

**STANDARD SPECIFICATIONS
FOR
PUBLIC WATER AND WASTEWATER
SYSTEM IMPROVEMENTS**



FEBRUARY 2020

Prepared by
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**CASSVILLE, MISSOURI
STANDARD SPECIFICATIONS FOR
PUBLIC WATER AND WASTEWATER SYSTEM IMPROVEMENTS**

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PRIORITY AND ADOPTION

These Construction Specifications, dated February 2020, supersede all others and, to the extent that any previous specification, rule, regulation, policy or past practice, written or unwritten, is in conflict with the provisions of these specifications, such is hereby withdrawn, voided and all Parties shall conduct themselves in conformity with these Specifications.

David Brock, Public Works Director

Revision Date: 06/09/2021

CERTIFICATE OF APPROVAL BY THE CITY COUNCIL OF THE CITY OF CASSVILLE, MISSOURI:

I, Cherry Bailey, City Clerk of the City of Cassville, Barry County, Missouri, do hereby certify that these Standard Specifications for Public Water and Wastewater System Improvements were presented to, accepted and approved by the City Council of said City of Cassville (Ordinance No.1848) on the 14th day of June, 2021 or as revised by the Public Works Director as authorized by said Ordinance.

Cherry Bailey, City Clerk

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Review #5000070-20 Public Drinking Water

Approved 04/23/2021 Water Pollution Control

DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01090

DEFINITIONS AND STANDARDS

PART 1 – GENERAL

1.01. SUMMARY:

- A. Basic definitions of general terms used in these Standard Specifications for Public Water and Wastewater System Improvements are covered in this Section.
 1. Agreement: The agreement, written contract or otherwise, between Developer and Contractor covering the Work to be performed and including any Public Water or Wastewater System Improvement. The City shall not be a party to the Agreement between the Developer and the Contractor.
 2. City: The City of Cassville, Missouri. The governmental entity which will assume ownership of the completed Public Water or Wastewater System Improvement Work from the Developer/Owner following the City's inspection of the completed Work and finding that the completed Work meets all the requirements set forth by the City for the construction of public water and wastewater system improvements in the City of Cassville, Missouri.
 3. City Public Works Department: The City of Cassville, Missouri, department representing the City during all phases of the Project. The Public Works Department shall be the designated contact between the Developer and the City. The Public Works Department will perform reviews of Developer submitted infrastructure construction drawings, will conduct periodic and final inspections of the Public Water and Wastewater System Improvement Work, and will issue notices of approval and acceptance, when appropriate, of the Work.
 4. Contractor: Any person, firm or corporation with whom the Developer/Owner enters into an Agreement to perform the Work for the Project, including any Public Water or Wastewater System Improvements.
 5. Developer/Owner: The person, firm, or corporation owning the property being developed and owning the Public Water and Wastewater System Improvement Work until the Work is completed, approved and accepted by the City. The person, firm, or corporation who will transfer ownership of the Public Water and Wastewater System Improvement Work to the City upon completion of the Work and the approval and acceptance thereof by the City.
 6. Engineer, Engineer of Record, Developer's Engineering Consultant, Developer's Engineering Representative: The person, firm, or corporation, licensed to perform engineering services in the State of Missouri, whom the Developer/Owner employs to prepare drawings and specifications covering the Work, including any Public Water and Wastewater System Improvements, and whom the Developer may designate as a representative to communicate with the Public Works Department.
 7. Project: The total construction of which the Work to be provided under the Standard Specifications for Public Water and Wastewater System Improvements may be the whole, or part as indicated elsewhere in these Standard Specifications or on the City approved construction drawings.
 8. Right of Way Manager: The appropriate governmental entity responsible for the management and oversight of a public right of way affected by the proposed work. For the City of Cassville roads, the Public Works Director or his designee. For County roads, the

Barry County Commission or their designee. For State roads, the Missouri Department of Transportation Southwest District, District Engineer or his designee.

9. Work: The entire completed construction of the various separately identifiable parts thereof required to be furnished under the Standard Specification for Public Water and Wastewater System Improvements and the City approved construction drawings. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Standard Specifications for Public Water and Wastewater System Improvements.

1.02. SPECIFICATION FORMAT AND CONTENT EXPLANATIONS:

- A. Specification Format: The Standard Specifications for Public Water and Wastewater System Improvements are organized into Divisions and Sections based on the Construction Specifications Institute's (CSI) 16 - Division format and Master format numbering system. Some portions may not fully comply and no particular significance will be attached to such compliance or noncompliance.
 1. Divisions and Sections: For convenience, a basic unit of Standard Specifications for Public Water and Wastewater System Improvements text is a "Section," each unit of which is numbered and named. These are recognized as the present industry consensus on uniform organization and sequencing of specifications. The Section title is not intended to limit meaning or content of Section, nor to be fully descriptive of requirements specified therein, nor to be an integral part of text.
 2. Section Numbering: Used for identification and to facilitate cross-references in the Standard Specifications for Public Water System Improvements. Sections are placed in numeric sequence; however, numbering sequence is not complete, and listing of Sections in Table of Contents at beginning of Construction Specifications must be consulted to determine numbers and names of Specification Sections in these Standard Specifications.
 3. Page Numbering: Numbered independently for each Section. Section number is shown with page number at bottom of each page, to facilitate location of text.
 4. Parts: Each Section of the Standard Specifications for Public Water and Wastewater System Improvements generally has been subdivided into three basic "parts" for uniformity and convenience (PART 1 – GENERAL, PART 2 - PRODUCTS, and PART 3 - EXECUTION). These "Parts" do not limit the meaning of text within. Some Sections may not contain all three "Parts" when not applicable, or may contain more than three "Parts" to add clarity to organization of Section.
 5. Underscoring of Titles: Used strictly to assist reader of Specification in scanning text for key words in content. No emphasis on or relative importance is intended except where underscoring may be used in body of text to emphasize a duty, critical requirement, or similar situation.
- B. Specification Content:
 1. These Standard Specifications for Public Water and Wastewater System Improvements use certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 - a. Imperative and Streamlined Language: These Specifications are written in imperative and abbreviated form. This imperative language of the technical Sections is directed at

the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall," "the Contractor shall," and "shall be," and similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. The words "shall be" shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated imperatively or otherwise.

- b. Specifying Methods: The techniques or methods of specifying requirements varies throughout the text, and may include "prescriptive," "compliance with standards," "performance," "proprietary," or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.
- c. Abbreviations: Throughout the Standard Specifications for Public Water and Wastewater System Improvements are abbreviations implying words and meanings which shall be appropriately interpreted. Specific abbreviations have been established, principally for lengthy technical terminology. These are normally defined at first instance of use. Organizational and associated names and titles of general standards are also abbreviated.

1.03. STANDARDS AND ABBREVIATIONS:

- A. Applicability of Standards: Except where the Standard Specifications for Public Water and Wastewater System Improvements include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Standard Specifications. Such standards are made a part of the Standard Specifications by reference and are stated in each section.
 - 1. Referenced standards, referenced directly in Standard Specifications or by governing regulations, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
 - 2. Where an applicable code or standard has been revised and reissued after the date of the Standard Specifications and before performance of Work affected, the revised or reissued code or standard shall apply.
 - 3. Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Standard Specifications indicate otherwise. Refer requirements that are different but apparently equal, and uncertainties as to which quality level is more stringent, to the City for a decision before proceeding.
 - 4. In every instance, the quantity or quality level shown or specified shall be the minimum to be provided or performed. The actual installation may comply exactly, within specified tolerances, with the minimum quantity or quality specified, or it may exceed that minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum values, as noted, or appropriate for the context of the requirements. Refer instances of uncertainty to the City for a decision before proceeding.
 - 5. Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Standard Specifications.
 - a. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.
- B. Abbreviations and Names: Trade association names and titles of general standards are

frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications, they mean the recognized name of the trade association, standard generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

PART 2 - PRODUCTS – Not Applicable.

PART 3 - EXECUTION – Not Applicable.

END OF SECTION 01090

SECTION 01200

PROJECT MEETINGS AND CERTIFICATION

PART 1 – GENERAL

1.01. SUMMARY: This Section includes the following requirements:

A. Project Meetings:

1. Preconstruction conference.

B. Certification:

1. Fire Service Installation.
2. Engineer's Final Certification of Completion.

1.02. PROJECT MEETINGS:

A. Preconstruction Conference:

1. Public Works Department will administer a meeting prior to commencement of any improvements to establish a working understanding between the parties as to their relationships during conduct of the Work.
2. Preconstruction conference shall be attended by:
 - a. Contractor and his superintendent.
 - b. Representatives of principal Subcontractors and Suppliers.
 - c. Public Works Department staff.
 - d. Developer/Owner or his representative.
3. Agenda:
 - a. Projected construction schedules.
 - b. Critical Work sequencing.
 - c. Project coordination.
 - d. Procedures and Processing of:
 - (1) Field decisions.
 - (2) Substitutions.
 - (3) Submittals.
 - e. Procedures for testing.
 - f. Procedures for maintaining record documents.

4. Location of Meeting: Cassville City Hall, 300 Main Street, Cassville, MO 65625.

1.03. CERTIFICATION:

A. Fire Service Installation:

1. All fire service installations shall meet fire flow requirements established by the City or by the applicable building codes.

B. Engineer's Final Certification of Completion:

1. The Engineer of Record shall perform site inspections as necessary to provide the City with a Certificate of Completion. Certificate shall state that all improvements have been constructed in general compliance with the City approved construction drawings and Standard Specifications for Public Water and Wastewater System Improvements. Certificate of Completion shall bear the name, signature, current date and Missouri Registration Number of the Engineer.
2. Upon completion of the water main, the Engineer of Record shall submit a copy of the duly executed "Application for Water Main Extension - Final Construction Approval" along with all testing data to the City of Cassville and to the Missouri Department of Natural Resources. Upon the City's receipt of the Final Construction Approval from Missouri Department of Natural Resources the water main will be allowed to be placed in service.
3. Upon completion of the sanitary sewer line, the Engineer of Record shall submit a copy of the duly executed "Application for Letter of Authorization" along with all testing data to the City of Cassville and to the Missouri Department of Natural Resources. Upon the City's receipt of the Letter of Authorization from the Missouri Department of Natural Resources the sanitary sewer line will be allowed to be placed in service.

PART 2 - PRODUCTS – Not applicable.

PART 3 - EXECUTION – Not applicable.

SECTION 01300

SUBMITTALS

PART 1 – GENERAL

1.01. SUMMARY:

- A. This Section includes definitions, descriptions, transmittal, review of "Compliance" Submittals, and record drawings.
- B. Related Work Specified Elsewhere:
 - 1. Project Meetings: SECTION 01200.

1.02. GENERAL INFORMATION:

- A. Definitions:
 - 1. Compliance Submittals include shop drawings and product data which are prepared by the Contractor, Subcontractor, Manufacturer, or Supplier and submitted by the Contractor to the Engineer as a basis for approval of the use of EQUIPMENT AND MATERIALS proposed for incorporation in the Work or needed to describe installation, operation, maintenance, or technical properties.
 - a. Shop drawings include custom-prepared data of all types including drawings, diagrams, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.
 - b. Product data includes standard printed information on materials, products and systems; not custom-prepared for this Project, other than the designation of selections from available choices.
 - 2. Contractor shall maintain in a safe place at the site one record copy of all Drawings, Specifications, and Addenda in good order and annotated to show all changes made during construction. Upon completion of the Work, these record documents will be delivered to the Engineer of Record who shall provide reproducible copies of the revised drawings to the City.
 - 3. Refer to Part 1.03, this Section for detailed lists of documents and specific requirements.
- B. Quality Requirements:
 - 1. Submittals such as shop drawings and product data shall be of the quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible. Drawings such as reproductions shall be usable for further reproduction to yield legible hard copy.
 - 2. Documents shall be submitted to the Engineer for review. Any variations from specified materials/equipment/procedures shall be approved by the City. One copy of each Engineer "Approved" shop drawing shall be submitted to the City upon completion of the work. Any unapproved material/equipment shall be removed and replaced with material/equipment specified herein.
- C. Language and Dimensions:
 - 1. All words and dimensional units shall be in the English language.

2. Metric dimensional unit equivalents may be stated in addition to the English units.

D. Submittal Completeness:

1. Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Engineer to review the information effectively.

1.03. COMPLIANCE SUBMITTALS:

A. Items shall include, but not be limited to, the following:

1. Manufacturer's specifications.
2. Catalogs, or parts thereof, of manufactured equipment.
3. Shop fabrication and erection drawings.
4. Concrete mix design information.
5. All drawings, catalogs or parts thereof, manufacturer's specifications and data, samples, instructions, and other information specified or necessary.
6. Record drawings.

PART 2 - PRODUCTS – Not applicable.

PART 3 - EXECUTION – Not applicable.

END OF SECTION 01300

SECTION 01530

TEMPORARY BARRIERS AND CONTROLS

PART 1 – GENERAL

1.01. SUMMARY:

- A. This Section includes General Requirements for:
 - 1. Protection of Work.
 - 2. Protection of existing property.
 - 3. Barriers.
 - 4. Environmental controls.
 - 5. Traffic control and use of roadways.
- B. Related Work Specified Elsewhere:
 - 1. Site Preparation and Earthwork: SECTION - 02200.
 - 2. Trenching and Backfilling for Utilities: SECTION - 02222.

1.02. REFERENCES:

- A. Manual on Uniform Traffic Control Devices (MUTCD).
- B. 2017 Missouri Standard Specifications for Highway Construction.

PART 2 – PRODUCTS – Not Applicable.

PART 3 – EXECUTION

3.01. PROTECTION OF WORK AND PROPERTY:

- A. General:
 - 1. Provide protection at all times against rain, wind, storms, frost, freezing, condensation, or heat so as to maintain all Work and Equipment and Materials free from injury or damage. At the end of each day all new Work likely to be damaged shall be appropriately protected.
 - 2. Notify Engineer immediately at any time operations are stopped due to conditions which make it impossible to continue operations safely or to obtain proper results.
 - 3. Construct and maintain all necessary temporary drainage and do all pumping necessary to keep excavations, floors, pits, trenches, manholes, and ducts free of water.
- B. Property Other than Developer's/Owner's:
 - 1. Report immediately to the owners thereof and promptly repair damage to existing facilities resulting from construction operations.
 - 2. Names and telephone numbers of representatives of agencies and utilities having jurisdiction

over streets and utilities in the Work area can be obtained from the City for the agencies listed below. Concerned agencies or utilities shall be contacted a minimum of 48 hours prior to performing Work, closing streets and other traffic areas, or excavating near underground utilities or pole lines.

- a. Water.
 - b. Gas.
 - c. Sanitary sewers.
 - d. Storm drains.
 - e. Pipeline companies.
 - f. Telephone.
 - g. Electric.
 - h. Municipal streets.
 - i. Fire.
 - j. Police.
 - k. Right of Way Manager
- 3. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.
 - 4. Where fences are to be breached on private property, the owners thereof shall be contacted and arrangements made to ensure proper protection of any livestock or other property thus exposed.
 - 5. The applicable requirements specified for protection of the Work shall also apply to the protection of existing property of others.
 - 6. Before acceptance of the Work by the City, restore all property affected by Contractor's operations to its original or better condition.

3.02. BARRIERS

A. General:

- 1. Furnish, install, and maintain suitable barriers as required to prevent public entry, protect the public, and to protect the Work, existing facilities, trees, and plants from construction operations. Remove when no longer needed or at completion of Work.
 - a. Barriers shall be required on all unattended excavations and at the direction of the Right of Way Manager
- 2. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards or regulatory agencies.
- 3. Barriers shall be of a neat and reasonable uniform appearance, structurally adequate for the required purposes.

4. Maintain barriers in good repair and clean condition for adequate visibility.
5. Relocate barriers as required by progress of Work.
6. Repair damage caused by installation and restore area to original or better condition. Clean the area.

3.03. ENVIRONMENTAL CONTROLS:

A. Dust Control:

1. Provide positive methods and apply dust control materials to minimize raising dust from construction operations; and to prevent airborne dust from dispersing into the atmosphere.

B. Water and Erosion Control:

1. Provide methods to control surface water to prevent damage to the Project, the site, or adjoining properties.
2. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - a. Hold the areas of bare soil exposed at one time to a minimum.
 - b. Provide temporary control measures such as berms, dikes, drains and erosion barriers.
3. Control fill, grading, and ditching to direct surface drainage away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper runoff.
4. Provide, operate, and maintain hydraulic equipment of adequate capacity to control surface and groundwater.
5. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas.

C. Debris Control and Clean-Up:

1. Keep the premises free at all times from accumulations of debris, waste materials, and rubbish caused by construction operations and employees. Responsibilities shall include:
 - a. Adequate trash receptacles about the site, emptied promptly when filled.
 - b. Periodic cleanup to avoid hazards or interference with operations at the site and to maintain the site in a reasonably neat condition.
 - c. The keeping of construction materials such as forms and scaffolding neatly stacked.
2. Prohibit overloading of trucks to prevent spillages on access and haul routes. Provide periodic inspection of traffic areas to enforce requirements.

D. Pollution Control:

1. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by the discharge of hazardous or toxic substances from construction operations.

2. Provide equipment and personnel, perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-site in approved locations deemed acceptable by the appropriate regulatory agency, and replace with suitable compacted fill and topsoil.
3. Take special measures to prevent harmful substances from entering public waters, sanitary, or storm sewers or waters of the state.

3.04. TRAFFIC CONTROL AND USE OF ROADWAYS:

A. Traffic Control:

1. Provide, operate, and maintain equipment, services, and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow on haul routes, at site entrances, on-site access roads, and parking areas. This includes traffic signals and signs, flagmen, flares, lights, barricades, and other devices or personnel as necessary to adequately protect the public. All construction sign and reflective materials shall conform to the Missouri Standard Specification for Highway Construction. Traffic control measures shall meet the requirements of the MUTCD and shall be reviewed and approved by the Right of Way Manager.
2. Remove temporary equipment and facilities when no longer required. Restore grounds to original, better, or specified condition when no longer required.
3. Provide and maintain suitable detours or other temporary expedients if necessary.
4. Bridge over open trenches where necessary to maintain traffic.
5. Consult with governing authorities to establish public thoroughfares which will be used as haul routes and site access. All operations shall meet the approval of owners or agencies having jurisdiction.

B. Maintenance of Roadways:

1. Repair roads, walkways, and other traffic areas damaged by operations. Keep traffic areas as free as possible of excavated materials and maintain in a manner to eliminate dust, mud, and hazardous conditions.
2. All operations and repairs shall meet the approval of owners or agencies having jurisdiction.

END OF SECTION 01530

DIVISION 2 – SITE WORK

SECTION 02200

SITE PREPARATION AND EARTHWORK

PART 1 – GENERAL

1.01. SUMMARY:

A. This Section includes site preparation activities and certain items of earthwork common to other related Work.

B. Related Work Specified Elsewhere:

1. Trenching and Backfilling for Utilities: SECTION 02222.

1.02. REFERENCES:

A. Applicable Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):

a. M80 – Coarse Aggregate for Portland Cement Concrete.

b. T104 – Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.

c. T180 – The Moisture-Density Relations of Soils Using a 10-Pound (4.54-kg) Rammer and an 18-Inch (457-mm) Drop.

2. American Society for Testing and Materials (ASTM):

a. D2167 – Test for Density and Unit Weight of Soil In-Place by Rubber-Balloon Method.

b. D2922 – Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).

c. D4253 – Maximum Index Density of Soils Using a Vibratory Table.

d. D4254 – Minimum Index Density of Soils and Calculation of Relative Density.

e. C88 – Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

f. D3786 – Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Test Method.

g. D4491 – Test Methods for Water Permeability of Geotextiles by Permittivity.

h. D4632 – Test Method for Grab Breaking Load and Elongation of Geotextiles.

i. D4751 – Test Method for Determining the Apparent Opening Size of a Geotextile.

j. D4833 – Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

- k. D698 – Test Methods for Moisture-Density Relations of Soil and Soil Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop.
- 3. Occupational Safety and Health Administration (OSHA):
 - a. Part 1926 – Safety and Health Regulations for Construction.

PART 2 – PRODUCTS

2.01. EARTHWORK:

- A. Materials suitable for use in embankment, structural backfill and fill include material free of debris, roots, organic matter, and frozen matter; free of stone having any dimension greater than 2 inches in areas requiring a high degree of compaction or 4 inches in other embankment and fill areas:
 - 1. Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands exclusive of clayey material:
 - a. Free-draining.
 - b. Materials for which impact compaction will not produce a well-defined, moisture-density relationship curve.
 - c. Maximum density by impact methods will generally be less than by vibratory methods.
 - d. For which generally less than 15 percent by dry weight, of soil particles pass the No. 200 sieve.
 - 2. Cohesive materials include silts and clays generally exclusive of sands and gravel:
 - a. Materials for which impact compaction will produce a well-defined, moisture-density relationship curve.
- B. Materials unsuitable for use in embankment and fill include all material that contains debris, roots, organic matter, frozen matter, stone (with any dimension greater than 2 inches in areas requiring a high degree of compaction or 4 inches in other embankment and fill areas), or other that are determined by Engineer to be too wet or otherwise unsuitable.
- C. Waste materials include excess usable materials and materials unsuitable for use in the Work.
- D. Borrow materials include all fill materials, structural backfill and topsoil obtained from locations on or off the jobsite.

2.02. RIPRAP:

- A. Riprap Material:
 - 1. All stone shall be durable and of suitable quality to ensure permanence in the structure and in the climate in which it is to be used.

2. Boulders or quarried rock may be used and shall be graded as follows:

<u>Weight in Pounds Per Stone</u>	<u>Percent of Total Weight Lighter than or Passing</u>
300	100
150	55-75
50	25-45
2-inch screen	5-15

3. Quantity of rock with an elongation greater than 3:1 shall not exceed 20% of the mass. No stone shall have an elongation greater than 4:1.
4. Stone shall be free from cracks, seams or other defects that would tend to increase its deterioration from natural causes.
5. Objectionable quantities of dirt, sand, clay, and rock fines will not be permitted.
6. Not more than 10% of the stone shall show splitting, crumbling, or spalling when subjected to five cycles of the sodium soundness test as required by AASHTO T104.
7. Contractor shall furnish a Sample of stone to Engineer for acceptance.
- B. Bedding material for riprap shall conform to all applicable requirements of AASHTO M80 and shall be reasonably well-graded within the following limits:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
4-inch	100
3-inch	80-100
2-inch	70-90
3/4-inch	45-60
No. 4	20-30
No. 10	5-15
No. 40	0-5

1. Crushed rock conforming to the gradation specified may be used.

2.03. STRUCTURAL BACKFILL:

- A. Crushed rock conforming to the following gradation may be needed.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1-1/2-inch	100
1-inch	75-95
1/2-inch	55-75
No. 4	35-55
No. 10	25-45
No. 40	14-30
No. 200	4-10

- B. Structural backfill material shall be subject to approval of the Engineer and arranged for by Contractor.

2.04. FILTER FABRIC:

- A. Filter fabric of nonwoven geotextile conforming to:

1. D3786 – Mullen Burst of 225 psi and Greater.
2. D4491 – Permittivity of 2.5 Per Sec-1 with a Flow Rate of 175 Gallons Per Minute Per Square Foot Minimum.
3. D4632 – Tensile Strength 90 Lbs. or Greater at 50% Elongation.
4. D4751 – Apparent Opening Size (AOS) of 70 on U.S. Sieve.
5. D4833 – Puncture 65 Lbs. or Greater.

2.05. SOIL STERILANT:

- A. Sterilant shall be Krovar as manufactured by E.I. Du Pont De Nemours and Co.

PART 3 – EXECUTION

3.01. SITE PREPARATION:

A. Clearing and Grubbing:

1. Perform selective clearing and grubbing as indicated or as necessary to perform excavation, trenching, embankment, borrow, and other Work required, and as directed by Engineer.
 - a. Clearing:
 - (1) Includes felling and disposal of trees, brush, and other vegetation.
 - (2) Conduct Work in a manner to prevent damage to property and to provide for the safety of employees and others.
 - (3) Keep operations within property lines as indicated.
 - b. Grubbing:
 - (1) Includes removal and disposal of tree stumps and roots larger 3 inches in diameter.
 - (2) Remove to a depth of at least 18 inches below existing grade elevation.
 - (3) Backfill all excavated depressions with approved material and grade to drain.

B. Protection of Trees:

1. Protect tops, trunks, and roots of existing trees on Project site which are to remain, as follows:
 - a. Box fence around, or otherwise protect trees before any construction Work is started.
 - b. Do not permit heavy equipment or stockpiles within branch spread.
 - c. Trim or prune to obtain working space in lieu of complete removal when possible. Conduct operation as follows:
 - (1) With experienced personnel.
 - (2) Conform with good horticultural practice.

(3) Preserve natural shape and character.

(4) Protect cuts with approved tree paint.

d. Grade around trees as follows:

(1) Trenching: Where trenching is required around trees which are to remain, avoid cutting the tree roots by careful hand tunneling under or around the roots. Avoid injury to or prolonged exposure of roots.

(2) Raising Grades: Where existing grade at a tree is below the new finished grade and fill not exceeding 16 inches is required, place 1 to 2 inches of clean, washed gravel directly around the tree trunk. Extend gravel out from trunk on all sides at least 18 inches and finish 2 inches above finished grade at tree. Install gravel before earth fill is placed. Do not leave new earth fill in contact with any tree trunks.

(3) Lowering Grades: Regrade by hand to elevation required around existing trees in areas where new finished grade is to be lower. As required, cut the roots cleanly 3 inches below finished grade and cover scars with tree paint.

e. Remove when damage occurs and survival is doubtful.

C. Stripping:

1. Remove topsoil from all areas within limits of the construction easement which are to be used for any purpose except for stockpiling excavated materials.

D. Debris:

1. Dispose of debris from clearing, grubbing, stripping, and demolition at a location off the jobsite as arranged for by Contractor.

3.02. EARTHWORK:

A. Excavation:

1. Perform excavation as indicated or as required to complete the work.

2. Normal materials to be excavated are earth and other materials which can be removed by power shovel, bulldozer, or other normal equipment, but not requiring the use of explosives or drills.

3. Blasting:

a. Drill and blast, including pre-split blasting, rock not removable by other excavation methods, in a manner that completes the excavation to lines indicated or acceptable and required for access, with the least disturbance to adjacent material.

b. Blasting shall be performed only by persons who are qualified, competent, and thoroughly experienced in the use of explosives for rock excavation.

c. Locate charge holes properly and drill to correct depth for charges used.

d. Limit charges in size to minimum required for reasonable removal of material by excavating equipment.

- e. Determine spacing of drill holes, size of explosive charges, time delays and blasting techniques, including the use of approved explosion mats, to avoid excessive overbreak or damage to adjacent structures, equipment, utilities, or buried pipeline and conduit.
 - f. Contractor shall monitor blasting operations at necessary locations throughout all blasting activities. Peak particle velocities and/or displacements at adjacent structures, equipment, exposed or buried, pipelines and conduits shall not exceed the level of criteria as determined by United States Department of Interior, Bureau of Mines in their Figure B-1 from Report of Investigations 8507 by D.E. Siskind, et. al., unless otherwise directed by Engineer.
 - g. Contractor shall assume full liability for any damage to adjacent structures, equipment, new construction, utilities, or buried pipelines and conduit caused by blasting operations.
 - h. Blasting near utilities shall be subject to approval of owning agency.
 - i. Before delivery of any explosives at jobsite, Contractor must have obtained a blasting endorsement on his public liability and property damage insurance policy.
 - j. Remove overblast rock materials to competent rock and replace as directed by Engineer.
4. Dewatering:
- a. Control grading around excavations to prevent surface water from flowing into excavation areas.
 - b. Drain or pump as required to continually maintain all excavations and trenches free of water or mud from any source, and discharge to approved drains or channels. Commence when water first appears and continue until Work is complete to the extent that no damage will result from hydrostatic pressure, flotation, or other causes.
 - c. Use pumps of adequate capacity to ensure rapid drainage of area, and construct and use drainage channels and subdrains with pumps as required.
 - d. Remove subgrade materials rendered unsuitable by excessive wetting and replace with approved backfill material.
5. Stockpiling:
- a. Stockpiling in amounts sufficient for and in a manner to segregate materials suitable for the following:
 - (1) Topsoiling.
 - (2) Constructing embankments and fills.
 - (3) Backfilling.
 - (4) Waste only.
 - b. Do not obstruct or prevent access to:
 - (1) Roads and driveways.
 - (2) Utility control devices.

- (3) Ditches or natural drainage channels.
 - c. Perform in a manner to avoid endangering the Work, stability of banks or structures, or health of trees and shrubs to be saved.
 - d. Maintain safe distance between toe of stockpile and edge of excavation or trench.
 - e. Stockpile in other areas or off site when adjacent structures, easement limitations, or other restrictions prohibit sufficient storage adjacent to the Work. Off-site areas shall be arranged for by Contractor and Developer/Owner.
6. Waste Materials:
- a. Remove waste materials from Work area as excavated.
 - b. Deposit such materials in locations and within areas designated by Engineer and as indicated.
 - c. Place excavated rock in the interior of waste area fills so that it will not be exposed to view.
 - d. Grade waste areas and leave them free draining and with an orderly and neat appearance.

B. Embankment:

- 1. Construct embankments to the contours and elevations indicated, using suitable Engineer approved material from excavations and borrow areas:
 - a. Borrow:
 - (1) Refers to all fill materials and topsoil obtained from Engineer approved locations off the jobsite.
 - (2) Borrow shall include all excavating, handling, and final disposal of materials as specified.
 - (3) Borrow areas shall be arranged for by Contractor and subject to approval of the Engineer.
 - (4) Material removed from borrow areas shall be as approved by the Engineer.
 - (5) Leave borrow areas graded to drain and to present a neat appearance.
 - b. Compaction:
 - (1) Compact embankments using equipment as required to obtain reasonable uniformity.
 - (2) Compaction shall be as obtained by normal methods and equipment during the placing and grading of layers and to 95% of the maximum density.
 - (3) Moisture content shall be that required to obtain specified compaction of the soil. Perform any wetting or drying of the material as required to maintain moisture content at time of placement to not less than 4% or more that 2% above optimum as determined by ASTM D698.

- (4) Achieve minimum densities specified as referenced. For cohesive soils, maximum density at optimum moisture, ASTM D698. For cohesionless soils, relative density per ASTM D4253 and D4254.

c. Placement:

- (1) Place fill material in 4-inch to 8-inch layers in areas requiring a high degree of compaction and in 8-inch to 12-inch layers in other embankment areas.
- (2) Place embankment only on subgrades approved by Engineer.
- (3) Do not place snow, ice, or frozen earth in fill; do not place fill on frozen surface.

C. Subgrades:

1. Excavate or fill as required to construct subgrades to the elevations and grades indicated. Remove all unsuitable material and replace with Engineer approved fill materials. Perform all wetting, drying, shaping, and compacting required to prepare a suitable subgrade.
2. Subgrade for Fills and Embankment: Roughen by diskings or scarifying. Wet or dry top 6 inches, as required, to bond with fill or embankment.
3. Subgrade for Roadways, Drives, Parking Areas, and Railroads:
 - a. Extend subgrade the full width of the roadbed plus 1 foot outside the edges of the overlying course to be placed.
 - b. Compact the top 6 inches of subgrades for traffic areas and railroads in embankment or excavation to 95%.
 - c. Subgrade shall be rolled (except those to receive aggregate-type surfacing).
 - d. Subgrade compaction shall be verified by in place moisture density testing and by proof rolling.
 - (1) Proof rolling shall be performed as directed by the City.
 - (2) Proof rolling shall be performed using a fully loaded single axle dump truck.

D. Site Grading:

1. Excavate, fill, compact fill, and rough grade to bring Project area outside of structures to subgrades as follows:
 - a. For surfaced areas, to underside of respective surfacing or base course:
 - (1) Prepare subgrades as specified in this Section.
 - b. For lawn and planted areas, to 4 inches below finished grade.
2. Rock:
 - a. Includes rock encountered in grading areas outside of structures.
 - b. Excavate rock to depths as follows:

- (1) Under surfaced areas, to 6 inches below the top of respective subgrades.
 - (2) Under lawn and planted areas, to 24 inches below finished grade. Boulder or protruding rock outcrop shall be left undisturbed where indicated.
 - c. Backfill to grade with approved earth fill compacted-in-place:
 - (1) Achieve minimum density specified for particular location.
- 3. Fill:
 - a. Fill as required to raise existing grades outside of structure areas to the new grades as indicated.
 - b. Such fill shall be performed as specified in Part 3.02.B – Embankment, this Section.
 - c. Remove all debris subject to termite attack, rot, or corrosion from areas to be filled.
- 4. Rough Grading:
 - a. All areas within the Project, including excavated and filled sections, and adjacent transition areas shall be reasonably smooth, compacted, and free from irregular surface changes.
 - b. Degree of finish shall be that ordinarily obtained from blade grader or scraper operations, except as otherwise specified.
 - c. Finished rough grades shall generally be not more than 0.5 foot above or below established grade or approved cross sections with due allowance for topsoil and sod.
 - d. Tolerance for areas within 10 feet of structures and areas to be paved shall not exceed 0.15 foot above or below established subgrade.
 - e. Finish all ditches, swales, and gutters to drain readily.
 - f. Unless otherwise indicated, slope the subgrade evenly to provide drainage away from structure walls in all directions at a grade not less than 1/4 inch per foot.
 - g. Provide roundings at top and bottom of banks and at other breaks in grade.

E. Topsoiling:

- 1. Includes placement of topsoil on all areas not specified to receive paving or other surface treatment (including borrow or waste areas).
- 2. Materials:
 - a. Those obtained from excavation which are most suitable and stockpiles for such purpose:
 - (1) Topsoil shall be a fertile, friable, and loamy soil of uniform quality, free from materials such as hard clods, stiff clay, stone with any dimension greater than 1 inch, and similar impurities. Relatively free from grass, roots, weeds, and other objectionable plant material.
 - b. Borrow when required.

3. Subgrade Treatment:

- a. Clear site of vegetation heavy enough to interfere with proper grading and tillage operations.
- b. Clear surfaces of all stones or other objects larger than 3 inches in thickness or diameter, all roots, brush, wire, grade stakes, or other objectionable material.
- c. Loosen subgrade by disking or scarifying to a depth of 2 inches wherever compacted by traffic or other causes to permit bonding of the topsoil to the subgrade.

4. Placement of Topsoil:

- a. Distribute over required areas without compaction in upper 1 foot, other than that obtained with spreading equipment.
- b. To extent material is available within following limits:
 - (1) Not less than 4 inches in depth.
 - (2) Do not exceed 2 feet in depth.
- c. Shape cuts, fills, and embankments to contours indicated.
- d. Grade to match contours of adjacent areas and permit good, natural drainage.
- e. Provide gentle mound over trenches.

5. Maintenance:

- a. After topsoil has been spread, clear surface of stones or other objects larger than 1 inch in thickness or diameter and all other objects than might interfere with planting and maintenance operations.
- b. Protect topsoiled areas from the elements until grass is established and repair eroded areas as required.
- c. Keep paved areas clean. Promptly remove topsoil or other dirt dropped upon surfacing.

3.03. RIPRAP:

A. Foundation Preparation:

- 1. Trim and dress areas requiring riprap to conform to cross sections indicated within an allowable tolerance of ± 3 inches from the theoretical slope lines and grades.
- 2. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with bedding material
- 3. Do not place bedding on the base until the base has been approved.

B. Filter Blanket Placement:

- 1. Place filter blanket only on foundation approved by Engineer. Material for filter blanket shall consist of filter fabric meeting the requirements of this Section.

