

Article 14

DRAINAGE

ADOPTED: JUNE 15, 2010

CASE NUMBER: TA100601

ORDINANCE NO. 10-0344

ARTICLE 14: DRAINAGE

SECTION 1 - PURPOSE

- 14.1.1 The purpose of drainage policies and standards are to protect the general health, safety, and welfare of the public by reducing flooding potential, controlling excessive runoff, minimizing erosion and siltation problems, and eliminating damage to public facilities resulting from uncontrolled ~~storm water~~ **stormwater** runoff.

All development shall comply with all City wide and local master plan requirements, UDC Articles 14 and 15, and shall be reasonably safe from flooding. At a minimum, the requirements listed in FEMA's Technical Bulletin 10 shall be submitted to the Floodplain Administrator in order to certify a structure as reasonably safe from flooding using the best available information.

SECTION 2 - APPLICABILITY

- 14.2.1 The procedures, policies and standards of this Article govern storm drainage facilities within the City and its extraterritorial jurisdiction.

SECTION 3 - PROCEDURES

14.3.1 Preliminary Study Required

The owner may be required to provide, at such owner's expense, a preliminary drainage study of the area proposed for development, in conjunction with any preliminary plat submittal.

The preliminary drainage study shall be submitted to the City Engineer prior to approval of the preliminary plat by the Planning and Zoning Commission.

The study shall include:

- A. A contour map of the entire drainage area contributing runoff to the subdivision equal to currently approved Public Works contour maps of the City, or two-foot contours, whichever is less. Drainage areas greater than 400 acres may be shown on a map at a scale smaller than one inch = 200 feet subject to the concurrence of the City Engineer.
- B. Sufficient design calculations showing preliminary sizes and locations of all on-site, adjacent and nearby existing and proposed drainage facilities, including storm drains, culverts, channels, inlets, detention basins, floodplains, etc.
- C. Design calculations and floodplain delineations supporting the floodplain information required by [Article 15 "Floodplain Management"](#).
- D. HEC-HMS analysis shall be required if hydrographs are developed for sub-areas, routed and/or combined (regardless of sub-area size) to size drainage facilities.

ARTICLE 14: DRAINAGE

- D. Detention basins

14.4.2 Closed Conduit Systems

~~Storm water~~ **stormwater** runoff shall be carried in a closed conduit when either of the following apply:

- A. The runoff can be carried in a pipe of 72 inches in diameter or smaller; or
- B. Where it is necessary for the protection of adjacent facilities that the ~~storm water~~ **stormwater** be carried in an enclosed facility; or
- C. Headwalls and erosion protection shall be constructed at the outfall of all storm drainage systems.

14.4.3 Concrete-Lined Channels

Reinforced concrete-lined open channels should be used when the criteria outlined above is exceeded, or in lieu of a closed conduit when it is mutually agreeable to both the City and the owner. They shall meet all city, state and federal requirements.

Reinforced concrete-lined open channels shall conform to the following:

- A. At low points in grade (sumps) of a closed conduit system, a concrete-lined overflow channel shall be provided to convey the 100-year flood overflow. If the 100-year flood is collected and conveyed in a closed conduit, then an overflow channel is not required. All such concrete overflow channels and other concrete channels that discharge 40 cfs or less shall be considered flumes. Flumes draining 20 cfs or less do not require freeboard. All other flumes with sub-critical flow must have a minimum of six inches of freeboard, and with super-critical flow, they must have one foot of freeboard.

