

ORDINANCE NO. 1168-9-99

AN ORDINANCE OF THE CITY OF NACOGDOCHES, TEXAS, CREATING ARTICLE V OF CHAPTER 8, "STORM DRAINAGE", OF THE CODE OF ORDINANCES OF THE CITY OF NACOGDOCHES, TEXAS

WHEREAS the continued growth and expansion of the City of Nacogdoches has Made it necessary to create the City's storm drainage policy in order to protect the City of Nacogdoches; and,

WHEREAS, the City Commission of the City of Nacogdoches, Texas, has determined it is in the best interest and welfare of the citizens of the City of Nacogdoches to create the policy for control of storm drainage in the city and its extra-territorial jurisdiction,

NOW, THEREFOR BE IT ORDAINED by the City Commission of the City of Nacogdoches, Texas, that Article V of Chapter 8 of the City of Nacogdoches Code of Ordinances be created so as henceforth same shall read as follows:

Article V. Storm Drainage Control

Sec. 8-60 General Provisions.

The developer shall design and construct drainage facilities in accordance with this ordinance and the City's Construction Specifications. The following design criteria are the City's minimum methods and standards. Other hydrologic and hydraulic design methods may be used to satisfy drainage requirements with prior approval of the City.

Sec. 8-61 Stormwater Detention.

All new development with proposed impervious surfaces exceeding 14,000 square feet shall provide for onsite stormwater detention in accordance with the following criteria:

- (a) 25-year storm runoff exceeding existing amounts shall be detained on site. Credit shall be given for runoff storage volumes equivalent to that generated by 14,000 square feet of impervious surface.
- (b) SCS TR-55 methodology shall be used for detention facility design.
- (c) Outfall shall be to the nearest approved public drainage facility.
- (d) Minimum discharge pipe size shall be 4 inches.
- (e) Discharge pipe materials: PVC - SDR 26 or Sch 40
RCP - Class III
CMP - 14 Ga. Min., Aluminized

HDPE – H20 per ASTM D 3350

- (f) Overflow spillways shall be reinforced concrete unless otherwise approved by the City.
- (g) All earthen areas shall have approved erosion protection.
- (h) Freeboard appropriate to the volume of detention shall be provided.
- (i) 3:1 maximum side slopes.
- (j) Property owner shall be responsible for detention facility maintenance.

Sec. 8-62 Plans.

A drainage plan shall be provided for all proposed development. For projects requiring runoff detention or drainage facility construction, the plan shall be prepared and sealed by a Registered Professional Engineer in the State of Texas and shall be supported by a detailed drainage study. The drainage study shall include hydrologic and hydraulic calculations and other design support documentation. This drainage plan shall be a complete construction document from which the proposed improvements can be constructed.

Drainage information on site plans required for issuance of building permits must include all information required by the City Engineer.

Sec. 8-63 Upstream Conditions.

The developer shall design all drainage facilities based on potential and fully developed upstream conditions in accordance with current land zoning.

Sec. 8-64 Discharge Points.

The developer shall terminate all drainage improvements at a discharge point approved by the City. Drainage flow patterns from developed property shall follow historic, pre-development patterns where such flow crosses property lines. Flow at the discharge point shall not exceed the capacity of downstream receiving facilities. The developer shall design and construct such discharge point, or outlet, to prevent damage to or overflowing into adjacent property. The City may require creek improvements, channel lining, energy dissipaters or other improvements for such outlet to prevent erosion or increase the downstream flow capacity.

Sec. 8-65 Public Streets as Drainage Facilities.

- (a) Construction of new streets shall require installation of storm drain facilities.
- (b) Maximum depth of water to be allowed in local streets at 10-year design flow shall be at the top of crown, or top of curb, whichever is least.

- (c) Maximum spread of water in collector streets at 10-year design flow shall allow for one clear lane of traffic (12 feet wide).
- (d) Maximum spread of water in arterial streets at 10-year design flow shall allow for two clear lanes of traffic (24 feet wide).
- (e) Street classification (local, collector, arterial) shall be as defined in the City's comprehensive plan or otherwise determined by the City.

Sec. 8-66 Drainage Channels and Structures.

- (a) The developer shall install an underground storm drain on curb and gutter streets beginning at the point where the calculated storm water runoff is of such a quantity that it exceeds the height specified above (see also Table 2). The developer shall construct the storm drain system from this point to an approved outlet.
- (b) If the developer proposes to construct a channel, the City shall approve the right-of-way width and channel configuration. The developer shall design and construct all channels to terminate at an approved outlet.

Sec. 8-67 Habitable Structures.

The developer shall provide adequate means for storm water run-off in excess of the street and drainage system capacity to flow around habitable structures. See Figures 1 and 2.