2. Filter fabric will be inspected by Engineer at the time of installation and will be rejected if damaged during manufacture, transportation or storage. The filter fabric shall be placed with its long dimension horizontal and shall be laid smooth and free of tension, stress, folds, wrinkles or creases.
 - a. Strips shall be placed to provide not less than 18 inches of overlap at each joint.
 - b. Contractor shall anchor filter fabric to prevent dislocation during placement of riprap. The method of anchoring shall be subject to the approval of the Engineer.
 - c. Tracked or wheeled equipment will not be permitted on slopes covered with filter fabric.
 - d. Filter fabric shall be left exposed no more than one week prior to riprap placement.

C. Placement of Riprap:

1. Place on the slopes within the limits as indicated.
2. Place stone for riprap on the prepared base in such a manner as to produce a reasonably well-graded mass of rock with a minimum practicable percentage of voids.
3. Place to its full course thickness in one operation in a manner to avoid displacing the bedding material.
4. Finished riprap shall be free from objectionable pockets of small stone and clusters of larger stones. Hand-place only if necessary to secure the desired results.
5. Maximum deviation from slope lines and grades indicated shall not exceed 6 inches. Maximum deviation shall not be continuous over an area greater than 10 square feet.
6. Maintain the riprap until accepted by City and replace any material displaced by any cause.

3.04. SOIL STERILANT:

A. Apply soil sterilant to the following areas:

1. Pump Station or Well areas prior to placement of crushed rock surfacing.
2. Along base of fencing with width not to exceed 12 inches.

B. Apply according to manufacturer's recommendations.

3.05. FIELD QUALITY CONTROL:

A. Compaction:

1. Developer/Owner will, through services of an independent laboratory, test all embankments, fills, structural backfill and subgrades under this Project to determine conformance with specified density relationships.
2. Method of test may be either of the following at Engineer's option:
 - a. ASTM D2167.
 - b. ASTM D2922.

B. Subgrades:

1. Engineer will inspect all subgrades to determine conformance with indicated lines and grades.
2. Subgrades for roadways, drives, parking areas, and railroads shall have a maximum deviation of not more than 1/2 inch in any 10 feet when tested with a 10-foot straightedge applied parallel with and at right angles to the centerlines of subgrade areas, except that subgrades to receive aggregate type surfacing shall have a maximum deviation of not more than 1 inch.

3.06. PROTECTION OF THE WORK:

A. Maintenance:

1. Protect newly graded and topsoiled areas from actions of the elements.
2. Fill and repair settling or erosion occurring prior to landscaping and reestablish grades to the required elevations and slopes.

B. Correction of Backfill Settlement:

1. Developer is responsible for correcting any settlement of backfill and damages created thereby within 1 year after acceptance of the Work by the City.
2. Developer to make repairs within 10 days from and after due notification by City of backfill settlement and resulting damage.
3. Developer to make own arrangements for access to the site for purposes of repair.

END OF SECTION 02200

SECTION 02222

TRENCHING AND BACKFILLING FOR UTILITIES

PART 1 - GENERAL

1.01. SUMMARY:

A. This Section includes:

1. Excavation, sheeting, bracing, and all operations necessary for the preparation of trenches for bedding of pipes and pipe appurtenances, conduit, and buried cable.
2. Pipe embedments and encasements.
3. Backfilling of trenches.

B. Related Work Specified Elsewhere:

1. Site Preparation and Earthwork: SECTION 02200.
2. Concrete: DIVISION 3 – SECTION 03300.

1.02. REFERENCES:

A. Applicable Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. T104 – Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
2. American Society for Testing and Materials (ASTM):
 - a. D4253 – Maximum Index Density of Soils Using a Vibratory Table.
 - b. D4254 – Minimum Index Density of Soils and Calculation of Relative Density.
 - c. D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - d. D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
3. Occupational Safety and Health Administration (OSHA):
 - a. Part 1926 - Safety and Health Regulations for Construction.
4. State of Missouri Standard Specifications for Highway Construction.

1.03. SUBMITTALS:

A. Submit as specified in DIVISION 1 – SECTION 01300.

B. Includes, but not limited to, the following:

1. Steel reinforcement for concrete encasement.

2. Steel reinforcement for concrete cradle.
 3. Concrete as specified in DIVISION 3 – SECTION 03300.
- C. Where selecting an option for excavation, trenching and shoring design from local, state, or federal safety regulations such as "OSHA Part 1926" or successor regulations, which request design by a registered professional engineer, the Contractor shall submit to the Engineer of Record (for information only and not for Engineer approval) the following:
1. Copies of design calculations and notes for sloping, benching, support systems, shield systems, and other protective systems approved by a professional engineer registered in the State of Missouri and obtained by Contractor.
 2. Documents provided with evidence of Registered Professional Engineer's seal, signature, and date in accordance with appropriate State of Missouri licensing requirements.

PART 2 – PRODUCTS

2.01. GRANULAR PIPE EMBEDMENT:

A. Material:

1. Granular pipe embedment shall be crushed limestone consisting of aggregate particles meeting the requirements of ASTM C33, Gradation 67, 1-inch to No. 8 size.

B. Gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
1-inch	100
3/4-inch	90-100
3/8-inch	20-55
No. 4	0-10
No. 8	0-5

C. Sand:

1. Sand used for bedding shall be capable of passing a 3/4" sieve with not more than 5% retained on a No. 4 sieve.

2.02. PIPE EMBEDMENT FOR GROUNDWATER BARRIER:

- A. Barrier material shall be soil meeting classification GC, SL, CL, or ML-CL or Portland cement concrete.

2.03. TRENCH BACKFILL MATERIALS:

A. Obtain from the following:

1. Trenches and other excavations included in the Project.
2. Borrow from location off jobsite.
3. As specified for pipe embedment.
4. Combination of above.

- B. Free from organic matter, refuse, ashes, cinders, frozen, or other unsuitable material.
- C. Gravel, rock, or shale particle size limited as follows:
 - 1. Not to exceed 2 inches in greatest dimension within 12 inches of pipe or conduit and upper 18 inches of trench.
 - 2. Maximum dimension one-half the depth of layer to be compacted in other areas.
- D. Contain sufficient fine materials to provide a dense mass free of voids and capable of satisfactory compaction.
- E. Have moisture content enabling satisfactory placement and compaction.
- F. Blended or otherwise processed to provide required gradation and moisture content.
- G. Use granular material as specified for pipe embedment and trench stabilization unless otherwise indicated.

2.04. COMPACTED GRANULAR BACKFILL:

- A. Compacted granular backfill shall be flowable fill or graded gravel as described below:
 - 1. Flowable fill for compacted backfill may be used for cuts in existing roadway, as approved by the City.
 - 2. Gravel for compacted backfill shall conform to the following gradation.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1-inch	100
3/4 inch	85-100
3/8 inch	50-80
No. 4	35-60
No. 40	15-30
No. 200	5-10

- 3. The gravel mixture shall contain no clay lumps or organic matter.

2.05. TUNNEL (CASING) MATERIALS:

- A. Smooth Steel Casing Pipe:
 - 1. Smooth wall casing conduit pipe shall be of welded steel construction and shall be new material with a minimum yield of 35,000 psi.
 - 2. Smooth wall casing pipe shall have the following minimum wall thickness:

<u>Casing Diameter</u>	<u>Wall Thickness</u>
< 6"	0.188"
6" – 16"	0.188"
18" – 22"	0.250"
24" – 26"	0.281"
28" – 34"	0.312"
36" – 48"	0.344"

B. Carrier Pipe Spacers:

1. Clamp-on or bolt-on style stainless steel casing spacers with U.H.M.W. Polymer Plastic runners and neoprene liners. Casing spacers shall be Pipeline Seal and Insulator, Inc. "PSI Ranger" or equal.

C. End Seals:

1. End Seal shall be Pipeline Seal and Insulators, Inc. "PSI Model C" or equal.

PART 3 – EXECUTION

3.01. TRENCHING:

A. Equipment and Methods:

1. Types of Equipment and methods may be at Contractor's option, where structures or other facilities are not endangered.
2. Equipment and methods shall be subject to approval of jurisdictional agency where stability or usefulness of other facilities may be impaired.
3. Perform by hand methods when required to save or protect trees, culverts, utilities, or other structures above or below ground.
4. Maximum length of open trench shall be limited to 100 feet in advance and to 100 feet behind pipe installation, except as approved by Engineer.
5. Remove all rocks and hard objects larger than 1" in diameter for a depth of 6" below bottom of pipe.

B. Side Walls:

1. Make vertical or slope within specified trench-width limitations below a horizontal plane 12 inches above top of pipe.
2. Vertical or sloped (stepped) as required for stability, above a horizontal plane 12 inches above top of pipe.
3. Sheet and brace where necessary.
4. Excavate without undercutting.

C. Trench Depth:

1. Trenches shall be excavated to six (6) inches below the bottom of the pipe when set to establish flowlines to provide clearance for the pipe bell and not less than six (6) inches of granular bedding material.
2. Do not exceed the indicated depth where conditions of bottom are satisfactory. Should the trench be excavated more than six (6) inches below the flowline where the bottom conditions are satisfactory, the Contractor shall use only granular bedding material to establish flowline grades.
3. Increase depth as necessary to remove unsuitable supporting materials.

4. Minimum depth of cover over top of pipe is 42 inches.
5. Maximum depth of cover over top of pressure pipe is 72 inches unless approved by the City.
6. Trenches cut to prevent high spots in pressure pipe.

D. Trench Bottom:

1. Protect and maintain when suitable natural materials are encountered.
2. Remove rock fragments and materials disturbed during excavation or raveled from trench walls.
3. Restore to proper subgrade with trench-stabilization material when overexcavated:
 - a. Correct when trench is overexcavated without authority or to stabilize bottom rendered unsuitable through negligence or improper operations.
 - b. Placement of Trench Stabilization Material:
 - (1) Compact in lifts not exceeding 6-inch loose thickness:
 - (a) With pneumatic or vibratory equipment.
 - (b) To density specified for granular pipe embedment.

E. Trench Width:

1. Excavate trench to a width which will permit satisfactory joining of the pipe and thorough tamping of the bedding.
2. Minimum trench width shall be pipe outside diameter plus 12" or 24", whichever is greater.
3. Minimum 6-inch clear space between outside diameter of pipe and trench wall when measured at top of pipe.
4. Maximum trench width shall be pipe outside diameter plus 24".

F. Trenching in Fill Areas: Perform trenching in fill areas only after compacted fill has reached an elevation of not less than 1 foot above the top of the pipe.

G. Pipe Deflection:

1. Pipe shall not be deflected by bending.
2. Maximum joint deflection shall be 1/2 of manufacturer's maximum allowable joint deflection.

3.02. PIPE EMBEDMENTS AND ENCASEMENTS:

A. Granular Pipe Embedment:

1. Place granular embedment as follows:

- a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout its length. Granular pipe bedding material shall be a minimum of six (6) inches below the pipe bell.
 - b. Form depression under each joint so that no part of bell or coupling is in contact with trench when pipe is placed in position.
 - c. Add second layer simultaneously to both sides of the pipe with care to avoid displacement.
 - d. Final depth of granular embedment material shall extend twelve (12) inches above the top of pipe bell.
 - e. Complete promptly after completion of jointing operations and Engineer approval to proceed.
 - f. Substitute for any part of earth backfill to within 2 feet of final grade at Contractor's option.
 - g. Obtain level depth of cover over top of pipe for trench width.
2. Compact granular bedding as follows:
 - a. In lifts not exceeding 12 inches in compacted depth.
 - b. Rod, space, or use pneumatic or vibratory equipment:
 - (1) As required to obtain not less than 80% relative density as determined by ASTM Method D4253 and D4254.
 - (2) Throughout depth of embedment.
- B. Arch and Total Concrete Encasement: Arch encasement is not required unless improper trenching or unexpected trench conditions require its use.
1. Include in locations indicated or where approved by Engineer to correct overwidth trench condition.
 2. Form to dimensions indicated or construct full width of trench.
 3. Start and terminate encasement at a pipe joint:
 - a. Exclude joints from encasement:
 - (1) Applies only to joints at either end of encasement.
 4. Install keyed construction joints coincident with pipe joints at 30- to 36-foot intervals. Provide separation of at least 75% of cross-section area at construction joints. Do not run horizontal steel through joint.
 5. Suitably support and block pipe to maintain position and prevent flotation.
 6. Place arch encasement promptly after installation of granular embedment.
 7. Protect against damage from heavy equipment with layer of earth. Use hand methods to a horizontal plane 12 inches above top of encasement.

C. Concrete Cradle:

1. Include in locations indicated and where designated by Engineer to reinforce unstable trench bottom.
2. Place on undisturbed trench bottom or on stabilized subbase.
3. Form to dimensions indicated or construct full width of trench.
4. Start and terminate concrete cradle at a pipe joint:
 - a. Exclude joints from cradle:
 - (1) Applies only to joints at either end of cradle.
5. Place without horizontal construction joints other than indicated.
6. Suitably support and block pipe to maintain position and prevent flotation.
7. Provide anchorage where indicated.

D. Pipe Embedment for Groundwater Barrier:

1. Include pipe embedment for groundwater barrier at intervals not to exceed 400 feet for pressure lines.
2. Use at impervious trench checks.
3. Shape trench bottom to fit the pipe and backfill throughout depth of trench with compacted impervious materials.
4. Soil shall be compacted to 95 percent of maximum density.

3.03. BACKFILLING:

A. Placement:

1. Complete promptly after Engineer approval to proceed:
 - a. Upon completion of pipe embedment.
 - b. Only after concrete encasement has obtained 70% of design strength. Determination of design-strength percentage obtained shall be as specified in DIVISION 3 – SECTION 03300.
2. Use hand methods to a horizontal plane 12 inches above top of pipe-barrel conduit or duct banks.
3. Use approved mechanical methods where hand backfill is not required.
4. Place in layers of thickness within compacting ability of equipment used.
5. Until compacted depth over conduit exceeds 3 feet, do not drop fill material over 5 feet. Then distance may be increased 2 feet for each additional foot of cover. Backfill conduit trenches in layers of 4 to 8 inches.

6. Compact to 80% of maximum density at optimum moisture.

B. Compacted Granular Backfill:

1. Compacted granular or flowable backfill shall be required for the full depth of the trench above the embedment and to within six inches of finish grade or subgrade of pavements in the following locations.
 - a. Where beneath pavements, driveways, curbs, parking lots, sidewalks.
 - b. Where in streets, roads, alleys or highway shoulders.
 - c. Where trench walls are within two feet of the back of the street curb.
2. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than 95 percent of maximum density at optimum moisture content as determined by ASTM D2167, ASTM D1557, or ASTM D2922.

3.04. TUNNEL (CASING) EXCAVATION: Pipelines shall be constructed in tunnels or bores in conformity with the following requirements.

A. Pipe Boring and Jacking:

1. Where designated on the drawings, the Contractor shall carry out underground excavations by tunneling, jacking, boring, or pilot hole reaming methods. Each method shall provide for removal of earth and rock coinciding with the installation of a smooth wall steel casing pipe.
2. Sections of the casing conduit in its final position shall be straight and true in alignment and grade as required by the drawings.
3. There shall be no void space between the earth and the outside of the casing. Any annular space between the casing and earth shall be pressure grouted with neat cement grout.
4. Shall be constructed in strict compliance with the requirements of the right-of-way owner.
5. Carrier Pipe shall be Ductile Iron or PVC as specified in SECTION 02615.
6. Carrier Pipe Spacers:
 - a. Shall be installed per the manufacturer's instruction, in a manner that there shall be no metallic contact between the casing and the carrier pipe.
 - b. Suitable thread lubricant shall be used on all stainless-steel fasteners to prevent galling.
 - c. The positioning of the spacer should ensure that the carrier pipe is adequately supported throughout its entire length.
 - d. Maximum spacing of the spacers shall be 5 feet with a maximum distance from female end of joint of 12 inches.
7. After the underground excavations are complete, the carrier pipe with casing spacers shall be pushed into place. All pipe joints shall be completed outside of the tunnel and inspected by the City before the carrier pipe is pushed into the casing.
8. End Seals:

- a. Both ends of each casing conduit shall be sealed with a minimum 1/8 inch thick pull-on synthetic rubber end seal.
- b. End seal shall be secured to the casing and carrier pipes with all stainless steel worm gear clamps.
- c. Lubricants approved by the end seal manufacturer may be used to aid in installation of the end seal.

B. Horizontal Directional Drilling (HDD):

1. Where designated on the drawings, the Contractor shall carry out underground excavations by HDD. HDD shall provide for removal of earth and rock coinciding with the installation of a restrained joint PVC water main as specified in Section 02615.
2. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. Existing utilities shall be located and exposed to determine depth if necessary.
3. There shall be no void space between the earth and the outside of the water main. Any annular space between the pipe and earth shall be pressure grouted with neat cement grout.
4. Shall be constructed in strict compliance with the requirements of the right-of-way owner.

3.05. FIELD QUALITY CONTROL:

- A. Concrete: Contractor shall test all concrete for use in encasements, cradles, and concrete cut-off walls to determine conformance with Specifications. Method of test shall be as specified in DIVISION 3 – SECTION 03300.

END OF SECTION 02222

SECTION 02605

MANHOLES, WETWELLS, LAMPHOLES, AND CLEANOUTS

PART 1 – GENERAL

1.01. SUMMARY:

- A. This Section includes the following structures and related appurtenances:
 - 1. Manholes.
 - 2. Pumping station wetwells.
 - 3. Lampholes
 - 4. Cleanouts
- B. Related Work Specified Elsewhere:
 - 1. Concrete: DIVISION 3.
 - 2. Submersible Wastewater Pumping Station: SECTION 11151.
 - 3. Wetwell Mounted Wastewater Pumping Station: SECTION 11152.
 - 4. Sanitary Sewer Pipe: SECTION 02610.
- C. See Standard Details for Manholes, Lampholes, and Cleanouts.

1.02. REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A48 - Gray Iron Castings.
 - b. C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - c. C478 - Precast Reinforced Concrete Manhole Sections.
 - d. C76 - Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
 - e. C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - 2. Federal Specification (FS):
 - a. SS-S-00210 - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.

PART 2 – PRODUCTS

2.01. MATERIALS:

- A. Concrete: Reinforced, 4000 psi. Conform to DIVISION 3.
- B. Castings:
 - 1. Manhole Steps.
 - a. Steel reinforced polypropylene plastic or rubber, M.A. Industries Model PS2-PF or equal as approved by the City.
 - 2. Manhole, lamphole, and cleanout frames and covers.
 - a. ASTM A48, Class 30B, pattern as specified for each structure under PART 3, this Section.
 - b. Interchangeable within same pattern, respectively.
 - 3. Conform to drawings in all essentials of design. Weight shall be within 10 percent of that listed for pattern.
 - 4. Machine-bearing surfaces to provide even seating.
 - 5. Coat with coal-tar pitch varnish.
- C. Mastic Gasket material shall meet FS SS-S-00210 and be K. T. Snyder “Ram-Nek” or equal.
- D. Coal tar coating shall be Kopper “Bitumasitc Super Service Black”, Porter “Tarmastic 103”, or Tnemec “Heavy Duty Black Series 46-449”.
- E. Flexible pipe connector shall meet the requirements of ASTM C923 and be A-Lok Products “A-Lok Compression Connector” or approved equal.

PART 3 - EXECUTION

3.01. MANHOLES:

- A. Design: Manholes shall have eccentric cone unless otherwise approved by City. Construction to conform to one of the acceptable alternatives described as follows:
 - 1. Precast manhole with cast-in-place base or precast concrete base.
 - a. Precast manholes shall conform to ASTM C478.
 - b. Minimum wall thickness equal to 1/12 of inside diameter plus one inch.
 - c. Precast cone section shall be eccentric.
 - d. Precast adjusting rings shall be provided with shear rings.
 - e. Precast manholes shall be provided with a double row of mastic gasket to seal joints between sections.

- f. When using precast manholes, drop connections must not enter the manhole at a joint.
 2. Cast-in-place reinforced concrete manhole.
 3. Conform to the Standard Construction Details.
 4. Submit compliance submittal for precast and cast-in-place reinforced concrete manholes prior to installation.
 5. Caulk and repair any leaks or remove entire work and rebuild to obtain watertight construction.
- B. Manhole Frames and Cover:
1. Type A frames and lids shall be installed in drainage area and shall be Neenah R-1916-F.
 2. Type B frames and lids shall be Neenah R-1642-A with self-sealing lid and concealed pick hole. Type B frames and lids shall be located in all areas except as specified in Item 1 and 3.
 3. Type C frame and lid shall be Neenah R-1642 with a non-rocking lid. Type C lids shall be used in all driving areas except those subject to frequent flooding.
 4. All frames should be set so that top of cover is two inches higher than finish grade or as directed by the City.
 5. Type A, B and C frames shall be anchored to the manhole by mastic gasket material.
- C. Connections:
1. Install all piping using an "A-Lok" flexible rubber entrance hole gasket joint.
 2. Provide stubouts, located to provide appropriate drop through manhole, for future connections where indicated.
 3. Place pipe stub in manhole wall with bell or coupling outside manhole wall to provide flexible joint.
 4. Include plug or stopper capable of withstanding 10 feet (4.3 psi) internal or external pressure without leakage for future connections.
 5. Connections of new pipe to existing structure shall be made with an "A-Lok" flexible connector. A-Lok connection shall be installed in strict conformance with manufacturer's recommendations.
- D. Invert Channels:
1. Form invert channel with 4000 psi Type II Portland cement concrete.
 2. Make changes in direction of flow with smooth curves of as large a radius as size of manhole permits.
 3. Make changes in size and grade smoothly and uniformly.

4. Slope floor of manhole adjacent to channels as indicated.
 5. Finish channel bottom smoothly without roughness, irregularity, or pockets.
 6. A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than one and eight tenths inch per foot (1.85 in/ft), or three inches (3") for a four foot (4') diameter manhole with an 8" sewer pipe. No pipe shall discharge onto the surface of the bench.
- E. Damp Proofing:
1. Apply 2 coats of coal tar coating to exterior walls, including bottom of the base, on all manholes from base to finish grade.
 2. Apply coating in two applications to minimum 15 mils dry film thickness per coat.
- F. Corrosion Protection for Manholes: Where corrosive conditions due to septicity or other causes are anticipated, corrosion protection on the interior of the manholes shall be provided.

3.02. PUMPING STATION WETWELLS:

- A. Design: Wetwells shall be precast concrete manholes with precast or cast-in-place concrete bases.
1. Precast manholes shall conform to ASTM C478.
 2. Minimum inside diameter 72 inches.
 3. Minimum wall thickness equal to 1/12 of inside diameter plus one inch.
 4. Precast manholes shall be provided with a double row of mastic gasket to seal joints between sections.
 5. Submit compliance submittal for wetwells prior to installation.
 6. Caulk and repair any leaks or remove entire work and rebuild to obtain watertight construction.
- B. Top:
1. Provide 12-inch thick flattop reinforced concrete wetwell top with opening for wetwell mounted pumping station or with embedded access hatch for submersible pumping stations.
- C. Bottom:
1. Provide cast-in-place or precast concrete bottom.
 2. Provide six inches of compacted granular fill beneath bottom.
 3. Provide concrete fill, on 1:1 slope, at bottom of wetwell to form wetwell bottom sump.

D. Connections:

1. Install all piping using an "A-Lok" flexible rubber entrance hole gasket joint.
2. Place pipe stub in wetwell wall with bell or coupling outside wetwell wall to provide flexible joint.

E. Waterproofing: Apply exterior waterproofing as specified for Manholes in this Section.

3.03. LAMPHOLES:

A. Design: Construction shall be in accordance with the following standards:

1. Lamphole pipe shall be 8-inch diameter PVC in accordance with Section 02610.
2. Lamphole shall be capped with 8" SDR 35 PVC gasket joint cap 3 inches below grade inside frame and cover.

B. Lamphole Frame and Cover:

1. Type A frames and lids shall be installed in drainage area and shall be Neenah R-1916-F.
2. Type B frames and lids shall be Neenah R-1642-A with self-sealing lid and concealed pick hole. Type B frames and lids shall be located in all areas except as specified in Item 1 and 3.
3. Type C frame and lid shall be Neenah R-1642 with a non-rocking lid. Type C lids shall be used in all driving areas except those subject to frequent flooding.
4. All frames should be set so that top of cover is two inches higher than finish grade or as directed by the City.
5. Type A, B and C frames shall be anchored to a minimum 6" thick, 24" internal diameter precast adjustment ring.

3.04. CLEANOUTS:

A. Design: Construction shall be in accordance with the following standards:

1. Cleanout pipe shall be the same diameter and material as the lateral line and shall be in accordance with Section 02610.
2. Cleanout frame and cover shall be cast into a 16" x 16" x 8" thick or 18" diameter by 8" thick concrete slab.

B. Cleanout Frame and Cover:

1. Frame and cover shall be East Jordan 1566Z. Lid shall have "Sewer" or "S" in the casting.

END OF SECTION 02605

SECTION 02610
SANITARY SEWER PIPE

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes all sanitary sewer pipe, fittings and specials.
- B. Related Work Specified Elsewhere:
 - 1. Pipe Installation and Testing: SECTION 02620.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. D 3034 - Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
 - b. D 2241 - Polyvinyl Chloride (PVC) Pressure Rated Pipe.
 - c. D1784 - Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
 - d. D2665 – Polyvinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
 - e. A746 - Ductile Iron Gravity Sewer Pipe.
 - 2. American Water Works Association (AWWA):
 - a. C110 - Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids.
 - b. C111 - Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Submit the following for acceptance prior to fabrication:
 - 1. Pipe and joint details.
 - 2. Special, fitting and coupling details.
 - 3. Laying and installation schedule.
 - 4. Manufacturer's design calculations.
- C. Certificates and Affidavits:

1. Submit as specified in DIVISION 1.
2. Furnish the following prior to shipment:
 - a. Affidavit of compliance with applicable standard.
 - b. Test certificates.

1.04 QUALITY ASSURANCE:

- A. Manufacturer:
 1. Experienced in the design, manufacture and commercial supplying of the specific material for a minimum period of three years.
 2. Experienced in the design, manufacture, and commercial supplying of the specific size of pipe for a minimum period of one year.
 3. Certify to above minimum experience requirements.

PART 2 - PRODUCTS

2.01 PIPE REQUIREMENTS:

- A. Furnish pipe of materials, joint types, sizes, and strength classes indicated or specified. Higher strengths may be furnished at Contractor's option. Furnish maximum pipe lengths produced by the manufacturer.
- B. Pipe shall be designed to withstand all stresses resulting from external loads including both earth load (120 lb/cu. ft.) and truck loads based on AASHTO H-20 truck (submit manufacturer's design calculations).
- C. Pipe Bedding: As specified.
- D. Pipe Marking:
 1. All pipe, fittings and specials shall be marked conforming to the applicable standard specification under which the pipe is manufactured and as otherwise specified.
 2. Mark field location of fittings and specials by station.
- E. Pipe Gaskets: All elastomeric gaskets and seals shall be synthetic rubber.
- F. Length of Pipe: Furnish in lengths of not less than 14 feet, except for fittings, closure pieces, and specials.

2.02 POLYVINYL CHLORIDE PIPE (PVC):

- A. Design and Manufacture of Pipe:
 1. PVC Pipe shall conform to ASTM D 3034, SDR 35 with minimum 46 psi stiffness rating for bury depths up to 10 feet.
 2. All materials used in the manufacture of pipe, fittings and accessories shall conform to ASTM D1784, Class 12454-B.

3. PVC Pipe shall conform to ASTM D3034. SDR 26 with minimum 46 psi stiffness rating for bury depths exceeding 10 feet.

B. Joints:

1. Provide push-on joints conforming to ASTM D 3212 with elastomeric seals conforming to ASTM F477.
2. Field cut joints and connections to other piping material shall be made with Can-Tex "C-T Adapters" with stainless steel bands.

2.03 DUCTILE-IRON PIPE:

A. Design and Manufacture of Pipe:

1. Ductile iron gravity sewer pipe shall conform to ASTM A746 except as otherwise specified.
2. With laying condition Type 5.
3. Use E' of 700 and bedding angle of 150 degrees.
4. With a maximum 5 percent design deflection for trench load calculations.
5. Net calculated thickness shall include standard casting tolerances plus 0.08-inch additional service allowance.
6. Select special class thickness next above total calculated thickness.

B. Dimensions:

1. The minimum pressure class for ductile iron pipe shall be 350 psi.

C. Joints:

1. Provide push-on joints conforming to AWWA C111 for all buried pipe unless otherwise specified or indicated.

D. Fittings:

1. Conform to AWWA C110 and be ductile iron.
2. Provide all specials, taps, and plugs as specified or indicated.

E. Lining:

1. Line all pipe, fittings and specials with Protecto 401 ceramic epoxy. Pipe shall be lined per the manufacturer's instructions by a certified installer.

F. Coating:

1. All pipe and fittings shall be coated with manufacturer's standard coating.

2.04 SEWER SERVICE LATERAL LINE:

- A. Shall be solid wall schedule 40 PVC pipe meeting requirements of ASTM D1784 and ASTM D2665 for 4" and 6" diameter pipe.

PART 3 – EXECUTION

3.01 INSTALLATION: Specified in SECTION 02620.

3.02 FIELD TESTING: Specified in SECTION 02620.

END OF SECTION 02610

SECTION 02615

PRESSURE PIPE

PART 1 - GENERAL

1.01. SUMMARY:

- A. This Section includes all pressure pipe, fittings, specials and appurtenances.
- B. Related Work Specified Elsewhere:
 - 1. Pipe Installation and Testing: SECTION 02620.
 - 2. Valves, Hydrants and Accessories: SECTION 02640.

1.02. REFERENCES:

- A. Applicable Standards:
 - 1. American Water Works Association (AWWA):
 - a. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - b. C115 – Flanged Ductile-Iron Pipe with Threaded Flanges.
 - c. C150 – Thickness Design of Ductile-Iron Pipe.
 - d. C151 – Ductile-Iron Pipe, Centrifugally Cast, for Water or Other liquids.
 - e. C153 – Ductile-Iron Compact Fittings, 3 Inches Through 16 Inches, for Water and Other Liquids.
 - 2. American Society for Testing and Materials (ASTM):
 - a. A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - b. D2241 – Polyvinyl Chloride (PVC) Pressure Rated Pipe.
 - 3. Steel Structures Painting Council (SSPC):
 - a. SP5 - White Metal Blast Cleaning.

1.03. SUBMITTALS:

- A. Submit as specified in DIVISION 1 – SECTION 01300.
- B. Submit the following for acceptance prior to fabrication:
 - 1. Pipe and joint details.
 - 2. Special, fitting and coupling details.
 - 3. Laying and installation schedule.

4. Specifications, data sheets and affidavits of compliance for protective shop coatings and linings.
 5. Manufacturer's design calculations.
- C. Certificates and Affidavits: Furnish the following prior to shipment:
1. Affidavit of compliance with applicable standard.
 2. Test certificates.
- 1.04. QUALITY ASSURANCE:
- A. Manufacturers shall be experienced in the design and manufacture of pipe, fittings, specials or appurtenances for a minimum period of 5 years.

PART 2 – PRODUCTS

2.01. PIPE REQUIREMENTS

- A. All proposed water mains shall be a minimum of 6-inches in diameter, constructed in a looped manner such that there are no dead end main water lines. A waiver from the City must be obtained if these conditions cannot be met.
- B. Furnish pipe of materials, joint types and sizes as indicated or specified.
- C. Pipe Marking: All pipe and fittings shall be marked conforming to the applicable standard specification under which the pipe is manufactured and as otherwise specified.
- D. All pipe, fittings, and appurtenances shall contain less than 0.25% lead calculated by weighted average.

2.02. DUCTILE-IRON PIPE:

- A. Design and Manufacture of Pipe:
1. Ductile-iron pipe shall conform to AWWA C150 and C151 except as otherwise specified.
 2. With laying condition Type 5.
 - a. Use E' of 700 and bedding angle of 150°.
 - b. 3% deflection limit.
 - c. Add service allowance and standard casting tolerances of AWWA C150.
 - d. Select standard pressure-class thickness or special thickness class next above total calculated thickness.
- B. Dimensions: The minimum thickness as defined by pressure class for mechanical or push-on-type joint ductile iron pipe shall be 350 psi.
- C. Joints:
1. Push-On:

- a. All pipe shall be provided with push-on joints unless otherwise noted.
- b. Manufacturers:
 - (1) U.S. Pipe and Foundry Company "Tyton".
 - (2) American Cast Iron Pipe Company "Fastite".
 - (3) James B. Clow & Sons "Bell-Tite".
- 2. Restrained:
 - a. Provide restrained joint pipe where required.
 - b. Provide restrained joints of following approved types:
 - (1) Restrained mechanical joint.
 - (2) Restrained push-on joint.
 - (3) Boltless or bolted ball and socket joint.
 - (4) Anchored couplings.
 - c. Joint restraint shall provide full circle contact and be EBAA Iron "Megalug" or equal.
- D. Fittings:
 - 1. Fittings shall conform to AWWA C110 or C153 and shall have a pressure rating of not less than that specified for pipe.
 - 2. Fittings shall be ductile iron.
 - 3. Fittings for pipe with mechanical joints shall have mechanical joints.
 - 4. Fittings for pipe with push-on joints shall have mechanical joints.
 - 5. Include all specials, taps, plugs, flanges and wall fittings as required.
- E. Lining:
 - 1. All pipe, fittings and specials for potable water service shall be cement lined in accordance with AWWA C104. Lining shall extend from edge of plain end to the gasket seat in the bell socket.
 - 2. All pipe, fittings and specials for sanitary sewer lines shall be lined with Protecto 401 ceramic epoxy. Lining shall be applied per manufacture's recommendations by a certified installer.
- F. Coating:
 - 1. All buried iron pipe and fittings shall be coated with manufacturer's standard bituminous coating.

2.03. POLYVINYL CHLORIDE (PVC) PRESSURE PIPE:

A. Design and Manufacture of Pipe:

1. PVC pipe for potable water service 6" to 12" in diameter shall be solid wall conforming to AWWA C900 with minimum wall thickness class DR 18 (235 psi).
2. PVC pipe for potable water service 14" to 24" in diameter shall be solid wall conforming to AWWA C905 with minimum wall thickness class DR 18 (235 psi).
3. PVC pipe for potable water service shall bear the National Sanitation Foundation seal for potable water.
4. PVC pipe for sanitary sewer pressure mains shall conform to ASTM D2241, pressure class 200 with thickness class of SDR 21.

B. Fittings:

1. Fittings shall be ductile iron and conform to AWWA C153.
2. Fittings shall be mechanical joint.
3. Fittings shall be pressure class 350 psi.
4. Fittings shall be coated and lined in same manner as pipe.

C. Joints:

1. Joints of PVC pipe to PVC pipe shall be push-on type and meet the requirements of ASTM D 2241.
2. Joints of PVC pipe to ductile iron shall meet the requirements of ANSI A21.11 and AWWA C111.
3. Gaskets shall be synthetic rubber and conform to ASTM F477.

2.04. RESTRAINED JOINT (RJ) POLYVINYL CHLORIDE (PVC) PRESSURE PIPE:

A. Design and Manufacture of Pipe:

1. RJ PVC pipe 6" to 24" shall be solid wall conforming to AWWA C900 with minimum wall thickness class DR 18 (235 psi).
2. RJ PVC Pipe shall bear the National Sanitation Foundation seal for potable water.
3. RJ PVC pipes shall be Lok-21 as manufactured by Diamond Plastics Corporation or approved equal.

B. Fittings:

1. Fittings shall be ductile iron and conform to AWWA C153.
2. Fittings shall be mechanical joint with a restraint device designed specifically for restraining PVC pipe to mechanical joints.
 - a. Restraint device shall be series 2000PV as manufactured by EBBA Iron, Ford Series 1500 Circle Lock, Star Series 4000 PVC Star Grip, or approved equal.
3. Fittings shall be pressure class 350 psi.

