ENGINEERING STANDARDS

within the

APPLEWOOD SANITATION DISTRICT

Jefferson County
Colorado

August 7, 2025

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APPLEWOOD SANITATION DISTRICT

SANITARY SEWER SPECIFICATIONS AND CONSTRUCTION REQUIREMENTS

The purpose of this manual is to provide information related to design and construction of a sewer system extension within the Applewood Sanitation District. The publication is divided into three sections: Administrative Procedures and Requirements, Technical Specifications, and Detail Drawings and Plan Check Notes.

Chapter 1: Sanitary Sewer System Administrative Specifications

This section provides information relative to the general procedures and requirements for submitting and obtaining approval of sanitary system construction plans. It also explains the requirements for constructing the sanitary sewer system in accordance with the approved plans, and for obtaining District acceptance subsequent to completion of construction.

Chapter 2: Sanitary Sewer System Technical/Construction Specifications

This section provides technical information for materials, processes and procedures used in the construction and testing of sewer facilities installed within Applewood Sanitation District.

Chapter 3: Sanitary Sewer System Details

This section provides details of the materials and facilities described in the technical specifications section. The appropriate detail drawings are to be printed on the construction plans submitted to the District for review and approval.

In all cases in these specifications where reference is made to “District Engineer,” the District Engineer shall mean any representative of the consulting engineering firm designated by the District to provide review of sewer system construction plans. The “District Observer” shall mean the firm or individual designated by the District Engineer to perform construction observation services on behalf of the District.

CHAPTER 1

APPLEWOOD SANITATION DISTRICT

SANITARY SEWER SYSTEM ADMINISTRATIVE SPECIFICATIONS

SANITARY SEWER SYSTEM ADMINISTRATIVE SPECIFICATIONS

1.1 Sanitary Sewer System Plan Submittal, Procedures and General Requirements.

1.1.1 All plans for sanitary sewer main extensions, improvements and modifications shall be submitted to the District Engineer. All plans must be approved by the District Engineer prior to initiation of construction. Plans shall be submitted and reviewed in accordance with the following procedure.

1.1.1.1 In order to initiate construction plan review, the following items must be submitted to the District Engineer.

Two sets of sanitary sewer system construction plans stamped and signed by a Professional Engineer licensed to practice in the State of Colorado.

An electronic copy in pdf format and two copies of the Applewood's Application and Agreement for Sanitary Sewer Main Extensions (see End of Section 1). All copies must be signed, as originals, notarized, and stamped with the corporate seal if the applications are executed as a Corporation. If executed as a partnership, a copy of the recorded trade name affidavit must be furnished.

Two copies of the District's easement checklist with all supplemental information required (see End of Section 1). This information is required for all facilities to be constructed outside of dedicated public rights-of-way.

A written statement from a representative of the Jefferson County Planning Department stating that none of the proposed facilities lie within or impact a Floodplain Overlay Zone District. In the event facilities do lie within or impact a Floodplain Overlay Zone District, proof that the Owner/Developer has applied for a Floodplain Development Permit will be required. In addition, the Owner/Developer must furnish a statement from Jefferson County approving the design of the facilities impacting the Floodplain District.

Two copies of a sanitary sewer study showing sewage contribution and hydraulic calculations used to size the sewer lines for the anticipated service area. The study will set forth all assumptions and criteria that serve as basis for the calculations and will show design

for initial and ultimate average and peak flows along the sewer lines including initial and final buildout.

1.1.1.2 Upon receipt of all information described under Section 1.1.1, the District will initiate review of the construction plans and other pertinent information. The plans will be reviewed by the District Engineer. If modifications to the plans are required, the plans will be returned to the design engineer for revision.

NOTE: The approval of sanitary sewer system construction plans signifies only that the plans meet the minimum requirements of the District's standards and specifications based on the information provided by the design engineer, Owner/Developer, and Contractor. Approval is not a representation or warranty that the system and associated components will perform any certain function.

The design engineer shall be fully responsible for the adequacy and satisfactory performance of the sanitary sewer system design.

1.1.1.3 Approved plans will be signed by the District Engineer using the following approval block.

ENGINEERING APPROVAL APPLEWOOD SANITATION DISTRICT	
REVIEW IS ONLY FOR GENERAL COMPLIANCE WITH APPLEWOOD SANITATION DISTRICT ENGINEERING STANDARDS AND REQUIREMENTS. ALL RESPONSIBILITY FOR EXISTING CONDITIONS, CORRECTNESS OF DIMENSIONS, DETAILS, CONCEPTS, QUANTITIES AND SAFETY DURING CONSTRUCTION SHALL REMAIN WITH THOSE DESIGNING, DEVELOPING AND CONSTRUCTING THE PROJECT.	
_____	_____
DISTRICT ENGINEER	DATE

1.1.1.4 All costs associated with District plan review expenses will be charged to the Owner/Developer.

1.1.1.5 Plans and specifications are approved for a six-month period only. If construction has not begun within this six-month period, or if it has been halted and not restarted prior to expiration of the approval period, the plans must be resubmitted for review and approval.

1.1.1.6 When construction plans and all other pertinent information has been approved by the District, the approved plans will be retained by the District until a pre-construction meeting is held. The pre-construction meeting will be scheduled by the District upon request of the Contractor, design engineer or Owner/Developer.

Representatives of the Owner/Developer, Contractor, design engineer, District, and/or District Engineer must be in attendance at the pre-construction meeting.

1.1.1.7 Authorization to commence construction will be granted by the District Engineer upon approval of the plans by the District and completion of the pre-construction meeting.

1.2 Sanitary Sewer System Construction Procedures and General Requirements

1.2.1 Construction may commence subsequent to approval of sanitary sewer system construction plans and completion of the pre-construction meeting. The District Observer requires a minimum of 48-hours' notice prior to initiation of construction.

1.2.2 The District will provide observation during construction. Observation of construction assists in quality control and achieving conformance with District specifications.

1.2.3 Observation should in no way be considered a guarantee of the Contractor's work. Construction observation does not relieve the Contractor of his obligation to construct facilities in accordance with the District's specifications, and the approved construction plans.

1.2.4 During construction, no work is allowed to be backfilled, including bedding material above the spring line of the pipe, until construction has been observed and accepted by the District Observer.

1.2.5 All construction work must be accomplished in accordance with District specifications and the approved sanitary sewer system construction plans. Any modifications, field changes, etc. to the approved plans must be approved by the District Observer prior to proceeding with the work.

1.2.6 If construction work is halted for more than three (3) working days, a 48-hour notice must be given to the District Observer prior to restarting construction.

1.2.7 Unless designated on the approved construction plans or approved in the pre-construction meeting, phasing of a construction project will generally not be

allowed. A desire to obtain acceptance and release for sewer taps on only a portion of a construction project designated on the approved plans requires a written approval of the District Engineer. A request for said approval must be submitted in writing and should include a description and drawing of the exact limits of the phased construction.

1.2.8 Owner/Developers are cautioned that all construction is undertaken at their risk. Approval of construction plans does not constitute a guarantee that construction will be accepted by Applewood Sanitation District.

1.2.9 Only acceptance of construction and initiation of warranty maintenance period as designated by the District Engineer's execution of the Application and Agreement for Sanitary Sewer Main Extension shall constitute acceptance of the constructed facilities.

1.2.10 All costs involved with the District's construction observation services are charged to the Owner/Developer.

1.3 Sanitary Sewer System Acceptance Procedures and General Requirements

1.3.1 The following conditions must be met and approved by the District prior to Initial Acceptance of construction and initiation of the warranty period.

1.3.1.1 The sanitary sewer main(s) and all appurtenances have been installed to the satisfaction of the District Engineer, all notes and field measurements have been made, and two full-size (22" X 34" or 24" X 36") prints of the Record Drawings with the As-Built conditions or changes in red and ACAD files have been supplied to, and approved by, the District Engineer.

As-Built/Record Drawings

Contractor/Owner shall verify the location, size, type, class, elevation, condition, updates, and changes in slope of all sanitary sewer pipes, manholes, inverts, and services and show these As-Built conditions on the original drawings/project plans. The Contractor/Owner shall make any other changes or additions to the original drawings to include those improvements outside of public ROW and off-site improvements.

The As-Built redline Drawings and electronics will be revised on the approved project plans to document all changes, revisions and construction conditions and to show all As-Built horizontal locations to within one foot (1') and all vertical elevations to within one tenth of a foot (0.1'). These As-Built redline Drawings shall be finalized as

"Record Drawings" with updates, requested changes, and clarifications, and submitted to the District Engineer for review and approval.

Record Drawings shall note the Contractor Name and date of completion on the cover sheet.

Approval block for As-Built/Record Drawings:

The Record Drawings, shall be reviewed and approved by the responsible professional engineer, licensed in the State of Colorado, namely, the District Engineer prior to submission.

The Approval block shall appear on the cover sheet of each set of drawings.

