

RULE NO.: R161-21.02

ADOPTION DATE: March 9, 2021

NOTICE OF RULE ADOPTION

By: Jorge L. Morales, P.E., CFM, Director
Watershed Protection Department

The Director of the Watershed Protection Department has adopted the following rule. Notice of the proposed rule was posted on January 14, 2021. Public comment on the proposed rule was solicited in the January 14, 2021 notice. This notice is issued under Chapter 1-2 of the City Code. The adoption of a rule may be appealed to the City Manager in accordance with Section 1-2-10 of the City Code as explained below.

A copy of the complete text of the adopted rule is attached to this notice.

EFFECTIVE DATE OF ADOPTED RULE

A rule adopted by this notice is effective on March 9, 2021.

TEXT OF ADOPTED RULE

R161-21.02: Modifies the Drainage Criteria Manual as follows:

- DCM Section 1: *Drainage Policy*
 - Section 1.2.2 *General* – Updated to reflect additional instance where on-site detention is not required for those developments downstream of the Waller Creek Tunnel Inlet at 12th Street that are immediately adjacent to the creek, discharge directly to the creek, and pay into the tunnel tax increment redevelopment zone (TIRZ). Also made minor changes to part G.

- DCM Section 8: *Stormwater Management*
 - Section 8.1.0, *General* – Updated to match language with Section 1.2 on SCMs.
 - Section 8.2.1, *Regional Stormwater Management Program, General* – Updated to reflect how the program is administered. Review of participation applications for the program is now completed in formal review cycles along with other disciplines.
 - Section 8.2.2, *Regional Stormwater Management Program, Participation Guidelines* – Updated to reflect list of participating watersheds located online and to reflect how the program is administered. Also made minor language changes from “fees” to “payments” and clarified some of the participation requirements.

COMMENTS AND CHANGES FROM PROPOSED RULE

No comments were received, and no changes were made.

AUTHORITY FOR ADOPTION OF RULE

The authority and procedure for the adoption of a rule to assist in the implementation, administration, or enforcement of a provision of the City Code is established in Chapter 1-2 of the City Code. The authority to regulate design and construction of drainage facilities and improvements is established in Section 25-7-64 of the City Code.

APPEAL OF ADOPTED RULE TO CITY MANAGER

A person may appeal the adoption of a rule to the City Manager. **AN APPEAL MUST BE FILED WITH THE CITY CLERK NOT LATER THAN THE 30TH DAY AFTER THE DATE THIS NOTICE OF RULE ADOPTION IS POSTED. THE POSTING DATE IS NOTED ON THE FIRST PAGE OF THIS NOTICE.** If the 30th day is a Saturday, Sunday, or official city holiday, an appeal may be filed on the next day which is not a Saturday, Sunday, or official city holiday.

An adopted rule may be appealed by filing a written statement with the City Clerk. A person who appeals a rule must (1) provide the person's name, mailing address, and telephone number; (2) identify the rule being appealed; and (3) include a statement of specific reasons why the rule should be modified or withdrawn.

Notice that an appeal was filed and will be posted by the city clerk. A copy of the appeal will be provided to the City Council. An adopted rule will not be enforced pending the City Manager's decision. The City Manager may affirm, modify, or withdraw an adopted rule. If the City Manager does not act on an appeal on or before the 60th day after the date the notice of rule adoption is posted, the rule is withdrawn. Notice of the City Manager's decision on an appeal will be posted by the city clerk and provided to the City Council.

On or before the 16th day after the city clerk posts notice of the City Manager's decision, the City Manager may reconsider the decision on an appeal. Not later than the 31st day after giving written notice of an intent to reconsider, the City manager shall make a decision.

CERTIFICATION BY CITY ATTORNEY

By signing this Notice of Rule Adoption (R161-21.02), the City Attorney certifies that the City Attorney has reviewed the rule and finds that adoption of the rule is a valid exercise of the Director's administrative authority.

REVIEWED AND APPROVED



Jorge L. Morales, P.E., CFM, Director
Watershed Protection Department

Date: 03/03/2021



Anne L. Morgan
City Attorney

Date: 3/4/2021

This Notice of Rule Adoption was posted on the City website by the City Clerk. The date and time stamp are on the front of the notice.

DRAINAGE CRITERIA MANUAL

PREFACE

The rules and design criteria contained herein shall be known as the Drainage Criteria Manual. The purpose of this drainage manual is to establish standard principles and practices for the design and construction of drainage systems within the City of Austin, Texas and within its extraterritorial jurisdiction. The design factors, formulae, graphs and procedures are intended for use only as engineering guides in the solution of drainage problems involving determination of the quantity, rate of flow, method of collection, storage, conveyance and disposal of storm water. Responsibility for actual design remains primarily with the design engineer. Users of this manual should be knowledgeable and experienced in the theory and application of drainage engineering.

Methods of design other than those indicated herein may be considered in those cases where experience indicates they are appropriate. However, any variations from the practices established herein must have the expressed written approval of the Director of the Watershed Protection and Development Review Department or his designated representative.

This manual represents the application of accepted principles of surface drainage engineering and is complementary to basic information obtainable from standard references on hydrology, hydraulics and water resources. It is presented in a format that assists in the logical development of solutions to the problems of storm drainage.

Principal authors and compilers include C.K. Taur, Ph.D, Andrea Faucett, Greg Toth, Franklin C. Houston, P.E., Jose M. Guerrero, and George E. Oswald, P.E. Special appreciation is given to Rachel Davila who typed and retyped the seemingly endless draft with patience and care. Randy Farthing is also acknowledged for his skillful CADD drafting technique in preparing the figures.

Special recognition goes to the two Technical Review Committees organized by the Austin Branch of the American Society of Civil Engineers and the Texas Capital Area Builders Association for their in-depth technical review and comments on the manual.

SECTION 1 - DRAINAGE POLICY

1.1.0 - GENERAL

This manual represents the application of accepted principles of surface drainage engineering and is a working supplement to basic information obtainable from standard drainage handbooks and other publications on drainage. The policy statements of this section provide the underlying principles by which all drainage facilities shall be designed. The application of the policy is facilitated by the technical criteria contained in the remainder of the manual.

1.2.0 - CITY OF AUSTIN DRAINAGE POLICY

The intent of Austin's drainage policy for stormwater management is to implement design principles and practices that control post-development runoff from all development such that no development will result in additional adverse flooding impacts to our waterways and storm drain systems in accordance with Chapter 25-7 of the Land Development Code.

Source: Rule No. [161-20.01](#), § 1, 1-13-2020.

1.2.1 - Application

The City of Austin drainage policy shall govern the planning and design of drainage infrastructure within the City of Austin and within all areas subject to its extraterritorial jurisdiction. Definitions, formulae, criteria, procedures and data in this manual have been developed to support this policy. If any condition requiring some additional measure of protection is identified during design or construction, the engineer shall make provisions within the design. In order to receive a waiver to any of the criteria or policies in this manual, the applicant must receive approval from the Director of the Watershed Protection Department. A request for a waiver must comply with State law regarding engineering work and must include justification from the engineer that compliance is not feasible.

