2025 Ventura County Technical Guidance Manual for Stormwater Quality Control Measures (TGM)

Ventura Countywide Stormwater Quality Management Program

Training Seminar

September 23, 2025

Welcome

Presenters

Hayley Luna
PE, CPESC, QSD
Deputy Director
Ventura County Watershed Protection District

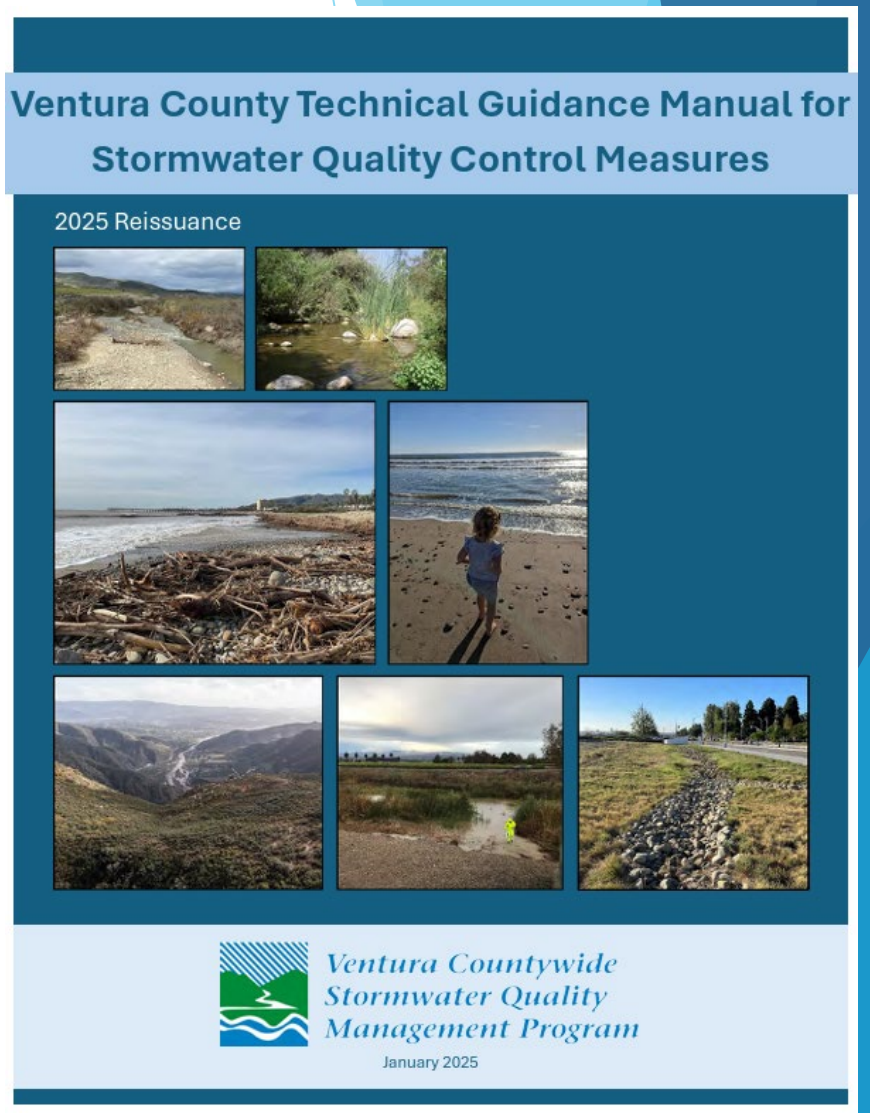
Peter Shellenbarger
CPMSM, CPSWQ, QSP/QSD
Environmental Compliance Supervisor
City of Ventura Public Works

Tai P. Chau
PE, CFM, MPA
Assistant Director / City Engineer (Land Development)
City of Oxnard Community Development

David Laak
Stormwater Resources Manager
Ventura County Watershed Protection District

Agenda

1. Local Land Use Authority - *Hayley Luna*
2. Ventura Countywide Stormwater Quality Management Program - *Hayley Luna*
3. Water Quality Background - *Peter Shellenbarger*
4. 2025 Ventura County Technical Guidance Manual for Stormwater Quality Control Measures - *Peter Shellenbarger*
5. 2021 Regional Phase I MS4 NPDES Permit - *Peter Shellenbarger*
6. 2025 TGM vs. 2011 TGM – Technical Calculations/BMPs Sizing – *Tai Chau*
7. Question & Answer - *David Laak*

