# CITY OF WAYNE

# STANDARD SPECIFICATIONS
# FOR CONSTRUCTION OF
# WATER, SEWER, STORM SEWER AND PAVING

August 1, 2019

# PREFACE

The standards contained herein are intended for the purpose of establishing certain minimum requirements for sewer, water, and paving improvements constructed in the City of Wayne. Additional and/or more stringent requirements should be used where necessary to meet the particular needs and conditions of specific constructions projects.

These standards should be reviewed and updated periodically to incorporate advancements in construction materials and methods

# STANDARD SPECIFICATIONS
# FOR CONSTRUCTION OF
# SEWER AND WATER UTILITIES AND PAVING

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## ARTICLE 1. DEFINITIONS:

A. Wherever used in these Standard Specifications, the Bidding Requirements, or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

(1) *Addenda* – Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

(2) *Agreement* – The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

(3) *Application for Payment* – The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

(4) *Bid* – The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

(5) *Bidder* – An individual or entity that submits a Bid to Owner.

(6) *Bidding Documents* – The Bidding Requirements, the proposed Contract Documents, and all Addenda.

(7) *Bidding Requirements* – The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

(8) *Change Order* – A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

(9) *Change Proposal* – A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-

off against payment due; or seeking other relief with respect to the terms of the Contract.

(10) *City* – The City of Wayne, as owner of the project, acting through its authorized representatives. The term Owner shall likewise mean the City of Wayne.

(11) *City Engineer* – Any engineer, registered to practice professional engineering in the State of Nebraska, who is retained by the City to review the Drawings (Plans) and Specifications and/or to make inspection of the Work performed by the Contractor.

(12) *Claim* – (a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.

(13) *Constituent of Concern* – Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental R3esponse, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to or imposing liability or standards of conduct concerning any hazardous, toxic, or dangerous waste, substance, or material.

(14) *Contract* – The entire and integrated written contract between the Owner and Contractor concerning the Work.

(15) *Contract Documents* – Those items so designated in the Agreement, and which together comprise the Contract.

(16) *Contract Price* – The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

(17) *Contract Times* – The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

(18) *Contractor* – The individual or entity with which Owner has contracted for performance of the Work.

(19) *Design Engineer* – Any engineer, registered to practice professional engineering in the State of Nebraska, who is retained by the City or others to design the Work and prepare and interpret the Contract Documents for the Work. When, at the option of the City, the Design Engineer also serves as the City Engineer these terms shall be considered interchangeable.

(20) *Drawings* – The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

(21) *Effective Date of the Contract* – The date, indicated in the Agreement, on which the Contract becomes effective.

(22) *Engineer* – The individual or entity named as such in the Agreement.

(23) *Field Order* – A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

(24) *Hazardous Environmental Condition* – The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

(25) *Laws and Regulations; Laws or Regulations* – Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

(26) *Liens* – Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

(27) *Milestone* – A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

(28) *Notice of Award* – The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

(29) *Notice to Proceed* – A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

(30) *Owner* – The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contactor for the performance of the Work, pursuant to the terms of the Contract.

(31) *Progress Schedule* – A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

(32) *Project* – The total undertaking to be accomplished for Owner by Engineers, Contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

(33) *Project Manual* – The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

(34) *Resident Project Representative* – The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.

(35) *Samples* – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

(36) *Schedule of Submittals* – A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.

(37) *Schedule of Values* – A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Application for Payment.

(38) *Shop Drawings* – All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for

Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

(39) *Site* – Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.

(40) *Specifications* – The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

(41) *Standard Specifications* - The directions, provisions and requirements, including standard drawings and design standards contained herein. The standards contained herein are intended as minimums to be incorporated by the Design Engineer into the Contract Documents, without restricting the use of more stringent design and construction requirements which may be determined necessary by the Design Engineer for the particular Work to which the Contract Documents apply.

(42) *Subcontractor* – An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

(43) *Substantial Completion* – The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

(44) *Successful Bidder* – The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated condition.

(45) *Supplementary Conditions* – The part of the Contract that amends or supplements the General Conditions.

(46) *Supplier* – A manufacturer, fabricator, supplier, distributor, materialman, or vendor have a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

(47) *Technical Data* – Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at

the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site.

(48) *Underground Utilities* – All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum projects, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

(49) *Unit Price Work* – Work to be paid for on the basis of unit prices.

(50) *Work* – The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

(51) *Work Change Directive* – A written direct to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

## ARTICLE 2. SUBSURFACE CONDITIONS:

A. Subsurface information, unless provided specifically by the Contract Documents, has not been obtained by the City of Engineer except as may have been advisable to aid in the design. Contractor should visit site and acquaint himself with site conditions and make his own subsurface investigations to satisfy himself of the construction conditions, before submitting a bid for work.

B. It shall be the contractor's responsibility when working around, over and under existing utility lines or other existing underground obstructions, and any existing utility line or other underground obstruction to determine the actual location of said utility. The locations of utilities as shown on the plans are approximate and reflect the results of utility locations completed for the City and City Engineer. If any utility is damaged by the Contractor during the construction of the project, the Contractor

shall notify the Utility Owner, City, and City Engineer immediately. The cost of repair or replacement of the damaged utility shall be the responsibility of the Contractor. Any existing utility and other underground obstruction information given in the Contract Documents is not guaranteed by the City or Engineer as to accuracy or completeness, but is furnished merely for the convenience of all concerned. It shall be the sole responsibility of the Contractor to ascertain the exact type, number, location, size, depth, and any other pertinent information relating to utilities that may affect the construction of any proposed work, prior to submitting a bid for the work.

C. The Contractor shall notify utility companies and the appropriate City departments and any other affected parties, at least 48 hours before any work involving excavation is scheduled to start, in order that they may locate their respective services at the job site. No utility may be permanently or temporarily relocated without the approval of the utility involved. Any temporary or permanent relocation of any utility shall be done in accordance with the requirements of the respective utility involved. Should it become necessary to permanently or temporarily relocate any utility, it shall be done at no expense to the City. No compensation will be allowed for delay caused by the necessity of any relocation.

## ARTICLE 3. BONDS AND INSURANCE:

A. The Contractor shall furnish performance and payment bonds as security for the faithful performance of all his obligations under the Contract Documents. These bonds shall be in amounts at least equal to the contract price and in such form and with such sureties as are acceptable to the Owner. The performance bond shall remain in full force and effect through the guarantee period.

B. In the case of improvements constructed by a developer, bonding and guarantees shall be in accordance with the most recently adopted Subdivision Regulation Ordinance for the City of Wayne.

C. The Contractor will not commence any work until he obtains at his own expense all insurance required by the Contract Documents and applicable laws. Such insurance must have the approval of the Owner as to limit, form and amount. The Contractor will not permit any Sub-Contractor to commence work until the same insurance requirements have been complied with by such Sub-Contractor. As a minimum, the types of insurance the Contractor is required to obtain and maintain for the full period of the Contract will be Workmen's Compensation Insurance, and Comprehensive General Liability Insurance, as detailed in the following portions of this specification. Any insurance bearing on adequacy of performance will be maintained after completion of the project for the full guarantee period. Nothing contained in these insurance requirements is to be construed as limiting the extent of the Contractor's responsibility for payment of damages resulting from his operations.

D. Before the agreement between the Owner and the Contactor is entered into, the Contractor will submit written evidence that he and all Sub-Contractors have

obtained for the period of the Contract full Workmen's Compensation Insurance coverage for all persons whom they employ or may employ in carrying out the work. This insurance will be in strict accordance with the requirements of the most current and applicable State Workmen's Compensation Insurance Laws.

E. Before commencement of the work, the Contractor shall submit written evidence that he and all his Sub-Contractors have obtained for the period of the Contract full comprehensive general liability automobile comprehensive general liability insurance coverage. This coverage will provide for both bodily injury and property damage arising directly out of or in connection with the work. The minimum limits of the coverage shall be as required by the Contract Documents or law.

F. The Comprehensive General Liability Insurance will include as Additional Named Insureds: the Owner; the Engineer and his consultants; and each of their officers, agents, and employees.

## ARTICLE 4. CONTRACTOR'S RESPONSIBILITIES:

A. The Contractor will supervise and direct the Work efficiently and with his best skill and attention. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor will be responsible to see that the finished Work complies accurately with the Contract Documents.

B. The Contractor will provide competent, suitably qualified personnel to lay out the Work and perform construction as required by the Contract Documents. He will at all times maintain good discipline and order at the site. The Contractor will furnish all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water and sanitary facilities and all other facilities and incidentals necessary for the execution, testing, initial operation and completion of the Work, except as otherwise provided in the Contract Documents. All materials and equipment will be new, except as otherwise provided in the Contract Documents. If required by the Engineer, the Contractor will furnish satisfactory evidence as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator or processors, except as otherwise provided in the Contract Documents.

C. The Contractor will be fully responsible for all acts and omissions of his Sub-Contractors and of persons directly or indirectly employed be them and of persons for whose acts any of them may be liable to the same extent that he is responsible for the acts and omissions of persons directly employed by him. Nothing in the Contract Documents shall create any contractual relationship between any Sub-Contractor and the Owner or the Engineer or any obligation on the part of the Owner or the Engineer to pay or to see to the payment of any moneys due any Sub-Contractor, except as may otherwise be required by law. The Contractor agrees to

bind specifically every Sub-Contractor to the applicable terms and conditions of the Contract Documents for the benefit of the Owner.

D. The Contractor will secure and pay for all construction permits and licenses and will pay all governmental charges and inspection fees necessary for the prosecution of the Work. He will also pay all public utility charges. The Contractor will give all notices and comply with all laws, ordinances, rules and regulations applicable to the Work. If the Contractor observes that the Specifications or Drawings are at variance therewith, he will give the Engineer prompt written notice thereof, and any necessary changes shall be adjusted be an appropriate Modification.

E. The Contractor will pay all sales, consumer, use and other similar taxes required by the law of the place where the Work is to be performed.

