RULE NO.: R161-23.17

NOTICE OF PROPOSED RULE **POSTING DATE: July 6, 2023**

The Director of the Watershed Protection Department proposes to adopt the following rule after August 8, 2023.

Comments on the proposed rule are requested from the public. Comments should be submitted to Kelly Strickler, at kelly.strickler@austintexas.gov or (512) 974-1845. To be considered, comments must be submitted before August 7, 2023 the 32nd day after the date this notice is posted. A summary of the written comments received will be included in the notice of rule adoption that must be posted for the rule to become effective.

An affordability impact statement regarding the proposed rule has been obtained and is available by contacting Kelly Strickler at kelly.strickler@austintexas.gov or (512) 974-1845.

EFFECTIVE DATE OF PROPOSED RULE

A rule proposed in this notice may not become effective before the effective date established by a separate notice of rule adoption. A notice of rule adoption may not be posted before August 7, 2023 (the 32nd day after the date of this notice) or not after September 14, 2023 (the 70th day after the date of this notice).

If a proposed rule is not adopted on or before September 14, 2023, it is automatically withdrawn and cannot be adopted without first posting a new notice of a proposed rule.

BRIEF EXPLANATION OF PROPOSED RULE

Environmental Criteria Manual

- 1.5.0 - Stream Buffers Updates to align criteria with recent Council-initiated code updates to support public mobility projects
- 1.6.2.E - Subsurface Ponds Reorganizing language to clarify inspection, reporting, and maintenance requirements for subsurface ponds. Clarifying that all subsurface ponds are subject to subsurface criteria, not just water quality ponds. Providing additional information on where to submit required reports.
- 1.6.4 - Structural Control Standard and Criteria for Fee-in Lieu of Structural Controls in Urban Watersheds Updates to align criteria with recent Council-initiated code updates to support public mobility projects
- 1.6.7 - Green Storm Water Quality Infrastructure Inspection staff have identified gravity retention/irrigation systems that are undersized and creating runoff, creating non-compliance with code. The proposed changes fix the sizing issue for gravity retention/irrigation systems.

- 1.6.9 - Guidance for Compliance with Technical Requirements of Chapter 25-8, Subchapter A, Article 13 (Save Our Springs Initiative) Inspection staff have identified gravity retention/irrigation systems that are undersized and creating runoff, creating non-compliance with code. The proposed changes fix the sizing issue for gravity retention/irrigation systems in the Barton Springs Zone.
- 1.8.0 - Impervious Cover Calculation Criteria Updates to align criteria with recent Council-initiated code updates to support public mobility projects
- 1.9.0 - Need for Water Quality Controls Updates to align criteria with recent Council-initiated code updates to support public mobility projects

A copy of the complete text of the proposed rule is available for public inspection and copying at the following locations. Copies may be purchased at the locations at a cost of ten cents per page:

Watershed Protection Department, located at 505 Barton Springs Road, 12th Floor, and

Office of the City Clerk, City Hall, located at 301 West 2nd Street, Austin, Texas.

AUTHORITY FOR ADOPTION OF PROPOSED RULE

The authority and procedure for adoption of a rule to assist in the implementation, administration, or enforcement of a provision of the City Code is provided in Chapter 1-2 of the City Code. The authority to regulate water quality is established in Chapter 25-8 of the City Code.

CERTIFICATION BY CITY ATTORNEY

By signing this Notice of Proposed Rule (R161-23.17), the City Attorney certifies 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

JLMorales ____________________ Date: 06/28/2023
Jorge Morales, Director
Watershed Protection Department

Anne L. Morgan ____________________ Date: 6/28/23
Anne L. Morgan
City Attorney

SECTION 1
WATER QUALITY MANAGEMENT

1.5.0 STREAM BUFFERS

1.5.3 Development Allowed in the Critical Water Quality Zone

In all watersheds, development is prohibited in the Critical Water Quality Zone except as provided by Sections 25-8-261 (Critical Water Quality Zone Development) and 25-8-262 (Critical Water Quality Zone ~~Street~~ Mobility Crossings) of the Land Development Code. The uses allowed in the Critical Water Quality Zone are described in more detail below. Any development allowed within the Critical Water Quality Zone shall be revegetated and restored within the limits of construction in accordance with the vegetative stabilization requirements of 1.4.0 (Erosion and Sedimentation Control Criteria) and Standard Specification 609S (Native Grassland Seeding and Planting for Erosion Control).

J. **~~Street~~ Mobility Crossings**

In all watersheds, multi-use trails may cross a Critical Water Quality Zone of any waterway. In an urban watershed, an arterial, collector, or residential street, or rail line may cross a Critical Water Quality Zone of any waterway. In a watershed other than urban, the following restrictions apply ~~to street crossings~~:

- a major waterway may be crossed by an arterial street or rail line identified in the Transportation Plan.
- an intermediate waterway may be crossed by an arterial or collector street or rail line, except:
  - a collector street crossing must be at least 2,500 feet from a collector or arterial street crossing on the same waterway; or
  - in a water supply suburban or water supply rural watershed, or the Barton Springs Zone, a collector street crossing must be at least one mile from a collector or arterial street crossing on the same waterway.
- a minor waterway may be crossed by an arterial and collector ~~streets~~, and rail line except:
  - a collector street crossing must be at least 900 feet from a collector or arterial street crossing on the same waterway; or
  - in a water supply suburban or water supply rural watershed, or the Barton Springs Zone, a collector street crossing must be at least 2,000 feet from a collector or arterial street crossing on the same waterway.
- a minor waterway may be crossed by a residential or commercial street if necessary to provide access to property that cannot otherwise be safely accessed.

Notwithstanding the restrictions above, a street or driveway may cross the Critical Water Quality Zone if the street or driveway is located in a designated center or corridor on the Imagine Austin growth concept map and if the proposed crossing is:

- located outside of the Barton Springs Zone;

- necessary to facilitate development or redevelopment of a designated center or corridor as recommended in the Imagine Austin Comprehensive Plan; and
- maintains the quality and quantity of recharge if located in a center or corridor designated as a sensitive environmental area in the Edwards Aquifer recharge zone or contributing zone, as determined by the director of the Watershed Protection Department.

Designated Imagine Austin centers or corridors must have an adopted boundary to qualify for this provision.

Source: Rule No. R161-14.22, 9-2-2014 ; Rule No. R161-18.05 , 6-12-2018.

1.5.4 Development Allowed in the Water Quality Transition Zone

The Water Quality Transition Zone only applies to water supply rural watersheds, water supply suburban watersheds, and in the Barton Springs Zone, excluding the shorelines of Lake Austin, Lake Travis, and Lady Bird Lake.

Over the South Edwards Recharge Zone, development is prohibited in a Water Quality Transition Zone, except for:

1. development described in Article 7, Division 1 (Critical Water Quality Zone Restrictions) of the Land Development Code and further detailed in Section 1.5.3 above; and
2. minor drainage facilities or water quality controls that comply with Section 25-8-364 (Floodplain Modification) and the floodplain modification guidelines of this manual.

Note: Minor drainage facilities include drainage appurtenances necessary for conveyance and outfall. Minor water quality facilities are relatively low-impact, green controls and include vegetative filter strips, rain gardens, and areas used for irrigation or infiltration of stormwater.

Outside of the South Edwards recharge zone, the following development is allowed in a Water Quality Transition Zone:

Water Supply Suburban

1. impervious cover equal to 18 percent of the land area within the Water Quality Transition Zone, excluding land in the 100 year floodplain, except that limits on impervious cover do not apply to a public mobility project in the right-of-way as defined by LDC 25-1-21(89) that are allowed to cross a critical water quality zone under Section 25-8-262; and
2. water quality controls.

Water Supply Rural

1. development described in Article 7, Division 1 (Critical Water Quality Zone Restrictions) of the Land Development Code and further detailed in Section 1.5.3 above;
2. streets or public mobility projects in the right-of-way;
3. minor drainage facilities or water quality controls that comply with Section 25-8-364 (Floodplain Modification) and the floodplain modification guidelines of this manual; and
4. duplex or single-family residential development with a minimum lot size of two acres and a density of not more than one unit for each three acres, excluding acreage in the 100 year floodplain.

Note: A lot that lies within a Critical Water Quality Zone must also include at least two acres in a water quality transition zone or uplands zone. Minor drainage facilities include drainage appurtenances necessary for conveyance and outfall. Minor water quality facilities are relatively low-impact, green controls such as vegetative filter strips, rain gardens, and areas used for irrigation or infiltration of stormwater.

Barton Springs Zone

1. development described in Article 7, Division 1 (Critical Water Quality Zone Restrictions) of the Land Development Code and further detailed in Section 1.5.3 above;
2. streets;
3. minor drainage facilities or water quality controls that comply with Section 25-8-364 (Floodplain Modification) and the floodplain modification guidelines of this manual; and
4. duplex or single-family residential development with a minimum lot size of two acres and a density of not more than one unit for each three acres, excluding acreage in the 100 year floodplain.

Note: Minor drainage facilities include drainage appurtenances necessary for conveyance and outfall. Minor water quality facilities are relatively low-impact, green controls and include vegetative filter strips, rain gardens, and areas used for irrigation or infiltration of stormwater.

Source: Rule No. R161-14.07, 3-5-2014 ; Rule No. R161-14.22, 9-2-2014 .

1.6.2 - General Design Guidelines

1.6.2.E Subsurface Ponds

E. Subsurface Stormwater Control Measures (SCM). Based upon field observations, subsurface ~~ponds~~ SCMs can be difficult to inspect and maintain due to accessibility and constructability restraints. This section describes the minimum design and submittal requirements for subsurface ~~ponds~~ SCMs.

1. The Engineer of Record shall prepare and submit a Subsurface Pond Maintenance Plan (SPMP) ~~plan~~ for the proposed development to be reviewed as part of the Site Development Permit. This document shall be signed and sealed by a Texas-Licensed Professional Engineer.
2. An SPMP ~~plan~~ must contain the following minimum components:

- **Access.** Adequate access including at least one temporary staging area for each subsurface pond must be provided for inspection and maintenance purposes. Minimum one access hatch per basin. Access hatch shall be designed and built for use in traffic bearing off-street and sidewalk applications and certified by a structural engineer. See Figure 1.6.2.E for minimum design standards for access points and sizing.

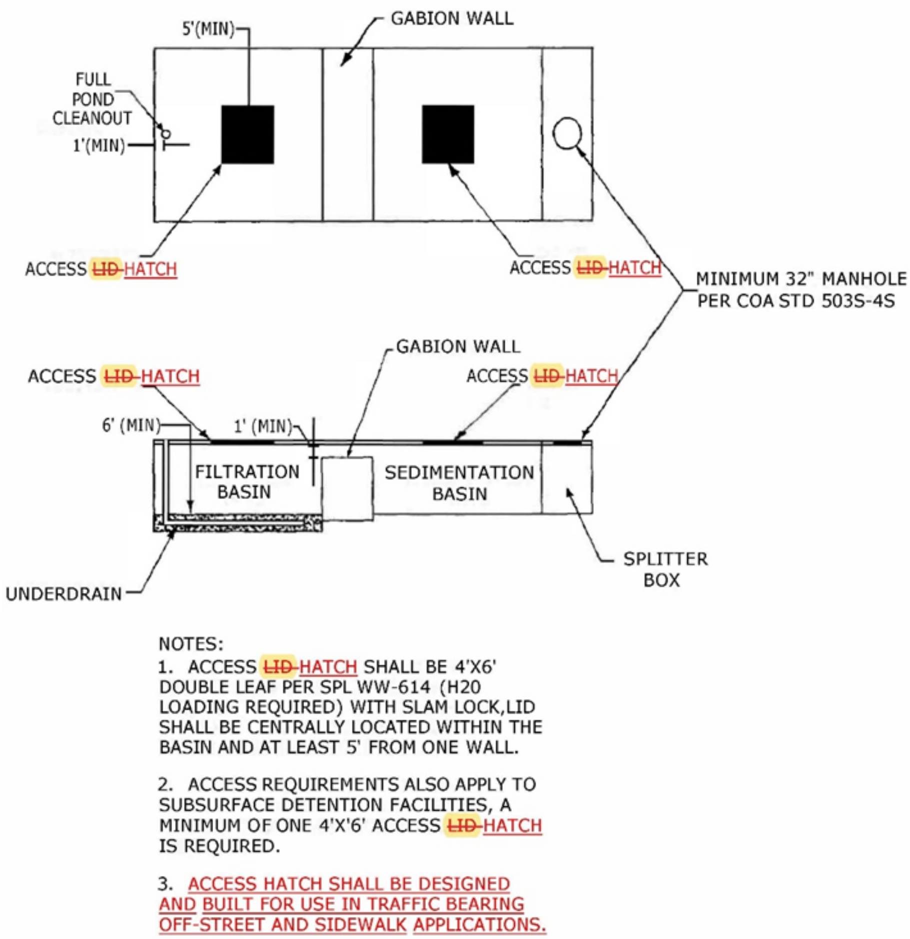


Figure 1.6.2.E Subsurface SCM Minimum Design Standards

- **Inspections**. ~~Underground water quality facilities~~ Subsurface stormwater control measures (SCM), as defined by DCM 1.2.4.E, must be inspected at least once ~~every six months and at least once~~ annually by the owner, preferably during, or immediately following, a significant rainfall event to evaluate ~~facility operation~~ SCM operation. A significant rainfall event for water quality SCMs will be rainfall equal to or greater than the designed capture depth (water quality volume). Subsurface detention SCMs must be inspected after a rainfall event. ~~During each inspection, erosion areas inside and downstream of the underground water quality facility must be identified and repaired immediately. With each inspection, any damage to the structural elements of the system (pipes, concrete drainage structures, retaining walls, etc.) must be identified and repaired immediately. Cracks, voids and undermining should be patched/filled to prevent additional structural damage.~~ Any structural damage or need for maintenance identified during an inspection should be addressed immediately.

- **Reporting.** At least once annually, a ~~pond~~ SCM drawdown report for each subsurface ~~pond~~ water quality SCM shall be completed in conjunction with a significant rainfall event as described in the previous section. ~~equal to or greater than the design capture depth of the subsurface facility or a test of the pond after being filled by a secondary water source.~~ The drawdown report shall verify the SCMs basins ~~indicate the date and time the pond(s) were observed full and the date and time the ponds were observed to be empty verifying that the sedimentation and filtration chambers both~~ drawdown in the time frames as required by the ECM. At least one inspection shall be done annually by a 3rd party ~~inspector~~ and an annual ~~3rd party~~ inspection report shall be submitted to the Watershed Protection Department (WPD) Pond Inspection and Dam Safety (PIDS) section for review. ~~WPD shall be notified at least seven days prior to the annual 3rd party inspection to allow for the opportunity for observation.~~ The annual 3rd party inspection report shall be sealed by a Texas-licensed Professional Engineer~~, shall~~ and include photographs of the ~~sedimentation and filtration chambers~~ SCM basins. ~~and the drawdown verification report~~. For subsurface detention SCMs, an annual engineer's concurrence is required stating that the SCM is functioning as designed. The WPD PIDS section will be notified at least seven days prior to the annual 3rd party inspection to allow for the opportunity for observation.

- **Major Maintenance Requirements.**

a. **Sediment Removal.** Remove sediment from the inlet structure and sedimentation ~~chamber~~ basin when sediment buildup reaches a depth of 6 inches or when the proper functioning of inlet and outlet structures is impaired. Sediment should be cleared from the inlet structure at least every year and from the sedimentation basin at least every 5 years.

b. **Media Replacement**. Maintenance of the filter media is necessary when the drawdown time exceeds 96 hours, provided all other components of the subsurface SCM ~~pond~~ are functioning correctly. When this occurs, the upper layer of sand should be removed and replaced with new material meeting the original specifications. If dewatering of the system is necessary due to lack of functionality, ensure dewatering is properly conducted.

c. **Debris and Litter Removal**. Debris and litter should be removed regularly. Particular attention should be paid to floating debris that can eventually clog the control device or riser.

d. **Filter Underdrain**. Clean the underdrain piping network to remove any sediment buildup as needed to maintain design drawdown time.

e. **Responsibility**. The responsibility of the inspection and maintenance of all subsurface SCMs ~~ponds~~ shall be the responsibility of the ~~operator~~ owner of the facilities.

The requirements discussed above should be considered minimum requirements for a SPMP ~~plan~~. In developing a SPMP ~~plan~~, during the design of the subsurface SCM, the engineer should consider the plan to be site-specific, and therefore add any additional requirements to ensure the ~~pond~~ subsurface SCM has adequate access and can be inspected. During the course of inspections and field observations, adjustments to the SPMP may be required. ~~The plan may be amended with the submission of additional or amended parts of the plan and approval by the Director of WPD or Planning and Development Review Department (PDRD).~~

3. For commercial and multi-family developments, a restrictive covenant and site plan notes will establish the requirements for the implementation and on-going maintenance of the SPMP ~~plan~~. The restrictive covenant must be in a form approved by the City Law Department.

Source: Rule No. R161-14.26, 12-30-2014.

1.6.4 Structural Control Standard and Criteria for ~~Fee-in Lieu of Structural Controls in Urban Watersheds~~ Optional Payment instead of Structural Controls

A. **Introduction.** Sedimentation/filtration is the primary structural water quality control to reduce non-point source pollution in Urban, Suburban, Water Supply Suburban and Water Supply Rural Watersheds. In the Barton Springs Zone, non-degradation water quality controls are required (Please refer to Section 1.6.9 for design criteria for non-degradation controls). Innovative controls may be acceptable pursuant to § 25-8-151 of the Land Development Code (Innovative Management Practices). However, these systems must be approved by the Director of the Watershed Protection and Development Review Department (WPDR). The guidelines for several alternative controls are described in section 1.6.7.