The revision block of each sheet shall be updated to show the record drawing revision.

If the improvements for a project are constructed in phases, As-built and Record drawings shall be submitted at the completion of each phase.

Submit

Submit one (1) full size paper copy, PDF, and acceptable AutoCAD files.

Initial Acceptance will not be granted until acceptable Record Drawings are received by the District.

1.3.1.2 The sanitary sewer main(s) and trace wire have been successfully tested to the requirements designated in the technical specification section of this standard.

1.3.1.3 All compaction test results required by the District have been submitted and accepted.

1.3.1.3.1 Compaction testing results related to backfilling of sanitary sewer mainline. Testing should be in accordance with applicable ASTM standards and the governing authority. If no governing authority, then testing to be to industry standards. Any compacted areas that do not meet the compaction testing requirements from a

certified geotechnical engineer shall be removed/replaced at no expense to the District.

1.3.1.3.2 Compaction at manholes. Testing should be in accordance with applicable ASTM standards and/or the Governing Authority. The Contractor shall give special emphasis to the backfill against and around all manholes, appurtenances, and structures. Backfill shall be placed in horizontal layers not exceeding 12-inches in depth and shall be adequately moistened and thoroughly hand tamped with air or vibrator plate or jumping jack compactor. This is in conjunction with mechanical compaction operations.

1.3.1.3.3 Settlement related to compaction – mainlines and manholes. Contractor will be responsible for repairing or complete replacement of the deterioration or settlement of the pipe trenches, manhole locations and associated street surfaces. All costs of repairs and all liability, as a result of surface deterioration or settlement, shall be the responsibility of the Contractor. The warranty period shall be extended for the full period for the entire project to cover future settlement deterioration until the Project as a whole shows no signs of settlement deterioration.

1.3.1.4 All sanitary lines shall be jet cleaned and videoed for District observation prior to Initial & Final Acceptance.

1.3.1.5 All easements have been accepted by the District and recorded.

1.3.1.6 Drawings identifying the "as constructed" location of sanitary sewer mains and appurtenances within the boundaries of recorded easements have been submitted and accepted (easement certifications/exhibits). These drawings are in addition to the full-size Record Drawings described in Section 1.3.1.1.

1.3.1.7 The accuracy of the easement certifications must be certified by a registered land surveyor, licensed by the State of Colorado.

1.3.2 Upon District approval of all items listed in Section 1.3.1 above, the Applications and Agreements for Sanitary Sewer Main Extensions will be dated and signed by the District Engineer. Execution of the applications shall constitute District acceptance of the facilities for initial acceptance and initiation of the warranty period.

1.3.3 Initial Acceptance, the maintenance and warranty period shall be as designated in the Applications and Agreements for Sanitary Sewer Main Extensions. The Owner/Developer guarantees all facilities against failure, defects and non-compliance for a period of two years from the date of Initial Acceptance and until Final Acceptance is granted by the District. In addition, the condition and operability of the sanitary sewer system remains the Owner-Developer's responsibility until all facilities have been inspected and accepted by the District.

1.3.4 Maintenance performed by the Contractor during the warranty period consists of observation and routine maintenance of the facilities. All remedial repairs and non-routine maintenance remain the responsibility of the Owner/Developer. Failure of the Owner/Developer to have all repairs carried out when requested by the District shall result in the District conducting the repairs at the Owner/Developer's expense. Repairs are subject to the District review and observation and possible extension of the warranty.

1.3.5 No sanitary sewer taps shall be issued, nor sanitary sewer taps allowed until the Applications and Agreements for Sanitary Sewer Main Extensions have been executed for acceptance of construction.

1.3.6 Final Acceptance and conveyance of the facilities to Applewood Sanitation District shall occur approximately two years after Initial Acceptance. The Owner/Developer is responsible for contacting the District 23 months after the date of Initial Acceptance to schedule a site walk thru and provide current videos of the sanitary sewer line for review by the District. The review of the video will conform to Section 1.3.1.4. Final Acceptance shall be subject to re-inspection of all facilities by the District and correction of any deficiencies by the Owner/Developer. Major repairs are subject to District review for possible extension of warranty period.

1.3.6.1 After proper notice, failure of the Owner/Developer to correct deficiencies found during final observation shall be cause for the District to correct the deficiencies at Owner/Developer expense.

1.4 Responsibilities of the Owner/Developer, Design Engineer, and Construction Contractor

1.3.7 The Owner/Developer is responsible for ensuring that the sanitary sewer system construction plans for large developments are designed to accommodate the sewer service requirements of anticipated development. The District reviews construction plans in order to promote compliance with the minimum standards of the District and does not guarantee the adequacy

of the plans to perform any certain function nor to protect against any specific condition applicable to the proposed construction site.

The Owner/Developer may be required to provide a Best Management Practices (BMP's) Plan. This plan will identify how the facilities handle solid and liquid wastes in adherence to District, Metro Wastewater Reclamation District, and any applicable State and Federal standards and or requirements.

The District does not perform engineering services for the Owner/Developer. It is the responsibility of the Owner/Developer, his Engineer and Contractor to prepare the design and plans, determine the material specifications and soil conditions, and construct the project in accordance with the specifications of the Applewood Sanitation District.

1.3.8 The Contractor shall be responsible for requesting a pre-construction meeting prior to the start of any construction. Representatives of the District Engineer, Owner/Developer, design engineer, governing agency and Contractor must be represented at this meeting.

1.3.9 The Contractor is responsible for notifying the District Engineer at least 48-hours prior to the start of any construction. If work is suspended for any period of time after the initial start-up, the Contractor must notify the District Observer 48-hours prior to re-starting.

1.3.10 The Contractor is responsible for performing construction in accordance with District standards and specifications and any other applicable agencies and the construction plans approved by the District. The Contractor must notify the District Observer of any modifications to the approved plans prior to accomplishing construction contemplated by the modifications. Failure of the Contractor to obtain approval of proposed changes in writing will require that construction be completed in accordance with the originally approved plans.

1.3.11 At all points of connection of new sanitary sewer mains to existing mains, the Contractor will be responsible for excavating and verifying the location of existing mains prior to the installation of new facilities. It is further the responsibility of the Contractor or Owner/Developer to obtain and verify the location of other utilities such as natural gas, electrical, telephone and cable television and fiber optics.

1.3.12 No pipe or appurtenance shall be backfilled, nor covered with bedding material, above the spring line of the pipe prior to observation and acceptance by the District Observer. It is the sole responsibility of the Contractor to assure that all construction is observed before backfilling. Any pipe covered prior to observation shall be excavated by the Contractor to

allow for observation. This shall be accomplished at no expense to the District.

1.3.13 The Owner/Developer shall be responsible for providing repair services to all portions of the construction project during the warranty period. The District reserves the right to perform any cleaning, repairs, or other maintenance, during the warranty period at the expense of the Owner/Developer.

The Owner/Developer shall be responsible for the correct alignment, cleanliness, and operation of all pipelines and manholes during the warranty period. Written notification of deficiencies discovered during this period will be provided by the District Engineer. If the deficiencies are not corrected during the prescribed time limits, the corrections shall be completed by the District at the expense to the Owner/Developer.

1.3.14 The Owner/Developer is responsible for promptly paying all charges associated with the District's plan review and construction observation services. All District costs for plan review and construction observation are charged to the Owner/Developer, as set forth within the Application and Agreement for Extension of Sanitary Sewer Mains.

1.3.15 The Owner/Developer is responsible for adhering to the Fats, Oil and Grease ordinance. Refer to the District Rules and Regulations, Part C, Fats, Oils and Grease (FOG) policy.

1.3.16 No connection to a District owned sanitary sewer main, or approved stub-out, shall be allowed prior to the purchase of a District tap Permit.

1.3.17 Tap permits will not be issued prior to District acceptance of the sewer main to be tapped.

1.3.18 Applewood Sanitation District shall not own nor be responsible for maintenance, repair, or rehabilitation of sanitary sewer service lines including tap fittings on the public sewer main.

1.3.19 Sewer wye fittings shall be used to make connection to the District sewer main. Connection fittings shall be installed during construction of the mainline whenever possible. The actual constructed location of all sewer wyes or tees shall be shown on the As-Built Drawings.

1.3.20 Wherever wye fittings are not used, connections shall be made by mechanical tapping apparatus using a factory-fabricated PVC service saddle.

1.4 General District Forms

- Exhibit A - Application and Agreement for Extension of Sewer Mains
- Exhibit B - Maintenance and Warranty Bond
- Exhibit C - Easement Preparation and Submittal Procedures
- Exhibit D - Funding Agreement

CHAPTER 2

APPLEWOOD SANITATION DISTRICT

SANITARY SEWER SYSTEM TECHNICAL/CONSTRUCTION SPECIFICATIONS

SANITARY SEWER SYSTEM TECHNICAL/CONSTRUCTION SPECIFICATIONS

2.1 Location of Lines and Appurtenances

2.1.1 Sanitary Sewer Mains in Streets

When the sewers are placed in streets, they shall be placed as follows:

All sanitary sewer mains shall be installed in all-weather surfaced dedicated streets of fifty feet (50') minimum width or in rights-of-way of thirty feet (30') minimum width. Rights-of-way of greater than thirty feet (30') width may be required when, in the opinion of the District Engineer, such additional width rights-of-way will enhance the installation, maintenance, repair, and rehabilitation of the sewer mains.

