



ENGINEERING DESIGN STANDARDS

Adopted: _____

TABLE OF CONTENTS

These *Engineering Design Standards* are intended to provide a reasonable basis for design of public and private improvements in the City of Junction City. They are not intended as substitute for sound engineering judgment. The Standards may not apply to all conditions, and alternate solutions shall be permitted as approved by the pertinent City Departments.

Description	Page #
Table of Contents	2
Section 1 - General	3
Section 2 - Water Systems Design Criteria	11
Section 3 - Sanitary Systems Design Criteria	21
Section 4 - Storm Systems Design Criteria	36
Section 5 - Streets Design Criteria	45
Section 6 - Record Drawings Criteria	52

SECTION 1 GENERAL

1.1 GENERAL PROVISIONS

These *Engineering Design Standards* are intended to provide a reasonable basis for design of public and private improvements in the City of Junction City. They are not intended as substitute for sound engineering judgment. The Standards may not apply to all conditions, and alternate solutions shall be permitted as approved by the pertinent City Departments.

1.2 SCOPE

The City Junction City *Engineering Design Standards* is composed of six parts: General Provisions, Streets, Water, Sanitary, Storm, and the Record Drawings.

Where, in any specific case, different sections of the Standards specify different requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.

The regulations are not intended to interfere with, abrogate, or annul any other ordinance, rule or regulation, statute, or other provision of law. Where any provision of these regulations imposes restriction different from any provision of these regulations or any other ordinance, rule, or regulation or other provision of law, whichever provisions are more restrictive or impose higher standards shall control.

1.3 REFERENCED STANDARDS

Whenever references are made to national or industry standards and specifications, methods of testing, materials codes, practices, and requirements, it shall be understood that the latest revision of said references shall govern unless a specific revision is stated. Whenever a reference, standard, or specification is not explicit or not specifically covered by this manual for any engineering and/or construction application, it shall be understood that generally accepted practices, references, standards, and specifications shall govern and shall be approved by the City Engineer.

1.4 PLAN REQUIREMENTS

This Section governs the preparation of plans for public and private improvements within the City, and those under the jurisdiction of the City of Junction City.

Alternatives to the *Engineering Design Standards* may be submitted to the City for consideration. They will be reviewed by the City Engineer and recommendation will be made to the City Commission. Such alternatives shall only be acceptable in those instances where the City finds that the proposed

design(s) will provide an acceptable level of serviceability, ease of maintenance and are consistent with sound engineering practices.

1.4.1 General: The plans shall include all information necessary to build and check the design of public and private improvements (water, sanitary, storm, streets and related appurtenances). The plans shall be arranged as required by the City Engineer. Applicable City Standard Detail Sheets shall be included by reference to standard plan number and title. Plans shall be sealed by a Licensed Professional Engineer in the State of Kansas.

The developer shall submit to the City a minimum of four (4) sets of full-size complete construction plans for review. All plan submittals must go directly to the City. Plans cannot be delivered directly to the City's Consultant Engineer. After the plans receive approval, they will be distributed as follows; one (1) set to the City, one (1) set to the developer/owner, one (1) set to the design engineer and two (2) sets to the City Engineer.

1.4.2 Sheet Sizes: Full-sized plan sheets shall be 24 inches by 36 inches, with white prints having black lines. Half-sized plan sheets shall be 11 inches by 17 inches. Plan and profile shall be drawn on combined or separate plan and profile sheets to minimum scales. All plans sheets shall include the developers and design professionals name(s), address, phone number, fax number and email address.

1.4.3 Scales: Plans shall be drawn at the following minimum scales. Larger scales may be needed to clearly present the design. Bar scales shall be shown on each sheet for each scale.

Plan: 1 inch = 20 feet (preferred), 1 inch = 50 feet (minimum)

Profile:

Vertical: 1 inch = 5 feet (preferred), 1 inch = 10 feet (minimum)

Horizontal: Scale Shall Match Plan Scale

Drainage Area Map:

On Site: 1 inch = 200 feet

Off Site: 1 inch = 1,000 feet

Structural Plans: 1 inch = 1 foot

Graphic Drawings: Standard Engineering (Varies)

1.4.4 Types of Sheets in Plans: The plans shall generally consist of (although all might not be required):

1. Title Sheet
2. General Notes and Quantities
3. General Layout Sheets
4. Plan and Profile Sheets
5. Landscaping Plans
6. Drainage Area Map
7. Storm Water Sheets
8. Traffic Signal Plans
9. Lighting Plans
10. Utility Plan and Profile Sheets
11. Erosion Control Plans
12. Pavement Marking Plans
13. Signing Plans
14. Traffic Control Plans
15. Standard and Special Detail Sheets
16. Cross-Section Sheets

Each sheet shall contain a sheet number, including the individual sheet number and the total number of sheets, proper project identification and date. The engineer's seal shall appear on the title sheet.

1.4.5 Minimum Required Information for Title Sheet:

1. Name of project.
2. Project number (where applicable).
3. Index of sheets included in plans.
4. A location map adequately showing project location in relation to major streets with north arrow and scale.
5. Signature block for city approval.
6. The project control bench marks shall be identified as to location and elevation: NGVD datum. A minimum of two (2) bench marks are required for any project (may be shown on an optional Project Control Sheet inserted directly after the Title Sheet).
7. Name, address and telephone number of the consulting engineer and owner/developer as well as signature block for the owner/developer.
8. List containing name and telephone number of each utility company and the State One-Call System.
9. A legend of symbols shall be shown that apply to all sheets (may be shown on an optional General Notes Sheet(s) inserted directly after the Title Sheet).
10. Design speed plus other traffic information as required by the City Engineer.
11. Engineer's seal, signed and dated.

1.4.6 Minimum Required Information for General Layout Sheet(s):

1. General Notes: Minor construction notes shall appear on the proper plan and profile sheet.
2. North arrow and bar scale. Scale of the general layout map shall be one (1) inch equals one hundred (100) feet.
3. Layout shall include name of subdivision, block designation (if any), lot designation or proposed block and lots, all street names, street alignment with back of curb lines, and an accurate tie to at least one quarter section corner and at least one additional physical permanent feature. An un-platted tract shall have an accurate tie to at least two (2) quarter section corners.
4. Boundary line of project area.
5. Schematic layout of existing conditions and proposed improvements shall be shown; including but not limited to: all proposed streets, grading, sidewalks and utility improvements including storm drainage, sanitary sewers, water lines, street lights, traffic signals, etc.
6. Typical street sections.

1.4.7 Minimum Required Information for Plan and Profile Sheets:

1. North arrows and bar scale.
2. Elevation and location of all applicable benchmarks: NGVD datum.
3. Existing and proposed streets with names and pavement widths.
4. Property lines properly identified as to existing or proposed lot, block and subdivision. Survey base line with adequate ties to land lines.
5. All existing and proposed utilities such as power, gas, oil, water, telephone, sewer, storm and other items shall be properly located in conformance with the best information available in the records of the owner of such facilities, or field location, and identified as to size, type, owner, and material. An itemized quantity list will be required for all proposed utility improvements (water main, sanitary sewer, storm sewer and paving).
6. All existing and known proposed improvements within 50 feet each side of right-of-way and 200 feet beyond the project limits shall be shown at the proper locations. This shall include such existing items as paved streets, curb and gutters, driveways, culverts, fire hydrants, utility poles, trees, shrubs, fences, walls, houses, and other such items, and shall be identified as to type, size, material, etc. as may be applicable.
7. All existing and proposed permanent and temporary easements and right-of-way information, including ownership shall be shown on the plans.
8. Locations and widths of existing and data (K value, stopping sight distance, intersection sight distance, length of curve, curve delta, curve tangent length, middle ordinate, PC, PT, PI, PVI, PRC, etc.). proposed sidewalks.
9. Horizontal curve data and vertical curve
10. Center line stations shall be marked at 100-foot intervals and at other pertinent points.

11. Top back of curb elevations shall be shown at maximum increments of 15 feet or quarter points, whichever is less, along the curb returns at street intersections.
12. Plan view of all ADA ramps showing all corner elevations. ADA ramp details shall also show all slopes of the ramp.
13. Profile shall show existing grade as a dashed line, proposed finish grades or established street grades by solid lines.
14. Storm sewer criteria shall be in accordance with the Storm Systems Criteria.
15. All utility trenches under the 45 degree zone of influence line of existing or proposed pavements, sidewalks or drive approaches shall be backfilled with base rock and/ or sand, compacted to at least 95% of maximum unit weight.
16. Utility crossings of paved roadways will be required to be bored. Open cutting of paved roadways will not be permitted.

1.4.8 Minimum Required Information for Cross-Section Sheets:

1. Street cross section at each station showing existing grade by dashed lines and proposed grade by a solid line. Cross sections to show existing grade lines a minimum of ten (10) feet beyond the right-of-way lines or grading limit, whichever is further. The center line and right-of-way limits shall be shown along with the proposed improvements.
2. Center line elevation of top of pavement.
3. Center line cross sections shall be shown at all intersecting streets and driveways.
4. Location of existing and proposed underground utilities. (It shall be the developer's engineer and contractor's responsibility to verify the existence and location of all existing underground utilities.)
5. Finished grade shall be indicated for all structures.
6. Additional cross sections shall be shown as required to clearly describe the extent of grading operations.
7. For residential development, a mass grading plan shall be required in lieu of cross sections.

1.4.9 Minimum Required Information for Standard and Special Detail Sheets: Detail sheets shall be included to show all details of appurtenances, materials, and construction. All engineering construction plans shall contain the latest version of the applicable City of Junction City Standard Detail Sheets. Other details shall conform to the requirements of the City and are to be drawn clearly and neatly with proper identifications, dimensions, materials and other information necessary to insure the desired construction.

1.4.10 Minimum Required Information for Traffic Control Plans:

1. Limits of any road closures, sidewalk closures, or multi-use trail closures shall be shown along with the traffic control devices used to affect the closure. Any closure restrictions, speed limit, length of time, etc. shall be indicated on the plans.

2. Detour plan shall be designed for traffic affected by closures. Detour signing used in the detour route shall be included in the detour plan.
3. Typical lane closure or lane shift plans including taper lengths and spacing of all channelizing devices. Types and spacing of all traffic control signs and markings shall be shown.
4. A traffic control plan shall be prepared for each phase of construction.
5. All traffic control shall be designed using the traffic control devices and application principals contained in the Manual on Uniform Traffic Control Devices (MUTCD). All required street name and traffic control devices shall be installed by the developer. Signs shall meet the requirements of the MUTCD and reflectivity standards of the City.

