

CHAPTER 5

COMMERCIAL SITES

SECTION 5.1 INTRODUCTION

The purpose of these guidelines is to provide information required to prepare construction plans for commercial, apartment and industrial developments.

SECTION 5.2 PLAN SUBMITTAL

There are four different plan submittals that may be required depending on the nature of the project. The following plan submittal information is general in nature and the City reserves the right to require additional plans as needed for the development.

A. Development Assistance Committee (DAC) Submittal

Requirements for the DAC site plan submittal are provided with the site plan application. The DAC is coordinated by the Department of Community and Economic Development. The DAC usually meets twice per month. Submittal deadlines may be obtained from the Department of Community and Economic Development or from the City's website. Site plans submitted for DAC review must be prepared by a licensed design professional in accordance with state law.

B. Private Improvement Plan Submittal

For larger sites, it may be necessary to provide a supplemental private improvements package to provide additional detail about private improvements associated with the project. For smaller sites, the information may be incorporated into the DAC submittal. Private improvement plans must be prepared by a licensed civil engineer. The following are typical items that must be included with the private improvements submittal:

- Storm Water Management Site Plan (scale no smaller than 1" = 100')
- Storm Water Pollution Prevention Plan (scale no smaller than 1" = 100')
- Drainage Area Map (scale no smaller than 1" = 100')
- Grading Plan
- Detention Pond Design
- Private Drainage Improvement Plans
- Applicable Details

Preliminary submittals shall include three sets of full size plans (22" x 34") for distribution within the City. The engineer shall submit one full size and four half size sets of the plans released for construction.

C. Public Improvement Plan Requirements

These are the plans that will be associated with the Community Facilities Contract. These plans must be prepared by a licensed civil engineer. The following items must be included with the public improvements plans:

- Public Street Construction Plans and Profiles (horizontal scale 1" = 20' or 1" = 40', vertical scale 1" = 4')
- Drainage Area Map (scale no smaller than 1" = 100')
- Public Storm Drain Plan and Profile (horizontal scale 1" = 20' or 1" = 40', vertical scale 1" = 4')
- Water and Sewer Plan
- Water and Sewer Profiles as required by this manual (horizontal scale 1" = 20' or 1" = 40', vertical scale 1" = 4')
- Median Opening/Deceleration Lane Plan
- Applicable Details
- Plat

Preliminary submittals shall include three sets of full size plans (22" x 34") for distribution within the City. Once the plans have been reviewed and accepted by the City, the engineer shall submit two full size and four half size sets of the plans released for construction.

D. Building Permit Plan Requirements

Building plans must be submitted for permit. Building plans may be reviewed concurrently with the above plans. No permit will be issued until the above plans have been reviewed and accepted. Building plan requirements shall be coordinated with the Building Official.

SECTION 5.3 ENVIRONMENTAL MANAGEMENT

A. Storm Water Management Site Plan – Permanent Controls

1. General Requirements

A Storm Water Management Site Plan (SWMSP) shall be prepared for developments that meet the following conditions:

- disturb a surface area of 12,000 SF or more, and

- create or add 5,000 SF or more of impervious surfaces

The SWMSP shall identify permanent site features and controls that will be included in the design and constructed with the project to minimize and mitigate the project’s long-term effects on storm water quality and quantity. A preliminary SWMSP shall be submitted with the plat in accordance with Section 6.2 of the Subdivision and Development Ordinance. The SWMSP shall be submitted with the public infrastructure plans and the site plan.

The SWMSP shall be developed and coordinated with the site drainage plan and may be shown on the same sheet. It shall also be coordinated with the landscaping plan to prevent conflicts and assure compatible land use. The SWMSP shall be sealed by a licensed engineer.

2. Permanent Best Management Practices (BMPs)

BMPs and design criteria to be used for the site shall be accepted by the City before the final plat is approved as required in the Subdivision and Development Ordinance. It is the responsibility of the engineer to design BMPs that address site-specific conditions using appropriate design criteria for the North Central Texas region. The NCTCOG Best Management Practices shall be referenced in the SWMSP, unless another source of design criteria has been specifically approved by the Public Works Director.

The following minimum number of BMPs shall be provided:

BMP Requirements	
<u>Area Disturbed</u>	<u>No. of BMPs (minimum)</u>
12,000 SF ≤ Disturbed Area < 5 acres	1
5 acres ≤ Disturbed Area < 10 acres	2
10 acres ≤ Disturbed Area < 20 acres	3
≥ 20 acres	4

The following items are acceptable permanent BMPs for commercial sites:

- a. Preservation of natural creeks – Refer to the Subdivision and Development Ordinance for requirements when preserving natural creeks.
- b. Site layout – Site layouts should be designed to require the least modification to existing topography and drainage. Factors to be considered are buildings and parking areas oriented to minimize the amount of pavement, drainage systems designed to minimize the change in time of concentration, and improvements designed to avoid existing trees and to minimize change in existing site grades.

- c. Vegetated swales – Vegetated swales may be used if drainage design criteria are met. Vegetated swales shall be designed with a trapezoidal cross section and a gentle slope that yields a maximum velocity of 2 fps for the 2-year storm event. The engineer shall evaluate flow depths to verify no upstream flooding is caused by the vegetated swale during larger events.
- d. Vegetated strips – Vegetated strips may be used to separate impervious areas. Each strip shall be a minimum of 20 feet wide and flow spreaders or other measures must be provided to ensure sheet flow across the strip. Vegetation for the strip shall be included in the site's landscaping plan.
- e. Floatables exclusion systems – Inlet inserts, trash racks on culverts, grates on curb inlets, and similar means of excluding trash are acceptable floatables exclusion systems when installed on private inlets and maintained by the property owner. BMP credit will not be given for grated surface inlets in parking lots.
- f. Permeable and semi-pervious pavement – Permeable and semi-pervious pavement may be used for spillover and excess parking areas. Permeable and semi-pervious pavement may also be used where pavement will only be subjected to foot traffic. The pavement design shall address life expectancy of the proposed material, load-bearing capacity, soil condition, and drainage to assure no standing water.
- g. 100-year drainage easement – Dedication of the unaltered, 100-year, fully-developed flood plain as a drainage easement with the creek left in its natural condition will receive two BMP credits. This BMP is only available when no credit is being given for preservation of natural creeks.
- h. Discharge of roof drains to pervious surface - Roof drains shall discharge to vegetated areas, infiltration trenches, or holding tanks for irrigation use to minimize the increase in runoff from the development.
- i. Retention ponds – Retention ponds may be used if the engineer can show that daily flows, ground water seeps, or other water sources are available to maintain a permanent pool with a healthy aquatic community. A water balance shall be submitted with the plan. Retention ponds shall be a minimum of 4 feet deep, have a 10H:1V slope for areas that are 1 foot deep or less, and be designed to prevent short-circuiting. Fountains, cascades, or other means of aeration shall be provided to prevent the pond from becoming stagnant. The pond shall be evaluated for its effect on the 5- and 100-year storm events to verify that the pond will not induce flooding.
- j. Grease traps – Apartment complexes and similar multi-family residential facilities may receive BMP credit for installing a grease trap that meets all the requirements of the City Code. Credit will not be given if a grease trap is required by the City Code.
- k. Parking lot drainage – Parking lots may be designed to drain to vegetated areas or infiltration trenches instead of directly into storm drains or a paved

channel. The design shall ensure that standing water does not occur. Sheet flow or the use of flow spreaders to disperse flow from a parking lot is preferred when draining to an adjacent vegetated area. Parking lots may also drain to sunken medians when implemented with appropriate landscaping.

- i. Subsurface treatment devices – Oil/water separators, centrifugal treatment devices, and other commercially available devices may be installed as part of the private drainage system. The devices shall be able to treat or pass the 100-year storm event without causing structure flooding.
- m. Rainwater harvesting – Runoff from roofs and other impervious areas that is collected for landscape watering or other uses shall be stored in tanks or covered containers that are not accessible to mosquitoes.
- n. Other BMPs – Other BMPs and innovative designs will be considered when submitted to the DPW with supporting calculations and references.

3. Construction and Maintenance

The owner shall construct all permanent BMPs and is permanently responsible for maintenance of the BMPs. When the BMP falls within a drainage easement, the plat or separate instrument dedicating the easement shall include a statement of the owner's responsibility for maintenance. The statement shall be identical to the one in Article 6, Drainage and Environmental Standards, Section 6.6.E, of the Subdivision and Development Ordinance with the words "storm water treatment facility" substituted for "storm water storage facility."

B. Storm Water Permit Required for Industrial Operations

The SWMSP shall identify if the planned facility operations, after completion of construction, will be classified by a Standard Industrial Classification (SIC) code that requires an industrial storm water permit. If the operations will require a permit, the drainage design shall provide for point discharges from the property and access to the discharge points for required storm water sampling. Storm water controls shall be included for outside storage areas.

C. Storm Water Pollution Prevention Plan (SWPPP) – Temporary Controls During Construction

1. Applicable Regulations and Ordinances

Construction activities shall comply with the SWPPP requirements in Ordinance B-652, Storm Water Pollution Control Ordinance, and the appropriate Environmental Protection Agency (EPA) and Texas Commission on Environmental Quality (TCEQ) regulations. When the ordinance and applicable regulations are in conflict, the most stringent requirements shall apply.

2. General Requirements

Projects that disturb less than 1 acre shall have a SWPPP that complies with the requirements in the Checklist for Small Sites. Projects that disturb 1 acre or more shall comply with the requirements in the Checklist for Large Sites. These checklists are in Appendices B and C, respectively.

The SWPPP shall be sealed by an engineer and submitted to the DPW with the paving and drainage plans for review and acceptance.

3. Best Management Practices (BMPs) During Construction

Structural BMPs shall comply with details and specifications in the latest edition of the NCTCOG BMP Manual titled "*Storm Water Quality Best Management Practices for Construction Activities*" and this manual. When the NCTCOG Manual and this manual are in conflict, this manual shall govern.

The SWPPP shall provide a series of changing BMPs that are appropriate for each phase of construction. The SWPPP shall also identify which owner/operator is responsible for installing, inspecting and maintaining each BMP during the different phases of construction. All temporary BMPs must be removed after final stabilization is achieved.

