

**CITY OF WOODLAND PARK, COLORADO**

**TITLE 3**

**SANITARY SEWER SPECIFICATIONS**

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**3.1 DESIGN**

**3.1.1 GENERAL**

All sanitary sewer mains and appurtenances shall be in conformance with these Engineering Specifications and shall be designed by or under the direct supervision of a registered PE licensed to practice in the State of Colorado. The following checklist is provided to assist in the development of plans which meet City of Woodland Park requirements:

**SANITARY SEWER PLANS CHECKLIST**

**A. PLAN SHEET FORMAT**

		Yes	No	N/A	Comments
1.	Title				
2.	Sheet size 24" X 36"				
3.	North Arrow				
4.	Scale(s) 1"=50' H, 1"=5' V				
5.	Professional Engineer Signature and Seal				
6.	City Approval Block				
7.	Bench Mark (USGS Datum)				
8.	Vicinity Map 1"=2000'				
9.	Key Map 1"=100'				
10.	Legend of Symbols				
11.	Plan Quantity Summary				
12.	Sheet Cross Reference				
13.	Title Block				
14.	Revision Blocks				
15.	Ownership and/or Subdivision Information				
16.	Street Names				
17.	Street Dimensions				
18.	Easements with Dimensions				
19.	Lot Lines				
20.	Lot Numbers (Location and Size)				

		Yes	No	N/A	Comments
21.	Existing Utilities Shown				
	a. Water				
	b. Gas				
	c. Telephone				
	d. Storm				
	e. Irrigation				
	f. Sanitary Sewer				
	g. Cable Television				
	h. Electric				
22.	Join to Existing Improvements				
23.	Construction Details				
24.	Construction Notes				
25.	Flow Arrows on Sewers				
26.	Manhole Sizes				
27.	Manhole Types				
28.	Manhole Numbers				
29.	Manhole Stationing				
30.	Stub-Outs to Future Filings or Future Development				
31.	Location of Cleanouts				
32.	Size and Type of Sewer Main				
33.	Size and Type of Water				
34.	Lengths Between Manholes				
35.	Minimum Clearance Between Water and Sewer				
36.	Location of Fire Hydrants				
37.	Crossing of Utilities Noted				
38.	Crossing Detail(s)				
39.	Location of Crossing(s)				
40.	Staking and Control Information				
41.	Removal of Existing Improvements				
42.	Sewer Lateral Locations				
43.	Proposed Wye and Riser Connections for Services				
44.	Vertical and Horizontal Grids with Scales				

	(Typically 1"=5')				
		Yes	No	N/A	Comments
45.	Datum Elevations				
46.	Datum Locations				
47.	Existing Ground Surface				
48.	Proposed Finish Grade Over Sewer				
49.	Manhole Numbers/Identification				
50.	Manhole Stationing				
51.	Underdrain Note				
52.	Type, Size, and Length of Sewer				
53.	Slope Between Manholes				
54.	Rim Elevation of Manholes				
55.	Invert Elevation(s) of Each Manhole (In and Out)				
56.	Fall Through Manholes				
57.	Utility Crossings Shown				
58.	Encasement Location				
59.	Can It Be Staked and Built?				

C. GENERAL NOTES

1. All materials and workmanship shall conform to the latest edition of the City of Woodland Park Engineering Specifications. Work shall be subject to inspection and approval by authorized City of Woodland Park personnel.
2. All new sewer mains shall be PVC, Standard Dimension Ratio (SDR)-35 Pipe in accordance with ASTM D-3034, bell and spigot with elastomeric seal. PVC pressure pipe C-900, DR-18/DR-24 may also be used. When PVC C-900 pressure pipe is used for sewers or force mains, the contractor shall request from the pipe manufacturer certification that the joint gaskets are compatible for use with raw sewage.
3. The Contractor shall furnish the Design Engineer “as constructed” locations of all facilities installed and this, in turn, shall be submitted to the City of Woodland Park on “As-Built” plans, prepared by the Design Engineer.
4. Rim elevations shown on the plan and profile sheets are approximate only and are not to be taken as final elevations. The pipeline contractor should allow approximately the top one (1’) foot to be adjusted either up or down in order to match final pavement elevation. The maximum adjustment to final grade is 12 inches with concrete rings.
5. Bedding and backfill materials for both water and sewer shall conform to the latest edition of the City of Woodland Park Engineering Specifications.

6. A pre-construction meeting must be held between the Contractor and City Engineer or appointed representative prior to the start of construction activities.
7. All sanitary sewer manhole cones shall be eccentric and the vertical portion shall be turned toward the center of the street in all instances.
8. The Contractor shall be responsible for cleaning nearby public streets of mud or debris due to construction activity on a daily basis or as otherwise directed by authorized City personnel.
9. The Contractor shall control the sewer installation using construction staking provided by a licensed surveyor. Sewer lines shall be staked for line and grade. Cut sheets shall be provided to the City inspector prior to construction of the sewer.

### **3.1.2 PLANNING CONSIDERATIONS**

Except where approved master plans exist, the following criteria for design shall be used unless specific approval for other criteria has been given by the City Engineer or appointed representative:

- A. **DESIGN PERIOD:** The sewer system shall be designed for the estimated ultimate tributary population.
- B. **POPULATION DENSITIES INCLUDING PUBLIC USE LANDS:**
  1. Single-family units at 2.63 persons per unit.
  2. Multi-family and condominiums at 2.63 persons per unit.
  3. Use maximum Single-family units per acre for zoning classification if specific lot plans are not available.
  4. 20 Multi-family cluster housing or condominiums per acre.
- C. **PER CAPITA FLOWS:** Sewer systems shall be designed on the basis of not less than the following:
  1. 92 gallons per person per day, with a peaking factor of 4:1.
  2. Infiltration of 250 gallons per inch of diameter per mile of line, per day.
  3. Commercial land uses at 1400 gallons per acre per day with a peak factor of 3.
  4. Industrial land uses at 1600 gallons per acre per day with a peak factor of 3.
  5. Public use, park and open space at 1000 gallons per day with a peak factor of 3.
- D. **New Subdivisions:** Sewer systems shall generally be designed to provide gravity sewer service to each lot including those with anticipated basements. To avoid household wastewater pumping systems or the excessive construction of additional sewer mains or excessively deep mains, in hilly areas, consideration should be given to the use of private sewer easements and larger service lines to reach down gradient sewer mains to serve lots on the downhill side of streets.

**3.1.3 MINIMUM SIZE**

No public sewer shall be less than eight (8”) inches in diameter. No residential building sewer shall be less than four (4”) inches in diameter. No commercial or institutional building sewer shall be less than six (6”) inches in diameter unless approved otherwise by the City Engineer or appointed representative. Pumped (ejector) sewer laterals will be considered on a case-by-case basis.