1.5 DISTRIBUTION OF PLANS

The developer or their engineer shall be responsible for forwarding plans for approval to any private utility company (gas, electric, phone, cable, etc.) and any Federal, State or County agency whose facilities, easements or rights-of-way may be affected by the proposed construction.

1.6 ENGINEER'S OPINION OF CONSTRUCTION COST

An Engineer's Opinion of Construction Cost must be supplied with the Construction Plan submittal. This estimate will be used by the City to establish review and inspection fees for the improvements in accordance with the City Ordinance(s).

1.7 PLAN REVIEW PROCESS

A general overview of the plan review process is described below:

1.7.1 Site Plan Review

The City's staff, departments, and/ or consultants will review the site plan including: water supply, wastewater disposal, storm water management, site grading, pavement improvements and right-of-way improvements.

Review comments will be issued to the developer/ design engineer.

Once the site plan has been accepted by the Metropolitan Planning Commission, the Developer will be required to submit detailed engineering drawings and an itemized cost estimate of the proposed improvements so that an escrow account may be established for plan reviews and construction observation. The amount of the escrow account will be determined by the City.

1.7.2 Construction Plan Review

The City Engineer will review the construction plans for conformance to City *Engineering Design Standards*. The City will strive to complete a typical review in five business days. More complex reviews may take as long as 10 business days or more. Once the plans are in an acceptable form, the plans will be issued as approved construction plans. The Developer will be responsible to apply for all

required County and State permits including: soil erosion, water supply, wastewater disposal, right-of-way, wetlands, etc.

Public water main and sanitary sewer improvements will require the submittal of plans and permit applications to the City for review and approval, prior to them being forwarded to the governing agency by the City Engineer.

1.7.3 Pre-Construction Meeting

Once the approved engineering plans have been issued, a pre-construction meeting with the Developer (or their representative) and their related contractors, is required prior to the start of any site work. This meeting will verify that all relevant permits have been applied for, that the proper insurance/bonds are provided and to schedule construction observation.

1.7.4 Site Construction and Observation

Observation by the City and/or its consultant(s) will be as described below. The City will assign observation responsibilities at the preconstruction meeting.

Roadways (public and private) - Spot observation on the subgrade and aggregate base. Full time observation curb & gutter and pavement placement.

Parking Lots (public and private) - Spot observation on the subgrade, aggregate base, curb& gutter and pavement placement.

Sidewalks - Spot observation.

Storm Sewer - Full time observation on public facilities, spot observation on private facilities.

Detention/Retention Facilities - Spot observation on grading.

Water Main (public and private) - Full time observation on all facilities with spot observation on 2" diameter and smaller service leads and full time observation on service leads larger than 2" diameter.

Sanitary Sewer - Full time observation with spot observation on private facilities.

Retaining Walls - Spot observation on all structures over 30" in height.

Additional construction observations may be required, on a case by case basis, at the discretion of the City.

Note: The developer will be required to provide backfill density testing for all public utility construction and work within the public road right-of-way.

1.7.5 Bond Inspection and Final Inspections

Once the proposed improvements have been completed, the Developer may request that the City perform a site inspection to establish bond amounts to complete the remaining site improvements for final acceptance by the City.

1.7.6 Record Drawing Plan Review

Record drawings, describing the location and elevations of the proposed site improvements are required to be submitted for review and approval. See Section 6 of the City's *Engineering Design Standards* for the requirement of the Record Drawings submittal. The developer will also be required to submit all public utility easements, detention basin maintenance agreement, off-site easements, etc. for review. Once approved, original copies of the applicable documents shall be submitted for recording at the Geary County Register of Deeds.

SECTION 2 WATER SYSTEMS DESIGN CRITERIA

2.1 GENERAL

These criteria shall be adhered to for the design of all water systems within the City.

2.1.1 INTRODUCTION

A. This document sets design standards for water supply system improvements, extensions and relocations within the jurisdiction of the City and within the service area surrounding the City of Junction City. The following requirements are minimum requirements.

B. These criteria cover design factors and provide guidelines for evaluations of plans and specifications by the City. These criteria are not intended to cover extraordinary situations and in such instances, deviations from the criteria must be approved by the City Engineer.

C. The design of water systems shall be sealed by a Professional Engineer Licensed in the State of Kansas. The designer shall submit such additional design information as the City Engineer requires. Design calculations, soil studies, and field survey data are examples of pertinent design information necessary for plan review.

2.1.2 COMPLIANCE

A. The proposed design shall be in accordance with the City Water Master Plan for the indicated area if formulated.

B. Water distribution system design within the jurisdiction of the City shall conform to the current addition of "Policies, General Considerations, and Design Requirements for Public Water Supply Systems in Kansas" as published by the Kansas Department of Health and Environment (KDHE).

C. Applicable ASTM Standards.

D. The proposed design shall be in accordance with latest version of the International Building Code as adopted by the City.

E. All designs shall meet the minimum required by these design standards.

D. The Kansas Department of Health and Environment, Division of Environment – Bureau of Water must review all water system plans after they are reviewed by the City. No construction can take place until KDHE comments are incorporated and a copy of the issued permit is received by the City.

2.1.3 Pipe Size: Minimum pipe size shall generally be eight (8) inches in diameter. Pipe shall be PVC or ductile iron for water mains.

2.1.4 System Sources: Water mains shall generally be designed with a minimum of two feed sources. Dead end mains will only be allowed under the following criteria:

A. Dead end water mains shall not exceed 700 feet in length.

B. All dead end water mains that are to be extended in the future shall be installed to the limits of the platted subdivision such that extensions to the mains to serve adjacent subdivision plats may be connected at the plat boundary and shall be installed with an inline valve and a temporary fire hydrant that is properly restrained. The valve shall be the same size as the main.

C. All dead end water mains that are not to be extended in the future shall be a minimum six (6) inches in diameter between the last two fire hydrants. No service leads from mains which are greater than 12" in dia. and less than 6" in dia. will be permitted

D. All dead end water mains serving a cul-de-sac shall be extended around the cul-de-sac sufficiently far so that no service lines need to be bored more than the width of the normal, non-cul-de-sac street ROW.

2.1.5 Connection to Existing Mains: Connections to existing mains shall be made in such a manner as to provide the least amount of interruption to water service. In the event that closing of valves to make a connection will affect a customer who cannot be without service, provisions shall be made on the plans for a temporary service. Where possible, connections to existing mains shall be made using tapping sleeves and valves.

When connections are made to an existing system under normal conditions, the exposed pipe and fittings shall be disinfected per AWWA C651.

2.1.6 Tracer Wire: All HDPE, PVC, and Plastic water main pipe shall be required to be provided with a minimum 12 gauge copper, colored black or white tracer wire, running the entire length of the pipe with ends accessible for line location purposes.

2.1.6 Customer Service: Water mains shall generally be designed such that not more than twenty five (25) customers will be without service when sections of the water main are isolated for service or emergency repairs.

2.1.7 Easements: Where required, easements shall be provided for the installation and maintenance of the public water main. Permanent easements shall be a minimum of ten (10) feet in width when adjacent to right-of-way or

access easements. Permanent easements shall be a minimum of fifteen (15) feet in width if not adjacent to right-of-way or access easements. Temporary easements shall be of sufficient width to allow the installation of the water main as shown on the plans. Consideration should be given to size of equipment, materials storage, and trench spoils stockpiling when establishing temporary construction easement widths.

2.1.8 Cross Connection: There shall be no physical connection between the public water main and any pipe, pump, hydrant, tank, or non-potable water supply whereby unsafe water or other contaminating material may be discharged or drawn into the system.

2.2 DESIGN CONSIDERATIONS

2.2.1 Pressure:

A. Water distribution systems shall be designed, constructed, and operated to provide an adequate supply of water at a pressure of not less than 40 psi (276 kPa) at ground level at all points in the distribution system under all flow conditions except extraordinary conditions including unusual peak fire flow demand and major distribution system breaks.

B. The normal working pressure in the distribution system should be in the range of 60 to 80 psi (414 kPa to 551 kPa). It is not uncommon for systems to have a normal working pressure in the range of 90 to 110 psi (620 kPa to 760 kPa) (AWWA, 2005b). Pressures in excess of 100 psi (690 kPa) may be necessary because of fire protection requirements, head loss associated with backflow prevention devices, or the need to serve low-lying areas. In the latter case, pressure reducing valves may be used to lower the pressure in these areas so long as their presence and operation do not conflict with fire protection requirements.

C. Variation in pressure at any single point in the distribution system should normally not exceed 20 to 30 psi (140 kPa to 210 kPa) (AWWA, 2005b). Additional guidance regarding distribution system design and working pressures may be found in the AWWA Manual of Water Supply Practices M32 (AWWA, 2005b).

2.2.3 Quantity:

A. Distribution and transmission mains should be sized to carry peak hourly flow plus fire flow.

B. In the absence of meter data, peak hourly flow can be assumed to be equal to twice the maximum daily flow or four times the average daily flow. Methods for estimating peak consumer demand are provided in the AWWA Manual of Water Supply Practices M22 (AWWA, 2003).

C. The minimum fire flow for one-and two-family dwellings having a fire flow calculation area which does not exceed 3,600 square feet shall be 1,000 gallons per minute with a residual pressure of 40 psi. Fire flow and flow duration for dwellings having a fire flow calculation area in excess of 3,600 square feet shall not be less than that specified in Table B105.1 of the most current edition of the International Fire Code.

D. The minimum fire flow for all other developments shall be 2,000 gpm or more with 40 psi residual pressure as determined by the most current edition of the International Fire Code.

2.3 LOCATION

2.3.1 Horizontal:

A. Water mains shall generally be located three (3) feet from the back of curb.

B. Water mains, if located within dedicated easements, shall generally be centered within the easement and maintain a minimum separation of five (5) feet from the centerline of the pipe to the edge of the easement.

C. Water mains shall be located a minimum of fifteen (15) feet from a building structure and 8 feet from all other structures.

D. No parallel utilities may be laid in the same trench as the water main.

E. Water mains shall generally be located to minimize special engineering conditions and to provide adequate separation from other utilities.

F. Allowable joint deflection shall not exceed manufacturers recommended maximums.

2.3.2 Vertical:

A. Water mains shall be installed with a minimum of forty two (42) inches of cover over the top of the pipe. This minimum of cover shall be from the top of the pipe to the finished grade.

B. The maximum cover allowed shall be seven (7) feet except for short lengths to avoid alignment conflicts.

C. Operable appurtenances such as hydrant and line valves shall generally be located at a depth of six (6) feet or less. Depths of cover for operable appurtenances greater than six (6) feet require the approval of the City Engineer.