The following items are acceptable temporary BMPs for use during construction:

- a. Preservation of existing vegetation - This is a preferred BMP. When areas of existing vegetation are to be preserved, the areas shall be delineated on the plans, and the plans shall include notes stating that temporary chain-link fencing shall be installed to protect the vegetation.
- b. Vegetated buffer strips – Buffer strips may consist of preserved or planted vegetation. The strip shall be at least 10 feet wide, identified on the SWPPP, and flagged or otherwise designated in the field to prevent disturbance. Wider strips shall be specified when the slope is steeper than 10H:1V. If existing vegetation is used, it may be removed at the end of the project for establishment of permanent landscaping. The following design criteria shall be met when using vegetated buffer strips:
 - 1.) The drainage area shall not exceed 0.25 acres per 100 feet length of vegetation.
 - 2.) The distance of flow to the vegetated buffer shall be 100 feet or less.
 - 3.) The up-slope grade perpendicular to the vegetated buffer shall not exceed 5H:1V.
- c. Staked hay bales - This BMP is only acceptable as a perimeter control for sheet flow on the down-slope side of the construction site. The ends of the line of bales shall be turned up-slope, perpendicular to the contours, to form a sediment trap. Bales shall not be placed across swales or other areas of concentrated flow or be placed in front of curb inlets. The following design criteria shall be met when using staked hay bales:

- 1.) The drainage area shall not exceed 0.25 acres per 100 feet of bale length.
 - 2.) For slopes of 3H:1V and flatter, the maximum distance of flow to the staked hay bales shall be 100 feet or less.
 - 3.) For slopes of 3H:1V and steeper, the maximum distance of flow to the staked hay bales shall be 20 feet.
 - 4.) The up-slope grade perpendicular to the line of bales shall not exceed 1H:1V.
- d. Silt fence - Silt fences shall have wire mesh backing and be supported by metal posts. When used as a perimeter control, they shall only be placed down-slope from the construction activity, with the ends turned up-slope, perpendicular to the contours, to form a sediment trap. Silt fences may be used for concentrated flows up to a maximum design flow rate of 0.5 cfs. The following design criteria shall be met when using silt fence:
- 1.) The drainage area shall not exceed 0.25 acres per 100 feet of fence length.
 - 2.) For slopes between 50H:1V and 3H:1V, the maximum distance of flow to the silt fence shall be 100 feet.
 - 3.) For slopes of 3H:1V and steeper, the maximum distance of flow to the silt fence shall be 20 feet.
 - 4.) The up-slope grade perpendicular to the fence line shall not exceed 1H:1V.
- e. Curb inlet protection - Inlet protection is the least desirable BMP. It will only be permitted with specific approval for use on private streets and on public streets when no other BMP is viable. Temporary inlet inserts shall be used unless a written request to use other measures is submitted to and approved by the Director. If other measures of protecting the inlet are requested, the engineer shall evaluate them for possible flooding in low areas and flow diversion on steep slopes.
- f. Temporary inlet inserts - Commercially available or fabricated inserts may be used when inlet protection is the only viable BMP. Inlet inserts must be configured to pass the inlet's design flow without causing flooding and are only permitted with specific approval.
- g. Temporary detention structure - If 10 acres or more drain to a common drainage point, the SWPPP shall require the low area to be excavated as a temporary detention structure while the drainage facilities are being constructed. This practice is advisable on smaller drainage areas where practicable.
- h. Rock check dams - Rock check dams are appropriate for areas of concentrated flow such as swales, ditches, and outfalls. Rock shall be contained within a wire mesh. Check dams shall be placed at a spacing that sets the top elevation of a dam at the toe elevation of the next upstream dam, with the top of the furthest upstream dam set at the invert of the last

stabilized portion of the swale or ditch. When check dams are used as an outfall control, the first check dam shall be at least 10 feet from the outfall, but no further than 50 feet from the outfall.

- i. Earthen berms - Earthen berms may be used as a perimeter control to retain runoff within the development. Earthen berms shall be stabilized within 14 days of their construction. The engineer shall analyze the impact of these berms on adjacent sites.
- j. Soil retention blankets – Soil retention blankets shall be anchored per the manufacturer’s recommendations. On lots with slopes of 3H:1V or flatter, the blanketed area shall be at least 8 feet wide. Greater widths and additional BMPs shall be specified on steeper slopes. Soil retention blankets used in channels shall meet TxDOT requirements for Type E-H blankets, as appropriate.
- k. Fibrous mulch - Fibrous mulch may be used as an erosion control to limit the runoff from disturbed areas within the development. Mulch shall be at least 3 inches thick and cover all disturbed areas. When used on steep slopes of 3H:1V or steeper and in critical areas such as waterways, mulch matting must be anchored with netting to hold it in place.
- l. Hydromulch - Hydromulch stabilization may be used as an alternative to seeding for erosion control when all disturbed area is covered by the hydromulch. A strip of hydromulch is not acceptable unless additional structural controls are provided.
- m. Stabilized construction entrance - All construction entrances shall be stabilized with rock or other non-erodible material. If rock is used, the minimum effective diameter shall be 3 inches. Entrances shall be placed at high points or other areas where runoff from the construction site will not be directed to the entrance. The construction entrance shall not extend into the street or block flow in the gutter.
- n. Other BMPs - It is the responsibility of the engineer to design appropriate BMPs for each site. If the most appropriate BMP is not in the NCTCOG BMP Manual, the engineer shall submit calculations and references for design of the BMP to the Public Works Department.

4. Waste and Hazardous Material Controls

Covered containers shall be provided for waste construction materials and daily trash. Hazardous materials shall be stored in a manner that prevents contact with rainfall and runoff. On-site fuel tanks and other containers of motor vehicle fluids shall be placed in a bermed area with a liquid-tight liner or be provided with secondary containment and spill prevention controls.

The SWPPP shall require federal, state and local reporting of any spills and releases of hazardous materials greater than the regulated Reportable Quantity

(RQ) and reporting to the Environmental Management Division of all spills and releases to the storm drainage system.

5. Temporary Stabilization

Portions of a site that have been disturbed but where no work will occur for more than 21 days shall be temporarily stabilized as soon as possible, and no later than 14 days after work temporarily ceases.

Temporary stabilization shall consist of providing a protective cover, without large bare areas, that is designed to reduce erosion on disturbed areas. Temporary stabilization may be achieved using the following BMPs: temporary seeding, soil retention blankets, fibrous mulches, hydro-mulches and other techniques that cover 100 percent of the disturbed areas until either final stabilization can be achieved or until further construction activities take place.

Perimeter BMPs such as silt fence, vegetated buffer strips or other similar perimeter controls are intended to act as controls when stabilization has not occurred. Perimeter BMPs may remain in place during temporary stabilization, however, they are not acceptable as temporary stabilization.

6. Final Stabilization

Final stabilization consists of soil cover such as vegetation, geotextiles, mulch, rock, chemical modification of the soil, or placement of pavement. For vegetative stabilization, perennial vegetation must cover all disturbed areas without large bare areas and with a density of 70 percent of the native background vegetative cover. Vegetated buffer strips are not allowed unless designed and credited as a permanent BMP. All other forms of stabilization must cover 100 percent of the disturbed area.

For stabilizing vegetated drainage ways, sod or seeded soil retention blankets shall be used. Hydromulch will not be allowed in vegetated swales, channels or other drainage ways. BMPs may remain in place during stabilization, however, BMPs shall be removed after stabilization is achieved.

The plan for final stabilization shall be coordinated with the permanent BMPs in the SWMSP and with the landscaping plan, if applicable.

7. Notice of Intent (NOI)

On projects 5 acres in size or larger, the owner and each contractor shall submit a copy of the NOI to the DPW at least 2 days prior to construction. When a contractor is acting as the owner's agent and has the ability to direct changes to the plans and specifications, only the contractor needs to submit a copy of the NOI.

8. TCEQ Construction Site Notice

On projects that are 1 acre and larger but smaller than 5 acres, the owner and each contractor shall complete the Construction Site Notice provided in the TCEQ's New General Permit for Construction and submit a copy of it to the DPW at least two days prior to commencement of construction activities. A signed copy of each Construction Site Notice must be posted at the construction site in a location where it is readily viewed by the general public during all construction activity. When a contractor is acting as the owner's agent and has the ability to direct changes to the plans and specifications, only the contractor must submit and post the Construction Site Notice.

9. Notice of Termination (NOT)

All parties that submitted a NOI shall submit a NOT within 30 days after final stabilization is established.

10. Inspection and Maintenance during Construction

The owner shall construct all BMPs and other controls required by the SWPPP. The owner shall have qualified personnel inspect the BMPs at least every two weeks during construction and within 24 hours after a storm event of 0.5 inches or greater. Alternately, inspections may be performed every 7 days with no additional inspections after rain events. Certified inspection reports shall be retained as part of the SWPPP. Within 7 days of the inspection, BMPs identified as damaged or deteriorated shall be repaired or replaced, as appropriate. BMPs shall also be cleaned to maintain adequate capacity.

If a discharge of soil or other pollutant occurs, the BMPs shall be evaluated. Changes or additions shall be made to the BMPs within seven days to prevent future discharges. In addition, the owner shall implement procedures to remove discharged soil from all portions of the Municipal Separate Storm Sewer System (MS4) that received the discharge, including streets, gutters, inlets, storm drains, channels, creeks, and ponds.

Notes requiring the inspection and maintenance shall be placed on SWPPP drawings. The SWPPP shall identify the responsible party for inspecting and maintaining each BMP. If no party is identified, each owner and operator that submitted a NOI for the site shall be fully responsible for implementing all requirements of the SWPPP.

Inspectors for the City will not allow construction of public improvements to start, nor will they grant final acceptance of public improvements, until the SWPPP is implemented and maintained.

SECTION 5.4 WATER AND SANITARY SEWER

A. Horizontal and Vertical Control

1. Horizontal Control

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City's web page.

2. Vertical Control

Vertical control shall be tied to NAVD88. The City has established vertical control throughout the City. This information is available in the map room or on the City's web page.

B. Design Plan Information

In addition to this design manual, the following resources for water and sanitary sewer requirements are:

- The Water Chapter and the Subdivision and Development Chapter of the City Code
- North Central Texas Council of Governments' *Public Works Construction Standards*.
- The Texas Commission on Environmental Quality (TCEQ)
- The National Sanitation Foundation (NSF)
- The Texas Department of Insurance
- The Insurance Services Office
- City of Burleson Standard Details

C. Design Requirements – Water

1. Pipe Sizing

- a. Water mains shall be sized for fully developed conditions based on the current Water and Wastewater Master Plan. In addition, 12-inch water mains shall be installed on a ½ mile grid pattern and 8-inch water mains shall be installed on a ¼ mile grid pattern. Water lines shall be a minimum of 8 inches throughout the distribution system.
- b. Water lines shall be designed based on the flow and pressure requirements of the adopted fire code.
- c. Water lines serving commercial and multi-family developments shall be looped.

2. Line Placement

If street improvements are proposed, the water line placement shall be coordinated with the street plans.

a. Vertical

- 1.) The following note shall appear on the water layout plan sheets:
"There shall be a minimum cover of 42 inches over the water pipe as measured from the top of the pipe to the existing ground. Existing ground may be the flow line of the bar ditch, natural ground on the low side of a county-type road, or the proposed finished grade, whichever is lowest."
- 2.) Water lines along unimproved streets shall have a minimum depth of 5 feet from the lowest ditch elevation to the top of pipe to provide grade for future street improvements.
- 3.) A profile drawing shall also be provided for all water mains 12 inches and larger.

b. Horizontal

- 1.) Water lines shall be located 4.5 feet behind the proposed curb. Lines shall be located to clear the back of curb inlets by at least 2 feet by deflecting the pipe or using offset bends.
- 2.) The minimum radius to be used for PVC water pipe is as follows:

<u>Pipe Size (Inches)</u>	<u>Minimum Allowable Radius (Feet)</u>
8	200
10	250
12	300

For pipe sizes larger than 12 inches, the minimum radius shall be: $300 \times D$ (where D = pipe diameter in feet), unless the pipe manufacturer recommends a greater radius.

