D 698).

3.14.1.4 Trace wire shall be installed in the trench a minimum of two (2) feet but no more than four (4) feet below final grade.

3.14.1.4.1 Trace wire shall be #14 solid copper wire with a vinyl covering. Stranded wire is not acceptable.

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- 3.14.1.4.2 Trace wire shall terminate inside manholes located at each end of a sewer run. See [section 3.11.1.6](#).
- 3.14.1.4.3 A warning tape shall be installed in the trench approximately one foot above the trace wire.
- 3.14.2 **From a point 12 inches above the top of pipe**, backfill shall be placed in one of the following methods depending upon the location of the pipe.
 - 3.14.2.1 **Pipe crossing streets, roads or driveways in regular use.** Sewer pipe laid in areas that are paved, including gravel and dirt roads and driveways in regular use, shall be backfilled with sand or gravel meeting the requirements of section [3.3.5 Backfill Material](#). Water jetting is not permitted.
 - 3.14.2.1.1 An earthen check as described in [section 3.14.1.3](#) shall be installed at both sides of the crossing.
 - 3.14.2.1.2 Backfill to within 13 inches of the finished surface in lifts not exceeding six (6) inches in depth.
 - 3.14.2.1.3 Each lift is to be compacted to 98% STD proctor (ASTM).
 - 3.14.2.1.4 Immediately place concrete, approved gravel or cement treated base (CTB), depending upon the pavement section, to within three (3) inches of the finished surface. Gravel is to be compacted to 98% STD proctor (ASTM).
 - 3.14.2.1.5 Road plates shall be required until the cement or CTB has cured.
 - 3.14.2.1.6 If paving can not be accomplished on the same working day, place three (3) inches of cold tar asphalt on the gravel base and level with the existing paved surface.
 - 3.14.2.1.7 For pavement, after a minimum of five (5) days, remove the plates or cold tar asphalt and install asphaltic concrete (hot mix) compacted to a minimum of 90% of maximum laboratory density until flush with existing surface. The appropriate asphaltic prime coat shall be applied to the base and joints prior to laying the asphalt.
 - 3.14.2.1.8 For gravel or dirt roads and driveways, after a minimum of five (5) days, remove the plates and install limestone gravel until flush with the existing surface.
 - 3.14.2.1.9 Concrete driveways will be repaired or replaced in kind.
 - 3.14.2.1.10 Maintain these crossings usable to vehicle traffic until acceptance by the City of Bartlett.
 - 3.14.2.1.11 Do not leave a street, road or private driveway unusable overnight.

3.14.2.2 **Pipe in areas to be paved.** Unless otherwise directed in the drawings or by the City Engineer, the contractor is permitted to backfill the remaining trench using one or both of the methods described below.

3.14.2.2.1 The remaining trench shall be backfilled in compacted lifts not exceeding eight (8) inches.

3.14.2.2.1.1 Backfill material can be any material excavated from the trench complying with the requirements listed in [section 3.14.1](#). Backfill around manholes with sand or gravel until within two (2) feet of the proposed subgrade.

3.14.2.2.1.2 Each lift is to be compacted to 98% Standard Proctor (ASTM).

3.14.2.2.2 If the area is not to receive the gravel or cement treated base immediately and trenches have ample time to settle and dry prior to placing the base, water jetting may be utilized.

3.14.2.2.2.1 Backfill material can be any material excavated from the trench complying with the requirements listed in [section 3.14.1](#) and water jetting utilized to achieve compaction. Backfill around manholes with sand or gravel until within two (2) feet of the proposed subgrade.

3.14.2.2.2.2 Refill and smooth the backfill as it settles.

3.14.2.2.2.3 Do not water jet earthen checks.

3.14.2.2.3 In neither instance will the base be placed over trenches that have not properly settled, have excessive moisture or have moderate to excessive pumping.

3.14.2.3 **Pipe in other locations.** Sewer lines laid in other areas shall continue to be backfilled to finished grade in compacted lifts not exceeding 12 inches in depth.

3.14.2.3.1 The remaining fill may be any excavated material from the trench complying with the requirements listed in [section 3.14.1](#).

3.14.2.3.2 Avoid using pressures that may damage the sewer lines.

3.14.2.3.3 Water jetting is required.

3.14.2.3.4 Do not water jet earthen checks.

3.14.2.3.5 After sufficient settlement satisfactory to the City of Bartlett has occurred, complete the surface dressing, removal of surplus material, and surface clean-up.

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- 3.14.3 The complete backfilling operation will not be paid for directly but all costs involved will be included in the price bid per linear foot of various size pipes complete and in place.
 - 3.14.3.1 When the City Engineer directs additional backfill material to be placed in the trench more than 12 inches from the top of the pipe, it shall be placed to the limits of his direction and brought to a condition of maximum compaction.
 - 3.14.3.2 The actual amount of backfill material so placed from 12 inches above the top of the pipe to the ground line or the depth directed for the length directed with the trench width based upon the maximum trench width at the top of the pipe will be paid for at the unit price per cubic yard of [Engineer directed backfill](#).
- 3.14.4 After the trenches have been properly backfilled, all excess material shall be removed from the streets and roadways and from improved private property so that pavements may be replaced and properties cleaned up.
 - 3.14.4.1 In open fields and unimproved property, the excess dirt shall be spread out or used to fill low spots on property adjacent to the right of way or easement.
 - 3.14.4.2 Such spreading or filling shall be done in such a manner that it will not obstruct surface drainage and is satisfactory to the property owner.
- 3.14.5 Refill and smooth off, as required, all backfill which settles so that all backfill conforms to the original ground surfaces.
 - 3.14.5.1 The contractor shall maintain frequent inspections of the backfill throughout the time of the project and the warranty period and repair any settlement as soon as it is discovered.
 - 3.14.5.2 Repair shall include the removal and replacement of all damaged asphalt or concrete and installation of sod or seeding and mulch.
- 3.14.6 For all pipes in tunneled or bored holes without casings, backfill only with sand. Thoroughly tamp or otherwise place the backfill in an approved manner to prevent caving and settlement.
- 3.14.7 Cleanup shall be performed as the work progresses.
 - 3.14.7.1 Negligence in proper cleaning up which causes undue inconvenience to citizens, presents an unsightly or dangerous condition, or causes embarrassment to civic officials shall be sufficient reason for rejection of construction estimates (pay request) or work shut down until the unsatisfactory conditions have been remedied.
 - 3.14.7.2 After all work is completed, make a final cleanup of all areas where work has been done and where equipment and materials have been stored and leave them in broom clean condition.
- 3.15 Railroad Crossings.** Before commencing work within the railroad right of way, obtain permission from the railroad company involved for each required crossing of the railroad tracks by sewer lines.

- 3.15.1 Do all work within the railroad right of way under the supervision of the railroad company involved and in strict accordance with their requirements.
 - 3.15.1.1 Do not place any excavated material, construction material, construction equipment or any other items on the tracks or any other location within the railroad traffic clearance limits.
 - 3.15.1.2 Arrange all work to conform to the railroad operating schedules and avoid all unnecessary interference therewith.
 - 3.15.1.3 As soon as practical, after installation of each sewer line across the railroad tracks, restore all railroad property at those locations to at least the conditions that existed prior to beginning work.
 - 3.15.1.4 The contractor shall be responsible for all charges from the railroad company for supervising sewer work on their property.
 - 3.15.2 All sewer pipes under the railroad tracks and to the limits indicated on the drawings or as required by the railroad company shall be ductile iron pipe meeting the requirements specified in these specifications.
 - 3.15.3 Where indicated on the drawings or as required by the railroad company, provide pipe casings around sewer lines which cross railroad tracks. Refer to section [3.18 Sanitary Sewer Boring and Encasement Requirements](#).
 - 3.15.3.1 Length of casings shall be as indicated on the drawings or as required by the railroad company.
 - 3.15.3.2 Bore holes under the railroad tracks and install the casings through these holes.
 - 3.15.4 When casings are not indicated on the drawings or required by the railroad company, install the sewer pipe under the railroad tracks by boring the smallest practical diameter hole and install the pipe through the hole by methods that will positively prevent damage to pipes and prevent separation or excessive deflection of pipe joints. Earthen checks as described in [section 3.14.1.3](#) will be required at both sides of the railroad crossing.
- 3.16 Highway Crossing.** Before commencing work within the highway right of way, obtain permission from the Tennessee Department of Transportation (TDOT) for each required crossing of the highway by sewer lines.
- 3.16.1 All work within the highway right of way shall be conducted under the supervision of the TDOT and in strict accordance with their requirements.
 - 3.16.1.1 Do not place any excavated material, construction material, construction equipment or any other items on the highway pavement or any other location within the highway traffic clearance limits.
 - 3.16.1.2 Arrange all work to avoid all unnecessary interference with highway traffic.
 - 3.16.1.3 As soon as practical, after installation of each sewer line across the highway, restore all highway property at those locations to at least the conditions that existed prior to beginning work.

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- 3.16.2 All sewer pipes under the highway and to the limits indicated on the drawings or as required by the TDOT shall be ductile iron pipe meeting the requirements specified in these specifications.
- 3.16.3 Where indicated on the drawings or as required by the TDOT, provide pipe casings around sewer lines which cross the highway. Refer to section [3.18 Sanitary Sewer Boring and Encasement Requirements](#).
 - 3.16.3.1 Length of casings shall be as indicated on the drawings or as required by the TDOT.
 - 3.16.3.2 Bore holes under the pavement and shoulders and install the casings through these holes. Open cut will only be permitted beyond the limits of the pavement and shoulders.
- 3.16.4 When casings are not indicated on the drawings or required by the TDOT, install the sewer pipe under the highway by boring the smallest practical diameter hole and install the pipe through the hole by methods that will positively prevent damage to pipes and prevent separation or excessive deflection of pipe joints. Earthen checks as described in [section 3.14.1.3](#) will be required at both sides of the highway crossing.

3.17 Location of Sewer in Streams.

- 3.17.1 **Cover.** The top of all sewers entering or crossing streams shall be of sufficient depth below the natural bottom of the stream to protect the sewer line.
 - 3.17.1.1 A minimum of one (1) foot of cover (poured in place concrete) is required where the sewer is located in rock.
 - 3.17.1.2 A minimum of three (3) feet of cover is required in stabilized stream beds.
 - 3.17.1.3 A minimum of seven (7) feet of cover is required in shifting stream beds.
- 3.17.2 **Material.** Sewers entering or crossing streams shall be constructed of ductile iron pipe with mechanical joints, concrete encased or otherwise constructed so as to remain watertight and free from change in alignment or grade.
- 3.17.3 **Sewers along Streambeds.** Sewers located along streambeds shall be located outside the streambed a sufficient distance to minimize disturbance or root damage to streamside trees and vegetation.
- 3.17.4 **Stream Obstruction.** Sewer outfalls, headwalls, manholes, gate boxes or other structures shall be located so they do not interfere with the free discharge or flow of the stream.
- 3.17.5 **Sewer Crossing Streams.** Sewers crossing streams shall be designed to cross the stream as nearly perpendicular to the stream flow as possible and free from change in grade.
 - 3.17.5.1 Concrete check dams shall be installed on both sides of the stream crossing in the pipe conduit trench to prevent a French drain effect.

3.17.5.2 Concrete check dams are to be separate from any required concrete encasement.

3.17.6 **Environmental Protection.** The contractor shall use construction methods that minimize siltation.

3.17.6.1 The consulting engineer shall specify the specific method or methods to be employed in the construction of the sewers in or near the stream to control siltation.

3.17.6.2 The contractor shall not unnecessarily disturb or uproot trees or vegetation along the stream bank or in the vicinity of the stream.

3.17.6.3 The contractor shall not dump soil or debris into streams or on the banks of streams.

3.17.6.4 The contractor shall not change the course of the stream without an Aquatic Resource Alteration Permit (ARAP).

3.17.6.5 The contractor shall not leave cofferdams in streams when no longer needed.

3.17.6.6 The contractor shall not leave temporary stream crossings in place when another entry is available or the stream crossing is no longer needed.

3.17.6.7 The contractor shall not operate equipment in the stream.

3.17.6.8 The contractor shall not pump or allow discharge of silt laden water into the stream.

3.17.6.9 The contractor shall make provisions to retard the rate of runoff from the construction site and control disposal of runoff including pump discharge resulting from dewatering operations.

3.17.6.10 The contractor shall make provisions to deposit all material and debris removed from the streambed out of the area of the stream flood plain.

3.17.7 **Construction Clean-up.** The stream crossing area shall be cleaned, graded, seeded, planted or restored as early as practical as the construction proceeds.

3.17.7.1 The stream shall be returned as nearly as possible to its original condition.

3.17.7.2 The stream banks shall be seeded, sodded, planted or otherwise stabilized to prevent erosion.

3.17.7.3 Where the tree canopy has been removed, replacement natural species trees shall be planted.

3.18 Sanitary Sewer Boring and Encasement Requirements. Pipes shall be installed in sewer bores when directed or when it is not practical to use open cut methods.

3.18.1 Sewer bores shall be made on the appropriate line and grade to accommodate the planned line and grade of the sewer.

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- 3.18.2 When no encasement is indicated on the drawings or required by others, bore holes shall be the smallest practical diameter. Install the pipe through the hole in such a manner as to prevent damage to the pipes and separation or excessive deflection of pipe joints. An earthen check as described in [section 3.14.1.3](#) shall be installed at both ends of the bore.
- 3.18.3 When encasement is required, the casings shall be one-quarter (¼) inch minimum wall thickness black steel pipe.
 - 3.18.3.1 The inside diameter of the casing shall be at least four (4) inches larger than the outside diameter of the sewer pipe bells.
 - 3.18.3.2 All casing joints shall be welded.
 - 3.18.3.3 Install pipes in casings by using casing spacers that will positively prevent separation of pipe joints and damage to pipes.
 - 3.18.3.4 If the casing is to be filled with grout or flowable fill, the spacers shall be such to preclude “floating” of the pipe.
 - 3.18.3.5 Casing spacers shall be approved by the City Engineer prior to use.
 - 3.18.3.6 The ends of casings shall be positively sealed against water or dirt intrusion using brick and mortar or other approved methods.

3.19 Force Mains.

3.19.1 General.

- 3.19.1.1 Force mains shall not be less than four (4) inches in diameter except for grinder pumps, septic tank effluent or vacuum applications.
- 3.19.1.2 At pumping capacity, a minimum self-scouring velocity of two (2) feet per second (fps) shall be maintained unless flushing facilities are provided. Maximum velocity shall not exceed eight (8) fps.
- 3.19.1.3 An air relief valve shall be placed at the necessary high points in the force main to relieve air locking.
- 3.19.1.4 Force mains shall be sufficiently anchored within the pump station and throughout the line length.
 - 3.19.1.4.1 The number of bends shall be as few as possible.
 - 3.19.1.4.2 Thrust blocks, restrained joints or tie rods shall be provided where restraint is needed.
- 3.19.1.5 Backflow preventers shall be installed as per the Design Criteria for Community Public Water Systems, Division of Water Supply. Below ground pit installation is not acceptable.
- 3.19.1.6 A trace wire shall be used for all force mains.
 - 3.19.1.6.1 Trace wire shall be #14 solid copper wire with a vinyl covering. Stranded wire is not acceptable.

- 3.19.1.6.2 Wire will be attached to the force main with electrical tape or nylon wire ties wrapped completely around the circumference of the force main with caution tape buried approximately one foot above the force main. Force mains greater than 4 feet deep shall comply with section [3.14.1.4](#).
- 3.19.1.6.3 The number of conductors shall be specified on the drawings.
- 3.19.1.6.4 Carsonite cathode-o-flex/trace-o-flex markers (or equivalent) with two (2) locating terminals shall be provided at a maximum of 500 foot spacing with the trace wire attached to the terminals.
- 3.19.1.6.5 Conductors shall terminate in a valve box installed in accordance with section [3.11.1.6.4](#).
- 3.19.1.7 The force main shall enter the receiving manhole with its centerline horizontal and with an invert elevation that will ensure a smooth flow transition to the gravity flow section and minimize turbulence at the point of discharge.
 - 3.19.1.7.1 The force main shall be designed to enter the gravity sewer system at a point no more than one (1) foot above the flow line of the receiving manhole.
 - 3.19.1.7.2 If the force main must enter a gravity system higher than one (1) foot above the invert, or enter a wet well higher than the lowest float elevation, a drop connection shall be made.
 - 3.19.1.7.2.1 The drop connection shall be made of the same material as the force main.
 - 3.19.1.7.2.2 A tee shall be installed on the force main where it enters the manhole or wet well with the outlet ends pointed up and down.
 - 3.19.1.7.2.3 A short length of pipe shall be added to the up side and capped to prevent splashing of sewage.
 - 3.19.1.7.2.4 The down side shall have a sufficient length of pipe to bring the discharge end of the pipe to within one foot of the invert in a gravity sewer manhole or below the lowest float elevation in a wet well.
 - 3.19.1.7.2.5 When installed in a gravity sewer manhole, the discharge end of the pipe shall have a 22° bend to point the discharge to the out flow of the manhole.
 - 3.19.1.7.2.6 The drop connection shall be attached to the manhole or wet well wall in such a manner as to preclude displacement. The material used for attachment shall be stainless steel straps and anchoring bolts resistant to the corrosive action of

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vapors or sewage installed at a maximum of four (4) foot spacing.

- 3.19.1.7.3 Manholes receiving force main discharges shall be given protective coatings to prevent deterioration as a result of hydrogen sulfide or other chemicals where such chemicals are present or suspected to be present because of industrial discharges or long force mains. See [Appendix B, Standard Specification for Lining of Sewer Manhole](#).

3.19.2 **Material.** The pipe material shall be adapted to local conditions such as character of industrial wastes, soil characteristics, exceptionally heavy external loading, internal erosion, corrosion, and similar problems.

3.19.2.1 All pipes shall be designed to prevent damage from superimposed loads. Proper allowance for loads on pipe shall be made because of the width and depth of the pipe trench.

3.19.2.2 When ductile iron pipe is specified, it will comply with the requirements set forth in section [3.2.2 Ductile Iron Pipe](#).

3.19.2.3 PVC pipe shall only be used where the maximum pressure shall not exceed two-thirds (2/3rds) of the pressure rating or 135 PSI. When PVC pipe is specified, the following shall apply.

3.19.2.3.1 PVC shall be manufactured from virgin, National Sanitation Foundation approved ASTM Type 1, Grade 1, impact improved resin suitable for use in transporting water.

3.19.2.3.2 Pipe and fittings shall be class 200 pipe, SDR21, schedule 40, schedule 80 or C-900 pressure rated for a minimum of 200 PSI.

3.19.2.3.3 Pipe joints shall be sealed with a rubber ring and non-toxic lubricant as provided by the manufacturer meeting or exceeding the requirements of ASTM D-3139 and ASTM F-477.

3.19.2.3.4 The pipe shall be clearly marked with the manufacturer's name, nominal diameter, SDR, pressure rating and NSF approval seal.

3.19.3 **Excavation, Bedding, Installation and Backfill.** Excavation, bedding, installation and backfill shall comply with the requirements previously specified herein.

3.19.4 **Testing.** Before backfilling, all force mains shall be hydrostatically tested.

3.19.4.1 Admit water slowly into the sections being tested and allow air to be expelled from the pipe.

3.19.4.2 After all air has been expelled, apply a pressure equal to 1.5 times the designed operating pressure and maintain it for not less than 30 minutes.

3.19.4.3 Leakage shall not exceed the amount given by the following formula:

$$L = \frac{ND(P).5}{7,400}$$

Where L is the allowable leakage in gallons per hour.

N is the number of pipe joints.

D is the pipe diameter in inches.

P is the test pressure in PSI.

3.20 Pavement Repair – City Streets and Roads. Immediately after installing each sewer line across a city street or road, restore that street or road (to include the right of way at that location) to at least the conditions which existed prior to the sewer work and to the satisfaction of the City of Bartlett. Refer to section [3.14. Backfill and Cleanup](#).

3.21 Trenching, Pipe Laying, Backfilling and Pavement Repairs – County Roads. Immediately after installing each sewer line across a county road, restore the road and its right of way at that location to at least the conditions which existed prior to the beginning of the sewer work and to the satisfaction of the County.

3.21.1 The county standard drawing **Typical Roadway Trench** shall be used for all phases of work within the county right of way.

3.21.2 For those phases of work not shown on the county standard drawing, comply with the applicable portions of these standards.

3.22 Cutting and Replacing Pavement and other Special Surfaces. Restore all surfaces disturbed by the sewer line installation to at least the conditions which existed prior to the beginning of the sewer work.

3.22.1 As each surface is being cut, the city inspector shall examine the existing surface with the contractor. The type of surface to be replaced shall be determined by mutual agreement of the inspector and contractor.

3.22.2 The maximum width of all pavement and other surface repairs allowable for payment by the city shall be the maximum trench width at the top of the pipe (as previously defined) plus 12 inches.

3.22.2.1 The contractor shall be responsible for all repairs outside this limit.

3.22.2.2 If the area to be repaired does not reach this limit, the city will pay only for the actual extent of the repairs.

3.22.3 Replace existing surfaces which are cut, removed, or otherwise damaged by the sewer work with new surfaces.

3.22.3.1 Existing gravel surfaces shall be replaced with a six (6) inch thick concrete cap.

3.22.3.2 Existing city and county streets and roads shall be repaired as specified in the applicable sections above.

3.22.3.3 Unless otherwise approved, concrete surfaces shall not be cut but shall have pipe installed by tunneling or boring. If cut, replace them with:

3.22.3.3.1 A six (6) inch thick compacted base of new gravel.

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3.22.3.3.2 A surface course of 4000 PSI concrete equal in thickness to that adjoining the concrete surface course.

3.22.3.3.3 Type of concrete used will match the existing concrete, i.e., washed stone, pea gravel, limestone, etc.

3.22.4 Where pipe is installed on the shoulders parallel to asphalt, concrete or other surfaces, maintain ditches until they are firm and present no traffic hazard. Where authorized, place six (6) inch thick compacted layers of new road gravel.

3.22.5 Do not cut streets or other surfaces except where necessary for sewer installation.

3.22.5.1 Damage outside of the limits specified above shall be repaired at the contractor's expense and to the satisfaction of the City Engineer.

3.22.5.2 All crossings shall be maintained by the contractor until project completion and the end of the warranty period.

3.23 Adjustment of Utilities. Field adjustments to any utility lines or apertures such as valves, fire hydrants, meter boxes, etc. shall be accomplished by the contractor and the cost of such adjustments will be considered as incidental to the project costs. When adjustment rings are required for water valve roadway boxes, they shall be SIGMA 2600 series risers (or an approved equivalent) of the appropriate thickness to adjust the valve box top to grade. When adjustment rings are required for drain or sewer manholes, they shall be SIGMA MH-2710 or MH-2715 (or an approved equivalent) to adjust the manhole top to grade.

3.24 Sewer Testing. All installed sewers shall be tested prior to being put in use or final acceptance by the City of Bartlett. All acceptance tests shall be conducted in the presence of a city municipal construction inspector. For force main testing, see section [3.19 Force Mains](#).

3.24.1 **Deflection Testing.** Deflection testing shall be performed for all semi-rigid and flexible pipe used.

3.24.1.1 The test shall be conducted after the backfill has been in place for at least 24 hours.

3.24.1.2 No pipe shall exceed a deflection of 5%.

3.24.1.3 The test shall use an engineer-approved 9-arm mandrel supplied by the pipe manufacturer or the contractor having a diameter equal to 95% of the inside diameter of the pipe.

3.24.1.4 The mandrel shall be manually pulled through the sewer line.

3.24.1.5 If the mandrel cannot be pulled through the line without the use of excessive force, the test is failed and the contractor shall perform whatever work is required to prepare the sewer line for re-testing at no additional cost to the City of Bartlett.

3.24.2 **Air Testing.** An initial portion of each of the various sizes and types of sewer pipe shall be tested immediately after installation to serve as a basis of judging the quality of workmanship. Subsequent testing is to be performed anytime after

the initial testing and prior to putting the sewer line in use. Sewer lines shall be clean and free of mud and other debris prior to testing.

3.24.2.1 Initial testing shall be conducted as soon as the first section of sewer (no more than 1,000 feet) is completed.

3.24.2.1.1 A length of pipe not less than 300 feet in length shall be laid and tested prior to backfilling.

3.24.2.1.2 One end shall be plugged and the other end shall terminate at a wye or manhole.

3.24.2.1.3 The section shall be tested in accordance with the applicable procedures outlined in section 3.24.2.2.

3.24.2.1.4 Any leaks shall be repaired and the method of laying pipe reviewed.

3.24.2.1.5 The construction methods required to achieve a successful test shall be maintained throughout the job.

3.24.2.1.6 If such testing is not accomplished within a reasonable time after construction start or the test results are unsatisfactory, the consulting engineer or City Engineer may order all other operations stopped until the matter is resolved.

3.24.2.1.7 The contractor shall immediately perform test as directed by the consulting engineer or City Engineer and assume responsibility for all cost.

3.24.2.2 Subsequent testing shall be conducted in accordance with the methods for low pressure air testing as specified in ASTM-C828.

3.24.2.2.1 The sewer line to be tested shall be tested between manholes.

3.24.2.2.2 The line shall be sealed at both ends with one end having an orifice through which to pass air into the pipe.

3.24.2.2.3 An air supply line shall be connected to the orifice and contain an on/off gas valve and a pressure gauge having a range of 0 to 5 PSI, with minimum divisions of .10 PSI and an accuracy of .04 PSI.

3.24.2.2.4 The pipe line shall be pressurized to 4 PSIG and allowed to stabilize between 3.5 and 4 PSIG for a period of no more than five (5) minutes.

3.24.2.2.5 If necessary, air should be added to the line to maintain the pressure above 3.5 PSIG.

3.24.2.2.6 After the stabilization period, the gas valve shall remain closed.

3.24.2.2.7 When the line pressure drops to 3.5 PSIG, commence timing with a stop watch.

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3.24.2.2.8 When the line pressure drops to 2.5 PSIG, the timing will stop and the elapsed time compared to the allowable time in [Table 6, Minimum Test Times and Allowable Air Loss](#).

3.24.2.2.9 If the time elapsed is greater than the time specified, the section undergoing testing shall have passed.

3.24.2.2.10 If the time elapsed is less than the time specified, the section under test has failed and the contractor shall perform whatever work is required to prepare that section for re-testing at no additional cost to the City of Bartlett.

Pipe Size (inches)	Time (seconds per 100 feet)	Allowable Air Loss (ft. ³ /minute)
6	42	2.0
8	72	2.0
10	90	2.5
12	108	3.0
15	126	4.0
18	144	5.0
21	180	5.5
24	216	6.0
27	252	6.5
30	288	7.0
NOTE: If the pipeline to be tested is beneath the ground water level, the test pressure shall be increased .433 PSI for each foot the ground water is above the invert of the pipe.		
<i>Table 6, Minimum Test Times and Allowable Air Loss</i>		

3.24.3 **Vacuum Testing.** All sewer manholes shall be vacuum tested as specified in *ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test*. Prior to delivery to the construction site, each manhole section is required to have the exterior painted and a vacuum applied to seal the pores of the concrete. Poured in place sewer manholes shall be painted and vacuum tested prior to backfill.

