

SOUTHGATE SANITATION DISTRICT SANITARY SEWER SYSTEM SPECIFICATIONS



June 2016

Southgate Water and Sanitation Districts
3722 East Orchard Road
Centennial, CO 80121
(303) 779-0261

www.southgatedistricts.org

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SANITARY SEWER SYSTEM SPECIFICATIONS**

ARAPAHOE AND DOUGLAS COUNTIES, COLORADO

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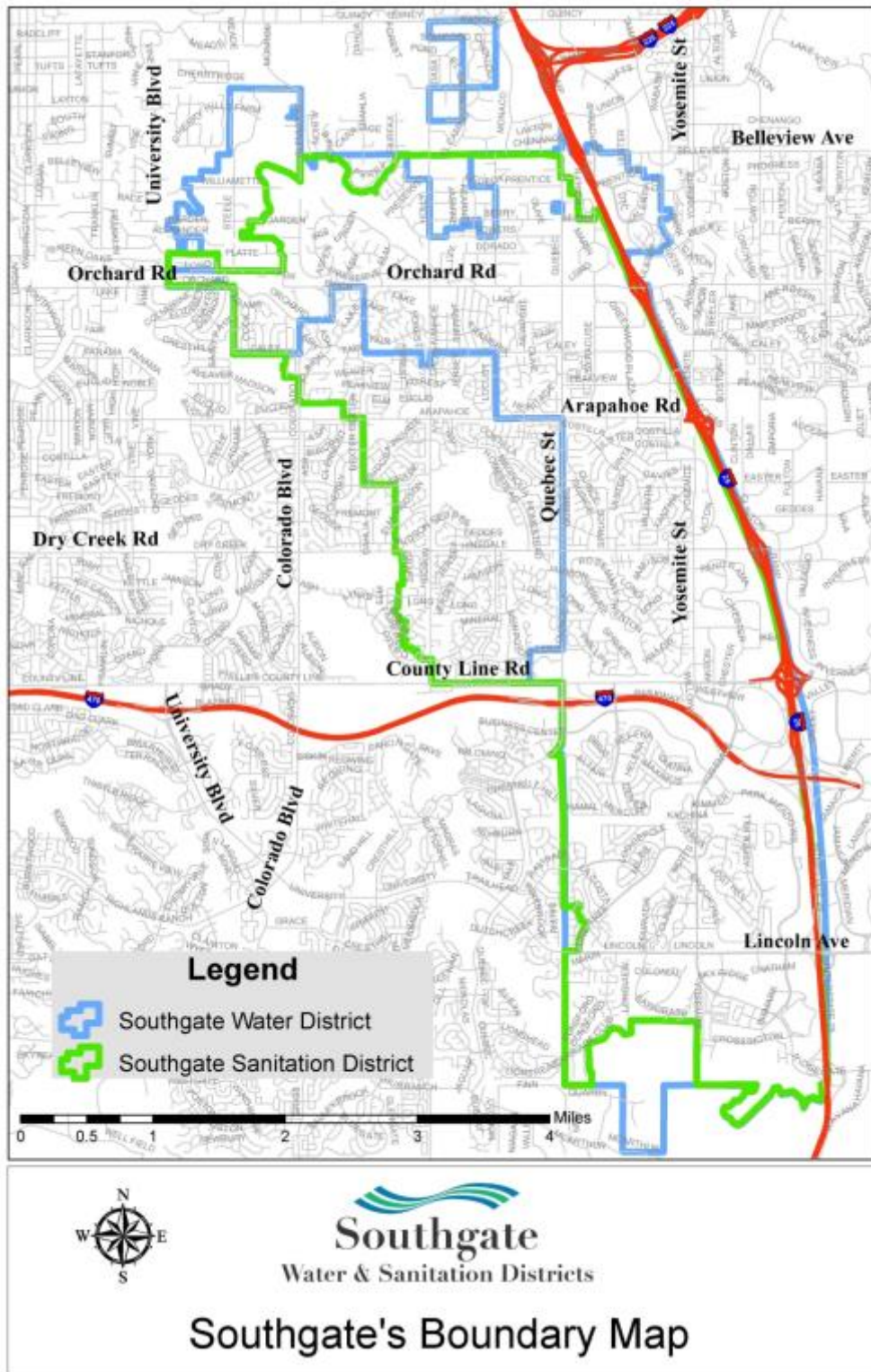
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SERVICE AREA



SECTION 1 – GENERAL

1.1. PURPOSE

These specifications set forth District regulations, engineering, design, materials specifications and construction procedures for all sewer facilities intended to become a part of the District System, and for privately owned sewer facilities connected thereto, to the extent regulated hereby. These Specifications are available for review or download free of charge from the District's website www.southgatedistricts.org.

All sanitary sewer systems shall comply with the requirements of these *Sanitary Sewer System Specifications* and may include special criteria established by the District. Special criteria shall be outlined at pre-design meetings and during the review process, as determined necessary by the District.

1.2. DISTRICT SERVICE AREA

The Southgate Sanitation District Service Area consists of approximately 10,200 acres located in both Douglas and Arapahoe Counties, Colorado. Generally, the District is located south of Belleview Avenue and west of Interstate Highway I-25. The District's Service Area is more particularly shown on the District Service Area Map found on the preceding page.

1.3. AUTHORITY

These Specifications shall be administered by the District, and all matters involving the interpretation and enforcement hereof shall be finally determined by the District.

1.4. REVISIONS

These Specifications are effective as of June 2016. Revisions to these Specifications may be made from time-to-time by the District and shall be in effect at the date of issuance by the District. Any person using these Specifications should contact the District for information relative to revisions.

1.5. DEFINITION OF TERMS

As used in these Specifications and the District Rules and Regulations, unless the context clearly indicates otherwise, the words defined below shall have the respective meanings set forth for them:

1.5.1. ACTUAL COSTS

Actual Costs comprise all direct and indirect costs attributable to any project or undertaking. Actual costs to the District shall include its engineering, legal, labor, material, equipment, administrative, and overhead expenses, calculated in accordance with the rates set forth in the [Rules and Regulations](#), and all direct payments to third parties, at cost.

1.5.2. BOARD OR BOARD OF DIRECTORS

The duly constituted Board of Directors of the District.

1.5.3. CONTRACTOR

Any person who performs any work, either for himself or another, on any sewer facilities, public or private, within the District, including all subcontractors, agents, employees, officers and other representatives of such person.

1.5.4. CONSTRUCTION PLANS

Plans and Specifications for the construction of a specific sanitary sewer system project which have been reviewed and signed by the District.

1.5.5. DISTRICT

The Southgate Sanitation District, Arapahoe and Douglas Counties, Colorado, its employees, agents, officers, directors, insurers, and professional consultants.

1.5.6. DISTRICT ENGINEER

The District's Staff Engineer.

1.5.7. DISTRICT MANAGER

The Manager of the Southgate Sanitation District appointed by the Board of Directors, or any other person duly authorized to perform the duties of the District Manager.

1.5.8. DISTRICT SYSTEM

Facilities, systems, assets, and appurtenant property rights owned or directly controlled by the District, but excluding all privately-owned sanitary sewer facilities.

1.5.9. ENGLEWOOD

The City of Englewood, Colorado, for itself and as operator and co-owner of the Littleton/Englewood Wastewater Treatment Plant.

1.5.10. FOREIGN MATERIALS

Objects or substances not appropriate for transmission by a sanitary sewage system, including, without limitation, paving or construction materials, debris, diapers, rags, wipes (whether marketed as flushable or non-flushable), mechanical parts, metals, furniture, clothing, , rocks, dirt, trash, grease, oil, sand, and grass, bush, or tree clippings, or any other item or material as prohibited by the Littleton/Englewood Wastewater Treatment Plant.

1.5.11. MAIN OR SEWER MAIN

Those pipes and appurtenant facilities used for carrying wastewater along public streets or easements or rights of way deeded or licensed to the District.

1.5.12. MAIN EXTENSION

The construction of any facilities, or the facilities themselves, which are intended to become a part of the District System upon acceptance by the District in accordance with Article 6 of the [Rules and Regulations](#).

1.5.13. PERMITTED PREMISES

The land area and improvements thereto to which sewer service is limited under any particular Tap/Service Connection Permit.

1.5.14. PERSON

Associations, corporations, firms, partnerships and bodies politic and corporate, as well as individuals.

1.5.15. PROPERTY OWNER/OWNER/DEVELOPER

All of these terms shall be synonymous with each other and shall mean any person who, whether solely or with others, owns real property within the District. When property is owned by more than one person, the term includes all owners thereof. As used in these Specifications, the term shall apply to such person only in connection with their ownership of any specific parcel of real property involved in any specific matter governed by these Specifications or Rules and Regulations.

1.5.16. RECORD OR AS-BUILT DRAWINGS

A separate set of full-scale construction plans marked to indicate completely and accurately the field-installed condition of facility construction as completed, as required by 3.11 of these Specifications.

1.5.17. RULES AND REGULATIONS

The comprehensive set of operating rules and requirements, as now or hereafter constituted, adopted by the Board of Directors for the purpose of regulating the design, construction, operation, maintenance, use, repair and replacement of the District System.

1.5.18. SERVICE LINES

Any sewer lines or portions thereof located upstream from the upstream end of the wye or saddle fitting on the District's Main, and intended or used to convey wastewater from Permitted Premises to the District System. Service lines are owned, operated, and maintained by the property owner.

1.5.19. SEWAGE

See Wastewater paragraph 1.5.24.

1.5.20. SWIMMING POOL DISCHARGE

Wastewater from any swimming pool carried by the District System, including swimming pool filter backwash effluent and water drained directly from the swimming pool itself.

1.5.21. TAP/SERVICE CONNECTION

The physical connection to a District Main which, together with the Tap/Service Connection Permit for same, effects sewer service to any Permitted Premises.

1.5.22. TAP/SERVICE CONNECTION PERMIT

The written authority to make a connection for sewer service to Permitted Premises from the District System.

1.5.23. USER

Any person who discharges or causes the discharge of wastewater to the District System.

1.5.24. WASTEWATER OR SEWAGE

The combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants and institutions, including polluted cooling water.

1.5.25. SANITARY WASTEWATER

The combination of liquid and water-carried wastes discharged from toilet and other sanitary plumbing facilities.

1.5.26. INDUSTRIAL WASTEWATER

The combination of liquid and water-carried wastes discharged from any industrial establishment and resulting from any trade process carried-on in that establishment, including the wastewater from pre-treatment facilities and polluted cooling water.

1.5.27. WASTEWATER UTILITY ORDINANCE

Chapter 2, Title 12 of the [City of Englewood Municipal Code](#).

1.6. STANDARDS AND SPECIFICATIONS

These Specifications utilize and otherwise make reference to other Standards and Specifications. Where these references are made, they shall refer to the latest edition or revision thereof.

| | |
|--------|--------------------------------------------------------------------|
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI | American Concrete Institute |
| AISC | American Institute of Steel Construction, Inc. |
| ANSI | American National Standards Institute, Inc. |
| ASA | American Standards Association |
| ASTM | American Society of Testing Materials |
| ASCE | American Society of Civil Engineers |
| AWWA | American Water Works Association |
| OSHA | Occupational Safety Health Administration |
| UL | Underwriter's Laboratories |
| UNI | Uni-Bell Association |
| UPC | Uniform Plumbing Code |

1.7. ABBREVIATIONS

| | |
|---------------|-------------------------------------------------------|
| BMP | Best Management Practices |
| CLSM | Controlled Low Strength Material |
| FPS | Feet Per Second |
| FOG | Fats, Oils, and Grease |
| GGI | Gravity Grease Interceptor |
| SOI | Sand/Oil Interceptor |
| GPD | Gallons Per Day |
| GPD/SF | Gallons Per Day Per Square Feet Developed Floor Space |
| L/E WWTP | Littleton/Englewood Wastewater Treatment Plant |
| N/A | Not Applicable |
| PF | Peaking Factor, or Peak Hour Factor |
| POGS | Petroleum Oil, Grease and Sand |
| PVC | Polyvinyl Chloride Pipe |
| SF | Square Feet Developed Floor Area |
| Single-Family | Detached Single-Family Residential Dwelling (Owned) |
| Multi-Family | Attached Single-Family Residential Dwelling (Rented) |
| Townhome | Attached Single-Family Residential Dwelling (Owned) |

SECTION 2 - SANITARY SEWER DESIGN CRITERIA

2.1. GENERAL

All sanitary sewer lines and manholes (District owned and privately owned), service connections, and related public facilities within the Southgate Sanitation District shall be designed in accordance with these Specifications. Any deviation from these Specifications shall require written permission from the District, prior to design or construction. Design of all sanitary sewer system construction plans shall be performed under the direct supervision of a Professional Engineer, registered in the State of Colorado. The intent is to provide a consistently designed, long-term, reliable system which can be easily located and maintained by the District.

2.2. PLAN REQUIREMENTS

Construction plans for sanitary sewer system shall meet the guidelines set forth in the Sanitary Sewer System Plan Requirements Check List and General Notes for Sanitary Sewer System Plans found in APPENDIX A, APPENDIX B, and APPENDIX B. The check list and general notes are guidelines and as such, some items may not be applicable to all projects as determined by the District.

2.3. FLOW DEVELOPMENT CRITERIA

Sanitary sewer lines shall be designed to transport average and peak sewage flows in accordance with these Specifications. Average and peak flow development criteria presented below and in Table 2.1 are minimum criteria, and the District reserves the right to modify flow criteria, at any time, for the design of specific projects. Flow development criteria for proposed uses not shown in Table 2.1 shall be determined by the District on a case-by-case basis using generally accepted planning criteria.

The relationship of the peak flow to average flow is given below. Peak flow along with maximum infiltration, shall determine the hydraulic capacity of sewers in all cases

$$\text{Peak Flow} = (\text{Avg. Flow} \times \text{Peaking Factor}) + \text{Infiltration/Inflow} \quad (\text{flow units in cfs})$$

Infiltration/Inflow (I+I) is estimated to be ten percent (10%) of the Average Flow

Peaking Factor (PF) shall be determined using Equation 1 below from the Denver Regional Council of Governments (DRCOG). In no cases shall the Peaking Factor be less than 2.0 or greater than 4.0.

$$\text{Equation 1: } PF = 2.6 * Q_{AVG}^{(-0.16)}$$

Where:

$$Q_{PEAK} = 2.6 * Q_{avg}^{(0.84)}$$

Q_{AVG} = Average Sanitary Sewer Flow in cfs

Q_{PEAK} = Peak Sanitary Sewer Flow in cfs

| Table 2.1 – Flow Development Criteria | |
|---------------------------------------------------------------|----------------------------------|
| Use | Average Daily Sewage Flow |
| <i>Multi-Family</i> | |
| 1-Bedroom or less than 900 SF | 100 GPD/Unit |
| 2-Bedroom or less than 1400 SF | 155 GPD/Unit |
| 3-Bedroom or less than 1800 SF | 220 GPD/Unit |
| 1800 SF or greater | 255 GPD/Unit |
| <i>Commercial</i> | |
| Office Building | 0.1 GPD/SF |
| Restaurants | 25 GPD/Seat |
| Bars & Lounges | 15 GPD/Seat |
| Hotels & Motels | 140 GPD/Room |
| Neighborhood Stores | 0.15 GPD/SF |
| Department Stores | 0.15 GPD/SF |
| Laundries & Dry Cleaning | 400 GPD/Machine |
| Banks & Financial Buildings | 0.1 GPD/SF |
| Medical Buildings & Clinics | 0.3 GPD/SF |
| Warehouses | 0.05 GPD/SF |
| Meat & Food Processing Plants | 2.8 GPD/SF |
| Car Washes | 540 GPD/Bay |
| Service/Gas Stations | 100 GPD/Plumbing Fixture |
| Auto Dealer, Repair & Service | 0.15 GPD/SF |
| Super Market | 0.2 GPD/SF |
| Trade Businesses (Plumbers, Exterminators, etc.) | 0.2 GPD/SF |
| Places of Assembly (Churches, Libraries, Theaters, etc.) | 5.0 GPD/Seat |
| Schools | 15 GPD/Student |
| Factories (Manufacturing raw products into finished products) | 0.8 GPD/SF |
| Hospitals | 450 GPD/Bed |
| Other, non-identified commercial uses | Determined by the District |

2.4. SANITARY SEWER SYSTEM HYDRAULIC DESIGN CRITERIA

2.4.1. GENERAL

The sanitary sewer system shall be designed to transport average and peak sewage flows in accordance with these Specifications, and shall prevent deposition of suspended materials within the system.

2.4.2. SANITARY SEWER MAIN LINES

No public sanitary sewer line (main) shall be smaller than eight (8) inches in diameter. Sanitary sewer mains shall be designed to provide peak flow velocities between two (2) feet per second (fps) minimum and ten (10) feet per second (fps) maximum using Manning's Formula as follows:

$$V = \frac{1.49}{n} R^{2/3} \sqrt{S}$$

Where: V = Flow Velocity (ft/sec)
 R = Hydraulic radius (ft), determined by dividing the flow area by the wetted perimeter.
 S = Slope (ft/ft) of the energy grade line, which is approximately equal to the sanitary sewer line design slope.
 n = Manning's Pipe Roughness Coefficient = 0.013

A Manning's Coefficient of 0.013 shall be used for all design calculations, regardless of pipe type and diameter.

The maximum design flow depth at peak flow shall not exceed 83% of the internal pipe diameter (i.e. d/D = 0.83, ratio flow depth to internal pipe diameter).

Hydraulic characteristics shall be calculated for each reach of the sanitary sewer system to show conformance with these Specifications and shall be shown on construction plans. Table 2.2 outlines minimum and generally acceptable minimum and maximum slopes for sanitary sewer lines as follows.

| Table 2.2 – Generally Accepted Slopes | | |
|---------------------------------------|-------------------|--------------------------------|
| Nominal Pipe Diameter (inches) | Minimum Slope (%) | Maximum Slope (d/D = 0.83) (%) |
| 4 (Service) | 2.0 | 12.0 |
| 6 (Service) | 1.0 | 10.0 |
| 8 | 0.50 | 10.0 |
| 10 | 0.35 | 6.0 |
| 12 | 0.25 | 4.0 |
| 15 | 0.20 | 3.0 |
| 18 | 0.20 | 2.2 |

Slopes for sewer services (4 and 6-inch) within dedicated easements and right-of-way shall conform to the values shown in Table 2.2. Service lines located outside these areas shall be per the Owner/Owner's Engineer.

Maximum slopes are based on d/D = 0.83. As flow depth decreases, the allowable maximum slope may also increase, as long as velocities do not exceed 10 fps. The minimum slopes indicated are absolute minimums.

All dead end sanitary sewer lines (i.e. cul-de-sacs) shall have a minimum slope of one percent (1%).

Construction plans shall develop and show average flows, peak flows, and other information at all points of connection to the existing sanitary sewer system as follows:

Q_{PEAK} Peak Sanitary Sewer Flow
 Q_{AVG} Average Sanitary Sewer Flow

| | |
|--------------|---------------------------------------------------------------------------------------|
| V_{PEAK} | Peak Flow Velocity |
| V_{AVG} | Average Flow Velocity |
| d_{PEAK} | Peak Flow Depth in Line at Point of Connection |
| d_{AVG} | Average Flow Depth in Line at Point of Connection |
| d/D_{PEAK} | Ratio of Peak Flow Depth to Inside Pipe Diameter |
| S | Slope of sanitary sewer line |
| n | Manning's "n" = 0.013 |
| PF | Peak Factor per Equation 1 |
| Development | Number and type of total ultimate planned units tributary to the point of connection. |

Sanitary sewer system layout shall provide a system of lines which generally increase in diameter from higher to lower areas within the basin. Once a line size is increased at any point in the system, it shall not be reduced in size at any downstream location, regardless of available line slope.

2.4.3. MANHOLES

Manholes shall be designed to promote smooth, continuous flow between adjacent reaches of sanitary sewer lines. The minimum inside drop from the lowest pipe invert upstream (in) and the pipe invert downstream (out) shall be 0.2 feet. The maximum inside drop from upstream invert to downstream invert shall be twelve (12) inches.

Where manholes are designed to collect flows from two or more incoming lines, the pipe crowns of the incoming lines shall match in elevation. Thus, larger incoming pipes will have a lower invert elevation than smaller incoming pipes. Minimum and maximum drop through the manhole will be as specified above as compared to the largest incoming pipe invert.

2.5. SANITARY SEWER SYSTEM LOCATION AND ALIGNMENT

2.5.1. GENERAL ALIGNMENT REQUIREMENTS

Design shall attempt to minimize the numbers of manholes. In no case shall the sewer line be designed closer than five (5) feet to the lip of a cross pan, or gutter, or ten (10) feet to any right-of-way line, or easement boundary. Curvilinear sewer mains are not allowed on a case-by-case basis with written consent by the District Engineer.

The District will not permit construction of a project until all plats, easements, and rights-of-way to be dedicated that are related to the project are fully signed and recorded by the appropriate County.

2.5.2. GENERAL LOCATION IN STREETS

Where sanitary sewers are located in the street right-of-way, of which shall be a minimum of 30-feet, they shall be designed to the following guidelines.

1. In streets running generally north and south, the sewer line shall be placed ten (10) feet west of the street centerline.
2. In streets running generally east and west, the sewer line shall be placed ten (10) feet south of the street centerline.

3. In streets which "meander" in each direction, the sewer line will conform to the above Specifications as near as is practical, but shall not "zig-zag" across the street centerline. A location shall be selected and shall be followed within the street. The final location shall be as determined by the District during plan review.

2.5.3. GENERAL LOCATION IN EASEMENTS

Where sanitary sewer lines are proposed in easements, they shall be designed within the easement boundary to the following minimum requirements.

