

## ARTICLE VI

### STORM WATER DETENTION REQUIREMENTS

#### Section 601 General

Storm water runoff and the velocity of discharge are considerably increased through development and growth of the City. Prior to the development of the land, surface conditions provide a higher percentage of permeability and longer time of concentration. With the construction of buildings, parking lots, etc., permeability and the time of concentration are significantly decreased, resulting in an increase in both the rate and volume of runoff. These modifications may create harmful effects on properties downstream. Therefore, to minimize these effects, the following minimum storm water detention requirements have been established.

#### Section 602 Storm Water Detention Plans

A complete set of storm water detention plans and calculations shall be provided for all construction projects that increase storm water runoff.

#### Section 603 Method of Evaluation

Differential runoff evaluation consists of the determination of the rates of runoff, before and after development, determination of required volume of detention and verification of adequacy of discharge and control structures. The 100-year (frequency) runoff coefficients shall be used. Differential runoff rates shall be evaluated by equation:

$$R = (C_d \times I_{100}) - (C_u \times I_{100})$$

Where R = Differential Runoff Rate  
C<sub>d</sub> = Runoff Coefficient for developed conditions  
C<sub>u</sub> = Runoff Coefficient for undeveloped conditions  
I<sub>100</sub> = Intensity for 100-year storm

"C" values shall be determined from the following table:

<b>Suggested Runoff Coefficients</b>	
<b>"C" Value</b>	<b>Surface Conditions</b>
.10 - .15	Tall grass, brush
.15 - .20	Parks, golf courses, farms and one (1) acres single family residences
.35	Single family residences on lots of not less than 15,000 sq. ft.
.45	Single family residences on lots of not less than 10,000 sq. ft.
.47	Single family residences on lots of not less than 7,500 sq. ft.
.51	Single family residences on lots of not less than 6,000 sq. ft.
.90	Gravel surfaces
.95	Asphalt and concrete surfaces
1.00	Buildings and other structures

### **Section 604 Volume of Detention**

Volume of detention can be evaluated according to the "Simplified Volume Formula", or other method with approval of the City Engineer.

Total volume of detention shall be computed by the equation:

$$\begin{aligned}
 V &= R \times A \times t_c \text{ (min.)} \times 60 \text{ (sec./min.)} \\
 V &= \text{Total volume of detention (cu. ft.)} \\
 R &= \text{Differential Runoff Rate} \\
 A &= \text{Area of project in acres} \\
 t_c &= \text{Time of concentration as determined for use with differential runoff rates}
 \end{aligned}$$

The design volume of detention shall be determined from the following table:

<b>Calculated Volume</b>	<b>Design Volume</b>
1 cu. ft. thru 500 cu. ft.	500 cu. ft.
501 cu. Ft. thru 4,999 cu. ft.	Round up to nearest 500 cu. ft.
5,000 cu. ft. thru 9,999 cu. ft.	Round up to nearest 1,000 cu. ft.
10,000 cu. ft. thru 49,999 cu. ft.	Round up to nearest 5,000 cu. ft.
50,000 cu. ft. thru 99,999 cu. ft.	Round up to nearest 10,000 cu. Ft.
100,000 cu. ft. and above	Round up to nearest 25,000 cu. ft.

### **Section 605 Method of Detention**

The following conditions and limitations shall be observed in the selection and use of method of detention.

605.1 **General Location.** Detention facilities shall be located within the parcel limits of the project under consideration with the following exceptions:

- A. No detention or ponding will be permitted within public road rights-of-way without specific written approval of the City.
- B. Location of detention facilities immediately downstream of the project will be considered by special request if proper documentation is submitted with reference to practicality, feasibility, proof of ownership or right-of-use of the area proposed and provisions are made for perpetual maintenance.

**605.2 Dry Reservoirs.** Wet weather ponds or dry reservoirs shall be designed with proper safety, stability and ease of maintenance features. Maximum side slopes for grassed reservoirs shall not exceed one (1) foot vertical for three (3) horizontal (3:1). In no case shall the limits of maximum ponding elevation be less than two (2) feet vertically below the lowest sill elevation, nor should the maximum limits of ponding be designed closer than ten (10) feet from a building unless waterproofing of the building and pedestrian accessibility are properly mulched, sodded or paved. A minimum of one (1) foot of freeboard is required above the spillway. The outlet structure shall be concrete or other equivalent material. Spillway areas shall be paved with a minimum of six (6) inches of concrete.

**605.3 Open Channels.** Normally permitted open channels may be used as detention areas provided that the limits of the maximum ponding elevation are not closer than thirty (30) feet horizontally from any buildings with habitable areas below ground level, and less than two (2) feet below the lowest sill elevation of any building. In no case should the maximum limits of ponding be designed closer than ten (10) feet from a building unless waterproofing of the building and pedestrian accessibility are properly documented. No ponding will be permitted within public rights-of-way without specific written approval of the City. Maximum depth of detention in open channels shall be four (4) feet. Maximum flow line grade shall be 0.5 percent (0.5%).

For trapezoidal sections, the maximum side slopes of the detention area of the channel shall not exceed one (1) foot vertical for three (3) horizontal (3:1). For design of other typical channel sections the features of safety, stability and ease of maintenance shall be observed.

The entire reservoir area of the open channel shall either be seeded, fertilized and mulched; sodded; or paved. The hydraulic elevations resulting from channel detention shall not adversely affect adjoining properties.

**605.4 Permanent Lakes.** Permanent lakes with fluctuating volume controls may be used as detention areas provided that the limits of maximum ponding elevations area no closer than thirty (30) feet horizontally from any building and less than two (2) feet below the lowest sill elevation of any building.