3.24.3.1 No standing water shall be allowed in the manhole excavation which may affect the accuracy of the test.

3.24.3.2 Methods shall be used to prevent the displacement of plugs while the vacuum is being pulled.

3.24.3.3 Installation and use of test equipment shall be in accordance with the specifications and instructions provided by the manufacturer.

3.24.3.4 The vacuum shall be pulled until ten (10) inches of mercury (Hg) is achieved.

3.24.3.5 The isolation valve shall be closed, the vacuum pump turned off and the time elapsed for the inches of mercury to drop one (1) inch shall be recorded.

3.24.3.6 If the time elapsed is greater than the times listed in [Table 7, Minimum Test Times for Sewer Manholes](#), the test is passed.

- 3.24.3.7 If the time elapsed is less than the times listed, the test is failed and the contractor shall perform whatever work is required to prepare the manhole for re-testing at no additional cost to the City of Bartlett.

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

Table 7, Minimum Test Times for Sewer Manholes

- 3.24.4 **Lamp Test (shining the lines) to test for line and grade.** The sewer lines shall be lamped to ensure an uninterrupted light from one manhole to another. If light is not visible or the true character and shape of the interior surface of the sewer is not circular, the contractor shall perform whatever work is required to prepare the sewer line for re-testing. Any section of pipe not in alignment or shows sign of settlement shall be removed and re-laid at no additional cost to the City of Bartlett.
- 3.24.5 **Infiltration Testing.** Infiltration testing shall be conducted when all other tests have passed and there is evidence of flowing water without the sewer lines being connected to a water source or when directed by the City Engineer.
- 3.24.5.1 Infiltration shall not exceed 25 gallons per inch of pipe diameter per mile per day of any section of pipe.
- 3.24.5.2 Infiltration shall be measured using a calibrated V-notch weir installed by the contractor.
- 3.24.5.3 The test shall be conducted over a period of time sufficient to determine the correct rate of ground water infiltration.
- 3.24.5.4 Where infiltration exceeds the amount specified above, the contractor shall locate and repair or replace the defective pipe sections.
- 3.24.5.5 When the defective portions cannot be located, remove and reconstruct as much of the original work as required to obtain allowable infiltration limits upon re-testing.

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3.24.5.6 Cost of all said repairs, replacements, reconstruction and re-testing shall be the responsibility of the contractor and shall not be reimbursed by the City of Bartlett.

3.24.6 **Exfiltration Testing of Wet Wells.** Wet wells that cannot be tested using the vacuum method of testing shall be tested using the exfiltration method. This test shall be delayed when the temperature is 33°F or less.

3.24.6.1 All incoming and outgoing lines shall be plugged and the wet well filled to the rim with clean water.

3.24.6.2 The initial water level shall be recorded.

3.24.6.3 The water level shall be checked after two (2) hours. No water is to be added during this time.

3.24.6.4 A deviation of more than 0.002 feet per vertical foot of wet well depth from the initial reading shall indicate a failed test and the contractor shall perform whatever work is required to prepare the wet well for re-testing.

3.25 Measurement and Payment. Payments shall be made to the nearest complete unit as listed in the proposal. Quantities submitted for payment shall be rounded to the nearest foot, yard, or other applicable unit.

3.25.1 **Classification of Cut.** Cut shall be classified on the basis of the average depth of cuts to sewer invert between 50 foot stations, measured between manholes, beginning at the manhole with lower invert elevation. The remaining distance between the last station and the center of the end manhole or the end of the sewer line shall be averaged separately. Cuts shall be classified as 0' to 6', 6' to 8', 8' to 10', 10' to 12', etc.

3.25.2 **Sewer pipe in open cut.** Paid for at the unit price per linear foot for the size, type and classification of cut of sewer pipe laid in trenches or excavations, measured as the horizontal distance between centers of manholes through wyes and fittings. No allowance shall be made for increased length due to slope.

3.25.3 **Sewer pipe in bore (no casing required).** Paid for at the unit price per linear foot of sewer pipe of the size and type indicated in place within bored, jacked or tunneled holes more than five (5) feet long without pipe casing, measured along the top centerline of the pipe for the full length of the bored, jacked or tunneled hole. The bore shall not be paid for separately but shall be included in the cost of the pipe. No payment will be made for any pipe in excess of the lengths indicated on the drawings or actually required. Pipe in bored, jacked or tunneled holes that are five (5) feet or fewer in length shall be classified and paid for as **Sewer pipe in open cut.**

3.25.4 **Sewer pipe in bore with casing.** Paid for at the unit price per linear foot of sewer pipe of the size and type indicated in place in pipe casing, measured along the top centerline of the pipe for the full length of the casing. The bore and casing shall not be paid for separately but shall be included in the cost of the pipe. Spacers, casing end seals and, when specified in the drawings or directed by the City Engineer, grout or flowable fill shall be considered incidental to the work. No payment will be made for any pipe in excess of the lengths indicated on the drawings or actually required.

- 3.25.5 **Wyes.** When installed with new sewer main, shall not be paid for separately but shall be considered incidental to the work. When installed in existing sewer, shall be paid for at the unit price per wye in place, including excavation, cutting into existing pipe and all necessary fittings, caps and stoppers and backfill.
- 3.25.6 **Service pipe in open cut.** Paid for at the unit price per linear foot of service pipe of the type indicated in place in open cut trenches or excavations, including all fittings and necessary plugs or caps. Measured along the service pipe from sewer main centerline to service end. Vertical sections and associated fittings and locater pipes shall not be paid for separately but shall be included in the cost of the pipe.
- 3.25.7 **Service in bore (no casing required).** Paid for and measured in accordance with the provisions of section **3.25.3 Sewer pipe in bore (no casing required).** Vertical sections and associated fittings and locater pipes shall not be paid for separately but shall be included in the cost of the pipe. Pipe in bored, jacked or tunneled holes that are five (5) feet or fewer in length shall be classified and paid for as **Service pipe in open cut.**
- 3.25.8 **Service in bore with casing.** Paid for and measured in accordance with the provisions of section **3.25.4 Sewer pipe in bore with casing.** The bore and casing shall not be paid for separately but shall be included in the cost of the pipe. Spacers, casing end seals and, when specified in the drawings or directed by the City Engineer, grout or flowable fill shall be considered incidental to the work. No payment will be made for any pipe in excess of the lengths indicated on the drawings or actually required. Vertical sections and associated fittings and locater pipes shall not be paid for separately but shall be included in the cost of the pipe.
- 3.25.9 **Standard manholes.** Paid for at the unit price per complete standard manhole in place, four (4) or five (5) foot diameter as applicable. A standard manhole is six (6) feet or fewer in depth from the top of the rim (top elevation) to the sewer invert (invert out elevation), including steps, rim and cover.
- 3.25.10 **Extra depth manholes.** Paid at the unit price per vertical foot for extra depth standard manhole in place, four (4) or five (5) foot diameter as applicable. Measurement shall be to the nearest .1 (1/10) foot from the top of the rim (top elevation) to the sewer invert (invert out elevation) minus six (6) feet paid as **Standard manhole.**
- 3.25.11 **Manhole drop connection.** Paid for at the unit price per vertical foot. Measurement shall be to the nearest .1 (1/10) foot from the high entering sewer invert to the low leaving sewer invert. Includes all necessary fittings and hardware required for securing to sewer manhole wall. When outside drop connections are used, this item includes cost of forms and concrete encasement.
- 3.25.12 **Connections to existing manholes and wet wells.** Paid for at the unit price for each complete connection made to existing sewer manholes. Includes all necessary fittings, hardware and drilling. This item is not paid when connecting to an existing stub.
- 3.25.13 **Drain rock, granular embedment material and granular backfill material.** This item is not normally paid as a separate item but is included in the various unit bid prices of the items involved. When listed separately on the bid tabulation sheet, paid for at the unit price per ton of loose material in place, as evidenced by delivery tickets signed by the city representative. Tickets must be delivered at

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time of pay request. No payment will be made for drain rock used for unsatisfactory subgrade unless the use was approved by the City Engineer, in which case, the cost of extra depth excavation below planned grade and compaction shall be included in the unit price bid for drain rock.

3.25.14 Encasement and foundation concrete. Paid for at the unit price per cubic yard in place. Measurement shall be actual amount used to the limits and dimensions specified on the drawings or as directed by the City Engineer. No payment shall be made for material in excess of the dimensions specified. Copies of the delivery tickets signed by the city representative are to be included with the pay request. The cost of forms and extra excavation below the planned grade shall be included in the unit price bid for encasement and foundation concrete.

3.25.15 Sheathing left in place. Paid for at the unit price per thousand board feet when authorized in writing. Measurement shall be to the nearest 100 board feet.

3.25.16 Road gravel in place. Paid for at the unit price per cubic yard of compacted road gravel in place. Measurement shall be the actual surface area covered with a compacted layer to the indicated, specified or otherwise authorized thickness. Includes base courses under pavement and special surface repairs. No payment shall be made for any road gravel placed without the City of Bartlett authorization or placed outside of the specified payment limits. Copies of the delivery tickets signed by the city representative are to be included with the pay request.

3.25.17 Replacement of pavement and special surfaces. Paid for at the unit price per square yard in place. Measurement shall be the actual areas repaired. No payment will be made outside the specified payment limits. Does not include gravel base courses which shall be paid separately as noted above.

3.25.18 Extra depth excavation. When extra depth excavation is required and approved by the City Engineer for unsatisfactory subgrade, the cost for the extra depth excavation shall not be paid for separately but shall be included in the unit bid price for the material used to replace the unsatisfactory subgrade. No payment shall be made for extra depth excavation that may be required to permit piping to pass under obstructions regardless to whether the obstructions are indicated on the drawings or not.

3.25.19 Gaskets, bolts, nuts, mechanical joint glands, couplings, compounds, lubricants, cements, joint material, iron fittings, trenching, excavating, boring, tunneling, backfilling, jacking, removal of existing pavement, testing, removal and replacement of sod and fences, roadway boxes, caution tape and other miscellaneous items. No separate payment shall be made unless specifically indicated. These items are incidental to the work and the cost shall be included in the various unit prices for pipe and other related items.

3.25.20 Engineer directed backfill. Paid for at the unit bid price per cubic yard of the type specified in place. Measurement shall be from 12 inches above top of pipe to the ground line or to the depth directed and for the length directed and for the width based upon the maximum trench width for the size of pipe involved at the top of pipe or the width otherwise directed. Copies of the delivery tickets signed by the city representative are to be included with the pay request.

4.1 General Design Information.

- 4.1.1 **Surveying.** Before installing any storm sewers calculate all proposed storm sewer grades.

4.1.1.1 Start all levels from established bench marks and tie in the close of the run to the point of beginning and to the inverts of all existing storm sewers to which the new storm sewer connects.

4.1.1.2 All pipe laying errors caused by failure to run levels properly shall be corrected by taking up and relaying pipe.

- 4.1.2 **Slope.** All storm sewers shall be designed and constructed to give mean velocities, when flowing full, of not more than 10 feet per second.

4.1.2.1 The minimum design slopes for 24 inch or smaller storm sewer pipe shall be one half (.5) percent.

4.1.2.2 When velocities greater than 10 feet per second or slopes greater than 20 percent are attained, special provisions shall be made to protect against displacement by erosion and shock.

4.1.2.3 Slope through detention basins shall be a minimum of one half (.5) percent when a concrete swale is used and a minimum of one (1) percent in all directions when no concrete swale is used.

- 4.1.3 **Pipe size.** The size of the storm sewer pipe shall be such that the pipe capacity is at the 25 year design flow SCS. Refer to [Appendix H, Pipe Sizing Chart](#). The minimum size pipe for driveway culverts shall be 15 inches unless otherwise indicated on the drawings or directed by the City Engineer.

- 4.1.4 **Superimposed Loads.** All storm sewers shall be designed to prevent damage from superimposed loads.

4.1.4.1 Proper allowance for loads on the storm sewer shall be made because of trench width and depth.

4.1.4.2 Trench widths shall be kept to a minimum.

4.1.4.3 Backfill material up to three (3) feet above the top of pipe shall not exceed six (6) inches in diameter at its greatest dimension.

- 4.1.5 **Pipe Cover.** Storm sewers shall have a minimum cover of one (1) foot except where this is prevented by job conditions. In this situation, cover shall be as much as possible under the conditions involved.

- 4.1.6 **As-Built Drainage Plans.** At the completion of construction, as-built drainage plans are required to be provided to the Department of Engineering. As-built plans will include, as a minimum, the following information, and other information as may be requested by the City Engineer:

4.1.6.1 Structure locations (including headwalls) to include top elevations, flow line elevations and throat elevations.

4.1.6.2 Size, length and slope of pipes, swales or other constructed drainage conveyances.

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- 4.1.6.3 Detention/retention analysis for detention or retention basins based upon the as-built conditions

4.2 **Types of Pipe.** Unless otherwise shown on the drawings or approved by the City Engineer, all storm drainage pipe shall be reinforced concrete pipe (RCP) conforming to ASTM C76 and ASTM C507.

- 4.2.1 Before delivery to the project, all RCP shall be inspected and tested for specification compliance by an independent testing laboratory acceptable to the City of Bartlett.
- 4.2.2 Each approved length of RCP shall be marked with the laboratory's inspection stamp.
- 4.2.3 Before laying any RCP, submit the certification reports to the City of Bartlett for approval.
- 4.2.4 All pipe and fittings shall be subject to inspection by the City of Bartlett at the trench.
- 4.2.5 No RCP shall be laid which does not bear the laboratory inspection stamp or for which certifications have not been received and approved by the City of Bartlett or are rejected by the City of Bartlett at the trench. All such RCP shall be removed from the project.
- 4.2.6 Cost of inspections and certifications by the laboratory shall be borne by the contractor.

4.3 **Joints.** All joints for RCP shall be rubber gasket joints conforming to ASTM C443.

- 4.3.1 Gaskets shall be continuous rubber rings fitting snugly into the annular space between the parallel surfaces of the tongue and groove ends of the RCP to form a flexible and watertight seal under all conditions of service.
- 4.3.2 Install rubber gasket joints using the manufacturer's recommended procedures.
- 4.3.3 All joints shall be inspected both inside and out for gasket faulting or displacement once installed.

4.4 **Concrete Foundations, Granular Drain, Pipe Embedment and Backfill Material.**

- 4.4.1 **Concrete Foundations.** Concrete foundations for pipe support shall consist of 4,000 psi minimum limestone concrete, poured the full width of the trench bottom, extending to a depth of not less than one-quarter ($\frac{1}{4}$) of the pipe diameter below the outside bottom of the pipe and no less than one-quarter ($\frac{1}{4}$) of the pipe diameter above the outside bottom of the pipe or to the dimensions directed by the City Engineer.
- 4.4.2 **Granular Drain.** Granular drain rock material for trench drainage and pipe support shall be washed gravel, washed crushed rock or washed crushed stone evenly graded from one-half ($\frac{1}{2}$) inch to two (2) inches in size, installed to the dimensions shown on the drawings or specified by the City Engineer.
- 4.4.3 **Pipe Embedment.** Unless otherwise indicated on the drawings, elsewhere in these specifications or directed by the City Engineer, the storm sewer pipe may be laid directly on the excavated trench bottom with holes excavated in the

bottom to facilitate the bell of pipes. When the use of granular embedment is directed, it shall be crushed rock, crushed stone or washed gravel with 100% passing a one-half (1/2) inch screen and 95% retained on a No. 4 sieve, installed to the dimensions specified by the City Engineer.

- 4.4.4 **Backfill Material.** Granular material for backfill to one half (1/2) of the pipe outside diameter (spring line) shall be clean, natural, unwashed gravel, sand or crushed stone with 100% passing a one (1) inch screen and 100% retained in a No. 60 sieve. Unless otherwise indicated on the drawings, elsewhere in these specifications or directed by the City Engineer, suitable excavated trench material may be used to backfill the remainder of the trench.

4.5 Concrete. Concrete shall be 4000 psi ready mix type limestone conforming to ASTM Specification C94 and composed of Portland cement, sand and washed aggregate all conforming to applicable ASTM specifications.

- 4.5.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali, inorganic matter and supplied by an approved ready mix plant.
- 4.5.2 The design shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.
- 4.5.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

4.6 Trenching. All trenches shall be open cut unless shown otherwise on the drawings or set out elsewhere in these specifications.

- 4.6.1 Excavate trenches to the indicated lines and locations to provide uniform and continuous bearing and support of each pipe barrel on firm, undisturbed earth at every point between bell holes.
- 4.6.2 The trenches shall follow lines parallel to and equal distant from the pipe centerline.
- 4.6.3 For pipe up to and including 18" diameter, the width of the trenches at the top of the pipe shall be such as to leave not less than six (6) inches on each side of the outside of the pipe.
- 4.6.4 For pipe larger than 18" diameter, the width of the trenches at the top of the pipe shall be such as to leave not less than 12" on each side of the outside of the pipe.
- 4.6.5 Any required shoring, sheathing and bracing shall be installed inside the maximum trench widths.
- 4.6.6 For pipe laid in tunnels, special instructions will be issued or drawings provided in the project drawings.
- 4.6.7 Where storm sewers are laid along or across streets or roadways or adjacent to houses or buildings, the sides of the trenches shall be vertical and protected against caving with suitable bracing and sheathing. See section [4.9 Shoring, Sheathing and Bracing](#). Before cutting any city or county road, obtain permission for each cut from the respective engineer's office.

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- 4.6.8 Where storm sewers are laid through fields and undeveloped territory, the sides of the trenches may be sloped to prevent caving provided that the width of the trench at the top of the pipe must not exceed the dimensions stated above.
- 4.6.9 No more than 200 feet of trench shall be opened at any time in advance of the completed storm sewer nor shall more than 100 feet be left unfilled except by written permission from the City Engineer. The City Engineer may limit these distances by notifying the contractor in writing.
- 4.6.10 Where a water pipe, gas pipe, sanitary sewer pipe or similar structure comes within the limits of the trench, such structures shall be supported properly. The City Engineer may direct the manner in which such structures shall be supported.
- 4.6.11 The contractor shall leave a path of at least two (2) feet in width on each side of the trench, between the trench and excavated material, to allow for free passage of the engineer or inspector to permit them to perform their work in an expeditious and satisfactory manner.
- 4.6.12 The contractor shall at all times be responsible for the condition of the trenches.
 - 4.6.12.1 The contractor shall maintain frequent inspections of the trenches and repair settled or sunken places as soon as they are discovered.
 - 4.6.12.2 All soft or dangerous trenches shall be marked or barricaded and lighted at night for protection of the public.
- 4.6.13 The contractor shall maintain a top grade line for 200 feet ahead of his machine and 50 feet in the rear so the cutting may be checked at any time and any error in grade corrected.
- 4.6.14 If the contractor carelessly or otherwise digs the trench below the required grade, he will, at his expense, refill the trench to the proper grade with sand or gravel in compacted lifts not exceeding six (6) inches.
- 4.6.15 Construction of manholes and inlets, removal of excess excavated material, building of access bridges and general clean-up operations will be kept close behind the laying of the storm sewer. The City Engineer may direct that the laying of the storm sewer cease until these auxiliary operations are caught up.
- 4.7 Unsatisfactory Subgrade.** Where indicated and/or where the subgrade material will not provide a sufficiently firm foundation to support the pipes and superimposed loads or contains ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material that in the City's opinion should be removed, remove the unsatisfactory material down to the depth indicated or required. See section [4.10 Pipe Embedment](#).
 - 4.7.1 Replace the unsatisfactory material with the specified drain rock, granular pipe embedment or granular backfill material.
 - 4.7.2 The City Engineer may direct the use of a concrete foundation for replacement material when in his opinion a rigid subgrade is necessary. See section [4.4 Concrete Saddles, Granular Drain, Pipe Embedment and Backfill Material](#).

- 4.7.3 No material shall be used until approved by the City Engineer. Material used prior to obtaining approval or measurement by the city representative shall not be paid for.
- 4.8 Maintaining Drainage.** Provide and maintain in proper working order all necessary de-watering equipment for the removal of water from the excavation. Where the trench bottom is mucky or otherwise unstable because of ground water and in all cases where the static ground water elevation is above the bottom of the trench, lower the ground water level by using drain rock or other acceptable methods as required to keep the trench free from water and the bottoms stable for pipe laying until the pipes have been installed properly and will be unaffected by submersion.
- 4.9 Shoring, Sheathing and Bracing.** Adequately shore and brace trenches and other excavations as required to protect personnel, adjacent structures and adjacent property.
- 4.9.1 Where required by conditions encountered or as required by OSHA, brace trenches and excavations with suitable close sheeting or sheet piling.
- 4.9.2 Do all necessary cribbing up required for proper operation of trenching equipment.
- 4.9.3 Repair all damage resulting from inadequate or improper shoring, sheathing and bracing.
- 4.9.4 Sheathing or shoring that does not extend below the RCP centerline may be removed after the trench backfill has been placed and compacted to a level one (1) foot above the top of the pipe.
- 4.9.4.1 Immediately after removal, fill all resulting void spaces and re-compact the backfill.
- 4.9.4.2 Sheathing may be left in place only where specifically approved.
- 4.9.4.3 Cut the tops of sheathing left in place at an approved depth below finished grade.
- 4.10 Pipe Embedment.**
- 4.10.1 Normal embedment uses the natural trench bottom as embedment and shall be used throughout the laying of the RCP except where the trench bottom is found to be unstable or otherwise unsuitable or unless otherwise shown in the drawings or directed by the City Engineer.
- 4.10.1.1 Hand excavate holes in the trench bottom to a depth sufficient to allow the bell of the RCP to not bear directly on the trench bottom.
- 4.10.1.2 Shape bell holes to facilitate joining of RCP and prevent ends from bearing on trench bottom.
- 4.10.1.3 Excavate a groove to fit the lower quadrant of the RCP barrel to provide a uniform and continuous bearing surface on the trench bottom at every point between bell holes.
- 4.10.2 Earthen checks constructed from suitable material excavated from the trench shall be installed at the midpoint between drain manholes and where drainage terminates at a headwall. Checks shall be at least five (5) feet long and no more

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than eight (8) feet long and extend the depth of the trench to include the embedment, all compacted to a minimum of 98% STD of maximum density by laboratory standard proctor test (ASTM D 698). See section [4.15 Backfill and Cleanup](#) for additional information.

- 4.10.3 Modified normal embedment shall be used whenever the natural trench bottom is found to be unstable or otherwise unsuitable for normal embedment or when shown in the drawings or directed by the City Engineer. See section [4.7 Unsatisfactory Subgrade](#).

- 4.10.3.1 Excavate trench to the depth specified or directed.
- 4.10.3.2 Spread the specified material across the full trench width using hand tools and thoroughly compact it.
- 4.10.3.3 Hand excavate holes in embedment material to a depth sufficient to allow the bell of the RCP to not bear directly on the embedment material.
- 4.10.3.4 Shape bell holes to facilitate joining of the RCP and prevent ends from bearing on trench bottom.
- 4.10.3.5 Once the RCP is in place, backfill to at least the RCP spring line with the same embedment material.

4.11 Laying Storm Sewer Pipe

4.11.1 General Requirements.

- 4.11.1.1 Provide and use suitable equipment for safe and convenient handling of pipe and piping material.
- 4.11.1.2 Provide suitable facilities and equipment for lowering the pipe into the trench without causing damage to the pipe or trench.
- 4.11.1.3 Do not drop or dump piping material from transportation vehicles or into trenches.
- 4.11.1.4 Inspect each pipe for cracks and other defects prior to installation. Remove all defective material from the job site.
- 4.11.1.5 Spigots ends, the inside of bells, gaskets grooves and gaskets must be clean and free of any foreign matter before installation and prior to joining pipe.
- 4.11.1.6 Lay pipe so that after installation, the interior bottom surface of the storm sewer will conform to the lines and grades as indicated on the project plans or drawings.
- 4.11.1.7 Provide lasers and other necessary equipment to ensure the pipe is installed to the proper line and grade.
- 4.11.1.8 Do not install any work until excavations are free of water, mud, and loose earth.
- 4.11.1.9 Do not install any work on frozen ground.

4.11.2 Pipe Installation.

- 4.11.2.1 Lay pipe in finished trenches starting at the lowest point and proceeding upgrade without breaks from structure to structure.
- 4.11.2.2 The bell, groove or collar end of the pipe shall be upgrade.
- 4.11.2.3 Lay all pipe on stable foundations utilizing the bedding method specified or required to accommodate the conditions encountered.
- 4.11.2.4 Provide uniform full length support of the pipe barrel at every point between bell holes.
- 4.11.2.5 Provide suitable indents in the bedding to facilitate joining and prevent bells or groove ends from bearing on the trench bottom.
- 4.11.2.6 Comply with the pipe manufacturer's installation requirements.
- 4.11.2.7 Plug lift holes with mortar.
- 4.11.2.8 Maintain the trenches water-free and as dry as practicable during bedding, laying and joining and until the work will not be adversely affected by submergence.

4.11.3 Joining Pipe.

- 4.11.3.1 All mating surfaces of each joint and all joint material shall be clean and dry.
- 4.11.3.2 Make all joints in strict accordance with the pipe and gasket manufacturer's printed directions, using the recommended lubricants, tools, jointing methods and laying methods.
- 4.11.3.3 Radius, arch and elliptical pipe shall have the joints sealed with mortar in addition to the use of gasket material.
 - 4.11.3.3.1 The inside joints shall be sealed across the bottom of the pipe from spring line to spring line.
 - 4.11.3.3.2 The outside joints shall be sealed across the top of the pipe from spring line to spring line.
- 4.11.3.4 As soon as possible after jointing, place sufficient backfill along each side of the pipe to prevent movement of the pipe.

4.11.4 Protection of Pipe.

- 4.11.4.1 Keep all dirt, trash and other foreign materials cleared from the inside of the pipes as it is being laid.
- 4.11.4.2 When pipe installation is not in progress, open pipe ends will be kept securely closed to prevent the entrance of water, mud or other foreign matter into the pipe.

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- 4.11.4.3 Secure pipe to prevent displacement by movement of backfill, flotation or other causes.

4.12 Manholes

- 4.12.1 **General.** Manholes shall be either concrete brick or pre-cast concrete type constructed neatly, accurately and complete as the work progresses and when pipe laying reaches the manhole location.

- 4.12.1.1 Unless otherwise shown on the drawings or directed by the City Engineer, all manholes shall have either of a 48 inch or 60 inch inside diameter.

- 4.12.1.2 Manholes shall be installed:

- 4.12.1.2.1 At all changes of grade unless an inlet or other structure is provided and approved for use.

- 4.12.1.2.2 At all changes in pipe size unless an inlet or other structure is provided and approved for use.

- 4.12.1.2.3 At all changes in pipe alignment unless radius pipe, an inlet or other structure is provided and approved for use.

- 4.12.1.2.4 At all intersections of pipe unless an inlet or other structure is provided and approved for use.

- 4.12.1.3 Manhole steps shall be Memphis, Tennessee standard, cast iron type or an approved equivalent.

- 4.12.1.3.1 Steps shall be set on 16 inch vertical centers.

- 4.12.1.3.2 The lowest step shall be no higher than 16 inches above the invert.

- 4.12.1.3.3 The highest step shall be no more than 12 inches below the top with one back step at the same elevation.

- 4.12.1.4 Rims and covers shall be Memphis, Tennessee Standard No. 7 cast iron type, with the tops marked "DRAIN".

- 4.12.1.5 Set manhole tops as follows except where otherwise indicated in the drawings or directed by the City Engineer:

- 4.12.1.5.1 In streets, roads, highways and other paved areas, set flush with the base pavement grade.