2.3.3 Separation:

A. Horizontal Separation:

1. A minimum of ten (10) feet horizontal separation, as measured from the outside edge to outside edge, shall be required between a potable water main and a sanitary sewer main or manhole.
2. Under no circumstance shall potable water main and sanitary sewer be placed in the same trench.
3. When water mains and other utilities are laid parallel to each other the separation distance shall be determined based on geotechnical considerations. A minimum of three (3) feet of undisturbed earth separating the trenches shall be required. Under no circumstance shall water mains and other utilities be installed in the same trench.
4. A minimum distance of twenty-five (25) ft. shall be maintained between all water mains and all pollution sources, e.g., septic tanks, etc.
5. Under no circumstances shall a water main be extended through an area that is a real or potential source of contamination to the water supply.
6. Under no conditions shall the encasement of a water main be considered as adequate protection of a water main or a water supply for the purpose of extending the water main through a real or potential source of contamination.

B. Vertical Separation:

1. A minimum of two (2) feet vertical separation, as measured from the outside walls of the pipe, shall be required between a sanitary sewer main and potable water main.
2. In general potable water mains shall be located above sanitary sewer lines and should cross at as close to perpendicularly as possible.
3. Potable water mains shall maintain a minimum of two (2) feet of vertical separation, as measured from the outside walls of the pipe, and shall always cross above any sewer force main.
4. Protective Measures: When potable water mains and gravity sanitary sewers cross with less than two (2) feet of vertical clearance, and in all cases where the potable water main is located below the gravity sanitary sewer, additional measures must be employed to protect the potable water main. Acceptable measures include:

a) Install a minimum twenty (20) foot length of sanitary sewer pipe on the crossing to maximize the joint spacing to a minimum of ten (10) feet from the crossing. Construction of the sanitary sewer line using one of the following materials:

1. Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.52 with a minimum thickness class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.
2. PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR26 or ASTM F679 (PS115) with gasketed push-on joints in conformance with ASTM F477 and D3212.

- b) Provide concrete encasement of the sanitary sewer line a minimum of six (6) inches in thickness for a minimum distance of ten (10) feet either side of the pipeline crossing.

2.3.4 Watercourse Crossings:

A. Aerial Crossings: The pipe shall be adequately supported, protected from damage and freezing, and be accessible for repair or replacement.

B. Water mains crossing a watercourse shall be designed to cross the watercourse as nearly perpendicular to the flow direction as possible and shall be on a constant grade.

C. Water distribution systems shall be designed to minimize the number of watercourse crossings.

D. Protection of the water main shall be provided at all watercourse crossings as required to prevent erosion.

E. If the depth of cover over the water main is five (5) feet or less, reinforced concrete encasement or steel casing pipe shall be provided extending the full width of the watercourse crossing to a point ten (10) feet beyond the top of bank.

F. Impervious ditch checks shall be provided immediately downstream of the watercourse crossing.

2.4 APPURTENANCES

2.4.1 Fire Hydrants:

A. Fire hydrants should be connected only to water mains adequately sized to carry fire flows, and located to permit flushing of all mains and in compliance with the latest City Fire Code requirements.

B. Fire hydrants shall be Mueller Super Centurion 250 with a five (5) inch Storz Quick connection and two 2-1/2 inch standard hose connections. Nozzle caps shall be the "nut type" having the same dimensions as the operating nut. Such caps shall be securely chained to the base of the hydrant.

C. All fire hydrants shall be the traffic model, break-away type, and comply with the current AWWA C502.

D. Hydrants shall have a minimum design working pressure of 150 psig and test pressure of 300 psig.

A. Direction to open shall be counterclockwise and be marked as such.

F. Hydrants shall be factory painted (baked on enamel). Hydrant assembly shall be red. Hydrant burry barrel shall be black.

G. For public water mains, not more than one fire hydrant shall be located on any 6-inch dead end main. For private fire lines, the size of fire line and number of hydrants shall be designed by a licensed professional e engineer and approved by the City's Fire Department.

H. Fire hydrants shall be placed no less than four (4) nor more than twelve (12) feet from the back of curb. No hydrant shall be placed in the bottom of a ditch.

I. Hydrant spacing shall not exceed six hundred (600) feet. Fire hydrant spacing will be reviewed and approved by City Fire Department on a case by case basis.

J. Fire hydrants shall generally be placed at intersections, end of permanent dead end lines, and intermediate points when block lengths exceed the required spacing. It is preferred to locate mid-block hydrants at property lines.

K. Only dry-barrel hydrants will be approved for installation.

L. Hydrant drains shall not be connected to a sanitary or storm sewer.

2.4.2 Valves:

A. Valves shall be Mueller A2360-20. Direction to open shall be counterclockwise and be marked as such. Valve boxes shall be provided for buried valves.

B. Water main valve spacing shall not exceed five hundred (500) feet in commercial districts, and eight hundred (800) feet in other districts.

C. Valves shall be placed at all tees, crosses, and other pipe intersections such that pipes in the system can be isolated and service interruptions, if required, may be limited to no more than twenty five (25) customers at a time. No more than 4 valves to isolate a break shall be provided.

D. Valves shall generally be placed no more than three (3) feet from the tee, cross or other pipe intersection.

E. Line valves shall generally be located at property lines or placed such that they can be referenced with respect to certain obvious monuments.

F. At high points in the water main where air can accumulate, provision shall be made to remove air by means of hydrants or air relief valves. Automatic air relief valves shall not be used where flooding of the vault may occur.

2.4.3 Thrust Restraint:

A. Thrust restraint shall be provided for all tees, crosses, wyes, bends, plugs, valves, direction changes, and hydrants.

B. Thrust restraint shall be either restraint joint pipe, thrust blocks, or straddle blocks. Thrust restraint shall be installed so that all joints are accessible for repair.

C. The bearing area of concrete reaction blocking shall be as shown on the standard drawings or as determined by the City Engineer.

D. If adequate support against undisturbed ground cannot be obtained, metal harness anchorages consisting of steel rods across the joint and securely anchored to pipe and fitting or other adequate anchorage facilities shall be installed to provide the necessary support.

2.5 FIRE LINES

2.5.1 General:

A. All water lines and hydrants connected to a dedicated fire line shall be considered private.

B. A fire line shall be defined as a fire protection water main which only has connections to hydrants and/or building fire sprinkler systems.

C. No service leads shall be connected to fire lines.

2.5.2 Backflow Prevention:

A. Construction of all private water mains requires the installation of an isolation valve located at the point the fire line becomes privately owned as well as an approved backflow prevention device and shall comply with the City's currently-adopted Plumbing Code, latest edition.

B. If the point of connection of the private line to the water main is fifty (50) feet or less the backflow prevention may be located within the building. If the point of connection of the private line to the water main is greater than fifty (50) feet then the backflow prevention device must be located outside the building within a privately maintained vault.

2.6 SERVICE LINES

2.6.1 General:

A. All water service lines extending from the public water main to the water meter are public. Service lines extending from the water meter to the building are

private. Service lines shall be at least 10 feet from sanitary sewer manholes and at least 5 feet from storm sewer structures.

B. Services shall be connected with corporation stops for 2-inch and smaller service lines and with a cut-in tee and appropriate valving for larger sizes.

C. An irrigation sprinkler system and its required backflow prevention device shall be tied to the service line outside of the meter well on the customer's side of the meter. Alternatively, a sprinkler system and its required backflow prevention device may be tapped to the public water main. However, this requires payment of a separate tap fee and installation of a separate meter.

D. No splices or fittings (e.g., flared copper coupling, pack joint coupling, 3-part union/coupling, etc.) shall be allowed between the water main and the meter.

E. Any splices between the meter and the customer shall comply with the City's currently-adopted Plumbing Code, latest edition.

F. Each individual residential or business unit, except apartments, shall have separate meters and service lines.

G. Service lines shall not be laid parallel to the ROW or run continuously within the ROW.

H. Service lines two (2) inch and smaller shall be soft type "K" copper and shall extend from the main a minimum of two (2) feet beyond the meter well (between the meter and the private customer).

I. Service lines greater than 2 inches in diameter shall be:

1. Ductile Iron (DI), special thickness Class 50.
2. Polyvinyl chloride (PVC), for 6- to 12-inch diameter pipe only AWWA C900 and AWWA C909.
3. Fusible Polyvinyl chloride (PVC), Fusible AWWA C900 and AWWA C905.

J. There shall be a curb stop in every service line attached to the water main. The curb stop shall be placed within R/W or within one (1) foot of the alley if the main is located in the alley.

K. When a service line is to be abandoned the City shall shut off and cap or plug the line at the corporation stop. If the line is to be utilized at a later date the line will be reactivated by the City at the property owner's expense.

2.7 WATER METERS

2.7.1 General:

A. The water meter shall be placed in the City ROW outside of the property line, or within one (1) foot of the alley line if the main is located in the alley, unless specifically allowed by the City Engineer to place the meter on private property.

B. Water meters must be located outside of paved areas, including sidewalks, unless otherwise approved by the City Engineer. In the event that the meter must be installed in a paved area, the Engineer shall submit plans for a traffic-bearing meter well and lid. The Developer shall pay for the additional costs associated with traffic-bearing meter well and lid for any meters placed in paved areas.

C. The top of the meter shall be 18 inches below the water meter lid.

D. Upon installation of the meter, any relocation or adjustment of the meter shall be at the Developer expense.

2.8 INSTALLATION

A. The Contractor/ Developer shall be responsible for all filling, disinfect and pressure testing all water main construction, per the most current AWWA standards, under the supervision of the City Engineer, prior to final acceptance by the City.

SECTION 3 SANITARY SYSTEMS DESIGN CRITERIA

3.1 GENERAL

These criteria shall be adhered to for the design of all sanitary systems within the within the City.

3.1.1 INTRODUCTION

This document sets design standards for sanitary system improvements, extensions and relocations within the jurisdiction of the City and within the service area surrounding the City of Junction City. The following requirements are minimum requirements.

These criteria cover design factors and provide guidelines for evaluations of plans and specifications by the City. These criteria are not intended to cover extraordinary situations and in such instances, exceptions from the criteria must be approved by the City Engineer.

The design of sanitary sewers shall be sealed by a Professional Engineer Licensed in the State of Kansas. The designer shall submit such additional design information as the City Engineer requires: Design calculations, soil studies, and field survey data are examples of pertinent design information necessary for plan review.

3.1.2 COMPLIANCE

A. The proposed design shall be in accordance with the City Sanitary Master Plan for the indicated area if formulated.

B. Other applicable design standards include the most recent published edition of the following:

1. Kansas Department of Health and Environment (KDHE) Minimum Standards of Design for Water Pollution Control Facilities.
2. Applicable ASTM Standards.
3. The proposed design shall be in accordance with latest version of the International Plumbing Code as adopted by the City.
4. All designs shall meet the minimum required by these standards.