B. **Criteria for Acceptance of Fee Payment Instead ~~-in-Lieu~~ of Structural Controls.** ~~Urban Rule for Water Quality Controls.~~ The City recognizes that incorporating structural water quality control facilities into some urban watershed land development projects can be difficult. In response to these challenges, Section 25-8-214(C) of the Land Development Code requires the Director to review and accept or deny projects to pay into the Urban Watersheds Structural Control Fund instead ~~lieu~~ of on-site controls. The funds received under this program have and will be used to study, design, implement, and construct Urban water quality improvement projects. This program is only for development within an urban watershed, as defined by Section 25-8-2 of the Land Development Code.

For public mobility projects only: The optional payment instead of structural controls also applies to watersheds outside of Urban as allowed in LDC Section 25-8-214(F). These include Suburban and Water Supply Suburban and Water Supply Rural. LDC 25-8-214 (F) requires the Director to review, accept, or deny projects to pay into the Suburban and Water Supply Structural Control Fund using the Appendix U request form. The funds received under this program are intended to be used to study, design, implement, and construct water quality improvement projects in watersheds outside of the Barton Springs Zone that have been impacted by public mobility projects.

1. Urban Watersheds Optional Payment Instead of Structural Control Fund Acceptance Guidelines

    a. Categories for Participation

    Type I - The City will strongly consider allowing ~~urban~~ qualifying developments that are classified as Type I to participate in the fee instead of ~~-in-lieu~~ program. Type I development features include, but are not limited to one or more of the following:

    - Commercial development sites of 1 acre or less
    - Single family development of subdivisions 2 acres or less
    - Development with run-off that sheet flows over pervious cover, prior to being concentrated
    - Development that is likely to be treated by an existing or future regional water quality facility

    Type II - The following Type II developments will in most cases be required to satisfy the water quality requirements through the use of on-site water quality controls. Type II development features include, but are not limited to one or more of the following:

    - No or minimal existing impervious cover
    - Substantial redevelopment

- Adjacent to an open channel stream
- Within 500 feet of Town Lake

b. Special Conditions. In addition to the specific criteria given above, the applicant should note the following conditions which could arise:

- Should a regional facility be committed to its maximum capacity, an applicant may (at the City's discretion) increase the capacity through approved modifications. The funding of any such modifications will be the responsibility of the applicant, and shall be credited towards any fees that are required.
- Existing on-site water quality facilities may be removed if the development is approved to participate in the fee instead of ~~-in-lieu~~ program and the WP~~DR~~D approves such removal.

c. Participation Payment ~~Fees~~. Participation payments ~~fees~~ are calculated by the applicant at the time of project submittal. The payment ~~fee~~ schedule will be posted within the Land Use Review Division. Any increase will be posted at least 30 days prior to enactment. The present ~~fees~~ payments for participation are listed in Appendix T and are revised by the annual adjustment factor based on the construction cost index. Participation ~~fees~~ payments received under this program will be used by the City to study, design, implement, and construct urban water quality improvement projects.

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

Commercial Site Development.

For commercial site development, including public mobility projects, payment (cash or cashier check only) must be made prior to issuance of a development permit.

Single Family and Duplex Subdivisions.

For single-family subdivisions which do require the construction of streets or drainage facilities, a letter of credit must be posted with the Watershed Protection and Development Review Department in an amount equal to the total participation payment ~~fee~~ prior to final plat approval. This letter of credit must be replaced by cash prior to construction plan approval. For single-family subdivisions which do not require the construction of streets, payment (cash or cashier check only) must be made prior to final plat approval.

In conjunction with payment ~~of fees~~, the agreement shown in Appendix T shall be signed and act as a binding agreement between the applicant and the City.

1.6.7 Green Storm Water Quality Infrastructure

A. Retention/Irrigation Systems.

1. Introduction . A retention/irrigation water quality treatment system consists of two (2) primary components: (1) a basin which captures and isolates the required volume of stormwater runoff; and (2) a distribution and land application system which generally utilizes pumps, piping and spray irrigation components. The main characteristic of retention/irrigation systems is the ability to retain the entire water quality volume on site and is generally the water quality technology used to meet the SOS non-degradation requirement, Section 25-8-514(A). The design should consider factors such as basin impermeability and the irrigation area's ability to infiltrate the water quality volume. Clay liners are not acceptable for retention/irrigation systems where liners are required in the Edwards Aquifer Recharge Zone. For technical requirements of liners, refer to Section 1.6.2. Additionally, refer to the Utilities Criteria Manual, Section 2, for high hazard backflow preventer requirements. When properly designed, this system is effective in removal of pollutants through settling in the retention basin and contact with vegetation, air and soils in the irrigation process, as well as in mitigating stream-bank erosion as required by Section 1.6.8 of the Environmental Criteria Manual. The effectiveness of this BMP at meeting required pollutant removal efficiencies is based upon the following criteria being met.

2. Minimum Design Criteria for the Retention Basin. Information on water quality volume, diversion structures, and lining requirements can be found in Section 1.6.2 (General Design Guidelines). In addition, applicable requirements of Section 1.6.3 (Maintenance and Construction Requirements) and Drainage Criteria Manual 1.2.4 (Drainage System) must be incorporated in the design.

   a. Retention Basin Volume. The basin must be of sufficient size to capture and hold the required capture volume. Retention basins are designed to capture and hold the water quality volume routed to them via diversion structures. All structural elements & piping below the Water Quality elevation shall be watertight. For development in the Barton Springs Zone, refer to Section 1.6.9.3. of this manual for the required capture volume.

   b. One-Hundred Year Storm. A bypass capable of conveying the 100-year storm around the basin must be provided.

   c. Lining. A liner will be required for a retention basin if the basin is located in the Edwards Aquifer recharge zone in accordance with Section 1. The liner must be designed in accordance with Section 1.6.2C (Basin Liners). All retention basins are subject to 1.6.3.C.4 (Maintenance and Construction Requirements).

   d. Erosion Prevention. The inlets to the retention basin must be designed to prevent erosion of the soil and liner. Rock rip-rap or other erosion prevention systems must be placed at the basin inlet to reduce velocities to less than three feet per second.

3. Minimum Design Criteria for Wet Well and Pumps.

   a. Pumps.

      (1) The retention basin must be emptied within 72-hours after a rain event ends. Emptying of the retention basin must not begin sooner than 12 hours (lag time) after the end of the rainfall event. The flow rate of the pumps (gpm) shall be designed ~~with either a~~ to empty the retention basin in 30 hours or 60 hours ~~drawdown time~~ (30 hrs for single zone ~~irrigation systems~~ and 60 hrs for multi-zone irrigation systems).

      (2) Pumps must be capable of delivering the required volume of water at the necessary rate and pressure to the irrigation system in the designated time period. Pumps and wet well

must be sized to minimize the number of on and off-cycles of the pumps. The rate (Q_I) of inflow from the retention pond Intake Riser (see 1.6.7(A)(3)(c)) to the wet well must exceed the pump rate (Q_P).

(3) A dual pump system must be provided, with each pump capable of delivering 100 percent of the design capacity.

(a) Plug valves must be located outside the wet well on the discharge side of each pump to isolate the pumps for maintenance and for throttling if necessary. Butterfly valves and gate valves must not be used.

(b) Check valve(s) must be provided to prevent backflow from the irrigation system back into the pump well.

(c) Pumps must be selected to operate within 20% of their best operating efficiency.

(4) Pump Operation.

(a) The pumps must alternate on start up. The control logic must allow the system to operate normally with only one pump in service.

(b) A manual control must be provided so both pumps can be turned on if necessary.

(c) A high/low-pressure pump shut off system (to detect line clogging or breaking) shall be installed in the pump discharge piping. As an alternative, an amp draw (overloads) or other equivalent monitoring device may be used.

(5) Float controls or submersible transducers must be provided to control operation of the pumps. Three control settings must be used: (1) one for starting the pump, (2) one for shutting off the pump at the normal low water level, and (3) one for back up shut off of the pump in case the first shut-off fails.

(6) An alarm system shall be provided consisting of a red light located at a height of at least five feet above the ground level at the wet well. The alarm shall activate when:

(a) The water level is below the primary shutoff float and the pump has not turned off.

(b) The high/low-pressure pump shut off switch has been activated.

(c) Any other pump failures or system shut down indicated by control panel.

The alarm must be vandal proof and weather resistant. If the system is to be privately maintained, a sign must be placed at the wet well clearly displaying the name and phone number of a responsible party that may be contacted if the alarm is activated.

(7) A green "pump run light" shall be provided which is activated any time a pump is running. The green light should be located directly adjacent to the red alarm light.

b. <u>Wet Well.</u>

(1) A separate wet well outside of the basin must be provided for the pumps. The wet well must be constructed of precast or cast in place concrete. Complete access to the pumps and other internal components of the wet well for maintenance must be provided through a lockable hatch cover. An isolation plug valve to prevent flow from the retention basin to the wet well during maintenance activities must be provided.

(2) Calculations must be provided with the design showing that the wet well will not float under saturated-soil conditions. The top elevation of the well must be higher than the water quality elevation. The wet well, lateral inflow pipe, and pump must be designed to completely evacuate the retention pond. A space of at least two feet must be available below the bottom of the pump intake. The two-foot minimum space below the bottom of the pump may be waived if the applicant demonstrates that adequate filtration of the water quality volume is provided.

(3) The pump installation in the wet well and access to the wet well must be designed to allow the pumps to be removed using truck-mounted hydraulic hoist equipment or a portable "A-frame." A system must be provided to allow pump removal without entering the wet well. If rails are used they must be stainless steel.

c. Intake Riser. Prior to entering the wet well, stormwater must pass through an appropriate intake riser with a screen to reduce the potential for clogging of distribution pipes and sprinklers by larger debris (e.g. cups, cans, sticks). The intake riser and screen should be designed similarly to Figure 1-54 in the Appendices of this manual. Alternative designs will be considered.

4. Minimum Design Criteria for the Irrigation System or Infiltration Field.

a. Irrigation Timing.

(1) The retention basin must be emptied within 72-hours after a rain event ends.

(2) Irrigation must be initiated no sooner than 12 hours after the rain event ceases.

(3) The irrigation controller must be set to provide alternating, equivalent irrigation and rest periods until the basin is emptied.

(4) The time of irrigation on any area must not exceed the rest time. Continuous application on any area must not exceed two hours.

(5) An adjustable rain sensor must be provided which will normally be set to temporarily halt irrigation during rainfalls exceeding one half inch. The rain sensor must be able to interrupt irrigation (stop pumps) in the event of subsequent rain events prior to emptying basin. The 12 hour pump delay may initiate after the rain sensor senses the rain event has terminated.

(6) Division of the irrigation area into two or more sections such that irrigation occurs alternately in each section is an acceptable way to meet the requirement for a rest period.

b. Irrigation Rate . The infiltration rate at which the soil can accept the irrigated storm water must be derived from the infiltration rate listed in the U.S. Department of Agriculture National Resources Conservation Service (NRCS) Soil Survey for the county, location, and soil type verified to be present at the irrigation site. If a range is given, the lower value of the range is to be used. The design irrigation rate is not to exceed 0.20 inches per hour even if the lower value of the range exceeds that rate. City of Austin field experience has shown that infiltration rates above 0.20 inches per hour do not function as designed and generate significant nuisance ponding and runoff issues. The application rate may not exceed the infiltration rate on any portion of the irrigation area.

c. Irrigation Area or Infiltration Field . Calculations must be provided which demonstrate that an adequate irrigation area or infiltration field will be provided based on the soil infiltration rate, water quality volume, and, for irrigation areas, the application rate and actual irrigation time. The irrigation area or infiltration field system must be included within the water quality easement.

d. Irrigation Area Slope. Irrigation must not occur on land with slopes greater than 10%.

e. Piping and Valves.

(1) All irrigation system distribution and lateral piping (i.e. from the pumps to the spray heads) must be Schedule 40 purple PVC. All pipes and electrical bundles passing beneath driveways or paved areas must be sleeved with PVC Class 200 pipe with solvent welded joints. Sleeve diameter must equal twice that of the pipe or electrical bundle. Buried piping must be marked with detectable marking tape labeled "CAUTION: BURIED NON-POTABLE WATER LINE BELOW".

(2) Valves. All valves must be designed specifically for sediment bearing water, and be of appropriate design for the intended purpose. All remote control, gate, and quick coupling valves must be located in ten-inch or larger plastic valve boxes with purple caps. All pipes and valves must be marked to indicate that they contain non-potable water. All piping must be buried to protect it from weather and vandalism. The depth and method of burial must be adequate to protect the pipe from vehicular traffic such as maintenance equipment. Velocities in all pipelines should be sufficient to prevent settling of solids. The irrigation design and layout must be integrated with the tree protection plan and presented as part of the Site Plan or Subdivision Construction Plan.

(3) Systems must include a plug valve to allow flushing at the end of every line.

f. Sprinklers. All sprinkler heads must have full or partial circle rotor pop-up heads and must be capable of delivering the required rate of irrigation over the designated area in a uniform manner. Sprinkler heads should have purple caps to indicate non-potable water. Irrigation must not occur beyond the limits of the designated irrigation area and sprinkler heads should be located at least twice the calculated spray radius from any residential lot. Partial circle sprinkler heads must be used as necessary to prevent irrigation beyond the designated limits. Sprinkler heads must be capable of passing solids that may pass through the intake. Sprinkler heads must be flush mounted and encased within a 2 feet × 2 feet concrete housing capable of protecting the head from mowing and service equipment (see Appendix V, Figure 1-59F for an example).

g. Vegetation. The irrigation area must have native vegetation or be restored or re-established with native vegetation, unless approved by the Director. These areas must not receive any fertilizers, pesticides, or herbicides. If landscaped areas are used for irrigation, fertilizers, pesticides, or herbicides must not be applied to those areas and this limitation must be outlined in the Integrated Pest Management (IPM) plan. For publicly maintained systems, fencing or signs must be installed to limit unauthorized use of the irrigation area. If signs are installed, they must include the phrase "Stormwater Irrigation Area - No Trespassing."

h. Soil. The irrigation area must contain a minimum of 12 inches of native or enhanced soil with the appropriate permeability rates. A soils report must be provided and must include at a minimum a soils map verifying soil types in the irrigation area, permeability rates, soil depths, percent of coarse fragments gravel size (2.0 mm diameter) and larger, found on the soil surface and in the subsurface soils, depth of roots, locations of borings or trenches, photographs of exposed soils, location and type of soil enhancement performed, soils testing results, etc. A site visit may be conducted by the city to confirm soil conditions, including when representative trenches have been opened or borings are being conducted. City staff must be given at least 72 hours notice of when borings or trenches are to be backfilled.

If soil is enhanced, topsoil or amended topsoil shall meet the requirements of Standard Specification 601S, Salvaging and Placing Topsoil. The condition, type, structure, and quality of the soil shall be conducive to infiltration and to plant growth. If alternative methods of amending soil can be demonstrated to increase the infiltration capacity by at least a factor of three, these methods may be used with approval from the Director of WPD.

i. Geological Features. The irrigation area must not contain any Critical Environmental Feature Buffer Zones.

j. Irrigation Area Buffer. A buffer area of un-irrigated vegetation must be provided downstream of the irrigation area to treat any runoff that may occur from the irrigation area during heavy rainfall or from excessive irrigation. This area must be a minimum of 50 feet in length (in the direction of flow) and be adjacent to all downstream edges of the irrigation area. As an option, a diversion system (e.g. a swale or berm) may be provided to route any runoff to the retention basin. This diversion system must be designed to carry the runoff from the two-year storm. Alternatively, the irrigation area may be located upstream from the development such that any runoff will be routed to the retention pond.

5. Manuals and As-Built Plans.

a. The applicant must provide two complete copies of an Operations Manual for the pumps and irrigation system, which must include:

(1) Pump curves, electrical schematics, pump and instrument technical information, components of the control panel, pump maintenance recommendations with required frequencies, irrigation controller operation instructions and a written warranty.

(2) As-built plans of the retention basin, wet well, pumps, piping and irrigation system. The plans must show the location, size, and type of all pipes, valves, wiring, wiring junctions, and sprinkler heads.

For retention-irrigation systems that are to be maintained by the City of Austin, both sets of plans and manuals shall be submitted to the Field Operations Division of the Watershed Protection and Development Review Department.

For systems that are to be maintained privately, one set of plans and one manual shall be included with the operating permit application and the second set of plans and one manual shall be retained on site at all times.

Source: Rule No. R161-14.26, 12-30-2014 ; Rule No. R161-16.19, 11-14-2016 ; Rule No. R161-21.03 , 3-9-2021.

D. Rainwater Harvesting

1. Introduction. Rooftops can generate large volumes of runoff which, when discharged to paved surfaces and landscaped areas, can generate large pollutant loads. Rainwater harvesting systems can capture this runoff before it is discharged, thus preventing pollution while also putting the captured water to beneficial use, such as landscape irrigation or cooling water. The amount of runoff captured will depend on the size (water quality volume) and drawdown time of the rainwater harvesting system. The systems can also control the peak flow rate for the 2-year storm. See Section 1.6.8 if specifically designed for this purpose. Rainwater harvesting systems can provide equivalent treatment to a standard sedimentation/filtration system and may be used within the Barton Springs Zone if the design achieves the non-degradation load requirements detailed in Section 1.6.9. Rainwater Harvesting systems will only be permitted for commercial developments.

   In an effort to promote water conservation, the State of Texas offers financial incentives and tax exemptions to offset the equipment costs. Additionally, the Water Conservation staff of the City of Austin Water Utility Department is available to provide input on how to achieve cost efficient design and equipment selection that will also help reduce water and wastewater costs.