- 4.12.1.5.2 In undeveloped areas such as fields, woods, etc., set 18 inches above ground.

- 4.12.1.5.3 In yards, set flush with grade.

- 4.12.1.5.4 In all other areas, set 12 inches above grade.

- 4.12.1.5.5 Protect and maintain each manhole to grade until it is accepted by the City of Bartlett.

- 4.12.1.6 Remove all debris which falls into manholes during construction and prior to final acceptance by the City of Bartlett.
- 4.12.2 **Excavation.** Excavate to the dimensions, shapes and elevations indicated on the drawings.
 - 4.12.2.1 Excavation for the manhole base shall be plumb, level, firm and clean.
 - 4.12.2.2 Excavation for the manhole base shall be free of loose earth, loose rock, vegetation, mud, water, frozen earth or any other unsatisfactory materials immediately before concrete placement or pre-cast concrete placement.
 - 4.12.2.3 The outside dimension of the excavation shall be at least 12" greater than the manhole outside diameter to facilitate manhole construction and backfilling around the structure.
 - 4.12.2.4 If the contractor carelessly or otherwise excavates below the required grade or the subgrade becomes spoiled in any way, he will, at his expense, refill the excavation to the proper grade with sand or gravel tamped in place.
- 4.12.3 **Brick Manholes.** When used, shall be built to the depths indicated on the plans or as directed by the City Engineer.
 - 4.12.3.1 Unless otherwise shown on the drawings or directed otherwise, a circular, concrete foundation pad no less than eight (8) inches thick at its minimum thickness (bottom of invert) and extending a minimum of six (6) inches beyond the outside diameter of the manhole shall be used.
 - 4.12.3.2 The foundation pad shall be poured at an elevation to ensure flow line elevations match the required elevations shown on the drawings or as directed by the City Engineer.
 - 4.12.3.3 Walls shall be nine (9) inches thick and brought up vertically, corbelled inward the top three (3) feet to fit the rim and cover.
 - 4.12.3.4 Brick, mortar and concrete shall be as specified in the standard drawing.
 - 4.12.3.5 Lay all brick in a radial header course with all joints filled with mortar.
 - 4.12.3.6 The entire outside wall and the vertical sections of inside walls shall be plastered with one-half (½) inch thick cement mortar.
- 4.12.4 **Pre-cast Concrete Manholes.** Pre-cast concrete manhole sections shall conform to ASTM Specification C478 and shall be built to the depths indicated on the drawings or as directed by the City Engineer.
 - 4.12.4.1 If a pre-cast bottom is not used, a circular concrete foundation base shall be poured using the specifications listed for brick manholes.
 - 4.12.4.2 Sections shall be reinforced concrete.

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- 4.12.4.3 Sections shall be furnished in 16, 32 and 48 inch lengths as required to bring the manhole to the top elevations as shown on the drawings or as directed by the City Engineer.
- 4.12.4.4 Each section shall have bell and spigot or tongue and groove ends.
- 4.12.4.5 Each section shall have lifting holes to facilitate handling.
- 4.12.4.6 The taper section shall be one piece 36 inch high and conical, either concentric or eccentric, with the inside diameter tapering uniformly from 48 or 60 inches inside diameter at the bottom to 24 inches inside diameter at top.
- 4.12.4.7 Each section shall have permanently embedded steps meeting the requirements specified in [section 4.12.1.3](#) above.
- 4.12.4.8 Assemble manholes using 48 inch long sections and not more than one shorter section to provide the required straight height.
 - 4.12.4.8.1 Lay sections with a full mortar bed, con-seal, or equivalent in each joint.
 - 4.12.4.8.2 After all sections are installed, plug lifting holes with mortar.
 - 4.12.4.8.3 Seal around all pipe entrances with mortar.
- 4.12.4.9 Set rim and covers to the proper elevation using 24 inch inside diameter poured in place concrete, brick masonry or pre-cast concrete spacers between the casting and the pre-cast taper section.
- 4.12.4.10 Where the highest step in the pre-cast taper section is more than 24 inches below the top of the manhole cover, provide a step set in the spacer section 16 inches above the highest step in the taper section.
- 4.12.5 **Backfill.** Place and compact backfill around manholes in accordance with the applicable requirements in section [4.15 Backfill and Cleanup](#). Backfill material shall be compacted sand or gravel until within two (2) feet of the proposed subgrade when manholes are in existing or planned roadways.
- 4.12.6 **Inverts.** Provide an invert in each manhole bottom as required to facilitate the in-flowing and out-flowing storm water.
 - 4.12.6.1 Inverts shall be constructed with concrete or brick and mortar with full pipe flow channels carefully and smoothly shaped and finished to prevent splashing and turbulence.
 - 4.12.6.2 Make all changes of flow directions with the maximum practical radius curves.
 - 4.12.6.3 Invert benches shall be smooth and shall slope towards the invert on a slope of at least three (3) to one (1).
- 4.12.7 **Manhole protection.** Protect and maintain each manhole to grade until accepted by the City of Bartlett. Tops are to be sealed to prevent intrusion of water and mud into the manholes.

4.13 Inlets. Drain inlets shall be of concrete brick or concrete construction type constructed neatly, accurately and complete as the work progresses and when pipe installation reaches the inlet location.

4.13.1 Inlets shall be constructed as shown in the standard drawings.

4.13.2 Excavation for inlets shall be to the dimensions, shapes and elevations indicated on the drawings.

4.13.3 Excavations for the inlet base shall be plumb, level, firm and clean.

4.13.4 Excavations for the inlet base shall be free of loose earth, loose rock, vegetation, mud, water, frozen earth or any other unsatisfactory materials immediately before concrete placement.

4.13.5 The outside dimension of the excavation shall be at least 12 inches greater than the outside dimension of the inlet to facilitate construction and backfilling around the structure.

4.13.6 If the contractor carelessly or otherwise excavates below the required grade or the subgrade becomes spoiled in any way, he will, at his expense, refill the excavation to the proper grade with sand or gravel tamped in place or concrete.

4.13.7 Curb plates for inlets shall be installed to match the slope of the curb without causing any sharp breaks in the line of curb.

4.13.8 Inverts shall meet the requirements as specified in section [4.12.6 Inverts](#).

4.14 Headwalls. Headwalls shall be of concrete construction type constructed neatly, accurately and complete as the work progresses and when pipe laying reaches the headwall location.

4.14.1 Headwalls shall be constructed as to the type shown in the drawings or directed by the City Engineer and to the dimensions shown in the standard drawings for the type specified.

4.14.2 If approved for use, pre-cast concrete headwalls shall match the dimensions shown in the standard drawings.

4.14.3 Any headwall that has a distance of more than 30" from top of headwall to flow line of pipe shall have a four (4) foot chain link fence meeting the requirements of the current edition of the *Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction Section 909.02* installed along the top and any wing walls.

4.14.4 Excavations for headwalls shall be to the dimensions, shapes and elevations indicated on the drawings.

4.14.5 Excavations shall be plumb, level, firm and clean.

4.14.6 Excavations shall be free of loose earth, loose rock, vegetation, mud, water, frozen earth or any other unsatisfactory materials immediately before concrete placement.

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- 4.14.7 The outside dimension of the excavation shall be at least 12" greater than the outside dimension of the headwall to facilitate construction and backfilling around the structure.
- 4.14.8 If the contractor carelessly or otherwise excavates below the required grade or the subgrade becomes spoiled in any way, he will, at his expense, refill the excavation to the proper grade with sand or gravel tamped in place or concrete.
- 4.15 Backfill and Cleanup.** Trenches and other excavations shall not be backfilled until the City of Bartlett has approved the pipe or other work or unless specifically altered or changed in the Special Provisions of an awarded contract with the City of Bartlett.
 - 4.15.1 General Requirements.** General requirements apply to all backfill locations unless specifically altered or changed in the Special Provisions of an awarded contract with the City of Bartlett or noted otherwise in the specific requirements for the area being backfilled.
 - 4.15.1.1 The material for backfilling, unless otherwise specified, shall be sand, earth, loam or gravel from trenches and free of stones, broken concrete or asphalt larger than three (3) inches in diameter.
 - 4.15.1.1.1 Before placing any backfill, all rubbish, forms, blocks, wires or other unsuitable materials shall be removed from the excavation.
 - 4.15.1.1.2 Backfill material up to three (3) feet above the top of the pipe shall not exceed six (6) inches in diameter at its greatest dimension.
 - 4.15.1.2 As soon as the pipe has been laid and jointed, the pipe is to be bedded in the trench and made secure against movement by backfilling to the spring line of the pipe with approved granular material. Comply with the applicable requirements of section [4.10 Pipe Embedment](#).
 - 4.15.1.3 Earthen checks shall be installed at the midpoint between drain manholes and where drainage terminates at a headwall.
 - 4.15.1.3.1 Checks are to be made from suitable material excavated from the trench and be free of sand or gravel.
 - 4.15.1.3.2 Checks shall be at least five (5) feet long and no more than eight (8) feet long.
 - 4.15.1.3.3 Checks shall extend the depth of the trench to include the embedment, all compacted to a minimum of 98% STD of maximum density by laboratory standard proctor test (ASTM D 698).
 - 4.15.2 From the spring line of the pipe,** backfill shall be placed in one of the following methods depending upon the location of the pipe.
 - 4.15.2.1 RCP crossing streets, roads or driveways in regular use.** RCP laid in areas that are paved, including gravel and dirt roads and driveways in regular use, shall be backfilled with sand or gravel meeting the requirements of section [4.4.4 Backfill material](#). Water jetting is not permitted.

- 4.15.2.1.1 Earthen checks shall be installed on both sides of the crossing.
- 4.15.2.1.2 Backfill to within 13 inches of the finished surface in lifts not exceeding six (6) inches.
- 4.15.2.1.3 Each lift is to be compacted to 98% Standard Proctor (ASTM).
- 4.15.2.1.4 Immediately place concrete, approved gravel or cement treated base (CTB) to within three (3) inches of the finished surface. Gravel is to be compacted to 98% STD proctor (ASTM).
- 4.15.2.1.5 Road plates will be required until the cement or CTB has cured.
- 4.15.2.1.6 If paving can not be accomplished on the same working day, place three (3) inches of cold tar asphalt on the gravel base and level with the existing paved surface.
- 4.15.2.1.7 For pavement, after a minimum of five (5) days, remove the plates or cold tar asphalt and install asphaltic concrete (hot mix) compacted to a minimum of 90% of maximum laboratory density until flush with existing surface. The appropriate asphaltic prime coat shall be applied to the base and joints prior to laying the asphalt.
- 4.15.2.1.8 For gravel or dirt roads and driveways, after a minimum of five (5) days, remove the plates and install limestone gravel until flush with the existing surface.
- 4.15.2.1.9 Concrete driveways will be repaired or replaced in kind.
- 4.15.2.1.10 Maintain these crossings usable to vehicle traffic until acceptance by the City of Bartlett.
- 4.15.2.1.11 Do not leave a street, road or private driveway unusable overnight.
- 4.15.2.2 **RCP in areas to be paved.** Unless otherwise directed in the drawings or by the City Engineer, the contractor is permitted to backfill the remaining trench using one or both of the methods described below.
 - 4.15.2.2.1 Backfill to a point approximately 12 inches above the pipe in lifts not exceeding six (6) inches. The remaining trench may be backfilled in lifts not exceeding eight (8) inches.
 - 4.15.2.2.1.1 Backfill material can be any material excavated from the trench complying with the requirements listed in [section 4.15.1.1](#). Backfill around manholes with compacted sand or gravel until within two (2) feet of the proposed subgrade.

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- 4.15.2.2.1.2 Each lift is to be compacted to 98% Standard Proctor (ASTM).
- 4.15.2.2.2 If the area is not to receive the gravel or cement treated base immediately and trenches have ample time to settle and dry prior to placing the base, water jetting may be utilized.
 - 4.15.2.2.2.1 Backfill to a point approximately 12 inches above the pipe in lifts not exceeding six (6) inches.
 - 4.15.2.2.2.2 Backfill material can be any material excavated from the trench complying with [section 4.15.1.1](#). Backfill around manholes with compacted sand or gravel until within two (2) feet of the proposed subgrade.
 - 4.15.2.2.2.3 Each lift is to be compacted to 98% Standard Proctor (ASTM).
 - 4.15.2.2.2.4 The remainder of the trench can be backfilled using any material excavated from the trench complying with [section 4.15.1.1](#) and water jetting utilized to achieve compaction.
 - 4.15.2.2.2.5 Do not water jet earthen checks.
 - 4.15.2.2.2.6 Refill and smooth the backfill as it settles.
- 4.15.2.2.3 In neither instance will the base be placed over trenches that have not properly settled, have excessive moisture or have moderate to excessive pumping.
- 4.15.2.3 **RCP in other areas.** RCP laid in other areas shall continue to be backfilled to finished grade in compacted lifts not exceeding 12 inches in depth.
 - 4.15.2.3.1 The remaining fill can be any material excavated from the trench complying with the requirements listed in [section 4.15.1.1](#).
 - 4.15.2.3.2 Avoid using pressures that may damage the RCP.
 - 4.15.2.3.3 Water jetting is required.
 - 4.15.2.3.4 Do not water jet earthen checks.
 - 4.15.2.3.5 After sufficient settlement satisfactory to the City of Bartlett has occurred, complete the surface dressing, removal of surplus material and surface clean-up.
- 4.15.3 **Manholes, inlets and headwalls.** Place and compact backfill around manholes, inlets and headwalls in accordance with the applicable requirements for RCP backfill. Backfill material shall be compacted sand or gravel until within two (2) feet of the proposed subgrade when manholes are in existing or planned roadways.

- 4.15.4 The complete backfilling operation will not be paid for directly but all costs involved will be included in the price bid per linear foot of various size pipes complete and in place.
 - 4.15.4.1 When the City Engineer directs additional backfill material to be placed in the trench more than 12 inches above the top of the RCP, it shall be placed to the limits of his direction and brought to a condition of maximum compaction.
 - 4.15.4.2 The actual amount of backfill material placed from 12 inches above the top of the RCP to the ground line or the depth directed for the length directed with the trench width based upon the maximum trench width at the top of the pipe will be paid for at the unit price per cubic yard of [Engineer directed backfill](#).
- 4.15.5 After the trenches have been properly backfilled, all excess material shall be removed from the streets and roadways and from improved private property so that pavements may be replaced and properties cleaned up.
 - 4.15.5.1 In open fields and unimproved property, the excess dirt shall be spread out or used to fill low spots on property adjacent to the right of way or easement.
 - 4.15.5.2 Such spreading or filling shall be done in such a manner that it will not obstruct surface drainage and is satisfactory to the property owner.
- 4.15.6 Refill and smooth off, as required, all backfill which settles so that all backfill conforms to the original ground surfaces.
 - 4.15.6.1 The contractor shall maintain frequent inspections of the backfill throughout the time of the project and the warranty period and repair any settlement as soon as it is discovered.
 - 4.15.6.2 Repair shall include the removal and replacement of all damaged asphalt or concrete and installation of sod or seeding and mulch.
- 4.15.7 For all pipes in tunneled or bored holes without casings, backfill only with sand. Thoroughly tamp or otherwise place the backfill in an approved manner to prevent caving and settlement. An earthen check shall be installed at both ends of tunneled or bored holes.
- 4.15.8 Cleanup shall be performed as the work progresses.
 - 4.15.8.1 Negligence in proper cleaning up which causes undue inconvenience to citizens, presents an unsightly or dangerous condition, or causes embarrassment to civic officials shall be sufficient reason for rejection of construction estimates (pay requests) or work shut down until the unsatisfactory conditions have been remedied.
 - 4.15.8.2 After all work is completed, make a final cleanup of all areas where work has been done and where equipment and materials have been stored and leave them in broom clean condition.

4.16 Pavement repair – City Streets and Roads. Immediately after installing each storm sewer line across a city street or road, restore that street or road (to include the right of

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way at that location) to at least the conditions which existed prior to the storm sewer work and to the satisfaction of the City of Bartlett. Refer to section [4.15. Backfill and Cleanup](#).

4.17 Trenching, Pipe Laying, Backfilling and Pavement Repairs - County Roads. Immediately after installing each storm sewer line across a county road, restore the road and its right of way at that location to at least the conditions which existed prior to the beginning of the storm sewer work and to the satisfaction of the County.

4.17.1 The county standard drawing **Typical Roadway Trench** shall be used for all phases of work within the county right of way.

4.17.2 For those phases of work not shown on the county standard drawing, comply with the applicable portions of these standards.

4.17.3 An earthen check shall be installed at both sides of road crossings.

4.18 Cutting and Replacing Pavement and other Special Surfaces. Restore all surfaces disturbed by the storm sewer installation to at least the conditions which existed prior to the beginning of the storm sewer work.

4.18.1 As each surface is being cut, the city inspector shall examine the existing surface with the contractor. The type of surface to be replaced shall be determined by mutual agreement of the inspector and the contractor.

4.18.2 The maximum width of all pavement and other surface repairs allowable for payment by the City shall be the maximum trench width at the top of the pipe (as previously defined) plus 12 inches.

4.18.2.1 The contractor shall be responsible for all repairs outside this limit.

4.18.2.2 If the area to be repaired does not reach this limit, the city will pay only for the actual extent of the repairs.

4.18.3 Replace existing surfaces which are cut, removed, or otherwise damaged by the storm sewer work with new surfaces.

4.18.3.1 Existing gravel surfaces shall be replaced with a six (6) inch thick concrete cap.

4.18.3.2 Existing city and county streets and roads shall be repaired as specified in the applicable sections above.

4.18.3.3 Unless otherwise approved, concrete surfaces shall not be cut but shall have the pipe installed by tunneling or boring. If cut, replace them with:

4.18.3.3.1 A six (6) inch thick compacted base of new gravel.

4.18.3.3.2 A surface course of 4000 psi concrete equal in thickness to that adjoining the concrete surface course.

4.18.3.3.3 Type of concrete used shall match the existing concrete, i.e., washed stone, pea gravel, limestone, etc.

- 4.18.4 Where pipe is installed on the shoulders parallel to asphalt, concrete or other surfaces, maintain ditches until they are firm and present no traffic hazard. Where authorized, place six (6) inch thick compacted layers of new road gravel.
- 4.18.5 Do not cut streets or other surfaces except where necessary for storm sewer installation.
 - 4.18.5.1 Damage outside of the limits specified above shall be repaired at the contractor's expense and to the satisfaction of the City Engineer.
 - 4.18.5.2 All crossings shall be maintained by the contractor until project completion and the end of the warranty period.
- 4.19 Adjustment of utilities.** Field adjustments to any utility lines or apertures such as valves, fire hydrants, meter boxes, etc. will be accomplished by the contractor and the cost of such adjustments will be considered as incidental to the project costs. When adjustment rings are required for water valve roadway boxes, they shall be SIGMA 2600 series risers (or an approved equivalent) of the appropriate thickness to adjust the valve box top to grade. When adjustment rings are required for drain or sewer manholes, they shall be SIGMA MH-2710 or MH-2715 (or an approved equivalent) to adjust the manhole top to grade.
- 4.20 Measurement and payment.** Payments will be made to the nearest complete unit as listed in the proposal. Quantities submitted for payment shall be rounded to the nearest foot, yard, or other applicable unit.
 - 4.20.1 **Storm sewer pipe.** Paid for at the unit price per linear foot for the size of storm sewer pipe specified in place in open cut trenches or excavations, measured as the horizontal distance between centers of manholes, inlets or headwalls. No allowance shall be made for increased length due to slope.
 - 4.20.2 **Standard manholes.** Paid for at the unit bid price per complete standard storm sewer manhole, brick or pre-cast, in place, four (4) or five (5) foot diameter as specified. A standard manhole is six (6) feet or less in depth from the top of the rim (top elevation) to the storm sewer invert (flow-out elevation) including steps, rim and cover.
 - 4.20.3 **Extra depth manholes.** Paid at the unit bid price per vertical foot for extra depth standard storm sewer manhole, brick or pre-cast, in excess of six (6) feet. Measurement shall be to the nearest .1 (1/10) foot from the top of the rim (top elevation) to the storm sewer invert (flow-out elevation) minus six (6) feet paid as **Standard manhole.**
 - 4.20.4 **Connection to existing manhole.** Paid for at the unit bid price for each complete connection made to existing storm sewer manholes. This item is not paid when connecting to an existing stub.
 - 4.20.5 **Inlets.** Paid for at the unit bid price for each complete inlet of the type specified in place, which will be full compensation for materials and materials' testing; excavation; necessary forming to include rebar and tying of same; special protection; placing, protection and curing of concrete; connection to pipes, channel lining or structure; cleaning and inspection; frames and grates; backfilling; etc.
 - 4.20.6 **Headwalls.** Paid for at the unit bid price for each complete headwall of the type specified in place, which will be full compensation for materials and materials'

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testing; excavation; necessary forming to include rebar and tying of same; special protection; placing, protection and curing of concrete; connection to pipes, channel lining or structure; cleaning and inspection; backfilling; fence; etc.

- 4.20.7 **Drain rock, granular pipe embedment material and granular backfill material.** This item is not normally paid as a separate item but is included in the various unit bid prices of the items involved. When listed separately on the bid tabulation sheet, paid for at the unit bid price per ton of loose material in place, as evidenced by delivery tickets signed by the city representative. Tickets must be delivered at time of pay request. No payment will be made for drain rock used for unsatisfactory subgrade unless the use was approved by the City Engineer, in which case the cost of extra depth excavation below planned grade and compaction shall be included in the unit price bid for drain rock.
- 4.20.8 **Sheathing left in place.** Paid for at the unit bid price per thousand board feet when authorized in writing. Measurement shall be to the nearest 100 board feet.
- 4.20.9 **Road gravel in place.** Paid for at the unit bid price per cubic yard of compacted road gravel of the type specified in place. Measurement shall be the actual surface area covered with a compacted layer to the indicated, specified or otherwise authorized thickness. Includes base courses under pavement and special surface repairs. No payment shall be made for any road gravel placed without the City of Bartlett authorization or placed outside of the specified payment limits. Copies of the delivery tickets signed by the city representative are to be included with the pay request.
- 4.20.10 **Replacement of pavement and special surfaces.** Paid for at the unit bid price per square yard of the type specified in place. Measurement shall be the actual areas repaired. No payment will be made outside the specified payment limits. Does not include gravel base courses which shall be paid separately as noted above.
- 4.20.11 **Extra depth excavation.** No separate payment shall be made for extra depth excavation that may be required to permit piping to pass under obstructions regardless to whether the obstructions are indicated on the drawings or not. When extra depth excavation is authorized and required to facilitate the removal of unsatisfactory subgrade, it shall not be paid for directly but shall be included in the cost of the material used to replace the unsatisfactory subgrade.
- 4.20.12 **Joint materials, lubricants, trenching, excavating, boring, tunneling, backfilling, jacking, removal of existing pavement, removing and replacing sod, fences, and other miscellaneous items not specifically listed as a payment item.** No separate payment shall be made unless specifically indicated in the project documents. These items are incidental to the work and shall be included in the various unit bid prices for pipe and other related items.
- 4.20.13 **Engineer directed backfill.** Paid for at the unit bid price per cubic yard of the type specified in place. Measurement shall be from 12 inches above top of pipe to the ground line or to the depth directed and for the length directed and for the width based upon the maximum trench width for the size of pipe involved at the top of pipe or the width otherwise directed. Copies of the delivery tickets signed by the city representative are to be included with the pay request.

- 4.20.14 **Concrete foundation.** Paid for at the unit bid price per cubic yard in place. Measurement shall be the actual amount used to the limits and dimensions specified on the drawings or as directed by the City Engineer. No payment shall be made for material in excess of the dimensions specified. Copies of the delivery tickets signed by the city representative are to be included with the pay request. The cost of forms and extra depth excavation below the planned grade shall be included in the unit price bid.

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Section 5: Sidewalks, Curbs, Gutters, Water Tables, Driveway Aprons and Wheelchair Ramps

5 Sidewalks, Curbs, Gutters, Water Tables, Driveway Aprons and Wheelchair Ramps.

Construct sidewalks, curbs, gutters, water tables, driveway aprons and wheelchair ramps to the cross section elevations, lines, grades and other details as indicated on the drawings and the applicable standard drawings. Construction requirements not shown on the drawings or specified in the proposal shall be as specified herein.

5.1 Concrete. Unless otherwise specified in the drawings or approved by the City Engineer, all concrete shall be Class A 4,000 PSI limestone, 4% to 8% air entrained, ready mixed type conforming to ASTM Specification C94 composed of Portland cement, sand and wash coarse aggregate all conforming to the applicable ASTM specifications and mixed with clean water, free of oil, acid, alkali or inorganic matter and supplied by an approved ready mix plant. For flatwork, fiber reinforcement shall be added at the plant at a rate of 1.5 pounds per cubic yard.

5.1.1 The design mix shall be the ready plant's standard for the specified strength as established and tested by an approved laboratory in accordance with the applicable ASTM standard specification.

5.1.2 If requested, submit to the City of Bartlett for approval a copy of the laboratory test reports of the proposed concrete mix and materials prior to using the proposed mix.

5.2 Forms. Forms shall be steel or two (2) inch thick lumber, true to proper dimensions, smooth, free from warp, sufficiently braced to resist springing out of shape and accurately set to the proper lines and grades.

5.2.1 Remove mortar and dirt from previously used forms and thoroughly treat them with oil before reusing them.

5.2.2 Cross forms used for curb and gutter shall be one-quarter (1/4) inch thick steel of the full width and depth of the concrete work and shall be left in place until the wearing surface has been floated and has attained its initial set.

5.2.3 The alignment and grade elevations of the forms shall be checked and adjusted by the contractor immediately before placing the concrete.

5.2.4 No concrete shall be placed before the City of Bartlett has inspected and approved the forms. This inspection does not alleviate the responsibility of ensuring the forms are set to the proper lines and grades by the contractor.

5.3 Joint Filler. Joint filler for all expansion joints shall be an approved pre-molded compound which will not become soft and push out in hot weather nor become hard and brittle and chip out in cold weather.

5.3.1 Joint material must provide elasticity and be waterproof.

5.3.2 Unless otherwise indicated in the plans or directed by the Engineer, joint filler for sidewalks and curb & gutter shall be at least one-half (1/2) inch but no more than one (1) inch thick. The filler shall be cut to the full cross section of the slab or curb & gutter thickness and be of a length equal to that of the expansion joint involved without the need for splicing.

5.3.3 Unless otherwise indicated in the plans or directed by the Engineer, joint filler for all other applications shall be no more than three-eighths (3/8) inch thick and shall extend the full depth of the concrete work involved.

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5.4 Subgrade. Prepare subgrades by excavating or filling to the proper depth and width that will permit the installation and bracing of the forms. The subgrade shall be shaped and compacted to a firm, even surface in reasonably close conformity with the grade and cross section shown on the drawings or directed by the Engineer.

- 5.4.1 Provide a gravel base where indicated on the drawings.
- 5.4.2 Remove all vegetation and organic material from the excavation or fill.
- 5.4.3 All soft and yielding material shall be removed and replaced with acceptable material.
- 5.4.4 Fill shall be applied in lifts not to exceed four (4) inches and thoroughly tamped or rolled until the fill is compact and firm.
- 5.4.5 The subgrade shall be filled or excavated to grade in a uniformly firm condition prior to concrete placement.
- 5.4.6 No concrete shall be placed before the City of Bartlett has inspected and approved the subgrade. This inspection does not alleviate the responsibility of ensuring the subgrade is set to the proper lines and grades by the contractor.