1. Sanitary sewer easements shall be a minimum of thirty (30) feet wide with a surfaced roadway or a minimum of fifty (50) wide in undeveloped areas and shall have legal descriptions and drawings prepared in accordance with these Specifications. Easement widths are subject to review by the District.
2. In no case shall the sewer line be designed closer than ten (10) feet to any easement boundary.
3. When selecting the location of utility lines within an easement, consideration shall be given to excavation, maintenance, and repair requirements.
4. Easements shall provide easy access to manholes by a tandem wheeled maintenance (jet) truck. Where easements straddle property lines, the sanitary sewer alignment shall be a minimum of ten (10) feet from one edge of the easement and a minimum of ten (10) feet from the property line.
5. Sewer lines in unpaved easements shall be Polyvinyl Chloride (PVC) minimum DR-18 meeting AWWA C900/905 requirements, and shall be green in color.

A copy of the Grading Plan and Landscaping Plan showing the proposed conditions at the easements shall be submitted for review by the District. The maximum longitudinal grade along the easement shall be 8%. The maximum cross slope within easement boundaries shall be 4%. Decorative landscaping such as trees, bushes, rock gardens, etc. are prohibited in the sanitary sewer easement. Landscaping shall be sod, gravel, or paved surface. Gravel surface is preferred. Fences parallel or askew within the easement are not permitted. Fences perpendicular to the easement should be avoided. Installation of fences perpendicular to easements require District approval and shall be installed with a 12-foot removal section or gate for access by District. Gate may be single or double-door, but when opened must provide an obstruction-free 12-foot minimum opening. The opening must be centered over the sewer main within the easement.

2.5.4. EASEMENT LEGAL DESCRIPTIONS AND EXHIBITS

Easement legal descriptions and exhibits (drawings) shall be prepared under the direct supervision of a Professional Land Surveyor, Registered in the State of Colorado. Easement documents must adhere to the Denver Water easement standards and CAD standards at a minimum. Refer to the easement requirements in Chapter 4 of the latest edition of the [Denver Water Engineering Standards](#).

Legal descriptions and exhibits shall be prepared on legal sized (8-1/2" x 11") paper, and shall be referenced to the nearest Section corner. The legal description shall be a "metes and bounds" description, accurately describing to a hundredth of a foot, the point of beginning, each easement line bearing and distance, and the total area contained in acres. Easement traverse shall close within 1/10,000. Surveyor shall provide polygon easement closure calculations

verifying this requirement.

Easement exhibits shall be presented at a scale sufficient to clearly show all easement boundaries. The drawing shall show the north arrow, referenced section corner, all bearings and distances, total acres, adjacent property identification, street names, and date of preparation.

Easement legal descriptions and exhibits shall bear a professional land surveyor (State of Colorado) seal and signature. The easement legal and drawing shall be included with the District's Standard Easement Deed. A sample copy of the Standard Deed is included in APPENDIX C. The District reserves the right to modify the conditions of the Easement Deed, at any time, for specific projects.

Legal descriptions and drawings should be submitted to the District for review along with a current Title Insurance Commitment covering the subject right-of-way. A copy of each document listed in the Title Commitment must be included. Title Commitment must be prepared within the last 30 days of date of submittal to District. All expenses incurred in obtaining Title Insurance shall be paid by the Applicant.

The District will not permit construction of a project until all easements related to the project are fully signed and recorded by the appropriate County.

2.5.5. RELATION TO OTHER UTILITIES

Sanitary sewer lines in streets and easements shall be designed to provide a minimum separation of ten (10) horizontal feet measured between the centerline of any water line or appurtenance and the centerline of the sanitary sewer. Horizontal edge-to-edge separation with utilities other than water lines shall be five (5) horizontal feet minimum, and shall in all cases allow for future excavation of the sewer line without causing damage to the adjacent utility.

Where sanitary sewer lines are proposed to cross water lines or other utility lines, they shall be designed to cross at an angle close to ninety degrees (90°). Minimum vertical clearance between the edge of sanitary sewer line and edge of the water line or other utility shall be eighteen (18) inches, minimum. See Section 2.14.3 for additional requirements related to water line crossings.

2.5.6. DEPTH

Minimum depth of sanitary sewer lines shall be six (6) feet measured from the top of pipe to finished grade. Lines proposed to be constructed with less than six (6) feet minimum cover shall require written special permission by the District. Maximum depth of sanitary sewer lines shall be reviewed by the District on a case-by-case basis, but in all cases, the maximum depth shall not exceed the depth where future excavation of the installed sewer line cannot be reasonably accomplished.

2.6. SANITARY SEWER SYSTEM LAYOUT AT CREEK CROSSINGS

Where sanitary sewer lines are proposed to cross creeks or drainage ways, they shall be designed to cross perpendicular to the creek or drainage way centerline. A specific geotechnical investigation shall be performed by the owner for each proposed crossing to evaluate potential 100 Year Flood scour depths of the creek or drainage way at ultimate development of the drainage

basin. After the investigation has been reviewed by the District, minimum depth of the sanitary sewer lines will be established, as well as any erosion protection requirements. Review by the County and the Urban Drainage and Flood Control District may be required.

All sanitary sewer mains that cross a creek or drainage way shall be protected by a steel casing pipe. Limits of casing pipe shall extend at minimum of ten (10) feet each way into the normal creek banks. Additional protection such as concrete encasement around the casing pipe, downstream drop structures, or channel bottom stabilization may also be required by the District.

2.7. MANHOLES

2.7.1. GENERAL

Manholes shall be provided at all pipeline changes in grade, changes in alignment, dead-end lines, and at junctions with other sanitary sewer mains. Manholes shall be installed on straight sections of line at distances not greater than four hundred (400) feet.

Sanitary sewer lines shall be designed so the angle between any upstream line and the downstream line is 90°, minimum.

2.7.2. MANHOLE SIZE

All manholes shall have a minimum inside diameter of four (4) feet, or two (2) feet greater than the outside diameter of the largest pipe entering or leaving the manhole. The following Table 2.3 should be used as a guideline.

TABLE 2.3 - MANHOLE SIZING

| Two-Way Manholes | |
|-------------------------|------------------------------|
| Max. Nominal Pipe Sizes | Min. Manhole Inside Diameter |
| 15" or smaller | 4'-0" |
| 18" to 36" | 5'-0" |
| 42" and up | Sizing by District |

| Three and Four-Way Manholes | |
|-----------------------------|------------------------------|
| Max. Nominal Pipe Sizes | Min. Manhole Inside Diameter |
| 3-Way 8" | 4'-0" |
| 4-Way 8" | 4'-0" |
| 3-Way 12" | 4'-0" |
| 4-Way 12" | 5'-0" |
| 3-Way 18" | 5'-0" |
| 4-Way 18" | 6'-0" |

Three and Four way manholes/vaults having a pipe larger than 18" will require a special design by the Owner's Engineer. Such design shall be reviewed and approved by the District.

2.7.3. MANHOLE HYDRAULIC DESIGN

(See Section 2.4.3)

2.7.4. MANHOLE DEPTH

Minimum manhole depth shall be as required to provide six (6) feet of cover over the top of the upstream pipe. Maximum depth shall be reviewed and determined by the District on a case-by-case basis. For manholes with a depth greater than 20-feet of cover over the top of the upstream pipe, the manhole diameter shall be increased by one (1) foot.

2.7.5. GRADE ADJUSTMENT

Manholes shall be designed and constructed to permit grade adjustments (either up or down) by use of precast concrete adjusting collars. A maximum of 12-inch grade adjustment and a maximum of three (3) adjusting collars are permitted. In paved areas, rims shall be set to the requirements of the jurisdiction (City or County) which is generally slightly lower than the finished pavement section. In open space areas, manhole rims shall be set a minimum of four (4) inches, and a maximum of ten (10) inches above finished grade to prevent infiltration from surface runoff.

2.7.6. DROP MANHOLES

Drop manholes shall not be constructed where the sanitary sewer line design can be modified to provide the maximum inside drop of twelve (12) inches. Generally, drop manholes are not to be designed or constructed within the District. When this is not possible, and by special request and approval of the District, drop manholes may be designed and constructed.

The design of drop manholes shall be in accordance with the "Drop Manhole" construction details found in the Standard Details (SS-11 and SS-12). All drop manholes are to be interior lined per Section 4.5.10. Maximum permitted outside drop shall be reviewed and approved by the District on a case-by-case basis.

2.8. SANITARY SEWER SERVICE CONNECTIONS

2.8.1. GENERAL REQUIREMENTS

Each home, business or wastewater producing facility shall convey wastewater to the District's mains by way of a service line. Each structure shall have a minimum of one service line.

Sanitary sewer services shall be designed to transport the peak sewage flow from any residential or non-residential use to the sanitary sewer system. Services shall be sized by the Owner's Architect or Engineer using the Uniform Plumbing Code (UPC) method, and shall be a minimum of four (4) inches in diameter. Service sizing calculations shall be submitted to the District for review whenever a new service line is proposed and whenever an existing service changes ownership or intended use. Service lines shall have a minimum slope of 2% and maximum slope of 12% for 4-inch and a minimum of 1% and maximum of 10% for 6-inch within right-of-way or District easement. Service slopes outside of the right-of-way or District easements shall be designed by the Owner/Owner's Engineer. The District is not responsible for the sizing or adequacy of the service line to perform its intended use and assumes no responsibility for the service lines maintenance or operation.

Service wye locations, including size, manhole reach, lot or building number, stationing from

nearest downstream manhole, right or left side connection (looking upstream), and the invert of the sewer main at wyes and plugs shall be shown in tabular form on the plans. Sanitary sewer services shall be located a minimum of ten (10) feet from water services, typically on the downhill side of the water service.

2.8.2. SERVICE CONNECTIONS TO MANHOLES

Service connections 6-inches and smaller are not permitted to directly connect to an in-line manhole. All service connections 8-inches and larger shall connect to a manhole. Installation of a service connection 6-inch and smaller directly to a dead-end manhole shall be approved by the District on a case-by-case basis and may not follow an alignment "behind" a dead-end manhole.

2.9. CLEANOUTS

Cleanouts are not permitted on Southgate Sanitation District mains (lines 8-inches in diameter or greater). Cleanouts are recommended on all private service lines at the following locations: any change in direction requiring horizontal or vertical bends, every 100 feet of installed service line, and at other locations as necessary for the property owner to clean the entire service line. The designer shall be responsible for providing cleanouts at a frequency and at locations required by the appropriate building code.

2.10. FATS, OILS, AND GREASE (FOG) GRAVITY INTERCEPTORS

2.10.1. GENERAL

All restaurants, cafeterias, supermarkets, bakeries, food processing, or other food preparation facilities shall have a gravity grease interceptor (GGI) installed on the sewer service line. Construction, ownership, and maintenance of the GGI shall be the Owner's responsibility. Bypasses are not permitted around GGIs. Generally, policies relating to placement, sizing, plumbing routing, and maintenance, can be found in the [Fats, Oils, and Grease \(FOG\) Policy of the Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division](#). Any design that is unable to comply with this policy will be reviewed by the District on a case by case basis.

In all cases, grease interceptors shall be located on the service line outside the building served, upstream of the location where human waste enters the service, and so installed and connected as to be easily accessible for inspection and cleaning. If the interceptor must be installed within the building due to space limitations, prior written authorization must be obtained from the District.

The District will determine whether a GGI is required whenever a new service line is proposed, and whenever an existing service line changes ownership or intended use. If the District determines that an existing facility needs to have a GGI installed, the Owner shall be required to provide the interceptor at the Owner's expense, even if the interceptor was not originally required on the service line. GGIs shall conform to the "Commercial Grease Interceptor Detail," Drawing SS-27.

2.10.2. ENGINEERING REVIEW

Two (2) sets of plans and specifications, including complete mechanical and plumbing sections

with interceptor detail and calculations shall be submitted to the District for review and approval prior to construction. This submittal will be accompanied by a narrative explanation of the operation or process from which the interceptor will be receiving drainage.

Drawings shall be submitted to the District indicating, but not limited to the following:

- 1) Building use and size, site layout, proposed service locations, size, alignment, grades and tie-in locations.
- 2) Service sizing calculations.
- 3) Proposed interceptor location with respect to the building, street improvements and landscaping.
- 4) Interceptor sizing and by-product rate of generation calculations.
- 5) Interceptor shop drawings.
- 6) Process description of system generating fats, oil and/or grease.
- 7) The proposed maintenance schedule.

The District will review the above information in order to verify that an interceptor will be installed that is generally in conformance with accepted practices. The District is not responsible for the sizing or adequacy of the interceptor to perform its intended use, and assumes no responsibility regarding the interceptors' maintenance or operation. Maintenance logs shall be available on-site for review at all times.

Review may also be required by the Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division policies regarding Fats, Oils, and Grease (FOG).

2.10.3. SIZING CRITERIA

Sizing shall be per the Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division [Fats, Oils, and Grease \(FOG\) Policy](#).

In no case, shall the interceptor be smaller than 750 gallons.

2.10.4. CONNECTIONS

Connections shall be per the Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division's [Fats, Oils, and Grease \(FOG\) Policy](#).

Generally, all fixtures associated with kitchen and food prep areas should be routed through the grease interceptor.

2.10.5. MAINTENANCE

Maintenance of the grease interceptor shall be per the Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division's [Fats, Oils, and Grease \(FOG\) Policy](#). As stated in this policy, no biological, enzymatic, emulsification, or chemical treatment is permitted for use in GGIs. In addition to these additives, no mechanical type equipment (i.e. mixers, agitators, etc.) shall be used.

The District does retain the right as allowed by Colorado State Statute, to review all interceptors during regular business hours, on an unscheduled basis, to determine if the unit is operating satisfactorily and being maintained on a regular basis.

2.11. PETROLEUM OIL, GREASE, AND SAND (POGS) INTERCEPTORS

2.11.1. GENERAL

Facilities which discharge any quantities of petroleum oil, grease, and sand or other inert debris into the sanitary sewer service shall have a sand/oil interceptor (SOI) installed on the sewer service line. Examples of such facilities include, but are not limited to: automobile service stations, mechanical repair shops, car washes, garden nurseries, warehouses, and parking garages with floor drains. Bypasses are not permitted around sand and oil interceptors. Generally, policies relating to placement, sizing, plumbing routing, and maintenance, can be found in the [Petroleum Oil, Grease, and Sand \(POGS\) Policy](#) of the [Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division](#). Any design that is unable to comply with this policy will be reviewed by the District on a case by case basis.

In all cases, grease interceptors shall be located on the service line outside the building served, upstream of the location where human waste enters the service, and so installed and connected as to be easily accessible for inspection and cleaning. If the interceptor must be installed within the building due to space limitations, prior written authorization must be obtained from the District.

The District will determine whether a SOI is required whenever a new service line is proposed, and whenever an existing service line changes ownership or intended use. If the District determines that an existing facility needs to have a SOI installed, the Owner shall be required to provide the interceptor at Owner's expense, even if the interceptor was not originally required on the service line. SOIs shall conform to the "Oil and Sand Trap Interceptor Detail," Drawing SS-28.

2.11.2. ENGINEERING REVIEW

Two (2) sets of plans and specifications, including complete mechanical and plumbing sections with interceptor detail and calculation shall be submitted to the District for review prior to construction. This submittal will be accompanied by a narrative explanation of the operation or process from which the interceptor will be receiving drainage.

Drawings shall be submitted to the District indicating, but not limited to the following:

- 1) Building use and size, site layout, proposed service locations, size, alignment, grades and tie-in locations.
- 2) Service sizing calculations.
- 3) Proposed interceptor location with respect to the building, street improvements and landscaping.
- 4) Interceptor sizing and by-product rate of generation calculations.
- 5) Interceptor shop drawings.
- 6) Process description of system generating petroleum oil, grease and/or sand.
- 7) The proposed maintenance schedule.

The District will review the above information in order to verify that an interceptor will be installed that is generally in conformance with accepted practices. The District is not responsible for the sizing or adequacy of the interceptor to perform its intended use, and assumes no responsibility regarding the interceptors' maintenance or operation.

The installation uses a two (2) stage precast vault located outside the building, in accordance with the Oil & Sand Interceptor and Commercial Grease Interceptor details found in Section 5 of these Specifications.

2.11.3. SIZING CRITERIA

Sizing shall be per the Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division [Petroleum Oil, Grease, and Sand \(POGS\) Policy](#).

In no case, shall the interceptor be smaller than 500 gallons

2.11.4. CONNECTIONS

Connections shall be per the Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division's [Petroleum Oil, Grease, and Sand \(POGS\) Policy](#).

2.11.5. MAINTENANCE

Maintenance of the grease interceptor shall be per the Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division's [Petroleum Oil, Grease, and Sand \(POGS\) Policy](#). As stated in this policy, no biological, enzymatic, emulsification, or chemical treatment is permitted for use in SOIs. In addition to these additives, no mechanical type equipment (i.e. mixers, agitators, etc.) shall be used.

The District does retain the right as allowed by Colorado State Statute, to review all interceptors during regular business hours, on an unscheduled basis, to determine if the unit is operating satisfactorily and being maintained on a regular basis.

2.12. INDUSTRIAL PRETREATMENT

Any development which generates industrial wastewater will be required to install a pretreatment process prior to the sewage effluent entering the public sanitary sewer system. Facilities may include (but are not limited to):

- Food Service Establishments
- Brewing Beer or Distilling Spirits
- Automotive Garages
- Coating (Painting) Facilities
- Medical, Dental, and Veterinary Facilities
- X-Ray and Medical Imaging Facilities
- Photo Processing Facilities
- Printing and Publishing Businesses
- Power Washing, Carpet Cleaning, and similar mobile washing facilities

It is the industrial Property Owner's responsibility to be in compliance with the [Littleton/Englewood Wastewater Treatment Plant, Industrial Pretreatment Division](#).

The Owner is required to contact the Littleton/Englewood Wastewater Treatment Plant (303-762-2600) to determine the type and degree of pre-treatment required.

2.13. UNDERDRAINS

For the purposes of this Section 2.13, Underdrains are defined as facilities and systems designed to collect and convey groundwater which may accumulate around building foundations.

Underdrains shall not be installed within any sanitary sewer trench, public or private, without the express written consent of the District, and then only upon the terms and conditions stated herein.

Underdrain systems are not part of the District system. The regulations, specifications and other requirements stated herein are solely to define the terms and conditions upon which underdrain systems may be allowed in public or private sanitary sewer trenches in the District, and any District plan review, plan acceptance, or construction observation relating to underdrains shall be for the sole purpose of ensuring the compliance of such underdrains with the conditions of any authorization for the same to be installed in sanitary sewer trenches.

Any Property Owner seeking District authorization to install an underdrain in a sanitary sewer trench in the District shall submit a written request therefore accompanied by an executed form of Underdrain Agreement found in the APPENDIX F. The District shall have sole, exclusive and unfettered discretion to deny or permit any proposed underdrain system to be constructed beneath sanitary sewer facilities. Allowing any such underdrain is an accommodation to the Property Owner.

- The underdrain shall be designed by the Owner's consulting engineer and shall observe the following guidelines to protect sanitary sewer facilities from adverse impacts from the under drain.
- The underdrain system shall be designed and constructed as a groundwater conveying system that is independent of the sanitary sewer foundation and bedding material.
- Sanitary sewer bedding shall not be used in the underdrain systems. An 8 mil polyethylene barrier shall be placed beneath of the sanitary sewer system and above the proposed underdrain systems. No allowance shall be taken for the porosity of the sewer system bedding material in calculating the under drain capacity.
- All pipes proposed to be installed beneath the sanitary sewer system shall have a pipe class equal to or greater than the sanitary sewer pipe.
- Underdrain systems shall have adequate daylight points as underdrain systems are not permitted below the District's outfall sanitary sewer lines. Clay cut-off walls shall be installed with solid wall pipe downstream of the cut-off wall where the underdrain system alignment daylights away from the sanitary sewer system.
- Underdrain systems shall not pass beneath any manhole or structure, but shall be routed around the manhole or structure using solid wall pipe.
- Underdrain cleanouts shall not be permitted to be installed in sanitary sewer manholes.
- Construction details for construction around manholes and cut-off walls shall be submitted to the District for review.
- The locations of the underdrain system and daylight points shall be referenced on the Construction Plans.
- Roof drains and other surface water collection systems shall not discharge into an underdrain system.

The following note must be placed on all sanitary sewer system construction plans for developments with underdrain systems:

"Underdrain systems composed of gravel, solid pipe, and/or perforated pipe are not a part of the District's sanitary sewer system and are not designed, owned, or maintained by the District."

2.14. PROTECTION OF WATER SUPPLIES

2.14.1. WATER SUPPLY INTER-CONNECTIONS

There shall be no physical connection between a public or private potable water supply system and a sanitary sewer, or appurtenance thereto which would permit the passage of any sanitary sewage or non-potable water into the potable water supply.

2.14.2. RELATIONSHIP TO WATER SUPPLY SOURCES

While no general statement can be made to cover all conditions, it is generally recognized that sanitary sewers must be kept remote from public water supply wells or other water supply sources and structures in accordance with the applicable Colorado State and/or County Health Department Standards.

2.14.3. RELATIONSHIP TO WATER LINES

Sewers shall be located a minimum of ten (10) feet horizontally from existing or proposed water lines (centerline distance). Where sewer lines cross water mains, the sewer pipe shall be a minimum of 18" clear distance vertical separation from the water line. If this clear distance is not feasible, the crossing must be designated and constructed so as to protect the water line. Minimum protection shall consist of the installation of an impervious and structural sewer. All such cases must be brought to the District's attention and a sound engineering solution shall be determined on a case by case basis.

In all cases, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of any pipe.