F. The Contractor will confine his equipment, the storage of materials and equipment, and the operations of his workmen to areas permitted by law, ordinances, permits, or the requirements of the Contract Documents, and shall not unreasonably encumber the premises with material or equipment. The Contractor will not load nor permit any part of the Work to be loaded with weights that will endanger the structure, nor will he subject any part of the Work to stresses or pressures that will endanger it.

G. The Contractor will keep one record copy of all Specifications, Drawings, Addenda, Modifications, and Shop Drawings at the site in good order and notated to show all changes made during the construction process. The Contractor will measure and record distances and ties to ends of service lines, valves, fittings and other buried items from prominent permanent features such as manholes, curb lines and structures. Contractor shall coordinate with City Staff to allow the City to obtain GPS coordinates on all service lines, valves, fittings, and other buried items and utilities. The Contractor will prepare and deliver to the Owner an "As-Built" set of Drawings and record book of ties upon completion of the Work.

H. The Contractor will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. He will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to:

1. All employees on the Work and other persons who may be affected thereby.

2. All the Work and all materials or equipment to be incorporated therein, whether in storage on or off the site.

3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction

I. The Contractor will comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. He will erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection, and in addition he will comply with all applicable recommendations of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc.

J. The contractor will be responsible for furnishing, erecting, and maintaining suitable and requisite barricades, signs, amber lights, flares, danger signals, watchmen or other adequate protection that may be necessary to insure the safety of the public and those engaged on the Work and to protect the Work.

K. In emergencies affecting the safety of persons or the Work or property at the site or adjacent thereto, the Contractor without special instruction or authorization from the Engineer or Owner, is obligated to act, at his discretion, to prevent threatened damage, injury or loss. He will give the Engineer prompt written notice of any significant changes in the Work or deviations from the Contract Documents caused thereby.

## ARTICLE 5. WARRANTY AND GUARANTEE:

A. The Contractor shall warrant and guarantee to the Owner that all materials and equipment will be new unless otherwise specified and that all Work will be of good quality and free from faults or defects and in accordance with the requirements of the Contract Documents.

B. The guarantee shall be for a period of one (1) year from the date of completion or such longer period of time as may be prescribed by law or required by the Contract Documents.

C. If any Work is found to be defective the Contractor will, promptly without cost to the Owner and in accordance with the Owner's written instructions, either correct such defective Work, or, if it has been rejected by the Owner, remove it from the site and replace it with non-defective Work. If the Contractor does not promptly comply with the terms of such instructions, the Owner may have the defective Work corrected or the rejected Work removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, will be paid by the Contractor.

## ARTICLE 6. MATERIAL SAMPLES AND TESTING:

A. The Contractor will submit to the Design Engineer for his review all shop drawings and samples required by the Contact Documents. All samples will have been checked by and stamped with the approval of the Contactor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which

intended. At the time of each submission, the Contractor will in writing notify the Design Engineer's attention to any deviations that the shop drawing or sample may have from the requirements of the Contract Documents. The Design Engineer shall return the shop drawings marked with one of the following action items:

1) Furnish as submitted;
2) Furnish with revisions;
3) Revise and Resubmit;
4) Rejected;
5) Review not required.

Records of shop drawing and samples will be made available to the City Engineer upon his request.

B. The Owner will arrange for services of an independent Testing Laboratory to perform materials testing specified by the Contract Documents. Payment for these services will be as stated in the Contract Documents. Employment of Testing Laboratory shall in no way relieve Contractor of his obligations to perform Work in accord with the Specifications. The Contractor will cooperate with Laboratory personnel, provide access to Work, provide samples of materials to be tested in required quantities, and provide casual labor and facilities to obtain and handle samples at the site. The Contractor will notify Laboratory sufficiently in advance of operations to allow for his assignment of personnel and scheduling of tests.

C. In the case of improvements constructed by a sub-divider, the sub-divider will arrange for and pay for services of an independent Testing Laboratory, subject to the approval of the City Engineer. Testing shall be as specified by these Standard Specifications or such more stringent testing as may be required by the Contract Documents. If the City Engineer believes there is just cause during the course of construction, he may require additional testing be performed and such additional testing will be paid for by the sub-divider.

## ARTICLE 7. CUTTING AND PATCHING

A. The Contractor shall execute cutting (including excavating), fitting or patching of Work, required to:

1. Make several parts fit properly

2. Remove and replace defective Work.

3. Remove and replace Work not conforming to requirements of Contract Documents

4. Remove samples of installed Work as specified for testing.

5. Install specified Work in existing construction.

B. Prior to cutting, Contractor shall:

1. Provide shoring, bracing and support as required to maintain structural integrity of Project.

2. Provide protection for other portions of Project.

3. Provide protection from elements.

C. The Contractor shall:

1. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances and finishes.

2. Execute cutting and demolition by methods which will prevent damage to other Work, and will provide proper surfaces to receive installation of repairs and new Work.

3. For replacement of Work remove, comply with specifications for type of Work to be done.

## ARTICLE 8. CLEANING

A. The Contractor shall comply with the following:

1. At all times keep premises free from accumulations of waste material and rubbish.

2. Upon completion of Work, remove all rubbish, tools, scaffolding and surplus materials from premises.

3. Leave all work in "broom clean" condition, unless more exactly specified elsewhere.

B. Unless indicated otherwise in the Contract Documents, the Contractor shall restore all surfaces to their original elevations and replace surfaces with materials equivalent to their original surface.

## ARTICLE 9. SANITARY SEWER AND WATER MAIN SEPERATION:

The following minimum sanitary sewer and water main separation distances shall be abided by unless more stringent requirements are imposed by the Contract Documents:

A. Horizontal Separation:

1. Horizontal separation between water and sanitary sewer main shall be in accordance with *Recommended Standards for Water Works, Part 8.8.2*.

2. Sanitary sewers shall be laid at least 10 feet horizontally, from any existing water main.

3. If conditions prevent the 10 foot horizontal separation, a sanitary sewer may be laid closer than 10 feet to the water main, provided the following criteria are met:

   a. The water main is in a separate trench or on an undisturbed earthen shelf located on one side of the sewer at such an elevation that the top of the sanitary sewer is at least 18 inches below the bottom of the water main; and

B. Vertical Separation

1. Vertical separation between water and sanitary sewer main when crossing shall be in accordance with *Recommended Standards for Water Works, Part 8.8.3*.

2. When water mains cross over or under the sanitary sewer, there should be a vertical separation between the pipes of at least 18 inches.

3. If local conditions prevent the 18 inches vertical separation, the sanitary sewer may be placed not less than 6 inches below a water main or not less than 18 inches above a water main.

4. If the sanitary sewer crosses over or less than 18 inches below a water main, the sanitary sewer shall be constructed of one full length (20 feet) of cast iron pipe or other pipe material capable of pressure testing, located so that both joints are as far as possible from the water main.

C. Special Conditions:

1. If local conditions prevent the horizontal and vertical separation as specified above, both the water main and sanitary sewer shall be constructed of cast iron or other pipe materials capable to pressure testing. Both the water main and the sanitary sewer should be pressure tested to assure water tightness.

D. Sewer Force Main and Water Main Separation:

1. Sewer force mains shall be laid at least 10 feet horizontally from any existing water main.

2. If conditions prevent the 10 foot horizontal separation, the force main shall be constructed of cast iron or other pipe material capable of pressure testing to 150 psig, and shall be located at least 4 feet from the water main.

## ARTICLE 10. TRENCHING, BACKFILLING, AND COMPACTING

A. General

1. Excavate all substances encountered to depths indicated on the drawings or as specified by the City Engineer or the City.

2. Place excavated materials suitable for backfilling in an orderly manner sufficiently away from the banks of any trench to avoid overloading and to prevent slides or cave-ins.

3. Remove and dispose of excess or unsuitable backfill material as directed by the Design Engineer, City Engineer or the City.

4. Perform site grading as required to prevent surface water from entering open trenches.

5. Perform dewatering operations as required to keep trenches dry.

6. Assure that all shoring and sheeting required complies with applicable local, state, and federal safety requirements.

7. All trenching shall be by open cut except where indicated otherwise on drawings or where otherwise specified by the City.

B. Trench Excavation

1. Trench banks shall be excavated to OSHA standards. Where limited space will not allow excavation to OSHA standards, proper bracing or shoring shall be implemented to allow the safe construction of the utility. The safety of construction shall remain the sole responsibility of the Contractor.

2. The cost of bracing or shoring shall be included in the Contractor's bid price, no additional payment will be issued due to the need for bracing or shoring.

3. Trench shall be excavated to allow for proper bury depth of the utility to be in accordance with the lines and grades shown on the approved plans and specifications.

4. No more than 400 feet of trench which is wider than 8 inches shall be open at one time. All trenches should be backfilled at the end of the day. If the

trench cannot be backfilled, proper methods shall be put in place by the Contractor to prevent surface water from entering the trench. The Contractor shall also rope, ribbon, or barricade the trench to warn the public of an open trench overnight. Pipe shall be properly supported to keep it from floating.

5. The bottom of the trench shall have a minimum width of not less than12 inches wider than the pipe to be installed and a maximum width of 3 times the diameter of the pipe.

6. Accurately grade trench bottom to provide uniform bearing and support for each pipe section.

7. Pipe shall lay on undisturbed suitable soils or compacted granular fill at every point along its length. Water mains shall be bedded in sand or approved alternate.

8. Over depth excavation shall be backfilled with compacted granular fill.

9. Where unsuitable trench bed conditions require, special rock bedding shall be used to stabilize the trench. Special rock bedding shall be 1 ½ inch to 2 ½ inch screened rock. Compacted granular fill may be substituted upon approval by the City.

D. Backfilling and Compacting

1. Backfill material shall be free from all trash, debris, boulders, frozen clods, large roots, excessive sod, or other vegetation.

2. Hand tamp backfill under and around all pipes to 12 inches above the top of the pipe in lifts not exceeding 6 inch loose thickness.