3. Gate Valves

Gate valves shall be installed at pipe intersections to allow for the isolation of lines for repairs. Valves shall also be placed such that no more than 35 lots will be out of service when a line is out of service. When installed at street intersections, main line valves shall be installed 4.5 feet behind the back of the curb at the point of tangency for the curb return. Valves installed between intersections shall align with common lot lines.

4. Fire Hydrants

- a. Fire hydrants shall be spaced to have an effective radius of 300 feet or a fire hose lay distance no greater than 300 feet to the front entrance of the building, whichever results in the closer fire hydrant spacing, or as required in the current Fire Code.
- b. When the street is designated on the Thoroughfare Plan Map as an arterial or larger, fire hydrants shall be required on the same side of the street that the building is to be constructed. All streets with medians shall have a fire hydrant on the same side of the street that the building is to be constructed.
- c. The minimum fire flow and flow duration for buildings other than one-and two-family dwelling shall be as specified in Table B105.1 from the *2003 International Fire Code*.
- d. All fire hydrants must provide a minimum of 35 psi static pressure and a 20 psi residual pressure.
- e. Fire hydrants shall be located in accessible protected areas. They shall be located a minimum of 3 feet and no more than 8 feet behind the back of curb. They shall not be located in the sidewalk.
- f. Fire hydrants shall be located outside curb returns and at least 4 feet from a driveway.
- g. A clear space of three feet shall be maintained around all fire hydrants.
- h. Fire hydrant mains shall be placed between 4 feet and 6 feet in depth. Offsets or bends shall be used to bring the fire hydrant up to allowable depths.
- i. Private fire protection systems shall be approved by the Fire Marshal prior to construction. A fire hydrant shall be installed no more than 150 feet from the fire department connection for an automatic sprinkler system.
- j. Fire hydrants within commercial sites shall be placed on a looped line. If line will be looped with future phases of the development, the City will evaluate the need for the loop on a case by case basis.
- k. A fire hydrant and the fire department connection, when required, shall not be located on the same dead end line. When the fire department connection is required, either the fire department connection or the fire hydrant shall be located on a looped water line.
- l. Fire hydrants and water lines associated with fire hydrants shall be located in a public utility easement or water line easement.

5. Water Services

- a. The minimum size water service shall be 3/4 inch.
- b. Where water meter banks are installed, permanent metal tags with addresses shall be installed on the service line at the curb stop to link the service with the address. The meters shall be installed in a logical sequence.
- c. Water meters shall be located in accordance with the standard details.

6. Miscellaneous

- a. Water mains constructed within a development shall be extended to the perimeter of the development to allow for the future extension of the water system into adjacent properties.
- b. All water lines shall be Class 150, AWWA C900, DR18 or other material as approved by the Public Works Director.
- c. All ductile iron fitting shall meet NCTCOG *Standard Specifications for Public Works Construction* and shall be of domestic manufacture.
- d. When the water facilities fall under the jurisdiction of a provider other than the City, the facilities shall meet or exceed all requirements contained herein. A water analysis must be provided with the zoning case or plat. The water analysis must be performed during a peak usage time between 5:00 and 7:00 p.m.

A copy of the plans shall be provided to the City for its records. Prior to construction, a letter must be provided to the City from the service provider stating that they have reviewed and accepted the plans for construction. The City reserves the right to verify water pressures and volumes upon installation. The owner shall bear any cost the City incurs for verification.

D. Design Requirements – Sanitary Sewer

1. Pipe Sizing

- a. Sanitary sewer mains shall be adequately sized to serve the development and upstream drainage basin. Sanitary sewer mains shall be extended through the development to serve abutting property as required. Sanitary sewer mains shall be a minimum of 8 inches in diameter.
- b. Sanitary sewer systems shall be designed based on 1 gpm of flow for up to 100 units or residences and 0.60 gpm for each unit or residence over 100. When the drainage area is larger than 100 acres and the proposed land use (zoning) is unknown, Harmon's Formula shall be used to determine peak dry weather flow.

Harmon's Formula:

M = Ratio of design load to average load

$$M = 1 + \frac{14}{4 + \sqrt{P}}$$

P = Population in thousands, assuming a density of 14 people per acre

Sewer Line sizing procedure is as follows:

$$L = \text{Load / Person / Day} = 100 \text{ gal/person/day}$$

$$A = \text{Average load / person} = L/1440 = 0.694 \text{ gal/min/person}$$

T = Total average load of a given population

$$T = A \times \text{ultimate population within sewer basin}$$

$$D = \text{Design Load} = M \times T = \text{gal/min (gpm)}$$

- c. In addition, infiltration shall be estimated at 100 gpd per acre of drainage basin and shall be added to the peak dry weather flow to determine the total peak flow. The peak flow shall be 75 percent of the pipe capacity. Capacities shall be calculated using a Manning's (n) equal to 0.013. The Engineer may be required to submit design calculations to the DPW for review.
- d. Other methods may be used with DPW approval. Line sizing is subject to the final approval of the DPW.
- e. A minimum velocity of 2 fps shall be maintained. Associated slopes are listed below:

<u>Diameter (inches)</u>	<u>Slope (ft/ft)</u> <u>n = 0.013</u>
8	0.0040
10	0.0028
12	0.0022
15	0.0015
18	0.0012
21	0.0010
24	0.0008
27	0.00067
30	0.00058
36	0.00046

2. Line Placement

If street improvements are proposed, the sanitary sewer line placement shall be coordinated with the street plans.

a. Vertical

- 1.) Sewer mains shall be installed on a uniform grade between manholes. Particular care shall be taken to avoid rapid grade changes or reduced velocities at the lower section of the sewer main.
- 2.) Sanitary sewer lines constructed along unimproved streets shall be a minimum of 8 feet below the level of the lowest part of the existing street or bar ditch to provide grade for future street improvements.
- 3.) Sanitary sewer mains and services shall be encased in Class 'A' concrete where:
 - the cover is 3 feet or less in paved areas, measured from the top of subgrade
 - the cover is 2 feet or less in parkways
 - the line has 2 feet or less of clearance beneath proposed storm drains or conduits.
- 4.) A profile drawing shall be provided for all sanitary sewer mains.
- 5.) Vertical curves in the sanitary sewer main will not be allowed.

b. Horizontal

- 1.) For pipe sizes up to and including 12 inches, the minimum radius for PVC sewer pipe shall be determined using the following formula:

$$R = 300 \times D$$

R = minimum allowable radius of curvature

D = pipe diameter

R & D are in the same dimensional units

For pipe sizes greater than 12 inches, only tangent sections will be permitted.

- 2.) Sanitary sewer lines shall be placed at the quarter-point of the street opposite the drainage pipe.

3. Manholes and Cleanouts

- a. Manholes shall be required at a maximum spacing of 500 feet on public sewer lines. Manholes are required at direction, pipe size, and grade changes.
- b. A standard manhole is 60 inches in diameter for pipe sizes up to 24 inches. Manholes installed on pipe 24 inches or larger will require a 72" diameter manhole. Special circumstances such as acute angles, numerous

connections or pipe diameters exceeding 36 inches may require modifications in size requirements which will be reflected in the design plans.

- c. Drop manholes shall only be used for depths greater than 12 feet, or where the difference in flowline is greater than 18 inches.
- d. A manhole shall be installed at the end of mains. Cleanouts shall not be permitted, except where the main will be extended as a result of a future development.
- e. Where manholes are located within the 100-year floodplain, watertight rings shall be used. Vents shall be provided in accordance with TCEQ requirements.
- f. The top of manholes shall be set at 1 foot below the top of the subgrade when located in future pavement and raised to grade with the pavement construction, or 6 inches above existing natural ground outside paved areas.
- g. When tying to existing manholes, the invert must be reworked.
- h. Manholes shall be installed as sampling ports on all automotive repair, food handling facilities or any industry deemed to discharge "abnormal sewage". The manhole must be located between the public sewer main and the grease trap.

4. Sanitary Sewer Services

- a. Generally, sanitary sewer services are a minimum of 4-inches in diameter and shall be installed below water services. Exceptions will be considered on an individual basis. Services greater than 4 inches in diameter are required to connect to a manhole installed on the main.
- b. All services shall be a maximum of 10 feet deep unless otherwise approved by the DPW. If the existing or proposed sewer main is deeper than 15 feet, a parallel sewer shall be constructed that is less than 15 feet deep. When the sewer service is between 10 feet and 15 feet deep, the deep sewer service detail shall be used.
- c. For sites where food service is proposed a standard 4' diameter manhole shall be installed on the service line between the grease trap and the connection to the public sewer system. The manhole shall serve as a sampling port for the property and will be a private facility.
- d. Where lot grades are lower than the street, located in the floodplain, or a storm drain crosses the sanitary sewer main, the flow line elevation of the sewer service line at the property line shall be provided.
- e. The plans shall show the stationing of the sanitary sewer service connection.

5. Miscellaneous

- a. Sanitary sewer pipe shall be SDR-35 for depths less than 12 feet and SDR-26 for depths greater than 12 feet.
- b. At sanitary sewer junctions within a manhole, the crown of each pipe shall be matched. Where a larger upstream line connects to a smaller downstream line, the flow lines shall be matched.
- c. Aerial crossings of open drainage features shall incorporate the use of trusses, wide flange beams, or the strapping of the line to bridge structures or culverts to minimize the number of piers within the open drainage feature. Spread footings shall not be used in pier design.
- d. Ductile iron pipe shall generally be used for aerial crossings, trench spans, fill areas, bored and grouted pavement crossings, or where cover is minimal.
- e. Sewer mains constructed within a subdivision shall be extended to the perimeter of the subdivision to allow for the future extension of the water system into adjacent properties.
- f. No connection shall be made to any sanitary sewer within the City that will permit the entrance of surface water or waste that has other than domestic characteristics without the authorization of the City Council.
- g. When the sanitary sewer facilities installed fall under the jurisdiction of a provider other than the City, the facilities shall meet or exceed all requirements contained herein. A copy of the plans shall be provided to the City for its records. Prior to construction, a letter must be provided to the City from the service provider stating that they have reviewed and accepted the plans for construction.
- h. All 12-inch and smaller sanitary sewer mains using poly-wrapped ductile iron pipe shall be Class 350 or greater. A greater pipe class may be required to accommodate trench conditions.

6. On-site sanitary sewer systems

Non-residential subdivisions may be approved with alternative sewer facilities according to the following criteria:

- a. An on-site sewage facility may be installed to service a commercial structure if:
 - 1.) the premise upon which the structure is located is more than 1000 feet from an approved sanitary sewer main.
 - 2.) the location of a septic tank is not within a designated floodplain.