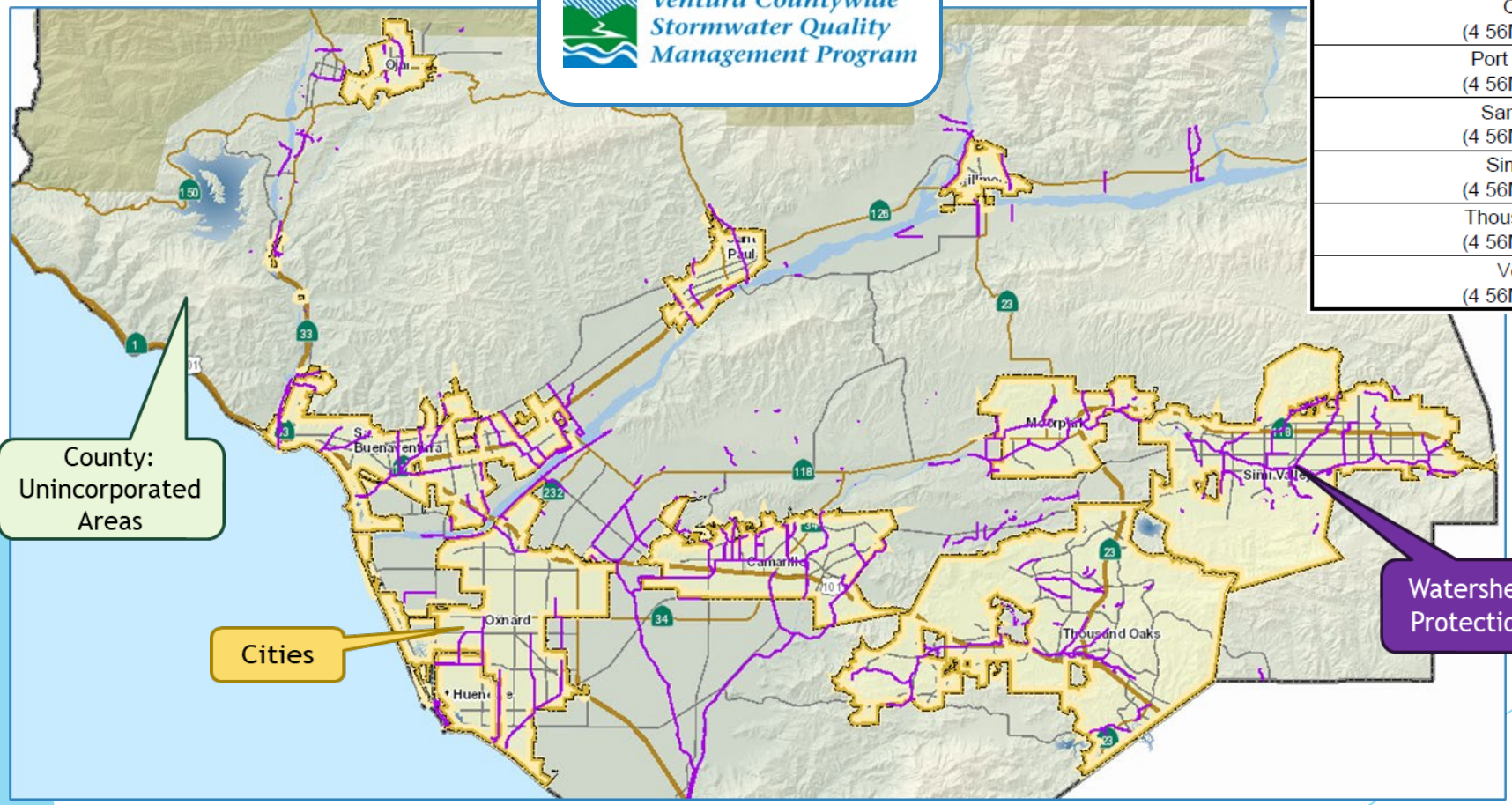


Local Land Use Authority

Cities, County, and Watershed Protection are separate MS4 permittees

Together, we are

Ventura Countywide Stormwater Quality Management Program



Permittee (SMARTS WDID)	Physical Address
Ventura County Watershed Protection District (4 56M1000326)	800 S. Victoria Ave. Ventura CA, 93009
Ventura County (4 56M1000183)	800 S. Victoria Ave. Ventura CA, 93009
Camarillo (4 56M1000173)	601 Carmen Drive Camarillo, CA 93010
Fillmore (4 56M1000174)	250 Central Ave. Fillmore, CA 93015
Moorpark (4 56M1000175)	799 Moorpark Ave, Moorpark, CA 93021
Ojai (4 56M1000176)	408 South Signal Street Ojai, CA 93023
Oxnard (4 56M1000177)	305 West Third Street Oxnard, CA 93030
Port Hueneme (4 56M1000178)	250 North Ventura Road Port Hueneme, CA 93041
Santa Paula (4 56M1000179)	970 Ventura Street Santa Paula, CA 93060
Simi Valley (4 56M1000180)	2929 Tapo Canyon Road Simi Valley, CA 93063
Thousand Oaks (4 56M1000181)	2100 Thousand Oaks Boulevard Thousand Oaks, CA 91362
Ventura[3] (4 56M1000182)	501 Poli Street Ventura, CA 93001

Ventura Countywide Stormwater Quality Management Program

Management Committee

- Construction
- Public Agency Activities
- Capital Improvement Projects
- Business and Illicit Discharges
- Public Outreach
- **Planning and Land Development**

- https://vcstormwater.org/
- https://www.cleanwatershed.org/

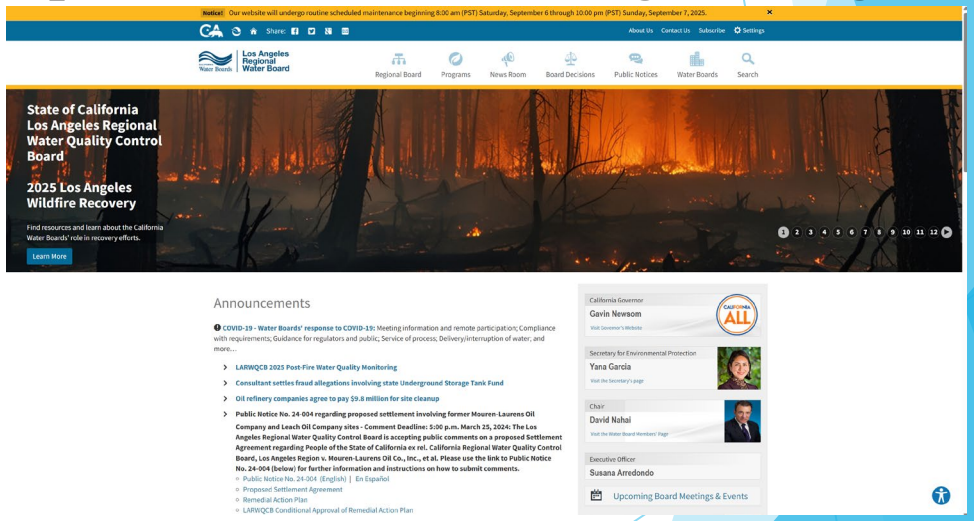
3. Water Quality Background

Water Quality Background

The Mission of the Regional Board is to preserve and enhance water quality in the Los Angeles Region for the benefit of present and future generations

- Water quality is managed locally by the Los Angeles Regional Water Quality Control Board
- Regional Boards issue discharge permits and waste discharge requirements for point and non-point dischargers associated with
  - Urban areas
  - Agriculture
  - Industrial areas
  - Construction
  - Septic systems
  - Sanitary sewer/treatment
  - Groundwater
- Local Land Use Authorities are required to implement MS4 Permit requirements as written and do not create the requirements

https://www.waterboards.ca.gov/losangeles/



Water Quality Background

Los Angeles Regional Water Quality Control Board MS4 Actions

- First Ventura County MS4 Permit 1994
- Second Ventura County MS4 Permit 2000
- Third Ventura County MS4 Permit 2009, challenged and readopted 2010
- Fourth Ventura County MS4 Permit 2021 (July)
- Each permit includes more stringent and prescriptive requirements

Water Quality Background

Regional Phase I MS4 NPDES Permit Los Angeles Region

Stormwater Management Program Minimum Control Measures

- Public Information and Participation
- Industrial/Commercial Facilities Program
- Planning and Land Development Program
- Construction Program
- Public Agency Activities
- Illicit Discharge Detection and Elimination Program

Water Quality Background

What are the Goals of the Planning and Land Development Program?