3. Do not disturb joint alignment or grade of pipe during backfill operations.

4. Backfill and compact remaining trench in maximum lifts of 12 inches, compacted thickness.

5. Moisten, aerate, or dry backfill material and compact as required to assure the following minimum densities on trench backfill:

   i) Areas under paved streets – 98 percent of Standard Proctor Density for the top 12 inches and 95% of Standard Proctor Density for all remaining portions of the trench.

   ii) Areas under sidewalks – 95 percent of Standard Proctor Density for the top 12 inches and 93% of Standard Proctor Density for all remaining portions of the trench.

iii) All other areas – 90 percent of Standard Proctor Density for the entire trench.

iv) The compacted density of backfill shall not be less than the maximum dry density of the adjacent soils.

v) Frequency and location of compaction tests shall be subject to approval of the City Engineer and the City.

6. It will be the Contractor's option as to the type of mechanical tamping equipment used to attain the specified soil densities. However the tamping equipment shall be sized and used in such a manner as to not disturb or damage any pipe or conduit. Use of a high force hammer will not be permitted until compacted backfill is in place to a minimum of 4 feet above the top of the pipe.

7. Backfill operations will be conducted such that no more than 400 feet of trench will be left open at any one time.

## ARTICLE 11. PIPE BORING AND JACKING

A. General

1. Casing pipe diameter shall be at least 2 nominal sizes larger than the diameter of the carrier pipe, but in no case shall the inside diameter of the casing pipe be any less than 2 inches larger than the largest outside diameter of the carrier pipe. Wall thickness as required by any crossing permit.

2. Contractor shall notify NDOT, City Engineer, or the City as required at least 48 hours prior to commencement of boring and jacking operations.

3. Work shall not interfere with the movements of traffic.

4. Operations shall comply fully with the rules and regulations of NDOT, Wayne County, and the City of Wayne.

5. Casing pipe shall be uniform in alignment from end to end without sags and summits.

i) Finished line and grade of pipe shall not deviate more than 6 inches from staked line and grade at any point.

ii) Do not reverse grade at any point for gravity pipe lines.

6. Adequate shore and brace jacking faces and pits as required.

7. Cast iron and ductile iron carrier pipe shall be supported by the bells of the pipe connections. PVC carrier pipe shall be supported along the entire length of the pipe barrel by treated wood skids, in accordance with the pipe manufacturer's recommendations. Fill the annular space between the carrier pipe and casing pipe with sand to the spring line of the carrier pipe, minimum.

8. Install casing vents where shown on drawings.

9. After installation of carrier pipe, end of casing pipe shall be sealed with grout to exclude water and soil.

## ARTICLE 12. CONCRETE REINFORCEMENT

A. Materials:

1. Concrete Reinforcing shall meet the requirements of *Nebraska Department of Transportation Standard Specification for Highway Construction, 2017 Edition* Section 707.

2. Reinforcing bars shall be new deformed billet steel, grade 40.

3. Bars shall be free from mill scale, excessive rust or other deleterious coatings.

B. Procedure:

1. Support and tie all bars

2. Thickness of concrete bars:

   i) 1 ½ inches for bars #5 and smaller.

   ii) 2 inches for bars larger than #5

3. Place temperature reinforcing for slabs on grade at center of slab.

## ARTICLE 13. CAST-IN-PLACE CONCRETE

A. Materials:

1. Structural Concrete shall meet the requirements of *Nebraska Department of Transportation Standard Specifications for Highway Construction, 2017 Edition* Section 704 – Concrete Construction.

2. Portland Cement: Type I or II, and shall meet the requirements of *Nebraska Department of Transportation Standard Specifications for Highway Construction, 2017 Edition* Section 1002 – Portland Cement Concrete, and Section 1004 Portland Cement.

2. Aggregates: Maximum coarse aggregate size 1 inch.

B. Workmanship:

1. Minimum strength of concrete shall be 3,500 psi at 28 days.

2. Maximum delivered slump shall be 5 inches.

3. Exposed slabs shall receive a broom or burlap finish.

## ARTICLE 14. PRECAST CONCRETE MANHOLES, JUNCTION BOXES, AND INLETS

A. Materials:

1. Manhole sections shall be precast reinforced concrete risers, tops, and adjustment rings, minimum diameter of 48 inches unless noted otherwise on Drawings or by the City.

2. Frame and lid shall have a minimum opening of 24 inches.

3. Steps shall be poly/epoxy coated.

B. Workmanship:

1. All water shall freely drain from the manhole.

2. Manhole bases shall be poured in place or shall be precast. If using poured-in-place, ground water shall be kept below bottom of base for 24 hours following pouring of base. If using precast bases, the Contractor shall place a minimum of 6 inches of crushed rock or crushed concrete as a subbase below to ensure a uniform surface for the manhole to be placed.

3. Finish manholes below frame and cover with removable concrete rings to facilitate future adjustment. Plastic rings may be substituted with approval by the City. Mortar concrete rings and frame securely in place.

4. All joints shall be tarred. Mortar remaining spaces of interior joints smooth and mortar shut manhole section lifting holes.

5. Coat exterior surfaces of manhole with one coat of a heavy bodied tar or bituminous paint.

6. All connections cut into manholes, junction boxes, and inlets shall be neatly built leaving no projections on the inside of the structure and made watertight.

## ARTICLE 15: CAST IRON OR DUCTILE IRON PIPE

A. Quality Assurance

1. Provide manufacturer's certificate that materials meet or exceed minimum requirements as specified.

B. Submittals:

1. Submit manufacturer's certificates of conformance.

2. Submit copies of test reports.

3. Submit manufacturer's gasket lubricant recommendations.

C. Product Delivery, Storage, and Handling:

1. During loading, transporting, and unloading, exercise care to prevent damage to materials.

2. Do not drop pipe or fittings.

3. Store materials on site in enclosures or under protective coverings above ground to keep clean and dry.

D. Pipe and Fittings:

1. Cast Iron Pipe:

   i) AWWA C106 or ANSI A21.6 or A21.8, Class 22 thickness, joints per AWWA C111 or ANSI A21.11.

2. Ductile Iron Pipe:

   i) AWWA C151 or ANSI A21.51, Class 50 thickness, joints per AWWA C111 or ANSI A21.11.

3. Fittings:

i) AWWA C110 or ANSI A21.10, Class 250, joints as required. Provide lugs where tie rods used

4. Cement Mortar Lining:

i) AWWA C104 or ANSI A21.4, thickness, 1/16 inch for sizes 3-12 inch, 3/32 inch for sizes 14 inch and up.

E. Gasket Lubricant:

1. As recommended by pipe manufacturer.

F. Inspection:

1. Examine areas to receive piping for:

i) Defects that adversely affect execution and quality of work.

ii) Deviations beyond allowable tolerances for piping clearances.

G. Workmanship:

1. Examine pipe and fittings before installation and assure no defective materials are incorporated.

2. Keep inside of pipe and fittings free of dirt and debris.

3. Valves to be cut into existing main shall be installed prior to connection newly constructed water main to the existing system. This will permit the isolation of as small segment of the system as possible in which service must be interrupted.

4. Before lowering, and while suspended, check for defective pipe by tapping with light hammer; defective, damaged or unsound pipe shall not be installed.

5. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other suitable means to prevent the ingress of foreign materials. This stipulation shall apply during noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

6. Where existing water main is to be abandoned the old main shall be exposed for a sufficient distance to inspect its general condition and removed or plugged adequately in accordance with the Engineer's direction. If directed to be removed, the salvaged pipe shall be stored carefully at a site of the

Owner's choosing and the ensuing trench backfilled in accordance with Article 10.

H. Placement:

1. Lay piping on firm bed for entire length of trench except where supports are otherwise provided.

2. Hand excavate for pipe bell ends.

3. Employ partial backfilling and cradling to hold pipe in secure position during backfilling operations.

4. Compression Joint Installation:
   i) Clean hub and inset gasket.

   ii) Apply gasket lubricant to spigot and inside of gasket.

   iii) Drive spigot into gasketed hub with pulling tool or suitable device.

5. Maximum allowable joint deflection shall be 4 degrees for pipe size 12 inch and smaller and 2 degrees for pipe sizes 14 inch through 24 inch.

6. For water mains:

   i) Lay piping with minimum earth cover of 5 ½ feet above the top of the pipe.

   ii) Provide thrust blocks to restrain piping at all abrupt changes in direction, tees, bends, dead ends, and hydrants.

## ARTICLE 16: PLASTIC PIPE

A. Quality Assurance:

1. Provide manufacturer's certificate that materials meet or exceed minimum requirements as specified.

B. Submittals:

1. Submit certified copies of test reports.

2. Submit manufacturer's certificates of conformance.

3. Submit manufacturer's gasket lubricant recommendations.

C. Product Delivery, Storage, and Handling:

1. Exercise care in transporting and handling to avoid damage to pipe and fittings.

2. Pipe ends shall be covered during delivery from the manufacturer to the jobsite.

3. Store materials on site in enclosure or under protective coverings.

4. Do not store materials directly on the ground.

5. Assure that materials are kept clean and dry.

6. Do not drop pipe or fittings.

D. Pipe:

1. SDR 21 Polyvinyl Chloride for Sewage Force Mains:

i) Class 200 (SDR 21) PVC 130 psi working pressure rated pipe with FLUID-TITE gasket couplings and fittings as manufactured by Certain-Teed Products Corporation or Clow Corporation BELL TITE or equal.

ii) Material used to produce the pipe, couplings and fittings shall conform to ASTM D1784, Type I, Grad I, 2,000 psi design stress.

iii) All PVC pipe shall conform to the latest revisions of the following specifications:
ASTM D2241 (PVC plastic pipe SDR-PR and Class T) Commercial Standard CS 256-63 (pressure rated pipe) National Sanitation Foundation Testing Laboratories (NSF).

iv) Designated as PVC 1120.

v) Joints shall be gasketed, push-on type in accordance with ASTM D3139. Rubber gasketing shall conform to ASTM D1869.

vi) The pipe shall be precision extruded from new polyvinyl chloride material and shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. The pipe shall be extruded in strict accordance with the raw material manufacturer's recommendations and specifications.

vii) The PVC pipe shall be supplied in standard laying lengths of 20 or 40 feet.