2.15. ENCASEMENTS AND CASINGS

2.15.1. CONCRETE OR CLSM ENCASEMENTS

Concrete or CLSM encasements may be required by the District, under the following conditions:

- Where sewer lines are at a depth too shallow to sustain traffic loads or any other load to which they are, or will be subjected.
- At locations where horizontal or vertical movement or loading of the sewer line may be experienced.
- At any other location designated by the District.

Encasements shall be of a length to completely span the condition encountered. The concrete encasement detail is generally acceptable for most conditions but the District may require a special, site specific concrete encasement on a case-by-case basis.

2.15.2. PIPE CASINGS

Pipe casing shall be used where pipe crosses under another utility 36-inch diameter and greater or protective installations (e.g. creek crossings) are required by the District. All pipe casings shall be constructed to conform to Section 4 and the "Pipe Casing" Detail, found in Section 5, of these Specifications.

SECTION 3 – CONTRACTOR'S CONSTRUCTION REQUIREMENTS

3.1. GENERAL CONSTRUCTION STANDARDS

All excavations affecting or involving any part of the District System, and all work on Main Extensions, Service Connections, or other District facilities shall be performed in conformity with and are subject to the requirements and conditions set forth herein. Whenever any provision of these Specifications or the Rules and Regulations imposes a duty addressed in this Section 3 upon a Contractor, the term "Contractor" in such context shall be deemed to apply also to the Property Owner.

3.1.1. COMPLIANCE

Contractor shall comply with all District, City of Englewood, State and Federal Rules, Regulations, Standards and Specifications.

3.1.2. PERMITS

The Contractor shall be solely responsible for determining and obtaining any and all permits required for the work from other governmental entities or agencies having jurisdiction, and shall perform the work in accordance with any and all applicable ordinances, regulations, laws and orders of, or permits issued by such entities or agencies.

3.1.3. SUBSURFACE STRUCTURES

The District will make available to the Contractor record drawings showing the general location of its facilities and such information as it has about other subsurface structures in the vicinity of the work, but the Contractor shall be finally and solely responsible for notifying all owners or operators thereof of the Contractor's intent to excavate in the area, and verifying the existence and horizontal and vertical location of all subsurface structures in such area.

If a Contractor damages any District facilities during construction, they shall immediately notify the District. The Contractor shall provide bypass pumping, at their own expense, until the District reviews the damage and proposes remedial measures. All costs to repair the District facilities shall be borne by the Contractor. Repairs shall be performed in accordance with the "Sanitary Sewer Line Repair" detail found in Section 5 of these Specifications and/or the District site specific recommendations.

Any Contractor who damages District facilities shall indemnify and hold the District harmless against any and all claims for damage resulting there from, and shall indemnify and hold the District harmless against any and all claims for damages to any such structures.

3.1.4. WARRANTY

All materials and workmanship furnished by the Contractor shall conform to these System Specifications and to all plans and designs accepted by the District, and shall be free from all defects due to faulty or non-conforming materials or workmanship.

3.1.5. INDEPENDENT INVESTIGATION

Contractor shall thoroughly examine the work site to ascertain for themselves all soil, geological, groundwater and other conditions to be encountered which might affect the work being undertaken. The Contractor shall enter into such work relying on their own investigation and information, and not on any statements or representations, if any, that have been made by the District.

3.1.6. INDEMNIFICATION

By undertaking any work subject to this section, Contractor agrees to indemnify and hold harmless the District from any and all liability, claims, and demands, on account of injury, loss, or damage, including without limitation claims arising from bodily injury, personal injury, sickness, disease, death, property loss or damage, or any other loss of any kind whatsoever, which arise out of or are in any manner connected with any work subject to this section if such injury, loss, or damage is caused in whole or in part by, or is claimed to be caused in whole or in part by, the act, omission, error, professional error, mistake, negligence, or other fault of Contractor, or which arise out of any Workmen's Compensation claim of any employee of the Contractor. Contractor agrees to investigate, handle, respond to, and to provide defense for and defend against such liability, claims or demands at the sole expense of Contractor. The Contractor also agrees to bear all other costs and expenses related thereto, including court costs and attorney fees, whether or not any such liability, claims, or demands alleged are groundless, false, or fraudulent. Nothing in this subsection shall be deemed to impose upon Contractor any obligation to defend or hold the District harmless against claims for damages legally caused by any unlawful act or omission of the District.

3.2. REQUIRED SUBMITTALS

No Contractor shall begin work on any Main Extension, Service Connection, or other District facilities until they have obtained the prior authorization of the District therefore, and has submitted, in addition to any other materials required elsewhere herein, the following, accepted as to form by the District:

3.2.1. WRITTEN AGREEMENT

If required by the District, a writing duly signed by Contractor (1) acknowledging their consent to be bound by the provisions of Section 3.1; (2) warranting that the work will conform to such provisions and will be free from defects due to faulty or non-conforming materials and workmanship; (3) agreeing to indemnify the District as provided in 3.1.6, and (4) agreeing to pay any and all applicable fees and charges provided by these Specifications and the Rules and Regulations in connection with the work.

3.2.2. FEES

The full amount of all fees payable in advance, or any required costs deposits, or both. Owner/Developer is responsible for being aware of all applicable fee required by the District. It will be the responsibility of the Owner/Developer to contact the District for the latest fees and schedule of payments to avoid delays. Fees are subject to change.

3.3. STOP WORK ORDERS

3.3.1. ORDER

The District may revoke any authorization for work and issue a Stop Work Order upon a determination that the Contractor has violated or is about to violate any condition of any plan acceptance, any provision of these Specifications or Rules and Regulations, or any other standard, specification, or rule imposed by the District. A Stop Work Order shall take effect immediately upon the entry thereof by the District and notice to the Contractor, and shall remain in full force and effect until rescinded in writing by the District.

3.3.2. EFFECT

It is unlawful for any person to do any work in violation of the terms of any Stop Work Order issued pursuant to this section except such as may be permitted by the District in order to render the construction site safe and secure.

3.4. CURE OF DEFECTS

3.4.1. ORDER TO CURE

If the District determines that any part of the work was not performed in conformity with these Specifications, Rules or Regulations or accepted plans, or is defective, of poor or unworkmanlike quality, or is otherwise not in conformity with any applicable warranty, it may give written notice thereof to the Contractor. Such notice shall specify the non-conformity, direct the Contractor at their expense to perform specified remedial work, and specify the period of time determined by the District reasonably necessary for completion of the remedial work.

3.4.2. DISTRICT CURE

If the Contractor fails within the time stated following such notice to cure the non-conformity specified therein, the District, in addition to and without waiving any of its other remedies, may perform the work and charge the Contractor for its actual costs incurred in connection therewith, calculated in accordance with the rates set forth the Rules and Regulations. The provisions of Article 7 of the Rules and Regulations applicable to invoicing and collection of fees and charges shall apply to any charges assessed to Contractor under this section.

3.5. PRE-CONSTRUCTION MEETING

A Pre-construction Meeting shall be held at the District Offices prior to the start of any work. The District, Contractor, Surveyor, Soils Engineer, and Developer, or Developer's Engineer, must be represented at this meeting, which shall generally be held at the District Office (3722 East Orchard Road; Centennial, Colorado 80121). Before scheduling the pre-construction meeting, the following requirements must be met:

- Construction plans are approved by the District.
- Construction Observation Fees are paid to the District.
- Improvements Agreement must be signed by the Owner/Developer.
- Easement Agreement has been executed and recorded (if in a private roadway) or the plat has been recorded (if in the public ROW).

After the Pre-construction meeting is held, the Contractor shall, at least 48 hours prior to the start of construction, notify the District of its construction schedule and start date.

3.6. CONSTRUCTION PLANS

Construction Plans shall be reviewed and signed by the District or the Districts authorized representative. The signed plans and a copy of these Specifications shall be kept on the project site by the Contractor at all times.

3.7. DEFECTIVE MATERIALS

All materials not conforming to the requirements of these Specifications shall be considered defective. Whether in place or not, such material shall be removed immediately from the site of the work, unless otherwise permitted by the District. Rejected material, the defects of which have been subsequently corrected, shall not be used until the District has reviewed them and found them acceptable. The District will not consider conveyance and acceptance of a project if the Contractor fails to comply promptly with any order of the District made under the provisions of this Section.

3.8. DESIGN REVISIONS DURING CONSTRUCTION

Should the Contractor encounter field conditions that prevent construction to occur in conformance with the reviewed and signed plans, a meeting shall be scheduled by the Contractor with the Owner's Engineer and the District to discuss an alternative design. The Contractor's construction shall not deviate from the signed plans without the review and approval of the District and the Owner's Engineer.

3.9. CONSTRUCTION WATER

The Contractor shall be responsible for obtaining any water required for various phases of construction. Arrangement and coordination of permits shall be made through Denver Water and thereafter the District. A hydrant-specific permit must be applied for through the District and applicable fees shall be paid at the District office. An approved water meter and subsequent meter permit must first be obtained from Denver Water. Information regarding temporary water service through Denver Water can be found at [Denver Water Operating Rules Chapter 3 – Temporary Water Service](#).

3.10. TEMPORARY HANDLING OF SEWAGE

Certain work in connection with tying into the existing sanitary sewer facilities may require the temporary handling of sewage either by pumping, bulk heading at low flows, or other means acceptable to the District. Sewage, so diverted, shall be handled in a manner so as not to create a public nuisance or health hazard. Any temporary ditching shall be backfilled and compacted, and the ground elevations restored to original conditions.

Handling of sewage shall conform, and be acceptable to current Colorado Department of Health requirements and/or applicable City/County Health Department requirements.

The District will review the Contractor's written "Bypass Pumping Plan". The plan shall be inclusive of all flow rates, pumping equipment, piping and routing, and all contingencies as required to successfully pump flows around working areas. The system should be able to handle at least twice the maximum month flow. At least one redundant pump and associated backup

equipment shall be provided in the case of failure. Contractor shall be responsible for metering the flow and determining appropriately sized equipment. Metering reports and calculations of flow rates shall be provided as part of this Bypass Pumping Plan.

3.11. RECORD DRAWINGS

See APPENDIX D for a complete listing of how record drawings shall be processed by the Owner and approved by the Engineer.

3.12. REPLACEMENT OF EXISTING STREET IMPROVEMENTS

In areas where existing pavements, concrete improvements, storm or drainage improvements, etc. are removed during construction, all facilities shall be replaced in kind to the limits disturbed by the sewer line construction. All replacement shall be in accordance with the appropriate City, County, or State Highway Department Standards.

3.13. SAFETY & TRAFFIC CONTROL

The Contractor shall determine, initiate, maintain, and supervise all measures necessary to protect the public during construction. It is the Contractor's responsibility to obtain and maintain any necessary permits as required by the jurisdictional City, County, or State Highway Department.

Traffic shall be controlled at those locations throughout the project area in order to maintain an efficient and orderly vehicular and pedestrian traffic flow. All traffic control, construction signing, and residential access, etc., shall be handled in conformance with the Uniform Traffic Control Manual and the appropriate City, County, or State Highway Department Standards.

The Contractor shall furnish, construct, maintain, and remove detours, road closures, lights, signs, fences, barricades, flares, miscellaneous traffic devices, flagmen, drainage facilities, reconstruct paving and such other items and services as are necessary to adequately safeguard the public, both traveling and otherwise, from hazard and inconvenience. The Contractor shall erect and maintain such warnings and directional signs as may be required by the City, County, or State Highway Department.

Should the progress of construction require closure of residential access, the Contractor shall notify the residents which may be affected at least 24 hours in advance of such closure, and provide temporary access. Prior to the start of construction, the Contractor shall notify affected residents as well as the appropriate police and fire departments, giving the approximate starting date expected, completion date, and the name and telephone number of a responsible person representing the contractor who may be contacted at any hour.

3.14. CONSTRUCTION OBSERVATION

The District shall decide any and all questions that may arise during construction as to the quality and acceptability of the materials furnished, the work performed, or the manner of performance of the work.

No observation or testing will be performed by the District on weekends, holidays, or at night without the express agreement of the District secured in advance. Whenever any observation or testing is required by any specific provision of these Specifications or the Rules and Regulations, or by the terms of any permit or plan acceptance, the Contractor shall give the District such notice

as is required and shall not cover or otherwise obscure the work until the observation or testing has been made. The Contractor shall, at their expense, uncover or otherwise make such work accessible for observation or testing when ordered to do so by the District if they violate this requirement.

The observations, testing and reviews performed by the District are for the sole and exclusive benefit of the District. No liability shall attach to the District by reason of any observations, testing, or reviews required or authorized by these Specifications or the Rules and Regulations, or by reason of the issuance of any acceptance or permit for any work subject to this section.

The District is not a guarantor of the construction Contractor's obligations and performance of contract.

Observations of work in progress and on-site visits are not to be construed as a guarantee by the District of the Contractor's performance.

The District is not responsible for safety in, on, or about the Project site, or for compliance by the appropriate party of any regulations relating thereto.

The District exercises no control of the safety or adequacy of any equipment, building components, scaffolding, forms, or any other work aids used in or about the project, or in the superintending of the same.

3.15. GEOTECHNICAL OBSERVATION

Geotechnical observation and backfill density tests will be performed by the Contractor's Soils Engineer to provide acceptable fill control, bedding compaction, and foundation suitability. All supervision necessary to control fill and compaction tests will be at the expense of the Contractor. If the first compaction test does not meet with the Specifications, the sub-standard areas shall be reworked and additional compaction tests will be performed until the Specification is met. Any deviation from the Plans, Specifications, or soils report must be corrected by the Contractor to the satisfaction of the District. Copies of all compaction tests shall be provided to the District on the working day following the test. The location and frequency of compaction testing shall be per the City, County, or District Specifications, whichever is more stringent. The minimum testing interval is as follows:

| Minimum Testing Interval | | |
|---------------------------------|-------------------------------|--------------------------|
| Location | Horizontal Interval | Vertical Interval |
| Sanitary Sewer Main | 150 feet | Every 1 foot |
| Sanitary Sewer Structure | Every Structure | Every 1 foot |
| Service Line | Every 3 rd Service | Every 1 foot |

3.16. FEES

Contractor will pay the District all fees imposed and assessed by the District for reviews, observation, tests, acceptance, and any other undertakings performed by the District or its professional consultants in connection with the administration and enforcement of these Specifications and the Rules and Regulations, as provided by [Article 7 of the Rules and Regulations](#).

SECTION 4 - MATERIALS, TESTING AND INSTALLATION

4.1. GENERAL

All sanitary sewer system materials, construction and testing shall be in accordance with these Specifications. Any material proposed as "an equal" must be reviewed and found acceptable by the District prior to design or construction unless specified otherwise by the District. PVC pipe material (as defined in Section 4.2 and 4.3) shall be used for sanitary sewer system construction.

4.2. PIPE MATERIAL

Sanitary sewer pipe and fittings shall be polyvinyl chloride (PVC) conforming to ASTM D1784 *Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds* shall meet one of two sets of requirements as stated below:

1. SDR-35 pipe meeting ASTM D3034 *Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings* or ASTM F679 *Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings* latest revision.
2. DR-18 pipe meeting AWWA C900 *Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., For Water Distribution* or AWWA C905 *Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., For Water Transmission and Distribution* latest revision.

Pipe and fitting markings shall include the appropriate ASTM and Cell Classification Numbers (12454-B or 12454-C or other ASTM approved classifications) and be GREEN in color. Unmarked pipe and fittings will be rejected.

Pipe selection will be determined based on location and depth of sewer pipe. Table 4.1 below outlines pipe selection requirements. The entire sewer segment between manholes shall be of the same material.

| Table 4.1 - Sanitary Sewer Pipe Selection | | |
|-----------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------|
| Location | Depth | Pipe Material |
| Public Right-of-Way | ≤ 18' | SDR-35 |
| | > 18' | C900/905 DR-18 |
| Easement (Unpaved) | ≤ 18' | C900/905 DR-18 |
| | > 18' | |
| Easement (Paved) | ≤ 18' | SDR-35 |
| | > 18' | C900/905 DR-18 |
| Steel Casing (Creek crossing, jurisdictional/owner requirement, District determination) | ≤ 18' | C900/905 DR-18 (All joints in casing to be fused or restrained using internal restraint device) |
| | > 18' | |

4.2.1. PIPE THICKNESS CLASS

Sewer pipe shall be either DR18 or SDR35 as outlined in Section 4.2 unless otherwise specified by the District.

4.2.2. STRAIGHTNESS

Maximum allowable curvature as measured from the concave side of the pipe shall not exceed 1/16" per foot of length.

4.2.3. LAYING LENGTHS

PVC pipe shall have normal laying length of either 18 or 20 feet. Random lengths shall not be acceptable.

4.2.4. PIPE JOINT TYPE

PVC joints shall be made using an integral bell and spigot type rubber gasketed joint. Each integral bell joint shall consist of a formed bell and a single rubber gasket. Gaskets shall conform to ASTM F477.

In cases where pipe joints are required to be restrained the pipe shall utilize an internal restraint system suitable for C900/905 PVC pipe such as the Bulldog Restraint System or approved equal.

4.3. POLYVINYL CHLORIDE (PVC) PIPE

4.3.1. INSTALLATION AND TESTING

See Sections 4.12 and 4.13 of these Specifications.

4.4. SANITARY SEWER PIPE FITTINGS

4.4.1. FITTINGS AND BRANCHES

Branches of the size and type shown on the reviewed and signed Construction Plans shall be furnished for service connections. In line "wyes" are the only fittings acceptable for service connections to new construction and shall be of equivalent standard as the main pipe it is installed on. "Wye" branches shall have their axis approximately 45° (unless otherwise specified on the plans) to the longitudinal axis of the pipe. All branches shall be of sufficient length to permit making a proper joint when the connecting pipe is inserted in the branch socket.

Service connections to existing PVC pipe requires the use of a long body style "wye" saddle and rubber gasket secured to the pipe using double stainless steel straps.

Secure connections to existing concrete or vitrified clay pipe require the use of a PVC "wye" saddle and rubber gasket secured to the pipe with double stainless steel straps. The service connection shall be encased in concrete.

4.4.2. PLUGS

Pipe plugs shall be 3/4" in thickness and shall have a factory-made plasticized polyvinyl chloride compound joint material cast and bonded to the pipe. The material shall be molded and cured to a uniform hardness and compressibility, and form a tight compression coupling when assembled. The material used for the compression joint shall conform to the type of pipe material specified.

Neoprene (synthetic rubber) plugs shall be equal to those manufactured by Gladding McBean and Company or equal. The joint formed by the plug and pipe shall be a tight compression coupling when assembled.

4.4.3. INSTALLATION AND TESTING

Fitting installation shall be in accordance with the manufacturer's recommendations and Sections 4.6, 4.12.6 and 4.13 of these Specifications.

4.5. MANHOLES

4.5.1. GENERAL

This Section outlines the material and installation requirements for manholes. Excavation, foundations and backfill requirements are described in Section 4.12. All manhole structures shall be designed for H-20 traffic loading in accordance with AASHTO Specifications.

Generally, manholes shall be constructed using pre-cast sections. Cast-in-place manhole bases are allowed only when practicable by construction. Examples of such installations are when new infrastructure is to connect to existing pipeline with a new manhole.

Riser sections (barrel sections) shall be pre-cast reinforced concrete. Top sections shall be eccentric cone and shall comply with ASTM C478. All precast sections shall have the date of manufacture and the name and trademark of the manufacturer clearly marked on the inside of each section. Manholes shall be in accordance with the Detail Drawings.

Manhole sections shall not be shipped or subjected to loading until the concrete compressive strength has attained a minimum of 3,000 psi, and not before 3 days after fabrication and/or repair, whichever is longer.

4.5.2. PRE-CAST CONCRETE BASES

Manhole base slabs for manholes constructed along new sewer mains shall be pre-cast. Material Specifications for pre-cast bases are as follows:

- Minimum 4000 psi concrete 28-day compressive strength manufactured using Type II cement.
- All base and barrel sections shall be poured monolithically. Reinforcement shall include a complete rebar cage with #4 bars on 12-inch centers.
- All areas of seam tears, cracks and honeycombs shall be patched and resurfaced prior to final curing.
- Prior to coring the pipe openings and installing the pipe connection boot, all exposed reinforcing shall be coated with coal tar or epoxy paint.

- Pipe boots or gaskets are to be placed in the cored openings shall be manufactured by Forsheda (Model F-910), or approved equal, meeting all ASTM C923 requirements. Boots and gaskets may be precast in to the manhole base if installed in the field.
- Manhole steps shall be manufactured by MA Industries, Inc., Model No. PS2-PF (black) copolymer polypropylene plastic with grade 60 reinforcement or approved equal.
- Inverts and benches shall be extended completely with continuous slope across the base with a 0.20-foot minimum and 12-inch maximum drop across the manhole invert.

Coring and benching of pre-cast manhole bases may be completed in the field or at manufacturer's facility. The void area between the pre-cast invert, benches, and pipe shall be filled with concrete.

Bedding for manhole structures shall be per Section 4.12.5.

4.5.3. CAST-IN-PLACE CONCRETE BASES

Manhole base slabs for manholes constructed over existing sewer mains shall be poured-in-place on a minimum 6-inch thick bed of 3/4-inch to 1-1/2 inch crushed rock. The placed concrete shall extend a minimum of 8-inches below the pipe invert and the overall outside base dimensions shall be one (1) foot greater than the outside diameter of the manhole barrel sections.

The base shall be constructed of premixed concrete having a 28-day compressive strength of 4,000 psi, minimum. The concrete shall be composed of well-graded, well-washed, aggregate, ranging from sand to gravel 1-1/2 inches in maximum diameter.

The mix shall contain five (5) sacks of Type I/II cement to the cubic yard and only enough water shall be used in the mix to give it a slump test of two-inches (2"). Air entrained in the mix when placed, shall be between 3% and 5%. Base reinforcing steel or wire mesh shall be in accordance with the "Standard Manhole" detail found in Section 5 of these Specifications.

