

PWSD NO. 1 OF LINCOLN COUNTY

STANDARD SPECIFICATIONS FOR SEWER AND WATER MAIN CONSTRUCTION



August 2025

SECTION 00010
TABLE OF CONTENTS

CONSTRUCTION REQUIREMENTS, SPECIFICATIONS, AND STANDARD DETAILS FOR
WATER AND SEWER MAIN CONSTRUCTION 1-5

MATERIALS SUMMARY 6-9

DIVISION 1 – GENERAL REQUIREMENTS

01110 SUMMARY OF WORK 10-17

DIVISION 2 – SITE CONSTRUCTION

02080 UTILITY MATERIALS 18-27
02230 SITE CLEARING 28-29
02315 EXCAVATING, FILLING AND GRADING 30-44
02373 SEDIMENTATION AND EROSION CONTROL 45-46
02374 FERTILIZING, SEEDING, AND MULCHING 47-50
02445 HIGHWAY & RAILROAD CROSSINGS 51-52
02510 WATER DISTRIBUTION 53-61
02533 DUPLEX LIFT STATION 62-72
02536 SANITARY SEWER MANHOLES, FRAMES AND COVERS 73-78
02537 GRAVITY SEWAGE COLLECTION LINES 79-87
02538 SEWAGE FORCE MAINS 88-94
02539 GRINDER PUMPS AND APPURTENANCES 95-102
02722 AGGREGATE BASE COURSE 103-105
02821 CHAIN LINK FENCING 106-112

DIVISION 3 – CONCRETE

03050 PORTLAND CEMENT CONCRETE 113-124

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07111 BITUMINOUS DAMPROOFING 125-126

TYPICAL DETAILS**GENERAL DETAILS:**

Thrust Blocks
Typical Highway Crossing
Steel Casing Section
Typical Creek Crossing
Bollard Post
Chain Link Fence (6 Sheets)

SEWER DETAILS:

Typical Trench (2 Sheets)
Manhole Details (2 Sheets)
Lamphole
Air/Vacuum Release and Clean Out
Type 1 Grinder Pump
Grinder Pump Electrical Hook-Up
Lift Station Control Schematic
Lift Station One-Line Diagram
Pressure Sewer Service Line
Sewer Sign Location
Typical Force main (2 Sheets)
Sewer/Water Specification

WATER DETAILS:

Typical Trench (2 Sheets)
Service Line Highway Crossing
Utility Sign Location
Adjustable Valve
Valve and Valve Box Detail
Typical Flush Hydrant
Meter Setting
Lift Station
Lift Station Details

**CONSTRUCTION REQUIREMENTS, SPECIFICATIONS AND STANDARD DETAILS FOR
WATER AND SEWER MAIN CONSTRUCTION**

1. AUTHORITY

This document is drawn and approved by the Board of Directors of Public Water Supply District No. 1 of Lincoln County, Missouri and shall be enforced, and no part thereof altered without approval of said Board or their duly appointed representative.

2. INTENTS AND DEFINITIONS

The intent of this document is to specify the type and quality of all water and sewer main materials, the method and procedure of construction, the construction observation and testing methods, and the terms of acceptance by Public Water Supply District No. 1 of any water or sewer main work or extension on any main or mains, that are or will be an active part of the water system of Public Water Supply District No. 1 of Lincoln County, Missouri.

2.1. Definitions

- 2.1.1. **AWWA:** American Water Works Association
- 2.1.2. **Board:** Those individuals elected by those living with the District boundaries as the governing body of the District
- 2.1.3. **Construction Observation:** Work performed by the Project Representative, Engineer or District that allows them to become generally familiar with the work in progress and to determine, if in general, that the work is proceeding in accordance with the approved plans and specifications.
- 2.1.4. **Contractor:** Any person or firm doing any type of work on existing or proposed water or sewer mains or appurtenances.
- 2.1.5. **Design Criteria Manual:** A document created by the District as the basis for the design and construction of improvement to their water and sanitary sewer systems. The document contains construction specification, standard construction details and procedural information, of which this document is a part thereof.
- 2.1.6. **District:** Public Water Supply District No. 1 of Lincoln County, Missouri.
- 2.1.7. **Engineer:** Firm employed by the District for engineering purposes.
- 2.1.8. **MoDNR:** Missouri Department of Natural Resources
- 2.1.9. **Or Equal:** Any part or fitting submitted to the District for evaluation and determined by the District to be equal in quality and performance to any currently specified acceptable manufacturer and model.
- 2.1.10. **Owner:** Any person owning rights to or sponsoring any work pertaining to water or sewer work, such as a landowner or Developer.
- 2.1.11. **Professional Land Surveyor:** A person who is qualified by education and experience, AND who has passed an examination for licensure required by the State of Missouri to practice Land Surveying in Missouri.

- 2.1.12. **Project Representative:** The person(s) designated by the District with being responsible for observing progress and quality of the work completed on the project.
- 2.1.13. **Staff:** Employees of Public Water Supply District No. 1 of Lincoln County, Missouri.
- 2.1.14. **Substantial Completion:** The date, established by the District, when the construction is sufficiently completed in accordance with the District accepted plans, so that it can be utilized for the purpose for which it was intended.

3. GENERAL

- 3.1. Prior to the submittal of the plans for review, it is recommended that either the design engineer or developer meet with the District to discuss the proposed plans. This will allow the district to consider if the proposal will appropriately serve the project, review how it will affect the immediate area and provide information on minimum line sizes, system looping requirements, etc.
- 3.2. All proposed improvements are to be planned and constructed in accordance with the Public Water Supply District No. 1 of Lincoln County's Design Criteria Manual, of which this document is a part thereof. Plans will be reviewed for general conformity and not necessarily for correctness of dimension or detail. The District does not accept any liability for the quality or completeness of the plans. Approval and acceptance of these plans does not relieve the design engineer, developer or contractor from meeting the requirements of the Design Criteria Manual or MoDNR regulations.

4. PLAN SUBMITTAL

- 4.1. Submit a minimum of three (3) sets of plans, and plats (should plats not be included in the plans). They must be prepared by a professional engineer registered in the State of Missouri. Plans must be submitted NO LATER THAN the close of business of the first weekday of the month to be considered for approval that month. Should the plans not be submitted by this deadline, the plans will not be considered for approval until the following month.
 - 4.1.1. The plans shall include an overall project, or site layout, showing all of the existing and proposed utility improvements. If applicable, a located sketch should be provided.
 - 4.1.2. If the improvements are part of a proposed development (subdivision), a copy of the plat must be included in the submittal to allow review of the proposed utility easements. If the improvements are not a part of a proposed development or if any of the improvements extend beyond the property lines of the development, a copy of the proposed easements must be included. A recorded copy of the plat and all easements must be submitted to the District prior to the start of construction.
 - 4.1.3. If portions of the improvements are NOT to be constructed in accordance with the Design Criteria Manual, or if some of the improvements are not covered in the manual, specifications and details for those portions shall be included as part of the plans.
 - 4.1.4. It is recommended that the design engineer make every effort to avoid conflict with existing utilities. Should any of the existing utilities require relocation, plans for the relocation of the utility and a letter of acceptance of the relocation from that utility must be submitted with the plans. The relocation must be completed prior to starting construction of the new improvements.
- 4.2. After review of the plans by the District Staff and District Engineer, the plans will be presented to the District Board at their next regularly scheduled meeting, contingent upon meeting the

submittal deadline. The Board reserves the right to execute any of the following actions upon the submittal:

- 4.2.1. Accept the submittal – Should the plans meet all District requirements, the Board will accept the plans. Acceptance of the plans will authorize the Staff to issue the Letter of Acceptance, which must be submitted with the plans to MoDNR.
- 4.2.2. Accept the submittal conditionally – Conditional acceptance of the plans means that there are specific issues that must be addressed. Once those issues have been resolved, the Staff is authorized to issue the Letter of Acceptance without the plans going back before the Board.
- 4.2.3. Reject the submittal – Should the plans be significantly non-compliant with the District requirements, Board will reject the submittal. A letter notifying the person submitting the plans will be prepared and sent explaining the reason(s) for the plan rejection. Rejected plans may be resubmitted for consideration, however, special care should be given to address ALL the issues which caused the initial rejection.
- 4.2.4. Table the submittal – Should in the opinion of the Board, the plans not include sufficient detail, require clarification, investigation, legal opinions, additional discussion, etc., the Board can vote to table the submittal.

5. RESPONSIBILITIES OF CONTRACTOR AND DISTRICT

- 5.1. The Owner shall be responsible for the proper location and grade of the proposed extension and appurtenances based upon plans approved by the District.

- 5.1.1. Prior to construction:

- 5.1.1.1. Property pins, or accurately placed laths, shall be provided at key lot corners, particularly at intersections and curves. Utilities shall not be located solely from street centerline markers.

- 5.1.1.2. The street must be cut or filled to final sub-grade prior to installation of the utilities.

- 5.1.2. Utility Separation – Vertical and horizontal separation of utilities shall be maintained from all current or proposed utilities. Should the construction of the new utility require the relocation of an existing utility, the Owner must prepare plans for the relocation and they must be approved by the District prior to relocation. Separation distances shall be in accordance with the strictest of the following:

- 5.1.2.1. Most current edition of the Design Guide for Community Water Systems

- 5.1.2.2. Missouri Department of Natural Resources design criteria (10 CSR regulations)

- 5.1.2.3. The Districts adopted policy.

- 5.1.3. Water – Possible problems with sanitary sewers, manholes, storm sewers, and drop inlets must be marked with the size and depths indicated. Failure to provide the above requirements will result in suspension of the work.

- 5.1.4. Sewer – Gravity mains and lift stations must be staked by a Professional Land Surveyor.

5.2. The Owner shall employ skilled workmen under the supervision of a foreman, experienced in water and sewer main construction or a licensed plumber to install the main. The foreman shall be on-site at all times when construction is underway. The Project Representative may suspend work until, in his opinion, skilled personnel are provided.

5.3. The Owner or Developer shall be responsible for any failure of the main extension that can be attributed to faulty workmanship or defective materials, and for maintenance of backfilled areas for one year after completion of the work. The maintenance shall include but not be limited to backfilling, grading, seeding, as well as siltation and erosion control. The date of Substantial Completion shall be determined by the Board, based on the reports of the Project Representative, who must have witnessed the required testing. The Owner or Developer shall be responsible for any cost incurred by the District for any work that they must perform to mains or appurtenances during construction and for one (1) full year after acceptance by the District of the completed work.

5.4. The Owner shall be responsible for providing all of the proposed easements shown on the plans. The easements shall be in a legally recordable form in the name of the District and shall transfer ownership of the line to the District upon District acceptance of the construction. The Owner shall also be responsible for providing copies of recorded easements that are shown on the plans as existing, unless the District is already in possession of the easements. Failure to provide these documents will result in a refusal of the District to make service connections to the affected mains.

5.5. The Owner shall have all previous work in the District boundaries completed and constructed to District's satisfaction, and, all other utilities or road entity's satisfaction. The District reserves the right to refuse the work of any Owner in which does not meet these criteria.

5.6. The Owner shall supply the District with a (1) year warranty on materials and workmanship.

5.7. The Owner AND Contractor shall supply the District and/or Project Representative with a (24) hour phone number during construction for use in case of emergency. Owner shall make required repairs in a timely fashion not to exceed (24) hours after emergency occurs.

5.8. Prior to the start of work, the District will establish the time and date for a pre-construction meeting. The District shall conduct the meeting which shall be attended by the Owner, Contractor, all Subcontractors, and the District Staff. Should any of these entities not be present at the meeting and in the Districts opinion any questions, concerns, conflicts or other issues exist, construction will not be allowed to begin until a proper pre-construction meeting can be held.

5.9. The Owner or Contractor shall contact the District office a minimum of 2 working days prior to beginning work on a new project or after a declared shutdown due to weather or other circumstances. This will allow the District sufficient time to schedule a Project Representative to the project. The Owner or Contractor shall also notify the Project Representative by 8:15 AM if work will not be conducted on any given day.

5.10. The Owner will erect and maintain, as required by the conditions and progress of the work, all necessary safeguards for safety and protection. THE OWNER AND CONTRACTOR ARE RESPONSIBLE FOR ALL JOB SITE SAFETY. The Contractor will notify Districts of adjacent utilities when completion of the work may affect them. The Owner or Contractor is responsible for requesting and coordinating all utility located prior to excavation.

6. CONSTRUCTION OBSERVATION

6.1. Agreement: It shall be agreed to by all parties that District Staff shall have full authority for Construction Observation at all times during the progress of any work. The Project Representative shall have full authority to observe the materials and the work performed.

- 6.1.1. Any intimidation or attempted intimidation of the Project Representative by the Owner or one of his employees shall be sufficient reason for suspension of work.
- 6.1.2. Such observation shall not relieve the Owner from any obligation to perform his work in accordance with design criteria or approved plans. Work not properly constructed shall be removed and replaced by the Owner at his expense, without reference to any previous oversight or error in observation.
- 6.1.3. No work shall be done between 7:00PM and 7:00AM nor on Saturdays, Sundays, or legal holidays without permission of the District Staff. However, emergency work may be done without prior permission. Emergency work consists of District customers without water or a severe leak. District must be contacted during emergency at (573) 474-9522.

MATERIALS SUMMARY

1. GENERAL

1.1. This material summary is provided as a "Quick Reference" only and in no way eliminates the Contractors or Districts responsibilities to meet all of the requirements in the project specific specifications.

1.2. In the event of a discrepancy, the specifications shall take precedence.

1.3. All materials and equipment used on this work shall be new, of the best quality and shall meet the requirements of these specifications.

2. MATERIALS

2.1. Ductile Iron Pipe

2.1.1. Minimum thickness class shall be Class 52 (Class 53 for flanged pipe.)

2.1.2. Mechanical joints or push-on joints.

2.1.3. Cement-lined and seal-coated.

2.1.4. Fittings shall be of the same type and class of material as the ductile iron pipe.

2.1.5. Couplings shall be solid-sleeve type with mechanical joint.

2.2. Steel Pipe

2.2.1. Grade B Seamless, Schedule 40.

2.2.2. Fittings shall be Schedule 40 carbon steel butt welding.

2.2.3. Flanges shall be forged, carbon steel.

2.2.4. Bolts shall be Grade B heavy hex head bolts with heavy hex nuts.

2.2.5. Gaskets shall be 1/8" thick durable.

2.3. Copper Tubing

2.3.1. Hard drawn, Type K, seamless in straight lengths or coils.

2.3.2. Fittings shall be copper tube to threaded adapters (MPT)

2.3.3. Unions shall be wrought copper fittings for silver brazing.

2.3.4. Flanges: 2" and below: 150# bronze screwed flanges with wrought copper tube to threaded adaptors listed above.

2.4. HDPE Tubing

2.4.1. HDPE tubing for all underground use as service lines, shall be "copper tube size, SDR 9, 200 psi rated". All HDPE tubing produced for this service shall be in accordance with applicable standards of ASTM 3350, ASTM 2737, and ASTM D638. Fittings for use with HDPE tubing material shall be constructed of brass or bronze, of the joint type as required for the specific connections and are subject to District approval. Insert stiffeners are required when using HDPE tubing, and shall be solid 304 tubular stainless steel, dimpled and flanged on the end. Stiffeners shall be Ford Series 50, or approved equal.

2.5. Polyvinyl Chloride Pipe (PVC) – SDR Rated: (Pressure Pipe)

2.5.1. The standard dimension ratio for the pipe shall be SDR 21 (Class 200)

2.5.2. Standard lay length shall be 20 feet.

- 2.5.3. Protect from sunlight if storing in the field for more than a month.
- 2.5.4. Lubrication shall be water soluble, non-toxic, be non-objectionable in taste.
- 2.5.5. Fittings shall be of the same type and class of material as the fittings specified in DUCTILE IRON PIPE.
- 2.5.6. PVC fittings will not be accepted for buried installation.

2.6. Polyvinyl Chloride Pipe (PVC) – SDR 35 and SDR 26: (Gravity Sewer)

- 2.6.1. Integral bell shall consist of an integral wall section stiffened with a PVC retainer.
- 2.6.2. PVC retainer shall securely lock the solid cross section rubber ring into position.
- 2.6.3. Fittings shall be of the same type and class of material as the pipe.

2.7. Polyvinyl Chloride Pipe (Restrained Joint PVC)

- 2.7.1. Shall be equal to CertainTeed's Certa-Lok Yelomine.
- 2.7.2. Couplings used to connect to the non-restrained joint PVC pipe shall be long style mechanical joint repair sleeve.

2.8. Flange Adapters

- 2.8.1. Flange adapters of gray cast iron flanges for 12" and smaller pipes.
- 2.8.2. Steel flanges for larger than 12" pipe, with ductile iron follower flanges.
- 2.8.3. Gaskets shall be synthetic rubber.
- 2.8.4. "O" rings shall be neoprene.
- 2.8.5. Shall be furnished with four or more anchor studs where noted on the plans.

2.9. Resilient Wedge Gate Valves

- 2.9.1. Shall be non-rising stem, ductile-iron body and wedge, bronze trim and stem.
- 2.9.2. Shall have a rubber encapsulated ductile iron wedge.
- 2.9.3. Shall be coated with fusion bonded epoxy inside and out.
- 2.9.4. The valve stem seal shall have three "O"-rings (one lower and two upper) and shall contain tow anti-friction (thrust) washers.
- 2.9.5. Shall be as supplied by Mueller, Clow, or approved equal.
- 2.9.6. Tapping valves shall be flanged by mechanical joint and shall be compatible with the specified tapping sleeve.
- 2.9.7. Shall open left (counterclockwise).
- 2.9.8. Buried valves
 - 2.9.8.1. Operating nut capable of being turned by a standard gate valve key.
 - 2.9.8.2. Shall have a cast-iron (bituminous coated) valve box in paved areas.
 - 2.9.8.3. Bury depth in excess of 6' shall have an extension stem installed.

2.10. Air/Vacuum Release Assembly

- 2.10.1. Shall have an inlet size of 2" NPT and a discharge size of 1" NPT.
- 2.10.2. Overall height less Back Wash Accessories shall not exceed 20 1/2".
- 2.10.3. Valve shall be constructed of cast iron body and cover, stainless steel trim and float with a Buna-N seat for positive seating.
- 2.10.4. Air/Vacuum Release Assembly shall be Val-Matic's Model 301 or District approved equal.

2.11. Valve Boxes

- 2.11.1. 4" and larger sizes.
- 2.11.2. Shall be cast iron, buffalo type, 2-piece screw type with 5 1/4" shaft of a length suited to the valve depth (paved areas) or 6" Class 200 PVC pipe with cast iron lid and ring (grass areas).

- 2.11.3. The lid shall have the word "sewer", "water", or "drain" cast in it to suit the service of the valve.
- 2.11.4. The ring and lid shall be Clay and Bailey Model 2194 or approved equal.
- 2.11.5. The base of the boxes shall be round and of the proper size for the valves.
- 2.11.6.

2.12. Positive Displacement Meters (2" and Smaller)

- 2.12.1. Meters shall be Neptune with radio read capability, or approved equal.
- 2.12.2. Shall be the straight reading type with test dial direct reading in gallons.
- 2.12.3. Gearing shall be contained in a permanently hermetically sealed, tamperproof enclosure.
- 2.12.4. Shall be capable of operating properly when submerged in water.
- 2.12.5. Shall be guaranteed to operate under a working pressure of 160 lbs. per square inch.

2.13. Service Meter Settings

- 2.13.1. Shall be Type 1 unless otherwise indicated.
- 2.13.2. Shall be set with copper setters or Ford VBH-72-15-44-33 5/8 x 3/4 with single check valve or approved equal.
- 2.13.3. Shall include provisions for adequately bracing the meter yoke approved bracing material.
- 2.13.4. Setters shall be 15" tall with a 15" extended leg.
- 2.13.5. Shall contain a check valve, or a backflow deterrent, on the customer side of the setter.
 - 2.13.5.1. Shall be serviceable, spring loaded, and to have one seat of resilient material.
 - 2.13.5.2. Shall be guaranteed and tested to withstand a vacuum of external pressure test of 10.8 psia (22 in Hg.) for one hour with no leakage.
- 2.13.6. Setter shall have:
 - 2.13.6.1. A Teflon coated ball valve at the inlet end of the meter.
 - 2.13.6.2. Padlock wings on the key valve with a seal wire hole.
 - 2.13.6.3. Integral pack joint fitting on inlet.
 - 2.13.6.4. Double purpose coupling on outlet.
 - 2.13.6.5. An extended leg to place the outlet connection outside of the meter box.

2.14. Meter Boxes

- 2.14.1. Shall be 18-inch interior diameters and 36 inches long PVC (Contech A-2000) and approved by the District.
- 2.14.2. Frame shall be 11-inch cover opening with 4 1/4-inch depth.
- 2.14.3. Cover shall have an integral handle or other approved means of providing easy removal and include 2-inch hole for radio read.

2.15. Service Pipe

- 2.15.1. Shall be either Type K copper or polyethylene plastic having a minimum of 200 psi rating and an SDR of 9.
- 2.15.2. Inserts for polyethylene tubing shall be solid stainless steel.
- 2.15.3. "Long Side" services shall include 2-inch SCH 40 PVC sleeve to encase the service line.

2.16. Corporation Stops and Saddles

- 2.16.1. Corporate stops shall be Ford FB F-1000-3 for 3/4" and F-1000-4 for 1" or approved equal, with AWWA taper thread and pack joint for copper or plastic tubing.
- 2.16.2. Service saddles shall be Ford Series S70 or approved equal.
- 2.16.3. All corporation stops and saddles shall be nominal 3/4" or 1".

2.16.4. All couplings, adapters, etc. necessary shall be brass and shall be subject to approval.

2.17. Steel Casing for Bores

2.17.1. Shall be continuous butt-welded steel pipe.

2.17.2. Casing diameter shall be a minimum of 6-inches larger than O.D. of carrier pipe.

2.17.3. Shall be sealed with PSI Model S pull-on casing end seals with stainless steel banding.

2.17.4. Casing Spacers

2.17.4.1. Shall be installed on 6' intervals around the carrier pipe.

2.17.4.2. Double spacers shall be installed at each end of the casing.

2.17.4.3. Shall have a minimum height that clears the pipe bell.

2.17.4.4. Shall be RACI or APS Model CI polyethylene with stainless steel bolts and nuts.

SECTION 01110 – SUMMARY OF WORK**1.1 GENERAL**

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance.

1.2 SCOPE OF WORK

- A. This specification includes but is not limited to the following items of work, which are listed for the convenience of the Contractor and Developer in understanding the internal scope of work:
 - 1. Site work, including clearing and grubbing, excavation and backfilling, placing and compacting fill material, grading, fertilizing, seeding and mulching.
 - 2. Concrete work, including form work, cast in place reinforced Portland Cement Concrete and setting pre-cast concrete structures.
 - 3. Metals, including manhole frames and covers and manhole steps.
 - 4. Gravity sewer, including installation, sewer pipe bedding, and testing thereof.
 - 5. Force main, including installation, force main bedding, and testing thereof.
 - 6. Water line extension, including installation, pipe bedding, and testing thereof.
 - 7. All items incidental to total completion.

1.3 DISTRICT

- A. The District, as referred to in these documents, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, MO 63389.

1.4 DEVELOPER

- A. The Developer, as referred to in these specifications, is any landowner or company that installs utilities that are turned over to the Public Water Supply District No. 1 of Lincoln County for ownership and maintenance.

1.5 CONTRACTOR

- A. The Contractor, as referred to in these Specifications, is any Contractor working for the District or Developer on utilities that are owned by the Public Water Supply District No. 1 of Lincoln County or are to be turned over to the Public Water Supply District No. 1 of Lincoln County for ownership and maintenance.

1.6 DRAWING SUBMITTAL

- A. The purpose of drawing submittals by the Contractor is to demonstrate to the District that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. The Contractor shall analyze the drawings and samples before submitting them to the District and shall certify that they meet the intent of the specifications and standard drawings.
- B. Drawings submitted to the District for review shall be assembly and installation drawings, including electrical, structural, and control details, together with detailed specifications

and data covering materials used, parts, devices, and accessories forming a part of the equipment furnished.

C. Each drawing submitted must be clearly and uniformly identified and include the following:

1. Drawing number.
2. Revision number and data (first submittals to have revision number of zero.)
3. Descriptive drawing title.
4. Manufacturer.
5. Supplier.
6. Contractor.
7. Project name.

D. Upon receipt of submitted drawings or samples, the District will review the drawings and mark "No Exceptions Taken, Make Corrections Noted, Amend and Resubmit, Rejected-See Remarks".

1.7 GENERAL CONDITIONS OF CONSTRUCTION

- A. The Contractor shall, at all times, carry on the work in such a manner as to minimize the interference of traffic, utility, and municipal services and adjoining property.
- B. The work shall be carried out in such a manner that all physical structures and natural features are restored to at least as good a condition as they were in before the work was done. It is understood that where specifications and standard drawings apply, their provisions shall determine the character and manner of restoration of existing structures and features.
- C. Any damage done to private or public property shall be repaired by the Contractor to the satisfaction of the District of said property.
- D. Valve and service boxes, valve vaults, gas drips, and other appurtenances on utility lines shall be kept free of excavated material and shall be left accessible and operable at all times.
- E. Construction in Easements: While in easement across private property, the Contractor shall confine all operations in the easement area and shall be responsible and liable for all damages outside of the easement area. Trees, fences, shrubbery or other type of surface improvements located in easement will require protection during construction. The provisions of this specification shall apply to all easement areas as well as the public right-of-way. Precautions shall be taken by adequate sheeting or other approved method to prevent any cave in or subsidence beyond the easement limits or damage to improvements within the easement. In general, the easement area is intended to provide reasonable access and working area for efficient operation by the Contractor. Where easement space for efficient operation is not provided, the Contractor shall be responsible for organizing his operations to perform within the restrictions as shown on the drawings.

1.8 PERMITS, CERTIFICATES, LAWS, AND ORDINANCES

- A. The Developer or Contractor shall, at his own expense, procure all permits, certificates and licenses required of him by law for the execution of this work. The Developer and Contractor shall comply with all Federal, State and Local laws, ordinances, or rules and regulations relating to the performance of the work.

1.9 LOCAL UTILITIES

- A. The Contractor shall avoid interference or damage to any utilities. If the Contractor causes damage to utilities due to carelessness or neglect, the repairs shall be made by the District of the utility involved, and all charges made for necessary repairs and replacements shall be borne by the Contractor.
- B. Utilities may be located by calling 1-800-344-7483 (1-800-DIG-RITE). Utilities that are not a part of the Missouri One-Call System must be contacted individually.
- C. The Contractor shall notify all Districts of subsurface facilities of his planned operations and have Districts locate all facilities prior to construction.
- D. The Contractor shall satisfactorily shore, support and protect any and all structures and all pipes, sewers, drains, conduits, and other facilities, and be responsible for any damage resulting thereto.
- E. The Contractor shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, he shall immediately notify a responsible official from the organization operating the utility interrupted. The Contractor shall lend all possible assistance in restoring service and shall assume all costs, charges, or claims connected with the interruption and repair of such services.

1.10 LOCAL CONDITIONS

- A. The Developer and Contractor shall satisfy themselves regarding all local conditions affecting the work by personal investigation. Information derived from maps, plans, specifications, standard drawings, available through the District or other agencies, shall not relieve the Developer and Contractor from their responsibility hereunder, or from fulfilling any and all of the terms and requirements of this specification.

1.11 PROTECTION OF THE SITE

- A. Except as otherwise provided herein or on the plans, the Contractor shall protect all existing structures, fences, sheds, garages, walks, pipelines, trees, shrubs, lawns, etc., during the progress of this work. The Contractor shall be responsible for removing from the site all excess excavation, debris and unused materials and shall, upon completions of the work, restore the site as nearly as possible to its original condition. This restoration would include the replacement of any facilities or landscaping which has been damaged, and will be done at the Contractor's expense.
- B. The Contractor shall provide continuous erosion control throughout the entire construction period through the use of berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains and other erosion and sediment control devices or methods required to assure effective and continuous erosion control throughout the construction period.

1.12 RESPONSIBILITY OF CONTRACTOR FOR BACKFILL SETTLEMENT

- A. The Contractor shall be responsible, financially and otherwise, for:
 - 1. Any and all settlement and erosion of trench and other backfill which may occur from the time of original backfilling until the expiration of a period of one year from and

after the date of final acceptance of the entire Contract under which the backfilling work was performed.

2. The refilling and repair of all backfill settlement and erosion and the repair or replacement to the original or better condition of all pavement, top surfacing, driveways, curbs, gutters, walks, surface structures, utilities, and drainage facilities, sod and shrubbery, which have been removed or destroyed in connection with backfill placement operations.
3. Any and all damage claims filed with the District or court actions brought against the District for and on account of any damage or damages directly or indirectly caused by said backfill settlement or erosion.

B. The Contractor shall make, or cause to be made, all necessary backfill placement, and repairs or replacement of appurtenances thereto, immediately from and after due notifications by the District of backfill settlement and erosion and resulting damage at any designated location or locations. If the Contractor does not make the necessary repairs and the District deems it necessary, the District may make the necessary repairs at the Contractor's expense.

1.13 CONSTRUCTION LIMITS

- A. All work on State, County, Township or Railroad right-of-way shall be carried out in accordance with the requirements of the governing authority. Any areas needed for the construction which have not been secured by the District shall be acquired by the Contractor at his sole expense.

1.14 PROTECTION AND STORAGE OF EQUIPMENT AND MATERIALS

- A. The Contractor shall exercise care in the protection of materials and equipment furnished and/or installed under this specification while they are in storage at the site, and during and after installation prior to final acceptance. Except as specifically noted to the contrary hereinafter, the Contractor shall be responsible for providing any on or off-site warehousing or storage, which may be necessary to adequately protect such materials and equipment.
- B. Store, handle and ship pipe, fittings and equipment so as to prevent permanent deformation or crimps in the materials.
- C. Exercise care and protect all equipment and materials during storage, shipment, and prior to delivery and acceptance. Keep openings in pipe, vessels, equipment and machinery closed with adequate durable covers after final shop inspection.
- D. Adequately crate, block, anchor and protect material for shipment. Replace items damaged without expense to District.

1.15 DEFECTIVE EQUIPMENT

- A. In the event of failure of equipment to conform to specifications or to operate satisfactorily, District shall have right to operate equipment until defects are corrected and guarantees met.
- B. District shall have right to operate rejected equipment until it is replaced, without cost for depreciation, use or wear.
- C. Contractor shall remove defective equipment from operation for examination, adjustment, alteration or change only at times approved by the District.

1.16 INTERFERENCE WITH TRAFFIC

- A. The work shall be carried out at all times in a manner causing a minimum of interference with traffic. The Contractor shall provide necessary warning signs, lights and flagmen, where required, to expedite the movement of traffic. He shall cooperate at all times with the traffic authorities.
- B. In no case shall traffic be completely blocked in a street or roadway without the express consent of the District.
- C. A traffic control plan may be required at the District's request.