- 3.) The DPW agrees in writing that the topography of the site makes normal connection with the existing sanitary sewer main impractical or impossible.
 - 4.) The operation of an on-site sewage facility is feasible on the site and will meet the standards and requirements of the Texas Commission on Environmental Quality (TCEQ) rules for on-site sewage facilities.
- b. If a septic tank is approved for use, it shall be installed on a lot or building site that contains a minimum of one acre or be of such greater area as determined by the City. All septic system installation shall comply with Chapter 7, Article IV, Section 7-60 et seq., "Private Sewage Facilities" in the Burleson Code of Ordinances.
 - c. Under normal circumstances, on-site sanitary sewage facilities will not be accepted as appropriate sewer facilities for the subdivision of land within the City.
 - d. The following shall be provided prior to approval of any plat of the property:
 - 1.) Soil analysis, groundwater evaluation, surface drainage analysis, and separation requirements as required by the TCEQ.
 - 2.) A statement from a licensed engineer or registered sanitarian that the site is suitable for on-site sanitary sewer systems.
 - e. Easements for the future construction of sanitary sewer lines to serve the subdivision shall be provided on the plat or by separate instrument.

E. Utility Easements (Water & Sanitary Sewer)

Utility easements are required for all public water and sanitary sewer lines installed outside of the street right-of-way. Generally, utility easements shall be a minimum of 15 feet wide except when a utility easement is adjacent to another easement or right-of-way where 10 feet is allowed. When both water and sanitary sewer lines are located in the same easement or other facilities are within the easement, the minimum width shall be 20 feet. Where water or sanitary sewer lines are constructed deeper than 10 feet, the easement width shall be a minimum of 20 feet. For deep lines, the width of the easement shall encompass the trench width and side slopes that are based on one horizontal to one vertical for each side of the trench unless otherwise approved by the DPW.

When utility easements are not dedicated by plat, the owner shall submit the ownership information, metes and bounds description, and the exhibit of the utility easement to the DPW. The description and easement shall be sealed, signed, and dated by a surveyor.

The filing process for separate easements can be found in Chapter 3 of this manual.

F. Certificates of Occupancy

No certificates of occupancy shall be issued until all water and sanitary sewer infrastructure is initially accepted.

SECTION 5.5 STREETS AND SITE STANDARDS

A. Master Thoroughfare Plan (MTP)

Included in Appendix D is a map illustrating the Master Thoroughfare Plan (MTP). All developments shall comply with the MTP. Contact the DPW for the latest amendments to the MTP.

B. Street Lighting Standards

Streetlights placed on public streets shall be designed by the developer and installed by the appropriate electric company in accordance with the following criteria:

1. All lights will be 100 watt HPS.
2. Lights will be placed at all street intersections except at major thoroughfares where median lighting is existing.
3. Lights will be spaced a maximum of 600 feet along local and collector streets. Lights will be spaced a maximum of 200 feet along arterial streets.
4. Lights will be placed no closer than 500 feet except for intersections, in cul de sacs, and where curves or grades require additional lighting.
5. All cul de sacs longer than 200 feet from centerline of street to center point of cul de sac shall have a light at the street intersection and at the end of the cul de sac.
6. All severe curves or areas with poor sight visibility shall be lighted.
7. Lights shall be placed so as to gain the maximum use of existing and proposed physical characteristics.
8. Electric service to the streetlight shall be underground.
9. Streetlights shall not be constructed in conflict with the sidewalk.
10. Decorative lights may be approved on a case by case basis.

C. Intersection Geometric Design

Typical layouts of various street intersections are included in Appendix F.

D. Sight Distance Criteria

At controlled or uncontrolled intersections of any public street, the minimum intersection sight distance (visibility triangles) shall have the dimensions as illustrated

in Figure 1 in Appendix G. Where a driveway intersects a public street, the minimum intersection sight distance shall have the dimensions as illustrated in Figure 2 in Appendix G. Additional sight distance may be required based on topography, roadway curvature, vegetation or other sight hindrance. Sight visibility easements must be dedicated on the plat.

Deviations from the minimum intersection sight distance requirements may be allowed provided that the owner has demonstrated that the area proposed will provide adequate sight distance as required based on AASHTO standards. All deviations from the above requirements must be approved by the DPW.

The City may require the submittal of a visibility study for street or driveway connections located in curves.

E. Parking Lot/Site Layout Design Criteria

Parking lots shall be designed in accordance with the standards as shown in Appendix K. The site shall be designed such that all vehicle maneuvers are accomplished on site.

F. Commercial Driveway Design Criteria

A site plan showing the following shall be submitted for review:

- All existing and future right-of-way and easements
- Curbs, storm drain, inlets and flumes
- Utilities
- Trees
- Sidewalks
- Driveway grade profile (15 feet beyond right-of-way)
- Existing driveways on both sides of the street and median openings (within 150 feet)

1. Design Standards

The values in Table 1 are standards for the design and construction of driveways. For each driveway, the DPW may require a specific combination of dimensions within these ranges based on the anticipated traffic flow and safety characteristics of the driveway and public street.

TABLE I
Driveway Design Criteria

<u>Requirements</u>	<u>Street Class</u>	<u>Apartment-Commercial Driveway</u>	<u>Industrial Driveway</u>
Driveway Throat Width	Local	24-36 feet	24-45 feet
	Minor Collector	24-36 feet	30-45 feet
	Major Collector	24-36 feet	30-45 feet
	Arterial	30-36 feet	30-45 feet
Driveway Curb Radius	Local	10-20 feet	15-30 feet
	Minor Collector	15-20 feet	15-30 feet
	Major Collector	15-30 feet	20-30 feet
	Arterial	20-30 feet	20-30 feet
Minimum Driveway Centerline Spacing	Local	100 feet	100 feet
	Minor Collector	150 feet	200 feet
	Major Collector	200 feet	305 feet
	Arterial	250 feet ¹	305 feet ¹
Driveway Angle		90 degrees	90 degrees
Minimum Distance ² from Driveway to Intersection	Local	75 feet	75 feet
	Minor Collector	100 feet	100 feet
	Major Collector	150 feet	150 feet
	Arterial	180 feet	180 feet
Max Approach Grade ^{3,5}	Local/Minor Col.	+6%	+6%
	All Others	+3%	+3%
Min Approach Length ^{4,5}	Local/Minor Col.	9 feet	9 feet
	All Others	20 feet	20 feet

Notes:

¹ Driveways on arterials served by deceleration lanes may be spaced at 200 feet intervals.

² Distance measured from the intersection of the extended right-of-way lines to the centerline of the driveway. In no case shall the driveway centerline be closer than 100 feet to the curb return departure of the major street facility.

³ The percent slope measured along the centerline of the driveway.

⁴ The minimum distance over which the maximum approach grade must be maintained.

⁵ The approach grade and length shall be altered to include a sidewalk section through the drive approach as applicable. See typical details for drive approaches.

For driveways located on TxDOT facilities, refer to the TxDOT Access Management Manual.

2. General Design Criteria

The driveway for any apartment, commercial or industrial property that connects to a major collector or arterial shall extend onto private property a minimum distance of 20 feet before intersecting any internal driveway.

Driveways having a projected design volume of 5,000 or more vehicles per day shall have a minimum of 100 feet continuous approach length without adjacent parking or vehicular cross flow.

All vehicle maneuvering on apartment, commercial and industrial properties into a parking space, up to a loading dock, or into any other area shall be accomplished by off-street maneuvering areas and internal driveways. No back-in or back-out vehicle maneuvering from a driveway shall be allowed to occur on any public street or right-of-way.

Shared access easements may be required by the Public Works Director for commercial properties abutting arterials or collector roadways in order to minimize the number of driveway connections.

Shared driveways shall require the dedication of a private access easement on each affected property and execution of a private maintenance agreement. If the dedication is not shown on the final plat, it shall be filed by separate instrument. The combined size of the access easement must be a minimum of 24 feet wide and 48 feet deep. The easement width shall encompass the entire width of the driveway and shall extend at least one foot onto each property.

The curb return shall not extend beyond the property line, except as provided in shared driveway agreements, or as approved by DPW.

Driveways shall not be located within 4 feet of a fire hydrant, utility pole or other above ground utility and within 6 feet up or downstream of an inlet. The owner may have the above ground utility moved at the owner's expense if the utility company agrees.

Driveway connections to rural road sections across bar ditches shall be installed in accordance with the City's standard detail. The culvert shall be sized by the owner's engineer. The minimum culvert size is 18" and shall be RCP. The maximum slope from the edge of the driveway to the top of the culvert pipe shall be 6:1 and the ends of the pipe shall contain sloped end treatments.

3. Maintenance

Maintenance of the driveway approach shall be the responsibility of the owner.

4. Auxiliary Lanes

As a condition of a driveway permit, the Director may require the applicant to provide a deceleration lane for any driveway located on a major collector or

arterial street facility or interstate frontage road where the right-turn ingress volume exceeds 40 right turns in the design hour of the street or if the use of driveway is determined to cause excessive delay on the roadway (i.e., heavy truck traffic). Such calculation shall be made by the DPW unless a traffic study is provided by the applicant. The deceleration lane shall have 100 feet of storage and 100 feet of transition, at a minimum, unless otherwise authorized by the Director.

When a driveway is approved within a right-turn lane or deceleration lane, the lane shall be extended a minimum of 50 feet in advance of the driveway. No driveway shall be permitted within the transition area of a right-turn or deceleration lane. If the owner is allowed to locate a driveway requiring a deceleration lane within 180 feet of an intersection, the deceleration lane shall be extended to the intersection.

A continuous deceleration lane may be required as a condition of a driveway permit when two or more deceleration lanes are planned, and their proximity necessitates that they be combined for proper traffic flow and safety. The transition taper for a continuous deceleration lane shall not extend into or beyond a public street intersection.

A left-turn lane may be required as a condition of a driveway permit when the projected product of the left-turn ingress volume (50 minimum) and the opposing volume per lane exceeds 420 trips in any design hour. In such cases, the Director will analyze the present and future traffic volumes to verify that the left-turn lane is necessary to maintain minimum levels of traffic flow and safety.

A left turn lane shall be constructed to serve the driveway if it aligns with an existing median opening. An existing left turn lane may require lengthening to provide adequate storage.

Auxiliary lanes may be required on existing county-type roadways if capacity issues exist.

The owner shall be responsible for the design, right-of-way acquisition, adjustment of utilities and construction costs of any auxiliary lane required.

5. Median Openings

Requests for median openings shall be submitted to the DPW for approval. The following shall be submitted with the request:

- A drawing showing the location and distance to the next median opening. The drawing shall also include any driveways, public streets, and property lines within 600 feet of the requested opening.
- A letter from property owners on both sides of the street within 600 feet stating their concurrence of the proposed location of the median opening.

Generally, median openings shall be spaced 600 feet apart (measured nose to nose) on major arterials and 450 feet (600 feet from major intersections) on

minor arterials. Median opening noses are typically 12-15 feet beyond the projection of the curb or driveway edge of the facility being served. Median openings may require the construction of left turn lanes. The typical storage length is 150 feet with 150 feet transition. The storage length may be altered based on projected traffic volumes.

If approved, all costs associated with the median opening shall be paid by the owner. The median opening shall be constructed or funds escrowed within 6 months of the date of approval, or the request shall be void.

a. Existing Improved Streets

The owner shall submit construction plans to the DPW for review. The plans shall be in accordance with the standard details. Upon acceptance of the plans, Community Facilities Contracts will be required for construction of the opening. All costs associated with the median opening shall be paid by the owner including construction and relocation of utilities and irrigation that may conflict with the opening. If the remainder of the median is less than 8 feet wide it must be constructed in accordance with City standard median details. The request for a median opening shall be void if the median opening has not been constructed within 6 months of the date of approval.

b. Unimproved Streets with Construction Drawings Available

Owner shall hire an engineer to modify the existing plans to include the median opening and prepare a construction cost estimate. The plans shall be in accordance with the standard details. The owner shall escrow the construction cost of the median opening with the City. The funds shall be escrowed within 6 months or the request shall be void.

c. Proposed Street – No Construction Plans Available

No median opening requests will be considered until an engineering services contract is initiated for the design of the street.