4. Fittings shall be coated and lined in same manner as pipe.

C. Joints:

1. Joints of PVC pipe to PVC pipe shall be a push-on type restrained joint. The restraint mechanism shall be located within the bell of the pipe. Exterior joint restraints that utilize couplings or splines; nuts, bolts, and torque wrenches will not be allowed.

2.05. WATER SERVICE LINE:

- A. A single service connection shall be provided for each lot between the water main and the meter setter. The service line shall be a minimum 1-inch diameter cross linked polyethylene 200 PSI, SDR-9, CTS-OD pipe meeting the requirements of AWWA C904.
- B. Service line fittings shall be as follows:
 1. Saddles: Brass, double strap A.Y. McDonald "Model 3855 AWWA" or equal with 1" minimum outlet.
 2. Corporation Stops: Ball type meeting requirements of AWWA C800, minimum working pressure 250 psi with AWWA tapered inlet threads.
- C. Coppersetter, Meter Pit and Cover: See Standard Construction Details.

2.06. GASKETS:

- A. Provide all gaskets, bolts, lubricant, and other accessories required to install pipe, fittings and specials complete and ready for service.

PART 3 - EXECUTION

3.01. INSTALLATION: Specified in SECTION 02620.

3.02. FIELD TESTING: Specified in SECTION 02620.

END OF SECTION 02615

SECTION 02620

PIPE INSTALLATION AND TESTING

PART 1 – GENERAL

1.01. SUMMARY:

A. This Section includes:

1. Handling, installation and testing of pipe, fittings, specials and appurtenances as indicated or specified.
2. Concrete anchor and thrust blocks.
3. Water service connections.

B. Related Work specified elsewhere:

1. Manholes and Wetwells: SECTION 02605
2. Sanitary Sewer Pipe: SECTION 02610
3. Pressure Pipe: SECTION 02615
4. Valves, Hydrants and Accessories: SECTION 02640.
5. Concrete: DIVISION 3 – SECTION 03300

1.02. REFERENCES:

A. Applicable Standards:

1. American Water Works Association (AWWA):
 - a. C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - b. C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - c. C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride Pressure Pipe and Fittings.
2. American Standard Testing and Materials (ASTM):
 - a. F1417 - Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.

1.03. DELIVERY, STORAGE AND HANDLING:

A. Handle in a manner to ensure installation in sound and undamaged condition.

1. Do not drop or bump.
2. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, linings and coatings.

B. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.

- C. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

PART 2 – PRODUCTS: Specified in respective Sections.

PART 3 – EXECUTION:

3.01. INSTALLATION - GENERAL:

- A. Utilize equipment, methods, and materials ensuring installation to lines and grades indicated.
 - 1. Maintain within tolerances specified or acceptable laying schedule.
 - a. Alignment: ± 1 inch per 100 feet in open cut or tunnel.
 - b. Grade: ± 1 inch per 100 feet.
 - 2. Do not lay on blocks unless pipe is to receive total concrete encasement.
 - 3. Accomplish horizontal and vertical curve alignments with bends, bevels, and joint deflections.
 - a. Limit joint deflection to one-half of manufacturer's recommended maximum.
 - b. Use short specials preceding curves as required.
 - c. Curvilinear alignment of sewers larger than twenty-four inches (24") (61 cm) may be considered on a case-by-case basis provided compression joints are specified and ASTM or specific pipe manufacturers' maximum allowable pipe joint deflection limits are not exceeded. Curvilinear sewers shall be limited to simple curves which start and end at manholes. When curvilinear sewers are proposed, the minimum slope must be increased to provide a minimum velocity of two feet (2') per second (0.6 m/s) when flowing full.
 - 4. Obtain acceptance of method proposed for transfer of line and grade from control to the work.
- B. Install pipe of size, materials, strength class, and joint type with embedment indicated or specified for plan location. Install pipe so that the identifying information printed on the pipe is turned right side up and visible from the top of trench. Pipe shall be carefully lowered into trench for installation to prevent damage to pipe.
- C. Commence laying at downstream end of line and install pipe with bell ends in direction of laying. Obtain approval for deviations therefrom.
- D. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during installation and at discontinuance of installation.
 - 1. Close open ends of pipe with snug-fitting closures.
 - 2. Do not let water control measures prove inadequate.
 - 3. Remove water, sand, mud and other undesirable materials from trench before removal of end cap.
 - 4. Contractor shall be responsible for keeping the interior of all pipelines clean and free of foreign matter until placed in operation.

- E. Brace or anchor as required to prevent displacement after establishing final position.
- F. Perform only when weather and trench conditions are suitable. Do not lay in water.
- G. Observe extra precaution when hazardous atmospheres might be encountered.
- H. Tracer Wire: All pressure pipe and water/sewer service lines shall be installed with a tracer wire to facilitate future location.
 - 1. Tracer wire shall be a #12 AWG (0.0808" diameter fully annealed, high strength solid copper clad steel conductor, HS-CCS), insulated with a 30 mil, high density, high molecular weight polyethylene (HDPE) insulation rated for direct burial use at 30 volts. HS-CCS conductor shall be at 21% conductivity for locate purposes and have a break load strength of 452 pounds. All wire splices shall be made with either rigid fittings or weatherproof connectors specifically designed for direct burial.
 - 2. Tracer wire for water mains shall be extended to the surface into valve boxes at each valve and fire hydrant isolation valve. Construct additional access points as described herein to obtain a maximum spacing of access points of 1000 feet.
 - a. An anode rod shall be placed in the trench at 1000 foot spacing and secured to the tracer wire.
 - 3. Tracer wire for water laterals shall be rigidly affixed to the water main's tracer wire with a 3-way direct bury waterproof connector and extended into the meter pit. A minimum of 2 foot of slack wire shall be required within the meter pit.
 - 4. Tracer wires for sewer laterals shall extend from an anode rod placed in the trench at the point of connection to the sewer main to the clean out. The tracer wire shall be extended with the cleanout to the surface and housed within the same protective enclosure as the clean out. A minimum of 2 foot of slack wire shall be required with the cleanout access.
 - 5. Tracer wires for all other pressure pipe shall be extended to the surface within a protective enclosure constructed out of a suitable length of 6-inch diameter class 200 PVC and a cast iron mushroom cap. This protective enclosure shall not be located within any driving or parking surface.
 - a. An anode rod shall be placed in the trench at 1000 foot spacing and secured to the tracer wire.
- I. Steep slope protection. Sewers on twenty percent (20%) slope or greater shall be anchored securely with concrete anchors or equal, spaced as follows:
 - 1. Not over thirty-six feet (36') (11 m) center-to-center on grades twenty percent (20%) and up to thirty-five percent (35%);
 - 2. Not over twenty-four feet (24') (7.3 m) center-to-center on grades thirty-five percent (35%) and up to fifty percent (50%);
 - 3. Not over sixteen feet (16') (4.9 m) center-to-center on grades fifty percent (50%) and over.
- J. High velocity protection. Where velocities greater than fifteen feet (15') per second (4.6 m/s) are attained, special provision shall be made to protect against displacement by erosion and impact.

3.02. JOINTING:

A. General Requirements:

1. Locate joint to provide for differential movement at changes in type of pipe embedment, impervious trench checks and structures.
2. Perform conforming to manufacturer's recommendations.
3. Clean and lubricate all joint and gasket surfaces with lubricant recommended by the pipe manufacturer.
4. Utilize methods and equipment capable of fully homing or making up joints without damage.
5. Check joint opening and deflection for specification limits.

B. Special Provisions for Jointing Ductile-Iron Pipe:

1. Conform to AWWA C600.
2. Visually examine while suspended and before lowering into trench.
 - a. Paint bell, spigot, or other suspected portions with turpentine and dust with cement to check for cracks invisible to the eye.
 - b. Remove turpentine and cement by washing when test is satisfactorily completed.

3.03. CUTTING:

A. Cut in neat manner without damage to pipe.

B. Observe Specifications regarding joint locations.

C. Cut cast-iron, ductile-iron, and steel pipe with carborundum saw or other acceptable method per manufacturer's instructions.

1. Smooth cut by power grinding to remove burrs and sharp edges.
2. Repair lining as required and approved.

D. Cut PVC pipe with a fine-toothed saw and mitre box or tube cutter. After cutting the end of the pipe shall be dressed to remove all roughness and sharp corners and beveled in accordance with the manufacturer's instructions.

3.04. CLOSURE PIECES:

A. Connect two segments of pipeline or a pipeline segment and existing structures with short sections of pipe fabricated for the purpose.

B. Observe Specifications regarding location of joints, type of joints, and pipe materials and strength classifications.

C. Field-fabricated closures, where required, shall be concrete encased between adjacent flexible joints.

D. May be accomplished with solid sleeve.

3.05. TEMPORARY PLUGS:

- A. Furnish and install temporary plugs at each end of work for removal by others when completed ahead of adjacent contract.
- B. Plugs:
 - 1. Test plugs as manufactured by pipe supplier.
 - 2. Fabricated by Contractor of substantial construction.
 - 3. Watertight against heads up to 20 feet of water or 150% of test pressure, whichever is greater.
 - 4. Secured in place in a manner to facilitate removal when required to connect pipe.

3.06. WATER SERVICE LINE:

- A. Water service line and tracer wire shall be installed from the water main to the coppersetter located within the meter box for each service connection. All service lines shall be bedded in conformance with SECTION 02222.
- B. Connect water service line to main line in accordance with the Standard Construction Details in a location approved by the City.
- C. Install meter box, lid, and coppersetter in accordance with the Standard Construction Details in a location approved by the City.

3.07. CONNECTIONS TO EXISTING STRUCTURES:

- A. Connect pipe to existing structures and pipelines where indicated.
- B. Prepare structure by making an opening with at least three inches clearance all around fitting to be inserted or as indicated.
- C. Observe pertinent articles of Specifications pertaining to joint locations and closures.
- D. Repair wall opening with non-shrinking grout or as indicated.
- E. Connections of new sanitary sewer pipe to existing manholes shall be made with a field cast A-Lok flexible connection.

3.08. POLYETHYLENE ENCASEMENT:

- A. Encase pipe, fittings, valves and other appurtenances with polyethylene film as indicated or specified.
- B. Materials:
 - 1. Polyethylene material shall be as follows:
 - a. Conform to AWWA C105.
 - b. Class C (Black).
 - 2. Adhesive tape shall be as follows:

- a. Approximately two inches wide and plastic backed.
- b. Capable of bonding securely to metal surfaces and/or polyethylene material.
- c. Polyken No. 900, Scotchrap No. 50.

C. Installation:

- 1. Conform to AWWA C105.
- 2. Use adhesive tape to fasten polyethylene film in place.
- 3. Minimize exposure of polyethylene film to sunlight.
- 4. Wrap pipe, valves, fittings and couplings per AWWA C105 installation standards.

3.09. CONCRETE ANCHOR AND THRUST BLOCKS:

- A. Install at tees, elbows, bends, and dead ends where indicated.
- B. Place against undisturbed earth or rock.
- C. Of design indicated or specified.
 - 1. Removable thrust blocks shall be constructed by utilizing a sheet of 1/4-inch plywood to prevent concrete adherence to pipe, fittings or accessories.
 - 2. Apply two coats of coal tar coating to minimum 20 mils dry film thickness on anchor bars, straps and hardware.

3.10. SEWER SERVICE CONNECTIONS:

- A. Install one sewer service connection complete with tracer wire, at locations indicated on the drawings for connection of building lateral to main sewer.
- B. Sewer service lateral connections shall be compression type service saddles (Romac or Ford) and shall be purchased from the City of Cassville. Coordinate location of all service connections with the City of Cassville.
- C. Install lateral and tracer wire in accordance with the Standard Construction Details.
- D. Provide bell, with removable plug, at end of service lateral if not immediately connecting to existing building lateral line.

3.11. SEPARATION OF WATER MAINS WITH SANITARY AND STORM SEWERS:

- A. Horizontal Separation:
 - 1. Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary or storm sewer line. The distance shall be measured edge to edge.

2. If local conditions prevent a horizontal separation of 10 feet, a water main may be laid closer than 10 feet to a sanitary or storm sewer or forcemain provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer line and at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer line. In areas where the recommended separation cannot be obtained, the sewer line shall be constructed of ductile iron pipe (DIP) with slip-on or mechanical joints or the sewer line continuously encased and be pressure tested to 150 psi to ensure water tightness.

B. Vertical Separation:

1. Where water mains cross sanitary or storm sewers or forcemains, the water main shall be laid to provide a minimum vertical separation of 18 inches between the outside of the water main and the outside of the sewer line. This shall apply whether the water main is above or below the sewer line or forcemain.
2. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than 10 feet. Where a water main crosses under a sewer or forcemain, adequate support shall be provided under the sewer or forcemain to maintain line and grade. In other areas where the recommended separation cannot be obtained, one of the following methods must be required:
 - a. The sewer or forcemain shall be constructed equal to the water pipe and be pressure tested to 150 psi in accordance with Part 3.12 Field Testing, this Section.
 - b. Either the water line or sewer line (and forcemain) shall be continuously encased or enclosed in a watertight carrier pipe which extends ten feet (10') on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall meet the requirements contained in SECTION 02615.

C. Special Conditions:

1. No waterline shall be located closer than 25 feet to any on-site disposal facility, agricultural waste facility or landfill.
2. Waterlines which cross surface waterways shall meet the requirements of Section 8.7 of Missouri Department of Natural Resources "Minimum Design Standards for Missouri Community Water Systems".
 - a. A stream crossing gate valve and meter, as shown on the Standard Construction Details, shall be installed on both sides of the stream crossing so that the crossing can be isolated for testing or repair.
 - b. Stream crossing gate valve and meter assembly shall be located in an easily accessible location that is not subject to flooding.
 - c. After completion of the stream crossing, the stream banks shall be protected from erosion by placement of stone rip rap or City approved alternative.

D. Construction Materials for Stream Crossings:

1. Materials: Sewers entering or crossing streams shall be constructed of ductile iron pipe with mechanical joints; otherwise, they shall be constructed so they will remain watertight and free from changes in alignment or grade. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.

2. Siltation and erosion: Construction methods that will minimize siltation and erosion shall be employed. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers in or near streams. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping silt laden water into the stream. Specifications shall require that clean-up, grading, seeding, planting, or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven (7) days.
3. Aerial Crossings:
 - a. Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning, and settlement.
 - b. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize frost heaving.
 - c. For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the fifty (50)-year flood.
 - d. Aerial crossings shall be constructed of ductile-iron pipe with mechanical joints; otherwise, they shall be constructed so that they will remain watertight and free from changes in alignment or grade.
4. Sewer outfalls, headwalls, manholes, gate boxes, or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.

3.12. FIELD TESTING:

A. Acceptance Tests for Gravity Sanitary Sewer:

1. General:
 - a. All sewers shall be visually inspected, mandrelled and tested for infiltration and exfiltration.
 - b. Exfiltration testing shall be achieved by a low-pressure air leakage test.
 - c. The Contractor shall furnish all labor, equipment, tools and materials and shall perform all acceptance tests.
 - d. All tests shall be witnessed and recorded by City Personnel.
2. Alignment:
 - a. Sewer shall be inspected (lamped) by flashing a light between manholes or by physical passage where space permits.
 - b. Contractor shall clean pipe of excess mortar, joint sealant and other dirt and debris prior to inspection.
 - c. Determine from Lamping or Physical Inspection:

- (1) Presence of any misaligned, displaced, or broken pipe.
- (2) Presence of visible infiltration or other defects.
- d. Correct defects as required prior to conducting leakage tests.
- 3. Leakage Tests: The leakage tests shall be performed on the full length (manhole to manhole) of all sewer lines prior to acceptance.
 - a. Air leakage testing. The Contractor shall perform low pressure air testing of the sewer lines for exfiltration testing. Air testing shall comply with ASTM F1417.

The general testing procedure shall be as follows: Raise pressure to 4.0 psi in sections being tested, throttle the air supply to maintain between 4.0 and 3.5 psi for at least 2 minutes in order to allow equilibrium between air temperature and pipe walls to be obtained. After temperature has stabilized, allow the pressure to decrease to 3.5 psi. At 3.5 psi begin timing to determine the time required for pressure to drop to 2.5 psi. If the time for the air pressure to decrease from 3.5 to 2.5 psi is greater than that shown in the table below, the pipe shall be presumed free of defects.

<u>Pipe Size (in.)</u>	<u>Required Time for Length (min:sec)</u>			
	<u>100 L.F.</u>	<u>200 L.F.</u>	<u>300 L.F.</u>	<u>400 L.F.</u>
8	7:34	7:34	7:36	10:08
10	9:26	9:26	11:52	16:49
12	11:20	11:24	17:05	22:47
15	14:10	17:48	26:42	35:36
18	17:00	25:38	38:27	51:16
21	19:50	34:54	62:21	69:48

If air test fails to meet above requirements, repeat test as necessary after all leaks and defects have been repaired.

In areas where ground water is known to exist, increase the test pressure by 0.43 psi for each foot of depth that the ground water is above the top of the pipe.

- b. Manhole Testing: The Contractor shall perform a vacuum exfiltration test on each manhole. Vacuum testing equipment shall be as manufactured by Cherne Industries, P.A. Glazier, Inc. or approved equal.

Vacuum testing shall be conducted following manhole construction, including connection to piping and setting of the lid and frame. No grout shall be placed in horizontal joints until manhole has passed the vacuum test. All lifting holes shall be grouted. Manholes which fail the test shall be reconstructed as required to adequately seal the manhole. Grouting of leak from the interior or exterior will not be acceptable.

Plug all pipes entering manhole. Securely brace all plugs as required. Install testing lead in manhole frame and inflate seal in accordance with manufacturer's recommendation. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With all valves closed, measure the time required for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time is greater than 120 seconds for a 48-inch diameter manhole and 150 seconds for a 60-inch diameter manhole.

If manhole fails the test, perform necessary repairs and retest until an acceptable test meeting the above requirement is achieved.

4. Mandrel Testing:

- a. Mandrel testing shall not be conducted prior to 30 days after backfilling is complete.
- b. Each reach of PVC gravity sewer shall be checked for excessive deflection by pulling a mandrel through the pipe.
- c. Mandrel shall be provided by Contractor.
- d. The rigid ball or mandrel used for the deflection test shall have a diameter not less than ninety-five percent (95%) of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM specification, including the appendix, to which the pipe is manufactured. The test shall be performed without mechanical pulling devices. A mandrel must have nine (9) or more odd number of flutes or points.
- e. Pipe with diametral deflection exceeding 5 percent shall be uncovered and the bedding and backfill replaced to prevent excessive deflection.
- f. Repaired pipe shall be retested after repair.
- g. Contractor shall submit all deflection test results to the Engineer.

B. Acceptance Tests for Pressure Pipelines:

- 1. Perform hydrostatic pressure and leakage tests.
 - a. Conform to the procedures described in AWWA C600 or AWWA C605 depending on the type of pressure pipeline installed, Ductile Iron or PVC, respectively.
 - (1) As modified herein.
 - (2) Conform to AWWA C600 procedures for all other pipe material specified.
 - b. Perform after backfilling but prior to the placement of permanent surfacing.
- 2. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs.
 - a. Contractor shall furnish and install test plugs.
 - (1) Including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs. Bracing against structure walls is not allowed.
 - (2) Be responsible for any damage to public or private property caused by failure of plugs.
- 3. Limit fill rate of line to available venting capacity. Fill rate shall be regulated to limit velocity in lines when flowing full to not more than 1 fps.
 - a. All air shall be expelled from the pipeline prior to testing by use of air release valves, hydrants, or taps. Taps shall be plugged after testing is completed.
- 4. Contractor shall make arrangements with utility owner for water required for testing at lowest rate step.

5. Pressure and Leakage Test:

- a. Test pressure shall not be less than 125 psi at the highest point along the test section. However, in no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.
- b. Be at least two-hour duration. Maintain pressure throughout test to within ± 5 psi of test pressure.
- c. Leakage test shall be conducted concurrently with the pressure test by utilizing a hand or motorized pump equipped with a shut-off valve, pressure relief valve, pressure gauge (for line pressure), and graduated tank for measurement of water loss.
- d. Leakage shall be defined as the quantity of water that must be supplied into the new pipeline section (makeup water) to maintain pressure within five (5) psi of the specified test pressure.
- e. Acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

L = maximum permissible leakage (makeup water), in gallons per hour.

S = length of pipe tested, in feet.

D = nominal diameter of pipe, in inches.

P = average test pressure during the hydrostatic test, in pounds per square inch (gauges)

- f. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr./in. of nominal valve size shall be allowed.
- g. When hydrants are in the test section, the test shall be made against the closed hydrant.
- h. Repeat test as necessary.
 - (1) After location of leaks and repair or replacement of defective joints, pipe, fittings or valves. All visible leaks are to be repaired regardless of the amount of leakage.
 - (2) Until satisfactory performance of test.
- i. Engineer and City shall witness pressure and leakage test.

END OF SECTION 02620

SECTION 02640

VALVES, HYDRANTS AND ACCESSORIES

PART 1 – GENERAL

1.01. SUMMARY:

- A. This Section includes all valves and accessories.
- B. Related Work Specified Elsewhere:
 - 1. Pipe Installation and Testing: SECTION 02620.
- C. Refer to Standard Construction Details for Fire Hydrant and Valve Installation.

1.02. REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A126 – Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - b. A276 – Specification for Stainless and Heat Resisting Steel Bars and Shapes.
 - c. A536 – Ductile Iron Castings.
 - d. A564 – Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat Resisting Steel Bars, Wire, and Shapes.
 - 2. American Water Works Association (AWWA):
 - a. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - b. C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.
 - c. C502 – Dry Barrel Fire Hydrants.
 - d. C515 – Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service.

1.03. SUBMITTALS:

- A. Submit as specified in DIVISION 1 – SECTION 01300.
- B. Include, but not limited to, the following:
 - 1. Catalog data or illustrations showing principal dimensions, parts and materials.
 - 2. Spare parts list referenced to illustration of parts.
 - 3. Assembly and disassembly or repair instructions.
 - 4. Dimensions of the clearance required for butterfly valve discs.

C. Certificates and Affidavits: Furnish prior to shipment. Include the following:

1. Test certificates.
2. Affidavit of compliance with applicable AWWA Standard.

1.04. QUALITY ASSURANCE:

- A. Manufacturers shall be experienced in the design and manufacture of specific valves and accessories for a minimum period of 5 years.

1.05. DELIVERY, STORAGE, AND HANDLING:

- A. Ship all valves with suitable end covers to prevent entrance of foreign material into valve body.
- B. Protect valves from damage.

1.06. WRENCH NUTS:

- A. Two-inch square wrench nuts shall be provided on all buried valves.
- B. All wrench nuts shall comply with Section 4.4.13 of AWWA C500.
- C. Contractor shall provide two operating keys (T-bars) for operation of the wrench nuts.

1.07. ROTATION:

- A. Direction of rotation of the wrench nut to open the valve shall be to the left (counterclockwise).
- B. Each valve body shall have cast thereon the word "OPEN" and an arrow indicating the direction to open.

1.08. ENDS:

- A. All 3-inch or larger buried valves shall have mechanical joint ends unless otherwise specified.
- B. All 2-1/2 inch or smaller valves shall have threaded ends.
- C. Mechanical joints shall conform to ANSI A21.11.

PART 2 - PRODUCTS

2.01. GATE VALVES:

- A. Acceptable Manufacturers:
 1. American AVK, "Series 65".
- B. All gate valves shall conform to AWWA C515 with design working pressure of 250 psi.
- C. All gate valves shall be resilient seated wedge type.
- D. All gate valves shall be non-rising stem type with "O"-ring seals.
- E. All gate valves shall be mounted horizontal with operator in the vertical position.

- F. All gate valves shall have Romac Alpha restrained joint connections as made by American Flow Control.

2.02 ECCENTRIC PLUG VALVES:

A. Acceptable Manufacturers:

1. DeZurik.
2. Henry Pratt Company.
3. Keystone Valve.

B. Design:

1. Quarter-turn nonlubricated eccentric type with resilient faced plug. Valves with vane type seat rings are not acceptable. Shutoff up to specified rating with pressure in reverse direction.
2. Flanged valve ends shall be faced and drilled to conform to ANSI B16.1, Class 125 for thickness and drilling.
3. Mechanical or push-on type rubber-gasketed joint ends shall conform to AWWA C111.
4. Port areas of valves shall be at least 80% of full pipe area.
5. Plugs shall be eccentric type with no backing ring or frame.
6. Valve body cavity shall be smooth without protrusions or baffles.

C. Materials and Construction:

1. Bodies shall be of ASTM A126, Class B cast iron or ductile iron, ASTM A536.
2. Valve plug shall be ASTM A126, Class B cast iron or ASTM A536 ductile iron. Resilient plug facing or replaceable style body seats shall be neoprene or Buna N compound suitable for use with water and wastewater applications.
3. Seat rings shall be threaded, or welded or corrosion-resistant 18-8 stainless steel, nickel or Monel conforming to AWWA C504. Sprayed or plated mating seat surfaces are not acceptable.
4. Bearings shall be replaceable. Sleeve type and thrust bearings in the upper and lower journals shall be corrosion-resistant stainless steel or TFE.
5. Shaft seals shall be multiple O-ring or self-adjusting U-cup or chevron type packing conforming to AWWA C504. Pull-down packing is not acceptable.
6. Shaft seals shall be field adjustable or replaceable under pressure and without valve assembly.
7. All exposed fastening hardware shall be zinc plated or stainless steel.

D. Actuators:

1. Manual Actuators:

- a. All valves shall open counter clockwise.
 - b. Provide indicators to show position of plug except on buried actuators.
 - c. Nut operators shall be AWWA 2-inch size for operation by valve key and wrench head lever. Furnish one lever for each valve.
 - d. Total enclosed operator shall be provided on all 8-inch and larger valves.
- E. Testing: Furnish certified copies of results of tests prior to shipment. All valves shall be subjected to an AWWA C504 procedure cycle life and pressure leak test at 150 psi and a body hydrostatic test at 300 psi. Valves shall be capable of providing drip-tight shutoff up to the full leak test rating. Certify reverse pressure capacity.

2.03 CHECK VALVES:

A. Acceptable Manufacturers:

- 1. American Valve and Hydrant.
- 2. Dresser.
- 3. Mueller.

B. Check valves for sewage pump discharges 4-inch and larger shall be of the unobstructed waterway, quick closing, spring-loaded, external lever arm, horizontal swing type with iron body, flanged ends and bronze trim.

C. Hing pins shall be stainless steel with both ends extending through bronze-bushed bearings and outside stuffing boxes with grease lubricated packing or O-ring seals.

D. Flanges shall be flat-faced with ANSI B16.1, Class 125 diameter drilling.

2.04. FIRE HYDRANTS:

A. Acceptable Manufacturer:

- 1. American-Darling, "Model B-84-B-5".

B. Fire hydrants shall conform to AWWA C502, Standard for dry-barrel fire hydrants.

C. Fire hydrant shall have a nominal 5-1/4 inch main valve with 6 inch Romac Alpha restrained joint inlet connection as made by American Flow Control.

D. Outlet nozzles shall be National (American) fire hose coupling screw threads and be as follows:

- 1. Two – 2-1/2 inch hose nozzles.
- 2. One – 4-1/2 inch pumper nozzle.

E. Main valve shall be equipped with "O"-ring seals and shall open to the left (counterclockwise).

F. Fire hydrant shall be of the break-flange safety-top type.

2.05. TAPPING SLEEVE AND ISOLATION VALVE:

- A. Tapping Sleeve shall be 18-8 type 304 stainless steel with 360° gasket and removable bolts.
- B. Tapping Sleeve outlet flange shall be machined for mating with isolation valve.
- C. Tapping Sleeve shall be Ford Style FTSS with stainless steel bolts or similar products from Smith-Blair, Mueller, JCM, or Romac.
- D. Isolation Valve shall meet the requirements of gate valves section above, except as modified, herein.
- E. Valve shall be Flanged x Mechanical Joint end.
- F. Valve shall have an oversized seat opening to allow entry of the tapping machine cutters and permit full diameter cuts.

2.06. VALVE BOXES:

- A. Acceptable Manufacturers:
 - 1. Clay and Bailey Manufacturing Company.
 - 2. Clow Corporation.
 - 3. Dresser Industries, Inc.
 - 4. Mueller Company.
 - 5. Neenah Foundry Company.
 - 6. Tyler Company.
- B. Provide for all buried valves.
- C. Design:
 - 1. Boxes shall be three-piece cast-iron slide type with 5-1/4-inch shaft.
 - 2. Provide extension stem to bring operating nut within 3 feet of valve box top.
 - 3. Drop cover shall be marked "WATER".

2.07. SHOP PAINTING:

- A. Prepare surfaces and paint or coat all valves, fire hydrants, valve boxes, corporation stops, and all related accessories standard of the manufacturer unless otherwise indicated or specified herein.
- B. Paint and coatings shall be suitable for the service intended.
- C. Submit type of paint or coating proposed with drawings and data prior to fabrication.

2.08. FLUSH HYDRANTS

A. Acceptable Manufactures

1. Eclipse No. 2 by John C. Kupferle Foundry Company.
2. Model A-411 Post Type Hydrant by Mueller Company.

B. Design

1. Provide with self-draining, non-freezing compression type.
2. Single hose nozzle shall be 2-1/2" IP.

2.09. BACKFLOW PREVENTER

A. Acceptable Manufacturers

1. Watts Double Check Detector Assembly or Approved Equal.
2. Four (4) Inch and larger Backflow Assemblies shall be located in a concrete vault on private property and as close to the water main as is practical.

PART 3 – EXECUTION

3.01. INSTALLATION:

- A. Comply with provisions of AWWA C600 and as specified.
- B. Thoroughly clean and remove all shipping materials prior to setting. Operate all valves from fully opened to totally closed.
- C. Gate valves shall be located at not more than 500-foot intervals in commercial districts and at not more than every block (800-feet) in residential or other districts. Gate vales shall also be located at every water main branch on both the feeder main and the branch line.
- D. Set fire hydrants with lowest nozzle at least 18 inches above finished grade but no more than 24-inches above finished grade. Check and fill stem bonnet lubricant reservoir.
 1. Hydrants shall be set so that the pumper nozzle faces the curb.

3.02. FIELD TESTING:

- A. Perform on piping and valves as specified in SECTION 02620.

END OF SECTION 02640

SECTION 02675
DISINFECTION OF PIPING

PART 1 – GENERAL

1.01. SUMMARY:

- A. This section covers disinfection of potable water piping with a strong chlorine solution.
- B. Disinfecting may be performed concurrently with pressure and leakage testing or after pressure and leakage testing at the Contractor's option.
- C. All necessary disinfection equipment and materials shall be provided by the Contractor.
- D. Related Work Specified Elsewhere:
 - 1. Pipe Installation and Testing – SECTION 02620.
- E. Disinfection work shall conform to the requirement of the latest version of AWWA C651, Standard for Disinfecting Water Mains as modified herein.

1.02. REFERENCES:

- A. Applicable Standards:
 - 1. American Water Works Association.
 - a. C651 – Standard for Disinfecting Water Mains.
 - b. B301 – Standard for Liquid Chlorine.
 - c. B300 – Standard for Hypochlorites.

1.03. SUBMITTALS:

- A. Submit as specified in DIVISION 1 – SECTION 01300.
- B. Includes, but not limited to the following:
 - 1. Product data: Manufacturer's technical data, specification, safety precautions for chlorine products.
 - 2. Results of bacteriological testing on each section of pipe.

PART 2 – PRODUCTS

2.01. CHLORINE:

- A. Calcium Hypochlorite – 70 percent available chlorine.
- B. Liquid Chlorine – 99.5 percent available chlorine.

PART 3 – EXECUTION

3.01. PIPE LAYING:

- A. Calcium hypochlorite granules shall be placed in pipe sections during construction.
- B. Granules (1/2 ounce) shall be placed at upstream end of the first section of pipe, at the upstream end of each branch line, and at 500-foot intervals. Granules shall not be placed in solvent welded PVC pipe.

3.02. FLUSHING:

- A. All water lines shall be thoroughly flushed prior to disinfection at a velocity of not less than 3.0 feet per second. The following table indicates the approximate flow rates required to produce a velocity of 3.0 fps in pipes.

<u>Pipe Diameter (in.)</u>	<u>Flow Rate (gpm)</u>
4	120
6	260
8	470
10	730
12	1,060
16	1,880

- B. Contractor shall verify that discharge points have adequate drainage to prevent flooding of surrounding area. Location of discharge point shall be approved by the City.
- C. Flushing shall continue until discharge stream is visibly clean (clear) or three pipe volumes have been replaced, whichever is greater.

3.03. FEEDING:

- A. Chlorine gas shall be used only as a solution. Introduction of chlorine gas into pipeline directly will not be permitted. Proper feeding operation shall utilize a chlorinator and booster pump with injector.
- B. Calcium hypochlorite shall be made into a solution and pumped into the pipeline with a suitable chemical feed pump.
- C. Feed chlorine solution at a point no more than 10 feet downstream from the beginning of the new pipeline.

3.04. APPLICATION:

- A. Pipeline shall be disinfected by the continuous feed method.
- B. Required chlorine to produce an initial 25 milligrams per liter concentration in 100 feet of pipe by diameter shall be as follows:

<u>Pipe Diameter (in)</u>	<u>100% Chlorine (lb)</u>	<u>1% Chlorine Solution (gal)</u>
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60

- C. Water from the existing distribution system shall be introduced at a constant measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine which is fed at a constant measured rate.
1. The chlorine feed shall be proportioned to the rate of water flow into the pipeline so that the entering water contains at least 25 mg/L of available chlorine. Chlorine application shall be continuous until the entire pipeline is filled with the chlorine solution.
 2. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the latest edition of Standard Methods for the Examination of Water and Wastewater or AWWA Manual M12 or using appropriate chlorine test kits.
 3. Amount of chlorine required for each 100 feet of pipe of various diameters is indicated in Part 3.04.B, this section. Solutions of 1 percent chlorine shall be prepared with calcium hypochlorite by mixing one pound of calcium hypochlorite with 8 gallons of water.
 4. During the application of chlorine, valves shall be positioned to prevent chlorine solution from flowing back into the line supplying the water. The chlorinated water shall be retained in the pipeline for at least 24 hours, during which time all valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. At the end of the 24-hour period, the treated water in all portions of the pipeline shall have a residual of not less than 10 mg/L of free chlorine.

3.05. FINAL FLUSHING:

- A. After the applicable retention period, heavily chlorinated water shall be flushed from the pipeline until chlorine residual is no higher than that generally prevailing in the system.
- B. Apply a chlorine reducing agent to the water to be wasted to neutralize the chlorine residual.

3.06. BACTERIOLOGICAL TEST:

- A. After final flushing and before the water main is placed in service, samples shall be collected from the main and be tested for bacteriological quality in accordance with the Standard Methods for the Examination of Water and Wastewater and shall show the absence of coliform organisms.
 1. At least two (2) samples shall be taken from each sampling point with 24 hours of separation between samples. Both sets of samples shall show the absence of coliform organisms.
 2. Samples points shall be as follows:
 - a. At 1200-foot intervals along the water main.
 - b. At the end of the water main.
 - c. At the end of each branch water main.
- B. No hose or fire hydrant shall be used in collection of samples. A corporation cock may be installed in the main with a copper-tube gooseneck assembly for collecting samples. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

3.07. RE-DISINFECTION (REPETITION):

- A. If the initial disinfection fails to produce two successive satisfactory bacteriological samples, the water main shall be re-chlorinated by the continuous-feed method of chlorination until two successive satisfactory results of the bacteriological testing are obtained.