When sanitary sewer mains are placed in public or private roadways, they shall be installed as follows:

2.1.1.1 STREETS RUNNING NORTH AND SOUTH

On streets running north and south, the sanitary sewer line shall be placed ten feet (10') west of the center line of the street

2.1.1.2 STREETS RUNNING EAST AND WEST

On streets running east and west, the sanitary sewer line shall be placed ten feet (10') south of the centerline of the street.

2.1.1.3 STREETS WITH TURNS

On streets shaped as a "U" or on streets having unusually sharp turns, the sewer line will conform to the above specifications as near as is practical, but the final location shall be determined by the Engineer or his representatives. Curvilinear sewer mains shall not be allowed without prior approval of the Engineer. Designs must attempt to minimize the use of manholes.

2.1.1.4 CURB AND GUTTER

In no case shall the sanitary sewer manhole be installed closer than three feet (3') clear to the lip of a concrete pan or gutter and five feet (5') clear for a sanitary sewer line.

2.1.1.5 WATERLINE CLEARANCE

In no case shall the sanitary sewer be installed closer than ten feet (10') clear to the waterline.

2.1.2 Tracer Wire

A 10-gauge, UF rated tracer wire shall be installed on all sanitary sewer mains and services. For services, a test station will be located at the building. For manholes, the tracer wire shall enter the top of the manhole through ½ inch groove in adjustment rings or through a ½ inch hole near the top of the cone, sealed with caulking. 3 feet of wire shall be inside the manhole and will be accessible from the surface.

2.1.3 Pipe – General

No public sewer main shall be less than eight inches (8") in diameter. Private sewer services shall not be less than four inches (4") in diameter. The minimum and maximum slopes for sewer lines shall be as shown in Table I below. The slopes between manholes must be uniform.

Minimum slopes – Sewer mainlines shall be designed to transport average sewage flow at mean velocities of 2.0 feet per second. Sanitary sewers that are designed to carry an average design flow of less than 0.01 cfs shall not be installed at a slope of less than 1.2 %. 0.01 cfs equates to 39 Single-Family detached units and 51 Multi-Family attached units

Table I

Size of Sewer Inches	Minimum Slope Feet per Hundred	Maximum Slope Feet per Hundred
4	2.0	20
6	0.7	10
8	1.0	7.5
10	0.35	6.0
12	0.30	5.0
15	0.25	4.0
18	0.15	3.0
21	0.10	2.0

NOTE: Where it is necessary to design or install sewers with greater slope than the maximum indicated in the preceding table, special provisions shall be made to protect against pipe displacement and erosion. Prior written approval must be obtained from the District Engineer in any case involving such slopes.

2.1.3.1 Design shall consider greater than minimum slopes if utility clearances exceed 18".

2.2 Sanitary Sewer Line Installation, Repair and Rehabilitation

All PVC gravity sanitary sewer service pipe and fittings shall conform to ASTM D3034 gasketed integral bell PVC gravity sewer pipe, SDR 35 at a minimum. Pipe supplied for gravity sewer applications is green in color. All joints should be bell and spigot. PVC pipe shall be straight and shall not be warped and shall be free of cracks, blisters, chips, and fractures.

All fittings and couplings should be PVC gasketed push-on type for SDR35 non-pressure sewer pipe, unless not otherwise on the approved plans.

All joint rubber coupling adaptors should be protected by a manufactured solid guard device for proper pipe alignment and for prevention of joint shear failure. Fernco Strong Back coupling with concrete (3,000 PSI) cradle below coupling required.
Elastomeric pipe joint gaskets should be lubricated, prior to pipe placement with a proper lubricant specified, or supplied, by the pipe manufacturer.

Pipe laying should proceed upgrade with the spigot ends pointing in the direction of the flow. 4" pipe should be laid with a minimum of 2% grade.

The following material deficiencies should be avoided:

Fractures or cracks through the pipe, chips, or fractures on the interior of the pipe, broken and large blisters on pipe or fittings, improper size or dimensions, deformation and warping of the pipe or fittings.

Pipe Bedding and Trench De-Watering:

Trench Gravel: Uniformly graded mineral aggregate should be placed and compacted for a minimum of 6 inches under, alongside and 12" on top of the entire length of installed pipe. Rocky and bedrock conditions will require engineering evaluation.

Stabilization Rock: In the event the trench subgrade is not stable, three fourths an inch to three inch (¾"-3") diameter stabilization rock should be placed below the trench bedding material to make a firm foundation. Sub-stabilization rock and fabric shall be evaluated by a District engineer.

All excavated sewer service trench should be free from ground water. Under no circumstance shall groundwater be allowed to enter the District sewer facility.

Trench Backfill and Compaction:

At locations where any portion of the sewer service trench is within the public street right-of-way, the Contractor must follow the requirements of the street cut permit issued by the governing jurisdiction for trench backfill materials and procedures.

Trench backfill material shall be placed in horizontal lifts of depth no greater than 8-inches, and then compacted to maximum dry density as required by the street cut permit, and as tested in accordance with procedures specified by AASHTO T-99, to a depth no greater than 12-inches below final surface grade level.

Trenchless Sewer Service Pipeline Renovation by Pipe Bursting:

Use of IPS SDR 17, PE4710, ASTMF714, with thermal butt-fusion joints is acceptable.

Trenchless Sewer Service Pipeline Renovation by Pushed-in-Place (PIPL):

Existing, deteriorated, cracked, broken, damaged with holes, root intruded, infiltrated/exfiltrated, joint gaps/separated pipelines shall be rehabilitated by placement of a new liner pipe installed to fit firmly against the existing pipe wall without any appreciable annular space between the inner wall of the existing pipe and the outer wall of the new linear tube.

The District will accept both polyester fiberglass-based and polyester felt-based seamless and jointless cured-in-place liner (CIPL) products of the industry's latest trenchless rehabilitation materials with epoxy resins to create a structurally sound, watertight, stable environment able to withstand the corrosive effect of the existing residential, commercial and industrial effluents, liquids and/or gases. The installed liner tub/pipe shall be fabricated from such materials that will withstand exposure to such substances and in such concentrations that may reasonably be expected to be present in domestic sanitary sewage.

Installation of the liner pipe shall be accomplished entirely by working within the interior of the existing sanitary sewer pipe with access provided only by existing cleanout or an opened service pipe.

After the new liner pipe is properly in place and adequate curing has occurred, the Contractor must examine the service connection into the District sewer main. If any portion of the newly installed liner is protruding into the District main beyond the inside pipe wall surface, the Contractor must diligently correct and remove the protruding liner, so it is flush with the main interior surface.

The correction and removal of the protruding newly installed liner must be accomplished from the interior of the District pipeline by means of a remotely controlled cutting device and monitored by a closed-circuit television camera. All work being performed within the District facilities must be done in accordance with the District rules and regulations, permits and standards, and in the presence of the District's Engineer, representative or District Observer.

2.2.1 Materials

Liner/tube pipe shall be formed of such materials, and be of such installed wall thickness, that the complete existing pipe/liner pipe combination will have properties meeting the minimum requirements of below referenced standards.

- ASTM C581, Standard Practice for Determining Chemical Resistance of Thermosetting Resins used in Glass Fiber Reinforced Structures, Intended for Liquid Service.
- ASTM D543, Test Method for Resistance of Plastic to Chemical Reagents.
- ASTM D790, Test Methods for Flexural Properties of Non-Reinforced and Reinforced Plastic.
- ASTM F1216, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube.
- ASTM F1743-96, Rehabilitation of Existing Pipeline and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermo-setting Resin Pipe.
- ASTM F2019, Standard Practice for Rehabilitation of Existing Pipelines and conduits by Pulled-in-Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermo-setting Resin Pipe.

The cured liner/pipe shall conform to the minimum structural standards as follows:

a. Tensile Stress (ASTM D638) of >3,000 psi
b. Flexural Stress (ASTM D790) of >4,500 psi.
c. Modulus of Elasticity (ASTM D790) of >250,000 psi.
d. Porosity/Water Tightness = zero void (tight).

And be designed for fully deteriorated pipe. The newly installed liner must have a minimum fifty-year service life under continuous loading conditions.

The tube-liner shall be constructed to withstand installation pressure and have sufficient strength to bridge missing pipe while meeting or exceeding the design wall thickness at all pipe locations during installation conditions and pressures.

