Appendix A

Automated Template for Post-Construction Storm Water Quality Plan

(Provided in Electronic Format Only)

http://www.placer.ca.gov/lowimpactdevelopment

Appendix B
BMP Fact Sheets

STREAM SETBACK AND BUFFERS

Fact Sheet SDM-1

Also known as: Aquatic buffers, riparian setbacks

DESCRIPTION

Stream setbacks and buffers are vegetated areas that exist or are established along a stream system, lake, reservoir, or wetland area where development is restricted or prohibited. They consist of trees, shrubs, and herbaceous vegetation that separates and physically protects aquatic ecosystems and habitats from future disturbance or encroachment. Stream setbacks and buffers can either be preserved natural areas or engineered BMPs specifically designed to treat storm water runoff before it enters a stream, shore, or wetland.

Stream zone avoidance in south Placer County.

Source: Placer County Conservation Plan

ADVANTAGES

- Can be used as part of a treatment train with other BMPs.
- Can provide high level water quality treatment with proper design.
- Limits development in floodplain areas.
- Improves aesthetics.
- Improves quality of aquatic ecosystems and habitats.
- Serves as foundation for present or future greenways.

LIMITATIONS

- A minimum stream setback and buffer width of 500 feet is required to obtain storm water runoff reduction credits.
- Restrictions on available space for development.
- Potential establishment of nuisance species.
- Not suitable for treating point-source storm water discharges (i.e. end of pipe).
- Can be difficult to delineate and demarcate stream setback and buffer widths.
- Natural stream shifts may alter stream setback and buffer widths.

KEY DESIGN FEATURES

The ability of a particular stream setback and buffer to function effectively depends on how well the buffer is planned or designed. In general, the following guidelines should be followed (for more information see *The Architecture of Urban Stream Buffers*, *The Practice of Watershed Protection: Article 39*):

- Maintain the stream setback and buffer in an ungraded and uncompacted condition.
- Protect the stream setback and buffer from vehicular traffic to reduce compaction.
- The contributing overland slope should be 5% or less unless a level spreader is used.
- Adopt a vegetative target based on predevelopment plant community.
- Expand the width of the middle zone to pick up wetlands, slopes, and larger streams.
- Use clear and measurable criteria to delineate the origin and boundaries of the buffer.
- The number and conditions for stream and buffer crossings should be limited.
- The use of buffer for storm water runoff treatment should be carefully prescribed.
- Buffer boundaries should be visible before, during, and after construction.

- Buffer education and enforcement are needed to protect buffer integrity.

A minimum stream setback and buffer width of 500 feet is required to obtain runoff volume reduction credits. However, smaller stream setbacks and buffers may be required by local jurisdictions even if runoff volume reduction credits are not obtainable. For areas within the West Placer County Phase II MS4 Permit boundary, local ordinances should be reviewed to determine required stream setback widths at a particular site.

Photo Source: USGS

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-6 should be used to calculate the retention volume (V_{ret}) of the Stream Setback and Buffer. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design storm for Regulated Projects. The equation for determining V_{ret} is as follows:

$$V_{ret} = A_{imp} * P_{85}$$

Where:

V_{ret} = storm water retention volume (ft^3);

A_{imp} = impervious area draining to the stream setback (ft^2); and

P_{85} = 85th percentile, 24-hour storm depth (ft)

RUNOFF REDUCTION CREDIT REQUIREMENTS

- A minimum stream setback and buffer width of 500 feet is required to obtain runoff volume reduction credits.

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specific inspection checklist. At a minimum, maintenance shall include the following:

- Establish and manage distinctions of allowable and unallowable uses in each buffer zone.
- Clearly identify buffer boundaries and maintain clear signs or markers defining buffer extents.
- Inspect newly established vegetation semi-annually to determine if landscape maintenance is needed (reseeding, irrigation, trimming, weed removal, etc.).
- Inspect disturbed and revegetated slopes semi-annually for erosion and repair as needed.
- Inspect trails, paths, and bridges annually for erosion or structural issues and repair as necessary.