**3.1.4 MINIMUM DEPTH**

No public mains shall be less than six (6’) feet deep measured from the top of pipe, except by written approval of the City Engineer or appointed representative. Sewer mains and service lines, which have less than four (4’) feet of cover or more than 12 feet of cover, shall be installed using PVC pressure pipe. Under no circumstances shall a sewer have less than three (3’) feet of cover, unless specifically approved by the City Engineer or appointed representative in writing. Sewer lines, which must cross under creeks, streams or through wet lands where the soil is unstable and water infiltration may be high, must be specifically designed by the design engineer and approved by the City Engineer or appointed representative.

Sanitary sewer service lines shall generally be buried a minimum of three (3’) feet below finished grade. Depths less than three (3’) feet may be approved on a case by case basis where drop between the building and the sewer main is inadequate to maintain the three (3’) feet of cover.

Where sewer mains or service lines cannot be installed with six (6’) feet of cover, the line shall be insulated in accordance with Section 3.1.27 of these specifications.

**3.1.5 SLOPES**

All sewers should be designed to transport average sewage flows at mean velocities of two (2’) feet per second based on a roughness factor of 0.013. In no case shall the slope be less than the following for sewer mains and services:

**MINIMUM SLOPE TABLE**

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Services

4 inch - ¼ inch per foot (2.08%)

6 inch - ⅛ inch per foot (1.04%)

Mains and Services

8 inch - 0.40%                      18 inch - 0.15%

10 inch - 0.35%                    21 inch - 0.12%

12 inch - 0.26%                    24 inch - 0.11%

15 inch - 0.20%                    30 inch - 0.08%

Sewers shall be laid with uniform slope between manholes. No vertical curves shall be permitted. Where sewer slopes are less than one (1) percent the sewer pipe shall be bedded in  $\frac{3}{4}$  inch rock. Bedding limits shall be in accordance with Figure 2.5.1.

### **3.1.6 HIGH VELOCITY PROTECTION**

In the case of sewer slopes over 15 percent, special provisions shall be made to prevent displacement by erosion and shock. Such high velocity protection shall be shown on detail drawings and approved by the City Engineer or appointed representative.

### **3.1.7 ALIGNMENT**

Manholes shall be located to limit possible storm water entrance. Proposed sewer lines which may conflict with the placement of other underground facilities will require prior approval of the sewer placement location by the controlling agencies whose facilities are affected. Locations other than those specified will require specific approval by the City Engineer or appointed representative. Installation of curvilinear pipelines for mains, sewer in sizes eight (8") inches through 12 inches in diameter are acceptable and necessary to obtain the standard location of sewer mains. PVC sewers with horizontal curves must be designed and constructed using a uniform slope between manholes and shall have a centerline radius no less than that recommended by the pipe manufacturer. The necessary horizontal curvature shall be attained by curving the trench. Horizontal curves shall be constructed using high deflection couplings. No vertical curves will be permitted. Changes in alignment for service lines shall be accomplished with preformed bends not to exceed 45 degrees. When changes of direction exceed 45 degrees, a two (2') foot section of pipe shall separate the fittings necessary to make the needed change of direction. Field bending of pipe will not be permitted.

### **3.1.8 INTERSECTIONS**

All pipes shall have free discharge into the collection system. Where possible, the flow line of the intersecting pipe shall be the spring line (horizontal center of pipeline) of the collection sewer. Where smaller pipes intersect larger pipes, the soffits (internal top of pipe) of the intersecting pipes shall match.

### **3.1.9 SERVICE CONNECTIONS**

All service connections to mains shall be made in the top one-half ( $\frac{1}{2}$ ) of the pipe. Connections made in the lower half of the main will not be permitted. All service connections (laterals) may be constructed of PVC pipe with gasketed joints or HDPE fusion welded joints pipe. If HDPE is used the internal weld bead shall be removed during construction of the service connection.

### **3.1.9.1 PRESSURE LATERALS**

Where structure sewer piping is lower than the sewer main in the street, a pressure sewer lateral may be approved by the City Engineer or appointed representative. Pressure laterals shall be constructed of PVC Sch. 40 pipe with solvent welded joints and fittings.

### **3.1.10 MANHOLES**

Manholes shall be installed at both ends of each line, changes in grade, changes in size, at all pipeline intersections, changes in alignment (except curvilinear sewers) and at distances not greater than 400 feet. For curvilinear sewers, manholes must be placed at all intersections, changes in grade and size, and at distances not greater than 400 feet. Manholes must also be provided at all points of reverse curve or where requested by the City Engineer or appointed representative. Manholes shall be provided with all weather access and must be located to allow unassisted access by City maintenance vehicles. The flow channel through the manhole base shall be made to conform to the shape and slope of the sewer. A minimum three-tenths (0.3') foot fall across manholes shall be maintained. When the sewer main slope is less than one (1) percent, the drop through a manhole, in a straight through or one having an alignment change of less than 30 degrees, shall be reduced to one-tenth (0.1') foot in order to maximize the slope of the sewer main. Lines and manholes located in areas where access, in the opinion of the City Engineer or appointed representative, is not possible, the sewer will not be approved for construction. Where possible, manholes shall not be located in concrete areas, such as sidewalks, cross-pans, aprons, or curbs and gutter.

Refer to Figures 3.4.1 and 3.4.2.

### **3.1.11 MANHOLE SIZES**

The inside diameter of the manhole shall be not less than four (4') feet on lines eight (8") inches through 12 inches in diameter; not less than five (5') feet on lines 15 inches through 36 inches in diameter; and not less than six (6') feet on lines in excess of 36 inches in diameter for standard design manholes. All inside drop manholes and all shallow manholes (six (6') feet in depth or less) shall have an inside diameter of not less than five (5') feet.

### **3.1.12 DROP MANHOLES**

An outside drop pipe shall be provided for a sewer entering a manhole at an invert elevation of 18 inches or more above the manhole invert. Where difference in elevation between the incoming sewer invert and the manhole invert is less than 18 inches, the invert shall be shaped in a filleted fashion to prevent solids deposition. Inside drop manholes, when approved for use, shall be constructed using a five (5') foot minimum inside diameter manhole structure.

Refer to Figures 3.4.3 and 3.4.4.

### **3.1.13 MANHOLE CHANNELS**

The flow channel shall be made to conform to the shape of the sewer pipe and shall be formed in the shape of a “U.” Wherever possible use the lower one-half ( $\frac{1}{2}$ ) of the sewer pipe for the invert of the open flow channel. In such cases the minimum slopes previously discussed shall not apply. At intersections with other lines, channels shall be formed with a curve to minimize turbulence.