2.2.2 Work within Public Right-of-Way

Any service line excavation performed within public right-of-way requires a specific right-of-way permit issued by the governing jurisdiction.

2.3 Manhole Size and Construction

2.3.1 General

Manholes shall be installed at distances not greater than four hundred feet (400'). Longer spacing may be permitted with the approval of the District Engineer. Manholes shall be installed at all changes in sewer grade and alignment.

All manholes shall be watertight or waterproof, wet precast concrete sections of minimum 28-day concrete strength of 5,000 psi, using Type II cement and shall comply with ASTM C478. The base of the manhole shall be a minimum 8" thick below the channel. Manholes will require an exterior coating of bituminous waterproofing or approval equal. Manhole structures shall be designed for H-20 traffic loading in accordance with AASHTO Specifications. Cast-in-Place manhole bases are allowed only with prior approval and only when practicable by construction such as the installation to connect to an existing pipeline with a new manhole. Manholes shall be in accordance with the District Details. Dry cast manholes are not allowed. If dry cast manholes are used, they shall be lined with an approved spray liner.

Manholes shall be minimum of forty-eight inches (48") in diameter. Manhole sizing shall be in accordance with the District Details. Whenever more than a two-way manhole of maximum pipe diameter is required, the manhole should be increased to a larger diameter. The top section shall be a concentric cone. Concrete adjustment rings shall be used to match final pavement elevations. 90 degree turns of pipe will require the manhole to be increased to a larger diameter.

Manholes – Minimum Drop – the minimum drop through any proposed manhole is two tenths a foot (0.20') and three tenths a foot (0.30') for perpendicular intersecting or turning lines into the manhole. Variances to this minimum drop requirement will not be allowed, and three tenths a foot (0.30') for perpendicular intersecting or turning lines in to the manhole.

Manhole channel depth shall be the full height of the largest pipe.

Manholes shall be installed at distances not greater than four hundred feet (400').

Where manholes must be extended to finished grade, concrete adjustments or riser rings shall be used. The height of the chimney must not exceed eighteen inch (18") and shall be composed of the largest height combination of rings. No multiple two-inch (2") and three-inch (3") height rings. If adjustment ring height greater than twelve inches (12") is necessary, additional barrel sections must be added. All adjustment rings shall be

embedded in butyl sealant strips and be watertight. Interior joints shall not be grouted.

2.3.2 Precast Manholes

All pipe to manhole connections shall be watertight flexible connections made in cored drilled or cast in place holes with NPC Kor-N-Seal rubber boots, manufactured by Trelleborg Pipe Seals Milford, Inc. or approved equal, meeting all ASTM C923 requirements. For connections to remain flexible, grouting shall follow the manufacturer's recommendations. Prior to installing pipe connection boots, all exposed concrete of the hole shall be coated with the bituminous waterproofing.

Manhole steps shall be copolymer polypropylene plastic with Grade 60 reinforcement or approved equal and aligned straight, not staggered and be centered over a concrete bench.

Precast barrel joints shall be watertight and constructed with butyl sealant strip equaling in three-quarter inch by three-quarter inch (¾" X ¾") as a minimum and continuously placed with no gaps or separations. A twelve inch (12") wide exterior wrap shall be applied to all joints. The interior joints shall not be grouted.

2.3.3 Cast-In-Place Manhole Bases

Manhole base shall be poured-in-place on a minimum 12" thick bed of ¾" to 1 ½" crushed rock as suited for the conditions or as designed. The base of the MH shall be a minimum of 8" below the bottom of the lowest pipe and be steel reinforced per the detail. The minimum 28-day concrete strength shall be 4500 psi using Type II cement.

All inlet and outlet pipes in the base shall have installed on them an approved water stop rubber gasket prior to the concrete pour.

2.3.4 Drop Manholes

Drop manhole concrete base shall be constructed large enough to form a base for the encasing of the exterior piping of the manhole. The bottom entering pipe shall be supported with concrete cradle up to the spring line. The drop piping shall be encased with flow fill.

The maximum amount of vertical drop shall be 6'. All drop manholes exceeding the limit will be reviewed prior to design.

All drop manholes shall be constructed in accordance with the District Detail and approved by the District prior to the final design.

All drop manholes must not exhibit a splashing effect to the walls and bench.

All drop manholes shall be lined with an approved spray liner.

2.3.5 Other Manhole Criteria

All manholes shall be plumb within one-eighth (1/8") per one foot (1').

The Contractor shall give special emphasis to the backfilling and compaction directly against and around manholes (12" horizontal Contact Zone), appurtenances and structures. This backfill shall be placed in 12" thick horizontal layers or depth suited for the hand compaction equipment. Compaction beyond the Contact Zone will be accomplished by mechanical equipment (vibratory and/or rolling equipment) to industry standards and soil report recommendations. Compaction tests will be required to be taken at each manhole, a minimum every vertical foot and a half (18") beyond the Contact Zone at the manhole, alternating each quarter side or as specified by the governing agency.

Manholes shall have a 24-inch cast iron ring (frame) and cover with the word "SEWER" and with a pick hole lifting notch. The standard depth for the ring is 8 inches. Manhole ring and cover shall be three hundred and thirty-eight (338) pounds or greater, conforming to ASTM A48 Class 35B and meet H-20-wheel loading.

Manholes shall have an eighteen inch (18") wide concrete collar two inches (2") below the last adjustment ring, onto the cone. Surface sloped away from cover. This is for field applications six inches (6") wide for landscaped areas.

2.3.6 Manhole Platform

All manholes in excess of eighteen feet (18') in depth shall have an intermediate platform located at the center of the depth, measured from cover to invert. The intermediate platform shall have a grating over manway and shall be in accordance with the District standard manhole details.

2.4 Private Sanitary Sewer Services

Existing Wye, Tee, or Mechanical Tap: New sewer service line pipe must be reconnected into the sewer main at its existing mechanical tap or wye/tee without disturbing the District main. NO ADDITIONAL TAPPING AND/OR WYE/TEE CONNECTION WILL BE ALLOWED. Replacement of taps per prior approval required.

Service line shall be perpendicular to main.

A PVC wye/tee branch fitting must be used for service connection into the sewer main. Wye or tee branches should be inclined upward at an angle of approximately 45° from a horizontal line minimum.

Sewer service riser pipe, the same diameter as the branch, should be installed and extended upward to approximately 10 feet below the ground surface.

Sewer service pipe should be covered and protected with a minimum of 5 feet of backfill materials. In case the pipe has less than 5 feet of cover it should be protected by other means such as concrete encasement, etc.

Sewer service clean out: A 4-inch diameter two-way clean out should be installed at building exterior and one-way cleanout every 100 linear feet of service pipe and/or prior to sharp bends where it may be necessary to provide access to the line for cleaning. Commercial 6-inch branch services and clean outs shall be designed for jet cleaning with clean out facing upstream. Plan location to be reviewed by District prior to construction.

4" private sanitary service lines will not be allowed to connect to manholes. Generally, a 6" and 8" private sanitary service lines shall require a manhole at the connection to the main line. A 6" private sanitary service line can connect to an 8" main line with a PVC WYE or a manhole. Upon review and approval, instead of a manhole, for new 8" PVC construction, an 8" x 6" wye can be used if the invert of the incoming 6" service wye is 0.42' minimum above the 8" main invert and the slope of the service line is greater than 2%. No service line shall connect to the main line closer than five (5') feet from the outside of the manhole.

2.5 Sanitary Sewer Encasement and Casings

Concrete sanitary sewer encasements shall be installed under the following conditions upon engineering evaluation and approval:

Where sewer lines are at a depth too shallow to sustain traffic load or any other load to which they may be subjected.

At locations where lateral forces may cause horizontal movement of the sewer (stream beds for example). Steel pipe casing may be substituted in all cases.

At any location designated by the District Engineer.

All encasements shall conform to the District standard details and shall be of sufficient length to span the condition encountered. Unless specifically designed, encasement shall be for the purpose of pipeline protection and shall not be considered a structural beam. Therefore, special attention to good foundation and subgrade compaction for the encasement must be provided.

Steel pipe casings shall be used where bored crossings are required under rights-of-way. Casing details shall conform to District standard details, and the requirements of any other applicable approving agency.

2.6 Traffic Control

2.6.1 General

The control of vehicular traffic, through the work areas, shall be the sole responsibility of the Contractor and shall adhere to the governing authority.

2.6.2 Traffic Control Devices and Procedures

If no governing authority is available, both vehicular and pedestrian traffic through, and adjacent to, all locations of work activity shall be protected by means of approved control devices in accord with provisions of the Manual on Uniform Traffic Control Devices and Traffic Controls in Construction and Maintenance Work Zones of the U. S. Department of Transportation, Federal Highway Administration, and the requirements of any applicable Right-of-Way permit.

2.7 Excavation, Trench Preparation and Backfill

2.7.1 Preparing for Excavation

The Contractor is required to notify adjacent residents of their work in the area with a door hanger providing the Contractor's contact information and duration of the project.