REFERENCES

Schueler, T. 2000. The Architecture of Urban Stream Buffers, The Practice of Watershed Protection: Article 39. Center for Watershed Protection, Ellicott City, MD. Pages 225-233. Available for download at:

https://owl.cwp.org/mdocs-posts/elc_pwp39/

Stormwater Center, Aquatic Buffers Fact Sheet: Buffer Zones. Available online at:
http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool3_Buffers/BufferZones.htm

U.S. Environmental Protection Agency. Aquatic Buffer Model Ordinance. Available online at:
http://water.epa.gov/polwaste/nps/upload/2002_09_19_NPS_ordinanceuments_Buffer_model_ordinance1.pdf

SOIL QUALITY IMPROVEMENT AND MAINTENANCE

Fact Sheet SDM-2

Also known as: Soil amendments, engineered soils

DESCRIPTION

The quality of existing soils on a project site can be improved by implementing soil amendments that alter the physical, chemical, and biological characteristics of the soil. Soil amendments can help restore disturbed soils by increasing organic matter content and reducing compaction. Amendments can also make soils with high clay content (i.e. hydrologic soil groups [HSG] C and D) more suitable to receive and filter/infiltrate site runoff. Soil amendments consist of humus such as compost and aged manure; fibrous materials such as peat, wood chips, and hardwood bark; inorganic materials such as vermiculite and perlite; and other soil conditioners and fertilizers as appropriate. The practice can increase infiltration rates, plant survival rates and health, enhance root growth, provide erosion stabilization, and decrease need for irrigation and fertilization.

Photo Source: U.S. EPA

ADVANTAGES

- Improves soil infiltration rates.
- Reduces surface runoff quantities and erosion.
- Improves soil filtration capabilities and pollutant removal.
- Enhances plant survival rates and health.
- Decreases need for landscape irrigation and fertilization.

LIMITATIONS

- Not recommended for slopes steeper than 3:1.
- Could result in increased water table elevations, lateral groundwater flows and other conditions that may create unwanted seepage or flooding at down gradient locations.

KEY DESIGN FEATURES

The type, mix, and amounts of soil amendments will vary from site to site in response to the local soil conditions and type of desired vegetation. Existing soils must be sampled and analyzed to determine soil characteristics and identify appropriate amendment types and quantities. Soil amendments should consist primarily of compost mixed with other materials as necessary. Detailed material and testing specifications for compost are provided in the Low Impact Development Center's Soil Amendment – Compost Specification.

Before soil amendments are applied, use a rototiller, soil ripper, or other equipment to loosen existing soils to the desired depth. Loosening soils below the depth of the amended soil layer will further improve infiltration. Design depths of soil amendment areas range from 6 inches minimum to several feet. Soil amendments should then be applied over the loosened soil area and incorporated into the existing soil until fully mixed. The amended soil should then be watered thoroughly and allowed to settle for at least one week prior to final grading. Seeding and planting should be performed immediately after final grading is complete.

SIZING DESIGN GOALS AND REQUIREMENTS

A qualified Geotechnical Engineer, Geologist, or Hydrogeologist should be consulted for the implementation of this Site Design Measure. The Post-Construction Storm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retention volume (V_{ret}) of the soil quality improvement and maintenance area. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design storm for Regulated Projects. The equation for determining V_{ret} is as follows:

$$\mathbf{V_{ret} = (A_{pond} * D_{pond}) + (A_{sa} * D_{sa} * n)}$$

Where:

V_{ret} = storm water retention volume (ft^3);

A_{pond} = ponding area (ft^2);

D_{pond} = ponding depth (ft);

A_{sa} = soil amendment area (ft^2);

D_{sa} = depth of amended soil (ft); and

n = porosity of amended soil

Soil quality improvement and maintenance areas must meet the ideal bulk densities provided in Table 1 below. Soil porosity (n) in the above equation is calculated as follows:

$$\mathbf{n = 1 - (\rho_{sa} / 2.65\ g/cm^3)}$$

Where:

n = porosity of amended soil; and

ρ_{sa} = bulk density of amended soil (g/cm^3)

Table 1. Ideal Bulk Densities for Amended Soils ($grams/cm^3$)

Sands, loamy sands	<1.6
Sandy loams, loams	<1.4
Sandy clay loams, clay loams	<1.4
Silts, silt loams	<1.3
Silt loams, silty clay loams	<1.1
Sandy clays, silty clays, clay loams	<1.1
Clays (>45% clay)	<1.1

Data source: USDA NRCS

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specific inspection checklist. At a minimum, maintenance shall include the following:

- Soil should be planted and mulched after installation. No part of the site should have bare soil exposed.
- Compaction of amended soils should be avoided.
- Amended soils should be inspected annually for signs of compaction, waterlogging, loss of vegetated cover, or erosion.
- Corrective actions include application of additional amendments and mechanical aeration.