END OF SECTION 02675

SECTION 02831

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01. SUMMARY:

- A. This Section includes chain-link fabric fence, gates, and related components.
- B. Related Work Specified Elsewhere:
 - 1. Concrete: DIVISION 3.

1.02. REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
 - b. A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. A392 - Zinc-Coated Steel Chain-Link Fence Fabric.
 - d. A491 - Aluminum-Coated Steel Chain-Link Fence Fabric.
 - e. A569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
 - f. B211 - Aluminum-Alloy Bar, Rod, and Wire.
 - g. B211 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.
 - h. F668 - Polyvinylchloride (PVC)-Coated Steel Chain-Link Fence Fabric.
 - i. F669 - Strength Requirements of Metal Posts and Rails for Industrial Chain-Link Fence.
 - j. F1083 - Pipe, Steel, Hot Dipped, Zinc-Coated (Galvanized) Welded, for Fence Structures.

1.03. SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Includes, but not limited to, the following:
 - 1. Product data: Manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, and accessories.
 - 2. Shop Drawings: Showing layout, location of fence, gates, posts, and including details illustrating fence height, sizes of posts, rails, braces, gates, hardware list, and accessories.

3. Mill certification that materials meet specifications of member size, strength, wall thickness, and coatings.

1.04. QUALITY ASSURANCE:

- A. Provide chain-link fences and gates as complete units, including necessary erection accessories, fittings, and fastenings, from a single source or manufacturer.

PART 2 - PRODUCTS

2.01. ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following:

1. Galvanized Steel Fencing and Fabric:

- a. Allied Tube and Conduit Corp.
- b. Anchor Fence, Inc.
- c. Cyclone Fence, USK Corp.

2.02. GENERAL:

- A. Fence height and gate width(s) shall be as indicated.
- B. Dimensions indicated for pipe, roll-formed, and H-sections are outside dimensions, exclusive of coatings.

2.03. FABRIC:

- A. Steel Fabric:

1. No. 9 gauge, 2-inch diamond-mesh steel, chain-link fabric. Furnish 1-piece fabric widths for fencing up to 12'-0" high.
2. Galvanized: Conform to ASTM A392 with zinc coating, Class 2, 2.0 ounces minimum per square foot of wire surface.
3. Top and bottom selvage knuckled for fabric 5'-0" and under.

2.04. FRAMING AND ACCESSORIES:

- A. Steel Framework:

1. General: Galvanized steel, ASTM F1083 or ASTM A123, with not less than 1.8-ounce zinc per square foot of surface, or steel conforming to ASTM A569 externally triple-coated with hot-dip galvanizing at 1.0 ounce/square foot, chromatic conversion coating and clear acrylic polyurethane and coated internally with zinc-rich coating.
2. Fittings and Accessories: Galvanized, ASTM A153, with zinc weights per Table I.

2.05. STEEL POSTS, TOP RAIL AND BRACES:

- A. Minimum size and weight of steel components shall be as follows:

1. Posts for Fabric Height Over 6 Feet:
 - a. End, Angle, Corner, or Pull Posts: 2.875 inches outside diameter at 5.79 pounds per foot.
 - b. Line Posts - 6-Foot to 8-Foot Fabric Height: 2.375 inches outside diameter at 3.65 pounds per foot.
 - c. Line Posts - Over 8-Foot Fabric Height: 2.875 inches outside diameter at 5.79 pounds per foot.
 - d. In lieu of pipe specified above, steel pipe conforming to ASTM A569 of greater strength but less wall thickness, will be acceptable.
2. Posts for Fabric Height 6 Feet or Less:
 - a. End, Angle, Corner, or Pull Posts: 2.375 inches outside diameter at 3.65 pounds per foot.
 - b. Line Posts: 1.90 inches outside diameter at 2.70 pounds per foot.
 - c. In lieu of pipe specified above, steel pipe conforming to ASTM A569 of greater strength but less wall thickness, will be acceptable.
3. Gate Posts:
 - a. Furnish posts for supporting single-gate leaf, or one leaf of a double-gate installation, for nominal gate widths as follows:

<u>Leaf Width</u>	<u>Gate Post</u>	<u>lbs./lin. ft.</u>
Up to 6'	3.5" x 3.5" roll-formed section or	4.85
	2.875" outside diameter pipe	5.79
Over 6' to 13'	4.000" outside diameter pipe	9.11
4. Top Rail:
 - a. 1.660 inches outside diameter at 2.27 pounds per foot.
 - b. 18-foot minimum length of each section.
 - c. Expansion-type couplings for each joint, approximately 6 inches long.
5. Post Bracing:
 - a. Diagonal adjustable rods 3/8 inch in diameter equipped with adjustable tightener.
 - b. Horizontal Braces: 1.660 inches outside diameter at 2.27 pounds per foot.
6. Post Tops:
 - a. Designed as a weather tight closure cap for tubular posts.
 - b. Furnish caps with openings to permit passage of top rail.
 - c. Malleable iron or pressed steel.

7. Stretcher Bars:
 - a. One-piece, full height of fabric.
 - b. 3/16-inch x 3/4-inch, galvanized.
 - c. Bands of galvanized steel or malleable iron.
8. Barbed Wire:
 - a. Galvanized, ASTM A121, Class 2 or Aluminum coated.
 - b. Two 12-1/2 gauge steel wire with 4 point barbs.
 - c. Three strands of barbed wire located above top rail.
9. Bottom Tension Wire:
 - a. Galvanized or aluminum coated coil spring wire, 7 gauge.

2.06. GATES:

A. Manual-Swing:

1. Framing:
 - a. Fabricate perimeter frames of gates from metal and finish to match fence framework.
 - b. Provide intermediate horizontal and vertical members for proper gate operation and for attachment of fabric, hardware, and accessories. Space so that frame members are not more than 8 feet apart unless otherwise indicated.
 - c. Frames assembled by welding or watertight galvanized steel rigid fittings.
 - d. Provide with same fabric as for fence. Install fabric with stretcher bars at vertical and top and bottom edges.
 - e. Diagonal cross bracing of 3/8-inch diameter adjustable truss rods to ensure frame rigidity without sag or twist.
 - f. Where barbed wire is indicated or specified, extend gate end members 1 foot above top members to receive barbed wire.
2. Hardware:
 - a. Hinges of pressed or forged steel, or malleable iron, nonlift-off type, offset to permit 180° gate opening, 1-1/2 pair per leaf.
 - b. Latches and Gate Stops: Double-leaf.
 - (1) Plunger-bar type latch, full gate height, designed to engage gate stop of flush-plate type, with anchors.
 - (2) Locking device and padlock eyes an integral part of latch.

- (3) Keeper to automatically engage gate leaf and secure free end of gate in open position.
- c. Latches: Single-leaf.
 - (1) Forked type to permit operation from either side of gate.
 - (2) Padlock eye as integral part of latch.
- 3. Coating: Galvanize conforming to A153.
 - a. Sliding Cantilevered:
- 4. Framing:
 - a. Inverted channel track, roller ball-bearing truck assemblies, guides, stays, bracing, hardware, and accessories as required.
 - b. Intermediate horizontal and vertical members for proper gate operation and for attachment of fabric, hardware, and accessories. Space so that frame members are not more than 8 feet apart unless otherwise indicated.
 - c. Frames assembled by welding or watertight galvanized steel rigid fittings.
 - d. Diagonal cross bracing of 3/8-inch diameter adjustable truss rods to provide frame rigidity.
 - e. Where barbed wire is indicated or specified, extend gate end members 1 foot above top members to receive barbed wire.

2.07. CONCRETE: As specified in Section 03300.

PART 3 - EXECUTION

3.01. PREPARATION:

- A. Grading: Perform final grading prior to installation of fence.

3.02. INSTALLATION:

A. Fence:

- 1. Follow general contour of ground and property alignment. Install as indicated.
- 2. Posts:
 - a. Set in concrete bases 3 feet below finish grade. Trowel-finish tops of footings and dome to direct water away from posts.
 - b. Temporarily brace until concrete in bases has set.
 - c. Install plumb and in straight alignment.
 - d. Space 10 feet center-to-center maximum.
 - e. Install pull posts every 300 feet if no corner posts are encountered in that distance.

- f. Install corner posts at changes in direction of 30° or more.
 - g. Install pull posts at changes in direction of 10° to 30°.
 - h. Install pull posts at all abrupt changes in grade.
- 3. Post Bracing:
 - a. Install at each end, pull and gate post, and each side of each corner post.
 - b. Install after concrete in post bases has set.
 - c. Install so posts are plumb when diagonal rod is under tension.
- 4. Top Rails:
 - a. Run continuously through post caps or barbed wire supporting arms (bend to radius for curved runs).
 - b. Install expansion couplings at each joint.
- 5. Fabric:
 - a. Run continuously through post caps or barbed wire supporting arms (bend to radius for curved runs).
 - b. Install fabric on security side of fence and anchor to framework so that fabric remains in tension after pulling force is released.
 - c. Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
 - d. Fasten fabric to steel posts with wire ties spaced 12 inches maximum.
 - e. Fasten fabric to top rail with wire ties spaced at 24 inches on center maximum.
- 6. Stretcher Bars:
 - a. Thread through or clamp to fabric 4 inches on center.
 - b. Secure to posts with metal bands spaced 15 inches on center maximum.
 - c. Install at each gate, pull and end post, and each side of corner post.
- 7. Post Tops: Install on each post.
- 8. Barbed Wire: Mount strands on 45-degree extension arms.
- 9. Bottom Tension Wire:
 - a. Install approximately 6 inches above grade.
 - b. Attach wire to each post and securely anchor to terminal gate posts.

B. Manual-Swing and Cantilevered Sliding Gates:

1. Install plumb and level.
2. Install all hardware, tracks, framing, supports, and appurtenances as required for gate type.
3. Install keepers, ground-set items, and flush plate in concrete for anchorage.
4. Adjust and lubricate as necessary for smooth operation.

C. Repairing Damaged Coatings:

1. Repair any damaged coatings in the shop or field by recoating with compatible and similar coating.
2. Apply per manufacturer's recommendations.

END OF SECTION 02831

SECTION 02950

SEEDING AND SODDING

PART 1 – GENERAL

1.01. SUMMARY:

A. This Section includes the following areas of Work:

1. Preparation of areas for seeding and sodding.
2. Seeding.
3. Sodding.
4. Mulching.
5. Fertilizing seed and sod areas.
6. Maintenance.

B. Related Work Specified Elsewhere:

1. Site Preparation and Earthwork: SECTION 02200.

1.02. SUBMITTALS:

A. Certificates:

1. Seed and fertilizer shall be accompanied by certificate from vendors certifying they meet requirements of these Specifications, stating botanical name, percentage by weight, percentage of purity, germination, and weed seed for each grass seed species.

PART 2 – PRODUCTS

2.01. TOPSOIL: Specified in SECTION 02200.

2.02. GRASS SEED:

- A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America and as required below.
- B. Be labeled according to the U.S. Department of Agriculture Federal Seed Act and shall be furnished in containers with tags showing seed mixture, purity, germination, weed content, name of seller, and date on which seed was tested:
 1. Seed Mixture:

- a. Meet the following minimum percentage requirements for purity and mix ratio:

<u>Common and Botanical Name</u>	<u>Minimum Pure Live Seed (%)</u>	<u>Rate of Pure Live Seed (Pounds per Acre)</u>
Alta Fescue or Kentucky 31 Fescue (Festuca Elatior, variation Arundinacea)	75	100
Rye Grass (Lolium perenne or L. Multiflorum)	80	25
Kentucky Blue Grass (Poa Pratensis)	75	15
Creeping Red Fescue (Festuca Rubra)	85	10
Total		150 Pounds

2. Moldy seed or seed that has been damaged in storage shall not be used.

2.03. SOD:

- A. Machine cut, strongly rooted, certified turf-grass sod, at least 2 years old, and be relatively free of weeds or other undesirable native grasses. Provide sod capable of vigorous growth and development when planted (viable, not dormant).
- B. Be composed principally of the following:
 - 1. Kentucky bluegrass or approved equal.
- C. Moisten sod to depth at which it is to be cut when stripped during dry periods.
- D. Provide sod in uniform thickness of 5/8-inch, plus or minus 1/4-inch, measured at time of cutting and excluding top growth and thatch. Strips shall be of supplier's standard size of uniform length and width with maximum 5% allowable deviation in either length or width. Broken or torn pads, or pads with uneven ends are not acceptable.
- E. Sod pads shall be capable of supporting their own weight and retaining size and shape when pad is suspended vertically from a firm grasp on upper 10% of pad.
- F. Handle sod with care to prevent loss of native soil from roots.

2.04. LIMING MATERIAL:

- A. Shall consist of agricultural liming materials conforming to the Missouri Agricultural Liming Materials Act of 1976.
- B. Material used for soil neutralization, unless otherwise specified, shall be agricultural lime with not less than 90% passing the No. 8 sieve and containing not less than 65% calcium carbonate equivalent.
- C. Manufacturer's certification shall include the minimum pounds of ENM (effective neutralizing material) per ton of the material to be supplied.

2.05. FERTILIZER:

- A. Commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 4% phosphoric acid, 2% potassium, and percentage of nitrogen required to provide not less than 1.0 lb. of actual nitrogen per 1,000 square feet of lawn area. Provide nitrogen in form that will be available to the lawn during initial period of growth.
- B. Deliver to site in labeled bags or containers.

2.06. MULCH:

- A. Vegetative Anti-Erosion Mulch: Seed- free salt hay or threshed straw of wheat, rye, oats, barley, or other approved materials.
- B. Wood Cellulose Fiber:
 - 1. Not contain germination or growth-inhibiting ingredients.
 - 2. Dyed an appropriate color to aid in visual inspection.
 - 3. Be easily and evenly dispersed when agitated in water.
 - 4. Supply in packages of not more than 100-pound gross weight, and be marked by the manufacturer to show the air-dry weight content.

2.07. JUTE NETTING:

- A. Uniform, open, plain weave mesh of smolder-resistant, unbleached single-jute yarn:
 - 1. Yarn of loosely twisted construction and not vary in thickness by more than one-half its normal diameter.
- B. Furnish in rolled strips and as follows:
 - 1. Minimum width of 42 inches.
 - 2. 5.5 wrap yarns by 3.5 filling yarns per inch.
- C. Staples of No. 11 gauge or heavier steel wire, U-shaped and not less than 6 inches in length.

PART 3 – EXECUTION

3.01. SOIL PREPARATION:

- A. Dispose of any growth, rocks, or other obstructions which might interfere with tilling, seeding, sodding, or later maintenance operations. Remove stones over 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter.
- B. Thoroughly loosen and pulverize topsoil to a depth of at least 4 inches.
- C. Grade planting areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions to meet finish grades. Limit fine grading to areas which can be planted within immediate future.
- D. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create a muddy soil condition.

- E. Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
- F. Spread planting soil mixture to depth required to meet thickness, grades, and elevations indicated after light rolling and natural settlement.
- G. Allow for sod thickness in areas to be sodded.

3.02. LIMING AND FERTILIZING:

- A. Lime and fertilizer shall be applied separately, but may be incorporated into the soil in one operation.
- B. Lime and fertilizer shall be applied not more than 48 hours before the seeding or sodding unless otherwise authorized by the Engineer.
- C. Contractor shall take a minimum of three samples of the topsoil stockpile and through the services of an independent laboratory have test run to ascertain the rates of application of soil amendments required to provide at least the quantity of effective neutralizing material and fertilizers to nourish new growth.
- D. Apply lime and fertilizer at the rates recommended by soil analysis in pounds per acre to prepared seedbeds and sod beds.
- E. Incorporate fertilizer into the soil to a depth of at least 3 inches by disking, harrowing, or raking, except where applied hydraulically on slopes steeper than 2 horizontal to 1 vertical.

3.03. SEEDING:

- A. Do not use wet seed or seed which is moldy or otherwise damaged in transit or storage.
- B. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.
- C. Sow not less than rate of 100 pounds per acre.
- D. Rake seed lightly into top 1/8-inch of soil, roll lightly, and water with fine spray.
- E. Seasonal Limitations:
 - 1. Perform seeding only during the following seasons:
 - a. March 1 to June 15.
 - b. September 1 to October 30.
- F. Methods of Application:
 - 1. Dry Seeding: Spreader or seeding machine.
 - 2. Hydroseeding: Mix seed, fertilizer and pulverized mulch with water and constantly agitate. Do not add seed to water more than 4 hours before application:

- a. On slopes of 3 horizontal to 1 vertical or flatter, apply seed separately from fertilizer. Cover seed with soil to an average depth of 1/2-inch by raking or other approved methods.
- b. On slopes steeper than 3 horizontal to 1 vertical, a Type 3 Mulch, meeting the content and application requirements specified in Section 802 of the Missouri Standard Specifications for Highway Construction is required.

3.04 MULCHING:

- A. Apply a mulch covering to all seeded areas.
- B. Apply vegetative mulch to a loose depth of 1-1/2 inches by means of a mechanical spreader or other approved methods.
- C. Apply wood-cellulose fiber mulch hydraulically at the rate of 1,000 pounds per acre:
 - 1. Mulch and seed may be applied in a single operation.
 - 2. Apply mulch to achieve a uniform coverage of the soil surface.
- D. Immediately follow the application of the mulch, water the seeded area in one watering, in sufficient amount to penetrate the seedbed to a minimum of 2 inches. Perform so as not to cause erosion or damage to the seeded surface.
- E. Protect seeded areas against hot, dry weather or drying winds by applying mulch not more than 24 hours after completion of seeding operations.

3.05 SODDING:

- A. Do not place sod during a drought or during the period from June 15 to September 1, except as authorized by the Engineer.
- B. Lay sod within 24 hours from time of stripping. Do not lay dormant sod or if ground is frozen.
- C. Sod shall be moist at the time it is placed.
- D. Lay sod strips along contour lines, by hand, commencing at the base of the area to be sodded and working upward:
 - 1. Carefully lay sod to produce tight joints. Butt ends and sides of sod strips; do not overlap.
 - 2. Stagger transverse joints of sod strips.
 - 3. Work from boards to avoid damage to subgrade or sod.
 - 4. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod, removing excess to avoid smothering adjacent grass.
- E. On slopes of 3 horizontal to 1 vertical and steeper, anchor sod by wooden pegs. Pegs shall be 1/2" x 12", driven into the ground on 2-foot centers. Top of peg after driving shall be not less than 1/2-inch but not more than 1 inch above top of sod.
- F. Water sod with fine spray immediately after planting. During first week, water daily or more frequently as necessary to maintain moist soil to depth of 4 inches.

3.06. RECONDITIONING EXISTING GRASS AREAS:

- A. Recondition existing grass areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition the areas where settlement or washouts occur or where minor regrading is required. Recondition other existing grass areas where indicated.
- B. Provide fertilizer, seed or sod, and soil amendments as specified for new grass and as required to provide satisfactorily reconditioned grass growth. Provide new planting soil as required to fill low spots and meet new finish grades.
- C. Cultivate bare and compacted areas thoroughly to provide a good, deep planting bed.
- D. Remove diseased or unsatisfactory grass areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations including oil drippings, stone, gravel, and other construction materials. Replace with new topsoil.
- E. Where substantial grass remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
- F. Water newly planted areas and keep moist until new grass is established.

3.07. PROTECTION:

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

3.08. MAINTENANCE:

- A. Mow grass to a height of 2 inches as soon as there is enough top growth to cut with mower. Remove no more than 40% of grass leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted.
- B. Remove weeds by pulling or chemical treatment.
- C. Perform maintenance until the date of final acceptance by City.
- D. Seeded Areas:
 - 1. Water as required by good practice and as necessary to obtain a flourishing cover.
 - 2. Repair any portion of the seeded surface which becomes gullied or otherwise damaged, or the seeding becomes damaged or destroyed.
- E. Sodded Areas:
 - 1. Thoroughly water daily for a period of 15 days after placing.
 - 2. Maintain sod in good live condition. Replace any sod not in good growing condition with fresh live sod.
 - 3. Water thoroughly whenever sod evidences excessive drying.

- F. Apply second fertilizer application after first mowing and when grass is dry. Use fertilizer which will provide not less than 1.0 pound of actual nitrogen per 1,000 square feet of lawn area.

3.09. ACCEPTANCE OF LAWNS:

- A. When lawn Work is Substantially Complete, including maintenance, Engineer and City will, upon request, make an inspection to determine acceptability:
 - 1. Lawn Work may be inspected for acceptance in parts agreeable to City, provided Work offered for inspection is complete, including maintenance.
- B. Replant rejected Work and continue specified maintenance until re-inspected by Engineer and City and found to be acceptable.
- C. Seeded lawns will be acceptable provided requirements, including maintenance, have been complied with and healthy, uniform, close stand of specified grass is established free of weeds, bare spots, and surface irregularities.
- D. Sodded lawns will be acceptable provided requirements, including maintenance, have been complied with and healthy, well-rooted, even-colored, viable lawn is established free of weeds, open joints, bare areas, and surface irregularities.

- 3.10. CLEANUP: Promptly remove soil and debris created by lawn Work from paved areas. Clean wheels of vehicles prior to leaving site to avoid tracking soil onto surfacing of roads, walks, or other paved areas.

END OF SECTION 02950

SECTION 02960

ROADWAY SURFACE AND SIDEWALK REPLACEMENT

PART 1 – GENERAL

1.01. SUMMARY

- A. This Section includes the replacement of all roadway surfaces and sidewalks removed or damaged during water or sewer line construction.
 - 1. Concrete pavement, asphaltic pavement, crushed stone pavement, and concrete sidewalk pavement, whether public or private, which is cut or damaged during construction of the project shall be replaced so as to conform to the lines and grades of the original surface, and shall be of a quality, thickness, and appearance equal to or better than that of the surface as it existed prior to construction.
- B. Related Work Specified Elsewhere:
 - 1. Site Preparation and Earthwork: SECTION 02200.
 - 2. Trenching and Backfilling for Utilities: Section 02222.
 - 3. Concrete: DIVISION 3 – SECTION 03300.
- C. Refer to Standard Construction Details for Pavement Replacement.

1.02 REFERENCES:

- A. American Association of State Highway and Transportation Officials (AASHTO).
 - 1. T99 – Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in) Drop.

1.03. SUBMITTALS:

- A. Submit as specified in DIVISION 1 – SECTION 01300.

PART 2 – PRODUCTS

2.01. COMPACTED GRANULAR BACKFILL: Specified in SECTION 02222.

2.02. CONCRETE: Specified in DIVISION 3 – SECTION 03300.

2.03. CRUSHED STONE PAVEMENT:

- A. Shall consist of a natural or artificial mixture of hard, durable, uniformly graded particles of coarse and fine limestone aggregate.
- B. The natural or processed mixture shall conform to the following:

<u>Sieve Size</u>	<u>Percent Passing</u>
2-inch	100
1-inch	55-85
3/4-inch	50-80
No. 4	30-60

2.04. ASPHALTIC CONCRETE PAVEMENT:

- A. Asphaltic concrete shall be hot mixed in an approved plant.

PART 3 – EXECUTION

3.01. GENERAL:

- A. Existing paving shall be cut vertically and horizontally to straight lines.
- B. The trench shall be backfilled with compacted granular or flowable backfill as specified in SECTION 02222.
- C. The level shall be maintained by the Contractor until all secondary settling has occurred. Additional compacted granular backfill may be required to maintain the trench in a suitable condition for traffic during this period.
- D. At the time of final repair, the Contractor shall remove sufficient material to allow placement of the roadway or sidewalk surfacing to the thickness specified within this Section.

3.02. ROADWAY SURFACE AND SIDEWALK REPLACEMENT:

A. Concrete Pavement:

- 1. Concrete surfaces, including private drives, shall be replaced with concrete surfacing equal to the thickness of existing pavement or 8 inches, whichever is greater.
- 2. Concrete shall be placed as specified in DIVISION 3 – SECTION 03300.
- 3. The final pavement repair elevation shall match the elevation of the adjacent pavement.

B. Crushed Stone Pavement:

- 1. Crushed stone surfaces, including county roads, and city streets, as well as dirt, or gravel shoulders of paved streets, roads, walking trails, or highways, shall be replaced with crushed stone pavement.
- 2. The crushed stone shall be placed and compacted in layers to a finished thickness of 6-inches.
 - a. The number of layers and the thickness of each layer shall be construed at the Contractor's option subject to the limitation that the compacted thickness of any one course or layer shall not exceed 4 inches.
- 3. The crushed stone shall be handled in such as manner as to avoid undue segregation.
- 4. Preliminary compaction shall be performed by means of pneumatic-tire rollers.
- 5. Finish compaction shall be carried to completion by means of self-propelled steel-wheeled rollers weighting not less than 10 tons.
- 6. Proper moisture contact shall be maintained by wetting the surface or allowing it to dry as required during shaping and compacting operations.
- 7. The crushed stone pavement shall be compacted to not less than 95 percent of the maximum density at optimum moisture content as determined by AASHTO T99.

8. The final pavement repair elevation shall match the elevation of the adjacent pavement.

C. Sidewalk Replacement:

1. Sidewalks shall be replaced with concrete surfacing equal to the thickness of existing sidewalk or 4 inches, whichever is greater.
2. Concrete shall be placed as specified in DIVISION 3 – SECTION 03300.
3. The sidewalk repair elevation shall match the elevation of the adjacent pavement.
4. In all cases, sidewalk replacement shall be constructed to meet all ADA requirements.
 - a. Contractor is required to install ADA compliant curb ramps at all street or alleyway crossings even if a curb ramp did not previously exist.

D. Asphaltic Concrete Pavement:

1. Asphaltic concrete roadway surfaces shall be replaced with a concrete base of 8 inches thickness and a minimum of 4 inches of asphaltic concrete or a depth matching the existing pavement depth, whichever is greater. Edges of the existing pavement at the trench shall be trimmed vertically to produce a neat even edge. The base surface and vertical edge shall be sprayed with a prime coat of Grade RC-250 liquid asphalt heated to no less than 130°F, at a rate of 0.15 gallons per square yard. This primer shall be applied delivered to the work area in dump trucks at a minimum temperature of 275°F. The asphaltic concrete shall be placed and then rolled while hot with an approved five-ton steel wheel roller to the same thickness as the existing pavement. In no case shall the total compacted thickness of a layer be less than two inches nor greater than four inches. No traffic shall be permitted on the finished pavement until it has cooled to atmospheric temperature.
2. Concrete shall be placed as specified in DIVISION 3 – SECTION 03300.
3. The final pavement repair elevation shall match the elevation of the adjacent pavement.

END OF SECTION 02960

DIVISION 3 – CONCRETE

SECTION 03300

CONCRETE

PART 1 – GENERAL

1.01. SUMMARY:

- A. This Section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work.
- B. All cast-in-place concrete shall be accurately formed and properly placed and finished as shown on the drawings and specified herein.
- C. Contractor shall inform the Engineer at least 24 hours in advance of the times and places at which he intends to place concrete.
- D. Submit as specified in DIVISION 1 – SECTION 01300.

1.02. REFERENCES:

A. Applicable Standards:

1. American Concrete Institute (ACI):

- a. 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- b. 304 – Standard Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
- c. 308 – Recommended Practice for Curing Concrete.

2. American Society for Testing and Materials (ASTM):

- a. C109 – Method of Test for Compressive Strength of Hydraulic Cement Mortars.
- b. C150 – Standard Specification for Portland Cement.
- c. C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- d. C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
- e. C33 – Standard Specification for Concrete Aggregates.
- f. C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- g. C494 – Standard Specification for Chemical Admixtures for Concrete.
- h. C94 – Standard Specification for Ready-Mixed Concrete.

- i. D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction.
- j. D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- k. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

PART 2 – PRODUCTS

2.01. CONCRETE:

A. Materials:

- 1. Portland cement shall conform to ASTM C150, Types I, II, or V. One sack of cement shall be considered as one cubic foot of volume or 94 pounds by weight.
- 2. Fine Aggregate shall be clean natural sand in conformance with ASTM C33.
- 3. Coarse Aggregate shall be crushed rock, washed gravel, or other inert granular material conforming to ASTM C33. Coarse aggregate gradation shall conform to ASTM C33, Size 57.
- 4. Water shall be potable, clean, and free from deleterious substances. Non-potable water may be used only if it produces mortar cubes having 7- and 28-day compressive strengths equal to the strength of similar specimens made with potable water, when tested in accordance with ASTM C109.
- 5. Air-entrainment admixtures shall conform to ASTM C260.
- 6. Water reducing, retarding, and accelerating admixtures shall conform to ASTM C494.
- 7. Reinforcing Steel shall conform to ASTM A615.

B. Required Concrete Qualities and Proportions:

1. Concrete Strengths:

- a. Structural Concrete: All concrete shall be considered structural concrete unless otherwise indicated or specified and shall be provided to develop a compressive strength of not less than 4,000 psi at 28-days for field-cured cylinders.
 - (1) Air Content: 3.5% to 6.5% by volume as tested in accordance with ASTM C231.
 - (2) Cement Content: 564 pounds per cubic yard of concrete (6-sack per cubic yard).
 - (3) Water-Cement Ratio: Shall not exceed 0.45 by weight. Moisture in the aggregate shall be measured and the quantity included in the water-cement ratio calculated.
- b. Fill Concrete: Shall be provided to develop a compressive strength of not less than 2,500 psi at 28-days for field-cured cylinders.
 - (1) Air Content: 3.5% to 6.5% by volume as tested in accordance with ASTM C231.

- (2) Water-Cement Ratio: Shall not exceed 0.55 by weight. Moisture in the aggregate shall be measured and the quantity included in the water-cement ratio calculated.

2. Mix Proportions:

- a. Concrete shall be proportioned to conform to ACI 211.1
- b. Mix proportions for all concrete, unless otherwise specified, shall be selected preferably on the basis of field experience; but in the case where sufficient or suitable strength test data is not available, concrete shall be proportioned on the basis of laboratory trial mix design.
- c. Slump of concrete shall be the minimum that is practicable and shall conform with the following:
 - (1) Footings, Heavy Walls, Piers, Buttresses shall be a maximum of 4" and a minimum of 2".
 - (2) Light Walls, Slabs, Beams, Columns, Stairs shall be a maximum of 5" and a minimum of 3".
 - (3) Concrete floors with monolith finish shall be a maximum of 3" and a minimum of 2".

C. Mixing Concrete:

1. Ready-Mixed Concrete shall conform with ASTM C94.
2. Batch Mixing at Site:
 - a. Concrete shall be mixed in a batch mixer, conforming to the requirements of the Mixer Manufacturer's Bureau of the Associated General Contractors of America. The mixer shall bear a manufacturer's rating plate indicated the rated capacity and the recommended revolutions per minutes.
 - (1) Mixer shall be equipped with a suitable charging hopper, water storage tank, and a water-measuring device.
 - (2) The mixer shall be clean and the pickup and throw-over blades shall be replaced when they have lost 10 percent of their original depth.
 - b. The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to ensure that additional water cannot be added during mixing and that the batch cannot be discharged until the required mixing time has elapsed.
 - c. Each batch of two (2) cubic yards or less shall be mixed for not less than 11.5 minutes. The minimum mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof.
3. Admixtures: Shall be as specified in Part 2.01.A.5 and 2.01.A.6, this Section.
4. Retempering: Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be retempered, but shall be discarded.

5. Indiscriminate addition of water to increase slump or workability shall be prohibited. When concrete arrives at the project with slump below that suitable for placing, water may be added only by authorized representatives of the concrete supplier, and then only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded.

2.02. GROUT

A. Non-Shrink, Non-Metallic Grout:

1. Shall be used unless otherwise indicated or specified.
2. Required for setting equipment recommended by the manufacturer to be set with non-shrinking grout and in other places as indicated or required.
3. Shall be manufactured by one of the following:
 - a. W.R. Meadows – 588-10K.
 - b. L&M Construction Chemicals – Crystex.
 - c. Five Star Products – Five Star Grout.
 - d. Master Builders Solutions by BASF – Masterflow 713.
 - e. Sauereisen Cements Company – No. F-100.
 - f. Cormix International – Congrout GP.
4. Prepare and place conforming to manufacturer's recommendations.

B. Grout for Dry Packing:

1. Volume: 1-part Portland cement to 2-parts sand.
2. Keep water to a minimum as required for placing by the dry packing method.
3. Place after the mixed grout has been allowed to stand for 2-hours.
4. The sand and cement shall be as specified for concrete.

C. Grout for Bonding:

1. Proportion (by weight): 1-part cement to 1-1/2 parts sand.
2. Keep water to a minimum.

2.03. CONCRETE ACCESSORIES:

A. Waterstops:

1. Serrated virgin polyvinyl chloride equal to one of the following:
 - a. Tamma Industries – Horn/Durajoint Type 3.
 - b. Vulcan Metal Products Company – Vulco 8013.

2. Plastic Waterstop: Performed plastic waterstop as manufactured by Synko-Flex Products Co.

B. Expansion Joints:

1. Expansion Joint Filler: Premolded cork of thickness indicated and conforming to ASTM D1752, Type III, self-expanding cork. Use at all locations unless indicated to be asphalt-impregnated fiber.
2. Expansion Join Filler: Preformed asphalt-impregnated fiber of thickness indicated and conforming to ASTM D1751.
3. Bond Breaker: Polyethylene tape or other plastic tape as recommended by the sealant manufacturer for preventing sealant from adhering to joint filler materials or joint surfaces at the bottom of the joint where such adhesion would result in sealant failure.
4. Sealant Backer Rod (closed cell, compatible with sealant):
 - a. Bostick Construction Products Division.
 - b. Chem-Calk – Backer Rod.
 - c. Dow Chemical Company – Ethafoam.
 - d. Hercules Foam Backer Rod.
 - e. Sonneborn Building Products – Sonofoam.
 - f. W.R. Meadows – Sealtight Backer Rod.
5. Joint Sealant:
 - a. Two-component polysulfide system as manufactured by one of the following:
 - (1) A.C. Horn – Hornflex L.
 - (2) Pecora – Synthacalk GC-2.

PART 3 – EXECUTION

3.01. Preparation for Concrete Placement:

- A. Hardened concrete and foreign materials shall be removed from the inner surfaces of the conveying equipment.
- B. Openings Through Concrete: Provide openings through concrete as indicated and for the proper installation of all equipment, piping, wiring, ductwork and similar items installed included in the Work.
- C. Installation of Embedded Items:
 1. Provide for accurate installation of embedded items included in the Work.

2. During cold weather, protect embedded items from moisture which may freeze, expand, and crack the concrete structure.
3. Grease or tape anchor bolt threads to protect from concrete splatter.

D. Formwork:

1. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown on the drawings.
2. Forms shall be substantial and sufficiently tight to prevent leakage of mortar and shall be maintained in proper position and accurate alignment.
3. Forms shall be thoroughly cleaned and oiled before concrete is placed and shall not be removed until the concrete has hardened sufficiently to support all loads without damage.

E. Reinforcement:

1. Reinforcement shall be accurately formed and positioned, and shall be maintained in proper position while concrete is being placed and compacted.

F. Installation of Joints:

1. Construction Joints:

a. Location:

- (1) Obtain Engineer's approval of joints located by Contractor prior to preparation of reinforcing steel shop drawings.

b. Preparation and Installation:

- (1) Clean and break laitance or other foreign material from bonding surface.
- (2) Tighten forms remaining in place (where applicable) to prevent seepage between forms and hardened concrete.
- (3) Provide waterstops and shear keys as indicated or specified and as required in any new construction joint requested by Contractor.

c. Waterstops:

- (1) Install conforming to manufacturer's standard installation instructions.
- (2) All joints and splices of PVC waterstop shall be 100% fused.

2. Expansion Joints:

- a. Install filler, backer rod and sealant in strict conformance with manufacturer's written instructions.

