SECTION 8– STORMWATER MANAGEMENT

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8.1.0 GENERAL

Stormwater Management (SWM) programs aimed at controlling increased urban runoff generated by development are a top priority in urban planning. More frequent flooding, increased rates and volumes of runoff, increased stream channel erosion and degradation, increased sedimentation and increased water pollution are all problems intensified by development. SWM facilities such as detention, retention, extended detention, infiltration, and sedimentation ponds have proven to significantly reduce downstream flooding, reduce sediment and pollutant loads, and provide debris removal which can benefit water quality.

The basic concept of SWM for peak rates of runoff is to provide for a temporary storage of stormwater runoff. Runoff is then released at a controlled rate which cannot exceed the capacities of the existing downstream drainage systems, or the predeveloped peak runoff rate of the site, whichever is less.

The solid lined hydrograph shown in Figure 8-1 in Appendix B of this Manual represents a storm runoff event without SWM, while the dashed line hydrograph depicts the same event with SWM. The peak flow of the undetained hydrograph could exceed the capacity of the downstream conveyance system and thereby cause surcharging and flooding problems. With the introduction of the SWM facility, the solid lined hydrograph is spread over a longer time period and its peak is reduced. The area between the two (2) curves to the left of their intersection represents the volume of runoff, temporarily stored or detained in the SWM facility.

The City approaches the control of excess flows through the application of both on-site and regional SWM. Essentially, the distinction between the two approaches is that on-site is generally limited to site specific criteria, while regional incorporates a basin wide hydrologic analysis.

8.2.0 REGIONAL STORMWATER MANAGEMENT PROGRAM

8.2.1 General

The Regional Stormwater Management Program (RSMP) provides for the planning, design and construction of regional drainage improvements, using fees paid by the owners of those developments. The RSMP uses a watershed-wide approach to analyze potential flooding problems, identify appropriate mitigation measures, and select site locations and design criteria for regional drainage improvements. These improvements include detention and retention ponds, waterway enlargement and channelization, and improved conveyance structures. The RSMP allows developers to participate in the

program (in lieu of constructing on-site controls) if the resulting use of regional drainage improvements will produce no identifiable adverse impact to other properties due to increased runoff from the proposed development.

The fees charged for participation in the RSMP are non-refundable and are based upon the size of the development, and the proposed land use. The fees are deposited in a dedicated fund.

The benefits afforded by the RSMP include the following:

A. A higher level of confidence in the hydrologic analysis is obtained because each pond's interrelationship within a given basin can be readily determined. This is accomplished by establishing a hydrologic data base watershed master plan of the entire basin, and then using this to determine the most hydrologically efficient location for SWM facilities. This procedure takes into consideration the interrelated nature of tributary subareas within a watershed.

B. Adequate maintenance is more likely due to the City's vested interest and responsibility in the RSMP.

C. The cost of construction and the total land required can be considerably less than that needed for comparable on-site SWM

D. The expanded land area required for regional ponds lends itself to other uses (e.g., parks, nature areas, organized sports, etc.).

8.2.2 Participation Guidelines

Participation in the regional stormwater management program shall be determined according to Section 8.602(2), Chapter 8 of the City of Round Rock Code of Ordinances, 1995 edition.

After a development is accepted for participation, fees shall be paid in accordance with the following:

A. Single Family and Duplex Subdivisions.

Fees shall be paid prior to plat recordation.

B. Commercial and Multi-Family Site Development. For commercial and multi-family site development (includes triplexes, fourplexes, apartments and condominiums), payment (cash or cashier check only) must be made prior to issuance of a development permit.

C. Multi-Family, Commercial and Industrial Subdivisions. For multi-family, commercial and industrial subdivisions, payment (cash or cashier check only) shall be made prior to final plat approval for the rights-of-way. In addition, the applicant shall assign, by plat note, the responsibility for payment of the participation fee by the individual lot developer prior to their development permit approval.

8.3.0 STORMWATER MANAGEMENT PONDS

8.3.1 General

Stormwater Management (SWM) ponds may be of two basic types: On-site and regional.