REFERENCES

Low Impact Development Center, Inc. 2003. Soil Amendment - Compost Specification. Available online at: http://www.lowimpactdevelopment.org/epa03/soilamend.htm

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: https://www.casqa.org/sites/default/files/downloads/socallid-manual-final-040910.pdf

U.S. Environmental Protection Agency. 2007. The Use of Soil Amendments for Remediation, Revitalization, and Reuse. Available online at: http://nepis.epa.gov/Exe/ZyPDF.cgi/60000LQ7.PDF?Dockey=60000LQ7.PDF

TREE PLANTING AND PRESERVATION

Fact Sheet SDM-3

Also known as: Interceptor Trees

DESCRIPTION

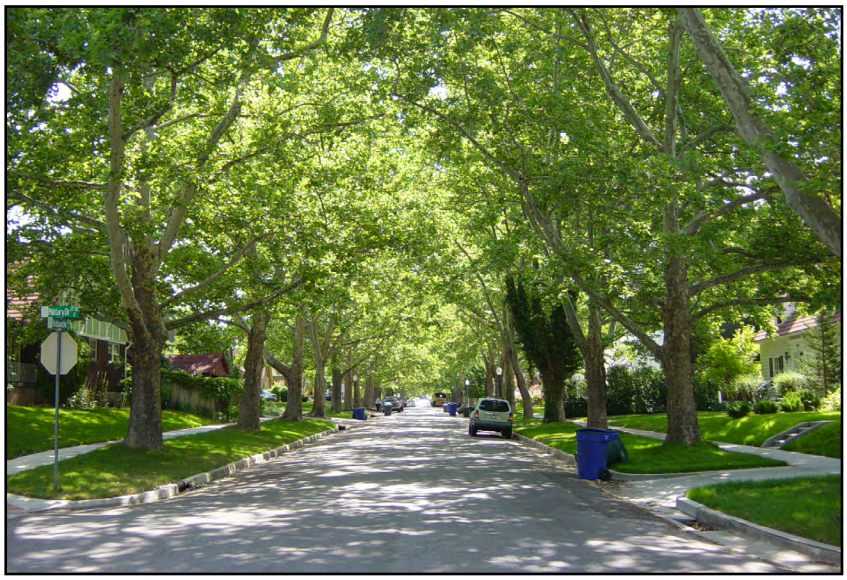


Photo Source: wfrc.org

Tree planting and preservation involves planting of new trees and preservation of existing trees to reduce storm water runoff volumes from a new development or redevelopment site. Trees intercept rain water on their leaves and branches before it lands on impervious surface below, allowing rain water to evaporate or run down the branches and trunk of the tree where it readily infiltrates into the soil. Trees absorb infiltrated runoff through their roots and further reduce storm water runoff by means of transpiration. Trees also provide shade over impervious surfaces which reduces the "heat island" effects of urban areas. Tree planting and preservation should be implemented on residential lots, throughout landscape corridors, in commercial and industrial parking lots, and along street frontages.

ADVANTAGES

- Reduces storm water runoff volumes and the amount of pollutants entering downstream BMPs and the storm drain system.
- Enhances aesthetic value.
- Provides shade to cool pavement and reduces surface runoff temperatures.
- Aids in removal of air pollutants and noise reduction.
- Trees required by the permitting agency may be counted as interceptor trees.
- Establishes habitat for birds and other pollinators like butterflies and bees.
- Extends life of asphalt paving.

LIMITATIONS

- Great care must be exercised when work is conducted near existing trees to be preserved.
- New and existing trees may require irrigation.
- New and existing trees must have adequate setback from buildings, structures, and utilities.
- Incorrect tree selection can result in high irrigation costs and pest infestation.
- Runoff reductions are dependent on the canopy area over the impervious surfaces created by the project.

KEY DESIGN FEATURES

- Appropriate new trees must be selected according to site and soil characteristics. Refer to the Landscape-Design-Guidelines-PDF for more information.
- Involve an arborist in the design process.
- Fire safety must be a consideration in areas with increased risk of fire hazard.
- Consider the future size/canopy and root zone of the fully-grown mature species when locating trees on the site, providing proper clearance from building foundations, pavement and overhead/underground utilities.