C. The KDHE, Division of Environment – Bureau of Water must review all sanitary sewer plans after they are reviewed by the City. No construction can take place until KDHE comments are incorporated and a copy of the issued permit is received by the City.

3.2 DESIGN FLOWS

3.2.1 General: Sanitary sewers shall be designed to provide capacity for the anticipated maximum hourly quantity of sewage and industrial wastes, with approved allowance for infiltration and other extraneous flows. It should be noted that the infiltration and extraneous flow allowances vary widely within any given area depending on a number of conditions. The values presented in this section are minimum general unit design flows. The design engineer should be cautious in the use of these values as a set rule since local conditions may cause variance from any value noted herein.

3.2.2 Design Period:

A. Collectors Sewers: Sewers of the size up to and including a nominal diameter of eighteen (18) inches shall be designed for ultimate development using existing and/or projected land use for the estimated ultimate population of the area served.

B. Larger Sewers: Sewers with a nominal diameter of larger than eighteen (18) inches shall be designed for a minimum design period of not less than twenty five (25) years using existing and/or projected land use. A longer design period shall be justified by a cost-effectiveness calculation using the "present worth" method. As approved by the City Engineer, staged development may be accepted for major lines with smaller initial sewers and later parallel construction.

3.2.3 Design Flow Factors:

A. Sewerage systems shall be sized to provide for the entire watershed in the City's currently adopted Comprehensive Plan.

B. Sanitary sewers shall be designed to provide capacity for the anticipated maximum hourly quantity of wastewater (hourly peak flow), including appropriate allowance for infiltration and inflow. Actual measured flows shall be used whenever reliable wet and dry weather flow measurements are available.

C. Capacity: In the absence of actual measured flows, the following minimum hourly peak design flows, by land use, shall be used (an infiltration/inflow allowance is included):

Land Use	Minimum Hourly Peak Design Flow Rate (Cubic Feet per second per Acre)
-----------------	--

Residential Housing:	
One-and two-family dwellings	0.005
Apartments: (Actual density to be considered)	
a. One through three stories	0.020
b. Four-story and above	0.022

Commercial: (Actual density and tenant types to be considered)	
a. Small stores, offices and miscellaneous businesses	0.010
b. Strip Shopping centers	0.015
c. Regional Shopping Centers	0.015
d. High rise	0.017

Industrial: (Actual density to be considered)	
a. Light	0.016
b. Heavy	As directed by the City Engineer

D. Limitations: These design factors shall apply to watersheds of 300 acres or less. Design factors for watersheds larger than 300 acres shall be as follows unless otherwise directed by the City Engineer:

Area in Acres	Minimum Hourly Peak Design Flow Rate (Cubic Feet per Second per Acre)
301-500	0.017
501-1,000	0.015
1,100-3,000	0.015-0.010 with linear decrease based on watershed

3.3 SEWER LINE SIZING

3.3.1 Gravity Lines: All public sewer lines shall be at least 8 inches in diameter. The downstream sewer pipe shall have the same or larger nominal diameter as the upstream pipe unless otherwise approved by the City Engineer. All public sewers shall be designed to have velocity of not less than 2.0 feet per second when flowing full and half full. The maximum velocity, when flowing full should be

less than 10 feet per second. For maximum velocities, greater than 10 feet per second special consideration shall be given to protect against erosion. All public sewers up to, and including, 18 inches in diameter shall be designed to carry the design flow at two-thirds full, and sewers larger than 18 inches shall be designed to carry the design flow at three-fourths full.

All velocity and flow calculations shall be by *Manning's Formula* using the following equation:

$$Q = \frac{1.486 * (A) * (R^{2/3}) * (S^{1/2})}{n}$$

Q = Discharge in cubic feet per second

A = Cross sectional area of flow in square feet

n = Roughness coefficient of 0.013 (use regardless of pipe material type)

R = Hydraulic radius (R = A/P) in feet

S = Slope in feet per foot

P = Wetted perimeter in feet

For straight sewer alignment between structures, the following minimum slopes shall be used:

Sewer Diameter (inches)	Slope in %* n=0.013
8 inch	0.400
10 inch	0.248
12 inch	0.194
15 inch	0.145
18 inch	0.114
21 inch	0.092
24 inch	0.077
27 inch	0.065
30 inch	0.057
33 inch	0.051
36 inch or greater	0.045

*Exceptions to the minimum slope 8 inch diameter sewer may be approved where a lift station can be eliminated. In these instances a slope of 0.30% may be allowed with prior KDHE approval on a case by case basis with adequate documentation.

All building sewer lines are governed by the City's current adopted Plumbing Code.

3.3.2 Inverted Siphon:

A. Inverted Siphons should have no less than two barrels with a minimum pipe size of 6 inches and shall be provided with necessary appurtenances for convenient flushing and maintenance. For easy hydraulic removal of solids, the following maximum grades are recommended on the rising leg: 6-inch pipe – 11 ½ degrees, 8 to 12-inch pipe – 22 ½ degrees, greater than 12-inch pipe – 45 degrees. The manholes shall have adequate clearance for rodding and in general sufficient head shall be provided and pipe sizes selected to maintain velocities of at least 3.0 feet per second for average flows. The inlet and outlet head losses should be addressed. The details shall be arranged so that the average flow is diverted to 1 barrel and so that either barrel may be taken out of service for cleaning.

B. The manholes located at the beginning and the end of the inverted siphon (upstream and downstream manholes) shall have a minimum internal diameter of 5 feet. This can be accomplished by providing a large hinged access door on the manholes and also provide an access road to one of the end manholes (preferably the upstream to permit convenient flushing). The inlet and outlet elevations shall be established based on hydraulic design to avoid surcharging the upstream line during design peak flow. The upstream manhole structure shall be designed so that the average daily flow is normally diverted to the flow barrel and so that either barrel may be taken out of service for cleaning.

C. The upstream manhole shall have either a vent for discharge of air or an air jumper pipe shall be connected between the upstream and downstream manholes. When air jumper pipes are utilized with an alignment that does not permit self-draining, some provision for automatic dewatering shall be included.

D. The final decision to permit the installation of an inverted siphon lies with the KDHE.

3.3.3 Force Mains:

A. All force mains for public sewers shall have at least a 4-inch nominal diameter except force mains with grinder pump installations may have a smaller size diameter when necessary to insure an adequate flushing velocity. Force mains shall have a velocity in excess of 2 feet per second at design average flow. Force mains should have normal operating velocity in suction lines between 2 feet per second and 8 feet per second and in discharge lines between 3 feet per second and 8 feet per second. Tracer Wire shall be required for all HDPE, PVC, Plastic force mains pipe with a minimum 12 gauge copper, colored black or white tracer wire, running the entire length of the pipe with ends accessible for line location purposes.

B. Construction and pumping costs are factors that should be considered before selecting the size of the force main. Flat sections of force mains 100 feet or longer in length should not be installed on a zero slope.

3.3.4 Air and Vacuum Relief Valves: Air relief and vacuum relief valves shall be provided in the lift station discharge piping and force main to adequately vent air and gas and to allow entrance of air as required. Air relief valves shall be sized to prevent line entrapped gas blockage. Vacuum relief valves shall be sized to protect the discharge pipe from collapsing.

3.4 SEWER ALIGNMENT AND LOCATION

3.4.1 Gravity Lines:

A. Straight Alignment: All sewers shall be designed on straight alignment between manholes unless otherwise directed or approved by the City Engineer

B. Location:

1. General: Sanitary sewers should be located within streets or alleys or, if necessary, in a permanent easement on private property. Imposed loading shall be considered in all locations. Manholes should be located outside of paved areas and not within water courses.

2. Water main and sanitary sewers shall be placed on opposite sides of the street.

3. Sanitary sewers shall not be placed in rear yards.

4. Not less than three (3) feet of cover shall be provided over the top of the pipe in street and alley right of-way. In all other areas, not less than thirty (30) inches of cover shall be provided over the top of the pipe. Sanitary sewers shall be located deep enough to serve existing basements proposed basements or the first floor of buildings with no basements.

5. Easements: Where public sanitary sewers are located outside of existing rights-of-way a minimum permanent sanitary sewer easement shall be provided.

a. Easements shall be a minimum of ten (10) feet wide when adjacent to existing rights-of-way

b. Easements shall be a minimum of twenty feet (20) feet wide when detached from the rights-of-way (i.e. between buildings or across undeveloped areas).

c. For installations greater than ten (10) feet deep, easements shall be a minimum of 2 feet wide for every foot of trench depth. For sewer mains not centered within the easement, the distance from the centerline of the pipe to the edge of the easement shall be at least equal to the depth of the pipe.

d. Temporary construction easements shall be acquired as necessary to complete the installation of the project.

e. Legal Descriptions: Legal descriptions shall include drawings indicating the point of commencement, the point of beginning, line bearings, line distances, the ending point, and the area described. The drawings shall be on letter size paper. Legal descriptions and drawings shall be sealed by a

Land Surveyor registered in the State of Kansas and meet the filing requirements of Geary County. All documentation shall be formatted to meet the requirements of the County Recorder. Aerial photographs shall not be used in the background of the drawing.

f. Sewer Mains Extending beyond Platted Areas: In the event that a sewer main needs to extend beyond the platted area of a development, proposed easements shall be provided for the main(s) prior to receiving approval of the Engineering Plans. From the centerline in each direction and the necessary temporary construction easement shall be provided.

g. In addition, provisions shall be made for access to maintain the entire sanitary sewer system. The types and sizes of equipment used for sewer maintenance shall be considered for both manhole location and access easements.

C. Streams:

1. Alignment: Sewers crossing streams should be designed to cross the stream as nearly perpendicular to the stream flow as possible and shall be on a constant grade. Sewer systems shall be designed to minimize the number of stream crossings. Sewers adjacent to streams shall be located outside of the stream bed and sufficiently removed to provide for future possible stream widening and to prevent siltation during construction.

2. Cover Depth: The top of all sewers crossing streams shall be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. All sewers crossing drainage ways with less than 3 feet of cover depth shall be encased in concrete. In no case shall the top of the encasement be above the stream bed.

3. Structures: Manholes or other structures shall be located as they do not to interfere with the free discharge of flood flows of the stream as required by the agency governing the stream.

4. Materials: Sewers crossing streams shall be concrete encased unless designed using restrained joint ductile iron pipe.

5. Stream Crossing Restoration: Stream crossing restoration information shall be submitted and approved by KDHE as a part of the permit approval process. The submitted information shall insure that the stream channel and banks have been restored to better than pre-existing conditions and measures have been addressed to minimize scour and erosion possibilities.