2. Water Quality Credit.

   The water quality credit will typically be applied as either a reduction in the water quality volume for a structural control or a reduction in the ~~fee-in-lieu cost~~ payment instead of structural controls. The basic water quality credit equation is calculated using Equation 1.6.7-1.

   For rainwater harvesting systems the BMPDF variable is a function of the following factors:

   - WQV_{rwh} is the water quality capture depth provided by the rainwater harvesting system in inches,
   - WQV_{ecm} is the ECM required water quality capture depth in inches, and
   - DDT_{rwh} is the rainwater harvesting system drawdown time in hours (a maximum of 120 hrs.).

   The BMPDF shall be determined using Figure 1.6.7.D-1 below:

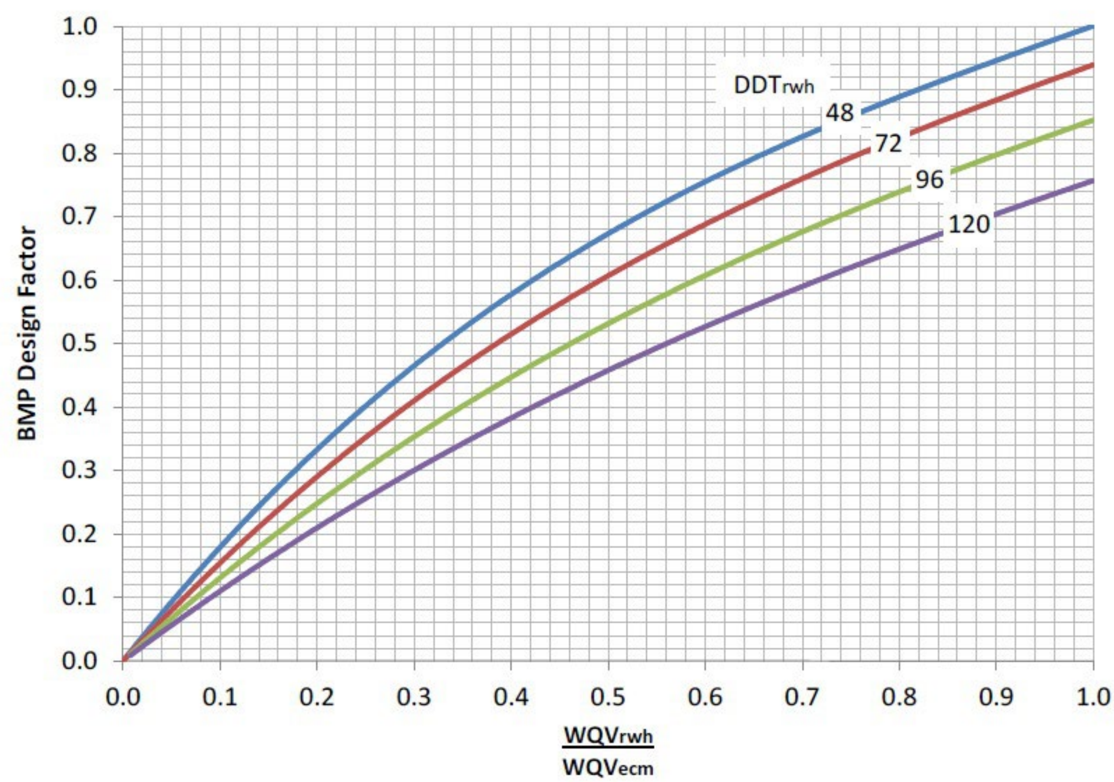


Figure 1.6.7.D-1. BMP Design Factor for Rainwater Harvesting Systems.

The derivation of the drawdown time will vary with the type of system, as described below for specific design options. In all cases the drawdown is calculated as:

$DDT = WQV/Q_{rwh}$

Where:

- DDT is the drawdown time, or time for full control to empty, including any lag time (hours)
- WQV is the water quality volume
- Q rwh is the rate of discharge from the rainwater harvesting system

Where:

3. Design Options.

   A typical configuration for a rainwater harvesting system is shown in Figure 1.6.7.D-2. To receive water quality credit, rainwater harvesting systems must be designed so that captured runoff is held for at least 12 hours after rainfall has ceased, then either gravity-drained to a vegetated area sized large enough to infiltrate all the water (Option A), or used to irrigate the vegetated area (Option B). The latter design is similar to a retention/irrigation system and Section 1.6.7(A) should be referenced for guidance. The vegetated area can also serve as a vegetated filter strip for flows that by-pass the rainwater harvesting system.

Because the required drawdown time is no more than five (5) days, these systems generally cannot be used to meet water conservation-oriented landscape irrigation needs (e.g., 5-day watering schedule). However, the portion of the system capacity that is recovered during the 5-day (maximum) drawdown period may be eligible for water quality credit. For example, water in the system may be pumped to a separate tank for subsequent beneficial reuse such as landscape irrigation during dry conditions. Or, a portion of the tank may be designated as water quality volume that empties within 5 days and the remaining portion of the tank is reserved for beneficial reuse. The amount of water harvested for beneficial reuse should be evaluated so that it may be usefully deployed over the service area to which it is directed. The annual capture and annual use (for irrigation, etc.) for the device should balance, and if they do not the annual use becomes the limiting capture quantity.

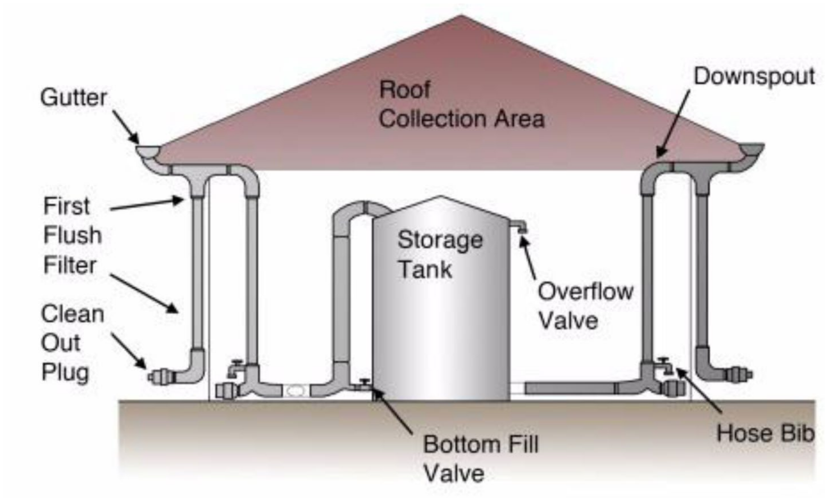


Figure 1.6.7.D-2. Typical configuration for a rainwater harvesting system.

Alternatively, and with approval from the Director, the system may be designed to empty or partially empty prior to the next forecasted rain event using an advanced real-time controller.

Option A - Captured Runoff Gravity-Drained to a Vegetated Area for Infiltration

The water quality volume must be provided by the system designer, with the drawdown time set to a maximum of 120 hours. The designer must demonstrate that the vegetated area is sufficiently large to infiltrate the entire water quality volume within 120 hours (see Figure 1.6.7.D-3 below).

The average "treatment" rate of the rainwater harvesting system is:

$Q_{avg} = WQV/DDT$

Where:

It is reasonable to assume saturated conditions, and the infiltration rate of the vegetated area can be calculated as:

$Q_{veg} = k * i * A$

Where:

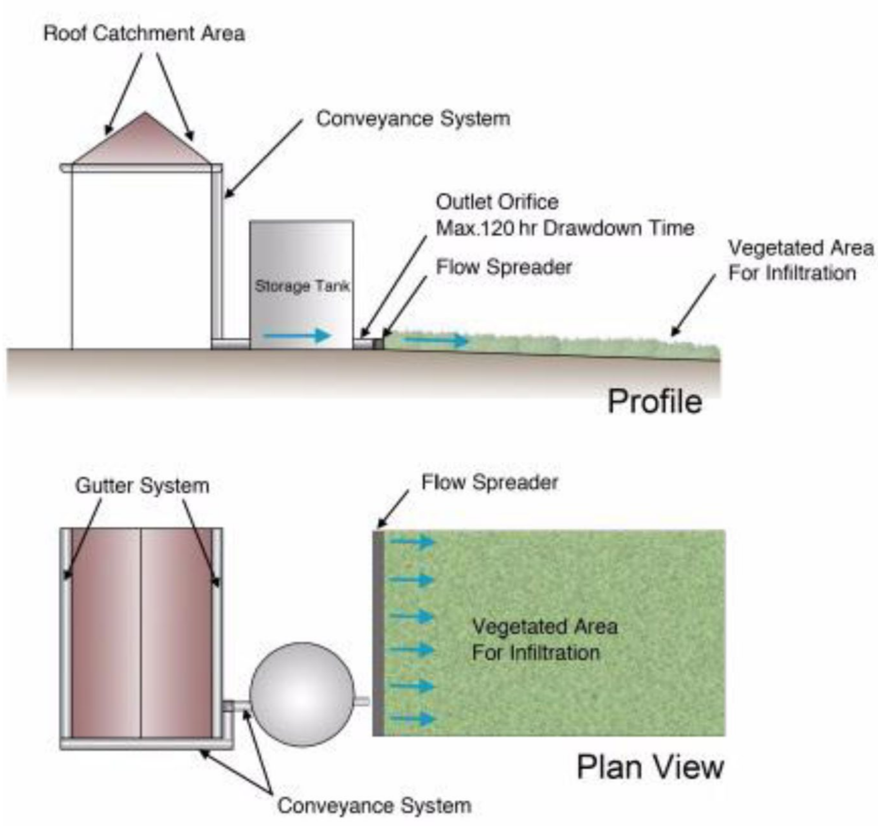


Figure 1.6.7.D-3. Design Option A with captured runoff discharged to a vegetated area for infiltration.

As minimal ponding of water over the vegetated area is expected, the hydraulic gradient can be assumed equal to 1, thus:

$Q_{veg} = k * A$

To be conservative, design the vegetated area for the maximum flowrate discharged from the rainwater harvesting system. A reasonable assumption is to assume a value twice Q_{avg}, and to also assume a lag time (LT) between the time runoff ends and when the rainwater harvesting system begins discharging:

$Q_p = (2 * WQV)/(DDT - LT)$

Setting the peak flow rate discharged from the rainwater harvesting system equal to the vegetated area infiltration rate, and solving for A:

$A = (2 * WQV)/(k * (DDT - LT)$

Where

A design infiltration rate (i.e., hydraulic conductivity) for the site must be established through desktop study and field sampling as described in Section 1.6.7.4. The lag time LT should be set to a minimum of 12 hours.

To be eligible for water quality credit the vegetated area also must meet the following criteria:

- The length (dimension in direction of flow) of the vegetative area should be at least 15 feet.
- The average slope of the vegetative area must be between 1% and 10%, with no portion exceeding 15%.

• The hydraulic loading rate should not exceed 0.05 cfs per ft. width for the maximum flowrate applied to the vegetated area (see below for procedure to calculate peak flowrate). Higher hydraulic loading rates are allowed but will reduce water quality credit. In this case, a maximum allowable rate of 0.15 cfs per ft. width is allowed.

• The soil depth should be a minimum of twelve (12) inches.

• The vegetated area should have dense vegetative cover (minimum 95% coverage as measured at the base of the vegetation). The use of native grasses is strongly recommended due to their resource efficiency and their ability to enhance soil infiltration. In the case of natural wooded areas where 95% vegetative cover is not present, a minimum of four inches of leaf litter or mulch must be in place.

• An irrigation plan is required.

Option B - Captured Runoff Used to Irrigate Vegetated Area

A typical design configuration in which captured runoff is used to irrigate a vegetated area is shown in Figure 1.6.7.D-4 below. The water quality volume must be provided by the system designer, with the drawdown time set to a maximum of 120 hours. The system should be designed according to the retention/irrigation criteria in Section 1.6.7.A.

Rainwater systems are considered auxiliary water sources by the Austin Water Utility. When a rainwater harvesting system meets the definition of Auxiliary Water per the City of Austin - Utility Criteria Manual (UCM) then the design of this system must comply with the backflow protection requirements established in Section 2.3.4 of the UCM, Backflow Prevention Rules and Regulations Pertaining to Sites With Both City Potable Water and Auxiliary Water.

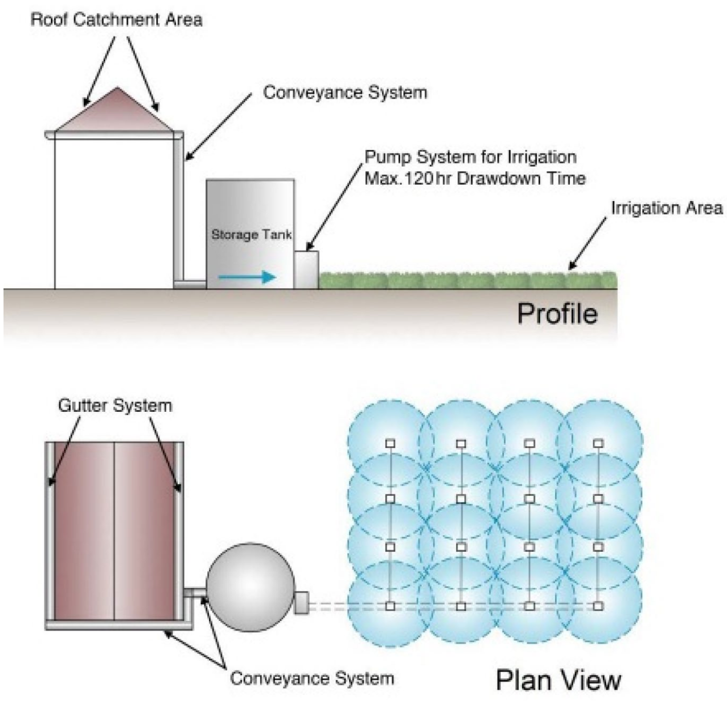


Figure 1.6.7.D-4. Design Option B with captured runoff used to irrigate a vegetated area.

4. Example.

A 5 acre commercial development with 50% impervious cover (2.5 impervious acres) is proposing a rainwater harvesting system that would capture runoff from 1 acre of rooftop and drain it by gravity to a vegetated area (Option A). The development is located outside of the Barton Springs Zone. The system would have a water quality volume of 25,000 gallons, which would be emptied in 96 hours by discharging to a vegetated area that is 260′ wide by 90′ long. The design hydraulic conductivity for the site was established to be 0.06 in/hour, or 0.005 ft/hour. Evaluate this design and determine the water quality credit it may be eligible for.

The water quality credit will typically be applied as either a reduction in the water quality volume of a structural control or a reduction in the ~~fee-in-lieu cost~~ payment instead of structural controls.

As the alternative control is for 1 acres of impervious cover, and the site has a total of 2.5 impervious acres, the IAF value is 0.40 (=1/2.5).

- The BMPDF factor is a function of two components, the rainwater harvesting system and the vegetated area. The BMPDF value for the rainwater harvesting system is based on the water quality volume and drawdown time, subject to the requirement that the vegetated area must be large enough to infiltrate the captured volume.

To determine the BMPDF value, first convert the water quality volume from gallons to inches:

WQV_{rwh} = (25,000 gallons * 1 ft^3 /7.481gal) = 3,342 ft^3 = 0.92-inch

The BMPDF value is a function of the following factors:

WQV_{rwh} /WQV_{ecm} and

DDT_{rwh}

The rainwater harvesting system will be capturing runoff from a rooftop that is 100% impervious cover. The water quality capture depth for 100% impervious cover is 1.30-inch for projects located outside of the Barton Springs Zone. Therefore, the factors to determine BMPDF are:

WQV_{rwh} /WQV_{ecm} = 0.92/1.3 = 0.71, and

DDT_{rwh} = 96 hours.

Inserting these values into Figure 1.6.7.D-1, gives:

BMPDF = 0.68.

Before this credit can be applied first determine if the vegetated area is sufficient to infiltrate the water quality volume in 96 hours.

Is it large enough?

Minimum size A = (2 * WQV)/(k * (DDT - LT)) = (2 * 3,342)/(0.005 * (96-12) = 15,914 ft^2 .

Size provided = 260′ * 90′ = 23,400 ft^2 - this is large enough

Is the length of the vegetated area at least 15 feet?

Yes as the proposed length is 90 feet.

Does it meet the 0.05 cfs/ft. width hydraulic loading rate for the discharge from the rainwater harvesting system?

To estimate peak flowrate and hydraulic loading rate:

Q_p = (2 * WQV)/(DDT - LT) = (2 * 3,342)/(96 - 12) = 80 cfh = 0.022 cfs

HLR = Q/W = 0.022/260 = 0.00008 cfs/ft width - Okay as < 0.05

All other slope, soil depth, vegetative cover, etc. criteria is also met, thus the vegetated area is acceptable and:

The total water quality credit for the proposed system is:

WQC = IAF * BMPDF = 0.4 * 0.68 = 0.272

5. **References:**

1. The Texas Manual on Rainwater Harvesting, 3rd edition 2005

2. City of Tucson Water Harvesting Guidance Manual, October 2005

3. City of Austin Energy, Green Building Program, 1995

Source: Rule No. R161-14.26, 12-30-2014 .

H. Rain Garden.

1. Description.

   A rain garden is a vegetated, depressed landscape area designed to capture and infiltrate and/or filter stormwater runoff. The growing medium for the rain garden consists of native soil or biofiltration media. If the infiltration capacity of the subgrade soils is limited, the rain garden can be underlain by an underdrain system. Rain gardens will provide removal of pollutants in stormwater runoff similar to other treatment systems. However, because they are restricted to smaller drainage areas and shallower ponding depths, which necessitate a larger surface area, infiltration, evapotranspiration, and biological uptake mechanisms may be more significant for rain gardens than other treatment BMPs.