5.5 Placing concrete. Concrete shall not be placed until the subgrades and forms have been inspected and approved by the City of Bartlett.

- 5.5.1 Concrete placement shall not begin unless the ambient temperature is 35°F and rising and shall be halted when the ambient temperature is 40°F and falling.
- 5.5.2 Concrete placement shall be discontinued in time to allow finishing to be completed in daylight hours unless an adequate and approved artificial lighting system is provided and operated.
- 5.5.3 The alignment and grade elevations of the forms shall be checked and adjusted by the contractor immediately before placing the concrete.
- 5.5.4 Concrete shall only be placed on a moist subgrade or base course.
- 5.5.5 Utility structures such as valve boxes and manhole tops shall be adjusted to the proper grade prior to placing concrete around these structures.
- 5.5.6 Transport concrete from the mixer and place it using methods that will prevent segregation of materials or loss of ingredients.
- 5.5.7 Deposit each successive batch in one layer by a continuous operation.
- 5.5.8 Do not place any concrete that has taken its initial set.
- 5.5.9 Concrete shall be thoroughly consolidated to fill all voids without honey combing especially against and along the faces of all forms and joints.
- 5.5.10 Strike off and tamp the concrete until the mortar is flushed freely to the surface and a dense surface, free from porous and rough spots, is obtained.

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- 5.5.11 Joints shall be constructed of the type, dimensions and locations specified in the standard drawings or as directed by the City Engineer.

5.6 Sidewalk construction. Sidewalks shall be constructed to the lines and grades indicated on the drawings and finished to an appearance comparable to one expected from a skilled craftsman.

- 5.6.1 Unless otherwise specified in the drawings or bid documents, sidewalk shall be five (5) feet wide and four (4) inches thick.
- 5.6.2 Unless otherwise shown on the drawings or directed by the City Engineer, set sidewalk forms to provide one-quarter (1/4) inch per foot of sidewalk fall with one-half (1/2) inch per foot of grass fall towards the curb or roadway for proper drainage.
- 5.6.3 Provide a transverse expansion joint on 25 foot maximum centers.
- 5.6.4 Provide an expansion joint where sidewalk meets wheelchair ramps and driveway aprons.
- 5.6.5 Preformed expansion joint filler, one (1) inch in thickness, shall be placed around all appurtenances such as manholes, valve, utility poles, fire hydrants, signs, etc., extending into or through the sidewalk area, forming an isolated square or rectangular slab around the appurtenance with a minimum of four (4) inches clearance of the appurtenance.
- 5.6.6 Provide a transverse scored groove on five (5) foot maximum centers. The grooves shall be cut to a depth of one-half (1/2) inch.
- 5.6.7 The edges of sidewalks and driveways shall be carefully finished and rounded with an edging tool to have a half-inch (1/2) inch radius.
- 5.6.8 An edge having a one-quarter (1/4) inch radius shall be placed adjacent to and on both sides of all intermediate transverse scored grooves and expansion joints.
- 5.6.9 All marks caused by the edging tool shall be removed with a wetted brush or wooden float.
- 5.6.10 The top of all expansion joint material shall be cleaned of all concrete, and the expansion joint material shall be trimmed if necessary as to be left slightly below the surface of the concrete.
- 5.6.11 After the concrete has been struck-off to the required cross section, it shall be finished with floats and straightedges until the required surface requirements have been obtained.
- 5.6.12 After the concrete has taken its initial set, brush the surface lightly with a soft bristle brush at right angles to the street centerline.
- 5.6.13 The longitudinal surface variation shall be not more than one-quarter (1/4) inch under a 12 foot straightedge, nor more than one-eighth (1/8) inch on a five (5) foot transverse section.
- 5.6.14 The surface of the concrete shall be so finished as to drain completely at all times.

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5.6.15 A pre-fabricated sidewalk drain shall be installed when shown on the drawings or directed by the City Engineer.

5.6.15.1 Sidewalk drains will be manufactured in accordance with the standard drawing.

5.6.15.2 Sidewalk drains will be installed the full width of the sidewalk and through any existing curb.

5.7 Curb and gutter construction. Curb and gutters shall be constructed to the lines and grades indicated on the drawings and finished to an appearance comparable to one expected from a skilled craftsman.

5.7.1 Each section shall be placed in one continuous operation so that the curb and gutter will be monolithic (combined curb and gutter).

5.7.2 Unless otherwise specified, the top edges of the curb and the edge of the gutter shall be rounded to a radius of three-quarter (3/4) inches and the edges of contraction and expansion joints shall be finished with an edging tool with a radius of not over one-quarter (1/4) inch and then all lines or marks shall be removed with a wet brush.

5.7.3 The back of curbs shall be finished not less than three (3) inches below the top of backfill against the curb.

5.7.4 Any exposed surface or surfaces against which some rigid type of construction is to be made shall be left smooth and uniform so as to permit free movement of the combined curb and gutter.

5.7.5 Provide a transverse expansion joint on maximum 40 foot centers when using a slip form curb machine and 20 foot centers all other times.

5.7.6 Provide a transverse expansion joint at all end of radius' (ERs).

5.7.7 Provide a transverse expansion joint no more than ten (10) feet or closer than five (5) feet from any curb inlet.

5.7.8 Provide a contraction joint on maximum ten (10) foot centers conforming to the requirements shown in the standard drawings. When using a slip form curb machine, contraction joints shall be saw cut two (2) inch deep into gutters and fully through the curb in lieu of using the cross form referenced in section 5.2.2.

5.7.9 All tool marks shall be removed with a wetted brush or wooden float and the finished surface shall present a uniform and pleasing appearance.

5.8 Wheelchair ramps. Wheelchair ramps shall be constructed to the lines and grades indicated on the drawings and finished to an appearance comparable to one expected from a skilled craftsman.

5.8.1 For new developments, the developer shall be responsible for the installation of wheelchair ramps as indicated on the subdivision plans or as directed by the Engineer.

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- 5.8.2 Detectable warning surfaces for pedestrian crossings shall be used that are approved by the City of Bartlett and conform to the applicable ADA requirements (see [Appendix C](#)).
 - 5.8.3 Provide an expansion joint where wheelchair ramps meet sidewalks.
 - 5.8.4 Where existing curb and gutter must be removed to facilitate ramp installation, the existing curb and gutter shall be saw cut at the width of the proposed wheelchair ramp and the existing curb and gutter removed.
 - 5.8.5 New curb and gutter shall be installed as shown on the standard drawing.
 - 5.8.6 Retrofit and new construction where the curb and gutter must be replaced for A.D.A. acceptance must have the wheelchair ramp and curb & gutter constructed monolithically.
 - 5.8.7 Provide an expansion joint in the new curb and gutter in alignment with both edges of the wheelchair ramp.
 - 5.8.8 Finish and edges shall be as shown on the standard drawings.
 - 5.8.9 Finish surface with a trowel and float to an approximately true plane.
- 5.9 Water tables.** Water tables shall be constructed to the lines and grades indicated on the drawings and finished to an appearance comparable to one expected from a skilled craftsman.
- 5.9.1 Provide expansion joints on 20 foot maximum centers and where otherwise indicated on the drawings or directed by the City Engineer.
 - 5.9.2 Provide contraction joints on 10 foot maximum centers and where indicated on the drawings or as directed by the City Engineer.
 - 5.9.3 Finish surface with a trowel and float to an approximate true plane.
- 5.10 Driveway aprons.** Driveway aprons shall be constructed to the lines and grades indicated on the drawings and finished to an appearance comparable to one expected from a skilled craftsman.
- 5.10.1 For residential driveway aprons in areas with existing curb and gutter, the existing curb shall be saw cut at the width of the proposed driveway apron and the existing curb broken or saw cut from the existing gutter.
 - 5.10.1.1 The new driveway may then be installed to meet the flow line of the existing gutter.
 - 5.10.1.2 Unless otherwise specified in the drawings or bid documents, residential driveway aprons shall be six (6) inches thick.
 - 5.10.1.3 Concrete other than that specified herein shall be submitted to the Director, City of Bartlett Department of Code Enforcement, for approval.

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- 5.10.2 For commercial driveway aprons in areas of existing curb and gutter, the existing curb and gutter shall be saw cut at the width of the proposed driveway apron and the existing curb and gutter removed.
 - 5.10.2.1 Unless otherwise specified in the drawings or bid documents, commercial driveway aprons shall be eight (8) inches thick.
 - 5.10.2.2 New curb and gutter shall be installed as shown on the standard drawing.
 - 5.10.2.3 The driveway apron will then be installed as shown on the standard drawing.
- 5.10.3 In no case shall a driveway apron and the curb and gutter be installed monolithically.
- 5.10.4 Provide an expansion joint where the driveway apron meets sidewalks.
- 5.10.5 Provide expansion joints where new curb and gutter meets existing curb and gutter.
- 5.10.6 Finish surface with a trowel and float to an approximate true plane.

5.11 Curing and Protection. The contractor shall be responsible for curing and protection of the concrete until accepted by the City of Bartlett. Any damaged concrete shall be repaired or removed and replaced, as directed by the City of Bartlett, at the contractor's expense.

- 5.11.1 As soon as the finished concrete work has hardened sufficiently to prevent damage, keep the surface damp for at least three (3) days.
 - 5.11.1.1 Cover the surfaces with approved curing compound, burlap, straw, earth, sand or other approved material.
 - 5.11.1.2 Apply water as required to keep forms and covering materials saturated continuously throughout the curing period.
 - 5.11.1.3 Sprinkling the surfaces without covering is not acceptable.
- 5.11.2 Protect freshly finished concrete from hot sun and drying winds until it can be covered and sprinkled as specified above.
- 5.11.3 Provide all necessary protective covers in case of rain. Surfaces damaged or pitted by rain is not acceptable.
- 5.11.4 Forms may be removed at any time that removal will not damage the concrete. No pressure shall be exerted upon the concrete in removing forms.
- 5.11.5 Protect all concrete from traffic for at least three (3) days. Pedestrians will not be allowed upon concrete until 12 hours after finishing concrete. The contractor shall construct and place such barricades and protection devices necessary to keep pedestrians and other traffic off placed concrete.
- 5.11.6 When the temperature is expected to fall to 32° F or less, spread straw or other blanketing material to sufficient depth to keep the concrete from freezing or

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provide an enclosure and heating device capable of maintaining concrete temperature of at least 50° F.

5.11.6.1 Maintain such protection for at least five (5) days.

5.11.6.2 The contractor shall be responsible for removing and replacing any concrete injured by frost action.

5.12 Backfilling. Immediately after removing the side forms, the spaces along the edges of placed concrete shall be filled with suitable material. This material shall be placed in layers not exceeding four (4) inches in loose thickness and compacted until firm and stable. Replace any sod or turf that may have been removed to facilitate concrete placement.

5.13 Adjustment of utilities. Field adjustments to any utility lines or apertures such as valves, fire hydrants, meter boxes, etc. will be accomplished by the contractor and the cost of such adjustments will be considered as incidental to the project costs. The contractor is responsible for any damage that may be caused to these utilities as a result of construction. When adjustment rings are required for water valve roadway boxes, they shall be SIGMA 2600 series risers (or an approved equivalent) of the appropriate thickness to adjust the valve box top to grade. When adjustment rings are required for drain or sewer manholes, they shall be SIGMA MH-2710 or MH-2715 (or an approved equivalent) to adjust the manhole top to grade.

5.14 Measurement and Payment. Payments will be made to the nearest complete unit as listed in the proposal. Quantities submitted for payment shall be rounded to the nearest bid unit.

5.14.1 **Sidewalks.** Paid for at the unit price per linear foot of sidewalk, at the specified width and thickness, in place. Sidewalk in areas at back of existing five (5) foot drive aprons shall be measured and paid for as specified for **Driveway apron**. Price shall be full compensation for excavating and preparing the subgrade; forming; furnishing, placing, finishing, and curing the concrete; providing all joints; and protecting the concrete until final acceptance, complete in place.

5.14.2 **Curb and gutter.** Paid for at the unit price per linear foot of curb and gutter in place, of the size and type specified, measured through driveways, which shall be full compensation for excavating and preparing the subgrade; forming; furnishing, placing, finishing, and curing the concrete; providing all joints; and protecting the concrete until final acceptance, complete in place.

5.14.3 **Wheelchair ramps.** Paid for at the unit price each for the type specified in place which shall be full compensation for excavating and preparing the subgrade; forming; furnishing, placing, finishing, and curing the concrete; providing all joints; and protecting the concrete until final acceptance, complete in place.

5.14.4 **Water tables.** Paid for at the unit price per square foot of water table in place which shall be full compensation for excavating and preparing the subgrade; forming; providing and installing reinforcing steel; furnishing, placing, finishing, and curing the concrete; providing all joints; and protecting the concrete until final acceptance, complete in place.

5.14.5 **Driveway aprons.** Paid for at the unit price per square foot of driveway apron of the specified thickness in place, measured from the back of the curb to a line ten (10) feet from the face of curb and to the width as indicated on the plans. Sidewalk in areas at back of existing five (5) foot drive aprons shall be measured and paid for as **Driveway apron**, the width and depth matching the driveway width and depth. When

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the sidewalk block extends beyond the driveway apron width, the sidewalk will be included as **Driveway apron**, measured from the first joint beyond either side of the driveway. Price shall be full compensation for excavating and preparing the subgrade; forming; installing reinforcing steel (when shown on the plans or specified); furnishing, placing, finishing, and curing the concrete; providing all joints; and protecting the concrete until final acceptance, complete in place.

- 5.14.6 **Surveying, staking, clearing, grubbing, joint filler or expansion material, saw cuts, curing compound, cold weather protection, backfilling, adjustment of utilities and other items not specifically listed as pay items.** Unless otherwise noted in the bid sheet for the awarded contract, no separate payment shall be made. These items are considered incidental to the work and shall be included in the unit bid price of the various bid items.

- 6.1 Licensed Contractor.** All contractors installing water mains within the City of Bartlett's utility system shall be licensed to install municipal water lines, taps, valves and services. A copy of such licensing shall be provided to the City Engineer prior to the start of any work.
- 6.2 General design information.**
- 6.2.1 **Pipe alignment.** The water system shall be designed to minimize as much as practical the number of bends requiring mechanical fittings.
- 6.2.2 **Pipe cover.** The minimum specified cover for water systems is based upon the final finished surface, including any pavement, and is measured from the top of the pipe.
- 6.2.2.1 All water mains and hydrant leads shall have a minimum cover of 30 inches unless otherwise specified or directed.
- 6.2.2.2 Water mains under streets or roads shall have a minimum of 48 inches of cover.
- 6.2.2.3 Fire hydrant leads crossing side ditches shall have a minimum of 18 inches of cover.
- 6.2.2.4 Water service lines shall have a minimum of 24 inches of cover.
- 6.2.3 **As-built water plans.** At the completion of construction, as-built water plans are required to be provided to the Department of Engineering. As-built plans will include, as a minimum, the following information, and other information as may be requested by the City Engineer:
- 6.2.3.1 Distance of water services from property lines. When services are not located directly between the curb and sidewalk, as-builts will also include the distance of the end of the service line to the water main.
- 6.2.3.2 Locations where rodding has been used for anchorage using property lines or other fixed points as a reference point for measurements.
- 6.2.3.3 Location of plugs and caps using property lines or other fixed points as a reference point for measurements.
- 6.2.3.4 Location of valves using property lines or other fixed points as a reference point for measurements. When valves are not located in a street where they can be easily found, distances between valves shall be included.
- 6.3 Types of Pipe.** All pipe used for construction of the water system and water services three inches or larger shall be ductile iron pipe (D.I.P.). Water services up to two (2) inches in size shall be copper tubing.
- 6.3.1 **Ductile iron pipe (D.I.P.).** Unless otherwise specified on the drawings, in these specifications, or required in special locations, D.I.P. used for City of Bartlett water systems shall conform to ANSI/AWWA Standard C 151 with the minimum iron strength being 60/42 and the minimum pipe thickness class as indicated in [Table 8, Ductile Iron Pipe Minimum Thickness Classes](#). All pipe shall have ANSI/AWWA Standard C104 standard thickness bituminous sealed cement-mortar lining, bituminous outside coating, and ends as required for the types of joints specified.

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- 6.3.1.1 Pipe interiors, sealing surfaces, fittings and other accessories shall be kept clean.
- 6.3.1.2 Pipe bundles shall be stored on flat surfaces with uniform support.
- 6.3.1.3 Protect stored pipe from prolonged exposure (over six (6) months) to sunlight with a suitable covering (canvas or other opaque material).
- 6.3.1.4 Provide air circulation under any covering.
- 6.3.1.5 Gaskets shall not be exposed to oil, grease, ozone (produced by electric motors), excessive heat or direct sunlight.
- 6.3.1.6 Fittings for D.I.P. shall be ANSI/AWWA C 110 cast iron or ductile short body pattern, class 250, bituminous coated inside and out, with ends as required for the type of joint specified. Push on fittings are not permitted.
- 6.3.1.7 Tees for connecting fire hydrants to water mains shall be mechanical joint anchoring types, each with a six (6) inch spigot outlet and a locked-on rotating mechanical joint gland ring.
- 6.3.1.8 All mechanical joint fittings and accessories shall be domestic made.
- 6.3.1.9 All joints shall be ANSI/AWWA Standard C 111 mechanical or push on type.
- 6.3.1.10 Comply with the manufacturer's specific storage and handling requirements.
- 6.3.1.11 Upon demand by the City Engineer, the contractor shall furnish certificates of inspection made by an approved testing laboratory for any type of material used on the project.

Pipe Sizes	Wall Thickness	Minimum Thickness Class
3	0.25"	51
4	0.26"	51
6	0.25"	50
8	0.27"	50
10	0.29"	50
12	0.31"	50
14	0.33"	50
16	0.34"	50
18	0.35"	50
20	0.36"	50
24	0.38"	50
30	0.39"	50
36	0.43"	50
42	0.47"	50
48	0.51"	50
54	0.57"	50

Table 8, Ductile Iron Pipe Minimum Thickness Classes

- 6.3.2 **Copper tubing.** All copper tubing shall be Type K copper and installed without couplings when the required lengths are commercially available. All connections

between the copper tube and fittings shall be compression type. Sweating or soldering of joints is not permitted.

6.4 Valves and roadway boxes. All valves for the City of Bartlett water systems shall be opened by turning in a clockwise direction of rotation (right hand open) and provided with a box for accessing the valve operating nut.

6.4.1 All valves shall be Mueller 2300 series, M&H C515 series or an approved equivalent consisting of a ductile iron body, bronze mounted, resilient wedge, parallel seat, non-rising stem gate type.

6.4.1.1 Valves shall conform to AWWA Specification C 500.

6.4.1.2 Valves shall have a minimum working pressure of 175 PSI.

6.4.1.3 Valves shall have "O" ring type stem seals with a two (2) inch operating nut.

6.4.1.4 Valves shall have AWWA Specification C 111 mechanical joint ends with plain rubber gaskets.

6.4.2 Provide over each valve operating stem a standard two-piece coal tar coated five and one-quarter ($5\frac{1}{4}$) inch inside shaft diameter screw type adjustable cast iron roadway valve box.

6.4.2.1 Each box shall be a SIGMA VB260 series or an approved equivalent consisting of a cover marked WATER, an upper telescoping section and a lower section.

6.4.2.2 Where necessary to provide extra depth, extension pieces shall be provided as required to allow the box to be set at finished grade.

6.4.3 For water valves that will remain closed at the completion of construction, a debris cap shall be installed in the roadway box directly below the cap.

6.4.3.1 Debris caps shall be SW Services DC455 series, AMPPro CMA562 series or an approved equivalent sized to fit the installed roadway box.

6.4.3.2 As-built drawings shall be annotated to show the valve as normally closed.

6.5 Fire Hydrants. Fire hydrants shall be break away Mueller A-423 Super Centurion 250, M&H Model 129 or an approved equivalent standard compression type conforming to the AWWA Specification C 502.

6.5.1 Each hydrant shall be complete with a five (5) inch minimum valve opening, a six (6) inch AWWA Specification C 111 mechanical joint inlet connection, a three (3) or four (4) foot bury, two each two and one half ($2\frac{1}{2}$) inch National Standard fire hose thread nozzle, one four (4) inch City of Memphis, Tennessee, standard pumper connection nozzle, and one (1) inch square operating and cap nuts.

6.5.2 Each hydrant shall be opened by turning in a clockwise direction of rotation (right hand open).

6.5.3 All interior working parts of the hydrant shall be solid bronze or bronze mounted.

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- 6.5.4 All nozzles shall be equipped with caps anchored to the standpipe with chains.
- 6.5.5 The hydrant shall be designed that all interior parts can be removed without removing the stand pipe from the set position.
- 6.5.6 The hydrant shall be equipped with a drain valve that will positively drain the lower barrel when the main valve is closed.
- 6.5.7 When requesting to use a hydrant other than the Mueller A-423 Super Centurian 250 or M&H Model 129, a cutaway view drawing shall be submitted with the request.
- 6.5.8 Each hydrant shall be factory painted on the outside below grade line with black asphalt paint and above grade line with silver enamel paint.

6.6 Granular Drain, Pipe Embedment, Concrete Encasement, Concrete Foundation and Backfill Material.

- 6.6.1 **Granular drain.** Drain rock material for trench drainage and pipe support shall be washed gravel, washed crushed rock, or washed crushed stone evenly graded from one-half (1/2) to two (2) inches in size, installed to the dimensions shown on the drawings or specified by the City Engineer.
- 6.6.2 **Pipe embedment.** Unless otherwise indicated on the drawings, elsewhere in these specifications or directed by the City Engineer, the D.I.P. may be laid directly on the excavated trench bottom with holes excavated in the bottom to facilitate the bell of pipes. When the use of granular embedment is directed, it shall be crushed rock, crushed stone or washed gravel with 100% passing a one-half (1/2) inch screen and 95% retained on a No. 4 sieve, installed to the dimensions specified by the City Engineer.
- 6.6.3 **Concrete Encasement.** Concrete encasement shall consist of concrete meeting the requirements in section **6.7 Concrete** and shall be used in the locations shown on the drawings, as specified in these specifications or as directed by the City Engineer. When used, concrete encasement shall be rectangular in section with a thickness of six (6) inches between the outside edge of the pipe and the outside of encasement at the closest point.
- 6.6.4 **Concrete Foundation.** Concrete foundations for pipe support shall consist of concrete meeting the requirements in section **6.7 Concrete**, poured the full width of the trench bottom, extending to a depth of not less than one-quarter (1/4) of the pipe diameter below the outside bottom of the pipe and no less than one-quarter (1/4) of the pipe diameter above the outside bottom of the pipe or to the dimensions directed by the City Engineer.
- 6.6.5 **Backfill material.** Unless otherwise indicated on the drawings, elsewhere in these specifications or directed by the City Engineer, suitable excavated trench material may be used to backfill trenches. When the use of granular backfill is directed, it shall be clean, natural, unwashed gravel, sand or crushed stone with 100% passing a one (1) inch screen and 100% retained in a No. 60 sieve.

6.7 Concrete.

Limestone concrete shall be 4000 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed coarse aggregate all conforming to applicable ASTM specifications.

- 6.7.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.
 - 6.7.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.
 - 6.7.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.
- 6.8 Trenching.** All trenches shall be open cut unless shown otherwise on the drawings or set out elsewhere in these specifications.
- 6.8.1 Excavate trenches to the indicated lines and locations to provide uniform and continuous bearing and support of each pipe barrel on firm, undisturbed earth at every point between bell holes.
 - 6.8.2 Trench depths shall be as required to:
 - 6.8.2.1 Provide the specified minimum cover over the tops of pipes.
 - 6.8.2.2 Permit pipes to pass under culverts, railroads, highways, existing pipelines and other obstructions.
 - 6.8.2.3 Accommodate valves and boxes.
 - 6.8.3 The trenches shall follow lines parallel to and equal distance from the pipe centerline.
 - 6.8.4 Trench widths shall be as required for the proper laying and jointing of pipes and proper placement and compacting of backfill.
 - 6.8.5 In areas requiring grading such as roads and streets, do not cut trenches until the final grading has been done unless directed otherwise in the drawings or by the City Engineer.
 - 6.8.6 Where D.I.P. is laid along or across streets or roadways or adjacent to houses or buildings, the sides of the trenches shall be vertical and protected against caving with suitable bracing and sheathing. See section [6.11 Shoring, Sheathing and Bracing](#). Before cutting any city or county road, obtain permission for each cut from the respective engineer's office.
 - 6.8.7 Where D.I.P. is laid through fields and undeveloped territory, the sides of the trenches may be sloped to prevent caving provided that the width of the trench at the top of the pipe must not exceed the inside diameter of the pipe plus 24 inches.
 - 6.8.8 Where D.I.P. crosses concrete or paved driveways, sidewalks or other areas as specified in the drawings or directed by the City Engineer, D.I.P. shall be installed by tunneling or boring.
 - 6.8.9 For pipe laid in tunnels, special instructions will be issued or drawings provided in the project drawings.

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- 6.8.10 No more than 200 feet of trench shall be opened at any time in advance of the completed water main nor shall more than 100 feet be left unfilled except by written permission from the City Engineer. The City Engineer may limit these distances by notifying the contractor in writing.
- 6.8.11 Where a sewer pipe, gas pipe, drain pipe or similar structure comes within the limits of the trench, such structures shall be supported properly. The City Engineer may direct the manner in which such structures shall be supported.
- 6.8.12 The contractor shall leave a path of at least two (2) feet in width on each side of the trench, between the trench and excavated material, to allow for free passage of the engineer or inspector to permit them to perform their work in an expeditious and satisfactory manner.
- 6.8.13 The contractor shall at all times be responsible for the condition of the trenches
 - 6.8.13.1 The contractor shall maintain frequent inspections of the trenches and repair settled or sunken places as soon as they are discovered.
 - 6.8.13.2 All soft or dangerous trenches shall be marked or barricaded and lighted at night for protection of the public.
- 6.8.14 If the contractor carelessly or otherwise digs the trench below the required grade, he will, at his expense, refill the trench to the proper grade with sand or gravel in compacted lifts not exceeding six (6) inches.
- 6.8.15 Placing of house service connections, installation of fire hydrants, pouring of thrust blocks (kickers), removal of excess excavated material, building of access bridges and general clean-up operations will be kept close behind the laying of the water main. The City Engineer may direct that the laying of the water main cease until these auxiliary operations are caught up.
- 6.9 Unsatisfactory subgrade.** Where indicated and/or where the subgrade material will not provide a sufficiently firm foundation to support the pipes and superimposed loads or contains ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material that in the City's opinion should be removed, remove the unsatisfactory material down to the depth indicated or required. See [section 6.6 Granular Drain, Pipe Embedment, Concrete Encasement, Concrete Foundation and Backfill Material](#).
- 6.9.1 Replace the unsatisfactory material with the specified drain rock, granular pipe embedment, granular backfill material, concrete encasement or concrete foundation.
- 6.9.2 No material shall be used until approved by the City Engineer. Material used prior to obtaining approval or measurement by the city representative shall not be paid for.
- 6.10 Maintaining drainage.** Provide and maintain in proper working order all necessary de-watering equipment for the removal of water from the excavation. Where the trench bottom is mucky or otherwise unstable because of ground water and in all cases where the static ground water elevation is above the bottom of the trench, lower the ground water level by using drain rock or other acceptable method as required to keep the trench free from water and the bottoms stable for pipe laying until the pipes have been installed properly and will be unaffected by submersion.