1.2.2 - General

- A. Stormwater runoff peak flow rates for the two (2), ten (10), 25 and 100-year frequency storms shall not cause increased inundation of any building or roadway surface or create any additional adverse flooding impacts.
- B. Street curbs, gutters, inlets and storm drains shall be designed to intercept, contain and transport all runoff from the 25-year frequency storm.
- C. In addition to B. above, the public drainage system shall be designed to convey those flows from greater than 25-year frequency storm up to and including the 100-year frequency storm within defined public rights of way or drainage easements.
- D. Stormwater runoff peak flow rates shall not be increased at any point of discharge from a site for the two (2), ten (10), 25 and 100-year storm frequency events.
- E. Regulation of peak flows to allowable levels, as determined by the provisions of this policy, shall be achieved by storage on-site or off-site or by participation in an approved Regional Stormwater Management Program. The Stormwater Management Section of this manual provides a guide to acceptable methods, but does not limit the designer to the methods presented therein. Guidelines for participation in the Regional Stormwater Management Program are contained in the Stormwater Management Section of this manual.
- F. ~~For those developments which are immediately adjacent and discharge directly into Lake Travis, Lake Austin, Lady Bird Lake and the Colorado River, on-site detention is not required.~~
Developments that meet the following requirements are not subject to D. or E. above:
 - 1. Developments that are immediately adjacent to and discharge directly into Lake Travis, Lake Austin, Lady Bird Lake and the Colorado River, or
 - 2. Developments that are immediately adjacent to and discharge directly into Waller Creek below the Waller Creek Tunnel Inlet (downstream of 12th Street) and that are located in the Waller Creek Tax Increment Reinvestment Zone (TIRZ).
- G. Detention Alternatives. The City recognizes the need for small projects to have an alternative means of meeting storm water quantity mitigation (detention) requirements. Section 8.2.0 of the Drainage Criteria Manual defines the Regional Stormwater Management Program and describes the requirements for participation in the program. The City will allow small land developments that meet the following requirements to automatically participate in the RSMP. This participation shall take the form of off-site improvements or payment-in-lieu of detention at the discretion of the Director of the Watershed Protection Department. Activity that meets all of the following requirements is not subject to D. ~~or E.~~ above.
 - 1. Commercial, multi-family or mixed-use developments with a site development area (limits of construction for redevelopment) of 0.5 acres or less or a single-family residential subdivision of one acre or less that does not require a preliminary plan application; ~~and~~
 - 2. The proposed impervious cover does not exceed the maximum allowed by ~~the zoning a~~ restrictive covenant, or plat note for the property, if applicable; ~~and~~
 - 3. The activity does not propose impervious cover over and above current zoning maximums through application of the various infill options provided in ~~n~~ Neighborhood plans; and

4. Any increase in runoff from the site shall be discharged to an existing storm drainage system, right-of-way, or dedicated drainage easement. If this cannot be achieved, a licensed engineer must submit the following:
 - i. A signed and sealed drainage plan; and
 - ii. A signed, sealed and dated letter, addressed to the Director of the Watershed Protection Department, stating without qualification: "I certify that I have personally conducted a topographic review and field investigation of the existing and proposed flow patterns for stormwater runoff from the subject development to the main stem of (name of creek). At build-out conditions allowable by zoning or watershed impervious cover limit, restrictive covenant, or plat note, the stormwater flows from the subject development will not ~~cause~~cause any additional adverse impacts for storms of magnitude up through the 100-year event."
- H. For site plans or subdivisions that are part of a phased development where prior phases of the development have been permitted or constructed using rainfall criteria pre-dating Atlas 14, the following drainage criteria criteria shall apply:
1. The current rainfall criteria shall be used to design the storm drain system (including gutters, inlets, pipes, spread requirements, etc.) within the current phase;
 2. The 100-year runoff generated from the current phase using the current rainfall criteria must be conveyed to the detention pond or designed outfall location via a storm drain system, including pipes, channels, and streets. This analysis must use the current rainfall criteria for the entire drainage area to the pond or outfall. For this analysis, the drainage system is not required to satisfy the minimum clear width requirements for the 25-year event in Table 3-1; and
 3. The 100-year runoff generated using the current rainfall criteria for the entire drainage area to the detention pond must not cause the peak water surface elevation of the pond to overtop the dam/embankment outside the controlled weir/overflow structure. The development will not be required to match the peak flow rates to pre-development conditions using the current rainfall criteria.
 4. If the development cannot satisfy these conditions, the design of the current phase must satisfy one or a combination of the following until the above conditions are satisfied:
 - a) Modify the existing detention pond or the intervening storm drain system; and/or
 - b) Provide on-site detention within the current phase until the above conditions are ~~satisfied~~satisfied or the peak flows from the current phase are not increased.

Source: Rule No. [161-19.22](#), 12-18-2019; Rule No. [161-20.01](#), § 1, 1-13-2020.

Cross reference— Supplemental requirements for development applications in certain planning areas, § 25-7-66.

1.2.3 - Street Drainage

- A. No lowering of the standard height of street crown shall be allowed for the purposes of obtaining additional hydraulic capacity.
- B. For non-curbed streets all flows for the 100-year frequency storm shall be contained within paralleling roadside ditches, medians, drainage channels or other drainage facilities located within public rights-of-way or drainage easements.
- C. Except as allowed by this Section or otherwise approved by the Watershed Protection Department, all discharges shall be conveyed by a closed conduit to the nearest existing storm drain.

No outlet structures from stormwater management facilities, groundwater collection, parking detention, or other improvements discharging concentrated flows shall be designed to discharge concentrated flow directly onto arterial or collector streets.

For local streets, no concentrated discharge from sites with a development site acreage larger than 0.25 acres shall be permitted.

If a development is located within 550 feet of an existing storm drain system, the developer shall provide all the necessary infrastructure designed in accordance with the criteria in this manual to connect appropriately to the storm drain system.

If the proposed connection is located more than 550 feet from an existing storm drain system, the developer shall work with the Watershed Protection department to determine the best plan to achieve an appropriate connection or convey storm water to a downstream system after confirming capacity and condition of the receiving system.

- D. Concentrated discharge across a sidewalk area will not be allowed. A channel section can be used under the sidewalk area, provided the outlet device utilizes sheet flow methods, maintains a minimum three (3) foot horizontal separation from all utility infrastructure, and it is covered by a method approved by the Public Works Department.

Source: Rule No. [161-19.22](#), 12-18-2019.

1.2.4 - Drainage System

Introduction

Drainage facilities, referred to as stormwater control measures (SCMs) throughout this section, include but are not limited to headwalls, open channels, storm drains, area inlets, easements, detention ponds, retention ponds, water quality controls, and their appurtenances. In addition to this section all SCMs shall comply with the following requirements in DCM Section 8.3, Stormwater Management Ponds, ECM Section 1.6.3, Maintenance and Construction Requirements, and applicable City of Austin Standard Specifications and Standards manuals.