The following items shall be for the 100-year, fully developed flood flows with one-foot freeboard, and checked for super elevation at bends:

- B. Channels draining an area of 200 acres or less shall be lined with reinforced concrete in a manner, which will contain the design flood plus one foot of freeboard within the concrete lining.
- C. Channels draining an area of 200 acres but not more than 1,000 acres shall be concrete-lined to contain the runoff from a 25-year flood with the balance of the required design flood contained within grassed slopes no steeper than four feet horizontal to one foot vertical (4H:1V) and with a minimum of one foot freeboard.
- D. Channels draining an area of 1,000 acres but not more than 4,000 acres shall be constructed with a reinforced concrete pilot channel not less than 12 feet in width and having at least six-inch curbs and a four-inch depressed invert. A stone riprap erosion protection mat four feet wide shall be placed continuously on both sides of the pilot channel. The remainder of the channel shall consist of earthen side slopes with proper

ARTICLE 14: DRAINAGE

4. Pilot channels may not be required for situations where the earthen channel is solely for the purpose of increasing conveyance under a bridge.

14.4.5 Detention Basins

Detention and retention basins with associated intake and outflow systems, pump stations, emergency and service channels and structures and necessary supporting systems shall be considered stormwater management facilities as defined in [Section 14.6.3](#) of this article and shall be subject to the requirements in [Section 14.6.3](#).

If the developer of a property proposes detention/retention facilities for the development to remain in place after the completion of the construction, then as condition to approval of the development the property owner of the detention/retention facility will be required to dedicate to the city a drainage and detention easement covering the detention/retention facility and the outfall system conveying the drainage outflows to the city storm drainage system and the property owner will be required to sign an inspection and maintenance agreement with the city as specified in [Section 14.6.3](#) of this article.

Detention Basins shall be required when downstream facilities are not adequately sized to convey a design storm based on current City criteria for hydraulic capacity. Detention basins shall not be required if downstream improvements will be constructed in conjunction with the project to safely convey the undetained flows from the project. Proposed calculated peak ~~storm water~~ **stormwater** discharge from a site shall not exceed the calculated peak discharges from existing conditions, unless sufficient downstream capacity above existing discharge conditions is available. Detention facilities when required shall be designed such that peak discharges or velocities are not increased when compared to pre-project conditions for the 2-, 10- and 100-year floods. Construction of proposed detention facilities and associated supporting systems shall be substantially complete before any building permits for improvements served by the detention facilities can be approved.

The perimeter boundary of a detention/retention basin, or a portion thereof, that is situated within 120 feet of a street right-of-way designated on the Master Transportation Plan as a Collector or Arterial thoroughfare shall be fenced with a four-foot high wrought iron type fence, equal in design to a Type 2 Screening Fence as specified in [Article 8, "Landscape and Screening,"](#) of the Grand Prairie Unified Development Code. Any portion of said fence for a basin that either directly adjoins or is situated within 15 feet of the designated street right-of-way shall contain brick columns. Said brick columns shall equal or exceed the height of the fence and be spaced a maximum of 24 feet apart on center along the designated street right-of-way. Otherwise, no brick columns shall be required for fences that do not adjoin, or are situated more than 15 feet from, the designated street right-of way.

The use of a chain link type fence as a substitute to the above requirement shall be considered by City staff if there are intervening structures or mature landscaping (existing or proposed) that would effectively screen the fence from view along the designated street right-of-way. See Item 11.0 of the Drainage Design Manual.

14-6

Grand
Prairie

14.4.6 Erosion Hazard Setbacks

ARTICLE 14: DRAINAGE

- A. Erosion hazard setback determinations shall be made for every stream in which natural channels are to be preserved.
- B. Erosion hazard setbacks, as set forth in Section 2.6 of the Drainage Design Manual, shall be required to protect structures and lot improvements from erosion hazards.
- C. A person commits an offense if the person erects or maintains a structure within an erosion hazard setback.

SECTION 5 - DESIGN STANDARDS

14.5.1 Purpose

The purpose of this Section is to establish standard criteria, principles, procedures, and practices for design of storm drainage facilities. The design factors, formulas, graphs and procedures presented or referred to herein are intended for use as engineering guides in the design of drainage facilities and in the solution of drainage problems involving the quantity, method of collection, conveyance, and discharge of ~~storm water~~ **stormwater**. Methods of design other than those indicated or referred to herein may be considered in complex and difficult cases where experience clearly indicates they are preferable; however, these deviations shall not be attempted until approval has been obtained from the City Engineer.