Sewer lines and manhole stub-outs shall be set before any concrete is placed and shall be rechecked for alignment and grade after the concrete pour, but before the concrete has set. All inlet and outlet pipes shall have installed on them an approved waterstop gasket prior to pouring concrete. Inlets and outlets to the manhole shall be located as indicated on the reviewed and signed Construction Plans.

All base deflectors shall be smooth and of the proper radius to provide a smooth flow transition in accordance with the "Base and Deflector" detail, found in Section 5 of these Specifications. The concrete base shall be shaped with concrete hand tools and shall receive a hard steel trowel finish before the concrete sets.

The accumulation of water on the surface of the concrete due to water gain, segregation, or other causes during placement and compacting, shall be prevented as much as possible. Provisions shall be made for the removal of such accumulated water. Under no circumstances shall new concrete be placed in standing water.

When concrete placement is performed during cold weather, the temperature of the concrete mix shall not be lower than 50° F. When concrete is placed during hot weather, the temperature of the concrete mix shall not be higher than 90° F.

For cast-in-place manholes constructed over existing mains, the upper half of the existing pipe shall be sawed out and the rough edges smoothed with cement mortar. Breaking out the top of the pipe is not permitted. No cutting of the pipe is permitted until after initial acceptance of the installations.

4.5.4. CONNECTIONS TO EXISTING MANHOLES

Sewer pipe connections to existing manholes where there is no existing pipe stubbed out shall be made in such a manner that the finished work will conform as nearly as practicable to the requirements specified for new manhole construction. The Contractor shall core drill a small opening in the existing manhole as necessary to insert the new sewer pipe. The core drill should extend through the manhole wall and into the channel. The core drill should not be “above the bench” so as to create additional fall through the manhole. The hole shall not be “broken out”. The existing concrete foundation bench shall be chipped to the cross-section of the new pipe in order to form a smooth continuous invert similar to what would be formed in a new concrete base. Where practical, the downstream invert shall be plugged during construction to prevent construction debris, storm and non-sewage flow from entering the system. The Contractor shall pump out and clean the manhole before removing the plug. A non-shrink grout shall be used to smoothly finish the new invert and to seal the new line, both inside and outside, so the junction is watertight.

4.5.5. PRE-CAST BARREL SECTIONS

Pre-cast concrete barrel sections are to be used for all sanitary sewer construction and shall conform to ASTM C-478, Standard Specification for Precast Reinforced Concrete Manhole Sections. Barrel sections shall have tongue and groove joints.

Minimum wall thickness shall be as shown in Table 4.2:

| Table 4.2 - Minimum Wall Thickness | |
|-------------------------------------------|-----------------------|
| Manhole I.D. | Wall Thickness |
| 48" | 5" |
| 60" | 6" |
| 72" | 7" |

Reinforcement shall be Grade 60 and for circumferential placement shall consist of one line of steel in compliance with ASTM C-478 latest revision, and shall not be less than 0.12 square inches per linear foot in 48" I.D. manholes, and not less than 0.17 square inch per linear foot in manholes 60" I.D. and greater. Spacing of circumferential steel shall not exceed six (6) inches. All splices shall be welded or lapped not less than 40 diameters of wire.

Slabs shall be reinforced with two layers of steel with a minimum area of 0.12 square inch per linear foot in both directions in each layer. Openings in flat slabs shall be additionally reinforced with a minimum of the equivalent of 0.20 square inches of steel at 90°. Straight rods used to reinforce openings shall have a minimum length equal to the diameter of the opening plus two (2) inches. Covers shall be reinforced with two layers of steel with a minimum area of 0.12 square inches per linear foot in both directions in each layer.

Concrete curing for precast material shall take place in a steam curing chamber or other

moisture controlled environment for such time and at such temperature as may be needed to enable concrete to meet the minimum 4000 psi 28-day compressive strength requirement. Type II cement shall be used for all components.

4.5.6. MANHOLE JOINT CONNECTIONS

Each manhole section shall be placed in accordance with the manufacturer's recommendations in a plumb position. The eccentric cone and steps shall be centered between the inlet and outlet pipes. A two ring, single layer, of preformed flexible joint sealant (Kent Seal No. 2, Con-Seal CS-102 or CS-202, Henry RAM-NEK RN103 or District-approved equal) shall be used between each manhole section and shall be continuous around the entire manhole section circumference. All external joints shall be sealed with a 6-inch joint seam wrap (Conseal CS-212, Henry Rub'R Nek RU-116, or District-approved equal).

4.5.7. MANHOLE STAIRS

All manholes and vaults shall have stairs installed at 12-inches on-center from 12-inches below the top of the structure to 12-inches above the bottom.

Manhole stairs shall conform to the drawings found in Section 5 of these Specifications.

Stairs shall be steel reinforced polypropylene plastic coated steps and shall be driven into tapered holes. Manhole stairs shall be plastic steps manufactured by MA Industries, Inc., Model No. PS2-PF made from copolymer polypropylene plastic with grade 60 reinforcement, or District approved equal.

Whenever possible, holes for rungs shall be performed during the casting of the sections and shall not be drilled out after casting. The preformed holes shall be a minimum of 3-1/2 inches deep and shall taper from 1-1/8 inch to 1-3/8 inch diameter.

Under no circumstances shall manhole steps be used to lift manhole sections.

4.5.8. RING AND COVERS

Cast iron rings and covers shall conform to the drawings found in Section 5 of these Specifications. The castings shall conform to ASTM Designation A48, free from cracks, holes or swells. Ring and covers shall be Denver Light Pattern Cast Iron in areas of no vehicular traffic and Denver Heavy Pattern Cast Iron in streets and highways. All manholes located in easements, landscaped areas, or drainage ways shall be required to have aluminum rings and covers with bolt locking assembly. Aluminum castings shall conform to ASTM B26. All manhole covers used for sanitary sewer shall be furnished with the word "SEWER" cast on the cover. All manhole covers shall be cast with a "U-shaped" type pick-hole and not a wide, rectangular slotted pick hole.

Ring and covers shall be 24-inch in diameter for 48-inch and 60-inch I.D. manholes and two piece 36-inch by 24-inch for 72-inch I.D. manholes. Refer to appropriate ring and cover details for additional requirements.

Manhole rings and covers shall be set to the final grades shown on the plans. Manhole rings shall be securely attached to the manhole riser section with a grout bed and preformed joint sealing compound in pavement, or with a concrete collar in unpaved areas. After the rings

are securely set in place, covers shall be installed and the assembly shall be cleaned and scraped of foreign materials.

4.5.9. EXTERIOR COATING

All exterior surfaces of concrete manholes shall be completely coated with a water/damp-proofing agent. Exterior coating should be applied in the precast factory, prior to shipping. Acceptable manufacturers shall be as follows:

Bituminous

- Carboline – Bitumastic 300 M
- Tnemec - H.B. Tnemecol 46-465
- Or Approved Equal

Non-Bituminous

- C.I.M. Industries Inc. – CIM 1000 (Black)
- International Paint – Devtar 5A (Black)
- Or Approved Equal

4.5.10. INTERIOR LINING

Sanitary manholes shall receive interior linings in the following circumstances:

- All outfall manholes (sewer mains 12-inches and greater)
- All manholes or structures associated with force mains (private or public)
- All manholes at or near creeks, ditches, ponds, lakes, or known high ground water table
- All drop manholes
- Manholes as otherwise identified or directed by the District

Manhole interior linings shall meet the following minimum requirements:

1. Shall be a monolithic, 100% solids, solvent-free corrosion protection material with exceptionally high physical strengths and a broad range of chemical resistance.
2. Shall be specifically designed for application onto properly prepared concrete surfaces.
3. The coating shall be completely monolithic with uniform thickness, covering the entire interior of the manhole being lined, including but not limited to, barrel and cone section. There shall be no gaps, breaks, or seams within the structure including transition sections, or precast joints.
4. Coating on horizontal and vertical surfaces shall be not less than 250 mils and it shall be an integral part of the sewer manhole

Before application of top coating substrate surfaces shall be made smooth and uniform using a cementitious build-back product. Cementitious build-back shall be designed for highly corrosive sanitary sewer environments. Acceptable manufacturers are Strong-Seal® QSR, SewperCoat®, or District approved equal. All interior surfaces shall be prepped in accordance with the manufacturer's recommendations prior to lining.

Acceptable materials include:

- Raven® 405 by Raven Lining Systems.

- S-301 Epoxy Spray System by Warren Environmental, Inc.
- Spraywall® by Sprayroq
- District-approved equal

Installation of lining system shall be per the manufacturer's recommendations. Installation and application shall be by a licensed installer as certified by the manufacturer. Lining may be applied in the factory or in the field, however, factory linings shall be made monolithic in the field.

If product(s) come in various colors, the color shall be selected by the District.

4.5.11. FLAT TOP COVER

Generally, all top manhole sections shall be eccentric cone. Flat top covers shall only be used with written permission of the District. Flat covers shall be a minimum of eight (8) inches thick and designed to withstand a minimum H-20 traffic loading.

4.5.12. FINAL GRADE ADJUSTMENTS

Final grade adjustments shall be made using minimum four (4) inch pre-cast concrete grade rings not to exceed twelve (12) inches in total height. In open space areas, manhole rims shall be set four (4) inches above grade to prevent infiltration from surface runoff.

Brick courses and metal rings are not allowed for vertical adjustment. If the riser section exceeds the vertical limitation, the riser and eccentric cone section shall be removed and the appropriate sized barrel section added, followed by cone and grade ring replacement.

Slanted final grade adjustments, to account for street cross slopes, shall be made using brick chips and cement mortar.

4.5.13. MANHOLE TESTING

The Contractor shall submit the concrete mix design to the District for review at least 48 hours prior to any concrete base pour. The District may require that concrete cylinders be sampled from base pours and tested at 28 days to show conformance with the required 28-day compressive strength requirement of 4000 psi. Slump and air entrainment may also be tested during concrete base pour, at the District's discretion.

No other specific testing procedures are established for manholes. Manhole construction will be observed by the District and shall conform to the requirements of this Section.

4.6. SANITARY SEWER SERVICE CONNECTIONS

4.6.1. GENERAL

The purpose of this sanitary sewer service connection specification is to address the actual connection between the public sanitary sewer system and the private service line. The District is responsible for the sanitary sewer main line, manholes, and the wye fitting (also includes saddle when wye is installed on existing sewer main) on the main line for the sanitary sewer service, only.

All sanitary sewer services are private. This includes any and all service fittings and service pipe upstream of the wye fitting at the sewer main. Section of these Specifications describes the material requirements for fittings, branches and plugs.

4.6.2. SERVICE CONNECTIONS TO NEW CONSTRUCTION

New main line construction shall use PVC in-line "wye" fittings for four (4) inch and six (6) inch service connections, or manholes for eight (8) inch service connections. Construction shall be in conformance with this Section and the "Service Connections to New Construction" construction detail found in Section 5 of these Specifications.

All in-line PVC wye fittings shall be of equal pipe class to the PVC materials used in public main line construction. Fitting material shop drawings shall be submitted to the District for review prior to construction.

In-line wye fittings shall be installed at the locations indicated on the reviewed and signed plans. The "wye" shall be rotated to provide entrance into the main line at the "ten" or "two" o'clock position. The Contractor shall record the connection invert elevation and distance from the nearest downstream manhole immediately upon installation. This information shall be shown on the record drawings.

4.6.3. SERVICE CONNECTIONS TO EXISTING CONSTRUCTION

Service connections to existing sanitary sewer lines shall be made using a "wye" saddle. Construction shall be in conformance with this Section and the "Service Connections to Existing Construction" construction detail found in Section 5 of these Specifications.

Connection to existing PVC material shall be made using a "wye" saddle with double stainless steel straps. The existing PVC sewer line shall be scored to the shape of the wye using a template approved by the saddle manufacturer. The hole shall be cut with a hole cutter or keyhole saw and cleanly machined by hand to remove all burrs, rough edges, and debris. The exterior of the main shall be wiped clean and prepared with an approved solvent prior to the installation of the saddle. The saddle shall be solvent welded to the pipe and drawn tight against the pipe using double stainless steel straps.

Upon completion of the tap, the main line, tapping saddle and service line within the sanitary sewer line trench shall be bedded per Section 4.12.5 and hand tamped prior to backfilling.

Connection to existing concrete or clay sewer lines shall be made using a PVC wye saddle and gasket with double stainless steel straps. When connecting to an existing concrete or clay main, a long-body style PVC wye saddle shall be used. The sewer main shall be "core drilled" with a circular bit. Necessary precautions shall be taken so that the removed circular segment is not lost in the sanitary sewer main. Percussion taps shall not be allowed. A percussion tap is defined as breaking the existing pipe material out in a circular fashion using a hammer and chisel or similar method.

The circular hole shall be cleaned by hand to remove all rough edges and debris. The exterior of the main shall be wiped clean and prepared with an approved solvent prior to the installation of the gasket wye saddle. The saddle shall be drawn tight against the gasket and existing line by means of double stainless steel straps.

Upon completion of the tap; the tapping saddle shall be reinforced with a concrete collar. The main and tapping saddle shall be bedded with materials per Section 4.12.5 and hand tamped prior to backfilling.

4.6.4. SERVICE CONNECTIONS TO DEAD-END MANHOLES

Installation of a service connection 6-inch and smaller directly to a dead-end manhole shall be approved by the District on a case-by-case basis and may not follow an alignment “behind” a dead-end manhole.

4.6.5. TESTING OF SERVICE LINE CONNECTIONS

No specific testing is required for the in-line fittings or saddle type connections by the District. However, the Contractor shall notify the District 24 hours prior to making any service connections so the District may be on-site to observe the connection.

All service lines shall be plugged at the end of the service with a watertight plug manufactured for use with the service line material. End plugs must be able to withstand the internal pressure of leakage testing in accordance with Section 4.13 of these Specifications.

4.7. CLEANOUTS

Cleanouts are not permitted on Southgate Sanitation District lines. Cleanouts are recommended on private services at: any change in direction requiring horizontal or vertical bends, every 100 feet of service line, and at other locations as necessary for the Owner to clean the entire service by rodding.

Construction details showing material requirements and installation procedures for cleanouts are found in Section 5 of these Specifications.

4.8. STEEL CASINGS

4.8.1. GENERAL

Steel pipe shall be used for casing of sewer pipe in locations such as creek crossings, where jurisdictional authority or owner requires, or at critical locations as determined by the District. Steel casing pipe shall be installed to the limits shown on the Construction Plans. However, should field conditions differ from the information shown on the reviewed and signed plans, (e.g., ground elevations, creek locations), the casing pipe limits shall be reviewed in the field by the District, prior to any steel casing installation.

4.8.2. MATERIALS

4.8.2.1. PIPE

Steel casing shall be new, smooth wall, welded steel pipe fabricated from ASTM A36 plate or ASTM A570 and ASTM A139 (straight seam pipe only) Grade “B” with minimum yield strength of 36,000 psi. The casing pipe shall be designed by the pipe manufacturer with sufficient wall thickness to resist the loads applied.

External loading shall be AASHTO H20 highway or railroad loading plus jacking load, E-80 railroad loading. Casing pipes shall have the minimum nominal diameter and wall

thickness as shown in table below. Field and shop welds of the casing pipes shall conform to the American Welding Society (AWS) standard specifications. Field welds shall be complete penetration, single-bevel groove type joints. Welds shall be airtight and continuous over the entire circumference of the pipe and shall not increase the outside pipe diameter by more than 3/4-inch.

Minimum casing inside diameter shall exceed outside diameter of carrier pipe joints or couplings by an amount appropriate to allow the installation of the insulator band to be used. Casing size stated above is a minimum but shall generally be as shown in the Table 4.3 below.

| Table 4.3 - Casing Pipe Minimal Nominal Diameter and Wall Thickness | | | |
|----------------------------------------------------------------------------|-------------------------------------|--------------------------------------------|------------------------------------------------|
| Carrier Pipe Nominal Dia. (in) | Casing Nominal Diameter (in) | Min. Thickness for Coated Pipe (in) | Min. Thickness for Non-Coated Pipe (in) |
| 8 | 18 | 0.250 | 0.312 |
| 10 | 20 | 0.281 | 0.344 |
| 12 | 24 | 0.312 | 0.375 |
| 16 | 30 | 0.406 | 0.469 |
| 18 | 30 | 0.406 | 0.469 |
| 20 | 36 | 0.469 | 0.531 |
| 24 | 42 | 0.500 | 0.563 |
| 30 | 48 | 0.563 | 0.625 |

4.8.2.2. CASING SPACERS

Casing spacers shall be 12-inch wide stainless steel, bolt on style type with a shell made of at least two halves. The bands shall be 14 gauge T304 stainless steel at a minimum, the risers shall be 10 gauge T304 stainless steel at a minimum, and the coating shall be fusion-bonded epoxy or heat fused PVC. Each spacer shall have a minimum of four runner supports manufactured of an ultra-high molecular weight polyethylene or glass reinforced polymer. Bolts shall be T304 stainless steel with lock nuts. The runner supports shall be of adequate height to position the carrier pipe in the center of casing with a maximum clearance of 1-inch from the upper runner to the inside of the steel casing. Spacers shall be installed on the carrier pipe per the manufacturer’s recommendations. Spacing of the casing spacers shall be per Section 4.8.4.1. Modifications to the casing spacers may be allowed on a case by case basis to maintain the correct grade of the carrier pipe. Acceptable manufacturers are as follows:

- Power Seal – Model 4810
- Cascade Waterworks – Model CCS
- Advance Products & Systems - Model SS1
- District Approved Equal

4.8.2.3. MODULAR WALL SEALS

Modular wall seals shall be adjustable modular mechanical type seals consisting of rubber bolted links with centering blocks and stainless steel bolts for adjustment. Wall seals shall be shaped to continuously fill the annular space between the casing and the carrier pipe so as to form a liquid tight seal. Construct so as to provide electrical isolation between the casing and the carrier pipe. Depending on the casing and carrier pipe annular space size, use of two modular seals stacked on top of each other, may be required to seal the annular space if approved by the modular seal manufacturer. Contractor shall coordinate with supplier at the time of ordering. Acceptable manufacturers are as follows:

- Link-Seal Modular Seals by GPT Industries
- District Approved Equal

4.8.2.4. END SEALS

Casing end seals shall be used to completely close both openings on either side of the casing water-tight. These ends seals shall be pull-on (seamless) or wrap-around with stainless steel straps for securing to the carrier pipe and the casing. End seals shall be constructed of specifically compounded synthetic rubber a minimum thickness of 1/8-inch. Acceptable manufacturers are as follows:

- Advance Products & Systems – Model AW
- PSI – Model C
- Power Seal
- District Approved Equal

4.8.3. CATHODIC PROTECTION

4.8.3.1. MATERIAL

For each continuous installation of steel casing one (1) anode shall be installed to provide cathodic protection. Anodes shall be high potential magnesium and meet the composition as shown in table 4.4 below.

| Table 4.4 – Magnesium Anode Composition | |
|-----------------------------------------|----------------|
| Aluminum (Al) | 0.10% maximum |
| Manganese (Mn) | 0.50 to 1.3% |
| Zinc (Zn) | 0.005% maximum |
| Copper (Cu) | 0.02% maximum |
| Nickel (Ni) | 0.001% maximum |
| Iron (Fe) | 0.03% maximum |
| Other Impurities – each | 0.05% maximum |
| Total | 0.30% maximum |
| Magnesium (Mg) | Balance |

All anodes shall be furnished prepackaged in special backfill material consisting of 75% ground hydrated gypsum, 20% powdered bentonite and 5% anhydrous sodium sulfate. The backfill shall have a grain size such that 100% is capable of passing through a 20-mesh screen and 50% will be retained by a 100-mesh screen. The backfill mixture shall be firmly

packaged around the anode within a cotton bag by means of adequate vibration.

Anode lead wires shall be No. 12 AWG stranded copper conductors with Type RHW/RHH/USE black insulation. Lead wires shall be a minimum of 25 feet in length. The lead wires shall be connected to the galvanized steel core of the anode by silver soldering and sealed with waterproof epoxy or electrical potting compound.

The anode weight shall be 48 lb. bare (100 lb. packaged). Anodes shall be shipped in waterproof bags or wrapping and shall remain dry until installation. Anodes shall be Far West "MaxMag" high potential magnesium anodes or approved equal.

4.8.3.2. TEST STATIONS

Steel casing cathodic protection shall include flush-to-ground test stations consisting of test station enclosure, cast iron lid, terminal block with studs, and shunt. Flush-to-ground test stations shall be concrete valve box enclosures with an H20 traffic rating such as Christy Mfg. Model "G3" or "G5" with the lid inscribed with the words "CP TEST". Flush-to-ground test stations shall be furnished with an insulated terminal board made of fiberglass reinforced polyester laminate similar to that as manufactured by CP Test Services, Inc. (test station model NM-5 or NM-7 terminal board).

All splices of buried test station or anode wires shall be made using a copper split bolt type mechanical connector or a copper compression type connector, soldered using paste flux and resin core solder, and sealed with an epoxy type material. Splice kits shall be Royston Mini-Splice-Rite or equal.

4.8.3.3. WELDS AND COATINGS

All electrical cable connections to the buried piping shall be made by an exothermic weld. Exothermic type weld materials including the proper size and type of weld cartridges and welder molds for use on steel pipe shall be Erico Products Inc. "CADWELD" or Burndy THERMOWELD" or other approved equal. Weld materials shall be compatible to the pipe material as recommended by the Manufacturer. Copper sleeves specifically designed for the purpose shall be crimped on all bare wire ends prior to exothermic welding to improve mechanical strength and thermal capacity.

Exothermic weld coatings shall be Royston 747 Primer plus plastic weld caps prefilled with mastic. Royston Handy Caps are acceptable. Weld caps using an integrated primer such as Royston/Tapecoat Handicap IP may also be used. Coat entire primer area and plastic cap with wax tape, as specified.