D. Aerial Crossings: This type of installations should be avoided except when no feasible alternative is possible because of terrain or infrastructure constraints.

1. All aerial sewer crossings must be prior approved by the City Engineer.

2. When joints are allowed by the City Engineer support shall be provided. The support shall be designed to prevent frost heave, overturning, and settlement.

3. Aerial crossings shall be designed using CL 52 Cement Lined DIP insulated with a Polyurethane Foam and wrapped in 20 Gauge Galvanized Spiral Lock pressure pipe.

4. The aerial crossing shall be located so as not to interfere with the flow of the stream as required by the agency governing the stream.
5. Precautions against freezing such as insulation and increased slope shall be provided.
6. Expansion jointing shall be provided between above-ground and below ground sewers.

E. Utility Protection:

1. Water Line: Sanitary Sewers are to be designed to pass a minimum of 2 feet vertical below water lines measures from outside diameter of pipe to outside diameter of pipe. In instances where the sewers do not pass 2 vertical feet below a water line, either a minimum of 6" of concrete encasement of the sanitary sewer must be installed to a distance of 10 feet in each direction from the outside edge of the water line pipe, or DIP pipe shall be used for the location meeting the same distances as encasement. This protective measure applies to all crossings where the sanitary sewers pass above water lines, and to public lines and service connection lines located in easements and rights-of-ways. The crossing shall be arranged so that the sewer joints will be equal distance and as far as possible from water main joints.
2. Water and sanitary sewer lines shall not be placed in the same trench or excavation.
3. Water Works Structures: Sewer line, (i.e., house connections, laterals, trunk lines, interceptors, force mains, etc.), shall not be constructed within a 100 foot radius of a public water supply well. Greater separation may be required where soil and drainage conditions indicate the need for greater protection.
4. Sewer lines constructed of cast iron or solvent welded plastic pipe materials may be constructed within 10 feet of a private water supply well. Sewer lines constructed of non-watertight materials must be at least 50 feet from a private water supply well.
5. Gas, Electric, Telephone, Storm Sewers and Other Utility Lines: A minimum horizontal distance of five (5) feet should be maintained between parallel sanitary sewer lines, storm sewers and utility lines other than water lines.
6. The vertical separation between storm sewers and sanitary sewers should be two (2) feet minimum. If tees and wyes are installed, they should be routed from under gas, electric, telephone, storm sewer and other utility lines.

F. Steep Grades: Sewers on 15 percent slope or greater shall be anchored securely with concrete anchors or approved equal, and spaced as follows: Not over 100 feet for grades 15-20 percent; not over 36 feet center to center for grades 20 percent to 35 percent; not over 24 feet center to center for grades 35 percent to 50 percent: and not over 16 feet center to center for grades 50 percent or greater.

3.4.2 Force Mains: Force mains should be placed in the street or alley right-of-way or if necessary in a permanent easement on private property. Force mains shall be placed at least forty-two (42) inches below the finished grade and generally may follow the topography of the terrain. The location of force mains with respect to water mains and other Utilities, aerial crossings, stream crossings and steep grades shall be the same as for gravity sewers.

3.4.3 New Development Building Services: Where sewers are located in the street or alley right-of-way a connection (wye, tee, saddle or stub) shall be provided for each building site in new development. The connection shall be extended with a service line to the property line of the building site. The connection shall be designed to provide a vertical angle of not less than thirty (30) and no more than forty-five (45) degrees to the horizontal centerline plane of the sanitary sewer. In conformance with the applicable plumbing code, a minimum drop shall be provided of not less than 3.0 feet between the basement floor elevation and sanitary sewer flow line elevation at the point of service line connection. The minimum basement floor elevation which sanitary sewer service can be provided shall be indicated. Consideration shall be given in providing sufficient depth where extra long connections, deep building service connections, or other atypical conditions may exist. Service line stub-outs shall be referenced to the downstream manhole and the centerline of the sewer. Stub-outs at angles other than 90 degrees off of the sanitary sewer shall be referenced by providing the angle between the sewer line and the service line and distance along the service line stub-out.

3.5 SEWER APPURTENANCES

3.5.1 Manholes:

A. General: Manholes shall conform to the standards of the City.

1. Supplied manholes shall conform to ASTM C478.

B. Manhole Casting:

1. Flooding: When located in areas subject to inundation by flooding or sheet flow, un-vented and bolted covers shall be provided.
2. Internal Pressure: When designed to function with internal pressure, un-vented, gasketed and bolted covers shall be provided and rings shall be anchored to manhole walls.
3. Vandalism: When located in areas where theft and vandalism are expected bolted covers may be required.
4. Larger than 15-inch Diameter Sewers: When the diameter of the manhole's outgoing sewer is at least 15-inches, bolted covers shall be provided.

C. Inverts: The difference in elevation between the invert of any incoming sewer and the invert of the outgoing sewer shall not exceed 24 inches except where

required to match crowns. When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An appropriate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation. A more conservative method is to match the crown of the smaller sewer to the crown of the larger. The minimum drop through manholes shall be as tabulated below:

Pipe Deflection Angle Range (degrees)	Drop through Manhole (feet)
0 to less than 10	0.1
10 to less than 45	0.1
45 and greater	0.2

D. Drop Manholes: Drop manholes should be avoided when possible. Free-fall drop manholes shall not be used. Inside drops are discouraged and shall require special approval by the City Engineer. Where inside drops are used, the incoming flow shall be piped to the manhole invert.

An outside or inside drop pipe, when an inside pipe is used, with a fall greater than 2 feet, a minimum 60" diameter structure shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. The outside drop pipe shall be protected against breaking or settling by the use of concrete encasement. For pipe diameters of 8 inches to 12 inches, the drop pipe shall have the same nominal diameter as that of the incoming sewer. For larger pipe sizes, a minimum 12-inch diameter drop pipe shall be provided.

E. Diameters: The minimum horizontal clear distance within the barrel of manholes shall be 48-inches.

F. Adjustment Rings: The minimum inside diameter of manholes shall be 42 inches. The minimum diameter of entry ways shall be 22 inches.

H. Cleanouts and Lamp holes: The use of cleanouts and lamp holes is prohibited.

G. Manhole Location: Manholes shall be installed at the end of each line, changes in pipes size, grade at intersections and at changes in alignment. The distances between manholes shall not be greater than 400 feet for sewers 18" and smaller and 500 feet for sewers 21" and larger. When a sewer is located in an easement not abutting street or alley right-of-way, access shall be provided to all manholes.

H. A monitoring manhole is required on the sanitary lead for all non-residential connections to the sanitary sewer system. The monitoring manhole can only have one (1) lead running through it. It must be located on a straight run of lead and cannot be a manhole on a public sewer main. Monitoring manholes shall be constructed per the City standard manhole.

3.5.2 Sanitary Sewer Service Laterals:

A. Service laterals shall extend from the sewer main to the ROW line. Each individual resident or business unit shall be responsible for the ownership and maintenance of the building's service lateral.

B. Building service laterals shall not be installed in pipe sizes 18 inches in diameter or larger.

C. Minimum diameter of sewer service laterals within the City's ROW shall be six (6) inches.

D. All building service laterals shall be SDR 26 (minimum) PVC.

E. Connections to existing service laterals at the ROW line shall be completed using an elastomeric PVC coupler with stainless steel band clamps. The coupler shall be sized to match the diameter and material type of both the new and existing service lateral pipes

F. Individual gravity building service laterals shall not connect directly into manholes.

G. Each individually owned residential or business unit, with the exception of apartments or condominium style properties (where the building sewer lateral is in common ground and access is maintained by the property owners' association), shall have a separate building service lateral.

H. Routing of building service laterals shall be as direct as possible to the sewer main.

I. Slope: Building service laterals shall be installed in accordance with the current Plumbing Code adopted by the City. Minimum slope of service laterals within the City's ROW shall be 1%.

J. In Right-of-Way: Building service laterals shall be installed by the Developer. New service laterals under streets shall be installed prior to construction of the street.

3.6 LIFT STATIONS

3.6.1 General:

A. Lift stations are pumping facilities which are used to convey wastewater from a point beyond which gravity flow is not practical.

B. All lift stations shall have at least two pumps with the size and number of pumps such that the rated capacity of the lift station can be met with the largest pump out of service.

C. The time between starts for any given pump shall be a minimum of 10 minutes with maximum number of starts per hour not to exceed that recommended by the pump motor manufacturer.

D. Unless equipment or facilities are provided which will limit the size of solids reaching the pump suction lift station pumps shall be capable of passing 3-inch diameter sphere.

E. Air and Vacuum Relief Valves: Air relief and vacuum relief valves shall be provided in the lift station discharge piping and force main to adequately vent air and gas and to allow entrance of air as required. Air relief valves shall be sized to prevent line entrapped gas blockage. Vacuum relief valves shall be sized to protect the discharge pipe from collapsing.

F. All equipment in the lift station wet well and that equipment or which can be exposed to gases from the wet well shall conform to the current adopted National Electric Code Class I, Group D, Division I, by the City.

G. Sanitary Sewer Lift Station Detail Sheets shall be submitted to KDHE, once approval has been obtained by the City, along with pertinent information concerning float settings and other project specific information, as required by KDHE, as part of the permit approval process.

3.6.2 Types: Acceptable types of lift stations are as follows:

A. Dry well:

1. Flooded suction
2. Wet well mounted with vacuum primed
3. Wet well mounted with self-priming pumps

B. Wet well:

1. Submersible pump and motor
2. Wet well centrifugal with motor located above the wet well

3.6.3 Layout and Siting:

A. Lift stations shall be located on public properties or on easements allowing for construction and access for maintenance of lift station structures, piping, valves, electrical service and all other required appurtenances.

B. A detailed general layout detail of the proposed lift station site that includes the routing of commercial power, orientation or wet well and valve vault, control panel, and site access shall be submitted to KDHE. In addition to the general project layout required for all sanitary sewer projects.

C. All weather vehicular access shall be provided to lift station sites. Adequate vehicular turnaround shall be provided. Lift station structures and equipment shall be suitably protected from vehicular damage.

D. To allow for maintenance, access shall be available to all mechanical equipment. Means of access shall meet all applicable requirements of the latest edition of applicable OSHA regulations. Access doors and hatches to lift station structures and control panels shall be equipped with lockable features.

E. Lift station wet and dry wells shall be vented with vent openings which prevent entrance by birds, small animals and rain. Wet well vents shall be equipped with odor control facilities where required. Wet and dry wells may be ventilated continuously or intermittently. Wet wells shall be ventilated at the rate of at least 12 air changes per hour if vented continuously and at the rate of at least 30 air changes per hour if vented intermittently. Dry wells shall be ventilated at the rate of at least 6 air changes per hour if vented continuously and at the rate of at least 30 air changes per hour if vented intermittently.