The following table lists which requirements apply to residential development (single family/duplex) and which requirements apply to commercial development. Throughout this section residential development is defined as single family and duplex development and commercial development is defined as all development other than open space and residential development (pursuant to the definition in LDC Section 25-8-1). The requirements below shall apply to all City maintained SCMs and all SCMs for residential development regardless of whether they are publicly or privately maintained.

The requirements of this section do not apply to rainwater harvesting, porous pavement, and subsurface ponds, unless otherwise stated in ECM 1.6.2.E. Subsurface Ponds.

The requirements of subsections 1-Access, 2-Staging Area, 6-Gates (a only), and 10-Signage do not apply if the total required storage volume (includes both detention and water quality as applicable) of the SCM(s), associated with a permit application, is less than or equal to 5,000 cubic feet and the maximum ponding depth is less than or equal to three (3) feet.

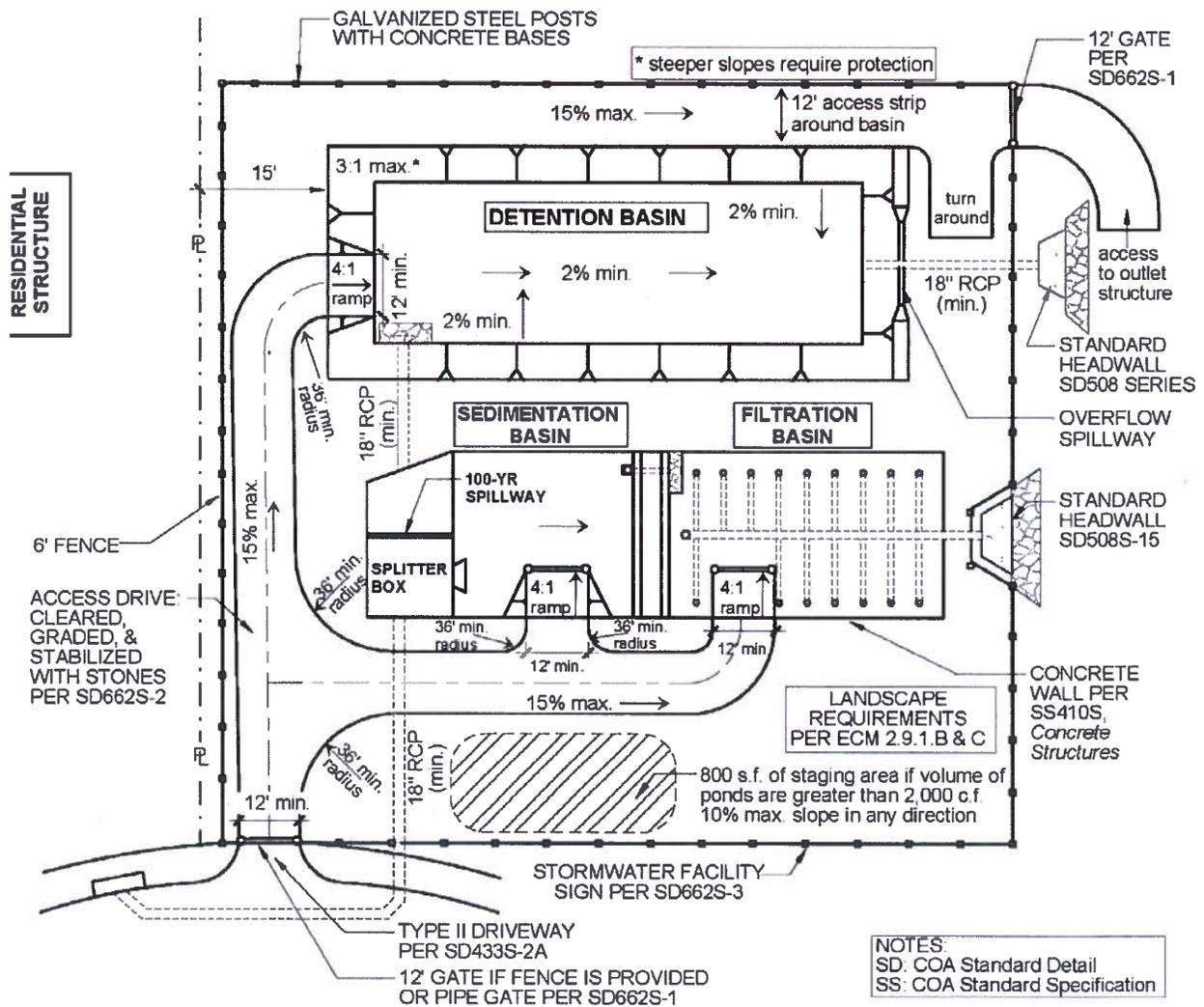
The requirements below are organized by the typical phase of permitting (preliminary plan, final plat, subdivision construction plan, and site plan) when these items will need to be addressed.

Preliminary Plan and Final Plat:	COA Maintained and Residential Development	Commercial Development
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1. Access Requirements for the following items:		
From ROW	X	
12 ft. perimeter	X	
To inlets and outlets	x	
Ramps into basins	X	X*
2. Staging area	X	
3. Drainage Easements	X	X*
4. Setbacks	X	X*
Subdivision Construction and Site Plan:		
5. Fencing	X	X
6. Gates	X	X
7. Outfalls	X	X
8. Slopes	X	X
9. Pilot Channels	X	X
10. Signage	X	X
11. Mechanical SCMs	X	
12. Landscaping	X	X

* Item may be addressed at site plan or subdivision construction plan stage.

Figure 1.2.4.E.1 Conceptual Layout (not to scale) - The layout of this figure is only conceptual, and code should be used as guidance for design.



1. **Access** - This section provides the minimum requirements for reasonable access into SCMs for maintenance and inspection activities for both residential and commercial developments.
 - a. Maintenance access drives and ramps shall be cleared, graded and stabilized with rock and comply with Standard Detail 662S-2 (Pond Maintenance Road Typical Cross Section).
 - b. For residential development, access from the right-of-way (ROW) to the SCM shall comply with Standard Detail 433S-2 (Type II Driveway) approach and curb cut on the abutting street.
 - c. Residential development shall provide a maintenance access drive around the perimeter of the SCM. The Director of the Watershed Protection Department may approve a maintenance access drive that does not follow the entire perimeter of the SCM if the applicant demonstrates that access is provided to all key components, including but not limited to basins, inlets, and outlets.
 - d. Maintenance access drives shall also be provided for facilities that will be maintained by the City when access is proposed between single family lots or when access from any other location exceeds a grade of twenty percent (20%).
 - e. Maintenance access drives shall meet the following requirements:
 - i. A minimum horizontal width of twelve (12) feet,
 - ii. A minimum vertical clearance of fourteen (14) feet from existing and proposed vegetation and all other objects,
 - iii. Be located outside the toe of any fill slope and the top of any cut slope, and
 - iv. An inside turning radius of no less than thirty-six (36) feet,
 - v. A means for equipment to turn around when located more than 200 feet from the public ROW,
 - vi. A maximum longitudinal slope of fifteen (15) percent,
 - vii. A maximum transverse slope of five (5) percent,
 - viii. A maximum vertical grade break of twelve percent (12%), and
 - ix. A maximum vertical curve grade change of one percent (1%) per horizontal foot.
 - f. Residential developments shall provide maintenance access ramps into each basin of the SCM. Commercial developments shall provide a maintenance access ramp into at least one basin of the SCM. Maintenance access ramps shall meet the following requirements:
 - i. Have a longitudinal slope no steeper than 4:1, and
 - ii. Have a clear distance of fifteen (15) feet from the bottom of the ramp to any interior slope.
2. **Staging Area** - A staging area is required in order to allow for storage of materials and equipment during inspection and maintenance operations.