6.11 Shoring, sheathing and bracing. Adequately shore and brace trenches and other excavations as required to protect personnel, adjacent structures and adjacent property.

6.11.1 Where required by conditions encountered or as required by OSHA, brace trenches and excavations with suitable close sheeting or sheet piling.

6.11.2 Do all necessary cribbing up required for proper operation of trenching equipment.

6.11.3 Repair all damage resulting from inadequate or improper shoring, sheathing and bracing.

6.11.4 Sheathing or shoring that does not extend below the pipe centerline may be removed after the trench backfill has been placed and compacted to a level one (1) foot above the top of the pipe.

6.11.4.1 Immediately after removal, fill all resulting void spaces and re-compact the backfill.

6.11.4.2 Sheathing may be left in place only where specifically approved.

6.11.4.3 Cut the tops of sheathing left in place at an approved depth below finished grade.

6.12 Bedding for ductile iron water mains. Unless otherwise shown in the drawings, specified elsewhere in these specifications or directed by the City Engineer, bedding shall consist of the natural trench bottom providing firm support for the length of the joint with holes excavated in the bottom to facilitate the bell of pipes.

6.13 Installation of D.I.P. water mains.

6.13.1 General requirements.

6.13.1.1 Provide and use suitable equipment for safe and convenient handling of pipe, fittings, valves and other water piping material.

6.13.1.2 Provide suitable facilities and equipment for lowering the pipe into the trench without causing damage to the pipe or trench.

6.13.1.3 Do not drop or dump water piping material from transportation vehicles or into trenches.

6.13.1.4 Inspect each pipe and fitting for cracks and other defects prior to installation. Suspend each length above ground and ring with a light hammer to detect cracks. Remove all defective material from the job site.

6.13.1.5 Spigot ends, the inside of bells, gasket grooves, gaskets, glands, bolts and nuts must be clean and free of any foreign matter before installation and prior to joining pipe.

6.13.1.6 Do not install any work until excavations are free of water, mud, and loose earth.

6.13.1.7 Do not install any work on frozen ground.

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- 6.13.2 **Water and sewer separation.** No water pipe shall pass through or come in contact with any part of a sewer or sewer manhole.

6.13.2.1 **Horizontal Separation.**

- 6.13.2.1.1 Water mains shall be laid at least ten (10) feet from any sanitary sewer or sewer manhole.
- 6.13.2.1.2 If local conditions prevent the required horizontal separation, the water main may be installed closer if installed in a separate trench as the sewer main and the elevation of the top (crown) of the sewer is at least 18 inches lower than the bottom (invert) of the water main.

6.13.2.2 **Vertical Separation.**

- 6.13.2.2.1 Whenever water must cross sewer mains or sewer services, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer lines.
- 6.13.2.2.2 The water main shall be relocated to provide this separation or reconstructed with mechanical joint pipe for a distance of ten (10) feet on each side of the sewer. One (1) full length of D.I.P. will be centered over the sewer so that both joints will be as far from the sewer as possible.
- 6.13.2.3 **Unable to maintain separation.** When it is impossible to obtain the proper horizontal and vertical separations as stipulated above, the sewer main shall be constructed of mechanical joint ductile iron pipe and pressure tested to assure water tightness prior to backfilling. Pipe shall be centered at the point of crossing so that joints will be as far from each other as possible. When water mains must pass under sewers, provide adequate support for the sewers to prevent excessive deflection of joints or settling on and breaking the water mains.

6.13.3 **D.I.P. installation.**

- 6.13.3.1 Lay pipe in finished trenches and on stable foundations utilizing the bedding method specified or required to accommodate the conditions encountered.
- 6.13.3.2 Provide uniform full length support of pipe barrel at every point between bell holes.
- 6.13.3.3 Provide suitable indents in the bedding to facilitate joining and prevent bells or groove ends from bearing on trench bottoms.
- 6.13.3.4 Comply with the pipe manufacturer's installation requirements.
- 6.13.3.5 Maintain the trenches water-free and as dry as practicable during bedding, laying and joining and until the work will not be adversely affected by submergence.

6.13.4 Joining pipes.

- 6.13.4.1 All mating surfaces of each joint and all joint material shall be clean and dry.
- 6.13.4.2 Make all joints in strict accordance with the pipe and gasket manufacturer's printed directions, using the recommended lubricants, tools, jointing methods and laying methods.
- 6.13.4.3 Taper each field cut spigot end back approximately one-eighth (1/8th) of an inch and at a 30 degree angle to prevent gasket damage.
- 6.13.4.4 Mechanical joints shall be built in strict accordance with manufacturer's printed directions, using the recommended lubricants, tools and methods. Retainer type glands shall have the set screws tightened once the joint has been built up and properly aligned.
- 6.13.4.5 Maintain lengths of pipe between fittings and valves a minimum of three (3) times the pipe diameter, i.e., for eight (8) inch diameter pipe, there shall be at least 24 inches between fittings and valves (3 X 8 = 24).
- 6.13.4.6 As soon as possible after jointing, place sufficient backfill along each side of the pipe to prevent movement of the pipe.

6.13.5 Pipe alignment. Lay the pipe in straight trenches to follow the centerline of the trench as closely as possible, using appropriate fittings at all sharp breaks in grade and using appropriate fittings or deflecting joints and using shorter lengths of pipe as necessary to make the required curves. Do not deflect any joint in excess of the pipe manufacturer's recommendation.

6.13.6 Protection of Pipe.

- 6.13.6.1 Keep all dirt, trash and other foreign materials cleared from inside of pipes as it is being laid.
- 6.13.6.2 When pipe installation is not in progress, open pipe ends will be kept securely closed with approved caps or plugs to prevent the entrance of water, mud, other foreign material or small animals into any part of the pipe work.
- 6.13.6.3 Secure pipe to prevent displacement by movement of backfill, flotation or other causes.

6.13.7 Anchorage. Provide anchorage for each bend, tee, plug, dead-end, and other fitting subject to blowing off of the line under pressure. Dry blocking is not permitted. All anchorage shall be in place prior to applying pressure to lines.

6.13.7.1 Concrete blocking. Unless otherwise specified or directed by the City Engineer, anchorage shall consist of concrete blocking poured between firm undisturbed earth and the unbalanced sides of the items to be anchored.

- 6.13.7.1.1 Provide sufficient earth bearing surface to prevent displacement of joints under pressure.

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- 6.13.7.1.2 Provide a flexible plastic barrier between the concrete and any bolts or set screws to facilitate access for repairs.
- 6.13.7.1.3 Concrete shall meet the requirements of section [6.7 Concrete](#).
- 6.13.7.1.4 Concrete blocking, in addition to the required retainer glands, shall be used for all fire hydrant installations.
- 6.13.7.2 **Set screw or Megalug retainer glands.** When authorized for use, retaining glands shall be U.S., CLOW, ACIPCO, Ford or as approved ductile iron set screw type mechanical joint retainer gland, installed in accordance with the manufacturer's directions.
 - 6.13.7.2.1 Retaining glands shall be used where indicated on the drawings or as directed by the City Engineer.
 - 6.13.7.2.2 Retaining glands shall be used where concrete anchorage is not practical.
 - 6.13.7.2.3 Retaining glands, in addition to concrete blocking, shall be used for all fire hydrant installations.
 - 6.13.7.2.4 Tighten set screws uniformly to approximately 80 foot pounds torque or as directed by the manufacturer.
- 6.13.7.3 **Anchoring type tees.** Anchoring tees shall be as specified in section [6.3 Types of pipe](#). Anchor fire hydrant cut off valves directly to the locked-on gland rings of the tee outlet.
- 6.13.7.4 **Rodding.** Rodding may be used where the use of concrete may complicate future construction, such as the end of a line with a valve installed, or where added retention is desirable such as a series of vertical bends, and then only when shown on the drawings or directed by the City Engineer.
 - 6.13.7.4.1 Approved retaining glands shall be used when using rodding as anchorage.
 - 6.13.7.4.2 Only stainless steel rods, nuts and washers shall be used.
 - 6.13.7.4.3 A concrete anchor shall be used to anchor the rod.
 - 6.13.7.4.4 When the use of concrete is not practical, the rod shall be anchored to the next available fitting which provides positive retention.
 - 6.13.7.4.5 As-built drawings shall reflect that rodding has been used for anchorage.

6.14 Installation of valves and roadway boxes.

- 6.14.1 Install valves with their operating stems plumb and in the approximate position as indicated in the drawings or as directed by the City Engineer.

- 6.14.1.1 Fire hydrant cut off valves shall be installed directly on the spigot outlets of the anchoring tees in the water main.
- 6.14.1.2 All other valves shall be installed at the ends of radius at intersections and at locations in runs where they will be easy to locate.
- 6.14.1.3 Where curb and gutter is available, the valve location shall be shown on the face of the curb with a painted red "V" and the distance to the valve (example, V7) stenciled in three (3) inch lettering on a painted white square background. If the valve is behind the curb, a minus sign shall be placed in front of the number (example, V-7). Maintain markings until the project has been accepted by the City of Bartlett.
- 6.14.1.4 Where the operating nut is more than three (3) feet below finished grade, an operating nut extension of sufficient length shall be installed.
- 6.14.2 Roadway boxes shall be installed for every valve regardless of its location.
 - 6.14.2.1 Set and support each valve box so that no stress or shock can be transmitted to the valve.
 - 6.14.2.2 The valve box shall be set centered and plumb over the valve operating nut.
 - 6.14.2.3 The valve box shall be set flush with finished grade. For new subdivisions, it shall be set flush with the initial asphalt surface (base asphalt) and riser rings added at the time of final asphalt paving.
 - 6.14.2.4 A concrete pad two (2) feet by two (2) feet square and six (6) inches thick shall be used to secure the valve box regardless of location. For asphalt areas, the concrete shall be recessed below final grade enough to allow it to be covered by the final lift of asphalt. A precast concrete ring may be used for valve boxes located in unpaved areas outside the right of way.
- 6.15 Fire hydrant installation.** Unless otherwise shown on the drawings or directed otherwise by the City Engineer, fire hydrants shall be located at the intersections of private property lines, between the curb and sidewalks.
 - 6.15.1 All hydrant leads shall be six (6) inch D.I.P.
 - 6.15.2 Each hydrant shall be set on a four (4) inch thick, 18 inch square concrete slab in true plumb position with the bury line flush with the proposed grade to assure proper breakaway.
 - 6.15.3 Each hydrant shall be securely blocked or anchored to prevent it from blowing off of the lead. See section [6.13.7 Anchorage](#). Concrete shall not obstruct the hydrant drain holes.
 - 6.15.4 Each hydrant shall have a minimum of six (6) cubic feet of washed rock or 57 stone placed around the base of the hydrant to approximately 12 inches above the hydrant drain holes to facilitate proper drainage from the hydrant when the operating valve is closed.
 - 6.15.5 Hydrant extensions shall be used to adjust the hydrant to the required height.

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6.15.5.1 When authorized, where extensions are required because of abnormal or adverse job conditions beyond the contractor's control, or when indicated in the drawings, extensions shall be paid at the unit bid price.

6.15.5.2 Where extensions are required as a result of contractor error or negligence, all such hydrant extensions necessary for satisfactory installation of the hydrant shall be provided by the contractor at his own expense.

6.15.6 Above ground portions of each hydrant shall be provided one coat of the highest quality, outside silver enamel paint after setting, testing and final clean up.

6.16 Service connections. All residential, irrigation and commercial water service connections shall be installed to the size and locations shown on the drawings or as directed by the City Engineer. Refer to the standard drawing **Water Service Detail**.

Size of Water Main	Maximum size Direct Tap
6"	1"
8"	1 ¼"
10"	1 ½"
12"	2"

Table 9, Maximum Size Direct Tapping

6.16.1 Unless otherwise shown on the plans or directed otherwise, each service shall be three-quarter (3/4) inch in size and consists of:

6.16.1.1 One (1) Mueller B-25008N or approved equivalent corporation stop with Mueller 110 or approved equivalent compression nut.

6.16.1.2 One (1) Type K soft copper tubing service pipe from water main to meter location, length as required.

6.16.1.3 One (1) Mueller B-21570RN or approved equivalent curb stop with Mueller 110 or approved equivalent compression nut.

6.16.1.4 One (1) curb stop lock with dust cap (to be purchased from the City of Bartlett Water Department).

6.16.2 Where a service terminates 40 feet or more from the water main, the service shall be one (1) inch in size and consist of the same items as listed above but sized for the one (1) inch service, with a reducer bushing installed in the curb stop to allow connection of a three-quarter (3/4) inch water meter.

6.16.3 Connect services to the water main using corporation stops at an angle of 45 degrees from vertical. When the service must cross a deep side ditch, the corporation may be installed in the horizontal position.

6.16.4 Where the service size exceeds the maximum allowable size direct tap for the water main involved (refer to *Table 9, Maximum Size Direct Tapping*), an approved tapping tee with the appropriate corporation stop shall be used. Refer to [Appendix D Standard List of Approved Water Main Fittings and Accessories](#) for a list of approved tapping sleeves.

6.16.5 All metered services shall be made as separate connections into the water main.

- 6.16.6 When authorized for use, couplings shall be Mueller H-15403N compression or an approved equivalent. Couplings shall not be used when the copper is commercially available in lengths required for the service.
- 6.16.7 Where a service line must cross existing concrete or asphalt, install the service by jacking a pilot hole or boring and then pulling the service pipe into place through the hole formed thereby.
- 6.16.8 Where service pipe passes under a railroad or highway, comply with the requirements specified in section [6.19 Railroad crossings](#) or [6-20 Highway crossings](#) as appropriate.
- 6.16.9 Terminate each service at the property line or right of way with the curb stop at the proper elevation and no deeper than 15 inches from finished grade for the water meter connection.
 - 6.16.9.1 Where curb and gutter are installed, the service shall terminate behind the curb for meter installation between the curb and sidewalk.
 - 6.16.9.2 Where no curb and gutter are installed, the end of the service shall be marked with a metal tee post painted blue.
 - 6.16.9.3 Where curb and gutter is available, the service location shall be shown on the face of the curb with a painted red "W" stenciled in three (3) inch lettering on a painted white square background.
 - 6.16.9.4 Maintain service location metal tee posts or stencils until the project has been accepted by the City of Bartlett or the meter and box have been set, whichever is the earlier.
- 6.17 Meter and boxes.** Unless otherwise shown in the drawings or directed by the City Engineer, meter and boxes shall be furnished and installed by the City of Bartlett.
 - 6.17.1 Where meter and boxes are to be installed by the contractor, the City of Bartlett shall provide the meters and boxes to the contractor.
 - 6.17.2 The contractor shall be solely responsible for the care and safekeeping of meter and boxes provided to them and shall be responsible for the cost of any item that must be replaced because of their negligence.
 - 6.17.3 After installation, the contractor shall provide a list of addresses and the serial number of the meter installed at that address to the City of Bartlett.
- 6.18 Backfill and cleanup.** Trenches and other excavations shall not be backfilled until the City has approved the pipe or other work or unless specifically altered or changed in the Special Provisions of an awarded contract with the City of Bartlett. Unless specified elsewhere or directed by the City Engineer, testing is not required prior to backfill.
 - 6.18.1 General Requirements.** General requirements apply to all backfill locations unless specifically altered or changed in the Special Provisions of an awarded contract with the City of Bartlett or noted otherwise in the specific requirements for the area being backfilled.
 - 6.18.1.1 The material for backfilling, unless otherwise specified, shall be sand, earth, loam or gravel from trenches and free of stones, broken concrete or asphalt larger than three (3) inches in diameter.

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- 6.18.1.1.1 Before placing any backfill, all rubbish, forms, blocks, wires or other unsuitable materials shall be removed from the excavation.
- 6.18.1.1.2 Backfill material up to three (3) feet above the top of the pipe shall not exceed six (6) inches in diameter at its greatest dimension.
- 6.18.1.2 As soon as the pipe has been laid and jointed, the pipe is to be bedded in the trench and made secure against movement by backfilling to the top of the pipe with approved backfill material for the area being backfilled and compacted to 98% STD proctor (ASTM). Refer to section 6.18.2 for type of backfill material.
 - 6.18.1.2.1 The backfill is to be placed by hand in six (6) inch loose lifts and tamped around the pipe with heavy iron tampers or pneumatic tampers, making certain that fill material is compacted around the haunches of the pipe.
 - 6.18.1.2.2 Once the material is tamped to top of pipe, continue the process of backfilling to a point 12 inches above the top of the pipe.
- 6.18.2 **From a point 12 inches above the top of the pipe**, backfill shall be placed in one of the following methods depending upon the location of the pipe.
 - 6.18.2.1 **Water lines crossing streets, roads or driveways in regular use.** Water lines laid in areas that are paved, including gravel and dirt roads and driveways in regular use, shall be backfilled with sand or gravel meeting the requirements of [section 6.6.5 Backfill material](#). Water jetting is not permitted.
 - 6.18.2.1.1 Backfill to within 12 inches of the finished surface in lifts not exceeding six (6) inches in depth.
 - 6.18.2.1.2 Each lift is to be compacted to 98% Standard Proctor (ASTM).
 - 6.18.2.1.3 Immediately place concrete, approved gravel or cement treated base (CTB), depending upon the pavement section, to within two (2) inches of the finished surface. Gravel is to be compacted to 98% STD proctor (ASTM).
 - 6.18.2.1.4 Road plates will be required until the cement or CTB has cured.
 - 6.18.2.1.5 If paving can not be accomplished on the same working day, place two (2) inches of cold tar asphalt on the gravel base and level with the existing paved surface.
 - 6.18.2.1.6 For pavement, after a minimum of five (5) days, remove the plates or cold tar asphalt and install asphaltic concrete (hot mix) compacted to a minimum of 90% of maximum laboratory density until flush with existing surface. The

appropriate asphaltic prime coat shall be applied to the base and joints prior to laying the asphalt.

6.18.2.1.7 For gravel or dirt roads and driveways, after a minimum of five (5) days, remove the plates and install limestone gravel until flush with the existing surface.

6.18.2.1.8 Concrete driveways will be repaired or replaced in kind.

6.18.2.1.9 Maintain these crossings usable to vehicle traffic until acceptance by the City of Bartlett.

6.18.2.1.10 Do not leave a street, road or private driveway unusable overnight.

6.18.2.2 **Water lines in areas to be paved.** Unless otherwise directed in the drawings or by the City Engineer, the contractor is permitted to backfill the remaining trench using one or both of the methods described below.

6.18.2.2.1 The remaining trench may be backfilled in compacted lifts not exceeding eight (8) inches.

6.18.2.2.1.1 Backfill material can be any material excavated from the trench complying with the requirements listed in [section 6.18.1.1](#).

6.18.2.2.1.2 Each lift is to be compacted to 98% Standard Proctor (ASTM).

6.18.2.2.2 If the area is not to receive the gravel or cement treated base immediately and trenches have ample time to settle and dry prior to placing the base, water jetting may be utilized.

6.18.2.2.2.1 Backfill material can be any material excavated from the trench complying with [section 6.18.1.1](#) and water jetting utilized to achieve compaction.

6.18.2.2.2.2 Refill and smooth the backfill as it settles.

6.18.2.2.3 In neither instance will the base be placed over trenches that have not properly settled, have excessive moisture or have moderate to excessive pumping.

6.18.2.3 **Water lines in other areas.** Water lines laid in other areas shall continue to be backfilled to finished grade in compacted lifts not exceeding 12 inches in depth.

6.18.2.3.1 The remaining fill can be any material excavated from the trench complying with the requirements listed in [section 6.18.1.1](#).

6.18.2.3.2 Avoid using pressures that may damage the water lines.

6.18.2.3.3 Water jetting is required.

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- 6.18.2.3.4 After sufficient settlement satisfactory to the City of Bartlett has occurred, complete the surface dressing, removal of surplus material and surface clean-up.
- 6.18.3 The complete backfilling operation will not be paid for directly but all costs involved will be included in the price bid per linear foot of various size pipes complete and in place.
 - 6.18.3.1 When the City Engineer directs additional backfill material to be placed in the trench more than 12 inches above the top of the pipe, it shall be placed to the limits of his direction and brought to a condition of maximum compaction.
 - 6.18.3.2 The actual amount of backfill material placed from 12 inches above the top of the pipe to the ground line or the depth directed for the length directed with the trench width based upon the maximum trench width at the top of the pipe will be paid for at the unit bid price per cubic yard of [Engineer directed backfill](#).
- 6.18.4 After the trenches have been properly backfilled, all excess material shall be removed from the streets and roadways and from improved private property so that pavements may be replaced and properties cleaned up.
 - 6.18.4.1 In open fields and unimproved property, the excess dirt shall be spread out or used to fill low spots on property adjacent to the right of way or easement.
 - 6.18.4.2 Such spreading or filling shall be done in such a manner that it will not obstruct surface drainage and is satisfactory to the property owner.
- 6.18.5 Refill and smooth off, as required, all backfill which settles so that all backfill conforms to the original ground surfaces.
 - 6.18.5.1 The contractor shall maintain frequent inspections of the backfill throughout the time of the project and the warranty period and repair any settlement as soon as it is discovered.
 - 6.18.5.2 Repair shall include the removal and replacement of all damaged asphalt or concrete and installation of sod or seeding and mulch.
- 6.18.6 For all pipes in tunneled or bored holes without casings, backfill only with sand. Thoroughly tamp or otherwise place the backfill in an approved manner to prevent caving and settlement.
- 6.18.7 Cleanup shall be performed as the work progresses.
 - 6.18.7.1 Negligence in proper cleaning up which causes undue inconvenience to citizens, presents an unsightly or dangerous condition, or causes embarrassment to civic officials will be sufficient reason for rejection of construction estimates or work shut down until the unsatisfactory conditions have been remedied.
 - 6.18.7.2 After all work is completed, make a final cleanup of all areas where work has been done and where equipment and materials have been stored and leave them in broom clean condition.

6.19 Railroad crossings. Before commencing work within the railroad right of way, obtain permission from the railroad company involved for each required crossing of the railroad tracks by water lines or services.

6.19.1 Do all work within the railroad right of way under the supervision of the railroad company involved and in strict accordance with their requirements.

6.19.1.1 Do not place any excavated material, construction material, construction equipment or any other items on the tracks or any other location within the railroad traffic clearance limits.

6.19.1.2 Arrange all work to conform to the railroad operating schedules and avoid all unnecessary interference therewith.

6.19.1.3 As soon as practical, after installation of each water line across the railroad tracks, restore all railroad property at those locations to at least the conditions existing prior to beginning work.

6.19.1.4 The contractor shall be responsible for all charges from the railroad company for supervising water work on their property.

6.19.2 Where indicated on the drawings or as directed by the railroad company, provide pipe casings around each water main and each service pipe which cross railroad tracks. Refer to section [6.21 Water Main Boring and Encasement Requirements](#).

6.19.2.1 Length of casings shall be as indicated on the drawings or as required by the railroad company.

6.19.2.2 Bore holes under the railroad tracks and install the casings through these holes.

6.19.3 When casings are not indicated on the drawings or required by the railroad company, install the water main or service under the railroad tracks by boring the smallest practical diameter hole and install the pipe through the hole by methods that will positively prevent damage to pipes and prevent separation or excessive deflection of pipe joints.

6.20 Highway crossings. Before commencing work within the highway right of way, obtain permission from the Tennessee Department of Transportation (TDOT) for each required crossing of the highway by water mains and services.

6.20.1 All work within the highway right of way shall be conducted under the supervision of the TDOT and in strict accordance with their requirements.

6.20.1.1 Do not place any excavated material, construction material, construction equipment or any other items on the highway pavement or any other location within the highway traffic limits.

6.20.1.2 Arrange all work to avoid all unnecessary interference with highway traffic.

6.20.1.3 As soon as practical, after installation of each water line across the highway, restore all highway property at those locations to at least the conditions that existed prior to beginning work.

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6.20.2 Where indicated on the drawings or as directed by the TDOT, provide pipe casing around water mains and services which cross the highway. Refer to section [6.21 Water Main Boring and Encasement Requirements](#).

6.20.2.1 Length of casings shall be as indicated on the drawings or as required by the TDOT.

6.20.2.2 Bore holes under the pavement and shoulders and install casings through these holes. Open cut will only be permitted beyond the limits of the pavement and shoulders.

6.20.3 When casings are not indicated on the drawings or required by the TDOT, install the water main or service under the highway by boring the smallest practical diameter hole and install the pipe through the hole by methods that will positively prevent damage to pipes and prevent separation or excessive deflection of pipe joints.

6.21 Water Main Boring and Encasement Requirements. Water mains and services shall be installed in bores when directed or when it is not practical to use open cut methods.

6.21.1 Water main and service bores shall be made at the depth and lengths specified on the drawings or as directed by the City Engineer or as required by the owning railroad company (for railroad crossings) or the TDOT (for highway crossings).

6.21.2 When no encasement is indicated on the drawings or required by others, bore holes shall be in the smallest practical diameter. Install the pipe through the hole in such a manner as to prevent damage to the pipes and separation or excessive deflection of pipe joints.

6.21.3 When encasement of water mains is required, the casings shall be one-quarter (1/4) inch minimum wall thickness black steel pipe.

6.21.3.1 The inside diameter of the casing shall be at least four (4) inches larger than the outside diameter of the water pipe bells.

6.21.3.2 All casing joints shall be welded.

6.21.3.3 Install pipes in the casings by using casing spacers that will positively prevent separation of pipe joints and damage to pipes.

6.21.3.4 If the casing is to be filled with grout or flowable fill, the spacers shall be such to preclude "floating" of the pipe.

6.21.3.5 Casing spacers shall be approved by the City of Bartlett prior to use.

6.21.3.6 The ends of casings shall be positively sealed against water or dirt intrusion using brick and mortar or other approved methods.

6.21.4 When encasement of water services is required, the casings shall be black steel pipe with threaded and coupled joints.

6.21.4.1 The inside diameter of the casing shall be at least one (1) inch larger than the outside diameter of the service pipe or coupler (if approved for use).

6.21.4.2 The ends of casings shall be positively sealed against water or dirt intrusion using brick and mortar or other approved methods.

6.22 Connections to Existing Water Systems. Unless otherwise indicated on the drawings or authorized by the City of Bartlett, make connections to existing water systems by removing plugs from an existing plugged fitting, inserting a tee and proper sleeve in the existing water main (non-pressure connection), or utilize an approved tapping sleeve and valve to tap an existing water main (pressure connection or wet tap).

6.22.1 Contractors shall not operate any valve connected to an existing water system without the approval and the presence of a City of Bartlett representative.

6.22.2 There shall be no interruption of water service to make connections to existing water systems without prior notification to those who shall be affected by the interruption. When practical, provide a minimum of 24 hours notice.

6.22.3 Prior to shutting down existing water mains, obtain approval from the City of Bartlett Water Department and the City of Bartlett Fire Department. Under certain conditions, such as an inability to match the supply to the demand, water shutoffs may need to be delayed until conditions permit the water shutoff.

6.22.4 When existing water service must be interrupted to connect to existing water systems, the work shall be planned and the material to perform the work must be available on site in order to restore water service as quickly as possible.