1.17 CONTRACTOR UTILITIES

- A. The Contractor shall make all arrangement and pay all costs for necessary quantities of water for purposes of filling, flushing, disinfecting and placing the system into service for the District's use. The Contractor must furnish any hoses, connections, temporary meters, etc., to convey the water to the new piping. The District fully intends to have water available to the Contractor at quantities and pressures requested; however, no guarantee is made of this. Volumes and pressures in excess of the available supply shall be at the expense of the Contractor.
- B. Power and other necessary utilities will be obtained by the Contractor at his own expense from the public utility or from other sources.

1.18 EXPLOSIVES

- A. The Contractor shall comply with all laws, ordinances, applicable safety code requirements, and regulations relative to the handling, storage and use of explosives and the protection of property. He shall be responsible for all damage caused by his blasting operations.

1.19 SAFETY

- A. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards as required shall be placed and maintained by the Contractor at his expense during the progress of the construction work and until it is safe for traffic to use the roads and streets. All material piles, equipment, and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the local authorities respecting safety provisions shall be observed.
- B. Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his expense and under the direction of the District. The structures which may have been disturbed shall be restored upon completion of the work.
- C. Property and surface structures shall be protected during construction operations unless their removal for purposes of construction is authorized by the District. Manmade surface improvements which are moved or disturbed by the Contractor shall be restored to the original condition, after construction is completed, at the Contractor's expense.
- D. Any trees or shrubbery which are located within the easement may be removed by the Contractor if they interfere with normal construction requirements. Care should be taken

to leave in place as many trees as possible. Responsibility for any damage or claims for damage caused by construction operations outside of the easement shall be assumed by the Contractor. Settlement of any damage or claims for damage shall be made by the Contractor as soon as possible and in a manner satisfactory to the District. Any grass area disturbed by the construction shall be seeded in accordance with the governing specification, Section 02374.

1.20 CONTROL WORK

- A. Basic horizontal and vertical control points shall be indicated on the construction drawings. These points shall be used as datum for the Work. All elevations shall be given using U.S.G.S. elevations.
- B. The Contractor shall complete the layout of the work and shall be responsible for all measurements that may be required for execution of the work to the location and limits required.
- C. Contractor shall submit to District one copy of all construction survey notes and data at the Owner's request.
- D. To the extent practicable, Contractor shall maintain all slope and cut stakes in excavation areas until the adjacent excavation has reached final grade or subgrade.
- E. When so requested by the District's Project Representative, the Contractor shall furnish one laborer to assist the District's Project Representative in spot-checking of the construction layout and grades.

1.21 LINES AND GRADES

- A. All staking required for the project shall be by the Developer. The Contractor shall be required to construct all facilities to the lines and grades as shown on the plans.
- B. When a pipeline is shown on the plans to parallel closely to the highway right-of-way or property line, it is intended to be installed within ten (10) feet of such right-of-way or property line, unless otherwise directed by the District. Deviations from this may be required to avoid obstructions, existing utilities, etc.
- C. When a pipeline is shown on the plans or otherwise necessary to construct the pipeline on public right-of-way, the location of said facilities shall meet all requirements of the governing authority.

1.22 TIE-IN OF NEW MAINS

- A. The tie-in of new mains to an existing main will be completed in the presence of an authorized representative of the Water District. The Water District shall be given 48 hour notice of scheduled tie-ins. All requirements of the tie-ins shall meet the approval of the Water District.

1.23 SANITARY FACILITIES

- A. The Contractor shall furnish and maintain portable toilets for construction employees during the construction period unless the District approves otherwise. These toilets are to be chemical-type conveniently located and secluded from public view and shall meet the requirements of the State Board of Health and the Federal Safety Construction Act, and shall be maintained in clean and sanitary condition.

1.24 ACCEPTANCE

- A. The Contractor shall notify the District when the work is substantially completed, and is ready for testing. The District's Representative shall be given advance notice and shall observe all pipeline testing and equipment testing until all are successfully tested. Final acceptance of the work shall not be given by the District until: approval of the cleanup work is obtained from the District and the appropriate governing authority, and the provisions of tests results conforming acceptable sterilization of all water pipelines and acceptable operation of new equipment.

1.25 LIMITED WARRANTY

- A. All manufacturers furnishing new equipment for the Project shall, in writing, warranty their equipment to be free of defects in materials and factory workmanship for a period of one (1) year from the date of start-up or two (2) years from the date of shipment, whichever comes first, providing the product is properly installed and operated under normal conditions.

The warranty shall state that material and labor for repair or parts replacement will be free of charge to the District during this period.

1.26 GENERAL GUARANTY

- A. The Contractor shall guarantee all materials and equipment furnished and work performed for a period of one (1) year from the date of completion and acceptance of the work. The Contractor warrants and guarantees for a period of one (1) year from the date of completion and acceptance of the work that the completed work is free from all defects due to faulty materials or workmanship and the Contractor shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any other damages that were caused by defects in the work.
- B. The District will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such repairs, adjustments, or other work that may be made necessary by such defects, the District may do so and charge the Contractor the cost thereby incurred.
- C. In emergency where, in the judgment of the District, delay would cause serious loss or damage, repairs and replacement of defects in the work and damage caused by defects may be made without notice being sent to the Contractor, and the Contractor shall pay the cost thereof.

1.27 SUBSURFACE PIPELINES, STRUCTURES AND INFORMATION

- A. The Contractor shall notify all Districts of subsurface facilities of his planned operations, and shall have such Districts locate all facilities prior to construction.

1.28 APPLICABLE CODES AND STANDARDS

- A. The latest revision of all codes and standards at the time of bid opening shall govern.
- B. Applicable codes and standards referred to in these specifications shall establish minimum requirements for equipment, materials, construction, and shall be superseded by more stringent requirements of drawings and specifications when and where they occur.

C. Any conflicts between specifications and applicable codes and standards shall be referred to the District for a decision thereon.

1.29 SUBSTITUTIONS, "OR EQUAL" PROJECTS

A. The Contractor shall be responsible for using equipment and materials which meet the specifications and requirements as indicated on the drawings.

The Contractor shall submit all drawings and product information for approval of equipment and materials prior to construction. The proposed product cannot be used until it is approved by the District.

B. In all cases, the District shall be the sole judge as to whether a proposed product is to be approved and the Contractor shall have the burden of proving, at his expense, to the satisfaction of the District, that the proposed product is similar and equal to the named product. In making such determination, the District may establish such criteria as he may deem proper that the proposed product must meet in order for it to be approved.

C. Where the District approves a product proposed by the Contractor, and such product requires a revision or redesign of any part of the work covered by the Contract, all such revision and redesign of any part of the work covered by the Contract, all such revision and redesign and all new drawings and details required therefore, shall be subject to the approval of the District, and shall be provided by the Contractor at his own expense. If an approved substitution of a product requires a different quantity and/or arrangement of ductwork, piping, wiring, or any part of the work from that in the plans, the Contractor shall provide the same at his own expense.

D. Whenever any product is specified in the Specification by a reference to the name, trade name, make or catalog number of any manufacturer or supplier, the intent is not to limit competition, but to establish a standard or quality which the District has determined is necessary for the Project. The words "or equal", if not stated, are implied.

1.30 RIGHT OF ENTRY

A. The authorized representative and agents of the District and Missouri Department of Natural Resources (DNR), shall be permitted to inspect and have access to all work, materials, payrolls, invoices of materials, and other relevant data and records.

END OF SECTION

SECTION 02080 – UTILITY MATERIALS**1.1 GENERAL**

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, written approval by the Public Water Supply District No. 1 of Lincoln County must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.2 DESCRIPTION OF WORK

- A. The work to be performed under this section consists of furnishing all materials, equipment, supplies and tools necessary for the construction of the water piping, sewer force main or gravity sewer included in this Specification, complete with valves, accessories and all necessary components.
- B. All work shall be completed in accordance with the project plans and details.
- C. Applicable Sections: 02315 Excavating, Filling and Grading.

1.3 QUALITY ASSURANCE

- A. Work shall conform to all local building codes.
- B. All codes referred to are those listed by:
 1. American Society for Testing Materials (ASTM).
 2. American Water Works Association (AWWA).
 3. American Standards Association (ASA).
 4. Commercial Standards (CS).
 5. American Association of State Highway & Transportation Official (AASHTO).
 6. Federal Specifications

Codes and standards referred to above shall be the current edition that is being used at the time of bid opening.

- C. All materials and equipment used on this work shall be new, of the best quality and shall meet the requirements of these specifications. Materials shall be sampled and tested in accordance with current ASTM Specifications or such others as specified hereinafter. The Contractor will be required to furnish certificates of conformance to ASTM or other applicable specifications. Materials shall be stored in such a manner that their conditions are still equivalent to new when installed.
- D. Submittals on pipe, valves and other accessories shall include manufacture, pressure class, materials of construction, reference AWWA or ASTM Standards the equipment complies with, and catalog cuts or shop drawings showing layout dimensions.
- E. Whenever in these specifications reference is made to the requirements of the ASTM, AWWA, ASA, or other standard specifications, it shall be understood that references are made to the latest modifications or revisions of such specifications.

- F. All material to be used in this work will be inspected before being placed and all rejected material must be removed immediately and not used in the work under this contract. Any material installed or placed without inspection shall be removed and replaced with new materials if so directed by the District's Representative.
- G. The Contractor shall be required to furnish such laborers as may be necessary to aid the District's Representative in the examination and culling of material.
- H. The Contractor shall pay for all tests required by the specifications. Such tests shall be performed by a competent independent laboratory approved by the District on test specimens selected by the Contractor under the direct supervision of the District. Copies of all test results shall be submitted to the District directly from the testing laboratory.

2.0 MATERIALS

2.1 DUCTILE IRON PIPE

- A. Ductile iron pipe shall conform to ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51 or ANSI/AWWA C115/A21.15 for flanged pipe. Minimum thickness class shall be Class 52 (Class 53 for flanged pipe). The pipe shall be manufactured from a grade of iron having a minimum mechanical property of 60,000 psi tensile strength, 42,000 psi yield strength, and a minimum of ten percent (10%) elongation.
- B. Mechanical joints or push-on joints conforming to ANSI Spec. A21.51 or A21.11 AWWA for all buried pipe unless otherwise specified or indicated.
- C. Flanged joints shall be used for all interior and exposed exterior pipe except where otherwise specified or indicated, conforming to ANSI/AWWA C115/A21.15.
- D. Restrained ductile iron pipe shall be similar to American Cast Iron Pipe Co. – Lok-Fast joint, U.S. Pipe and Foundry Co. – Field Lok joint, or approved equal for pipe sizes 4" and larger. Restrained ductile iron pipe for pipe sizes smaller than 4" shall be mechanical joint with retainer gland.
- E. Water line shall be cement-lined and seal-coated in conformance with ANSI Spec. A21.4 and AWWA C104. Sewer pipe shall also be cement-lined and seal coated.
- F. Fittings: Furnish ell, tees, reducers, wyes, couplings, crosses, transitions and end caps and plugs of the same type and class of material as the ductile iron pipe, or of material having equal or superior physical and chemical properties as acceptable to the District.
 - 1. Conform to ANSI A21.10 with a 350 psi pressure rating.
 - 2. Fittings for pipe with mechanical joints shall have mechanical joints.
 - 3. Include all specials, taps, plugs, flanges, adapters and wall fittings, as required.
- G. Couplings:
 - 1. Furnish where indicated or required to make corrections.
 - 2. Coupling material shall be ductile iron.
 - 3. Couplings shall be solid-sleeve type with mechanical joint conforming to one of the following:
 - a. Ford Style FCI, Ford Meter Box Co., Wabash, Indiana
 - b. Dresser Style 153, Dresser Mfg. Division, Bradford, PA
 - c. Tyler Union Long Style Solid Sleeve, Tyler Union, Tyler, Texas
 - d. Or equal
 - 4. Bodies, rings and glands shall be ductile iron.
 - 5. Sleeves shall be without pipe stop.

H. Gaskets and Bolting Materials

1. Provide all gaskets, bolts, lubricants and other accessories required to install pipe, fittings and specials, complete and ready for service.
2. Gaskets for flanged joints: Conform to ANSI B16.21, 1/8" thick full face red rubber.
3. Bolts for flanged joints: Conform to ASTM A307, Grade B. Nut and bolt heads shall be hexagonal.

2.2 STEEL PIPE

- A. Steel pipe shall conform to ASTM A53, Grade B Seamless, Schedule 40.
- B. Fittings shall be Schedule 40 carbon steel butt welding L.R. elbows, caps and reducers, ASTM A234, Grade WPB.
- C. Flanges shall be forged, carbon steel, 150# ANSI welding neck, F&D, RF, per ASTM A181, Grade 1.
- D. Bolts shall conform to ASTM A307, Grade B heavy hex head bolts with heavy hex nuts.
- E. Gaskets shall be 1/8" thick durable.
- F. Galvanized steel pipe shall conform to ASTM A 120-72A, hot-dipped zinc-coated (galvanized) welded and seamless steel pipe for ordinary uses.

2.3 COPPER TUBING

- A. Tubing: Copper tube ASTM B88, hard drawn, Type K, seamless in straight lengths or coils.
- B. Fittings for Above Ground Use: L.R. elbows, tees, caps, reducers, couplings, copper tube to threaded adapters (MPT) and unions-all to be wrought copper fittings for silver brazing per ANSA B16.22.
- C. Fitting for Buried Use: Fittings for use with the copper tube material shall be constructed of brass or bronze, of the joint type as required for the specific connections, and are subject to District approval. Allowable manufacturers are Ford and Mueller.
- D. Flanges: 2" and below: 150# bronze screwed flanges per ANSI B16.24 with wrought copper tube to threaded adaptors listed above.

2.4 HDPE TUBING

- A. HDPE tubing for all underground use as service lines, shall be "copper tube size, SDR 9, 200 psi rated". All HDPE tubing produced for this service shall be in accordance with applicable standards of ASTM 3350, ASTM 2737, and ASTM D638. Fittings for use with HDPE tubing material shall be constructed of brass or bronze, of the joint type as required for the specific connections and are subject to District approval. Insert stiffeners are required when using HDPE tubing, and shall be solid 304 tubular stainless steel, dimpled and flanged on the end. Stiffeners shall be Ford Series 50, or approved equal.

2.5 POLYVINYL CHLORIDE PIPE (PVC) – SDR RATED: (Pressure Pipe)

- A. Rigid PVC pressure pipe as described in this specification is design to carry pressures (including surge) up to the maximum class rating.

- B. Material used to produce the pipe, couplings and fittings shall conform to ASTM D1784, Type 1, Grade 1, 200 psi design stress.
- C. The standard dimension ratio for the pipe shall be SDR 21 (Class 200) unless otherwise indicated.
- D. Standard lay length shall be 20 feet.
- E. All pipe shall conform to the latest revisions of the following specifications:
 - 1. ASTM Specification D2241
 - 2. Department of Commerce PS22-70 (SDR-PR) (Pressure-Rated Pipe).
 - 3. National Sanitation Foundation Testing Laboratories (NSF)
 - 4. Rubber gasketing shall conform to ASTM F-477.
 - 5. Only elastomeric ring seals are to be used in joining pipes. The elastomeric ring seal joint shall conform to ASTM D3139. The joints shall have been tested and approved by the National Sanitation Foundation and certification of said approval shall be submitted to the District.
- F. Markings:
 - 1. Pipe markings shall include the following, marked continuously down the length.
 - a. Manufacturer's Name
 - b. Nominal Size
 - c. Class Pressure Rating
 - d. Dimension Ration Number
 - e. PVC 1120
 - f. NSF Logo
 - g. Identification Code
- G. Storage:
 - 1. Avoid storage of pipe in direct sunlight for extended periods of time. If field storage for more than a month is required, cover pipe to protect from exposure to sunlight.
- H. Lubrication:
 - 1. Lubrication shall be water soluble, non-toxic, be non-objectionable in taste and odor imparted to the fluid, be non-supporting of bacteria growth and have no deteriorating effect on the PVC or rubber gaskets.
- I. Fittings:
 - 1. Furnish ells, tees. Reducers, wyes, couplings, crosses, transitions and end caps and plugs of the same type and class of material as the fittings specified in DUCTILE IRON PIPE, or of material having equal or superior physical and chemical properties as acceptable to the District unless otherwise indicated.
 - 2. PVC glue joint fittings will **not** be accepted for pressure pipe buried installation.
- J. Bell Depth:
 - 1. The bell depth/entry dimension of the SDR rated pipe shall not be less than the following dimensions:
 - a. 2" diameter – 4.00"
 - b. 3" diameter – 4.84"
 - c. 4" diameter – 5.00"
 - d. 6" diameter – 6.25"
 - e. 8" diameter – 6.37"

2.6 POLYVINYL CHLORIDE PIPE (PVC) – SDR 35 and SDR 26: (Gravity Sewer)

- A. 15" Pipe and Smaller: Polyvinyl chloride plastic gravity sewer pipe with integral wall bell and spigot joints shall be made from clean, virgin, approved class 12454-B or 12454-C PVC compound conforming to ASTM Resin Specifications D1784. All pipe shall comply with ASTM Specifications 3034 made to SDR 35 or SDR 26 dimensions. The integral bell shall consist of an integral wall section stiffened with a PVC retainer which securely locks the solid cross section rubber ring into position. All fittings and accessories shall be as manufactured and furnished by the pipe supplier.
- B. Pipe Larger than 15": Polyvinyl chloride plastic gravity sewer pipe with integral wall bell and spigot joints shall be made from clean, virgin, approved class 12364-C or 12454-C PVC compound conforming to ASTM Resin Specification D1784. All pipe shall comply with ASTM Specification 679. The integral bell shall consist of an integral wall section stiffened with PVC retainer which securely locks the solid cross section rubber ring into position. All fittings and accessories shall be as manufactured and furnished by the pipe supplier.

2.7 POYLYVINYL CHLORIDE PIPE (RESTRAINED JOINT PVC):

- A. Restrained joint PVC pipe shall be equal to Certain Teed's Certa-Lok Yelomine restrained joint PVC pressure pipe meeting dimensional requirements of ASTM D2241. Joints are to meet the requirements of ASTM D3139 and ASTM F477. Pipe shall be NSF approved.
- B. Restrained joint PVC shall be installed using a "permanent" joint system. Joint system shall provide a noncorrosive restrained joint by using machined grooves on the pipe and in the coupling which, when aligned, allow a spline to be inserted locking the pipe and coupling together. Provide an o-ring in the coupling to create a hydraulic seal.
- C. Couplings used to connect to the non-restrained joint PVC pipe shall be at least 18" long.

2.8 FLANGE ADAPTERS

- A. Flange adapters shall consist of gray cast iron flanges for 12" and smaller pipes, steel flanges for larger than 12" pipe, with ductile iron follower flanges. The bolt circle, bolt size, and spacing shall conform to ANSI Standard B16.1 for 125 pound flanges. Gaskets shall be synthetic rubber. "O" rings shall be neoprene. Each flange adapter shall be furnished with four or more anchor studs where noted on the plans.

2.9 KWIK FLANGE:

- A. The Kwik-Flange shall be designed for use on cast iron or ductile iron piping. The unit shall be provided with setscrews giving restraint against the pressure force and shall have both Underwriter's Laboratories, Inc. and Factory Mutual Research Corp. approval. It shall be manufactured by Standard or equal.

2.10 VALVES:

- A. Resilient Wedge Gate Valves:
 - 1. All gate valves shall be non-rising stem, ductile-iron body and wedge, bronze trim and stem, resilient seat gate valves conforming to AWWA C515, unless otherwise indicated. The valve shall have a rubber encapsulated ductile iron wedge. The valve shall be coated with fusion bonded epoxy inside and out. The valve stem seal shall have three "O"-rings (one lower and two upper) and shall contain two anti-friction (thrust) washers. The valve shall be American Flow Control Series 500, Mueller Model A-2360, or approved equal.

2. Valve ends shall be compatible with the pipe in which they are installed. Tapping valves shall be flanged by mechanical joint and shall be compatible with the specified tapping sleeve.
3. All valves shall open left (counterclockwise) and have an operating nut capable of being turned by a standard gate valve key for buried valves and a handwheel for exposed valves.
4. Each buried valve in paved areas shall have a cast-iron (bituminous coated) valve box. Valve box shall be two-piece, screw type, 5 1/4" shaft, cast-iron collar and lid and shall be of the length suited to the valve depth.
5. All valves with a bury depth in excess of 6' shall have an extension stem installed. Stem extensions shall be Mueller A-26441 or approved equal, or Mueller A-26440 or approved equal for applications with handwheel actuators.

B. Pressure Reducing Valves:

1. Shall be reviewed and approved by the District on a case by case basis.

C. Air/Vacuum Release Assembly:

1. Air/Vacuum Release Assembly shall be of the type that automatically exhausts large quantities of air during the filling of a system and allows air to re-enter during draining or when a vacuum occurs. The valve shall have an inlet size of 2" N.P.T. and a discharge size of 1" N.P.T. The over-all height less Back Wash Accessories shall not exceed 20 1/2". Valve shall be constructed of cast iron body and cover, stainless steel trim and float with a Buna-N seat for positive seating.
2. Air/Vacuum Release Assembly shall be Val-Matic's Model 301 or District approved equal.

2.11 VALVE BOXES

- A. Valve boxes shown on the drawings for 4" and larger sizes in paved areas shall be cast iron, buffalo type, 2-piece screw type with 5-1/4" shaft of a length suited to the valve depth or 6" Class 200 PVC pipe, with cast iron lid and ring in grass areas. The cast iron lid shall have either the word "sewer", "water", or "drain" cast in it to suit the service of the valve. The base of the boxes shall be round and of the proper size for the valves. Smaller sized boxes may be used for 3" and smaller size valves providing the Contractor can demonstrate their suitability for the conditions of their use.
- B. Ring and lid shall be Clay and Bailey Model 2194 or approved equal.

2.12 VALVE MARKERS:

- A. Valve markers must be located at all water and sewer valves. Said marker shall be a glass fiber/resin reinforced composite utility stake with the words "Water Valve" or "Sewer Valve". The utility stake shall be "blue" in color for water "green" in color for sewer, and shall be manufactured by custom marking products, or approved equal.

2.13 ACCESSORIES:

- A. Positive Displacement Meters (2" and Smaller):
 1. The meters shall be magnetic drive, positive displacement oscillating piston type cold water meters conforming to AWWA C-700. Meters shall be Neptune, or approved equal.
 2. Meters shall have an outer case of bronze with a separate measuring chamber which is easily removed from the case. Meter bottoms must be provided for frost protection. All meters shall have cast on them in raised characters the size and direction of flow through the meter.
 3. The register shall be the straight reading type with test dial direct reading in gallons at the meter. The gearing shall be contained in a permanently hermetically sealed, tamperproof enclosure. The register shall be capable of operating properly when submerged in water.

4. The measuring chamber shall not be cast as part of the main case. All piston assemblies will be interchangeable in all measuring chamber assemblies.
5. All external bolts and washers shall be of corrosion-resistant material and be easily removed from the main case and be tapped for seal wire.
6. An internal strainer must be provided, made of corrosion-resistant material and be easily removed from the meter. Stainless steel strainer will be preferred.
7. Meters must conform to American Water Works Association Specifications with the following flow capacity:

a. $\frac{5}{8}$ " x $\frac{3}{4}$ "	1-20 gpm
b. $\frac{3}{4}$ "	2-30 gpm
c. 1"	3-50 gpm
d. $1\frac{1}{2}$ "	5-100 gpm
e. 2"	8-160 gpm
8. A certified copy of compliance with Standard AWWA tests for this type of meter shall accompany each meter upon delivery.
9. Meter shall be guaranteed to operate under a working pressure of 160 lbs. per square inch without a leakage or damage to any part.

B. Service Meter Settings:

1. Service meter setting shall be Type 1 unless otherwise indicated. Meters shall be set with copper setters. The setters shall be Ford VBH-72-15-44-33 5/8 x 3/4 with single check valve or approved equal. Each meter setting shall include provisions for adequately bracing the meter yoke in the meter pit with approved bracing material. Setters shall be 15" tall with a 15" extended leg.
2. All meter settings shall contain a check valve, or a backflow deterrent, on the customer side of the setter. The check valve is to be serviceable, spring loaded, and to have one seat of resilient material. Check valves shall be guaranteed and tested to withstand a vacuum of external pressure test of 10.8 psia (22 in Hg.) for one hour with no leakage.
3. Each copper setter shall have a Teflon coated ball valve at the inlet end of the meter. It shall be constructed to as to hold the meter rigidly in such a way that the piping is undisturbed when the meter is removed. Each copper setter shall have padlock wings on the key valve with a seal wire hole.
4. The inlet of the setter shall be provided with an integral pack joint fitting. The outlet shall be provided with a double purpose coupling. The outlet shall be furnished with an extended leg to place the outlet connection outside of the meter box.
5. Meter boxes shall be 18-inch interior diameters and 36 inches long. Boxes shall be PVC (Contech A-2000) and shall be approved by the District.
6. Meter box frames shall be 11-inch cover opening with 4 1/4-Inch depth. Meter box covers shall have an integral handle or other approved means of providing easy removal of the cover and 2-inch hole for radio read.

C. Service Pipe:

1. Service pipe shall be either Type K copper or polyethylene plastic as approved by NSF, having a minimum of 200 psi rating, a SDR of 9 and meeting the requirements of ASTM D2737, PE3408, CTS-OD. The Contractor shall, at the District's or District's Representative's direction, make any adjustments to services deemed necessary by him. Long side services shall include 2-inch SCH 40 PVC sleeve to encase the service line.
2. All inserts for polyethylene tubing shall be solid stainless steel, Ford Series 50, or approved equal.

D. Corporation Stops and Saddles:

1. Corporation stops shall be Ford 3/4" F1000-3 or 1" F1000-4 or approved equal, with AWWA taper thread and pack joint for copper or plastic tubing.
2. Service saddles shall be Ford Series S70 or approved equal.
3. All corporation stops and saddles shall be nominal 3/4" or 1".

4. All couplings, adapters, etc. necessary shall be brass and shall be subject to District's approval.
- E. Sampling Station:
 1. Sampling stations shall be an Eclipse No. 88 as manufactured by the Kupferle Foundry Company or approved equal.
 2. The sampling point shall be located in a lockable aluminum enclosure with storage shelves.
 3. The waterway shall be of brass construction and protected from freezing without the use of drain holes.

2.14 HYDRANTS :

- A. Hydrants shall be a traffic model with dry barrel and compression valve to open against water pressure. Nozzle threads to meet ASA specifications B26 for National American Standard Fire Hose coupling screw threads.
- B. Cap with conforming threads shall be supplied for each nozzle. Cap nuts shall have same dimensions identical to those of operating nut. Pentagonal operating nut dimensions (1 1/2) inches from point to flat to open counter clockwise.
- C. Bonnet, body and caps shall be painted with silver-aluminum Tnemec "Poly-Ura-Prime 50-330", or approved equal, per paint manufacturer's specifications. Main valve to be faced with synthetic rubber.
- D. Main valve opening to be determined by style of hydrant. Hydrants shall have a coefficient of (9) nine or greater.
- E. Nozzles shall be (2 1/2) inches and (4 1/2) inches respective to style. Two-way nozzle hydrants shall have (2) (2 1/2) inch nozzles, configured at a 45 degree angle on the barrel, with a (4 1/2) inch valve opening with a (4) inch mechanical joint foot piece. Three-way nozzle hydrants shall have (2) (2 1/2) inch nozzles and (1) (4 1/2) inch steamer nozzle with a (5 1/4) inch valve opening with a (6) inch mechanical joint shoe. Bury to be (4) feet unless otherwise specified.
- F. All hydrant installations to have an isolation valve equal to shoe size of hydrant.
- G. All flush hydrants shall be the Main Guard 4" Blow-off #7500 Kupferlee.

2.15 STEEL CASING FOR BORES:

- A. Casing pipe shall be continuous butt-welded new steel pipe capable of withstanding highway and railway loading in not less than 10 foot lengths.
- B. In all cases, pipe diameter shall be great enough to allow carrier pipe to be removed subsequently without disturbing the casing pipe, roadbed or railway bed.
- C. Annular spaces at the ends of the casing shall be sealed with Pipeline Seal and Insulator (PSI) Model S pull-on casing end seals with stainless steel banding straps.
- D. Casing spacers shall be installed on 6' intervals around the carrier pipe with double spacers at each end of the casing. Spacers shall have a minimum height that clears the pipe bell. Casing spacers shall be RACI or APS model CI polyethylene with stainless steel bolts and nuts.
- E. Steel Casing for bores:
 1. Steel pipe shall have a minimum yield strength of 35,000 psi.

2. Minimum wall thickness for steel casing pipe shall be as follows:

<u>Nominal Thickness Inches</u>	<u>Nominal Diameter Inches</u>
0.250	Under 20
0.281	20
0.312	22
0.344	24
0.375	26
0.406	28 and 30
0.438	32
0.469	34 and 36
0.500	38, 40, 42, & 48

F. Length of casing shall be as shown on the plans.

2.16 CONNECTION TO PRESENT SYSTEM:

A. Materials to be used for connections to the present water distribution system shall be in accordance with the preceding Articles as applicable, under this Section of these specifications. Installation, testing and sterilization of all items shall be in strict accordance with the following Section of these specifications. Under all circumstances, extreme care must be exercised when connecting to the present system. Foreign materials of whatever nature must not be permitted to enter the system. All direct connection fittings and valves shall be thoroughly rinsed or washed with a chlorine solution just prior to installation and connection. The chlorine solution to be used shall be mixed as stated in the following Section of the specifications.

Where shown on the Construction Drawings, hot taps should be used to prevent system shut down.

Tapping sleeves for water lines shall be Smith-Blair Model 665, with stainless steel full circumference band and stainless steel flanged outlet as manufactured by the Smith-Blair Company or approved equal.

Tapping valves for water lines shall be Mueller flanged to mechanical joint Model T-2360-16, non-rising stem, resilient wedge seat, tapping valves or approved equal. Each valve shall include the required Mueller transition glands (A-3999). Said valves shall be of the size required in the approved plans. All valves shall be manufactured in accordance with AWWA Standards C-515.

The Contractor shall notify the District when system shutdown is required so that proper notification to those affected by the shutdown can be provided. Where system segment shutdown is required, the actual shutdown is not to be done until all connection materials, equipment, and personnel are at the site, and the existing system point of connection has been exposed, thoroughly cleaned, and prepared for immediate installation of the connection materials. All personnel shall be thoroughly instructed as to the procedure to be followed and ready for work. All connections are then to be made in an efficient manner requiring the least amount of time and maximum amount of care.

3.0 CONSTRUCTION REQUIREMENTS

A. Installation of utility materials is specified in other sections of these technical specifications.

3.1 SHIPPING AND HANDLING:

- A. Handle pipe in a manner to ensure installation in sound, undamaged condition using proper equipment, tools and methods, as follows:
 - 1. Suitable slings or skids.
 - 2. Without hooks in contact with joint surfaces.
 - 3. Provisions for preventing contact with adjacent units during moving or storage.
 - 4. Protection for all pipe ends such as beveled ends, flanges, mechanical joints, plain ends, threads, etc., prior to shipping to job site.

3.2 PIPE INSPECTION:

- A. All pipe shall be subject to approval of the District.
- B. Pipe sections damaged by handling which, in the opinion of the District, cannot be satisfactorily repaired shall be rejected. This shall include, but is not limited to, broken bells and spigots, bent bell-and-spigot rings, excessive deflection and similar damage.