- b. Reinforcing steel shall not extend through expansion joints unless indicated otherwise.
 - c. Attach rigid joint filler to the face of the joint prior to placing adjacent concrete. The filler shall occupy the entire width of the joint.
 - d. Install sealant backer rod for sealant except where indicated to be omitted. Install bond breaker where indicated.
 - e. Clean joint surfaces immediately before application of sealant.
 - f. Install joint sealants to conform to ASTM C962. Tool sealant to provide smooth, uniform bead with a slightly concave surface, eliminate air pockets, and insure sealant contact and adhesion with sides of joint.
 - g. Protect joints from moisture and ice during freezing.
3. Contraction Joints: As specified in Part 3.03 - Finishing, this Section.
- G. All embedded items, formwork, reinforcement, and joints shall be reviewed by the City before any concrete is placed.

3.02 PLACING OF CONCRETE:

A. Conventional Placing:

1. General Requirements:

- a. Conform to ACI 304.
- b. Bonding surfaces, including reinforcement, shall be clean, free of laitance and foreign materials.
- c. Face horizontal bonding surfaces with 1-inch-thick coat of fresh "grout for bonding". Wet all other surfaces.
- d. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavation and forms.
- e. Use forms for all concrete except where otherwise indicated or specified.
- f. Do not place concrete that has partially hardened or has been contaminated by foreign materials.
- g. Prevent mud or foreign materials from entering the concrete or forms during placement operations.
- h. Where required, a polyethylene vapor barrier or 4 mil. thickness, or approved equal, shall be installed in accordance with the manufacturer's recommendations. A layer of sand shall be placed on the granular fill to protect the vapor barrier during placement of concrete.

2. Conveying:

- a. Convey concrete from the mixer and deposit in place by methods which will prevent the segregation or loss of materials.
- b. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to provide a practically continuous flow of concrete at the delivery end.
- c. Aluminum conveying equipment shall not be used.

3. Depositing:

- a. Place concrete continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness with the section.
- b. Maximum free drop of concrete and grout for bonding shall be 5 feet, in walls 10 inches or less in thickness, with 1-foot additional drop allowed for each inch of wall thickness over 10 inches, with a maximum drop of 10 feet.
- c. When moisture barrier is used, keep lapped joints closed and take precautions to avoid puncturing the barrier.

4. Consolidation of Concrete:

- a. Consolidate concrete in conformance with ACI 309. Characteristics and application of concrete vibrators shall be as set forth in Table 5.1.4.
- b. Provide an adequate number of vibrators of sufficient capacity to keep up with the maximum rate of concrete placement. Keep on hand adequate standby equipment in good operating condition.
- c. Vibrate concrete only until the concrete is thoroughly consolidated and the voids filled, as evidenced by the leveled appearance of the concrete at the exposed surface and the embedment of the surface aggregate.
- d. Insert internal vibrators vertically to the full depth of the layer being placed and into the previous layer. Do not drag vibrators through the concrete. Insert and withdraw vibrator slowly with the vibrator running continuously so that no hole will be left in the concrete. Do not flow concrete from one location to another by use of a vibrator.
- e. Consolidate concrete layer to full depth when using a surface vibrator. Use thinner layers or a more powerful vibrator if necessary to achieve complete consolidation.
- f. Use form vibrators only where sections are too thin or where sections are inaccessible for internal vibrators.

5. Time Requirements:

- a. Place concrete at a sufficient rate to assure that lifts below have not taken initial set before fresh concrete is deposited.
 - b. Place concrete within 45 minutes after mixing. This period may be extended to 1 hour and 30 minutes provided that the combined air temperature, relative humidity, and wind velocity are such that the plasticity of the fresh concrete is satisfactory for placement and consolidation, and that the specified mixing water is not exceeded. Concrete which has partially set shall not be re-tempered but shall be discarded.
6. Placing Concrete at Joints:
- a. Bed horizontal joints with 1 inch of grout for bonding.
 - b. Take precautions to ensure tight, well-bonded construction joints with no air pockets or voids.
 - c. Take special precautions to avoid bending or displacing waterstop while placing concrete around it.
 - d. Delay construction at a joint a minimum of 16 hours where placement is continued past joint, except where otherwise indicated.

3.03. FINISHING:

A. Unformed Surfaces:

1. Screed Finish:

- a. Use as first stage for all concrete finishes.
- b. Use as final finish on surfaces that will be covered by additional concrete, grout placement, or mortar setting bed except as otherwise specified.
- c. Immediately after screeding, use a wood float, darby, or bullfloat to eliminate high and low spots and to embed large aggregate. This shall be done in a manner to produce even, uniform surfaces so that surface irregularities do not exceed 3/8 inch in 10 feet when used as final finish.

2. Floated Finish:

- a. Use as second stage of broomed, troweled, or magnesium-troweled finish.
- b. Float with mechanical float. Hand floating will be permitted only in areas inaccessible to mechanical float.
- c. On surfaces not to receive troweled or magnesium-troweled finish, finish with wood or cork float after mechanical floating to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet, except at floor drains.

3. Broomed Finish:

- a. Use as final finish on all outdoor slabs including pavements and sidewalks.
 - b. After floated finish, draw a stiff bristle broom across the surface making uniform corrugations, perpendicular to the direction of traffic, not more than 1/16 inch deep.
4. Troweled Finish:
- a. Use as final finish on all other unformed surfaces not otherwise indicated or specified.
 - b. Trowel with steel trowel, mechanical or hand, to obtain a smooth, dense finish. The final troweling shall be done after the concrete has become hard enough so that no mortar adheres to the edge of trowel and a ringing sound is produced as the trowel passes over the surface.
 - c. Do not trowel before surface water has evaporated or has been removed with a squeegee.
 - d. Finish to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet, except at floor drains.
 - e. Do not add sand or cement to the floor surface.
5. Magnesium-Troweled Finish:
- a. Perform as specified in Part 3.03.A.4 - Troweled Finish, this Section, except use a magnesium trowel by hand instead of a steel trowel to obtain a dense, but not slick, finish.
 - b. Use where floor will receive protective coating after curing.
6. Contraction Joints:
- a. Locate as indicated.
 - b. Maintain true alignment with straightedge.
 - c. Joints shall be grooved except where sawed joints or preformed joints are indicated.
 - d. Grooved Joints:
 - (1) Perform during the finishing process.
 - (2) Width of groove shall not exceed 1/4 inch.
 - (3) Depth of groove shall be at least 1 inch.
 - e. Sawed Joints:
 - (1) Cut joints with power blade as soon as concrete surface is firm enough to resist tearing or damage by the blade and before random shrinkage cracks can occur. (Usually required 4 to 12 hours after finishing.)

(2) Make joints approximately 1/8 inch wide with depth as indicated.

(3) Seal with the same type sealant specified for expansion joint sealant.

B. Formed Surfaces:

1. Repair surface defects as specified in Part 3.03.C - Repair of Defective Surfaces, this Section.

C. Repair of Defective Surfaces:

1. Defined as any concrete surface showing misalignment, rock pockets, poor joints, holes from ties, voids, honeycomb, or any other defective area.
2. Repairing:
 - a. Repair as soon as forms have been removed.
 - b. Chip surface back to minimum depth of 1/2 inch, chip edges perpendicular to surface, pre-wet depression and brush with neat cement immediately before patching.
 - c. Patch surfaces using stiff mortar with same sand-cement ratio as original concrete and with minimum water for placing. Blend with white cement to match concrete color.
 - d. Compact mortar into depressions so that after curing, hole is filled and mortar is flush with surface. Use hammer and ramming rod for compacting the holes.
 - e. Moist-cure for 3 days or use curing compound.
 - f. Engineer shall be notified of areas containing defects or where reinforcing steel is exposed, prior to determination of repair method.

3.04 CURING:

A. Cure all concrete by one of the following methods in accordance with ACI 308:

1. Leaving in forms for a minimum of 7 days. Keep formwork wet to prevent drying of concrete surfaces.
2. Use of saturated bays, soaker hoses, or sprinkler for a minimum of 7 days. Keep concrete continuously wet.
3. Using one coat of a liquid membrane forming compound conforming to ASTM C309, Type 1. Apply immediately after removal of forms (which have been continuously wet); or in case of a slab, after the concrete has been finished and is hardened sufficiently to walk on.
4. Using polyethylene sheets applied in full contact with surfaces.
5. Curing of concrete during hot or cold weather shall conform to Parts 3.05 and 3.06 - Hot Weather Concreting and Cold Weather Concreting, respectively, this Section.

3.05 HOT WEATHER CONCRETING:

- A. Follow the recommendations of ACI 305 if any of the following conditions occur:
 - 1. When the temperature is 90°F or above.
 - 2. When the temperature is likely to rise above 90°F within the 24-hour period after concrete placement.
 - 3. When there is any combination of high air temperature, low relative humidity, and wind velocity which would impair either concrete strength or quality.
- B. Concrete shall have a maximum temperature of 85°F during placement.
- C. Dampen subgrade and forms with cool water immediately prior to placement of concrete.
- D. Protect freshly placed concrete immediately after placement so that the rate of evaporation as determined by ACI 305 (Figure 2.1.5) does not exceed 0.2 pounds per square foot per hour.
- E. Protect concrete with suitable insulation if rapidly decreasing nighttime temperatures occur, which would cause thermal shock to concrete placed during warm daytime temperatures.
- F. Protect the concrete with temporary wet covering during any appreciable delay between placement and finishing.
- G. Begin curing unformed surfaces immediately after finishing and continue for 24 hours. Curing shall consist of application and maintenance of water-saturated material to all exposed surfaces; horizontal, vertical, and otherwise. After the 24-hour interval, continue curing using one of the following methods:
 - 1. Moist curing for 6 days.
 - 2. Application of one coat of curing compound conforming to ASTM C309, Type 2.
 - 3. Application and maintenance of curing paper or heat-reflecting plastic sheets for 6 more days.
- H. Begin curing formed concrete immediately after placing. Curing shall consist of keeping forms continuously wet for 24 hours. Thereafter, continue curing using one of the following methods:
 - 1. Loosen forms and position soaker hose so that water runs down along concrete surfaces. Continue for 6 days.
 - 2. Strip forms and apply curing compound conforming to ASTM C309, Type 2. Do not allow concrete surfaces to dry prior to application of curing compound.

3.06 COLD WEATHER CONCRETING:

- A. When the temperature is 40°F or is likely to fall below 40°F during the 24-hour period after concrete placement, follow the recommendations of ACI 306 to prevent loss of concrete strength or quality.
- B. Minimum temperature for concrete as mixed shall be as indicated on lines 2, 3, and 4 of Table 1.4.1 of ACI 306. Maximum temperature for concrete as mixed shall be 10°F greater than the corresponding minimum temperature.
- C. Place and maintain concrete so that its temperature is never less than the temperature indicated on line 1 of Table 1.4.1 of ACI 306. Maintain the required temperature for the time duration indicated on Table 1.4.2 of ACI 306.
- D. Monitor temperature of concrete in place at corners or edges of formwork as applicable.
- E. Air Heaters:
 - 1. Do not expose concrete to carbon monoxide or carbon dioxide fumes from heaters or engines.
 - 2. Oil- or coke-burning salamanders will not be permitted.
 - 3. Heaters shall be ultramatic portable heaters made by the Union Chill Mat Company or Engineer approved equal.
 - 4. Personnel shall be present at all times to maintain safe, continuous operation of heating system.
- F. Control temperature and humidity of protected concrete so that excessive drying of concrete surfaces does not occur.
- G. Calcium chloride will not be permitted as a concrete accelerator or to thaw frozen subgrade prior to concrete placement.
- H. The maximum allowable temperature drop during the first 24-hour period after protection is discontinued shall be as indicated on line 5 of Table 1.4.1 of ACI 306.
- I. Cure the concrete in accordance with Chapter 5 of ACI 306.

3.07 LOW-STRENGTH CONCRETE:

- A. Low-Strength Concrete:
 - 1. Defined as either:
 - a. Concrete whose average, of any sets of three consecutive 28-day strength tests, is below the required 28-day strength.
 - b. Concrete whose individual 28-day strength test (average of two cylinders) is more than 500 psi below the required 28-day strength.

2. Should concrete meet either definition of low-strength concrete as a minimum, the Contractor shall take the following steps:

- a. Increase the cement content. The increase shall be based on a statistical evaluation of the strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature as follows:
 - (1) If sufficient concrete has been furnished to accumulate 30 tests, these should be used to establish a new target average strength in accordance with ACI 318, Section 4.3.1.
 - (2) If less than 30 tests have been made, the new target average strength should be at least as great as the average strength used in the initial selection of the mix proportions. Increase the target average strength based on a statistical evaluation of the available strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature. If the statistical average equals or exceeds the initial mix-design level, a further increase in the average level is required.
- b. Remove and replace with acceptable concrete when the quality and location of the concrete is such that the Engineer considers the strength or durability of the structure is impaired and so orders.

B. Potentially Low-Strength Concrete: Defined as concrete whose 7-day test (average of two cylinders) is less than 70% of the specified minimum 28-day compressive strength.

3.08 MISCELLANEOUS CONCRETE ITEMS:

A. Concrete Seal Coat:

1. Apply to the ground surface immediately beneath all "on-grade" slabs and footings where indicated or specified.
2. Seal coat shall consist of a concrete slab of the thickness indicated but not less than 2 inches.
3. Accurately screed so that the top of the seal coat will not be higher than the bottom elevation of structural slabs or footings to be placed thereon.
4. Do not place seal coat until after all excavating in the area have been completed and all drain lines, conduits, and other items under the area are completed and properly backfilled and compacted.

B. Equipment Bases:

1. Construct equipment bases, pads, and foundations as indicated or, when not indicated, conforming to equipment manufacturer's requirements.
2. Reinforce conforming to typical detail unless otherwise indicated.
3. Equipment bases shall include concrete, reinforcing steel, form work as required, and anchor bolts. Place grout for equipment included in the Work.

4. Finish top area of bases between anchor bolts and forms with a troweled finish.

3.09 TESTING:

A. Field Testing of Concrete Plant and Mixing Trucks:

1. The concrete plant shall be inspected and tested to ensure conformance with ACI 304 and the "Concrete Plant Standards of the Concrete Plant Manufacturers Bureau". The scales shall be calibrated at the initial setup and at 3-month intervals thereafter.
2. Mixing trucks shall be inspected and tested to ensure conformance with ACI 304 and "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau" of the National Ready-Mix Concrete Association. Tests shall be done at initial setup and every 3 months thereafter.
3. Submit test reports when requested.

B. Field Testing of Concrete and Making of Concrete Test Cylinders:

1. Contractor shall furnish on request test equipment, test cylinder molds, and certified personnel to perform all required field tests, make the required concrete test cylinders, and deliver test cylinders to the testing laboratory. The prescribed tests shall be made in the presence of or with the concurrence of the City.
2. Field testing personnel shall be on-site throughout placement of concrete.
3. Concrete sampling for tests and cylinder making shall be done conforming to ASTM C172 except samples for slump, air and temperature tests shall be taken from the first portion of the batch discharge. Samples shall be taken at random and at the point of truck discharge.
 - a. Moisture content, ASTM C566. Perform this test a minimum of twice a day and adjust the amount of mix water to compensate for the moisture content of the aggregates.
 - b. Prepare test cylinders conforming to ASTM C31, with not less than one set of cylinders (four cylinders) from each day's placement for each 100 cubic yards or fraction thereof.
 - c. Slump test conforming to ASTM C143. Perform tests on the first batch produced each day, for every 50 cubic yards or fraction thereafter, and with every set of test cylinders. Additional tests shall be run when directed by the Engineer.
 - d. Air content test conforming to ASTM C231. Perform for first batch of day and with each set of test cylinders.
 - e. The batch of concrete being tested for slump or air content shall not be placed until acceptable results are obtained.
 - f. Discard concrete used for slump and air tests.
 - g. Perform concrete and air temperature tests for first batch of day and with each set of test cylinders. Additional readings shall be taken when directed by the Engineer.

- h. Any batch of concrete with slump or air content not in conformance with Specifications shall be rejected.
- i. Furnish slump, air content, and temperature test results to the testing laboratory for inclusion in the cylinder test reports.

C. Laboratory Testing of Aggregates and Concrete During Construction:

- 1. An independent testing laboratory will be selected and paid by the Developer/Owner to perform the required laboratory tests and statistical evaluations of aggregates and concrete being used in the Work.
- 2. Laboratory will cure and test concrete cylinders conforming to ASTM C192 and C39, testing two cylinders 7 days of age and two at 28 days of age.
- 3. Contractor shall have the right to observe all phases of concrete cylinder curing and testing. Should Contractor observe any deviations from the prescribed testing procedures that he considers detrimental to concrete strength test results, he shall immediately notify Developer/Owner in writing.
- 4. Contractor shall assist laboratory in obtaining Samples of fine and coarse aggregate for testing.
- 5. The Contractor shall make arrangements with the testing laboratory to receive copies of test reports. The cost of providing a maximum of two copies of each report to the Contractor will be paid by the Developer/Owner.
- 6. Should the test results indicate low strength concrete as defined in Part 3.07 - Low-Strength Concrete, this Section, Contractor shall take immediate corrective action.
- 7. Should the statistical data indicate an excessive margin of safety, the concrete mix may be modified subject to Engineer's approval.
- 8. Should the material tests taken during construction indicate nonconformance with the Specifications, the Contractor shall take immediately corrective action.

END OF SECTION 03300

DIVISION 11 – EQUIPMENT

SECTION 11151

SUBMERSIBLE WASTEWATER PUMPING STATION

PART 1 – GENERAL

1.01 SUMMARY:

- A. This section covers furnishing and installing submersible wastewater pumping stations and related components.
- B. Pumping stations shall be:
 - 1. Capable of pumping raw wastewater and be of the duplex type.
 - 2. Furnished complete and include pump casings, shafts, bearings, seals, lubrication, floor mounted discharge bases, piping assemblies, guide rails, anchor bolts, submersible motors, controls, power cables, access hatch cover and all other parts and accessories indicated, specified or required for proper installation, operation and maintenance.
- C. Related Work Specified Elsewhere:
 - 1. Site Preparation and Earthwork: Section 02200.
 - 2. Manholes and Wetwells: Section 02605.
 - 3. Valves, Hydrants and Accessories: Section 02640.
 - 4. Pipe Installation and Testing: Section 02620.
 - 5. Chain-Link Fences and Gates: Section 02831.
 - 6. Concrete: DIVISION 3.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American National Standards Institute (ANSI).
 - a. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - 2. American Iron and Steel Institute (AISI).
 - 3. Anti-Friction Bearing Manufacturer's Association (AFBMA).
 - 4. Hydraulic Institute Standards (HIS).
 - 5. National Electrical Manufacturer's Association (NEMA).
 - 6. Institute of Electrical and Electronics Engineers (IEEE).

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Shop drawings shall be submitted showing materials and assembly of all elements of the pumping station. In addition to pump and motor data to be submitted descriptive literature shall clearly indicate all information necessary to evaluate conformance with specification requirements for all features of the pump station including valves. Complete data for all electrical items, switches, enclosures, relays, motor starters and controls, and a drawing of the control panel layout and a schematic diagram of the control panel circuitry shall be included. Submittals shall include, but not be limited to, the following:
 - 1. Equipment submittals as specified in DIVISION 1.
 - 2. Standard performance curves for each pump model furnished. Curves shall cover range from shutoff to 150% of design flow rate at the conditions specified, and shall be submitted for the following parameters as a function of pump capacity:
 - a. Total developed head.
 - b. Required brake horsepower.
 - c. Pump efficiency.
 - d. Required wire-to-water horsepower.
 - e. Minimum nameplate horsepower with 1.15 derating factor (excluding motor S.F.).
 - f. Required NPSH.
 - g. Minimum recommended submergence.
- C. Report of factory tests.
- D. Top slab details including reinforcement and access hatch catalog cuts.

1.04 QUALITY ASSURANCE:

- A. Factory Tests and Reports:
 - 1. Perform tests on each pump in accordance with Hydraulic Institute Standards except as otherwise specified.
 - 2. Statically balance pump impellers and dynamically balance all pump/motor units such that equipment vibration displaced (peak-to-peak) as measured at any point on the machine shall not exceed 5.0 mils for 1200 r.p.m. and 4.0 mils for 1800 r.p.m.
 - 3. Submit results of factory tests in accordance with DIVISION 1.
 - 4. Perform standard tests on all motors in accordance with IEEE.

1.05 FACTORY ASSEMBLY:

- A. Pump/motor units shall be completely shop assembled and aligned prior to shipping.
- B. After completion of the specified factory tests, pumps shall be prepared for shipment with the

minimum amount of disassembly, and such that no field disassembly, cleaning, or flushing is required.

- C. Any components removed for shipping shall be match-marked prior to removal and shipment.
- D. Prepare all cast iron surfaces and provide manufacturer's standard paint system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. FLYGT
- B. EBARA
- C. KSB
- D. City approved equal.

2.02 GENERAL REQUIREMENTS:

- A. Provide totally sealed submersible electrically operated pumps capable of pumping raw unscreened sewage.
- B. Pumps shall be capable of operating dry continuously for at least 24 hours without damage.
- C. Pump controls shall be as indicated and as specified in this section.
- D. Pump shall operate at or near maximum efficiency at operating conditions.
- E. Pump head-capacity curve shall be continuously falling from shutoff head.
- F. Pump discharge connection elbow and discharge piping shall be installed such that pump will automatically connect and seal to discharge connection elbow when lowered into place.
- G. Pump shall be easily removable for inspection or service.
- H. Provide guide rail system and pump rail guide bracket to raise or lower pump unit by lifting chain.
- I. Guide entire weight of pump unit with a minimum of two guide bars.
- J. Seal interface of the pump and discharge elbow by O-ring, gaskets, or metal to metal contact.
- K. Pumps shall be capable of pumping 3-inch diameter non-compressible solids.
- L. All equipment to be installed inside the wetwell shall be explosion-proof rated for use in Class I, Division 2, Group C and D areas.
- M. Pumping station equipment shall be installed in a concrete wetwell.

2.03 DESIGN REQUIREMENTS: Design requirements will be determined by the Engineer. The following requirements at a minimum shall be established for each pump and provided to the City for review and approval prior to ordering of any equipment. The City shall review all information submitted in a timely manner.

- A. Number of Pumps (2 min.)
- B. Design Capacity
- C. Design Heads:
 - 1. Minimum, ft.
 - 2. Rated, ft. (at Design Capacity)
 - 3. Shutoff, ft. (minimum)
- D. Maximum Motor Speed, rpm (not to exceed 1800 rpm)
- E. Minimum Efficiency at Rating Point, %
- F. Brake horsepower
- G. Wire to Water Horsepower
- H. Minimum Nameplate Motor Horsepower: Nameplate horsepower, regardless of service factor, shall be at least 115 percent of the maximum load imposed by the driven equipment.
- I. Maximum Depth of Water in Wetwell, ft.
- J. Minimum Depth of Water in Wetwell, ft.
- K. Minimum Discharge Elbow Outlet Size, In.

2.04 MATERIALS AND CONSTRUCTION:

- A. Construct motor housing, pump casing, and major pump components of cast iron conforming to ASTM A48.
- B. Provide bolts, nuts, and washers of AISI Series 300 stainless steel.
- C. Impeller:
 - 1. Cast iron.
 - 2. Non-clog design with two discharge ports.
 - 3. Secured to shaft with pinned fasteners to prevent slipping in either direction.
 - 4. Balanced statically and dynamically to eliminate vibration and minimize hydraulic end thrust.
 - 5. Castings shall not have been repaired by plugging, welding, or other means.
 - 6. Provide renewable stainless-steel or Nitrile coated steel casing wearing ring for efficient sealing between volute and impeller.
- D. Shaft:
 - 1. Ample diameter to assure first critical speed will occur at not less than 150% of rated pump speed.

- E. Bearings:
 - 1. Minimum B-10 life of 40,000 hours.
 - 2. Pump shaft to rotate on two (upper and lower) permanently lubricated bearings without end movement.
- F. Shaft Seal:
 - 1. Two mechanical seals arranged in tandem in an oil bath reservoir shall seal pumped liquid from motor compartment.
 - 2. Moisture detector shall be installed in stator housing and connected to pump controls.
 - 3. Seal faces shall be made of tungsten carbide and carbon.
- G. Oil Chamber:
 - 1. Oil chamber shall contain an inspection plug, drain plug and vent plug.
- H. Mating Surface Seals:
 - 1. All mating surfaces of major components shall be machined and fitted with O-rings where watertight sealing is required.
 - 2. The use of elliptical O-rings, gaskets, or seals requiring specific fastener torque to obtain and maintain seal compression and watertightness will not be acceptable.

2.05 ACCESSORIES:

- A. Pump Discharge Base:
 - 1. Base shall be sufficiently rigid to firmly support the guide rails, discharge piping and pumping unit under all operating conditions.
 - 2. Base shall be provided with integral support legs suitable for bolting to the floor of the wetwell with stainless steel anchor bolts.
 - 3. Designed to automatically connect to the pump discharge without bolts.
 - 4. Constructed of cast or ductile iron.
 - 5. Diameter and drilling of the elbow outlet flange shall conform to ANSI B16.1, Class 125.
- B. Rail Guides:
 - 1. Fasten stainless-steel guide supports to pump so that no lifting loads are applied to pump or motor housing.
- C. Lifting Cable:
 - 1. Provide one stainless-steel cable for each pump.
 - 2. Design to raise and lower pump with additional safety factor for overcoming force of pump hang-ups.

3. Provide hook for cable when not in use.
 4. Provide one portable hoist assembly for removal of pumps:
 - a. Hoist shall be electrically operated.
 - b. Hoist shall have mounting plate/socket cast into top of concrete slab.
- D. Guide Rails:
1. Stainless-steel pipe.
 2. All 316 stainless steel, including rails, brackets, and anchor bolts.
 3. Size shall be 2-inch minimum.
 4. Shall not support any portion of the pump weight.
 5. Provide a minimum of two guide rails.
 6. Shall extend to the top of the wetwell at the access hatch cover.
- E. Cable Holder:
1. Provide grip holders for pump and control cables.
 2. Cables shall be easily adjusted to pumping level without splices.
 3. Provide continuous cables from control panel to pumps and level controls.
- F. Access Hatch Cover:
1. Fabricated aluminum hatch suitable for a live load of 150 pounds per square foot with stainless steel accessories.
 2. Spring loaded to minimize opening effort.
 3. Automatic latching mechanism shall prevent the hatch from closing unintentionally.
 4. Double leaf type construction of structural shapes and reinforced diamond pattern checkered plate.
 5. Structural shapes and plates shall have a minimum thickness of 1/4 inch.
 6. Hatch Cover shall be set in concrete top. All aluminum surfaces to be in contact with concrete shall be given a heavy coat of coal tar paint.

2.06 ELECTRICAL EQUIPMENT:

- A. Conform to NEC, NEMA and IEEE on all electrical equipment and controls.
- B. Controls:
1. Wetwell level and alarm controls shall be 120 volt and shall be provided by sealed float type mercury switches. The mercury tube switches shall be hermetically sealed stainless steel capsule surrounded by polyurethane foam and encased in polypropylene for

corrosion and shock resistance.

2. The support wire for each float switch shall have a neoprene jacket.
 3. The float shall contain an internal weight to hold the switch in place in the wetwell.
 4. Each float switch shall hang in the wetwell supported only by the individual cord connected thereto.
 5. Three level sensors (normally-open) shall be provided for automatic operation with an electric alternator. The lower control shall be at the turn-off level, the upper control is set at the turn-on level required and the override control is set above the upper control so that both pumps will come on if the level rises above upper control. If one pump fails for any reason, the other pump shall automatically operate on the override control until trouble is corrected. A fourth level sensor (normally-open) shall be used to operate a high level alarm and relay to a telephone dialer in the control panel. Alarm shall be audio and visual. A fifth level sensor (normally-closed) shall be provided and used to operate a low level alarm and turn off any pumps that are running and relay to a telephone dialer in the control panel. Alarm shall also be audio and visual.
- C. Provide the electrical control panel, motor starters, and pump controls as indicated on the drawing. Control shall include indicating lights for pump run, moisture detection, overload and thermal trip. All lighted indicators shall be push to test.
- D. Prefabricated Exterior Control Panel Design Requirements:
1. NEMA Type 4X enclosure with gasketed hinged door, padlock hasp, screw-type door clamps and padlock.
 2. Interior steel mounting panel.
 3. Sized to house motor starters, relays, alternator, etc.
 4. Mount on unistruct rack that is sized adequate to hold the two disconnect switches and the common control panel.
 5. Watertight termination fittings for all pipes and conduits entering enclosure.
 6. Interior of box insulated with 1-inch-thick noncombustible Styrofoam board insulation with foil facing.
 7. Chromalox 150-watt (minimum) Type S strip heater and a Chromalox WR-90 thermostat wired to power supply terminal block through a 5-A cartridge type fuse.
 8. Furnished by pump manufacturer.
 9. Panel shall be equipped with a HAND-OFF-AUTO switch for operation.
 10. Panel shall be provided with a run time meter for each pump. Meter shall be calibrated in one-hundredth hour increments.
 11. An automatic alternator with manual switch shall be provided to change the sequence of operation at the end of each pumping cycle. The manual switch shall allow for either pump to be selected as lead pump or for automatic alternation. Timed alternation will not be acceptable. The alternator shall have a light indicating which pump is in the lead. In the event that either pump is out of service the alternator shall be bypassed.

12. Control panel shall be provided with 120 volt single phase service receptacle.

E. Submersible motors.

1. Each pump shall be driven by an air-cooled, totally submersible, electric motor furnished by the pump manufacturer.
2. Each motor shall be rated 480 volts, 60 Hz, 3-phase.
3. The starter housing shall be an air-filled, watertight casing.
4. Motor insulation shall be moisture resistant, Class F, 155°C and shall be NEMA Design B for continuous duty.
5. Each pump motor shall be provided with a special cable suitable for submersible pump applications.
6. Cable size shall conform to NEC requirements.
7. The cable entry water seal design shall be such that a specific fastener torque is not required to ensure a watertight and submersible seal. The use of epoxies, silicones or other secondary sealing systems will not be acceptable.
8. Three additional pump/motor tags shall be provided for each motor/pump unit. Each set shall have identical information as the corresponding motor/pump set.

F. Alarm System.

1. The alarm system shall be activated in cases of power failure, pump failure, low or high water level, unauthorized entry and all available generator alarms based on the approved make/model of generator (example: low fuel, over-temp, low oil pressure).
2. Alarm system shall activate a red warning light located on the electric service pole, an audible horn, and a telephone dialer. Telephone dialer shall be RACO Chatterbox Model CB or approved equal with a minimum of eight discreet inputs. The red warning light and audible horn shall have separate on/off switches. The horn shall have a sound pressure level of at least 100 dB at ten(10) feet and be housed in a weather proof box. The horn and light shall be provided with battery back-up in the case of a power failure. The alarm system shall be enclosed in a weather-proof housing.

2.07 EMERGENCY OPERATION:

- A. All pump stations shall provide overflow protection by means of a riser from the force main with quick connect coupling and appropriate valving to hook up portable pumps.
1. The diameter of the quick connect coupling shall be designated by the City.
 2. Riser assembly shall be housed in a concrete vault. Riser assembly shall include a check valve and a plug type shutoff valve.
 3. Access to the assembly shall be through an aluminum hatch cover cast into the top slab. Hatch cover shall be provided by the pump manufacturer and meet requirements covered in Section 2.05(F).
 4. All valves, piping and fittings shall be field painted. Field painting shall consist of a minimum of two coats of epoxy enamel paint. Color to be selected by the City.

- B. Pumping stations designated by the City as temporary shall be provided with a quick couple connection for a portable generator. Quick couple connection type shall be compatible with existing City of Cassville equipment.
- C. Pump stations not designated temporary by the City shall provide overflow protection by a quick connect coupling and one of the following methods:
 - 1. Connection to two independent public utility sources, or;
 - 2. Provide power generating equipment.
 - a. Provide low fuel alarm relay to telephone dialer.
 - b. Provide automatic transfer switch.
 - c. The telephone dialer shall be engaged upon transfer of power to the standby generator.
 - d. Provide automatic day/time selection timer to exercise the generator at user's selectable time.
 - e. Type of fuel to be determined by the City and on board fuel storage volume shall be sufficient for 24 hours of continuous operation under full load.

2.08 VENTILATION

- A. Pump station wetwell shall be provided with adequate ventilation.
- B. Ventilation piping shall be provided with 1/4-inch screen mesh.

2.09 STATION GROUNDS

- A. Fencing:
 - 1. A chain-link fence shall be provided around the pump station.
 - 2. The fence shall have a fabric height of six feet and be provided with three barbed wire strands above the top of the fabric.
 - 3. The fence shall be provided with a 12-foot wide double-leaf gate with locking system.
- B. Valve Vault:
 - 1. A suitable valve vault shall be provided to house a plug valve and check valve from the discharge of each pump. Check valve shall be located between the plug valve and the pump. Valves shall be placed only in horizontal pipe runs. Valves shall not be located in the wetwell.
 - 2. Check valves shall be as specified in other sections of the specification.
 - 3. Plug valves shall be as specified in other sections of this specification.
 - 4. Valve vault shall be constructed of concrete and be provided with an aluminum access hatch cover of similar design and manufacture of the hatch cover provided for the wetwell. Access hatch cover shall be of single leaf design and be a minimum of 30 inches

by 30 inches.

5. Provide drain connecting vault to wetwell. Provide a shut off valve in the drain piping between the vault and wetwell. Shut off valve shall be provided with a valve box and extension stem if it is located exterior to the structures.
6. All valves, piping and fittings shall be field painted. Field painting shall consist of a minimum of two coats of epoxy enamel paint. Color to be selected by the City.

C. Gravel Surfacing:

1. Crushed rock: Gradation of 3/4-inch to 1-inch sizes.
2. The area inside the fence shall be provided with a minimum of 4 inches of gravel surfacing on a four mil polyethylene sheeting placed over entire enclosed area. Polyethylene sheeting shall be provided with 3 -one inch holes per square yard.
3. Treat soil with soil sterilant prior to sheeting application.

D. Outside Lighting:

1. An outside weatherproof pole mounted light shall be provided.
2. Light shall be of the high-pressure sodium type with electric eye (photo cell) for dusk to dawn operation.

E. Access Road:

1. Pump station shall be provided with an asphalt access road/drive.
2. Access road shall be 12 feet wide and extend from the pump station gate to the concrete driveway entrance.
3. Access road shall be constructed in accordance with Section 02512 and consist of 4 inches of Type 301 base on 6 inches of rolled stone base.
4. Access road shall have a turn-around provided at the pumping station.

F. Water Supply:

1. Provide metered water supply to pumping station with a 3/4" freeze proof yard hydrant within perimeter fence.

PART 3 - EXECUTION

3.01 INSTALLATION, START-UP, AND TESTING: All Work shall conform to manufacturer's recommendations.

3.02 MANUFACTURER'S FIELD SERVICE: Provide installation, start-up and testing services for all equipment.

3.03 INSTALLATION:

- A. Make all electrical and control connections.
- B. Provide all necessary lubrication for initial start-up, testing and as required for final acceptance.
- C. Provide a complete unit with all materials, components and adjustments as required for successful operation.
- D. Installation, start-up and setting of all equipment and associated construction shall conform to manufacturer's recommendations.
- E. Do not place grout for pump discharge bases until pumps are completely aligned.
- F. Install pipe and pipe appurtenance supports to minimize stresses being placed on pump nozzles.
- G. Electrical junction boxes not permitted inside wetwell.

