DC2 – DESIGN CRITERIA FOR SANITARY SEWERS AND APPURTENANCES

DC2-001 **GENERAL.** Sanitary sewers shall be designed for the ultimate development conditions within the tributary area. The ultimate development conditions shall be estimated using current zoning regulations, land use master plans and approved planning and zoning reports, where applicable. Sewer capacities shall be adequate to convey the anticipated peak flow in accordance with the Design Criteria in this Section.

DC2-002 **SEWER DESIGN.** Sewers shall be designed for the total tributary area using the following minimum criteria. An Equivalent Dwelling Unit (EDU) is a standard quantity of water usage as required for one single family residence. The 25-year design flow rate per EDU shall be as follows:

1 Equivalent Dwelling Unit (EDU) = 300 gpd

Table DC2-002-1 shall be used to determine the total EDUs for an area. Extrapolations to determine design flow rates for industrial zonings, or zonings not listed below in Table DC2-002-1, shall be submitted to, and approved by the City Engineer.

Table DC2-002-1 *– 25-Year Design Flow Rates*

Type of Development	Gardner Zoning	EDUs per unit	Peaking Factor
Single-Family	R1	1.0 EDU per Living Unit	3.7
Multi-Family	R3, R4	0.8 EDU per Living Unit	3.7
Commercial/Industrial design flows shall be on a case-by-case basis and shall conform to KDHE standards.			

Peak flows can be increased by outside circumstances, such as other watershed contributions into the design watershed, and shall be considered in the design.

Sanitary sewer pipes 18 inches and larger in diameter shall be designed with a maximum flow depth of **three-fourths** of the pipe diameter. Pipes smaller than 18 inches in diameter shall be designed with a maximum depth of flow equal to **two-thirds** of the pipe diameter. All sewers shall be designed to convey the 25-year return interval storm. Design calculations shall be included on the General Layout Sheet of the plans within a table for approval.

DC2-003 **MAXIMUM SIZE.** The diameter of proposes sewers shall not exceed the diameter of the outlet pipe, unless otherwise approved by the City Engineer.

DC2-004 **MINIMUM SIZE.** No public sewer shall be less than eight (8) inches in diameter, and the minimum diameter for service connections shall not be less than six (6) inches.

DC2-005 **PIPE MATERIAL.** Sanitary sewer pipes shall be resistant to or protected from bacterial degradation, acid and alkaline solutions, temperature variation, abrasion, industrial wastes or other materials which may be transmitted by the collection system.

Unless otherwise specified or approved by the City Engineer, the following types of pipe are approved for proposed gravity sanitary sewer systems:

Polyvinyl Chloride Pipe (PVC) with a minimum thickness of SDR of 26

HDPE (gray and de-beaded) with a minimum thickness of DR 13.5

All pipe material shall be in accordance with the City of Gardner *Technical Specifications for Public Improvement Projects*.

DC2-006 **MINIMUM SLOPE.** All sewers shall be designed to provide a minimum velocity of 2.0 feet per second, when flowing one-half full.

All velocity and flow calculations shall be based on the Manning Formula using an N value of 0.013. Table DC2-006-1 outlines the minimum slope based upon pipe diameter.

***Table DC2-006-1** – Minimum Design Slope Based Upon Pipe Diameter*

	MINIMUM SLOPE IN PERCENT
SEWER SIZE	FULL AND HALF FULL FLOW
8”	0.40
10”	0.28
12”	0.22
15”	0.15
18”	0.12
21”	0.10
24”	0.08
27”	0.065
30”	0.058

Exceptions to these minimum slopes shall be made at the upper end of the lateral sewers serving under 30 houses. Said sewers shall have a minimum slope of 0.76 percent. All sewers larger than 30 inches in diameter shall have the slope approved by the city engineer.

Where lateral sewers serve less than 10 houses, the minimum slope shall not be less than 1 percent (1%).

DC2-007 **INCREASING PIPE SIZE.** When a sewer pipe joins a larger pipe, the invert of the larger sewer should be lowered sufficiently to match the crown elevation of the smaller pipe.

DC2-008 **HIGH VELOCITY PROTECTION.** In situations where flow is continuous and grit is a concern, velocities are greater than 10 feet per second or after the first five (5) manholes downstream of a lift station or a low-pressure sewer system, special provisions shall be made to protect against abrasion damage to the pipe and manhole.

Pipe and manhole protection shall be achieved using a protective coating included on the Approved Materials List. The protective lining shall cover all interior surfaces, including the adjustment rings, casting and lid.

Installers of the protective coating must be trained and certified according to the manufacturer’s specifications. Installer certification shall be submitted to the City Engineer for approval prior to commencement of any work.

DC2-009 **ALIGNMENT AND GRADE.** All sewers shall be laid with straight horizontal alignment, with no deflections in vertical grade between manholes.

DC2-010 **MANHOLE LOCATION AND SPACING.** Manholes shall be installed at the end of each line, all changes in grade, size or alignment and all main line intersections. The maximum spacing between manholes shall be less than four hundred (400) feet for sewers eighteen (18) inches or less in diameter, and not greater than six hundred (600) feet for larger sewers.

DC2-011 **MANHOLES.** Manholes shall conform to the applicable Standard Details and the City of Gardner *Technical Specifications for Public Improvement Projects*. The maximum depth of any manhole shall not exceed eighteen (18) feet unless approved by the City Engineer.

The minimum horizontal clearance between pipes within the barrel of standard manholes should not be less than four (4) feet. Manholes with two or more connecting pipe diameters greater than eighteen (18) inches shall have a minimum inside clear dimension of five (5) feet. Manholes with three or more connecting pipe diameters of twenty-four (24) inches or greater shall have a minimum inside clear dimension of six (6) feet.