The Contractor will protect and maintain benchmarks and survey control points from disturbance during construction.

Any existing bituminous or concrete paving shall be neatly scored by saw-cutting and removed prior to the excavation operations.

The Contractor will provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways per the governing authority.

The Contractor will protect existing improvements on the site and adjacent land from damage during construction. The Contractor will restore damaged improvements to their original condition, as acceptable to the Owner of the improvements.

The Contractor shall perform necessary minor clearing and grading along the sewer alignment to facilitate construction and to prevent surface water from entering the excavation.

2.7.2 Protection of Existing Underground Utilities

Prior to any excavation, the Contractor shall request on-site underground utility line location marking from all utility companies.

The Contractor shall take all necessary precautions to protect existing underground utility lines shown on the plans or encountered during construction. The Contractor shall locate, dig out and expose, by hand means if necessary, all underground lines encountered, and these lines shall be adequately supported during backfill operations.

2.7.3 Sewage Bypass

A sanitary sewer bypass plan and description shall be submitted to the District for approval.

Normal sewer flow must be maintained continuously during sewer replacement and construction operations. Sewage shall not be allowed to back up into basements and other low areas and no sewage shall be allowed to leak or otherwise be discharged on to the ground or into any waters of the State of Colorado.

Where necessary, sewage flow shall be transferred around each manhole-to-manhole reach of existing sewer construction by pumping through a temporary pipeline on the ground surface. Temporary pipeline joints and connections shall be watertight.

The Contractor shall maintain continuous observation and supervision of the pumping operation to guard against manhole surcharge at the pump location (that could produce back up into basements) and to guard against pipeline leakage.

At nights, on weekends, or at any other times that the pumping operation might be unattended, the Contractor will return the sewer to gravity flow by making temporary connection of dissimilar pipe materials, which shall be accomplished by use of appropriate adapter couplings. Otherwise full-time bypass pumping and monitoring is required, a 2nd backup pump is required on all bypass pumping operations.

2.7.4 Excavation

Trench excavation shall be made in open cut, through whatever material encountered, to the depth shown on the drawings. The trench walls shall be

kept nearly vertical to a point at least one foot above the top of the pipe and, if required, shall be shored. Trench excavation shall not advance more than fifty feet (50') ahead of pipe laying. Trenches shall be not less than twelve inches (12") and not more than twenty-four inches (24") wider than the outside diameter of the pipe, to a point at least one foot (1') above the top of the pipe and shall provide equal space on each side of the pipe. Excavation for manholes shall be sufficient for the installation of the manhole and outside construction activities.

At locations around unattended excavations, or as determined at the site, temporary fence and protection shall be erected for protection and safety.

2.7.5 Shoring-Trench Safety

Shoring and trench safety, conforming to the requirements of the Occupational Safety Health Authority, shall be employed where necessary for the safety of the workers, and to retain the banks of the trench in a vertical position.

Trench safety is the responsibility of the Contractor.

2.7.6 Excavation Below Normal Grade

At locations where the bottom of the excavation is soft or unstable, and in the opinion of the District Engineer, cannot satisfactorily support the pipe or structure, a greater depth and width shall be excavated and refilled to proper subgrade with stabilization rock to provide a firm foundation for the pipe or structure. The pipe or structure will then be installed in accordance with the standard requirements of other articles and paragraphs of these specifications. Unauthorized and excessive trench or structural excavation depths shall be filled to proper subgrade with stabilization rock per an engineering evaluation.

2.7.7 Dewatering Excavations

Groundwater infiltration of excavations may be expected during construction projects.

If groundwater is present, concrete cut-off walls will be required. Location and frequency per District Engineer.

All excavations shall be kept free from excess groundwater accumulation during construction of sanitary lines and appurtenances.
Excessive groundwater shall be removed from excavations to provide a firm subgrade for installation, of pipe and appurtenances; to allow pipe joints to be made in dry conditions; and to prevent entry of groundwater into the sewer pipeline under construction.

Trench and structure excavation shall be kept free from water accumulation until the installation of pipeline and appurtenances is complete to the extent that no damage from hydrostatic pressure, or unsafe condition will result.

Groundwater discharged from excavations shall be made to an approved location in compliance with water quality control requirements of the receiving entity.

No groundwater may be discharged to any sanitary sewer system or facility under any circumstances.

Dewatering any excavation shall be in accordance to the Governing Agency. The Contractor will obtain a State Dewatering Permit, if required.

Groundwater may require addition of a sub-base of crushed stoned and fabric per the site conditions encountered and evaluation of the engineer.

2.7.8 Access to Private Property

All tools and equipment used in the work shall be stored, and all material excavated or intended for installation shall be stockpiled, so as not to endanger the work and workmen, and in a manner that will avoid obstructing sidewalks and driveways.

The work shall be carried on in a manner that will cause the least possible interference with traffic, the operations of nearby commercial activities and with access to private properties.

2.7.9 Preparation of Trench

The trench shall be dug to a minimum depth of six inches (6") below the required grade for the bottom of the pipe barrel to allow for proper bedding.

At locations where soft yielding trench bottom is encountered, the trench shall be undercut to the extent directed by the Engineer and then backfilled to a point six inches (6") below the pipe barrel with stabilization rock.

2.7.10 Pipe Bedding Installation

Pipe bedding material (trench gravel) shall be placed in the trench to a loose depth and then fine-graded along the pipe centerline to a thickness of six inches (6"). Special precautions shall be taken to remove sufficient bedding material at the point where the pipe bell will fall to ensure a uniform bearing of the pipe barrel throughout its entire length.

After the pipe is properly set and jointed to line and grade, a second loose lift of bedding material, not to exceed six inches (6") in depth, shall be placed along each side of the pipe and then consolidated by tamping or vibration until uniform support under the pipe haunch is obtained. All additional bedding shall be carefully placed to the limits specified and consolidated by a combination of tamping and vibrating. At all times, special precautions shall be taken to prevent displacement or damage to the pipe.

Bedding material shall be thoroughly tamped until bedding material around the pipe is uniformly consolidated.

2.7.11 Removal of Existing Sewer Pipeline and Manholes

Existing sewer pipeline shall be removed as common excavation and disposed of offsite at an approved location.

Where indicated on the plans, existing manholes shall be disassembled and removed for disposal offsite at an approved location. Removed manhole materials shall become the property of the Contractor upon removal from the work site. No existing manhole materials shall be reused in construction of the new sewer facilities.

2.7.12 Concrete Saddle

At locations where the depth of cover above the installed sewer pipe will be less than three feet (3') and at other locations as directed by the District Engineer, a concrete saddle, will be installed as pipe protection.

2.7.13 Trench Backfill

The trench shall be backfilled with bedding gravel and hand tamped up to twelve inches (12") above the top of the pipe promptly after the pipe is laid. Hand-backfilling shall be continued, with suitable native material, over the top of the trench gravel to a depth sufficient to protect the pipe from damage or deflection during the remainder of backfill operations. The remainder of the excavation will be backfilled with suitable native material in layers, not to exceed eight inches (8") in depth.

Native materials excavated from the trench shall be used for backfill. The materials shall be free from vegetable matter, frozen material and other deleterious substances and shall not contain rocks or lumps having a diameter of more than four inches (4"). Backfill material shall be placed in evenly spaced layers and thoroughly mixed to insure uniformity of material in each layer.
At locations where, in the opinion of the District Engineer, native soil excavated from the trench is not suitable for trench backfill, the Contractor will remove the excavated material from the site for disposal at an approved

location, and will import other material, acceptable to the District Engineer, to the site for trench backfill purposes.

Imported trench backfill material will be placed only when so directed by the District Engineer in writing and only to the specific limits set forth by the Engineer.

It shall be the responsibility of the Contractor to adjust the moisture content of trench backfill materials to meet compaction specifications. Adjustment of moisture content of the backfill material shall be accomplished by aeration or by blending excavated soil with water or with drier backfill material, as necessary.

Trench backfill material shall be placed in eight inch (8″) loose and horizontal lifts, then compacted to maximum dry density as required by the street cut permit, and as tested in accord with procedures specified by AASHTO T-99, latest revision, to a depth no greater than twelve inches (12″) below final surface grade level.

2.7.14 Flowable Trench Backfill – Controlled Low Strength Material (CLSM)

Following pipe installation, at locations indicated on the plans, or at locations designated or approved by the District Engineer, the trench will be backfilled with imported, flowable material.

The Contractor will place a minimum of two feet (2′) in depth of well consolidated, cohesive soil material over the pipe bedding to prevent dislocation of the installed pipe alignment by placement of the flowable fill.

Flowable backfill shall be placed in layers not to exceed three feet (3′) in depth. Additional layers shall not be placed until the previous layer has lost sufficient moisture to support foot traffic without more than two inch (2″) indentation.

The exposed surface of each layer shall be protected from freezing or from shrinkage or cracking due to evaporation.