The staging area must meet the following requirements:

 - a. Be at least 800 square feet in area with no dimension less than twenty (20) feet,
 - b. Be located within 100 feet of the SCM basin,
 - c. Be adjacent to the access drive and within an access or drainage easement,
 - d. No portion can be located within any ponding area, interior slope of the facility, or access drive,
 - e. Have a vertical clearance from existing and proposed vegetation and all other objects of no less than fourteen (14) feet, and

f. Have no finished slope greater than ten (10) percent.

3. Drainage Easements.

a. Drainage or drainage access easements are required per LDC 25-7-151 and 25-7-152.

b. Drainage or drainage access easements that are required along property lines shall be located adjacent to a property line and shall not be centered on a property line.

An easement or right-of-way as required in this Drainage Criteria Manual must be of sufficient width to provide continuous access for the operation, maintenance, or repair of a drainage facility or conveyance of stormwater.

(1) A minimum of 25 feet in width for an open drainage system; or

(2) A minimum of 15 feet in width See information below for an enclosed drainage system.

Minimum Easement Width (feet)												
Based on Depth of Invert of Pipe or Box Culvert (feet)												
Pipe Inside Diameter or Box Span (inches)	Depth of Invert of Pipe or Box Culvert (feet)											
	5	6	7	8	9	10	11	12	13	14	15	
18	20	20	20	20	25	25	30	30	30	35	35	
24	20	20	20	20	25	25	30	30	30	35	35	
30		20	20	25	25	25	30	30	35	35	35	
36		20	20	25	25	25	30	30	35	35	35	
42			20	25	25	30	30	30	35	35	40	
48			20	25	25	30	30	30	35	35	40	
54				25	30	30	35	35	35	35	40	
60				25	30	30	35	35	35	35	40	
66					30	30	35	35	35	40	40	
72					30	30	35	35	35	40	40	

Notes:

1. Minimum easement widths for depths or pipe sizes not shown in this table must be approved by the Director of the Watershed Protection Department.
2. If the enclosed drainage system is parallel to the right of way the easement width outside of the right of way may be reduced to the to one-half of the width listed in the Table if the drainage system is located in the right of way.
4. **Setbacks.**
 - a. For any new development, the SCM basin shall have a minimum fifteen (15) foot setback from any property line adjacent to a residential development. This requirement does not apply to rain gardens that use no concrete per LDC 25-2-1062.
 - b. The setback shall be measured from the outside edge of the SCM basin. If the basin is an earthen embankment the outside edge is measured from the toe of the slope on the outside (dry side) of the basin.
5. **Fencing** - This section applies to all residential and commercial development.
 - a. A six (6) foot high fence is required when:
 - i. A portion of the SCM basin has an interior slope or wall steeper than three (3) feet horizontal to one (1) foot vertical with a height exceeding one (1) foot, or
 - ii. An exterior slope or wall steeper than three (3) feet horizontal to one (1) foot vertical with a height exceeding three (3) feet above adjacent ground.
 - b. Fence Location:
 - i. Fencing is allowed on top of vertical walls to achieve the six (6) foot minimum requirement. The total combined height of the wall and fence must be a minimum of six (6) feet above the exterior finished grade, or
 - ii. If the fence is not placed on top of the vertical walls, the fence shall be located no less than twenty (20) feet past the toe of the embankment or to the edge of the property line.
 - c. Materials - Allowable fence materials include, but are not limited to, chain link, solid wood, masonry, stone or wrought iron.
 - i. Metal components of the fence shall be corrosion resistant and wood components of the fence shall be weather resistant.
 - ii. Any fence posts used shall be galvanized steel with a concrete footing of at least twelve (12) inches in diameter and at least eighteen (18) inches in depth (see Standard Specification No. 701).
 - d. Handrail option - SCMs with a total ponding depth less than or equal to three (3) feet and that require fencing per (a) above may provide a pedestrian handrail in lieu of the six (6) foot high fence. The design must meet the requirements in Standard Details 707S-1 or 707S-2 (Pedestrian Handrail).
6. **Gates.**
 - a. For residential development, a pipe gate is required at the end of the driveway at the ROW. The design must meet the requirements in Standard Detail 662S-1 (Pond Pipe Gate at Ramp Detail).
 - i. No pipe gate is required if an access gate for a fully fenced pond or SCM is located within twenty-five (25) feet of the ROW.
 - b. All fences shall have at least one gate, which shall open fully inward and outward and shall be at least twelve (12) feet in width.

- c. The first gate shall provide access to the SCM from either the easement or ROW. Access to the outfall structures is required for inspection and maintenance.
 - d. If the fencing prohibits access to the outfall structure, then a second gate shall be provided allowing access to the outfall structure.
7. **Outfalls** - Discharge from storm drain outfalls shall not cause channel, bluff, or stream bank erosion. If the storm drains discharge to an open channel system, creeks, channels, or ditches that convey stormwater (as determined by the City), the applicant shall show:
- a. Acceptable nonerosive conveyance from the SCM per section 5.8.0.
 - b. That the angle of intersection between the outfall flow path and the channel flow path is not greater than 45-degrees.
 - c. That storm drains that discharge into open channels conform to the design guidelines in Standards 508S-13 or 508S-16 through 508S-20, as appropriate for site specific conditions, and
 - d. Appropriately designed outfalls including adequate energy dissipation, which may include stream stabilization.
8. **Slopes.**
- a. All side slopes, earthen embankments, and pond bottoms, shall be compacted to ninety-five (95) percent of maximum density in accordance with established embankment construction requirements (Standard Specification 132S).
 - i. The bottom of the SCM is not required to meet the compaction requirements above if the design proposes a SCM that is fully reliant on infiltration to meet water quality standards.
 - b. Side slopes for earthen embankments shall not exceed three (3) horizontal to one (1) vertical.
 - c. Rock slopes may exceed these limits if a geotechnical report warrants a deviation. Actual field conditions may override the geotechnical report.
 - d. Detention ponds with earthen berms shall have a minimum bottom slope of two (2) percent.
 - e. Detention ponds with full concrete bottoms shall have a minimum slope of one-half (0.5) percent.
9. **Pilot Channels.**
- a. The pilot channel shall be at least four (4) feet wide and two (2) inches deep. Refer to DCM Section 6.4.1.C.
 - b. Pilot channels are not permitted in water quality SCMs due to short-circuiting and standing water problems.
10. **Signage** - Signs are required on each side of a residential or City-maintained stormwater control measure. The design must meet the requirements shown in Stormwater Facility Sign (Standard Detail 662S-3).
11. **Mechanical SCMs** - Mechanical SCMs include, but are not limited to, detention, rainwater harvesting, and retention irrigation SCMs that utilize pump systems to redistribute stormwater to meet a required discharge rate.
- a. All mechanical SCMs to be maintained by the City shall meet City of Austin Water and Wastewater criteria as stated in the Utilities Criteria Manual, Section 2.
 - b. OSHA confined space requirements must be met for any facility determined to be a confined space or that is subsurface. For subsurface SCMs, refer to ECM Section 1.6.2.E, Subsurface Ponds, for specific design standards.
12. **Landscaping.**