4.8.4. INSTALLATION

Steel casing shall be installed in accordance with the "Steel Casing" construction detail, found in Section 5 of these Specifications. Minimum distance between end of steel casing and manhole structures shall be five (5) feet. Installation shall adhere to the same requirements for sewer pipe installation outlined in Section 4.12.

4.8.4.1. CASING SPACER

Furnish spacers for pipe alignment guides as indicated for all carrier pipe to be installed in casing:

1. Pipe skids shall be positioned on the pipe as shown on the drawings.
2. On both ends of casing place first casing insulator within 12 inches of the casing end.
3. On both ends of casing place second casing insulator within 12-inches of the first casing insulator (24 inches from the casing end).
4. Place third casing insulator within 5-feet of the second casing insulator.
5. Place remaining casing insulators at a spacing of :
 - a. 10-feet for carrier pipes 10-inches or smaller
 - b. 7.5-feet for carrier pipes 12-inches to 34-inches and
 - c. 5.0 feet for carrier pipes 36-inches and larger
6. Place additional casing insulators for bell and spigot or mechanical joint piping 12-inches on each side of a joint.
7. Size to fit outside diameter of carrier pipe and inside diameter of casing pipe.
8. Insulators to be sized, at a minimum, slightly larger than carrier pipe's outside joint diameter.

4.8.4.2. MODULAR WALL SEALS

Construct modular wall seal as indicated and as follows:

1. After inside of casing has been thoroughly cleaned and approved by the District or its Representative.
2. After carrier pipe has been permanently placed inside casing. Pipe shall be centered and restrained, where called for in casing.
3. Place on both ends of the casing pipe.

4.8.4.3. END SEALS

Install end seal as indicated and as follows:

1. After inside of casing has been thoroughly cleaned and approved by the District or its Representative.
2. After carrier pipe has been permanently placed inside casing. Pipe shall be centered and restrained, where called for in casing.
3. Place on both ends of the casing pipe.

4.8.4.4. CATHODIC PROTECTION

Cathodic protection shall be installed in accordance with the "Cathodic Protection" construction detail, found in Section 5 of these Specifications.

Install galvanic anodes as follows:

1. All anodes shall be installed vertically or horizontally in native soils, a minimum of three feet laterally from the pipe to be protected and with the top of the anode below

- the centerline of the pipe. However, anode spacing and lateral distance can be adjusted from permanent obstacles with the approval of the Owner's Representative.
2. The specified magnesium anodes shall be installed horizontally or vertically, completely dry and shall be lowered into the excavated (augured or otherwise) holes as shown on the Drawings by rope sling or by grasping the closest gopher. The anode lead wire shall not be used in lowering the anodes. The anode shall be backfilled with fine native excavated soil (imported sand or other select backfill shall not be allowed) in 6-inch layers and each layer shall be hand tamped around the anode. Care must be exercised not strike the anode or lead wire with the tamper. After the anode has been backfilled approximately halfway, a minimum of ten gallons of fresh water shall be added and allowed to soak into and around the anode. After water absorption by the anode and surrounding soil, continue backfilling and tamping with native soil to a point approximately 6-inches above the anode. Add another 5 gallons minimum of fresh water and allow it to soak into the soil. After water has soaked in, backfilling and soil compaction may be completed to the top of the hole.

Perform exothermic welding as follows:

1. Exothermic welding techniques shall comply with the manufacturer's recommendations. Only properly sized cartridges and welders will be permissible. The Contractor shall ensure that the appropriate weld metal charges are used for each type of material.
2. The surface of the pipe shall be cleaned with a grinder or metal file to a bright, shiny condition. The exothermic weld shall be completed using the proper weld charge and welder as per the manufacturer's recommendations. A properly size copper wire sleeve shall be installed around the bare wire end prior to welding to improve weld strength and thermal capacity. Completed welds shall withstand moderate hammer blows.
3. After cooling, the weld and surrounding cleaned metal surface shall be primed. After the primer has dried, the weld shall be covered with an exothermic weld cap. The weld cap shall then be secured to the pipe with tape wrap as necessary.

4.9. CONCRETE ENCASEMENTS

4.9.1. GENERAL

Reinforced concrete encasement shall be constructed to the limits shown on the Construction Plans. However, should field conditions differ from the information shown on the reviewed and signed plans, (e.g., ground elevations, creek locations), the encasement limits shall be reviewed in the field by the District, prior to any encasement construction. Reinforced concrete encasement shall only be approved for use in special circumstances and shall require District approval prior to construction.

4.9.2. MATERIALS

Encasements shall be constructed of concrete made from well-graded aggregate and Type II cement, having a minimum twenty-eight (28) day compressive strength of 4000 psi, slump of 2"-4", and air entrainment of 3% to 5%.

Reinforcement steel used in encasements shall be ASTM A36 steel.

4.9.3. INSTALLATION

Reinforced concrete encasement shall be installed in accordance with the "Concrete Encasement" construction detail, found in Section 5 of these Specifications. Minimum clear distance between steel reinforcement and the edge of the concrete encasement shall be three inches. The encasement shall be formed using undisturbed soils or concrete formwork. Concrete shall be vibrated around steel reinforcement using vibration equipment or manual poling and shall not be placed on a frozen or unstable foundation. Suitable concrete protection shall be provided to reduce rapid moisture loss and to protect the concrete from freezing.

4.9.4. TESTING

The Contractor shall submit the concrete mix design to the District for review at least 48 hours prior to encasement construction. The District may require that concrete cylinders be sampled on-site and tested at twenty-eight (28) days to show conformance with the required twenty-eight (28) day compressive strength requirement of 4000 psi. Slump and air entrainment may also be tested at the time of concrete pour, at the District's discretion.

4.10. MARKER POSTS

Marker posts are required adjacent to manholes or other appurtenances installed outside of paved rights-of-way in order to provide a physical reference for field location.

Steel marker posts shall be four inch (4") diameter steel posts, painted yellow, and filled with concrete.

Redwood marker posts shall be 4-inch by 4-inch (4"x4") and may also be used, at the Owner's discretion.

The appurtenance description, size, type, and distance from the post shall be stenciled (steel post) or routed (wood post) directly on the marker post.

Marker posts shall be installed at the locations indicated on the reviewed and signed plans and at other locations requested by the District during construction. Marker post installation shall be performed in accordance with the details, found in Section 5 of these Specifications.

4.11. CUT OFF WALLS

Cut off walls shall be constructed of Controlled Low Strength Material (CLSM) as specified in Section 4.12.7.3. Install double wrap of polyethylene wrap around all pipe in contact with CLSM cutoff wall.

4.12. SANITARY SEWER TRENCHING & BEDDING

4.12.1. EXCAVATION

4.12.1.1. GENERAL

Excavation for sanitary sewer lines, manholes, fittings and other appurtenances shall be an open trench excavation to the depth required by the reviewed and signed Construction Plans.

All excavations shall be properly supported in the manner as required by OSHA Code of Federal Regulations, Part 1926 “Safety and Health Regulations for Construction”, Subpart P “Excavations”, Standard Number 1926.652 “Requirements for protective systems”, and the related sections, or as required by State laws and municipal ordinances, and as may be necessary to protect life, property and the work.

4.12.1.2. LIMITS OF EXCAVATION

Length - Except by expressed written permission of the District, the maximum length of open trench shall be 600 feet or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller. The distance is the collective length at any location, including open excavation, pipe laying, appurtenances, construction, and backfill. The trench shall not be left open when the Contractor has left the project site and is not engaged in construction operations, unless temporary fences or barricades are provided. Additional controls such as steel plating shall be placed by the Contractor as required by the City, County, or State, or as stipulated by local conditions, to ensure construction safety at all times.

Width - Trench width at the ground surface may vary with and depend upon the depth, type of soils, and position of surface structures. In general, the minimum clear width of the trench, sheeted or un-sheeted, measured at the top of the pipe should be one (1) foot greater than the outside diameter of the pipe. The maximum clear width of the trench at the top of the pipe should not exceed a width equal to the outside pipe diameter plus two (2) feet.

If the above defined trench widths must be exceeded, or if the pipe is installed in a compacted embankment, the pipe embankment shall be compacted to 95% Standard Proctor Density, to a point at least 2.5 (two and one-half) pipe diameters from both sides of the pipe or to the undisturbed trench walls, whichever is less.

4.12.1.3. TRENCHING BY HAND OR MACHINE

Hand methods for excavation shall be employed in locations directed by the District. The Contractor shall use whatever equipment or hand methods necessary to protect all existing utilities.

4.12.1.4. BRACING EXCAVATIONS

All excavations shall be properly supported in the manner as required by OSHA Code of Federal Registrations Part 1926, Sub-part P, Section 1926.652 and other related sections or as required by state laws and municipal ordinances, and as may be necessary to protect life, property and the work. Excavations shall be so braced, sheeted and supported that they will be safe, and the ground alongside the excavation will not slide or settle. Excavations shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times. The sheeting, shoring and bracing shall be so arranged as to not place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

Care shall be exercised in the withdrawing or removing of sheeting, shoring, bracing and timbering to prevent the caving in or collapsing of the excavation faces which are being supported.

4.12.1.5. ROCK EXCAVATION

Solid rock, boulders, and large stones shall be removed to provide a minimum clearance of at least nine (9) inches below the pipe and fittings.

In general, blasting will be allowed in order to expedite the work if a permit by the local authority having jurisdiction is granted. All explosives and appurtenances shall be transported, handled, stored and used in accordance with the laws of the local, state and federal governments, as applicable.

All blasting shall be controlled so as not to injure any existing structure or facility. Owners or occupants of nearby structures or facilities must be notified at least 72 hours in advance of blasting, in writing, by the Contractor. The notice shall state the anticipated date and time of blasting, and entity responsible for performing the blasting.

Blasting shall be controlled so as not to make any excavation unduly large or irregular as to shatter the rock on the bottom or sides of any excavation or surface upon or against which concrete is to be placed. If, in the opinion of the District, blasting could cause damage to rock foundations, supports, or structures, blasting shall not be allowed, and excavation shall be continued by jack-hammering, barring, wedging or other methods.

4.12.2. TUNNELING AND BORING

Tunneling or boring may be required by the City, State or County Highway Department where construction crosses major roadways. Boring and casing materials and construction methods shall be reviewed by the District on a case-by-case basis but will generally conform to the requirements outlined in Section 4.8 and on the "Pipe Casing" detail found in Section 5 of these specifications.

4.12.3. GRADING AND STOCKPILING

The Contractor shall control stockpiling and grading in such a manner to prevent water from flowing into excavations. Obstruction of surface drainage shall be avoided and means shall be provided to allow storm water to flow uninterrupted into existing gutters, other surface drains or temporary drains. Excavated material shall not be placed or stockpiled closer than two feet (2') from the top edge of the trench.

4.12.4. FOUNDATIONS AND SUBGRADE

4.12.4.1. GENERAL

All manholes or vault foundations and pipe subgrade installation shall be in a stable condition. Any and all questions relative to foundation and subgrade stability shall be coordinated through the District and the owner's Geotechnical Engineer. The Geotechnical Engineer will be responsible for determining if the foundation and/or subgrade are stable prior to the utility installation.

4.12.4.2. STABLE FOUNDATIONS AND SUBGRADE

The trench bottom shall be excavated six (6) inches below the invert of the pipe and structures unless otherwise designated on the plans. Before the pipe is laid, the foundation shall be prepared by backfilling with bedding material conforming to these Specifications.

4.12.4.3. DEWATERING

No sanitary sewer installations shall be made in the presence of groundwater.

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades at the bottoms of excavations. These methods may include well points, sump pumps, suitable rock or gravel drains placed below the bedding, temporary pipelines and other means, all of which shall be subject to the review of the District.

Dewatering of the sewer line trenches shall commence when groundwater is first encountered, and shall be continuous until such time that, in the opinion of the Owner's Geotechnical Engineer, it is safe to allow the water table to rise. Pipe trenches shall contain sufficient backfill to prevent pipe flotation.

The Contractor shall dispose of the water from the work site in accordance with federal, state, and local requirements, including but not limited to Colorado Department of Public Health and Environment, without damage to adjacent property or endangering public health or safety. Water shall not be drained into the sanitary sewer system.

4.12.4.4. FOUNDATIONS IN UNSTABLE SOIL

When excessively wet, soft, spongy, unstable or similarly unsuitable materials is encountered at the surface upon which the bedding material or foundations are to be placed, dewatering shall be performed and unsuitable materials shall be removed to a depth as determined in the field by the Owner's Geotechnical Engineer and the District.

The degree of soil instability will determine the limits of over excavation. In general, over excavation will be required, and stabilization rock shall be installed as indicated on the "Special Bedding" construction detail until the foundation and/or subgrade is stable as determined by the Owner's Geotechnical Engineer and the District.

4.12.4.5. OVERDEPTH EXCAVATION

Where excavation is inadvertently or otherwise carried below subgrade and/or foundation elevations, suitable provision shall be made to adjust the deeper excavation beneath pipe or structures. Over-depth backfilling, with bedding material or on-site material, shall be compacted to provide a firm and unyielding foundation, as directed by the Owner's Geotechnical Engineer and the District.

4.12.4.6. FOUNDATIONS IN ROCK

Where rock is encountered, it shall be removed below grade. The trench shall be backfilled

with clean imported bedding material to provide a compacted foundation cushion. The minimum clearance between rock and the pipe shall be nine (9) inches.

4.12.5. BEDDING

4.12.5.1. GENERAL

Unless specified otherwise on the Drawings or elsewhere in the Contract Documents, or directed otherwise by the District, the Contractor shall bed all pipelines according to these Specifications. If, in the course of construction, it is determined that the pipe foundation is unsatisfactory or the prescribed maximum allowable trench width is exceeded, the District may require that an alternative class of bedding be installed. The Contractor shall be required to place the improved bedding class or make other remedies, at their expense.

All pipe bedding materials for stable and unstable installation conditions shall be reviewed by the owner’s Geotechnical Engineer and the District, prior to delivery of the bedding to the construction site. The area indicated in the bedding details from the trench bottom to twelve (12) inches above the pipe shall be referred to as the "pipe zone". Bedding materials and installation shall meet or exceed the requirements of this section.

4.12.5.2. BEDDING MATERIAL

Shall conform to ASTM C-33 or ASTM D-448, gradation size #67 Bedding as shown in Table 4.5.

| Table 4.5 - Class 67 Gradation | |
|--------------------------------|-----------------|
| Nominal Size | % Passing by Wt |
| 1” | 100% |
| 3/4” | 90-100% |
| 3/8” | 20-55% |
| No. 4 | 0-10% |
| No. 8 | 0-5% |

This bedding shall consist of a durable crushed granular material with a well graded mineral aggregate mixture, which will provide good stability. Pipe bedding shall not contain recycled or manufactured materials. The size range of the aggregate shall be from 3/4-inch maximum with the amount of fines passing a No. 8 sieve not to exceed 5% by weight. At least 50% of the material greater than the 3/8-inch sieve shall contain particles having 3 or more fractured faces.

Substitutions of recycled materials or manufactured materials in place of mineral aggregate mixtures for pipe bedding will not be allowed.

4.12.5.3. SPECIAL BEDDING MATERIAL

Special bedding material shall only be used where required within the Contract Documents or requested within the project scope. All such bedding materials must be submitted and separately approved for use by the District. Recycled or manufactured materials will not be considered and alternate bedding materials used on site which have not been approved shall be rejected and the removal and replacement of these materials will be at the

Contractor's expense.

4.12.5.4. BEDDING INSTALLATION

The pipe shall be bedded as indicated in the "Standard Bedding" and "Special Bedding" details, found in Section 5 of these Specifications. The Contractor shall be responsible for accurately shaping the pipe subgrade to fit the bottom of the pipe. The intent is to relieve the bell of the pipe from all loading and provide continuous bearing of the pipe barrel on the bedding. Use of a drag template shaped to conform to the outer surface of the pipe will be required if other methods do not give satisfactory results.

The pipe shall be centered in the trench, adjusted to line and grade and bedding shall be simultaneously placed on both sides of the pipe as not to disturb alignment and grade. The bedding material shall be rodded, sliced, and cut under the haunches of the pipe to fill all voids. The rodding, slicing, and cutting shall be performed when the bedding material covers approximately one-third (1/3) of the pipe's diameter.

4.12.5.5. BEDDING COMPACTION

Initial bedding layer shall be laid in a uniform, level manner and compacted (i.e. hand tamping, "cutting and rodding", vibratory mechanism) as needed to achieve suitable compaction. Successive 6-inch lifts shall be laid and compacted in the same manner up to 12-inches above the top of pipe. Each lift shall be solidly compacted with the proper tools so as not to injure, damage or disturb the pipe. Backfilling shall proceed simultaneously on each side of the pipe. All bedding material shall be compacted to a minimum Relative Density of seventy percent (70%) as determined by ASTM D4253. Compaction tests for bedding may be required at the discretion of the District. Water settling for compaction is generally not permitted and must be reviewed by the District prior to its use.

4.12.5.6. BEDDING TESTING REQUIREMENTS

All bedding shall meet the gradation set forth in this Section. Bedding material shall be tested by the Owner's Geotechnical Engineer for gradation requirements, and test reports shall be submitted to the District, prior to delivery of and bedding material to the project site.

Bedding compaction may be required to be tested using the methods set forth in ASTM D4253 or other methods reviewed by the District. Compaction test results shall be submitted to the District on the working day following the test. If compaction tests do not meet these Specifications, the sub-standard area shall be reworked and retested until these Specifications are met. The location and frequency of bedding compaction testing will be determined by the District on a case-by-case basis.

4.12.6. SANITARY SEWER LINE INSTALLATION

4.12.6.1. GENERAL

Pipe shall be laid without grade break from structure to structure, with the bell ends of the pipe upgrade. Pipe shall be laid to the lines and grades shown on the reviewed and signed construction plans and shall form a close concentric joint with the adjoining pipe. The interior of the sewer pipe shall be cleaned of all dirt and superfluous material of all

descriptions, as the work progresses.

When pipe laying is not in progress, the open end of the pipe shall be closed with a tight fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon/lunch hour, and breaks, as well as overnight and on holidays. In no event shall sanitary sewers be used as drains for removing water which has infiltrated into the trench.

A water-tight plug (Pollard, or equal), shall be installed at the point of connection to the existing system at the start of construction, and shall not be removed without permission of the District.

4.12.6.2. MATERIAL REVIEW BEFORE INSTALLATION

All pipe and fittings shall be carefully examined for cracks and other defects before installation. Spigot ends of pipe shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective materials shall be set aside for review by the District. Provisions of Section 3.4 of these Specifications also apply.

4.12.6.3. LAYING OF SANITARY SEWER PIPE

Placement of PVC sanitary sewer pipe in the trench shall conform to ASTM D2321 Specification for "Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications" and these Specifications. Insofar as possible, commence laying at downstream end of line and install pipe with bell ends in direction of laying. Deviations from this will require approval from the District. Under no circumstances shall any sewer pipe be dropped or dumped into the trench.

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 put the pipe into the trench and place it without getting earth into it, the District may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size, or plastic caps, shall be placed over each end of the pipe and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed inside the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell or coupling and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with bedding material. Precautions shall be taken to prevent dirt from entering the joint space.

4.12.6.4. ALIGNMENT AND GRADE

The sewer line shall be laid and maintained to the required lines and grades as shown on the plans.

Where obstructions or field conditions are encountered during construction which interfere to such an extent that an alternation in the reviewed plans is required, the District shall have the authority to change the plans in accordance with Section 3.8 of these Specifications.

Laser beam equipment shall be used to provide line and grade.

4.12.6.5. JOINT INSTALLATION

When manufacturer's prefabricated joints are used in the laying of sanitary sewer lines, such lines shall be jointed using lubricants, primers, adhesives, solvents, etc., recommended by the pipe manufacturer. All factory fabricated joints shall be placed, fitted, joined and adjusted in such a manner as to obtain the degree of water tightness required and be in compliance with recommended methods of manufacturer, and as accepted by the District.

4.12.6.6. FITTINGS AND BRANCH INSTALLATIONS

Pipe "wyes," shall be furnished and installed along with the sanitary sewer line. Wyes of the size(s) specified on the reviewed plans shall be installed for all sanitary sewer service connections as shown on the reviewed and signed construction plans. The longitudinal barrel or branch fittings to be placed in line and grade with the sanitary sewer mains shall be of the same diameter, quality and type as the adjoining sewer line.

Installation, earthwork and bedding for branches shall conform to the applicable provisions set forth for the sewer line. Unless otherwise specified, the branch of "wye" fittings shall be inclined upward at an angle not greater than 45° from a horizontal line. No wye for a sanitary sewer service connection branch may be placed closer than 5 feet, to the downstream edge of any structure, or three (3) feet from the bell or spigot end of a pipe section, and shall be in conformance with the "Service Connection to New Construction" detail. The Contractor shall hand tamp the backfill under every "wye" branch after it is installed.

All joints for plugs shall be installed in order to withstand the internal pressure of the leakage and/or infiltration test; however, joints shall be made in such a manner that they may be removed without injury to the socket.

4.12.6.7. PIPE AT MANHOLES OR STRUCTURES

A pipe joint of the same inside diameter as the adjoining pipe shall be placed at the inlet(s) and/or outlet to each manhole or structure as shown on the reviewed and signed plans.

Pipe bells shall not be cast into manholes or structures. The bell shall be cut off so that the plain end of the pipe is flush with the inside wall of the manhole or structure, or as otherwise shown on the accepted Construction Plans.

Subsequent to placing the pipe through the boot/gasket, the Contractor shall place a 1-inch thick bead of butyl resin concrete sealant or equal between the pipe and the core hole.