### **3.1.14 MANHOLE RINGS AND COVERS**

Manhole rings and covers shall conform to the detail sheets for ring and cover designs. Only concrete grade rings will be accepted for use. All manholes located outside of dedicated street or alley right-of-way will be designed and constructed with a locking type cover with the manhole ring bolted to the concrete cone. Grade adjustment rings between the ring and cover of the concrete cone shall not exceed 12 inches.

Refer to Figures 3.4.5, 3.4.6 and 3.4.7.

### **3.1.15 MANHOLE WATERTIGHTNESS**

Precast manhole joints shall be made watertight with a rubber “O” ring, Ramnek or similar approved material and grouted to a smooth finish.

### **3.1.16 INVERTED SIPHONS**

Inverted siphons may be approved for use when alternate designs are not feasible. Approval must be granted by the City Engineer or appointed representative in writing.

Inverted siphons should have not less than two (2) barrels of cast or ductile iron pipe, with a minimum pipe size of six (6”) inches and shall be provided with necessary appurtenances for convenient flushing and maintenance; the manholes shall have adequate clearances for crossing; and in general, sufficient head shall be provided and pipe sizes selected to insure velocities of at least three-point-zero (3’) feet per second (fps) for average flows. The inlet and outlets shall be arranged so that the normal flow is diverted to one barrel, and so that either barrel may be cut out of service for cleaning. The Consulting Engineer shall submit complete calculations, with diagrams, for the design of the siphon for review by the City Engineer or appointed representative.

### **3.1.17 LOCATION**

- A. **EASEMENTS:** All mains shall be installed in dedicated street rights-of-way, or dedicated easements. Location for these sewer mains shall be six (6’) feet from the centerline of the street. Sewer mains shall be installed in easements, either by plat or separate document when as determined by the City Engineer or appointed representative, it is not practical to make such installation in a dedicated street ROW. No structures shall be constructed within these easements or ROW without prior written approval, including terms and

conditions, as set by the City. The minimum width requirements for sanitary sewer main easements are 20 feet or twice the depth of the pipe, whichever is greater. The pipeline shall be offset a minimum of five (5) feet from any property line. In the event two (2) utility lines share the same easement, the minimum width for the easement shall be 30 feet.

B. **RELATION TO WATER MAINS:** Sewers shall be located a minimum of 10 feet horizontally from existing or proposed water mains. Sewers crossing below water main shall be a minimum of 18 inches clear distance vertically below the water main. If this clear distance is not feasible, the crossing must be designed and constructed to protect the water main. Minimum protection shall be as follows:

1. **SANITARY SEWER LINE CROSSING OVER A WATERLINE.** When there is less than 18 inches of vertical clearance between the bottom of the sanitary sewer and the top of the water main, the water main shall be ductile iron pipe, bedded in compacted granular material, a minimum of 10 feet on each side of the centerline of the crossing. In all cases, regardless of vertical clearance, the waterline shall be encased in reinforced concrete, a minimum of 10 feet on each side of the centerline of the crossing.

Refer to Figure 2.5.11.

2. **WATERLINE CROSSING OVER A SANITARY SEWER LINE.** When there is less than 18 inches of vertical clearance between the bottom of the water main and the top of the sanitary sewer, the water main shall be ductile iron pipe a minimum of 10 feet on each side of the centerline of the crossing. In addition, the sanitary sewer shall be encased in concrete, a minimum of 10 feet on each side of the centerline of the crossing.

Refer to Figure 2.5.12.

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

C. **RELATION TO OTHER UTILITIES:** Sewers shall be located a minimum distance of five (5') feet from utilities other than water. When other utilities are installed in the vicinity of an existing sewer main, they shall be installed a minimum distance of five (5') feet, except at crossings which shall be at angles of 45° or greater.

### **3.1.18 STREAM AND DRAINAGE CHANNEL CROSSINGS**

All stream and drainage channel crossings shall be ductile iron pipe encased in reinforced concrete (see detail sheets for stream crossing designs). Crossings less than four (4) feet below existing or proposed channel bottoms shall be supported by reinforced concrete

caissons drilled a minimum of five (5') feet into an impervious soil or 20 feet whichever is less. In the absence of impervious soils, caissons shall extend 20 feet below the invert of the sewer main. A 15 foot splash pan consisting of 18 to 24 inch rip rap or gabions shall be placed downstream tapering from six (6') feet deep at the crossing to three (3') feet deep at the end to prevent erosion. The Consulting Engineer shall submit, for review by the City Engineer or appointed representative, a scour study for all proposed live stream crossings of water and sewer pipelines based upon a one (1), five (5), and 100 year storm event.

### **3.1.19 CROSSINGS UNDER HIGHWAYS**

Crossings under highways shall consist of a cast or ductile iron pipe (Carrier) laid inside a steel casing pipe, which has been jacked underneath the roadway. The steel casing pipe shall be jacked horizontally through the ground on substantially the grade of the sewer, with due allowance for the bells of the iron pipe. As the pipe is jacked along, the earth shall be excavated from the face and removed so that it will not be necessary to force the pipe through solid ground. The casing shall be of the sizes shown on the plans. The casing diameter shall be a minimum 1½ times the outside diameter of the carrier pipe. After the casing has been completed, the iron pipe shall be placed inside and blocked in exact position and grade with an isolator/spacer behind each bell and as recommended by isolator/spacer manufacturer. The annular space between the carrier pipe and the casing shall be left empty. Each end of the casing shall then be plugged tight around the iron pipe and inside the casing pipe. The flexible end seal and isolator/spacers shall be as manufactured by Pacific Seal & Insulator or approved equal.

### **3.1.20 STUB OUTS FROM MANHOLES**

Stub outs from manholes shall not exceed 40 feet except for lines that will be extended in the future. Whenever practical, designs to complete the manhole run shall be submitted for review to insure proper grade and alignment for future construction. Future extension of stub outs shall be of like material using the same grade and alignment.

### **3.1.21 SERVICE STUBS**

Service stubs for each property shall be extended to a point 13 feet inside the property line at a point generally 10 feet uphill from lowest front property corner or as approved by the City Engineer or appointed representative. Service lines shall include clean-outs installed at the property line and five (5') feet outside the building foundation, and spaced at a distance not greater than 100 feet.

Refer to Figures 3.4.10 and 3.4.12.