   There are three different types of rain garden designs included in this section:

   - full infiltration (no underdrain);
   - partial infiltration (filtration system with raised outlet or partial underdrain); and
   - filtration system with no infiltration.

2. Site Selection.

   Rain gardens can be used in new developments or as a retrofit within an existing site. Unlike conventional centralized stormwater management systems, multiple rain gardens may be dispersed across a development, and incorporated into the landscape, providing aesthetic as well as ecological benefits. Rain gardens allow for all or a portion of the water quality volume (WQV) to be treated within landscaped areas, and therefore may reduce landscape irrigation requirements by making use of stormwater runoff. Rain gardens are especially suited for small sites and are typically installed in locations such as parking lot islands, site perimeter areas, and other landscape areas.

Figure 1.6.7.H-1. Multiple rain gardens may be dispersed across a development, and incorporated into the landscape, providing aesthetic as well as ecological benefits.

The following site characteristics must be considered when designing a rain garden:

Land Use - The use of rain gardens as a water quality control is limited to Commercial, Multi-Family, Civic Uses, Public Right of Way , and single family residential projects. The restrictions on use of rain gardens for single family residential are as follows:

1. Rain Garden must be located in a dedicated common area or within a drainage easement that is accessible by standard maintenance equipment from the right of way.
2. A minimum of four (4) single family lots must be treated by the rain garden.
3. No rain gardens are to be located in backyards or fenced in yards.
4. The City of Austin will provide functional maintenance per City Code Section 25-8-231. Homeowners may add additional native landscaping and provide more frequent care.

Full infiltration and partial infiltration rain gardens are not allowed in areas where land use or activities generate highly contaminated runoff due to the potential for ground water contamination. These areas include commercial nurseries, auto recycle facilities, hazardous materials generators (if containers are exposed to rainfall), industrial process areas, gas stations, food production/distribution loading dock and trash compactor areas, vehicle fueling and maintenance areas, and vehicle and equipment washing and steam or dry cleaning facilities.

Drainage Area - Rain gardens are restricted to a contributing drainage area not to exceed two acres and a ponding depth not to exceed 12 inches.

Barton Springs Zone - At this time, an unlined rain garden is not acceptable as a primary method for controlling non-point source pollution in watersheds within the Barton Springs Recharge Zone. If a rain garden is proposed for use in the Barton Springs Recharge Zone, then a liner is required and the discharge from this facility must be managed to comply with the Save Our Springs ordinance.

Setbacks - Rain gardens must be designed to prevent adverse impacts to building foundations, basements, wellheads, and roadways from the infiltration of water.

Slopes - Rain gardens should not be located on slopes exceeding 15 percent.

Soil conditions - When siting a full or partial infiltration rain garden, appropriate soil conditions must be present. The depth to an impermeable layer must be at least 12 inches below the bottom of the rain garden. For full infiltration rain gardens, the underlying native soil must have a design infiltration rate that will draw down the full ponded depth in less than 48 hours. For example, for a 12 inch maximum ponding depth, the design infiltration rate must be at least 0.25 inches per hour. For a 6 inch maximum ponding depth, the design infiltration rate must be least 0.13 inches per hour. For a 3 inch maximum ponding depth, the minimum design infiltration rate is 0.06 inches per hour. The design infiltration rate is based on applying at least a factor of safety of two (2) to the measured steady state saturated infiltration rate (i.e., the design infiltration rate is equal to one-half of the measured infiltration rate). A higher factor of safety may be used at the discretion of the design engineer to take into variability associated with assessment methods, soil texture, soil uniformity, influent sediment loads, and compaction during construction. For full infiltration systems the infiltration rate of the soil subgrade below the growing medium of the rain garden must be determined using in-situ testing as described in Section 1.6.7.4. If a range of values are measured then the geometric mean should be used.

Water Table - Full and partial infiltration rain gardens are not allowed in locations where the depth from the bottom of the growing medium to the highest known groundwater table is less than 12 inches.

Bedrock - Full and partial infiltration rain gardens are not allowed in locations where depth from the bottom of the growing medium to bedrock is less than 12 inches. In cases with bedrock less than 3 feet from the bottom of the growing media, soil testing should be conducted in-situ to account for the effect of this limiting horizon.

Groundwater and Soil Contamination - Full and partial infiltration rain gardens are not allowed in locations where infiltration would cause or contribute to mobilization or movement of contamination in soil or groundwater or would interfere with operations to remediate groundwater contamination. If filtration rain gardens are proposed under these conditions, the potential for incidental infiltration should be evaluated to determine whether an impermeable liner must be used.

3. Maintenance Considerations.

Maintenance requirements are included in ECM Section 1.6.3. During design, the following should be considered to facilitate long-term maintenance:

Whenever possible, design the rain garden to be offline (whereby surface flow enters and exits (only when full) the system through the same opening), with runoff by-passing the system once ponding depth equals the water quality volume elevation. This configuration may reduce erosion from larger storm events and will also minimize mixing of the water quality volume.

While not required, consider providing pre-treatment to help reduce the extent and frequency of maintenance, especially if the contributing drainage area is expected to generate sediment, debris, or other pollutant that may cause decreased system functionality. Pre-treatment may include a sedimentation chamber, a vegetated or manufactured separator element (to functionally separate the rain garden into higher deposition and lower deposition zones), a vegetated filter strip, or an inlet designed at a minimal slope to encourage sediment deposition prior to flows entering the rain garden.

Select native vegetation whenever possible to reduce the need for long-term irrigation and maintenance. If rain gardens are over-irrigated and receive significant applications of fertilizers and herbicides, they can become sources of pollution rather than pollutant removal BMPs. Thus, it is essential that these rain garden systems be managed carefully and that an approved and recorded Integrated Pest Management plan be required for the drainage area up to and including the rain garden.

Whenever possible, vegetation should be planted throughout the entire rain garden to provide a fully stabilized surface. Containerized plants are typically grown in a looser growing medium conducive to drainage whereas grass sod is sometimes grown in more cohesive soils that may inhibit drainage. Avoid the use of wood chips because they tend to float and may clog the outlet or be washed downstream. Coarsely-shredded hardwood mulch such as that obtained from the primary run through an industrial tub grinder will be more resistant to movement and is recommended. Gravel or stone mulch is also resistant to movement but may cause sediment to build up and inhibit infiltration.

If pedestrian traffic is expected, provide stepping stone paths along a predefined route to discourage trampling of vegetation and compaction of soil. Planting spiny vegetation such as yucca, sotol, or agarita along the edge of the rain garden may effectively discourage pedestrian use.

Design the rain garden depression to be as shallow as possible to facilitate mowing and reduced erosion.

4. Sizing.

Rain gardens may be sized to capture and treat the entire water quality volume, or a water quality credit may be provided for rain gardens that capture and treat only a portion of the water quality volume. In each of the three rain gardens designs, the storage volume provided is the combined volume of the ponded water in the basin and the effective porosity volume in the growing medium. Growing medium requirements are provided in Part 5 of this section. Because rain gardens have comparatively smaller drainage areas and larger surface areas, water quality credit is provided for 80% of the effective porosity (assumed to be 30%) of the growing medium.

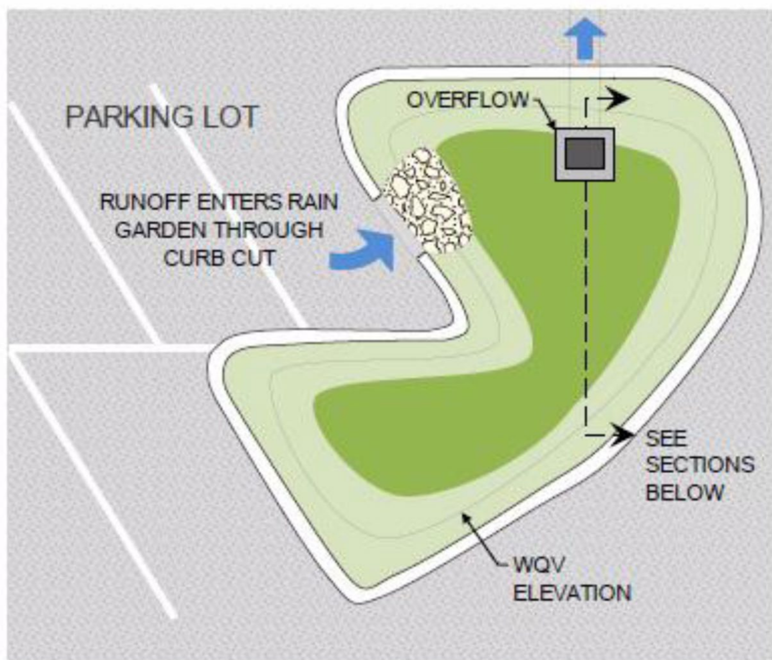


Figure 1.6.7.H-2. Rain gardens can be sized to capture and treat all or a portion of the required water quality volume (WQV).

Sizing criteria for the three general types of rain gardens are provided below:

- Full Infiltration

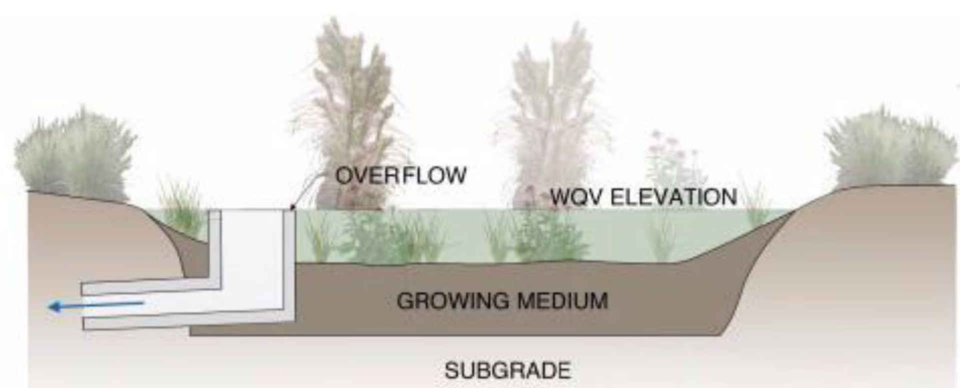


Figure 1.6.7.H-3. Full infiltration rain gardens use the infiltration capacity of the site soils to reduce stormwater runoff volume and associated pollutants.

$A_i \geq 0.87 * WQV/(H + 0.24 * L)$ (Equation H-1)

Where:

The maximum allowable head over the growing medium for a full infiltration rain garden is 12 inches provided the design infiltration rate of the subgrade soil allows for draw down of the ponded depth in at most 48 hours (see soil condition requirements in Site Selection section above). Ponding depths in excess of 12 inches are not permitted.

Partial Water Quality Credit - For calculating partial water quality credit (see Equation 1.6.7-1 and Figure 1.6.7-1), the water quality capture depth for a full infiltration rain garden can be calculated using the following equation:

$WQV_{BMP} = 12 * A_i * (H + 0.24 * L)/(0.87 *A)$ (Equation H-2)

Where:

Note that maximum ponding depth and minimum design infiltration rate criteria are based on a maximum 48 hour drawdown time. Drawdown times less than 48 hours are permitted (and encouraged).

- Full Filtration

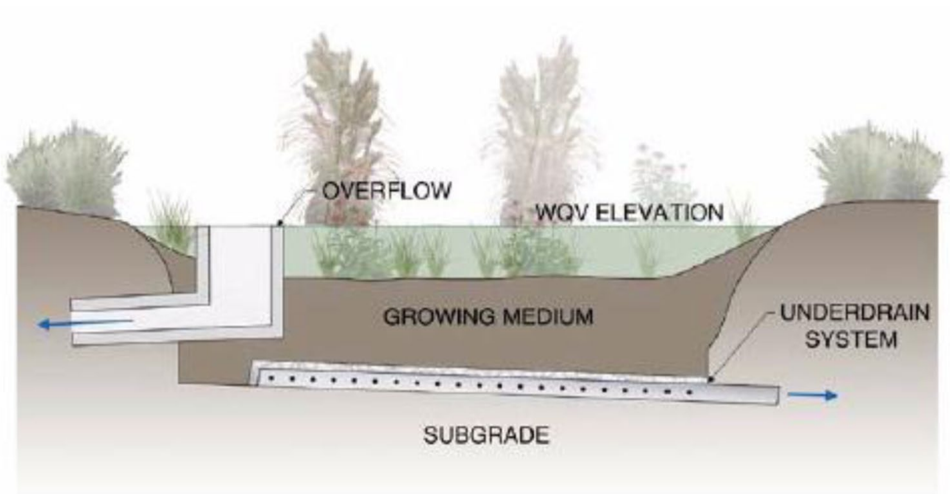


Figure 1.6.7.H-4. Full filtration rain gardens are sized to capture and convey runoff through a biofiltration bed underlain by an underdrain system.

$A_f \geq WQV/(H + 0.24 * L)$ (Equation H-3)

Where:

Partial Water Quality Credit - For calculating partial water quality credit (see Equation 1.6.7-1 and Figure 1.6.7-1), the water quality capture depth for a full filtration rain garden can be calculated using the following equation:

$WQV_{BMP} = 12 * A_f * (H + 0.24 * L)/A$ (Equation H-4)

Where:

- Partial Infiltration

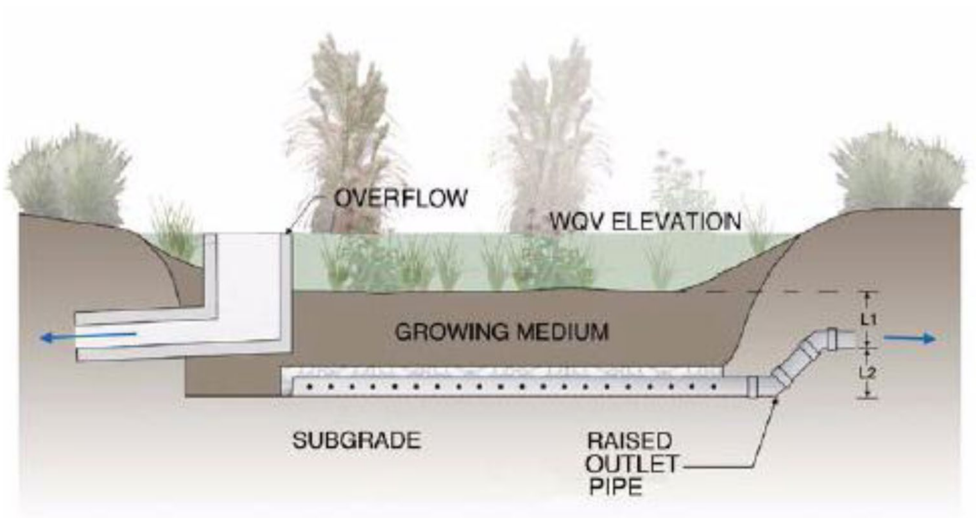


Figure 1.6.7.H-5. Partial infiltration rain gardens are designed so that treated runoff exits the biofiltration bed by discharge through a raised outlet pipe and by infiltration into the underlying soil.

$A_f \geq WQV/(H + 0.24 * L_1 + 0.24 * I_f)$ (Equation H-5)

Where:

Growing medium or gravel must be placed across the bottom of the rain garden below the invert of the raised outlet pipe to provide additional storage. Use of growing medium is recommended to promote greater rooting depths and biological activity. The available storage is a function of the depth below the invert of the raised outlet pipe and the porosity of the material. The ability to regenerate storage is a function of the infiltration rate of the subgrade. The infiltration factor, If, is based on the depth of storage below the invert of the raised outlet (L_2) and the 2-day drawdown provided by the soil subgrade design infiltration rate (i_{sub}):

For cases where $L_2 \geq i_{sub} * 2$ days,

For cases where $L_2 < i_{sub} * 2$ days,

Where:

For partial infiltration rain gardens, the design infiltration rate of the soil subgrade below the growing medium may be estimated using the desktop study and field sampling methods as described in ECM Section 1.6.7.4. For design purposes, the estimated infiltration rate must be reduced by at least a factor of safety of 2 to account for uncertainty in infiltration rate estimates and potential clogging over time.

Partial Water Quality Credit - For calculating partial water quality credit (see Equation 1.6.7-1 and Figure 1.6.7-1), the water quality capture depth for a partial infiltration rain garden can be calculated using the following equation:

$WQV_{BMP} = 12 * A_f * (H + 0.24 * L_1 + 0.24 * I_f)/A$ (Equation H-7)

Where:

5. Growing Medium.

   The rain garden growing medium should have sufficient water holding capacity to support vigorous plant growth, enhancing the ability for plants to survive during dry periods. It should also sustain a healthy microorganism population which, in concert with vegetation, should enhance biological removal of pollutants in stormwater.

Requirements for the growing medium depend on the type of rain garden design being considered. For full infiltration rain gardens, the growing medium should be native soil. In the event the designer is not certain about the native soil's ability to support vegetation, a 6 inch layer of topsoil may be added to the soil. This additional depth of soil must be accounted for in the depth and volume required for the pond. For full filtration and partial infiltration rain gardens, only the biofiltration medium may be used. See Standard Specification 660S Biofiltration.

6. Underdrain System.

- Full Infiltration Rain Garden - A full infiltration rain garden does not have an underdrain system and does not require a geotextile under the growing medium.
- Partial Infiltration and Full Filtration Rain Garden - The underdrain for a partial infiltration and full filtration rain garden consists of gravel-surrounded perforated pipes as illustrated in Figure 1.6.7.H-6 (for details see Standard Detail 661-3).