3.3 CLEANING:

- A. Thoroughly clean interior of all pipe, fittings and joints before installation.
- B. Exclude foreign matter during installation by providing temporary covers over end of pipe, if necessary.
- C. Do not place tools, clothing or materials at any time in pipe.
- D. Visually inspect, remove all articles in pipe, brush or flush clean immediately prior to final fitting of system.

3.4 VALVES AND ACCESSORIES

- A. All valves and accessories for the piping systems shall be installed in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 02230 – SITE CLEARING**1.0 GENERAL**

- A. This specification includes work performed by the Public Water supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.1 DESCRIPTION OF WORK:

- A. The extent of this section shall cover all site clearing performed prior to or during any part of construction, and all final clearing necessary to ensure proper drainage and prevent unsightly or unsafe conditions.
- B. The work shall include, but not be limited to, the following:
 1. Protection of existing trees designated to remain.
 2. Clearing and grubbing.
 3. Removal of existing fence.
 4. Removal of all unsuitable material from public and private property resulting from construction operations.
- C. Applicable sections: 02315 Excavating, Filling and Grading.

1.2 JOB CONDITIONS:

- A. Protection of Existing Improvements:
 1. Extreme care shall be taken to protect all improvements on adjoining properties, and on public and private property. Damaged improvements shall be restored to their original condition, as acceptable to the parties having jurisdiction.
 2. Precautionary measures shall be taken to prevent damage to existing improvements to remain in place on or near the new construction.
- B. Protection of Existing Trees:
 1. Existing trees indicated to remain in place shall be protected by temporary guards to avoid unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering resulting from stockpiling construction or excavation materials within the drip line, excess foot or vehicular traffic, and vehicular parking within the drip line. Trees damaged by construction operations shall be repaired by specialized personnel, in a manner acceptable to the District. Trees which cannot be repaired and restored to full growth status, as determined by such specialized personnel, shall be replaced at the Contractor's expense.
 2. Trees to remain within the limits of the contract work shall be properly cared for to maintain their health during the course of construction operations.
 3. Cut roots faces over 1 1/2" in diameter shall be coated with an emulsified asphalt or other acceptable coating formulated for use on damaged plant tissues. Exposed roots shall be temporarily covered with wet burlap to prevent drying. Roots shall be covered with earth as soon as possible.
- C. Salvageable Improvements: Items indicated to be salvaged shall be carefully removed and stored on the District's premises as directed by the District.

2.0 MATERIALS

Not Applicable

3.0 CONSTRUCTION REQUIREMENTS**3.1 GENERAL:**

- A. Improvements, vegetation, stumps, roots or obstructions interfering with the installation of new construction shall be removed and disposed of as specified in Section 02315 Excavating, Filling, and Grading.
- B. Roots and branches of trees obstructing new construction shall be carefully and cleanly cut.

3.2 CLEARING AND GRUBBING:

- A. The site shall be cleared of trees, shrubs, and other vegetation interfering with construction, except where any of the above is to remain in place. Stumps, roots and other debris protruding through the ground surface shall be completely removed. Hand methods only shall be used for grubbing inside the drip line of tees remaining in place.
- B. Depressions caused by clearing and grubbing operations shall be filled with satisfactory soil material unless further excavation or earthwork is scheduled.
- C. When construction is on private easement, the width of clearing shall be field determined by the District, with the maximum width being the width of the easement.

3.3 DISPOSAL OF WASTE MATERIALS:

- A. Transport and dispose all trash, debris, trees, stumps, roots, ashes, cinders, or their refuse to areas as acceptable to the District.

END OF SECTION

SECTION 02315 – EXCAVATING, FILLING AND GRADING**1.0 GENERAL**

- A. This specification includes work performed by the Public Water supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.1 DESCRIPTION OF WORK:

- A. This section includes, but is not limited to, the following:
 1. Excavation
 2. Trenching
 3. Backfill, Compaction and Grading
 4. All Related Items
- B. All work shall be completed in accordance with the project plans and details.
- C. Applicable sections: 02230 Site Clearing; 02374 Fertilizing, Seeding and Mulching; 03050 Portland Cement Concrete

1.2 QUALITY ASSURANCE:

- A. Applicable Standards:
 1. American Society for Testing and Materials (ASTM)

1.3 JOB CONDITIONS

- A. Subsurface Information: See Division 1 – Summary of Work
- B. Existing Utilities:
 1. Locate existing underground utilities in the areas of work before starting earthwork operations. Where utilities are to remain in place, provide adequate means of protection during earthwork operations.
 2. Should uncharted, or incorrectly charted piping or other utilities be encountered during excavation, consult the utility District immediately for directions. Cooperate with the District and public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility District.
 3. Do not interrupt existing utilities servicing facilities occupied and used by the District or others, except when permitted in writing by the District and only after acceptable temporary utility services have been provided. Completely remove from the site underground utilities indicated to be removed. Coordinate with local utility companies for shut-off services if lines are active.

C. Use of Explosives:

1. If blasting is required, the Contractor shall not transport or use explosives on the site without notification and approval of the District in writing. The Contractor shall comply with existing State and Federal laws regarding transporting, storing and handling explosive materials. The Contractor shall be solely responsible for the handling, storage and use of explosive materials, and of any damage which might be caused.

D. Temporary Protection:

1. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
2. Protection structures, utilities, sidewalks, pavements and other facilities from damages caused by settlement, lateral movement, undermining, washout and other hazards created by excavation operations.
3. Temporary covering or enclosures and temporary heat shall be provided as necessary to protect bottoms of excavations from freezing and frost action when the atmospheric temperature is less than 35 degrees F. Work shall not be installed on frozen excavation bases or subbases.

E. Temporary Erosion Control:

1. The Contractor shall be responsible for keeping surface water runoff free from silt, sediment and earthfill material in areas disturbed by all construction activities.

F. Private Easements:

1. Where excavation occurs on private easement, stockpile topsoil and replace after construction on disturbed areas.

2.0 MATERIALS

2.1 MATERIALS DESCRIPTION:

- A. Cohesionless materials shall include gravels, gravel-sand mixtures, sands, and gravelly sands exclusive of clayey and silty material, materials which are free-draining and for which impact compaction will not produce a well-defined moisture-density relationship curve and for which the maximum density by impact methods will generally be less than by vibratory methods.
- B. Cohesive materials shall include silts and clays generally exclusive of sands and gravel - materials for which impact compaction will produce a well-defined moisture-density relationship curve.
- C. Impervious cohesive materials shall be defined as CH or CL materials as defined by the Unified Soil Classification System.
- D. Permeable materials shall be defined as either non-cohesive or cohesive materials that do not meet the specifications for impervious cohesive materials.
- E. Waste:
 1. Waste materials include excess suitable materials and all materials unsuitable for use in the work.

- a. Unsuitable materials include all materials that contain debris, roots, organic matter, frozen mater, rock (with any dimension greater than one-half the loose layer thickness) or other materials that are determined by District as too wet or otherwise unsuitable for providing a stable subgrade or stable foundation for structures.
- b. Suitable materials include materials that are free of debris, roots, organic matter, refuse, ashes, cinders, frozen matter and that which is free of rock with any dimension great than one-half of the specified loose layer thickness.

2. All waste materials (excess suitable and all unsuitable) encountered during trenching shall be removed from the immediate work area and disposed of, as directed by the District.

F. Borrow:

1. Borrow materials include all fill materials and topsoil obtained from approved locations.
2. Borrow shall include all excavating, handling, and final disposal of materials as specified.
3. Borrow Areas: the Contractor is responsible for obtaining, excavating, loading, hauling, and placing all fill material.

G. Backfill:

1. Backfill materials shall include satisfactory soil materials form excavations and borrow areas.
2. Materials shall not contain gravel, stones, or shale particles.
3. Backfill shall be free of roots or other organic matter, refuse, ashes, cinders, frozen earth or other deleterious matter.

H. Topsoil:

1. Topsoil shall be friable clay loam surface soil having a minimum depth of 4" and relatively free of subsoil, clay lumps, stones, and other objects over 2" in diameter, and without weeds, roots, and other objectionable material.
2. Topsoil shall be stripped to appropriate depths to prevent intermingling with the underlying subsoil or other objectionable material. Heavy growths of grass shall be removed from construction areas prior to stripping.
3. Topsoil stripping shall be stopped a sufficient distance from trees to be left in place to prevent damage to the main root system.
4. Topsoil shall be stockpiled in designated areas or as otherwise directed. Piles shall be constructed to freely drain surface water.

I. Granular Base Materials:

1. Material shall be crushed stone with the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
Passing 1-Inch Sieve	100
Passing ½-Inch Sieve	60-90
Passing No. 4 Sieve	40-60
Passing No. 30 Sieve	15-35
Passing No. 200 Sieve	0-15

2. Material shall not have loss of more than 15% after 5 cycles when tested for soundness with sodium sulfate as described in ASTM C88.
3. Material shall have a percentage of wear not to exceed 50% as determined by ASTM C131.
4. Material shall be used in locations as shown on the Plans.

J. Bedding:

1. Bedding shall be in accordance with ASTM D2321 using Class I, II, or III material:

- a. Class I: Minimum 6" uniform bedding. If Class I bedding is used, then Class I material must also be utilized for haunching up to the spring line of the pipe.
- b. Class II: Minimum 6" compacted to 85 percent Standard Proctor Density.
- c. Class III: Minimum 6" compacted to 90 percent Standard Proctor Density.

2. Granular bedding shall be prepared as follows:

- a. Bedding shall be in accordance with the typical details as shown on the drawings.
- b. Trenches shall be of necessary depths to accept bedding material to conform to proper grades as shown on the drawings.
- c. Placement of bedding material shall be carefully made so that when pipe is placed in position, it is true to line and grade.

K. Haunching and Initial Backfill: Haunching and initial backfill shall be in accordance with ASTM D2321 using Class I, II, or III material.

1. Class I: As specified in ASTM D2321 to a point atleast 12" over the top of the pipe.
2. Class II: Initial backfill shall be compacted to a point at least 12" over the top of the pipe.
3. Class III: Initial backfill shall be compacted to a point at least 12" over the top of the pipe.

L. Granular Non-Trench Backfill Materials:

1. The fine aggregate shall consist of clean sand, stone sand, stone screenings, chats, wet bottom boiler slag or slag sand.
2. The fine aggregate shall be clean and reasonably free from an excess of soft or unsound particles and other objectionable matter.
3. The gradation shall be as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
No. 4	92-100
No. 100	0-40
No. 200	0-10

2.2 SOIL CLASSIFICATIONS

- A. Satisfactory soil materials shall be non-swelling materials with plastic indexes of less than 20 and liquid limits less than 40. Soil meeting these requirements under the Unified Soil Classification system for the following soil groups are acceptable:

<u>Classification</u>	<u>Description</u>
GW	Well graded gravels, gravel-sand mixtures, little or no fines
GP	Well graded gravels, gravel-sand mixtures, little or no fines
GM	Silty gravels, poorly graded gravel-sand-silt mixtures
SW	Well graded sands, gravelly sand, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SM	Silty sands, poorly graded sand-silt mixture
SC	Silty sands, sand-clay mixtures
ML	Inorganic silts, and very fine sands with slight plasticity
CL	Silty or sandy clays of low plasticity

B. Unsatisfactory soil materials consist of all other materials including the following that are classified under the Unified Soil Classification System:

<u>Classification</u>	<u>Description</u>
OL	Organic silts and organic silty clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Inorganic clays of medium to high plasticity, organic silts
PT	Peat and other highly organic soils

2.3 SOIL CATEGORIES:

A. Embedment soils used in pipe installation are described by ASTM and are grouped into five categories below:

1. Class I – Angular; 6 to 40 mm (1/4" to 1 1/2") graded stone, including materials such as coral, slag, cinders, crushed stone, and crushed shells.
2. Class II – Coarse sands and gravels with maximum particle size of 40 mm (1 1/2") including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.
3. Class III – Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM, and SC are included in this class.
4. Class IV – Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH, and CL are included in this class. These materials are not recommended for bedding, haunching, or initial backfill.

5. Class V – This class includes the organic soils, OL, OH, and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1 ½" in diameter), and other foreign materials. These materials are not recommended for bedding, haunching, or initial backfill.

3.0 CONSTRUCTION REQUIREMENTS

3.1 EXCAVATION:

- A. Earth excavation includes the removal and disposal of pavements and other obstructions visible on the ground surface, underground structures and utilities indicated to be replaced and removed, material of any classification indicated in date on subsurface conditions and all other materials encountered that are not classified as rock excavation or unauthorized excavation.
- B. Rock excavation consists of the removal of igneous, metamorphic, or sedimentary rock or stone boulders over two cubic yards in volume in open areas and one cubic yard in volume in trenches; and masonry, concrete, or solid frozen soil that cannot be removed by an excavator with an operating weight of at least 52,600 pounds and flywheel horse power of at least 153 HP, by rippers or other mechanical methods and, therefore, requires the use of a mechanical breaker.
 1. "Solid Rock Excavation" shall be paid on a cubic yard basis as indicated on the Bid Form Proposal.
 2. If Solid Rock Excavation is required, the Engineer shall be notified of such rock excavation, and he must then visit the site and verify the necessity for excess Solid Rock Excavation, and determine an estimated quantity. In the event the estimated quantity is exceeded, the Engineer shall again be notified to establish a revised estimated quantity. Payment for the authorized work shall be by a Change Order to the Contract.
- C. Unauthorized excavation consists of removal of materials beyond indicated elevations without the specific direction of the District. Unauthorized excavation shall be replaced by backfilling and compacting as specified for authorized excavations of the same classification, unless otherwise directed by the District.
- D. Additional excavation consist of carrying excavations deeper and replacing the excavated material as directed by the District if unsuitable materials are encountered at the required subgrade elevations. When excavation has reached required subgrade elevations, the Contractor shall notify the District, who will make an inspection of conditions.
- E. Excavation for Structures:
 1. Conform to elevation and dimension shown on the drawings, within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction, and for inspection.
 2. In excavating for footings and foundations, take care not to disturb the bottom of the excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to the required lines and grades to leave a solid base to receive concrete.
- F. Excavation for Trenches:

1. Trenches: Excavations having vertical sides whose depths exceed its width, made for storm water drainage, sanitary sewer, water, and gas pipes, electric, communications, and steam conduits, and related uses.
2. Pay Width: Pay width for trench shall not be wider than 1-4/10 times the pipe diameter in inches plus 12 inches (1.4d" + 12").
 - a. Trenches shall be excavated to lines and grades necessary to accept the pipes shown on the plans or as established by the District. Trenching in all instances shall be kept to minimum widths to a point 12" above top of pipe. Remaining trench to be kept to minimum width as near as possible. Contractor is to use sheeting or an approved method to ensure voidances of excessive widths. Trenching under existing utilities shall be by hand method and the utility supported by approved methods.
3. Trenches in rock shall be excavated to minimum widths as specified. All rock and shale excavation not suitable for backfill materials shall be removed from the site and disposed of at the expense of the Contractor. All work in connection with blasting operations, including necessary and proper safety precautions, shall be performed under expert supervision and in compliance with all laws, ordinances, and applicable safety code requirements and regulations. The Contractor shall in no way hold the District responsible for any damage or suits caused by his blasting operation.
4. If overdigging occurs, all loosened earth must be removed and brought back to grade with approved granular base material, compacted to 95% density per ASTM D698 without additional cost to the District.
5. Any material below the specified plan grade which is not, or cannot be made stable by drainage or compaction, in the opinion of the District or his representative, shall be remove and replaced with an approved select granular material. This granular material stabilization shall be considered incidental and shall be included in price bid for other items.
6. Mechanical excavation of the trench in solid rock shall be to 4" below the bottom of the pipe. The trench bottom shall be dry when excavated, then filled with granular bedding material to place the pipe at the planned grade. The granular material shall be prepared to receive the pipe barrel and bell holes (if the pipe has bells) shall be excavated to relieve the bell from bearing.
7. Tunneling operations shall be done only where such is required by the plans, provided that the adjacent trench depth and soil conditions are adequate and suitable for such construction. All bracing, shoring, sheeting, pipe placement, and backfill shall be the responsibility of the Contractor to be performed in compliance with OSHA regulations.
8. Foundations: Native soils in the foundation should be firm and stable to provide support for the construction operations and eventual overburden loads.
 - a. Unstable Trench Bottom: Where unstable foundations exist, replace them with over-excavation (see 8.b.) or wood piling, steel piping or sheeting all capped with concrete, steel, or wood. When using piling or sheeting, place 4"-6" of Class I, II, and/or III soil bedding as described above over the special foundation cap. Do not use cinders in these foundation conditions, as they tend to become unstable when wet.
 - b. Over-Excavation: If the trench depth is cut more than 6" below the pipe invert into the foundation zone, replace this over-excavation with Class I, II, or III soils. Class III soils shall be densified in 6" lifts. When the trench is wet and unstable, do not over-densify, as this may create a more unstable condition (such as pumping).
 - c. Rock, Hardpan, etc. Excavation: When the trenching is to be cut in hardpan, rock, or other similar native soil, remove that soil a sufficient

depth to provide 4"-6" of bedding as described in Section 2.01, K. Bedding.

9. All open trenches and other excavations shall be provided with suitable barriers, signs, and lights to the extent that adequate protection is provided to the public. Obstructions, such as material piles and equipment, shall be provided with similar warning sign and lights. All barricades and obstructions shall be illuminated by means of warning lights at night. All lights used for this purpose shall be kept burning from sunset to sunrise. Materials stored upon or alongside public streets and highways shall be so placed, and the work at all times shall be so conducted, so as to cause the minimum obstruction and inconvenience to the traveling public. All barricades and light expense will be paid for by the Contractor.
10. Trenches with Sloping Sides-Limited:
 - a. The Contractor may, at his option, where working conditions permit (as determined by the District), excavate pipeline trenches with sloping sides, but with the following limitations:
 1. In general, only braced and vertical trenches will be permitted in traveled street, alleys and narrow encasement.
 2. Where trenches with sloping sides are permitted, the slopes shall not extend below the top of the pipe, and trench excavations below this point shall be made with vertical sides with widths not exceeding those specified hereinbefore, and shown on the drawings, of the various sizes of pipe.
11. A minimum of 4" Class I Bedding shall be placed under all manholes, junction boxes, drop inlets and catch basins.

3.2 SHORING AND BRACING:

- A. Slope the sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible either because of space restrictions or stability of material excavated.
- B. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced and shored as necessary to prevent caving or sliding to provide protection for the workmen and the work, and to provide protection for existing structures and facilities. Sheetling, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining its shape and position under all circumstances, per OSHA requirements.
- C. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- D. Provide shoring and bracing to comply with local codes and authorities having jurisdiction.
- E. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
- F. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. Carry down shoring and bracing as the excavation progresses.

3.3 DEWATERING:

- A. Prevent surface water and subsurface or groundwater from flowing into excavations and flooding the project site and surrounding area.

- B. Do not allow water to accumulate in excavations. Remove water from excavations to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to the stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey the water away from the site.
- C. Convey water removed from excavations and rainwater to collector run-off areas. Do not use trench excavations for site utilities as temporary drainage ditches.
- D. Provide an adequate system to lower and control the groundwater in order to permit excavation, construction of structures and the placement of fill materials to be performed under dry conditions. Install sufficient dewatering equipment to pre-rain the waterbearing strata above and below the bottom of the structure foundations, drains, sewers, and other excavations

Reduce the hydrostatic head in the waterbearing strata below structure foundations, drains, sewers, and other excavations to the extent that the water level and piezometric water levels in the construction areas are below the prevailing excavation surface at all times.

Maintain piezometric water level a minimum of 1' below the excavation surface.

- E. Prior to excavation below groundwater level, place the dewatering system into operation to lower the water levels as required and then operate it continuously 24 hours a day, 7 days a week until drains, sewers and structures have been constructed, including placement of fill materials, and dewatering is no longer required.
- F. Dispose of water removed from excavations in such a manner so as to not endanger public health, property, and portions of the work under construction or completed. Dispose of water in such a manner that will cause no inconvenience to others engaged in work about the site. Provide sumps, sedimentation tanks, and other flow control devices as required by governing authorities.
- G. Provide complete standby equipment, installed and available, for immediate operation as may be required, to adequately maintain dewatering on a continuous basis in the event that any part of the system becomes inadequate or fails. In the event dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional expense.

3.4 MATERIAL STORAGE:

- A. Stockpile excavated materials classified as satisfactory soil material where directed until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
- B. Locate and retain fill materials away from edges of excavations.
- C. Dispose of excess soil material and waste materials as herein specified, and as acceptable to the District.

3.5 MOISTURE CONTROL:

- A. Where the subgrade layer of soil material must be moisture conditioned before compaction, uniformly apply water to the surface of subgrade, or layer of soil material to prevent free water from appearing on the surface during or subsequent to compaction operations.

B. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

1. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until the moisture content is reduced to a satisfactory value.

3.6 BACKFILLING STRUCTURES:

A. Ground Surface Preparation:

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
2. When the existing ground surface has a density less than that specified under "Compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to the required depth and percentage of maximum density.

B. Backfilling shall not be performed until:

1. Construction has been completed below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Underground utility locations have been recorded, inspections have been performed, and approval has been granted.
3. Concrete formwork has been removed.
4. Shoring and bracing have been removed and voids have been filled with satisfactory materials. Temporary sheet piling driven below the bottom of the structures shall be cut off and removed in a manner that will prevent settlement of the structure or utilities or left in place, if required.
5. Trash and debris have been removed.
6. Permanent or temporary horizontal bracing is in place.
7. Concrete has attained its design strength, but not sooner than seven (7) days after it was placed.
8. A sufficient portion of the structure has been built to resist the imposed load.

C. Perform backfilling simultaneously on all sides of the structures.

D. Exercise extreme care in the use of heavy equipment in backfill areas.

E. Placement and Compaction:

1. Granular Backfill/Base:

- a. General: Granular base material shall be placed in the areas and to the cross-sections and thickness as indicated on the plans.
- b. Place granular base material on prepared subgrade in layers not to exceed 6" compacted depth.
- c. Maintain optimum moisture content for compacting material during placement operations.
- d. The material shall be compacted by rolling or mechanical tampers.
- e. Base material shall be compacted to 95% conforming to ASTM D698, whichever is applicable.
- f. Thickness and grade tolerances shall be plus or minus 0.10'.

2. Minimum Density Requirements: Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with ADTM D698; and not less than the following percentages of relative density determined in accordance with ASTM D2049, for soils which will not exhibit a well-defined moisture density relationship.

- a. Structures: Compact top 12" of subgrade and each layer of backfill or fill material at 95% maximum dry density.
- b. Pavements: Compact top 6" of subgrade and each layer of backfill or fill material at 95% maximum dry density per ASTM D698.
- c. Unpaved Areas: Compact each layer of backfill at 90% dry density.
- d. Basin Berms: Compact each layer of backfill or fill material to at least 95% standard proctor density.

3.7 BACKFILLING TRENCHES:

- A. All trenches and excavations shall be backfilled immediately after pipe is laid therein, unless other protection of the pipeline is directed. Under no circumstances, however, shall water be permitted to rise in unbackfilled trenches after pipe has been placed or during the laying of pipe. Material used for backfill shall not contain stones 3" or greater in size, frozen earth, debris, or earth with an exceptionally high void content. Class II haunching and initial backfill material shall be only approved granular material used and placed in uniform layers not exceeding 6" in depth up each side. Each layer shall be placed, then carefully and uniformly tamped so as to eliminate the possibility of later displacement. Any excess backfill material shall be removed from the job site. Where unsuitable backfill material is encountered, the Contractor shall, at his own expense, provide and place acceptable backfill material. All sod in lawns, all pavedlots, and any other surfaces damaged by trenching operations, shall be replaced or repaired as directed by the District.
- B. Puddling or water flooding for consolidation backfill material shall be subject to approval of the District. In general, the addition of water should be limited to achieving optimum moisture content for tamping procedures.
- C. Whenever trenches or other excavations made by the Contractor in the performance of work under this Contract have not been properly filled, or where settlement has occurred at any time prior to the final acceptance of the entire work covered by the Contract, to the extent that the top of the backfill is below the original ground surface, such trenches shall be refilled and the backfill surface compacted and smoothed to conform to the elevations of the adjacent ground surface. The Contractor shall be responsible for all damage which might occur as a result of the settlement of trench or other backfill made by him in the fulfillment of his contract within and during a period of one year from and after the date of final acceptance of entire project thereof by the District, including (a) the cost to the District of all claim for damages filed with and court action brought against the said District for and on account such damage, and (b) the repair to the satisfaction of the District of any and each pavement, driveway, curb, slab, walk, lawn, or structure damages by such backfill settlement.
- D. Full depth granular backfill shall be placed above the initial backfill and extending up to existing grade. It is the intent to backfill all street and driveway crossings and areas where new utility lines will be under the street roadbed with granular trench backfill or flowable fill. The cost of these aggregates and their installation shall be incidental to the cost per lineal feet of utility pipe, unless a separate item is set out in the proposal. The granular trench backfill shall consist of a Class I type material compacted to 95% standard proctor density in accordance with ASTM D698.

E. Flowable Fill:

1. This work shall consist of placing a flowable fill material to be used as backfill at locations as shown on the plans or as specified. The work shall be done in accordance with the Standard Specifications and this specification.
2. Materials: All materials shall meet requirements for the respective items as follows:

- a. Flowable Fill: Flowable fill is a Portland concrete cement mix placed above the initial backfill and extending up to a grade appropriate for placement of the pavement resurfacing. It is the intent to backfill all street and driveway crossing and areas where new utility lines will be under the street roadbed with flowable fill. The mix design for flowable fill as follows:

<u>Quantity of Dry Materials Per Cubic Yard</u>	
Cement	80 pounds
Fly Ash	300 pounds
Fine Aggregate	2620 pounds

- b. Cement shall be Type I as specified in Division 3, Section 03050, "Portland Cement Concrete", Paragraph 2.01.
 - c. Fly Ash shall meet requirements of ASTM C618, Class C, and shall come from a source approved by the District.
 - d. Fine Aggregate for flowable mortar shall be natural sand consisting of mineral aggregate particles. The gradation of this material shall be as follows:

<u>Sieve Size</u>	<u>%Passing</u>
¾	100
8	80-95
200	0-10

The Contractor will not be responsible for certified aggregate testing. The District will provide observation that he deems appropriate, normally source approval followed by visual observation.

These quantities of dry materials, with approximately 50 gallons of water, will yield approximately 1 cubic yard of flowable fill of the proper consistency.

- e. Fluidity of the flowable fill shall be measured by the Corps of Engineers flow cone method according to their specification CRD-C611-80. Prior to filling the flow cone with flowable mortar, the mixture shall be passed thru a ¼ inch screen. Time of efflux shall be approximately 12 seconds. These measurements shall be made by the Contractor, at least once every 4 working hours.
3. Proportioning and Mixing Equipment: This equipment shall meet requirements of Division 3, Section 03050. Sufficient mixing capacity or mixers shall be provided to permit the intended pour to be placed without interruption.
4. Decanting Water: The flowable fill shall be placed in the fill area in a manner to direct the water to a sump point to which it can be immediately be decanted off. The water shall be removed to prevent saturating the adjacent earthen embankment. All drains shall be shielded with 6 mil polyethylene to prevent clogging.
5. Placement of Fill:
 - a. When placing flowable fill, the flowable fill shall be discharged from the mixer by any reasonable means around and into the excavated areas. Placement shall continue until the fill is placed to the grades indicated on the plans. Placement shall then cease for at least an overnight period.

6. Limitation of Operations:

- a. Fill shall not be placed on frozen ground.
- b. Fill batching, mixing, and placing may be started, if weather conditions are favorable, when the temperature is at least 34 degrees F and rising. At time of placement, mortar must have a temperature of at least 40 degrees F. Mixing and placing shall stop when the temperature is 38 degrees F or less and falling.
- c. Each filling stage shall be as continuous as practicable.

3.8 GRADING

A. Grading shall involve the bulk cutting, moving, redistribution, compaction and shaping of soil wherein there results a change in the topography of the site. Areas upon which fills are to be placed shall be scarified prior to placement of any fill material. All fill required for the construction shall be of material not containing stones larger than six inches in diameter, or frozen earth shall be free from stocks, large roots, or other organic matter coarser than grass roots, and shall have a moisture content such that optimum compaction is obtained when properly tamped or rolled. All fill shall be placed in layers of not more than 8 inches in uncompacted thickness and compacted to a density equal to or greater than 95% of maximum laboratory dry density as determined by ASTM D698. No frozen material shall be placed nor shall any fill material be placed upon or against frozen surfaces. Compaction efforts will be determined by random testing of the material with no less than one (1) test per acre per lift. The Contractor shall not proceed with additional lifts until the District has approved the previous lift of fill. The Contractor shall provide a District approved testing serves to determine proper compaction of fills at no additional cost to the District.

B. The fill areas shall be compacted by a minimum of two passes of tamping with a sheep's-foot roller over the surface of each layer. Fills shall be compacted to a density equal to or greater than 95% of maximum laboratory dry density as determined by ASTM D698.

C. General:

1. Uniformly grade areas within the limits of site grading including adjacent transition areas. Smooth finished surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
2. The degree of finish required will be that ordinarily obtainable from either blade-grader or scraper operations.

D. Ditches:

1. Finish ditches to ensure proper flow and drainage. Conduct final rolling operations to produce a hard, uniform and smooth cross-section.

E. Unpaved Areas:

1. Finish areas to receive topsoil to within not more than 0.10' above or below the required subgrade elevations, compacted as specified, and free from irregular surface changes.

F. Surface of Fill Under Slabs:

1. Grade the surface of fill under slabs smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of not more than 0.10' above or below the required subgrade elevation.

3.9 PAVEMENT REMOVAL AND REPLACEMENT:

- A. Where surfaced streets, walks, drives, or parking areas are cut, removed, or damaged in the completion of the work, the Contractor shall replace all pavements or other surfacing materials removed or damaged to their original, or better state and condition.
- B. After trench backfill with granular material or flowable fill, the Contractor shall maintain the surface at pavement grade until the permanent pavement is replaced.
- C. Pavements constructed of asphalt or concrete shall be removed in a careful manner and so that not less than 6" in width at any point is left between the cut edge of the pavement and the top of the trench. All asphalt or blacktop pavement, removed or damaged shall be replaced with an equal thickness of asphalt concrete. Asphalt concrete shall comply with minimum requirement for Type "BP-2" mixes as specified under Section 401 of the most current edition of the Missouri Department of Transportation's Standard Specifications.
- D. All concrete pavements, removed or damaged, shall be replaced with an equal thickness concrete slab of Class A concrete reinforced with 0.25% steel.
- E. Gravel surfaced streets shall require no repaving other than the gravel surface of trench backfill or a 12" surface layer of better material if such is normally used by the authority maintaining the road. A trench in a graveled street will be considered as having been repaved when the graveled surface has become stable and is at proper grade.