F. Allowance shall be made for removal of all equipment and piping through access openings.

G. Adequate space shall be provided around piping and equipment located inside structures such that personnel can perform all tasks as required for maintenance, removal and replacement of equipment.

H. A hoisting system for maintenance of the lift station shall be provided when an alternate means for equipment removal is not available.

I. Lift station structures and equipment shall remain fully operational and accessible during the 25-year flood. Lift station structures and electrical and mechanical equipment shall be protected from damage by the 100 year flood.

J. Lift stations shall be provided with a SCADA system connect per the latest version operated by the City at the time of lift station approval/ construction and final acceptance by the City. All costs related to connection and start of this SCADA shall be by the Developer.

3.6.4 Power Supply:

A. Pumping facilities shall be designed to operate using available utility power. The design of the pumping facilities shall be coordinated with the supplying electric utility and meet their requirements. Transformers may be required to provide proper voltage for the lift station.

B. Auto-transformer starters shall be used when required by the electric utility or by the City.

C. Provisions for continued operation during power outages shall be made and based on protection of property, safety considerations and the most cost effective alternative which affords the protection acceptable to the City. Acceptable options include: overflow retention basins, standby power generating equipment, alternate electric power supply or alternate pump motor.

D. Normal utility power supply shall provide power for pump motor starting as well as lights, ventilation and other auxiliary equipment necessary for safe and proper operation of the lift station. Sequencing controls shall be provided for staging the starting of pump motors unless the power supply is adequate to share all pump motors simultaneously while other electrical equipment is in operation.

E. Transfer from normal power to emergency or alternate power may be accomplished automatically or manually. When manually transferred, adequate storage of wastewater shall be provided to allow time for the transfer to be implemented. Lift stations shall be provided with an emergency quick disconnect per the City standard as part of the lift station construction.

3.6.4 Monitoring and Control:

A. All monitoring and control equipment shall be located outside of the wet well.

B. Alarm systems shall be provided which activate in the event of any of the following:

1. Power or pump failure
2. Use of a standby or lag pump
3. Unauthorized entry
4. High wet well level

C. A telemetry system shall transmit alarm signals to the desired location and/or audiovisual alarms provided locally at the discretion of the City.

3.6.5 Appurtenances:

A. The proper type of isolation valves shall be provided in the suction line of each pump between the wet well and the pump (this shall not apply to submersible or to vacuum primed lift stations) and in the discharge piping of each pump after the check valve. Isolation valves shall not be located in the wet well.

B. Check valves shall be provided in the discharge piping of each pump, located between the pump and the isolation valve and not located in the pump wet well. Check valves shall be the swing or ball check type. Swing type check valves shall be the outside lever type and shall be horizontally mounted. Ball type check valves may be either horizontally or vertically mounted.

C. Surge protection facilities shall be provided as required to protect the force main and lift station from surge conditions.

D. A sump pump or other suitable means shall be provided to remove water or sewage from the dry well as required protecting equipment located in the dry well.

E. Corrosion of underground surfaces shall be minimized through use of passive or active cathodic protection systems use of appropriate coatings or use of other acceptable means.

3.7 INSTALLATION

A. The Contractor/ Developer shall be responsible for all filling and pressure testing all sanitary sewer construction, per the most current KDHE standards, under the supervision of the City Engineer, prior to final acceptance by the City.

SECTION 4 STORM SYSTEMS DESIGN CRITERIA

4.1 GENERAL

These criteria shall be adhered to for the design of all storm systems within the within the City.

4.1.1 INTRODUCTION

This document sets design standards for stormwater system improvements, extensions and relocations within the jurisdictions of the City and within the service area surrounding the City of Junction City. These cover design factors and provide guidelines for evaluations of plans and specifications by the City. These criteria are not intended to cover extraordinary situations and in such instances, exceptions from the criteria must be approved by the City Engineer.

The design of stormwater systems shall be sealed by a professional engineer licensed in the State of Kansas. The designer shall submit such additional design information as the City Engineer requires: Design calculations, soil studies, and field survey data are examples of pertinent design information necessary for plan review

The stormwater design shall be based on land use in the tributary area as zoned, actually developed, or indicated by an adopted future land use plan, whichever basis produces the greatest runoff.

These design criteria shall apply to all developments, including subdivisions, which alter the surface of the land to create additional impervious surfaces, including, but not limited to, pavement, buildings, and structures with the following exceptions:

A. Redevelopment, Expansion, Renovation, Repair and Maintenance Activities Listed Below

1. Additions to, improvements, and repair of existing single-family and single duplex dwellings.
2. Remodeling, repair, replacement, or other improvements to any existing structure or facility and appurtenances that does not cause an increased area of impervious surface on the site.
3. Remodeling, repair, replacement or other improvements to any existing structure or facility and appurtenances on sites smaller than two acres that does not cause an increased area of impervious surface on the site in excess of 10 percent of that previously existing.

4. Remodeling, repair, replacement, or other improvements to any existing structure or facility and appurtenances that does not cause an increased area of impervious surface on the site in excess of 10 percent of that previously existing, provided the total impervious area of the site is less than 5,000 square feet.

B. New Construction Meeting the Following Criteria

1. Construction of any one new single family or duplex dwelling unit, irrespective of the site area on which the structure may be situated, provided the total impervious area of the site is less than 5,000 square feet.
2. Construction of any buildings, structures, and/or appurtenant service streets, drives, and walks on a site having previously provided stormwater management, as part of a larger unit of development, or a site previously relieved of stormwater management requirements.

C. Existing Drainage System: Existing drainage system component pipes, structures, and appurtenances within the project limits may be retained as elements of an improved system providing:

1. They are in sound structural Condition. Their hydraulic capacity, including surcharge, is equal to or greater than the capacity required by these criteria.
2. Easements exist or are dedicated to allow operation and maintenance.

Discharge from an existing upstream storm drainage system shall be computed assuming its capacity is adequate to meet the performance criteria listed. The computed discharge shall be used to design the new downstream system even if the actual capacity of the existing upstream system is less.

4.2 DESIGN REQUIREMENTS

In no event will the maximum design rate or volume of discharge exceed the maximum capacity of the downstream land, channel, pipe or watercourse to accommodate the flow. It is the Developer's obligation to meet this standard. Should a stormwater system, as-built, fail to comply, it is the Developer's responsibility to redesign, reconstruct, or make modifications at his/her expense to the stormwater management facilities. Such modifications or additional facilities will be subject to the City Engineer's review and approval.

The following agencies have jurisdiction over streams and/or drainage systems and may require further permits. Other regulations, permits and requirements may not be limited to these agencies.

Federal Emergency Management Agency.
U.S. Army Corps of Engineers.
Kansas Department of Agriculture – Division of Water Resources.
Kansas Department of Health and Environment

4.2.1 Drainage System Design: Storm drainage systems shall be designed for a 10-year intensity rainfall. The *Rational Method*

$$(Q=K \cdot C \cdot i \cdot A)$$

for arriving at storm sewer runoff shall be used.

K shall be as follows:

Design Storm	K
10-year or more frequent	1.0
25-year	1.1
50-year	1.2
100-year	1.25

Rainfall intensities (*i*) shall be determined from the Kansas Department of Transportation Geary County, Kansas Rainfall Intensity Table. The Rainfall Intensity Table can be found at the following website:

www.ksdot.org/burDesign/KansasRainfallIntensities.PDF.

T shall be determined by the TR-55 method or as approved by the City Engineer. The minimum T shall be 5 minutes. T is generally between 5 to 15 minutes for new developments.

The design engineer shall use the following minimum values for "C", the runoff coefficient, in the "Rational Formula" of computing storm water flows.

Surface Type	C Factor
Single Family Residential	0.35
Multi Family	0.55
Commercial	0.70
Industrial	0.70
Agricultural	0.20

Other values of the runoff coefficient may be used or required at the discretion of the City Engineer for such areas as parks, open-spaces or unusual sites.

All storm sewer pipes shall be per Materials within this Section. The following list of "n" values shall be used for design.

Description	n
Closed Conduits	
High Density Polyethylene (HDPE)	0.011
Reinforced Concrete Pipe (RCP)	0.013
Corrugated Metal Pipe (CMPs)	0.024
Open Channels (Lined):	
Gabions	0.025
Concrete	0.015
Riprap	0.033
Grass (Sod)	0.030
Open Channels (Unlined) Excavated or Dredged:	
Earth, straight and uniform	0.027
Channels, not maintained, weeds & brush uncut	0.090
Street Curbing	0.014

Sufficient capacity shall be provided in the storm sewer system to take fully developed upstream drainage into the system. When a storm sewer is designed to provide capacity for upstream areas, the hydraulic gradient shall remain in the pipe.

Storm sewer design calculations, including a drainage area map shall be submitted with the construction plans. The storm district map shall show all onsite and off-site drainage districts. The district limits must be overlaid on a proposed grading plan for the site.

All public storm sewers must be located in a public right-of-way or an easement. The minimum storm sewer easement shall be 12 feet. The easement size will vary as required for maintenance and access. Any storm sewer that accepts runoff from abutting property or public right-of-way must be placed in a minimum 12 foot wide storm sewer easement.

If a storm sewer is designed to take on-site drainage only, the hydraulic gradient must be no higher than 1 foot below ground. When the hydraulic gradient is above the top of the sewer pipe, the design elevation of the hydraulic gradient shall be indicated on the profile at each manhole.

4.2.2 Manholes: Manholes shall be located as follows:

A. General:

1. All changes in alignment
2. Points where the size of the sewer changes
3. Points where the grade of the sewer changes
4. The junction of sewer lines
5. Street intersections or other points where catch basins or inlets are to be connected.

B. Manhole spacing for storm sewers shall be as follows:

Diameter of Sewer (inches)	Maximum Manhole Spacing (feet)
12 - 18	400
21 - 30	450
36 - 42	500
48	550
54 - 60	600
66 & Larger	650

4.2.3 Storm Sewer Pipe: The minimum diameter of a public storm sewer is 12 inches. A 10 inch diameter pipe will be allowed for sewer lines that pick up footing drain or roof conductor drainage. No open covers will be permitted for a 10 inch diameter storm sewer.