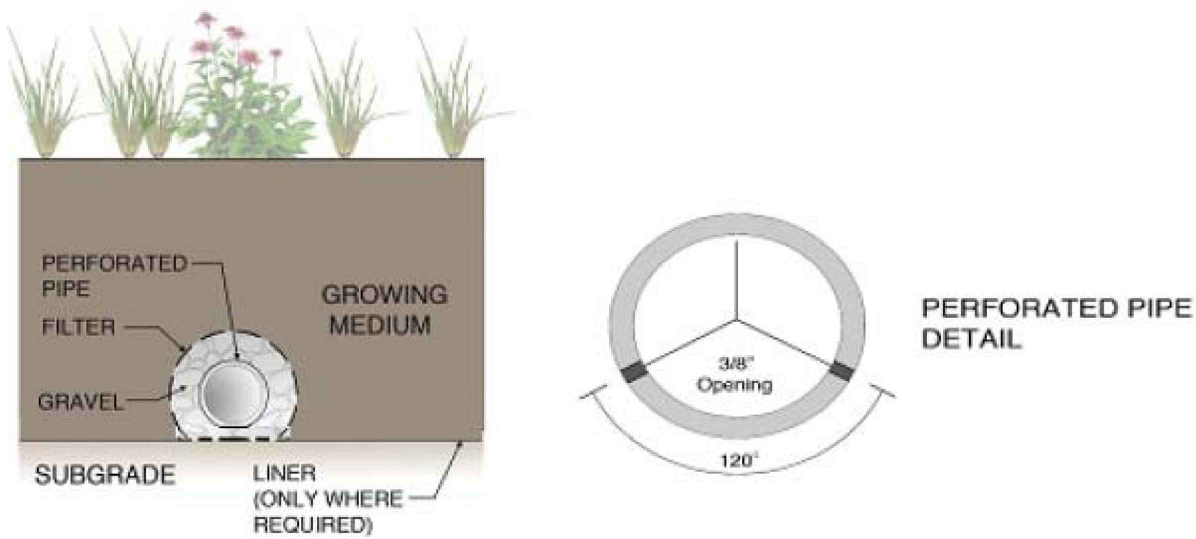


Figure 1.6.7.H-6. Underdrain design for partial infiltration and full filtration rain gardens.

The underdrain piping must comply with the criteria located in ECM section 1.6.7.C.4.B, Biofiltration Basin Details. For partial infiltration systems with raised outlets, the pipe does not require a slope.

For full filtration designs, if an impermeable liner is required it shall meet the specifications given in Section 1.6.2.C. A geotextile (or gravel separation lens) is not required at the bottom of unlined rain gardens.

7. Flow Control.

Inflow: How runoff enters (and for larger storms overflows or bypasses) the rain garden depends on the overall drainage configuration for the site. Runoff may enter via sheet flow from surrounding areas (for example, a parking lot with a ribbon curb), or runoff may enter as concentrated flow through a curb cut, a splitter box, or other inlet. When using a curb cut approach, ensure that inflow curb cuts have sufficient positive slope into the rain garden to prevent minor obstructions such as leaves in the curbline from obstructing flow into the system. Provide energy dissipation for rain gardens with concentrated points of inflow. The maximum velocity discharged to the rain garden should not exceed 2 feet per second.

Internal Flow Management: Rain gardens located on a sloped area can be designed to pool to a specified water quality elevation and then overflow into downstream cells through a raised outlet structure or level spreader.

Outflow: The preferred design to manage volume in excess of the WQV is to use an offline system configuration such that when the rain garden is full, additional runoff does not enter the system and instead flows past the inflow opening. Outflow of volume in excess of the WQV can also be managed through the use of standpipe risers, elevated catch basins, or down gradient curb cuts. When selecting the type and location of the outlet structure, incorporate enough detail in the design to prevent unintentional bypass of the rain garden before it is full. For example, when using an adjacent curb inlet to a storm drain for overflow, make sure to include sufficient grade control to establish preferential flow to the rain garden. The surface discharge from the rain garden shall be non-erosive with a maximum permissible flow velocity of 2 feet per second.

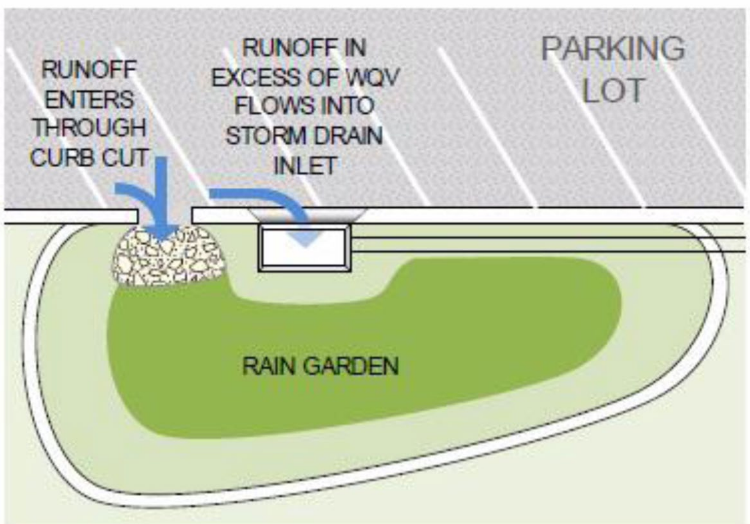


Figure 1.6.7.H-7. Example of the preferred offline system configuration for flow control.

8. Landscape Design.

   Although an essential role of the vegetation is to make the rain garden attractive, the highest priority shall be to meet the water quality and soil stabilization functional requirements. Another important function of the vegetation is to help reduce clogging of the growing medium. Vegetation should be selected based on its ability to survive under alternating conditions of inundation and extended dry periods. High plant diversity is recommended and will provide resiliency to the system and help prevent a situation where all vegetation is lost. Over time, the plant species that are best suited to the unique conditions of each rain garden will naturally self-select and spread.

   Vegetation quantity, size, spacing, and selection shall meet the requirements for filtration basins as provided in ECM Section 1.6.7C, Biofiltration, with the exception that rain gardens do not require a minimum of five different species (i.e., one species is acceptable), although higher diversity is recommended.

9. Examples.

EXAMPLE CASE STUDY 1 - Full Infiltration Rain Garden (no underdrain system)

A 5 acre site has a total of 3 acres of impervious cover. Runoff from a 1 acre parking lot will be routed to a 0.08 acre parking lot island which will be designed as a full infiltration rain garden to capture and treat a fraction of the water quality volume. Based on the 1 acre parking lot and 0.08 acre parking lot island, the rain garden drainage area has a total impervious cover of 92.4%. The depressed parking lot island is 18 ft wide, 200 ft long, and 6 inches deep. The flat bottom of the parking lot island is 14 ft wide and 190 ft long. Infiltration tests indicate the infiltration rate of the subgrade is 0.25 in/hr. Determine the BMP Design Factor (BMPDF) and water quality credit for the rain garden (Figure 1.6.7-1 and Equation 1.6.7-1).

From Equation H-2,

$WQV_{BMP} = 12 * A_i * (H + 0.24 * L)/(0.87 * A)$

Based on the proposed geometry, the infiltration area, A_i, of the proposed rain garden is:

*(area @ full depth + area @ zero depth)/2 = (18' * 200' + 14' * 190')/2 = 3,130 ft*^{2}

The growing medium is proposed to be topsoil amended with 15% expanded shale to a depth, L, of 1 ft.

Thus, the water quality capture depth provided by the rain garden is:

$WQV_{BMP} = 12 * 3130\ ft^2 * [(0.5\ ft + 0.24 * 1\ ft)]/(0.87 * 43560\ ft^2) = 0.73$ *inches*

WQV_{ECM} *for a 92.4% impervious cover area is 1.22 inches.*

Next determine the BMPDF:

BMPDF is determined using Figure 1.6.7-1 and is a function of WQV_{BMP}/WQV_{ECM}

$WQV_{BMP}/WQV_{ECM} = 0.73$ *in./1.22 in. = 0.60*

Using Figure 1.6.7-1, BMPDF = 0.75

The water quality credit from Equation 1.6.7-1 can be calculated as follows:

WQC = IAF × BMPDF = ⅓ × 0.75 = 0.25

Therefore, the rain garden design would provide treatment for 25% of the required water quality volume for the entire site. The remainder of the required water quality volume must be treated using additional down gradient controls or through ~~fee-in-lieu cost~~ payment instead of structural controls.

EXAMPLE CASE STUDY 2 - Full Filtration Rain Garden (underdrain system with orifice)

A 1.75 acre site includes a 1.5 acre parking lot (total impervious cover of 86%) and proposes to use a full filtration rain garden at the perimeter of the parking lot to capture and treat the full water quality volume for the site. Determine the required filtration area for the rain garden.

From Equation H-3,

$A_f \geq WQV/(H + 0.24 * L)$

Assume a maximum ponding depth of H = 1 ft and a minimum biofiltration growing medium depth of L = 2 ft. The ECM required water quality volume for 86% impervious cover is 1.16 inches. Converting this depth into a volume results in the following:

$WQV = 1.75\ ac * 43{,}560\ ft^2/ac * 1.16\ in * 1\ ft/12\ in = 7{,}351\ ft^3$

The required filtration area for full treatment can be calculated as:

$A_f = 7,351\ ft^3/(1\ ft + 0.24 * 2\ ft) = 4,967\ ft^2$

EXAMPLE CASE STUDY 3 - Partial Infiltration Rain Garden (raised outlet pipe)

The same 1.75 acre site with a 1.5 acre parking lot (86% impervious cover) discussed in Example 2 is to be designed with a partial infiltration rain garden to capture and treat the full water quality volume. Desktop studies and field sampling indicate the subgrade consists of a Hydrologic Soil Group B type soil with a design infiltration rate of approximately 0.5 in/hr accounting for a factor of safety of 2. Determine the required filtration area for the rain garden.

From Equation H-5,

$A^f \geq WQV/(H + 0.24 * L_1 + 0.24 * I_f)$

Assume a maximum ponding depth of H = 1 ft and a minimum depth from the top of the growing medium to invert of the raised outlet pipe of $L_1 = 1.2$ *ft. The proposed depth from the invert of the raised outlet pipe to the subgrade surface is* $L_2 = 0.8$ *ft. The infiltration factor is based on the depth of storage below the underdrain (*L_2*) and the 2-day drawdown provided by the subgrade infiltration rate of* $i_{sub} = 0.5$ *in/hr.*

For this case,

$L_2 = 0.8$ *ft and*

$i_{sub} * 2$ *days = 0.5 in/hr * 48 hr * 1 ft/12 in = 2 ft.*

Therefore, $L_2 < i_{sub} * 2$ *days.*

The infiltration factor is determined from Equation H-6b.

$I_f = i_{sub} * 2$ *days = 2 ft.*

The ECM required water quality volume is the same as in Example 2, WQV = 7,351 ft^3.

The required filtration area for full treatment can be calculated as:

$A_f = 7,351\ ft^3/(1\ ft + 0.24 * 1.2\ ft + 0.24 * 2\ ft) = 4,158\ ft^2$.

Source: Rule No. R161-14.26, 12-30-2014 ; Rule No. R161-15.12, 1-4-2016 .

1.6.9 Guidance for Compliance with Technical Requirements of Chapter 25-8, Subchapter A, Article 13 (Save Our Springs Initiative)

1.6.9.3 Control Measure Design

For each site within the Barton Springs Zone, the average annual stormwater pollutant load for the specified pollutants (Section 1.6.9.3.B.1) discharged from a site shall not exceed the existing pollutant load. This is the non-degradation requirement. A series of steps for calculating whether a site's proposed conditions meet non-degradation requirements in the Barton Springs Zone is provided below:

- Calculating existing condition loads (Section 1.6.9.3.B);
- Calculating developed conditions uncontrolled runoff volume and pollutant concentrations (Section 1.6.9.3.C);
- Identifying the stormwater control measures that are currently approved for use within the Barton Springs Zone (Section 1.6.9.3.D);
- Calculating the effluent pollutant concentration of controls operating in series (Section 1.6.9.3.E);
- Calculating proposed developed condition loads (Section 1.6.9.3.E);
- Determining whether the proposed developed condition load complies with non-degradation requirements (Section 1.6.9.3.F); and
- Evaluating alternative stormwater control measures, if applicable (Section 1.6.9.3.G).

For stormwater control measures that do not discharge directly to the surface drainage system (i.e. infiltration measures), the proposed treatment methodology shall be designed to meet the pollutant loading reduction requirements for runoff prior to the treated runoff's re-emergence to the surface or entering the local groundwater system.

To the maximum extent feasible, areas of the site which are to remain undisturbed and undeveloped should not contribute runoff to a proposed developed area and are excluded from the calculations. Such undeveloped areas must remain in their natural condition and must be protected by a plat note or restrictive covenant referenced on the site plan and filed with the appropriate County to prevent the application of fertilizers or pesticides and to limit the disturbance of the natural areas. The removal of diseased or damaged trees or other plants which pose a hazard to health and safety or which pose a threat to the health of other plants in the area may be allowed, upon review and approval of the Watershed Protection Department (WPD).

A. Definitions.

1. Existing conditions. Existing conditions is a reference condition against which to compare developed conditions for the purposes of calculating pollutant loads in this section. (ECM Section 1.6.9.3.B). When calculating existing conditions load, use base impervious cover. (ECM 1.9.2.B). Existing conditions does not include development constructed in violation of City Code.

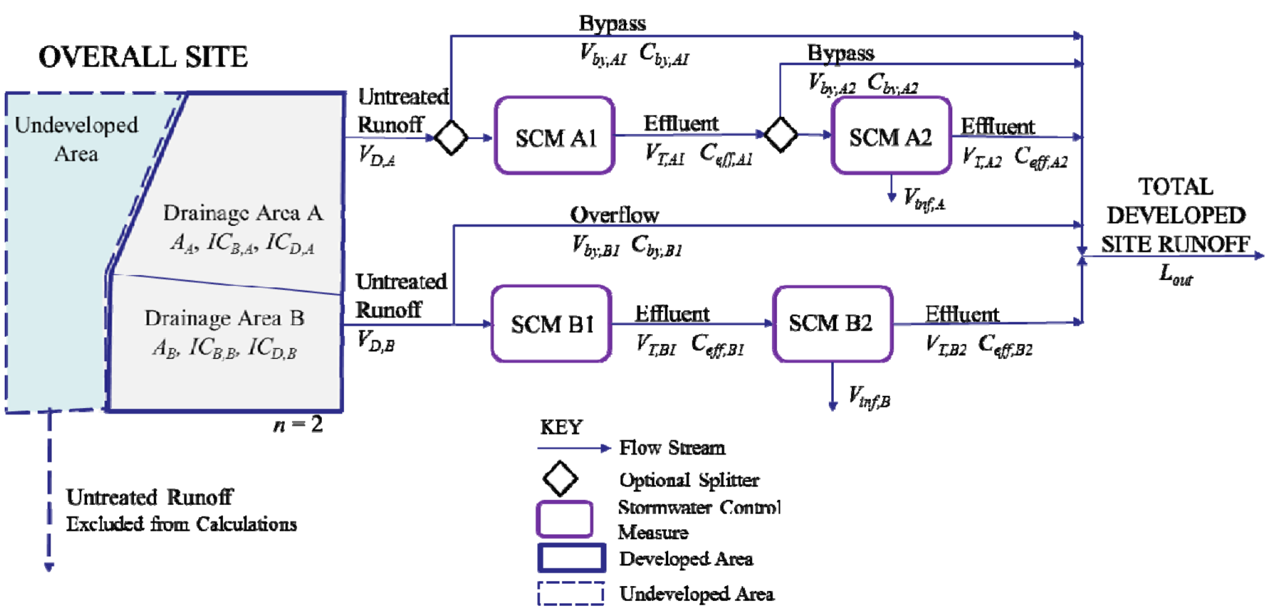
2. Developed conditions. Developed conditions represents the site characteristics under the proposed future development or redevelopment for the purposes of calculating pollutant loads in this section.

3. Stormwater Control Measure. All stormwater runoff treatment systems in this section are referred to as stormwater control measures (in short, SCMs or controls). SCMs are also commonly known as best management practices (BMPs).

4. Calculation Variables and Conceptual Layout. The pollutant load calculations in Section 1.6.9.3.B are based on a mass balance on the developed site runoff streams. Figure 3.A.1 shows an example conceptual layout of a site with multiple drainage areas and treatment trains. The applicant may customize the layout for their site by varying: the number of drainage areas, the presence, absence, type, and size of each SCM, and the flow volumes directed to each SCM. Each SCM and treatment train shall comply with requirements listed in Sections 1.6.9, 1.6.7, and other applicable Sections.

The goal of the ordinance is to treat all of the developed land. In the event that it is not physically possible to route all developed area runoff to an SCM, the runoff from the remaining developed drainage areas shall be treated to a greater extent such that the entire developed site load meets non-degradation requirements.

Figure 1.6.9.3.A.1: Example site showing two developed drainage areas, two SCM treatment trains, and associated calculation variables.