3.10 TOPOSIL PLACEMENT:

- A. Topsoil shall not be placed until the area to be covered has been shaped, trimmed and finished to subgrade elevations in accordance with earthwork and site grading specifications.
- B. All irregularities or depressions in the surface due to weather or other causes shall be filled and smoothed out before the topsoil is placed.
- C. If the existing surface has become hardened or crusted or if directed by the District, it shall be disked, raked, or by other approved means scarified to a depth of at least 2" so as to provide a bond with the layer of topsoil to be placed.
- D. Topsoil shall be distributed over areas required placement to a minimum compacted depth of 4".
- E. The surface of the topsoil shall be free from clods and debris and shall conform to the lines, grades and minimum thickness as described. The finish grading shall be done so as to prevent irregularities and depression in which water will be retained. One rolling of the entire surface will be made.
- F. Surplus topsoil shall be distributed over the entire area. Distribution shall be in a manner conforming to cross-sections and not hindering drainage.

3.11 FIELD QUALITY CONTROL:

- A. The testing service, provided by the Contractor, will inspect and approve subgrades and fill layers before additional construction work is performed.
- B. Field density tests will be performed in accordance with ASTM C1556 (sand cone method, ASTM D2167 (rubber balloon test), ASTM D2922-91 (density of soil and soil-

aggregates in-place by Nuclear Methods) or ASTM D3017 (water content of soil and rock in-place by Nuclear Methods).

- C. If, in the opinion of the District, based on testing service reports and inspection, the subgrade or fills which have been placed are below the specified density, additional compaction and testing will be required at no additional expense to the District.

3.12 MAINTENANCE:

- A. Protection of Graded Areas:

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.
3. Reconditioning Compaction Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape and compact to the required density prior to further construction. Use hand tamping for recompaction over underground utilities.

3.13 DISPOSAL OF EXCESS AND WASTE MATERIALS:

- A. Transport all trash, debris, trees, stumps, roots, ashes, cinders, or other refuse to an approved disposal area. Excess excavated material shall be placed at locations approved by the District.
- B. The disposal of waste and excess excavated materials, including hauling, handling, leveling and surfacing, shall be subsidiary obligation of the Contractor and no separate payment will be made therefore.

3.14 SEEDING AND SODDING:

- A. Seeding and sodding shall be competed in accordance with Fertilizing, Seeding, and Mulching in Division 2, Section 02374.

END OF SECTION

SECTION 02373 – SEDIMENTATION AND EROSION CONTROL**1.0 GENERAL**

- A. This specification includes work performed by the Public Water supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.1 DESCRIPTION OF WORK

- A. The contractor shall provide sediment and erosion controls for all exposed areas within the project limits, throughout the duration of the contract, including any warrant periods. These controls shall include temporary erosion control, temporary sediment control, and final erosion control.
- B. Applicable sections: 02315 Excavating, Filling and Grading; 02374 Fertilizing, Seeding and Mulching.

1.2 SUBMITTALS

- A. All submittals shall be made in accordance with applicable requirements of Division 1.
- B. All submittals shall be made within 45 days prior to anticipated placement of material.
- C. Material Reports: Submit material reports for the materials supplier under this section. Reports shall include:
 - 1. Source and Location of Material.
 - 2. Name and Address of Producer.
 - 3. Type and Name of Material. .

2.0 MATERIALS**2.1 CONTROL MEASURES:**

- A. Temporary Erosion Control shall include protection of all exposed surfaces within the project limits, by surface grading/rolling, surface water diversion, temporary seeding and/or mulching, or by temporarily cover. Alternate methods may be submitted by the Contractor for review and approval by the District.
- B. Temporary Sediment Control shall include silt fence, silt dike, straw bale dikes, temporary sediment checks, etc. Sediment controls shall be placed as required to maintain all sediment within the project boundaries. Sediment controls shall be inspected and cleaned/maintained as necessary to maintain function, following each major runoff event. All temporary sediment controls shall be removed and all surfaces protected upon project completion.
- C. Permanent Sediment Controls, if required, shall be as shown on the drawings. Permanent sediment controls shall be constructed and maintained by the Contractor, until accepted at project completion.

D. Final Erosion Control shall include final seeding and mulching, 02374 Fertilizing Seeding and mulching. Disturbed slopes steeper than 3:1 (horizontal: vertical) shall also require erosion protection fabric in place of the mulch specified in the seeding and mulching specification section. Erosion control fabric shall be utilized as follows:

1. 3:1 to 2:1 Slope, S150 as manufactured by North American Green or Regular Curlex Excelsior Blanket as manufactured by American Excelsior Company or approved equivalent.
2. 2:1 to 1:1 Slope, SC150 as manufactured by North American Green or Mid-Velocity Curlex Excelsior Blanket as manufactured by American Excelsior Company or approved equivalent.

E. Sediment Control shall include silt fence, silt dike, straw bale dikes, temporary sediment check, etc. Sediment controls shall be placed as required to maintain al sediment within the project boundaries. Sediment controls shall be inspected and cleaned/maintained as necessary to maintain function, following each major runoff event. All temporary sediment controls shall be removed and all surfaces protected upon project completion. Permanent sediment controls shall be constructed and maintained until accepted at project completion. Permanent sediment controls, if required, shall be as shown on the drawings.

3.0 PROCEDURE

3.1 CONSTRUCTION REQUIREMENTS

- A. The Contractor shall install control measures as shown on the plans and as necessary to limit erosion and prevent sediment from leaving the project site. The control measures shall be built in accordance with the project plans, specifications and detail drawing, as well as the use of good construction practices.

END OF SECTION

SECTION 02374 – FERTILIZING, SEEDING & MULCHING**1.0 GENERAL**

- A. This specification includes work performed by the Public Water supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.1 DESCRIPTION OF WORK

- A. The contractor all seed, labor and materials, and perform all operations in connection with the placing, watering and firming of seeded areas, complete and in strict accordance with these specifications and applicable Drawings, and subject to the terms and conditions of the Contract. The Contractor shall seed all areas disturbed for any reason during construction.
- B. Applicable Sections: 02315 Excavating, Filling and Grading; 02373 Sedimentation and Erosion Control.

2.0 MATERIALS**2.1 SEED:**

- A. Agricultural seed for cover crops shall comply with the requirements of the Missouri Seed Law. The following percentages for rate, purity and germination will be the minimum requirements in the acceptance of seed, unless otherwise permitted by the District.

<u>TYPE</u>	<u>PURITY</u>	<u>GERMINATION</u>	<u>RATE</u>
Kentucky Bluegrass	85	80	15lbs./Acre
Redtop	92	85	10lbs./Acre
Tall Fescue (Alta of KY)	97	85	40lbs./Acre
White Clover	98	85	5lbs./Acre
Wheat	95	85	10lbs./Acre

2.2 COMMERCIAL FERTILIZER:

- A. Shall be composed of a formula 20-12-10 and shall conform to the applicable state fertilizer laws. It shall be uniform in composition, dry and free flowing and shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.
- B. Agricultural limestone with not less than 90 percent passing the No. 4 sieve with percentages of calcium carbonate common to the area or hydrated lime containing not less than 45 percent calcium hydroxide shall be used for soil neutralization, unless otherwise indicated.

2.3 MULCH

- A. Vegetative mulch shall be straw from stalks of oats, wheat, rye or barley, or other foliage from plants as approved by the District. The straw shall be relatively free from noxious and undesirable seeds, relatively free from foreign materials and dry enough to evenly spread.
- B. Anchoring – Straw mulch shall be crimped into the soil by means of a straw crimper manufactured specifically for such purposes.

3.0 CONSTRUCTION REQUIREMENTS

3.1 TIME OF PLANTING:

- A. Seeding shall be performed only during the seasons when satisfactory growing conditions exist. The planting operation shall not be performed during times of drought or other unfavorable climatic conditions.

3.2 PLANTING PROCEDURES:

- A. The areas to be seeded shall be prepared immediately prior to the placing of the seed by thorough cultivating, smoothing, removal of clods, surface stone 1-inch diameter or larger, and weeds. Soil shall be in a most condition prior to placing seed.
- B. Grades on the areas to be seeded shall be maintained in true, even and compacted conditions so as to prevent the formation of depressions. Areas that have washed or eroded shall be brought to grade and compacted thoroughly by the Contractor at his own expense prior to placing the seed. No grading shall be done when the soil is in a muddy or frozen condition.

3.3 APPLYING FERTILIZER:

- A. The previously described fertilizer shall be applied to the finished grade by approved spreader at the minimum rate of 250 lbs. per acre and shall be thoroughly raked into the top 2 inches of the surface before planting of seed.
- B. Lime shall be applied into the top 2 inches of the soil at a rate of 2,000 lbs. per acre by disking, harrowing or raking prior to the planting of seeds.

3.4 PLANTING SEED:

- A. Seeding Schedule: Seeding shall be performed only during the specific time periods as stated hereafter:
 1. March 15 through May 1.
 2. August 15 through October 1.
- B. Seed mixed in proportions as hereinbefore specified shall be broadcast by approved sowing equipment at the rate of 150 lbs. per acre. The seed shall be covered to an average depth of $\frac{1}{2}$ inch by means of a brush harrow, spike tooth harrow, chain harrow, cultipacker, or other approved device.

- C. Mulch shall be evenly distributed at a rate of 2 tons per acre over the seeded area within 24 hours following seeding. The mulch shall be crimped into the soil to reduce movement due to wind or erosion. After mulching, precautions to prohibit foot or vehicular traffic over the area should be taken.
- D. When delays in operations carry the work beyond the most favorable planning season for the grasses designated, or when conditions are such, by reason of drought, high winds, excessive moisture, or other factors, that satisfactory results are not likely to be obtained, the seeding operation shall be stopped and work shall be resumed only when conditions are favorable again or when approved alternate or corrective measure and procedures have been put into effect. If inspection during seeding operations or after there is a show of green indicates that areas have been skipped, the sowing of additional seed on these areas will be required.
- E. The seeded areas will be inspected for acceptable grass coverage and will be acceptable when the grasses designated are growing and are in good condition, and no area more than $\frac{1}{2}$ of one percent of the total areas shall be bare, of which no single areas shall be more than three square feet in area. Any area larger than this will not be acceptable and shall be reseeded.

3.5 MAINTENANCE:

- A. All seeded areas shall be kept in a healthy, growing condition by water, mowing, rolling, trimming, edging, etc., until completion and acceptance by the District.
- B. Reconditioning Existing Areas:
 - 1.Existing areas damaged by the Contractor's operations (e.g. Contractor's storage areas) including storage of materials and equipment and movement of vehicles are to be reconditioned. Contractor is also to recondition existing grass areas were minor regarding is required.
 - 2.Contractor is to provide fertilizer, seed, lime and mulch as required for reconditioned areas as well as new soil as may be required to fill low spots to finished grade.
 - 3.Contractor is to remove diseased and unsatisfactory grass areas. These grasses shall not be buried in the soil at a depth less than 24". Contractor shall remove topsoil containing foreign materials resulting from the Contractor's operation including oil drippings, stone, gravel, and other materials as directed by the District's Representative.
 - 4.Where substantial grass remains (but is thin) the Contractor shall mow, rake, aerate (if compacted), fill low spots, remove humps, cultivate, fertilize, seed and mulch in accordance with these specifications.
- C. Overwinter Protection: If the site cannot be seeded during the fall planting period, immediately following the grading operations the Contractor shall be required to stabilize the project site with either straw mulch or a temporary seed crop of wheat or oats. Such operations, if required, will be performed at no additional cost to the District.
 - 1.If the Contractor chooses to mulch the project site, he shall do so at the same rate and by the same methods as previously described in this section for mulching operations.
 - 2.If the Contractor chooses to sow a temporary seed crop, he shall submit proposed rates of application to the Consultant for approval. All seeding shall be complete prior to November 1st.
 - 3.The permanent grass species shall not be drilled directly into the mulched or temporary seeded areas. Temporary mulch or grass species shall be

incorporated to a depth of 6" by disking, harrowing or other approved methods or shall be disposed of in a manner approved by the District's Representative. All operations previously described under this section for seedbed preparation, liming, and fertilization shall be performed prior to Spring seeding.

4. The seedhead of the temporary crop shall not be allowed to mature. Should the Contractor be unable to incorporate this crop prior to seedhead maturity, he should mow the crop to prevent maturity. Should wet conditions not allow the Contractor to mow the crop and the seedhead matures, the Contractor shall combine the crop to prevent a volunteer cereal crop.

D. The Contractor shall protect all seeded areas from damage of any sort due to operations of other contractors and trades, and trespassers. Maintenance shall commence immediately following seeding operations and shall continue throughout the guarantee period. Contractor shall repair or replace damaged areas as directed by the Consultant.

END OF SECTION

SECTION 02445 – HIGHWAY & RAILROAD CROSSINGS**1.0 GENERAL**

- A. This specification includes work performed by the Public Water supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.1 DESCRIPTION OF WORK

- A. Furnish all materials, accessories, equipment, tools, transportation, services, labor and perform all operations necessary for the installation of pipelines on or under railway and/or highway property.
- B. Pipelines laid under highways and railroad tracks and across highway and railroad rights-of-way shall be encased in a larger pipe or conduit (casing pipe).
- C. Casing pipes shall be installed by simultaneously dry boring and jacking.
- D. Pipelines located within 25 feet of the centerline of any track or where there is danger of damage from leakage to any bridge, building or other important structure, shall be encased or of special design as approved by the Engineer.
- E. Laws and orders of highway or railroad authority prescribing a higher degree of protection than specified herein shall supercede the applicable portions.
- F. Pipelines and casing pipe shall be suitably insulated from underground conduits carrying electric wires on rights-of-way.
- G. Applicable sections: 02315 Excavating, Filling and Grading; 02080 Utility Materials.

2.0 MATERIALS

- A. See Section 02080, Utility Materials for Specific Information.

2.1 CARRIER PIPE:

- A. Carrier line pipe and joints shall be restrained joint PVC.
- B. Pipe shall be laid with sufficient slack so that it is not in tension.

2.2 CASING PIPE:

- A. The casing pipe shall be as described under "Steel Casing for Bores: of Section 02080 Utility Materials.

3.0 PROCEDURE

3.1 GENERAL:

- A. Casing shall be installed as to prevent the formation of a waterway under the right-of-way, with an even bearing throughout its length and shall slope to one end.
- B. Where casing and/or carrier pipe is cathodically protected, the Engineer shall be notified and suitable test made to ensure that other structures and facilities are adequately protected from the cathodic current in accordance with the recommendations of current Reports of Correlating Committee on Cathodic Protection, published by the National Association of Corrosion Engineers.

3.2 METHOD OF INSTALLATION:

A. Boring and Jacking:

1. Bored and jacked installations shall have a bored hole diameter essentially the same as the outside diameter of the pipe plus the thickness of the protective coating.
2. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (including coating) by more than approximately 1", remedial measures as approved by the Engineer shall be taken. Boring operations shall not be stopped if such stoppage would be detrimental to the highway or railroad.
3. Once the casing pipe has been installed, the receiving pit shall be opened up to establish if proper elevation of the casing has been accomplished. The carrier pipe, casing spacers and end seals shall be installed immediately after the encasement installation is completed. Protect ends of carrier pipe from backfill. An adequate amount of the yelomine pipe shall be available for connection to the 18" long couplings.

3.3 EXECUTION OF WORK:

- A. The execution of work on rights-of-way shall be subject to the inspection and direction of both the District and respective rights-of-way Engineers or their designated representatives.
- B. The Contractor shall comply with all requirements, including bonding and insurance, of the highway or railway authorities having jurisdiction and shall also comply with any permits, licenses, etc. issued with respect to this project.

END OF SECTION

SECTION 02510 – WATER DISTRIBUTION**1.0 GENERAL**

- A. This specification includes work performed by the Public Water supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.1 DESCRIPTION OF WORK

- A. The work to be performed under this section consists of furnishing all materials, equipment and supplies, tools and pipe; the performance of all necessary labor for the construction of the water piping included in this Contract, complete with valves, accessories and all necessary components.
- B. All work shall be completed in accordance with the project plans and details.
- C. Applicable sections: 02315 Excavating, Filling and Grading; 02080 Utility Materials.

1.2 QUALITY ASSURANCE:

- A. Work shall conform to all local building codes.
- B. All codes referred to are those listed by:
 1. American Society for Testing Materials (ASTM)
 2. American Water Works Association (AWWA)
 3. American Standards Association (ASA)
 4. Commercial Standards (CS)
 5. American Association of State Highway & Transportation Official (AASHTO)
 6. Federal Specifications

Codes and standards referred to above shall be the current edition which is being used at the time of bid opening.

- C. All materials and equipment used on this work shall be new, of the best quality and shall meet the requirements of these specifications. Materials shall be sampled and tested in accordance with current ASTM Specifications or such others as specified hereinafter. The Contractor will be required to furnish certificates of conformance to ASTM or other applicable specifications. Materials shall be stored in such a manner that their conditions are equivalent to new when installed.
- D. Submittals on pipe, valves and other accessories shall include manufacture, pressure class, materials of construction, reference AWWA or ASTM Standards the equipment complies with, and catalog cuts or shop drawings showing layout dimensions.
- E. Whenever in these specifications reference is made to the requirements of the ASTM, AWWA, ASA, or other standard specifications, it shall be understood that references are made to the latest modifications or revisions of such specifications.
- F. All material to be used in this work will be inspected before being placed and all rejected material must be removed immediately and not used in the work under this contract. Any

material installed or placed without inspection shall be removed and replaced with new materials if so directed by the District's Representative.

- G. The Contractor shall be required to furnish such laborers as may be necessary to aid the District's Representative in the examination and culling of material.
- H. The Contractor shall pay for all tests required by the specifications. Such tests shall be performed by a competent independent laboratory approved by the District on test specimens selected by the Contractor under the direct supervision of the District. Copies of all test results shall be submitted to the District directly from the testing laboratory.

2.0 MATERIALS: See Section 02080-Utility Materials for materials specifications.

3.0 CONSTRUCTION REQUIREMENTS

3.1 SHIPPING AND HANDLING:

- A. Handle pipe in a manner to ensure installation in sound, undamaged condition using proper equipment, tools and methods, as follows:
 - 1. Suitable slings or skids.
 - 2. Without hooks in contact with joint surfaces.
 - 3. Provisions for preventing contact with adjacent units during moving or storage.
 - 4. Protection for all pipe ends such as beveled ends, flanges, mechanical joints, plain ends, threads, etc., prior to shipping to job site.

3.2 PIPE OBSERVATION:

- A. All pipe shall be subject to approval of the District.
- B. Pipe sections damaged by handling which, in the opinion of the District, cannot be satisfactorily repaired shall be rejected. This shall include, but is not limited to, broken bells and spigots, bent bell-and-spigot rings, excessive deflection and similar damage.

3.3 CLEANING:

- A. Thoroughly clean interior of all pipe, fittings and joints before installation.
- B. Exclude foreign matter during installation by providing temporary covers over end of pipe, if necessary.
- C. Do not place tools, clothing or materials at any time in pipe.
- D. Visually inspect, remove all articles in pipe, brush or flush clean immediately prior to final fitting of system.

3.4 INSTALLATION OF BURIED PIPING:

- A. Proper implements, tools and facilities satisfactory to the District's Representative, shall be provided and used by the Contractor for the safe and convenient execution of the work. All pipe, fittings and valves shall be carefully lowered in the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment in such a manner as to prevent damage to piping materials and protective coatings and lining. Under no circumstances shall materials be dropped or dumped into the trench.
- B. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying crew cannot install the pipe in place without getting earth into it, the Contractor will be required before lowering the pipe into the trench, to place a

heavy, tightly woven bag over each end of the pipe to be left in place until the connection is made to the adjacent pipe. During laying operation, no debris, tools, clothing or other material shall be placed in the pipe. At times when pipe laying is not in progress, the open ends of pipe must be closed by a watertight plug or other suitable means to seal the open end of the pipe.

- C. Wherever possible, pipe shall be laid with bell ends facing upstream (in the direction of laying). Wherever it is necessary to deflect the pipe from a straight line either in the vertical or horizontal plane to avoid obstructions, the angle of the deflection allowed shall not exceed that recommended by the manufacturer of the pipe. The use of fittings to make vertical bends shall be subject to the approval of the District.
- D. Preparatory to making pipe joints, the joint material on both the bell and spigot ends shall be thoroughly cleaned and coated with the proper lubricant or cement to facilitate assembly. The spigot end shall be inserted in the bell and pressure applied until the pipe is properly sealed.
- E. Thrust blocks as indicated shall be installed at all elbows, tees, reducers, valves, caps, etc.
- F. Trenching shall comply with Section 02315. Trench should be sufficiently wide to permit tamping around pipe. Bottom should be smooth and cleared of stones or protruding hard objects. Pipe should be supported over its entire length.
- G. All piping is to have a minimum of 48" of cover over the pipe, unless otherwise specified. All water pipes installed on State or County Right-of-Way (either in the flowline or on the side slopes) shall have a minimum cover of 60".
- H. Locator wire shall be installed with all pressure pipelines, fittings, and valve installation. The material to be installed for this purpose shall consist of standard electric service wire, a single No. 12 U.L. approved copper wire of the solid type with insulation for 600 volts. Insulated wire for this service shall be provided in standard rolls of not less than five hundred (500) foot lengths.
 - 1. Splices: Splices shall only be allowed where accessible. Buried splices will not be allowed.
 - 2. Locate Wire Contact: In order to make use of the wire for water main location purposes, a splice point shall be placed adjacent to a valve box location. The wire shall be brought to the ground surface at these locations so a power source can be connected. The wire shall run outside up along side the valve box, then notch a V through the top of the valve box, then bend the wire into the top. The splice connector shall be left exposed at the top of the valve box at the wire contact locations. Wire contact points shall be provided at no more than 1500-foot intervals. Wire shall also be run to allow for the location of water services. Wire shall be installed with service line from main to meter.

Water main locator wire installation shall be in accordance with applicable Articles of these specifications.

- I. Locator Wire Color Code:

Water – Blue Insulation

- J. A locate wire station riser shall be installed every 1,500'. The riser shall consist of 2" Endot Industries Blue coiled tubing extended 36" above grade with a push-on style cap, NOT GLUED, in which the locator wire shall be looped.
- K. No pipe shall be laid in water or in trench conditions unsuitable for laying water pipe in conformance with these specifications.

- L. Backfill operations shall commence immediately after laying pipe in trench upon authorization of District's Representative.
- M. The Contractor shall provide adequate equipment to eliminate "skips" during the trenching operation. Skips will not be permitted unless approved by the District or District's Representative.

3.5 PIGGING:

- A. All of the water mains shall be pigged for preliminary cleaning before final flushing, sterilization and pressure testing. Pigging shall be completed with the use of a "hard" pig followed by a "soft" pig.
- B. Pigs shall be construction of polyurethane foam of five (5) pounds per cubic foot density and two (2) pounds per cubic foot density, each, and coated with a polyurethane rubber coating. (Aqua-Pig by Girard Industries, Poly Pig by Pipeline Pigging Products, or approved equal.) Pig shall be slightly greater in diameter than the inside diameter of each pipe size to be pigged. Pig size and type shall be as per the pig manufacturer's recommendations.
- C. Pigs of appropriate size and type shall be inserted into launching assembly at one end of the pipe segment to be pigged. Launching assembly shall be closed and water pressure slowly applied to move the pigs down the line. Continue water pressure behind the pigs to allow movement at a rate to provide thorough cleaning of the pipe interior without pressure surges in the pipe. Continue pigging operation until pigs exit the receiver point. Continue water flushing as per the specifications until clean water without dirt or debris results.
- D. Contractor shall provide or fabricate suitable launching and receiving assemblies per the pig manufacturer's recommendations. Exit points shall be located where the flushing water and debris may be handled without damage to adjacent property or contamination or damage to the new and existing water mains and appurtenances.

3.6 DUCTILE IRON PIPE INSTALLATION:

- A. Installation shall conform to the requirements of AWWA C600 and the following:
 - 1. Mechanical Joints: The outside of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned to remove all foreign matter from the joint. The cast iron gland shall then be slipped on to the spigot end of the pipe with the lip extension of the gland toward the socket or bell end. The rubber gasket shall be placed on the spigot end with the thick edge toward the gland. The pipe shall be pushed forward to completely seat the spigot end in the bell. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly located around the entire joint. The ductile iron gland shall then be moved along the pipe into position and bolted. Nuts spaced 180 degrees shall be tightened alternately to AWWA C600 standard in order to produce and equal pressure on all parts of the gland.
 - 2. Flanged Pipe: Install piping with flanges carefully faced and properly bolted, without piping being subject to unnecessary or excessive strains.
 - 3. Assemble pipelines from full lengths of pipe, using short sections on where required.
 - 4. An anti-seize compound designed for 1000 degrees F shall be the lubricant for all flange bolt and stud threads, with the compound applied to male threads only.

3.7 COPPER & PVC PIPE:

- A. Copper and/or PVC Piping shall be installed in accordance with the manufacturer's recommendations and at depth and conditions specified.

3.8 VALVES AND ACCESSORIES:

- A. Prior to installation, all valves shall be checked for bolt tightness and operation. All foreign matter, dirt, and debris, shall be removed from inside the valve body. The valve gate and guide shall be cleaned free of grease and dirt. After thoroughly cleaning and checking the valve for operation, the valve gate shall be closed, and the valve shall be installed in place. Following placement and connection to both sides of the valve, excavation for the valve bearing thrust block shall be made. The thrust block shall then be poured of concrete, in accordance with the following Section of these specifications. The valve holding clamps, No. 4 reinforcing bars, shall then be placed over the valve with embedment in the concrete thrust block.

Following initial set of the concrete, the valve box as specified under the previous Section of these specifications shall be placed over the valve body. The valve box shall be set plumb and earth shall be thoroughly tamped around the box to maintain the plumb position. The top of the valve box shall be adjusted for height to the level of the adjacent pavement if in a paved area, or shall be adjusted to stand four (4) inches above ground level, if located in an unpaved area. The lid or cover shall then be placed on the valve box. The valve box may require vertical adjustment from time to time as trench settling occurs. It is intended that upon final project completion, all valve boxes shall be left in a vertical plumb, usable position, centered over the valve operating nut.

3.9 SAMPLING STATIONS:

- A. Sampling stations shall be located as approved by the District and installed in accordance with the manufacturer's recommendations.

3.10 LINES AND GRADES:

- A. The general alignment of the new main is shown on the drawings. Minimum covers shall be 48" to top of pipe with the only exceptions being where tie-ins are to existing mains less than 48" deep. Where the new main conflicts with another pipeline or structure, the new main shall pass beneath such pipeline or structure.

3.11 SERVICE WATER METERS:

- A. Service water meters shall be installed in locations designated by the District or District's Representative. The location shown on the drawings is only the general location.

3.12 SEPARATION OF WATER MAINS, SANITARY SEWERS AND COMBINED SEWERS:**A. Parallel Installation:**

1. Water mains shall be laid at least ten feet horizontally from any existing or proposed pipe carrying non-potable fluids such as, but limited to, drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, and process waste or product lines. The distance shall be measured edge to edge.
2. If specifically approved by MoDNR, installation of the water main closer to a non-potable pipe may be allowed, provided that the water main is laid in a separate trench located as far away from the non-potable pipe as feasible, at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable pipe while meeting minimum cover requirements.
3. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable pipe shall be constructed of mechanical joint pipe or cased in a

continuous casing. Casing pipe must be a material that is approved for use as water main.

B. Crossings:

1. Water mains crossing non-potable pipes shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the non-potable pipe. This shall be the case where the water main is either above or below the non-potable pipe.
2. A full length of water pipe shall be located so both joints will be as far from the non-potable pipe as possible but in no case less than ten feet. Special structural support for the water and non-potable pipes may be required.
3. In areas where the recommended separations cannot be obtained either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing. Casing pipe must be a material that is approved for use as water main.

C. Exception:

1. Any variance from the specified separation distances in paragraphs A and B must be submitted to MoDNR for approval.

D. Force Mains:

1. There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains or other force mains carrying non-potable fluids and they shall be in separate trenches.
2. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable line shall be constructed of mechanical joint pipe or cased in a continuous casing, be constructed of mechanical joint pipe, or be jointless or fusion welded pipe.
3. Where possible, the waterline shall also be at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable line. Casing pipe must be a material that is approved for use as water main.

E. Sewer Manholes:

1. No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.
2. Where the separation cannot be obtained, the waterline shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main.
3. The full length of water pipe shall be located so both joints will be as far from the manhole as possible, but in no case less than ten feet or centered on a 20-foot pipe. No water pipe shall pass through or come into contact with any part of a sanitary or combined sewer manhole.

F. Disposal Facilities:

1. No water main shall be located closer than 25 feet to any wastewater disposal facility, agricultural waste disposal facility, or landfill.
2. Water mains shall be separated by a minimum of 25 feet from septic tanks and wastewater disposal areas such as cesspools, subsurface disposal fields, pipe privies, land application fields, and seepage beds.

G. In the event ductile iron water main pipe is required and no bid item exists for ductile iron pipe, the Contractor shall be paid only for the additional cost of material used in lieu of specified materials.

3.13 FILLING/FLUSHING:

- A. The Contractor shall contact the District at least two working days prior to filling or flushing a main.
- B. The operation of all valves necessary to perform the fitting/flushing operations shall be performed by Public Water Supply District No. 1 of Lincoln County employees.

3.14 PRESSURE AND LEAKAGE TESTS:

A. After the pipe has been installed and backfilled as specified, all newly laid pipe shall be subjected to the hydrostatic pressure of 1.5 times the working pressure or the rated pressure of the pipe, whichever is less. The duration of each pressure test shall be at least two (2) hours. Each valve section shall be tested independently. The Contractor shall furnish the gauge and measuring device for the pressure test, as well as the pump, pipe, connections and all other necessary apparatus, and shall furnish all necessary labor to conduct the test.

Allowable pressure drop during the 2 hour test shall be limited to 3% of the test pressure.

B. All tests shall be made in the presence of the District or his authorized representative. The Contractor shall notify the District at least twenty-four (24) hours before any work is to be tested.

C. All connections to piping systems shall be completed prior to testing unless otherwise authorized by the District.

D. All pipe shall be slowly filled with water to the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the District. The pump, pipe connections and all necessary apparatus, including gauges, shall be furnished by the Contractor. The Contractor will furnish the gauges for the test and will make all taps into the pipe for conducting the tests.

E. Before applying the specified test pressure, all air shall be expelled from the pipe. If blowoffs are not available at necessary locations, the Contractor shall make the taps at the necessary locations before the test is made and insert the plugs after the test has been completed.

F. The duration of each leakage test shall be one hour, and during the test, the piping shall be subjected to a hydrostatic pressure of 1.5 times the working pressure or the rated pressure of the pipe, whichever is greater. No pipe installation will be accepted until the leakage is less than ten (10) gallons per mile of pipe per inch diameter per 24 hours. Should any tests of pipe laid disclose leakage greater than that specified, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

G. The pressure and leakage tests are only an indication to the District that the distribution system, including service lines, may be fit for use at the time the test were performed. In no way does the pressure or leakage test relieve the Contractor of his responsibility under the terms of the contract agreement.

H. The Contractor shall be responsible for all arrangements and costs for all water and power used during filling, flushing, and testing of the complete project until final acceptance by District.