- a. The landscaping requirements of ECM Section 2.9.1 apply to SCMs for residential development or for such facilities that will be maintained by the City. This requirement may only be provided via screening types B or C.
- b. Landscaping and other vegetation shall not encroach into or impede use of any access drive or access strip. based upon the size of the landscaping or vegetation at maturity.

Source: Rule No. 161-15.11, 1-4-2016; Rule No. [R161-19.21](#), 11-25-2019; [161-19.22](#), 12-18-2019;.

1.2.5 - Computations

Computations to support all drainage designs shall be submitted to the appropriate City departments for review. The computations should be in such form as to allow for timely and consistent review and also to be made a part of the permanent City record for future reference. All computations submitted shall be certified by a professional engineer registered in the State of Texas.

1.2.6 - Floodplain Delineations

A. **City of Austin.**

1. For purposes of this Drainage Criteria Manual, a drainage area of 64 acres or greater is required within a contributing watershed to create a "floodplain". For areas of flow with less than 64 acres of contributing area, no floodplain shall be defined unless the City or FEMA currently indicates the area as a floodplain. In all cases where a floodplain delineation is required, its determination shall be based on the projected full development of all properties contributing to the point of consideration. It is the responsibility of the design engineer to determine, based on the most accurate information available, what the floodplain delineation is.
2. The design engineer may elect to utilize a floodplain delineation previously approved by the Director of the Watershed Protection Department, assuming the same is still applicable under present requirements and criteria. In so doing the engineer does not remove himself from the responsibility for the delineation's accuracy.

B. **Federal Emergency Management Agency.**

1. The Federal Emergency Management Agency (FEMA) maintains Flood Insurance Rate Maps (FIRM's) that depict floodplain boundaries. The floodplain boundaries depicted on FIRM's are based on existing conditions of development in the contributing area at the time the floodplain study that delineated the floodplain was completed.
2. FEMA reviews and approves or denies all revisions or amendments to FIRM's. FEMA revises or amends FIRM's by approval of a Letter of Map Change (LOMC). FEMA establishes the process and fees necessary for review of an application for a LOMC.
3. FEMA reviews the impact of proposed site developments and offers or denies conditional assurance that a FIRM may be changed by the proposed development. FEMA offers this assurance by a Conditional Letter of Map Change (CLOMC). The CLOMC is a conditional statement that the FIRM may be changed if (1) the development is constructed as proposed in the CLOMC application, and if (2) a complete LOMC is submitted after construction of the proposed development.
4. As the local floodplain administrator, the City must review and acknowledge certain LOMC or CLOMC requests. The City establishes the process necessary for review of an application for a LOMC or CLOMC.

C. **Coordination of City of Austin and FEMA Floodplain Delineations.**

1. The 100-year floodplain as determined in accordance with this Manual is a standard for dedication of drainage easements. This floodplain is theoretically equal to or greater than the 100-year floodplain depicted by FEMA on the FIRM. If the floodplain on the FIRM extends beyond a drainage easement required by the Land Development Code, or offered by the applicant, then the floodplain depicted on the FIRM must be changed by FEMA. This requirement assures that floodplain boundaries and associated regulations are coordinated between the City of Austin and FEMA. Floodplain mapping may be changed due to updated analysis of the floodplain under existing conditions, or due to land development activities that alter existing conditions.
2. If the floodplain depicted on the FIRM is required to be changed, pursuant to C.1. above, due to updated analysis of the floodplain under existing conditions, then the following requirements are applicable:
 - (a) Prior to approval of a preliminary plan, the applicant must provide to the City a letter of acknowledgement by FEMA of receipt of a complete application for a LOMC.
 - (b) Prior to approval of a final plat, the applicant must provide to the City evidence of approval by FEMA of the LOMC submitted under C.2.(a). If the final plat is approved before it is determined that a LOMC is necessary or desired, prior to release of a subdivision construction permit or site plan permit, the applicant must provide to the City a letter of acknowledgement by FEMA of receipt of a complete application for a LOMC.
 - (c) Prior to final acceptance of the construction of the subdivision or issuance of building permits for buildings that are within the floodplain at the time of application, the applicant must provide to the City evidence of final acceptance by FEMA of the LOMC submitted under C.2.(a) above.
3. If the floodplain depicted on the FIRM is required to be changed, pursuant to C.1. above, due to land development activities that alter existing conditions, then the following requirements are applicable:
 - (a) Prior to approval of a preliminary plan, the applicant must provide to the City either: evidence that the proposed land development activities do not increase the level of the FEMA floodplain; or a letter of acknowledgement by FEMA of receipt of a complete application for a CLOMC.
 - (b) Prior to approval of a final plat, the applicant must provide to the City either: evidence that the proposed land development activities do not increase the level of the FEMA floodplain; or evidence of approval by FEMA of the CLOMC.
 - (c) If the final plat is approved before it is determined that a CLOMC is necessary or desired, then prior to approval of a subdivision construction permit or site plan permit, the applicant must provide to the City either: evidence that the proposed land development activities do not increase the level of the FEMA floodplain; or a letter of acknowledgement by FEMA of receipt of a complete application for a CLOMC.
 - (d) Prior to final acceptance of the subdivision construction or site plan improvements or issuance of building permits for buildings that are within the portion of the FEMA floodplain affected by a required LOMC, the applicant must provide to the City evidence of final acceptance by FEMA of the CLOMC if required under C.3 above, and a letter of acknowledgement by FEMA of a complete application for a LOMC.
 - (e) Prior to issuance of a certificate of occupancy for buildings within the portion of the FEMA floodplain affected by a required LOMC, the applicant must provide to the City evidence of final acceptance by FEMA of the LOMC.
4. The applicant shall bear the cost of engineering services required to develop the application, respond to review comments, and obtain final approval of LOMCs and CLOMCs. The

applicant shall bear the cost of any fees associated with review and disposition of LOMCs and CLOMCS that are established by FEMA.