4.12.6.8. SANITARY SEWER LINE TESTING AND ACCEPTANCE

(See Section 4.13)

4.12.7. BACKFILLING

4.12.7.1. GENERAL

All trenches shall be backfilled after pipe, fittings and appurtenances have been installed and reviewed. When a compaction requirement value is specified herein, the optimum moisture content and density shall be determined in accordance with the appropriate ASTM specification.

4.12.7.2. BACKFILL MATERIAL

Backfilling shall be done with on-site material, sand or gravel. No oil cake, bituminous pavement, concrete, rock or other lumpy material shall be used in the backfill unless these materials are scattered and do not exceed 3" in any dimension. Material of perishable, organic, spongy, frozen debris, or otherwise unacceptable nature shall not be used in backfilling. No material greater than 3" in any dimension shall be placed within 1 foot of any pipe, manhole or structure. Backfill material shall be subject to the review of the District.

Within the street right-of-way, the road subgrade and final grade, including base course and asphalt placement, shall be replaced in strict accordance with the appropriate City, State or County Highway Department's Standards.

4.12.7.3. CONTROLLED LOW STRENGTH MATERIAL (CLSM)

Low strength flowable fill with a 28-day compressive strength not less than 50 psi or more than 200 psi as determined in accordance with ASTM D4832. CLSM should have a design slump between 6 and 10 inches when tested in accordance with ASTM C142. Slumps of less than 6-inches will not be permitted for placement, since the flowability to avoid settlement is impaired, and strengths may increase. CLSM backfill shall be of the removable type:

Removability of backfill shall have a Removability Modulus (RM) of 1.0 or less. Removability Modulus, RM, is calculated as follows:

$$RM = (W^{1.5} \times 104 \times C^{0.5}) / 10000000$$

W = unit weight of cured (dry) sample (pcf)
C = 28-day compressive strength (psi)

All CLSM (flow-fill and flash-fill) shall meet the following requirements for mix design:

Flow-fill:

1. Flow-fill is a self-leveling concrete material composed of cement, fly ash, aggregates, water, chemical admixtures and/or cellular foam for air-entrainment.
2. Flow-fill shall have a slump of 7 to 10 inches, when tested in accordance with ASTM C143 or a minimum flow consistency of 6 inches when tested in accordance with ASTM D6103.
3. Flow-Fill shall have a minimum compressive strength of 50 psi at 28 days, when tested in accordance with ASTM D4832.
4. Flow-Fill shall be a thoroughly mixed combination of the following ingredients:

| CLSM – Flow-fill | |
|------------------|----------------------------|
| Components | lbs/CY |
| Cement | 50 |
| Coarse Aggregate | 1700 (AASHTO No. 57 or 67) |
| Fine Aggregate | 1845 (AASHTO M6) |
| Water | 325 (or as needed) |

5. The amount of water shall be such that the Flowfill material flows into place properly without excessive segregation.
6. Approximately 39 gallons of water per cubic yard of flow-fill is normally needed
7. Alternative aggregate which does not meet the above specifications may be used if the cement is increased to 100 pounds per cubic yard and the aggregate conforms to the following gradation:

| Alternative Aggregate | |
|-----------------------|-----------|
| Sieve Size | % Passing |
| 1 inch | 100% |
| No. 200 | 0-10% |

8. A substitution of 30 pounds per cubic yard of cement and 30 pounds per cubic yard of fly ash may be used for 50 pounds per cubic yard of cement
9. A substitution of 60 pounds per cubic yard of cement and 60 pounds per cubic yard of fly ash may be used for 100 pounds per cubic yard of cement.
10. Sulfate resistant cement shall be used in areas prone to sulfate attack.

Flashfill (cementious fly ash):

1. Shall consist of a controlled low-strength, self-leveling cementious material composed of various combinations of cement, fly ash, water, chemical admixtures, and/or cellular foam for air-entrainment.
2. 28-day compressive strength not less than 100 psi or more than 200 psi as determined in accordance with ASTM D4832.
3. Flash-fill shall have a slump of 8 to 11 inches, when tested in accordance with ASTM C143 or a minimum flow consistency of 8 inches when tested in accordance with ASTM D6103.
4. Fly ash shall meet the requirements of ASTM C618 Type C or Type F.
5. Use only potable water or water clean and free of chemicals
6. Entrainments and Admixtures:
 - a) Air-entraining admixtures shall conform to the requirements of ASTM C260.
 - b) Foaming agents shall conform to the requirements of ASTM C869 and C796, or as otherwise approved by the engineer
7. Flash-fill shall be air entrained with a “foaming” cellular admixture which provides frost heave resistance and to improve removability.
8. Flowable fly ash backfill shall be a thoroughly mixed combination of the following ingredients:

| CLSM – Flash-fill | |
|-------------------------------------------|---------------------------------------------------|
| Components | lbs/CY |
| Class C Fly Ash | 200 – 400 |
| Class F Fly Ash | 1600 – 1800 |
| Water | 800 (as needed for consistency) |
| Cellular air entrainment admixture (Foam) | As required to produce 15% air content or greater |

Flash-fill shall be air entrained with a “foaming” cellular admixture which provides frost heave resistance and to improve removability. Flash-fill shall have an air content of 15% to 25%, when tested in accordance with ASTM C231.

The mix shall result in a product having a slump in the range of 8 to 11 inches, when tested in accordance with ASTM C142. Slumps of less than 7-inches will not be permitted for placement, since the flowability to avoid settlement is impaired, and strengths may increase.

4.12.7.4. BACKFILL INSTALLATION

In street rights-of-way the portion of the trench above the "pipe zone" to the finished roadway surface shall be backfilled, compacted and/or consolidated by methods reviewed by the District to obtain a Standard Proctor Density of 95% (ninety-five percent) or equivalent relative density. In easements and other areas outside street rights-of-ways, the remaining portion of the trench above the "pipe zone" shall be backfilled, compacted and/or consolidated by methods reviewed by the District to obtain a Standard Proctor Density of 90% (ninety percent) or equivalent relative density.

CLSM backfill may be used when required by the District or City/County. Generally, use of CLSM backfill over sewer installations should be avoided.

Backfill to be compacted by heavy compaction equipment shall be placed in uniform horizontal lifts not exceeding 15" in depth or as specified by the District. Heavy compaction equipment shall not be used closer than three feet to walls at the top of any structure nor closer than three feet to the top of the pipe. Before each lift is compacted, the material therein shall be brought within 1% above or 3% below the optimum moisture content for the specified compaction.

Flooding, pooling, or jetting shall not be allowed unless reviewed and accepted by the District, prior to construction.

Any damage to the pipe as a result of the Contractor's backfill and compaction operation shall be repaired and/or replaced by the Contractor.

4.12.7.5. BACKFILL COMPACTION TEST

Compaction tests shall be taken by a qualified testing laboratory at locations designated by the District. All expenses involved in these tests shall be borne by the Contractor or Developer.

Copies of test results shall be provided to the District. In all cases where the tests indicate

sub-standard compaction, additional compaction effort and tests will be required until these Specifications are met. Final acceptance of the lines by the District will be contingent upon satisfactory compaction results. Leakage and deflection testing of the sewer main shall not be performed until backfill compaction conforms to these Specifications.

4.12.7.6. CLSM STRENGTH SAMPLES

The Owner will be responsible, through services of an independent laboratory, to test all placed CLSM to determine conformance with specified material properties. CLSM shall be tested prior to placement in accordance with ASTM D5971. Testing shall include test for air content in accordance with ASTM C231, unit weight in accordance with ASTM D6023, and slump in accordance with ASTM C143 or flow consistency according to ASTM D6103. Determine unconfined compressive strength using cylinders of CLSM sampled, handled, cured, and tested in accordance with ASTM D4832. Perform a minimum of one set of four cylinders for every 50 cubic yards of CLSM placed but not less than one set for each day's placement, unless otherwise directed by District. If required the bearing strength shall be determined using penetration testing in accordance with ASTM C403. If required test flow of CLSM in accordance with ASTM C939.

4.12.8. FINAL CLEAN UP

Prior to probationary acceptance, the Contractor shall clean street right-of-ways and easements of all rubbish, excess materials, temporary structures and equipment and shall leave the same areas to plus or minus 1/10 of a foot from the elevations that existed prior to construction or the final grades as shown on the reviewed and signed plans.

4.13. SANITARY SEWER LINE TESTING AND ACCEPTANCE

4.13.1. VISUAL REVIEW PRIOR TO INSTALLATION

The following imperfections in any type of pipe or special fitting will be considered defects and cause rejection.

- Any cracks, lumps, blisters, pits or flakes on any interior or exterior surface of a pipe or fittings.
- When the pipe varies from a true circle more by than 3% of its internal diameter.
- When a pipe or fitting, designated to be straight, deviates from a straight line more than 1/16" per linear foot. The deviation shall be measured using a straight edge at a point midway between the ends of the pipe.
- When a piece is broken from either the socket or spigot end.

4.13.2. FLUSHING

Prior to any testing, the lines may be required to be hydraulically cleaned at a water pressure of not less than 1000 psi to remove debris, dirt or other foreign matter. The most downstream manhole (or manholes) within the project shall be plugged with a water-tight plug (Pollard or equal) on the downstream outlet of the manhole and all water, silt and debris shall be pumped from this manhole and disposed of properly.

4.13.3. ALIGNMENT AND GRADE TESTING

After the sewer line and all appurtenances have been installed and flushed, and satisfactory compaction test results have been submitted to the District, but prior to paving, the line shall be visually reviewed by the District for alignment and grade.

100% of all new sewer installations are required to be completely videoed using CCTV. Sags, high points or other alignment or grade problems shall be repaired by the Contractor to the District's satisfaction.

4.13.4. TELEVISION INSPECTION

After completion of the pipe installation, service connections, flushing and cleaning, the sewer line shall be televised with a color closed-circuit television (CCTV) with tilt-head camera. The CCTV video of the sanitary sewer shall include at a minimum the upstream and downstream manhole number, segment footage, location footage, date, project name, operator name, pipe diameter and material, surface condition (i.e asphalt, roadway, undeveloped easement), and weather conditions. CCTV video shall be recorded to a DVD or thumb drive and submitted to the District for review. Video format shall be NAASCO/PACP 4.2 compatible with Granite XP or IT Pipes.

4.13.5. LOW PRESSURE AIR TESTING

Each section of sanitary sewer line between manholes shall be low pressure air tested in accordance with UNI-BELL UNI-B-6 and ASTM F1417, Latest Revision and as specified herein.

4.13.5.1. PLUGS

All outlets from the pipe section being tested shall be plugged and braced to prevent plug blow-out during the pressure test. Either mechanical or pneumatic plugs may be used.

4.13.5.2. PRESSURING EQUIPMENT

All pressurizing equipment used in pressure testing shall include a regulator or relief valve set no higher than 9.0 psi to prevent over-pressurizing the line and to prevent plug displacement.

The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0.0 to at least 10.0 psi. The continuous monitor gauge shall be at least 4-inches in diameter, with a minimum division of 0.10 psi and an accuracy of + 0.04 psi.

Two separate hoses shall be used. One to connect the control panel to the sealed line for introduction of low pressure air, and another separate hose connection for measurement of air pressure buildup in the line.

4.13.5.3. LINE PRESSURIZING

Low pressure air shall be slowly introduced into the sealed line until the air pressure reaches a value of 4.0 psi.

If the line being tested is in a groundwater condition, the internal air pressure value of 4.0 psi shall be increased to include the addition of groundwater pressure on the pipe.

The additional pressure shall be calculated by adding 0.433 psi internal air pressure for each foot of water over the sealed pipes invert, but the maximum allowable internal air pressure in the pipe shall not exceed 9.0 psi. Therefore, the low pressure air test may be used in a groundwater condition as long as the average depth of water over the line does not exceed 11.5 feet. Should the average groundwater depth exceed 11.5 feet, the infiltration test shall be performed in accordance with Section 0 of these Specifications.

4.13.5.4. PRESSURE STABILIZATION

After a constant pressure of 4.0 psi, (or 4.0 psi greater than groundwater back pressure over the pipe) is reached, the air supply shall be throttled to maintain the 4.0 psi air pressure for two (2) minutes. This allows the temperature of the air to equalize with the temperature of the pipe.

4.13.5.5. TIMED PRESSURE LOSS

After pressure stabilization, the air hose from the air supply shall be disconnected or shut off. The continuously monitoring pressure gauge shall be observed while the pressure is decreased to 3.5 psi (or 3.5 psi greater than the back pressure of any groundwater over the pipe). At that time, timing shall commence using a stopwatch, and the time interval measured until the internal pressure reaches 3.0 psi (or 3.0 psi greater than the back pressure of any groundwater over the pipe).

4.13.5.6. PASSING TEST REQUIREMENTS

If the timed pressure loss is greater than the minimum time outlined in the following tables, the segment undergoing the test shall pass. If the minimum time in Tables 4.5 & 4.6 is not met, the air loss is considered excessive and the test fails.

TABLE 4.6 – MINIMUM TIME FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE FOR Q = 0.0015

Note 1: Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. diameter.

| Pipe Dia., in. | Min. Time, min:s | Length for Min. Time, ft | Time for Longer Length,s | Specification Time for Length (L) Shown, min:s | | | | | | | | |
|----------------|------------------|--------------------------|--------------------------|------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|------|
| | | | | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft | |
| 4 | 3:46 | 597 | 0.380 L | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 |
| 6 | 5:40 | 398 | 0.854 L | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:42 | 6:24 |
| 8 | 7:34 | 298 | 1.520 L | 7:34 | 7:34 | 7:34 | 7:34 | 7:36 | 8:52 | 10:08 | 11:24 | |
| 10 | 9:26 | 239 | 2.374 L | 9:26 | 9:26 | 9:26 | 9:53 | 11:52 | 13:51 | 15:49 | 17:48 | |
| 12 | 11:20 | 199 | 3.418 L | 11:20 | 11:20 | 11:24 | 14:15 | 17:05 | 19:56 | 22:47 | 25:38 | |
| 15 | 14:10 | 159 | 5.342 L | 14:10 | 14:10 | 17:48 | 22:15 | 26:42 | 31:09 | 35:36 | 40:04 | |
| 18 | 17:00 | 133 | 7.692 L | 17:00 | 19:13 | 25:38 | 32:03 | 38:27 | 44:52 | 51:16 | 57:41 | |
| 21 | 19:50 | 114 | 10.470 L | 19:50 | 26:10 | 34:54 | 43:37 | 52:21 | 61:00 | 69:48 | 78:31 | |
| 24 | 22:40 | 99 | 13.674 L | 22:40 | 34:11 | 45:34 | 56:58 | 68:22 | 79:46 | 91:10 | 102:33 | |
| 27 | 25:30 | 88 | 17.306 L | 25:30 | 43:16 | 57:41 | 72:07 | 86:32 | 100:57 | 115:22 | 129:48 | |
| 30 | 28:20 | 80 | 21.366 L | 28:20 | 53:25 | 71:13 | 89:02 | 106:50 | 124:38 | 142:26 | 160:15 | |
| 33 | 31:10 | 72 | 25.852 L | 31:10 | 64:38 | 86:10 | 107:43 | 129:16 | 150:43 | 172:21 | 193:53 | |
| 36 | 34:00 | 66 | 30.768 L | 34:00 | 76:55 | 102:34 | 128:12 | 153:50 | 179:29 | 205:07 | 230:46 | |

TABLE 4.7 – MINIMUM TIME FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE FOR Q = 0.0015

Note 1: Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. diameter.

| Pipe Dia. (in) | Min. Time, min:s | Length for Min. Time, ft | Time for Longer Length, s | Specification Time for Length (L) Shown, min:s | | | | | | |
|----------------|------------------|--------------------------|---------------------------|------------------------------------------------|--------|--------|--------|--------|--------|--------|
| | | | | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft |
| 4 | 1:53 | 597 | 0.190 L | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 |
| 6 | 2:50 | 398 | 0.427 L | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:51 |
| 8 | 3:47 | 298 | 0.760 L | 3:47 | 3:47 | 3:47 | 3:47 | 3:48 | 4:26 | 5:04 |
| 10 | 4:43 | 239 | 1.187 L | 4:43 | 4:43 | 4:43 | 4:57 | 5:56 | 6:55 | 7:54 |
| 12 | 5:40 | 199 | 1.709 L | 5:40 | 5:40 | 5:42 | 7:08 | 8:33 | 9:58 | 11:24 |
| 15 | 7:05 | 159 | 2.671 L | 7:05 | 7:05 | 8:54 | 11:08 | 13:21 | 15:35 | 17:48 |
| 18 | 8:30 | 133 | 3.846 L | 8:30 | 9:37 | 12:49 | 16:01 | 19:14 | 22:26 | 25:38 |

Line Repair or Replacement - If the section being tested fails, the Contractor may be required to video the sewer line to determine the location of the defective area. The defective pipe shall be repaired or replaced and the low pressure air test performed until the test requirements are satisfied.

4.13.6. PIPE DEFLECTION TESTING

All sanitary sewer systems constructed of PVC pipe shall be tested for vertical ring deflection using a properly sized "Go, No-Go" Mandrel, or sewer ball. Maximum allowable vertical ring deflection shall be 5% of the pipe mean internal diameter. Tables 4.8 and 4.9 indicate minimum mandrel diameters for testing. Pipe shall be tested after backfill and compaction. Mandrel shall be suitable for the pipe type installed and maximum allowed deflection specified. Any pipe not meeting deflection limits shall be removed and replaced.

| Table 4.8 – 5% Deflection Mandrel Dimensions for SDR35 PVC Sewer Pipe | | |
|-----------------------------------------------------------------------|-----------------|-------------------|
| Nominal Size (in) | Nominal ID (in) | Mandrel Size (in) |
| 8 | 7.920 | 7.524 |
| 10 | 9.900 | 9.405 |
| 12 | 11.780 | 11.191 |
| 15 | 14.426 | 13.705 |
| 18 | 17.629 | 16.748 |

| Table 4.9 – 5% Deflection Mandrel Dimensions for C900/905 PVC Sewer Pipe | | |
|--------------------------------------------------------------------------|-----------------|-------------------|
| Nominal Size (in) | Nominal ID (in) | Mandrel Size (in) |
| 8 | 7.98 | 7.581 |
| 10 | 9.79 | 9.301 |
| 12 | 11.65 | 11.068 |
| 16 | 15.35 | 14.583 |
| 18 | 17.20 | 16.340 |

4.13.7. INFILTRATION TESTING

Where specified by the District, infiltration testing shall be performed instead of low pressure air testing. This generally would occur when a severe groundwater condition is present. The allowable infiltration for any portion of the sanitary sewer system shall not exceed 50 gallons per inch of inside pipe diameter per mile, per day (50 Gal/in-dia/mi/day), including manholes. The amount of infiltration shall be measured using a pipe weir, flume or other method proposed by the District. Groundwater pumping or dewatering shall not occur adjacent to lines being tested for a period of at least three days prior to the infiltration test.

The following Table 4.10 outlines the allowable units of infiltration for various sizes of pipe.

| Table 4.10 – Allowable Limits of Infiltration | |
|------------------------------------------------------|-------------------------------------|
| Sewer Diameter (in) | Infiltration (Gal/hr/100-ft) |
| 8 | 0.32 |
| 10 | 0.40 |
| 12 | 0.48 |
| 15 | 0.60 |
| 18 | 0.72 |
| 21 | 0.84 |
| 24 | 0.96 |

Note: (50 Gal/in-dia/mi/day = 0.04 Gal/in-dia/100-ft/hr)

4.13.8. INTERIOR COATING TESTING

After the protective lining has set hard to the touch it shall be inspected with high-voltage holiday testing equipment. All detected holidays shall be marked and repaired by abrading the coating surface with grit disc paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be applied to the repair area. All touch-up procedures shall follow the protective coating manufacturer’s recommendation. A final visual inspection will also be required and may require a manufacturer’s representative if determined by the District. The District also reserves the right to request a bond strength test.

4.13.9. CONVEYANCE AND ACCEPTANCE

Conditional and final acceptance by the District of facilities intended to be owned and operated by the District shall be accomplished as provided in Article 6 of the Rules and Regulations.

4.13.10. FINAL TESTING

Approximately 11 months after the start of the Warranty Period, the District will perform a final inspection and provide Owner/Contractor a final punch-list identifying any items in need of repair or replacement. The District will review 100% of the installed line segments by CCTV video inspection for grade variations, separated pipes, leaks, deflection, debris, cracked, broken or otherwise defective pipe to ensure overall pipe integrity.

SECTION 5 – CONSTRUCTION DETAIL DRAWINGS

| | |
|-------|-------------------------------------------------------------------------|
| SS-01 | Standard Bedding for Sanitary Sewer Lines |
| SS-02 | Special Bedding for Sanitary Sewer Lines |
| SS-03 | Standard Manhole |
| SS-04 | Manhole on Existing Sewer |
| SS-05 | Manhole Base and Deflector |
| SS-06 | Standard 24" Ring and Cover |
| SS-07 | Aluminum 24" Ring & Bolt Down Cover |
| SS-08 | 36" x 24" Double Ring and Cover |
| SS-09 | Plastic Step |
| SS-10 | Manhole Stub-Out (Future Connection) |
| SS-11 | Outside Drop Manhole for Pipe 15" & Smaller |
| SS-12 | Outside Drop Manhole for Pipe 18" & Larger |
| SS-13 | PVC Pipe Service Connection to New Construction |
| SS-14 | Service Connections to Existing Construction |
| SS-15 | Optional Service Connection to Existing Mains 15" and Larger |
| SS-16 | Sewer Service Connection to Existing Interceptor |
| SS-17 | Concrete Encasement Detail |
| SS-18 | Steel Casing For Carrier Pipe |
| SS-19 | Cathodic Protection & Test Station |
| SS-20 | CLSM Cut-Off Wall |
| SS-21 | Standard Steel Marker Post |
| SS-22 | Redwood Marker Post |
| SS-23 | Sanitary Sewer Line Repair |
| SS-24 | Sanitary Sewer Service Cleanout |
| SS-25 | Sanitary Sewer Manhole Abandonment |
| SS-26 | Service Line Abandonment Detail |
| SS-27 | Sanitary Sewer Gravity Grease Interceptor |
| SS-28 | Sanitary Sewer Sand/Oil Interceptor |
| SS-29 | Sanitary Sewer Trench with Privately Owned Underdrain |
| SS-30 | Sanitary Sewer Service Plan Connections with Privately Owned Underdrain |
| SS-31 | Southgate Sanitation District General Notes |
| SS-31 | Typical Utility Cross Section in Easement |

APPENDIX A - SANITARY SEWER DRAWING REQUIREMENTS

This checklist is intended as a general guideline only, and is subject to additional project-specific requirements.