2. Polyvinyl Chloride pipe for gravity sanitary sewers:

NOTICE: PVE sewer pipe shall not be used in line segments (manhole to manhole) where the depth of bury at any point, exceeds fifteen (15) feet.

i) Gasketed PVC pipe for gravity sanitary sewer mains.

ii) Gasketed PVE pipe for house service connections and riser lines.

iii) All future service connection lines shall be brought up at a 45 degree angle beginning at the property line and capped within 6' of the surface. The City shall be notified before the end is buried to allow the opportunity to GPS the location. The end shall also be marked with a 2" x 2" wood stake or metal rod at least 5' in length.

iv) Pipe and fittings shall meet requirements of ASTM D3034, but shall conform to a minimum pipe nominal diameter ratio to wall thickness (SDR) of 26. Type PSM (XH) (Poly vinyl chloride) (PVC) Sewer Pipe and Fittings.

v) Joints shall be gasketed, push-on type in accordance with ASTM D3212.

vi) Material used to produce pipe and fittings shall conform to ASTM D1784 for Rigid Poly (vinyl chloride) compounds and Chlorinated Poly (vinyl chloride) Compounds.

vii) Rings for gasketing shall be locked-n rubber sealing rings and shall conform to ASTM D1869.

viii) Pipe shall be supplied in standard laying lengths of 12.5 and 20 feet.

3. For water mains in general:

i) Plastic pipe water mains shall be precision extruded from new polyvinyl chloride (PVC) material and plastic pipe service lines from new polyethylene (PE) material. Pipe material shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. The pipe shall be extruded in strict accordance with the raw material manufacturer's recommendations and specifications.

iv) Pipe shall be marked to indicate nominal pipe size, material code designation, standard dimension ratio, pressure rating, manufacturer's name or trademark, National Sanitation Foundation seal and appropriate ASTM or AWWA designation numbers.

v) The PVC pipe shall be supplied in standard laying lengths of 20 or 40 feet. However, 40 feet of longer lengths of pipe will be approved only upon adequate information the Installer has equipment capable of fully supporting the pipe while being transported and distributed over the project.

vi) Pipe shall be installed with a covered copper, minimum No. 12 size, tracer wire located within 6 inches of pipe and up along outside of each valve box, terminating in loop at top of each valve box.

v) Rubber gasketing shall conform to ASTM D1869.

4. DR 18 Polyvinyl Chloride (PVC) Pipe:

i) Class 150 (DR 18) PVC pressure rated pipe with gasket bell end and cast iron pipe equivalent O.D.

ii) Pipe shall conform to the following specifications:

a. AWWA C900.

b. National Sanitation Foundation Testing Laboratories (NSF).

iii) The pipe shall have a maximum anticipated sustained, operating pressure of 150 psi. The pipe shall have a minimum sustained bursting pressure of 500 psi.

5. SDR 7 Polyethylene (PE) Service Line Pipe:

i) Pressure class 200 psi pipe, minimum size 1 inch, polyethylene 3406 material, tested and certified by National Sanitation Foundation Testing Laboratories (NSF) as suitable for potable water.

ii) Pipe shall conform to requirements of AWWA C901.

iii) Pipe shall be installed with a covered copper, minimum No. 12 size, tracer wire located within 6 inches of pipe and up along outside of curb box, terminating in loop at top of curb box.

iv) Compression type connections, pressure rating equal to or greater than that of the pipe, with rigid insert plastic or stainless steel liner to prevent collapse of PE pipe.

6. Gasket Joint Coupling.

i) Couplings shall be furnished by the pipe manufacturer and shall accommodate the pipe for which they are to be used.

ii) Couplings shall have a SDR rating equal to that of the pipe.

iii) If couplings are used they shall be twin gasketed coupling with a positive stop in the center that will automatically position the pipe ends within the coupling. Single gasket couplings welded to one end of the pipe will not be accepted.

iv) Pipe that has an integral bell, designed to be at least as strong as the pipe wall, as a part of the pipe with a single gasket will be accepted.

v) All coupling or bells shall have a seating depth per the pipe manufacturer's specifications.

vi) The male ends of the pipe shall be beveled at the factory for ease of entry into the coupling and shall have a ring painted around the end in such a manner as to allow field checking of the setting depth of pipe in the socket.

7. Fittings for Gasket Joint Pipe:

i) Fittings shall be furnished or approved by the pipe manufacturer and shall accommodate the pipe for which they are to be used.

ii) Fittings shall have wall thickness no less than that for the specified pipe and shall have a SDR or minimum pressure rating equal to that of the pipe.

iii) The fittings shall be solvent weld or gasketed with the same gasket design as used on the pipe coupling. The socket depths shall meet all of the requirements listed for the adjoining pipe Service wyes may be saddle type.

iv) Mechanical joint adapters, when required for valve settings or connections to cast iron pipe, shall be made of Schedule 80 PVC at least 12 inches long. One end shall be built up to an O.D. equal to that required by the mechanical joint fittings.

8. Pipe Connection to Manhole:

   i) Provide flexible water stop at pipe connection to manhole.

   ii) Water stop shall be B.F. Goodrich Geon 83718, white 132, flexible PVC compound, durometer hardness 80 on the A scale, or approved equal.

9. Service Saddles:

   i) All taps shall be installed with a pipe saddle. Saddles shall have an 'O' ring seal between pipe and the saddle and shall be Clow-Vega Twin Seal Style 3401 or F-6350, or approved equal.

   ii) The City shall be notified before the saddle is buried to allow the opportunity to GPS the location.

E. Inspection:

1. Examine areas to receive piping for:

   i) Defects that adversely affect execution and quality of work.

   ii) Deviations beyond allowable tolerances for piping clearances.

2. Start work only when conditions are corrected satisfactorily.

F. Workmanship:

1. Examine pipe and fittings before installation and assure no defective materials are incorporated.

2. Keep inside of pipes and fittings free of dirt and debris.

3. Cup pipe in a neat workmanlike manner without damage to pipe.

G. Placement of PVC Force Mains:

1. Placement and joint installation in accordance with manufacturer's recommendations.

2. Place the pipe and fittings in the trench with care; under no circumstances shall the pipe or other materials be dropped into the trench.

3. The pipe shall not be dragged in such a manner as to scratch the pipe surface; an excessive amount of scratching or any deep scratches shall be cause for rejection of the pipe.

4. The bottom of the trench shall be free from rocks, clods, or other sharp-edged objects.

5. Each section of pipe in the trench shall rest upon the pipe bed for the full length of its barrel.

6. The subgrade upon which the pipe bedding material is placed shall consist of materials suitable for supporting the pipe without excessive settlement or stress development.

7. Excavate to a depth of not less than two (2) inches nor more than six (6) inches below grade and provide a sand cushion for the purpose of grading and bedding the pipe.

    i) Bedding material shall be sufficiently damp to insure proper compaction and shaping of the bed.

8. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other suitable means to prevent the ingress of foreign materials. This stipulation shall apply during noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

9. Provide thrust blocks, as shown on the Drawings to restrain piping at all abrupt changes in direction, tees, bend and dead ends.

10. The placement of backfill to 18 inches above the top of the pipe shall be done as per Article 10, with the following added requirements:

    i) The backfill material shall contain no stones of greater than ¾ inch in diameter.

    ii) The method shall be such that the material is not dropped from the top of the trench onto the unprotected pipe.

11. Employ partial backfilling and cradling to hold pipe in secure position during backfilling operations.

12. Backfilling remainder of the trench as per Article 10.

C. Placement of PVC Gravity Sanitary Sewers:

1. Each pipe shall be laid true to line and grade by use of overhead grade boards or an inline laser beam.

   i) Actual line and grade shall be accurate within 0.02 feet of staked line and grade at any point.

2. Commence pipe laying at lowest point, with spigot ends pointing in the direction of flow.

3. Lay piping on compacted granular material bed for entire length of trench.

   i) Class II bedding materials - coarse sands and gravels with maximum particle size of ¾ inches.

4. Employ partial backfilling and cradling to hold pipe in secure position during backfilling operations.

5. Compression Joint Installation:

   i) Clean hub and spigot

   ii) Apply joint lubricant to spigot and inside of hub.

   iii) Drive spigot into hub with pulling tool or suitable device.

6. Solvent weld water stops to outside of PVC pipe at points where pipe penetrates concrete manholes prior to cementing space between outside of pipe and manhole wall.

D. Placement of PVC Water Main:

1. Install in accordance with manufacturer's recommendations.

2. Lay piping with minimum earth cover of 5-1/2 feet above top of pipe, except where specifically shown otherwise on the drawings.

3. Place the pipe, fittings and valves in the trench with care; under no circumstances shall the pipe or other materials be dropped into the trench.

4. The pipe shall not be dragged in such a manner as to scratch the pipe surface; an excessive amount of scratching or any deep scratches shall be cause for rejection of the pipe.

5. The bottom of the trench shall be free from rocks, clods, or other sharp-edged objects.

6. Each section of the pipe in the trench shall rest upon the pipe bed for the full length of its barrel.

7. The sub-grade upon which the pipe bedding material is placed shall consist of materials suitable for supporting the pipe without excessive settlement or stress development.

8. Excavate to a depth of not less than two (2) inches nor more than six (6) inches below grade and provide a sand cushion for the purpose of grading and bedding the pipe.

    i) Bedding material shall be sufficiently damp to insure proper compaction and shaping of the bed

9. During the laying operation of a short section of replacement pipe, immediately prior to the making of joints, run a swab (of sufficient size to lightly touch the pipe walls) through the pipe so as to thoroughly clean the inside.

10. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other suitable means to prevent the ingress of foreign materials. This stipulation shall apply during noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

11. Provide (or pour) thrust blocks or anchors to restrain piping at all abrupt changes in direction, tees, bends, dead-ends and hydrants.

12. The placement of backfill to 18 inches above the top of the pipe shall be done as per Article 10, with the following added requirements:

    i) The backfill material shall contain no stones of greater than ¾ inch in diameter.

    ii) The method shall be such that the material is not dropped from the top of the trench onto the unprotected pipe.