6. Signalized Driveways

On major collectors or arterials, if a traffic study indicates traffic signal warrants are met to require a signal at a driveway, the owner shall pay for the traffic signal installation costs. The owner may also be required to construct onsite and offsite improvements necessary to provide proper alignment, adequate signal capacity, smooth traffic flow and safety for the public street/driveway intersection.

A traffic signal access easement (minimum 20 feet wide by 60 feet deep) must be provided along the driveway to allow the City to install and/or maintain the signal detectors placed in the driveway.

If a driveway is permitted and installed at an existing signalized intersection, the applicant shall pay any costs and dedicate easements necessary to modify the existing signal and intersection to accommodate the new driveway.

7. Special Driveway Designs

The DPW may require internal driveway improvements, turning movement prohibitions, auxiliary lanes and traffic control devices to address safety or capacity problems within the property that will have a detrimental effect on the adjacent public street system.

All driveways on undivided arterial roadways having a projected exiting left-turn volume that will operate at a level of service "D" or worse may be required to be constructed with a left-turn egress control median. In addition, any driveway having a projected ingress left-turn volume that will have a level of service "D" or worse may be required to have a left-turn ingress control median. If both conditions exist, a right-in/right-out driveway design may be required.

Driveways may be prohibited where adequate sight distance is not available for the established speed limit or the design speed of a future street improvement. Sight distances shall be calculated in accordance with the latest edition of the AASHTO Handbook. If an inspection indicates that driveway sight distance may be insufficient, the applicant will be required to submit vertical and horizontal information to the City that verifies adequate sight distance is available for the proposed driveway location. The Director may deny access or a specific driveway location to any abutting public street if said access cannot be provided in a reasonable and safe manner.

G. Right-of-Way

Right-of-way shall be required in accordance with the Master Thoroughfare Plan (MTP), Subdivision and Development Ordinance and Zoning Ordinance.

H. Horizontal and Vertical Control

1. Horizontal Control

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City's web page.

2. Vertical Control

Vertical control shall be tied to NGVD29. The City has established vertical control throughout the City. This information is available in the map room or on the City's web page.

I. Paving Plan Design Requirements

When the development of a commercial site requires construction of a public street, the following paving plan design requirements shall be used.

1. Design Speed

All streets shall be designed and constructed to provide the following design speeds:

<u>Street Type</u>	<u>Design Speed</u>
Arterial	50 miles per hour
Major Collector	45 miles per hour
Minor Collector	35 miles per hour
Local Street	35 miles per hour

2. Minimum Radius

The required radius for curb returns at intersections shall be as follows:

Arterial/Arterial	80 feet*
Arterial/Collector (departure side)	80 feet*
Collector/Collector	30 feet
Arterial/All Others	30 feet
Collector/All Others	30 feet
Local Streets	20 feet
Alleys/All Others	30 feet

*The minimum allowable radii are 35 feet and 30 feet, respectively. See Intersection Geometric Standards in Appendix F.

The minimum radius for the back of curb on a cul-de-sac shall be 40 feet.

3. Vertical Alignment

- a. All streets shall be designed and constructed to a minimum grade of 0.5 unless the required geotechnical report indicates the soil has a PI greater than or equal to 40, a minimum grade of 1% shall be required.

All streets shall have a maximum grade as follows:

<u>Street Type</u>	<u>Maximum Grade</u>
Arterial	6.0%
Major Collector	8.0%
Minor Collector	8.0%
Local	10.0%

- b. In order to maintain adequate sight distance, all streets shall be designed and constructed to comply with the following minimum vertical curve length for each algebraic percent difference in grade. Grade changes where the algebraic percent difference is less than one percent are not required to use vertical curves.

<u>Street Type</u>	<u>Crest Curves</u>	<u>Sag Curves</u>
Arterial	120	90
Major Collector	80	70
Minor Collector	50	50
Local	30	40

- c. The following maximum intersection grades involving arterial and major collector roadways shall be used at controlled intersections.

<u>Design Street Type</u>	<u>Intersecting With</u>	<u>Design Street Maximum Grade</u>	<u>Distance</u>
Arterial	Arterial	2%	300 feet
Arterial	Major Collector	3%	300 feet
Major Collector	Arterial	3%	200 feet
Major Collector	Major Collector	3%	200 feet
Minor Collector/Local	Arterial/Major Collector	4%	150 feet

4. Horizontal Alignment

- a. The following minimum centerline radii shall be used in the design of all street construction:

<u>Type Street</u>	<u>Minimum Centerline Radius</u>
Arterial	1000 feet
Major Collector	800 feet
Minor Collector	500 feet
Local	As approved by the DPW
Cul-de-sacs and Loop Streets	50 feet radius to right-of-way line

- b. Reverse curves shall be separated by a tangent section in accordance with the following table:

<u>Type Street</u>	<u>Minimum Centerline Radius</u>
Arterial	200 feet
Major Collector	100 feet
Minor Collector	50 feet
Local	As approved by the DPW

- c. Collector or arterial roadways intersecting other collector/arterial roadways shall have the following minimum horizontal centerline approach tangent section length as measured from the nearest right-of-way line of the intersecting street, unless such requirement is waived by the DPW:

<u>Type Street</u>	<u>Intersecting With</u>	<u>Minimum Approach Tangent</u>
Arterial	Arterial	200 feet
Collector	Arterial	150 feet
Collector	Collector	100 feet

- d. More than two street intersecting at a point shall be avoided. No street intersecting an arterial street should vary from a 90 degree angle of intersection by more than 5 degrees. Streets intersecting collector streets should not vary from a 90 degree angle of intersection by more than 10 degrees. All other street intersections should not vary from 90 degrees angle of intersection by more than 15 degrees.
- e. All streets should be designed to be in line with existing streets. When conditions require the centerlines to be offset, a minimum of 135 feet offset distance is required. Greater centerline offsets may be required when necessary for traffic safety.

5. Paving Requirements

Both public and private streets shall be designed in accordance with the requirements outlined below:

- a. Standard pavement widths and sections shall be constructed on prepared subgrade in accordance with the City of Burleson Standard Details and Specifications. Pavement widths shall be measured from back of curb except for local rural roadways where the width is measured from edge of pavement. The street classification shall be as shown in the Thoroughfare Development Plan. The widths and thicknesses shall be in accordance with the information provided on the typical section details and the following table:

Street Type	Width	Thickness Concrete	Thickness HMAc
Local ⁽¹⁾	31 feet or less	6 inches	7 inches
Minor Collector	41 feet	7 inches	8 inches
Major Collector	49 feet	7 inches	N/A
Minor or Major Arterial	As indicated in Thoroughfare Plan	8 inches	N/A
Local Rural	30 feet	6 inches	7 inches
Private Access Easement	20 feet ⁽¹⁾	6 inches	N/A

⁽¹⁾ The pavement width of a private access easement shall be increased to 24 feet when it functions as a required fire lane. The width may be reduced if used for a one way alley-way.

- b. All concrete shall have #4 bars on 24-inch centers.
- c. All streets shall be constructed with a lime stabilized or cement stabilized subgrade. In order to determine the appropriate stabilization and application rate, the owner shall provide a geotechnical report prepared by an engineer. The application rate shall be specified in the plans.
- d. In small areas, such as the addition of median openings or auxiliary lanes to existing facilities, lime and cement stabilization can be difficult. In these areas 6-inch flexible base (TxDOT Type A, Grade 1) or 4-inch additional pavement thickness on compacted base may be utilized.

6. Sidewalks and Access Ramps

Sidewalks and access ramps must be constructed in accordance with State and Federal regulations. The owner is responsible for submitting all pertinent information with regard to sidewalks and access ramps to the Texas Department of Licensing and Regulation (TDLR) prior to construction as required. The following describes general requirements for sidewalk and access ramp construction:

- a. Sidewalks shall be shown on the site construction drawings and shall be constructed by the owner.
- b. Sidewalks shall be placed within the right-of-way, shall be 4 feet wide and placed 1 foot off the right-of-way line. If necessary, sidewalks may be placed closer to the curb, but no closer than two feet except where site restrictions require the sidewalk to be placed closer to the curb. In these cases, the sidewalk shall be adjacent to the curb and shall be six feet in width.
- c. Obstructions shall not be permitted in the sidewalk.

- d. Access ramps shall be designed and constructed at all street intersections. Mid-block ramps are required for local street “T” intersections and signalized intersections.
- e. When required, sidewalks along TxDOT facilities shall be 5 feet wide and located 4 feet off the right-of-way line.

7. Masonry Screening Wall

Where commercial, industrial and apartment development backs up to an arterial street, masonry screening walls shall be provided along the rear lot lines. Natural tree or other acceptable plant cover shall be used in addition to the screening wall.

J. Private Facilities

Private street improvements shall be designed in accordance with City standards and shall meet the minimum construction standards for public streets. Inspections of private facilities shall be performed by the City at the owner’s expense at the fee set by the City Council.

Prior to initial acceptance of private street improvements, an as-built letter sealed, signed, and dated by the design engineer shall be submitted certifying that the facilities were constructed in accordance with the accepted plans.

SECTION 5.6 DRAINAGE

When the development of a commercial site requires the construction of drainage facilities, the following drainage plan design requirements shall be used.

A. Peak Runoff

The City may have flow rates available for watersheds with a drainage area greater than 1,000 acres. If so, these shall be used in the drainage calculations. Where no flow rates are available, unit hydrograph techniques shall be used.

The Rational Method ($Q=CIA$) shall be used for calculating peak runoff from watersheds of 200 acres or less.

1. Runoff Coefficients

Storm water runoff shall be based on a fully developed watershed. The most intense land use zoning shall be used to determine the runoff coefficient for the fully developed watershed. The following table gives values for runoff coefficients that shall be used in the determination of storm water runoff.

RUNOFF COEFFICIENT "C"				
Zoning or Land Use	Hydrologic Soil Groups			
	A	B	C	D
Parks and Permanent Open Space	.35	.37	.39	.41
SFE Zoning	.43	.45	.47	.50
SF7, SF7D, SF10, and SF16 Zoning	.50	.52	.55	.58
2F Zoning	.60	.63	.66	.70
MH and MHP Zoning	.65	.68	.72	.76
MF and SFA Zoning	.65	.71	.87	.90
NS, GR, C, Zoning and Schools & Churches	.95	.96	.98	1.00
CC, OT, and I Zoning	1.00	1.00	1.00	1.00

SOIL GROUP CLASSIFICATION

- Group A Deep sand, aggregated silts
- Group B Sandy loam
- Group C Clay loam, shallow sandy loam
- Group D Heavy plastic clays

2. Intensity

TP-40 shall be used to determine the rainfall intensity. Refer to Appendix H.