6.22.5 All connections to existing water systems shall be performed with a City of Bartlett representative present.

6.22.6 Pressure connections may be made by installing a mechanical joint split tapping sleeve and valve or a stainless steel, full circle gasket tapping tee and valve. Refer to [Appendix D, Standard List of Approved Water Main Fittings and Accessories](#).

6.22.7 Install all tees, sleeves, tap sleeves and tap valves in accordance with the manufacturer's printed directions, using the recommended tools and materials from same.

6.22.8 Any damage occurring to the existing water system mains or services resulting from connecting to the system shall be repaired by the contractor, to the specifications and satisfaction of the City of Bartlett, and at no expense to the City of Bartlett.

6.23 Testing and Sterilization. After backfilling and prior to acceptance of the new water system by the City of Bartlett and opening to existing water systems, all pipes shall be tested for leakage and for bacteriological contamination.

6.23.1 Do not open the sectionalizing valves between the new water system and the existing water system until the bacterial analysis of the new water systems involved have been approved by the City of Bartlett.

6.23.1.1 Valves shall only be operated with approval from the City of Bartlett and with a City of Bartlett representative present.

6.23.1.2 Valves may be opened only as required to admit water into the new system for testing, sterilizing and flushing.

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6.23.2 **Hydrostatic Testing.** Hydrostatic testing shall be used to test the new system for leaks and shall be performed with a City of Bartlett representative present.

6.23.2.1 Admit water slowly into the section being tested, expelling air through approved corporation stops installed in the high points of the pipe and through other openings as required.

6.23.2.2 After all air has been expelled, apply a pressure equal to 1.5 times the working pressure of the pipe, not to exceed 150 PSI, and maintain it for not less than two (2) hours.

6.23.2.3 Leakage shall not exceed that permitted by AWWA Standard C600 for mechanical joint and push on joint pipe as given by the following formula:

$$L = \frac{ND(P).5}{7,400}$$

Where L is the allowable leakage in gallons per hour.

N is the number of pipe joints in the section.

D is the nominal pipe diameter in inches.

P is the average test pressure in PSI.

6.23.2.4 Should the measured leakage exceed the maximum specified allowable leakage, locate and repair the leaks and repeat the test on sections of pipe involved until all tests have been passed.

6.23.2.5 The contractor shall provide all approved testing equipment to include:

6.23.2.5.1 A suitable pump to apply and maintain test pressure.

6.23.2.5.2 Accurate pressure gauges.

6.23.2.5.3 Suitable equipment to measure volume of water pumped into system to maintain the test pressure.

6.23.2.5.4 A copy of AWWA Standard C600, which shall be maintained on the job and in good condition for computing the permissible leakage in each section tested.

6.23.3 **Sterilization.** Sterilization shall be conducted in accordance with AWWA Standard C651-14 and consists of the introduction of sufficient chlorine into the system to provide chlorine strength of not less than 50 PPM throughout the entire system using either liquid chlorine or a chlorine bearing compound similar to HTH chlorinating granules.

6.23.3.1 Determine the required quantity of chlorinating agent in accordance with the manufacturer's directions and AWWA C651-14 for the calculated volume of water to be tested.

6.23.3.2 Chlorine bearing compounds may be introduced into the system as pipe laying is performed.

6.23.3.3 Inject chlorine solutions into the system through corporation stops installed at the proper locations in the pipe line or by other approved means.

- 6.23.3.4 The chlorine solution shall be retained in the system for not less than 24 hours.
- 6.23.3.5 Testing for residual chlorine shall be performed after the 24 hour retention period in accordance with AWWA C651-14, Section 4.3 or 4.4, as applicable, to insure a minimum 0.2 residual is achieved.
- 6.23.4 **Bacteriological Testing.** After the sterilization retention period, the chlorinated water shall be thoroughly flushed out of the system from its extremities and water samples taken from approved locations for bacteriological testing. See AWWA C651-14, Section 5.1.
 - 6.23.4.1 Water samples shall be analyzed for bacterial purity by an approved laboratory.
 - 6.23.4.2 Continue the process of flushing and testing until the samples indicate that the water is free of contamination and safe for domestic use.
- 6.23.5 Water for testing, sterilization and flushing shall be furnished by the City of Bartlett from existing water facilities without cost to the contractor.
 - 6.23.5.1 The contractor shall furnish all piping and equipment to convey the water to the new water system.
 - 6.23.5.2 The contractor shall maintain a record of what items were opened to flush the lines and how long flushing was performed.
 - 6.23.5.3 The flush record shall be provided to the City of Bartlett.
- 6.23.6 If corporation stops were installed specifically to facilitate testing and sterilization, they shall remain in place with the outlets plugged. Any copper and curb stops installed on said corporations shall be removed.
- 6.24 **Service, Valve and Hydrant Check.** After completion of all work and testing and prior to acceptance, a final check of each water service, valve and hydrant installed as part of the project and each existing valve that has been operated in connection with this project shall be checked.
 - 6.24.1 All checks shall be performed in the presence of a City of Bartlett representative.
 - 6.24.2 Each water service shall be checked for water flow and then locked using the approved curb stop lock purchased from the City of Bartlett Water Department.
 - 6.24.3 Each valve shall be operated and demonstrated to be in the fully open or closed position, consistent with its intended purpose.
 - 6.24.4 Each fire hydrant shall be operated to fully open and then closed.
- 6.25 **Pavement Repair – City Streets and Roads.** Immediately after installing each water line across a city street or road, restore that street or road (to include the right of way at that location) to at least the conditions which existed prior to the water line work and to the satisfaction of the City of Bartlett. Refer to section [6.18 Backfill and Cleanup](#).
- 6.26 **Trenching, Pipe Laying, Backfilling and Pavement Repair – County Roads.** Immediately after installing each water line across a county road, restore the road and its

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right of way at that location to at least the conditions which existed prior to beginning the water line work and to the satisfaction of the County.

6.26.1 The county standard drawing **Typical Roadway Trench** shall be used for all phases of work within the county right of way.

6.26.2 For those phases of work not shown on the county standard drawing, comply with the applicable portions of these standards.

6.27 Cutting and Replacing Pavement and other Special Surfaces. Restore all surfaces disturbed by the water line installation to at least the conditions which existed prior to the beginning of the water line work.

6.27.1 As each surface is being cut, the city inspector shall examine the existing surface with the contractor. The type of surface to be replaced shall be determined by mutual agreement of the inspector and contractor.

6.27.2 The maximum width of all pavement and other surface repairs allowable for payment by the city shall be the maximum trench width at the top of the pipe (as previously defined) plus 12 inches.

6.27.2.1 The contractor shall be responsible for all repairs outside this limit.

6.27.2.2 If the area to be repaired does not reach this limit, the city will pay only for the actual extent of the repairs.

6.27.3 Replace existing surfaces which are cut, removed, or otherwise damaged by the water line work with new surfaces.

6.27.3.1 Existing gravel surfaces shall be replaced with a six (6) inch thick concrete cap.

6.27.3.2 Existing city and county streets and roads shall be repaired as specified in the applicable sections above.

6.27.3.3 Unless otherwise approved, concrete surfaces shall not be cut but shall have pipe installed by tunneling or boring. If cut, replace them with:

6.27.3.3.1 A six (6) inch thick compacted base of new gravel.

6.27.3.3.2 A surface course of 4000 PSI concrete equal in thickness to that adjoining the concrete surface course.

6.27.3.3.3 Type of concrete used will match the existing concrete, i.e., washed stone, pea gravel, limestone, etc.

6.27.4 Where pipe is installed on the shoulders parallel to asphalt, concrete or other surfaces, maintain ditches until they are firm and present no traffic hazard. Where authorized, place six (6) inch thick compacted layers of new road gravel.

6.27.5 Do not cut streets or other surfaces except where necessary for water line installation.

6.27.5.1 Damage outside of the limits specified above shall be repaired at the contractor's expense and to the satisfaction of the City Engineer.

6.27.5.2 All crossings shall be maintained by the contractor until project completion and the end of the warranty period.

6.28 Adjustment of Utilities. Field adjustments to any utility lines or apertures such as valves, fire hydrants, meter boxes, etc. shall be accomplished by the contractor and the cost of such adjustments will be considered as incidental to the project costs. When adjustment rings are required for water valve roadway boxes, they shall be SIGMA 2600 series risers (or an approved equivalent) of the appropriate thickness to adjust the valve box top to grade. When adjustment rings are required for drain or sewer manholes, they shall be SIGMA MH-2710 or MH-2715 (or an approved equivalent) to adjust the manhole top to grade.

6.29 Measurement and Payment. Payments will be made to the nearest complete unit as listed in the proposal. Quantities submitted for payment shall be rounded to the nearest foot, yard, or other applicable unit.

6.29.1 Pipe, Ductile Iron, in open cut. Paid for at the unit bid price per linear foot of pipe, of the size specified, in place in open cut trenches or excavations, measured along the top centerline of the pipe between intersecting centerlines or ends of pipes and through fittings and valves.

6.29.2 Pipe, Ductile Iron, in bore (no casing required). Paid for at the unit bid price per linear foot of pipe, of the size specified, in place within bored, jacked or tunneled holes more than five (5) feet long, without pipe casing, measured along the top centerline of the pipe for the full length of the bored, jacked or tunneled hole. The boring, jacking or tunneling shall not be paid for separately but shall be included in the cost of the pipe. No payment shall be made for any pipe in excess of the lengths indicated on the drawings or authorized. Pipe in bored, jacked or tunneled holes that are five (5) feet or fewer in length shall be classified and paid for as **Pipe, Ductile Iron, in open cut**.

6.29.3 Pipe, Ductile Iron, in casing. Paid for at the unit bid price per linear foot of pipe, of the specified size, in place in pipe casing, measured along the top centerline of the pipe for the full length of the casing. The bore and casing shall not be paid for separately but shall be included in the cost of the pipe. Spacers, casing end seals and, when specified in the drawings, grout or flowable fill shall be considered incidental to the work. No payment shall be made for any pipe in casing in excess of the lengths indicated on the drawings or authorized.

6.29.4 Ductile Iron and Cast Iron Fittings. When specifically listed in the proposal, paid for at the unit bid price per pound of fittings in place, as established by the invoice weight of the fittings on the basis of ANSI/AWWA C110 published body of bolts, nuts, glands, gaskets or cement linings; or at the unit bid price of each of the specified fitting of the specified size in place which shall include body, nuts, bolts, washers, glands (including retaining type), gaskets and installation. Does not include tap sleeves used for pressure connections which shall be paid for as described in **Pressure Connections**. When not specifically listed in the proposal, these items are not paid for separately but are considered incidental to the work and the cost shall be included in the various unit bid prices for pipe and other related items.

6.29.5 Valves and Boxes. Paid for at the unit bid price for each valve of the specified size and its box in place. Includes concrete pad and extensions. Does not include tapping type valves and their associated box, which shall be paid for as described in **Pressure Connections**.

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- 6.29.6 **Fire Hydrants.** Paid for at the unit bid price for each hydrant in place, complete with base support, anchorage, drainage gravel and painting, based upon standard three (3) or four (4) foot bury hydrants.
- 6.29.7 **Fire Hydrant Extensions.** Paid for at the unit bid price per linear foot of hydrant extensions, in place. No payment shall be made for unauthorized hydrant extensions (see section [6.15 Fire Hydrant Installation](#)).
- 6.29.8 **Fire Hydrant Leads.** Paid and measured as specified for **Pipe, Ductile Iron, in open cut.**
- 6.29.9 **Connections to Existing Plugged Valves or Lines.** Unless specified otherwise in the proposal, no separate payment. Cost shall be included in the various unit bid prices. Pipe and fittings involved in the connection shall be paid for as specified hereinbefore.
- 6.29.10 **Non-Pressure Connections.** Unless specified otherwise in the proposal, no separate payment. Cost shall be included in the various unit bid prices. Pipe and fittings involved in the non-pressure connection shall be paid for as specified hereinbefore.
- 6.29.11 **Pressure Connections.** Paid for at the unit bid price for each complete pressure connection of the size specified made to existing water mains, while the main is in service and under pressure. Includes the tap sleeve, tap valve, tap valve box with concrete pad, required hardware, in place, with the appropriate size hole cut into the existing water main. For payment purposes, the size of the tap valve shall determine the size of the pressure connections as shown on the proposal. Pressure connections for water services shall not be paid under this item but shall be included under item **Single Service Unit.**
- 6.29.12 **Single Service Unit.** Paid for at the unit bid price for each complete single service unit of the size specified in place. Includes tapping, corporation stop and fittings required to attach the corporation to the water main, curb stop, meter coupling, service pipe couplings and fittings, adapters, excavation and backfill. Includes service pipe when service pipe is not listed separately on the proposal. This item will not be paid when the service is installed to facilitate testing of the water main.
- 6.29.13 **Service Pipe, in open cut.** Normally included in the unit bid price for **Single Service Unit.** When listed separately, paid for at the unit bid price per linear foot of service pipe of the size specified in place in open trenches or open cut excavations, measured from the center of the water main to the end of the pipe, and through fittings and stops. This item will not be paid when the service is installed to facilitate testing of the water main.
- 6.29.14 **Service Pipe, Bored (no casing required).** Paid for at the unit bid price per linear foot of service pipe of the size specified in place within bored, jacked or tunneled holes more than five (5) feet long, without pipe casing, measured for the full length of the bored, jacked or tunneled hole. The boring, jacking or tunneling shall not be paid for separately but shall be included in the cost of the pipe. No payment shall be made for any pipe in excess of the lengths indicated on the drawings or authorized. Service pipe in bored, jacked or tunneled holes that are five (5) feet or fewer in length shall be classified and paid for as **Service Pipe, in open cut.**

- 6.29.15 **Service Pipe, in casing.** Paid for at the unit bid price per linear foot of service pipe of the size specified in place in pipe casing. The bore and casing shall not be paid for separately but shall be included in the cost of the pipe. Spacers and casing end seals shall be considered incidental to the work. No payment shall be made for any service pipe in casing in excess of the lengths indicated on the drawings or authorized.
- 6.29.16 **Drain rock, granular embedment material and granular backfill material.** This item is not normally paid as a separate item but is included in the various unit bid prices of the items involved. When listed separately on the bid tabulation sheet, paid for at the unit bid price per ton of loose material in place, as evidenced by delivery tickets signed by the city representative. Tickets must be delivered at time of pay request. No payment will be made for drain rock used for unsatisfactory subgrade unless the use was approved by the City Engineer, in which case, the cost of extra depth excavation below planned grade and compaction shall be included in the unit price bid for drain rock.
- 6.29.17 **Encasement concrete.** Paid for at the unit bid price per cubic yard in place. Measurement shall be actual amount used to the limits and dimensions specified on the drawings or as directed by the City Engineer. No payment shall be made for material in excess of the dimensions specified. Copies of the delivery tickets signed by the city representative are to be included with the pay request. The cost of forms and extra excavation below the planned grade shall be included in the unit price bid for encasement concrete.
- 6.29.18 **Foundation concrete.** Paid for at the unit bid price per cubic yard in place. Measurement shall be the actual amount used to the limits and dimensions specified on the drawings or as directed by the City Engineer. No payment shall be made for material in excess of the dimensions specified. Copies of the delivery tickets signed by the city representative are to be included with the pay request. The cost of forms and extra excavation below the planned grade shall be included in the unit bid price.
- 6.29.19 **Road gravel in place.** Paid for at the unit bid price per cubic yard of compacted road gravel in place. Measurement shall be the actual surface area covered with a compacted layer to the indicated, specified or otherwise authorized thickness. Includes base courses under pavement and special surface repairs. No payment shall be made for any road gravel placed without the City of Bartlett authorization or placed outside of the specified payment limits. Copies of the delivery tickets signed by the city representative are to be included with the pay request.
- 6.29.20 **Replacement of pavement and special surfaces.** Paid for at the unit bid price per square yard in place. Measurement shall be the actual areas repaired. No payment will be made outside the specified payment limits. Does not include gravel base courses which shall be paid separately as noted above.
- 6.29.21 **Extra depth excavation.** No payment shall be made for extra depth excavation that may be required to permit piping to pass under obstructions regardless to whether the obstructions are indicated on the drawings or not. When extra depth excavation is authorized and required to facilitate the removal of unsatisfactory subgrade, it shall not be paid for directly but shall be included in the cost of the material used to replace the unsatisfactory subgrade.

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- 6.29.22 **Gaskets, bolts, nuts, mechanical joint glands, compounds, lubricants, cements, joint material, iron fittings, trenching, excavating, boring, tunneling, backfilling, jacking, removal of existing pavement, testing, removal and replacement of sod and fences, and other miscellaneous items.** No separate payment will be made unless specifically indicated in the proposal. These items are incidental to the work and the cost shall be included in the various unit bid prices for pipe and other related items.
- 6.29.23 **Engineer directed backfill.** Paid for at the unit bid price per cubic yard of the type specified. Measurement shall be from 12 inches above top of pipe to the ground line or to the depth directed and for the length directed and for the width based upon the maximum trench width for the size of pipe involved at the top of pipe or the width otherwise directed. Copies of the delivery tickets signed by the city representative are to be included with the pay request.

- 7 Roadway Base.** The base shall be of the cross section, lines, grades and arrangements indicated on the drawings and of the minimum thickness specified. Maintain the base in good condition until the asphaltic concrete or concrete surface has been placed thereon. Concrete surfaces, i.e., curbs, gutters, water tables, etc., shall only be placed upon base when indicated on the drawings or otherwise directed. Repair all faulty areas immediately prior to placing the surface material over the base. If at any time during the construction of the base the City of Bartlett representative believes the application rates or compaction are not meeting the required specifications, additional testing may be ordered. Such testing will be at the contractor's expense.

Compaction Requirements			
Type of Fill	Std. Proctor ASTM	Mod. Proctor ASTM	Proof Rolling Gross WT. Lbs.
Compacted fill under buildings and structures	98%	95%	50,000
Compacted fill under roadway base or other areas to be paved	98%	95%	40,000
Roadway base	98%	95%	50,000
Compacted fill in levees and dikes	98%	95%	50,000
Compacted fill in over lot areas	95%	90%	40,000
All compactor test costs shall be borne by the contractor. Locations or number of tests are to be indicated on the construction plans as approved by the Engineering Department or as directed by the City Engineer.			
<i>Table 10, Compaction Requirements</i>			

- 7.1 Subgrade preparation.** Before placing or constructing the base, grade and shape the subgrade to the required lines and grades indicated on the drawings.
- 7.1.1 Remove all unsuitable soil and replace with acceptable soil.
 - 7.1.2 The subgrade shall be firm and able to support the construction equipment and specified compaction without displacement.
 - 7.1.3 The subgrade shall be proof rolled in the presence of a City of Bartlett representative prior to the base being placed or constructed using a pneumatic-tired, dual wheel, tandem axle truck having a gross weight as indicated in *Table 10, Compaction Requirements*.
 - 7.1.3.1 Proof rolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tires tracks covering the entire area being proof rolled.
 - 7.1.3.2 All soft spots will be cut out and repaired prior to any building or placing of base material for roads or parking lots. Mixing of soil cement without removing the unsatisfactory material in an effort to bridge soft spots is not acceptable.
- 7.2 Clay Gravel Base.** Gravel bases shall not be placed over trenches that have not properly settled, have excessive moisture or have moderate to excessive pumping.
- 7.2.1 **Thickness.** Unless otherwise shown on the drawings or directed otherwise, the gravel base shall be placed to the compacted thickness specified below.
 - 7.2.1.1 For right of ways less than 60 feet in width, the base shall be at least six (6) inches thick after compaction.

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7.2.1.2 For right of ways 60 feet or more in width, the base shall be at least eight (8) inches thick after compaction.

7.2.1.3 For right of ways over 60 feet in width, the base shall have cement incorporated into the gravel at a rate of eight (8) to ten (10) percent cement by weight of gravel at thicknesses as specified in the plans. Comply with the applicable portions of section **7.3 Soil Cement Base**.

7.2.2 **Material.** Gravel base materials shall be road type gravel, consisting of hard durable particles or fragments of granular aggregates mixed or blended with fine sand, clay or crushed stone meeting the requirements in *Table 11, Gravel Base Gradation*. Pit run materials may be used provided that it conforms to the specified requirement. If the binder is insufficient to bond the aggregate properly, add a satisfactory binding material to make the resultant mixture comply with these specifications.

Gradation	
Sieve Size	Percent passing
2"	100
1-1/2"	95-100
3/8"	40-65
No. 40	10-30
Clay content as determined by 1-12 AASHTO T-88 Hydrometer Test	
All material passing the No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 6 when tested in accordance with AASHTO T89 and T90	
<i>Table 11, Gravel Base Gradation</i>	

7.2.3 **Compacting gravel base.** After placing the gravel, wet and compact it to at least 95% Modified Proctor density using a tandem or wobble wheel roller weighing at least ten (10) tons.

7.2.3.1 Begin rolling at edges of base and work gradually to the street crown.

7.2.3.2 Loosen the surface of all low points, pockets and depressions developed by the rolling, place additional gravel thereon, and repeat rolling as required to obtain an approved smooth surface.

7.2.3.3 Repeat wetting and rolling as required to obtain the specified density.

7.3 Soil Cement Base. Soil cement base shall consist of natural soil in the roadway, or of selected soil, and Portland cement uniformly mixed, moistened, compacted, finished and cured in accordance with these specifications and shaped in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the drawings or directed by the City Engineer.

7.3.1 **Thickness.** Unless otherwise shown on the drawings or specified elsewhere, soil cement base shall have a compacted thickness of six (6) inches on local streets (R.O.W. 50 feet and less) and eight (8) inches on all other streets.

7.3.2 **Materials.**

7.3.2.1 Portland cement shall conform to ASTM C150, C175 or C595.

7.3.2.2 Soil shall consist of the material existing in the area to be paved, approved selected soil, or a combination of these materials.

- 7.3.2.3 Soil shall be free of rocks, stones, bricks or broken concrete larger than three (3) inches in their greatest dimension.
- 7.3.2.4 Soil shall be free of rubbish, vegetable materials or other unapproved materials.
- 7.3.3 **Laboratory soil tests.** Prior to beginning any work on the base, the contractor shall have an approved independent testing laboratory test the soil material proposed for use in the base.
 - 7.3.3.1 The following fundamental requirements shall be determined by the laboratory tests in accordance with AASHTO test methods T134, T135 and T136.
 - 7.3.3.1.1 The minimum amount of cement required to harden the soil adequately to provide unconfined compression strength of 400 to 450 PSI. The amount shall be reported as pounds per square yard.
 - 7.3.3.1.2 The density to which the soil cement shall be compacted.
 - 7.3.3.1.3 The optimum moisture content required to achieve the required compaction.
 - 7.3.3.2 The laboratory test results and recommended mix design shall be submitted to the City of Bartlett for review and approval prior to construction of the base.
 - 7.3.3.3 After approval of the laboratory test and mix design, construct the base in strict accordance with the requirements established by the laboratory on the basis of their material tests.
 - 7.3.3.4 An independent soil technician from an approved soils laboratory shall be on site during the construction of the base to ensure the moisture content and rate of application is consistent with the approved mix design.
- 7.3.4 **Pulverization.** Prior to applying the cement, pulverize the soil so that after moist-mixing, 100% by dry weight passes a one (1) inch sieve and at least 80% passes a No. 4 sieve, exclusive of the gravel or stones retained on these sieves.
- 7.3.5 **Cement application, mixing and spreading.** Mixtures shall not be applied when the soil or subgrade is frozen or when the ambient temperature in the shade is less than 40° F.
 - 7.3.5.1 The application rate for cement shall be 10 to 12 percent by weight for soil, eight (8) to ten (10) percent by weight for gravel or as specified in the approved soil mix design.
 - 7.3.5.2 The moisture content shall be two (2) to three (3) percent above the optimum or as directed by the soils engineer, prior to mixing, to allow for hydration.
 - 7.3.5.3 Soil, cement and water shall be mixed by using one of the following two methods.

Section 7: Roadway Base

7.3.5.3.1 **Mixed in place method.** This method involves distributing the cement at the required rate uniformly on the soil.

7.3.5.3.2 After application, replace all cement that may have been displaced prior to mixing.

7.3.5.3.3 Mix the cement with the soil until it has been sufficiently blended to prevent formation of cement balls when water is applied.

7.3.5.3.4 Immediately after mixing the cement and soil, incorporate water into the mixture so that all areas involved have the required water within three (3) hours.

7.3.5.3.5 Avoid excessive concentration of water at or near the surface.

7.3.5.3.6 After application of all mixing water, continue mixing as required to obtain an intimate mixture of soil, cement and water.

7.3.5.3.7 **Central plant method.** This method involves the mixing of soil, cement and water in batches at a pugmill equipped with feeding and metering devices which add ingredients into the mixer in the required quantities.

7.3.5.3.7.1 Mix soil and cement sufficiently to prevent formation of cement balls when water is added.

7.3.5.3.7.2 Add water and continue mixing to obtain a uniform and intimate mixture of soil, cement and water.

7.3.5.3.7.3 Haul the mixture to the pavement area in covered trucks.

7.3.5.3.7.4 Place mixture on moistened subgrade in a uniform layer using suitable spreaders.

7.3.5.3.7.5 Dumping mixtures into piles or windrows is not permitted.

7.3.5.3.7.6 Not more than 30 minutes shall elapse between the placement of soil cement mixtures in adjacent lanes at any location except longitudinal construction joints.

7.3.5.3.7.7 Not more than 60 minutes shall elapse between the commencing of moist mixing and commencing of compaction.

7.3.6 **Compaction.** Prior to beginning compaction process, the mixture shall be in a loose condition through its full depth.

7.3.6.1 At the start of compaction, the percentage of moisture in the mixture and un-pulverized soil lumps, based upon oven dry weights, shall be below or

no more than two (2) percent above the required optimum moisture and not less than the quantity which will cause the soil cement mixture to become unstable during compaction and finishing.

7.3.6.2 Compact the loose mixture uniformly to the required density within two hours of mixing.

7.3.7 **Finishing.** After compacting the soil cement to the required density, shape it to the required lines and grades.

7.3.7.1 Lightly scarify the surface as required to remove marks left by equipment and re-compact the resulting surface to the required density.

7.3.7.2 Maintain the moisture content at least to the required optimum during finishing operations.

7.3.7.3 Complete the surface compaction within two (2) hours and provide a smooth, dense surface free of contraction planes, cracks, ridges or loose material.

7.3.7.4 Correct all portions of the surface that have a density below the required density.

7.3.7.5 Prime coat soil cement immediately after finishing to prevent drying.

7.3.8 **Curing.** Protect the finished soil cement from drying for a minimum of seven (7) days.

7.3.8.1 Apply water as required to keep the soil cement continuously moist, filling the surface voids immediately before applying a bituminous material, to prevent penetration of the bituminous material during its application.

7.3.8.2 No later than 24 hours after finishing, apply a prime coat of emulsified asphalt, Grade AE-P or CAE-P, at a rate of approximately two-tenths to five-tenths (0.2 – 0.5) gallons per square yard using appropriate heating and distribution equipment.

7.3.8.3 The exact bituminous material application rate and temperature shall be as required for complete coverage without excessive runoff.