- *Mitigation of potential pollutants from urbanization surfaces*
- *Implementation of non-structural best management practices*
- *Construction and implementation of structural best management practices*

Water Quality Background

Planning and Land Development Program

- Land development and urbanization linked to water quality impacts
- Poorly planned and constructed new development and re-development projects have potential to impact hydrology and water quality of surface waters
  - Increased peak storm stream flows
  - Increased pollutant loading
  - Reduced base flows

Table 3-2: Land Uses and Associated Pollutants

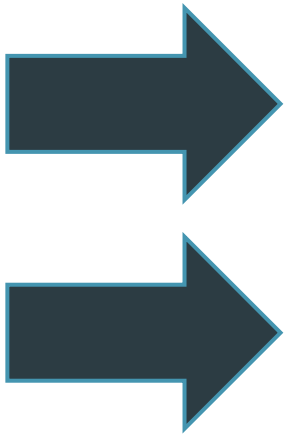
Class of Pollutant	Potential Land Use and Activities Sources
Sediment (TSS and Turbidity)	Streets, driveways, roads, landscaped areas, construction activities, soil erosion (channels and slopes)
Nutrients	Landscape fertilizers, atmospheric deposition, automobile exhaust, soil erosion, animal waste, detergents
Metals/Metalloids	Automobiles, bridges, atmospheric deposition, industrial areas, soil erosion, metal surfaces, combustion processes
Pesticides	Landscaped areas, roadsides, utility rights-of-way
Organic Materials/ Oxygen Demanding Substances	Landscaped areas, animal wastes, industrial wastes
Oil and Grease/ Organics Associated with Petroleum	Roads, driveways, parking lots, vehicle maintenance areas, gas stations, automobile emissions, restaurants
Bacteria and Viruses	Lawns, roads, leaky sanitary sewer lines, sanitary sewer cross-connections, animal waste (domestic and wild), septic systems, homeless encampments, sediments/biofilms in stormwater conveyance system
Trash and Debris (Gross Solids and Floatables)	Commercial areas, roadways, schools, trash receptacles/storage/disposal

Adapted from US EPA, 1999 (Preliminary Data Summary of Urban Stormwater BMPs)

Water Quality Background

US EPA And CA Water Boards Want Paradigm Shift

- Moving away from curb/gutter transporting stormwater quickly away from development projects
- Moving away from small footprint flow-based treatment approach



- Moving toward the concept of managing stormwater the way natural environments do through infiltration, evapotranspiration, capture & use, biofiltration
- Promotes healthier soils, groundwater recharge, flood reduction, urban heat island effect mitigation, improved water quality, etc.

Water Quality Background

City of Ventura Kellogg Park

4. 2025 Ventura County Technical Guidance Manual for Stormwater Quality Control Measures - General Information

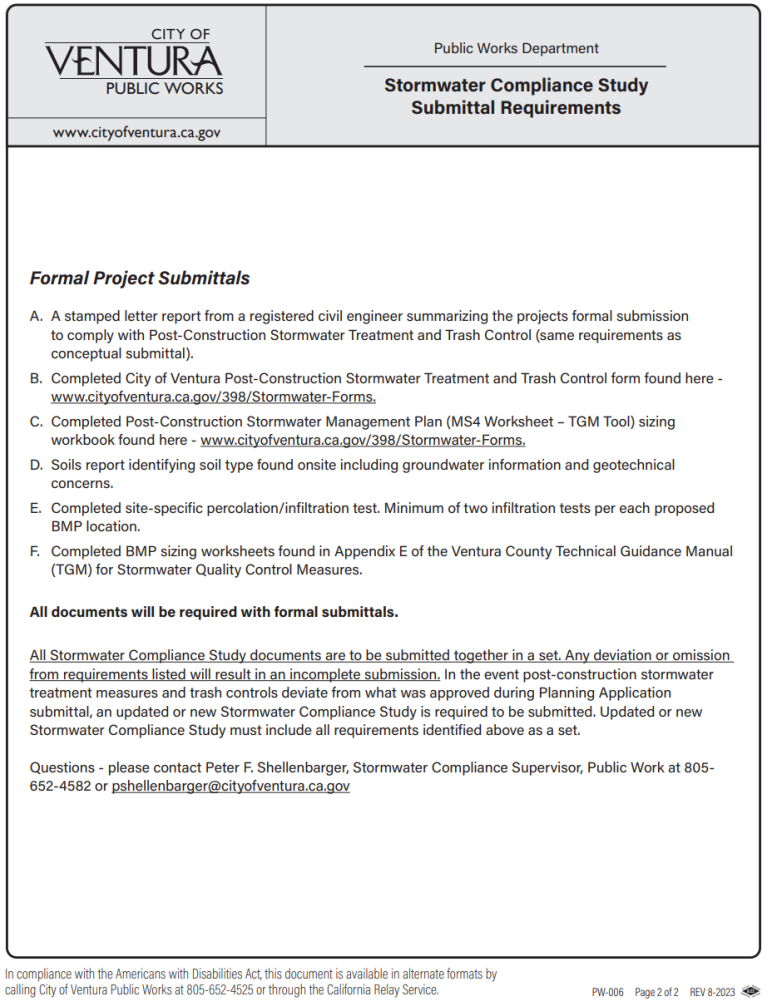
Technical Guidance Manual

Ventura County Technical Guidance Manual (TGM) for Stormwater Quality Control Measures

- Manual changes to reflect 2021 Regional MS4 Permit requirements
- Majority of content remains the some, however some information moved to different sections of manual
- **Applies to entitlements and new projects that are not deemed complete for stormwater mitigation by May 12, 2025**

Technical Guidance Manual

- 2025 TGM is a tool to assist in design of post-construction stormwater treatment BMPs that meet 2021 Regional MS4 Permit requirements
- MS4 agencies have different submittal, review and approval processes for stormwater compliance
- MS4 agencies' collective goal = improve TGM's chapter structure, update equations and worksheets to improve use and agency review



CITY OF VENTURA PUBLIC WORKS

www.cityofventura.ca.gov

Public Works Department

Stormwater Compliance Study Submittal Requirements

Formal Project Submittals

A. A stamped letter report from a registered civil engineer summarizing the projects formal submission to comply with Post-Construction Stormwater Treatment and Trash Control (same requirements as conceptual submittal).