### **3.1.22 WASTEWATER PUMPING STATIONS**

Preliminary Engineering: A basis of design for all wastewater pumping stations shall be prepared and submitted to assist the City Engineer or appointed representative in reviewing the project plans and specifications. The basis of design shall include, but not necessarily be limited to, the following:

- A. Calculations showing average daily flow, peak daily flow and peak hourly flow for present and design flows. Firm pumping capacity shall be provided for 115 percent of peak hourly flow.
- B. Number, type, capacity, motor horsepower and NPSH requirements of proposed pumping units. Motors shall be non-overloading.
- C. System head curve or head computations for design conditions of pumping system. Future pumping capacity requirements shall also be considered in sizing pumping equipment.
- D. System head calculations shall include the size and length of force mains and assumed friction factor.
- E. Design considerations shall include station size, type of construction, pump and motor selection, system design, controls, valves, piping, access and pumping efficiency.
- F. Force mains shall generally be designed for velocities of two (2) to four (4) feet per second (fps) at the design pumping rate.
- G. All wastewater pumping stations shall include emergency storage capacity with a volume appropriate for the specific station. Consideration shall be given to design size, environmental and health risks and emergency response capability.

### **3.1.23 GENERAL REQUIREMENTS**

- A. Wastewater pumping stations shall not be subject to damage by flooding. Suitable superstructures located off the right-of-way of streets and alleys shall be provided, except when approved by the City Engineer or appointed representative. It is important that the station be readily accessible.
- B. Where it may be necessary to pump wastewater prior to grit removal, the wet well and the discharge piping shall be designed to prevent grit accumulation.

### **3.1.24 PUMP STATION DESIGN**

The following items shall be required in the design of wastewater pumping stations:

- A. TYPE: Sewage pumping stations shall be of the dry pit/wet well type when the design pumping capacity is 500 GPM or greater.

Sewage pumping stations shall be of the submersible pump type when the design pumping capacity is less than 500 GPM.

B. STRUCTURES:

1. Separation: Wet and dry wells, including their superstructure, shall be completely separated. Minimum inside diameter of wet and dry wells shall be 60 inches.
2. Equipment Removal: Provisions must be made to facilitate removing pumps, motors and valves.
3. Access: Suitable and safe means of access shall be provided to pump stations dry wells and to wet wells.

C. EQUIPMENT: Equipment shall be consistent with equipment already in use in the City's wastewater system, except when approved otherwise by the City Engineer or appointed representative.

1. Pumps:

- a. Duplicate Units: At least two (2) pumps must be provided. If only two (2) pumps are provided, they shall have the same capacity. Each shall be capable of handling flows in excess of the expected maximum flow. Where three (3) or more pumps are provided, they shall be designed to fit actual flow conditions and must be of such capacity that with any one (1) pump out of service, the remaining pumps will have the capacity to handle maximum wastewater flows.
- b. Pump Openings: Pumps shall be capable of passing spheres of at least three (3") inches in diameter. Pump suction and discharge openings shall be at least four (4") inches in diameter.
- c. Priming: The pump shall be so placed that under normal operating conditions, it will operate under a positive suction head.
- d. Electrical Equipment: Electrical equipment in enclosed places where gas may accumulate, shall comply with the National Board of Fire Underwriters' specifications for hazardous locations (NEMA Type 7) or submersible locations (NEMA Type 6). Electrical equipment for pump motors shall contain elapsed time meters.
- e. Intake: Each pump shall have an individual intake. Wet well design shall be such as to avoid turbulence near the intake and cavitation in the pump.
- f. Dry Well Dewatering: A separate sump pump shall be provided in dry wells to remove leakage or drainage with the discharge to the wet well above the overflow level or the wet well. Water ejectors connected to a potable water supply will not be approved. All floor and walkway surfaces shall have an adequate slope to point of drainage.

D. CONTROLS: Liquid level controller activators shall be so located as not to be affected by flows entering the wet well or by the suction of the pumps. Float tubes in dry wells shall extend high enough to prevent overflow. In small stations with duplicate units, provisions shall be made to provide automatic alterations of the pumps in use.

- E. VALVES: Suitable shutoff valves shall be placed on suction and discharge lines of each pump. A check valve or pump control valve shall be placed on each discharge line, between the shutoff valve and the pump.
  
- F. WET WELLS:
  - 1. Divided Wells: Where continuous pump station operation is required, consideration shall be given to dividing the wet well into two (2) sections, properly interconnected, to facilitate repairs and cleaning.
  - 2. Size: The effective capacity of the wet well shall provide a holding period not to exceed 30 minutes for the design minimum flow. Smaller wet wells may be considered when utilizing variable capacity pumping systems.
  - 3. Floor Slope: The wet well floor shall have a minimum slope of one-to-one to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the pump inlet.
  - 4. All concrete wet wells shall be lined with PVC to prevent corrosion of internal concrete surfaces.
  
- G. VENTILATION: Adequate ventilation shall be provided for all pump stations to mechanically ventilate the dry well. Wet well vents shall be provided. There shall be no interconnection between the wet well and dry well ventilating systems. In pits over 15 feet deep, multiple inlets and outlets are required. Dampers shall not be used on exhaust or fresh air ducts, and fine screens or other obstructers in the air ducts shall not be used. Switches for operation of ventilation equipment shall be marked and located conveniently. Consideration shall be given to automatic controls where intermittent operation is practiced. To prevent excessive moisture or low temperatures, installation of heating and/or dehumidification equipment shall be required. Ventilation may be either continuous or intermittent. For continuous operation, at least six (6) complete air changes per hour shall be provided. For intermittent operation, at least 30 air changes per hour shall be provided.
  
- H. FLOW MEASUREMENT: Pump stations shall be equipped with a magnetic flow meter, on the discharge force main, for measuring, recording and totaling sewage flow.
  
- I. WATER SUPPLY: There shall be no physical connection between any potable water supply and a sewage pumping station, which under any conditions might cause contamination of the potable water supply.
  
- J. POWER SUPPLY: Power supply shall be available from at least two (2) independent generating sources, or emergency power equipment shall be provided. Automatic starting of emergency power equipment shall be required.
  
- K. ALARM SYSTEM: Alarm systems shall be provided for all pumping stations. The alarm shall be activated in cases of power failure, pump failure, or any cause of

pump station malfunction. Additionally, unauthorized entry, flooding, smoke, fire and other alarms may be required.

- L. **OVERFLOW CONTAINMENT:** Provisions for overflow of the wet well shall be included into the pump station design to prevent basement flooding or discharge to the environment. Such provisions may include an additional wet well or a holding pond that can hold the appropriate flow from the tributary system.
- M. **LIFT STATION:** Submersible pump type lift stations shall be used where possible and shall be approved on a case-by-case basis by the City Engineer or appointed representative.
- N. **FORCE MAIN PIPING:** Pump station discharge force mains shall be constructed of PVC pressure pipe, ductile iron pipe or high density polyethylene pipe (HDPE) with heat fusion welded joints as specified herein.