3. Time of Concentration

The time of concentration shall be based on fully developed conditions for the upstream watershed. The total time of concentration shall include overland and channelized flow. The maximum length allowed for the overland portion of the calculation is 50 feet. The remainder of the watershed shall be considered channelized flow. Refer to Appendix I to determine the velocity, which is used to calculate the time of concentration. The minimum time of concentration shall be 5 minutes.

4. Storm Frequency

The following table shows the minimum design frequency to be used when designing drainage facilities:

<u>Type of Facility</u>	<u>Minimum Design Frequency</u>
On-grade inlets	5 years
Low point inlets	100 years
Storm sewers upstream of low points	5 years
Storm sewers downstream of low points	100 years
Street right-of-way	100 years
Channels and creeks	100 years
Creek culverts and bridges	100 years
Permanent bar ditch and associated culverts	5 years

Depending on the amount of flow in the right-of-way, additional drainage infrastructure may be required to reduce the flow in order to protect the health, safety and welfare of the general public.

5. Drainage Areas

The drainage area shall be based on fully developed areas within and contributing to the development and shall follow natural drainage features and shall not be diverted. Existing or anticipated features modified by the development shall be considered when outlining drainage areas. However, upstream detention shall not be considered.

B. Roughness Coefficients and Permissible Velocities

The following table provides roughness coefficients and permissible velocities:

Type of Section/Feature	Coefficient of Roughness "n"	Velocity fps ¹
I. Natural Creeks		
A. Creek Section		
1. Some grass and weeds; little or no brush	0.045	3.0 to 8.0
2. Dense growth of grass or brush	0.055	3.0 to 8.0
3. Dense brush and trees	0.065	3.0 to 8.0
B. Floodplain/Overbank Areas		
1. Grass, Weeds, Some Brush and Trees	0.045	3.0 to 8.0
2. Dense Grass, Weeds or Brush	0.055	3.0 to 8.0
3. Dense Brush and Trees	0.080	3.0 to 8.0
II. Improved Open Channels		
A. Gabion Channels	0.035	3.0 to 10.0
B. Pre-Cast Concrete Block Channels	0.035	3.0 to 10.0
C. Natural Stone Channels	0.035	3.0 to 10.0
D. Grass Vegetated Channels	0.045	3.0 to 8.0
E. Concrete Channels	0.016	5.0 to 15.0
F. Rock Rip-Rap Channels	0.035	5.0 to 10.0
III. Streets		
A. Concrete	0.015	N/A
B. Asphalt	0.015	N/A
VI. Pipe		
A. Reinforced Concrete Pipe	0.013	3.0 to 15.0
B. Corrugated Metal Pipe	0.022	3.0 to 15.0
C. High Density Polyethylene Pipe	0.011	3.0 to 15.0

¹ Froude number should not be between 0.86 and 1.13.

C. Street Capacity Design

1. Streets with Curb and Gutter

Local and minor collector streets shall be designed to flow less than curb deep during a 5-year storm. For collectors and arterials, one lane in each direction shall remain dry during the design storm. On all streets, the runoff from the 100-year storm shall be contained within the street right-of-way and shall not exceed 0.2 feet above the lowest top of curb.

2. Local Rural Streets

Local rural streets shall be constructed with bar ditches in lieu of curb and gutter. The 100-year storm shall be contained within the right-of-way and the flow shall not exceed the street crown elevation. Transitional materials may be required at driveway culverts to prevent erosion. Culverts under driveways shall be reinforced concrete pipe and a minimum of 18 inches and designed to carry the 5 year storm. The driveway or roadway shall also have an invert above the pipe for positive overflow. If a culvert is not feasible, the driveway shall be constructed with an invert.

D. Closed System Design

Closed systems shall be used when the flow can be carried in a 60-inch diameter pipe or smaller, unless otherwise approved by the Director. The closed system shall be connected to an existing system or extended until it reaches an open channel or natural creek.

1. Drainage Easements

A drainage easement shall be dedicated for all closed public systems. The minimum width of a drainage easement is 15 feet. When combined with other utilities, the minimum width is 20 feet. The easement may need to be larger to accommodate systems with pipe sizes larger than 60 inches or deep systems.

A private drainage easement shall be dedicated for ponds in which runoff for more than one lot contribute to the pond. The City will not maintain the pond.

2. Hydraulic Grade Line (HGL)

The hydraulic grade line (HGL) for the design storm shall be shown on the plans and shall be below the bottom of the subgrade for systems under pavement. For systems outside of the pavement, the HGL shall be lower than all inlet throats and shall not exceed one pipe size above the top of pipe. The HGL shall start at the inside top of pipe or at the HGL of a connecting feature, whichever is higher.

3. Head Losses

The design techniques and methods used in the determination of all head losses shall be approved by the DPW. The City of Fort Worth's Storm Water Management Design manual or TxDOT's Hydraulic Design Manual are acceptable guides for calculating head losses.

4. Entrance/Outfall Structures

Headwalls or sloped end treatments shall be constructed at the pipe ends of all storm sewer systems. Sloped end treatments are required along streets when the drainage feature is adjacent and parallel to traffic flow. The sloped end treatment shall be a 6H:1V end section. Storm sewer systems that outfall to a creek shall be extended to the centerline of the creek. Gabion mattresses shall be installed at the outfall structure to lower velocities and prevent erosion.

5. Pipe

Underground systems shall be constructed, as a minimum, with Class III reinforced concrete pipe. The pipe size shall be a minimum of 18 inches. A higher class of pipe may be required when constructed shallow or deep. The City may allow plastic pipe for certain applications; however, plastic pipe is never allowed under public street paving.

All pipe bends and fittings shall be prefabricated. Collar connections shall be in accordance with the City standards.

Radius pipe is allowed and shall be placed in accordance with the manufacturer's lay schedule. Pipes shall not be designed with vertical curves.

Field connections may be allowed when the main pipe is twice the diameter of the lateral; however, field connections are not allowed when the lateral slope is greater than 10 percent.

6. Access Points

A manhole or inlet with minimum 36-inch RCP lateral shall be constructed every 500 feet to provide access into the closed system.

7. Inlets

Curb inlets shall be a minimum of 10 feet in length. Recessed curb inlets are required on all concrete streets except local streets. Grate inlets are not allowed on public systems. Drop/Y inlets may be utilized to intercept offsite drainage.

E. Open System Design

A development that includes, or is adjacent to a creek, shall submit a hydraulic analysis (flood study) to determine easements and minimum finished floor (MFF)

elevations, or to modify existing floodplain or floodway. The requirements for each flood study differ according to the existing creek designation (i.e., within a FEMA designated floodplain) and whether improvements are proposed for the creek. This section will address the requirements for flood studies.

1. Unimproved Creeks (Natural)

If a developer chooses to leave the creek in its natural undisturbed state, a flood study shall be submitted to determine the easement limits and MFF elevations for the property. The requirements for this type of submittal are included in the Flood Study Matrix in this section.

A drainage easement shall be dedicated containing all land having an elevation below the water surface elevation for the 100-year storm event based on existing conditions or as shown on the FIRM.

Where natural creeks connect to improved systems, permanent transitional materials are required. Additionally, in areas along natural creeks where potential excessive erosion or head cutting may occur, grade control structures, drop structures, or other structures may be required to stabilize the creek. Stabilization materials shall be approved by the Director of the DPW.

2. Improved Open Channels

If a developer chooses to improve or alter a natural creek, a flood study shall be submitted to the City for acceptance. The study shall define the easement limits and MFF elevations. If the creek is located in a FEMA designated floodplain (Zone A or AE), then the study will be sent to FEMA. Additional hydraulic analyses are required and shall be in accordance with the information outlined in the Flood Study Matrix in this section.

- An improved open channel shall have a concrete-lined bottom, but in no case shall the bottom be less than 8 feet in width. The concrete-lined bottom shall have 6-inch curbs on each side and shall have a bottom thickness of six inches. The concrete-lined bottom shall be at least 3000 psi concrete reinforced with #3 bars on 18" centers. Adequate weep holes shall be provided but in no case shall the weep holes be less than 2" in diameter on 25' spacing. Appropriate filter media shall be provided to protect the weep holes from clogging.
- When the velocity in a proposed earthen channel exceeds 8 feet per second, the City Engineer may require that the side slopes of the channel be lined with concrete, gabions, or another material that will eliminate the potential for erosion.
- In certain instances, a reinforced concrete access ramp may be required for access to improved channels from a public street. The ramp shall be a minimum of 12 feet wide with a maximum slope of 16 percent.

- Earthen channel side slopes shall be a minimum of 4 feet horizontal to 1 foot vertical.

A drainage easement shall be dedicated to include a channel designed to convey the runoff from the 100-year storm plus one foot of freeboard. The drainage easement shall also contain 12 feet on each side of the channel for access and maintenance. Additional easement may be needed at specific locations for access to the feature for maintenance.

Where improved open channels connect to a closed system, natural creeks, or a channel of a different material, a transitional area shall be designed to prevent erosion.

F. FEMA Designated Floodplain

In order to remove all or portions of property from the floodplain, or to improve a creek and construct a channel (concrete, earthen or other approved material), the hydraulic analyses must be submitted to the City for acceptance and then to FEMA for approval. There are several types of map changes available through FEMA. The following lists the types of map changes available:

1. CLOMA – Conditional Letter of Map Amendment

A CLOMA is FEMA's concurrence that a proposed structure, upon construction, would be excluded from the Special Flood Hazard Area (SFHA) shown on the effective National Flood Insurance Program (NFIP) map. The letter becomes effective on the date sent. The letter does not revise an effective NFIP map; it indicates whether the project, if built as proposed, will be recognized by FEMA.

2. LOMA – Letter of Map Amendment

A LOMA is an official amendment, by letter, to an effective NFIP map. This is typically used to correct an error on the map and is based on current detailed topographic information. A LOMA establishes a property/structure's location in relation to the SFHA based on natural ground. The letter becomes effective on the date sent.

3. CLOMR-F – Conditional Letter of Map Revision Based on Fill

A CLOMR-F is FEMA's concurrence that a proposed structure/property involving the placement of fill outside of the floodway would exclude an area from the SFHA shown on the NFIP map. The letter becomes effective on the date sent. This letter does not revise an effective NFIP map, it indicates whether the project, if built as proposed, will be recognized by FEMA. The City will only allow a CLOMR-F for small (less than 2 acres) single lot developments where there are no anticipated water surface increases upstream or downstream from the lot.

4. LOMR-F – Letter of Map Revision Based on Fill

A LOMR-F is an official revision, by letter, to an effective NFIP map. A LOMR-F provides FEMA's determination concerning whether a structure or parcel has been elevated on fill above the Base Flood Elevation (BFE) and excluded from the SFHA. The letter becomes effective on the date sent. The City will only allow a LOMR-F for small (less than 2 acres) single lot developments where there are no anticipated water surface increases upstream or downstream from the lot.

5. CLOMR – Conditional Letter of Map Revision

A CLOMR is FEMA's concurrence that a proposed project will affect the hydrologic and/or hydraulic characteristics of a channel/creek and thus result in the modification of the existing regulatory floodway or effective base flood elevations (BFEs). The letter becomes effective on the date sent. This letter does not revise an effective NFIP map; it indicates whether the project, if built as proposed, will be recognized by FEMA.