B. Completed City of Ventura Post-Construction Stormwater Treatment and Trash Control form found here - www.cityofventura.ca.gov/398/Stormwater-Forms.

C. Completed Post-Construction Stormwater Management Plan (MS4 Worksheet – TGM Tool) sizing workbook found here - www.cityofventura.ca.gov/398/Stormwater-Forms.

D. Soils report identifying soil type found onsite including groundwater information and geotechnical concerns.

E. Completed site-specific percolation/infiltration test. Minimum of two infiltration tests per each proposed BMP location.

F. Completed BMP sizing worksheets found in Appendix E of the Ventura County Technical Guidance Manual (TGM) for Stormwater Quality Control Measures.

All documents will be required with formal submittals.

All Stormwater Compliance Study documents are to be submitted together in a set. Any deviation or omission from requirements listed will result in an incomplete submission. In the event post-construction stormwater treatment measures and trash controls deviate from what was approved during Planning Application submittal, an updated or new Stormwater Compliance Study is required to be submitted. Updated or new Stormwater Compliance Study must include all requirements identified above as a set.

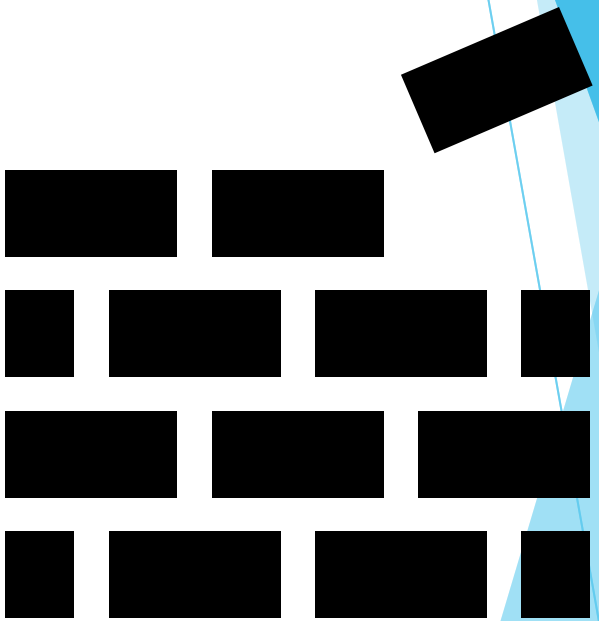
Questions - please contact Peter F. Shellenbarger, Stormwater Compliance Supervisor, Public Work at 805-652-4582 or pshellenbarger@cityofventura.ca.gov

In compliance with the Americans with Disabilities Act, this document is available in alternate formats by calling City of Ventura Public Works at 805-652-4525 or through the California Relay Service.

PW-006 Page 2 of 2 REV 8-2023

Technical Guidance Manual

- Each TGM version has built upon past versions; first TGM was released over 20 years ago
- **2000 Ventura County MS4 Permit**, Stormwater Quality Urban Impact Mitigation Plan (SQUIMP), 2002 TGM
- **2010 Ventura County MS4 Permit, Planning and Land Development Program**, 2011 TGM, 2015 Errata TGM, 2018 Errata TGM
- **2021 Los Angeles Regional MS4 Permit**, Planning and Land Development Program, 2025 TGM
- MS4 agencies' collective goal = consistency with current regulatory requirements



5. 2021 Regional Phase I MS4 NPDES Permit

2021 MS4 Permit

Planning and Land Development Program Requirements

- Los Angeles County and Ventura County now have same Planning and Land Development requirements
- Requirements similar to the 2010 Ventura County MS4 Permit and 2012 Los Angeles County MS4 Permit

2021 MS4 Permit

- Requires agency review, approval and plan checks
  - Public Works/Engineering and Building and Safety
- Strict adherence to MS4 Permit requirements
  - Required to implement water quality mitigation for applicable projects
- Requires operations and maintenance plan and maintenance covenant
- Routine maintenance of ROW, emergency work, reconstruction of parking lots, implementation of ADA requirements still do not require stormwater mitigation incorporation

2021 MS4 Permit

- New and redevelopment projects are complying with requirements within the 2021 Regional MS4 Permit, not the 2025 TGM
- The 2025 TGM is intended for projects to rely upon to develop post-construction control measures that comply with 2021 Regional MS4 Permit
- If projects have specific questions about stormwater treatment or certain structural approaches/constraints outlined in the 2025 TGM, it is always **best to reach out to the local land use authority for discussion and guidance**

2021 MS4 Permit

Hydromodification Management Requirements

- Permittees must require (i) Priority Development Projects within natural drainage systems in Los Angeles County and (ii) Priority Development Projects disturbing land areas of 50 acres or greater in Ventura County to implement hydrological control measures to prevent accelerated downstream erosion and protect stream habitat.
  - Should decrease number of projects subject to Hydromodification Management in Ventura County
  - Los Angeles Permittees will require more hydromodification control for projects that drain to natural drainage systems

2021 MS4 Permit

Water Quality/Flow Reduction Requirements

- Storm Water Quality Design Volume (SQDV). The SQDV is defined as the greater of the following:
  - (a) The runoff from the 0.75-inch, 24-hour rain event; or
  - (b) The runoff from the 85th percentile, 24-hour rain event.
- Stormwater Quality Design Flow (SQDF). Filter or treat either:
  - The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour, for each hour of a storm event; or
  - The maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity (for each hour of a storm event), as determined from the local historical rainfall record, multiplied by a factor of two;
  - Certified for "Enhanced/Metals Treatment" under the Washington State Department of Ecology's TAPE Program