7.3.8.4 Barricade areas from all traffic during the curing period.

7.4 Adjustment of utility. Field adjustments to any utility lines or apertures such as valves, fire hydrants, meter boxes, manhole tops, etc. shall be accomplished by the contractor and the cost of such adjustments shall be considered as incidental to the project costs. When adjustment rings are required for water valve roadway boxes, they shall be SIGMA 2600 series risers (or an approved equivalent) of the appropriate thickness to adjust the valve box top to grade. When adjustment rings are required for drain or sewer manholes, they shall be SIGMA MH-2710 or MH-2715 (or an approved equivalent) to adjust the manhole top to grade.

7.5 Measurement and Payment. All types of base shall be paid at the unit bid price per square yard of base in place. The unit price shall include all material, operations, testing and protection for the type of base specified.

- 8 Asphalt Paving.** Asphalt paving shall consist of an asphalt surface laid hot in a single course on a prepared base, conforming to the cross sections, lines and grades indicated on the drawings and to the requirements specified herein. A proof roll of the prepared base shall be performed and any required repairs accomplished prior to laying the base asphalt. The City of Bartlett may direct a proof roll prior to the placement of the surface asphalt as described in [section 8.13.3](#).

8.1 Thickness. Unless otherwise indicated on the drawings or otherwise approved by the City of Bartlett, asphalt pavement shall consist of a base asphalt course and a surface asphalt course totally a minimum of three (3) inches in depth, with the surface lift conforming to the approved lines, grades and cross sections.

8.1.1 The base course shall be a minimum of two (2) inches thick and applied immediately after the prepared base has cured and is approved by the City of Bartlett.

8.1.2 The surface course shall be a minimum of one (1) inch thick placed and compacted on the existing base course that has been proof rolled and repaired, and applied when the development surrounding the roadway is 100% complete or when directed by the City of Bartlett.

8.1.3 Overlays of existing streets shall be a minimum of one (1) inch thick unless otherwise indicated in the proposal, after any necessary repairs have been performed.

8.2 Types of mixtures. Unless otherwise specified in the proposal or directed, the following are the only types of mixtures authorized for use in the City of Bartlett.

8.2.1 **Base Course.** The base course shall be an asphalt mixture complying with the current edition of the *Tennessee Department of Transportation (TDOT) Standard Specification Section 307 – Bituminous Plant Mix Base (Hot Mix)* for Grading C.

8.2.2 **Surface Course.** The surface course shall be an asphalt mixture complying with the current edition of the *TDOT Standard Specification Section 411 – Asphaltic Concrete Cement (Hot Mix)* for Grading D.

8.2.3 **Patching.** The asphalt mixture used to repair existing asphalt shall be a mixture complying with the current edition of the *TDOT Standard Specification Section 307 – Bituminous Plant Mix Base (Hot Mix)* for Grading C.

8.2.4 **Leveling.** The asphalt mixtures used to level irregularities in existing asphalt shall be either a TDOT standard specification 307-C base asphalt mixture or a TDOT standard specification 411-D mixture, depending upon the depth of the leveling course or as directed by the City of Bartlett.

8.3 Laboratory tests and certificates. All asphaltic concrete cement paving materials shall be tested by an approved independent testing laboratory prior to use.

8.3.1 The contractor shall submit to the City of Bartlett acceptable certifications from the laboratory to the effect that these materials conform to the specifications herein.

8.3.2 The contractor shall submit to the City of Bartlett for review and approval a job mix formula complying with the applicable portions of the current edition of the *TDOT Standard Specification Section 407.03 – Bituminous Plant Mix Pavements (General)* for each type of asphalt mixture to be used.

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- 8.4 Asphalt.** Asphalt shall be refined asphalt or asphalts and flux where flux is required, with 60 to 70 penetration at 77° F.

	Min 60/70 Penetration	Max
Penetration @ 77°F 100 g/5 sec	60	70
Penetration @ 32°F 200 g/60 sec	15	N/A
Penetration @ 115°F 50 g/3 sec	N/A	325
Flash Clev. Open Cup, degrees F	500	N/A
Ductility @ 77°F 5 cm/min	125	N/A
Ductility @ 32°F ¼ cm/min	Penetration at 77°F	N/A
*Fluidity Factor	10	N/A
Specific Gravity @ 77°F	1.02	N/A
Soluble in CCL 4	99.5	N/A
Sulfur (Bomb) -%	3.5	N/A
Paraffin Scale (Holds) -%	N/A	3.5
Spot Test (Oliensis)	Neg	N/A
Penetration of Residue @ 77°F min	75% original	N/A
Evaporation loss, 50 gm 5 hrs 325°F	N/A	2.0%
*The Fluidity Factor shall be figured according to the formula $FF = (VP) \times P/100$ where FF is fluidity factor, V is the Furol Viscosity at 275°F (using a viscosity thermometer calibrated for the proper immersion) and P is the penetration at 77°F 100 g/5 sec.		
<i>Table 12. Asphalt Specifications</i>		

- 8.4.1 Refined asphalt shall be prepared from either native asphalt or an asphaltic or semi-asphaltic petroleum, which upon refining will produce asphalt as specified herein.
- 8.4.2 Only straight run asphalt produced by approved methods will be acceptable. Air blowing and cracking shall not be used in the manufacturing process.
- 8.4.3 Asphalt shall contain no water, decomposition products, granular particles or other impurities and shall be homogeneous.
- 8.4.4 The proper portions of refined asphalt or asphalts and flux shall be melted together at 275° F to 400° F and thoroughly agitated by suitable appliances until they are completely blended into a homogeneous asphalt cement, and thereafter shall not be heated to more than 350° F.
- 8.4.5 Recycled asphalt is not permitted.
- 8.4.6 Asphalt shall comply with the requirements specified in *Table 12, Asphalt Specifications*.
- 8.5 Stone.** Stone shall be clean, hard, broken stone free from weathered or soft particles, conforming to the following requirements when tested in accordance with applicable ASTM test. Additionally, the stone shall not break down or disintegrate to any appreciable extent when subjected to compaction by rolling.
- 8.5.1 Percentage of wear shall not exceed 5.
- 8.5.2 Toughness shall not be less than 6.

8.5.3 Soundness (sodium sulfate) reversals shall be 5.

8.5.3.1 Immerse ten (10) small pieces (total weight approximately 1,000 grams) of the stone in a saturated solution of sodium sulfate (Na_2SO_4) for 20 hours with the solution at 70° F.

8.5.3.2 After the 20 hour immersion period, place them in a drying oven for four (4) hours with the temperature maintained at 220° F.

8.5.3.3 Repeat the operation five (5) times.

8.5.3.4 The operation of immersion, heating, re-immersion, etc., shall be continuous.

8.5.3.5 Note the condition of the stone as to soundness at the end of the test cycle.

8.5.3.6 Samples which exhibit marked disintegration shall be considered to have failed this test.

8.6 Sand. Sand shall be hard, clean grained and sharp.

8.7 Filler. Filler shall be thoroughly dry limestone dust, dust from equally satisfactory stone or Portland cement all of which shall pass a No. 50 sieve and at least 70% of which shall pass a No. 200 sieve.

8.8 Composition of the Mixture. The base and surface courses shall be composed of a combination of aggregate (coarse, fine or mixture thereof), mineral filler (if required) and asphalt cement mixed in the proportions specified in [Table 13, Proportions of Asphalt Paving Mixture, Percent by Weight](#). The several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mixture will meet the grading and physical properties specified herein or of the approved job mix formula.

8.8.1 The aggregate for the base course shall comply with the current edition of the *TDOT Standard Specification 903.06 – Aggregate for Plant Mix Base and Leveling Course (Hot Mix)* for Grading C.

8.8.2 The aggregate for the surface course shall comply with the current edition of the *TDOT Standard Specification 903.11 – Aggregate for Asphaltic Concrete Surface Courses (Hot Mix)* for Grading D.

8.8.3 The aggregates and the asphalt cement shall be heated separately to such a temperature as will provide, after mixing, a mixture of the proper temperature for the materials employed.

8.8.4 The asphalt cement and aggregates shall be thoroughly mixed in an approved asphalt mixing apparatus until a homogenous mixture is produced in which all the particles are thoroughly coated with asphalt cement.

Mix Type	Combined Mineral Aggregate	Asphalt Cement
Base	94 – 96	4 - 6
Surface	93 – 95	5 - 7

Table 13. Proportions of Asphalt Paving Mixture, Percent by Weight

8.9 Mixing plant. An asphalt producing plant meeting the requirements of the current edition of the *TDOT Standard Specification 407.04 – Bituminous Mixing Plant* shall be provided

Section 8: Asphalt Paving

with suitable means for heating, drying and mixing the mineral aggregate with the asphalt cement.

8.9.1 The asphalt plant shall shut down processing each day at such a time that will enable all loads to be hauled, laid and completely compacted and finished before dark.

8.9.2 The asphalt plant shall shut down processing without delay if rain falls during the work. No loads shall be laid in the rain or on excessively wet foundations.

8.10 Base preparation. In all cases, the base material shall be swept to remove all loose materials prior to the laying of asphalt pavement. Contact surfaces of curbing, gutters, manholes and other structures shall be painted with a thin, uniform coating of bituminous material prior to the mixture being placed against them to aid in the prevention of water infiltration in the joint.

8.10.1 **Gravel Base.** A tack coat of bituminous material shall be applied in accordance with the requirements of the current edition of the *TDOT Standard Specification Section 403 – Tack Coat* and uniformly at the rate of .05 to .15 gallons per square yard or as required by base conditions.

8.10.2 **Soil-Cement Base.** A prime coat of RS-1 emulsified asphalt shall be applied in accordance with the requirements of the current edition of the *TDOT Standard Specification Section 402 – Prime Coat* and uniformly at the rate of .40 to .60 gallons per square yard or as required by base conditions.

8.10.3 **Existing Asphalt Base.** When the base or surface asphalt material is to be placed upon an existing bituminous pavement, any areas containing excess bitumen and any failures in the existing surface and base shall be removed as directed by the City of Bartlett.

8.10.3.1 Unsatisfactory subgrade material encountered when existing pavement is removed shall be removed and replaced with approved material.

8.10.3.2 Openings left by the pavement and base removal shall be filled to the full depth of the existing pavement with an asphalt patching mixture complying with the current edition of the *TDOT Standard Specification Section 307 – Bituminous Plant Mix Base (Hot Mix)* for Grading C in compacted layers not to exceed three (3) inches in thickness.

8.10.3.3 Existing surfaces that are warped or irregular shall be brought to uniform grade and cross section by the use of a leveling mixture complying with the current edition of the *TDOT Standard Specification Section 307 – Bituminous Plant Mix Base (Hot Mix)* for Grading C or *Section 411 – Asphaltic Concrete Surface (Hot Mix)* for Grading D as appropriate for the thickness of the leveling mixture required.

8.10.3.4 Where directed by the City of Bartlett, asphalt shall be milled to the depths and widths directed in order to avoid excessive height of the asphalt at curbs or when trying to maintain roadway crowns.

8.10.3.5 The contractor shall adjust all manhole tops, catch basin frames, utility valve covers and like structures to the finished grades of the pavement. Unless otherwise specified, these adjustments shall be made without additional compensation.

8.10.3.6 A tack coat of bituminous material shall be applied in accordance with the requirements of the current edition of the *TDOT Standard Specification Section 403 – Tack Coat* and uniformly at the rate of .05 to .15 gallons per square yard or .05 to .20 for milled surfaces.

8.11 Transportation of the mixture. Unless otherwise specified or permitted, bituminous mixtures shall be delivered and spread in ample time to secure thorough compaction and finishing during daylight hours.

8.11.1 Trucks or other suitable conveyances used for hauling bituminous mixtures to the asphalt paving machine shall be suitably covered to protect the contents from excessive temperature loss.

8.11.2 Loads shall have a temperature of from 290° F to 350° F or as required by the job mix formula at the time of placement.

8.11.3 All loads failing to fall within the permissible temperature range are subject to rejection.

8.11.4 All loads shall have delivery tickets indicating the weight of the material carried and signed by a certified weigh master.

8.12 Spreading and compacting. Bituminous plant mix shall only be placed on properly constructed and approved subgrades and existing pavements.

8.12.1 The subgrade and surface upon which the bituminous plant mix is placed shall be free of excessive moisture.

8.12.2 Bituminous plant mix shall not be placed when the temperature is less than 45° F or 45° F and falling.

8.12.3 The mixture shall be placed upon an approved surface, spread and struck off to the established line, grade and elevation by means of an approved, self-propelled asphalt paving machine.

8.12.4 In areas where irregularities or unavoidable obstacles make the use of the mechanical spreading equipment impractical, the mixture shall be taken from the hopper of the spreading machine and shall be distributed immediately into place by means of suitable shovels and other tools and spread with rakes and lutes in a uniformly loose layer of such depth as will result in a completed course having the required thickness.

8.12.5 Unevenness of texture, segregation (including end-of-load segregation), tearing or shoving of the bituminous mixture that occurs during the paving operation shall be reason to stop the paving until the condition is corrected.

8.12.6 If the mixture has been allowed to cool sufficiently to prevent proper compaction, the mixture shall be removed and replaced at the contractor's expense.

8.12.7 After spreading, roll the mixture with a five (5) to eight (8) ton tandem roller until no further surface compression is obtainable and the surface is free from waves, roller marks and honey combing.

8.12.8 Cross roll pavement where roadway widths permit.

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- 8.12.9 In areas where irregularities, unavoidable obstacles, manholes or other fixtures make the use of the finishing equipment impractical, the mixture shall be compressed and smoothed using hot iron tampers.
 - 8.12.10 Deviations in the surface from the edge of a ten (10) foot straightedge shall not vary more than one-quarter (1/4) of an inch.
 - 8.12.11 Remedy all depressions which may develop before the completion of rolling by loosening the mixture laid and adding new material to bring such depressions to true surface grade.
 - 8.12.12 Depressions remaining after the final compaction has been obtained shall be removed and replaced at the contractor's expense.
 - 8.12.13 The City of Bartlett may require core samples of the finished pavement to verify thickness of the asphalt after paving. The contractor shall be responsible for obtaining the samples from the areas specified by the City of Bartlett and filling and re-compacting the sample holes.
- 8.13 Warranty.** All asphaltic concrete pavements shall be warranted against defects in material and workmanship for a period of not less than one year after its acceptance by the City of Bartlett.
- 8.13.1 Roadways in developments or which have been paved as part of development work shall remain under warranty until the surface course of asphaltic cement is placed.
 - 8.13.2 The normal and proper maintenance of the pavement during the warranty period shall be the responsibility and at the cost of the developer.
 - 8.13.3 Prior to placement of the surface course, the City of Bartlett may elect to proof roll the base course. Any defects discovered during the proof roll shall be corrected by and at the cost of the developer prior to the surface course being placed.
 - 8.13.4 Before expiration of the warranty period, the contractor shall make such repairs as may be necessary to produce a pavement which shall:
 - 8.13.4.1 Have a contour substantially conforming to that of the pavement indicated on the drawings.
 - 8.13.4.2 Be free from depressions of any kind exceeding three-eighths (3/8) of an inch deep as measured between any two points four (4) feet apart on a line conforming substantially to the original contour of the paved area.
 - 8.13.4.3 Be free from cracks or depressions showing disintegration of the asphalt paving mixture.
 - 8.13.4.4 Contain no disintegrated asphalt paving mixture.
 - 8.13.4.5 Not have been reduced more than three-eighths (3/8) of an inch in thickness in any part.

8.13.4.6 Have a base free from such cracks or defects which will cause disintegration or settling of the pavement, or impair its usefulness as a roadway or other purpose for which it is intended.

8.14 Repairing. Except as otherwise specified below or directed otherwise, make all repairs to asphalt paving by cutting out the defective material down to the base and replacing it with new, freshly prepared asphalt surface made and laid in compliance with these specifications.

8.14.1 Where defects are caused by the failure of the base, remove the defective asphalt and the base there under and replace them with new material properly compacted in layers.

8.14.2 In all cases, the surface of the finished repair shall be at the grade of the adjoining pavement and shall conform to the contour of the adjoining paved area.

8.14.3 The surface heater method of repair may be used only in those cases where repairs are not necessitated by failure of the base or failure caused by disintegration of the lower portion of the asphalt surface.

8.14.3.1 Where the surface heater method is used, remove all defective surface material before replacing it with new material.

8.14.3.2 In all cases, remove the old surface to at least one-quarter (1/4) of an inch depth and apply new material at least one-half (1/2) inch thick after compaction.

8.14.3.3 Apply the heat without injuring the remaining pavement.

8.14.3.4 Immediately remove all burnt and loose materials and lay the new surface in strict accordance with these specifications.

8.14.4 Cost of all warranty repairs is borne by the contractor or developer.

8.15 Adjustment of utilities. Field adjustments to any utility lines or apertures such as valves, fire hydrants, meter boxes, etc. shall be accomplished by the contractor and the cost of such adjustments shall be considered as incidental to the project costs. When adjustment rings are required for water valve roadway boxes, they shall be SIGMA 2600 series risers (or an approved equivalent) of the appropriate thickness to adjust the valve box top to grade. When adjustment rings are required for drain or sewer manholes, they shall be SIGMA MH-2710 or MH-2715 (or an approved equivalent) to adjust the manhole top to grade.

8.16 Cleanup. After all paving operations are complete, all loose asphalt and other debris, to include that which may have fallen into drain inlets or manholes, shall be collected and disposed of properly by the contractor.

8.17 Measurement and payment. Payment for the base and initial surface courses of asphalt in a subdivision or as part of the approved plans for a subdivision shall be paid by the developer. The developer shall contract for and directly pay the asphalt paving company for the base course of asphalt. The City of Bartlett shall collect the estimated cost of the surface course from the developer when the City of Bartlett schedules the surface course installation. Any funds remaining after the final surface asphalt and any required roadway striping costs have been paid will be refunded to the developer; any shortage will be billed to the developer. Final bond reduction shall not occur until all payments have been collected.

Section 8: Asphalt Paving

- 8.17.1 **Asphalt paving.** Asphalt paving shall be paid for at the contract unit bid price per ton, each type, of asphalt in place, as evidenced by delivery tickets signed by a City of Bartlett representative. Delivery tickets must be presented at time of payment request. The unit bid price shall include all necessary labor, equipment and materials required for mixture preparation, transportation, surface preparation, tack or prime coats, spreading, leveling and compaction of the asphalt to the depths and area as specified, utility adjustments and clean up.
- 8.17.2 **Milling.** Paid for at the contract unit bid price per ton as evidenced by weigh tickets. Weigh tickets must be presented at time of payment request. The unit bid price shall include all necessary labor, equipment and materials required to mill existing asphalt to the depths and area specified; utility adjustments; removal of the milled asphalt from the project and clean up.
- 8.17.3 **Asphalt patching.** Paid for at the contract unit bid price per ton of patching asphalt in place, as evidenced by delivery tickets signed by a City of Bartlett representative. Delivery tickets must be presented at time of payment request. The unit bid price shall include all necessary labor, equipment and material required to excavate existing asphalt and base to the area and depths specified, removal of the excavated material; delivery, placement and compaction of the asphalt patching; utility adjustment and clean up.
- 8.17.4 **Laboratory tests and certificates.** When conducted for subdivision development, cost shall be borne entirely by the developer. Otherwise, no separate payment, cost considered incidental to the project and is included in the cost of the asphalt.
- 8.17.5 **Asphalt repairs.** No additional payment. Included under warranty.

Section 9: Traffic Control and Street Name Signage

9.1 General. All temporary and permanent traffic control and street name signage shall be in accordance with the current edition of the Manual for Uniform Traffic Control Devices (MUTCD) unless otherwise shown on the plans or specified in the City of Bartlett Standard Drawings and these specifications.

9.2 Traffic Control Posts. Traffic control posts shall be slotted green “U” section steel posts, 12 feet long.

9.2.1 Post are to be set plumb and in the ground with a minimum of two feet bury.

9.2.2 Bottom of traffic control signs shall be a minimum of seven feet above top of curb (five feet above top of asphalt when curb is not present) except as specified below.

9.2.3 Excess post lengths are to be below grade or cut off.

9.3 Street Name Posts. Street name posts shall be 3” galvanized round post, 12 feet long.

9.3.1 Post are to be set plumb and in the ground with a minimum of two feet bury.

9.3.2 Bottom of street name signs shall be a minimum of nine feet above top of curb (seven feet above top of asphalt when curb is not present).

9.3.3 Excess post lengths are to be below grade or cut off.

9.3.4 Where street name and traffic control signs are in the same location, one post shall be used with the street name on top. Post length is required to be sufficient to ensure a minimum two feet bury and minimum bottom of sign height.

9.4 Object Markers for End of Roadway. Shall be Type OM4-1.

9.4.1 Number and spacing shall be as shown in the City of Bartlett standard drawing.

9.4.2 Bottom of sign shall be a minimum of four feet above top of asphalt.

9.5 Chevron Alignment Signs for Widened Roadways. Shall be Type W1-8, measuring 18’X24”.

9.5.1 Install signs as shown in the City of Bartlett standard drawing.

9.5.2 Bottom of sign shall be a minimum of four feet above top of asphalt.

9.6 Street Name Signs on Posts. Blanks shall be nine inches high and fully covered in white reflective material conforming to the requirement of the current edition of the MUTCD.

9.6.1 Green film with the street name cut out shall be EC film (3M Electro Cut) series 1170.

9.6.2 For private roads, blue EC film (3M Electro Cut) series 1170 shall be used.

9.6.3 Film shall be applied so as to leave a one-inch white border on all sides.

9.6.4 Font shall be TrafficAD series B sized in accordance with the MUTCD.

Section 9: Traffic Control and Street Name Signage

9.7 Basis of Payment.

- 9.7.1 For development work, the developer shall install temporary and permanent traffic control and street name signs at their expense and maintain such until final acceptance of the development work.
- 9.7.2 For CIPs, basis of payment shall be as noted on the bid sheet, complete in place.
 - 9.7.2.1 Such payment is considered full compensation for furnishing all materials, equipment, tools, labor and incidentals necessary to complete the work.
 - 9.7.2.2 Posts, mounting hardware, excavation, backfill, concrete and any other work or materials required for proper sign installation shall be considered incidental and not paid for separately.
 - 9.7.2.3 Signs shall be maintained until final acceptance of the project.

Section 10: Reduced Pressure Backflow Preventer

- 10.1 General.** The reduced pressure backflow preventer is a device used to protect a water supply system from substances which are hazardous to health and is effective against backflow caused by back-pressure and back siphonage.
- 10.1.1** The reduced pressure backflow preventer is normally used in locations where an air-gap separation is impractical or where there is a tendency to modify an air gap.
- 10.1.2** The reduced pressure zone type of backflow prevention device consists of two independently acting, spring-loaded approved check valves, separated by a reduced pressure zone.
- 10.1.3** The device is installed between two tight-closing gate valves and has properly located test cocks.
- 10.1.4** During normal operation, the pressure between the two valves is maintained at a pressure lower than the supply pressure.
- 10.1.5** If either check valve should leak, the pressure relief valve will maintain a differential pressure of not less than two (2) PSI between the supply pressure and the zone between the two check valves by discharging to the atmosphere.
- 10.1.6** Reduced pressure type backflow preventers must meet the latest revisions of the American Water Works Association (AWWA C511-97) and American Society of Sanitary Engineers (ASSE 1013-1999) standards.
- 10.2 Installation.** The reduced pressure backflow preventer shall be installed with adequate space to facilitate maintenance and testing. The manufacturer's recommendations concerning space needed for repair and testing of the device shall be followed.
- 10.2.1** The water line shall be thoroughly flushed prior to installing the device to expel all debris. Debris hanging under one of the check valves is one of the most common causes of trouble with these devices.
- 10.2.2** Except as described in [section 9.2.5](#), reduced pressure backflow preventer devices shall never be installed below ground level.
- 10.2.2.1** The operating effectiveness of the device is nullified if the relief port is subject to flooding.
- 10.2.2.2** The relief port shall be located a minimum of 12 inches above ground level at the point of discharge and never subjected to flooding.
- 10.2.2.3** Under no circumstance shall the relief port be plugged. The device depends upon an open relief port for safe operation.
- 10.2.2.4** Care must be taken to protect the device from freezing.
- 10.2.3** Reduced pressure backflow preventers will spill or discharge water under some normal and most abnormal conditions.
- 10.2.3.1** When the device is located inside a building, there must be a suitable means of taking care of any discharge without creating a safety or nuisance problem.

Section 10: Reduced Pressure Backflow Preventer

10.2.3.2 If a drain is to be provided for the relief valve port, there must be a fixed air gap between the relief port and the drain.

10.2.4 All reduced pressure backflow prevention devices are to be installed horizontally.

10.2.5 Below ground installation is only authorized in pit-type structures where one side of the pit will permit direct drainage to the atmosphere. The drain must be capable of handling the volume of water that can be discharged from the relief port.

10.3 Double Check Valve Assemblies. A double check valve assembly consists of two (2) internally loaded, approved, independent acting check valves, either spring loaded or weighted. They include tightly closing shut-off valves located on each end of the assembly and suitable connections for testing the water tightness of each valve.

10.4 Approved Reduced Pressure Backflow Prevention Devices. Only units currently approved by the State of Tennessee Department of Health, Division of Water Quality are to be used for the protection of the City of Bartlett public water supply system against backflow hazards. [Appendix F, Approved Reduced Pressure Backflow Prevention Devices](#) and [Appendix G, Approved Reduced Pressure Backflow Prevention Devices No Longer in Production](#) list those units currently approved for use. For information on any units which may have been approved since printing this list, call 615-532-9191.

10.4.1 Double check-detector check and double check valve assemblies have only been approved by the Division of Water Supply for certain (low hazard) fire service lines.

10.4.2 Reduced pressure backflow prevention devices are required for domestic and/or process service lines where maximum backflow protection is needed.

10.4.3 Unless otherwise specified by the manufacturer all assemblies are to be installed on cold potable water applications – below 110°F.

10.4.4 All Double Check Valve Assemblies, Reduced Pressure Principle Assemblies, Double Check Detector Assemblies, and Reduced Pressure Principle Detector Assemblies are approved for HORIZONTAL ORIENTATION ONLY, unless specifically noted.

10.4.5 Use of spare parts other than those of the original manufacturer invalidates the approval.

10.5 Measurement and Payment. Unless otherwise shown in the proposal, reduced pressure backflow preventers shall be paid at the unit bid price each complete reduced pressure backflow preventer installed and operational.

Section 11: Factory Built Above-Ground Fiberglass Pumping Station with Duplex Self-priming Pumps

- 11.1 General.** The station shall be built in two major sections consisting of a steel reinforced concrete base to support the pumps and a fiberglass enclosure.
- 11.1.1 Major design characteristics consideration for the enclosure shall be given to structural stability, corrosion resistance and water tight properties.
- 11.1.1.1 The station fiberglass enclosure shall be manufactured of molded fiberglass reinforced orthophthalic polyester resins in a ratio of 30% glass and 70% resin.
- 11.1.1.1.1 The polyester laminates shall provide a balance of mechanical, chemical and electrical properties to ensure long life.
- 11.1.1.1.2 The polyester laminates shall be impervious to micro organisms, mildew, mold and fungus and completely non-corrosive inside or outside.
- 11.1.1.2 The station enclosure shall contain all pumps and equipment.
- 11.1.1.3 The station enclosure shall be of a doghouse style.
- 11.1.1.4 All exposed hardware shall be of a tamperproof design.
- 11.1.1.4.1 Tamperproof retaining devices shall be provided to secure the enclosure side panels to the station frame.
- 11.1.1.4.2 One side panel shall have a locking access door for quick entry to the motor control center enclosure.
- 11.1.1.4.3 The access door shall have a piano type hinge and two-point latching mechanism.
- 11.1.1.5 One enclosure panel shall have increased ventilation capabilities and shall be interchangeable with other side panels in order to maximize air flow.
- 11.1.2 The station base shall be constructed of pre-cast, reinforced concrete with molded anchor recesses and drainage provisions. An access opening of sufficient size shall be formed in the base for piping and service connections to the wet well.
- 11.1.3 The pumps shall be manufactured by the Smith and Loveless Company, or an approved equivalent specifically designed for the pumping of raw, unscreened sewage and capable of passing a three (3) inch diameter spherical solid.
- 11.1.3.1 The shaft seal shall be the double floating, self-aligning, oil lubricated, mechanical type.
- 11.1.3.2 The stationary and rotating sealing members shall be of tungsten-titanium carbide alloy.
- 11.1.3.3 The impeller shall be two (2) vane, semi-open, non-clog, cast in ductile iron and accessible through a removable cover plate.