The methods outlined or referred to herein include accepted principles of surface drainage engineering and should be a working supplement to basic design information obtainable from textbooks and publications on drainage.

14.5.2 Supplemental Design Information

The following design information shall be available at the City Engineer's office, and adhered to as if contained herein:

- A. Drainage Design Manual and checklist to facilitate approval of storm drainage construction plans; and
- B. Standard details and technical specifications for storm drainage construction.

14.5.3 Grading Plan

A grading plan shall be prepared for all projects. The plan shall include:

- A. A contour map of existing elevations based on field survey of the entire site, any off-site areas to be graded as a part of the project, and about 100 feet beyond the limits of the project or as needed to confirm the direction of local drainage. As a minimum the map shall have a scale of not less than one inch=40 feet with a one-foot contour interval. In certain cases, it may be necessary to adjust the map scale, reduce the contour interval, or extend the distance of the field survey beyond the project limits to fully characterize

14-7

Grand
Prairie

ARTICLE 14: DRAINAGE

The outline of drainage areas must follow natural drainage features in non-urbanized areas. Flow diverted by fence or agricultural ridge rows will require a detailed ground survey and rigorous hydraulic analyses for verification. If it cannot be determined that such diversions were constructed per City Code, or if they appear to have occurred by sedimentation along a fence, it will be necessary to design any downstream storm drainage systems to accommodate runoff from such areas.

Consideration shall be given to man-made features in urbanized areas. In preparing drainage maps particular attention should be given to gutter and ditch configurations at intersections. The direction of flow in gutters (on-site and off-site) should be shown on the maps and construction plans.

14.5.6 Runoff Coefficients

Storm drainage shall be designed for ultimate development of the watershed and, therefore, runoff coefficients used shall consider these fully developed conditions. Master plans, zoning maps, land use plans and this Unified Development Code shall be used to determine the ultimate development.

Table 14-A gives values for runoff coefficients that shall be used in the determination of **storm water stormwater runoff**.

TABLE 14-A
Runoff Coefficient "C"

Type of Area or Land Use	Zoning Class*	Runoff Coefficient "C"
Parks & Permanent Open Space	A, Easements	0.30
Single-Family Residential	SF-E, SF-1, SF-2, SF-3, SF-4, SF-5, SF-5/16, SF-6	0.50
Multi-Family Residential & Schools	MH, MF-1, MF-2, MF-3, SF-A, SF-ZLL, SF-T, 2F	0.75
Commercial/Retail	O, O-1, NS, C-1, CO, C, PD, HD, GR, GR-1	0.80
Industrial & Manufacturing	HC, IP, LI, HI	0.85
Central Business District (CBD)	CA	0.90
Church	All Zoning Classes	0.75

* See Unified Development Code [Article 3](#) for Zoning Class descriptions

14.5.7 Time of Concentration

Time of concentration is defined as the longest time that will be required for a drop of water to flow from the upper limit of the drainage area to the point of concentration. Time of concentration is a combination of inlet time and time of flow in the storm drainage facility.

ARTICLE 14: DRAINAGE

Accepted minimum inlet times of concentration are shown in Table 14-B.

TABLE 14-B
Minimum Inlet Time of Concentration

Type of Area or Land Use	Minimum Inlet Time
Undeveloped, Agricultural	20 Minutes
Parks, Permanent Open Areas, Playgrounds	15 Minutes
Single-Family Residential	15 Minutes
Manufacturing, Industrial, Commercial/Retail, Church	10 Minutes
Central Business District	5 Minutes

* Includes zoning classes: MH, SF-A, SF-ZLL, SF-T, 2F

When inlet times of concentration which are in excess of these minimum times are used, the techniques and assumptions used in computing these times must be submitted with the plans and approved by the City Engineer.

14.5.8 Curve Charts

See Item 4.0 of the Drainage Design Manual.