13. Employ partial backfilling and cradling to hold pipe in secure position during backfilling operations.

14. Backfill remainder of the trench as per Article 10.

15. Maximum allowable joint deflection shall be 1 degree.

## ARTICLE 17: PIPING SPECIALTIES

A. Quality Assurance:

1. Provide manufacturer's certificate that materials meet or exceed minimum requirements as specified.

B. Submittals:

1. Manufacturer's literature and illustrations.

2. Statement of net assembled weight of each piece of equipment.

3. Shop Drawings of Equipment:

   i) Dimensions.

   ii) Construction details.

   iii) Materials.

4. Complete manufacturer's installation instructions.

5. Maintenance Data:

   i) Maintenance instructions.

   ii) Parts lists.

C. Product Delivery, Storage, and Handling:

1. Box, crate, completely enclose, and protect equipment and accessories from accumulations of foreign matter.

2. Store equipment and accessories in area protected from weather, moisture, or possible damage.

3. Do not store materials directly on ground.

4. Handle items to prevent damage to interior or exterior surfaces.

D. Products

1. Inserting Valve:

i) Manufacturer: Mueller Cat. No. H-800 or approved equivalent.

ii) Size as noted on drawings.

2. Tapping Sleeve:

i) Manufacturer: Mueller Cat. No. H-615 with duck-tipped gaskets or approved equivalent.

ii) Size as noted on drawings.

3. Tapping Valve:

i) Manufacturer: Mueller Cat. No. H-667 with 'o' ring seals or approved equivalent.

ii) Size as noted on drawings.

4. Cut-In Sleeve:

i) Manufacturer: Mueller Cat. No. H-840 or H-841, as required or approved equivalent.

ii) Size as noted on drawings.

5. Cut-In Valve:

i) Manufacturer: Mueller Cat. No. H-862 or approved equivalent.

ii) Size as noted on drawings.

E. Installation:

1. Install valves and sleeves where shown on the drawings.

2. Install equipment and accessories in accordance with manufacturer's instructions.

3. Place concrete block under buried valves to provide firm support.

F. Adjustments:

1. Check and adjust equipment and accessories for proper operation.

## ARTICLE 18: ANCHORS

A. Quality Assurance:

1. Acceptable Manufacturers:

i) Star Supply Corporation.

ii) Or approved equal.

B. METAL HARNESS SYSTEMS:

1. Clamps shall be ½ inch x 2 inch bar stock for pipe size 4 inch, 6 inch, 8 inch, 10 inch and 12 inch.

2. Rods shall be ¾ inch diameter for pipe size 4 inch, 6 inch, 8 inch, 10 inch, and 12 inch.

3. Entire assembly, clamps, rods, bolts, washers, nuts, shall be as manufactured by Star Supply Corporation, Columbus, Ohio, or approved equal.

C. Installation:

1. All plugs, tees, caps, hydrants and bends shall be provided with anchorage by attaching suitable metal rods and clamps, by installation of thrust blocks, or by other suitable methods to prevent displacement and assure no leakage from the fittings.

## ARTICLE 19: GATE VALVES

A. Quality Assurance:

1. Acceptable Manufacturers:

i) Mueller Company or approved equivalent.

B. Submittals:

1. Manufacturer's literature and illustrations.

2. Statement of net assembled weight of each size of valve furnished.

3. Shop Drawings of Valve and Operators:

i) Dimensions.

ii) Construction details.

iii) Materials.

4. Complete manufacturer's installation instructions.

5. Maintenance Data:

i) Maintenance instructions.

ii) Parts list.

7. Certificates: Obtain manufacturer's certification that valves and accessories meet or exceed specification requirements.

C. Product Delivery, Storage, and Handling:

1. Seal valve ends to prevent entry of foreign matter into valve body.

2. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.

3. Store valves and accessories in area protected from weather, moisture, or possible damage.

4. Do not store materials directly on ground.

5. Handle items to prevent damage to interior or exterior surfaces.

D. Gate Valves:

1. AWWA C500

2. Mueller No. A-2370-20 Resilient Seat Wedge Valve or approved equivalent.

3. Shall be resilient wedge type valves with non-rising stem and 2-inch operating nut shall offer no resistance when fully open.

4. End Connections: Mechanical joint.

5. Operators:

i) Direction of rotation to open: counter-clockwise.

ii) Two inch square wrench nut.

6. All valves 12 inch and smaller shall be designed for 200 psi working pressure.

E. Valve Boxes:

1. Mueller Cat. No. H-10360, Buffalo type, 5-1/4 inch shaft, two piece, screw type, extension length as required, or approved equal.

F. Installation:

1. Install valves and accessories as show on the drawings.

2. Install valves and accessories in accordance with manufacturer's instructions.

G. Adjustment:

1. Check and adjust valves and accessories for smooth operation.

## ARTICLE 20: CORPORATION STOPS AND SERVICE CONNECTIONS

A. Quality Assurance:

1. Acceptable Manufacturers:

i) Mueller.

ii) Ford.

iii) Approved equivalent.

B. New Construction:

1. 250 PSI Iron Pipe size poly pipe, minimum size 1 inch.

C. Replacement of Existing Services:

1. 250 PSI Iron Pipe size poly pipe, minimum size ¾ inch.

D. Service Saddles:

1. Install service saddle for all taps. The City shall be notified before the saddle is buried to allow the opportunity to GPS the location.

E. Installation:

1. Install corporation stops into upper half of main. For ductile iron mains, double wrap threads with 3-mil Teflon tape.

F. Replacement of Existing Services:

1. If existing service line is PE class 200 psi plastic in good condition, it shall be directly connected to the new corporation stop or shall be extended to the new main using the same pipe materials of the same diameter.

2. If existing service line is plastic or copper and of sufficient length in good condition, it shall be directly connected to new corporation stop. If plastic or copper service line is not of sufficient length or if part or all of the line back to the curb stop is judged by the City Water Department to be in need of replacement, a sufficient length of PE class 200 psi iron pipe size plastic service pipe shall be installed to complete the connection to the new main.

3. If existing service line is galvanized iron, it shall be replaced back to the curb stop with minimum 1 inch PE class 250 psi iron pipe size plastic service pipe.

4. If existing service line is lead pipe it shall be replaced with new minimum 1 inch PE class 250 psi iron pipe size plastic service pipe back to the curb stop.

5. No barb fittings are allowed below ground.

## ARTICLE 21: CURB STOPS AND BOXES

A. Quality Assurance:

1. Acceptable Manufacturers:

i) Mueller.

ii) Ford.

iii) Or approved equivalent.

B. Curb Stops:

1. Mueller (Copper Pipe) or (PE Plastic Pipe), brass, Mark II Oriseal, Minneapolis pattern, minimum size 1 inch.

C. Curb Boxes:

1. Mueller, extension type, Minneapolis pattern base, length 6-1/2 feet, size 1-14 inch.

D. Installation:

1. Install new curb stop and box at the location shown on the drawings or as directed by the city.

E. Replacement of Existing Services:

1. If connection of replacement service line to existing curb stop is impractical due to the condition of the curb stop and if approved by the City Engineer, a new curb stop shall be installed.

2. Install new curb stop and/or box at the location occupied by the old curb stop, or as shown on the drawings or directed by the City.

F. Adjustment:

1. Check and adjust curb stops and accessories for smooth operation.

## ARTICLE 22: HYDRANTS

A. Quality Assurance:

1. Acceptable Manufacturers:

i) Mueller Company.

ii) American-Darling.

B. Submittals:

1. Manufacturer's literature and illustrations.

2. Statement of net assembled weight of each hydrant.

3. Shop Drawings:

i) Dimensions.

ii) Construction Details.

iii) Materials.

4. Complete manufacturer's installation instructions.

5. Maintenance Data:

   i) Maintenance instructions.

   ii) Parts list.

6. Manufacturer's certification that hydrants and accessories meet or exceed specification requirements.

C. Product Delivery, Storage, and Handling:

1. Store hydrants in area protected from weather, moisture, or possible damage.

2. Do not store materials directly on ground.

3. Handle items to prevent damage to interior or exterior surfaces.

D. Fire Hydrants:

1. Fire hydrants shall meet the requirements of AWWA C502 and be red.

2. Mueller Centurion Cat. No. A-423, or American-Flow Control No. B-84 B with 5-1/4 inch hydrant main valve, two 2-1/2 inch hose connections, on 4 inch pumper connecting 6 inch mechanical joint inlet, operating direction City standard, with traffic type break-off flange.

3. Hydrant length shall be sufficient to allow for minimum 5-1/2 foot depth of cover over top of hydrant inlet (depth of bury equal to depth of cover plus diameter of inlet pipe.)

4. Hydrant main valve shall close with the water pressure.

5. Hydrants shall be designed for a minimum of 150 psi working pressure.

E. Auxiliary Valves and Valve Boxes:

1. Per Article 19.

F. Installation:

1. Install hydrants and accessories as shown on the drawings.

2. Install hydrants and accessories in accordance with manufacturer's instructions.

3. Place concrete block under auxiliary valve to provide firm support.

4. Pour concrete thrust block at hydrant shoe with a plastic barrier between the hydrant and the concrete. Weep holes must remain open and be covered with gravel.

    i) Place concrete block, similar to that shown for valves, under hydrant to provide firm support if a tie-down system is used in lieu of the thrust block.

G. Adjustments:

1. Check and adjust hydrants and accessories for smooth operation.

## ARTICLE 23: TESTING OF SEWER MAINS

A. General:

1. Contractor shall perform all tests required for the type of sewer installed. Required tests are indicated in the respective specification sections for the type of material to be installed.

2. Contractor shall furnish all required test equipment and conduct tests.

3. Testing will be observed by the City Engineer. Contractor shall notify City Engineer 48 hours in advance of conducting tests.