6. LOMR – Letter of Map Revision

A LOMR is an official revision, by letter, to an effective NFIP map. A LOMR may change flood insurance risk zones, floodplain and/or floodway boundary delineations, and BFE.

G. Flood Study Submittal Requirements

1. Structures and Property

In order to remove structures or property from a FEMA designed floodplain, either a LOMA or LOMR-F must be submitted. The MT-1 form is used for CLOMA, LOMA, CLOMR-F, and LOMR-F. To remove an entire lot and structure from the SFHA, both the lowest point on the lot and the lowest floor of the structure must be higher than the 100-year flood elevation. The community must determine that the land and any existing or proposed structures to be removed from the SFHA are "reasonably safe from flooding." Follow the directions for the MT-1 for submittal. The information shall be submitted to the City and upon acceptance will be forwarded to FEMA for approval.

2. Unimproved Creeks and Improved Open Channels

The following information shall be submitted for all flood studies.

- a. Letter/report from the Engineer that explains the purpose of the study, (i.e., to define easement limits, determine minimum finished floor elevations, revise

the floodplain/floodway, etc.), describes the project and details all information submitted.

b. Hydrology

- A current drainage area map
- A proposed drainage area map, including all offsite area and adjacent subdivisions
- All hydrology computations and describe the methods used
- Channel cross sections showing the property lines, easement lines, 100 year floodplain, and floodway.
- Any other calculations – including verification that the downstream systems (bridges, pipes, bar ditches, etc.) are designed to handle the increased runoff.

c. Hydraulics

- A site map showing existing topography and cross section locations
- A site map showing proposed contours and cross section locations
- The required HEC runs (see the following sections for details)
- Corresponding maps for each HEC run submitted.

d. Submit the flood study in a bound notebook with all pertinent information included. In addition to the above information, an MT-2 form must be completed and included in the report if the information will be submitted to FEMA.

e. City Flood Study Review Fee in accordance with the City's Current Fee Schedule.

d. FEMA Flood Study Fee (if applicable).

3. Flood Study Matrix

Various HEC runs are required to establish criteria set by the City and FEMA. The matrix below is an attempt to clarify which HEC runs are required for the type of creek and improvements proposed. The matrix is divided into creek type (i.e., whether the creek is proposed to remain in its natural (unimproved) condition or be improved as an earthen or concrete channel. For each type, the creek is further classified as mapped (FEMA designated Zones A and AE), or unmapped. For the specific type and classification of the creek, the following matrix indicates the HEC runs that are required with the Flood Study submittal. Additional HEC runs may be required depending on the analysis.

Flood Study Matrix							
		City		FEMA			
	FEMA Class	1	2	3	4	5	6
Unimproved Creeks	Mapped Zones A & AE	x	x				
	Unmapped	x	x				
Improved Open Channels	Mapped Zone A	x	x			x	x
	Mapped Zone AE	x	x	x	x	x	x
	Unmapped	x	x				
<u>HEC Runs</u> Type 1: 25-year fully developed conditions model Type 2: 100-year fully developed conditions model Type 3: Duplicate effective model Type 4: Corrected effective model Type 5: Existing or pre-project conditions model Type 6: Revised or post-project conditions model							

a. Unimproved Creeks (Natural)

The following HEC runs are required when a natural creek is mapped or unmapped. The information will not be submitted to FEMA.

- HEC analysis based on the 100-year storm event for a fully developed watershed. This information shall be used to define the minimum finished floor (MFF) elevations and the easement.

b. Improved Open Channels (Earthen/Concrete)

The following HEC runs will be required when the development changes the FIRM maps or cross sections of the creek significantly. Some of the information will be submitted to FEMA (CLOMR/LOMR).

The following information is required by the City for all mapped or unmapped creeks. This information will not be submitted to FEMA.

- HEC analysis based on the 100-year storm event for a fully developed watershed. This information shall be used to define the MFF elevations and the easement.

The following HEC models are required and will be sent to FEMA for review if the creek is within Zone A:

- HEC model based on existing or pre-project conditions – to reflect current conditions prior to the construction of the project using current

cross sections and flows from development within the drainage area since the date of effective model.

- HEC model based on revised or post-project conditions – based on current flows plus additional flow caused by the development.

The following additional HEC models are required and will be sent to FEMA for review if the creek is within Zone AE:

- Duplicate Effective Model – model used in the effective Flood Insurance Study (can be obtained from FEMA).
- Corrected Effective Model - corrects any errors that occur in the duplicate effective model, adds cross sections, or incorporates more detailed topographic information.

It is the responsibility of the owner to obtain all required local, state and federal permits including, but not limited to, the Corps of Engineers. The City may require documentation of coordination with any state or federal agency.

H. Drainage Easements

1. Unimproved Creeks

The minimum easement is the 100-year fully developed floodplain.

2. Improved Open Channels

The minimum easement is the width of the channel, which shall hold the runoff from the 100-year storm for fully developed conditions plus one foot of freeboard. An additional 12 feet shall be dedicated on either side of the channel for access and maintenance.

I. Storage (Detention/Retention)

Storm water storage shall be designed and constructed with any non-residential development, including apartments, equal to or greater than one acre in size. The size of the development shall be based upon the total acreage included in the preliminary plat.

The storage and release rates shall be evaluated for the 5-year and 100-year storm events. The release velocities shall be designed to minimize erosion downstream of the facility. A minimum of one foot of freeboard shall be provided.

All above ground facilities that store more than a total depth of 4 feet shall be designed to meet all state and federal criteria for small dams.

Acceptable design methods include the Dallas and NCRS methods.

J. Positive Overflow

Positive overflow shall be evaluated for the entire development. Positive overflow means conveying the difference between the 100-year flow and the design frequency flow in a secondary drainage feature without flooding structures.

K. Flumes

Flumes visible from a street shall be constructed with alternative materials or finishes in lieu of traditional reinforced concrete to soften the appearance. Examples of acceptable alternatives are colored, stamped concrete, exposed aggregate concrete or concrete pavers. Other alternatives may be submitted with the construction plans and will be evaluated for acceptance.

Flumes are not allowed in lieu of an underground drainage system without approval of the DPW.

L. Concentrated Runoff from Development

In areas where concentrated runoff leaves the development, the following information shall be provided:

- The 5-year and 100-year design discharges.
- The depth of inundation of these discharges.
- The impacts on existing and proposed facilities for the 100-year discharge.

Upon analysis of the information submitted, the owner may be required to provide facilities to address negative impacts from the 100-year discharge.

Where drainage features such as storm sewer systems, ditches, channels, and natural creeks are available to receive concentrated runoff, the design storm shall be collected on-site and connected to the feature.

When offsite grading is required or the development discharges concentrated flow on an adjacent property, a Notarized Letter of Permission from the affected property owner(s) shall be required. The letter shall state that the permission binds all future owners of the property and shall be a covenant running with the land. It shall also reference the subdivision plans. The letter shall be filed with the County by the City. An letter of permission template may be found in Appendix O.

M. Site Grading

The construction drawings shall include a site-grading plan designed in accordance with the drainage area map. The site-grading plan shall show existing and proposed contours and any additional information to clearly show how the site will be graded.

N. Minimum Finished Floor Elevation

The City reserves the right to require minimum finished floor elevations on any lot. Minimum finished floor elevations are required for all lots located in the floodplain or near open drainage features and shall be set one foot above the 100-year fully developed water surface elevation, as determined by a flood study. Elevation certificates will be required for lots located in the floodplain. Refer to the FEMA website for the most current version.

O. Temporary Tie-ins to County-type Roads

Tie-ins to existing county-type roadways planned for future improvements are considered temporary. Culverts under driveways and roadways shall be a minimum of 18 inches and designed to carry the 5-year storm. The driveway or roadway shall also have an invert above the pipe for positive overflow and safety end treatments. If the driveway or roadway is located in an area of shallow bar ditches and a culvert is not feasible, the driveway or roadway shall be constructed with an invert. Other requirements are noted on the typical detail.

SECTION 5.7 FIRE SAFETY

A. Fire Protection

1. Water Lines

- a. An approved water supply capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings or portions of buildings are constructed, in accordance with the Fire Code. Total fire flow requirements depend upon the type of construction and number of square feet.
- b. In all cases, it is the responsibility of the owner to provide adequate water line piping capacity in order to provide the minimum water flow.

2. Hydrants

- a. An additional fire hydrant shall be required for every 2,000 gallons per minute (gpm) or portion of fire flow required. (Example: Fire flow of 3,100 gpm. is required. Two fire hydrants shall be required to supply this amount).
- b. Fire hydrants are required within 300 feet of all exterior portions of the building. The distance shall be equal to the laying distance for fire apparatus hose lines along public street and fire lanes from the nearest water supply.
- c. A fire hydrant is required within 150 feet of lay distance from the fire department connection for a standpipe or fire sprinkler system.
- d. When the street is designated on the Master Thoroughfare Plan as a minor arterial or larger, fire hydrants shall be required on the same side of the street that the building is to be constructed. All streets with medians, regardless of size, shall have fire hydrants on the same side as the construction.
- e. All required fire hydrants shall be in place and accepted before any construction above the slab commences.
- f. A clear space of 3 feet shall be maintained around all fire hydrants.
- g. The Fire Department requires looped water systems for fire hydrant supply lines.
- i. Wall hydrants are to be used only where fire lane access is not possible or where otherwise required by the policy for fire lanes. Wall hydrants are not allowed as an alternative to fire hydrants.

3. Fire Sprinkler Systems

All underground piping, beginning at the point where water is used exclusively for sprinklers, shall be installed by a State certified fire sprinkler firm.

- a. Pipe depth shall be 42 inches minimum and 60 inches maximum to top of pipe.
- b. In all cases, clean sand backfill shall be provided a minimum of 6 inches around pipe. In rock, tamped backfill shall be used six inches under and around the pipe and at least two feet above the pipe, per NFPA.
- c. Standard thrust blocks shall be provided at each change in direction and at all tees, hydrants, plugs, caps, and bends.
- d. All underground mains shall have a clearance of 2 feet to any other utility or obstruction.
- e. All plans shall have the registration number of a State certified firm and RME number with original signature.
- f. A fire hydrant shall be installed no more than 150 feet from the Fire Department connection for a standpipe or automatic sprinkler system. The Fire Department Connection shall be within 50 feet of a fire lane or street.