A. General Plan Information

1. 1st submittal sheet size 24" x 36"
2. Vicinity Map and Location Map
3. Index to drawings
4. List of quantities
5. Contact List, including owner/developer, project engineer, agencies, surveyor, soils engineer, etc.
6. Southgate Sanitation District System Plan Notes
7. Professional Engineer, State of Colorado, seal and signature on every sheet
8. North arrow on vicinity map, location map and each plan view
9. Title block on each sheet
10. Bench mark, including U.S.G.S. datum, location, elevation and monument type
11. Street alignment and names (existing and proposed) shown on overall plan
12. Existing and Final grades shown on profile
13. Typical street cross-section(s)
14. Street addresses, lot, and block number for all lots and/or buildings indicated on plan
15. Property, easement and tract lines shown on plan
16. Existing and new improvements identified
17. Match lines and sheet references called out in plan and profile
18. Street cross-pans shown
19. Sewer main extensions, all sizes, shown in both plan and profile
20. All other utilities shown (water, storm, communications, electric, gas, etc.) in plan and profile
21. Located within a minimum of 30' ROW or Southgate dedicated easement without encroachments
22. Sewer line horizontal alignment generally 10' south and west of street centerline, 5' minimum from lip of cross pan or gutter, and 10' minimum from ROW or easement line
23. Sewer system details included
24. Note added to plans: "No connections to existing systems shall be made until the new system has been tested and accepted by Southgate Sanitation District"
25. Flow development information shown, including building use, total square footage, number of residential units, and calculated average and peak flows

B. Sanitary Sewer - Plan View Requirements

1. Scale: 1" = 40'
2. Linear footage, pipe type, and size called out on each segment of pipe
3. Outside angles between sewer segment noted at each manhole (deflection angle)
4. Manholes numbered, stationed with northings/eastings
5. Service wyes, including location, size, manhole reach, lot or building number, northing/easting, stationing from nearest downstream manhole, right or left-side connection looking upstream, and the invert of the main at wyes and plugs shown in tabular form on the plans
6. Flow direction arrows shown
7. Service connections shown

8. Manhole markers shown for sewer lines outside of paved ROW/easement
9. Sewer lines dimensioned from street centerline or property line, from all other utilities, and from nearest flow line
10. A minimum of 10 feet workable easement margin on each side of the sewer line
11. Minimum 10 feet horizontal separation from water utilities centerline to centerline, minimum 5 feet horizontal separation from other utilities outside of pipe to outside of pipe

C. Sanitary Sewer - Profile View Requirements

1. Scale: Horizontal 1" = 40'
Vertical 1" = 4'
2. Manholes numbered and stationed
3. Linear footage, pipe type, and size called out on each segment of pipe
4. Entering and existing pipe invert elevations, rim elevations, depths identified for each manhole
5. Minimum 6 feet of cover from finished grade to the top of pipe
6. Hydraulic calculations (Q, V, D, d/D, S, and n=0.013) shown for each segment of pipe
7. Service connection locations noted
8. Inside manhole drop between inverts of highest entering pipe and lowest existing pipe not to exceed 1-1/2 inches
9. Connections to existing system shown on profile
10. Crossings with other utilities shown on profile
11. Minimum 1-1/2 feet vertical separation from other utilities outside of pipe to outside of pipe

**APPENDIX B – SANITARY SEWER SERVICE LINE ONLY DRAWING
REQUIREMENTS**

This checklist is intended as a general guideline only, and is subject to additional project-specific requirements. In certain cases, sewer service line plan requirements may be included in the “Water Service Line Only” plan submittal – discuss project with Engineering Staff prior to 1st submittal to determine if permitted.

A. General

1. Submittal sheet size 24”x36”.
2. Vicinity Map and Location Map.
3. Contact List, including owner/developer, project engineer, agencies, surveyor, soils engineer, etc.
4. Southgate Sanitation District System Plan Notes.
5. Professional Engineer, State of Colorado, seal and signature on every sheet.
6. North arrow on vicinity map, location map, and each plan view.
7. Title block on each sheet.
8. Bench mark, including U.S.G.S. datum, location, elevation and monument.
9. Building limits indicated on plans.
10. Street addresses, lot, and block number for all lots and/or buildings indicated on plan.
11. Street alignment and names shown on plans.
12. Property, easement and tract lines shown on plan view.
13. Existing and new improvements identified.
14. All other utilities shown (water, storm, communications, electric, gas, etc.) in plan and profile.
15. Service line location shown with clearances from other utilities noted.
16. Point of connection shown at Southgate sewer main and at building.
17. Linear footage, pipe, type, size, and slope called out on each segment of pipe.
18. Cleanouts located at change of direction.
19. Dimension from nearest manhole.
20. Note size, type and depth/elevation of sewer main at connection.
21. Include, at a minimum, the following sewer system details as applicable;
 - a) Service line connection
 - b) Cleanout
 - c) Typical trench
 - d) Standard manhole (if applicable)
 - e) Manhole ring and cover (if applicable)

APPENDIX C – STANDARD SEWER EASEMENT AGREEMENT**EASEMENT AGREEMENT**

(Sanitary Sewer Non-Exclusive)

THIS EASEMENT AGREEMENT, hereinafter “Agreement”, effective the _____ day of _____, 2016, is made between **[GRANTOR’S LEGAL NAME]**, a [type of company, ex: Colorado Corporation], and any assigns or successors in interest, hereafter called “Grantor”, (whether grammatically singular or plural) and **SOUTHGATE SANITATION DISTRICT**, Arapahoe and Douglas Counties, Colorado, a quasi-municipal corporation and political subdivision of the State of Colorado, hereinafter called “District,” whose legal address is 3722 East Orchard Road, Centennial, Colorado 80121.

WITNESSETH:

For good and valuable consideration, the receipt and sufficiency whereof are acknowledged, Grantor hereby grants to the District, its successors and assigns, a permanent non-exclusive right to enter, reenter, occupy and use the property situate in the County of [Arapahoe or Douglas], State of Colorado, and more fully described on **Exhibit A** attached hereto and incorporated herein by reference (the “Property”) to construct, lay, install, inspect, monitor, maintain, repair, renew, substitute, change the size of, replace, remove, and operate one or more underground sanitary sewer pipelines and all underground and surface appurtenances thereto, including electric or other related control systems, underground cables, wires and connections and surface appurtenances in, through, over and across the Property. By way of example and not by way of limitation, the parties intend to include within the terms “pipelines” and “appurtenances” the following: mains and interceptors, vaults, manholes, control systems, ventilators, and the like, of such size and capacity as necessary or required by the District.

IT IS HEREBY MUTUALLY COVENANTED AND AGREED by and between the parties as follows:

1. The District shall have and may exercise the right of ingress and egress in, to, over, through and across the Property for any purpose needful for the full enjoyment of any other right of occupancy or use provided for herein.

2. Grantor shall neither cause nor permit the parking or storage of vehicles or other goods or equipment, or the construction or placement of any structure or building, street light, power pole, yard light, mailbox or sign, temporary or permanent, or the planting of any tree, woody plant or nursery stock, of any kind, on any part of the Property. Where paved roadways are installed on all or any part of the surface of the Property they shall be installed and maintained by Grantor on and over the entire width thereof, with no planters, islands or median structures. The lateral edges of the Property shall be clearly delineated by permanent surface features approved in advance by the District. Any prohibited use or installation located on the Property as of or after the date of this Agreement, including utility installations not conforming to Paragraph 11 (eleven) hereof, may be removed by the District at Grantor’s expense without liability for damages arising therefrom.

3. The Grantor, for itself, its successors and assigns, shall provide to the District any information within its possession about past and currently existing Environmental Contamination in the easement area. Such information shall include but not be limited to environmental studies, reports, samples, agreements, liens, letters and any remediation work that has been done or is ongoing to clean the area or is planned to occur. If contaminated soils exist in the easement area upon the effective date of this Agreement, for which the Grantor or its successors or assigns are responsible under applicable state or federal laws, the Grantor, at Grantor’s sole expense, shall take Corrective Action to clean the contamination to the full width of the

easement area and a depth of at least twelve (12) feet from finished grade or to two (2) feet below the bottom of the sanitary sewer line as determined by the District. Contamination shall be cleaned to the appropriate state and federal standards set forth by the U.S. Environmental Protection Agency and Colorado Department of Public Health and Environment or to the standards of Corrective Action plans for the property currently approved by the U.S. Environmental Protection Agency and Colorado Department of Public Health and Environment. Grantor shall provide documents verifying Corrective Action to the District prior to the installation of pipeline facilities.

4. To the extent it legally may, and as long as the District did not cause Environmental Contamination, the Grantor, for itself, its successors and assigns, shall indemnify the District against any liability, damages, costs, expenses, causes of action, claims, losses, settlements, fines and penalties, and reasonable attorneys' fees claimed against the District relating to (1) the existence, mitigation, or remediation of Environmental Contamination in the easement area; (2) any Corrective Action in the easement area; (3) any Environmental Contamination in the easement area that occurs or is discovered after conveyance of the easement; or (4) the occurrence, disturbance, or movement of existing contaminated soils resulting directly or indirectly from any work conducted by the District in exercise of the District's functions.

5. As used in this Agreement, "Corrective Action" shall refer to risk assessment, active remediation, passive remediation, voluntary cleanup, investigation and/or monitoring of Environmental Contamination.

6. As used in this Agreement, "Environmental Contamination" means the presence within the easement area of any hazardous material, including but not limited to any substances defined as or included in the definition of "hazardous substance," "hazardous material" or "toxic substances" in the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9601, et seq., the Hazardous Materials Transportation Act, 49 U.S.C. § 5101, et seq., the Resource Conservation and Recovery Act, 42 U.S.C. § 6901, et seq., or any other federal, state or local statute, law, ordinance, code, rule, regulation, order, decree or other requirement of governmental authority regulating, relating to or imposing liability or standard of conduct concerning any hazardous, toxic or dangerous substance or material, as now or at any time hereafter in effect, and in the regulations adopted, published and/or promulgated pursuant to said laws.

7. Fences existing as of the date hereof which are disturbed or destroyed by the District in the exercise of its rights hereunder shall be replaced by the District to their original condition as nearly as may reasonably be done. Grantor shall not, however, construct or install new fencing across or within the Property without the written approval of the District.

8. All pipelines installed within the Property shall be laid not less than six (6) feet below the surface of the adjacent ground.

9. The District shall have and exercise the right of subjacent and lateral support to whatever extent is necessary or desirable for the full, complete and unmolested enjoyment of the rights herein granted. Grantor shall neither take nor permit any action which would impair the lateral or subjacent support for any sanitary sewer pipelines or appurtenances or cause the earth cover over any sanitary sewer pipeline within the Property to be less than six (6) feet, measured vertically from the top of the pipeline. Grantor shall not modify the earth cover over a District sanitary sewer pipeline without advance written authorization from the District, which shall provide for full payment or reimbursement to the District of all costs of adjusting District facilities made necessary by such modification.

10. After any construction or other operations by the District which disturb the surface of the Property, the District will restore the general surface of the ground, including paving and authorized appurtenances, as nearly as may reasonably be done to the grade and condition it was in immediately prior to construction, except as necessarily modified to accommodate District facilities. Topsoil shall be replaced in cultivated and agricultural areas, and any excess earth resulting from installations by the District shall be removed from the Property at the sole expense of the District. For a period of one year following disturbance of the surface of the Property by the District, the District will maintain the surface elevation and quality of

the soil by correcting any settling or subsiding that may occur as a result of the work done by the District.

11. Service lines from adjacent properties receiving service from District facilities in the Property, and other public utilities such as sanitary sewer, storm sewer, gas, electric, telephone, and TV cable lines, may be installed in the Property, *provided* that they do not interfere with the District's rights herein granted. Public utilities which cross the Property shall cross at approximately right angles, and utilities which parallel the District's facilities shall not be located closer than ten (10) feet thereto. Except for utilities as herein authorized and for roadways, all surface and subsurface uses of the Property, including fences, must be approved in writing by the District before installation.

12. Grantor retains the right to the undisturbed use and occupancy of the Property insofar as such use and occupancy are consistent with and do not impair any grant or covenant herein contained.

13. The District is acquiring its rights in the Property in order to insure to it a dominant easement for the exercise of the District's functions. The exercise of any rights in the Property other than those expressly retained by Grantor shall be within the discretion of the District. The District may permit and authorize such other uses of the Property not reserved in Grantor as will not impair the District's dominant rights, upon payment of reasonable compensation to the District and upon such terms, limitations and conditions as the District shall find reasonably necessary to protect its dominant right of occupancy without undue or unnecessary injury to or impairment of the estate retained by the Grantor.

14. If the District, by written instrument, abandons or releases its rights herein granted and ceases to use the same, all right, title and interest of the District hereunder shall cease and terminate, and the Grantor or its successors in title shall hold the Property, as the same may then be, free from the rights so abandoned or released and shall own all material and structures of the District so abandoned or released, but nothing herein shall be construed as working a forfeiture or abandonment of any interest derived hereunder and not owned by the District at the time of the termination of the District's rights.

15. Grantor warrants that it has full right and lawful authority to make the grant herein contained, and promises and agrees to defend the District in the exercise of its rights hereunder against any defect in title or in Grantor's right to make said grant, subject to general taxes for the year this instrument is recorded, and subject further to easements, encumbrances, exceptions, limitations, restrictions and reservations contained in instruments of record prior to the date of this Agreement.

16. Each and every one of the benefits and burdens of this Agreement shall inure to and be binding upon the respective legal representatives, heirs, executors, administrators, successors and assigns of the parties hereto.

17. This writing constitutes the whole agreement between the parties and no additional or different oral representation, promise or agreement shall be binding on any of the parties hereto with respect to the subject matter of this instrument. Any special provisions added hereto which conflict with printed provisions set forth above shall control and supersede such conflicting printed provisions.

18. SPECIAL PROVISIONS:

APPENDIX D – RECORD DRAWING PROCEDURES**1. Record Drawing Requirements**

Surveyed Record Drawings of the main extension project shall be submitted for review and approval as a condition for project Acceptance, and subsequently a condition of releasing the project for tap sales.

2. Construction Plans

The Contractor shall maintain on the job site, a dedicated, full-set of approved construction plans marked to fully indicate field installed conditions (contractor redlines). These drawings shall be maintained in a current condition at all times until completion of the work and shall be available for review by Southgate at all times. All variations from the approved Construction plans, including those occasioned by optional materials or those required by coordination between trades, shall be indicated. These variations shall be shown in the same general detail utilized in the original design.

3. Field Survey Requirements

The following Datum shall be used:

Vertical: NAVD 88

**Horizontal: NAD 83 Colorado Central State Plane (modified to ground)
Conversion factor shall be provided to convert back to State Plane (grid)**

For water projects: All surface appurtenances shall be surveyed (valves, fire hydrants, etc.). Note on drawings if survey was performed prior to, or after final lifts of paving.

For sewer projects: All surface appurtenances shall be surveyed (e.g. manholes, etc.). All manhole pipe inverts shall be surveyed prior to manhole barrel and/or cone sections being placed. Note on drawings if rims were surveyed prior to, or after final lifts of paving.

4. Record Drawing Plan Submittal

There are **2 STEPS** to follow in order to complete the Record Drawing process:

STEP 1 – Draft Plan Submittal and Review

Upon completion of the work, the marked set of construction plans (contractor redlines) and a copy of the certified Field Survey Notes obtained from the surveyor's as-built collection points shall be furnished to the Project Engineer. The Project Engineer shall prepare a *draft* version of the Record Drawings for Southgate review.

The following items shall be included as part of the 1st Draft Plan Submittal:

1. Certified Field Survey Notes – if in electronic format, points shall clearly identify the feature

being referenced

2. Contractor redlines
3. Draft Surveyed Record Drawings submitted for review including the following:
 - a. Every sheet shall be stamped “Surveyed Record Drawing”
 - b. Engineer Certification – every sheet shall be attested to and sealed by a Colorado Registered Engineer (signature required only on final submittal)
 - c. Surveyor Certification – this shall be provided, as a minimum, on the cover sheet (signature required only on final submittal)
 - d. Surveyed Northings and Eastings (N/Es) shall be updated and noted – update N/Es by striking through original N/Es and adding actual N/Es.
 - e. CAD files shall reflect the actual physical location of the updated N/Es by moving valves, manholes, etc. to their new locations.
 - f. Pipe inverts, pipe lengths, pipe slopes, etc. (including hydraulic calculations on the plans) shall be updated by striking through original data and adding actual data.
 - g. Plans indicate whether rims were surveyed prior to, or after final lift of paving.
 - h. Quantity list is updated to included materials (manufacturer/model) used
 - i. The following construction information added to the Cover Sheet:
 - i. Date Installed:
 - ii. Contractor:
 - iii. Southgate Field Representative:
 - iv. Owner/Developer:
 - v. Project Engineer:
 - vi. Soils Engineer:
 - vii. Surveyor:

STEP 2 – Final Plan Submittal

Following Southgate’s review the draft submittal, the Project Engineer will then prepare the final submittal package based on Southgate’s review comments and submit to Southgate. The final submittal package shall include the following items:

1. Two bound, signed, half-sized print sets (11” x 17”)
2. A disc containing both electronic file (latest version of AutoCAD) and .pdf files
 - a. Electronic drawings shall include appropriate linetypes/styles per Southgate CAD Standards.

Note that Surveyed Record Drawings must be completed prior to purchasing taps.

APPENDIX E – STANDARD SEWER IMPROVEMENTS AGREEMENT**IMPROVEMENTS AGREEMENT
(SEWER)**

1. **PARTIES.** The PARTIES to this AGREEMENT are the **SOUTHGATE SANITATION DISTRICT**, Arapahoe and Douglas Counties, Colorado, a quasi-municipal corporation and political subdivision of the State of Colorado (the “DISTRICT”) whose legal address is 3722 East Orchard Road, Centennial, Colorado 80121, and, **[APPLICANT’S LEGAL NAME]** a **[TYPE OF COMPANY]** (the “APPLICANT”) whose legal address is **[APPLICANT’S ADDRESS]**.
2. **RECITALS AND PURPOSE.** The APPLICANT is the owner of certain real property as further described herein. The APPLICANT has determined to undertake sewer system improvements associated with the development of the property. The DISTRICT is a Title 32 special district organized under Colorado law which provides service to its customers for which monthly service charges are imposed. DISTRICT’s service is contingent upon APPLICANT’s extension of the applicable main lines to or within the property to be serviced and then upon APPLICANT’s purchase of taps pursuant to DISTRICT Rules and Regulations. The purpose of this AGREEMENT is to set forth the terms and conditions concerning APPLICANT’s extension of the necessary main lines. Accordingly, the PARTIES agree to the following provision in consideration of the mutual covenants set forth herein. No express or implied reservation or limitation of capacity is made herein.
3. **LEGAL DESCRIPTION OF PROJECT.** The APPLICANT desires to develop that certain parcel of real property located in the **[SECTION, TOWNSHIP, RANGE, COUNTY, STATE THAT PROJECT IS LOCATED IN]**, commonly known as **[COMMONLY KNOWN NAME]**. For purposes of this AGREEMENT, the term “PROJECT” or “PROPERTY” shall mean the property so described. The map provided in this AGREEMENT is for reference only and is not a binding legal description of the PROPERTY. The APPLICANT agrees to furnish a reproducible copy of the approved plat or improvements plan to the DISTRICT and the conditions and restriction of said plat or plan are expressly incorporated in this AGREEMENT. Any subsequent change or alteration in the area, size, shape, usages, requirements, or timing of development of the PROJECT which may affect the size or configuration of main or service lines needed to service the PROJECT shall be subject to further engineering review and plan revisions by the DISTRICT.
4. **DESIGN SPECIFICATIONS AND CONSTRUCTION.**
 - 4.1 The main line extension(s) which are required to service the PROJECT are: as set forth on plans entitled “**[TITLE OF CONSTRUCTION DRAWINGS]**”, as prepared by **[A/E COMPANY’S NAME ON DWGS]** for DISTRICT Project Number **[Project #]**, stamped and dated by **[RESPONSIBLE ENGINEER’S NAME ON DWGS]** on **[DATE DWGS WERE STAMPED BY ENGINEER]**.
 - 4.2 It is agreed, as a condition precedent to service to the PROJECT, that all necessary main and service lines and appurtenant facilities which are to be constructed both within and without the PROJECT and which are necessary to connect with the main lines of the DISTRICT as presently engineered and installed, or as proposed for construction pursuant to this AGREEMENT, shall be in accordance with design and engineering standards and specifications as established by the DISTRICT and which may be modified or amended from time to time.
 - 4.3 Within thirty calendar days of execution of this AGREEMENT, APPLICANT shall submit detailed construction plans and engineering designs to the DISTRICT for its review and approval prior to the commencement of any construction of said extension or extensions. The APPLICANT and DISTRICT’s Engineer shall schedule and conduct a preconstruction meeting prior to any construction.
 - 4.4 The PARTIES understand and agree that the APPLICANT and APPLICANT’s successors in interest or in title shall be solely and exclusively responsible for service lines (those lines which

run from the individual tap to the individual structure or facility serviced) pursuant to DISTRICT's Rules and Regulations.