1.2.7 - City Ordinances

The ordinances empowering the drainage policies and criteria presented in this Manual are contained in Chapter 25-7 of the Code of the City of Austin as amended. Any revisions or changes to the policies, criteria or guidelines shall be posted in accordance with the notification procedures in the development code.

1.3.0 - DEFINITIONS

All terms and abbreviations used in the text are presented in the "Glossary" of this manual.

1.4.0 - DESIGNATION AND DELINEATION OF AUSTIN AREA WATERSHEDS

The Austin area is divided into drainage basins with outlets at the Colorado, Blanco and Brazos Rivers. These basins, in turn, are divided into drainage areas contributing to the main tributaries. Subareas are formed within the drainage areas by natural branches or by the construction of open or enclosed storm drains. Please refer to <http://www.austintexas.gov/page/austin-watersheds-list> for a list of the Austin area watersheds, tributaries, and their codes. Watershed boundary delineations are maintained by the City. Use of any other delineation must be approved by the City and reflected on official City GIS maps, as designated by the Director of the Watershed Protection Department, prior to use.

Section 2

Add CSV file with the frequency storm rainfall distributions as a link in Appendix B.

SECTION 8 - STORMWATER MANAGEMENT

8.1.0 - GENERAL

Stormwater Management (SWM) programs aimed at for the purpose of 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 Stormwater control measures (SCMs) such as detention ponds, open channels, and storm drains (for a full list refer to DCM 1.2.4), 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-SCM 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 D of this manual represents a storm runoff event without SWM-SCM, while the dashed line hydrograph depicts the same event with SWM-SCM. 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-SCM facility, the solid lined hydrograph is spread over a longer time period and its peak is reduced. The area between the two curves to the left of their intersection represents the volume of runoff, which is temporarily stored or detained in the SWM-SCM facility.

The City of Austin approaches the control of excess flows through the application of both on-site/off-site and regional SWM detention facilities. Essentially, the distinction between the two approaches is that on-site or off-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 public regional drainage improvements, using fees paid payments made by the owners of those developments. The RSMP is administered by the Watershed Protection Department. 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 may include regional detention ponds, channel modifications, improved conveyance structures, and voluntary floodplain buyouts. The RSMP is established in for all watersheds inside and outside of within the City of Austin's planning jurisdiction that are currently developing and have potential for flooding problems as undeveloped land is converted to impervious cover. In these watersheds, have, or are likely to have at some point in the future, capital projects for flood risk reduction. The RSMP allows developers to participate in the program in lieu of constructing on-site detention facilities if the proposed development will produce no additional adverse flooding impact to other nearby and downstream properties due to increased runoff. A list of participating watersheds is available on the Austin Watersheds List, available at www.austintexas.gov/page/austin-watersheds-list. Existing limitations for RSMP participation include: the lack of conveyance or flooding problems in the downstream conveyance system, such as existing buildings in and near flood prone areas; undersized storm drain systems and substandard roadway crossings in the public right-of-way; and flood-prone tributaries and creeks.

The fees charged payments for participation in the RSMP are non-refundable and are based upon the size of the development, the proposed land use and the development intensity maximum impervious cover. The fees payments are deposited in a dedicated fund and are allocated for the watershed in which each

development is located. For additional information on the RSMP, please refer to the RSMP link on the Watershed Protection Department Programs page on the City of Austin's website, www.austintexas.gov.

8.2.2 - Participation Guidelines

A. **General.** The following guidelines are provided for those developments that desire to participate in the RSMP. Participation is available in all watersheds that drain into or through the City of Austin full purpose jurisdiction. A list of participating watersheds is available on the Austin Watersheds List, at www.austintexas.gov/page/austin-watersheds-list. Participation may also be available within the City's Extra Territorial Jurisdiction with the concurrence of the stormwater management program of the relevant county or other entity.

Participation may be through payment, construction of off-site drainage improvements, or verification that a previous agreement covers the proposed development. Developers who choose to provide off-site SWM should refer to Section 8.3.0 for design criteria. Participation may be granted upon determination of the applicant's ability to satisfy the requirements below. It should be understood, however, that this policy cannot cover all situations and that final determination of eligibility shall be made by the Watershed Protection Department.

Reference should be made to Table 8-1 for a listing of the watersheds in which participation is available.

Table 8-1 lists the Austin-area watershed codes named after the primary watercourse of the watershed and indicates those watershed basins which are presently a part of the RSMP. However, this does not preclude a regional application in any watershed. Watershed boundary delineations are maintained by the City. Use of any other delineation must be approved by the City and reflected on official City GIS maps, as designated by the Director of the Watershed Protection Department, prior to use.

To determine the exact service area boundaries and regional pond locations the engineer should contact the Watershed Protection Department. Developers who choose to provide on-site SWM should refer to Section 8.3.0 for design criteria. Participation may be granted upon determination of the applicant's ability to satisfy the requirements set forth below. It should be understood however, that this policy cannot cover all situations and that final judgment of eligibility shall be made by the Watershed Protection Department.

Table 8-1 Watersheds Eligible for RSMP Participation		
Code	Watershed Name	Discharges Into
BAR	Barton Creek	Lady Bird Lake
BER	Bear Creek	Onion Creek
BUL	Bull Creek	Lake Austin
CAR	Carson Creek	Colorado River
CTM	Cottonmouth Creek	Onion Creek

CCE	Country Club East	Colorado River
CCW	Country Club West	Colorado River
DKR	Decker Creek	Gilleland Creek
DRE	Dry Creek East	Colorado River
EBO	East Bouldin Creek	Lady Bird Lake
ELM	Elm Creek	Colorado River/Gilleland Creek
HRS	Harris Branch	Gilleland Creek
LKC	Lake Creek	Brushy Creek
LWA	Little Walnut Creek	Walnut Creek
LBR	Little Bear Creek	Bear Creek
NFD	North Fork Dry Creek	Dry Creek (East)
ONI	Onion Creek	Colorado River
RAT	Rattan Creek	Lake Creek
RIN	Rinard Creek	Onion Creek
SHL	Shoal Creek	Lady Bird Lake
SLA	Slaughter Creek	Onion Creek
SBG	South Boggy Creek	Onion Creek
SFD	South Fork Dry Creek	Dry Creek (East)
WLN	Walnut Creek	Colorado River
WBL	West Bull Creek	Bull Creek

WMS	Williamson-Creek	Onion-Creek
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B. Order of Preference for Participation. The goal of the RSMP is to provide control of increased runoff due to development both in the watershed as a whole and in the immediate vicinity of the proposed development. Options that achieve such local benefits are generally preferred. As such, preference for RSMP participation is as follows:

1. Improvement of a portion of the downstream drainage system or of SCMs in the immediate vicinity of the project;
2. Off-site detention;
3. Dedication of easements or donation of land for regional improvements; or
4. Payment in lieu of detention.