The following list summarizes the variables that will be introduced in the calculation procedure in Sections 1.6.9.3.B through 1.6.9.3.F:

A_{field} = Irrigation field size (Acres)

A_n = Area of each drainage area (Acres)

b = Interevent time (hours)

C_{Ex} = Pollutant concentration for existing conditions (mg/L or CFU/100 mL)

$C_{by,1}$ = Pollutant concentration in flow that bypasses or overflows the first SCM in series (mg/L or CFU/100 mL)

$C_{by,2}$ = Pollutant concentration in flow that bypasses the second SCM in series

C_D = Pollutant concentration for developed conditions (mg/L or CFU/100 mL)

C_{eff} = Treated surface effluent concentration for each pollutant (mg/L or CFU/100 mL)

C_i = The concentration associated with the i^th^ flow stream (mg/L or CFU/100 mL)

$C_{inf,2}$ = Infiltrated concentration for each pollutant for the second SCM in series (mg/L or CFU/100mL)

CF = Conversion factor

For pollutant in mg/L CF = 0.2267 [lb-L/(mg-Ac-in)]

For pollutant in CFU/100 mL CF = 1.0279 [100 mL/(Ac-in)]

DDT = Drawdown time, or time for control to empty its full water quality volume, ~~starting at the beginning of drawdown (hours)~~ including any lag time (hours)

I = Field-verified infiltration rate (in/hr)

IC_B = Base impervious cover (percentage, 0 to 100)

IC_D = Developed impervious cover (percentage, 0 to 100)

LEF_p = Load equivalency factor for pollutant p (unitless)

L_{Ex} = Existing pollutant load (lb/yr or 10^6 CFU/yr)

L_n = The load of each pollutant in the runoff for a single drainage area n (lb/yr or 10^6 CFU/yr)

L_{out} = The annual pollutant load off the site (lb/yr or 10^6 CFU/yr)

m = Peak discharge multiplication factor (unitless)

n = Drainage area ID number

n_z = Number of application zones where irrigation is alternated

n_{max} = Total number of distinct drainage areas on the site

p = Pollutant ID

RCE = Runoff Capture Efficiency, or percent of total drainage area runoff that is captured on an average annual basis (%)

RCE_{inf} = Runoff capture efficiency for infiltrated (or reused) volume on an annual average basis (%)

R_v = Runoff-rainfall ratio (unitless)

S_d = Depression storage (inches)

t = Mean annual rainfall event duration (hours)

t_D = Drain time for full control to empty, ~~starting at end of rain event (hours)~~ excluding any lag time (hours)

LT = Lag time between end of rain event and beginning of ~~drawdown~~ drain time (hours)

v = Mean annual rainfall event volume (inches)

$V_{by,1}$ = Annual bypassed/untreated runoff volume (in/yr)

$V_{by,2}$ = Annual runoff volume treated by SCM 1 but bypassing SCM 2 (in/yr)

V_D = Developed annual runoff volume (in/yr)

V_{Ex} = Existing annual runoff volume (in/yr)

V_i = The volume associated with the i^{th} flow stream (in/yr)

V_{inf} = Annual average volume that is infiltrated (or reused) (in/yr)

$V_{T,1}$ = Annual average runoff volume treated by the first SCM in series (in/yr)

$V_{T,2}$ = Annual average runoff volume treated by SCM 2 but not infiltrated (or reused) (in/yr)

WQV = Water quality volume, or storage volume in SCM 1, normalized to the drainage area (inches)

WQV_{inf} =Infiltrated (or reused) water quality volume normalized to the drainage area (inches)

B. Calculating Pollutant Load for Existing Conditions.

1. Pollutants. Existing and developed pollutant loads shall be calculated for the following pollutant species:

   Chemical Oxygen Demand (COD)

   Escherichia coli (EC)

   Total Lead (Pb)

   Total Nitrogen (TN)

   Total Phosphorus (TP)

   Total Suspended Solids (TSS)

   Total Zinc (Zn)

   Although cadmium (Cd) is also a pollutant of concern, cadmium levels are typically lower than City of Austin monitoring detection limits. Therefore there is insufficient monitoring data to publish cadmium runoff concentrations. Zinc is more easily detected, therefore zinc (Zn) concentrations are calculated to determine compliance. See Section 1.6.9.2.B for additional cadmium requirements.

2. Drainage Areas. Each site shall be subdivided into one or more drainage areas. Pollutant load calculations shall be provided for each drainage area that contains any development, including both impervious and pervious cover, regardless of whether it drains to proposed stormwater control measures or does not drain to any stormwater control measure. The following variables shall correspond to each drainage area:

   A_n = Area of drainage area (Acres)

   n = Drainage area ID number

   Flows from off-site as well as undeveloped areas should be diverted around proposed developed drainage areas. Such diversions may be constructed as open waterways or closed conduits. If swales or berms are used, they must be revegetated and located such that they do not receive on-site flow from developed areas. If flows from off-site and undeveloped areas are not diverted, the total contributing area must be considered when calculating the existing load, developed load, and volume to be captured and treated. However, undeveloped and offsite areas shall not be used to decrease average impervious cover percentage of the drainage area. Where a drainage area must include off-site drainage, the water quality volume associated with the drainage area shall be no less than the required water quality volume for the developed area alone.

3. Base Impervious Cover. Each drainage area has an associated base impervious cover, which is defined in Section 1.9.2. Note that base impervious cover may be 0%, such as if the site is undeveloped or if the entire site is redeveloped, or it may be greater than 0%.

   IC_B = Base impervious cover (percentage, 0 to 100)

4. Existing Runoff. Each drainage area has an associated existing yearly runoff, which can be interpolated from Table 1-9, below. The table was developed from monitoring data collected and analyzed by the City of Austin. From the data, correlations were developed which relate a site's

impervious cover to its runoff-rainfall ratio, R_v, and depression storage, S_d (Glick et al. 2009). Through an additional procedure (Adams & Papa, 2000) these variables were further correlated to annual runoff volume, V, as a function of impervious cover.

V_{Ex} = Existing annual runoff volume, a function of IC_B (in/yr)

Table 1-9: Yearly Runoff as a Function of Impervious Cover.

Impervious Cover, IC (%)	Runoff-Rainfall Ratio, R_v	Depression Storage, S_d (in)	Annual Number of Runoff Events, θ	Annual Runoff, V (in/yr)
0	0.064	0.218	46	1.18
5	0.1	0.198	48.4	1.94
10	0.136	0.18	50.6	2.76
15	0.172	0.163	52.8	3.63
20	0.208	0.148	54.8	4.55
25	0.243	0.134	56.7	5.52
30	0.279	0.122	58.5	6.54
35	0.315	0.11	60.2	7.59
40	0.351	0.1	61.8	8.67
45	0.387	0.091	63.2	9.78
50	0.423	0.082	64.6	10.91
55	0.458	0.075	65.8	12.06
60	0.494	0.068	66.9	13.23
65	0.53	0.062	68	14.42
70	0.566	0.056	69	15.61
75	0.602	0.051	69.9	16.82
80	0.637	0.046	70.7	18.03
85	0.673	0.042	71.5	19.24
90	0.709	0.038	72.2	20.46
95	0.745	0.034	72.8	21.69
100	0.781	0.031	73.4	22.91
Austin Total	—	—	79.3	31.7

Source: COA WPD, CM-09-03.

5. Pollutant Concentration. Each drainage area has an associated existing pollutant concentration. The standard concentrations for the 8 pollutants, based on local monitoring data collected and analyzed by the City of Austin, are shown in Table 1-10, below. When determining pollutant concentrations, the applicant shall use column A for all cases where any development exists, including where the development is pervious (i.e. landscaped areas), and column B only where the site has no existing development.

   C_{Ex} = Pollutant concentration for existing conditions (mg/L or CFU/100 mL)

Table 1-10: Pollutant Concentrations in Surface Runoff

Pollutant, i		Pollutant Concentration, C_{Ex} or C_D	
		A Site Contains Development (IC ≥ 0%)	B Site Completely Undeveloped (IC = 0%)
COD	mg/L	= 38.9 + 66.6·IC	38.9
E. coli	CFU/100 mL	25000	8370
Pb	mg/L	= 0.00428·exp(2.42·IC)	0.00428
TN	mg/L	2.22	1.19
TOC	mg/L	13.03	13.03
TP	mg/L	0.396	0.124
TSS	mg/L	166	166
Zn	mg/L	= 0.0236·exp(2.18·IC)	0.0236

Source: COA WPD, CM-09-03.

6. Pollutant Load. To calculate the existing pollutant load, evaluate Equation 1 for each of the eight pollutant species for each drainage area.

$L_{Ex} = C_{Ex} \cdot V_{Ex} \cdot A_n \cdot CF$ **(Equation 1)**

Where:

L_{Ex} = Existing pollutant load (lb/yr or 10^6 CFU/yr)

C_{Ex} = Pollutant concentration for existing conditions (mg/L or CFU/100 mL), see Section 1.6.9.3.B.5

V_{Ex} = Existing annual runoff volume (in/yr), See Section 1.6.9.3.B.4

A_n = Area of drainage area (Acres), see Section 1.6.9.3.B.2

CF = Conversion factor

CF (pollutant in mg/L) = 0.2267 (lb-L/mg-Ac-in)

CF (pollutant in CFU/100 mL) = 1.0279 (100 mL/Ac-in)

C. Calculating the Developed Conditions Runoff Volume and Pollutant Concentrations.

1. Impervious Cover. Calculation of developed condition pollutant loads must use the same drainage area used to determine the existing conditions loads. Within each drainage area, the total developed impervious cover will be determined as a percent of the gross drainage area. Total developed impervious cover includes all base impervious cover, new impervious cover, and redeveloped impervious cover as defined in Section 1.9.2.B. All developed areas, including areas of impervious cover, lawns, landscaping, gardens, and other maintained pervious areas, shall be included in the developed impervious cover percentage calculation and should be routed to a control. Existing or restored natural areas which are restricted from development, and pesticide, herbicide, or fertilizer application through a plat note or restrictive covenant shall be excluded from the drainage area and associated impervious cover calculations; refer to Section 1.6.9.3.B.2.

IC_D = Developed impervious cover (percentage, 0 to 100)

2. Runoff. Each developed drainage area has an associated annual average runoff volume that is a function of the developed impervious cover. This value can be interpolated from Table 1-9, above.

   V_D = Developed annual runoff volume (in/yr), a function of IC_D

3. Pollutant Concentration. The runoff from each developed drainage area, prior to treatment by any control, has an associated pollutant concentration for developed conditions. This concentration can be found in Column A of Table 1-10, above.

   C_D = Pollutant concentration for developed conditions (mg/L or CFU/100 mL)

D. Determining Treatment Volumes.

1. Approved Stormwater Control Measures (SCMs). For each drainage area, the stormwater control measures shall be designed as two SCMs in series. The first shall be a volume retention-type control that does not allow infiltration. The second shall be a volume reduction-type control; volume reduction, such as by infiltration, is generally the only practical way to achieve non-degradation criteria. Approved SCMs that can be used to treat the runoff from each drainage area are the following:

   - First control in series (SCM 1):
     - Sedimentation/filtration (see Section 1.6.7.C)
     - Retention basin (see Section 1.6.7.A)
     - Rainwater cistern (see Section 1.6.7.D)
     - Biofiltration (see Section 1.6.7.H)
     - Alternative, approved SCM (see Section 1.6.9.3.G)
   - Second control in series (SCM 2):
     - Infiltration field (see Sections 1.6.7.A and 1.6.7.D)
     - Beneficial reuse (typically following a rainwater cistern)
     - Alternative, approved SCM (see Section 1.6.9.3.G)

   SCM 1 shall be designed such that the full capture volume is released over a minimum 48 hour period. This allows better treatment of VOCs, pesticides, herbicides, and other toxic pollutants. Where basins are required to have liners, such liners shall be designed in accordance with the criteria in Section 1.6.2 of the Environmental Criteria Manual.

   Beneficial reuse includes other volume reduction techniques that result in less runoff discharged offsite. Examples include plumbing for non-potable uses such as toilet flushing or irrigation of a landscaped area. If selecting this option, the applicant shall provide calculations that quantify the volume reduction on an average annual basis.

   Water shall be applied to infiltration fields through either irrigation, designed per Section 1.6.7.A, or level-spreading, designed per Section 1.6.7.D. Water from SCM 1 can be conveyed to the infiltration field through pumping or, in cases where site topography allows, gravity drainage. Infiltration fields shall be located to avoid impacts to existing springs and other Critical Environmental Features, including impacts resulting from the discharge of inadequately treated runoff at such locations.

   Infiltration fields shall be designed and sized such that there is no runoff of the applied water from the infiltration field. Application of water from SCM 1 onto the infiltration field shall not commence until a minimum of 12 hours after rainfall ends. This is known as the lag time, t_L. However, systems that satisfy all of the following do not require the 12 hour lag time:

(1) Use a sedimentation/filtration basin for SCM 1.

(2) Gravity-drain to the infiltration field.

(3) Include measures to ensure infiltration of the entire water quality volume, such as berms a maximum of six inches high and that contain two inches of freeboard.

Where higher treatment levels are proposed in one drainage area to compensate for lower treatment levels in another drainage area on the same site, the applicant shall provide information which shows the following:

- The discharge from the area with lower treatment is within the same named watershed as the discharge which provides higher load removal and that the confluence of the discharges occurs within ½ mile of the site;
- No significant recharge features are present in the receiving waterway below the area with lower pollutant load removal and prior to the confluence with the waterway which drains the area with better treated runoff.

Development within the Barton Springs Zone must meet the guidelines in other areas of the ECM such as Section 1.6.7, plus the guidelines listed in Section 1.6.9. Where design guidelines within the ECM conflict, the guidelines in Section 1.6.9 shall take precedence for development.

2. Treatment Volume for First SCM in Series. The runoff capture efficiency (RCE) is the annual average percent of runoff that is captured by a control, considering all storm events. To determine the RCE for SCM 1, the applicant shall either use the equations presented below, perform an independent engineering analysis, or use the City of Austin's Stormwater Load Analysis Tool (SLAT), which is available at the Watershed Protection Department's stormwater management web page (www.austintexas.gov/department/stormwater-management).

Equation 2.A is an expression for runoff capture efficiency that was derived using a probabilistic methodology (Adams & Papa, 2000). In this expression, the runoff capture efficiency is a function of the SCM water quality volume, the SCM drain time, rainfall/runoff variables listed in Table 1-9, and rainfall statistics from a period of record. These rainfall statistics are mean annual rainfall event volume v, mean annual event duration t, and interevent time b and are further defined below.

$$RCE = 1 - \frac{t_D}{t_D + \frac{t \cdot WQV}{v \cdot R_v}} * \frac{\left(\frac{t_D}{b \cdot WQV}\right) + \left(\frac{1}{v \cdot R_v}\right) \exp\left[-\left(\frac{t_D}{b \cdot WQV} + \frac{1}{v \cdot R_v}\right) WQV\right]}{\frac{t_D}{b \cdot WQV} + \frac{1}{v \cdot R_v}} \exp\left(\frac{-S_d}{v}\right)$$

Remove the equation above

$$RCE = 1 - \frac{DDT}{DDT + \frac{t.WQV}{v.R_v}} * \frac{\left(\frac{DDT}{b \cdot WQV}\right) + \left(\frac{1}{v \cdot R_v}\right) \exp\left[-\left(\frac{DDT}{b \cdot WQV} + \frac{1}{v \cdot R_v}\right) WQV\right]}{\frac{DDT}{b \cdot WQV} + \frac{1}{v.R_v}} \exp\left(\frac{-S_d}{v}\right)$$

Add the equation above

(Equation 2.A)

Where:

RCE = Runoff capture efficiency, or percent of drainage area runoff that is captured, on an average annual basis (%)

v = Mean annual rainfall event volume = 0.40 inches

t = Mean annual rainfall event duration = 5.77 hours

b = Interevent time = 103.63 hours

~~t_D = DDT + LT = drain time for full control to empty, starting at end of rain event (hours)~~

DDT= t_D + LT = drain time plus any lag time (hours)

Where:

~~DDT = Drawdown time, or time for control to empty its full water quality volume, starting at beginning of drawdown (hours)~~

t_D = drain time, or time for control to empty its full water quality volume, excluding any lag time (hours)

LT = lag time between end of rain event and beginning of drain time ~~drawdown~~ (hours) (See Section 1.6.9.3.D.1)

R_v = Runoff-rainfall ratio (unitless) (See Table 1-9)

S_d = Depression storage (inches) (See Table 1-9)

WQV = Water quality volume, or storage volume in SCM available to capture runoff normalized to the drainage area (inches)

Typically, the water quality volume is first assumed or iteratively calculated (see Section 1.6.9.3.F).

To calculate the runoff volume treated by SCM 1 on an annual basis, evaluate Equation 3.A:

3. Treatment Volume for SCM 2. Unless proposing a non-volume reduction-based alternative, SCM 2 reduces runoff volume by infiltrating or irrigating into the soil, or reusing water that later joins the sanitary sewer system. Pollutants associated with the infiltrated volume are assumed to pass through sufficient soil to achieve undeveloped concentrations.

   The infiltrated (or reused) water quality volume, WQV_{inf}, is the maximum volume of water that is infiltrated (or reused) over the drawdown period of SCM 1, normalized to the drainage area. The designer typically selects WQV_{inf}.

   Often, WQV_{inf} is equal to the water quality volume of the first control, WQV, and in this case the average annual volume infiltrated (or reused), V_{inf}, is equal to the average annual treated volume of SCM 1, $V_{T,1}$ (see Section 1.6.9.3.D.2). However, WQV_{inf} can be less than WQV depending on design criteria, for example, a limited infiltration field area or a slow rate of beneficial reuse.