3.15 DISINFECTION OF PIPING SYSTEMS:

- A. Continuous Feed: Feeding a solution of not less than 25 mg/l free chlorine throughout the length of the main. The solution shall be in the main for 24 hours.
- B. Slug Method: The chlorine shall be applied continuously and for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/l for at least 3 hours.
- C. General: After all piping has been installed and satisfactorily tested for strength and water tightness, the interior of all pipes, fittings and other accessories shall be flushed and disinfected with chlorine. This work shall be done by the Contractor under the supervision of the District's Representative. All materials, equipment and arrangements shall be furnished by the Contractor.
- D. Flushing: Flushing shall be done by turning the system's pressure into one end of the newly laid pipe and discharging it to waste at the other end through flush valves or hydrant heads. Flushing shall continue until the effluent appears clear to the eye when viewed through a drinking glass. Contractor shall provide temporary flushing devices on line not equipped with suitable flushing device. The contractor is to request to flush the line at least twenty-four (24) hours before the work is completed.
- E. Chlorination:
 1. Disinfection of the piping systems shall be in accordance with AWWA C651 and may be of the continuous-feed or slug method.
 2. In the process of chlorinating newly laid pipe, all valves, hydrants and other appurtenance shall be operated while the pipeline is filled with chlorine solution.
 3. Following chlorination, all the water in the main shall be flushed from the pipeline until all traces of chlorine over and above normal line levels have been eliminated.
 4. Upon successful completion of the testing and sterilization of each water main segment, and prior to placing same in service, the Contractor shall collect and submit two (2) separate standard bacteriological samples, taken a minimum of 24 hours apart, for analysis to a State of Missouri certified laboratory. Upon receipt of satisfactory test results, the water main segment may be placed in permanent service.
 5. Should the initial treatment fail to result in conditions specified above, the chlorination procedure shall be repeated until such results are obtained.
 6. After all sterilization has been completed satisfactorily, the Contractor shall dismantle the equipment, plug temporary taps and outlets, and restore all areas to their final required condition.

3.16 HIGHWAY AND RAILROADS:

- A. All pipe crossing of highways and railroads shall conform to the requirements of governing authorities: Where the pipeline crosses highways and railroads, the District and Contractor shall be required to obtain necessary permits and clearances from and to meet the requirements for the proper installation of the pipe within the jurisdiction of the interested governing authorizes.
- B. Furnish all materials, accessories, equipment, tools, transportation, services, labor and perform all operations necessary for the installation of pipelines on or under railway and/or highway property.
- C. Pipelines laid under highways and railroad tracks and across highway and railroad rights-of-way shall be encased in a larger pipe or conduit (casing pipe).

- D. Casing pipes shall be installed by simultaneously dry boring and jacking.
- E. Pipelines located within 25 feet of the centerline of any track or where there is danger of damage from leakage to any bridge, building or other important structure, shall be encased or of special design as approved by the District.
- F. Laws and orders of highway or railroad authority prescribing a higher degree of protection than specified herein shall supercede the applicable portions.
- G. Pipelines and casing pipe shall be suitably insulated from underground conduits carrying electric wires on rights-of-way.
- H. Carrier line pipe and joints shall be restrained joint PVC pipe – as specified in Section 02080.
- I. Pipe shall be laid with sufficient slack so that it is not in tension, lengths of carrier pipe shall be as shown on the plans.
- J. Casing pipe shall be as specified in Section 02080.
- K. Casing shall be installed as to prevent the formation of a waterway under the right-of-way, with an even bearing throughout its length and shall slope to one end.
- L. Where casing and/or carrier pipe is cathodically protected, the District shall be notified and suitable test made to ensure that other structures and facilities are adequately protected from the cathodic current in accordance with the recommendations of current Reports of Correlating Committee on Cathodic Protection, published by the National Association of Corrosion Engineers.
- M. Boring and Jacking and Tunneling:
 - 1. Bored and jacked installations shall have a bored hole diameter essentially the same as the outside diameter of the pipe plus the thickness of the protective coating.
 - 2. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (including coating) by more than approximately 1", remedial measures as approved by the District shall be taken. Boring operations shall not be stopped if such stoppage would be detrimental to the highway.
 - 3. Tunneling operations shall be conducted as approved by the District and the authorities having jurisdiction.
 - 4. If voids are caused by tunneling operations, they shall be filled by pressure grouting or other approved methods which will provide proper support.
- N. Once the casing pipe has been bored, the receiving end shall be opened up to establish if proper elevation of the casing has been accomplished. The carrier pipe, casing spacers and end seals shall be installed immediately after completion of boring. Protect ends of carrier pipe from backfill. Restraining grooves on the yelomine pipe shall be available for connection to the 18" long couplings.
- O. The execution of work on rights-of-way shall be subject to the inspection and direction of both the District and respective rights-of-way Engineers or their designated representatives.
- P. The Contractor shall comply with all requirements, including bonding and protective liability insurance, of the highway or railway authorities having jurisdiction and shall also comply with any permits, licenses, etc. issued with respect to this project.

END OF SECTION

SECTION 02533 – DUPLEX LIFT STATION**1.00 GENERAL**

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 DESCRIPTION OF WORK

- A. The Contractor shall furnish, install and place in satisfactory operating condition the Duplex Pump Station and appurtenances as shown on the drawings and described in the specifications.
- B. This section covers the Duplex Pump Station including:
 1. Pumps
 2. Valve Pits
 3. Level Controls
 4. Control Panel
- C. Related sections include the following:
 1. 02315 Excavating, Filling, and Grading
 2. 02536 Sanitary Sewer Manholes, Frames, and Covers
 3. 03050 Portland Cement Concrete
 4. 07111 Bituminous Damproofing

1.03 DEFINITIONS (NONE)**1.04 PERFORMANCE REQUIREMENTS**

- A. Design Summary:

1. Furnish and install a minimum of two (2) totally submersible electrically operated sewage pumps with level controls. The pumps and controls shall be located as shown on the contract plans.

2. Required Performance:

A three point performance curve for the pump(s) shall be submitted and included in the project specific specifications or on the plans.

1.05 SUBMITTALS

- A. Product Data: Include the following:
 1. Product literature
 2. Manuals
 3. Complete product description
 4. Affidavits of compliance with referenced standards and codes.
 5. Manufacturer's warranty
 6. A list of all deviations from drawings and specifications.
- B. Shop Drawings: All shop drawing submittals shall be in accordance with the General Conditions and Division 1 and include the following:
 1. Dimensions and required clearances
 2. Weights and forces
 3. Layout for all equipment including installation details
- C. Operation and Maintenance Data: Two (2) copies of each manufacturer's Maintenance and Operating Instructions Manual shall be provided with the equipment at the time of delivery. Three (3) copies that include all revisions made during start-up shall be provided after final acceptance.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Control Panel Submittal: A master wiring diagram for the control panel(s) shall be submitted for District's review and approval before beginning construction. This diagram shall be drawn in standard ladder logic format. All ladder rungs shall be numbered in the left hand margin, and all relay contacts referenced to these numbers in the right hand margin. Each electrical node in the control schematic shall have a different wire number. A bill of materials and a layout drawing shall be placed in the door (or inner door or inner bracket). All components shall appear on this drawing with a listing of nameplates pertaining to the components. Included in the submittal package shall be data sheets of all equipment used in the control panel, as listed in the bill of materials. Submittal drawings may be on 11" x 17" paper.
- F. Control Panel As-Built Drawings: Final As-Built drawings shall be on full-size 17" x 22" or 24" x 36" paper, as required. A waterproof reduced copy of the master "as-built" wiring diagram shall be laminated in clear plastic and permanently fastened to the inside of the panel door. A full-size as-built drawing shall be placed in the panel.

1.06 QUALITY ASSURANCE

- A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these specifications that all equipment called for under this Section shall be supplied by the single manufacturer. The equipment manufacturer shall, in addition to the Contractor, assume the responsibility for proper installation and functioning of the equipment.
- B. The Contractor Documents represent the minimum acceptable standards for equipment specified in this section on this project. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. If not named, the equipment which is a "standard product" with that manufacturer shall be modified, redesigned from the standard mode and shall be furnished with special features,

accessories, materials of construction or finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the specification.

C. Factory Tests: Manufacturer shall factory assemble equipment to detect any defects and demonstrate that they will function satisfactory under all conditions specified. Manufacturer shall prepare and submit a written report on the results of remedial action taken, if any.

- i. Pump Test: The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:
 - a. Impeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.
 - b. A motor and cable insulation test for moisture content or insulation defects.
 - c. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
 - d. The pump shall be ran for 30 minutes submerged a minimum of 6 feet under water.
 - e. After Operational Test "d", the Insulation Test "b" is to be performed again.

A written report stating the foregoing have been done, shall be supplied with each pump at the time of shipment. The pump cable end will then be fitted with a shrink fit rubber boot to protect it prior to electrical installation.

D. Reference Standards: Comply with all applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. National Electrical Code (NEC).
2. National Electrical Manufacturers Association (NEMA)
3. Occupational Safety and Health Act (OSHA)
4. American Society of Testing and Materials (ASTM)
5. American Welding Society (AWS)
6. American Institute of Steel Construction (AISC)
7. American Society of Civil Engineers (ASCE)
8. Steel Structures Painting Council (SSPC)
9. American Gear Manufacturers Association (AGMA)
10. American National Standards Institute (ANSI)

1.07 DELIVERY, STORAGE, AND HANDLING:

A. Preparation for Transport: Prepare all equipment according to the following:

1. Ensure that all the equipment is dry and protected.
2. Package all the equipment to protect from damage while in transport, loading, and unloading.

B. Storage:

1. Carefully prepare for storage and label all equipment and materials after they have been inspected.

2. Store materials to permit easy access for observation and identification. Support all material off of the ground and protect steel members and package material from corrosion and deterioration as per manufacturer's instructions.
- C. Handling: Handle all equipment as per manufacturer's instruction.
- D. Inspect all equipment and materials against reviewed shop drawings at the time of delivery.
- E. Equipment and materials damaged or not meeting the requirements of the reviewed shop drawings shall be immediately returned for replacement or repair.

1.08 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by District or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify District not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without District's written permission.

1.09 COORDINATION

- A. Coordinate Work on this section with interfacing and adjoining Work for proper sequencing of each installation.

2.00 MATERIALS

2.01 GENERAL

- A. The pump station shall consist of a precast reinforced concrete basin with pump guide rails, sealing flange, stainless steel lifting chains, electrical controls, level controls, inlet hub and flange and other necessary appurtenances. The pump shall have ample power to handle solids normally found in domestic household water, domestic waste from commercial and industrial establishments, storm flow, and to pump the waste to the point of discharge.
- B. The unit shall be suspended in such a manner that the pump discharge nozzle will be guided into the discharge pipe via guide rails without it being necessary to manually mate the two pipes or necessary for a man to enter the basin and physically connect the two pipes. When the pump unit is in place, it shall be vertical and suspended in such a manner that the wastewater is fed in an upflow direction to the unit with no feet or other obstruction below the pump inlet.
- C. It is assumed by the District that the Contractor has prepared his bid on the basis of the specified materials and equipment. No substitutions may be made without receiving prior approval of the District. Notwithstanding the above policy of changes in layout, design, etc., are required in order to accommodate a substitute piece of equipment, all additional engineering, construction, start-up and related cost shall be borne by the contractor.
- D. All pumps shall be purchased from a single manufacturer, due to the design being such that pump units may be interchangeable. Appurtenant items, such as float switches and access hatches, may be secured from other sources, however, Contractor is solely responsible for verifying that components so purchased are compatible with the proposed pumping equipment. Should the proposed pumping equipment require supplemental sensors to

validate warranty requirements (i.e.: seal leak detectors), such sensors and alarm indicators shall be provided at no additional cost to the District.

2.02 PUMPS

- A. The pumps shall be capable of handling raw, unscreened sewage. The design shall be such that the pump unit will be automatically and firmly connected to the discharge connection, permanently installed in the wet well. The pump shall be easily removable for inspection or service, requiring no bolts, nuts or other fastenings to be disconnected. For this purpose, there shall be no need for personnel to enter the wet well. Each pump shall be fitted with a stainless steel lifting chain of adequate strength and length to permit raising and lowering the pump for inspection or removal. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet. The submersible pumps shall be capable of handling domestic sanitary sewage with three (3) inch solids and shall be self priming.

Each pump shall be equipped with a factory supplied 60 hertz motor.

B. Pump Construction:

1. All major parts, such as the stator casing, oil casing, sliding bracket, volute and impeller shall be of grey iron. All surfaces coming into contact with sewage shall be protected by a coating resistant to sewage. All exposed bolts and nuts shall be of stainless steel.
2. A wear ring system shall be installed to provide efficient sealing between the volute and impeller. The impeller shall be gray cast iron of non-clogging design coated with abrasion resistant ceramic, capable of handling solids, fibrous material, heavy sludge and other matter found in normal sewage applications. The impeller shall be constructed with a long through let without acute turns. The impeller shall be dynamically balanced. Static and dynamic balancing operations shall not deform or weaken it. The impeller shall be slip fit to the shaft and key driven and fastened to the shaft with an anti-corrosion ring.
3. Each pump shall be provided with a mechanical rotating shaft seal system running in an oil reservoir having separate, constantly hydro-dynamically lubricated lapped seal faces. The (lower) seal unit between the pump and oil chamber shall contain one stationary and one positively driven rotating tungsten-carbide ring. The (upper) seal unit between the oil sump and motor housing shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon ring. Each interface shall be held in contact by its own spring system supplemental by external liquid pressures. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable. Shaft seals without positively driven rotating members or conventional double mechanical seals with a common single or double spring acting between the upper and lower units, requiring a pressure differential to offset external pressure and effect sealing shall not be considered acceptable nor equal to the dual independent seal system specified. The shaft sealing system shall be capable of operating submerged to depths of, or pressured equivalent to 65 feet. No seal damage shall result from pumping with the pumping unit not fully covered with liquid. The seal system shall not rely upon the pumped media for lubrication.
4. A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron

discharge connection, which when bolted to the floor of the sump and discharge line will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps, or similar devices.

5. Installation of the pump into to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by no less than two stainless steel guide bars.
6. No other motion of the pump unit, such as tilting or rotating, shall be required. Sealing of the discharge interface by means of a diaphragm, O-ring or other devices will not be considered acceptable nor equal to a metal to metal contact of the pump discharge flange and mating discharge connection specified and required. No portion of the pump unit shall bear directly on the floor of the wet well. There shall be no more than one 90 degree bend allowed between the volute discharge flange and station piping.
7. The pump motor shall be housed in an air-filled watertight casing and shall have moisture resistant Class F 155 degree C insulation. The motor shall be NEMA Design B and designed for continuous duty.
8. The cable entry water seal design shall be of such that precludes specific torque requirements to insure a watertight and submersible seal. Epoxies, silicones, or other secondary sealing systems shall not be required or used. The cable entry junction box or motor shall be separated by a stator lead sealing gland or terminal board which shall isolate the motor interior from foreign materials gaining access through the pump top.
9. Pump motor cable installed shall be suitable for submersible pump applications and this shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor voltage conversion without replacing the cable.
10. All mater surfaces of major parts shall be machines and fitted with nitrile o-rings where watertight sealing is required. Machining and fitting shall be such that sealing is accomplished by automatic compression in 2 planes and o-ring contact made on four surfaces, without the requirements of specific torque limits to affect this. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered adequate nor equal.
11. Tolerances of all parts shall be such that allows replacement of any part without additional machining required to insure sealing as described above. No secondary sealing compounds, greases, or other device shall be used.
12. Motor and power line protection for overload and short circuit conditions must conform to NEC standards. The stator shall be protected by three thermal switches (one per phase) imbedded in the windings. These switches are wired in series of two leads are brought up to the pump terminal board for connection to the control panel. The switches must be connected so that the pump is turned off if the stator overheats. Starting characteristics shall be in strict conformance with Section 2A. Each system shall be provided with an adequately designed cooling system. Thermal radiators integral to the stator housing, case in one unit, are acceptable.
13. These shall be used in conjunction with and supplemental to external motor over current protection.

2.02 CONTROL PANELS

- A. The control panel shall be supplied by the pump manufacturer. It shall be factory wired and tested. It shall be a **NEMA 3R** enclosure, weatherproof, tamperproof construction with a keyed lock, gasketed, front hinged weather door, hinged inner dead front operators panel and mounting brackets for mounting as shown on the Drawings. It shall be a minimum of 14 gauge welded steel construction with a rust-inhibiting surface protective coating and an oven-baked, exterior grade enamel, with the color to be selected by the District.
- B. The following described equipment shall be furnished in the panels and accurately matched to the specific lift station equipment.
 1. One combination circuit breaker overload disconnect unit per pump with magnetic trip elements sized for individual pump protection. This unit serves not only as a circuit breaker and manual disconnect switch, but is also to provide the motor with ambient temperature insensitive overload protection. Extra space shall be provided in the panel for a future third pump.
 2. One across-the-line magnetic contactor per pump, sized in accordance with NEMA horsepower standards.
 3. Low voltage level sensing circuitry for minimum shock hazard.
 4. An automatic two pump alternator for the pump control panel.
 5. Individual selector type switches to provide Hand-Off-Auto (H-O-A) control of each pump.
 6. A 24 volt AC control transformer protected by circuit breakers (no fuse type allowed) on both the primary and secondary.
 7. Terminals for connection of level sensors.
 8. A 120 volt, 3 prong receptacle and power transformer 120 volt AC protected by circuit breakers on both the primary and secondary.
 9. A high level alarm relay with dry contact, transformer and terminals.
 10. A high level alarm relay with bottom mounted, weatherproof alarm light, 100 watt bulb, red globe with guard, with battery backup.
 11. Individual pump control circuits shall be provided with H-O-A switches, elapsed time meters, green pump running lights, and individual seal leak relays with red indicator lights. LED type lights or LCD type counters will not be acceptable.
 12. Condensation protection, including heater and adjustable thermostat.
 13. Lighting arrester: a three poly thyrite unit mounted in panel.
 14. A 3 phase power monitor for 240 or 480 volt installation. It shall stop the pump from low voltage, single phasing and phase reversal.
 15. Each of the across-the-line magnetic contactors shall have an auxiliary contact which shall be brought to a terminal strip for use by others.

16. The lift station shall be connected to the District's existing MOSCAD (Motorola) SCADA system by radio telemetry as required by the district. Motorola MOSCAD equipment shall be made an integral part of the control panel, being manufactured by the Motorola supplier, and shall be programmed and started by a licensed Motorola Value Added Reseller (VAR). Intellution FIX Dynamics equipment shall be programmed and started up by a licensed Intellution VAR. MOSCAD VAR office shall be within 100 mile of the project site. The following shall be transmitted from the lift station to the system: Pump #1 and #2 status (on/off/fail), intrusion switch on each enclosure and High Water Alarm. The existing SCADA system was installed by: Electric Controls Company, Inc., St. Louis, MO, Phone (314) 645-2400. All new SCADA equipment (RTU, radio transmitter, etc.) in the lift station shall be of the same manufacturer and design as the existing equipment to ensure compatibility.

C. The control panel shall function as follows:

1. The selector switch provided for each of the pumps controlled shall operate as follows: In the hand position, the pump will operate regardless of the wet well level. The pump will continue to run until the switch is turned to "off" or "auto". In the auto position, the level sensors in the wet well control the operation of the pumps automatically in the following manner: The control circuit is energized when the liquid level rises to tilt the lowest level sensor. As the level continues to rise and the next level sensor is tilted, the first (lead) pump will start.
2. As the level in the wet well is pumped down, the pump will continue to operate until the level drops just below the lowest level sensor. If the level in the wet well continues to rise with one pump in operation, the second pump will be turned "on" when the level reaches the third level sensor. Both pumps will now run.
3. If the level in the wet well continues to rise after the second pump has been activated, a fourth float will energize the alarm light and lock it on until the reset button is pushed. The locking alarm relay shall have a set of dry contacts to be used to transmit this alarm condition to the telemetry.

2.02 ACCESSORIES

- A. Lifting Chains: The working load of the lifting system shall be a minimum of 50% greater than the pump weight. Pump lifting chains shall be sized and provided by the pump manufacturer. The chain shall be sized to accommodate the installed pump weight and shall be type 316 stainless steel. The chain length shall be five feet greater than the station depth.
- B. Access Frame and Guides:
 1. Furnish and install aluminum access frames and covers with stainless steel hardware as shown on the drawings.
 2. The frames shall be complete with hinged and hasp-equipped cover(s), stainless steel upper guide holder and stainless steel level sensor cable holder. Frame shall be securely mounted above the pumps. The single leaf door shall have a safety handle to maintain the door in the open position. Lower guide bar holds shall be integral with the discharge connection; guide bars shall be stainless steel pipe of the size indicated on the drawings.

Two guide bars are required for each pump and shall not support any portion of the weight of the pump.

3. The frame shall be made from an extruded aluminum shape incorporating a continuous anchor flange sufficient to secure hatch in concrete.
4. All aluminum surfaces of the frame which are in direct contact with concrete shall be given a coat of bituminous primer to installation. Primer is not to be visible on the completed project.
5. A neoprene cushion/gasket shall be permanently installed in the frame to seal the hatch in the closed position.
6. The frame shall also incorporate a nut rail to allow the installation and adjustment of accessories.

C. Pump Hoist and Socket: Shall be as shown on the drawings.

D. Float Switches: The float switches to control the pumps shall be Flygt Model ENH-10 Liquid Level Sensors, Consolidated Electric Company, Model LS Direct Acting Float Switch with Model WI weight kit or equal with the necessary brackets and cable for each installation. The floats shall be capable of tripping the mercury switch, within 2" of the specified elevation. The cables for the float switches shall extend to a junction box outside the wet well and shall leave 5' of extra cable for each float.

E. Cable Holder: Two (2) Halliday series J stainless steel cable holder constructed of type 304 SS shall be provided. Each cable holder shall have six (6) hooks and be wall mounted.

F. Cable Supports: All of the pump power/sensor electrical cables and each of the float cables shall be provided with a stainless steel Kellums grip constructed of 300 series stainless steel. The pump supplier shall determine the actual size of the grips and supply the grips with the pumps.

G. Electrical Rack: As noted on the plans. A seal fitting shall be located between the pump control panel and the junction box on each piece of connecting conduit. The terminal strips in the junction box shall be tagged with numbers identical to the terminal strips in the control panel.

H. All piping, valves, and fittings to complete the lift station shall be installed as shown on the drawings.

3.00 CONSTRUCTION REQUIREMENTS

3.01 GENERAL

- A. The pump unit shall arrive at the job site ready for installation. The hookup to the sewer shall conform to the drawings and the specifications. The pump unit is to be installed as shown on the Drawings. The Contractor shall be responsible for ordering and installing units of the depth as shown on the drawings. The units are to be installed at locations as shown on the drawings.

B. Equipment Manufacturer:

1. All fabricated steel parts (excluding stainless steel) shall be commercially cleaned and give one (1) shop coat of rust inhibitive primer.
2. All items such as motors, reducers, and equipment completely shop assembled and ready for installation shall be given one (1) coat of the manufacturer's machinery enamel.

C. General Contractor:

1. The General Contractor shall furnish and install an influent, effluent, and drain piping.
2. The General Contractor shall furnish and install all field wiring required including proper sized wire, conduit, fittings, and supports.
3. The General Contractor shall furnish and install all electrical items required but not specifically called for as furnished by the equipment manufacturer.
4. The General Contractor shall furnish and apply all touch-up of the prime coat and all finish coatings; and be responsible for compatibility of the primer with finish coatings.
5. The General Contractor shall place the anchorage in accordance with certified prints supplied by the equipment manufacturer.

3.02 ELECTRICAL INSTALLATION

- A. All wiring shall be in complete conformity with the National Electric Code and state and local NEMA standards.
- B. The entire installation of the pumps, electrical connections and any other work associated therewith shall adhere to the manufacturer's instructions, and shall be in compliance with all applicable codes.

3.03 CORROSION PROTECTION

- A. Non-stainless steel portions of the pump casting and appurtenant iron castings shall be pretreated with all metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
- B. The interior of the pump volute and passageways shall be painted as described herein. Other exposed surfaces subject to corrosion within the pump basin shall be protected either by painting, industry standards, or other acceptable methods.
- C. The Contractor shall provide moisture protection for each control panel that will provide protection from condensation for 3 years.
- D. The interior of the valve vault, wet well and storage basins, as well as any interior piping shall be epoxy coated.
 1. The coating shall be as follows:

Patch/Filler/Surfacer:	Tnemec Series 218 Mortar Clad
Primer:	Tnemec Series 201 Epoxo-Prime

Finish Coat: Tnemec Series 435S Perma-Glaze

2. The coatings shall be applied per manufacturer's specifications.

3.04 FIELD TESTING

- A. The Contractor shall, at his own expense, provide the necessary facilities to provide hydraulic and electrical performance tests on each of the pumps as shipped and/or assembled on the construction site.
- B. The specifications for hydraulic and electrical characteristics as stated elsewhere in this section are minimum requirements. Any pump failing to meet the minimum requirements shall be rejected. All rejected equipment shall be removed from this project and substituted with brand new merchandise.
- C. The performance test instruments to be used shall measure amperes, volts, feet of head, and flow. The instruments used shall have full scale accuracy of at least 1.5%. The minimum number of instruments required are one each with ranges so indicated:
 1. Ampere meter, ranges 0 to 20 amperes, and 0 to 100 amperes, direct reading, clamp on type.
 2. Volt meter, direct reading capable of reading 0 to 500 volts.
- D. The Contractor may elect for a properly equipped independent testing laboratory to perform the required performance testing. The Contractor shall submit to the District a list of gauges and meters to be used in the testing and drawings of the proposed layout for performing the test, prior to testing for his approval. The Contractor shall notify the District no less than 24 hours prior to when testing is to be done.
- E. Each pump may be subjected to a 24-hour operation test before acceptance as follows:
 1. Preparation: The unit under test shall be properly installed in the wet well, firmly upon its discharge connection after determination (a) proper service voltage is being supplied and (b) proper rotation of the impeller. No cooling by forced or circulated air shall be allowed.
 2. Dry pumping test (all sizes): Liquid shall be at a level sufficient to keep the pump volute submerged during the test. Pump shall be operated at full load for one hour unsubmerged without failure or damage to the windings.
 3. Supplier may be allowed to provide independent documentation of such capabilities. The use of thermal sensors to protect the motor shall not be considered as an acceptable means of meeting this requirement.

3.05 LIMITED WARRANTY

- A. The furnished equipment shall be guaranteed against defects in materials or workmanship for a minimum period of five (5) years following date of start-up. During the warranty period, all defective equipment shall be repaired or replaced without cost or obligation to the District the first year, with a stair stepped warranty for the remaining four years.

END OF SECTION

SECTION 02536 – SANITARY SEWER MANHOLES, FRAMES AND COVERS**1.3 GENERAL**

- A. This specification includes work performed by the Public Water supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.4 DESCRIPTION OF WORK

- A. Manholes are to be new and constructed in accordance with the drawings and the typical details. Unless otherwise specified, they shall be pre-cast concrete.
- B. The cast iron manhole lids and frames to be furnished and installed is as indicated on the drawings and specified herein.
- C. Manhole steps are to be provided and installed in all concrete manholes which are a part of this project and are either mentioned in these specifications or in the drawings.
- D. Job Conditions: It shall be the responsibility of the Contractor to see that accessories to casting that are required to be cast in concrete are available at that time.
- E. Applicable Standards:
 1. American Society for Testing Materials (ASTM)
 2. Federal Specifications
 3. American Association of State Highway and Transportation Officials (AASHTO)
- F. Shop drawings shall be required in accordance with Division 1 requirements.
- G. Applicable Sections: 02315 Excavating, Filling and Grading; 02537 Sewage Collection Lines; 03050 Portland Cement Concrete

2.1 MATERIALS**2.2 BASE:**

- A. Pre-cast with base cast monolithic with bottom section walls.

2.3 PRE-CAST CONCRETE MANHOLES:

- A. ASTM C478, sized as indicated. They shall have eccentric cone pre-cast tops unless otherwise approved by the District. Absorption of the concrete shall not exceed 8 percent of the dry weight as determined by ASTM C497 (ten minute soaking test). Permeability Tests (ASTM C497 section filled with water) may be required prior to installation of any section which the District deems necessary after visual inspection.
- B. Precast sections shall be aligned to provide vertical sides and vertical alignment to the steps. The completed manhole shall be rigid, true to dimensions and be watertight.
- C. Flat-top and drop manhole shall be built in accordance with the project details.

2.4 PRE-CAST MANHOLE PIPE SEALS:

- A. All pre-cast concrete manholes shall include a compressive-type joint for sewer pipe seals and provide 10 degrees of omnidirectional deflection which eliminates infiltration due to settlement or ground movement.
- B. The compression type pipe seal is to be cast integrally into the pipe opening of the manhole at the time of manufacture. The seal shall be a one-piece, compression type joint with no moving parts meeting the performance and test requirements of ASTM C923.
- C. The manhole pipe seal shall be similar to A-LOK Products Corporation or meet performance requirements of ASTM C-923 for "Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes".

2.5 MANHOLE DAMPROOFING:

- A. The manhole damproofing shall be a solvent based asphalt non-fibered coating similar to Uniseal 1600 by Anchor-Tite, Gicahn Manufacturing Company, Inc. Kansas City, Missouri, or approved equal and shall be applied by the pre-caster.

2.6 BUTYL SEALANT:

- A. The butyl sealant used to seal joints between manhole sections shall be a flexible butyl resin sealant similar to Con-Seal CS-302 by Concrete Sealants, Inc., New Carlisle, Ohio, or approved equal.

2.7 FRAME AND LID:

- A. General: Gray iron castings shall be as manufactured by Neenah Foundry Co., of Neenah, Wisconsin, East Jordan Iron Works, Inc., of East Jordan, Michigan, or approved equal. They shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. They shall be smooth and well-cleaned by sandblasting.
- B. Quality: Materials used in the manufacture of castings shall conform to ASTM A48, Class 30 or better.
- C. Finish: All castings shall be manufactured true to pattern; component parts shall fit together in a satisfactory manner. Round frames and covers shall have machined bearing surfaces to prevent rocking and rattling.
- D. Weight: All weights as given are average (and approximate) values. Deviation shall not exceed tolerances by ASTM Standards.
- E. Manhole Frame and Lid: For Sanitary Sewer.
 1. 325 pound casting
 2. Clear opening of 24" diameter
 3. Lid diameter of 26"
 4. Frame base diameter of 34"
 5. Type "C – Self Sealing" with 2" high lettering indicating "Sanitary Sewer"
 6. Similar to Neenah R-1642
- F. Special Manhole Frame and Lid:
 1. 305 pound casting
 2. Clear opening of 25" diameter

3. Lid diameter of 28"
4. Frame base diameter of 25"
5. Bolted lid
6. Frame shall be bolted to concrete manhole with four 5/8" wedge anchor bolts
7. Similar to Neenah R-1916-T

2.8 STEPS:

- A. The manhole steps shall be fabricated from plastic covered grade 60 1/2" diameter reinforcing steel rod. The manhole step shall be similar to M.A. Industries, Inc. Model PSI-PF, American Step Co., Inc., Model ML-10, or approved equal.

The manhole steps shall be polypropylene plastic coated reinforcing steel. The portion of the step to be embedded in the concrete shall have a configuration such that it will prevent any pullout. The steps shall have properties such that they will withstand a single concentrated load of three-hundred (300) pounds without distortion on that portion protruding from the wall. The steps shall be a minimum of twelve (12") inches wide and shaped to prevent the foot from slipping off the side. The step shall project a minimum distance of four (4") inches from the wall of the riser or cone section measured from the point of embedment. The steps shall be embedded a minimum distance of three (3") inches. All steps shall be constructed, textured and installed in accordance with OSHA standards.