B. C. Participation requirements.

It is required that eEach RSMP applicant shall submit a completed feasibility determination request form and attend a required feasibility meeting. Each RSMP applicant shall submit a complete participation application form and engineering submittal to the Watershed Protection Department at the time of preliminary plan submittal or site plan submittal. To view the request form and a check list information about for the engineering submittal, please refer to the RSMP program link in the Watershed Protection Programs page of the City of Austin's website at www.austintexas.gov-.

In order to participate in the program, the applicant must satisfy all of the following conditions:

1. The intervening drainage system from the site to the tributary or main branch of the downstream mapped floodplain must have the capacity to provide for the fully developed 100-year storm from the entire drainage area (refer to Section 1.2.2 for capacity requirements). If the downstream systems are undersized or downstream flooding conditions exist, RSMP participation may be approved if it can be verified there will be no additional adverse flooding impact to downstream properties for storm events up to and including the 100-year storm.
2. The submitted engineering analysis must include a certified statement by a licensed engineer in the State of Texas that no additional adverse flooding impacts to other property will occur as a result of the proposed improvements.
3. An easement for unconditional conveyance of the fully-developed 100-year flood event from the site to the main branch or tributary of the watershed must be either in place, or acquired before participation is allowed.

C. D. Special Conditions. In addition to the specific criteria given above the engineer should note the following conditions which could arise:

1. Should a regional detention facility or the intervening public drainage system be committed to its maximum capacity, an applicant may (at the City's discretion), increase the capacity of the regional facility or drainage system through approved modifications. The funding of any such modifications will be the responsibility of the applicant, and may take the place of the required participation fee payment:
 - a. if the improvements provide a public benefit; and
 - b. if the cost of the improvements are is equal to or greater than the required fee payment; or

if the cost of the improvements is less than the required payment, the cost of the improvements will be credited towards the total payment amount and the difference will be paid;

and

~~b. the improvements provide a public benefit.~~

2. If the subject tract desires to participate but intends to develop prior to construction of the regional facility or conveyance improvements, provisions must be made by the applicant for temporary on-site detention.
3. Existing on-site ponds may be removed if the development is approved as a participant in the RSMP and the Watershed Protection Department reviews and approves such removal.

D. E. Participation Fees Payments. Payment calculations are finalized at the time of RSMP application approval and issuance of formal agreement for owner signature. RSMP application reviews are completed during the site plan or subdivision review process and will not be approved out of cycle. Participation fees will be calculated at the time of SWM concept plan submittal. To view the fee payment schedule and the present fees payment amounts for participation, please refer to the RSMP link on the Watershed Protection Department Programs page on the City of Austin's website, www.austintexas.gov. Any increase will be posted at least 30 days prior to enactment. The participation fees payments shall apply to all areas be based on the total site area of the development, except less any dedicated greenbelts, undeveloped common areas, permanent retention facilities, and other areas undevelopable in accordance with under applicable City of Austin Ordinances code. These areas may be deducted from the total site area to reduce the land cost area in the payment calculation.

~~Participation fees will be used by the City to fund the design and construction of regional drainage facilities for the management of stormwater peak rates of runoff.~~

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

1. Single Family and Duplex Subdivisions.
 - a. For single-family subdivisions which do that require the construction of streets or drainage facilities, a letter of credit must be posted with the Watershed Protection Review Department in an amount equal to the total participation fee payment prior to final plat approval. This letter of credit must be replaced by cash prior to construction plan approval.
 - b. For single-family subdivisions which that do not require the construction of streets, payment must be made prior to final plat approval.
 - c. For single-family subdivisions the payment amount shall be based on the maximum allowable impervious cover (by zoning or watershed ordinance, whichever is more restrictive) unless the developer records a restrictive covenant and includes a plat note to limit the allowable impervious cover. The plat note must reference the restrictive covenant and the maximum allowable impervious cover per the restrictive covenant.
2. Commercial and Multi-Family Site Development. For commercial and multi-family site development (including triplexes, fourplexes, apartments and condominiums), payment must be made prior to issuance of a development permit.
3. Multi-Family, Commercial and Industrial Subdivisions. For multi-family, commercial and industrial subdivisions, payment for the rights-of-way 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 amount by the individual lot developer prior to their development permit approval.

Upon payment, ~~of fees the~~ the participation agreement, available via the RSMP link on the Watershed Protection Department Programs page on the City of Austin's website, www.austintexas.gov, shall be signed and act as a binding agreement between the developer and the City.

8.2.3 - Watershed Floodplain Models

The City of Austin maintains hydrologic and hydraulic floodplain management models for most of the watersheds within the City of Austin's Full Purpose, Limited Purpose and Extra Territorial Jurisdictions. Where applicable, these City of Austin regulatory models should be used as base models for the impact analyses and drainage design associated with development. Users of these models should be aware that the floodplain models provided have been developed on a watershed-wide basis and may therefore not be applicable without modification on a site-by-site basis. A licensed engineer in the State of Texas must certify any results based on these models or modified versions thereof that are submitted to the City as part of the land development review and permit approval process. The City also maintains copies of the FEMA regulatory models. However, since the City has obtained these models directly through the consultants who developed them, there may be changes which have been approved by FEMA that are not incorporated into the models that the City has on file. Only FEMA can provide the official regulatory models used for flood insurance purposes. All models maintained by the City may be obtained, free of charge, through the FloodPro application at the following location: www.austintexas.gov/floodpro. Model requests, comments, concerns and questions also may be sent to the City's Floodplain Office via email at FloodPro@austintexas.gov.

8.3.0 - STORMWATER MANAGEMENT PONDS

8.3.1 - General

Stormwater Management (SWM) ponds may be of two basic types: On-site/off-site and regional. In general, on-site or off-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) stormwater control measures (SCMs) as defined in the Environmental Criteria Manual. The performance and safety criteria in this section apply to all ponds ~~which~~ that provide management of peak rates of stormwater runoff regardless of type.

8.3.2 - Performance Criteria for SWM Ponds

- A. Detention ponds shall be designed to reduce post-development peak rates of discharge to existing pre-development peak rates of discharge for ~~the 2-, the 2-,~~ 10-, 25- and 100-year storm events at each point of discharge from the project or development site. For the post-development hydrologic design of the SWM pond, any off-site areas ~~which~~ that drain to the pond shall be assumed to remain in the existing condition. If off-site flows are conveyed through the SWM pond, the SWM pond outlet structure must be designed to safely pass 100-year fully developed off-site flows in accordance with the Safety Criteria set forth in Section 8.3.3.
- B. For design purposes, any pond with a drainage area larger than 64 acres shall be classified as a regional pond. Performance criteria for regional ponds shall be reviewed and approved by the Watershed Protection Department on a project-by-project basis. The determination shall be based on a preliminary engineering study prepared by a licensed engineer in the State of Texas.
- C. Maximum retention or "draw-down" time for flood detention ponds shall not exceed 24 hours from the time of peak storage to the time of complete emptying of the pond, as determined by hydrograph routing or other calculations acceptable to the City. This requirement does not apply to facilities in which retention or "draw-down" time is required to be greater than 24 hours. Only

However, only the portion of the volume within a water quality control available after 24 hours of drawdown time may be used or credited towards detention requirements.