Ideally, provide a setback of 10 to 15 feet from the expected 10-year canopy to overhead lines.

- Utilize approved root barriers when trees are planted in near proximity to infrastructure, per the local permitting agency standards.
- Evergreen trees provide the greatest benefit to water quality due to their retention of leaves throughout the rainy season.
- Install irrigation systems according to local specifications.
- Do not install grass or turf within 24 inches of the tree trunk.
- Use mulch around the base of newly planted trees to reduce irrigation needs and protect bare soils from erosion. Consult an Arborist or nursery on appropriate amounts and types.

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retention volume associated with tree planting and preservation. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design storm for Regulated Projects. The equation for determining V_{ret} is as follows:

$$\mathbf{V_{ret} = ((n_e * 218) + (n_d * 109) + A_{tc}) * (V_{85} * 1\ ft/12in)}$$

Where:

V_{ret} = storm water retention volume (ft^3);

n_e = number of new evergreen trees;

n_d = number of new deciduous trees;

A_{tc} = canopy area of existing trees to remain on the property (ft^2)

V_{85} = runoff volume from the 85th percentile, 24-hour design storm (in)

(Consult an arborist or nursery for guidance in estimating canopy sizes for different tree species.)

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specific inspection checklist. At a minimum, maintenance shall include the following:

- Irrigate as necessary to establish and maintain trees.
- Remove fallen leaves and debris annually to prevent materials from being transported in storm water runoff.
- Prune dead vegetation from trees on a regular basis.
- Minimize the use of chemical fertilizers and pesticides.
- Maintain lawn and turf at least 24 inches from trunk of tree.
- Remove and replace dead trees as needed.

REFERENCES

Placer County Planning Services Division. 2013. Placer County Landscape Design Guidelines.

Available online at: https://www.placer.ca.gov/DocumentCenter/View/9391/Landscape-Design-Guidelines-PDF?bidId=

Sacramento County, et al. 2014. Stormwater Quality Design Manual for the Sacramento Region. Available online at: https://www.beriverfriendly.net/stormwater-quality-design-manual/

ROOFTOP & IMPERVIOUS AREA DISCONNECTION, AND SNOW STORAGE

Fact Sheet SDM-4

Including: Downspout Disconnection, Pavement Disconnection, and Flowpath Disconnection.

OVERVIEW

Rooftop and impervious area disconnection are techniques that reduce the volume of storm water delivered to storm drains or receiving waters by disconnecting the runoff from these areas and redirecting it to permeable locations that promote soil filtration and runoff infiltration. This can be accomplished by configuring roof gutter downspouts and impervious areas (e.g., driveways, pathways, small parking areas, and patios) to discharge runoff into landscaped areas, rain barrels and cisterns, or designed storm water management areas such as vegetated swales, stream buffers, amended soil areas, and bioretention cells.

Rooftop disconnection. Source: LID Center

This Fact Sheet is organized to include separate sections for rooftop disconnection, and impervious area disconnection. Details on specific storm water management strategies discussed herein, including stream setbacks and buffers, soil quality improvement and maintenance, porous pavement, vegetated swales, rain barrels and cisterns, and bioretention, can be found in other Fact Sheets included in this manual.

ROOFTOP DISCONNECTION

Roof drains and downspouts can be disconnected from the storm drain system by routing discharge to vegetated areas or into subsurface infiltration systems. The two rooftop disconnection methods discussed in this Fact Sheet include splash blocks and bubble-up emitters which both provide means of dissipating flow energy and spreading flows over the pervious area. Rooftop drainage is also ideal for harvest/reuse applications; refer to the Rain Barrels and Cisterns Fact Sheet for more information.

SPLASH BLOCK

Splash blocks are a low tech and cost efficient option to hard piped downspout systems. Existing downspouts can easily be retrofitted using splash blocks that reduce the velocity and impact of runoff discharging from downspouts. This reduces soil erosion and promotes infiltration.

ADVANTAGES

- Reduces peak flow rates and total runoff volumes.
- Directs runoff away from foundations and structures.
- Simple to implement in retrofit applications.
- Reduces the size of downstream BMPs.