2021 MS4 Permit

Technically Infeasibility/Alternative Compliance

- Technical Infeasibility for onsite retention unchanged compared to 2010 MS4 Permit except for saturated in-situ soils.
  - The infiltration rate of saturated in-situ soils changed from less than 0.5 inch per hour (2010) to less than 0.3 inch per hour (2021) and it is not technically feasible to amend the in-situ soils to attain an infiltration rate necessary to achieve reliable performance of infiltration or bioretention BMPs in retaining the SWQDV on-site.
    - **Above rate is not BMP design percolation rate, but rather existing native soil infiltration rate**
    - **Design percolation rate shall not be used for determining onsite retention infeasibility**

2021 MS4 Permit

Structural BMP Water Quality Mitigation Hierarchy

Structural BMP Performance Requirements follow the same order of preference when compared to 2010 MS4 Permit

1. On-site infiltration, bioretention and/or rainfall harvest and use (volume)
2. If 1 above infeasible, on-site biofiltration, off-site groundwater replenishment, and/or off-site retrofit (volume)
3. If 1 and 2 above are infeasible, on-site treatment (flow)*

2021 MS4 Permit

Alternative Compliance/Onsite Biofiltration

- Onsite biofiltration continued to biofilter 1.5 times required retention volume
- Sizing for onsite biofiltration will always need to be volume based, not flow-based
- Biofiltration typically does not include proprietary biofiltration or any other “high flow biotreatment” devices with an impervious vault and underdrain as defined by the Regional Water Board

2021 MS4 Permit

Alternative Compliance/Offsite Measure

- Offsite mitigation is available, but dependent upon available agencies' programs

1. Offsite Infiltration - Projects may use infiltration or bioretention BMPs to intercept a volume of stormwater runoff equal to the SQDV, less the volume of stormwater runoff reliably retained onsite, at an approved offsite project located within the same sub watershed (HUC-12) as the Priority Development Project
   - Must be sited in HUC-12 watershed which can limit implementation
2. Groundwater Replenishment Projects - Permittees may propose regional projects to replenish regional groundwater supplies at offsite location, provided the groundwater supply has a designated beneficial use in the Basin Plan
   - Must be sited in HUC-12 watershed which can limit implementation
3. Offsite Project Retrofit - Project proponents may use infiltration, bioretention, rainfall harvest and use and/or biofiltration BMPs to retrofit an existing development, with similar land uses.
   - Must still treat stormwater onsite with Basic TAPE BMPs

2021 MS4 Permit

Alternative Compliance/Onsite Flow-based BMPs

- If a Permittee determines that onsite biofiltration and offsite alternative compliance measures are not technically feasible, the Permittee may request the Executive Officer allow the use of onsite flow-based BMPs. In the request, Permittees must outline why none of the other alternative compliance measures are feasible. Approval will only be granted to areas where other alternative compliance measures are not feasible due to significant technical issues.

- Onsite Flow-based BMPs required to:
  - Filter or treat either:
    1. The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour, for each hour of a storm event; or
    2. The maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity (for each hour of a storm event), as determined from the local historical rainfall record, multiplied by a factor of two;
  - Be certified for "Enhanced/Metals Treatment" under the Washington State Department of Ecology's TAPE Program; or an appropriate future BMP certification developed by the State of California.

6. 2025 TGM vs. 2011 TGM - Technical Calculations/BMPs Sizing (Tai Chau)

- 2010 MS4 Requirements
- 2021 MS4 Requirements (compared to 2010)
- 2025 Technical Guidance Manual Sizing Calculations (vs. 2011 TGM)
  - Common Required Items
  - Removed Required Items
  - New/Modified Required Items
  - Sample Sizing Calculations

2010 MS4 Permit – Part 4 Recap

4.E) Planning and Land Development – Section II

New Development - Triggers

1) All Project>1 acre disturbance ≥ 10,000 SF impervious
2) Industrial Parks ≥ 10,000 SF total altered surface area
3) Commercial strip malls ≥ 10,000 SF impervious
4) Retail gasoline outlets ≥ 5,000 SF total altered surface area
5) Restaurants ≥ 5,000 SF total altered surface area
6) Parking lots adding ≥ 5,000 SF impervious or 25 or more parking spaces
7) Streets/roads/highway adding ≥ 10,000 SF impervious areas
8) Automotive service facilities ≥ 5,000 SF total altered surface area
9) Project in or directly adjacent to/or discharging to an ESA, where;
   - »Discharge runoff is likely to impact sensitive biological species or habit; and
   - »Creation of ≥ 2,500 SF impervious
10) Single-family hillside homes

Redevelopment - Triggers

- Creation/addition/replacement of ≥5,000 sf of impervious (on development categories above).
- Does not include maintenance activities/projects.
- 50% Rule
  - »Treat the entire site if alternation is more than 50% of impervious of the existing site.
  - »Treat only the disturb area if less than 50% of impervious of the existing site.

2010 MS4 Permit – Part 4 Recap

4.E) Planning and Land Development – Section III

- **<u>Stormwater Performance Criteria</u>**

1) Infiltration BMPs (SQDV) – collect, pretreat, and infiltrate (surface or underground)
   - I*nfiltration basin, infiltration trench, bioretention, drywell, permeable pavement*

2) Biofiltration BMPs (SQDV or SQDF) – collect, treat with vegetation, soil media, and release
   - *Biofiltration, planter box, bioswale, filter strip*

3) Propriety Treatment (SQDF)– treat with vegetation, engineered soil, and release
   - Modular Wetland, Filterra, etc.

2021 MS4 Permit Overview – Part VIII

(with marked changes compared to 2010 Permit)

VIII.F) Planning and Land Development – Section 1

- New Development - Triggers
  1) All Project>1 acre disturbance ≥ 10,000 SF impervious
  2) Industrial Parks ≥ 10,000 SF total altered surface area
  3) Commercial ~~strip~~ malls ≥ 10,000 SF total altered surface area ~~impervious~~

- Redevelopment - Triggers
  1) Creation/addition/replacement of ≥ 5,000 sf of impervious (over the entire project area)
     (Does not include maintenance activities/projects)
     - » Existing sites of 10,000 SF or more impervious
     - » Industrial parks of 10,000 SF or more surface area
     - » Commercial malls of 10,000 SF ~~impervious~~ or more of surface area

     50% Rule: Treat the entire site if alternation is 50% or more of impervious of the existing site.

