

**3.5 SANITARY SEWER DESIGN.** This sub-section sets forth the criteria for engineering design of wastewater collection systems. All wastewater lines shall be designed to be located in roadways or other vehicle travel ways unless approved by the Wastewater Division Manager.

Minor additions, renovations and repairs to an existing sewer or plumbing system shall be permitted in the same manner and arrangement as in the existing system, provided that such repairs or replacements are not hazardous and are approved by inspection.

All sewer main lines installed in public or private streets shall be inspected in accordance with these Standard Specifications for Design and Construction. These lines are public lines unless otherwise approved by the City Representative.

**3.5.1 DESIGN FLOWS.** All sanitary sewers and appurtenances shall be designed to carry the design flows from all contiguous areas which may, within a reasonable period in the future, be tributary thereto. Trunk lines shall be designed in accordance with the system master plan.

Sanitary sewers shall be designed to carry the peak discharge as specified below; also, all sewers shall be designed to transport suspended material so as to preclude the deposition of any solids in the sewer line.

New sewer systems shall be designed on the basis of an average daily per capita flow of not less than one hundred gallons per day. Other flow rates, based on accepted engineering practice, may be submitted to City's Engineer for review and/or approval. Sanitary sewer systems shall be designed to prohibit infiltration and exfiltration. To provide for peak loads, sanitary sewers shall be designed to carry not less than the flow shown in Table 3.4 when running 2/3 full.

**TABLE 3.4  
SANITARY SEWER DESIGN FLOWS**

Laterals and sub mains galls/capita/day	400
Mains, trunks and outfalls gallons/capita/day	250

All sewers shall be designed and constructed with hydraulic slopes sufficient to give mean velocities (when flowing one half full) of not less than two feet per second, based on Manning's formula. As a minimum, Manning's "n" value shall be in accordance with pipe manufacturer's recommendation. An "n" value which

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Will yield higher friction losses shall be used where disturbing influences are known or anticipated, such as disruption of flow by tributary inflows, varied pipe materials, etc. The minimum slopes to be provided shall be as shown in Table 3.5, unless approved otherwise by the Wastewater Division Manager.

**TABLE 3.5  
SANITARY SEWER MINIMUM SLOPES**

SEWER SIZE (Inches)	MINIMUM SLOPE (ft/100 feet)
4	2.00
6	0.80
8	0.50
10	0.40
12	0.35
15	0.30
18	0.25
21	0.20
24	0.15

Under special conditions, when justifiable reasons are given, slopes slightly less than those required for the two feet per second velocity when flowing one half full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for the design average flows, and where computations of the depth of flow in such pipes at minimum, average and peak rates of flow are submitted showing the basis of design. The Design Engineer must furnish computations for velocities and depth of flow for grades in excess of ten percent (10%) and for extremely low flow situations.

Hydraulic jumps shall be avoided whenever possible. Where velocities greater than fifteen feet per second are attained, special provision shall be made to protect against displacement by erosion and shock.

All Fernco repairs shall be encased in concrete and inspected. Repairs made on 8" or larger diameter pipes will be mandrel tested. Repairs made using solid couplers will be visually inspected before the repaired area is backfilled.

**3.5.2 MINIMUM SIZE AND DEPTH.** No public sanitary sewer shall be less than eight inches in diameter except as otherwise permitted in this sub-section. Minimum size of house connections shall be four inches in diameter. Minimum size of commercial connections shall be four inches in diameter. Lateral size and slope shall be based on the number of fixture units. Up to ninety (90) fixture

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units shall be allowed per four inch lateral line. Each lateral connected to the public main shall serve only one residence, structure, or building. No connection of any sewer lateral to buildings or structures will be allowed until all downstream sewer lines have been tested and passed and all associated manholes have been raised and collared at asphalt grade.

In general, sanitary sewers shall be designed to a minimum depth of nine feet to the pipe invert in order to facilitate basements. Depth of pipe shall be measured from top of back of curb at low side of property to be served, in order to permit sewer laterals from basements to be connected. Exceptions may be granted in subdivisions or areas in which houses without basements are to be constructed. In such case a note to that effect shall be made on the plat map and on all plans presented for approval. In no case shall sanitary sewers be designed for a depth of cover less than thirty six inches over the top of the sewer pipe. All sewers shall be designed to prevent damage from super-imposed loads as well as trench loading conditions. When more shallow depths are unavoidable, consideration for approval may be given upon submittal of proper engineering design criteria to the City Engineer.