LIMITATIONS

- Adjacent buildings and overflow requirements need to be considered in design.
- Only appropriate for sites with pervious areas near downspouts.
- If groundwater exists within two feet of the ground surface, seasonal fluctuations may result in periods of decreased infiltration and/or standing water.
- Runoff reduction credits cannot be claimed for rooftop disconnection if credits for stream setbacks and buffers or vegetated swales are being claimed in the same drainage management area (DMA).

ROOFTOP & IMPERVIOUS AREA DISCONNECTION, AND SNOW STORAGE

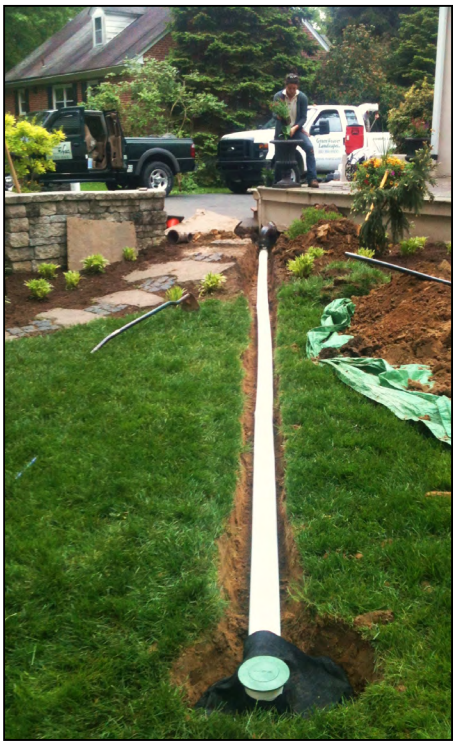
Fact Sheet SDM-4

KEY DESIGN FEATURES

- Sites should be evaluated to ensure that splash blocks won't have negative impacts.
- Rain water must be directed away from foundations and footings.
- Do not compact soils in areas where infiltration of storm water is planned.
- Downspouts must extend at least six feet from a basement and two feet from a crawl space or concrete slab.
- The area of rooftop connecting to each downspout must be 600 square feet or less.
- Downspouts should not be directed to paved areas or across sidewalks.
- Landscaped areas receiving roof water should be adequately sized to prevent runoff or erosion. An impervious: pervious ratio of 2:1 should be applied.
- Flow spreaders should be implemented downstream of splash blocks for sites with steep slopes.

BUBBLE-UP EMITTER

Bubble-up emitters function very much like splash blocks, but allow for roof drainage to be discharged into vegetated areas that are not directly adjacent to the building. Downspouts are connected to underground pipes then released through a valve that opens with water pressure.



Bubble-up emitter installation.
Photo Source: green-weaver.com

ADVANTAGES

- Reduces peak flow rates and total runoff volumes.
- Directs runoff away from foundations and structures.
- Can discharge to vegetated areas not adjacent to buildings.
- Reduces the size of downstream BMPs.

LIMITATIONS

- Overflow requirements need to be considered in design.
- Increased maintenance and cost over splash blocks.
- Runoff reduction credits cannot be claimed for rooftop disconnection if credits for stream setbacks and buffers or vegetated swales are being claimed in the same drainage management areas (DMA).

KEY DESIGN FEATURES

- The area of rooftop connecting to each downspout should be 600 square feet or less.
- Landscaped areas receiving roof water should be adequately sized to prevent runoff or erosion. An impervious:pervious ratio of 2:1 should be applied.
- Overflow systems and backflow prevention should be incorporated into design.
- Piping and valves must be able to convey the design storm event.

ROOFTOP AND IMPERVIOUS AREA DISCONNECTION

Fact Sheet SDM-4

IMPERVIOUS AREA DISCONNECTION

Disconnecting impervious areas involves routing runoff from paved areas such as roads, parking lots, pathways, courtyards, and patios to adjoining vegetated areas as sheet flow. As the sheet flow passes over vegetated areas it is filtered by the soil and infiltrated thereby reducing the volume of storm water discharged to receiving waters or the storm drain system. Examples of vegetated areas to accept sheet flow runoff include vegetated swales, stream buffers, amended soil areas, and bioretention cells. Another alternative for disconnecting impervious surfaces involves implementation of pervious pavement; refer to the Pervious Pavement Fact Sheet for more information.