Drop manholes should be avoided as much as possible. However, an outside drop pipe shall be provided for a sewer entering a manhole at an elevation of twenty-four (24) inches or more above the manhole invert. The outside drop pipe shall conform to the applicable Standard Detail.

Without utilizing drop manholes, the difference in elevation between the invert of any incoming sewer and the invert of the outgoing sewer shall be less than twenty-four (24) inches, except where required to match crown elevations. When a sewer joins a larger sewer connection, the crown of the smaller sewer shall not be lower than the crown of the larger pipe. The minimum drop through manholes shall be 0.2 feet for manholes with greater than 45^{o} turns, and 0.1 feet for up to 45^{o} turns.

Manholes located in close proximity to streets shall have the top of the manhole elevation set within the following tolerances:

Minimum Elevation	1/4" per foot rise above top back of curb
Maximum Elevation	1/2" per foot rise above top back of curb

Manholes located in unimproved areas and stream corridors shall have the top elevation of manholes set one (1) foot above the existing ground elevation or one (1) foot above the 100-year floodplain, (gasket and locking) anchored to grade rings whichever is greater. The maximum top of manhole elevation shall not be more than three (3) feet above finish grade.

Any variation from the above top of manhole criteria is subject to approval by the City Engineer.

The invert of dead-end manholes shall be constructed shaped and sloped to match anticipated extensions and/or service lines in the future. All connections shall meet requirements of this Section and all stubs shall be properly plugged to prevent any groundwater from entering the manhole. No service line connections to existing manholes shall be allowed.

DC2-012 **SEWER LOCATIONS.** Sanitary sewers shall be located within sewer or utility easements dedicated to the City of Gardner or street or alley rights-of-way. When the sewer is located in easements on private property, access shall be provided to all manholes. A manhole shall be provided at each street or alley crossing. End lines shall be extended to provide access from street or alley rights-of-way where possible. Street and alley crossing shall have a minimum overburden depth of eight (8) feet. The minimum overburden depth for sanitary sewer outside the right-of-way shall be five (5) feet, unless otherwise approved by the City Engineer. All trenches shall be backfilled in accordance with the City of Gardner *Technical Specifications for Public Improvement Projects*.

Sanitary sewer mains shall be extended to property lines. A manhole shall also be provided at the edge of the property line to accommodate future main extensions.

DC2-013 **PROTECTION OF WATER SUPPLIES.** There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, which would permit the passage of any wastewater or polluted water into the potable water supply.

When potable water pipes and sanitary sewer systems, including gravity mains, force mains and manholes, are installed parallel to each other, the minimum horizontal separation shall be ten (10) feet, measured from the nearest points. Sanitary sewer pipes and waterlines shall not be installed in the same trench, regardless of the width of the trench. In cases where it is not practical to provide ten (10) feet of separation, alternate designs which provide equivalent protection shall be submitted to the City Engineer and KDHE for approval.

The minimum vertical clearance between waterlines and gravity sanitary sewer pipes shall be two (2) feet. Crossings with less than two (2) feet of vertical separation shall be in accordance the material and jointing requirements of B.1 of Chapter VIII of KDHE's *Policies, General Considerations And Design Requirements for Public Water Supply Systems In Kansas* and pressure tested to assure water tightness pursuant to the most recent revision of KDHE's *Minimum Standards of Design of Water Pollution Control Facilities*. If concrete encasement is the selected alternative when two (2) feet of vertical separation between the gravity sanitary sewer and the waterline, the encasement for the sanitary sewer shall have a minimum thickness of six (6) inches and extend a minimum of 10 feet on each side of the crossing.

The vertical clearance between waterlines and sanitary sewer force mains shall be a minimum of two (2) feet and the waterline shall always cross above the sanitary sewer force main.

Joints in the sewer pipe shall be located as far as practical from the intersected water main.

DC2-014 **UNSEWERED DWELLINGS.** All existing dwellings without sewer service shall be provided access to the sanitary sewer.

DC2-015 **MAXIMUM SLOPE.** All sewers which are designed to flow at seven (7) feet per second or greater shall be reviewed and approved by the City Engineer.

DC2-016 **SERVICE LINES.** Services shall not be permitted in manholes.

Wyes shall be installed in sewer mains for all private service lines. The service line shall be extended from the wye at the main's using a 45-degree riser and shall be extended to the edge of the utility easement or right-of-way, whichever extends furthest onto the property to be served. The service line shall be installed to provide a minimum slope in the service line of 1%, taking into account at least a three (3) feet Minimum Serviceable Floor Elevation (MSFE) at the structure to be served.

All service lines provided for future connection shall be plugged and marked by placing a 2"x4" wood post with metal cap or #4 rebar directly over the end of the service. Markers shall extend vertically from the end of service to one foot (1') below existing grade for the purpose of locating the stub line upon future connection.

DC2-017 **GROUNDWATER BARRIERS.** Groundwater barriers shall be provided to impede the conveyance of groundwater along the pipe at approximately the midpoint of the pipe when the distance between manholes exceeds 280 feet.

DC2-018 **LIFT STATIONS.** All lift stations shall be manufactured by Smith and Loveless, Inc. (classic style) and shall be wetwell mounted. The lift station must meet firm pumping capacity and shall be designed in accordance with the design criteria as specified under Sewer Design. Any variation from the specified lift station or design must be approved by the city engineer.

DC2-019 **EASEMENTS.** Permanent easements must be provided for all sanitary sewer mains. Permanent easements for sanitary sewer mains shall be centered on the main. The minimum easement width shall be 15 feet; however, easement widths may be increased depending upon the depth of the sewer main.