3.04 PERFORMANCE TESTS:

- A. Conduct in the presence of Contractor, Engineer and City.
- B. Equipment Tests:
 - 1. Check performance of all components as a functioning unit.
 - 2. Check alignment of each unit.
- C. Operational Tests:
 - 1. Conduct such operational tests as necessary to determine that the performance of equipment and controls is as specified.
 - 2. Tests will generally consist of placing equipment in operation under varying conditions and observing performance.
- D. Make all necessary equipment adjustments and corrective work indicated by tests.
- E. Submit a written test report to Contractor with one copy to Engineer in a letter form stating operations performed and results obtained for each unit.
- F. Wetwell hydrostatic tests as specified for Manhole Water Testing in the Pipe Installation and Testing Section.

3.05 PAINTING: Prepare surfaces of damaged and uncoated areas and touch-up as required for complete protection.

END OF SECTION 11151

SECTION 11152

WETWELL MOUNTED WASTEWATER PUMPING STATION

PART 1 - GENERAL

1.01 SUMMARY:

- A. This section covers a wetwell mounted duplex pumping station to be furnished and installed complete with all equipment and appurtenances specified or required to provide a complete and satisfactory pumping installation.
- B. Pumping stations shall be:
 - 1. Capable of pumping raw wastewater.
 - 2. Furnished with all equipment and appurtenances and shall be constructed, assembled and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the pumping station manufacturer unless exceptions are noted by the Engineer.
- C. The principal items of equipment shall include two vertical, close-coupled, motor driven, vacuum primed, non-clog sewage pumps; valves; internal piping; central control panel with circuit breakers; motor starters and automatic pumping level controls; heater; ventilating blower; priming pumps and appurtenances; and all internal wiring.
- D. Related Work Specified Elsewhere:
 - 1. Site Preparation and Earthwork: SECTION 02200.
 - 2. Manholes and Wetwells: SECTION 02605.
 - 3. Valves, Hydrants and Accessories: SECTION 02605.
 - 4. Pipe Installation and Testing: SECTION 02620.
 - 5. Chain-Link Fences and Gates: SECTION 02831.
 - 6. Concrete: DIVISION 3.
 - a. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American National Standards Institute (ANSI).
 - 2. American Iron and Steel Institute (AISI).
 - 3. Anti-Friction Bearing Manufacturer's Association (AFBMA).
 - 4. Hydraulic Institute Standards (HIS).
 - 5. National Electrical Manufacturer's Association (NEMA).

6. Institute of Electrical and Electronics Engineers (IEEE).
7. American Society for Testing and Materials (ASTM):
 - a. A48 - Gray Iron Castings.
 - b. A307 - Specification for Carbon Steel Bolts and Studs.
8. American Water Works Association (AWWA):
 - a. C151 - Ductile Iron Pipe, Centrifugally Cast for Water or Other Liquids.
 - b. C110 - Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Submittals shall include, but not be limited to, the following:
 1. Equipment submittals as specified in DIVISION 1.
 2. Shop drawings shall be submitted showing materials and assembly of all elements of the pumping station. In addition to pump and motor data to be submitted descriptive literature shall clearly indicate all information necessary to evaluate conformance with specification requirements for all features of the pump station including valves. Complete data for all electrical items, switches, enclosures, relays, motor starters and controls, and a drawing of the control panel layout and a schematic diagram of the control panel circuitry shall be included and permanently laminated to the inside door of the control panel. Information submitted shall include but not limited to the following:
 - a. Pump data
 - (1) Name of manufacturer
 - (2) Type and Model
 - (3) Design and Model
 - (4) Size of pump suction inlet
 - (5) Size of pump discharge
 - (6) Type and number of bearings
 - (7) Maximum bhp requirement of pump at any total head above specified minimum for continuous operation
 - (8) Maximum diameter of test sphere
 - (9) Complete performance curves showing capacity, head, NPSH requirements, efficiency and bhp requirements
 - (10) Shaft diameter

(11) Type of pump seal

b. Motor data

(1) Name of manufacturer

(2) Type designation

(3) Rated size of motor (hp), service factor, and temperature rating

(4) Full load rotative speed

(5) Weight

(6) Input-output efficiency at:

(i) Full Load

(ii) Rated Pump Condition

(7) Full load current

(8) Locked rotor current

(9) Shaft diameter

(10) Type of lubricant

(11) Description of special moisture resistant treatment of motor air gap surfaces.

C. Report of factory tests.

D. Top slab details including reinforcement and access opening layout.

1.04 QUALITY ASSURANCE:

A. Factory Tests and Reports: Before shipment from the factory, the pumping station shall be operated to check alignment, faulty equipment and controls, proper wiring, leaks in piping, seals, or welds, and proper operation of the automatic control system and auxiliary equipment. Pump suction and discharge lines shall be connected to a water tank and the sewage pumps operated at least one hour to simulate the field service conditions. The automatic control shall be adjusted to the specified levels.

Defective equipment and materials disclosed by such tests shall be replaced and the station placed in satisfactory operating condition before shipment.

1.05 FACTORY ASSEMBLY:

A. Pump/motor units shall be completely shop assembled and aligned prior to shipping.

B. After completion of the specified factory tests, pumps shall be prepared for shipment with the minimum amount of disassembly, and such that no field disassembly, cleaning, or flushing is required.

- C. Any components removed for shipping shall be match-marked prior to removal and shipment.
- D. Prepare all cast iron surfaces and provide manufacturer's standard paint system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Smith & Loveless, Inc.
- B. City approved equal.

2.02 PUMPING STATION CONSTRUCTION:

- A. The pumping station shall be constructed as one complete factory-built assembly.
- B. Pumping station shall be sized to rest on the top of the wetwell as detailed on the construction drawings. The supporting floor plate shall be minimum 3/8" thick steel with broken down edges or other reinforcing, as required, to prevent deflection and insure an absolutely rigid support.
- C. The pump station shall be enclosed by an insulated fiberglass cover. The cover shall be hinged and have a suitable drip-lip around the edge and shall be provided with a hasp and staple connection to the floor plate to allow the pump chamber to be locked with a padlock. The cover shall have a latch mechanism to keep the cover open under load. Adjustable ventilating louvers shall be provided on each end of the fiberglass cover which are capable of being closed during cold weather operation.
- D. A steel manway cover located exterior to the fiberglass pump chamber shall be provided, complete with padlocking provisions. The manway shall be an integral part of the station floor plate and provide access to the wetwell.

2.03 SEWAGE PUMPING EQUIPMENT: The sewage pumping equipment to be furnished and installed shall consist of vertical non-clog sewage pumps, each complete with all specified accessories and appurtenances. Pumps shall be close coupled. All pumps in the station shall be the same type.

2.04 DESIGN REQUIREMENTS: Design requirements will be determined by the Engineer. The following requirements at a minimum shall be established for each pump and provided to the City for review and approval prior to ordering of any equipment. The City shall review all information submitted in a timely manner.

- A. Number of Pumps (2 min.)
- B. Rated Total Head, ft.
- C. Capacity at Rated Head, gpm
- D. Normal Operating Head Range, ft
- E. Min. Total Head for continuous operation, feet
- F. Min. Shutoff Head, feet
- G. Max. pump operating speed, rpm (not to exceed 1800)

- H. Max. bhp Required at the Motor for any Point in the Operating Head Range
- I. Min. Diameter of Test Sphere, inches (3 inch min.)
- J. Min. Suction Inlet Diameter, inches
- K. Min. Discharge Outlet Diameter, inches
- L. Head losses through the pump are not included in the total pumping heads stipulated in the foregoing design data tabulation.
- M. Each unit shall be designed so that reverse rotation is either prevented or will not damage any part of the unit.

2.05 MATERIALS AND CONSTRUCTION:

A. Pump Material:

- 1. Case, Cast iron, ASTM A48
- 2. Impeller, Cast iron, ASTM A48
- 3. Shaft, Stainless steel or carbon steel with stainless steel sleeve
- 4. Mechanical Seal, Durametallic "Dura Seal", double seal, carbon and ceramic with No. 9 or better carbon rings, or equivalent.

B. Close-Coupled Pump Construction:

- 1. Case: Such that impeller can be removed without disconnecting piping.
- 2. Suction and Discharge Flange: ANSI 125 lb.
- 3. Impeller: One piece enclosed "non-clog" type with two discharge ports, locked to shaft with pinned fastener.
- 4. Shaft: Pump-motor shaft shall be one-piece stainless steel construction with shaft extension turned, ground, and polished and provided with tapered end for easy impeller removal.
- 5. Minimum Shaft Diameter: 1-7/8 inches through the mechanical seal. This minimum shaft diameter will not apply to pumps having a carbide bearing immediately above the impeller hub as furnished by Baldwin-Lima-Hamilton.
- 6. Mechanical Seal: Lubricated with water from pump discharge, through a filter that screens out all solids larger than 50 microns. Provide a replacement pump shaft seal assembly, a spare volute gasket, and a spare filter cone for each pump.
- 7. Accessories: Gage cock on each suction and discharge nozzle.

C. Balance:

- 1. All rotating parts shall be accurately machined and in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at

normal operating speeds is avoided.

2. At any operating speed, the ratio of rotative speed to critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

D. Motors:

1. Motors shall be drip proof, NEMA Design B, not over 60 degrees C rise on continuous duty, with a 1.15 service factor, suitable for 480 volt, 60 Hz, 3 phase power supply.
2. Nameplate horsepower rating shall be equal or be greater than the maximum load imposed by the pump when at any head in excess of minimum head specified for continuous operation.
3. Each motor shall have special moisture resistant insulation and the rotor and stator air gap metal surfaces shall be coated with rust preventive compound.
4. Bearings shall be effectively protected from contamination and dirt. Grease lubricated bearings shall be provided with relief facilities positively preventing over greasing. Oil lubricated bearings shall have idle and running oil level indication. Motor bearings shall be antifriction type with an average life of not less than 10 years. Motors shall have engraved or stamped nameplates and the bearings and lubricant identity permanently marked.
5. Each motor shall be fitted with heavy lifting eyes or lugs designed to support the entire weight of the pump and motor.

E. Shop Tests:

1. Each pump shall be shop tested for capacity, power requirement, and efficiency at specified minimum head for continuous operation, rated head, shutoff head, and at as many other points as necessary for accurate performance curve plotting in each case. All tests shall be made in conformity with the requirements and recommendation of the Hydraulic Institute. Shop tests shall be conducted by the pump manufacturer or by the pumping station manufacturer after installation in the pumping station.
2. Not less than five certified copies of a report covering each test, and capacity, power, and efficiency curves based on shop tests results shall be prepared and delivered to the Engineer not less than 10 days prior to shipment of the equipment from the factory.

- F. Responsibility: The manufacturer of the pumping station assembly shall be responsible for proper installation, alignment, and operating conditions of the pumping equipment when placed in service.

2.06. PUMPING STATION ELECTRICAL SYSTEM:

A. General:

The pumping station shall be designed for 3 phase, 3 wire, 480 volt power service. Single phase, 120 volt auxiliary power requirements and 24 volt control power requirements shall be provided for by furnishing suitably sized dry type transformers within the station. All wiring shall conform to the National Electrical Code and shall comply with local regulations and ordinances of the community for which the station is constructed.

B. Cable:

1. Except for continuation of exterior cables, cable and wiring shall be factory installed.
2. On stations where the disconnect means employ more than one breaker, breaker cable lugs shall be sized to fully accommodate both service entrance conductors and branch service conductors.
3. Removal of outer strands of conductors to make up branch connections will not be permitted.
4. Thermoplastic insulated neoprene covered service entrance conductors of the size required shall be provided.
5. All power and control cable installed in the station shall be copper, insulated for 600 volts, 75C, wet and dry locations, Underwriters Laboratories Type RHH for power cable and Type RHH or THW for control cable.
6. All wires and cables shall be identified on both ends with permanent system and referenced on schematics and as-builts.

C. Equipment:

1. All equipment and devices expressly intended as a means of switching, adjusting, or actuating shall be mounted within convenient reach of an attendant.
2. Externally operable circuit breaker type disconnect means shall permit disconnecting all phase conductors in the station from service entrance conductors.
3. Control and switching equipment enclosures shall be NEMA Type 4X finished steel of rigid heavy-duty construction. Enclosures housing an assembly of switches, contractors, relays, starters, etc., shall have hinged doors with latches.
4. Each pump and motor and auxiliary circuit shall be provided with thermal-magnetic circuit breakers. Breakers for 3 phase loads shall be 3 pole. All breakers shall be operable from outside the control panel.
5. A three position selector switch with HAND-OFF-AUTO position shall be flush mounted on the panel door for operation of each pump motor.
6. Auxiliary and control power may be supplied through a circuit breaker load center.
7. All equipment shall be identified by nameplates and device identifications in agreement with wiring diagrams.
8. Panel shall be provided with a run time meter for each pump. Meter shall be calibrated in one-hundredth hour increments.

D. Panel Wiring:

1. All control wiring in switching and control assemblies shall be color coded or numbered. Color coding shall be such that electrically common interconnections of devices are the same color. The colors may be used more than once but not in the same circuit or cable grouping. Color of plug-in cord conductors does not need to comply with the color code.
2. The power and control enclosure shall contain ground lugs or an AWG ground in the service entrance circuit and each ground cable to devices in the station.

3. The enclosure shall be well grounded to the station shell by mounting or by an AWG bond jumper. Control panel shall be provided with a 120 volt service receptacle.

E. Controls:

1. Wetwell level and alarm controls shall be 120 volt and shall be provided by sealed float type mercury switches. The mercury tube switches shall be a hermetically sealed stainless steel capsule surrounded by polyurethane foam and encased in polypropylene for corrosion and shock resistance.
2. The support wire for each float switch shall have a neoprene jacket.
3. A weight shall be attached to each support cord above the float to hold the switch in place in the wetwell. Weight shall be above the float to effectively prevent sharp bends in the cord when the float operates.
4. Each float shall contain an internal weight to hold the switch in place in the wetwell. Each float switch shall hang in the wetwell supported only by the individual cord connected thereto.
5. Three level sensors (normally-open) shall be provided for automatic operation with an electric alternator. The lower control shall be at the turn-off level, the upper control is set at the turn-on level required and the override control is set above the upper control so that both pumps will come on if the level rises above upper control. If one pump fails for any reason, the other pump shall automatically operate on the override control until trouble is corrected. A fourth level sensor (normally-open) shall be used to operate a high level alarm and relay to a telephone dialer in the operations building. A fifth level sensor (normally-closed) shall be provided and used to operate a low level alarm and turn off any pumps that are running and relay to a telephone dialer in the control panel. Alarm shall be audio and visual.
6. An automatic alternator with manual switch shall be provided to change the sequence of operation at the end of each pumping cycle. The manual switch shall allow for either pump to be selected as lead pump or for automatic alternation. Timed alternation will not be acceptable. The alternator shall have a light indicating which pump is in the lead.

- F. Wiring Diagram: The manufacturer shall provide both connection diagrams and schematics, identifying all items in wiring connections in accordance with terminal identification of equipment.

2.07. ALARM SYSTEM:

- A. The alarm system shall be activated in case of power failure, pump failure, low or high water level, unauthorized entry and all available generator alarms based on the approved make/model of generator (example: low fuel, over-temp, low oil pressure).
- B. Alarm system shall activate a red warning light located on the electric service pole, an audible horn and a telephone dialer. Telephone dialer shall be RACO "Chatterbox". The red warning light and audible horn shall have separate on/off switches. The horn shall have a sound pressure level of at least 100 dB at ten (10) feet and be housed in a weather proof box. The horn and light shall be provided with battery back-up in case of power failure. The alarm system shall be enclosed in a weather-proof housing.

2.08. PIPING:

- A. Except where otherwise shown, all sewage piping shall be ductile iron as specified in Section

02615.

- B. Mechanical joints shall conform to AWWA C111 and flanges shall be Class 125, AWWA C110.
- C. All pipe and fittings shall be coated as specified in Section 02615.
- D. Flange bolts and nuts shall be ASTM A307, Grade B, of such length that, after installation, bolts will project 1/8 to 3/8 inch beyond the outer face of the nut.
- E. Flange gaskets shall be of ring type made from 1/16-inch thick red rubber or other approved material.
- F. Flanged or mechanical joint pipe and fittings shall be used inside the pumping station, and mechanical joint type bells shall be provided outside the station walls as shown on the drawings.

2.09 VALVES:

- A. Each pump discharge shall be provided with an eccentric plug valve and a spring loaded check valve. Valves shall be as specified in the Section 02640.

2.10. VENTILATING BLOWER AND HEATER:

- A. A ventilating blower shall be provided, capable of delivering 250 cfm at 0.1 inch static water pressure, in order to remove the heat generated by continuous motor operation. The ventilating blower shall be turned on and off automatically by a pre-set thermostat. The ventilating lower shall be rigidly mounted from the station floor. The discharge outlet shall have a thick resilient gasket which will match with a louvered opening in the fiberglass cover to seal the discharge to the cover when the cover is closed. A 500-watt electric heater controlled by a pre-set thermostat shall be furnished. The heater shall be rigidly mounted in the station to prevent removal.

2.11. VACUUM PRIMING SYSTEM:

- A. A separate and independent priming system shall be furnished for each sewage pump, providing complete standby operation. Each priming system shall include a separate vacuum pump. Vacuum pumps shall have corrosion resistant internal components. They shall each be capable of priming the sewage pump and suction piping in less than 60 seconds under rated static suction lift conditions of 20 feet at mean sea level.
- B. Each priming system shall be complete with vacuum pump, vacuum control solenoid valve, prime level sensing probe, and a float operated check valve installed in the system ahead of the vacuum pump to prevent liquid from entering the vacuum pump. The float-operated check valve shall have a transparent body for visual inspection of the liquid level and shall be automatically drained when the vacuum pump shuts off.
- C. The priming system shall automatically provide positive lubrication of the mechanical seal each time the sewage pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which sewage must pass shall be smaller than the equivalent of a 2-1/2" opening.

2.12 EMERGENCY OPERATION:

- A. All pump stations shall provide overflow protection by means of a riser from the force main with quick connect coupling and appropriate valving to hook up portable pumps.

1. The diameter of the quick connect coupling shall be designated by the City.
 2. Riser assembly shall be housed in a concrete vault. Riser assembly shall include a check valve and a plug type shutoff valve.
 3. Access to the assembly shall be through an aluminum hatch cover cast into the top slab. Hatch cover shall be provided by the pump manufacturer and meet requirements covered in Section 11151, paragraph 2.05(F).
- B. Pumping stations designated by the City as temporary shall be provided with a quick couple connection for a portable generator. Quick couple connection type shall be compatible with existing City of Cassville equipment.
- C. Pump stations not designated temporary by the City shall provide overflow protection by a quick connect coupling and one of the following methods:
1. Connection to two independent public utility sources, or;
 2. Provide power generating equipment.
 - a. Provide low fuel alarm relay to telephone dialer.
 - b. Provide automatic transfer switch. The telephone dialer shall be engaged upon transfer of power to the standby generator.
 - c. Provide automatic day/time selectable timer to exercise the generator at user's selectable times.
 - d. Type of fuel to be determined by the City and on board storage volume shall be sufficient for 24 hours of continuous operation under full load.

2.13 STATION GROUNDS:

- A. Fencing:
1. A chain-link fence shall be provided around the pump station.
 2. The fence shall have a fabric height of six feet and be provided with three barbed wire strands above the top of the fabric.
 3. The fence shall be provided with a 12-foot wide double-leaf gate with locking system.
- B. Gravel Surfacing:
1. Crushed rock: Gradation of 3/4-inch to 1-inch sizes.
 2. The area inside the fence shall be provided with a minimum of 4 inches of gravel surfacing on a four mil polyethylene sheeting placed over entire enclosed area. Polyethylene sheeting shall be provided with 3 -one inch holes per square yard.
 3. Treat soil with soil sterilant prior to sheeting application.
- C. Outside Lighting:
1. An outside weatherproof pole mounted light shall be provided.

2. Light shall be of the high-pressure sodium type with electric eye (photo cell) for dusk to dawn operation.
- D. Access Road:
1. Pump station shall be provided with an asphalt access road/drive.
 2. Access road shall be 12 feet wide and extend from the pump station gate to the concrete driveway entrance.
 3. Access road shall be constructed in accordance with Section 02512 and consist of 4 inches of Type 301 base on 6 inches of rolled stone base.
 4. Access road shall have a turn-around provided at the pumping station.
- E. Water Supply:
1. Provide metered water supply to pumping station with a 3/4" freeze proof yard hydrant within perimeter fence.

PART 3 - EXECUTION

3.01 INSTALLATION, START-UP, AND TESTING: All Work shall conform to manufacturer's recommendations.

3.02 MANUFACTURER'S FIELD SERVICE: Provide installation, start-up and testing services for all equipment.

3.03 INSTALLATION:

- A. Make all electrical and control connections.
- B. Provide all necessary lubrication for initial start-up, testing and as required for final acceptance.
- C. Provide a complete unit with all materials, components and adjustments as required for successful operation.
- D. Installation, start-up and setting of all equipment and associated construction shall conform to manufacturer's recommendations.
- E. Electrical junction boxes not permitted inside wetwell.

3.04 PERFORMANCE TESTS:

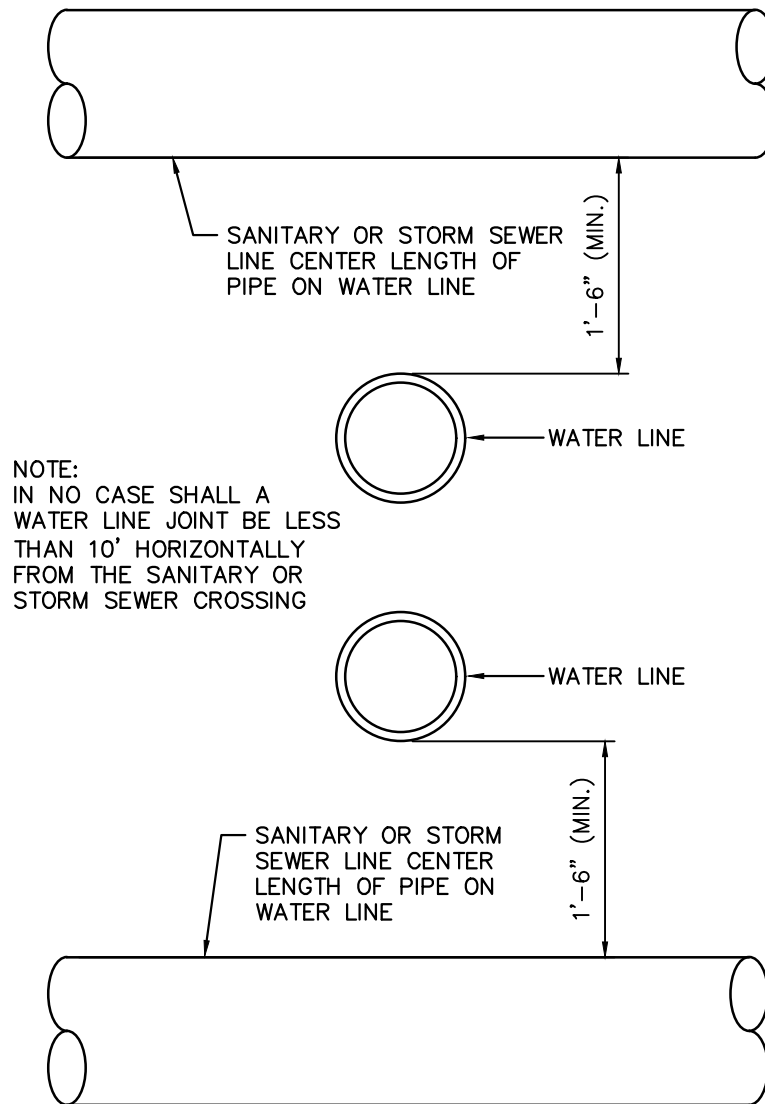
- A. Conduct in the presence of Contractor, Engineer and City.
- B. Equipment Tests:
 1. Check performance of all components as a functioning unit.
 2. Check alignment of each unit.
- C. Operational Tests:
 1. Conduct such operational tests as necessary to determine that the performance of equipment and controls is as specified.

2. Tests will generally consist of placing equipment in operation under varying conditions and observing performance.
- E. Make all necessary equipment adjustments and corrective work indicated by tests.
- F. Submit a written test report to Contractor with one copy to Engineer in a letter form stating operations performed and results obtained for each unit.
- G. Wetwell hydrostatic tests as specified for Manhole Water Testing in the Pipe Installation and Testing Section.

3.05 PAINTING AND CORROSION PROTECTION:

- A. Preparation of surfaces to be painted and all painting shall be done in the shop before shipment of the station assembly so that field painting will be limited to coating joints or areas not previously painted, or damaged or abraded areas.
- B. All pumps, motors, the control cabinet, and controls, and other machines or equipment shall be painted in the shop using epoxy coating or machinery enamel.
- C. All painted surfaces damaged during shipment or installation shall be repainted using the same or equivalent materials as used in the original application.
- D. All field welded joints, together with all edge and joint surfaces of plates and structural members not previously painted and surfaces from which damaged paint has been removed, shall be prepared for painting by sandblasting or high-speed wire brushing or other effective mechanical means. All such surfaces shall then be painted with the same or equivalent materials as used in the original application.

END OF SECTION 11152

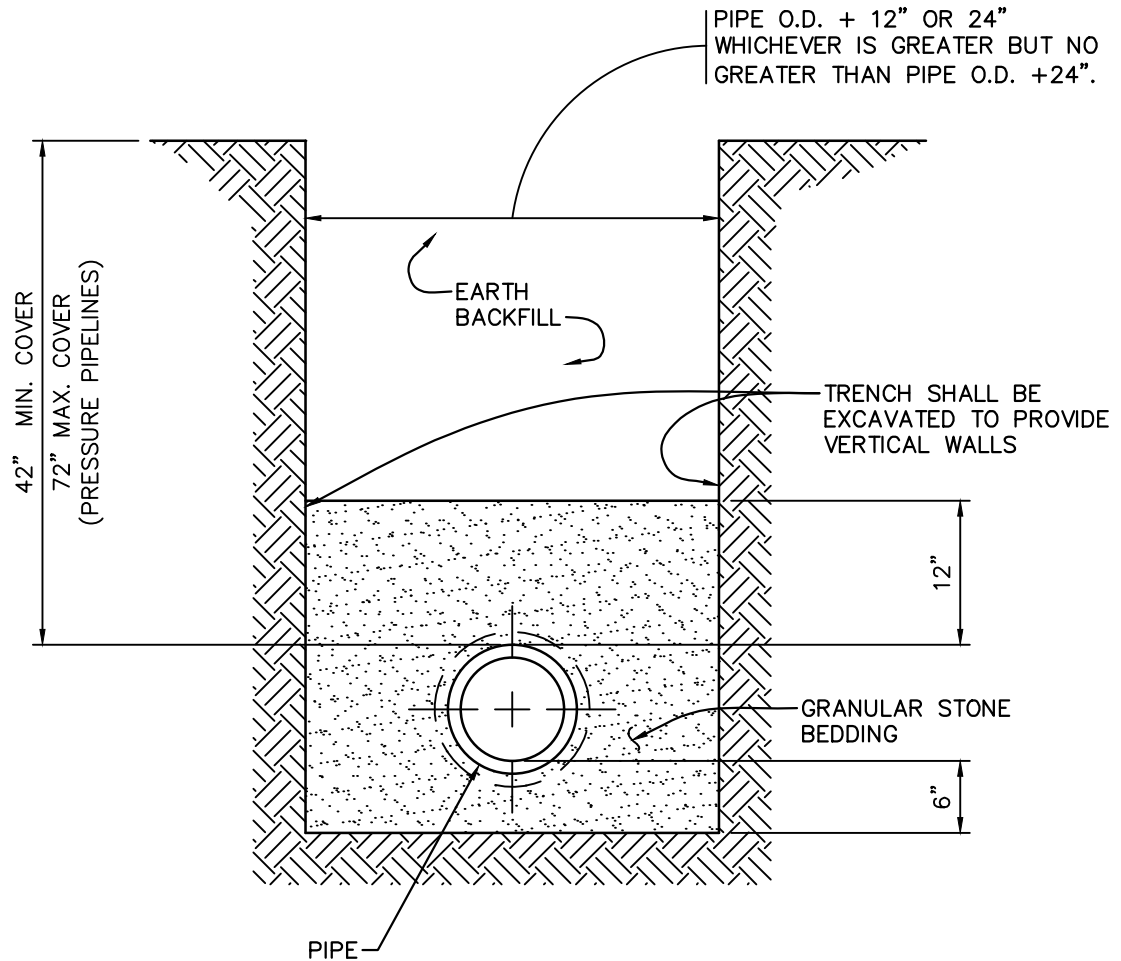


N.T.S.

WATER & SEWER LINE CROSSING DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
CITY OF CASSVILLE, MO

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CONSULTING ENGINEERS and SURVEYORS
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SCALE: 3/4" = 1'-0"

STANDARD TRENCH & BEDDING DETAIL
STANDARD CONSTRUCTION DETAILS

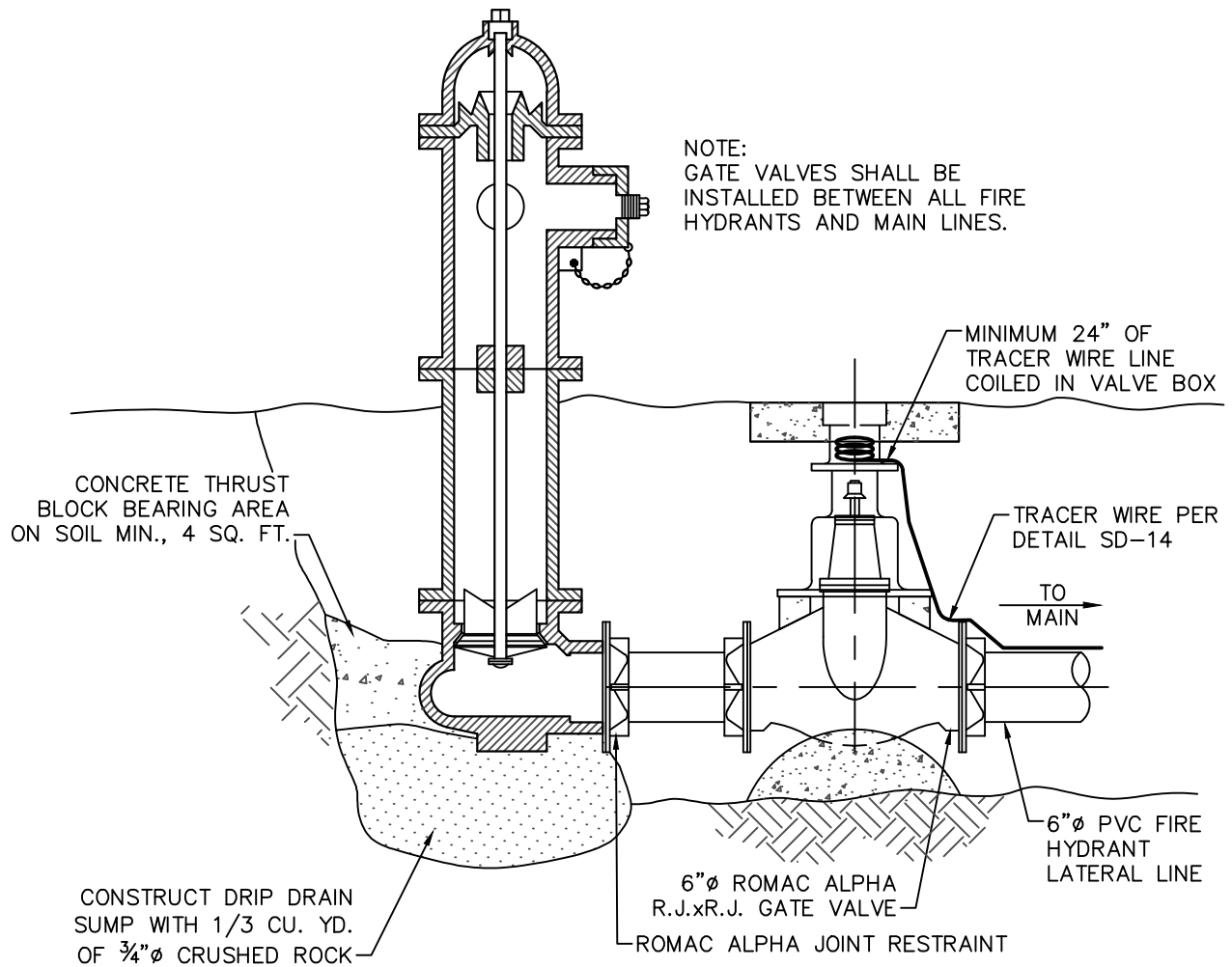
FEBRUARY 2020
CITY OF CASSVILLE, MO



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5¼", 3-WAY FIRE HYDRANT
WITH A MIN. 42" BURY DEPTH.



N.T.S.