### **3.1.25 INSTRUCTION, EQUIPMENT OPERATION AND MAINTENANCE**

The City Engineer or appointed representative shall be supplied with a complete set of equipment operation and maintenance manuals with instructions, including emergency procedures, maintenance procedures, tools and such spare parts as may be considered necessary. All emergency power generation equipment shall also be provided with operation and maintenance instructions requiring routine starting and running of such units at full load.

### **3.1.26 GREASE AND SAND/OIL INTERCEPTORS**

All commercial operations involved in food preparation, automotive servicing, or any other business or industry discharging any grease, sand, or oil into the City sanitary sewer system shall be required to install a grease or sand/oil interceptor.

#### **A. GREASE INTERCEPTORS:**

All interceptors shall be located outside, within 30 feet of the facility served and shall be easily accessible at all times for inspection and maintenance. All interceptors shall be concrete and of a single, precast monolithic pour and shall be installed in accordance with the project's construction documents. Smaller, in-line grease interceptors shall be permitted only where larger interceptors are impractical and upon the specific approval of the City Engineer or appointed representative.

Sizing calculations are to be prepared by the consulting engineer and submitted to the City Engineer or appointed representative using the following method:

1. Based on the seating capacity, compute:
  - a. Number of seats x a full capacity factor of 0.9 x turnover rate of 2.2 per meal period = number of meals served per meal period.

- b. Number of meals per meal period x 2.5 gallons per meal = volumetric capacity of the grease interceptor.
- c. Ten (10) percent rule - if the computed size is within ten (10) percent of a smaller standard approved "shelf" available interceptor, that unit may be acceptable. Custom interceptors may be designed to size specifications so long as it conforms to City of Woodland Park requirements.

**B. SAND/OIL INTERCEPTORS:**

- 1. Location Design:
  - a. All sand and oil interceptors shall be located outside, within 30 feet and not less than five (5') feet from the facility, unless specifically authorized by the City Engineer or appointed representative. Interceptors shall be accessible for inspection and maintenance.
  - b. All sand and oil interceptors shall have two (2) compartments, the smallest of which shall have at least  $\frac{1}{3}$  the capacity of the entire interceptor.
- 2. Sizing:
  - a. Sizing calculations are to be prepared and submitted to the City Engineer or appointed representative using the following standards listed below:
    - (1) Three (3") inch diameter floor drains shall be rated at six (6) fixture units.
    - (2) Four (4") inch diameter floor drains shall be rated at eight (8) fixture units.
    - (3) One (1) fixture unit equals 7.5 gpm.
    - (4) The sizing formula shall be as follows: Number of fixture units connected x 7.5 gpm x five (5) minutes equals interceptor size.
  - b. Where trough drains are used, each bay or compartment area equaling the square foot surface of a standard service station bay, which is served by the trough drain, shall be rated at six (6) fixture units per bay. Vehicle wash drains shall be rated at eight (8) fixture units each, regardless of size.
  - c. No combination sand and oil interceptor smaller than 320 gallons capacity shall be installed at a single bay facility.
  - d. All interceptors shall be installed in accordance with the design engineer's drawings, as approved by the City Engineer or appointed representative.
  - e. Cleanouts are required immediately downstream of the sand and oil interceptor.

**3.1.27 THERMAL INSULATION FOR SEWER MAINS AND SERVICE LINES**

Sewer mains installed with less than six (6') feet and service lines installed with less than six (6') feet of cover to the top of the pipe shall be insulated from low soil temperatures during

winter months. The insulation material shall be a dry granular material and consist of inorganic non-toxic, non-flammable, Sodium Potassium Aluminum Silicate insulation with Calcium Carbonate filler. The insulation shall be chemically treated to render it hydrophobic. The insulation shall be free of Asbestos.

The material shall be packaged in bags or in bulk and shall be capable of being poured into the trench and around the pipe being protected. The material shall be capable of being consolidated prior to backfill and provide excellent load bearing properties without loss of coverage due to shrinkage or settling during backfill operations. The material shall be GILSULATE 500xr as manufactured by Gilsulate International, Inc. PO Box 802650, Santa Clarita, CA 91380, (800) 833-3881.

Material specified is that which has been evaluated for the specific service. Products of Gilsulate International, Inc. are listed to establish a standard of quality. Standard products of manufacturers other than that specified will be accepted when it is proved to the satisfaction of the City Engineer or appointed representative, they are equal in composition, durability, usefulness and convenience for the purpose intended.

### **3.2 MATERIALS**

All materials furnished shall be new and undamaged. Everything necessary to complete all installations shall be furnished and installed whether shown on approved drawings or not and all installations shall be completed as fully operational.

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Responsible Party of the responsibility for furnishing materials meeting the requirements of the specifications. The City Engineer or appointed representative reserves the right to require or deny use of certain types of materials in specific circumstances.

All materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality and fitness for the work.

#### **3.2.1 POLYVINYL CHLORIDE PIPE FOR SEWERS AND FORCE MAINS**

- A. All new sewer mains shall be PVC, Standard Dimension Ration (SDR)-35 pipe in accordance with ASTM D-3034, bell and spigot with elastomeric seal. PVC pressure pipe conforming to AWWA C-900, DR-18/DR-24 may also be used for gravity sewers when approved by the City Engineer or appointed representative. Force mains may also be constructed of PVC pressure pipe conforming to AWWA C-900, DR-18/DR-24, or HPDE pipe with heat welded joints.
- B. All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe. However, fittings for force mains shall be manufactured of ductile iron with mechanical joints conforming to ANSI/AWWA C-110/A21.10.