A. Connection must be made at manholes, blind taps are not allowed.

B. End sections are required for all storm sewers.

C. The following information shall be indicated on the storm sewer profile:

1. Length of run between structures
2. Type, class, size and slope of pipe and service lines
3. Rim elevations of all structures
4. Existing & proposed ground elevations above the route of the sewer
5. A logical numbering system for structures shall be included
6. Invert elevations of all sewers at structures
7. Locations and limits of sand backfill (where required)
8. Locations and elevations of crossing with other utilities

D. The following table of minimum slopes for storm sewers shall be adhered to:

Size (inches)	Minimum Grade (%)
12	0.32
15	0.24
18	0.18
21	0.14
24	0.12
27	0.10
30	0.09
36	0.07
42	0.06
48	0.05

E. The minimum velocity may not be less than 2.5 feet per second in a pipe flowing full. The maximum velocity in storm sewers shall be 15 feet per second. The contents of a larger pipe will never be discharged into a smaller line even though the slope may be steeper for the smaller line. This principle does not apply, however, to a restricted opening or discharge.

F. Where possible provide a minimum of 3 feet of cover from the top of curb (or road centerline) to the top of any storm sewer.

G. For subdivisions, storm sewers shall be located in the public road right-of-way or in easements adjacent to the right-of-way. Storm sewers shall not be located in rear yards except to pick up rear yard drainage, or for sump pump discharge lines.

H. At all pavement curb inlets located at sumps, 40 lineal feet (20 feet in each direction) of 6 inch perforated edge drain with sock shall be constructed at the back of curb line, backfilled with clean stone.

I. The maximize street spread for a street cross section will be either the crown of the road or one lane of traffic. No more than 1.0 acre of area shall be tributary to one standard curb inlet. Curb inlets may be placed side by side in order to provide for additional capacity.

J. Where lateral storm sewers are proposed, all new homes must be constructed with sump pumps, which discharge to an underground pipe connected to an underground public rear yard drain, or an approved alternate storm drain. The sump pump discharge shall be a minimum of 4 inch diameter and shall be constructed to each lot in a new subdivision from the rear yard under drain. The service line shall be constructed at a minimum 1.0% grade.

K. Culvert crossings shall be designed to meet the storm event before road overtopping.

Street Classification	Minimum Design Storm Capacity
Arterial	50-year
Collector	25-year
Residential	10-year
Residential with Open Channel Downstream	25-year

The depth of overtopping shall be limited to a maximum depth of 7 inches over the road centerline or 14 inches at the gutter line. A guard rail shall be provided at a culvert crossing for any 100-year storm event that has greater than 250 cfs overtopping the road.

4.2.4 Storm Swales: The minimum grade for swales shall be 1.00%.

4.2.5 Storm Systems Best Management Practices: The City encourages the use of Best Management Practices (BMPs) in the design of the storm water collection system. These shall include, but are not limited to: rain gardens, bioswales, green roofs, oil/water separators, porous pavements, etc. Design calculation for the BMPs shall be submitted for review with the construction plans. The use of BMPs will be reviewed and approved on a site by site basis by the City's Engineer. A good source for BMP design criteria can be found at the following website:

kcmetro.apwa.net/chapters/kcmetro/specs/BMPManual_Oct2012.pdf

The City reserves the right to require additional storm water management criteria/procedures for a site based on its intended usage and impact on storm water runoff.

4.2.6 Storm Sewer Materials: Allowable pipe material for storm sewers shall be:

- A. ASTM C76 reinforced concrete pipe conforming to Classes III, IV or V.
- B. Perforated high density polyethylene with smooth interior and annular exterior corrugation meeting requirements of ASTM F2306.
- C. Bedding and backfill shall be as shown in the City Standard Detail, Storm Sewer Bedding.
- D. Joints for storm sewer shall be tongue and groove premium joints with rubber gaskets.
- E. All service line material shall be Schedule 40 PVC or SDR 35.

4.2.7 Detention Basin Design Requirements: A storm water detention basin is required for all new developments in the City, unless it is demonstrated that the downstream system has sufficient capacity for the proposed developed for a 10-year event. The City encourages Best Management Practices (BMPs) of detention facilities.

- A. Detention basins shall be designed to detain improved storm water over the developed areas on site. The Developer is not required to detain water from off-site areas in the drainage district.
- B. The SCS Type II 24-hr rainfall distribution shall be used for all detention basin design calculations.

C. Detention basins shall be designed to store a volume of storm water to meet the release rates as follows:

Storm Event	Release Rate (cfs/acre)
2-year	0.5
10-year	2.0
100-year	3.0

D. All detention basins shall have an emergency spillway with the capacity to convey a 100-year storm event. The emergency spillway shall be constructed in existing embankment.

E. All open detention basins must be fenced if the side slopes exceed 1 vertical to 6 horizontal. This may be waived by the City when the design is an integral part of the landscaping and the location and depth does not present a potential hazard. The maximum earthen side slope shall be 1 vertical to 3 horizontal. All residential subdivisions detention basins shall be unfenced with a 5 foot minimum flat shoulder around the perimeter of the basin.

F. Fences shall be a minimum of 6 feet high vinyl clad chain link with a locking access gate, 8 feet wide. Alternate types of fencing may be permitted, for aesthetic purposes, subject to approval by the City.

G. An agreement for operation and maintenance of all detention systems must be completed by the Developer and submitted to the City prior to final acceptance of the project by the City. Standard agreement forms are available at the City.

H. The entire detention basin must be seeded or sodded, except below the water line for detention basins designed to have a permanent body of water. A native plant buffer of 10 feet or more is encouraged along the embankments. The City will not approve the basin until turf is established.

I. Riprap is required at all pipe entrances and exits to the basin. The minimum width of the riprap shall be twice the outside diameter of the pipe. The riprap shall extend from bottom of basin to the top of the slope.

J. A minimum of 12 inches of freeboard must be maintained in all detention basins.

K. The overland overflow must be designed as to not flood adjacent properties, and the back-water elevation must be no higher than 1 foot below the lowest ground elevation of the developed area.

L. Detention basins that drain into an open drain must have the outlet pipe invert above the normal water level of the drain.

M. Access and Easements

Permanent access and buffers must be provided for maintenance of a detention facility with the following minimum requirements:

1. The water surface of the design storage pool shall be a minimum of 20 feet from property lines and building structures. A greater distance may be necessary when the detention facility might compromise foundations or slope stability is a consideration.
2. A 20 foot wide access strip, with slopes less than 5 horizontal to 1 vertical, shall be provided around the perimeter of the facility, unless it can be demonstrated that all points of the facility can be maintained with less access provided.
3. The detention facility owner shall also maintain a minimum 20 foot wide access route to the detention facility from a street or parking lot with slopes no greater than 5:1 in any direction.
4. Structures, inlet pipes, outlet pipes, spillways, and appurtenances required for the operation of the facility shall also be provided access which is no less than easement widths as set within this Section
5. Easements are required for all detention facilities. At a minimum the dedicated easements shall include: 1) the detention pond per se, which extends to the design storage pool elevation and the toe of the embankment slope; 2) appurtenances; and 3) access strip areas.

N. Maintenance and Continued Performance

Maintenance responsibility for all elements of the detention facility should be designated prior to construction of any detention facility. However, when no designation is made the property owner shall be considered the responsible party. Annual or more frequent inspections shall be made by the responsible party to assure that all inlet and outlet structures are fully functional and the detention basin has full storage capacity.

SECTION 5 STREETS DESIGN CRITERIA

5.1 GENERAL

These criteria shall be adhered to for the design of all streets within the City.

5.1.1 INTRODUCTION

The purpose of these criteria is to provide uniform procedures for designing and checking the design of streets in the City. Specific criteria have been developed and are applicable to the types of conditions ordinarily encountered in local urban areas. Other special situations may be encountered that require added criteria or more complex design than included herein.

5.1.2 Abbreviations:

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADT	Average Daily Traffic
APWA	American Public Works Association
ASTM	American Society for Testing and Materials
FHWA	U. S. Department of Transportation/Federal Highway Administration
MUTCD	Manual of Uniform Traffic Control Devices
NGVD	National Geodetic Vertical Datum
ITE	Institute of Transportation Engineers
R-O-W	Right-of-way

5.1.3 Governing Criteria: Design shall be in accordance with the latest edition of the following publications and the current interim supplements thereto except as modified herein or modified for the specific project:

- A. Policy on Geometric Design of Highways and Streets, AASHTO.
- B. Manual on Uniform Traffic Control Devices for Streets and Highways, FHWA.
- C. Roadside Design Guide, AASHTO.
- D. Design of Pavement Structures, AASHTO.

5.2 FUNCTIONAL CLASSIFICATION OF STREETS:

Streets are divided into seven street functional classifications: Arterial, Collector, Local Commercial, Local Industrial, Local Residential, Frontage Streets, Cul-De-Sacs.

5.3 STREET DESIGN

5.3.1 Street Layout: The arrangement, character, extent, width, grade, and location of all streets shall conform to the City of Junction City Comprehensive Master Plan and shall be considered in their relation to existing and planned streets, topographical, conditions, to public convenience and safety, and their appropriate relation to the proposed uses of the land to be served by such streets.

5.3.2 Design Criteria: This section governs the general design requirements for streets by type. See Table JC-1. All street design is subject to approval by the City.

	Arterial	Collector	Local Commercial	Local Industrial	Local Residential	Frontage Streets	Cul-De-Sacs
R-O-W Width	100 feet (2)	80 feet	80 feet	60 feet	60 feet (4)	40 feet	60 feet radius
Roadway Width (1)	53 feet (3)	41 feet	41 feet	41 feet	31 feet	24 feet	45 feet radius
Stopping Sight Distance	600 feet	400 feet	400 feet	600 feet	200 feet	400 feet	NA
Min. K Value, Sag Vert. Curve	64	64	30	30	30	30	5
Min. K Value, Crest Vert. Curve	44	44	50	50	20	20	3
Min. Radii for Horizontal Curves	500 feet	250 feet	300 feet	500 feet	200 feet	250 feet	
Maximum Grade	6%	8%	6%	6%	10%	8%	6%
Minimum Grade	5%	5%	5%	5%	5%	5%	5% at gutter line
Minimum Curb Return Radius (5)	45 feet	45 feet	45 feet	45 feet	35 feet	35 feet	

- (1) Street width is measured back-to-back of curb.
- (2) Additional right-of-way width may be required on both sides of any intersection with another arterial or collector street.
- (3) Arterial roadway width is variable; listed measurement is the minimum.

- (4) May be reduced in a residential planned development district.
- (5) Radius measured to the back of curb. Radius should accommodate the design vehicle(s), as determined by the City Engineer.

5.3.3 Alleys: Alleys shall be a minimum width of twenty (20) feet.

5.3.4 Cul-de-sacs: At locations where streets are to be terminated and a vehicular connection between adjacent streets is not required, the termination shall be a cul-de-sac. Cul-de-sacs shall be constructed to the design criteria in Table JC-1.