- (a) If adjacent topography rises away from the street, the developer shall provide a grading/drainage plan which shows that all building sites can provide a finished floor elevation at least one foot (1') above the top of the curb using the highest point along the portion of such curb directly fronting the building site, or
- (b) If adjacent topography falls away from the street, the developer shall provide a grading/drainage plan that shows that all building sites can provide a finished floor elevation at least one foot above the ground elevation along all sides of the building site.
- (c) The developer shall design and construct all streets to minimize any fill required to bring building pads into compliance with these criteria.
- (d) The City upon submittal of detailed engineering plans may consider alternate methods of building protection to those above.

Sec. 8-68 Improvements.

- (a) Inlet & Outlet Structures - Headwalls, wingwalls, splash pads and riprap shall be provided at the inlet and outlet of all pipe systems. Design shall be appropriate for the individual situation and subject to approval of the City.
- (b) Pipe vs. Channel - If an underground drainage system is required, and a 60-inch or smaller pipe will handle the design flow, pipe shall be used. If a 60-inch pipe is not adequate, the developer has the option to use concrete pipe or natural and/or a lined open drainage channel. Lining materials, if used, shall be approved by the City.
- (c) Line of Flow - The developer shall allow water courses to follow their natural lines of flow; provided however, that rechanneling or re-routing of water courses may be allowed where approved by the City and where the point at which the water course enters the tract and the point at which it leaves the tract are not changed. Upstream and downstream water surface elevations shall not be increased unless a study prepared by a registered professional engineer demonstrates that no potential damage due to flooding will be created.
- (d) Bridges and Box Culverts - The developer shall design and construct bridges or box culverts at all street crossings over all drainage ways and floodways in accordance with Table 2.
- (e) Valley Gutters - The developer shall provide concrete valley gutters if the gutter flow must be carried across intersections of curbed streets. Maximum valley depth shall be one inch (1") and minimum width shall be six feet (6').
- (f) Public Easements Required - All public drainage facilities shall be placed in public easements subject to approval by the City. Minimum easement width is twenty feet (20').

Sec. 8-69 Design.

- (a) Basis for Storm Discharge.

The following methods of stormwater runoff calculation shall be used for the design of drainage improvements:

- (1) For watershed areas of 200 acres or less, use the Rational Formula as shown below. Figure 1 and Table 1 show average velocities to be used in calculating the time of concentration.
- (2) For watershed areas of greater than 200 acres the Regional Regression Equations as described in the Texas Department of Highways Hydraulic Manual shall be used.

THE RATIONAL FORMULA

$$Q = CIA$$

where:

Q = is the maximum storm flow rate at a given point (in cubic feet per second):

C = a run-off coefficient which varies with the topography, land use and moisture content of the soil at the time. The run-off coefficient shall be based on the ultimate use of the land. The run-off coefficient can be selected from the major use classification shown below or other coefficients may be used when supported in an approved drainage study

Paved Areas	0.95
Shopping Centers	0.90
Business Centers	0.80
Industrial Areas	0.85
Residential Areas:	
Less than 2 lots/acre	0.40
Greater than 2 lots/acre, but less than 4 lots/acre	0.50
Greater than 4 lots/acre, but less than 8 lots/acre	0.60
Greater than 8 lots/acre	0.75
Apartments	0.75
Park & Open Space	0.30

I = the average intensity of rainfall in inches per hour for a period equal to the time of concentration of flow from the farthest point of the drainage area to the point under consideration.

$$I = \frac{b}{(t+d)^e}$$

The Texas Department of Highways Hydraulic Manual shows that in Nacogdoches County

d = 8.0 and

	<u>5 year</u>	<u>10 year</u>	<u>25 year</u>	<u>50 year</u>
b =	71	73	81	86
e =	.773	.748	.740	.733

t = time of concentration in minutes

TIME OF CONCENTRATION

$$t = \frac{D}{V \times 60}$$

where:

- t = Time of concentration in minutes. The minimum time of concentration shall be 10 minutes.
- D = Distance in feet from point of concentration to the hydraulically most distant part of the drainage basin under construction.
- V = Velocity in feet per second from Figure 3 or Table 1 or velocity calculated by an engineer for streets and/or storm sewers.
- A = the drainage area, in acres, tributary to the point under design calculated from the drainage map of the area. The drainage map shall be submitted with any drainage plans submitted for consideration by the City.

Table 1

AVERAGE VELOCITIES OF RUNOFF

% SLOPE OF GUTTER	ASSUMED VELOCITY (FT/SEC)
0.5%	1.5
1.0%	2.2
2.0%	3.1
3.0%	3.8
4.0%	4.3
5.0%	4.9
6.0%	5.3
8.0%	6.1
10.0%	6.9

(b) Storm Frequency - Design storm frequencies for storm drainage improvements are shown in Table 2.