14.5.9 Design Flood

It is general practice to design municipal storm drainage systems to accommodate the runoff from ten-year and 100-year storm events.

Table 14-C shows the flood frequencies to be used in the design of drainage facilities:

TABLE 14-C
Design Flood

Type of Facility	Design Flood
Storm Drains (with Inlets on Grade)	10 Year
Storm Drains Draining Low Point inlets	100 Year
Culverts, Bridges, Channels, Creeks, Low Point Overflows ¹	100 Year

¹ 100-year flood low point overflows must be contained within easements. If low point overflows are in parking lots or access drives depth must not exceed 6 inches and must be contained in a dedicated drainage easement.

In connection with the design of facilities such as City streets conveying storm runoff and low point inlets, the discharge for a 100-year flood and the resulting possible damages there from shall be evaluated to determine if said damages are sufficient to warrant the enlargement of the planned facility. In any areas where storm water runoff concentrates at low points of grade or where discharge in excess of the storm drainage facility capacity flows across private property, the following information shall be shown:

- A. The 100-year flood discharge and inundation limits.

ARTICLE 14: DRAINAGE

- B. The depth of inundation of this discharge.
- C. An evaluation of the possible damages resulting from the overflow discharge.
- D. Location and width of a dedicated drainage easement sufficient to convey the discharge to another drainage facility.

14.5.10 Head Losses

The design techniques and methods used in the determination of all head losses shall be approved by the City Engineer. See also see Item 8.5 of the Drainage Design Manual.

14.5.11 Flow in Gutters

The drainage capacities of streets and gutters shall be determined by Manning's Formula using an 'n' value of 0.016 for concrete streets. Streets and curb inlets shall be designed to flow not more than curb deep during a 10-year flood. When existing street slopes are less than five feet per 1,000, the hydraulic capacity of the street and right-of-way shall be determined assuming a slope of three feet per 1,000. Where a flow of water is directed toward a curb and is required to turn in direction, the height of the curb against which the water is directed shall not be less than the depth of water flow plus the city head of the water plus two inches. Where water is dumped from a street directly into an open watercourse, it shall be dumped through an approved type of catch basin or through a concrete lined structure.

SECTION 6 - OFF-SITE DRAINAGE, EASEMENTS, AND CONSTRUCTION

14.6.1 Off-Site Drainage

The owner or developer of property to be developed shall be responsible for all storm drainage discharge flowing on such person's property. This responsibility includes the drainage directed to that property by prior development as well as drainage naturally flowing through the property by reason of topography. In the event ~~storm water~~ **stormwater** flowing onto such person's property cannot be carried in the equivalent of a seventy-two inch pipe, the City may participate in a direct percentage method of those costs in excess of seventy-two inches based upon written agreements prior to final plat approval and availability of funds and approval by City Council.

Adequate consideration shall be given by the owner in the development of property to determine how the discharge leaving the proposed development will affect downstream property, with the city of said downstream drainage discharge into an adequate storm drain system, defined creek or waterway based on the suggested maximum permissible velocities in Table 9.1 of the Drainage Design Manual.

14.6.2 Easements and Construction

On lots or tracts where ~~storm water~~ **stormwater** runoff has been collected or concentrated, it shall not be permitted to drain onto adjacent property except in existing creeks, channels, drainage

14-11

Grand Prairie

ARTICLE 14: DRAINAGE

swales or storm sewers unless proper drainage easements or a letter of release of liability from the affected property owner is filed for record with the County Deed of Records.

All proposed storm drainage facilities (i.e. closed conduits, channels, graded swales, detention basins) which convey concentrated storm runoff beyond the boundary of a single property shall be placed within the limits of a dedicated drainage easement or public right-of-way. Private storm drainage systems which collect only on-site storm drainage runoff from one lot or tract shall not be placed in a dedicated storm drainage easement (no lot-to-lot drainage). Easement width for storm drainpipe shall not be less than 15 feet and easement width for open channels shall be at least 20 feet wider than the width of the top of the channel banks. Where maintenance access is required, one side shall be 15-feet wide.