In general, on-site ponds are those which are located off-channel and provide stormwater management for a particular project or development. Regional ponds are designed to provide stormwater management in conjunction with other improvements on a watershed-wide basis. SWM ponds may be further classified as retention or detention ponds and may incorporate water quality Best Management Practices (BMPs) such as sedimentation, infiltration, or filtration. The performance and safety criteria in this Section apply to all ponds which provide management of peak rates of stormwater runoff regardless of type.

8.3.2 Performance Criteria for on-Site SWM Ponds

A. On-site SWM ponds are further classified as either small or large, as follows:

ON-SITE SWM POND CLASS	DRAINAGE AREA
Small	<25 acres
Large	25-64 acres

For design purposes, any pond with a drainage area larger than sixty-four (64) acres shall be classified as regional pond.

B. On-site SWM ponds shall be designed to reduce post-development peak rates of discharge to existing pre-development peak rates of discharge for the 2, 10, and 25 year storm events at each point of discharge from the project or development site. For the post-development hydrologic analysis, any off-site areas which drain to the pond shall be assumed to remain in the existing developed condition.

8.3.3 Performance Criteria For Regional SWM Ponds

A. Regional SWM ponds are classified as small and large, based on the following criteria:

REGIONAL POND CLASS	IMPOUNDED VOLUME, AC-FT
Small	0-150
Large	>150

Any regional pond with a height of dam over fifteen (15) feet shall be classified as a large regional pond.

B. Performance criteria for regional ponds shall be determined by the Engineering and Development Services Department on a project-by-project basis. The determination shall be based on a preliminary engineering study prepared by the Engineer.

8.3.4 Safety Criteria For SWM Ponds

All ponds shall meet or exceed all specified safety criteria. Use of these criteria shall in no way relieve the Engineer of the responsibility for the adequacy and safety of all aspects of the design of the SWM pond.

A. The spillway, embankment, and appurtenant structures shall be designed to safely pass the design storm hydrograph with the freeboard shown in the table below. All

contributing drainage areas, including on-site and off-site areas, shall be assumed to be fully developed. Any orifice with a dimension smaller than or equal to twelve (12) inches shall be assumed to be fully blocked. For all spillways (especially enclosed conduits), the ability to adequately convey the design flows must take into account any submergence of the outlet, any existing or potential obstructions in the system and the capacity of the downstream system. For these reasons, enclosed conduit spillways connecting directly to other enclosed conduit systems are discouraged. If used, they must be justified by a rigorous analysis of all enclosed conduit systems connected to the spillway.

DETENTION POND CLASS		DESIGN STORM EVENT	FREEBOARD TO TOP OF EMBANKMENT, FT.
On-site:	Small	25 year	0
	Large	25 year	1.0
Regional:	Small	100 year	2.0
	Large	100 year	*

*Design storm event and required freeboard for large regional ponds shall be determined by a dam break analysis based on the principles outlined in Title 30, Part 1, Chapter 299 of the Texas Administrative Code. The dam break analysis shall be submitted to the Engineering and Development Services Department for approval.

B. If an embankment is classified as a dam pursuant to Title 30, Part 1, Chapter 299 of the Texas Administrative Code, all design criteria found in Title 30, Part 1, Chapter 299 of the Texas Administrative Code must be met, as evidenced by certification by an engineer licensed in the State of Texas.

C. All SWM ponds shall be designed using a hydrograph routing methodology. The appropriate City of Austin rainfall distribution, as provided for in Appendix A of this Manual, shall be used to determine all runoff hydrographs.

D. The minimum embankment top width of earthen embankments shall be as follows:

TOTAL HEIGHT OF EMBANKMENT, FT.	MINIMUM TOP WIDTH, FT.
0-5	7
5-15	15
15-+	*

*****To be determined on a case by case basis by the City Engineer.

E. The constructed height of an earthen embankment shall be equal to the design height plus the amount necessary to ensure that the design height will be maintained once all settlement has taken place.

This amount shall in no case be less than five (5) percent of the total fill height. All earthen embankments shall be compacted to ninety-five (95) percent of maximum density in accordance with the City of Round Rock DACS - Standard Specifications Manual.