4. Corrective work required shall be performed at the Contractor's expense.

5. Contractor shall perform tests until satisfactory results are obtained.

B. Materials:

1. Contractor shall furnish all materials required to conduct tests.

C. Pressure and Leakage Testing for Sewer Force Mains:

1. Pressure Test:

    i) Test pressure shall be 120 psig at the lowest portion of the line under test.

ii) Partially backfill valved section of line to be tested such that backfill will hold line in place under test pressure.

iii) Provide at least five (5) days of setting time for concrete thrust blocking on each segment of main prior to the pressure test on that segment. If high-early strength cement is used in the thrust blocking, provide at least two (2) days of setting time prior to the pressure test.

iv) Provide temporary thrust blocking for each segment of main to be pressure tested, if required to insure that the line will not move under pressure and that no "blow-offs" will occur.

v) Vent all air from line prior to testing through air-released hydrants or corporation cocks, installed for this purpose if necessary, at all high points in the line.

vi) Fill like with water and pump to test pressure.

vii) Maintain test pressure for at least two (2) hours during each pressure test. A drop in gauge pressure in excess of 5 psi will cause the pressure test to fail.

viii) Carefully examine all exposed pipe, fittings, valves, air released hydrants, and joints during the pressure test.

ix) Remove and replace any cracked or defective pipe, fittings, valves or air-released hydrants discovered.

x) Repeat pressure tests until requirements of this Section are met.

2. Leakage Test:

i) Conduct leakage test concurrently with the pressure test.

ii) Test pressure shall be 120 psig at the lowest portion of the line under test.

iii) Vent all air from line prior to testing.

iv) Fill line with water and pump to test pressure.

v) Maintain test pressure for 2 hours.

vi) Maximum allowable leakage determined by:

$$L = \frac{ND\,(P)^{1/2}}{}$$

Where L = allowable leakage, gallons per hour;
N = the number of joints in the pipe being tested;
D = nominal diameter of pipe, inches; and
P = test pressure, psig.

vii) Locate and repair leaks and retest until requirements of this Section are met.

D. Leakage Testing for Gravity Sanitary Sewer:

1. Maximum infiltration or exfiltration in any section of sanitary sewer, including manholes, shall not exceed 200 gallons per inch of pipe diameter per day per mile of sewer.

2. Infiltration Test:

i) Infiltration test shall be performed if the ground water level is at least two feet above the top of the pipe at the highest point in the section being tested.

ii) Test head shall be maintained at least 24 hours prior to measuring infiltration.

iii) Infiltration shall be measured using a V-notch weir or other flow-measuring device approved by the City Engineer in the downstream manhole of the section being tested.

3. Exfiltration Test:

i) Exfiltration test shall be performed if the ground water level is less than two feet above the top of the pipe.

ii) Plug the inlet of the upstream and downstream manholes using watertight plugs.

iii) Sewer and upstream manhole shall be filled with water to an elevation two feet above the top of the pipe being tested, or two feet above the existing ground water level, whichever is greater.

iv) Measure exfiltration for a period of one hour starting one hour after filling.

4. Locate and repair leaks and re-test until requirements of this Section are met.

E. Low Pressure Air Test For Gravity Sanitary Sewers:

1. Air test may be used in lieu of infiltration/exfiltration test.

2. Conduct in accordance with ASTM C828.

3. Plug the ends of the section to be tested with air-tight plugs. Brace plugs to prevent slippage due to internal pressure. One plug must have provisions for connecting an air hose.

4. Connect air hose to plug and to portable air control equipment consisting of valves and pressure gauges to control the rate of air flow into the test section and monitor air pressure inside the pipe.

5. Supply air to test section such that internal pressure in the pipe section does not exceed 5 psig. When pressure reaches 4.0 psig, throttle air supply to maintain internal pressure between 3.5 and 4.0 psig for minimum of 2 minutes.

6. Disconnect air supply and allow pressure to drop to 3.5 psig. At 3.5 psig start a stop watch and determine the time required for the pressure to drop to 2.5 psig.

7. Minimum allowable time for pressure drop to occur shall be as follows:

| Pipe Size | Time |
|---|---|
| 6" | 2 min. 50 sec. |
| 8" | 3 min. 47 sec. |
| 10" | 4 min. 43 sec. |
| 12" | 5 min. 40 sec. |
| 15" | 7 min. 5 sec. |
| 18" | 8 min. 30 sec. |
| 21" | 9 min. 50 sec. |
| 24" | 11 min. 20 sec. |

8. Maximum allowable length of sewer line that can be tested by air test shall be as follows.

| Pipe Size | Length |
|---|---|
| 4" | 1114.0 Ft. |
| 6" | 742.7 Ft. |
| 8" | 557.0 Ft. |

| | |
|---|---|
| 10" | 445.6 Ft. |
| 12" | 371.3 Ft. |
| 15" | 297.0 Ft. |
| 18" | 247.5 Ft. |
| 21" | 212.2 Ft. |
| 24" | 185.0 Ft. |

9. Locate and repair leaks and re-test until requirements of this Section are met.

F. Alignment Test:

1. Completed sewers shall be checked for alignment using either a laser beam or lamping.

2. Completed sewers that do not show sufficient artificial light from manhole to manhole shall be corrected by the Contractor.

G. Deflection Test:

1. Conduct deflection test on sanitary sewers constructed of plastic pipe (PVC).

2. Conduct deflection test after final backfill has been in place at least 30 days.

3. Maximum deflection shall not exceed 5 percent of the inside diameter of the pipe being tested.

4. Conduct deflection test using Go No Go deflection testing gauge or mandrel with dimensions as shown in the Standard Drawings. Outside diameter of mandrel shall not be less that 95 percent of the specified inside diameter of the pipe being tested.

5. Thoroughly flush line prior to testing to remove mud and debris.

6. Float pull rope from upstream manhole to downstream manhole of section being tested and attach mandrel to pull rope. Attach a second rope to back of mandrel to receive mandrel if blockage is encountered.

7. Mark pull rope so that if blockage is encountered, the location of blockage can be determined.

8. Pull mandrel through the sewer line. Mechanical pulling devices shall not be used.

9. If resistance to pulling or blockage is encountered, remove mandrel and re-flush or clean sewer line, if necessary.

10. If blockage remains, locate and determine cause of blockage and make necessary repairs. Repeat test until requirements of this Section are met.

## ARTICLE 24: TESTING AND DISINFECTION OF WATER MAINS

A. General:

1. Contractor shall test and disinfect all water mains installed as specified herein.

2. Contractor shall furnish all required test equipment, chemicals and other materials required to test and disinfect the water mains. Contractor shall perform all testing and disinfection.

3. Testing will be observed by the City Engineer. Contractor shall notify City Engineer 48 hours in advance of conducting tests.

4. Corrective work required shall be performed at the Contractor's expense.

5. Contractor shall perform testing and disinfection until satisfactory results are obtained.

B. Materials:

1. Contractor shall furnish all materials required to conduct testing and disinfection.

C. Hydrostatic Testing for Water Mains:

1. Pressure Test:

i) Conduct in accordance with AWWA C600.

ii) Test pressure shall be 120 psig at the lowest portion of the line under test.

iii) Partially backfill valved section of line to be tested such that backfill will hold line in place under test pressure.

iv) Provide at least five (5) days of setting time for concrete thrust blocking on each segment of main prior to the pressure test on that segment. If high-early-strength cement is used in the thrust blocking, provide at least two (2) days of setting time prior to the pressure test.

v) Provide temporary thrust blocking for each segment of main to be pressure tested, if required to insure that the line will not move under pressure and that no "blow-offs" will occur.

vi) Vent all air from line prior to testing through air-release hydrants or corporation cocks, installed for this purpose if necessary, at all high points in the line.

vii) Fill line with water and pump to test pressure.

viii) Maintain test pressure for at least two (2) hours during each pressure test. A drop in gauge pressure in excess of 5 psi will cause the pressure test to fail.

ix) Carefully examine all exposed pipe, fittings, valves, hydrants, and joints during the pressure test.

x) Remove and replace any cracked or defective pipe, fittings, valves or hydrants discovered.

xi) Repeat pressure tests until requirements of this Section are met.

2. Leakage Test

i) Conduct leakage test concurrently with the pressure test.

ii) Test pressure shall be 120 psig at the lowest portion of the line under test.

iii) Vent all air from line prior to testing.

iv) Fill line with water and pump to test pressure.

v) Maintain test pressure for 2 hours.

vi) Maximum allowable leakage determined by:

$$L = \frac{ND\,(P)\,\frac{1}{2}}{7400}$$

Where L = allowable leakage, gallons per hour;
N = the number of joints in the pipe being tested
D = nominal diameter of pipe, inches; and
P = test pressure; psig

vii) When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size shall be allowed.

viii) Locate and repair leaks and retest until requirements of this Section are met.

D. Water Main Disinfection:

1. Pipe interior, fittings and valves shall be protected against contamination during delivery, storage and installation.

2. New lines shall be flushed thoroughly prior to disinfection until all traces of construction materials and soil or other foreign matter have been removed. Flushing shall be at a velocity of not less than 4.0 ft/sec. Flushing time shall be adequate to replace the volume of water in the line a minimum of 4 times. The City reserves the right to determine when the Contractor has exceeded a reasonable amount of flushing and to require other action to properly clean the section of pipe as necessary.

3. Disinfect water lines as follows.

   i) Rate of hypochlorite application should be adequate to maintain a minimum of 50 parts per million available chlorine.

   ii) Chlorinated water shall be retained in the main for at least 24 hours. Minimum residual chlorine concentration in any part of the system after 24 hours shall be 25 parts per million, and the minimum free residual chlorine concentration shall be 10 parts per million.

   iii) Thoroughly flush all lines containing the heavily chlorinated water until a chlorine residual determination shows the residual chlorine at any point is not over 2 parts per million.

4. After final flushing, and before the water main is placed in service, samples shall be collected from the end of the line and tested for bacteriologic quality. Flushing and chlorination shall continue until two samples, free of chlorine and taken at least 24 hours apart, show the absence of coliform organisms. Sampling and testing shall be in accordance with State of Nebraska Department of Health regulations.

5. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained.