Channels delineated on the FEMA study and maps as adopted by [Article 15, "Floodplain Management,"](#) and earthen channels accepted by the City as part of the development plan shall be placed within a dedicated drainage easement/~~storm water~~ **stormwater** management area or public right-of-way of sufficient size to contain the 100-year fully-developed flood with a minimum ten feet over bank area within the floodplain on each side of the stream. The drainage easement shall be of sufficient size to take into account any additional width to accommodate future bank erosion as determined by engineering slope stability calculations. A future stable four feet horizontal to one-foot vertical (4:1) earthen bank slope plus ten feet may be assumed in establishing the limits of the drainage easement measured from the bottom edge of the creek bottom. ***In no case shall the slopes be steeper than 3:1.***

The sub divider, developer or builder shall bear the cost of all drainage improvements required for the development of such person's subdivision or other construction, including the cost of any necessary downstream off-site channels or storm drains as described in [Subsection 14.6.1](#) and the cost of acquisition of the required easements, with the following exceptions:

- A. If the owner is unable to acquire the necessary off-site easements, such owner shall provide the City with documentation of such owner's efforts, including evidence of a reasonable offer made to the affected property owner. Upon such a written request for assistance, the City shall acquire these easements either through negotiations or condemnation. In either case, the cost of these easements shall be paid by the owner.
- B. In areas where the proposed off-site improvements are to be made within existing City right-of-way, an estimate of these off-site costs shall be prepared and submitted along with the plans. Subject to availability of funds and City Council approval, cost for such off-site improvements shall be prorated such that the owner pays for a percentage of the off-site cost based on the increase of the discharge originating within the limits of such owner's property.

All construction shall be in accordance with the standard specifications and construction details for street and drainage construction in the City as currently amended.

14-12 14.6.3 ~~Storm Water~~ **Stormwater** Quality and Construction

Grand
Prairie

All construction activities shall be in compliance with all current City of Grand Prairie, State (TPDES) and Federal (NPDES) stormwater quality regulations. A copy of the Notice of Intent or

ARTICLE 14: DRAINAGE

Construction Site Notice shall be submitted to the City Engineer when runoff from a construction site enters a public system. A ~~Storm Water~~ **Stormwater** Erosion Control Plan shall be included in the construction plans submitted to the City. As applicable, a ~~Storm Water~~ **Stormwater** Pollution Prevention Plan (SWPPP) shall be prepared and a general permit secured by the Developer/Owner and Contractor as required and kept on the construction site during construction with the NOI and construction site notice posted in clear view of the public at the construction entrance.

Stormwater management facilities shall include detention/retention basins, rain gardens, bio-retention areas, riparian buffers and associated inflow and outfall structures, pipes, pump stations, aeration facilities, drainage swales and channels and other associated storm drainage facilities designed to improve the quality of stormwater discharges from developments and mitigate adverse impacts from the development due to flooding and erosion.

All stormwater management facilities shall be designed in accordance with the approved city design standards and recommended guidelines. Developers proposing stormwater management facilities to remain in place after the completion of the construction of the development shall provide to the city an executed agreement from the property owner(s) on the city approved agreement form (Attachment D) for filing with the county records against the property. The developer and property owner(s) shall agree to comply with the city guidelines and policies for operation and maintenance of the stormwater management facilities (Attachments A and B) and provide periodic inspections of the condition of the stormwater management facilities as outlined in the guidelines and inspection form (Attachment C) and submit to the city a copy of the inspection report on an annual basis.

The documents referred to in this section, and attached hereto, once approved by the City Council, shall be maintained in the office of the City Secretary, the Drainage Engineer, the City Engineer, and the Planning Director along with the date of approval and effective dates. Whenever the policies, guidelines, or forms of agreement are changed or amended, and the changes or amendments approved by the City Council, those changes and amendments, along with the effective date, shall be similarly maintained.