Flowable backfill shall be imported to the work site in ready-mix concrete trucks.

2.7.15 Backfill Material Specifications

Trench gravel (bedding material) structural backfill, stabilization rock and flowable material shall conform to the following requirements:

TRENCH GRAVEL shall consist of well-graded sand and gravel having a maximum size of a three quarter inch (3/4″), and of which not more than

fifteen percent (15%) will pass through a No. 100 sieve, No. 67 gravel is acceptable.

STABILIZATION ROCK shall consist of gravel of uniform size ranging between one and a half inch (1-1/2″) and two inches (2″) in diameter. The material shall be free from organic matter and excessive flat or elongated particles. The Contractor will provide copies of weight tickets for this material to the District Engineer immediately upon delivery of the material to the project site. Stabilization rock will be used only when ordered in writing by the District Engineer.

FLOWABLE BACKFILL (CLSM) CONTROLLED LOW STRENGTH MATERIAL:

The following structural mix shall be used for flowable backfill materials:

Flow Fill Mixing Proportions	
Material	Cement Fly Ash
Course Agg (size 57)	
Sand (ASTM C-33)	Water

Pounds per Cubic Yard
40-50
100 (Min.)
1,700
1,800
As Needed

Or conform to CDOT specifications.

FLOWABLE BACKFILL (FLASH FILL):

At locations where, in the opinion of the Engineer, native soil excavated, flow fill, imported structural fill or any other form of the trench backfill are not suitable for the trench backfill, Contractor will remove the excavated material from the site for disposal at an approved location, and will import Controlled Low Strength Material (CLSM) Flash Fill material approved and acceptable to the District Engineer for trench backfill purposes.

CLSM shall have a minimum strength of thirty (30) psi and the one (1) year compressive strength shall not exceed one hundred and fifty (150) psi. Excavation shall be evaluated on the basis of unconfined compressive strength tested in accordance with ASTM 04832, latest revision.

The following structural mix shall be used for CLSM, flash fill backfill materials:

Flash Fill CLSM Mixing Proportions

Material Pounds per Cubic Yard		
Fly Ash	Cement	Water
1,600 – 2,600		
.80 – 125		
375 – 625		

Flash fill may be used with prior District approval and shall meet CDOT specifications.

STRUCTURAL BACKFILL:

In areas where flowable backfill is not required and the native materials are not suitable for trench backfill, the imported backfill material shall meet CDOT's specifications for Class 1 or Class 2 structural backfill. The materials shall be placed on horizontal lifts of a maximum of eight inches (8") loose, moisture conditioned and then compacted to a maximum dry density as required by the street cut permit, and as tested in accordance with procedures specified by AASHTO T-99, latest revision.

2.7.16 Site Restoration and Clean-Up

The Contractor shall, at all times, keep the construction area free from accumulations of waste materials and rubbish, and upon completion of the work shall leave the work and premises in a sightly condition and, as nearly as practicable, in the same condition as prior to construction.

2.8 Construction of Sanitary Sewer Pipeline

2.8.1 Alignment and Grade

Pipe shall be laid to the line and grade established by the approved plans. Offset stakes will be provided and cuts from these offset stakes to the pipe flow line will be furnished.

After the pipes have been installed and backfill material has been placed and compacted, the pipe between manholes will be examined and as built for vertical and horizontal alignment.

The pipeline shall be constructed to a vertical and horizontal accuracy of 0.025% (0.025-foot deviation per one hundred feet (100') of line).

The stationing shall match the design construction plans.

2.8.2 Method of Alignment

A laser beam alignment device shall be used. An alignment accuracy of 0.025% shall be maintained between all manhole locations.

2.8.3 Laying and Joining Sanitary Sewer Pipe

Pipe laying shall proceed upgrade with the spigot ends pointing in the direction of the flow. Each pipe shall be laid to the line and grade given by the approved plans.

Full lengths of pipe or maximum pipe lengths are to be used to minimize the number of joints. No short lengths of pipes are to be connected along an alignment in lieu of a longer or full length of pipe,

Pipe shall not be laid when the trench condition or weather are not suitable for the proper conduct of such work. When work is not in progress, open ends of the pipe shall be securely closed.

2.8.4 Wye Branches

The Contractor shall place wye branches for service connections into sewer lines where required. Wye branches shall be inclined upward at an angle of approximately sixty degrees (60°) from a horizontal line, unless otherwise directed. The branch opening of each branch shall be closed, before laying, by an appropriate PVC cap/plug.

All service line connections shall be located at the 2 O'clock or 10 O'clock position of the mainline section.

At locations shown on the approved plans, sewer riser pipe, the same diameter as the branch, shall be installed and extended upward to approximately ten feet (10') below the ground surface, or as directed by the District Engineer, and closed with an appropriate stopper.

2.8.5 Sewer Service Line Reconnection

The wye branches shall be extended with an appropriate pipe size extension for approximately ten linear feet (10') to connect to the existing sewer service line.

Service connections to the new line will be made by installation of appropriate branch fittings at the time the new line is installed.

Existing service line locations listed on the plans represent only the opinion of the District Engineer as to the location of service lines. It shall be the

responsibility of the Contractor to locate and expose all existing service lines prior to installing branch fittings.

For connections to an existing PVC main, a PVC tapping saddle with stainless steel straps shall be used. The tap hole into the existing main shall be oval to suit for a clear opening from the wye or tee saddle. For unlined clay (VCP) main, complete sections of the clay pipes are to be replaced with PVC pipe, a wye fitting and StrongBack couplings. For lined clay pipe (CIPP), the service tap shall be core drilled through and a transition piece (Top Hat) installed for a professional smooth transition into the main. The resulting connections to the existing mains shall be videoed by the Contractor for the District review and approval.

2.8.6 Cutoff Walls

Concrete cut off wall shall be installed at manholes and 300ft± spacing on sanitary lines or additional locations as specified on the plans or as directed by the Engineer/District when groundwater is present, to prevent migration of water through the pipe trench bedding.

2.8.7 Testing

After backfill material has been placed in the trench and properly consolidated, the pipe between manholes shall be examined for vertical and horizontal alignment. In case the examination finds defective alignment or construction, the Contractor shall remedy such defect.

2.8.7.1 The sanitary line shall be jet cleaned prior to low pressure air testing.

Each section of constructed sanitary sewer between manholes shall be low-pressure air tested in accordance with ASTM-F1417, latest revision and/or UBPPA-UNI-B-6, latest revision.

2.8.7.1.1 Jet Cleaning and Video Mainlines

All sanitary lines shall be jet cleaned and videoed for District review prior to Initial and Final Acceptance.

Videoing of post construction. Mainlines shall be backfilled prior to videoing. An appropriate amount, 50 gallons, minimum, of water, shall be introduced to the mainline sections before videoing. All mainlines to be videoed should be cleaned and debris shall be caught and removed as a part of this operation. In no circumstances shall material cleaned not be removed by the Contractor and

allowed to travel downstream of the newly installed mainline section(s). Double plugs shall be installed between systems per the District review. Items to be reviewed as part of videoing:

- Consistent grade/slope between manholes – No mainline, especially pipes set at a low slope (<1%) should exhibit any standing water/debris buildup of more than half of an inch (1/2") or related 5% of the pipes cross-sectional area. Any pipe indicating these inconsistencies shall be removed/replaced at no expense to the District.
- All mainline sections shall be seated per manufacturer recommendation and mainline sections from manhole to manhole shall be watertight. All manhole pipe penetration shall be watertight. Any mainlines exhibiting infiltration or material entry shall be removed/replaced at no expense to the District.

2.8.7.1.2 Manholes

All sanitary MHS shall be cleaned, watertight, and vacuum tested prior to Initial Acceptance. Vacuum test shall be performed in accordance with ASTM C1244, latest edition with the exception that backfill will be allowed. At no time up to Final Acceptance shall the manhole leak water.

2.8.8 Sewer Pipe Material

POLYVINYL CHLORIDE (PVC) PIPE: Gravity sewer pipe shall conform to the following specifications for single wall plastic pipe:

a. ASTM 01784, latest revision, Polyvinyl Chloride Compounds

b. ASTM 02412, latest revision, External Loading Properties of Plastic Pipe.

c. ASTM 03034, latest revision, Type PSM-PVC Sewer Pipe and
Fittings with SDR-35 Wall Thickness.
PVC pipe shall be supplied with the coupling integrally molded to the pipe barrel. All joints shall be bell and spigot.

Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint. Solvent-cement joints are strictly prohibited.

Fittings shall be of the O-ring push-on type as required for non-- pressure sewer type. O-ring shall conform to ASTM 01869, latest revision.
Elastomeric pipe joint gaskets shall be lubricated, prior to pipe placement with a proper lubricant specified, or supplied, by the pipe manufacturer.

Each pipe shall be a standard laying length of fourteen feet (14'). Random lengths of pipe shall not be acceptable.