3.17 CONSTRUCTION REQUIREMENTS

3.18 PRE-CAST CONCRETE MANHOLES:

- A. Shop drawings are required to determine total height and size and number of section required to attain finished elevation.
- B. Bottom section to be pre-cast monolithic with bottom section walls, unless approved by the District.
- C. If the construction requires that the bottom of the manhole and inverts be cast-in-place, the following procedure shall be used:
 1. The "dog house" manhole section shall be positioned over the existing pipe and support by solid concrete block, so that it does not bear directly on any of the pipe. The bottom of this section shall be at an elevation that permits a minimum of 2" of penetration into the floor once it is poured.
 2. Reinforcing steel shall be placed and tied in accordance with the detail drawings.
 3. Concrete has been placed to create the floor, inverts and seals around the pipes.
 4. The construction shall provide an integral watertight unit.
- D. All sections to be of size for easy and safe handling with equipment available to the Contractor.
- E. Joints shall be sealed with two rings of (1" minimum) premolded butyl sealant material at the interface between the precast sections.
- F. All exterior surfaces of the manhole must be waterproofed with an asphaltic coating by the pre-caster. Once the manhole has been installed, the contractor shall apply coating to any exposed concrete.
- G. Pre-cast sections shall be placed and aligned to provide vertical sides and vertical alignment of the steps. The completed manhole shall be rigid, true to dimensions and be watertight.

- H. Backfilling shall be done carefully with selected earth fill, free from rocks and debris, without injury to the manhole.
- I. The distance that can be made up with masonry units between the cone top and the base of the frame shall not exceed 12" or use more than two units.
- J. All lift holes one pre-cast elements for manholes shall be completely filled with non-shrink, non-metallic grout.

3.19 MANHOLE TOPS:

- A. Shall be eccentric cones, unless otherwise specified or if conditions are too shallow; they shall be a flat top slab.
- B. Flat top slabs shall be constructed of cast-in-place or pre-cast concrete of adequate section, material and reinforcement to support a concentrated wheel load of eight (8) tons, plus 100% impact.

3.20 MANHOLE INVERTS:

- A. Inverts to be carefully constructed and shaped with Portland Cement Concrete to maintain proper velocities through the manhole.
- B. In no case shall the invert sections through the manhole be greater than that of the outgoing pipe.
- C. The shape of the invert shall conform exactly to the lower half of the pipe it connects.
- D. Side branches shall be connected with as large of a radius of curve as practical.
- E. All inverts shall be plastered, troweled and brushed to a smooth, clean surface.
- F. Concrete placed between the invert and the walls of the manhole shall slope up from the invert as shown on the typical details.

3.21 FRAMES AND LIDS:

- A. All manhole frames and lids to be set level true to grade or specified elevation.
- B. All manhole frames to be set in grout. Where indicated shall be anchor bolted to manhole top.
- C. Manhole frames that are to be cast in concrete slabs shall be set level and flush with finish surface of slab.
 - 1. Position to prevent any ponding of water at the manhole frames when finished.
 - 2. Anchor securely in position before placing concrete.
 - 3. Adequately vibrate concrete at frame to ensure proper seal between frame and concrete.
- D. Properly clean all frames and lids from mud, concrete or other foreign matter.
- E. All frames and lids shall be in place before final acceptance and payment.

3.22 STEPS:

- A. Steps shall be installed in manhole risers in a vertical row, 16" o.c. and in accordance with OSHA specifications.

3.23 SEPARATION OF WATER MAINS AND SANITARY SEWERS AND COMBINED SEWERS

A. Parallel Installation:

1. Water Mains shall be laid at least 10 feet horizontally from any existing or proposed pipes carrying non-potable fluids such as, but not limited to, drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, and process waste or product lines. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, MoDNR may allow deviation on a case-by-case basis. Such deviation may allow installation of the water main closer to a non-potable pipe, provided that the water main is laid in a separate trench located as far away from the non-potable line as feasible, at such an elevation that the bottom of the water main is at least 18" above the top of the non-potable pipe while meeting minimum cover requirements.

B. Crossings:

1. Water mains crossing non-potable pipes shall be laid to provide a minimum vertical clear distance of 18" between the outside of the water main and the outside of the non-potable pipe. This shall be the case where the water main is either above or below the non-potable pipe. At crossing, the full length of water pipe shall be located so both joints will be as far from the non-potable pipe as possible. Special structural support for the water and non-potable pipes may be required.
2. When it is possible to obtain proper horizontal and vertical separation, the sewer shall be designed and constructed equal to water pipe, and shall be pressure tested to assure watertightness prior to backfilling.

C. Force Mains:

1. There shall be at least a 10' horizontal and 18" vertical separation between water mains and sanitary sewer force mains.

D. Sewer Manholes:

1. No waterline shall be located closer than 10' to any part of a sewer manhole.

3.24 ACCEPTANCE TEST:

- A. Upon completion of the sewers, acceptance tests will be conducted by the Contractor in the presence of the District's Representative to determine the acceptability of the manholes.
- B. Each manhole shall be subjected to an exfiltration test. The manhole to be tested shall be isolated from the sewer lines by installing pneumatic plugs in the sewer lines using the same procedures as for air testing, except that the plugs shall be installed in such a manner that there is a clear distance of at least 18" between the inside face of the manhole and the face of the plug. The plug shall be inflated to 25 psi.

Hydraulic Testing: the manhole shall then be filled with water to a depth just below the top of the manhole. Depth shall be at least 3' above ground water. A liquid level measure shall be made and recorded after initial filling and 15 and 30 minutes thereafter. The test is acceptable when no water loss is observed between the 15 and 30 minute readings. Addition of water during the testing shall not be allowed.

Vacuum Testing: the vacuum test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations. Vacuum of 10" of mercury shall be drawn on the manhole. The valve on the vacuum line of the test head closed and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9" of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10" of mercury to 9" of mercury meets or exceeds the values indicated in the table below.

Depth (ft)	Diameter (Inches)								
	30	33	36	42	48	54	60	66	72
Times (Seconds)									
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	48	51	57
18	22	24	30	34	40	45	52	58	67
18	25	27	32	35	45	52	58	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	45	55	54	72	79	89
24	33	36	42	51	59	64	78	87	97
26	38	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

- C. Once vacuum testing has been completed, the top elevation of the manhole shall be rechecked. If the completion of the test has compressed the manhole in such a manner that grade rings are required, the grade rings will be installed and the manhole retested.
- D. If the manhole fails the initial test, necessary repairs shall be made by and approved method. The manhole shall then be retested until a satisfactory test is obtained.

END OF SECTION

**DIVISION 2 – SITE CONSTRUCTION
SECTION 02537 – GRAVITY SEWAGE COLLECTION LINES**

1.00 GENERAL

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.05 DESCRIPTION

- A. The work in this section consists of furnishing all materials, accessories, equipment, tools, transportation, services, labor and performing all operations required to complete the gravity sewer pipeline, and related appurtenances, as shown on the drawings and as herein specified. Provide all work in this section in place, complete and ready for service.
- B. Applicable Sections: 02080 Utility Materials; 02315 Excavating, Filling and Grading; 02536 Sanitary Sewer Manholes, Frames and Covers

1.06 QUALITY ASSURANCE

- A. Work shall conform to all local building codes.
- B. All codes referred to are those listed by:
 1. American Society for Testing Materials (ASTM).
 2. American Standards Association (ASA).
 3. Commercial Standards (CS).
 4. American Association of State Highway & Transportation Official (AASHTO).
 5. Federal Specifications.

Codes and standards referred to above shall be the current edition which is being used at the time of bid opening.

- C. All materials and equipment used on this work shall be new, of the best quality and shall meet the requirements of these specifications. Materials shall be sampled and tested in accordance with current ASTM specifications or such others as specified hereinafter. The Contractor will be required to furnish certificates of conformance to ASTM or other applicable specifications. Materials shall be stored in such a manner that their conditions are equivalent to new when installed.
- D. Submittals on pipe, valves and other accessories shall include manufacture, pressure class, materials of construction, reference the ASTM Standard the equipment complies with, and catalog cuts or shop drawings showing layout dimensions.

- E. Whenever in these specifications reference is made to the requirements of the ASTM, ASA, or other standard specifications, it shall be understood that references are made to the latest modifications or revisions of such specifications.
- F. All material to be used in this work will be inspected before being placed and all rejected material must be removed immediately and not used in the work under this contract. Any material installed or placed without inspection shall be removed and replaced with new materials if so directed by the District's Representative.
- G. The Contractor shall be required to furnish such laborers as may be necessary to aid the District's Representative in the examination and culling of material.
- H. The Contractor shall pay for all tests required by the specifications. Such tests shall be performed by a competent independent laboratory approved by the District on test specimens selected by the Contractor under the direct supervision of the District. Copies of all test results shall be submitted to the District directly from the testing laboratory.

1.07 SUBMITTALS

- A. Submit as specified in Division 1. Included, but not limited to the following:
 - Layout Drawings.
 - Materials Specifications.
 - Complete Details of Pipe and Fittings.
 - Bill of Materials.
 - Factory and field test reports.

2.00 MATERIALS

2.01 GENERAL

- A. See Section 02080, Utility Materials for pipe and material specifications.
- B. All pipe and other materials used in the construction of sanitary sewer systems shall be of the type indicated on the drawings and as indicated in these specifications. All pipe and specials will be subject to inspection by the District. All damaged pieces as well as any pieces not conforming to these specifications shall be immediately removed and replaced with pipe and specials as may be acceptable to the District at the expense of the Contractor.

3.00 CONSTRUCTION REQUIREMENTS

3.01 SHIPPING AND HANDLING

- A. Handle pipe in a manner to ensure installation in sound, undamaged condition using proper equipment, tools and methods, as follows:
 - 1. Suitable slings or skids.
 - 2. Without hooks
 - 3. Provisions for preventing contact with adjacent units during moving and storage.

4. Protection for all pipe ends such as beveled ends, flanges, mechanical joints, plain ends, threads, etc., prior to shipping to job site.

3.02 PIPE OBSERVATION

- A. All pipe shall be subject to approval of the District.
- B. Pipe sections damaged by handling which, in the opinion of the District, cannot be satisfactorily repaired shall be rejected. This shall include, but is not limited to, broken bells and spigots, bent bell-and-spigot rings, excessive deflection and similar damage.

3.03 CLEANING

- A. Thoroughly clean interior of all pipe, fittings and joints before installation.
- B. Exclude foreign matter during installation by providing temporary covers over end of pipe, if necessary.
- C. Do not place tools, clothing or materials at any time in pipe.
- D. Visually inspect, remove all articles in pipe, brush or flush clean immediately prior to final fitting of system.

3.04 GRAVITY SEWER INSTALLATION

- A. Terminology: The haunch is the triangular shaped area in the trench next to the bottom half of the pipe extending from the spring line of the pipe to the bedding material.

The terms consolidate, compact, tamp and density are widely used in describing soil consolidation efforts in sewer pipe construction. They have varying implications as to technique. The term densify is used in this document without distinction as to method.

Graded soils are those containing a mixture of several different sized particles.

Select native soils, as described by visual inspection, is clean of Class V type material and debris, normally finely divided and not highly saturated with water.

Spring line of pipe is the horizontal centerline of the pipe.

Bedding is the material required beneath the pipe used to support the pipe and bring the pipe to grade above the foundation.

Initial backfill is the material above the haunching extending to 6 inches above the top of the pipe which is carefully placed to provide protection to the pipe during subsequent backfilling operations.

Final backfill is the material from the top of the initial backfill to the finish grade (minus pavement replacement – if required).

- B. Unless otherwise specified on the plans, SDR 35 PVC pipe shall be used on installation up to 14', SDR 26 PVC shall be used on installations greater than 14' but not exceeding 24', DIP shall be used on installations over 24'.

C. The pipe shall be bedded true to line and grade with uniform and continuous support from a firm base. Blocking with wood, brick, or any hard object shall not be used to bring the pipe to grade. Foundations, bedding and backfill shall be constructed to provide even restraint and support in all directions.

D. Special Situation:

1. Bell Holes for Elastomeric Seal Joints: As specified in ASTM D 2321.
2. Minimum Cover for Load Application: As specified in ASTM D 2321.
3. Use of Compaction Equipment: As specified in ASTM D 2321.
4. Removal of Trench Protection: As specified in ASTM D 2321.
5. Water Densification: When required, use water flooding, puddling or jetting only after the District observes conditions and approves the practice. These methods are most successful with Class II and III soils while normally ineffective with Class I soils.

E. Connections:

1. Where required by actual field conditions, as directed by the District, connections to existing structures, wye service connections, and existing line connections shall be made at no addition cost to the District.
2. Connections to Existing Structures: Existing structures are defined to be manholes, pump station wet wells, etc. An opening of sufficient size shall be cut to permit the end of the new pipe to be installed flush with the inner face of the existing masonry. Any portion of an existing structure that is damaged shall be repaired or replaced at the Contractor's expense.
3. Connections to Existing Lines: The Contractor will be required to locate by excavation existing sewer mains which are to be connected to the new main sufficiently in advance to coordinate the existing lines with planned lines and grades of new construction. These lines shall be connected to the new lines as shown on the drawings or as directed by the District. The existing and new lines shall be joined in the neat and workmanlike manner. Wherein, in the opinion of the District, a satisfactory joint cannot be made by use of a standard fitting, a concrete collar connection shall be installed.
4. Wye Service Connections: Wye service connections are defined to be connections made from a main sewer line to an individual property such as a home. The service connection shall consist of a standard connection, necessary length of pipe, airtight plug, plus any excavation or backfilling required.

F. Alignment and Grade:

1. Unless otherwise shown on the drawings, all gravity sewer pipe shall be laid straight between changes in alignment and at a uniform grade between changes in grade. All lines shall be laid so that each section between manholes will lamp.
2. The Contractor shall establish construction line and grade by the proper use of laser equipment.

G. Laser Equipment:

1. The laser equipment used shall be specifically designed for use in the construction of sewers to line and grade. The laser shall be rigidly mounted with two point suspension, to its support platforms. The laser aligning method selected must be shown to have worked satisfactorily on at least three similar projects within the last two years. The laser shall be operated by manufacturer trained competent persons. Proof and demonstration of such training shall be required. The laser equipment used shall be as manufactured by Laser Alignment, Inc., Spectrophysics, Construction Laser Systems, AGL, or equal.

H. Service Connections:

1. House service connections shall be provided from the sewer main to the points as shown on the drawings or as directed by the District.
2. The connection to the main may be accomplished by either installing an outlet wye or tee. Tees or wyes shall be factory molded fittings and of like material of the sewer main.
3. The service connection shall be installed in accordance with the details shown in the plans.
4. The joint material used for the house service outlet facilities shall be completely waterproof and shall be capable of withstanding any condition of stress or strain likely to be encountered in normal sanitary sewer construction or maintenance. Concrete encasement will not be considered waterproof and will not be an acceptable joint material.

3.05 FORCE MAIN SEWER INSTALLATION (SEE SECTION 02538)**3.06 DUCTILE IRON PIPE INSTALLATION****A. Installation shall conform to the requirements of AWWA C600 and the following:**

1. Mechanical Joints: The outside of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned to remove all foreign matter from the joint. The cast iron gland shall then be slipped on to the spigot end of the pipe with the lip extension of the gland toward the socket or bell end. The rubber gasket shall be placed on the spigot end with the thick edge toward the gland. The pipe shall be pushed forward to completely seat the spigot end in the bell. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly located around the entire joint. The ductile iron gland shall then be moved along the pipe into position and bolted. Nuts spaced 180 degrees shall be tightened alternately to AWWA C600 standards in order to produce an equal pressure on all parts of the gland.
2. Flanged Pipe: Install piping with flanges carefully faced and properly bolted, without piping being subject to unnecessary or excessive strains.
3. Assemble pipelines from full lengths of pipe, using short sections only where required.
4. Provide flanges or unions as applicable at all equipment connections and as otherwise required.

5. An anti-seize compound designed for 1000 degrees F shall be the lubricant for all flange bolt or stub threads, with the compound applied to male threads only.

3.07 SEPARATION OF WATER MAINS, SANITARY SEWERS AND COMBINED SEWERS

A. Parallel Installation:

1. Water mains shall be laid at least ten feet horizontally from any existing or proposed pipe carrying non-potable fluids such as, but not limited to, drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, and process waste or product lines. The distance shall be measured edge to edge.
2. If specifically approved by MoDNR, installation of the water main closer to a non-potable pipe may be allowed, provided that the water main is laid in a separate trench located as far away from the non-potable line as feasible, at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable pipe while meeting minimum cover requirements.
3. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable pipe shall be constructed of mechanical joint pipe or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main.

B. Crossings:

1. Water mains crossing non-potable pipes shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the non-potable pipe. This shall be the case where the water main is either above or below the non-potable pipe.
2. A full length of water pipe shall be located so both joints will be as far from the non-potable pipe as possible but in no case less than ten feet. Special structural support for the water and non-potable pipes may be required.
3. In areas where the recommended separations cannot be obtained either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing. Casing pipe must be material that is approved for use as water main.

C. Exception:

1. Any variance from the specified separation distances in paragraphs A and B must be submitted to MoDNR for approval.

D. Force Mains:

1. There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains or other force mains carrying non-potable fluids and they shall be in separate trenches.
2. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable line shall be constructed of mechanical joint pipe or cased in a

continuous casing, be constructed of mechanical joint pipe, or be jointless or fusion welded pipe.

3. Where possible, the waterline shall also be at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable line. Casing pipe must be a material that is approved for use as watermain.

E. Sewer Manholes:

1. No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.
2. Where the separation cannot be obtained, the waterline shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main.
3. The full length of water pipe shall be located so both joints will be as far from the manhole as possible, but in no case less than ten feet or centered on a 20-foot pipe. No water pipe shall pass through or come into contact with any part of a sanitary or combined sewer manhole.

F. Disposal Facilities:

1. No water main shall be located closer than 25 feet to any wastewater disposal facility, agricultural waste disposal facility, or landfill.
2. Water mains shall be separated by a minimum of 25 feet from septic tanks and wastewater disposal areas such as cesspools, subsurface disposal fields, pit privies, land application fields, and seepage beds.

3.08 GRAVITY SEWER ACCEPTANCE TEST

- A. Upon completion of the sewers, acceptance tests will be conducted by the Contractor in the presence of the District to determine the acceptability of the sewers. The testing schedule shall be submitted to the District by the Contractor prior to testing. The Contractor shall furnish suitable test equipment, materials and manpower to conduct the test. The Contractor shall cooperate fully with the District for the inspection and testing of the completed work.

B. A low pressure air test will be conducted after backfilling and before replacing pavement.

1. Air Testing of Sewers – After completing backfill of a section of wastewater line, the Contractor shall, at his expense, conduct a line acceptance test using low pressure air. The test shall be performed using the below stated equipment according to stated procedures and under the supervision of the District. Test procedures shall be in accordance with applicable provision of ANSI/ASTM C828.

2. Equipment:

- a. Pneumatic plugs: Cherne Air Lock Equipment, as manufactured by Cherne Industrial, Inc. of Edina, Minnesota; United Survey Products, Inc., Cleveland, Ohio; or approved equal. Equipment used shall meet the following minimum requirements:

1. Shall have a sealing length equal to or greater than the diameter of the pipe to the inspected.

2. Shall resist internal test pressures without requiring external bracing or blocking.
- b. All hoses shall be of sufficient length that pressurizing and testing operations can be completed outside of the manhole.
- c. Pressure gauges shall be 2" minimum with pressure increments indicated every 0.5 psi, starting at 0.5 psi.
3. After the pipe has been backfilled, the inside of the pipe shall be cleaned and the plugs shall be placed in the line at each manhole and inflated to twenty-five (25) psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches four (4) psig greater than the average back pressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize.
4. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from air supply shall be disconnected. That portion of the line being tested shall be termed "Acceptable" if the time required in minutes for the pressure decrease by one (1) psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the table below (minimum testing time shall not be less than 2 minutes):

Diameter of Pipe in Inches	T (Time)	Min./100 Feet
4	0.3	
6	0.7	
8	1.2	
10	1.5	
12	1.8	
15	2.1	
18	2.4	
21	3.0	
24	3.6	

- C. There shall be no substitute for good construction. The replacement of any pipes, pipe or fraction thereof shall require the end connections to be made with factory manufactured pieces having flexible gasketed joints to fit intended use. The use of half bell pipe and/or concrete collar will not be acceptable. Test shall be repeated as often as necessary until the installation meets the requirements of the acceptance test.
- D. All sewer pipes shall be flushed to remove any debris, sand or grit from the completed sewer prior to being placed in service. The Contractor shall flush and pump or remove all water from the flushing process.
- E. Each section of the sewer line between manholes is required to be straight and uniformly graded. Each section will be lamped in the presence of the District's Representative.
 1. Using a high intensity lamp or mirrors, light shall be directed through every pipe section.
 2. A "target" shall be held by the District's Representative at the opposite end of the pipe section. The target shall clearly depict a circle which is equal to 80% of the inside diameter of the pipe.

3. The section of pipe shall pass if the light appearing on the target is equal to or greater than the size on the circle.
- F. Deflection testing shall be done on all flexible sewer pipe. Deflection testing shall be done on 100% of the flexible sewer pipe installed in the project. The sewer line shall be tested for excess deflection by pulling a mandrel through the pipe from manhole to manhole without the aid of a mechanical pulling device.
 1. Deflection (mandrel) testing shall not occur until the pipe to be tested has been backfilled for at least thirty (30) days.
 2. The outside diameter of the test mandrel shall be ninety-five (95) percent of the original inside diameter of the pipe being tested. The mandrel shall be commercially made and shall clearly indicate the intended pipe it is designed to test.
 3. If deflection is more than five (5) percent of the original diameter, the Contractor shall excavate to the point of excess deflection and carefully compact around the point where the excess deflection was found. This length of pipeline shall be retested after a period of thirty (30) days after backfilling. However, should after the initial testing, the pipe fail to return to the original size (the inner diameter), the pipe shall be replaced.
- G. If the installation fails to meet these requirements, the Contractor shall, at his own expense, repair or replace all defective materials and/or workmanship and re-test until the installation meets these requirements.

3.09 HIGHWAYS AND RAILROADS

- A. All pipe crossing of highways and railroads shall conform to the requirements of governing authorities: Where the pipe line crosses highways and railroads, the Contractor shall be required to obtain necessary permits and clearances from and to meet the requirements for the proper installation of the pipe within the jurisdiction of the interested governing authorities.

3.10 CONSTRUCTION NEAR EXISTING UTILITIES

- A. The Contractor shall maintain in operating condition, all active utilities, sewers, gutters and other drains encountered in the new sewer installation.

END OF SECTION

**DIVISION 2 – SITE CONSTRUCTION
SECTION 02538 – SEWAGE FORCE MAINS**

1.00 GENERAL

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.01 DESCRIPTION

- A. The Contractor shall furnish and install all pipe and appurtenances of sizes and materials shown on the drawings and specified herein.
- B. Applicable Sections: 02080 Utility Materials, 02315 Excavating, Filling and Grading, and 02374 Fertilizing, Seeding and Mulching

1.02 QUALITY ASSURANCE

- A. Work shall conform to all local building codes.
- B. All codes referred to are those listed by:
 1. American Society for Testing Materials (ASTM).
 2. America Water Works Association (AWWA).
 3. American Standards Association (ASA).
 4. Commercial Standards (CS).
 5. American Association of State Highway & Transportation Official (AASHTO).
 6. Federal Specifications.

Codes and standards referred to above shall be the current edition which is being used at the time of bid opening.

- C. All materials to be used in this work will be inspected before being placed and all rejected material must be removed immediately and not used in work under this Contract. Any material placed without inspection shall be removed and replaced with new materials if so directed by the District.
- D. The Contractor shall pay for all the tests required by the specifications. Such tests shall be performed by the Contractor or a competent independent laboratory approved by the District

on test specimens selected by the Contractor under the direct supervision of the District. Copies of all the test results shall be submitted to the District directly from the testing laboratory.

3.00 MATERIALS

3.01 SEE SECTION 02080 UTILITY MATERIALS FOR MATERIAL SPECIFICATIONS

3.02 GRANULAR TRENCH BACKFILL

A. Granular trench backfill where called for on the drawings shall consist of sand, stones and stone screenings or chat and shall be reasonably free from an excess of soft and unsound particles and other objectionable matter. The aggregate shall be uniformly graded and shall conform to the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100%
1/2"	60-90%
No. 4	40-60%
No. 40	15-35%

3.00 CONSTRUCTION REQUIREMENTS

3.01 SHIPPING AND HANDLING

- A. Handle pipe in a manner to insure installation in sound, undamaged condition using proper equipment, tools and methods.
- B. Pipe damaged during transporting or handling which, in the opinion of the District's Representative cannot be satisfactorily repaired, will be rejected.

3.02 CLEANING

- A. Thoroughly clean interior of all pipe, fittings and joints before installation.
- B. Exclude foreign matter during installation by providing temporary covers over end of pipe, if necessary.
- C. Do not place tools, clothing or materials at any time in pipe.
- D. Visually inspect, remove all articles in pipe, brush or flush clean immediately prior to final fitting of system.

3.03 INSTALLATION OF BURIED PIPING

- A. Proper implements, tools and facilities satisfactory to the District's Representative, shall be provided and used by the Contractor for the safe and convenient execution of the work. All pipe, fittings and valves shall be carefully lowered in the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment in such a manner as to prevent damage to piping materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.
- B. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying crew cannot install the pipe in place without getting

earth into it, the Contractor will be required before lowering the pipe into the trench, to place a heavy, tightly woven bag over each end of the pipe to be left in place until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe. At times when pipe laying is not in progress, the open ends of pipe must be closed by a watertight plug or other suitable means to seal the open end of the pipe.

- C. Wherever possible, pipe shall be laid with bell ends facing in the direction of the laying. Wherever it is necessary to deflect the pipe from a straight line either in the vertical or horizontal plane to avoid obstructions, the angle of the deflection allowed shall not exceed that recommended by the manufacturer of the pipe. The use of fittings to make vertical bends shall be subject to the approval of the District's Representative.
- D. Preparatory to making pipe joints, the joint material on both the bell and spigot ends shall be thoroughly cleaned and coated with the proper lubricant or cement to facilitate assembly. The spigot end shall be inserted in the bell and pressure applied until the pipe is properly sealed.
- E. No pipe shall be laid in water or in trench conditions unsuitable for laying pipe in conformance with these specifications.
- F. Trench should be sufficiently wide to permit tamping around pipe. Bottom should be smooth and cleared of stones or protruding hard objects. Pipe should be supported over its entire length.
- G. Thrust blocks as indicated shall be installed at all elbows, tees, reducers, valves, caps, etc.
- H. All piping is to have a minimum of 48" of cover over the pipe, unless otherwise specified.
- I. Backfill operations shall commence immediately after laying pipe in trench upon authorization of District's Representative.
- J. The Contractor shall provide adequate equipment to eliminate "skips" during the trenching operation. Skips will not be permitted unless approved by the District's Representative or District.
- K. Water main locator wire shall be installed with all water main, fittings, and valve installation. The material to be installed for this purpose shall consist of standard electric service wire, a single No. 12 U.L. approved copper wire of the solid type with insulation for 600 volts. Insulated wire for this service shall be provided in standard rolls of not less than five hundred (500) foot lengths.

Splices: Splices shall only be allowed where accessible. Buried splices will not be allowed.

Locate Wire Contact: In order to make use of the wire for water main location purposes, a splice point shall be placed adjacent to a valve box location. The wire shall be brought to the ground surface at these locations so a power source can be connected. The wire shall run outside up along side the valve box, then notch a V through the top of the valve box, then bend the wire into the top. The splice connector shall be left exposed at the top of the valve box at the wire contact locations. Wire contact points shall be provided at no more than 1500-foot intervals. Wire shall also be run to allow for the location of water services. Wire shall be installed with service line from main to meter.

Water main locator wire installation shall be in accordance with applicable Articles of these specifications.

Prior to final acceptance by Owner, Contractor shall demonstrate that the locator wire works to the satisfaction of the Owner and/or his representative.

- L. A locate wire station riser shall be installed every 1500'. The riser shall consist of 2" Endot Industries Blue coiled tubing extended 36" above grade with a push-on style cap, NOT GLUED, in which the locator wire shall be looped.
- M. The general alignment of the new force main is shown on the drawings. Minimum covers shall be 48" to top of pipe with the only exceptions being where tie-ins are to existing mains less than 48" deep. Where the new force main conflicts with another pipeline or structure, the new main shall pass beneath such pipeline or structure.

3.04 BACKFILL AND FILL

- A. Place acceptable fill material in layers to required subgrade elevations, for each area classification as listed below:

1. In trenches and excavations, use satisfactory excavated or borrow material provided no rocks, hard clay, frozen earth, broken pavement, tree limbs, heavy vegetation, debris, etc. are contained therein.
2. Under grassed areas, use satisfactory excavated or borrow material as specified for trenched areas.
3. Under walks and pavements, use crushed rock material as specified for granular trench backfill.

- B. Placement and Compaction

1. Unimproved areas, cropland, parks, grassed areas, etc. shall be backfilled with previously excavated soil, free of frozen material, stones, broken pavement, tree limbs, heavy vegetation, debris, etc. Placement may be by dragline, bulldozer, front-end loader or other suitable equipment. Depositing in layers or tamping will not be required. Sufficient surplus material shall be neatly rounded over the trench to compensate for settlement.
2. Aggregate surface streets alleys, driveways and parking areas shall be backfilled with granular trench backfill.
 - a. Granular trench backfill shall be placed above the initial backfill and extending up to existing grade. It is the intent to backfill all street and driveway crossings and areas where new water lines and new sewer lines will be under the street roadbed with granular trench backfill. The cost of these aggregates and their installation shall be incidental to the cost per lineal feet of installed pipe. Granular trench backfill shall be compacted to 95% standard proctor density.
3. Rigid surfacing shall be backfilled with granular trench backfill placed in layers not to exceed 6" and carefully compacted to 95% Standard Proctor Density (ASTM D698). The

disturbed surfacing shall be resurfaced with materials and thicknesses equal to the existing surface.

3.05 SEPARATION OF WATER MAINS, SANITARY SEWERS AND COMBINED SEWERS

A. Parallel Installation:

1. Water mains shall be laid at least ten feet horizontally from any existing or proposed pipe carrying non-potable fluids such as, but not limited to, drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, and process waste or product lines. The distance shall be measured edge to edge.
2. If specifically approved by MoDNR, installation of the water main closer to a non-potable pipe may be allowed, provided that the water main is laid in a separate trench located as far away from the non-potable line as feasible, at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable pipe while meeting minimum cover requirements.
3. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable pipe shall be constructed of mechanical joint pipe or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main.

B. Crossings:

1. Water mains crossing non-potable pipes shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the non-potable pipe. This shall be the case where the water main is either above or below the non-potable pipe.
2. A full length of water pipe shall be located so both joints will be as far from the non-potable pipe as possible but in no case less than ten feet. Special structural support for the water and non-potable pipes may be required.
3. In areas where the recommended separations cannot be obtained either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing. Casing pipe must be material that is approved for use as water main.