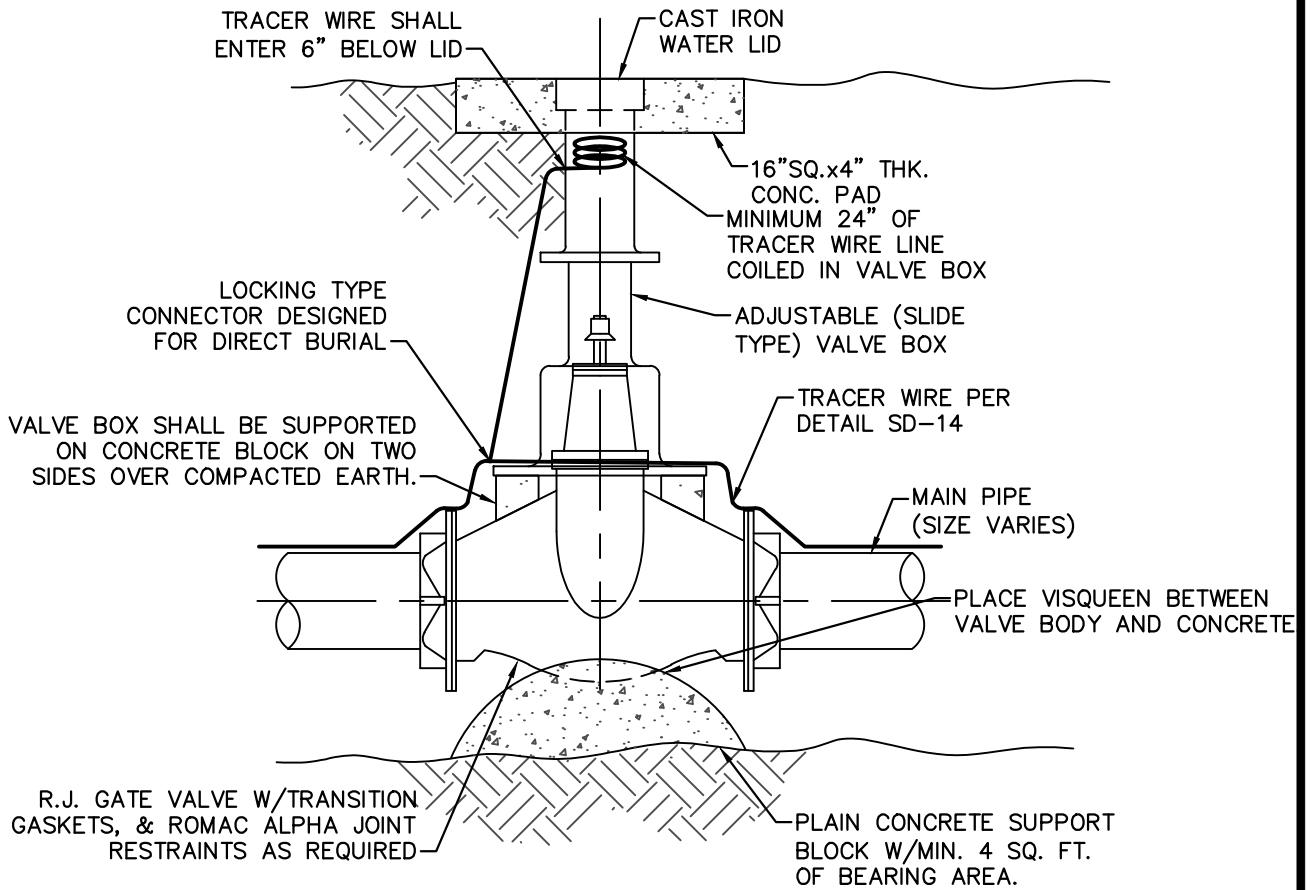
FIRE HYDRANT INSTALLATION
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
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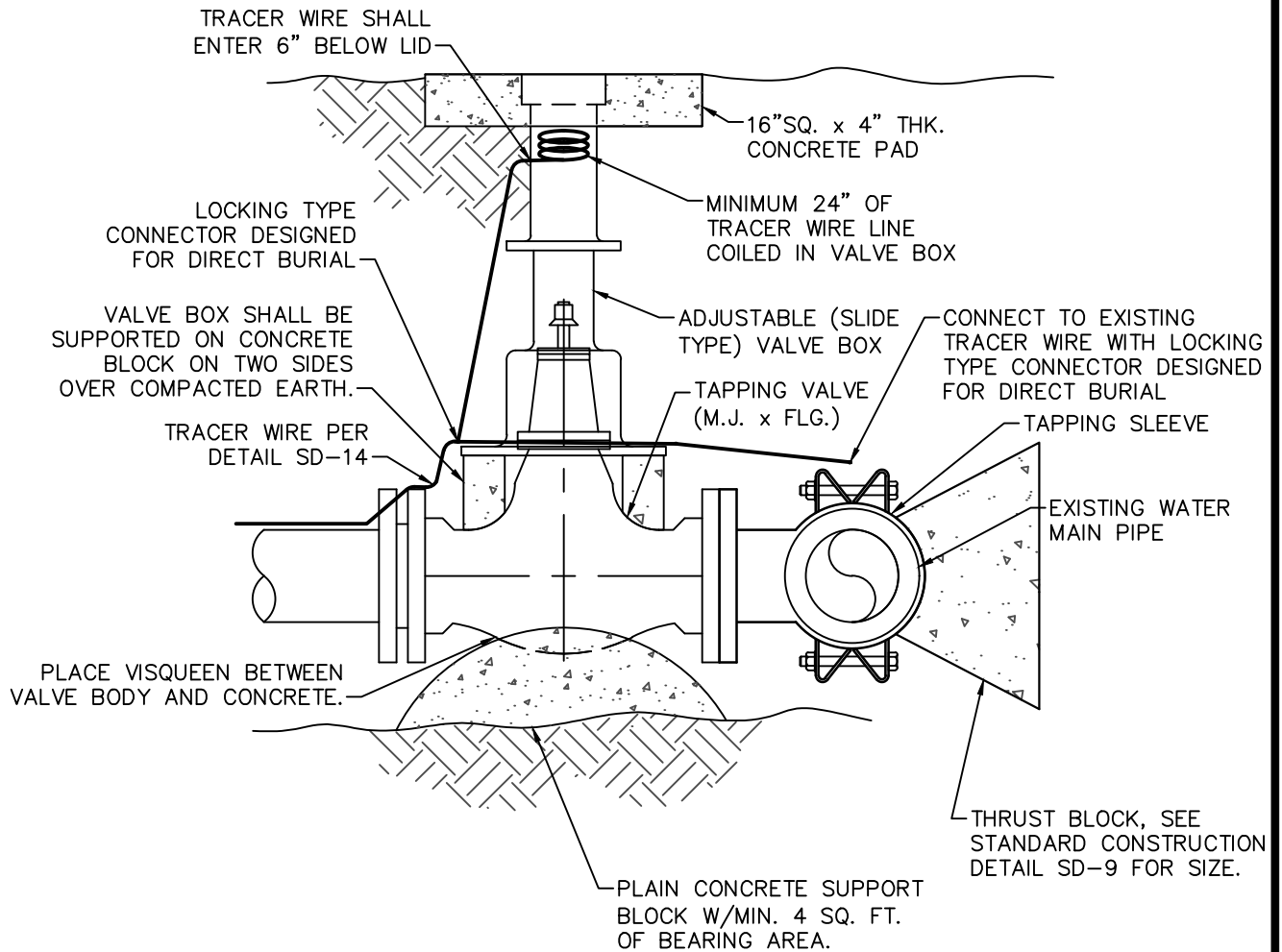
N.T.S.

GATE VALVE INSTALLATION
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
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NOTE:
CONTRACTOR SHALL FIELD VERIFY TYPE
& SIZE OF EXISTING PIPES TO BE TAPPED



N.T.S.

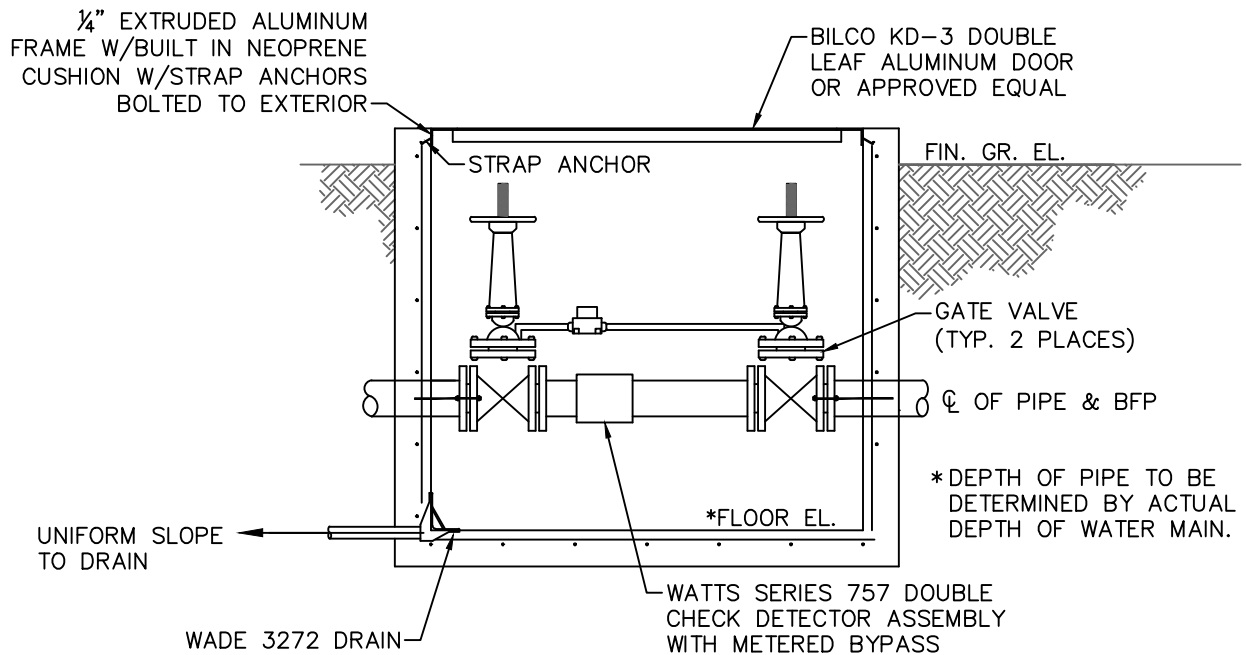
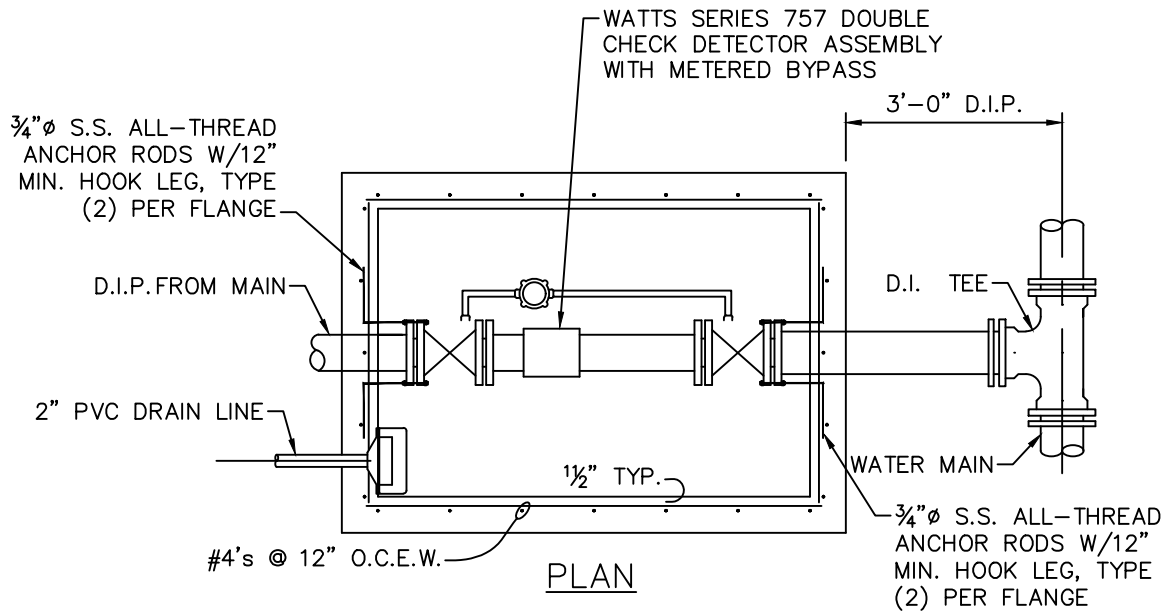
TAPPING SLEEVE AND VALVE INSTALLATION
STANDARD CONSTRUCTION DETAILS

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N.T.S.

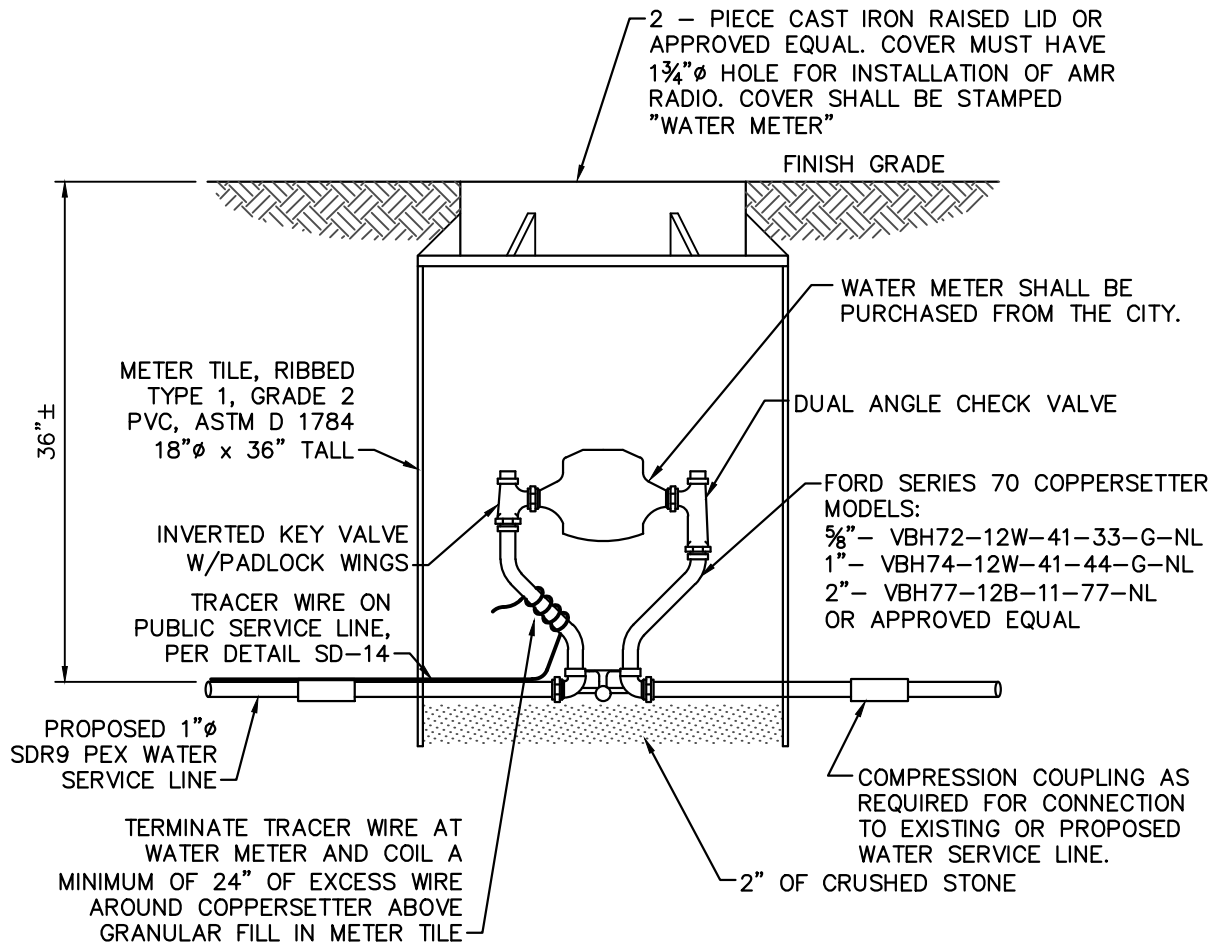
BACKFLOW PREVENTER DETAIL
STANDARD CONSTRUCTION DETAILS

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NOTE:
 USE 1" ϕ PVC PIPE IN BRACE EYE TO SUPPORT METER & COPPERSETTER.

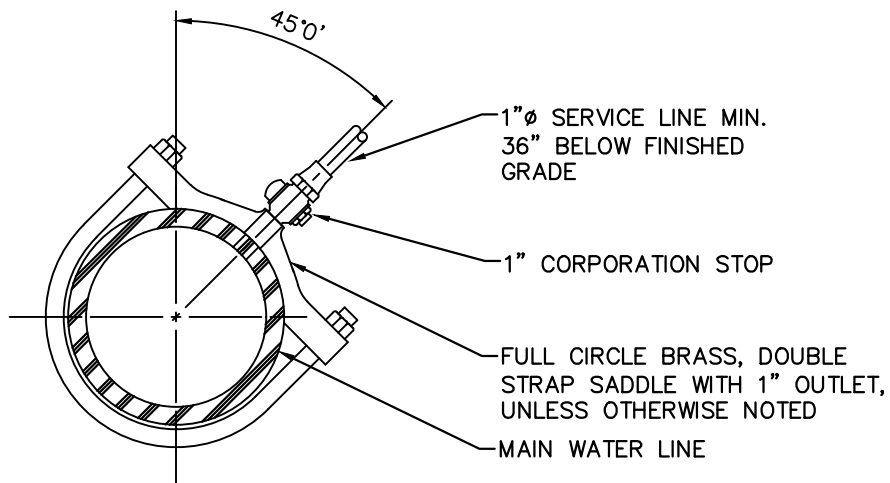
COPPERSETTER MATERIAL SHALL CONTAIN LESS THAN 0.25% LEAD CALCULATED BY WEIGHTED AVERAGE.

N.T.S.

WATER METER INSTALLATION
 STANDARD CONSTRUCTION DETAILS

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N.T.S.

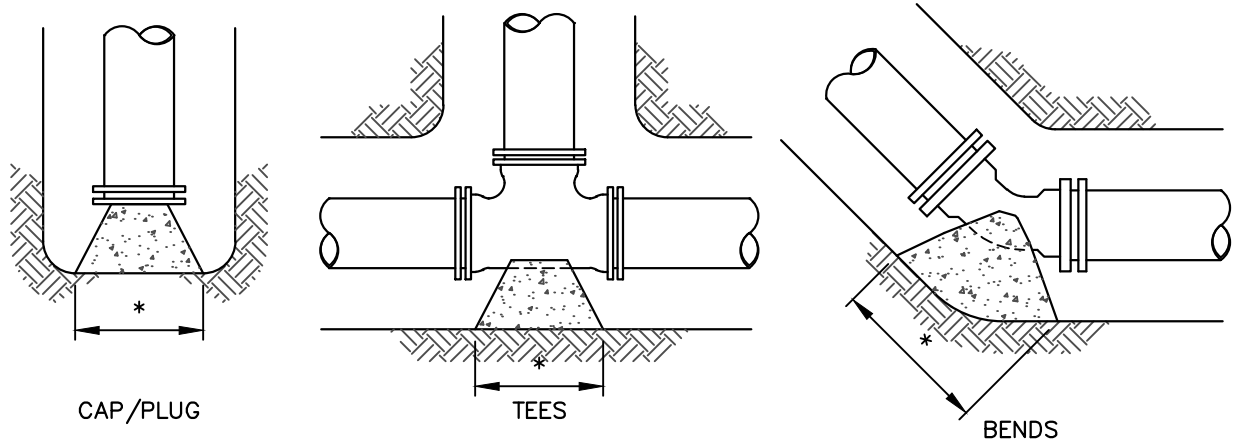
SERVICE TAP DETAIL
STANDARD CONSTRUCTION DETAILS

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* SEE THRUST BLOCK SIZING TABLE

CONCRETE THRUST BLOCK SIZING					
PIPE SIZE (IN)	*MINIMUM AREA OF BEARING ON UNDISTURBED SOIL (SF)				
	90° BEND	45° BEND	22.5° BEND	11.25° BEND	TEES, PLUGS, CAPS, & HYDRANTS
4 & 6	3	2	1	1	3
8	6	3	2	1	4
10	9	5	3	2	6
12	12	7	4	2	9
14	17	9	5	3	12
16	22	12	6	3	16

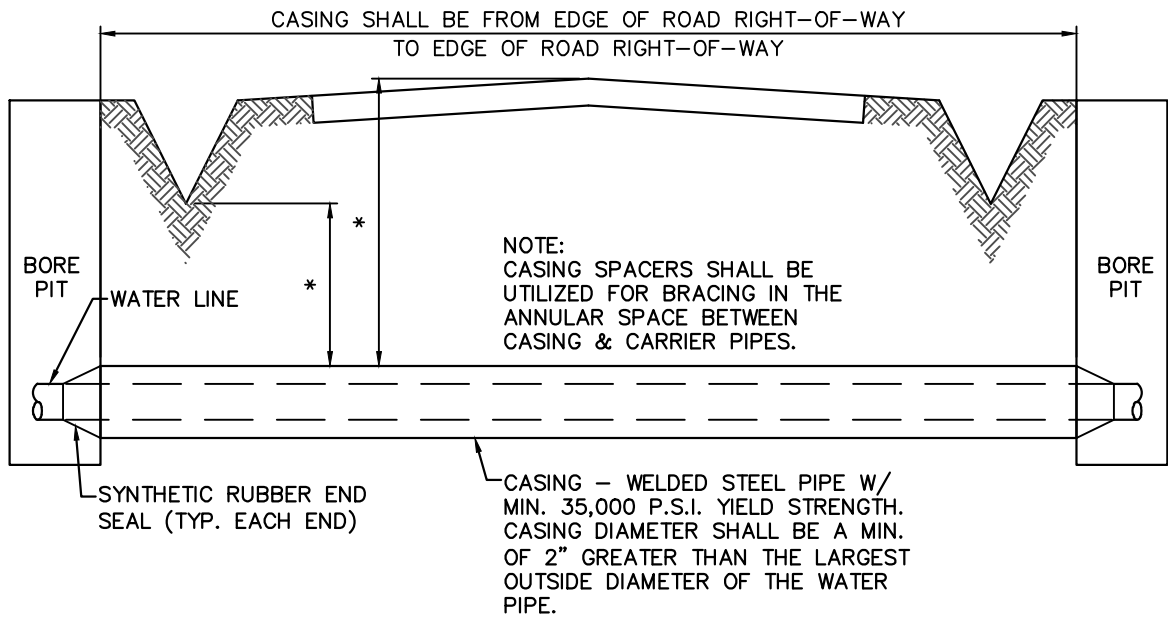
AREAS ARE BASED ON A WORKING PRESSURE OF 150 P.S.I.
AND A SOIL RESISTANCE OF 2000 POUNDS PER SQUARE FOOT.

N.T.S.

THRUST BLOCK DETAIL
STANDARD CONSTRUCTION DETAILS

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* - MIN. DEPTH OF COVER SHALL BE 5'
BELOW CROWN GRADE OR 3.5' BELOW
DITCH GRADE, WHICHEVER IS GREATER.

N.T.S.

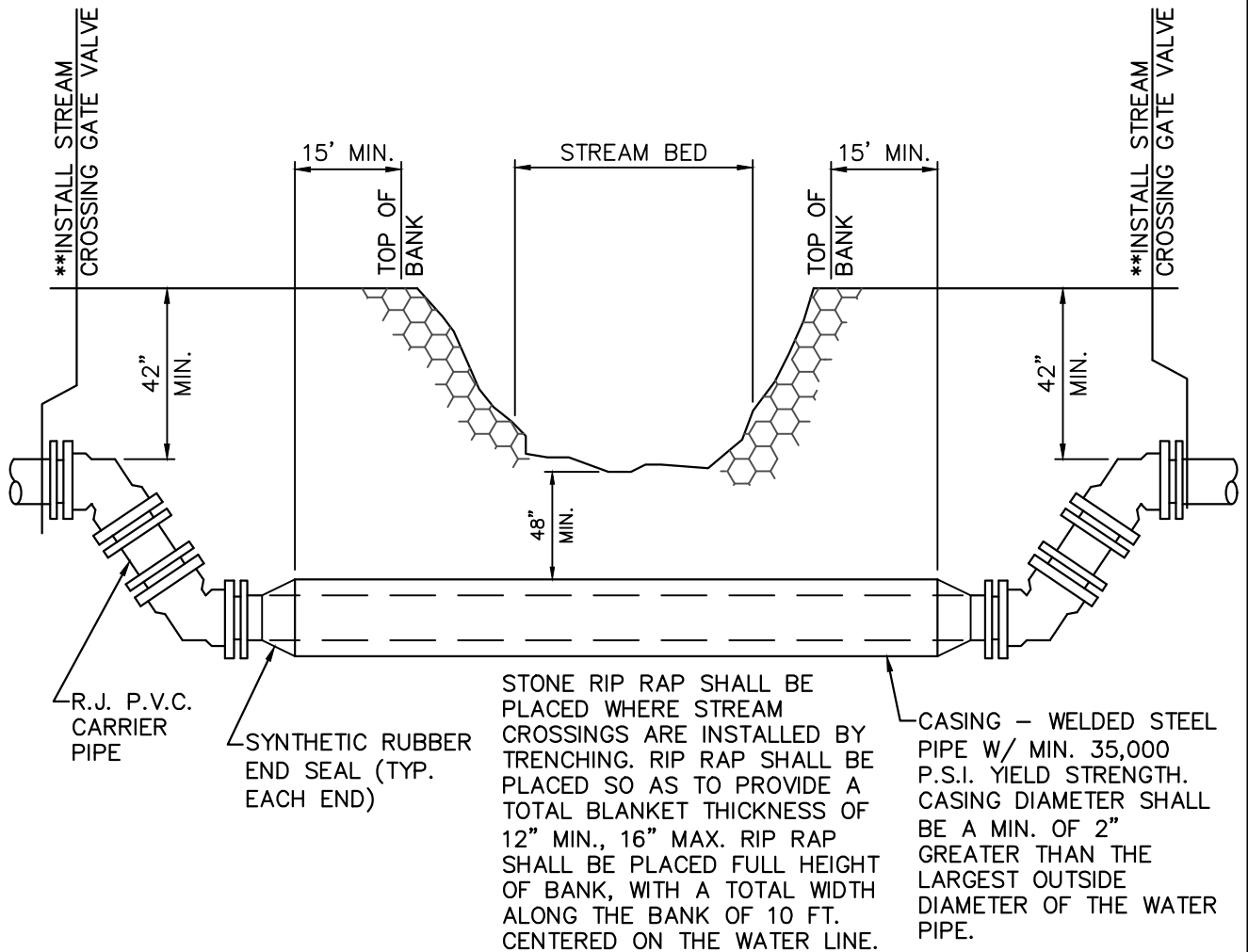
HIGHWAY CROSSING DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
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NOTES:
CASING SPACERS SHALL BE UTILIZED FOR BRACING IN THE ANNULAR SPACE BETWEEN CASING & CARRIER PIPES.

STREAM CROSSINGS MAY BE INSTALLED BY OPEN CUT WITH STEEL CASING PIPE OR HORIZONTAL DIRECTIONAL DRILLING AT THE CONTRACTORS OPTION.

** FOR PERMANENT FLOW STREAM CROSSINGS GREATER THAN 15 FEET, SEE DETAIL PAGE SD-13.

N.T.S.

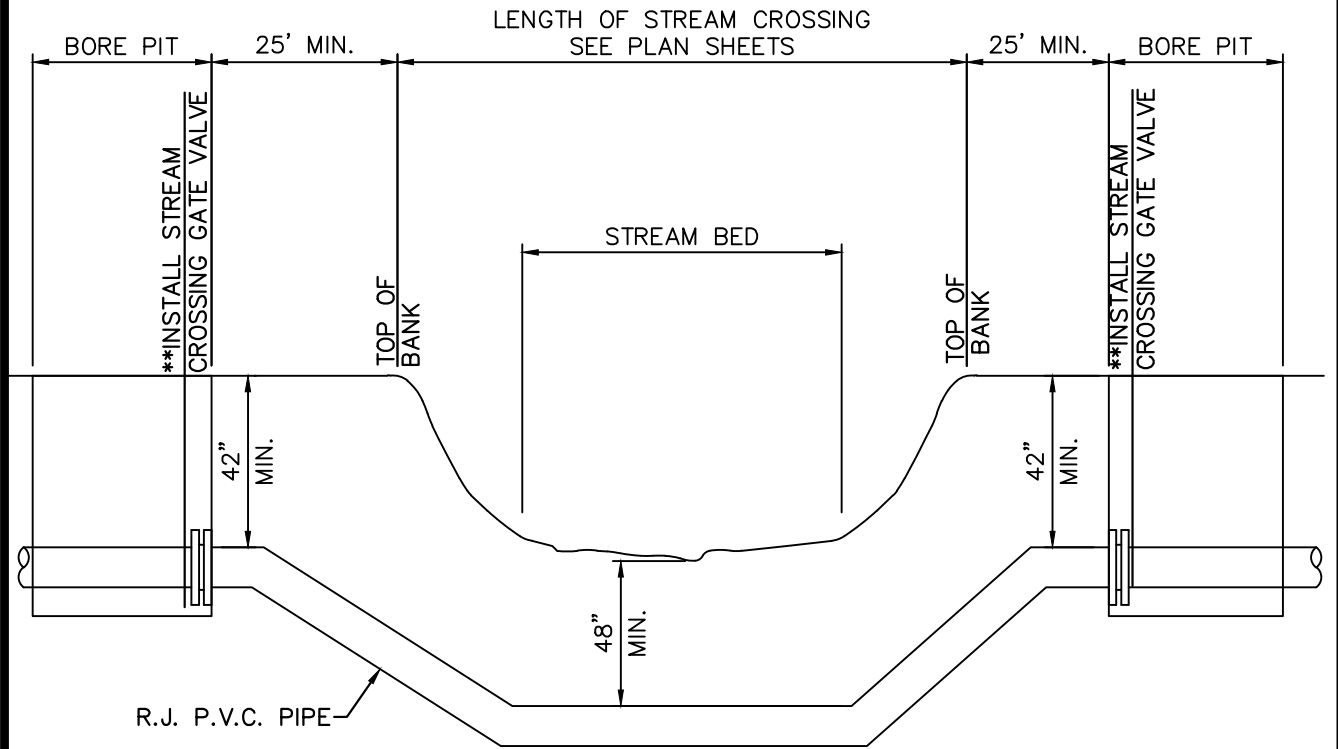
OPEN TRENCH STREAM CROSSING DETAIL
STANDARD CONSTRUCTION DETAILS

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NOTE:

STREAM CROSSINGS MAY BE INSTALLED BY OPEN CUT
W/STEEL CASING PIPE OR HORIZONTAL DIRECTIONAL
DRILLING AT THE CONTRACTORS OPTION.

** FOR PERMANENT FLOW
STREAM CROSSINGS GREATER
THAN 15 FEET, SEE DETAIL
PAGE SD-13.

N.T.S.

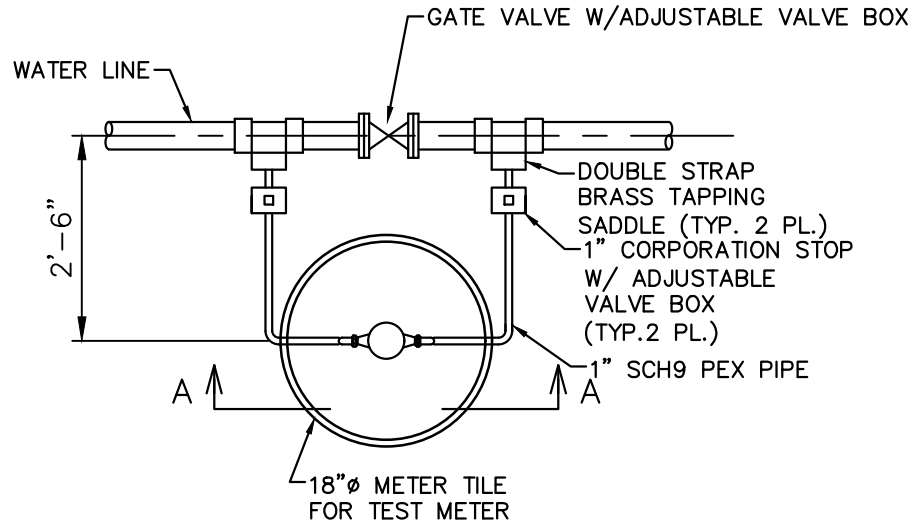
HDD STREAM CROSSING DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
CITY OF CASSVILLE, MO

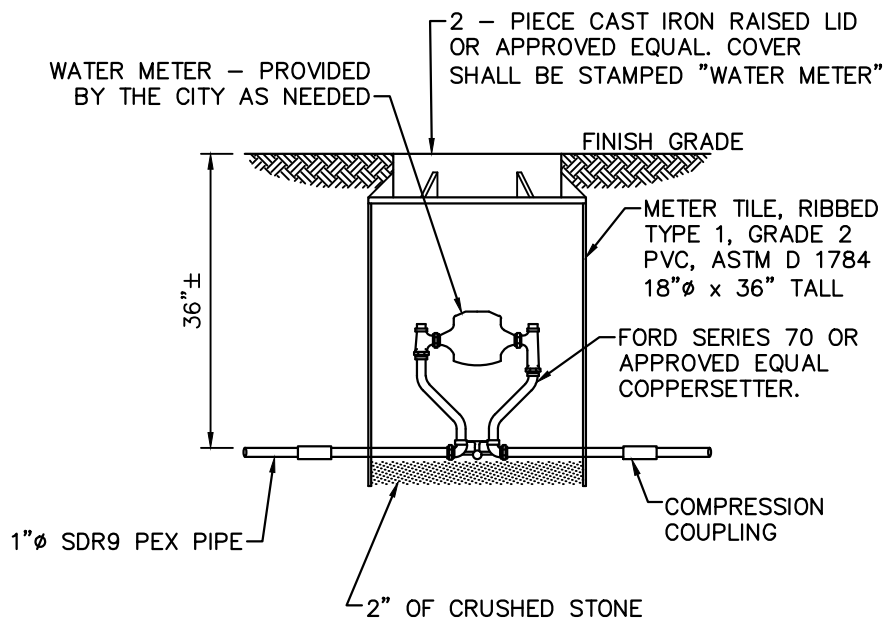


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PLAN



SECTION A-A

NOTE:
USE PVC PIPE BRACE
TO SUPPORT METER
& COPPERSETTER

STREAM CROSSING GATE VALVES SHALL BE INSTALLED
AT LOCATIONS SHOWN ON THE STREAM CROSSING
DETAIL (SEE DETAILS SD-11 AND SD-12).

N.T.S.

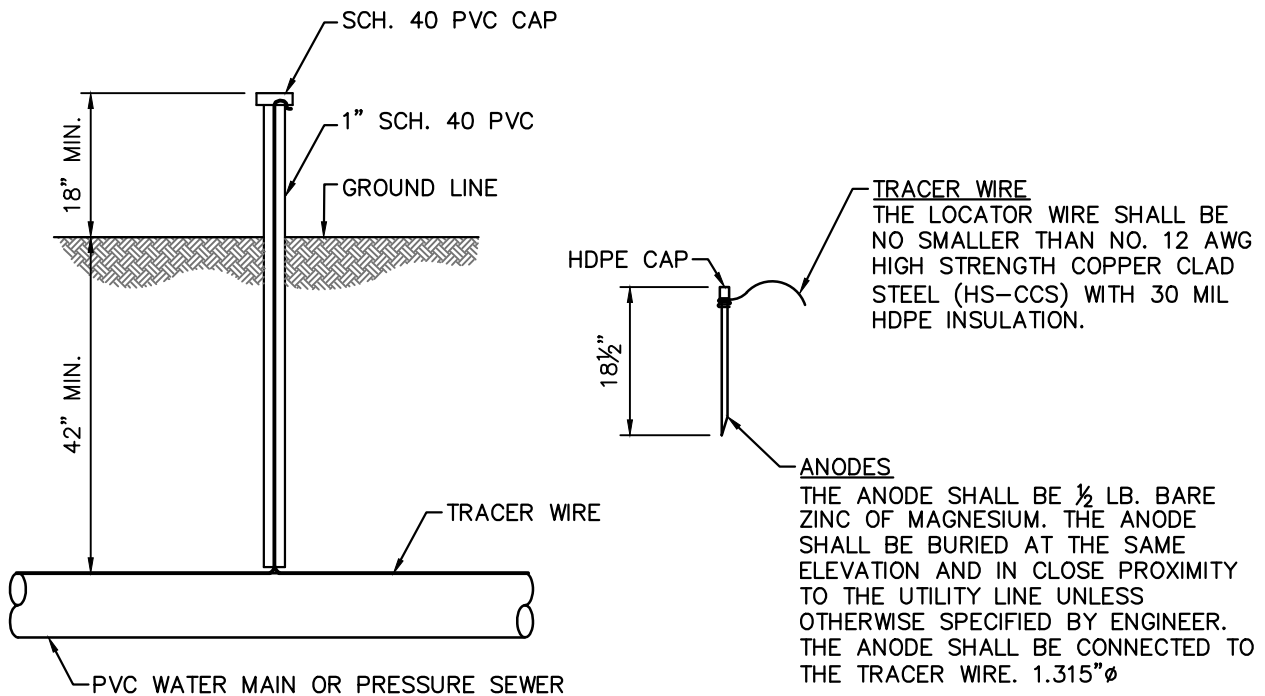
STREAM CROSSING GATE VALVE
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
CITY OF CASSVILLE, MO



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NOTES:

1. DETECTION WIRE RISERS SHALL BE INSTALLED AS REQUIRED TO PROVIDE A RISER SPACING, INCLUDING THOSE AT GATE VALVES, FLUSH STATIONS, AND FIRE HYDRANTS, NOT EXCEEDING 1000 FEET.
2. THE CITY PREFERS NO SPLICES. IF NECESSARY, USE RIGID FITTINGS OR WATERPROOF CONNECTORS SPECIFICALLY DESIGNED FOR DIRECT BURIAL AS DIRECTED BY MANUFACTURER.
3. DETECTION WIRE SHALL BE LOOPED ON OUTSIDE OF VALVE BOX AND ENTER 6" BELOW THE LID.
4. TRACER WIRE MUST BE PROPERLY GROUNDED AT ALL DEAD ENDS/STUBS. GROUNDING OF TRACER WIRE SHALL BE ACHIEVED BY USE OF A DRIVE-IN MAGNESIUM GROUNDING ANODE ROD WITH A MINIMUM OF 20 FT OF #12 RED HDPE INSULATED COPPER CLAD STEEL WIRE CONNECTED TO ANODE (MINIMUM 1.5 LB) SPECIFICALLY MANUFACTURED FOR THIS PURPOSE, AND BURIED AT THE SAME ELEVATION AS THE UTILITY.
5. CONDUCTIVE TYPE PIPE LOCATOR/TRACER WIRE SHALL BE INSTALLED TO LOCATE PRESSURE LINES, WATER SERVICE LINES, AND SEWER LATERALS, PER THE REQUIREMENTS OF MISSOURI STATE STATUTE. THE WIRE SHALL EXTEND THE ENTIRE LENGTH OF THE PROPOSED LINE. THE WIRE SHALL BE INSTALLED DIRECTLY ON TOP OF THE PIPE AND SECURED TO THE LINE BY TAPE AT BASE OF RISER AND PIPE AND AT EVERY 10' ALONG THE LINE. A STRIP OF DUCT TAPE IS ACCEPTABLE FOR ATTACHMENT. THHN WIRE IS PROHIBITED AS IT IS NOT RATED FOR DIRECT BURY.
6. CORROSION PROOF WIRE CONNECTORS SHALL BE USED AT SPlice LOCATIONS TO EXISTING TRACER WIRE. ELECTRICAL TAPE SHALL BE USED AND NO BARE WIRE SHALL BE EXPOSED. ALL CONNECTORS USED SHALL BE DIRECT BURIAL RATED AND SHALL BE FILLED WITH DIELECTRIC SILICON TO SEAL OUT MOISTURE AND CORROSION. CONDUCTIVITY TO BE TESTED BEFORE ACCEPTANCE.