## ARTICLE 25: REINFORCED CONCRETE PIPE

A. Quality Assurance:

1. Provide manufacturer's certificate that materials meet or exceed minimum requirements as specified.

B. Submittals:

1. Manufacturer's certificates of conformance.

C. Product Delivery, Storage, and Handling:

1. During loading, transporting and unloading, exercise care to prevent damage to materials.

2. Do not drop pipe or fittings.

D. Reinforced Concrete Pipe:

1. Standard reinforced concrete sewer pipe, conforming to Nebraska Highway Specification Section 1029.

E. Flared End Sections:

1. Same material as pipe. If guards are required, they shall be in accordance with the Nebraska Highway Specifications.

F. Workmanship:

1. Each pipe will be carefully inspected before it is laid and defective pipe will be rejected.

2. The pipe shall be laid upgrade beginning at the lower end of the line and shall be laid true to the grades shown on the plans. Any pipe which has its grade disturbed after laying shall be taken up and re-laid. No pipe shall be laid, when in the opinion of the City Engineer, weather or trench conditions will not permit a satisfactory installation.

3. Laying of pipe to true line and grade shall be accomplished by use of an overhead grade line, plumb bob, and grade boards and/or by the laser beam method. The overhead grade line shall be stretched tight at all times and be parallel to the correct alignment and grade of the sewer.

4. The groove on concrete pipe shall be laid upstream.

5. Reinforced concrete pipe joints may be made by:

i) Thoroughly filling the joint, inside and outside, around the circumference of the pipe, with cement mortar. The mortar to be used shall consist of two parts of cement to three parts of mortar sand to one part of Embeco, or

ii) Thoroughly filling the joint, inside and outside, around the circumference of the pipe, with "Kalktite", "Sewertite", or approved equal such as a rubber gasket. Lift holes shall be plugged with plastic pop-its or a concrete plug with tar.

## ARTICLE 26: PAVING EARTHWORK

REMOVAL, ADJUSTMENT, AND REPLACEMENT ITEMS:

A. Walks and Driveways:

1. Existing sidewalk pavement and driveway pavement shall be removed as indicated on the plans or directed by the City Engineer.

2. The juncture between the existing pavement to remain and that to be removed shall be made by sawing and carefully removing the portion required in such a manner that the remaining pavement will not be damaged. Removal shall be to existing contraction joints and perpendicular and parallel to existing curb lines where practical.

3. Replacement shall be form the approved line of removal to the back of curb line.

B. Street Pavement:

1. Street pavement which is to be removed shall be done as shown on the plans or directed be the City Engineer.

2. The juncture between the existing pavement or the surfacing to remain and that to be removed shall be made by sawing and carefully removing the portion required in such a manner that the remaining pavement will not be damaged. Entire panels will be removed unless otherwise directed by the City.

3. Replacement shall be as shown on the plans or directed by the City Engineer.

D. Tree Removal:

1. Trees which are indicated on the plans to be removed and where directed by the City Engineer shall be cleared and grubbed. Stumps shall be completely removed within areas to be paved and removed to at least one foot below finished grade in areas not to be paved.

E. Manhole, Valve Box and Inlet Adjustments:

1. The Contractor shall adjust existing manholes, valve boxes, and inlets to finished grades. This may be accomplished by regulating the height of the masonry walls or use of metal adjusting rings or both in the case of manholes and inlets, and by inserting valve box adapters into the sockets of the existing valve boxes.

2. A box-out with keyway and bars will be required around all existing manholes and valve boxes. The box-out shall be square, the edges of which shall be a minimum of one foot from the outer-most limit of the casting of valve box.

3. A smooth neat matching of the casting and adjacent street surface is required.

4. All necessary materials shall be furnished by the Contractor unless indicated otherwise by the specifications.

5. Any backfill disturbed during adjustment shall be thoroughly tamped to achieve as a minimum the soil densities specified herein for new pavement construction.

F. Existing Culvert, Pipe and Drainage Appurtenances:

1. Existing culverts, pipes and miscellaneous drainage appurtenances shall be removed as indicated on the plans or directed by the City Engineer.

G. Removal of Existing Concrete Headers:

1. Existing concrete headers which are indicated on the plans to be removed and where directed by the City Engineer shall be completely removed within the street area from face to face of gutters.

H. Materials removed in paragraph A. to G. above, shall be loaded, hauled, and disposed of by the Contractor in locations designated by the City. Culverts, piping and appurtenances shall be salvaged and remain the property of the City, unless indicated otherwise by the specifications.

I. Replacement of material removed shall be as follows:

1. Thickness of replacement concrete shall be a minimum of 4 inches for walks and 6 inches of concrete driveways.

2. Concrete for replacement shall be of the quality specified in Article 13.

3. After placement, screeding, and compaction, the surface shall be given a light brush finish and cured.

4. Walks, at their line of juncture with walls, curbs, driveways or other pavement, shall be provided with a ½ inch thick preformed asphalt saturated expansion board or approved equivalent material.

STREET AND TERRACE EXCAVATION, EMBANKMENT AND GRADING:

A. General:

1. The Contractor shall perform all excavation, embankment and grading required for the pavement and terraces.

2. Streets shall be graded to the cross section with crown as shown on the drawings.

3. All suitable excavated materials shall be used on the street proper to the extent necessary to raise the sub-grade to the required elevation and to grade terraces.

4. Terraces shall be graded, from the back of curb line to the sidewalk line and/or street property lines, as shown on the typical section or as otherwise directed by the City Engineer.

5. Excavated material not needed for use in the streets or terraces shall be disposed of by the Contractor in locations designated by the City.

B. Unstable Soils:

1. If unstable soils are encountered, they shall be removed and replaced with suitable material.

2. The size and depth of undercut and material to be used for backfill shall be approved by the City Engineer.

3. Unstable sub-grade resulting from the Contractor's negligence in providing proper drainage protection for the work shall be repaired by the Contractor.

C. Street Embankment:

1. The embankment shall be free from all rocks, wood, and other foreign material.

2. Each layer of embankment material shall be compacted to a minimum of 95 percent of Standard Proctor Density as determined by ASTM D698.

3. Any area not accessible to large equipment shall be compacted by hand or smaller equipment.

4. Suitable excavation from the streets shall be used as embankment material from another source.

D. Terrace Embankment and Grading:

1. Upon completion of the paving work, the Contractor shall excavate or fill in order to grade the terraces in accordance with the typical cross section shown on the drawings or as directed by the City Engineer.

2. The size and type of equipment utilized on this portion of the work shall be commensurate with the work to be accomplished.

3. Care shall be taken in working around existing utilities, trees, shrubs, and private sidewalks so that damage to same will not be done.

4. A sufficient quantity of native topsoil, free from gravel and other foreign material and suitable for growing grass, shall be retained from the general excavation so the all terraces will have a surface at least 6 inches thick of this material. Material below the top 6 inches shall be similar to the soil which is natural to the immediate area.

5. The final surface shall be one equal to a light harrowing followed by hand raking so that the terraces will be suitable for seeding.

COMPACTION:

A. General:

1. The following procedure shall apply in the compaction process to the point of finished sub-grade under the pavement:

   i) Remove all sod, roots, and vegetation from the area in which the embankment is required and from the embankment material.

ii) In areas of excavation, scarify material to a depth of 12 inches, windrow, spread and compact to a minimum of 95 percent of Standard Proctor Density.

iii) The embankment shall be built of suitable material in successive horizontal layers not exceeding 12 inches in compacted thickness.

iv) Each 12 inch embankment layer shall be compacted to a minimum of 95 percent of Standard Proctor Density.

v) Add water or air dry material as required for adequate compaction. The moisture content of the material shall not be more than 2 percent below, nor more than 4 percent above the optimum moisture content.

B. Sub-grade Protection:

1. After the rough grading work has been completed, the entire graded areas shall be smoothed and shaped to produce the proper finished grade.

2. The Contractor shall be responsible for maintaining the finished sub-grade under the pavement in top condition until subsequent operations are performed.

## ARTICLE 27: PAVEMENT REPAIR AND RESURFACING

A. General:

1. The old pavement shall be removed to the limits shown on the plans or as designated by the City Engineer.

2. Connecting edges shall be cut and chipped to true lines with vertical faces.

3. The existing sub-grade shall be prepared to a uniform condition of compaction in accordance with Article 10.

4. For asphalt concrete repair, a tack coat shall be applied to the vertical edge of the existing pavement prior to placing the asphaltic concrete.

5. For asphalt concrete repair, asphaltic mix shall be placed in lifts with a maximum compacted thickness per lift of 4 inches for base course material and 2 inches for surface course material.

B. Paving Brick Repair:

1. Existing brick shall be salvaged as much as practicable and reused in repair. All broke, cracked or otherwise unacceptable bricks shall be removed from the area of replacement.

2. Existing concrete base course and sub-grade shall be removed to a depth of 7 inches below the bottom of the brick.

3. Sub-grade shall be prepared for base course of Portland cement concrete.

4. Base course shall consist of 6 inches of Portland cement concrete pavement. Concrete need only be screeded as no finish is required.

5. A leveling course of clean fine sand shall be placed on the concrete base to a depth of 3/4 inch to 1 inch.

6. Paving bricks shall be placed tightly together and leveled by embedding in sand.

7. After placement of brick the area will be swept with clean dry sand to fill all voids to top of bricks.

8. Expansion joint material will be placed where concrete base abuts Portland cement concrete pavement or curb.

C. Resurfacing:

1. Preparation.

   i) The surface to be covered shall be cleaned of all dirt, foreign material, asphalt crack filler or joint sealing material and cold-mix bituminous patches.

   ii) A tack coat shall be applied.

2. Leveling Course and Patching.

   i) The leveling course, if required by the specifications, shall consist of surface mix asphalt concrete.

   ii) All holes more than 2 inches deep in the surface to be covered shall be coated with hot asphalt cement and filled level with compacted surface mix.

3. Surface Course.
    i) Compacted thickness of surface course shall be 1-1/2 inches minimum, or greater thickness as otherwise required by the specifications.