C. Exception:

1. Any variance from the specified separation distances in paragraphs A and B must be submitted to MoDNR for approval.

D. Force Mains:

1. There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains or other force mains carrying non-potable fluids and they shall be in separate trenches.
2. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable line shall be constructed of mechanical joint pipe or cased in a

continuous casing, be constructed of mechanical joint pipe, or be jointless or fusion welded pipe.

3. Where possible, the waterline shall also be at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable line. Casing pipe must be a material that is approved for use as watermain.

E. Sewer Manholes:

1. No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.
2. Where the separation cannot be obtained, the waterline shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main.
3. The full length of water pipe shall be located so both joints will be as far from the manhole as possible, but in no case less than ten feet or centered on a 20-foot pipe. No water pipe shall pass through or come into contact with any part of a sanitary or combined sewer manhole.

F. Disposal Facilities:

1. No water main shall be located closer than 25 feet to any wastewater disposal facility, agricultural waste disposal facility, or landfill.
2. Water mains shall be separated by a minimum of 25 feet from septic tanks and wastewater disposal areas such as cesspools, subsurface disposal fields, pit privies, land application fields, and seepage beds.

3.06 PRESSURE AND LEAKAGE TESTS

- A. After the pipe has been installed and backfilled as specified, all newly laid pipe shall be subjected to the hydrostatic pressure of 1.5 times the working pressure or rated pressure of the pipe, whichever is less. The duration of each pressure test shall be at least two (2) hours. The Contractor shall furnish the gauge and measuring device for the pressure test, as well as the pump, pipe, connections, and all other necessary apparatus, and shall furnish all necessary labor to conduct the test. Allowable pressure drop during the 2 hour test shall be limited to 3% of the test pressure.
- B. All tests shall be made in the presence of the District or his authorized representative. The Contractor shall notify the District at least twenty-four (24) hours before any work is to be tested.
- C. All connections to piping systems shall be completed prior to testing unless otherwise authorized by the District.
- D. All pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the District. The pump, pipe connections and all necessary apparatus, including gauges, shall be furnished by the Contractor. The Contractor will furnish the gauges for the test and will make all taps into the pipe for conducting the tests.

- E. Before applying the specified test pressure, all air shall be expelled from the pipe. If blowoffs are not available at necessary locations, the Contractor shall make the taps at the necessary locations before the test is made and insert the plugs after the test has been completed.
- F. In the event that the pressure test indicated leakage, a leakage test shall be conducted as follows:
 1. The Contractor shall furnish the gauge and measuring device for the leakage test, as well as the pump, pipe, connections and all other necessary apparatus, and shall furnish all necessary labor to conduct the test. The duration of each leakage test shall be one hour, and during the test, the piping shall be subjected to a hydrostatic pressure of 1.5 times the working pressure or rated pressure of the pipe, whichever is less. No pipe installation will be accepted until the leakage is less than ten (10) gallons per mile of pipe per inch diameter per 24 hours. Should any tests of pipe laid disclose leakage greater than that specified, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.
- G. The pressure and leakage tests are only an indication to the District that the force main may be fit for use at the time the tests were performed. In no way does the pressure or leakage test relieve the Contractor of his responsibility under the terms of the contract agreement.
- H. The Contractor shall be responsible for all arrangements and costs for all water and power used during filling and testing of the force main until final acceptance by District.

END OF SECTION

DIVISION 2 – SITE CONSTRUCTION
SECTION 02539 – PRESSURE SYSTEM GRINDER PUMPS AND APPURTENANCES – TYPE 1

1.00 GENERAL

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.01 DESCRIPTION

- A. The Contractor shall furnish and install all material and services necessary for the installation of the grinder pump units.

The installation, when complete shall be ready for service, except however, the Contractor shall not connect the grinder unit to the house sewer. This final connection will be accomplished by the homeowner.

2.00 MATERIALS

2.01 GENERAL

- A. The grinder pump unit shall be furnished and installed complete, consisting of a grinder pump and motor, suitably mounted in a basin constructed of fiberglass, electrical disconnect or junction box, internal discharge piping, check valve, shut-off valve, anti-siphon valve, high water alarm, inlet filling, remote alarm panel and liquid level system to control the grinder pump "on" and "off" as the wastewater level varies within the pump chamber.
- B. All equipment shall be factory installed except for the grinder pump, inlet fitting and externally mounted alarm panel. For ease of serviceability, all pump/motor/grinder units shall be of like type and horsepower throughout the collection system.
- C. The grinder pump unit shall be mounted in the basin in such a manner that the pump discharge nozzle will be mated to the discharge pipe without it being necessary for a serviceman to enter the basin to manually make the connection or to remove the grinder pump unit.

2.02 GRINDER PUMPS

- A. Pump: Type I – Centrifugal:

1. The pump shall be a slide mounted centrifugal type driven by the submersible type motor. The grinder pump shall be adequate power to grind solids normally found in domestic household waste, and to pump the ground waste to the point of discharge. The grinder cutter, pump impeller, and motor shall be attached to a common shaft. The shaft shall be held rigid by the use of two adequate ball bearings sets. Sleeve bearings will not be

permitted. The lower ball bearing shall prevent shaft deflection at the lower seal from radial thrust of the grinder unit and pump impeller. The pump impeller shall provide an open unobstructed passageway through the volute and shall not impede the flow of the slurry formed by the grinding of the solids. The grinder pump shall be a two (2) horsepower, single phase, 230 volt, LSG 200 Series grinder pump as manufactured by Liberty Pumps, or equal.

2. Pump disassembly of the grinder pump unit shall be such that the District will be able to perform routine service work, repair and/or replacement of parts of the grinder pump unit, such as but not limited to the grinder unit, impeller, bearings and/or seals.

The disassembly shall be accomplished in the field or shop by one individual, safely and expeditiously without blows to the housing and/or parts with tools such as hammers, screw drivers, etc., which may weaken or otherwise cause damage to the grinder pump unit.

Should the disassembly of the grinder pump require any special tools whatsoever, the grinder pump manufacturer or his authorized representative shall furnish two sets of said tools to the District. The manufacturer or his authorized representative shall instruct the District on how to easily disassemble and assemble the grinder pump unit.

3. Characteristics and Performance: The grinder unit shall:

- a. Consist of a shredding ring and cutter.
- b. Grind domestic wastewater solids to a maximum size of 1/4".

4. Impeller shall be:

- a. Recessed Type.
- b. Capable of passing solids discharged from grinding unit (3/4" minimum).
- c. Required performance of 2 hp model.
- d. Constructed of 316 Stainless Steel.

<u>Discharge Head</u>		
<u>Flow Per Minute U.S. Gallons</u>	<u>Feet</u>	<u>RPM</u>
0	108	3450
7	100	3450
28	76	3450
40	64	3450

5. Bearing Design:

- a. The ball bearings shall be designed for a B-10 life of 50,000 hours.

B. Grinder Unit:

1. The grinder shedding ring and cutter shall be mounted below the pump impeller intake. The shredding ring shall be easily removed from the pump housing, with the cutter being easily removed from the common motor, impeller and grinding unit shaft with disassembly of pump volute. The grinding unit cutter should be so designed to prevent pump starvation. The grinding unit shall be capable of macerating all material found in domestic and commercial wastewater including reasonable amounts of foreign material

such as wood, plastic, glass, rubber, feminine hygiene articles, disposable diapers, etc., to a slurry that will pass freely, and without clogging the pump impeller and pump volute passages ways and 1 1/4" discharge pipe. Both grinder pump shredding ring and cutter shall be of material with at least the same characteristics of 440c stainless steel, hardened to 58-60 Rockwell C. Grinder pump impeller shall be and shall fasten to the common motor, pump and grinder shaft via threads and a locking device. The common motor, pump and grinder shaft shall be of material with at least the same characteristics of #416 stainless steel.

C. Electric Motors: The electric motors shall be of a design which will assure ready availability of replacement motors. Motor characteristics shall be as follows:

1. Type: Submersible.
2. Capacitor start.
3. Capacitor run.
4. The motor shall be protected from "burn-out" by a heat sensor thermostat and overload sensor. The heat sensor thermostat shall be attached to the top end of the motor winding and shall be connected in series with float switch which will stop the motor when the motor winding temperature reaches 200 degrees F. The high temperature shutoff will cause the pump to cease operation should a control failure cause the pump to run in a dry wet well. The thermostat shall reset automatically when the motor cools.

D. Electric Motor Characteristics:

1. Manufactured for 230 volts, 60 hertz, single phase.
2. Speed shall be 3450 rpm.
3. Shall be held rigid in housing.
4. 2 hp grinder pump units shall:
 - a. Not draw more than 15 amperes when operating at "no load" conditions.
 - b. Ampere draw when operating under full load conditions shall not exceed 15 amp by more than 195%.
 - c. Ampere draw at locked rotor condition shall not exceed 15 amp by more than 300%.
 - d. Ampere draw shall be measured at 230 volts, 60 hertz, single phase.

E. Wastewater Level Controls – Pump on and off water level shall be controlled by a heavy-duty float switch tethered to the grinder pump. The alarm water level shall also be controlled by a float switch. Both float switches shall consist of sealed corrosion-resistant floats with SJOW/A or SOW/A jacketed cable. The cables shall be of sufficient length to reach the junction box with no splices. Level controls shall be UL/CSA listed. Cord grip seal connectors shall be used when electrical cord enters a junction electrical box. Switches that make use of arms will not be acceptable.

F. Power Cord – The motor power cord shall be 14-5 SOW/SOWA. The cable jacket shall be sealed at the motor entrance by means of a rubber compression washer and compression nut. A heat shrink tube filled with epoxy shall seal the outer cable jacket and the individual leads to prevent water from entering the motor housing.

G. Level Control – An automatic control is provided by a heavy-duty UL/CSA listed float switch tethered to the side of the pump, having a piggyback plug on one end. This piggyback float switch operates the pump directly without need of control panel.

H. Junction Box – The junction box shall be constructed of structural plastic for corrosion resistance and of adequate thickness to provide stability and mechanical strength. The junction box shall have a fully gasketed cover that is held in place by four (4) captive stainless steel screws with heads of adequate size so that they may easily be installed and removed without the use of special tools. The heads of the screws shall be totally encapsulated so that no metal parts are exposed. The cover shall be fastened to the main body of the junction box by means of a totally corrosion-resistance tether to prevent dropping the cover during service. An adequate number of sealing-type cord grips shall be supplied for incoming pump and level control cords. The cord grips shall be made of non-corrosive material, such as PVC or nylon, and shall make an effective seal around the wire jacket. The cord grips shall seal to the junction box with an "O" ring or gasket.

The junction box shall have a PVC solvent weld socket type conduit hub of adequate size to accommodate the number of wires required for pump and level control operation. The incoming wires shall be sealed by an external EY type seal-off (supplied by others) so that condensation from the conduit or groundwater will not enter the enclosure. The interior of the enclosure shall be of adequate size to accommodate the wires and connections for pump and level control operation.

The wires running between the control panel and the junction box shall be color-coded and fastened to the pump and level controls by means of adequately sized and insulated twist lock or crimp connectors.

The junction box shall be designed to NEMA 6 standards for occasional submergence.

I. Alarm Panel – A remote alarm panel shall be installed as shown on plans. The alarm enclosure shall be rated NEMA 4X and shall be constructed of fiberglass. The alarm panel shall have a red lexan alarm light and be equipped with an audible alarm. The light shall glow brightly during high water conditions and shall go out when the water level drops. The alarm panel shall be mounted in view of the grinder pump and on the face of the building. The alarm panel shall also have a rotary type non-fusible horsepower rated disconnect switch with lockable handle. Bussman BDNF-30 or equal.

2.03 FIBERGLASS HOLDING BASIN

- A. The grinder pump and the necessary piping and fittings shall be housed within a 24 inch fiberglass holding basin with depth shown on the plans. The basin shall be molded of fiberglass reinforced polyester resin using the layup and spray technique to assure that the interior is smooth and "resin rich". At least 25% fiberglass shall be used. The resin shall be Polycar 939-X100. The wall thickness shall be no less than 1/4" thick. An anti-flootation collar extending a minimum of 3" beyond the O.D. of the basin wall shall be provided.
- B. Basin Cover – A one-piece, solid basin cover shall be provided with each basin assembly. The cover shall be constructed of fiberglass, with a minimum thickness of 1/2", meeting the previous material specifications for the holding basin. The cover shall be grass green in color. The cover shall be bolted to the basin with stainless steel cap screws. Zinc plated nuts shall be embedded in the upper flange of the fiberglass basin for corrosion resistance and to prevent turning.
- C. Discharge Pipe Assembly – A discharge pipe assembly shall be provided for each unit, as shown in the plans. The pipe assembly shall consist of 1-1/4" Schedule 80 PVC pipe. A full flow PVC swing check valve and a PVC true union ball type shutoff valve with Teflon seat

shall be furnished as an integral part of the pipe assembly. The true union ball valve provides for each disconnection and grinder pump assembly removal without personnel entering wet well. A lifting chain shall be provided on grinder pipe assembly for aiding in removal. The pipe assembly shall terminate at a discharge flange mounted at the height shown in the plans. The discharge flange shall have 1-1/4" PVC female threaded discharge coupling for attaching external discharge piping. The piping assembly shall have incorporated an anti-siphon valve that shall be mounted horizontally and shall be made of PVC and will not interfere with pump removal and installation.

- D. Inlet Fitting – A one-piece inlet fitting for 4" SCH 40 plastic pipe shall be shipped loose for field installation as required.
- E. The fiberglass basin shall be stored in a vertical position until it has been installed.

3.00 CONSTRUCTION REQUIREMENTS

3.01 GENERAL

- A. The grinder pump unit shall arrive at the job site ready for installation. The hookup to the sewer shall conform to the drawings and the specifications. The grinder pump unit is to be installed as shown on the drawings. The Contractor shall be responsible for ordering and installing units of the depth as shown on the drawings. The units are to be installed at locations as shown on the drawings.
- B. The installation of the fiberglass basin containing the grinder pumps, electrical controls, valves, piping and other necessary appurtenances shall be done in such a manner as to disturb the least amount of ground area as possible. The disturbed ground area shall be returned to its original condition.

3.02 FIBERGLASS BASIN INSTALLTION

- A. The Contractor shall install the fiberglass basin to assure that the basin is in a true vertical plane. The concrete anti-flotation collar shall be poured in such a manner as to assure that the entire bottom area of the fiberglass basin is resting on said collar and covering the antiflotation flanges that are integral with the basin. The remaining excavated area, including the area excavated for the inlet pipe, shall be backfilled with 1" clean rock in accordance with Section 2.4 of these specifications. The rock shall be used to within 36" of the top of the grinder pump basin.
- B. In lieu of this, the Contractor may elect to backfill with select earthen materials that are acceptable to the District, with the materials being placed in 12" lifts and compacted.
- C. Depth of fiberglass basin shall be determined by the Contractor to ensure gravity tie into the existing service line.

3.03 RESTORATIONS

- A. Upon completion of the installation of the fiberglass basin, the Contractor shall remove all construction materials, tools, equipment and excess dirt from the site.
- B. The disturbed surface area around the fiberglass basin shall be graded to drain away from the basin. The disturbed area shall be smoothed and made ready to be returned to its original condition.

3.04 EXCAVATION EXCEPTIONS

- A. Should any exceptions be made to Section 3.02, the Contractor shall coordinate such exceptions with the District prior to making such excavations.

3.05 ELECTRICAL INSTALLATION

- A. The Contractor shall provide 1-1/2" electrical conduit from the 1-1/2" cord sealing condulet at the fiberglass basin to the alarm panel described with this Section. The locations of the alarm panel shall be coordinated with the Building Owner. Three 12 gauge copper wire plus ground shall be run in the conduit with the alarm wires as required by the manufacturer from the junction box and/or motor terminal within the fiberglass basin to the alarm panel. Please note that the number of alarm wires may be different for different manufacturers. In addition to the motor wiring, the conduit is to carry wiring for the alarms that are provided. All electrical wiring and connections are to be done as required by the manufacturer and to maintain waterproof connections as required for successful operation.
- B. The entire installation of the grinder pumps, electrical connections and any other work associated therewith shall adhere to the manufacturer's instructions, and shall be in compliance with all applicable codes.

4.00 SHOP DRAWINGS

- A. The Contractor shall submit shop drawings in accordance with the General Conditions and the General Requirements.

5.00 CORROSION PROTECTION

- A. The grinder pump casting and appurtenant iron castings shall be pretreated with phosphate and chromic rinse, and painted with a high temperature baked-on epoxy protective coating before machining. All machined surfaces exposed to wastewater, including nicks, scratches, imperfections shall be repainted with high temperature baked-on epoxy.
- B. The interior of the pump volute and passageways shall be painted as described herein. Other exposed surfaces subject to corrosion within the grinder pump basin shall be protected either by painting, industry standards, or other acceptable methods.

6.00 FIELD TESTING

- A. The Contractor shall, at his own expense, provide the necessary facilities to provide hydraulic and electrical performance tests on each of the grinder pumps as shipped and/or assembled on the construction site.
- B. In lieu of field testing, the Contractor may elect to submit certified pump curves for all the grinder pumps.
- C. The specifications for hydraulic and electrical characteristics as stated elsewhere in this section are minimum requirements. Any grinder pump failing to meet the minimum requirements shall be rejected. All rejected equipment shall be removed from this project and substituted with brand new merchandise.

D. The performance test instruments to be used shall measure amperes, volts, feet of head, and flow. The instruments used shall have full scale accuracy of at least 1.5%. The minimum number of instruments required are one each with ranges so indicated:

1. Ampere meter, ranges 0 to 20 amperes, and 0 to 100 amperes, direct reading, clamp on type.
2. Volt meter, direct reading capable of reading 0 to 500 volts.
3. Flow meter, direct reading, range 0 to 100 gallons per minute.
4. A pressure gauge direct reading in feet of water, range 0 to 150 feet.

E. The Contractor may elect for a properly equipped independent testing laboratory to perform the required performance testing. The Contractor shall submit to the District a list of gauges and meters to be used in the testing and drawings of the proposed layout for performing the test, prior to testing from his approval. The Contractor shall notify the District no less than 24 hours prior to when testing is to be done.

7.00 PUMP SERIAL NUMBERS

A. The Contractor shall provide the District with the serial number of each grinder pump installed and the location of the grinder pump basin in which it is installed.

8.00 MATERIALS OF CONSTRUCTION

A. Major components of the grinder pump units shall be constructed of the following materials. Other materials may be used provided they are of like or better quality than those specified, provided however, the Contractor requests in writing from the District approval of a departure in material of construction herein specified.

1. Pump and motor housing – cast iron.
2. Seals, carbon and ceramic faces.
3. Motor and pump shaft – stainless steel.
4. Impeller – engineered thermoplastic.
5. Grinder – stator and rotor – stainless steel hardness to range between 58 and 60 Rockwell C.
6. Fasteners – 302 stainless steel.

9.00 LIMITED WARRANTY

A. The manufacturer shall issue an unlimited warranty for all grinder system components, supplied by the manufacturer, to be free from any defects for a period of 24 months from the date of installation or 30 months from the date of shipment, whichever occurs first, provided the product is properly installed, serviced, and operated within design conditions. Obligation of this warranty will be to replace or repair, at no charge, with a new or remanufactured part FOB, factory.

This warranty shall continue to be in effect for a total of five (5) years from the date of shipment with the exception of the following parts and components which will be replaced or repaired upon payment of the following percentage of list cost, in effect at the time of replacement.

MONTHS AFTER SHIPMENT

	<u>0-30</u>	<u>31-45</u>	<u>46-60</u>
Mechanical Seal	0%	25%	50%
Rotor or Impeller	0%	25%	50%
Pump Housing	0%	25%	50%
Wear Rings	0%	25%	50%
Ball Bearings	0%	25%	50%
Stator	0%	25%	50%
Electrical Components	0%	25%	50%

10.00 MANUALS

- A. The Contractor shall furnish to the District four complete new and unused manuals which described the operation and maintenance of each major unit of the grinder pump. The manual shall contain, but not be limited hereto, written descriptions, pictures and troubleshooting guides for the grinder pumps, level controls and electrical controls. The manual shall have a pictorial guide for the disassembly-reassembly of the grinder unit, pump impeller, bearings, seals and other appurtenances of the grinder pump. The pictorial guide shall show any and all special tools required and be coordinated with a written narrative describing the operation being performed.
- B. The manuals shall include simple to follow wiring diagrams with color code for the wiring.
- C. The manuals shall include pump performance curves.

END OF SECTION

**DIVISION 2 – SITE CONSTRUCTION
SECTION 02722 – AGGREGATE BASE COURSE**

1.00 GENERAL

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.01 DESCRIPTION OF WORK

- A. Work covered under this section consists of furnishing and placing one or more courses of crushed stone aggregate on prepared subgrade.
- B. Construction of aggregate base course shall conform to the typical sections, lines, grades and thicknesses as shown on the drawings. Type 5 aggregate base shall conform to the gradation specified in the most current edition of the Specifications for highway construction.
- C. Applicable Sections: 02315 Excavating, Filling, and Grading; 02230 Site Clearing

1.02 TESTING AND INSPECTION

- A. Contractor will engage soil testing and inspection service for quality control testing.
- B. Referenced standards of the American Society for Testing of Materials (ASTM) apply to this section.

2.00 MATERIALS

- A. Aggregate shall be crushed stone, and shall be the angular fragments resulting from crushing by mechanical means of calcareous or dolomitic limestone from undisturbed, consolidated deposits.
- B. The crushed stone shall contain not more than 15 percent deleterious rock and shale. Sand may be added to the crushed stone only for the purpose of reducing the plasticity index of the fraction passing the No. 40 sieve in the finished product. Any sand, silt, and clay, and any deleterious rock and shale shall be uniformly distributed throughout the mass.
- C. Gradation: The aggregates shall conform to the following gradation requirements:

	<u>Percent</u>
Passing 1 Inch Sieve.....	100
Passing 1/2 Inch Sieve.....	60-90
Passing No. 4 Sieve.....	40-60
Passing No. 30 Sieve.....	15-35
Passing No. 200.....	0-15

D. Quality: The aggregate base material shall be from an approved source.

3.00 CONSTRUCTION REQUIREMENTS

3.01 INSTALLATION

A. INSPECTION

1. Examine the areas and conditions under which the aggregate base course is to be placed for conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.
2. The subgrade shall be compacted, graded and cut to proper lines, grades, and cross-sections to the satisfaction of the District before placing of the base course.
3. Subgrade shall be protected from cold weather, base course shall not be placed on frozen subgrade or when the atmospheric temperature is less than 35 degrees F.

B. Placing Base Course:

1. Contractor shall be responsible for maintaining lines and grades including crown and cross-slope in base course.
2. The Contractor shall be responsible for placing the correct quantity of base material to construct a base of the required finish thickness.
3. The thickness of the compacted base course shall be as shown on the drawings.
4. The maximum compacted thickness of any one layer shall not exceed six (6) inches.
 - a. When specified compacted depth of base course exceeds 6 inches, the base course shall be constructed in two or more layers of approximately equal thickness.
 - b. No single layer shall be less than 3 inches in thickness when compacted.
5. The mixture shall be uniformly spread in successive layers of such depth that when compacted, the base will approximate the thickness specified.
6. Immediately before spreading the aggregate, the subgrade shall be wetted as directed by the District.
7. The base material shall be delivered to the site for placement with the material thoroughly mixed with water to approximate moisture content for desired compaction.

C. Compaction:

1. Maintain optimum moisture content for compacting base course material during placement shaping and compaction operations.
2. Each layer shall be compacted to not less than 95% maximum dry density per ASTM D698.

3. Required compaction shall be accomplished by a self-propelled smooth-wheeled roller, weighing not less than 5 tons, or other methods approved by the District.
- D. Quality Control Testing During Construction:
 1. Contractor shall engage a testing service to inspect and test base course layer before further construction work is performed.
- E. Grading:
 1. Base course material after compaction shall be cut to proper lines, grades, sections and cross-slopes as shown on the drawings.
 2. Tolerances shall be plus or minus .1 of a foot.
 3. Compacted areas that are below .1 of a foot of grade, additional material shall be brought in place, shaped and compacted to attain the proper thickness and subbase elevation.
- F. Maintenance:
 1. Protect newly graded areas from traffic and erosion.
 2. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerances.
 3. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape and compact to required density prior to further construction.
- G. Remove excess material, trash, debris and waste materials from the site.

END OF SECTION

**DIVISION 2 – SITE CONSTRUCTION
SECTION 02821 – CHAIN LINK FENCING**

1.00 GENERAL

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The Contractor shall furnish, install and place in satisfactory operating condition the chain-link fences, gates and appurtenances as shown on the drawings and described in the specifications.
- B. The section covers the Chain-Link Fencing including:
 1. Fabric
 2. Intermediate Posts
 3. Terminal Posts
 4. Top and Brace Rails
 5. Tension Wire
 6. Fittings and Hardware
 7. Barbed Wire
 8. Gates and Gate Posts
- C. Related sections include the following:
 1. 02230 Site Clearing
 2. 02315 Excavating, Filling and Grading

1.03 SUBMITTALS

- A. Product Data: Include the following:
 1. Product literature
 2. Manuals
 3. Complete product description
 4. Affidavits of compliance with referenced standards and codes.
 5. Manufacturer's warranty

6. A list of all deviations from drawings and specifications.
- B. Shop Drawings: All shop drawing submittals shall be in accordance with the General Conditions and Division 1 and including the following:
 1. Dimensions and required clearances
 2. Weights and forces
 3. Layout for all material including installation details

1.04 QUALITY ASSURANCE

- A. The Contract Documents represent the minimum acceptable standards for materials specified in this section on this project. All materials shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. If not named, the material which is a "standard product" with that manufacturer shall be modified, redesigned from the standard mode and shall be furnished with special features, accessories, materials of construction or finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the specification.
- B. Reference Standards: Comply with all applicable provisions and recommendations of the following, except as otherwise shown or specified.
 1. Occupational Safety and Health Act (OSHA)
 2. American Society of Testing and Materials (ASTM)
 3. American Society of Civil Engineers (ASCE)
 4. American National Standards Institute (ANSI)

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare all equipment according to the following:
 1. Ensure that all material is protected.
 2. Package all the material to protect from damage while in transport, loading, and unloading.
- B. Storage:
 1. Carefully prepare for storage and label all materials after they have been inspected.
 2. Storage materials to permit easy access for inspection and identification. Support all material off of the ground, if necessary, and protect steel members and package material from corrosion and deterioration as per manufacturer's instructions.
- C. Handling: Handle all material as per manufacturer's instructions.
- D. Inspect all materials against reviewed shop drawings at the time of delivery.
- E. Materials damaged or not meeting the requirements of the reviewed shop drawings shall be immediately returned for replacement or repair.

1.06 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by District or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify District not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without District's written permission.

1.07 COORDINATION

A. Coordination Work on this section with interfacing and adjoining Work for proper sequencing of each installation.

2.00 PRODUCTS**2.01 GENERAL**

A. The chain-link fencing shall be comprised of 6' high fabric, intermediate posts, top and brace rails, tension wire, barbed wire, ground rods, fittings and hardware, and gates. The fence shall have 45 Degree angle extension arms slotted to carry three (3) evenly spaced strands of barbed wire.

2.02 FABRIC

A. The wire fabric shall consist of individual pickets helically wound and interwoven in the form of a continuous chain-link fabric without knots or ties except knuckling or twisting and barbing at the ends of pickets and in the selvage of the fabric only. The fabric shall be steel wire in the form of approximately uniform square meds, having parallel sides and horizontal and vertical diagonals of approximately uniform dimensions. The mesh size shall be 2 inches measure in either direction as the minimum clear distance between the wires forming the parallel sides of the mesh. A tolerance of plus or minus 1/8" will be permitted. The fabric height shall be considered as the overall dimension from the ends of the barbs or knuckles and measured without tension applied. Variation in height of plus or minus one (1) inch will be permitted.

B. The size of the wire constituting the fabric shall be a minimum of 9 gauge (0.148 inch nominal diameter) and shall have a normal tensile strength of 80,000 psi based on the coated wire diameter.

C. The wire fabric shall be galvanized conforming to the requirements of ASTM A-392, Class II.

2.03 INTERMEDIATE POSTS

A. The intermediate posts shall be C-section roll formed from steel conforming to ASTM A-570, Grade 45, 2.25" x 1.70" with a minimum theoretical bending strength of 316 pounds under a 6' cantilever load; or 2 3/8 inch outside diameter plane end SS-40 pipe weighing 3.12 pounds per lineal foot; or 2.375 inch outside diameter Schedule 40 steel pipe weighing 3.65 pounds per lineal foot.

B. The intermediate posts shall be galvanized with 2 ounce zinc coating per square foot of surface

- C. The intermediate posts shall be of sufficient length to provide for a minimum of 36 inches of bury and extend to the top of the fabric.
- D. Line post shall be installed in a uniform manner with spacing not to exceed 10'.

2.04 TERMINAL POSTS

- A. All the end, corner and pull posts shall be rolled formed section 3.5" x 3.5" with a minimum theoretical bending strength of 486 lbs. under a 6' cantilever load or 2.875" outside diameter Schedule 40 steel pipe weighing 5.79 lbs per linear foot; or 2.875" O.D. plain end SS-40 pipe, 4.64 lbs. per foot.
- B. The terminal posts shall be galvanized with a 2 ounce zinc coating per square foot of surface area conforming to ASTM A-123 or SS-40 pipe.
- C. The terminal posts shall be of sufficient length to provide for a minimum of 3' of bury and extend to the top of the fabric.
- D. Terminal posts shall be placed where fence line has a change in direction of 25 degrees or more, but not at intervals greater than 660 feet. They shall be installed in accordance with the same requirements of a corner post.

2.05 TOP AND BRACE RAILS

- A. The top and brace rails shall be roll formed section of 1.625" x 1.625" 35,000 psi yield strength channel shaped rail with a minimum theoretical bending strength of 192 lbs. on a 10' span midpoint load or 1.625 outside diameter Schedule 40 steel pipe weighing 2.27 lbs. per linear foot or 1 5/8" O.D. plain end SS-40 pipe, 1.84 lbs. per foot.
- B. The rails shall be galvanized with a 2 ounce zinc coating per square foot of surface area conforming to ASTM A-123 or SS-40 pipe and shall be in lengths of not less than 18'.
- C. The maximum length for the top rail shall be 24' between couplings.
- D. Top rail couplings shall be not less than 6" long and shall allow for expansion and contraction of the rail. OPE seam sleeves shall not be permitted.

2.06 TENSION WIRE

- A. The tension wire shall be 7 gauge steel, coil-spring Class III wire, conforming to ASTM A-824.
- B. The tension wire shall be galvanized in accordance with the requirements of ASTM A-392 Class II.

2.07 FITTINGS AND HARDWARE

- A. All the fittings shall be pressed steel or malleable iron. The wire ties shall be a minimum of 11 gauge galvanized steel wire. The tension bar bands shall be of a suitable size steel bevel stock.
- B. All the fittings and hardware shall be galvanized in accordance with ASTM A-121 or A-123 or A-153.