The average annual volume infiltrated (or reused), V_{inf}, can be calculated using the same method as $V_{T,1}$ but replacing WQV with WQV_{inf} as shown in Equations 2.B and 3.B:

$$RCE_{inf} = 1 - \frac{t_D}{t_D + \frac{t \cdot WQV_{inf}}{v \cdot R_v}} * \frac{\left(\frac{t_D}{b \cdot WQV_{inf}}\right) + \left(\frac{1}{v \cdot R_v}\right) \exp\left[-\left(\frac{t_D}{b \cdot WQV} + \frac{1}{v \cdot R_v}\right) WQV_{inf}\right]}{\frac{t_D}{b \cdot WQV_{inf}} + \frac{1}{v \cdot R_v}} \exp\left(\frac{-S_d}{v}\right)$$

Remove the equation above

$$RCE_{inf} = 1 - \frac{DDT}{DDT + \frac{t.WQV_{inf}}{v.R_v}} * \frac{\left(\frac{DDT}{b \cdot WQV_{inf}}\right) + \left(\frac{1}{v \cdot R_v}\right) \exp\left[\left(\frac{DDT}{b \cdot WQV} + \frac{1}{v \cdot R_v}\right) WQV_{inf}\right]}{\frac{DDT}{b \cdot WQV_{inf}} + \frac{1}{v.R_v}} \exp\left(\frac{-S_d}{v}\right)$$

Add the equation above

(Equation 2.B)

Where:

RCE_{inf} = Runoff capture efficiency for infiltrated (or reused) volume on an average annual basis (%)

v = mean annual rainfall event volume (See Section 1.6.9.3.D.2)

t = mean annual rainfall event duration (See Section 1.6.9.3.D.2)

b = interevent time (See Section 1.6.9.3.D.2)

~~t_D = drain time (total time for full control to empty) (See Section 1.6.9.3.D.2)~~

DDT = drawdown time (total time for full control to empty, including any lag time) (See Section 1.6.9.3.D.2)

R_v = Runoff-rainfall ratio (unitless) (See Table 1-9)

S_d = depression storage (inches) (See Table 1-9)

WQV_{inf} = Infiltrated (or reused) water quality volume normalized to the drainage area (inches)

Equation 3.A is then re-evaluated using RCE $_{inf}$ instead of RCE and becomes Equation 3.B:

If using an infiltration (or irrigation) field, the infiltrated water quality volume is related to field area by Equation 4. Equation 4 is based on the expressions in Section 1.6.7.D but has been modified to fit the variable definitions of Section 1.6.9. The expression assumes minimal ponding over the infiltration area, and thus, the infiltrated water quality volume is a function of the soil properties, field area, and application rate~~. For irrigated systems, the application rate is assumed to be a constant irrigation rate of WQV_{inf} / DDT. For gravity-draining systems, the application rate is assumed to be an average of WQV inf / DDT.~~ To be conservative, for both gravity-draining systems and irrigated systems, the maximum flow rate is assumed to size the infiltration area. The maximum flow rate is defined as twice the average application rate of WQV_{inf} / DDT. If instantaneous application rates exceed the average, the field shall include design measures, such as low berms, to ensure that there is no excess runoff (see Section 1.6.9.3.D.1).

$$A_{field} = \frac{WQV_{inf} \cdot n_z}{DDT \cdot I} A_n$$

Remove equation above

$$A_{field} = 2\,x \frac{WQV_{inf}}{(DDT - LT) \cdot I} A_n$$

Add equation above

(Equation 4)

Where:

A $_{field}$ = Irrigation field size (Acres)

WQV $_{inf}$ = Infiltrated (or reused) water quality volume normalized to the drainage area (inches)

~~n_z = number of application zones where irrigation is alternated (usually 2 for typical retention/irrigation)~~

DDT = Drawdown time, or time for first control to empty its full water quality volume, including any lag time ~~starting at the beginning of drawdown~~ (hours)

LT = lag time between end of rain event and beginning of drain time (hours)

I = Field-verified infiltration rate (in/hr) (See ECM Section 1.6.7.4)

A $_{n}$ = Area of each drainage area (acres) (See Section 1.6.9.3.C)

If SCM 2 does not infiltrate 100% of the volume, i.e. it has overflow on an average annual basis or is a non-infiltration-based alternative SCM, then the effluent load of the non-infiltrated component is included in the load calculations. The non-infiltrated volume, V $_{T,2}$, shall be determined with Equation 5, which assumes that no bypass from SCM 1 is routed to SCM 2. If this assumption is not met, the volume shall be calculated independently such as with a continuous simulation model.

4. Bypass Volume. A portion of the runoff volume may bypass or overflow both the first and second SCM, thus remaining untreated. To calculate the annual average bypass volume which is not treated by any SCM, use a continuous simulation model or SLAT. For a typical configuration where two SCMs in series treat the same drainage area, Equation 6 can be used to find this bypass volume:

$V_{by,1} = V_{D} - V_{T,1}$ **(Equation 6)**

Where:

$V_{by,1}$ = Annual bypassed/untreated runoff volume (in/yr)

V_{D} = Developed annual runoff volume (in/yr), see Section 1.6.9.3.C.2

$V_{T,1}$ = Annual average runoff volume treated by the first SCM in series (in/yr), see Equation 3.A

The treatment train design may divert a portion of the SCM 1 effluent offsite, bypassing SCM 2. To determine the annual average runoff volume that is treated only by SCM 1 before running offsite$V_{by,2}$, evaluate Equation 7, which assumes that two SCMs in series treat the same drainage area:

E. Calculate the Pollutant Load for the Developed Site with Controls.

1. Treated Effluent Pollutant Concentrations. Each volume component calculated in Section 1.6.9.3.D has an associated pollutant concentration. To find the pollutant concentrations associated with treated effluent, use Table 1-11 below. If using an alternative SCM, apply the effluent concentrations proven with approved testing protocols per Section 1.6.9.3.G.

For SCMs in series, pollutant concentrations are assumed not to increase as they travel through the treatment train. Therefore, for each individual pollutant, the effluent concentration after the final SCM in series shall be the minimum effluent concentration of any of the SCMs that are in that series.

C_{eff-1} = Treated effluent concentration for each pollutant (mg/L or CFU/100 mL)

Table 1-11: Effluent Concentrations for Approved SCMs

Pollutant	Unit	C_{eff}					
		Infiltration Field[1]	Retention Basin[2] and Rain Gardens without Underdrain	Rainwater Harvesting[2]	Sedimentation /Filtration	Biofiltration[3]	Approved Alternative SCM
COD	mg/L	38.9	43.79	43.79	22.4	22.4	Applicant Provided
EC	CFU/100 mL	8370	11065	11065	4895	4895	Applicant Provided
Pb	mg/L	0.00428	0.00831	0.00831	0.00574	0.00574	Applicant Provided
TN	mg/L	1.19	1.42	1.42	1.07	1.07	Applicant Provided
TOC	mg/L	13.03	11.45	11.45	7.33	7.33	Applicant Provided
TP	mg/L	0.124	0.224	0.224	0.099	0.099	Applicant Provided
TSS	mg/L	166	134	134	20.62	20.62	Applicant Provided
Zn	mg/L	0.0236	0.0453	0.0453	0.0230	0.0230	Applicant Provided

Source: COA WPD, CM-13-02.

Table 1-11 Notes:

1. The infiltrated fraction is assumed to achieve background, or undeveloped, loads.
2. These SCMs, given sufficient settling time, are assumed comparable to sedimentation basins.
3. These SCMs are assumed comparable to sedimentation/filtration basins.

2. Bypass Pollutant Concentrations. Runoff that bypasses SCM 1 remains untreated. However, due to the first flush phenomena, the pollutant concentration in the bypass may be less than the event mean concentration. In this calculation methodology, the bypass concentration is a function of SCM 1's water quality volume in inches. Different bypass concentrations are assigned depending on whether SCM 1 is off-line and isolates the water quality volume (typically a splitter is used) or on-line. Table 1-12 summarizes the bypass concentrations for the flows identified in Figure 1.6.9.3.A.1 and defined below:

   $C_{by,1}$ = Pollutant concentration in flow that bypasses or overflows SCM 1 (mg/L or CFU/100 mL)

   $C_{by,2}$ = Pollutant concentration in flow that bypasses SCM 2 (mg/L or CFU/100 mL)

Table 1-12: Bypass Concentrations

Pollutant	Units	SCM 1 Bypass Concentration, $C_{by,1}$		SCM 2 Bypass Concentration, $C_{by,2}$
		Off-line	On-line	
COD	mg/L	= min{$C_{D,COD}$, exp[4.493-0.510(WQV)]	= min{$C_{D,COD}$, exp[4.916-0.545(WQV)] }	= C_{eff-1}, Table 1-11
EC	CFU/100mL	= min{$C_{D,EC}$, exp[10.18-0.465(WQV)]	= min{$C_{D,EC}$, exp[10.79-0.624(WQV)]	= C_{eff-1}, Table 1-11
Pb	mg/L	= min{$C_{D,Pb}$, 0.001·exp[2.882-0.489(WQV)]	= min{$C_{D,Pb}$, 0.001·exp[3.522-0.529(WQV)]	= C_{eff-1}, Table 1-11
TN	mg/L	= min{$C_{D,TN}$, exp[0.957-0.267(WQV)]	= min{$C_{D,TN}$, exp[1.322-0.236(WQV)]	= C_{eff-1}, Table 1-11
TOC	mg/L	= min{$C_{D,TOC}$, exp[2.724-0.189(WQV)]	= min{$C_{D,TOC}$, C_{by} = exp[3.112-0.282(WQV)]	= C_{eff-1}, Table 1-11
TP	mg/L	= min{$C_{D,TP}$, exp[-0.613-0.469(WQV)]	= min{$C_{D,TP}$, exp[-0.223-0.400(WQV)]	= C_{eff-1}, Table 1-11
TSS	mg/L	= min{$C_{D,TSS}$, exp[5.290-0.934(WQV)]	= min{$C_{D,TSS}$, exp[5.862-0.765 (WQV)]	= C_{eff-1}, Table 1-11
Zn	mg/L	= min{$C_{D,Zn}$, 0.001·exp[4.610-0.442(WQV)]	= min{$C_{D,Zn}$, 0.001·exp[5.200-0.531(WQV)]	= C_{eff-1}, Table 1-11

Source: COA WPD, SR-14-10.

Note that the bypass concentration shall not exceed the event mean concentration for the developed drainage area. In the table, min{C_D, C_{by}} means to use the minimum of the two terms.

3. Treated Pollutant Load. Pollutant loads are found by multiplying the volume of each flow component by its associated concentration and then summing for every flow component that contributes to offsite runoff. For each drainage area n, find the pollutant load by evaluating the general expression in Equation 8.A:

   $L_n = A_n \cdot CF \cdot \Sigma(Ci \cdot Vi)$ **(Equation 8.A)**

   Where:

   L_n = The load of each pollutant in the runoff for a single drainage area (lb/yr or 10^6 CFU/yr)

   A_n = Area of drainage area (Acres), see Section 1.6.9.3.B.2

   CF = Conversion factor, see Section 1.6.9.3.B.6

   Ci = The concentration associated with the i^{th} flow stream (mg/L or CFU/100 mL)

   Vi = The volume associated with the i^{th} flow stream (in/yr)

   Written more explicitly, Equation 8.A becomes Equation 8.B. Note that the infiltrated volume is omitted from the calculation, as only the load in surface runoff is considered.

$L_n = A_n \cdot CF \cdot \Sigma(C_{eff\text{-}1} \cdot V_{by,2} + C_{eff\text{-}2} \cdot V_{T,2} + C_{by,1} \cdot V_{by,1})$ **(Equation 8.B)**

Where:

L_n = The load of each pollutant in the runoff for a single drainage area (lb/yr or 10^6 CFU/yr)

A_n = Area of drainage area (Acres), see Section 1.6.9.3.B.2

CF = Conversion factor, see Section 1.6.9.3.B.6

$C_{eff\text{-}1}$ = Treated surface effluent concentration for each pollutant from first SCM in series (mg/L or CFU/100 mL), see Section 1.6.9.3.E.1

$V_{by,2}$ = Annual runoff volume treated by SCM 1 but bypassing SCM 2 (in/yr), see Section 1.6.9.3.D.4

$C_{eff\text{-}2}$ = Treated surface effluent concentration for each pollutant from second SCM in series (mg/L or CFU/100mL), see Section 1.6.9.3.E.1

$V_{T,2}$ = Annual average runoff volume treated but not infiltrated (or reused) (in/yr), see Section 1.6.9.3.D.3

$C_{by,1}$ = Pollutant concentration in flow that bypasses or overflows the first SCM in series (mg/L or CFU/100 mL), see Section 1.6.9.3.E.2

$V_{by,1}$ = Annual bypassed/untreated runoff volume (in/yr), see Section 1.6.9.3.D.4

4. Total Developed Pollutant Load. Find the total developed pollutant load for the entire site by summing the pollutant loads from each developed drainage area n, as in Equation 9:

$L_{out} = \Sigma L_n$ for n=1 to n_{max} (Equation 9)

Where:

L_{out} = The annual pollutant load off the entire site (lb/yr or 10^6 CFU/yr)

n_{max} = Total number of distinct drainage areas on the site

F. Compare the Proposed Developed Load to the Existing Load. Compare the developed pollutant load to the existing pollutant load for each of the pollutants. If the developed load is less than the existing pollutant load for all pollutants, then the site is compliant.

A quick way to demonstrate compliance is with the load equivalency factor (LEF), shown in Equation 10. The LEF normalizes the proposed load to the existing load.

$LEF_p = L_{out,p} / L_{Ex,p}$ (Equation 10)

Where:

LEF_p = Load equivalency factor for pollutant p (unitless)

If the LEF is less than or equal to one for every pollutant, then the proposed design is compliant. No further calculations are necessary to satisfy the requirements of Section 1.6.9.

If the LEF is greater than one for any pollutant i, then the proposed design is not compliant and the applicant shall modify their design. Options for design modifications include but are not limited to:

- Increase the water quality volume of the SCM(s).
- Increase the area of the infiltration field(s).
- Reduce the developed impervious cover.

The applicant should iterate through the calculation procedure with the modified design until compliance is demonstrated.

G. Evaluation of Alternative Stormwater Control Measures. All stormwater control measures not explicitly listed in Section 1.6.9.3.D, as well as those listed but that modify the standard designs in the Environmental Criteria Manual and/or that propose effluent concentrations that vary from Table 1-11, are considered alternative designs. Designs for alternative stormwater control measures must be reviewed and approved by the Director of the WPD, and the design criteria must be substantiated in the scientific and engineering literature.

The applicant shall submit an engineering report from a third party testing source to verify the effluent concentrations from the proposed alternative SCM. Appropriate third party testing sources include Accreditation Board for Engineering and Technology (ABET) approved universities, peer-reviewed, published journal articles, tests performed according to Technology Assessment Protocol-Ecology (TAPE) (Washington State Department of Ecology, 2011) or Technology Acceptance Reciprocity Partnership (TARP, 2003) protocols. Testing data provided only from the manufacturer, without certified third party testing, is unacceptable. Additional criteria used to determine the acceptability of the alternative design include: similarity of studied site to conditions in the Austin, Texas area including items such as rainfall patterns, soil characteristics, and type of development; applicability of study to the proposed site; and conformance of proposed design with that studied.

The applicant is encouraged to discuss proposed designs with the WPD staff at an early stage to ascertain the acceptability of all alternative or innovative design concepts. The final acceptability of data shall be determined by the Director of the WPD. If approved, the applicant may use the data in pollutant load removal calculations to determine compliance with the appropriate Land Development Code requirements.

H. References.

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Source: Rule No. R161-14.27, 12-30-2014 ; Rule No. R161-17.04 , 3-2-2017; Rule No. R161-18.05 , 6-12-2018.

1.8.0 IMPERVIOUS COVER CALCULATION CRITERIA

1.8.1 Calculations

G. For the purposes of calculating impervious cover for public mobility projects as defined by LDC 25-1-21(89) in the right-of-way, the site area is the total area from right-of-way line to right-of-way line along the length of the project. For determining compliance with watershed impervious cover limits, the percentage of proposed impervious cover is calculated as a percentage of the project's right-of-way area, not as a percentage of the area inside the limits of construction.

1.9.0 NEED FOR WATER QUALITY CONTROLS

1.9.1 General Requirements

Section 25-8-211 of the Land Development Code establishes the need for water quality controls for subdivisions and site plans. Water quality controls are not required on a single-family or duplex lot but apply to the residential subdivision as a whole. In all watersheds, water quality controls are not required for a roadway improvement with less than 8,000 square feet of new impervious cover, as defined below. Roadway improvements are limited to intersection upgrades, low-water crossing upgrades, additions for bicycle lanes, and additions for mass transit stops.

In the Barton Springs Zone, water quality controls are required for all development except for the minor roadway improvements described above. In a watershed other than a Barton Springs Zone watershed, water quality controls are required for development if the total of new and redeveloped impervious cover exceeds 8,000 square feet. Water quality controls are also required for development located in the Water Quality Transition Zone and for the development of golf courses and playfields where fertilizers, pesticides or herbicides are applied.

Removal of impervious cover and replacement with vegetation does not require water quality controls. Removal and replacement of impervious cover necessary for the installation, repair or replacement of utilities does not require water quality controls. For public mobility projects in the right-of-way that span multiple watersheds, water quality treatment requirements shall be determined on a watershed basis. Existing impervious cover within the same watershed that is removed and replaced with vegetated area that has been decompacted as per Standard Specification 661S can be deducted from the total overall water quality treatment requirement. (New IC + Redeveloped IC – Removed and decompacted = Total)

Development of less than 1,000 SF for which a site plan exemption is granted in accordance with Section 25-5-2 of the Land Development Code, does not require water quality controls, however, cumulative impervious cover resulting from a project claiming this exemption on more than one occasion will require water quality controls according to the criteria below.

Source: Rule No. R161-14.21, 9-2-2014; Rule No. R161-18.05 , 6-12-2018.

1.9.2 Requirements For Water Quality Controls In The Uplands Zone

Water quality control requirements vary with watershed regulatory category and development situation, as described below. In some instances, it may not be possible to collect all areas of a development to a water quality control. In those cases, it may be acceptable to treat an approved equivalent area. The approved equivalent area must be an area that does not currently receive treatment and is not likely to be treated in the future such as those areas that meet the definition of base impervious cover, public rights-of-way and/or single family subdivisions. An approved equivalent area is hereby defined as one (1) to one and one-half (1.5) times the proposed impervious cover area that requires water quality controls.