5.3.5 Street Design Geometrics:

A. Cross Slopes: The finished cross slopes within the limits of the right-of-way shall be between one quarter (1/4) inch vertical to one (1) foot horizontal, minimum, to one-half (1/2) inch vertical to one (1) foot horizontal, maximum, except for sidewalks which must meet the current ADA requirements. Back slopes shall be 3:1 maximum, 4:1 or flatter desired.

B. Tangent Length: Fifty (50) foot tangent lengths shall be required between reverse curves for residential access and residential local streets. The minimum tangent length between reverse curves shall be 100 feet for collector streets and commercial/industrial local streets. Major and minor arterial streets shall comply with current AASHTO guidelines.

C. Off-Center Street Intersections: Street jogs are to be avoided on arterial and collector streets. On local streets with right-of-way of sixty (60) feet or less, centerline offsets of less than one hundred (100) feet shall be avoided.

D Intersection Angle: It is desirable for all intersections to meet at approximately a ninety degrees (90°) angle. Skewed intersections should be avoided and in no case should the angle be more than one hundred degrees (100°) nor less than eighty degrees (80°).

E. Intersecting Minor/Major Arterial Streets: Where any minor or major arterial streets intersect each other, the crowns of both streets shall be uniformly transitioned into a plane at the intersection. Changes from one cross slope to another should be gradual.

F. Curb Radii: When two streets of different classification intersect, the higher classification street shall govern the curb radii dimension listed in Table JC-1. Equivalent three-center compound curves may be used in lieu of a single radius curve if the design vehicle can be accommodated. Curb ends facing the flow of traffic shall have a five-foot taper from full height to matching existing condition.

G. Sight Distance at Intersecting Streets: Sight distance triangles at intersecting side streets shall be in accordance with the current edition of A Policy on Geometric Design of Highways and Streets, AASHTO. Every effort shall be made to select intersection locations so that the maximum sight distance is possible.

H. Considerations for Connection to Existing and Future Streets: Consideration shall be given to the horizontal and vertical alignment of streets where they connect to existing streets or where streets may be extended in the future.

5.3.6 Driveways:

A. All driveway approaches within public R-O-W shall be constructed of concrete.

B. Driveway grades shall conform to the typical section of the street within the R-O-W. Driveways shall attain a minimum elevation of six (6) inches above the gutter elevation within the R-O-W with a maximum grade of 8%. The algebraic difference in grades at the R-O-W on crest drives shall be 8% maximum and on sag drives shall be 12% maximum.

C. Grades of driveway approaches shall also be constructed to accommodate required sidewalks. Cross slopes on driveways in line with sidewalks must meet the current ADA requirements.

5.3.7 Pavement Transitions: Reduction in pavement width in the direction of traffic flow shall be accomplished by a taper. The minimum length for merging taper shall be determined by the formula $L=WxSxS/60$ where posted speeds are 45 mph or less. The formula $L=WxS$ should be used for roadways having a posted speed limit greater than 45 mph. Under either formula, L=taper length in feet, W=width of the transition, and S=design speed in mph.

5.3.8 Access for the Disabled: Ramps shall be required at all planned sidewalk-curb intersections in accordance with standard practice and current ADA requirements. Non-standard driveways and alleys will also be designed to the current ADA requirements.

5.3.9 Storm Drainage: All storm drainage shall be designed in accordance with Section 4, Storm Systems.

5.3.10 Survey Monument Boxes: Monument boxes shall be installed at all quarter section corners involved in the street construction. The monument boxes shall be set by a Registered Land Surveyor licensed in the State of Kansas.

5.3.11 Obstructions: Rigid structures such as poles, signs and hydrants shall be placed a minimum horizontal distance of 1.5 feet from the back of curb to

edge of obstruction. When required, guardrail and barricades shall be installed in accordance with the latest AASHTO Roadside Design Guide or as required by the City. Vertical clearance of 14.5 feet shall be provided. Along sidewalks, a minimum vertical clearance of seven feet shall be provided.

5.3.12 Other Design Criteria: Design criteria not covered by this document shall be in accordance with the most current edition of A Policy on Geometric Design of Highways and Streets by the American Association of State Highway and Transportation Officials (AASHTO) or other AASHTO design guides.

5.4 PAVEMENT DESIGN STANDARDS

5.4.1 Minimum Pavement Sections: The pavement thicknesses shown in Tables JC-2 and JC-3 are the minimum allowed for all street types. All pavement sections shall be constructed on a stabilized subgrade with a minimum CBR of ten (10). Methods to achieve the required subgrade CBR may include: mechanical compaction and/or soil modification with fly-ash, cement, or lime addition. The use of geo-grid reinforced granular sub-base may also be considered.

For Arterial, Collector, and Industrial streets a pavement design shall be completed by a Licensed Professional Engineer within the State of Kansas, and shall be based upon project specific traffic and geotechnical engineering studies.

Street Classification	Pavement Option	Asphalt Surface (in.)	Asphalt Base (in.)	Granular Subbase (in.)	Subgrade Stabilization (in.)
Arterial	A	2	4	12	8
	B	2	7.5	--	12
Collector	A	2	4	12	8
	B	2	7.5	--	12
Local Industrial	A	2	4	12	8
	B	2	7.5	--	12
Local Commercial	A	2	4	12	8
	B	2	5.5	--	12
Local Residential	A	2	4	11	8
	B	2	5.5	--	12
Alleys and Private Parking Lots	A	2	2	11	8
	B	2	5.5	--	12

Street Classification	PCC Surface (in.)	Granular Base (in.)	Subgrade Stabilization (in.)
Arterial	8	6	8
Collector	8	6	8
Local Industrial	8	6	8
Local Commercial	7	6	8
Local Residential	6	6	8
Alleys and private Parking Lots	6	6	8

5.4.2 Pavement Design Criteria:

A. Minimum AASHTO pavement design parameters for arterial and collector streets are as follows:

1. Design Life: 35-years
2. ADT: Based upon traffic study
3. Truck Traffic: Percentage of truck traffic shall be based upon traffic study
4. Subgrade Support: CBR and k values shall be determined by the project specific geotechnical report
5. Stabilized Subgrade: Stabilized subgrade shall not be used as the subgrade soil strength. It shall be treated as "sub-base" layer, and the underlying native soils shall be used for subgrade values
6. Terminal Serviceability (pt): 2.5
7. Reliability: 95% (ZR = -1.645).

B. The pavement design report must show all the actual parameters used for the design, as well as the design method used.

C. Arterial and collector street pavements shall include stabilized subgrade. Subgrade stabilization shall be (a) flyash treated subgrade, (b) lime treated subgrade or (c) geogrid-reinforced aggregate base or City approved alternative.

D. Arterial and Collector Street Widening.

1. Uncurbed or Interim Street Sections – The widened pavement shall use the crushed aggregate option for subgrade stabilization and have a minimum of 10 inches of bituminous asphalt or City approved alternative.
2. Curbed or improved Streets – The widened pavement shall be the same type as the existing pavement.

E. Minimum thicknesses for bituminous asphalt pavement are shown in Table JC-2 and Portland Cement Concrete (PCC) pavement are shown in Table JC-3.

F. Concrete pavement joint details and joint layout patterns, dowelling and tie bar layout shall be per the City Standards.

5.5 SIDEWALK DESIGN STANDARDS

5.5.1 General Sidewalk Design

A. Sidewalks shall be constructed on both sides of the street and located one (1) foot inside of the ROW line.

B. Sidewalk cross slope shall be 2% maximum, sloped toward the street. When the running slope of the sidewalk is greater than 5%, the cross slope shall be reduced to 1% maximum.

C. The standard cross slope between the sidewalk and back of curb is ½" per foot but may be modified with the approval of the City Engineer.

D. Curb-cut ramps shall be provided at all crosswalks and shall be in accordance with the latest revisions of the Americans with Disabilities Act.

E. ADA compliant detectible warning areas shall be placed on all ramps at street crossings and at commercial driveways.

F. Sidewalks shall be constructed of four (4) inch minimum Portland Cement concrete pavement.

G. Sidewalk ramps shall be constructed of six (6) inch minimum Portland Cement concrete pavement.

5.5.2 Sidewalk Widths

A. Sidewalks shall have a minimum width of Five (5) feet.

B. Sidewalks within the Central Business District shall have sidewalks full width from back of curb to building face. Modifications for streetscaping features may be allowed upon approval of the City Engineer.

5.6 INSTALLATION

A. The installation of streets and sidewalks within the City shall be required to be inspected by the City' Engineer at the following stages:

1. After the sub grade has been rough cut to plan elevation
2. After the placement of aggregate base
3. Full-time during the placement of the bituminous asphalt or concrete pavements

B. The developer or his engineer/ contractor shall be responsible to provide an independent testing firm to certify that the sub-base, aggregate base and bituminous asphalt or concrete meets compaction/ density/ design requirements.

SECTION 6 RECORD DRAWINGS CRITERIA

6.1 GENERAL

Two (2) sets of record drawings (a/k/a as-builts) shall be submitted to the City by the design engineers for review. The record drawings shall contain the following information:

- A. Plans shall be provided in both mylar and electronic format. The minimum scale shall be one (1) inch equals 50 feet. All as-built plans shall bear the seal of a registered professional engineer or professional surveyor licensed to practice within the State of Kansas.
- B. All as-built lengths and elevations must be labeled as "As-Built". Locations shall be shown on the plans with an accuracy of \pm one (1) foot.
- C. As-Built drawings shall be tied to the Kansas State Plain Coordinate System.

6.2 REQUIREMENTS

The following individual system requirements must also be submitted:

A. Water System

- 1. Locate gate valves, wells, hydrants and all water system appurtenances from the nearest property corner (using an X-Y coordinate system).
- 2. Itemized as-built quantities list, which indicates the size, type, brand name and lengths of water main used. Hydrants, gate & blowoff valves and appurtenances must also be listed showing type, brand name, and quantity.

B. Sanitary System

- 1. Indicate the length of sewer, invert elevation, rim elevation, percentage of grade, manhole location from the nearest property corner (using an X-Y coordinate system), sewer material and joints used.
- 2. Itemized as-built quantities list, which indicates the size, type, brand name and lengths of pipe used.

C. Storm System

- 1. Indicate length of sewer, invert elevation, rim elevation, percentage of grade, manhole location from the nearest property corner (using an X-Y coordinate system), sewer material and joints used.
- 2. As-built storm system plans are required to be accompanied by a letter (8.5" x 11") signed and sealed by the design engineer stating that the detention/ retention basin is properly sized according to the approved construction plans, and that the outlets are properly located and sized.

3) Itemized as-built quantities list, which indicates the size, type, brand name and lengths of pipe used.

One (1) CD, of the as-built plans shall be provided to the City, per the City Standards once the as-built plans are in an approval form.