- C. Pipe stiffness for all pipe sizes shall be tested in accordance with ASTM D-2412, while joint tightness shall be tested in accordance with ASTM D-3212. Pipe shall be subjected to drop impact tests in accordance with ASTM D-2444.
- D. Installation of PVC gravity sewer pipe shall be in accordance with Green-Tite PVC Gravity Sewer Pipe Installation Guide TR-614B, published by J-M Pipe, except as modified by these Specifications. Installation of PVC pressure pipe shall be in accordance with Ring-Tite PVC 125-160-200 PSI Installation Guide TR-533A, published by J-M Pipe, except as modified by these Specifications.
- E. All PVC joints shall be of the bell and spigot type with solvent cement or rubber ring gasket for four (4") inch and six (6") inch pipe. Joints for eight (8") inch and larger shall be gasketed joints only. The rubber ring shall be in accordance with ASTM D-3212, except that they shall be compatible for use in a raw sewage environment. Jointing with dissimilar materials shall be accomplished using a compression gasket or other approved commercial connection specifically manufactured for such jointing.
- F. The following markings shall be clearly shown on the exterior of the pipe:
  - 1. Manufacturer's name.
  - 2. Appropriate ASTM designation.
  - 3. Appropriate SDR number for pipe.
  - 4. Spigot mark.
- G. Care shall be taken to store all pipe and fittings to maintain the condition of the pipe as manufactured. To prevent damage and deformation, pipe shall be stored on level ground for even support. Pipe shall not be dropped from trucks, storage piles, or drag across sharp objects or abrading surfaces. Pipe shall be protected from exposure to ultraviolet radiation. Pipe that is shipped to the site having significant discoloration on the pipe surface is generally considered to be evidence of ultraviolet damage and may be reason for rejection and removal from the project. It is the responsibility of the contractor to protect the pipe from ultraviolet damage during storage at the job site.
- H. Bedding and backfill compaction shall meet the requirements of Title 7- Excavation in the Public Right-Of-Way. Pipe depths less than six (6') feet and greater than 12 feet shall require special approval of the City Engineer or appointed representative. PVC pipe installed at depths in excess of 12 feet shall be installed with engineering bedding approved by the City Engineer or appointed representative.
- I. PVC pipe which has any of the following visual defects will not be accepted:
  - 1. Improperly formed pipe such that pipe intended to be straight is curved, measured from the concave side of the pipe exceeding  $\frac{1}{16}$  inch per foot of length.
  - 2. Pipe which is out-of-round to prohibit proper jointing.
  - 3. Improperly formed bell and spigot ends.

4. Discoloration of pipe material.
5. Pipe which is fractured, cracked, chipped or damaged in any manner.
6. Pipe that has been damaged during shipment or handling.
7. Pipe or fittings not properly marked as required by this specification.

The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the City Engineer or appointed representative upon request.

### 3.2.2 CAST IRON AND DUCTILE IRON GRAVITY SEWER PIPE

- A. All cast iron and ductile iron pipe material to be incorporated in the construction of sanitary sewers shall conform to the requirements specified herein or as modified elsewhere in these specifications. The diameter indicated on the drawings shall mean the inside diameter of the pipe.

Except as modified or supplemented herein, all cast iron and ductile iron pipe, fittings and specials shall meet the requirements of the following standard specifications:

American National Standards Institute, ANSI

Numbers in parenthesis are American Water Works Association designations for the standard.

A21.4-03 (C-104)	Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
A21.10-03 (C-110)	Ductile-Iron and Gray-Iron for Water.
A21.11-03 (C-111)	Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
A21.15-03 (C-115)	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

- B. WALL THICKNESS AND CLASS: Pipe shall conform to ANSI 21.51 thickness, Class 51. Fittings shall conform to ANSI 21.10-03 for flanged, mechanical joint and push on joints.
- C. PROTECTIVE LINING AND COATING: Pipe shall be coated with manufacturers' standard bituminous coating approximately one mil thick. Protective lining shall consist of standard thickness cement mortar in conformance with ANSI A21.4 standards.
- D. BEDDING AND BACKFILL COMPACTION: Bedding and backfill Title 7 – Excavation in the Public Right-Of-Way. Pipe depths less than four (4') feet and greater than 20 feet shall require special approval by the City Engineer or

appointed representative. Cast Iron and Ductile Iron pipe shall not be installed at depths in excess of 20 feet with Class C bedding without specific approval of the City Engineer or appointed representative.

### **3.2.3 HIGH DENSITY POLYETHYLENE GRAVITY SEWER PIPE (HDPE)**

High Density Polyethylene Sewer Pipe can be used in the City of Woodland Park for main line sanitary sewers with the approval the City Engineer or appointed representative. The HDPE AWWA C-906 DR-17 with a pressure Class 100 is equivalent to the PVC AWWA C-900 DR-18 with a pressure Class 150. The pipe manufacturer shall provide certification that the stress regression testing has been performed on the specific product. The said certification shall include a stress life curve per ASTM D-2837 and the manufacturer shall provide a product supplying a minimum hydrostatic design basis (HDB) of 1,600 psi as determined by ASTM D-2837.

When HDPE pipe is used for sewer pipe the internal weld bead shall be removed during installation.

### **3.2.4 MANHOLES**

Manholes shall be constructed of precast concrete manufactured in accordance with ASTM Designation C-478.

Manhole steps shall be aluminum, Alcoa No. 12653B, as manufactured by the Aluminum Company of America, or approved equivalent, or plastic coated steel steps manufactured by N.A. Industries, Inc. #PS-2-PF-S, or approved equivalent, spaced 12 inches on center, aligned away from the invert over largest bench. All cones shall be eccentric.

The pre-forming flexible plastic joint sealing compound shall be "RAMNEK" as manufactured by K.T. Snyder Company or approved equal. The application of the priming compound and the sealing compound shall be accomplished in strict conformance with the manufacturer's instructions as to the quantity of material, the grade of the materials and the application temperatures. This plastic joint compound shall be applied to all manhole joints.

The cone section shall not extend closer than 12 inches to the top of the manhole cover. Precast concrete adjustment rings shall be used on top of the cone to support and adjust the manhole frame to the required final grade. Use of bricks to adjust the frame is not permitted.

The manhole barrels shall be watertight at all joints and riser sections. Precast manhole deck (flat top) sections may be used on shallow lines where cone sections are impractical.

Concrete bases shall be poured in place, Class "A" concrete, with a minimum thickness of 18 inches. Manhole inverts shall be formed as indicated in the detail drawings to ensure smooth flow through the manhole. Precast bases may be used in lieu of poured in place bases.

Refer to Figures 3.4.1 and 3.4.2.

### **3.2.5 DROP MANHOLES**

A drop manhole shall be constructed at all manholes where the incoming pipe invert is more than 18 inches above the manhole invert.

Refer to Figures 3.4.3 and 3.4.4.

### **3.2.6 CONCRETE**

Concrete shall conform to Section 6.2 of these specifications.

## **3.3 CONSTRUCTION**

The following is a suggested guideline for sewer system construction. Any deviation from this guideline must be discussed at the pre-construction conference and approved in writing by the City Engineer or appointed representative.

### **3.3.1 EXCAVATION AND PREPARATION OF TRENCH**

Excavation and preparation of trench shall be in accordance with Title 7 - Excavation in the Public Right-Of-Way.

### **3.3.2 LAYING OF PIPE**

Proper implements, tools and facilities satisfactory to the City Engineer or appointed representative shall be provided and used by the contractor for the safe and convenient execution of the work.