8.3.3 - Safety Criteria ~~f~~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, outfall, embankment, and appurtenant structures shall be designed to safely pass the design storm hydrograph with the freeboard shown in the table below. All contributing on-site drainage areas, and off-site areas which are routed through the SWM pond, shall be assumed to be fully developed in order to properly size the spillway, outfall, embankment and appurtenant structures. Any orifice with a dimension smaller than or equal to 12 inches shall be assumed to be fully ~~developed~~ **blocked** in order to properly size the spillway, outfall, embankment and appurtenant structures. 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.

DETENTION POND CLASS	DESIGN STORM EVENT	FREEBOARD ON TOP OF ENBANKMENT, FT
On-site/Off-site		
Small (DA < 25 ac)	100-year	0
Large (25 ≤ DA ≤ 64 ac)	100-year	1.0
Regional DA ≥ 64 ac	100-year	2.0

- B. Any hydraulic structure designed to impound storm water that has a height greater than or equal to six (6) feet at any point along the perimeter of the SWM pond is a dam and must be designed to safely pass the minimum design flood hydrograph expressed as a percentage of the probable maximum flood (PMF) as described in DCM 8.3.3.B.3 and as evidenced by certification using the statement provided in DCM 8.3.3.B.3 by an engineer licensed in the State of Texas. The certification statement may be divided into the four disciplines of hydrology, hydraulics, structural and geotechnical and independently certified.
1. The height of the hydraulic structure (dam) is measured from the top of the structure to the downstream intersection of the structure and the natural or excavated ground, whichever is lower.
 2. The PMF is computed by using the probable maximum precipitation (PMP) values as described in Section 2-6 of the Drainage Criteria Manual.
 3. A dam as defined in DCM 8.3.3.B must be designed to pass the minimum design flood hydrograph which is the greater of:
 - a. 75 percent of the PMF.
 - b. The percentage of the PMF as defined in Texas Administrative Code Chapter 299 Dams and Reservoirs. (Figure: 30 TAC § 299.15(a)(1)(A))
 4. Dam Safety Certification Statement:

I [name of professional engineer] Texas license number [number] certify that the design of the dam in this set of plans can safely pass the minimum design flood hydrograph as required by the City of Austin and the State of Texas based on the hydrologic, hydraulic, structural and geotechnical analysis using standard accepted engineering practices.

5. SWM ponds that are considered dams as defined in this section of the Drainage Criteria Manual may not be designed or constructed with any trees or other woody vegetation on the dam structure or within 20-feet of the upstream or downstream toe of the dam. This 20-foot clear zone must be called out on the site plan and for City maintained facilities must be part of the drainage easement dedicated for the dam facility. The toe of the dam is the junction of the constructed dam structure with the natural ground.
 6. SWM ponds that are considered dams as defined in this section of the Drainage Criteria Manual may not have permanent irrigation systems installed on the dam.
 7. SWM ponds that are considered dams as defined in this section of the Drainage Criteria Manual must be vegetated with grasses that do not exceed 12-inches in height and can be mowed as frequently as weekly. Examples include Bermuda grass and buffalo grass.
 8. SWM ponds that are considered dams as defined in this section of the Drainage Criteria Manual shall provide a fixed vertical marker on or near the emergency spillway indicating the water surface elevation relative to the top of the main embankment. The markings should be in half foot increments, viewable from the furthest point of access, and must be retroreflective as defined by the Texas Manual on Uniform Traffic Control Devices (TMUTCD).
- C. All SWM ponds shall be designed using a hydrograph routing methodology. The appropriate City of Austin rainfall distribution 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.
0-6	4
6-10	6
10-15	8
15-20	10
20-25	12
25-35	15

- 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 5% of the total fill height. All earthen embankments shall be compacted to 95% of maximum density in accordance with COA standard specifications.

- F. Earthen embankment side slopes shall be no steeper than 3 horizontal to 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. A 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 becomes the inflow of another), a licensed engineer in the State of Texas 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. 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).
- J. All pipes discharging into a public storm drain system shall have a minimum diameter of 18 inches and shall be constructed of reinforced concrete. In all cases, ease of maintenance and/or repair must be assured.
- K. 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.

Source: Rule No. [161-19.01](#), 3-14-19.

8.3.4 - 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 60% 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 D of this manual)

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

Where

Q = Weir discharge, cubic feet per second

C = Weir Coefficient

L = horizontal length, feet

H = Head on weir, feet

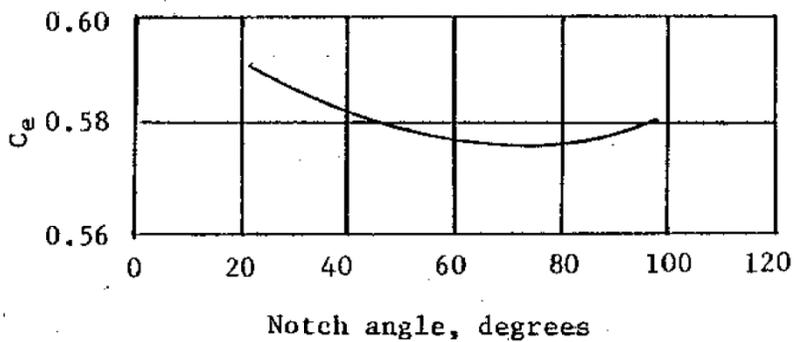
- B. **V - notch Weir Flow Equation** (See Figure 8-2 in Appendix D of this manual)

$$Q = 4.28 C_e \tan (\Theta/2)H^{2.5} \text{ (Eq. 8-2)}$$

Where

Q = Weir Discharge, cubic feet per second

C_e = Weir Coefficient, $25^\circ < \Theta < 100^\circ$



Weir Coefficient for V-notch weir Equation 8-2

Θ = Angle of the weir notch at the apex (degrees)

H = Head on Weir, feet

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

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

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/sec²

H = Head on orifice measured from centerline, feet

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

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

Source: Rule No. [161-19.01](#), 3-14-19.

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 (TR-20) and the Hydrologic Engineering Center (HEC) hydrologic methods (HEC-HMS) may be used. The engineer may use other methods but must have their acceptability approved by the Director.

8.5.0 - DETENTION BASIN MAINTENANCE AND EQUIPMENT ACCESS REQUIREMENTS

Refer to Section 1.2.4. for subsurface ponds see Environmental Criteria Manual Section 1.6.2(E).

Source: Rule No. 161-15.11, 1-4-2016.