Watertight and flexible coupling of plastic pipe to concrete manhole bases will be accomplished by use of factory fabricated manhole water stop gasket fittings.

2.9 Steel Sewer Casing

2.9.1 General

Where indicated on the plans, the Contractor will place a steel sewer casing by augering or tunneling while hydraulic jacking a steel casing through the excavation to the lines and limits indicated on the drawings.

Prior to performing any fieldwork, the Contractor will submit to the District Engineer for approval, a detailed plan for augering or tunneling the placement of the steel casing.

2.9.2 Casing Placement

While placing the steel casing with hydraulic jacks, spoil material will be removed from the casing by rotating auger or by tunneling procedures.

Contractor must maintain the face of excavation to preclude free flow of soft or unstable soil material.

No excavation shall exceed the outside diameter of the casing by more than half-inch (1/2"). No over-excavation for hand tunneling will be permitted. Excavation shall at no time lead the casing placement. Unsupported excavation ahead of pipe is prohibited.

The use of water or other liquids to facilitate casing placement and spoil removal is prohibited. If voids develop, or if excavation diameter is more than one inch greater than the outside diameter of the casing, cement-grout must be placed to fill the voids.

A bulkhead at the completed excavation face will be placed at any interruption of jacking of the casing.

Joints will be completely welded around the entire circumference between sections of the steel casing with complete penetration of the weld.

Excavation and jacking of the casing shall not interrupt or endanger surface activities.

2.9.3 Casing Alignment

The Contractor will establish and continuously monitor and control alignment and grade of the casing during placement operations.

Horizontal and vertical alignments of the encasing pipe shall not deviate from those stated on the plans by more than the following:

Alignment	Starting Point	End Point
Horizontal	0.02 feet	.70 feet
Vertical	0.02 feet	0.15 feet +/-

2.9.4 Casing Material

Steel casing pipe shall be steel pipe with a minimum yield strength of thirty-five thousand (35,000) psi (ASTM A53 Grade B).

Casing spacers shall be stainless steel metal or approved polymer construction.

All fasteners shall be stainless steel A304 min.

Carrier pipe shall be as specified on the plans and in the specifications

Runners shall be high-density molecular polyethylene or polymer reinforced fiberglass with DURO hardness A of eighty (80) and a minimum dielectric strength of five hundred (500) volts per mil. Runners shall be attached to risers with bolts or welded studs. Bolt holes shall be filled with silicone caulk.

Casing end seals shall be an appropriate size rubber boot at each end of the casing. 1/8" minimum thickness. Large opening spaces (≥8") will require removable steel end plates. Design shall be approved by the District.

2.10 Manhole Construction

2.10.1 General

Sewer pipe at manholes shall be constructed continuously through the manhole where possible, and the concrete base placed under and around the pipe. At locations where there is a change in the grade or alignment of the sewer, or where a branch enters the manhole, the invert shall be hand-shaped to a true semi-circular section, for a full height channel to the largest pipe.

There shall be no rough pipe or concrete edges left and the mortar finish in the bottom of the manhole shall be such that it will not inhibit flow through the manhole.

Manholes shall be constructed of precast concrete manhole material. The cone portion of the manhole shall be oriented concentric over the manhole bench. Manhole steps will be non-staggered.

2.10.2 Concrete Base Manholes

The poured-in-place concrete manhole base shall conform to details and dimensions shown in the drawings.

Concrete shall be composed of Portland cement, fine and coarse aggregate, and water, so proportioned as to produce a dense, workable, mixture of slump appropriate for the placement circumstances but not greater than five inches (5″) and having a minimum compressive strength of four thousand five hundred (4,500) psi after twenty eight (28) days of field curing. The concrete shall be adequately protected from injury due to mechanical means, rapid evaporation, freezing, or heavy rain during the curing period.

2.10.3 Precast Concrete Material

Precast concrete manhole material shall be wet cast with Type II cement and shall conform to the requirements of ASTM C478, latest revision.

Polypropylene encased steel manhole steps shall be non-skid type with provision for anchoring into the wall. The steps shall be positioned approximately twelve inches (12″) apart, but no farther apart than sixteen inches (16″) and shall be non-staggered. Polypropylene encased steel steps shall contain a half-inch (1/2″) diameter steel rod and be encapsulated in copolymer polypropylene plastic, similar and equal to No. PS2-PF steps, manufactured by M.A. Industries, Inc.

Precast concrete manhole material shall be joined to the poured-in- place concrete base and to other precast manhole sections by installation of flexible mastic sealant material. A continuous, even rope of gasket compound, free from gaps, lumps, or overlaps, shall then be placed on the bearing seat. The precast manhole section shall be carefully placed so that an even, continuous bead of joint compound is forced out of the joint as a visual indication of seal continuity.

2.10.4 Ring and Cover

Manhole rings and covers shall be circular, concealed pick-hole, heavy-duty pattern, and shall provide a clear opening of at least twenty-four inches (24") and shall be cast of gray cast iron conforming to ASTM Designation A-48, latest revision.

2.10.5 Altering Existing Manhole

A hole shall be made in the wall or base of the existing manhole, sufficient in size, to provide at least one inch (1") clearance between the manhole material and the outside diameter of the properly aligned and graded pipe. The space between the pipe and the manhole material shall be filled with sand-cement mortar, and hand-rammed, both inside and outside to make the alteration, as shown in the detailed drawings, watertight.

The floor of the manhole shall be shaped by using cement-sand mortar to form an invert from the new pipe into the existing invert. All mortar work inside the manhole shall be left with a smooth, uniform surface.

All manhole alteration work shall be accomplished in a manner that will not injure the existing manhole or other lines into or out of the manhole. Care shall be exercised to prevent debris from getting into the manhole. A suitable device shall be used to catch any mortar or demolition debris from entering existing sewer pipes. Any material that does enter the sewer lines shall be removed immediately by whatever means necessary.

2.10.6 Sand-Cement Mortar

Cement mortar shall be mixed in a watertight container, either by hand or by machine. The mortar shall consist of two (2) parts mortar sand and one (1) part Portland cement or masonry cement. A minimum amount of water, sufficient to make a workable mixture, shall be used and no re- tempering shall be done. Mortar that has partially set shall not be used.

2.10.7 Manhole Construction

Testing – Air vacuum testing of all installed manholes shall be required in accordance with ASTM C 1244. Testing results shall be provided to the District for record purposes.

2.10.8 Visual Inspections of Manholes

Review of the interior of each manhole installed will occur to ensure all entry points are appropriately grouted. Air vacuum testing will be required in accordance with ASTM C 1244. Manholes must be watertight.

If sanitary manholes are dry cast, the manhole shall be required to be lined at the Contractor's expense, with an approved spray-in liner.

2.11 Road Resurfacing and Repair

2.11.1 General

After construction of the new sewer and appurtenances, the Contractor will restore streets, drives and parking areas within the area of construction activity to their pre-construction condition by grading, graveling and/or by sweeping and bituminous or cement concrete patching, as appropriate, in accordance with applicable street cut permits or property Owner requirements.

2.11.2 Surface Grades

Unless specifically shown otherwise on the plans, or otherwise directed by the District Engineer, the ground surface shall be restored to original grades and contours following construction of the sewer and appurtenances.

2.11.3 Gravel Resurfacing

Following backfill compaction and fine grading, select gravel material (road base gravel) will be spread and compacted to a depth of eight inches (8″), unless otherwise specified by road-cut permit or property Owner requirement.

2.11.4 Pavement Restoration

The Contractor will clean the existing pavement surface by brooming for the full width to be treated, of all soil, gravel, dust, and other objectionable matter. The Contractor will then square the shoulders of the excavation, and areas of pavement damaged by the Contractor's operations, to limits established by the Street Cut Permit or by the property Owner. If shoulders that were scored prior to excavation have become broken or rounded, the Contractor shall re-cut them. Edges shall be squared by cutting the pavement vertically with a saw, or by other approved means that will result in a neat, true cut. Excess soil will be removed to depth below the existing pavement surface that will accommodate the required depth of patch and the subgrade surface compacted with a vibrating compactor.

Paving material, as specified by the street cut permit, or by the property Owner, shall be placed only when the base is dry and when weather conditions are suitable. Vehicular traffic will not be allowed over the patch area until the surfacing material has cured sufficiently to avoid damage or tracking.

2.12 Required Manhole Entry Procedures

Approval to access manholes must be obtained from District prior to accessing manhole. All applicable OSHA standards are to be followed when accessing manholes.

2.12.1 Hazardous Confined Workspace

All sanitary sewer manholes within the Applewood Sanitation District system of facilities are non-ventilated confined spaces in which the normal atmosphere may be unsafe because of depletion of oxygen or because of the presence of toxic or flammable gases. Workers may fall while entering or exiting manholes because of slippery surfaces.