Pipe materials shall be unloaded and distributed on the job in a manner approved by the City Engineer or appointed representative. In no case shall materials be thrown or dumped from the truck.

Before lowering and while suspended, the pipe shall be inspected for defects to detect any cracks. Any defective, damaged or unsound pipe shall be rejected, and removed from the job site. The inside of the pipe shall be cleaned before it is lowered into its position in the trench, and it shall be kept clean by approved means, as determined by the City Engineer or appointed representative, during and after laying. All openings along the line of the sewer shall be securely closed as directed, and in the suspension of work, suitable stoppers shall be placed to prevent earth or other foreign substances from entering the sewer.

Pipes shall be laid to true line and at uniform rates of grade between manholes as shown on the plans. Fine grading, to the bottom of the barrel, shall proceed ahead of the pipe laying, and should any over-excavation exceeding two inches be encountered, the material added shall be moistened and compacted or foundation material shall be added at the expense of the contractor to the satisfaction of the City Engineer or appointed representative.

Holes shall be dug for the pipe bells. Bell holes shall be adequate to make the joint, but no larger than necessary so that maximum support will be provided for the pipe. The remainder of the pipe shall be surrounded as required by the appropriate bedding material, shovel placed and hand tamped, to fill completely all spaces under and adjacent to the pipe.

Pipe laying shall proceed upgrade with the spigot ends pointed in the direction of flow. No pipe shall be laid in water or when trench conditions are unsuitable for pipe installation. Generally, pipe shall be laid so that the manufacturer’s labeling is on the top quadrant of the pipe and plainly visible.

When connecting to existing sewers, the contractor shall take every precaution necessary to prevent dirt or debris from entering the existing lines.

### 3.3.3 TRACER WIRE

Continuity of a tracer signal shall be maintained for all curvilinear sewer installation and all sewer service lines from clean-out to clean-out. Number 12 AWG insulated copper tracer wire shall be taped to the top of the pipe at four (4’) foot intervals with PVC adhesive tape with the installation of all new curvilinear sewer installations. The wire shall be accessible within the manhole ring and cover of all inline manholes. Tracer wire shall be accessible at intervals of no greater than 400 feet as measured along the pipe. For service lines the tracer wire shall be accessible at each clean-out and from the property line to the foundation. All splices shall be made using approved connectors or thermowelding.

### 3.3.4 MANHOLES

Except as otherwise provided in these specifications, manholes shall be precast and manufactured in accordance with ASTM C-478, and shall conform to the drawings. Manholes shall have steps unless otherwise specified. The internal diameter shall be as follows:

<b>Size of Sewer Main</b>	<b>Inside Diameter of Manhole</b>
<b><u>Inches</u></b>	<b><u>Feet</u></b>
Up to 12	4
15 through 36 (and all drop manholes and flat top manholes)	5
42 and above	6

All cements used in manhole construction shall be Type V.

The manhole base shall be cast-in-place concrete of the size and depth shown on the plans. Concrete used for bases shall have a 28-day compressive strength of at least 4,000 pounds per square inch.

All manhole covers shall be set to the following grades, irrespective to the exact elevations specified on the drawings:

1. In areas sustaining no normal traffic the covers shall be set six (6) inches above the finished grade, which shall correspond as nearly as possible to the original grade. These covers shall be of the lockable or bolt down type.
2. In paved streets the cover shall be set to ½ inch below proposed finished surface elevation.

### **3.3.5 MANHOLE CASTINGS**

Manhole rings and covers shall be of cast iron or alloyed aluminum corresponding to model number MH 310-24, as supplied by Castings, Inc., of Grand Junction, Colorado, or City Engineer or appointed representative approved equal. Manholes located outside of improved streets shall be rings and covers bolted on the concrete cone with the lid lock assembly.

The manhole lid shall be drilled with a ½ inch hole six (6”) inches off center to the right of the “R” in the word SEWER.

All below grade cast bodies shall be coated for additional protection. Cast iron products conform to physicals of Grade 25, Specific Gravity 7.207 (Reference – Mechanical Engineers Handbook, McGraw Hill Book Co., New York, N.Y.)

The composition of the aluminum alloy shall conform to ASTM B-0179, Alloy SNI22A and Alloy CN42A, and ASTM B-108, Alloy SCIO3A. The tensile strength shall be 30,000 psi. The maximum elongation shall range from ½ to 1½ percent. The Brinell hardness shall range from 75 to 105. The total weight of the ring and cover shall not exceed 150 pounds.

### **3.3.6 FITTINGS, COUPLINGS, WYES AND SADDLES**

Fittings, couplings, wyes and saddles shall be of the same material as the pipeline. Joining of dissimilar materials shall be permitted only through the use of fittings, couplings, wyes, saddles, and adapters or glues specifically manufactured for such transitions.

### **3.3.7 SERVICE CONNECTIONS**

No sewer service connections shall be installed until the engineer or surveyor has set stakes delineating the front property corners. Service connections for each property shall be extended to a point 13 feet inside the property line at a point generally 10 feet uphill from the lowest front property corner or as approved by the City Engineer or appointed representative. Service connections shall include clean-outs spaced at a distance not greater than 100 feet. Tracer wire shall be accessible at all cleanouts and be electrically continuous from the main to the building foundation.

### **3.3.8 DEEP SERVICE CONNECTIONS**

Service connections to mains in excess of 14 feet deep shall conform to Figure 3.4.10 for deep service connections except when approved by the City Engineer or appointed representative.

See Figure 3.4.10 for deep service connections.

### **3.3.9 BACKFILLING AND COMPACTION**

Backfilling and compaction shall be done in accordance with Section 7.5.

### **3.3.10 SERVICE LINE DISCONNECTIONS**

Disconnection of sewer services shall be inspected by the City Engineer or appointed representative to determine the acceptability for future reuse and proper plugging of the pipe.

Services to be disconnected shall be plugged at a point two (2') feet inside the property line with an approved gasket or solvent cemented plug. If the location of the existing pipe at the property line cannot be determined or disconnection at this point would interfere with service to another structure, the service shall be plugged at another point, to be determined by the City Engineer or appointed representative.

### **3.3.11 SERVICE LINE INSPECTIONS**

Service stubs and building sewer lines shall not be backfilled until the City Engineer or appointed representative gives approval. Any deficiencies noted by the City Engineer or appointed representative shall be corrected by the contractor prior to calling for reinspection. The contractor will be notified by the City Engineer or appointed representative of all deficiencies requiring correction. After approval is given for service stubs or building sewers, the contractor shall commence backfilling in accordance with these rules, as soon as practical.