- 4.5 APPLICANT agrees that the actual installation and construction shall be subject to the supervision and inspection by the DISTRICT and all costs of engineering study, review and approval and inspection shall be at the cost of, and paid by, APPLICANT. APPLICANT further agrees to give the DISTRICT, through the DISTRICT's Engineer, adequate notice but in no event less than two working days, prior to commencement of construction, of the date when such construction shall begin.
- 4.6 Conditions precedent to the DISTRICT'S providing service to the PROJECT shall include but not be limited to completion of construction, testing, inspection and approval by the DISTRICT's Engineer, payment of all construction costs and fees and charges of the DISTRICT, and delivery to the DISTRICT of a complete and accurate set of "as built" drawings showing the exact location of all constructed lines and facilities, including service lines.
- 4.7 Upon execution of this AGREEMENT, or at such time or times as may be requested by DISTRICT, APPLICANT agrees to furnish DISTRICT a topographical survey of the PROPERTY described in this AGREEMENT; or a recorded subdivision plat (or individual plats if the PROJECT is phased) approved by appropriate regulatory agencies, together with requirements and conditions fixed by such agencies for development and evidence of the APPLICANT's compliance or plan for compliance.

5. EASEMENTS NECESSARY TO SERVE PROJECT.

- 5.1 APPLICANT shall furnish, at APPLICANT's expense, a title insurance commitment or other evidence of title pursuant to DISTRICT's Rules and Regulations. APPLICANT shall thereafter furnish, at APPLICANT's sole expense, all easements, rights-of-way, or consents within the PROJECT (other than dedicated utility easements or rights of way designated in any recorded plat) which may be required before the construction of any portion of the main lines and appurtenant facilities which may be needed to service the PROJECT. Such easements, rights-of-way or consents shall be provided prior to commencement of construction.
- 5.2 APPLICANT shall coordinate with the DISTRICT to obtain all easements and rights-of-way which are necessary to extend the main lines from the DISTRICT's existing facilities to the boundary of the PROPERTY. APPLICANT shall be solely responsible for and pay, directly or indirectly, all costs and expenses of whatever kind which may be required or associated with the acquisition of such easements and rights-of-way. In the event that such easements and rights-of-way are required to be obtained from any private party or entity, such costs and expenses shall include the consideration paid to such property owner for such easement or easements, together with all costs and expenses which the DISTRICT may incur in obtaining such easements through eminent domain or other process, including without limitation, real estate appraisals, expert witness fees, attorneys fees, court costs, mediation/arbitration expenses, and all other costs and expenses incurred in conjunction therewith. Nothing herein shall be construed as imposing any requirement upon, or consent by, the DISTRICT to utilize its powers of eminent domain.
- 5.3 All such easements, rights of way or consents, including any dedications, shall be free of any prior lien or encumbrance. DISTRICT, at its discretion, may require a properly executed and acknowledged release to exempt such easements and rights-of-way from the prior lien of any mortgage or deed of trust.
- 5.4 All easements and rights-of-way granted to the DISTRICT shall consist of a legal description certified by a land surveyor licensed by the State of Colorado, and an accurate survey drawing of such property or properties indicating the easements and their dimensions. The actual documents of conveyance shall be subject to and in conformity with DISTRICT's standard procedures and approved forms as may be amended from time to time or at any time in the DISTRICT's sole discretion.

6. **CONVEYANCE OF MAIN LINES AND FACILITIES.** Upon completion, approval and acceptance of the work by the DISTRICT, as shown by the authorized signature of the DISTRICT's authorized

representative set forth below, this AGREEMENT shall operate as a sale, conveyance, transfer and assignment by the APPLICANT of all APPLICANT's rights, title, interest and ownership in said main lines and facilities constructed pursuant to this AGREEMENT, such conveyance warranted by the APPLICANT to be free and clear of all claims, liens or encumbrances of any kind or nature whatsoever. APPLICANT shall warrant and defend (or indemnify and hold harmless the DISTRICT at its request) such conveyance against any and all persons or entity's claims or assertions. In addition to the satisfactory performance of all other conditions and terms of this AGREEMENT, the following shall be express conditions precedent to the DISTRICT's acceptance of the work:

- 6.1 A duly executed written statement that all suppliers of labor and materials, including all subcontractors, have been paid in full, with appropriate executed lien waivers attached.
- 6.2 All deeds or other instruments conveying such easements and rights of way as set forth in paragraph 5 herein have been accepted and approved by the DISTRICT.
- 6.3 Adequate security has been posted with the DISTRICT in accordance with paragraph 7 herein.

7. **WARRANTY AND SECURITY FOR REPAIRS/REPLACEMENT.** Upon conveyance of the lines and facilities pursuant to this AGREEMENT, APPLICANT warrants, covenants and agrees that the work is in full compliance with the laws of the State of Colorado, and all other governmental subdivisions, agencies and units and in accordance with the design standards and other engineering and construction specifications and requirements of the DISTRICT. Following completion, approval, full acceptance, conveyance and transfer of lines and facilities to the DISTRICT, the DISTRICT shall assume all responsibility thereafter, and all operational maintenance pursuant to its Rules and Regulations, except as to the 12 month warranty period in accordance with this paragraph 7. APPLICANT shall warrant to the DISTRICT the lines and facilities, as installed, against faulty workmanship and materials for a period of 12 months from date of final acceptance and shall, during said period, pay all cost and expense to cure, repair or replace at the request of the DISTRICT any part or parts of the extension or constructed facilities which the DISTRICT reasonably determines were not designed or constructed in conformity with DISTRICT Rules and Regulations, approved plans, construction notes or its specifications or standards, that the DISTRICT reasonably determines to be defective, of poor or un-workmanlike quality or are not performing to DISTRICT standards for any other reason. Following expiration of the 12 month warranty period and satisfactory remediation of any outstanding warranty issues, the APPLICANT shall be released from all warranty responsibilities owed to the DISTRICT.

- 7.1 To ensure such repairs and replacements will be accomplished, APPLICANT shall furnish to the DISTRICT an irrevocable letter of credit or other security acceptable to the DISTRICT in an amount equal to 10% of the total costs of construction and installation of the lines and facilities, but not less than \$1,000, or such greater amount as the DISTRICT may require in its sole discretion is necessary to adequately protect itself on account of special circumstances arising from the construction of the extension/appurtenances or any portion thereof. Such security shall be maintained for a period of 15 months from the date of final acceptance, and shall be restored to the full amount within 10 calendar days after written notice to the APPLICANT in the event that the DISTRICT draws against such security to effect repairs or replacement. Upon expiration of 15 months following final acceptance, the security required by the DISTRICT shall be released to the APPLICANT. The security may either be extended or called upon at the DISTRICT's discretion if there are any pending claims or assertions which arose during the 12 month warranty period which remain unresolved. In any event, the security shall be maintained until such time as all claims or assertions are resolved to the DISTRICT's satisfaction.

- 7.2 In the event that the costs and expense of curing any defect, or repairing or replacing any portion of the extension or facilities exceeds the security posted pursuant to this AGREEMENT, the APPLICANT covenants, warrants and agrees that it will reimburse the DISTRICT within 30 calendar days of presentment or pay directly the full costs and expenses of such remedial work.

8. **SERVICE FROM IMPROVEMENTS.** APPLICANT covenants and agrees that it will not make any warranties or representations to any contractor, home builder, other developer, home owner, lessee, tenant, individual property owner, or any other person or entity, regarding the DISTRICT's system, its

capabilities, availability, pressures, or flows, and expressly including the timing of acceptance of any improvements or their authorized activation.

9. **DISTRICT FEES AND REGULATIONS.** The obligations, duties, rights and responsibilities of each party arising under this AGREEMENT shall be subject to all applicable Rules and Regulations of the DISTRICT and applicable review, observation and other fees applicable to the Project which may be amended from time to time. APPLICANT shall have the sole responsibility for inquiring as to the current Rules and Regulations and fee schedule of the DISTRICT.
10. **GOVERNMENTAL REGULATIONS.** All provisions of this AGREEMENT to the contrary notwithstanding, the obligation of the DISTRICT to furnish service under this AGREEMENT, to accept any improvements, and to perform any and all other duties and obligations arising hereunder is limited by, and subject to, all orders, requirements and limitations which may be imposed by federal, state, county or any other governmental or regulatory body or agency having jurisdiction or control over the DISTRICT and the operation of its system pursuant to any statute, regulation, or agreement.
11. **PARAGRAPH CAPTIONS.** The captions of the paragraphs are set forth only for convenience and reference, and are not intended in any way to define, limit, or describe the scope or intent of this AGREEMENT.
12. **ADDITIONAL DOCUMENTS OR ACTION.** The PARTIES agree to execute any additional documents and to take any additional action necessary to carry out this AGREEMENT.
13. **INTEGRATION AND AMENDMENT; PRIOR AGREEMENTS.** This AGREEMENT represents the entire AGREEMENT between them and there are no oral or collateral agreements or understandings. This AGREEMENT may be amended only by an instrument in writing signed by the PARTIES. The APPLICANT shall reimburse the DISTRICT for any expenses incurred by the DISTRICT in connection with any amendment of this AGREEMENT requested by the APPLICANT. If any provision of this AGREEMENT is held invalid or unenforceable, no other provision shall be affected by such holding, and all of the remaining provisions of this AGREEMENT shall continue in full force and effect. All prior agreements and contracts between the PARTIES and regarding the sale and purchase of taps are hereby rescinded. By execution of this AGREEMENT, each of the parties acknowledges that it has had the opportunity to fully review and seek legal counsel regarding the content hereof.
14. **ALTERNATIVE DISPUTE RESOLUTION.** In the event of any dispute or claim arising under or related to this AGREEMENT, the PARTIES shall use their best efforts to settle such dispute or claim through good faith negotiations with each other. If such dispute or claim is not settled through negotiations within 30 calendar days after the earliest date on which one party notifies the other party in writing of its desire to attempt to resolve such dispute or claim through negotiations, then the PARTIES agree to attempt in good faith to settle such dispute or claim by mediation conducted under the auspices of the Judicial Arbitrator Group (JAG) of Denver, Colorado or, if JAG is no longer in existence, or if the PARTIES agree otherwise, then under the auspices of a recognized established mediation service within the State of Colorado. Such mediation shall be conducted within 60 calendar days following either PARTY's written request therefore. If such dispute or claim is not settled through mediation, then either PARTY may initiate a civil action in the District Court for County of either Arapahoe or Douglas County, as applicable for the location of the PROPERTY.
15. **ASSIGNMENT.** If APPLICANT is not in default hereunder, APPLICANT may assign this AGREEMENT without the prior consent of the DISTRICT, provided said assignment is in writing and further provided that the assignment is made in conjunction with a transfer of all or substantially all of the PROPERTY described herein. No assignment shall, however, be effective upon the DISTRICT unless and until the DISTRICT receives written notice and a copy of the assignment including the name and address of the assignee. If assignment is made by APPLICANT, the DISTRICT reserves the right to require proof of financial capacity to perform the terms of this AGREEMENT of any assignees and to reject such assignment based upon its review thereof.
16. **BINDING EFFECT.** This AGREEMENT shall inure to the benefit of, and be binding upon, the PARTIES, and their respective legal representative, successors, and assigns; provided, however, that

nothing in this paragraph shall be construed to permit the assignment of the AGREEMENT except as otherwise specifically authorized herein.

17. **INDEMNIFICATION/INSURANCE.** APPLICANT hereby warrants and agrees that it will indemnify and hold DISTRICT, its Board of Directors, consultants and employees harmless from any and all claims, demands, judgments or awards resulting from any third party loss, injury or property damage (specifically including claims involving property disputes, infringements, wrongful takings or encroachments) which occurs as a result of, or arises from, the construction, installation, or conveyance of the line extension or extensions, easement acquisition, or the performance of any other obligation of APPLICANT arising hereunder. Such indemnification shall extend to all of DISTRICT's costs and expenses, (including reasonable attorneys fees, court costs, costs of litigation, mediation, arbitration or dispute resolution) which it may incur in investigating, processing, and/or defending such claim or demand. The DISTRICT shall be named as an additional insured on all APPLICANT insurance policies related to the PROJECT subject to this AGREEMENT.
18. **EXHIBITS.** All exhibits referred to in this AGREEMENT are, by reference, incorporated in this AGREEMENT for all purposes.
19. **SURVIVAL OF WARRANTIES.** Except as provided in paragraph 7 above, all warranties and representations, and specifically including the obligation of indemnification shall survive completion and conveyance, and shall continue thereafter for a period of three years from date of execution of this AGREEMENT, provided however that if any claim is made against the DISTRICT during such three year period, APPLICANT's obligations shall extend beyond such three year period until such claim is resolved, paid or otherwise compromised.
20. **STATUS OF APPLICANT.** APPLICANT, its employees or contractors shall not represent itself as employees or contractors of the DISTRICT nor in any way authorized to bind the DISTRICT, take action on behalf of or make statements to any third parties on behalf of the DISTRICT.
21. **SPECIAL PROVISIONS:**

APPENDIX F – STANDARD UNDERDRAIN AGREEMENT**UNDERDRAIN AGREEMENT**

THIS UNDERDRAIN AGREEMENT (herein “AGREEMENT”) is made this _____ day of _____, 2016, between **SOUTHGATE SANITATION DISTRICT**, Arapahoe and Douglas Counties, Colorado, a quasi-municipal corporation and political subdivision of the State of Colorado (herein “DISTRICT”) whose legal address is 3722 East Orchard Road, Centennial, Colorado 80121, and **[PROPERTY OWNER]**, a [type of company] and any assigns or successors in interest (herein “DEVELOPER” whether singular or plural) whose legal address is [property owner’s legal address].

RECITALS

WHEREAS, DEVELOPER is the owner of a tract of land commonly known as **[Name of Development]** (hereinafter referred to as "PROPERTY"), located in [Arapahoe or Douglas] County, Colorado, and more particularly described on **Exhibit A** attached hereto and made a part hereof; and

WHEREAS, for DEVELOPER’s convenience and for DEVELOPER's better enjoyment of the PROPERTY, DEVELOPER has requested permission to install and construct a private underdrain system in the same trench with sanitary sewer facilities owned and operated by, or subject to the control by DISTRICT, that will serve the PROPERTY; and

WHEREAS, the DISTRICT has determined that granting the DEVELOPER’s request will be of a benefit to the future inhabitants of DISTRICT.

NOW, THEREFORE, in consideration of the mutual promises and covenants hereinafter set forth, the parties hereto agree as follows:

1. Consent. DEVELOPER may, at DEVELOPER's sole expense and before or contemporaneously with installation of the sanitary sewer facilities intended to serve the PROPERTY, install DEVELOPER's underdrain (hereinafter "UNDERDRAIN") in the same trench with sanitary sewer lines that serve the PROPERTY. If such UNDERDRAIN is installed, DEVELOPER shall, at all times, have the obligation, enforceable at the demand of DISTRICT, to operate, maintain, repair, and replace said UNDERDRAIN as may be necessary or desirable from time to time to avoid or eliminate any adverse impact on sanitary sewer facilities, as determined by DISTRICT.

Before performing any maintenance on or repair or replacements of the UNDERDRAIN, DEVELOPER agrees to give DISTRICT at least five (5) days' written notice of the time and place where any such maintenance, repair, or replacement operations are to take place. All maintenance, repair or replacement operations shall be performed in a manner so as not to interfere with or endanger the physical condition or operation of sanitary sewer facilities.

In emergency situations, DEVELOPER need not give five (5) days' written notice before performing maintenance, repair, or replacement operations; however, DEVELOPER agrees to notify DISTRICT by telephone of emergency maintenance, repair, or replacement operations and to provide DISTRICT with written notice of the same as soon as practicable thereafter.

2. Ownership and Control. It is expressly understood and agreed that DISTRICT does not own and will not operate, manage, control, maintain, repair or replace the UNDERDRAIN contemplated herein; that DISTRICT shall have no obligation to operate, manage, control, maintain, repair, or replace the UNDERDRAIN; and that said UNDERDRAIN is and shall remain at all times private property, completely separate and apart from sanitary sewer facilities; and that DEVELOPER and its successor, as provided below, shall own, operate, manage, control, maintain, repair and replace

the UNDERDRAIN contemplated herein. Nothing contained herein and nothing hereafter done by DEVELOPER, its successors and assigns, shall constitute a dedication of the UNDERDRAIN to DISTRICT. DISTRICT shall under no circumstances whatsoever accept the UNDERDRAIN, or be deemed to have accepted the UNDERDRAIN, as property of DISTRICT.

Notwithstanding anything contained in this AGREEMENT to the contrary, it is understood and agreed that if the physical condition or operation of sanitary sewer facilities is interfered with or endangered, or constitutes a risk to the health and safety of the public as a result of DEVELOPER's UNDERDRAIN, then in that event, DISTRICT shall have the right, but no obligation, at DEVELOPER's expense, to do whatever is reasonable and necessary under the circumstances to eliminate such condition.

3. Record Drawings. DEVELOPER agrees to furnish DISTRICT with a set of record drawings for the UNDERDRAIN the DEVELOPER installs per DISTRICT's Sanitary Sewer System Specifications.
4. Indemnification. DEVELOPER agrees to indemnify and save DISTRICT, its officers, Directors, agents, and employees harmless from and against every claim, demand, liability, cost, charge, suit, judgment, and expense of whatsoever kind or nature, including, but not limited to, interest, court costs, and attorneys' fees which DISTRICT, its officers, Directors, agents, or employees may pay or incur by reason of or which in any way arise out of: (1) this AGREEMENT, (2) the enforcement of this AGREEMENT, or (3) the UNDERDRAIN contemplated herein.

This indemnification shall extend to claims, demands, and liability for injury to persons and property and financial loss which occur off the job site as well as on, and for injury and damage to person and property and financial loss occurring after construction of the UNDERDRAIN contemplated herein, as well as for any such injury, damage, or loss occurring during the construction of the UNDERDRAIN.

5. No Reliance. DEVELOPER acknowledges that DEVELOPER has not relied upon DISTRICT to determine whether the UNDERDRAIN system and its various components will perform any certain function. DEVELOPER is relying solely upon DEVELOPER's professional engineer and contractor to: (1) prepare the design and plans for the UNDERDRAIN, (2) determine the material, specifications, and soil conditions with regard to the UNDERDRAIN, (3) incorporate DISTRICT minimum design standards as deemed necessary by DISTRICT, and (4) construct the UNDERDRAIN according to the DEVELOPER's plans and specifications.
6. Subdivision Documents. DEVELOPER agrees that the PROPERTY will be held, sold, and conveyed subject to recorded covenants, conditions and restrictions that, among other things, shall expressly:
 - a. Refer to this AGREEMENT and recite the book, page, and reception number at which said AGREEMENT is recorded in the office of the Clerk and Recorder of the County in which the PROPERTY is located;
 - b. Provide for an owners' association as part of the plan for the development of the PROPERTY, of which owner's association shall, among other things, assume and perform all of DEVELOPER's obligation hereunder, expressly including the indemnity stated in paragraph 4 above.
 - c. Permit DISTRICT to require the repair, reconstruction, replacement, or relocation of the UNDERDRAIN, or any portion thereof, if DISTRICT determines for any reason that sanitary sewer facilities are being damaged or endangered by the UNDERDRAIN;
 - d. Subordinate any easement granted to the owners' association for the operation and maintenance of the UNDERDRAIN to the rights granted to DISTRICT by recorded

easement deed or agreement, plat dedication, or platted easement for the operation and maintenance of DISTRICT's facilities;

- e. Require the owners' association to establish an adequate fund to cover the cost of predictable operation, maintenance, repair, replacement, and relocation costs, which fund shall be maintained by the assessment of sufficient fees against members of the association to satisfy said obligations;
 - f. Reaffirm that DISTRICT does not own, operate, manage, or control the UNDERDRAIN system, that the UNDERDRAIN system is private property and that DISTRICT shall not have any obligations for its operation, maintenance, repair, replacement, or relocation.
7. Continuance of Benefits and Obligations. This AGREEMENT shall inure to the benefit and shall be binding upon the successors and assigns of the parties hereto, including, but not limited to, the Grantees of the DEVELOPER. It is agreed that the conditions, covenants and restrictions, together with the owners' association referred to in paragraph 6 above, are vehicles for facilitating the performance of DEVELOPER's obligations hereunder and shall in no way supersede this AGREEMENT or relieve DEVELOPER or the Grantees of DEVELOPER from any obligation hereunder.
 8. Statement on Recorded Plat. DEVELOPER agrees that there shall be a statement on the recorded plat for the PROPERTY stating that the owners' association shall be responsible for the operation, maintenance, and repair of the UNDERDRAIN.
 9. Authority to Execute. Each person or persons executing this AGREEMENT on behalf of DEVELOPER personally warrants and covenants to DISTRICT that he or she has full and complete authority to bind the DEVELOPER in accordance with the terms of this AGREEMENT.

Special Provisions. DEVELOPER agrees that there shall be a statement on the recorded plat for the PROPERTY stating that the owner's association shall be responsible for the operation, maintenance, and repair of the UNDERDRAIN; however, PROPERTY (plat) having been previously recorded prior to this AGREEMENT, a variance to this requirement was requested by DEVELOPER to not re-record the PROPERTY plat, It is understood that the conditions referred to in paragraph 8, as described herein, remains in full effect and acknowledged as such by DEVELOPER. The variance, granted by DISTRICT, is accepted by both parties as part of this AGREEMENT.