## ARTICLE 28: SIDEWALKS

A. Procedure:

1. Sidewalks shall be Portland cement concrete, 4 inches thick except through driveways, which shall be 6 inches thick.

2. Contraction joints shall be marked off into square blocks having an area of 16 square feet for 4 foot wide walks and 36 square feet for 6 foot wide walks. Jointing of sidewalk widths that deviate from the preceding shall meet with the approval of the City Engineer.

3. Contraction joints shall be D/4 inches deep, "D" equals depth of sidewalk, 5/16 inch width with edges rounded to ½ inch radius using double edging tool or sawed.

4. Expansion joints for sidewalks shall be located where sidewalks abut walls, curbs, driveways, or other pavement. Place flush with top surface of sidewalk including a polyurethane sealant laid on top of the expansion material.

5. Edges shall be finished with an edging tool having dimensions corresponding to those of double edging tool used for contraction joints.

6. There shall be a minimum of 1/2" compacted sand/gravel mix or approved equivalent material placed under all proposed sidewalks.

## ARTICLE 29: EXPANSION AND CONTRACTION JOINTS

A. General:

1. Placement and finishing of joints shall be subject to approval of the City Engineer.

2. All joints shall be perpendicular to the finished pavement, except at intersections where special jointing arrangements are required.

3. Adjacent slabs shall not vary from a straightedge perpendicular to the joint by more than 1/8 inch.

4. Joints in abutting pavements shall not be staggered.

5. Joints abutting integral curb or curb and gutter shall not be staggered.

6. Unless specifically permitted by the City Engineer, joints shall be located as shown on the standard details.

B. Contraction Joints:

1. Extend joints entirely across pavement, at right angles to centerline.

2. Joints shall be prepared and placed as indicated on the Standard details, maximum spacing between joints 15 feet unless approved otherwise by the City Engineer.

3. Sawing of the joints at intervals specified shall begin as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually 4 to 24 hours.

4. All joints shall be sawed before uncontrolled shrinkage cracks occurs.

5. Sawing of any joint shall be omitted if a crack occurs near the joint location before the time of sawing.

6. Sawing shall be discontinued if a crack develops ahead of the saw.

7. All joints shall have a depth equal to ¼ of the slab thickness.

C. Construction Joints:

1. General.

i) Shall be installed as directed by the City Engineer.

ii) All construction joints shall be edged with a grooving tool of sufficient width and depth to receive and retain joint sealing material.

2. Transverse Construction Joints.

i) Locate where concrete placement has stopped long enough for concrete to harden and at end of day's work.

ii) Provide bulkhead with holes for required steel reinforced bars.

3. Longitudinal Construction Joints.

   i) Sawed.

      a. Saw within seven (7) days after concrete placement in multi-lane construction.

      b. The depth of saw cut shall be at least ¼ of the pavement depth.

      c. Joints with keyway and tie bars may be substituted for sawed joints.

   ii) Keyed and Tied.

      a. Use as a longitudinal construction joint.

      b. Attach keyway to forms with sufficient support to prevent movement during concrete placement.

      c. Support tie bars to insure proper positioning after concrete placement.

      d. Submit proposed method of forming keyed and tied joint for approval by the City Engineer if slip forming is proposed.

D. Expansion Joints:

1. Expansion joints shall be prepared and placed as indicated on the Standard details, maximum spacing between joints of 200 feet unless approved otherwise by the City Engineer.

2. The expansion joint filler shall be continuous from form to form, shaped to the sub-grade, curb section, and to the keyway along the form.

3. The expansion joint filler shall be held in a vertical position.

4. Finished joints shall not deviate in horizontal alignment more than ¼ inch from a straight line.

E. Sealing Joints:

1. All joints and shrinkage cracks which may occasionally occur shall be filled with approved sealing material.

2. Before sealing, each joint shall be cleaned of foreign material, including curing compound, joint faces cleaned and surface-dry when seal is applied.

3. The joints shall be filled immediately following the curing period or as soon thereafter as weather conditions permit, or as directed by the City Engineer.

4. Sealing material to be heated to temperature specified by manufacturer with temperature maintained during pouring period if applicible.

## ARTICLE 30: CONCRETE PAVING

A. Proportions:

1. The concrete shall develop a minimum 28 day strength of 3,500 psi in compression. In general the following proportions shall apply:

   i) Cement, sacks per cubic yard.
   6.0

   ii) Total water-cement-ratio
   Gallons/sack cement not over 5.5

   iii) Fine aggregate
   50%-70%

   iv) Coarse aggregate
   30%-50%

   v) Air content by volume
   5%-8%

   vi) Water reducer
   Maximum cement reduction of 5%

   vii) Fly ash
   Only with the approval of Engineer

   viii) Maximum allowable slump 2 inches for slip-form pavement and 3 inches for fixed-form pavement.

2. Control.

   i) Contractor to submit samples of cement, admixtures, and aggregate to the testing firm for trial batch design which will produce results within the specified limits.

3. Curing compound shall be used after placing concrete to avoid cracking.

B. Concrete Compressive Strength Testing:

1. A minimum of one representative set of three (3) cylinder samples for each 1.000 square yards of pavement placed will be required.

2. These cylinders will be tested at 7 days (one cylinder) and 28 days (two cylinders).

C. Pavement Quality Requirements:

1. Additional testing of the cured concrete slab may be required at the City Engineer's option when test specimens fail to meet specified strength. The City Engineer may require the Contractor to take cores for any area of a given day's pour when any cylinder from this day's pour fails to meet the specified 28 day strength.

2. The Contractor shall furnish the City Engineer with scale tickets on all concrete.

3. The City Engineer or the City may at their discretion require the Contractor to take core samples to determine pavement thickness.

## ARTICLE 31: DESIGN STANDARDS

A. General:

1. The design standards contained herein are intended for the purpose of establishing minimum requirements for sewer, water, and paving improvements constructed in the City of Wayne. These design standards are intended to supplement but not supersede the standard and criteria set forth in the City's Subdivision Ordinance and Building Codes, and those requirements prescribed by Local, State, or Federal laws. These design standards are not intended to be all inclusive or completely comprehensive, but rather to establish minimum criteria for certain aspects of design for public improvements being planned by the City or developers.

B. Water Distribution System:

1. Water mains will be sized to meet fire flow requirements of the State Insurance Services Office insomuch as is practicable, considering delivery capabilities of the in-place water facilities. Water mains for residential areas will be 8 inch minimum size except where 6 inch mains can be shown to be adequate size for looped streets and cul-de-sacs. No water main less than 6 inch size will be permitted.

2. Water facilities including pumping, storage, and distribution will be designed to provide a minimum working pressure of approximately 35 psi and a normal working pressure for approximately 60 psi. Where maximum pressures will exceed 100 psi, pressure reducing devices will be required.

3. Dead-ends must be minimized by looping off all mains wherever practicable. Where dead-end mains cannot be avoided, they will be provided with a fire hydrant if flow and pressure are sufficient, or with a State Department of Health approved blow-off for flushing purposes. In no case will flushing devices be directly connected to any sewer.

4. Sufficient valves will be provided on water mains so inconvenience and sanitary hazards will be minimized during repairs. Valves will be located at no more than one block intervals and at no more than 500 feet and 800 feet intervals in commercial and residential areas, respectively.

5. In all new residential developments requiring connection to the city system, water mains will be provided for each lot either within the street right-of-way abutting the lot, in an easement along the back lot line of the lot, or in an easement along the side lot line of the lot. Water mains are to be located with the street right-of-way rather than in an easement wherever it is practicable.

C. Sanitary Sewers:

1. Sanitary sewers will be sized to carry the peak design flow including allowances for infiltration and inflow. Sewers will be designed for the estimated ultimate tributary population unless a plan of phased construction of smaller lines can be shown to be advantageous to the City. No gravity sewer main less than 8 inch size will be permitted.

2. The minimum slopes which must be provided for gravity sewer mains are as follows.

| Sewer Size | Slope in Feet/100 Feet |
|---|---|
| 8 inch | 0.04 |
| 10 inch | 0.28 |
| 12 inch | 0.22 |
| 14 inch | 0.17 |
| 15 inch | 0.15 |
| 16 inch | 0.14 |
| 18 inch | 0.12 |
| 21 inch | 0.10 |
| 24 inch | 0.08 |

3. Sewers will be laid with straight alignment between manholes and with uniform slopes between manholes. Manholes or cleanouts will be installed at the end of each line; at all changes in grade, size or alignment; at all intersections and at distances not greater than 500 feet.

4. In all new residential developments requiring connection to the city system, sewer mains will be provided for each lot either within the street right-of-way abutting the lot, in an easement along the back lot line of the lot, or in an easement along the side lot line of the lot. Sewers are to be located with the street right-of-way rather than in an easement wherever it is practicable.

D. Storm Water Drainage:

1. Storm drainage systems will be designed to carry as a minimum, with adequate allowance for free-board and head losses, storm water flow from storms having the following frequency of occurrences:

| | |
|---|---|
| Residential areas | 10 years |
| Commercial and industrial areas | 25 years |

2. Storm sewers will have a minimum size of 15 inches.

3. Sewers less than 30 inches in diameter will be laid with straight alignment between manholes and with uniform slopes between manholes. Sewers greater than 30 inches in diameter may be laid with bends in alignment and changes in slope between manholes with the approval of the City Engineer.

4. Protective measures will be provided at pipe outlets and along open ditches to minimize soil and erosion.

5. Storm drainage systems will be designed for the estimated ultimate developed tributary area unless a plan of phased construction along with intermediate storm water control measures can be shown to be advantageous to the City.

E. Paving:

1. New streets constructed with integral curb and gutter shall be poured with no less than ½ of the street width such that the only cold joint would be at the center of the street with minimum distance of 150' for each pour. Full width street paving is preferred in all instances and is required for any paving project more than 400' in length.

2. New streets shall be constructed at a depth of 7 inches minimum for local streets and 8 inches minimum for arterial and collector streets. Paving mix shall be approved by the City or the City Engineer.