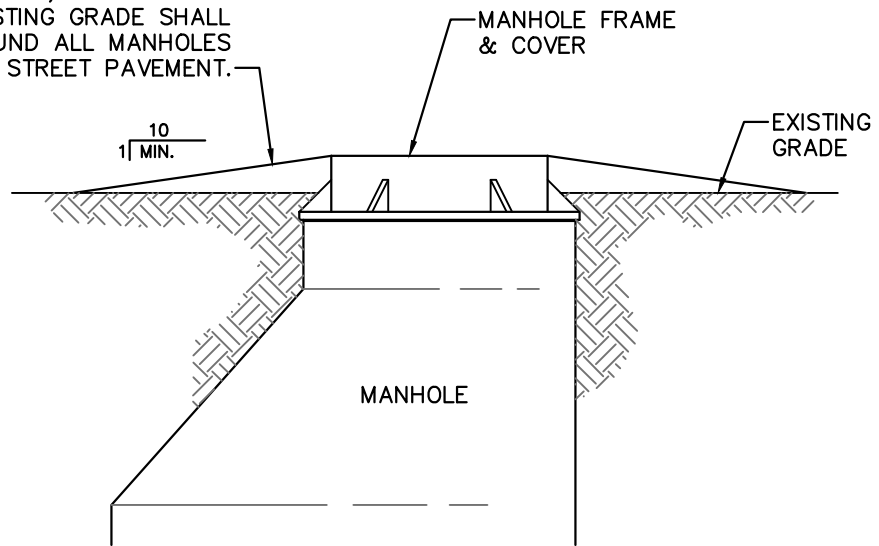
N.T.S.

TRACER WIRE AND RISER DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
CITY OF CASSVILLE, MO

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NOTE: COMPACTED BACKFILL, SLOPED FROM
MANHOLE FRAME TO EXISTING GRADE SHALL
BE PROVIDED AROUND ALL MANHOLES
EXCEPT THOSE WITHIN STREET PAVEMENT.



N.T.S.

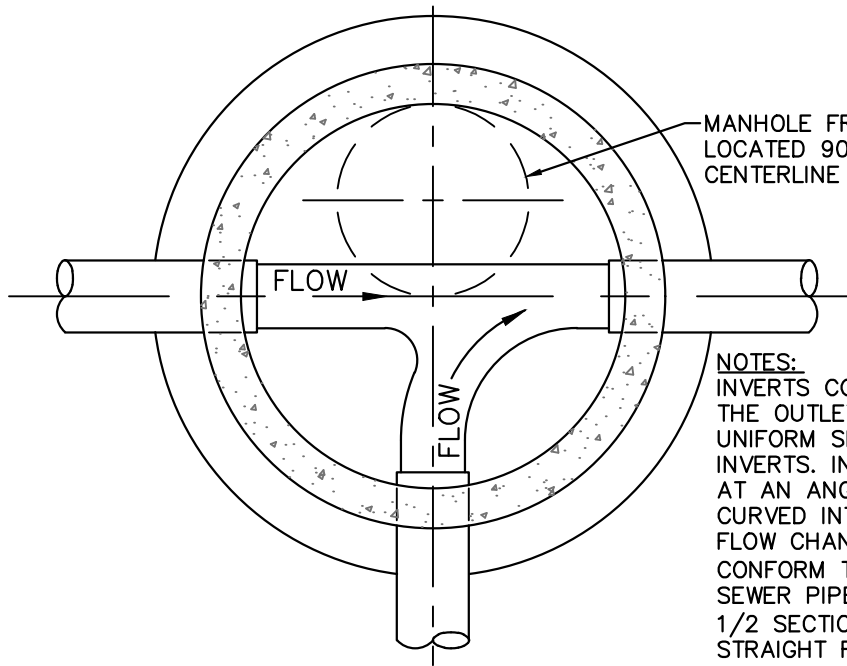
MANHOLE GRADING DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
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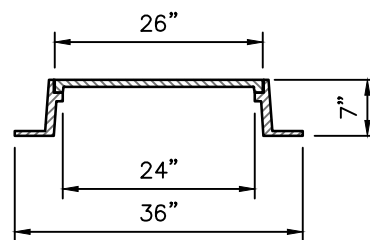
MANHOLE FRAME & COVER SHALL BE LOCATED 90° FROM OUTLET SEWER CENTERLINE ON ALL MANHOLES

NOTES:

INVERTS COMING IN AT ELEVATION HIGHER THAN THE OUTLET INVERT SHALL BE FILLETED TO A UNIFORM SLOPE BETWEEN INLET AND OUTLET INVERTS. INVERTS COMING INTO THE MANHOLE AT AN ANGLE WITH THE OUTLET PIPE SHALL BE CURVED INTO THE OUTLET CHANNEL. FLOW CHANNEL THRU ALL MANHOLES SHALL CONFORM TO 1/2 THE INSIDE DIAMETER OF THE SEWER PIPE CROSS SECTION.

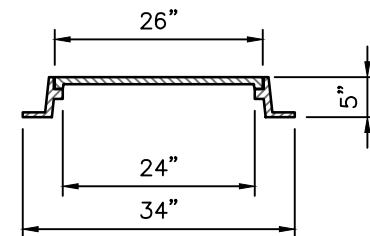
1/2 SECTION OF SEWER PIPE MAY BE USED ON STRAIGHT RUNS THRU MANHOLES FOR FLOW CHANNEL.

PLAN



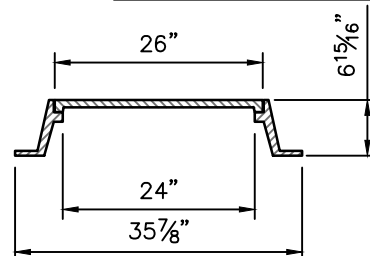
NEENAH R-1916-F (BOLTDOWN) WATERTIGHT FRAME AND COVER FOR USE IN DRAINAGE AREAS.

TYPE A - FRAME AND COVER



NEENAH R-1642-A FRAME AND COVER FOR USE OUTSIDE DRIVE SURFACES.

TYPE B - FRAME AND COVER



NEENAH R-1642 FRAME AND COVER FOR USE IN DRIVING AREAS.

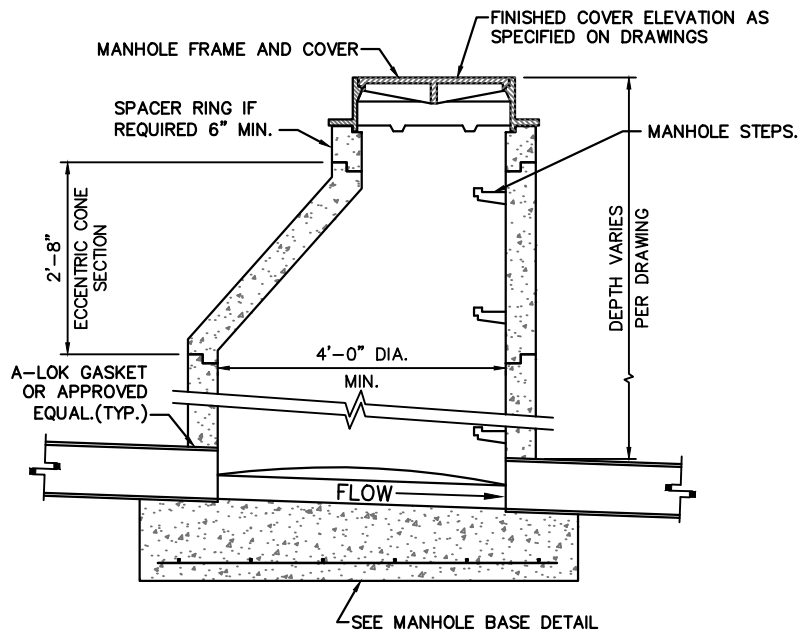
TYPE C - FRAME AND COVER

N.T.S.

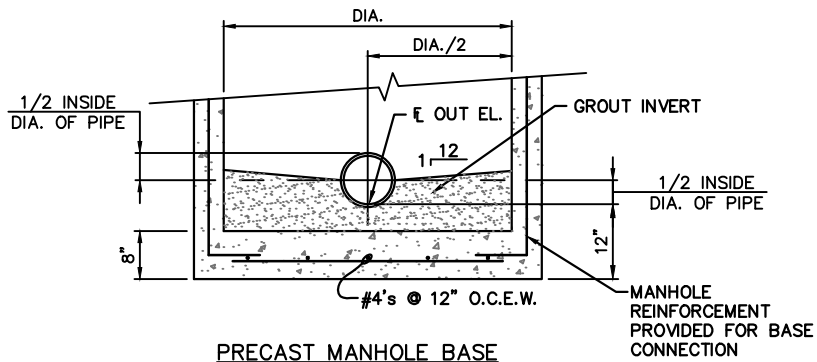
MANHOLE PLAN AND FRAME & COVER DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
CITY OF CASSVILLE, MO

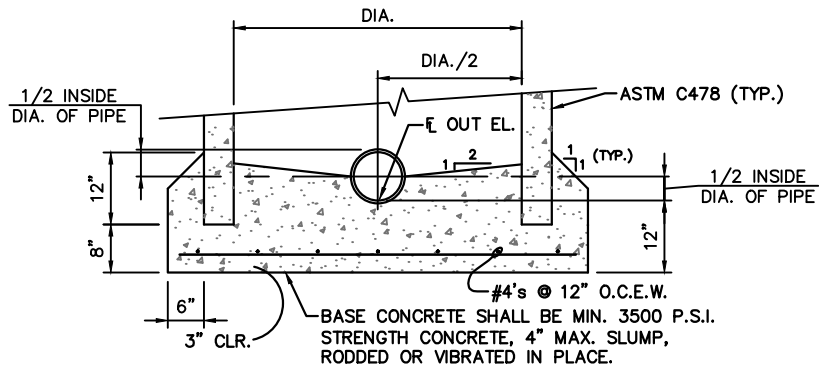
AM ALLGEIER, MARTIN and ASSOCIATES, INC
CONSULTING ENGINEERS and SURVEYORS
7231 EAST 24th STREET JOPLIN, MISSOURI 64804 (417) 680 - 7200



MANHOLE ELEVATION



PRECAST MANHOLE BASE



CAST-IN-PLACE MANHOLE BASE

N.T.S.

MANHOLE ELEVATION AND BASE DETAIL
STANDARD CONSTRUCTION DETAILS

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NOTE:

TYPE 'A' DROP - 2' MIN. to 8' MAX.

PIPE - SDR 35 P.V.C.

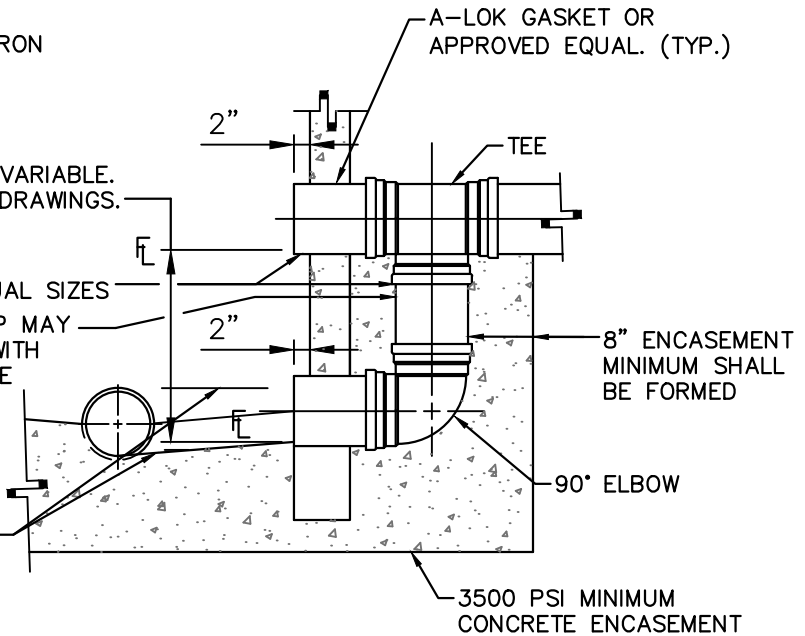
TYPE 'B' DROP - OVER 8'

PIPE - CLASS 50 DUCTILE IRON

2'-0" MINIMUM - DEPTH OF DROP VARIABLE.
AS REQUIRED ON PLAN & PROFILE DRAWINGS.

PIPE EQUAL SIZES
VARIABLE - OUTSIDE DROP MAY
BE CONSTRUCTED FLUSH WITH
OUTSIDE WALL OF MANHOLE

0.10' FALL MINIMUM
ON EQUAL SIDES OR
MATCH TOP OF PIPE.



N.T.S.

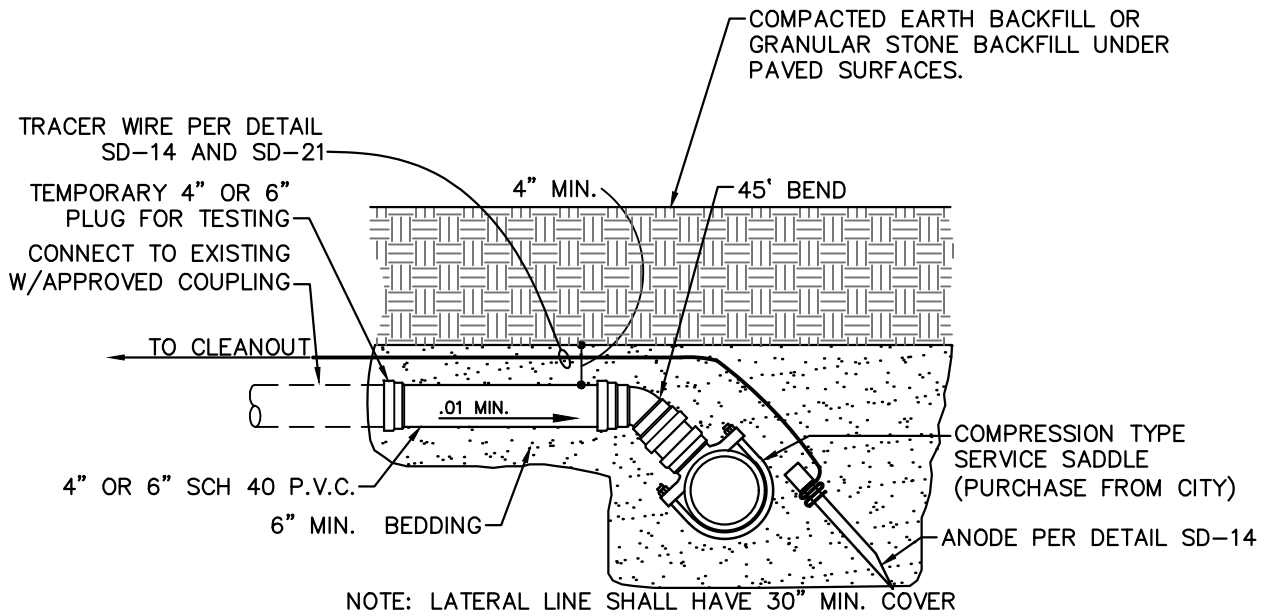
DROP MANHOLE DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
CITY OF CASSVILLE, MO

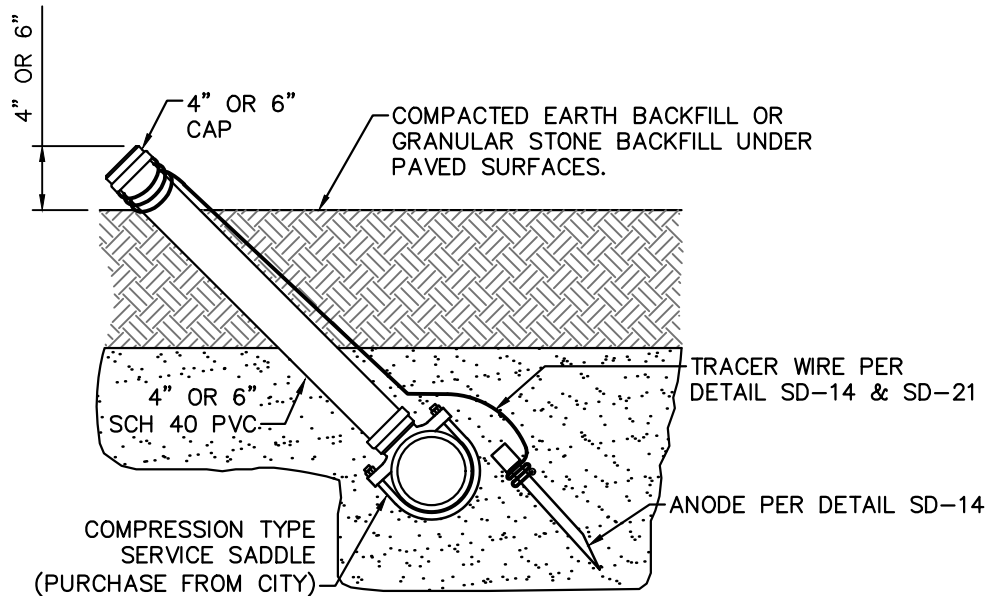


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SERVICE LATERAL DETAIL 1
(CONNECTION TO EXISTING SERVICE LATERAL)



SERVICE LATERAL DETAIL 2
(FUTURE SERVICE LATERAL CONNECTION)

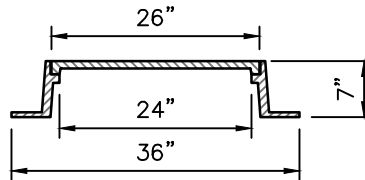
NOTES:
TRACER WIRE FOR FUTURE SERVICE LATERAL CONNECTIONS SHALL BE EXTENDED TO CLEANOUT AT THE TIME OF CONNECTION TO FUTURE SERVICE.

N.T.S.

SERVICE LATERAL DETAIL
STANDARD CONSTRUCTION DETAILS

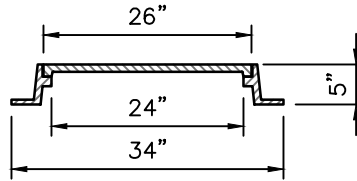
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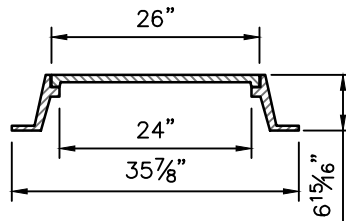
NEENAH R-1916-F (BOLTDOWN)
WATERTIGHT FRAME AND COVER
FOR USE IN DRAINAGE AREAS.

TYPE A - FRAME AND COVER



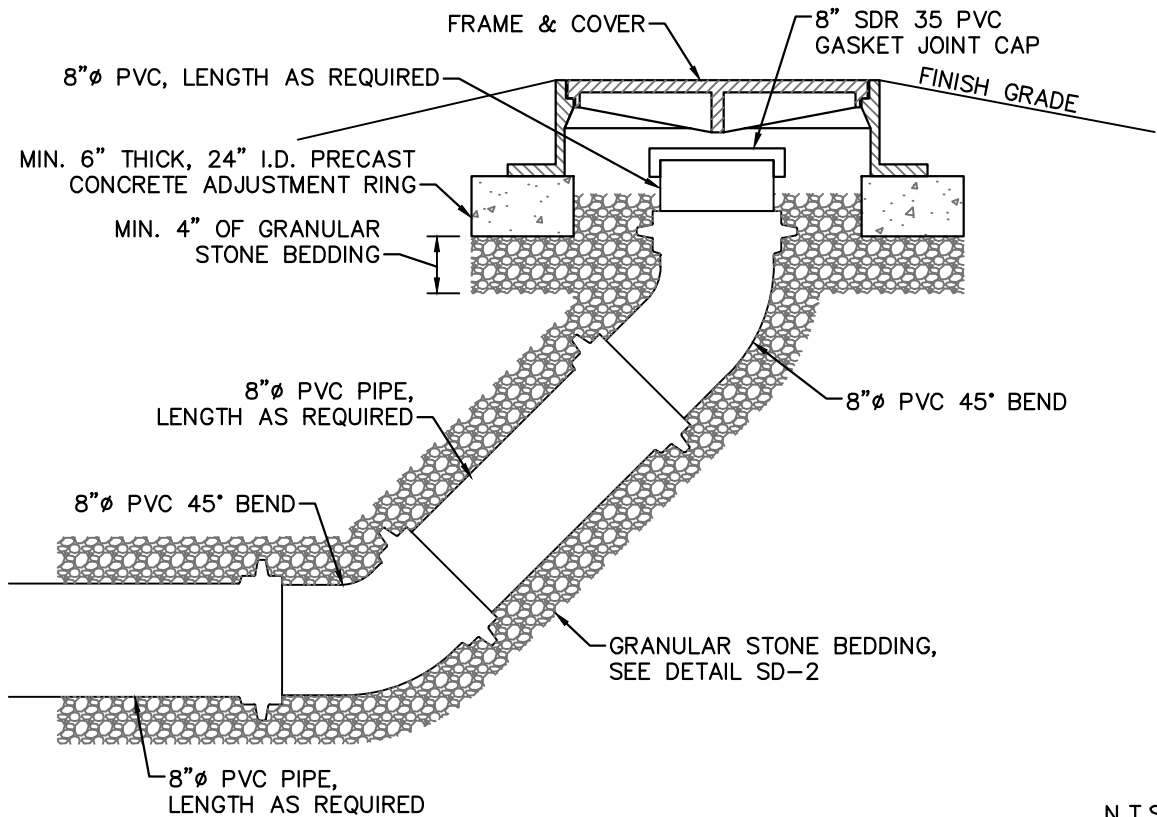
NEENAH R-1642-A FRAME AND
COVER FOR USE OUTSIDE DRIVE
SURFACES.

TYPE B - FRAME AND COVER



NEENAH R-1642 FRAME AND
COVER FOR USE IN DRIVING
AREAS.

TYPE C - FRAME AND COVER



N.T.S.

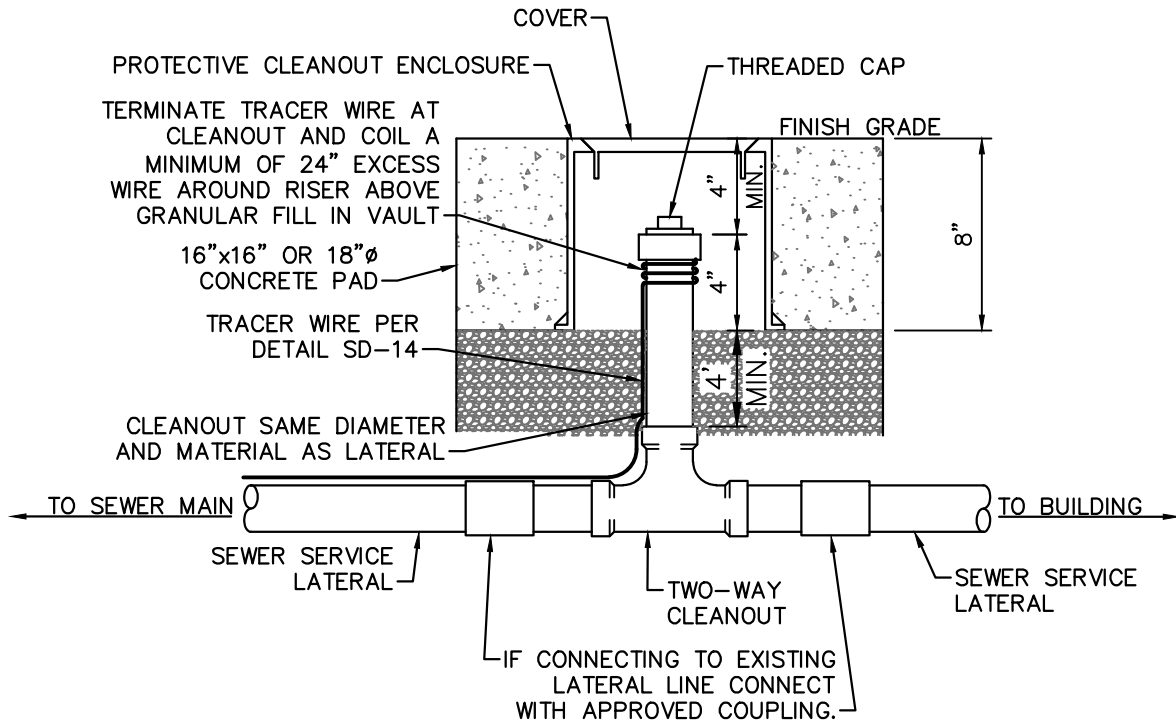
LAMPHOLE DETAIL
STANDARD CONSTRUCTION DETAILS

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NOTES:

1. A SEALED CLEANOUT WITH REMOVABLE CAP SHALL BE INSTALLED AS CLOSE AS POSSIBLE TO THE EDGE OF THE PUBLIC EASEMENT, OR PROPERTY LINE AND SHALL BE HOUSED IN A PROTECTIVE ENCLOSURE, AS REQUIRED BY MISSOURI STATE STATUTE. THIS PROTECTIVE ENCLOSURE SHALL BE THE ACCESS POINT FOR THE SERVICE LINE CLEANOUT AS WELL AS THE ACCESS POINT FOR CONNECTION TO THE TRACER WIRE. THE TOP OF THE PROTECTIVE ENCLOSURE SHALL BE INSTALLED TO FINISH GRADE.
2. PROTECTIVE ENCLOSURE SHALL BE EAST JORDAN 1566Z ASSEMBLY. CLEANOUT BOX LID SHALL HAVE THE WORD "SEWER" OR "S" IN THE CASTING.
3. CAP THE END OF THE WIRE INSIDE THE PROTECTIVE ENCLOSURE WITH A THERMOPLASTIC SHELL CONNECTOR RATED FOR DAMP, UNDERGROUND APPLICATIONS.

N.T.S.

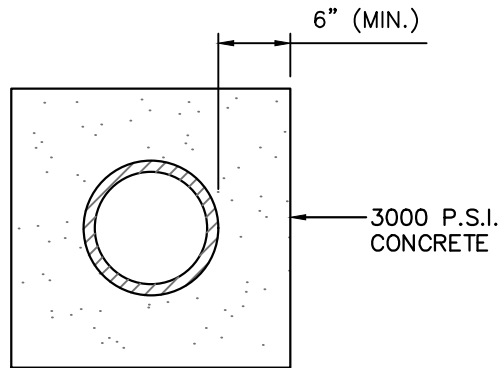
CLEANOUT DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
CITY OF CASSVILLE, MO

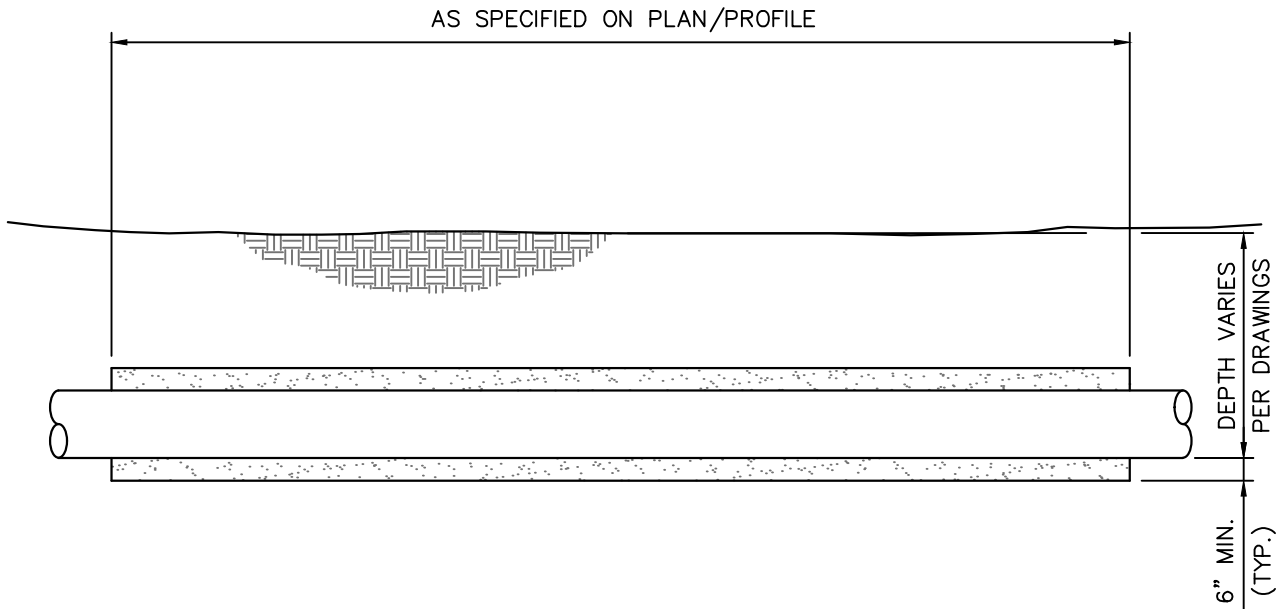


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SECTION



N.T.S.

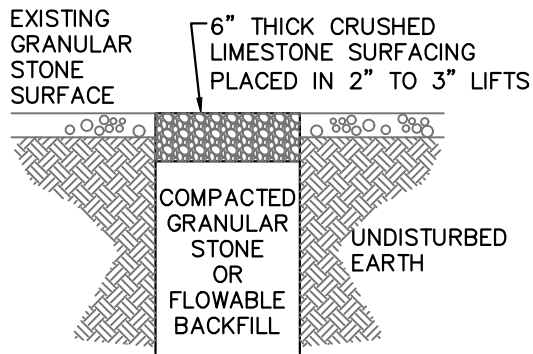
CONCRETE ENCASEMENT DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
CITY OF CASSVILLE, MO

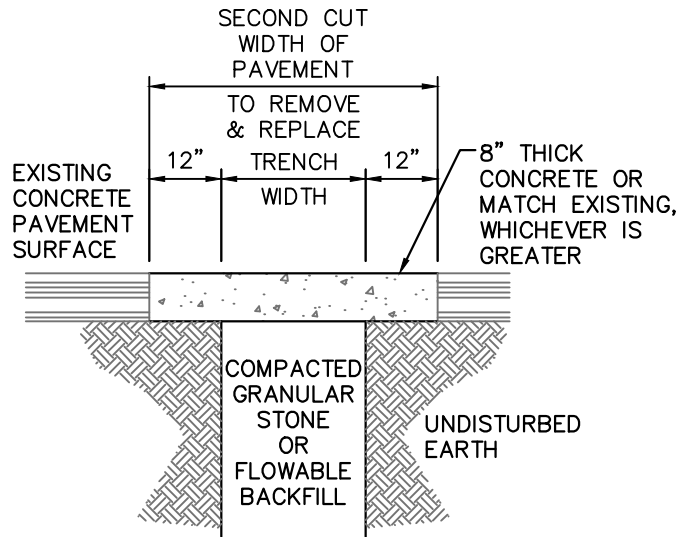


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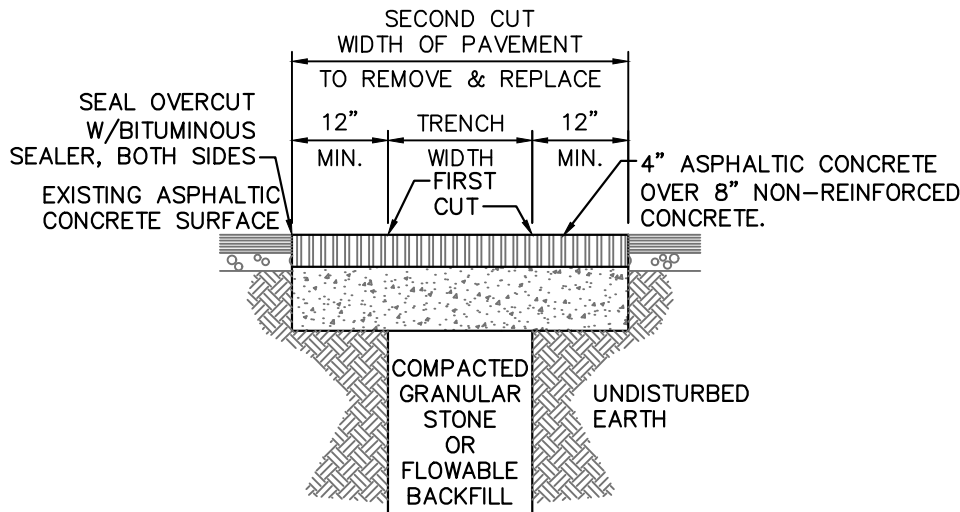
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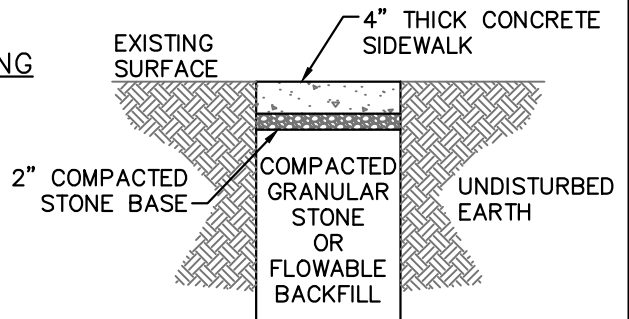
CRUSHED STONE SURFACING



CONCRETE SURFACING



ASPHALTIC CONCRETE SURFACING



SIDEWALK REPLACEMENT

NOTES

PAVEMENT SHALL BE REMOVED AT THE TRENCH WIDTH AFTER THE FIRST CUT WITHOUT DAMAGE TO ADJACENT PAVEMENT.

AFTER TRENCH IS PROPERLY BACKFILLED, PAVEMENT SHALL BE CUT AND REMOVED AN ADDITIONAL 12" ON EACH SIDE OF THE FIRST SAW CUT, AS SHOWN. THE SECOND CUT SHALL BE SAWN TO FULL DEPTH OF THE EXISTING SURFACE.

N.T.S.

PAVEMENT REPLACEMENT DETAIL
STANDARD CONSTRUCTION DETAILS

FEBRUARY 2020
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