- New Development/Redevelopment – Triggers
  1) Create and/or replace ≥ 5,000 sf of impervious and support:
     - » Restaurant
     - » Parking lots ~~with 25 or more parking spaces~~
     - » Automotive facilities ~~total altered surface area~~
     - » Retail gasoline outlets ~~total altered surface area~~

- New/Redevelopment Projects discharging to an ESA that create and/or replace ≥ 2,500 SF of impervious area.

2021 MS4 Permit Overview – Part VII

(with marked changes compared to 2010 Permit)

E) Planning and Land Development – Section III

- **<u>Stormwater Performance Criteria</u>**

1) Infiltration BMPs (SQDV) – collect, pretreat, and infiltrate (surface or underground)
   - *Infiltration basin, infiltration trench, bioretention, drywell, permeable pavement*

2) Biofiltration BMPs (SQDV ~~or SQDF~~) – collect, treat with vegetation, soil media, and release
   - *Biofiltration, planter box, ~~bioswale, filter strip~~*

3) ~~Propriety~~ Flow-based Treatment (shall be approved by Regional Board) - TAPE Certified for Enhanced/Metals Treatment (SQDF) – treat with vegetation, engineered soil or device and release
   - Modular Wetland, Filterra, etc.

Technical Similarities & Differences

(2025 TGM vs. 2011 TGM)

Shared items by the 2025 TGM & 2011 TGM

- *Soil infiltration rate ≥ 0.3 in/hr for Infiltration-based BMPs*
- *Pre-treatment/Forebay requirements*
- *5-ft above the seasonal high groundwater*
- *150% SQDV for Biofiltration-based BMPs*
- *SQDV Equation (0.75-in or 85th percentile –24 hour*)*
- *SQDF Equation (0.2 in/hr or 2x 85th percentile hourly)*

Items removed by the 2025 TGM

- 5% EIA
- **A**retain –> now as **A**project or **A**tributary
- Bioswale & Filter Strip as Primary BMPs --> now considered as pre-treatment
- 80% Average Annual Runoff Volume

New/Modified Items by the 2025 TGM

- *0.75-in or 85th percentile – 24 hour event (**whichever is higher**, see new GIS Map)
- Drain Rock = Caltrans Class 2 Permeable Material (*not to be confused with Class 2 Base Rock*)
- 1-year 1-hour rain event for TAPE-Basic Treatment for onsite treatment when offsite mitigation is used.

2025 TGM Sample Sizing Calculations

- Infiltration-based (INF-1, INF-2, INF-4)
- Biofiltration-based (BIO-2, BIO-2)
- Flow-based (FLO-1, FLO-2, FLO-3)

SQDV Sizing for Infiltration-based BMPs

Infiltration BMPs (SQDV) – collect, pretreat (if required), and infiltrate via surface or underground.

The runoff volume that is to be retained onsite should be calculated using Equation 2-1 below:

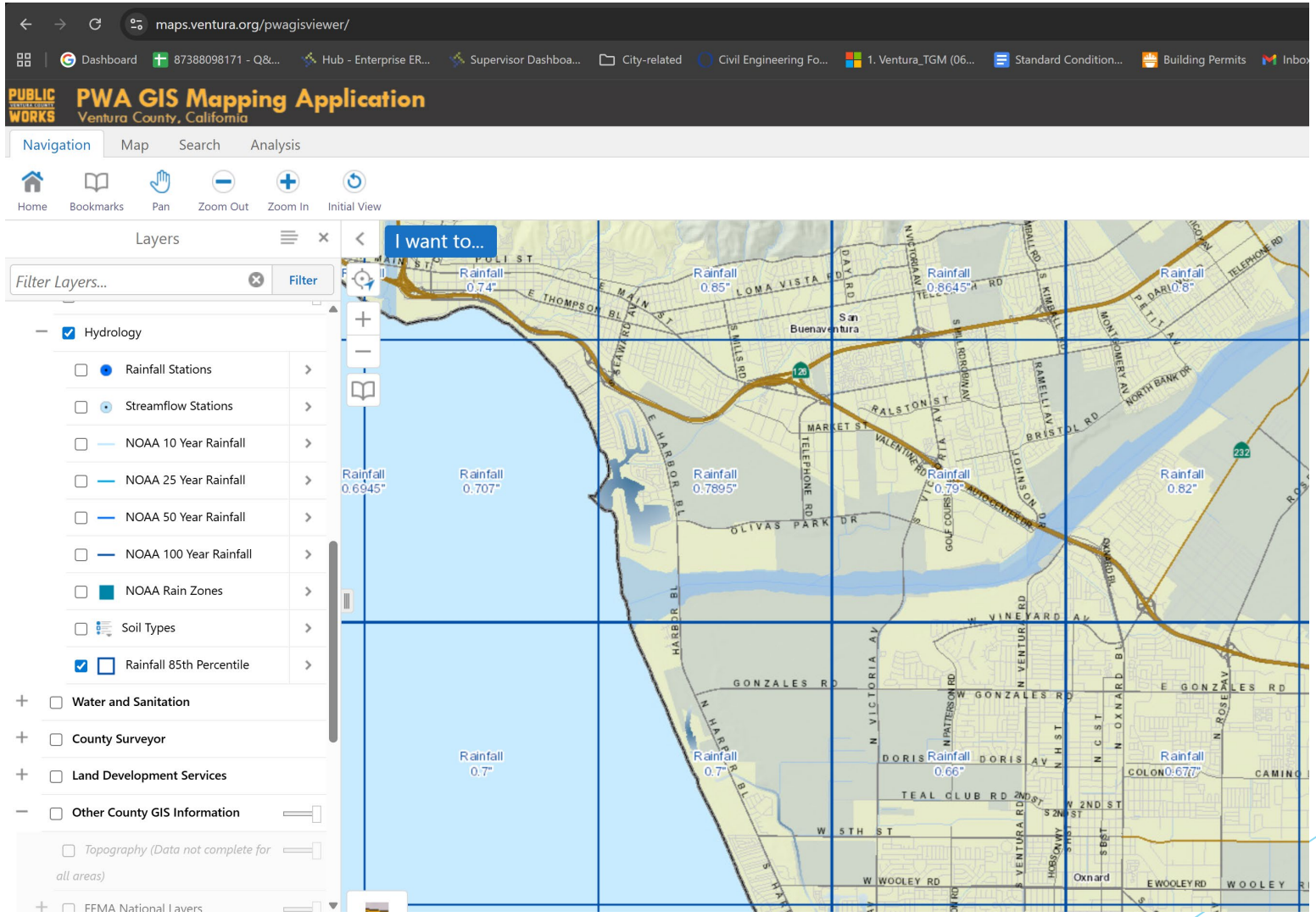
$$SQDV = 43{,}560 * C * (P/12) * A_{project} \qquad \text{(Equation 2-1)}$$