Section 11: Factory Built Above-Ground Fiberglass Pumping Station with Duplex Self-priming Pumps

11.1.3.4 The pumps shall incorporate removable, molded, one piece, suction check valves.

11.2 Operating Conditions. The operating conditions shall be those listed in the proposal or as shown in the construction drawings.

11.3 Station Piping. The station suction and discharge valving and fittings shall be complete to that point where the contractor connects the riser pipes to the suction elbows and ties in the force main to the flanged discharge outlet.

11.3.1 The discharge check valves shall be wafer style swing checks with resilient seats and outside arm and spring as manufactured by the Price Valve Company or an approved equal.

11.3.2 The discharge shut off valve shall be a three (3) way plug valve with neoprene coated plug as manufactured by DeZurik Corporation or an approved equal.

11.3.3 The pumps shall be fitted with air release valves to permit automatic unattended re-priming.

11.4 Control Panel. The control panel shall consist of a circuit breaker and magnetic starter for each pump motor actuated by a mercury float control system.

11.4.1 The control assembly shall provide means to operate each pump manually or automatically.

11.4.2 When operated in the automatic mode, the control assembly shall provide means to automatically alternate the position of the lead and lag pumps after each pumping cycle.

11.4.3 All components shall meet the requirements of the National Electric Code.

11.5 Motor and Level Control Enclosures. The motor and level controls shall be mounted in suitably sized enclosures.

11.5.1 Each enclosure shall be J.I.C. type, steel construction with continuously welded seams.

11.5.2 The enclosure door shall have a neoprene gasket and equipped with a continuous hinge and captivated closing hardware.

11.6 Operation. A mercury float switch level control system shall continuously monitor wet well liquid level and control operation of the pumps according to level variations.

11.6.1 The system shall actuate pump motors on an alternating lead-lag basis, with independently adjustable lead pump and lag pump start levels.

11.6.2 The lead pump motor shall be actuated when wet well liquid rises to a pre-set lead pump start level and shall be shut down when wet well liquid has been pumped down to the pre-set stop level.

11.6.3 Lag pump operation shall be independent of lead pump operation.

11.6.4 Circuitry which provides lag pump operation contingent on proper lead pump circuit operation is not acceptable.

Section 11: Factory Built Above-Ground Fiberglass Pumping Station with Duplex Self-priming Pumps

- 11.6.5** The lag pump motor shall be actuated when wet well liquid rises to a pre-set lag pump start level and shall shut down when wet well liquid has been pumped down to the re-set stop level.
- 11.7 Components.** All motor branch circuit breakers, motor starters and control relays shall be securely fastened to the removable back panel with screws and lock washers.
- 11.7.1** Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
- 11.7.2** A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motors.
- 11.7.3** Operator handles for the disconnect mechanisms shall be located on the exterior of the motor control center door, with interlocks which permit the door to be opened only when the circuit breakers are in the off position.
- 11.7.4** An open frame, across-the-line NEMA rated, magnetic motor starter, Bulletin 790, Series K as manufactured by Allen Bradley or an approved equivalent, shall be furnished for each motor pump.
- 11.7.5** All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases.
- 11.7.6** Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position.
- 11.7.7** Overload relays shall be manual reset and shall not provide means for converting to automatic reset.
- 11.7.8** Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressure requiring pressure reducing valves, rate of flow control valves and air storage reservoirs shall not be acceptable.
- 11.7.9** A manually operated switch shall be furnished to alternate the use of the air pump. An air bell shall be supplied for installation in the wet well.
- 11.8 Operating Controls and Instruments.** Switches shall be furnished to alternate air pumps and to select mode of operation for each pump.
- 11.8.1** Switches shall be military type toggle switches with contacts rated at 15 amps at 115 VAC, non-inductive.
- 11.8.2** The air pump selector switch shall be connected in such a manner that either air pump may be selected to operate continuously.
- 11.8.3** Pump mode selector switches shall be HAND-OFF-AUTO type to permit manual control of either pump motor. Operation of pumps in manual mode shall bypass all safety shutdown circuits except pump motor overload.
- 11.8.4** A thermal magnetic air circuit breaker shall provide over-current protection for control circuits and shall be connected in such a manner as to allow electrical power to be disconnected from all control circuits.

Section 11: Factory Built Above-Ground Fiberglass Pumping Station with Duplex Self-priming Pumps

- 11.9 Time Meters.** Panel shall be equipped with elapsed time meters to indicate total running time of each pump in hours and tenths of hours. Elapsed time meters shall be HK Series as manufactured by Eagle Signal or an approved equivalent.
- 11.10 Gauging.** Each pump shall be equipped with a suction compound gauge and discharge pressure gauge. Gauges shall be glycerin-filled type, graduated in feet water column.
- 11.11 Heater.** The heater shall be a Titan "Milk House" Style type No. 2H934 or an approved equivalent, 1300/1500 watts with a high BTU rating of 5120. The fan shall be heavy duty and the cabinet shall be made of 20 gage steel with two-tone gray enamel finish. The heater shall contain an automatic thermostat with an off position and automatic off at tip over.
- 11.12 Generator Receptacle.** A receptacle shall be installed rated at the correct voltage and amperage in order to operate the pump station by portable generator. This receptacle shall be installed along with a manual transfer switch and mounted in close proximity to the meter center. The contractor shall be responsible for matching the receptacle plug with the existing plug on the City of Bartlett generator. This generator can be inspected by the contractor's authorized electrician upon request.
- 11.13 Alarm Dialer.** A 4-channel Verbatim dialer shall be furnished and installed by the contractor. The contractor will be responsible for the installation of the telephone line in order to activate the dialer for the following alarms prior to completion and acceptance of the project. The contractor shall be responsible for programming approximately ten (10) pagers and/or telephone numbers into the dialer and run several alarm tests to test the dialer.
- 11.13.1 Power Fail Alarm
- 11.13.2 High Water Level Alarm
- 11.14 Surge Suppression.** This section describes the materials and installation requirements for a Surge Protective Device (SPD) also known as a Transient Voltage Surge Suppressor (TVSS). Surge protective devices are used for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.
- 11.14.1 Related Work Specified Elsewhere.** The following items shall be specified in the proposal.
- 11.14.1.1 General electrical requirements.
- 11.14.1.2 Raceways, boxes and fittings.
- 11.14.1.3 Wire and cable.
- 11.14.1.4 Low voltage motor control.
- 11.14.1.5 Variable frequency drives.
- 11.14.1.6 Grounding.
- 11.14.1.7 Lightning protection systems.

Section 11: Factory Built Above-Ground Fiberglass Pumping Station with Duplex Self-priming Pumps

11.14.2 Submittals. Submit product data and manufacturer's installation instructions. The submittals shall also include:

11.14.2.1 Dimensional drawings of each suppressor type indication mounting arrangements.

11.14.2.2 UL 1449, Second Edition, clamping voltage documentation.

11.14.3 Test Reports. The SPD manufacturer shall provide test results, upon request, for models shipped.

11.14.3.1 Testing shall be conducted in accordance with ANSI C 62.41.2-2002 and ANSI C 62.45-2002.

11.14.3.2 The units shall be tested in all modes listed in the referenced specifications for Category C.

11.14.4 Warranty. The SPD manufacturer shall warrant the SPD and supporting components against defects in material and workmanship for a period of not less than ten (10) years.

11.14.5 Manufacturer Qualifications. The SPD shall be manufactured in the USA by a company normally engaged in the design and manufacture of such devices for at least five (5) years. Both the service entrance and distribution panel SPDs shall be of the same manufacturer.

11.14.6 Safety Agency Approvals. SPDs shall be listed in accordance with UL 1449, Second Edition, standard for safety, transient voltage surge suppressors. They shall also be CSA or UL approved.

11.14.7 Suppressors at Service Entrance. SPDs shall be installed at all service entrances of each building and/or as shown on the riser diagram.

11.14.7.1 Suppressors shall be tested with a Category C high exposure waveform of 10KA, 8/20 μ sec.

11.14.7.2 Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and the ground.

11.14.7.3 The surge suppressor shall have a Short Circuit Current Rating (SCCR) per NEC 2002, Article 285, up to a maximum of 200kA.

11.14.7.4 Visible indication of proper suppressor connection and operation shall be provided.

11.14.7.5 The surge protection device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.

11.14.7.6 Suppressors shall meet or exceed the following criteria:

11.14.7.6.1 Minimum current rating (L-N + L-G) of 120,000 amperes per phase.

Section 11: Factory Built Above-Ground Fiberglass Pumping Station with Duplex Self-priming Pumps

11.14.7.6.2 UL 1449, Second Edition, clamping voltage shall not exceed the following:

VOLTAGE	L-N	L-G	N-G
120/208	400 volts	400 volts	400 volts
277/480	800 volts	800 volts	800 volts

11.14.7.7 Suppressors shall consist of solid-state components and shall be operated bi-directionally.

11.14.7.8 Maximum continuous operating voltage of the suppressor shall be greater than 115% of the nominal system voltage.

11.14.7.9 The following equipment models are approved per the above specification (xxx/xxx is voltage shown above):

11.14.7.9.1 500MP

11.14.7.9.2 400MP

11.14.7.9.3 320MP

11.14.7.9.4 250MP/xxx/xxx

11.14.7.9.5 160P/xxx/xxx

11.14.7.9.6 200/120BPF/xxx/xxx

11.14.8 Secondary Service Suppressors for Distribution Panels. SPDs shall be installed at designated distribution panels as shown on the riser diagram.

11.14.8.1 Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and the ground.

11.14.8.2 The surge suppressor shall have a Short Circuit Current Rating (SCCR) per NEC 2002, Article 285.

11.14.8.3 Visible indication of proper suppressor connection and operation shall be provided.

11.14.8.4 The surge protection device shall be equipped with an audible alarm (where available) that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.

11.14.8.5 Suppressors shall meet or exceed the following criteria:

11.14.8.5.1 Minimum current rating (L-N + L-G) of 80,000 amperes per phase.

Section 11: Factory Built Above-Ground Fiberglass Pumping Station with Duplex Self-priming Pumps

11.14.8.5.2 UL 1449, Second Edition, clamping voltage shall not exceed the following:

VOLTAGE	L-N	L-G	N-G
120/208	400 volts	400 volts	400 volts
277/480	800 volts	800 volts	800 volts

11.14.8.6 Suppressors shall consist of solid-state components and shall be operated bi-directionally.

11.14.8.7 Maximum continuous operating voltage of the suppressor shall be greater than 115% of the nominal system voltage.

11.14.8.8 The following equipment models are approved per the above specification (xxx/xxx is voltage shown above):

11.14.8.8.1 160P/xxx/xxx

11.14.8.8.2 200/120BP(F)/xxx/xxx

11.14.8.8.3 100W(F)/xxx/xxx

11.14.8.8.4 80W/E/xxx/xxx

11.14.8.8.5 OSW/E/xxx/xxx

11.14.9 Service Entrance Suppressor Installation. Follow the manufacturer's installation instructions and install one primary suppressor at each utility service entrance or as indicated on the riser diagram.

11.14.9.1 The suppressor shall be installed on the load side of the service entrance.

11.14.9.2 Conductors between the suppressor and the point of attachment shall be at least #6 AWG stranded copper conductor or larger kept as short and straight as possible.

11.14.9.3 The suppressor's ground shall be connected to the service entrance ground.

11.14.10 Secondary Distribution Panel Suppressor Installation. Follow the manufacturer's installation instructions and install one secondary suppressor at each distribution panel location or as indicated on the riser diagram.

11.14.10.1 Conductors between the surge protection device and the point of attachment shall be at least #10 AWG stranded copper conductor or larger kept as short and straight as possible.

11.14.10.2 The contractor shall install a circuit breaker in the distribution panel matched to the connecting wire size to the surge protection device and in accordance with all national and local electrical codes.

11.15 Tie to Existing Wet Well. The contractor shall core drill when tying into an existing wet well. Inlet pipes shall be on the opposite side from the floats.

11.16 Measurement and Payment. Unless otherwise shown in the proposal, wet wells shall be paid at the unit bid price each complete wet well installed and operational.

Appendix A: Standard Specification for Lining Ductile Iron Pipe for Sewer Service

1. **Condition of Ductile Iron prior to Surface Preparation.** All ductile iron pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old lining may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining material and no coating shall have been applied to the first six (6) inches of the exterior of the spigot ends.
2. **Lining Material.** The material shall be Protecto 401™, an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and certification of the test results.
 - a. A permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
 - b. The following test must be run on coupons from factory lined ductile iron pipe:
 - i. ASTM B-117 Salt Spray (scribed panel – Results to equal 0.0 undercutting after two years.
 - ii. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F – Results to equal no more than 0.5 mm undercutting after 30 days.
 - iii. Immersion Testing rated using ASTM D-714-87.
 1. 20% sulfuric acid – No effect after two (2) years.
 2. 140°F 25% sodium hydroxide – No effect after two (2) years.
 3. 160°F distilled water – No effect after two (2) years.
 4. 120°F tap water (scribed panel) – 0.0 undercutting after two (2) years with no effect.
 - c. An abrasion resistance of no more than three (3) mils (0.75 mm) loss after one million cycles using European Standard EN 598, 1994 Section 7.8 Abrasion Resistance.
3. **Application.** The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
 - a. **Surface Preparation.** Prior to abrasive blasting, the entire area to receive the protective lining shall be inspected for oil, grease, etc. Any areas with oil, grease, or any other substance which can be removed by solvent shall be solvent cleaned to remove those substances. After the surface has been made free of oil, grease or other substances, all areas to receive the protective lining shall be abrasive blasted using sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering oxide may be left on the surface. Any area where rust reappears before lining must be re-blasted.
 - b. **Lining.** After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401™ or an approved equivalent. No lining shall take place when the substrate or ambient temperature is below 40° F. The surface must be dry and dust free. If flange pipe or

Appendix A: Standard Specification for Lining Ductile Iron Pipe for Sewer Service

fittings are included in the project, the lining shall not be used on the face of the flange.

- c. **Coating of Bell Sockets and Spigot Ends.** Due to the tolerances involved, the gasket area and spigot end up to six (6) inches back from the end of the spigot must be coated with 6 mils nominal, ten (10) mils maximum, using Protecto Joint Compound or an approved equivalent. The joint compound shall be applied by brush to ensure coverage. Care should be taken that the joint compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be accomplished after application of the lining.
- d. **Number of Coats.** The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall the lining be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. **To prevent de-lamination between coats, no material shall be used for lining which is not indefinitely re-coatable with itself without roughening of the surface.**
- e. **Touch-Up and repair.** Protector Joint Compound or an approved equivalent shall be used for touch-up or repair in accordance with the manufacturer's recommendations and procedures.

4. Inspection and Certification.

a. Inspection.

- i. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in **SSPC-PA-2 Film Thickness Rating**.
- ii. The interior lining of all pipe barrels and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defects found shall be repaired prior to shipment.
- iii. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of this work.

- b. **Certification.** The pipe and fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification and the material used was as specified.

5. Handling.

Protecto 401™ or an approved equivalent lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning or laying.

Appendix B: Standard Specification for Lining Sewer Manhole

- 1. Scope.** This specification covers the supply and applications of a spray on coating material for manholes to protect the exposed concrete surfaces from corrosion.
 - 1.1. All work shall be done in strict conformity with the applicable specifications, instructions and recommendations of the lining manufacturer.
 - 1.2. The manufacturer of the lining shall furnish an affidavit attesting to the successful use of its material as a coating for sewer manholes for a period of five (5) years in sewage conditions recognized as corrosive or otherwise detrimental to concrete.
 - 1.3. The manufacturer of the concrete manhole riser shall provide the City of Bartlett a three (3) year written performance warranty that shall cover damage to the concrete substrate from effects of hydrogen sulfide or delamination of the coating from the sewer manhole.
- 2. Materials.** Coating shall be a polyisocyanate/polyol resin as manufactured by Madison Chemical Industries, Inc., Milton, ON Canada or an approved equivalent.
 - 2.1 The material used in coating manhole risers shall consist of an ASTM D16 Type V polyisocyanate resin and polyol resin.
 - 2.2 The material shall possess material properties conforming to ASTM D1259A.
 - 2.3 The material shall comply with the performance properties outlined in ASTM D4541, D2794, D543, and D4060 when tested in accordance with said standards.
 - 2.4 The material shall be repairable for the lifetime of the structure.
 - 2.5 The material shall be a minimum of 1,000 microns (40 mils) in thickness.
- 3. Installation.**
 - 3.1 The manhole risers shall have both the exterior and interior surfaces coated.
 - 3.2 The coating shall be applied to the full circumference of the manhole riser.
 - 3.3 The manhole riser manufacturer shall apply the coating as recommended by the coating manufacturer.
 - 3.4 Care shall be exercised in handling, transporting and placing coated manhole risers to prevent damage to the coating.
 - 3.5 Field coating of existing manhole risers shall be performed in strict conformance with the manufacturer's specifications and instructions.
 - 3.6 After the manhole risers have been installed, a Holiday inspection shall be conducted in accordance with NACE SP0188 using a spark tester.
 - 3.7 All patches over holes or repairs to the coating wherever damage has occurred shall be done in accordance with the manufacturer's recommendation.

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Appendix C: Standard Specification for Wheelchair Ramp Composite Detectable Warning Surfaces

1. Composite detectable warning surfaces for pedestrian crossings and adhesives shall meet all applicable ADA requirements and ASTM specifications.
2. The applicable ASTM specifications include but are not limited to the following:
 - a. ASTM D570, Water Absorption
 - b. ASTM D543, Chemical Resistance
 - c. ASTM C482, Adhesion/Bond Strength
 - d. ASTM D1037, Freeze-Thaw Cycling
 - e. ASTM D2299, Stain Resistance
3. The approved composite warning surface for the City of Bartlett shall be manufactured by Access Tile, ADA Solutions, Inc. or an approved equivalent.
4. The composite warning surface color shall be Federal Yellow and installed as per the manufacturer's specifications and guidelines.

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Appendix D: Standard List of Approved Water Main Fittings and Accessories

Item	Manufacturer	Part #
Curb Stop – Compression with female ball valve, locking wing reduced port		
3/4"	Mueller	B-25170RN
3/4"	Ford	B41-344WQNL
1"	Mueller	B-25170RN
1"	Ford	B41-444WQNL
1 1/2"	Mueller	B-25170RN
1 1/2"	Ford	B41-666WQNL
2"	Mueller	B-25170RN
2"	Ford	B777-WQNL
Corporation Stop – Compression with taper "CC thread ball valve		
3/4"	Mueller	B-25008N
3/4"	Ford	FB-1000Q-3NL
1"	Mueller	B-25008N
1"	Ford	FB-1000Q-4NL
1 1/2"	Mueller	B-25008N
1 1/2"	Ford	FB-1000Q-6NL
2"	Mueller	B-25008N
2"	Ford	FB-1000Q-7NL
Compression Coupling – Compression with compression for copper tubing		
3/4"	Mueller	H-15403N
3/4"	Ford	C44-33QNL
1"	Mueller	H-15403N
1"	Ford	C44-44QNL
1 1/2"	Mueller	H-15403N
1 1/2"	Ford	C44-66QNL
2"	Mueller	H-15403N
2"	Ford	C44-77QNL
Meter Coupling – Straight meter coupling, male iron pipe thread with meter swivel nut		
3/4"	Mueller	H-10890N
3/4"	Ford	C38-23-2.5NL
1"	Mueller	H-10890N
1"	Ford	C38-44-2.652NL
Male Adapter – Compression with male iron pipe thread for copper tubing		
3/4"	Mueller	H-15428N
3/4"	Ford	C84-33QNL
1"	Mueller	H-15428N
1"	Ford	C84-44QNL
1 1/2"	Mueller	H-15428N
1 1/2"	Ford	C84-66QNL
2"	Mueller	H-15428N
2"	Ford	C84-77QNL

Appendix D: Standard List of Approved Water Main Fittings and Accessories

Item	Manufacturer	Part #
Female Adapter – Compression with female iron pipe thread for copper tubing		
3/4"	Mueller	H-15451N
3/4"	Ford	C14-33QNL
1"	Mueller	H-15451N
1"	Ford	C14-44QNL
1 1/2"	Mueller	H-15451N
1 1/2"	Ford	C14-66QNL
2"	Mueller	H-15451N
2"	Ford	C14-77QNL
Fire Hydrant		
	Mueller	A-423 Super Centurion 250
	M&H	Model 129
Water Valves		
	Mueller	2300 Series
	M&H	C515 Series
Tapping Tee		
	Mueller	304 L
	Mueller	H-615
Tapped Full Circle Repair Clamp (for water service taps)	Smith Blair	264 Series
	Smith Blair	600 Series
Corporation Caps		
	Mueller	H-15540

Appendix E: Standard Specification for Stainless Steel Tap Sleeve

1. Tap sleeves shall be the split sleeve, drop-in bolt design. Once inserted, the bolts shall be 'captured' to prevent them from spinning during tightening. The sleeve design shall allow the bolts to be reversed to ease installation.
2. The tapping sleeve shall be manufactured of 304 L stainless steel to minimize the potential for carbide precipitation corrosion.
3. The tap sleeve outlet shall be at least 12 gauge material and one-half (1/2) inch oversized to allow the use of a full size shell cutter.
4. The tap sleeve outlet shall be provided with a three-quarter (3/4) inch NPT test plug with a square head for quick and easy removal. The plug shall be composed of either brass or 304 stainless steel.
5. The tap sleeve shall have a class 125 outlet flange with drilling and dimensions that fully comply with ANSI B 161.
6. The tap sleeve outlet flange shall have a machined recess to match the machined projections on standard tapping valves to assure correct alignment in accordance with MSS-SP 60.
7. The tap sleeve outlet flange material shall be type 304 stainless steel.
8. The tap sleeve shall have a rated pressure of 250 PSIG in sizes four (4) to 12 inches and 200 PSIG in sizes 14 to 24 inches.
9. The tap sleeve shall have a complete circle gasket on the interior of the shell.
 - a. The shell gasket shall be composed of NBR (nitrile) virgin rubber and be of the waffle design.
 - b. The shell gasket shall provide a complete 360 degree seal.
 - c. The outlet gasket shall be provided with a minimum of two (2) concentric raised surfaces to maximize sealing on the pipe surface.
10. The tap sleeve bolts, nuts and washers shall be type 304 stainless steel.
 - a. The nuts shall be of the heavy hex type.
 - b. The bolts shall be a rolled thread, drop-in style, coated with an anti-galling compound.
11. The tap sleeve shall have an integral gap bridging that eliminates separate gap bridges and reduces deformation of the bridge under high torques on sleeves up to 12 inches. Tap sleeves in larger sizes shall have gap bridges.
12. The tap sleeve welds shall be passivated, in addition to the entire sleeve, to maintain optimum corrosion resistance, in accordance with ASTM A 380.

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Appendix F: Approved Reduced Pressure Backflow Prevention Devices

Brand Name	Model	Size in Inches
Ames	4000BM2-FP	1¼, 1½, 2
ARI	DC501	½, 1
	RP501	½
	VB-501	½, ¾, 1
Apollo/CONBRACO	RPLF4AR	8
Backflow Direct	Deringer 20G	8
	Deringer 20GX	6
	Magnum 20	2½, 3, 4, 8
	Magnum 20G	8
	Magnum 20GX	6
	Magnum 20X	6
	Magnum 40	2½, 3, 4, 8
	Magnum 40X	6
Febco	LF870V	10
	450ST	4, 6
	450STR	4, 6
	LF880V	10
This list is current as of 9/6/2018 and compiled from https://fccchr.usc.edu/list.html		

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Appendix G: Approved Reduced Pressure Backflow Prevention Devices No
Longer in Production

Brand Name	Model	Size in Inches
Cash Acme	DC100	¾, 1, 1½, 2
	DC500	¾, 1
Febco	750	2½, 3, 4, 6, 8, 10
	750N	2½, 3, 4, 6
Flomatic	DCV	¾, 1, 1½, 2, 2½, 3, 4, 6, 8
	DCVE	¾, 1, 1¼, 2
	PVB	¾, 1
Hershey	2	3, 4, 6, 8, 10
This list is current as of 9/6/2018 and compiled from https://fccchr.usc.edu/list.html		

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Appendix H: Drainage Pipe Sizing Chart

The attached pipe chart will be used as the basis for design of new drainage systems. This is the minimum standard and may be modified by the Director or design engineer when field conditions warrant changes for additional capacity.

DESIGN STANDARDS FOR RAINFALL RUNOFF CALCULATIONS

Utilizing the Rational Method in Computing Runoff Amounts $Q=C \times I \times A$

RESIDENTIAL		C = 0.525 Years Storm	
ACRES	T _c	i-25	CFS/Acre
1	5	8.0	3.5
2	6.37	7.6	3.5
5	10.22	6.4	3.2
10	13.02	5.8	2.9
20	16.60	5.25	2.6
30	19.13	5.00	2.5
40	21.15	4.75	2.4
50	22.87	4.60	2.3
75	26.36	4.25	2.1
100	29.15	4.04	2.0

OFFICE PARK/INDUSTRIAL		C = 0.75	Tr = 25 years
ACRES	T _c	i-25	CFS/Acre
1	5	8.0	5.0
2	5.46	7.8	5.0
5	7.68	7.1	5.0
10	9.99	6.5	4.9
20	13.03	5.8	4.3
30	15.42	5.6	4.2
40	17.56	5.25	3.9
50	19.64	4.9	3.7
75	22.63	4.6	3.5
100	25.03	4.4	3.3
125	27.06	4.25	3.2
150	28.85	4.15	3.1
175	30.45	4.0	3.0
200	31.90	3.9	2.9

Appendix H: Pipe Sizing Chart

COMMERCIAL		C = 0.82	Tr = 25 years
ACRES	Tc	i-25	CFS/Acre
1	5	8.0	6.0
2	5	8.0	6.0
5	7.07	7.3	6.0
10	9.28	6.7	5.5
20	12.02	6.0	4.9
30	14.10	5.72	4.7
40	15.90	5.4	4.4
50	17.55	5.2	4.3
75	20.23	4.8	3.9
100	22.36	4.6	3.8

INLET	CAPACITY
#10	3.00 CFS
3070	3.00 CFS
#11	6.50 CFS
#6-72	6.50 CFS
3 X 3	14 CFS

Appendix I: Summary of Changes

Change #	Date	Paragraph	Change
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