**3.5.3 ALIGNMENT.** All sanitary sewer mains shall be designed for uniform slope and alignment between manholes and shall be laid a distance of at least ten feet (horizontally) from any existing or proposed water main. In the event that a sewer main cannot be laid at least ten feet from an existing or proposed water main, then the City's Representative may authorize the implementation of the provisions of the appropriate section of the State of Utah Public Drinking Water Regulations.

All sewer laterals shall intersect the sewer main on the top third of the sewer main pipe as shown in the standard drawings.

**3.5.4 SERVICE CONNECTIONS.** Service connections to any public sanitary sewer shall be made only to a wye installed at the time of the sewer main installation or by a machine tap and approved saddle compatible with the main line sewer material in accordance with the standard drawings. They shall be a minimum of ten (10) feet, measured horizontally, from any culinary water line or tapping. All connections and service lines must be water tight. All sewer clean-outs shall be made with a standard wye fittings. New subdivisions shall install a sewer lateral from the main sewer to each proposed lot. The lateral shall be located fifteen feet from the low lot line, unless otherwise approved, and shall extend into the property a minimum of five to a maximum of ten feet from the front property line. Clean outs are required at 100-foot maximum spacing on straight runs and for each change in direction where the total aggregate change exceeds 135°.

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Service connections shall not be made to any sewer outfall line with a diameter greater than fifteen (15) inches or into a manhole unless otherwise approved by the City's Representative.

All sewer laterals connected to public sewer mains shall conform to Table 3.6. Laterals shall not be connected into main line stub ends extending from manholes.

All restaurants, food service establishments and other buildings that use high amounts of grease or oil shall install grease traps approved by the City's Representative and shall comply with City "pretreatment" standards.

Multiple connections to a lateral are not permitted.

Under no circumstances shall swimming pool drains, roof drains, foundation drains, storm drains or sub-drains be connected to the sanitary sewer system.

**TABLE 3.6  
SANITARY SEWER LATERALS**

TYPE OF UNIT OR RESIDENCE	MINIMUM SEWER LATERAL SIZE (Diameter)	MINIMUM SLOPE
Single Family Residences	4 inches	2%
Townhomes (each unit)	4 inches	2%
Mobile Homes	4 inches	
Multi-family Condominiums	4 inches	1%
Commercial establishments	4 inches (see note below)	1%
Mobile Homes	4 inches (see note below)	22%
Apartments	4 inches (see note below)	

NOTE: Lateral size and slope shall be based on the number of fixture units. Up to ninety (90) fixture units shall be allowed per four-inch lateral pipe.

**3.5.5 MANHOLES.** Manholes shall be installed at all changes in grade, direction, pipe size or at all intersections; and at distances no greater than four hundred feet apart. All manholes shall be accessible to maintenance vehicles, and all sewer easements shall provide at least twelve feet of unobstructed width.

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Drop manholes shall be provided for a sewer line entering a manhole at an elevation of eighteen inches, or more, above the manhole invert.

Floor troughs shall be furnished for all sewers entering manholes, and shall be at least as deep as the full diameter of the sewer main in the manhole. Lines entering a manhole above the main trough but less than eighteen inches above the invert shall be provided with a slide inside the manhole to prevent sewage from getting into the manhole shelf and to minimize splashing of sewage.

A sewer main or service eight inches or larger connecting to an existing sewer main shall require a manhole at the point of connection. Where the junction consists of the same size sewers, a 0.2 foot drop shall be provided between the branch and main sewer. When a smaller sewer main joins a larger sewer main in a manhole, the top of pipe elevations shall match.

All manholes shall have eccentric manhole cones conforming to the detailed dimensions, construction details and materials as shown in the standard drawings.

Sewer manholes for all sewer mains of less than twelve (12) inches in diameter shall be a minimum four feet inside diameter. For sewer mains twelve inches in diameter or larger or over twelve (12) feet in depth, the manholes shall be not less than five feet in inside diameter. When the sum of all pipe sizes connecting to the manhole totals 24 inches or greater, the manhole diameter shall be five feet or greater.

When a sewer line is installed in a development or in a phase of a development, the line may be extended up to three feet beyond the last manhole on the line. The open end of the extension (the "stub") shall be the bell end of the pipe and must be sealed with a water-tight plug to allow for future extension. The stub shall be grouted and sealed around the pipe as it exits the manhole, to promote a water-tight fit.

Manhole sections shall be installed no less than 14 days after date of manufacture. Each manhole section shall be clearly marked on the inside with the name of the manufacturer and the date it was manufactured.