Where:

SQDV	=	the stormwater quality design volume that must be retained onsite (cu-ft)
C	=	runoff composite coefficient for the project area (refer to Appendix C-1)
P	=	the design rainfall depth (in), either the 0.75-inch or the 85th percentile 24-hour rain event, whichever is greater for the project location. Refer to the *Ventura County 85th Percentile Rain Depths* Map in Appendix B-1.
$A_{project}$	=	the project area (ac)

SQDV Sizing for Infiltration-based BMPs

85th Percentile 24-HR Event



SQDV Sizing for Infiltration-based BMPs

✓ ***Use TGM Worksheets in the design calculations.***

Design Example

Step 1: Determine water quality design volume

For this design example, a 10-acre residential development with a 60% total impervious area is considered to drain to an infiltration basin. The 85th percentile storm event for the project location is 0.75 inches.

Step 1: Determine Water Quality Design Volume			
1-1. Enter Project area (acres), $A_{project}$ If this BMP captures runoff from a portion of the project area, enter the tributary area	A =	10	acres
1-2. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp=	0.6	
1-3. Determine pervious runoff coefficient using Table C-1, C_p	C_p =	0.05	
1-4. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1\text{-}imp)$	C =	0.59	
1-5. Enter design rainfall depth of the storm (in), P_i	P_i =	0.75	in
1-6. Calculate rainfall depth (ft), $P = P_i/12$	P =	0.06	ft
1-7. Calculate water quality design volume (ft^3), $SQDV=43560\times C*P*A_{project}$	SQDV =	15,420.2	ft^3

SQDV Sizing for Infiltration-based BMPs

All sites that are considering infiltration-based BMPs require infiltration testing unless it is technically infeasible to retain or infiltrate due to contamination or documented high groundwater table (see Section 3.2 Technical Infeasibility Screening). Guidance for conducting infiltration tests is available in the Los Angeles County Public Works Guidelines for Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration (June 30, 2021, and subsequent versions). Soils with infiltration rates of 0.3 in/hr (before applying the reduction factor) or greater are considered feasible for infiltration.

Step 2: Calculate Design Percolation Rate

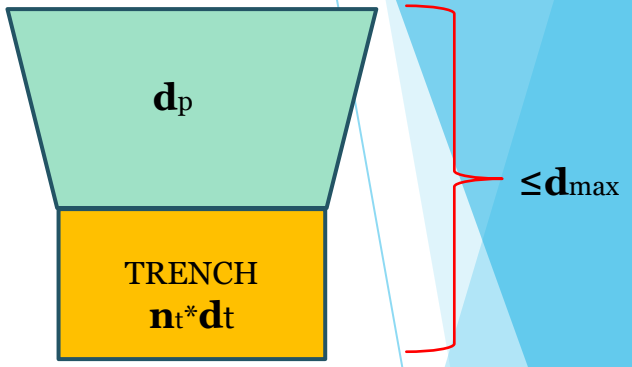
Step 2: Determine the Design Percolation Rate			
2-1. Enter measured soil infiltration rate (0.3 in/hr min.), $P_{measured}$	$P_{measured}$ =	4.0	in/hr
2-2. Determine percolation rate correction factor, S_A, based on suitability assessment (see Appendix C.2)	S_A =	3	
2-3. Determine percolation rate correction factor, S_B, based on design (see Appendix C.2)	S_b =	3	
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S =	9	
2-5. Calculate the design percolation rate, $P_{design} = P_{measured}/S$	P_{design} =	0.44	in/hr

SQDV Sizing for Infiltration-based BMPs

Step 3: Determine Facility Size

The size of the infiltrating surface is determined by assuming the SQDV will fill the available ponding depth (plus the void spaces of the computed porosity (usually about 32%) of the gravel in the trench).

Step 3: Calculate the Surface Area			
3-1. Enter drawdown time (72 hrs max.), t_d	t =	72	hrs
3-2. Calculate max. depth of runoff that can be infiltrated within the *drawdown time*, $d_{max} = P_{design}\ t/12$	d_{max}=	2.64	ft
3-3. Enter trench fill aggregate porosity, n_t	n_t=	0.32	
3-4. Enter depth of trench fill, d_t	d_t =	4	ft
3-5. Select trench ponding depth d_p such that $d_p \leq d_{max} - n_t d_t$	d_p=	1.1	ft
3-6. Enter the time to fill infiltration basin or trench with water (Use 2 hours for most designs), *T*	T =	2	hrs
3-7. Calculate infiltrating surface area for infiltration basin: A_b =	A_b =	*6,285 or* 13,142.2	ft^2



3) Calculate infiltrating surface area (filter bottom area) required:

$$A = \frac{SQDV}{((TP_{design}/12)+d_p)}$$ For Infiltration Basins (Equation E-15)

$$A = \frac{SQDV}{((TP_{design}/12)+n_t d_t + d_p)}$$ For Infiltration Trenches or aggregate-filled Drywells (Equation E-16)

- ***Pre-treatment*** *is required for infiltration basin, surface or underground.*

SQDV Sizing for Biofiltration-based BMPs

Biofiltration BMPs (SQDV) – collect, treat with vegetation & soil media, and release.