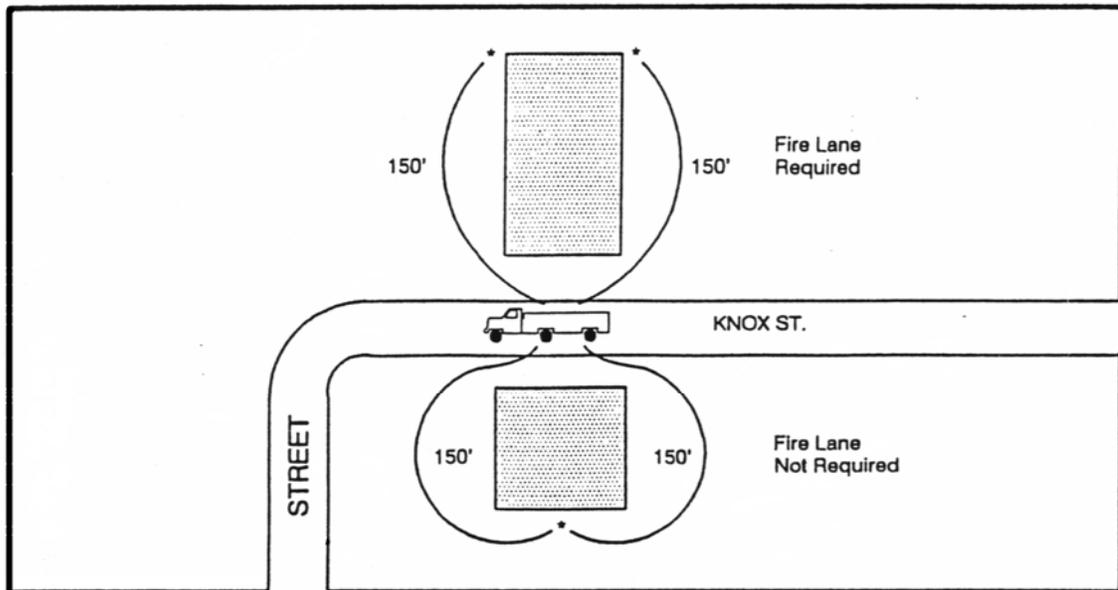
B. Fire Lane Requirements

1. Construction Requirements

To provide adequate emergency vehicle access all required streets or fire lanes be shall installed and accepted before any construction goes above the slab.

2. Hose Lay Distance

All buildings or structures shall be constructed in such a way that all ground level, exterior sides of the building are within 150 feet of the dedicated street or fire lane. The 150 feet is measured along the route necessary to extend fire hose lines around the building. If the 150 feet cannot be reached from a public street, a fire lane will be required on site.



3. Unusual Conditions

When fire lanes cannot be installed due to topography, waterways, non-negotiable grades or other similar conditions, the Fire Department may require an additional fire protection system or systems.

4. Surface

Fire lanes shall be constructed with a concrete surface to provide all-weather driving capabilities and shall support a 60,000 pound vehicle. The minimum pavement thickness is 6" concrete on 6" stabilized subgrade.

5. Vertical Clearance

All fire lanes shall have a minimum vertical clearance of 14 feet to allow a fire truck to pass under.

6. Width

The minimum unobstructed width of a fire lane shall be 24 feet to allow two fire trucks to pass in case of an emergency.

7. Turning Radius

All fire lanes shall have at least a 20 foot inside turning radius and a 44 foot outside turning radius.

8. Grade

The maximum grade for a fire lane is 10 percent when serving a building not protected throughout by an automatic sprinkler system.

9. Bridges

When a bridge is required to be used as access, it shall be constructed and maintained to carry a load of 75,000 pounds.

10. Gates

All gates across private access easements or fire lanes must be approved by the Fire Marshal and DPW. Plans shall be submitted to both departments and approved prior to a permit being issued. Opticom receivers are required for all electric gates across fire lanes. A manual means of opening the gate shall also be provided. A call box shall be required for all gates. Refer to Appendix E of this manual for Gated Entry guidelines.

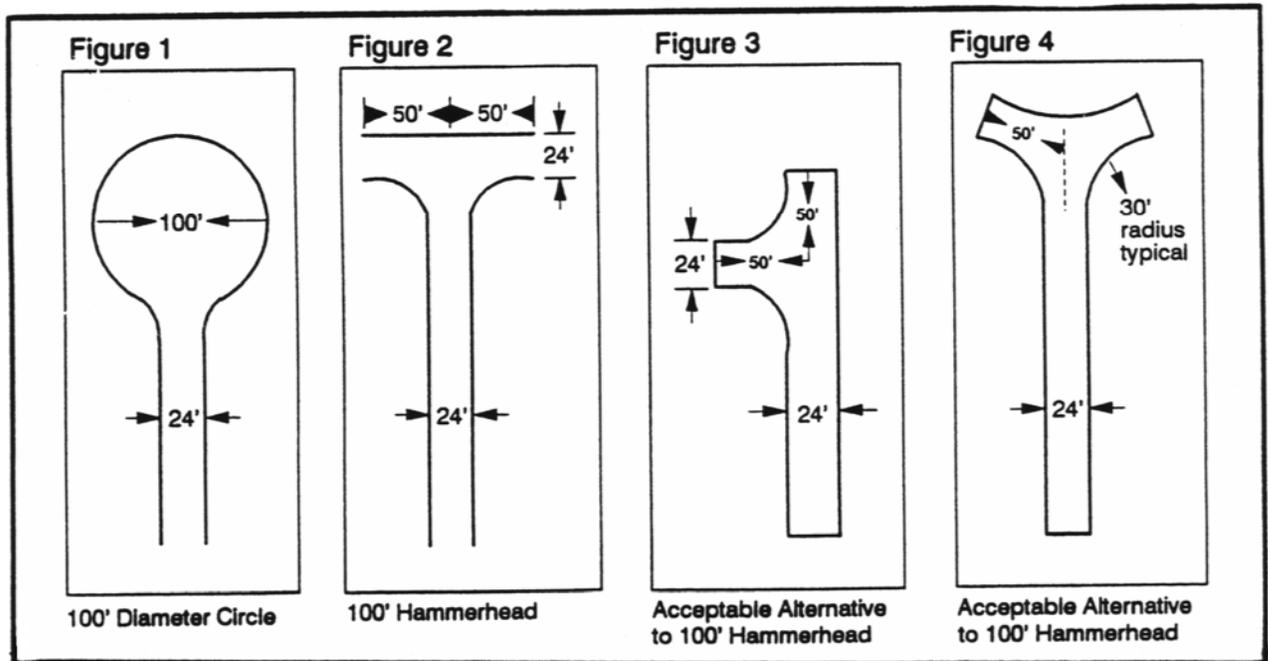
11. Obstruction

The required fire lane width shall not be obstructed by parked vehicles or other obstructions. Speed bumps or similar obstacles that have the effect of slowing or impeding the response of fire apparatus shall be approved by the Fire Marshal prior to installation.



12. Turn-Around Areas

When it is not possible to connect a fire lane at both ends to a dedicated street, an approved turn-around shall be provided. Dead-end fire lanes shall not exceed 150 feet in length. Illustrations of approved turn-around arrangements are as follows:



13. Marking

Approved striping or, when allowed by the Fire Marshal, signs or both, shall be provided for fire apparatus access roads to identify such roads or prohibit the obstruction thereof. Signs and striping shall be maintained in a clean and legible condition at all times and be replaced or repaired when necessary to provide adequate visibility.

- a. Striping. Fire apparatus access roads (fire lanes) shall be marked by a painted lines of red traffic paint six inches (6") in width to show the boundaries of the lane. The words "NO PARKING FIRE LANE – Tow Away Zone" or "FIRE LANE NO PARKING – Tow Away Zone" shall appear in four inch (4") white letters at 25 feet intervals on the red border markings along both sides of the fire lanes. Where a curb is available, the striping shall be on the vertical face of the curb.
- b. Signs. Signs shall read "NO PARKING FIRE LANE" or "FIRE LANE NO PARKING" and shall be twelve inches (12") wide and eighteen inches (18") high. Signs shall be painted on a white background with letters and borders in red, using not less than two inch (2") lettering. Signs shall be permanently affixed to a stationary post and the bottom of the sign shall be six feet, six inches (6' 6") above finished grade. A companion "Tow-Away Zone" sign shall be placed directly under this sign. The sign shall read "Tow-Away Zone" and shall be twelve inches (12") wide and borders in red, using not less than two inch (2") lettering. Signs shall be spaced not more than fifty feet (50')

apart. Signs may be installed on permanent buildings or walls or as approved by the Fire Marshal.

Fire lanes shall be maintained with fire lane striping that consists of a 6 inch wide red background stripe with 4 inch high white letters stating "No Parking, Fire Lane" painted on the red stripe every 15 feet. Where a curb defines the fire lane, the markings shall be painted on the vertical surface of the curb. When repainting, additions to the existing fire lanes are not allowed without prior approval of the Fire Department. Only designated fire lanes shall be marked

14. Maintenance

All designated fire lanes shall be maintained by the property owner.

15. Special Hazards

Fire lanes for high-pile combustible storage have special requirements in accordance with the Fire Code

SECTION 5.8 CONSTRUCTION REQUIREMENTS

A. Construction Responsibility

The owner shall be responsible for all improvements required for the development, including any necessary offsite facilities and construction staking. If construction is not feasible at the time of site development, the owner may request to escrow the funds with the City. The escrow amount shall be equivalent to the owner's share of the construction cost plus actual engineering cost. The City shall determine whether escrow will be accepted in lieu of construction. The escrow shall not be subject to refund.

B. As-built Letter/Plans

1. Private Site Improvements

Prior to Certificate of Occupancy being issued, an as-built letter prepared by the engineer or architect shall be submitted for the private site improvements. The letter shall state the site grading and drainage improvements are constructed in accordance with the plans. The following information may be requested with the as-built letter:

Paving

Survey data/cross sections
Subgrade densities and thickness
Lime application rate
Steel size and placement
Concrete thickness and strength

Drainage

- Survey data/cross sections
- Pipe embedment
- Pipe placement
- Pipe connections
- Pipe sizes
- Ditch backfill and densities
- Steel size and placement for structures
- Concrete thickness and strength for structures

If the improvements were not constructed in accordance with the plans, appropriate documentation shall be provided to substantiate any changes. The owner's engineer or architect shall provide one set of paper and one set of mylar as-built plans. The as-built plans shall be clearly marked as such.

2. Public Improvements

Once the public improvements are initially accepted, the owner's engineer shall furnish the City with one mylar set and two paper sets of as-built drawings and electronic files of the plans. The as-built drawings shall be clearly marked as such.

The owner's engineer shall furnish the City an electronic file of the water and sewer construction drawings in AutoCAD R14 or higher in .DXF or .DWG format. The information shall be provided to the City on CD-ROM. The following layer names shall be used:

DATA	LAYER NAME
Water Lines	C-WTR-WL
Water Line Text	C-STR-WL-TXT
Water Line Valves	C-WTR-GV
Water Line Valve Text	C-WTR-GV-TXT
Water Line Fire Hydrants	C-WTR-FH
Water Line Fire Hydrant Text	C-STR-FH-TXT
Sewer Lines	C-SWR-SL
Sewer Line Text	C-SWR-SL-TX
Sewer Lines Cleanouts	C-SWR-CO
Sewer Lines Cleanout Text	C-SWR-CO-TXT
Sewer Lines Manholes	C-SWR-MH
Sewer Lines Manhole Text	C-SWR-MH-TXT
Closed Storm Sewer System	STORM
Back of Curb	CURB
Right-of-way	ROW
Edge of Sidewalk	SIDEWALK
Open Storm Sewer Systems	CHANNEL

All files shall be in the same directory, including all construction documents with their dependencies (XREFS), plot files, and any support files needed. The electronic files shall use only standard AutoCAD fonts with "ROMANS" as the main font.

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