A. Criteria For Urban Watersheds

An alternative to providing on-site water quality controls is provided for in LDC Section 25-8-214, Optional Payment Instead ~~Lieu~~ of Structural Water Quality Controls ~~in Urban Watersheds~~. Additional information is provided in Appendix T of the Environmental Criteria Manual, "Request for Fee Instead ~~in Lieu~~ of Water Quality Controls ~~in the Urban Watersheds~~." In addition, under Section 25-8-215, a person who redevelops property in an Urban Watershed qualifies for Cost Recovery by the City if the following Criteria are met:

1) Construction of structural controls

a. Redeveloped portion is greater than 1 acre; and

b. Structural control treats at least 10 acres of previously untreated off-site drainage, in addition to the ECM required volume required for redevelopment.

2) Payment instead ~~lieu~~ of structural controls

a. Project drains to an existing or proposed regional structural control funded by Urban Structural Control Fund. Pond must have capacity to treat proposed development at ECM levels.

Upon either of the aforementioned conditions being met, the City may reimburse the applicant according to Part D of Appendix T. If Cost Recovery is pursued in addition to City of Austin Cost Participation for a Regional Water Quality Pond via a Community Facilities Contract, the maximum COA reimbursement shall not exceed 100% of the cost of the pond.

Base impervious cover is that which both existed on the site on the effective date of the Urban Watershed Ordinance (September 10, 1991) and which currently exists at the time of application for a new or revised permit, or which is permitted or existing for which water quality controls have been provided, and is not proposed to be redeveloped. If any portion of base impervious cover is redeveloped or proposed to be redeveloped, that portion becomes redeveloped impervious cover as defined below and is no longer base impervious cover. New impervious cover is the cumulative total of all impervious cover added or proposed to be added to a project since the effective date of the Urban Watershed Ordinance, and for which water quality controls have not been previously provided. Redeveloped impervious cover is the cumulative total of all impervious cover redeveloped or proposed to be redeveloped on a project since the effective date of the Urban Watershed Ordinance, and for which water quality controls have not been previously provided. Cumulative total of impervious cover shall include that impervious cover added to a site under one or more of the following: permits, site plans, exemptions, waivers, or unapproved development. This shall apply to each site plan or development permit regardless of the number of lots within that plan or permit.

For all levels of impervious cover, projects in the Urban Watersheds must provide water quality controls when the cumulative total of both new and redeveloped impervious cover exceeds 8,000 square feet. Water quality controls must be added for 100% of the area of development containing new impervious cover or redeveloped impervious cover. The area of development containing base impervious cover does not require water quality controls unless it is redeveloped.

B. Criteria For Barton Springs Zone

1. SOS ORDINANCE (920903D)

Base impervious cover is that which both existed on the site on May 18, 1986, and which currently exists at the time of application for a new or revised permit, or which is permitted or existing for which water quality controls have been provided, and is not proposed to be redeveloped. If any portion of base impervious cover is redeveloped or proposed to be redeveloped, that portion becomes redeveloped impervious cover as defined below and is no longer base impervious cover. New impervious cover is the cumulative total of all impervious cover added or proposed to be added to a project since May 18, 1986, and for which water quality controls have not been previously provided. Redeveloped impervious cover is the cumulative total of all redeveloped impervious cover or proposed redeveloped impervious cover since May 18, 1986, and for which water quality controls have not been previously provided. Cumulative total of impervious cover shall include that impervious cover added to a site under one or more of the following: permits, site plans, exemptions, waivers, or unapproved development. This shall apply to each site plan or development permit regardless of the number of lots within that plan or permit.

According to Section 25-8-514 of the Land Development Code, all development requires that water quality controls and onsite pollution prevention techniques be provided which result in no increases in respective average annual loading of the specified pollutants. Water quality controls must be added for 100% of the area of new development or redevelopment. Base impervious cover does not require treatment unless it is redeveloped. Refer to Section 1.6.9 ECM for design information.

Section 25-8-516 excludes the application of SOS to development limited to a total of 8,000 SF for existing tracts and platted lots existing as of November 1, 1991. Development excluded from these provisions should follow the requirements set forth under the following Section 1.9.2C “Criteria for Watersheds other than Barton Springs Zone and Urban.”

2. Redevelopment Exception

Section 25-8-26 of the Land Development Code provides an exception for redevelopment in SOS regulated areas. If proposed development is opting to comply with Section 25-8-26 (Barton Springs Zone Redevelopment Exception) refer to ECM Appendix Q-4 for water quality control requirements.

C. Criteria For Watersheds Other Than Barton Springs Zone And Urban

Base impervious cover is that which existed on the site on the effective date of the Comprehensive Watershed Ordinance which is May 18, 1986, and which currently exists at the time of application for a new or revised permit, or which is permitted or existing for which water quality controls have been previously provided, and is not proposed to be redeveloped. If any portion of base impervious cover is redeveloped or proposed to be redeveloped, that portion becomes redeveloped impervious cover as defined below and is no longer base impervious cover. New impervious cover is the cumulative total of all impervious cover added or proposed to be added to a project since May 18, 1986, and for which water quality controls have not been provided. Redeveloped impervious cover is the cumulative total of all redeveloped or proposed redeveloped impervious cover since May 18, 1986, and for which water quality controls have not been previously provided. Cumulative total of impervious cover shall include that impervious cover added to a site under one or more of the following: permits, site plans, exemptions, waivers, or unapproved development. This shall apply to each site plan or development permit regardless of the number of lots within the plan or permit.

1.9.2 Requirements For Water Quality Controls in the Uplands Zone

Projects in watersheds other than the Barton Springs Zone and the Urban watersheds, must provide water quality controls when impervious cover results in a cumulative total of more than 8,000 square feet of both new and redeveloped impervious cover. Water quality controls must be added for 100% of the area of development containing new impervious cover or redeveloped impervious cover. The area of development containing base impervious cover does not require water quality controls unless it is redeveloped.

D. Criteria for Public Mobility Projects in the Right of Way Outside of the Barton Springs Zone.

A public mobility project is defined in LDC 25-1-21 (89). The calculation of base impervious cover for public mobility projects is the same as is described in Sections A-C above depending upon the relevant watershed regulation area. The calculation of impervious cover for compliance with LDC 25-8-211 (B)(3) or Subsection (E) in any watershed shall:

(1) be determined on a watershed basis for development applications that span multiple watersheds; and

(2) shall be allowed to treat the net impervious cover proposed by deducting existing impervious cover that is removed by the same project if the area with removed impervious cover is:

(i) decompacted and revegetated as prescribed in the Environmental Criteria Manual and the Standard Specifications Manual; and

(ii) located within the same watershed.

An alternative to providing on-site water quality controls is provided for in LDC Section 25-8-214, Optional Payment instead of Structural Water Quality Controls. Additional information is provided in Appendix U of the Environmental Criteria Manual, "Request for Payment Instead of Water Quality Controls."

Projects must provide water quality controls or provide payment instead of water quality when impervious cover results in a cumulative total of more than 8,000 square feet of both new and redeveloped impervious cover. Water quality controls must be added for 100% of the area of development containing new impervious cover or redeveloped impervious cover. The area of development containing base impervious cover does not require water quality controls unless it is redeveloped.

Source: Rule No. R161-14.21, 9-2-2014 ; Rule No. R161-17.04 , 3-2-2017.

REMOVE AND REPLACE

APPENDIX U
FINDINGS OF FACT

Watershed Variances - Findings of Fact

As required in LDC Section 25-8-41, in order to grant a variance the Planning Commission must make the following findings of fact: Include an explanation with each applicable finding of fact.

Project: ________

Ordinance Standard: ________

JUSTIFICATION:

1. Are there special circumstances applicable to the property involved where strict application deprives such property owner of privileges or safety enjoyed by other similarly situated property with similarly timed development? YES/NO
2. Does the project demonstrate minimum departures from the terms of the ordinance necessary to avoid such deprivation of privileges enjoyed by such other property and to facilitate a reasonable use, and which will not create significant probabilities of harmful environmental consequences? YES/NO
3. The proposal does not provide special privileges not enjoyed by other similarly situated properties with similarly timed development, and is not based on a special or unique condition which was created as a result of the method by which a person voluntarily subdivided land. YES/NO
4. Does the proposal demonstrate water quality equal to or better than would have resulted had development proceeded without the variance? YES/NO
5. For a variance from the requirements for development within the Critical Water Quality Zone and/or Water Quality Transition Zone: Does the application of restrictions leave the property owner without any reasonable, economic use of the entire property? YES/NO

A variance requires all above affirmative findings with explanations/reasons.

NEW

APPENDIX U: REQUEST FOR PAYMENT INSTEAD OF WATER QUALITY CONTROLS FOR PUBLIC MOBILITY PROJECTS OUTSIDE OF THE BARTON SPRINGS ZONE

Please refer to instructions before completing this form. An electronic form is available on the Watershed Protection website.

A. OWNER/AGENT INFORMATION:

Company: Owner/Agent Name:

Phone Number: Email:

B. PROJECTINFORMATION:

Project name: ______________________

Locationor Address: ______________________

Development Case Number: ______________________

Case Manager: ______________________

Redeveloped Impervious Cover (R)______+ New Impervious Cover________= Total Impervious Cover (T)_________ac.

R/T Ratio = Redeveloped IC/ Total IC: ____________________

C. PAYMENT CALCULATIONS:

1. SITE IMPERVIOUS COVER COMPONENT (SICC)	Rate ($) x	Acreage (ac.) =	Total ($)
0 to 1.0 acre	114,000	A1	
1.01 to 2.0 acres	58,000	A2	
2.01 to 5.0 acres	34,000	A3	
5.01 to 10.0 acres	21,000	A4	
10.01 to 20.0 acres	14,000	A5	
20.01 acres or greater	8,000	A6	

SICC SUBTOTAL ____________

CONSTRUCTION COST ADJUSTMENT FACTOR (ENR CCI AF) ____________

SICC TOTAL (PAYMENT 1) **SICC X ENR CCI AF =** (PAYMENT 1)

2. BUILDING COMPONENT(PAYMENT 2) $0.10 X (B) ____________sf = (PAYMENT 2)
(NOTE: CITY PORTION = $0)

3. SITE AREA IMPACT COMPONENT (SAIC = PAYMENT 3)

LAND VALUE (CURRENT TCAD OR MOSTRECENT APPRAISAL) $____________

LAND AREA (CURRENT TCAD OR MOSTRECENT APPRAISAL) ____________ac.

LAND VALUE/ LAND AREA ($/ac.) ________X Site Acreage________ X 80% X 3% X SIC= (PAYMENT 3)

4. PAYMENT AMOUNTS

TOTAL PAYMENTS (1 + 2 + 3) = ____________

CITY PORTION (CP): IF SUBJECT PROPERTY DRAINS TO PROPOSED OR EXISTING REGIONAL SCM
OTHERWISE CP = 0 **CP = (PAYMENT 1 + PAYMENT 3) X R/T X 75% =** ____________

APPLICANT PAYMENT: **TOTAL PAYMENTS - CP=** ____________

D. COST RECOVERY:

PARTICIPATION MUST BE APPROVED BY A WATERSHED PROTECTION - STORMWATER TREATMENT SECTION REPRESENTATIVE.

APPROVED CONSTRUCTION COST = $____________ATTACH 300U STANDARD BID DOCUMENT WITH ENGINEER'S COSTESTIMATE.

CITY PORTION (CONSTRUCTION COST X R/T X 75%) = ____________

E. AUTHORIZATION:

OWNER/AGENT: ______________________ DATE: ____________
SIGNATURE

REVIEWED BY: ______________________ DATE: ____________
SIGNATURE FOR THE DIRECTOR, DEVELOPMENT SERVICES DEPARTMENT

NEW

INSTRUCTIONS FOR COMPLETING REQUEST FOR PAYMENT INSTEAD OF WATER QUALITY CONTROLS FOR PUBLIC MOBILITY PROJECTS (LDC 25-8-214(F))

PART A. OWNER/AGENT INFORMATION:

Provide the name of the sponsoring department, project manager, or agent for the project, phone number, and email address.

PART B. PROJECT INFORMATION:

Provide the name of the project, location or address, site development or site plan number, and the name of the case manager in the Development Services Department.

Provide the net area of impervious cover, in acres, that is considered new and redevelopment (R) per ECM 1.9.2.D. Impervious cover shall be measured to the nearest 0.01 acre. Net impervious cover for public mobility projects means that the areas of existing impervious cover that are removed, decompacted, and revegetated may be deducted from the total area of required water quality treatment. In order to take credit for areas of existing impervious cover that are proposed to be decompacted and revegetated, the plan set must clearly delineate each area to be removed and restored as required by the Director. Each plan set must also clearly show the square foot area of impervious cover to be removed, decompacted, and restored along with the sum total of all restored area. Water quality review staff may request additional clarifying language as necessary to achieve clarity. Standard decompaction specification 661S.1 shall apply to these areas and shall be clearly referenced within the plan set.

Calculate the total impervious cover (T) by summing the two acreages determined above.

Calculate the ratio of redeveloped impervious cover (R) to total impervious cover (T) for this project by dividing the redeveloped impervious cover by the total impervious cover. This ratio is called R/T on the form. If the R/T is zero (0), the project is not considered redevelopment.

PART C. PAYMENT CALCULATION

1. **Site Impervious Cover Component (SICC)**: Calculate the portion of the payment related to site impervious cover. The total impervious cover constructed by this project should be divided into the following increments.

   A1: Area of IC = 0 to 1.0 acres A2:
   Area of IC = 1.01 to 2.0 acres A3:
   Area of IC = 2.01 to 5.0 acres

   A4: Area of IC = 5.01 to 10.0 acres A5:
   Area of IC = 10.01 to 20.0 acres A6:
   Area of IC = 20.01 or greater

   Insert these areas into the payment formula and calculate the individual parts of the payment. Sum these to calculate the unadjusted total payment associated with the site impervious cover (SICC subtotal).

   Calculate PAYMENT 1 by multiplying the SICC subtotal by the Engineering News Record Construction Cost Index Adjustment Factor (ENR CCI AF). This construction cost index adjustment factor must be calculated annually using the Engineering News Record (ENR) 20 city average Construction Cost Index (CCI) with the base index being the ENR CCI of September 2018 (11170.28). For each fiscal year, the ENR CCI AF shall be recalculated in October as the ratio of the current September ENR CCI divided by the September 2018 CCI. Multiplying the new ENR CCI AF to the SICC subtotal will provide the SICC portion of the payment (PAYMENT 1) adjusted for the current fiscal year.

2. **Site Area Impact Component (SAIC)**: Calculate the portion of the payment related to size of the site area under development. Determine the SAIC by providing a current applicable appraisal district land value or the land value from a certified appraisal. For requests that involve multiple lots, the total land value and acreage of all lots shall be used. Certified appraisals must have been performed within six (6) months of the project submittal date. Calculate PAYMENT 3 by the dividing the current applicable appraisal district land value (or the land value from a certified appraisal) by the land area associated with that appraisal to achieve a land value per land acre rate. Multiply this rate by the development application site acreage, then multiply by 80% (0.8), multiply by 3% (0.03), and finally multiply by the Site Impact Component (SIC), which is defined as the ratio of New IC plus Redeveloped IC divided by total IC. This will provide the SAIC portion of the payment (PAYMENT 3).

   (Land Value / Land Area) X Site Acreage X 0.8 X 0.03 X SIC= SAIC

3. **Payment Amounts:** Calculate the total payment owed by the applicant and the City. The total payment is calculated by summing the individual portions of the payment calculated under 1, 2, and 3 above (Payment 1 + Payment 2 + Payment 3).

   If the site drains to a proposed or existing regional water quality control, the applicant qualifies for up to 75% cost recovery of portions of this payment (75% is the cost share ratio established by City Council for water quality controls associated with redevelopment in Urban watersheds). Calculate the City's Portion (CP) of this component by summing PAYMENT 1 and 3 and then multiplying that sum by the R/T ratio and by 0.75 (75%). Verification that the site drains to a proposed or existing regional water quality control must be provided by a Watershed Protection – Stormwater Treatment section representative. The applicant's share of the payment is calculated by subtracting the CP from the total payment.

PART D. COST RECOVERY FOR ON-SITE CONTROLS (LDC 25-8-215)

This portion of the form shall be used if the applicant proposes, or the City requires construction of a water quality control on-site and the site is undergoing redevelopment (see ECM 1.6.2.A and 1.9.2.A for cost recovery participation criteria).

Provide the engineer's estimate of the cost of constructing the water quality control, excluding the cost of the land. A detailed estimate of costs (300U Unit Price Bid form) shall be attached to the form and sealed by the engineer. The cost recovery payment is calculated by multiplying the construction cost by the R/T ratio and then by 0.75 (75%).

Upon completion of construction at the site sponsoring department, project manager, or agent shall notify the Environmental Site Inspector and a representative of the Watershed Protection Stormwater Treatment section that the water quality control is complete. In addition, the engineer's concurrence letter shall be provided which includes a statement that the water quality control has been built in accordance with the approved plans.

The City shall inspect the control to ensure that it is built in compliance with the approved plans and is operating properly. If deficiencies are noted during the inspection, the City shall notify the Owner in writing within 30 days of the specific deficiencies. The owner shall remedy any such deficiencies and notify the Environmental Site Inspector that the controls are ready for inspection. When the controls are determined by the City to be in conformance with the approved plans and the control has been accepted by Watershed Protection, per ECM 1.6.3.A, the City will issue a check to the owner for the approved amount.

PART E. AUTHORIZATION

The sponsoring department, project manager, or agent for the project must sign and date the Request form. Upon review and approval of the payment or cost recovery amount, the Director of the Watershed Protection Department or designee will sign and date the form indicating approval of the payment. A copy of the approved form will be given to the fiscal staff for processing. In conjunction with the payment, the agreement shown in Appendix T shall be signed and act as a binding agreement between the applicant and the City per ECM 1.6.4.B.1.c