F. Earthen embankment side slopes shall be no steeper than four (4) horizontal to one (1) vertical. Slopes must be designed to resist erosion to be stable in all conditions, and to be easily maintained. Earthen side slopes for regional facilities shall be designed on the basis of appropriate geotechnical analyses.

G. Detailed hydraulic design calculations shall be provided for all SWM ponds. Stage-discharge rating data shall be presented in tabular form with all discharge components, such as orifice, weir, and outlet conduit flows, clearly indicated. Stage-storage table shall also be provided. In all cases, the effects of tailwater or other outlet control considerations should be included in the rating table calculations.

H. When designing ponds in series (i.e., when the discharge of one (1) becomes the inflow of another), the engineer must submit a hydrologic analysis which demonstrates the system's adequacy. This analysis must incorporate the construction of hydrographs for all inflow and outflow components.

I. No outlet structures from detention, filtration and/or sedimentation ponds, parking detention or other concentrating structures shall be designed to discharge concentrated flow directly onto arterial or collector streets. Such discharges shall be conveyed by a closed conduit to the nearest existing storm sewer. If there is no existing storm sewer within three hundred (300) feet, the outlet design shall provide for a change in the discharge pattern from concentrated flow back to sheet flow, following as near as possible the direction of the gutter.

J. Storm runoff may be detained within parking lots. However, the Engineer should be aware of the inconvenience to both pedestrians and traffic. The location of ponding areas in a parking lot should be planned so that this condition is minimized. Stormwater ponding depths (for the 100 year storm) in parking lots are limited to an average of eight (8) inches with a maximum of twelve (12 inches). Maximum depths shall be permitted only in overflow parking areas not typically in daily business.

K. All pipes discharging into a public storm sewer system shall have a minimum diameter of eighteen (18) inches and shall be constructed of reinforced concrete. In all cases, ease of maintenance and/or repair must be assured.

L. All concentrated flows into a SWM pond shall be collected and conveyed into the pond in such a way as to prevent erosion of the side slopes. All outfalls into the pond shall be designed to be stable and non-erosive.

8.3.5 Outlet Structure Design

There are two basic types of outlet control structures: those incorporating orifice flow and those incorporating weir flow. Rectangular and V-notch weirs are the most common types.

Generally, if the crest thickness is more than sixty (60) percent of the nappe thickness,

the weir should be considered broad-crested. The coefficients for sharp-crested and broad-crested weirs vary. The respective weir and orifice flow equations are as follows:

A. **Rectangular Weir Flow Equation**(See Figure 8-2 in Appendix B of this Manual)

$$Q = CLH^{3/2} \quad \text{(Eq. 8-1)}$$

where

Q = Weir discharge, cubic feet per second
C = Weir Coefficient
L = horizontal length, feet
H = Head on weir, feet

B. **V - notch Weir Flow Equation**(See Figure 8-2 in Appendix B of this Manual)

$$Q = C_V \tan (0/2) H^{2.5} \quad \text{(Eq. 8-2)}$$

where

Q = Weir Flow, cubic feet per second
C_V = Weir Coefficient
O = Angle of the weir notch at the apex (degrees)
H = Head on Weir, feet

C. **Orifice flow equation**(See Figure 8-2 in Appendix B of this Manual)

$$Q = C_O A(2gH)^{0.5} \quad \text{(Eq. 8-3)}$$

where

Q = Orifice Flow, cubic feet per second
C_O = Orifice Coefficient (use 0.6)
A = Orifice Area, square feet
g = Gravitation constant, 32.2 feet/sec^2
H = Head on orifice measured from centerline, feet

Analytical methods and equations for other types of structures shall be approved by the SWMD prior to use.

In all cases, the effects of tailwater or other outlet control considerations should be included in the rating table calculations.

8.4.0 DETENTION POND STORAGE DETERMINATION

A flow routing analysis using detailed hydrographs must be applied for all detention pond designs. The Soil Conservation Service hydrologic methods (available in TR-20, HEC-1) and the Hydrologic Engineering Center (HEC) hydrologic methods may be used. The Engineer may use other methods but must have their acceptability approved by the City Engineer.