2.12.2 Required Manhole Entry Procedures

Required manhole entry procedures will be fully communicated to all of those persons actually participating in the entry prior to entry activities and all pre-entry and entry activities shall conform to the requirements.

A copy of the entry procedures shall be present on the site for reference by entry participants during all entry activities.

All of the following procedures will be followed prior to, and during, entry to any manhole, made under any circumstances for any reason whatsoever:

A. Locate the manhole to be entered. Put on a hard hat and other personal safety devices as appropriate and required. Observe the surrounding area as to surface conditions and general traffic flow.

B. If the manhole is located within the right-of-way of a public street or highway, set up traffic control devices and proper signage in accordance with requirements of the Manual on Uniform Traffic Control Devices for Street and Highway Construction and Maintenance Operations of the U.S. Department of Transportation, Federal Highway Administration or with the specific requirements of any applicable Right-of-Way permit.

C. Remove the manhole cover by use of appropriate tools and proper techniques. Place the removed manhole lid away from active traffic lanes.

D. A person remaining on the ground surface will maintain a written log of circumstances associated with, and occurring during, the

manhole entry. The log will record the following minimum information:

1. Date
2. Manhole Number and Location
3. Time of Entry
4. Purpose of Entry
5. Names of Persons Participating in the Entry
6. A record of all atmospheric gas readings taken preparatory to manhole entry and during the time any worker is within the manhole
7. Pertinent remarks regarding the condition of the manhole, changes in water levels within the manhole, or other matters related to manhole safety

E. Ventilate the manhole a minimum of five (5) minutes by use of power- driven mechanical ventilating equipment manufactured for the purpose.

F. Lower an atmospheric gas detection device (or its remote sensing unit) into the manhole and test the atmosphere at several levels for oxygen content, lower explosive limit (LEL) and Hydrogen Sulfide (H2S). The limits for these gases are as follows:

Oxygen (O2) - not less than 19.5%
LEL - not more than 5%
H2S - not more than 10 ppm

Or the latest OSHA standards

If any reading exceeds these limits, do **NOT** enter the manhole**.** Continue to ventilate the manhole for at least five (5) minutes, or as necessary to bring the atmosphere into compliance with the above stated limits**.** If the gas meter continues to detect a hazardous atmosphere, **DO NOT ENTER THE MANHOLE.** Report the condition to the District Engineer.

G. Atmospheric testing with the gas detector shall be ongoing while the manhole is occupied.

H. Entry requires the use of a full body retrieval harness, retrieval line and adequate lifting capacity. Adequate lifting capacity requires the use of a mechanical lifting device or two persons outside the manhole opening, available to pull the confined space worker out manually with the attached retrieval line.

I. At least one (1) standby person on the ground surface shall remain in constant contact with the person inside the manhole and shall attend the attached retrieval line. Tension should be applied to the retrieval line, by the person attending the retrieval line, during entry and exit operations to help prevent falls.

J. All tools and small equipment shall be lowered and raised from the manhole using an appropriate bucket or tool bag, and lanyard.

K. With changing conditions inside the manhole such as an increase in water level, alarm of atmospheric tester, light-headedness of the worker, etc., the worker shall exit the manhole IMMEDIATELY.

L. In the event of an emergency where the worker inside the manhole becomes injured or immobilized and cannot exit without assistance, the person on the surface should do everything possible to remove the injured worker without endangering the life of the worker or the lives of others. If an immobilized worker within the manhole cannot be removed, persons remaining on the surface will NOT enter the manhole themselves.

   Emergency medical and rescue services shall be requested, immediately, by calling 911 or by contacting local fire or police authorities.

   The circumstances surrounding any accident or injury to a worker participating in a manhole entry shall be reported to the District Engineer as soon as practical.

2.13 Trenchless Sewer Pipe Point Repair

2.13.1 General

Existing, deteriorated sanitary sewer pipeline may be improved by placement of new liner pipe installed to fit firmly against the existing pipe wall with no appreciable annular space between the inner wall of the existing pipe and the outer wall of the new pipe. Installation of the liner pipe shall be accomplished entirely by working within the interior of the existing sewer pipe, with access provided only by existing sewer manholes. Existing lateral sewer service lines will be reopened from within the new liner pipe by use of a video controlled robotic cutting tool. The liner is to be designed for fully deteriorated pipe.

2.13.2 Materials

Liner pipe shall be formed of such materials, and be of such installed wall thickness, that the complete existing- pipe/liner-pipe combination will have properties meeting the minimum requirements of ASTM D2412, D790, D5813, F1216, F1743 and other ASTM standards, latest revisions, that apply to materials, procedures and methods for cured-in-place pipe.

The installed liner pipe shall be fabricated from materials that will withstand exposure to such substances and in such concentrations that may reasonably be expected to be present in domestic sanitary sewage.

Where the material composition of the liner pipe is of a proprietary nature, the pipe materials furnished shall meet all applicable requirements of the process lining entity.

2.13.3 Procedures

Access to sewer: Prior to the Contractor's onsite activity, the Owner will verify that existing manholes on the sewer to be renovated are exposed and reasonably accessible.

2.13.4 Cleaning Existing Sewer

The Contractor will remove all debris, roots and other deposits that would hinder the proper installation of the new pipe liner, by use of high-pressure hydraulic jet cleaning apparatus.

2.13.5 Bypassing of Sewage Flow

The Contractor shall provide for the flow of sewage around the section of sewer in which the liner pipe is to be installed. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent sanitary sewer system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Under certain circumstances, approval may be granted by the Owner, for part, or all, of the installation to be carried out with some flow in the existing pipe.

2.13.6 Initial Acceptance

The section of existing pipe to be renovated shall be inspected by means of CCTV, and video recorded. During the video, water will be run at a constant rate. The location of all lateral connections, obstructions, and discontinuities of the existing pipe will be noted for the line pipe installation and service line reconnection phases. A DVD or flash drive and written log of the initial

observation shall be made and delivered to the District Engineer upon completion of the project.

2.13.7 Line Obstructions

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of the liner pipe. If the initial observation reveals an obstruction, such as a protruding service connection, dropped joint, or a collapse that will prevent the installation process, and it cannot be removed by conventional sewer cleaning equipment, then the Owner will arrange for a point repair excavation to uncover and remove or repair the obstruction. Such point repair shall be considered as a separate pay item as provided by a Change Order or by a separate contract, at the discretion of the Owner.

2.13.8 Installation of Cured-in-Place Liner Pipe (CIPP)

The Contractor shall designate a location where the liner tube will be impregnated within resin materials. This procedure may be conducted in a warehouse facility or on the job. The Contractor will allow the Owner and the District Engineer to inspect the materials and impregnation procedures. The quantities of thermosetting materials shall conform to the minimum requirements of the process licensing entity and the quantities shall provide the necessary liner pipe wall thickness.

The impregnated liner tube shall be installed and positioned within the existing sewer pipe in accordance with standards of the process patent holder.

The finished liner pipe shall be continuous over the entire length of a run between two (2), or more, manholes and shall be free as practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination.

If due to broken or misaligned existing sewer pipe at the manhole wall, the line tube fails to make a tight seal, the Contractor shall apply a seal at that point, with a material compatible with the liner pipe material.

2.13.9 Reopening of Service Connection

After the new liner pipe is properly in place and adequate curing has occurred, the Contractor shall reopen/restore the existing active service connections. This shall be accomplished from the interior of the pipeline by means of a remotely controlled cutting device, monitored by a closed-circuit television

camera that re-establishes them to not less than ninety-eight percent (98%) capacity.

2.13.10 Final Acceptance

When the Contractor has completed all fieldwork, and before Final Acceptance of the work by the Owner, the Contractor will provide the District Engineer with a DVD or flash drive and written log showing final conditions of the renovated sewer pipelines.

CHAPTER 3

APPLEWOOD SANITATION DISTRICT

SANITARY SEWER SYSTEM DETAILS

SANITARY SEWER SYSTEM DETAILS

DRAWING	TITLE
1-3	General Sanitary Sewer Notes
4	Typical Trench Section Pipe Protection
5	Concrete Pipe Saddle
6	Concrete Sewer Encasement
7	Metallic Detection Tape
8	Steel Marker Post
9	Sanitary Sewer Bore Casing
10	Bulkhead Construction
11	Sanitary Sewer Wye Less Than 12’
12	Sanitary Sewer Wye Greater Than 12’
13	Sanitary Sewer Manhole (CIP Base)
14	Sanitary Sewer Manhole (Precast Base)
15	Confined Space Safety Tag
16	Standard Drop Manhole
17	Manhole Base and Deflector
18	Manhole Platform
19	Manhole Ring and Cover with Lift Slot
20	Clean-Out
21	Sewer Tapping
22	Stormline Crossing Pipe Support Construction
23	Monitoring Manhole
24	Grease Interceptor
25	Engineering Approval Block

CHAPTER 4

APPLEWOOD SANITATION DISTRICT

GENERAL DISTRICT FORMS