All new manhole lids and replacement lids on existing manholes shall have the City of St. George emblem.

**3.5.6 UTILITY CLEARANCES.** The following clearances must be maintained between sewer lines and other utilities unless otherwise approved by the City Representative:

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- A. Utility clearances specified in applicable laws and codes shall be adhered to.
- B. Sewer mains should be placed lower than other utilities.
- C. Water distribution and sewage collection lines shall be laid in separate trenches, with at least ten (10) feet of separation measured horizontally.
- D. Where the water line is less than eighteen (18) inches over the sewer line, where the water line is under the sewer line, and where the horizontal separation cannot be maintained because of physical obstructions, the water line shall be protected by construction of the sewer line with 1) ductile iron pipe; 2) water supply quality materials and joints; or 3) encasement with a minimum of two (2) inches of concrete. Each of these provisions shall extend ten feet on each side of the crossing. These provisions shall also be extended for other than ninety degree crossings to the point at which the ten (10) foot separation between the water and sewer lines is achieved.
- E. Wastewater laterals and mains crossing under power, storm drain telephone, traffic signal conduit and/or street lighting conduit shall have at least one (1) foot separation, measured vertically. The clearance for gas lines shall be five (5) feet horizontally. If the required vertical clearance cannot be met, as determined by City Representative, a cushion of sand and cement slurry may be used to separate the utilities. Where use of sand and cement slurry are not practical, the Engineer may propose alternate methods.
- F. The following clearances must be maintained between waterlines and other utilities
- Water to phone lines/cable TV - five (5) feet
  - Gas to water or wastewater - five (5) feet
  - Water to power - ten (10) feet
  - Water to irrigation - five (5) feet
  - Water to wastewater - ten (10) feet horizontal and eighteen (18) inches vertical.
  - Gas to power - ten (10) feet.

**3.5.7 SUSPENDED CROSSINGS.** When suspended crossings are required, adequate support shall be provided for all joints in the pipe utilized for the crossings. The supports shall be designed to prevent frost heave, overturning and settlement. Precautions against freezing, such as insulation and increased

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slope, shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. For suspended crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the one hundred year flood plain. When possible, the crossing supports shall be designed to allow for future adjustment in grade.

**3.5.8 PRESSURE (FORCE) MAINS.** The following defines design criteria and standards for pressure mains.

A. **Velocity:** A velocity of no less than three (3) feet per second shall be achieved at design flow. Calculation of pressure main velocity, design pressure, and hydraulic losses shall be submitted to the City's Representative for approval.

B. **Air Relief Valves:** Where required, an automatic air relief valve specifically designed for raw sewage application(s) shall be placed in the force main to prevent air locking.

C. **Slope:** To limit accumulations of gases, no segment of a force main shall have a zero slope. Wherever possible, low points which are subject to solids accumulation shall be avoided.

D. **Termination:** Pressure mains shall enter the gravity sewer system at a manhole. If necessary, provisions shall be made to direct or baffle sewage as it enters the manhole.

E. **Design Pressure:** The pressure main and fittings, including reaction blocking, shall be designed to withstand normal pressure, pressure surges (water hammer), and total (active and passive) earth loads.

F. **Suspended Crossings:** Pressure mains used for suspended crossings shall meet applicable requirements of SECTION 3.5.7.

G. **Hydraulic Losses:** Friction losses through pressure mains shall be based on the Hazen-Williams formula. For the Hazen-Williams formula, "C" = 100 shall be used for unlined iron or steel and "C" = 120 for all other materials. Turbulent losses at fittings, bends and valves shall be determined in a similar manner. The design data shall be submitted to City's Representative for review and prior approval.

H. **Thrust Blocks:** Thrust blocks and other restraints shall be included as necessary to secure the pressure main from movement.

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I. **Identification Ribbon:** A pipe locator ribbon shall be placed no less than eighteen (18) inches above the top of pipe, centered along the entire length of the pressure main. The ribbon shall be green in color and shall have the clearly printed legend, "Buried Sewer Line Below", printed continuously along its length with minimum one inch letters. The ribbon shall be not less than two (2) inches wide. For nonmetallic pressure mains, the locator ribbon shall have a metallic component, such as plastic-coated aluminum.

J. **Connection Into Existing Systems:** When connecting any sewer main or sub-main into an existing sewer system a plug shall be installed at the time the sewer is cut into, both on the downstream and upstream ends of the new line. The plug shall be a Cherne Gripper Mechanical Plug, or approved equal. The plugs shall not be removed until the new sewer system is approved and accepted by the City's Representative.

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