2.08 BARBED WIRE

- A. The barbed wire shall be triple strand twisted 12-1/2 gauge steel wire with 14 gauge 4 point barbs spaced on approximately 5-inch centers, conforming to ASTM A-121 Class III Coating, or the barbed wire shall be aluminum coated conforming to the requirements of ASTM A-585, Type I, with 5" barb spacing.

2.09 GATES

- A. The gates shall be constructed with frames of the same material as specified for the rails and fabric as specified for fabric. Aluminum frame members as indicated on the drawings may be acceptable upon specific authorization by the District during shop drawing review. The frames shall be fastened together by welding or clamps and braces. Each gate panel shall be cross braced with a minimum of two (2) 3/8-inch adjustable truss rods. The gates shall be equipped with hardware of suitable design and strength to provide structural integrity and satisfactory operation. The gates shall have a latch and locking attachment. The gates, including all welds and hardware, shall be coated as specified for the components of its construction. Gate stops shall be included for all gates 6' and over.

2.10 GATE POSTS

- A. Gate post shall be in accordance with ASTM F-900.
- B. Gate post for opens of 4' or less, shall be supported by 2.875" post with a steel weight of 5.79 lbs/ft set in a concrete footing with minimum dimensions of: 12" diameter and 36" depth.
- C. Gate post for gates with a length of 6' to 12', shall be supported by 4.000" post with a steel weight of 9.11 lbs/ft in a concrete footing with minimum dimensions of 14" diameter and 40" depth.
- D. Gate post for gates with a length of over 12' to 18' shall be supported by a 6.625" post with a steel weight of 18.02 lbs/ft, set in a concrete footing with minimum dimensions of 18" diameter and 42" depth.
- E. Gate post for gates with a length over 18' to 24' shall be supported by a 8.625" with a steel weight of 27.12 lbs/ft set in a concrete footing with minimum dimensions of 18" diameter and 42" depth.

2.11 GROUND RODS

- A. Continuous fence shall be grounded at intervals not exceeding 100 feet in urban areas and 500 feet in rural areas. Except there shall be a ground rod not exceeding 100 feet from a gate in each section of the fence adjacent to gate.
- B. Fence under a power line shall be grounded by a power line by three grounds, one directly under the crossing and one on each side, 25 to 50 feet away. A single ground shall be located directly under each telephone wire or cable crossing.
- C. The counterpoise ground shall be used only where it is impossible to drive a ground rod because of an impervious earth structure.

D. The ground wire shall be connected to the fabric and the ground rod by a mechanical clamp of cast bronze body and bronze or stainless steel bolts and washers. When a tension wire is required, the bottom connection of the ground wire shall be made to the tension wire.

3.00 EXECUTION

3.01 INSTALLATION

- A. Install all material specified in this section as indicated on the contract drawings and in accordance with the manufacturer's instructions.
- B. The Contractor shall fill, cut or trench where necessary to produce a smooth and uniform, ground surface so the bottom of the fabric is not more than 2 inches above the finished ground line. Posts shall be set plumb, true to line and grade in concrete footings, and shall be located as shown on the Drawings or as directing by the District. Footing shall be of concrete of a commercial mixture, with a uniform thickness around the post. Fabric shall not be attached to posts until the concrete in the footings is at least five (5) days old.
- C. Fabric shall be attached to end, corner, gate, and pull posts by weaving fabric into integral lock loops formed in the posts on the roll formed posts and by stretcher bars and stretcher bar bands spaced 12+ inches on centers on the tubular posts. The rails and braces shall be fastened with wire ties with a maximum spacing of 24 inches on centers to the fabric. Attach fabric to line posts with wire ties spaced no more than 12 inches on centers. The tension wire shall be fastened with 9 gauge hog rings a maximum of 24 inches on centers to the fabric. All the fabric shall be pulled taut by approved hand-powered mechanical means before it is attached to line posts or top rails. Top rails shall be continuous from terminal post, connected with outside sleeve couplings, either screw or self-centering type, every fifth one of which in any continuous length shall be a slip coupling with an enclosed compression spring.
- D. The gate, complete with hinges, latches, braces, stops and locking device, shall be installed at locations shown on the Drawings. Gates shall have 180 degree opening swing with stops. The gates shall be to the dimensions and located as shown on the Drawings.
- E. All end corner and pull posts shall be embedded in concrete 14" in diameter to a depth of 3' below grade. Intermediate posts shall be embedded in concrete 12" in diameter to a depth of 30 inches below the surface. Braces shall be placed at the corner and gate posts in the fence and shall extend to the first line post. Concrete posts footings per CLFMI and ASLM-AF14 recommendations. All concrete footings shall be 4" deeper than post embedment. Braces shall be attached midway of the fence height.
- F. All posts shall have a maximum spacing of 10 feet.
- G. The top rail may pass through line post tops, but shall be secured at all gate and corner posts.
- H. The finished fence shall be in proper alignment with posts plumb and chain-link fabric pulled taut. Care shall be exercised to equalize the tension on the full width of the fabric. Wire fabric shall be securely fastened to the posts. Gate shall operate freely and shall be installed so the keeper and gate latch operate freely.

3.02 WARRANTY

- A. Warranty all parts to be free from defects in material and workmanship for a period of one year after final acceptance by the District. Furnish and install replacement parts found to be defective within the defined one year warranty period.

END OF SECTION

**DIVISION 3 – CONCRETE
SECTION 03050 – PORTLAND CEMENT CONCRETE**

1.00 GENERAL

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389.

1.01 DESCRIPTION

- A. This section of the specifications covers the materials, methods of construction, and requirements necessary to complete the Portland Cement Concrete work as indicated on the Drawings or as specified herein.

1.02 TESTING AGENCY

- A. Observation and testing will be performed by a firm approved by the District and paid for by the Contractor.
- B. Mix Design Submittals: Prior to beginning the work and within 14 days following the notice to proceed, the Contractor shall submit to the District, for review, previous independent laboratory generated data detailing performance (measures of performance as defined below) of the proposed mix design. Contractor shall also provide certification that materials used and their proportions are to be essentially unchanged from the mixture for which the data was generated. If independent laboratory data is not available, the proposed mix design shall be checked by an independent laboratory acceptable to the District. All costs related to such testing shall be paid for by the Contractor. Since laboratory trial batches require 35 calendar days to complete, the Contractor may consider testing more than one mix design for each class of concrete. Include the following information for each mix design:
 1. Water/cement materials ratio
 2. Slump as per ASTM C 143
 3. Air content as per ASTM C 231 (pressure method), or ASTM C 173 (volumetric method)
 4. Unit weight of concrete as per ASTM C 138
 5. Compressive strength at 3, 7, and 28 days per ASTM C 39
 6. Shrinkage (length change) as measured in accordance with Section 1.01 – Testing Agency, Paragraph C. – Shrinking Testing Procedure

C. Shrinkage Testing Procedure: Testing and reporting shall conform to the latest ASTM C 157-93 with the following modifications:

1. Wet cure specimens for a period of 7 days (including the period of time the specimens are in the mold). Wet cure may be achieved either through storage in a moist cabinet or room in accordance with ASTM C511, or through storage in lime saturated water.
2. Slump of concrete for testing shall match job requirements and need not be limited to restrictions as stated in ASTM C 157 Section 7.4.
3. Report results in accordance with ASTM C 157 at 0, 7, 14, and 28 days of drying.

D. Test of cement and aggregates shall be performed to ensure conformances with specification requirements. Manufacturer's certification that cement materials meet specification requirements and results of manufacturer's own material tests will be acceptable in lieu of tests by observation and testing firm. Aggregate testing shall be performed by independent observation and testing firm, for compliance with ASTM C33, including limits for deleterious substances, grading and physical property requirements.

E. Field quality control tests are specified in Part 3 of this section.

1.03 REFERENCE STANDARDS

- A. ACI 301 – Specification for Structural Concrete for Buildings.
- B. ACI 340 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- C. ACI 305 – Recommended Practice for Hot Weather Concreting.
- D. ACI 306 – Recommended Practice for Cold Weather Concreting.
- E. ACI 318 – Building Code Requirements for Reinforced Concrete.
- F. ASTM C33 – Concrete Aggregates.
- G. ASTM C39 – Compressive Strength of Cylindrical Concrete Specimens.
- H. ASTM C94 – Ready-Mix Concrete.
- I. ASTM C138 – Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- J. ASTM C143 – Slump of Portland Cement Concrete.
- K. ASTM C150 – Portland Cement.
- L. ASTM C157-93 – Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
- M. ASTM C171 – Sheet Materials for Curing Concrete.
- N. ASTM C173 – Air Content of Freshly Mixed Concrete (Volumetric Method).

- O. ASTM C231 – Air Content of Freshly Mixed Concrete (Pressure Method).
- P. ASTM C260 – Air Entraining Admixtures for Concrete.
- Q. ASTM C309 – Liquid Membrane – Forming Compounds for Curing Concrete.
- R. ASTM C494 – Chemical Admixtures for Concrete.

2.00 MATERIALS

2.01 PORTLAND CEMENT

- A. The Portland Cement shall conform to A.S.T.M. Specifications C-150, Type I, or A.S.T.M. Specification C-175, Type IA air entrained cement, if approved by the District.
- B. The Portland Cement used under this contract shall be a standard brand of Portland Cement which has been in practical use in public works and which has heretofore given satisfactory results. The cement when delivered to the site or at the location where the concrete is to be mixed, shall be stored so as to protect it from damage; and no damaged, partially set, or lumpy cement shall be used in the work and shall immediately be removed from the premises. The cement shall be manufactured by only one mill and used throughout the entire project. Brands of cement shall not be mixed.

2.02 FINE AGGREGATE

- A. The fine aggregate shall consist of clean, natural sand of hard, strong, durable material, free from all foreign organic material or other injurious impurities conforming to A.S.T.M. C-33. The sand shall be graded to meet the following sieve analysis using the U.S. Standard sieve series, with all percentages determined by weight.

<u>SIEVE SIZE</u>	<u>PERCENT PASSING</u>
3/8 Inch	100
No. 4	95-100
No. 16	60-75
No. 50	10-30
No. 100	0-5

The fineness modulus of the fine aggregate shall not be less than 2.50 nor more than 3.00.

2.03 COARSE AGGREGATE

- A. The coarse aggregate shall be clean washed and screened gravel or crushed limestone, having a specific gravity of not less than 2.56. The gravel shall be free from dust, loam, clay, alkali, or organic impurities, and free from thin porous, elongated, or laminated particles. A sample of the gravel when subjected to the sodium sulfate accelerated soundness test for freezing and thawing shall have a weighted average loss of not more than 15%. Crushed limestone aggregate shall consist of uncoated particles of sound, durable rock of uniform quality without an excess of flat, elongated, or laminated pieces.
- B. The gravel or crushed limestone shall be graded to meet the following sieve analysis using the U.S. Standard Sieve Series, with all percentages determined by weight.

SIEVE SIZE	PERCENT PASSING
3/8 Inch	100
No. 4	95-100
No. 16	60-75
No. 50	10-30
No. 100	0-5

C. The use of frozen aggregates will not be permitted. When the temperature of the air permits concreting to be carried on, the aggregates must be thawed out, thoroughly removing all frost before inclusion in the concrete mixture.

2.04 WATER

A. The water in mixture concrete shall be clean and free from injurious amounts of oil, acids, alkalis, salts, or organic matter. The water used shall be of potable quality.

2.05 ADMIXTURES

A. Should the Contractor desire to incorporate in the concrete mix an admixture to improve the workability of the concrete, the approval must be obtained from the District. However, no additional payment will be made for the use of the admixture; the use of such admixture will be made at the Contractor's expense.

1. Air Entrainment: ASTM C260.
2. Chemical: ASTM C-494, Type A – water reducing. Type B – retarding. Type C – accelerating. Type D – water reducing and retarding. Type E – water reducing and accelerating. Type F – high range water reducer. Type G – high range water reducing and retarding.
3. Shrinkage Reducing Admixture (SRA): Provide Eclipse™ Shrinkage Reducing Admixture as supplied by Grace Construction Products (or approved equal) at a rate of 1.5 gallons per cubic yard (liters per cubic meter).
4. Fibrous Reinforcing: Provide Grade MicroFiber® as supplied by Grace Construction Products (or approved equal at a dosage rate not less than 0.5 per cubic yard).
5. The use of calcium chloride in concrete is strictly prohibited.

2.06 GROUT

A. The grout shall be placed 2" deep in bottom of wall before any concrete is placed.

1. Mix in proportions of one part cement to one and one-half parts sand by weight keeping water to a minimum.

2.07 PREMOULDED EXPANSION JOINT

A. The premoulded expansion joint material shall be non-extruding resilient type conforming to ASTM designation D 1751.

B. The joint filer shall be full depth of concrete section and 2" thick unless shown otherwise.

2.08 WATERSTOPS

- A. The waterstops shall be polyvinylchloride plastic, serrated type of the width as shown on the Drawings. Similar to "Sealtight Duo-PVC", Type No. 4332D, W.R. Meadows, Inc., Style 703 Greenstreak Plastic Products, or equal.
- B. Moisture Barrier: Provide moisture barrier where indicated on the drawings or where specified herein. Barrier shall be resistant to decay similar to polyethylene of 6 mils thickness.

2.09 REINFORCING STEEL

- A. The reinforcing steel shall be rolled from new Billet-Steel Bars for Concrete Reinforcement A.S.T.M.-615 with deformations conforming to A.S.T.M.-305 and 60,000 psi minimum yield strength, A.S.T.M. A-432.
- B. The reinforcing, when delivered, shall be protected from the weather. The reinforcing shall not be oiled or painted. Reinforcing with slight rust which can easily be removed with a wire brush may be used after removal of rust. All reinforcing steel unacceptable to the District will be immediately removed from the job site.
- C. Welded wire fabric shall conform to A.S.T.M. A-185 and shall be the size and gauge shown on the Drawings.
- D. All bent bars shall be accurately cold bent to conform to the approved shop drawings.
- E. All bars shall be tagged and bundled. Imperishable marking tags are to be used.
- F. Metal accessories, including spacers, chairs, ties, and other devices necessary for properly assembling, placing and spacing and supporting all reinforcing in place, shall be provided.
- G. Reinforcing steel shall be carefully handled so that it will not become bent or otherwise damaged, shall be stored on racks, skids or other supports which will keep the steel from contact with the ground.

2.10 CONCRETE ADHESIVE

- A. Where indicated on the Drawings or requested by the District, SIKA Corporation, SIKADUR 32, HI-MOD LPL, or equal adhesive shall be used.

2.11 EXPOSED WALL COATINGS

- A. As specified herein or as requested by the District, a cement-base, aggregate type, heavy duty, coating shall be applied to exposed concrete wall surfaces. The material shall be thoro seal as manufactured by Thoro System Products or an approved equal.

2.12 SIDEWALK TEXTURING

- A. Sidewalks shall be sprinkled with "Silicon Carbide" grains as manufactured by Carborundum Company or equal.

2.13 LIQUID MEMBRANE CURING COMPOUND

- A. Liquid Membrane Curing Compound shall comply with ASTM-C309, Type 1, and AASHTO M-148.
- B. Polyethylene Film: 4 mil thick, opaque ASTM C 171.

3.00 CONSTRUCTION REQUIREMENTS**3.01 CONCRETE**

- A. Mix concrete in accordance with ASTM C94.
- B. Provide concrete of the following strength:
 1. Compressive strength (28 day): 4000 psi
 2. Entrained Air Content: As indicated in ACI 301, Table 3.4.1 or 7.5% \pm 1.5% with the Shrinkage Reducing Admixture.
 3. Water Cement Ratio: Maximum 0.45.
 4. Slump: 1 inch minimum, 3 inch maximum for footings and substructure walls; 4 inch maximum for slabs, beams, reinforced walls and columns. Loss of slump in pumping shall not exceed 1 1/2 inch.
- C. Select proportions for normal weight concrete in accordance with ACI 301, Chapter 3, Section 3.9 or 3.10.
- D. Admixtures shall be included with the mix design submittal and reviewed by the District.
- E. Use accelerating admixtures for use only in cold weather. Concrete techniques and placement requirements shall be in place under the application and reviewed by the District. Calcium chloride or admixtures containing chlorides may not be used in the concrete.
- F. Use retarding admixtures only in hot weather and shall follow hot weather concrete techniques to lower concrete temperature to an acceptable level. These techniques shall be reviewed by the District.
- G. Use air entrained concrete for all concrete exposed to the exterior.

3.02 MIXING

- A. Ready Mix (Central Plant) concrete shall be used for all work on this project, provided the concrete conforms to the proportions and strength as specified herein. Two speed mixer trucks shall be utilized for transit to the job site.
- B. The concrete must be in place within one hour after water is added to the mix. A.S.T.M. Specifications for Ready Mix Concrete C-94 shall apply. The Central Mixing Plant shall be designated in writing to the District for his approval one week prior to the usage of concrete on the job site.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Cold weather concreting shall not be continued when the air temperature is below 45 degrees F, unless the following conditions are maintained.
 - 1. Mixing water shall be heated to a maximum of 150 degrees F.
 - 2. Aggregates shall be heated until free of all ice and frost.
 - 3. The concrete temperature after mixing shall be between 50 degrees F and 70 degrees F if the air temperature is 25 degrees F to 45 degrees F.
 - 4. After the concrete is placed, it shall be covered, protected and heated so as to maintain a minimum of 70 degrees F air temperature for the first 24 hours and 50 degrees F for the next six days.
 - 5. Moist conditions shall be maintained during the heating period.
 - 6. All covering, heating equipment, etc., shall be on hand and approved by the District before any concrete is placed.
- B. No concrete shall be placed on iced or frozen subgrade or when the air temperature is below 25 degrees F.
- C. Hot weather concrete work will not be permitted on exposed surfaces while air temperature exceeds 100 degrees F. Cover and protect and cool as necessary to maintain the internal temperature of the concrete below 100 degrees F. Concrete delivered to the job site while in the Ready mix truck shall maintain a temperature less than 85 degrees F.

3.04 CURING

- A. Curing shall be accomplished by preventing loss of moisture, rapid temperature change, and mechanical injury or injury from rain or flowing water for a period of not less than 5 days when normal Portland Cement has been used. Curing shall be started as soon as free water has disappeared from the surface of the concrete after placing and finishing. Curing shall be accomplished by using any of the following methods or combination thereof, as approved by the District.
 - B. Unformed surfaces shall be covered with approved fabric, mats, burlap, or with sand, and shall be kept continually wet, or be covered with waterproof paper or polyethylene sheeting, or be coated with liquid membrane. Where formed surfaces are cured in forms, the forms shall be kept continually wet or the top forms may be loosened, as directed or approved by the District and water allowed to run down between the forms and concrete. If forms are removed before the end of the curing period, curing shall be continued as on unformed surfaces. Burlap shall be used only on surfaces which will be exposed in the finish work and shall be in two layers. Water shall be applied in a manner which will not damage the concrete, and shall be free from impurities which may damage or discolor the concrete.
 - C. Liquid membrane-forming curing compounds, when approved by the District, shall be applied by power spraying equipment using a spray nozzle equipped with a wind guard. The compound shall be applied in a two-coat, continuous operation at a coverage of not more than 200 square feet per gallon for each coat or as recommended by the manufacturer. The

compound shall form a uniform, continuous, adherent film that will not check, crack or peel and shall be free from pinholes or other imperfections. Surfaces subject to heavy rainfall within 3 hours after application of compound shall be re-sprayed at the rate specified above. Surfaces coated with curing compound shall be kept free of foot and vehicle traffic or other abrasions during the curing period. Membrane curing compound shall not be used on surfaces that are to receive concrete, bituminous membrane waterproofing, resilient floor covering, nor surfaces that are to be painted.

- D. Waterproof paper or polyethylene sheeting shall be placed to completely cover the concrete with enough overlap for secure anchorage around the edges. Adjoining sheets shall be lapped 6 inches and approximately weighted, or sealed with tape or other approved means. Edge and lap anchorage shall be sufficient to prevent billowing or displacement by the wind. The sheeting material shall be no less than 4 mils thick and black in color for cold weather use and white or clear for hot weather.
- E. To facilitate rubbing of concrete, or for other reasons, forms may be removed from vertical surfaces of thick sections 48 hours after concreting, with the approval of the District. Extreme caution should be exercised to prevent injury of concrete surfaces and edges during form removal. Surfaces revealed by form removal before the 5 day curing period shall have one of the other curing methods applied as soon as possible after form stripping.

3.05 FORMS

- A. The forms utilized for concrete shall be watertight, true to line and elevation, and rigidly braced so as not to be disturbed during the placement of concrete. If the forms develop any defects such as bulging, sagging, or showing signs of lateral displacement after the concrete has been placed, the concrete shall be removed and replaced correctly at the Contractor's expense. The inside of all forms shall be coated with a light, clear, paraffin based oil, which will not discolor or otherwise mar the concrete surface. The oil will be applied prior to erection of the forms; any reinforcing steel contaminated with form oil will be removed and replaced.
- B. Forms for concrete surfaces which will be visible in the finished structure shall be lined with wooden sheets such as Masonite or smooth plywood. The joints of this lining shall be neat and close. Lining damaged with hammer imprints shall not be used.
- C. Removal of forms shall be restricted to the following minimum time requirements:

1. Floor slab (structural):	120 hours
2. Floor slab on grade:	48 hours
3. Walls:	48 hours
4. Beam bottom forms:	7 days or develop at least 3,000 psi
- D. The minimum times, shown above, shall be utilized unless specific instruction to increase this time period has been requested by the District.
- E. Form ties shall be of the removable end, permanently embedded body type and shall have sufficient strength, stiffness, and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders. Ties shall also have water stop collars.

F. Chamfer strips shall be placed in forms to bevel all salient edges and corners and the top edges of walls. Unless otherwise noted, bevels shall be 3/4 inch wide and shall be cast in place.

3.06 PLACING REINFORCEMENT

- A. Reinforcement shall be accurately formed and positioned, and shall be maintained in proper position while the concrete is being placed and compacted. Unless otherwise shown on the Drawings, the details of fabrication shall conform to ACI 315 and 318. In case of conflict, ACI 318 shall govern.
- B. Approval by the District's Representative is required at the completion of placing reinforcing steel prior to the placing of any concrete.

3.07 PLACING OF CONCRETE

- A. The placing of concrete shall be accomplished by placing in one continuous operation between the limits of the work or between properly constructed and permissible construction joints.
- B. The Contractor shall place no concrete until after observation by the District of forms, reinforcing, and embedded items. Place no concrete over water covered, muddy, frozen soil or dry soil or sub-base. Dry sub-base shall be sprinkled with water prior to the placement of concrete.
- C. In preparation for the placing of concrete, all chips, and other construction debris and extraneous matter, shall be removed from the interior of the forms. Struts, stays and braces, servicing temporarily to hold the forms in correct shape and alignment pending the placing of concrete in their locations, shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete. Concrete shall be placed so as to avoid segregation of the materials and displacement of the reinforcement.

The use of long troughs, chutes, and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization from the District. In case an inferior quality of concrete is produced by the use of such conveyors, the District may order discontinuance of their use and the substitution of a satisfactory method of placing.

- D. Concrete shall be conveyed to place of deposit by methods which prevent separation of materials. Hoppers, chutes, tubes, or pumping equipment shall be sized to insure a practically continuous flow of concrete to point of delivery without separation of materials.
- E. The maximum free fall of concrete shall be less than six feet (6').
- F. Concrete shall be placed in a continuous operation until the panel or section is completed. Concrete for walls, piers, and columns shall be placed in layers not to exceed eighteen inches (18") in depth. Layers shall be incorporated together by vibrating a minimum of three inches (3") into the previously placed layer.
- G. During the placing of the concrete, it shall be compacted by mechanical vibration obtained by mechanical power operating within the mass of the concrete, supplemented by spading tools. Vibrators shall be of a type and design approved by the District.

- H. The intensity of vibration shall be such as to visibly affect a mass of concrete of 1 inch slump over a radius of at least 18 inches. The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. Vibration shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and in the corners and angles of the forms. Vibration shall be applied at the point of deposit and in the areas of the freshly deposited concrete.
- I. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation of aggregate. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.
- J. Vibrations shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.
- K. Vibration shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

3.08 FINISHING

Finishing of the concrete shall be accomplished as follows:

- A. Immediately after removing the forms, all fins or irregular projections shall be removed from all surfaces exposed above ground. On all surfaces the areas of cavities produced by form ties, holes, honeycombing, broken edges or corners, and other surface defects, shall be cleaned and carefully filled, pointed, and troweled to a true uniform smooth surface with sand-cement mortar mixed in the proportions used in the grade of concrete being furnished. Defective concrete as determined by the District shall be repaired by cutting out the unsatisfactory material and placing new concrete which shall be secured with keys dovetails or anchors. Concrete for patching shall be drier than the usual mixture and shall be thoroughly tamped into place.
- B. All exposed concrete surfaces, that is, those surfaces which will be visible (except floor slabs and sidewalks) shall be finished in the following manner: Forms shall be removed from such surfaces as soon as structurally possible, as approved by the District and all depressions or imperfections immediately patched as described above. The surface shall then be machine or hand-rubbed until the entire surface has a smooth, homogeneous pleasant-appearing finish of uniform texture and color. Any delay in patching or rubbing such surfaces shall be cause of rejection of the entire structure or for requiring the surfaces to be ground smooth and painted or coated with thoroseal as specified in 2.11 of this specification.
- C. All surfaces to receive a decorative or protective coating shall be ground, rubbed and filled as necessary to provide a surface smooth enough to insure a good paint coverage.
- D. No mortar wet cement shall be used in finishing except the mortar necessary to fill imperfections. Edging tools shall be used on all exposed top edges.

- E. The top surface of walls where exposed shall receive a smooth trowelled finish. Where the top surface joins the sides, a 3/4 inch chamfer shall be provided. All floor slabs shall receive a steel trowel finish.
- F. On pedestrian walks, before final troweling and brooming, and while concrete is still wet, apply Carborundum Company "Silicon Carbide" grains by sprinkling on at a rate of 1/4 pound per square foot and working grains with a wood float. Walks shall receive a light brush finish.

3.09 MONOLITHIC FLOOR AND SLAB FINISHES:

- A. Monolithic finish shall be applied to all interior floor slabs of building as follows:

Trowel Finish: Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise indicated, and slab surfaces that are to be covered with resilient flooring, carpet, paint or other thin film finish coating system. After screeding and consolidating concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4" in 10' when tested with a 10' straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operations, free of trowel marks, uniform to texture and appearance, and with a surface plane tolerances not exceeding 1/8" in 10' when tested with a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system. Sand and cement dusting will not be permitted.

- B. Exterior Walks and Slabs: Broomed finish shall be applied to all exterior walks and loading dock slabs. Strike off concrete and tamp with mechanical or hand screed; remove water and laitance by floated. Steel trowel concrete after it has hardened sufficiently to prevent excess fines from working to surfaces. Bring finish to smooth surface, free from defects and blemishes. Sand and cement dusting not permitted. On pedestrian walks, before final troweling and brooming, and while concrete is still wet, apply Carborundum Company "Silicon Carbide" grains, or approved equal, by sprinkling on at rate of 1/4 lb. per sq. ft. and working in grains with a wood float; follow with final brooming. Brooming shall be done after concrete has further hardened. Walks shall receive a light brush texture.

3.10 SAMPLES AND TEST

- A. Concrete Control Tests: For strength tests of cylinders during work provide 4 cylinders for each 50 cu. Yd. of concrete, a part thereof over 20 cu. yds. used on one day's pour. Test 2 at 7 days; 2 at 28 days. Make and cure test cylinder per ASTM C31. Cure specimens under laboratory conditions except District may require curing under field conditions when he considers that there is a possibility air temperature may fall below 40 degrees F. Test cylinders per ASTM C39.
- B. Testing Questionable Concrete: In event cylinders indicate that concrete does not meet specified strength requirements, District reserves right to order cores from hardened concrete secured and tested per ASTM C-42, or order load tests per ACI 318, or both. Costs of such cores and tests shall be borne by Contractor. If tests indicate that concrete placed does not

conform to drawings and specifications, Contractor shall take measures as directed by District to correct deficiency without extra cost to District.

- C. Slump Test: Test should occur at the beginning of the day, whenever questionable concrete is encountered and whenever test cylinders are taken.
- D. Air Test: Test should occur whenever the air temperature changes, the aggregate grading changes and whenever test cylinders are taken.
- E. Reinforcing Steel: With each shipment of steel, submit to District three (3) copies of certified mill test covering tensile strength of samples from shipment.

4.00 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Conditions and General Requirements. The Contractor shall furnish certified mill tests for all bars and shall submit duplicate copies of the bar drawings and schedules for preliminary checking and copies for final approval as specified in the General Conditions and General Requirements. Bending details shall conform to the standards of the Reinforcing Steel Institute.

END OF SECTION

**DIVISION 7 – THERMAL AND MOISTURE PROTECTION
SECTION 07111 – BITUMINOUS DAMP PROOFING****1.00 GENERAL**

- A. This specification includes work performed by the Public Water Supply District No. 1 of Lincoln County and any contractors building facilities to be accepted by the Public Water Supply District No. 1 of Lincoln County for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Public Water Supply District No. 1 of Lincoln County and the Water District Manager must be obtained before commencing construction.
- B. The District, as referred to in these specifications, is the Public Water Supply District No. 1 of Lincoln County, 3451 South Highway W, Winfield, Missouri 63389

1.01 DESCRIPTION

- A. Related Documents: The general provisions of the Contract apply to the work specified in the section.
- B. Scope: Furnish all labor and materials to complete damp proofing of all below grade concrete work. Additional damp proofing shall be as specified herein as shown on the plans.
- C. Surface Conditions: Application of material constitutes acceptance of surface conditions by waterproofing contractor. Before start work, check the following:
 1. Concrete walls and tops for footings: Cleaned of fins, mortar droppings, mud, oil, etc.
 2. Wall ties cut back and pointed.
 3. Pipes, sewers, etc., through walls: caulked or grouted tightly in place, flush with outside of wall.
 4. Exterior surfaces of foundation walls below grade to be damp proofed shall be prepared in accordance with the damp proofing manufacturer's recommendations.
 5. All pre-cast concrete structures not specifically required to be coated by the pre-caster.

2.00 MATERIALS

- A. "Sonneborn Hydrocide 700 Mastic", or approved equal, a heavy-bodied non-sag coating formulated with a heavy content of selected bitumens for trowel application.
- B. Sonneborn 700B, or approved equal for spray or brushed application. Brush application shall receive two coats. Total mil thickness shall be 10-12 mils dry film thickness. Surface preparation shall be brush-off blast (SSPC-SP7) and in accordance with the manufacturer's recommendations.
- C. Tnemec Series 46H-413 for spray application. Total mil thickness shall be 10-12 mils dry film thickness. Surface preparation shall be brush-off blast (SSPC-SP7) and in accordance with the manufacturer's recommendations.

3.00 CONSTRUCTION REQUIREMENTS

A. Apply in accordance with manufacturer's printed specifications to 1/8" film thickness.

4.00 GUARANTEE

A. This Contractor shall guarantee damp proofing work for a period of one (1) year protecting District against dampness on inside of damp proofed walls caused by defective materials or workmanship.

END OF SECTION

GENERAL DETAILS

SEWER DETAILS

WATER DETAILS