Step 1: Determine water quality design volume

For this design example, a 10-acre residential development with a 60% total impervious area is considered. The 85th percentile storm event for the project location is 0.75 inches.

Step 1: Determine Water Quality Design Volume			
1-1. Enter project area (acres), $A_{project}$ If this BMP captures runoff from a portion of the project area, enter the tributary area	$A_{project}$ =	10	acres
1-2. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp=	0.6	
1-3. Determine pervious runoff coefficient using Table C-1, C_p	C_p =	0.05	
1-4. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C =	0.59	
1-5. Enter design rainfall depth of the storm, P_i (in)	P_i =	0.75	in
1-6. Calculate rainfall depth, $P = P_i/12$	P =	0.06	ft
1-7. Calculate water quality design volume, $SQDV = 43560 \bullet P*A_{project}*C$	SQDV =	15,420.2	ft^3

- ***150% SQDV Required: This will be factored in at the end of the sizing worksheet.***

SQDV Sizing for Biofiltration-based BMPs

Step 2: Determine the design percolation rate

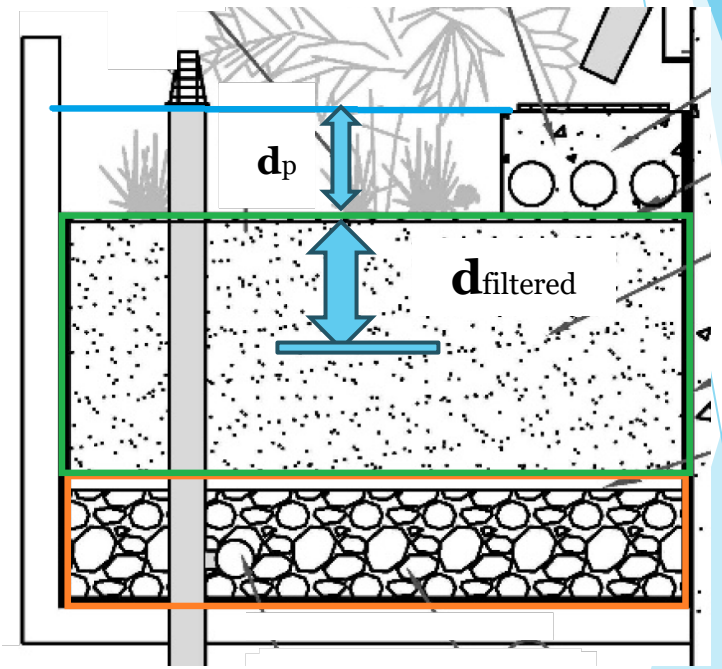
For this design example, the recommended amended filter hydraulic conductivity is used, 2.5 in/hr.

Step 2: Determine the design percolation rate			
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} =	2.5	in/hr

Step 3: Determine bioretention/ planter box area footprint

A bioretention area is designed with two components: (1) temporary storage reservoir to store runoff, and (2) a plant mix filter bed (planting soil mixed with sand content = 70%) through which the stored runoff must percolate to obtain treatment.

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	15,420.2	ac-ft
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Biofiltration, 1 ft for Planter Box) above area, d_p	d_p =	1.5	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding}^{*} = (d_p/K_{design}) \times 12$ **If tponding exceeds 48 hours, reduce surface ponding depth or increase media Kdesign.*	$t_{ponding}$=	7.2	hrs
3-5. Calculate the depth of water (ft) filtered, $d_{filtered} = Minimum\left[\frac{K_{design} \times T_{routing}}{12\ in/ft}, d_p\right]$ where $T_{routing}$= 3 hours	$d_{filtered}$ =	0.625	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = 1.5 \times SQDV/(d_p + d_{filtered})$	A_{req} =	10,884.8	ft^2



dfiltered *is the depth of stormwater that has been filtered into the soil media section for the first 3 hours.*

SQDF Sizing for Flow-based BMPs

Flow-based Treatment (shall be approved by Regional Board) - TAPE Certified (SQDF) – treat with engineered soil or device and release

- Modular Wetland, Filterra, etc.
- TAPE Certified – Enhanced (Metal Treatment) under Washington State Department of Ecology
- Rain Intensity, I=0.2 in/hr or 2 x 85th percentile hourly

$SQDF = CiA_{project}$ (Equation C-3)

Where:

SQDF	=	design flow rate (cfs)
C	=	runoff coefficient, calculated using Equation C-1 (unitless)
i	=	rainfall intensity (in/hr) (0.2 in/hr)
$A_{project}$	=	total project area (acres)

Sample

- 10 acres
- imp = 60% total impervious = 0.60
- Cp = pervious runoff coefficient = 0.05
- C=0.95*imp + Cp (1-imp) = 0.95*0.60 + 0.05(1-0.60) = 0.59

SQDF = C*I*Aproject = 0.59 * 0.2 * 10 = **1.18 cfs**

SQDF Sizing for Flow-based BMPs

ecology.wa.gov/regulations-permits/guidance-technical-assistance/stormwater-permittee-guidance-resources/emerging-stormwater-treatment-technologies

Approved technologies

The following table lists the devices that have received a designation through the TAPE process.

In addition to our certification, local jurisdiction approval is required (and not guaranteed) for installation of treatment technologies we have evaluated and given a use designation.

Note: We have changed the term in the table from Enhanced Treatment to Metals Treatment. The only change is in the terminology and all the requirements are still in effect for Metals Treatment BMPs. The underlying treatment requirements remain in place and all devices that previously had a GULD for Enhanced Treatment now have a GULD for Metals Treatment.

All | Pretreatment | Oil | Metals | Basic | Phosphorus | Construction

Manufacturer	Device Name	Treatment Type	Use Designation
Bellingham, City of	Phosphorus Optimized Stormwater Treatment System (POST)	Metals Treatment	Pilot Use Level**
Contech Engineered Solutions, LLC.	Filterra System	Metals Treatment	General Use Level
Contech Engineered Solutions, LLC.	Filterra Bioscape	Metals Treatment	General Use Level
Contech Engineered Solutions, LLC.	Modular Wetlands Linear	Metals Treatment	General Use Level
Contech Engineered Solutions, LLC.	Modular Wetlands 360	Metals Treatment	Pilot Use Level**


Q&A