Table 2

DESIGN STORM FREQUENCY

TYPE OF FACILITY	DESCRIPTION OF AREA TO BE DETAINED	MINIMUM DESIGN FREQUENCY (YRS)
Streets and Storm Sewers or Side Ditches Combined*	Residential, Commercial and Industrial	Local - 10 Collector - 10 Arterial - 10
Culverts, Bridges, Channels and Creeks	Any type of area less than 200 acres	25
Culverts, Bridges, Channels and Creeks	Any type of area greater than 200 acres	100

* If in a storm drain system, an inlet is located at a low point so that flow in excess of the storm drain capacity would be directed onto private property, and such overflow could cause damage or serious inconvenience in the opinion of the City, the design frequency shall be twenty-five (25) years.

(c) Underground Drainage Facility Design

The engineer shall calculate underground drainage facility (storm drain) capacity by Manning's Formula as follows:

$$Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$$

where:

Q = the discharge in cubic feet per second

A = the cross - sectional area of flow in square feet

R = the hydraulic radius in feet = area/wetted perimeter

S = the slope of the hydraulic gradient in feet per foot

n = the coefficient of roughness

The elevation of the hydraulic gradient of the storm sewer shall be a minimum of 1.5 feet below the elevation of the adjacent street gutter. The developer shall use storm drain pipe sized so that the average velocity in the pipe will not exceed 15 feet per second and the outlet velocity will not exceed velocities shown in Table 4 for the discharge conditions.

(d) Open Channel Design

The engineer shall design and construct open channel facilities based on frequencies shown in Table 2 and calculated by Manning's Formula with roughness coefficients and velocities as shown in Table 3. Side slopes of channels shall be no steeper than 3:1 in earth and 1:1 when lined with concrete.

Table 3

COEFFICIENT OF ROUGHNESS

OPEN CHANNELS	MAXIMUM PERMISSIBLE VELOCITY (FT/SEC)	COEFFICIENT "n"
Paved		
Concrete-----	-----15-----	-----0.011 to 0.020
Asphalt-----	-----15-----	-----0.013 to 0.017
Rubble or Riprap-----	-----15-----	-----0.017 to 0.030
Earth		
Bare, sandy silt, weathered-----	-----2.0-----	----- 0.020
Silt Clay or soft shale--	-----3.5-----	----- 0.020
Clay-----	-----6.0-----	----- 0.020
Soft sandstone-----	-----6.0-----	----- 0.020
Clean gravelly soil-----	-----6.0-----	-----0.030 to 0.150 ¹
Turf		
Shallow Flow-----	-----6.0-----	----- 0.06 to 0.06
Depth of flow over 1 foot	-----6.0-----	----- 0.04 to 0.06

¹ will vary with the straightness of alignment, smoothness of bed and side slopes and whether channel has light vegetation or is choked with weeds and brush.

(e) Culvert Design

The developer shall install enclosed culverts if a creek or ditch crosses proposed roadway improvements. The size of the culvert required shall be the larger size, checking both inlet and outlet flow control.

Design of culverts shall include the determination of upstream backwater conditions as well as downstream velocities and flooding conditions. The developer shall not design or install culverts with discharge velocities that exceed those provided in Table 4.

Table 4

CULVERT DISCHARGE - VELOCITY LIMITATIONS

CULVERT DISCHARGING ONTO	MAXIMUM ALLOWABLE VELOCITY (FT/SEC)
Earth	6
Sod Earth	8
Paved or riprap apron	15
Shale	10
Rock	15

(f) Minimum Design Standards

The design requirements set forth in this Policy are minimum design standards. The City reserves the right to require additional precautions or treatments consistent with sound engineering practice and the protection of public health and safety, to provide for conditions not specifically covered in this Policy. Drainage requirements for developments adjacent to or draining into state highway right-of-way shall be subject to all requirements of the Texas Department of Transportation.

Sec. 8-71 Appeals.

The owner of a property affected by the provisions of this ordinance may appeal a decision of the city to the Construction Board of Adjustment and Appeals whenever one of the following conditions are alleged:

1. The provisions of this ordinance do not apply to a specific case.
2. An equally good or more desirable design or installation can be employed in a specific case.
3. The true intent and meaning of this ordinance has been misconstrued or incorrectly interpreted.

Sec. 8-72 Penalty.

Any person, firm or corporation violating the terms and provisions of this ordinance shall be deemed guilty of a misdemeanor, and upon conviction, shall be fined in a sum not to exceed two thousand dollars (\$2,000.00). Each violation of a provision and each day a violation continues shall be a separate offense.

PASSED AND APPROVED on this the 7th day of September, 1999.

Richard Johnson, Chairman
City Commission

ATTEST:

Lila Fuller
City Secretary

APPROVED AS TO FORM:

Rob Atherton
City Attorney