### **3.3.12 ABANDONMENT OF MAINS AND APPURTENANCES**

When new facilities cause or allow the abandonment of existing mains or appurtenances, all materials to be removed by the contractor, or all materials determined to be salvageable by the City Engineer or appointed representative shall be carefully removed and delivered to a site as directed by the City Engineer or appointed representative.

### **3.3.13 REPAIRS AND REPLACEMENTS**

Repairs or replacement of existing sewer mains and appurtenances, service stubs or building sewers shall be done in accordance with the rules and shall be inspected and approved by the City Engineer or appointed representative before backfilling.

### 3.3.14 TESTING

- A. **CONNECTION PROHIBITED:** Connection of services to mains and service stubs shall be prohibited unless and until such mains and service stubs have been inspected and approved by the City Engineer or appointed representative. All work and required cleaning shall be completed prior to requesting testing and acceptance by the City.
- B. **CLEANING:** Prior to acceptance of each section of sewer main, the contractor shall remove foreign material, which may cause interruption of flow. When excessive debris has entered or exists in the pipeline (sewers up to 24 inches in diameter), the City Engineer or appointed representative may require the contractor to flush a pneumatic cleaning ball through. Larger sewers shall be cleaned by other appropriate methods approved by the City Engineer or appointed representative. All dirt and debris shall be prevented from entering the active sewer system by means of watertight plugs or other methods approved by the City Engineer or appointed representative.
- C. **COMPACTION TESTS:** Shall be in accordance with Title 7 – Excavation in the Public Right-of-Way.
- D. **INFILTRATION AND EXFILTRATION TESTS:** Infiltration and exfiltration tests conducted by and at the expense of the contractor shall be performed on a representative portion of the project. The contractor shall select one (1) of the following tests to perform on one manhole run or approximately 10 percent of the project. Sections to be tested shall be selected by the City Engineer or appointed representative.

### 3.3.15 AIR TESTS

The contractor shall perform these tests with suitable equipment specifically designed for air testing sewers.

**LOW PRESSURE TEST:** All pipe outlets shall be plugged with suitable test plugs. If the pipeline to be tested is submerged in groundwater, the Responsible Party shall determine the groundwater elevation at the test location and provide it to the Inspector. The back pressure on the pipe due to groundwater shall be determined and the internal pipeline test pressure shall be established at 4.0 psi (gauge) in excess thereof. Add air slowly to the portions of the pipe being tested. After the pipeline has been filled to the required pressure, allow at least two (2) minutes for the air temperature to stabilize, adding only the amount of air necessary to maintain the test pressure. After the two (2) minute period, disconnect the air supply and allow the initial pressure to drop to 3.5 psi (gauge) in excess of the groundwater back pressure.

The time interval required for the pipeline internal pressure to drop from 3.5 psi (gauge) to 2.5 psi (gauge) above the excess of ground water back pressure shall be measured and recorded.

The basis for acceptance of the air test shall be the minimum time required for the internal pressure to drop 1.0 psi (gauge). The minimum allowable pressure drop time is computed based upon an allowable leakage rate not to exceed 0.003 cfm per square foot of internal pipe surface. Pipelines 15 inches in diameter and smaller shall be tested from manhole to manhole.

Minimum allowable pressure drop (time in seconds) shall be in accordance with the following table:

<b>Pipe Diameter (Inches)</b>	<b>Length of Pipe Being Tested (Feet)</b>			
	<b><u>100</u></b>	<b><u>200</u></b>	<b><u>300</u></b>	<b><u>400</u></b>
8	38	76	114	152
10	47	94	141	188
12	56	113	170	226
15	71	141	212	283

### 3.3.16 EXFILTRATION TEST

The test section shall be bulkheaded and the pipe subjected to a hydrostatic pressure produced by a head of water at a depth of three (3') feet above the invert of the sewer at the upper manhole under test. In areas where ground water exists, this head of water shall be three (3') feet above the existing water table.

This head of water shall be maintained for a duration of one (1) hour during which it is presumed that full absorption of the pipe body has taken place, and thereafter for a further duration of one (1) hour, the measured maximum allowable rate of exfiltration for any section of sewer, including service stubs, shall be as listed below:

<b>Main Sewer Diameter (Inches)</b>	<b>Maximum Allowable Exfiltration Gallons per Hour per 100 Feet</b>
4	0.32
6	0.47
8	0.63
10	0.79
12	0.95
15	1.20

Larger diameter pipes may be tested with a joint tester and method approved by the City Engineer or appointed representative.

If measurements indicate an exfiltration greater than the maximum allowable leakage, additional measurements shall be taken and continued until all leaks are located and the necessary repairs and corrective work have reduced the leakage in the section being tested below the maximum allowed. All repair work and materials used must be approved by the City Engineer or appointed representative. For purposes of the test, the line between adjoining manholes will be considered a section and will be tested as such.

The contractor shall furnish the plugs, standpipe and other material and labor for placing the plugs and standpipe in the sewer and shall assist the City Engineer or appointed representative in making measurements. Any substance introduced into the system with the intent of sealing such leaks will not be permitted. If results of these tests are not satisfactory, the contractor, at his expense, will make the necessary repairs or pipe replacement until the City Engineer or appointed representative is satisfied that the leakage requirements are met.

### **3.3.17 INFILTRATION TEST**

If the ground water level is greater than three (3') feet above the invert of the upper manhole and the City Engineer or appointed representative gives approval, infiltration tests may be allowed in lieu of the above tests. The allowable leakage for this test will be the same as for the exfiltration test.

Any visible leaks detected by observation or closed circuit television shall be repaired even if the section does not exceed the allowable infiltration rate. Failure of the tested sections to pass the allowable rates will result in additional sections of the project being tested.

### **3.3.18 TELEVISION INSPECTION**

- A. INITIAL INSPECTION: The City will televise all new sanitary sewer installations after the initial installation. If on the initial television inspection the cleaning is unsatisfactory and prevents the television inspection from being completed, the Responsible Party shall reclean the sewer line and shall be responsible for all costs incurred by a second television inspection. Pre-flooding of pipe is required prior to television inspection. All inspection reports and videos shall be available for review by the Responsible Party. The Responsible Party shall be responsible for any repairs or replacement of any portions of the pipeline that are determined defective as a result of the television inspections.
  
- B. FINAL INSPECTION: Prior to the final acceptance, there shall be another television inspection. If there are any discrepancies, a punch list shall be formulated and sent to the Responsible Party. All items must be completed before final acceptance shall be granted. If it is determined that the City's television inspection schedule may delay final acceptance, the contractor may provide VHS or DVD copies of video inspections conducted by an independent contractor at no cost to the City.