Maximum side slopes for the fluctuating area of permanent lakes shall be one (1) foot vertical to three (3) feet horizontal (3:1) unless proper provisions are included for safety, stability and ease of maintenance.

Maximum fluctuation from permanent pool elevation to maximum ponding elevation shall be three (3) feet. Special consideration is suggested to safety and to limiting accessibility of small children in design of permanent lakes in residential areas.

The entire fluctuating area of the permanent reservoir shall be seeded, and fertilized and mulched, or sodded, or concrete paved. Any area susceptible to or designed as overflow shall be paved with concrete.

**605.5 Parking Lots.** Detention will not be permitted in primary parking lots. A primary parking lot will be considered to be the most accessible eighty percent (80%) of total parking for a facility.

In no case should the maximum limits of ponding be designed closer than ten (10) feet from a building unless waterproofing of the building and pedestrian accessibility are properly documented.

When detention is being effected on parking lots by means of retaining walls or curbs, these retaining walls and curbs must be constructed or reinforced concrete.

The minimum freeboard from the maximum ponding elevation to the lowest sill elevation shall be two (2) feet.

## **Section 606 Verification of Adequacy**

Analysis of all elements of design is always performed by the Engineer. The following outline is provided to ascertain that certain critical elements of design are in workable compliance to the aims of design.

1. Volume of detention for the total project
2. Tributary (Q) peak runoff to basin
3. Sizing of the overflow facilities
4. Stability of detention dikes
5. Safety features
6. Maintenance features

Routing calculations shall be submitted in legible tabulated form. Proof of adequacy of the volume of detention and sizing computations for low-flow structure shall also be submitted. Features of stability and safety will also need to be documented if the scope of the project requires special attention in this area of design.

Spot elevations shall be included in sufficient detail on the site plan so that the final direction of water flow can be determined, and so that the volume of detention can be ascertained. Projects over two hundred (200) acres in area shall provide documented verification of adequacy according to scope and complexity of design.

**Section 607 Control Structures**

Detention facilities shall be provided with obvious and effective outlet control structures. These outlet structures may include v-notch weirs or rectangular weirs, as well as pipe. Plan view and sections of the structure with adequate detail shall be included in plans.

The design discharge (Q) for the low-flow outlet shall not exceed the existing runoff for the 1-year storm. The maximum discharge shall be designed to take place under total anticipated design-head conditions. The design-head storage volume if not to be considered as part of the volume of detention required.

Low-flow pipes shall not be smaller than four (4) inches in diameter to minimize maintenance and operating problems, except in parking lot and roof detention where minimum size and configuration of opening shall be designed specifically for each condition. The low-flow pipe shall be provided with a bar-screen on a minimum 2:1 slope to reduce blockage by debris.

Overflow spillways will be required on all detention facilities that have storage volumes of 1,000 or more cubic feet.

The overflow opening or spillway shall be designed so that the combination flow of the low-flow outlet and the flow over the spillway will not exceed the total peak runoff for the improved area. The total peak runoff is to be determined from a 25-year frequency rain for drainage areas less than 1.0 square mile and from a 100-year frequency rain for drainage areas 1.0 square mile or greater.

<b>Street Classification</b>	<b>Allowable Depth and Inundate Areas of 100-Year Storm</b>
Local & Collector	Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. Water depth over the gutter flowline shall not exceed eighteen (18) inches.
Arterial	Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. Depth of water at the street crown shall not exceed six (6) inches to allow operation of emergency vehicles. The depth of water over the gutter flowline shall not exceed eighteen (18) inches.

## Section 608 Detention Basin Alternatives

Responsible storm water management should consider all available alternatives including construction of onsite detention basins, improvements to the conveyance system, or by making a payment in lieu of providing improvements. This regulation allows the City to make a permit decision as to whether it is more protective of the community to have the developer construct onsite detention and/or make conveyance system changes, or to buyout when downstream conditions permit.

**608.1 Conveyance Improvements.** Whenever a storm water detention basin is required and the City Engineer determines that the receiving storm water conveyance system should be improved to accommodate the additional storm water, the developer may provide to the City sufficient funds or material and labor to construct the improvements to the conveyance system. The decision to accept or allow additional drainage to the conveyance system shall rest with the City. The funds for improvement to the conveyance system shall be in an amount determined by the developer's engineer upon acceptable review by the City Engineer to be reasonable and adequate to accommodate the improvement, and shall be spent solely for that purpose by the City.

**608.2 Buyout Option.** The developer of a tract of land (through his engineer) shall determine the detention volume necessary for the tract of land being developed. This volume shall be determined using the methods outlined in Article VI. Whenever the storm water volume analysis presented by the developer and accepted by the City shows that detention has no reduction in downstream flooding, the developer may pay to the City in lieu of constructing storm water detention facilities the amount of \$3.00 for each cubic foot of detention volume. Whenever the storm water volume analysis presented by the developer and accepted by the City shows that detention will increase downstream flooding, the developer is required to pay to the City in lieu of constructing storm water detention facilities the amount of \$3.00 for each cubic foot of detention volume. This money shall be used by the City to construct and maintain conveyance systems within the city limits, and does not offset the cost by the developer to construct downstream conveyance improvements within the drainage basin where the storm water detention facilities would have been constructed.

A waiver of the detention facility construction may not be allowed if the City Engineer has made a finding that there is a significant drainage problem below the property where the waiver is proposed to occur even though the detention facility is marginally efficient. The City Engineer may consider in making such determination that the discharge of any additional waters at an increased rate onto the properties below is not desirable due to the significant drainage problems that exist on subservient properties.