Impervious Area Disconnection.
Photo Source: City of Kitchener, ON

In general, curb and gutter should be avoided to reduce concentrated flows from impervious surfaces. However, curb cuts can be effectively implemented to direct runoff from roads and parking lots into permeable storm water management areas. Level spreaders should be considered for energy dissipation and promotion of sheet flow to the pervious areas. This technique works well for retrofitting existing sites at a relatively low cost. Care must be taken to provide adequate clearances between vegetated infiltration areas and building foundations and paved surfaces.

ADVANTAGES

- Reduces peak flow rates and total runoff volumes.
- Eliminates need for storm water conveyance infrastructure.
- Promotes groundwater recharge and is aesthetically pleasing.
- Reduces the size of downstream BMPs.

LIMITATIONS

- Soil permeability may limit use of existing vegetated areas.
- Not suitable for sites with high concentrations of oil & grease or potential spills.
- Could result in increased water table elevations, lateral groundwater flows and other conditions that may create unwanted seepage or flooding at down gradient locations.
- Runoff reduction credits cannot be claimed for impervious area disconnection if credits for stream setbacks and buffers are being claimed in the same data management areas (DMA).

KEY DESIGN FEATURES

- The area of impervious surface discharging to a single vegetated area must be 5,000 square feet or less.
- The size of the pervious area receiving runoff should be at least 50% of the contributing impervious area (i.e. use a impervious:pervious ratio of 2:1).
- The maximum contributing impervious flow length should be less than 75 feet. If equal or greater than 75 feet, a storage device (e.g. French drain, bioretention area, gravel trench) should be implemented as a buffer prior to discharging to the impervious area.
- Water barriers may be required when infiltrating adjacent to paved surfaces in order to prevent undermining of pavement and baserock.
- If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the the pervious area. Curb cuts should be at least 12 inches wide to prevent clogging.

ROOFTOP AND IMPERVIOUS AREA DISCONNECTION

Fact Sheet SDM-4

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retention volume (V_{ret}) associated with rooftop and impervious area disconnection. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design storm for Regulated Projects. The equation for determining V_{ret} is as follows:

$$\mathbf{V_{ret} = A_{imp} * V_{85} * (1/12)}$$

Where:

V_{ret} = storm water retention volume (ft^3);

A_{imp} = impervious drainage area (ft^2); and

V_{85} = runoff volume from the 85th percentile, 24-hour design storm (in)

RUNOFF REDUCTION CREDIT REQUIREMENTS

- Downspouts and any extensions must extend at least six feet from a basement and two feet from a crawl space or concrete slab.
- The area of rooftop connecting to each disconnected downspout must be 600 square feet or less.
- Roof runoff from the design storm must be fully contained in a landscaped area.
- The impervious area discharging to an impervious disconnection area must be 5,000 square feet or less.
- The maximum contributing impervious flow path length for impervious area disconnection must be less than 75 feet or, if equal or greater than 75 feet, a storage device (e.g. French drain, bioretention area, gravel trench) is required to achieve the required disconnection length.
- Credits for roof runoff and impervious area disconnection cannot be obtained if stream setbacks and buffers are used within the same DMA.
- Credits for roof runoff disconnection cannot be obtained if vegetated swales are used within the same DMA.

REFERENCES

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: https://www.casqa.org/resources/lid/socal-lid-manual

Sacramento County, et al. 2014. Stormwater Quality Design Manual for the Sacramento Region. Available online at: https://www.beriverfriendly.net/stormwater-quality-design-manual/

POROUS PAVEMENTS

Fact Sheet SDM-5

Also known as: Pervious pavement and permeable pavement.

DESCRIPTION

Porous Pavement is a system comprised of a load-bearing, durable surface coupled with an underlying drainage layer that temporarily stores water prior to infiltration or drainage to a controlled outlet. The surface can be porous such that water infiltrates across the entire surface of the material, or it can be constructed of impermeable blocks separated by spaces and joints, through which the water can drain. There are many types of porous pavement including pervious concrete and asphalt, modular block, reinforced grass, cobblestone block, and gravel.

Pemeable pavement. Source: EPA

Porous pavement is well-suited for low traffic roadways, parking lots, walking paths, sidewalks, playgrounds, plazas, tennis courts, and other similar uses. It has been widely applied in retrofit situations where existing standard pavements are replaced. Porous pavements should not be used in industrial and commercial applications where pavement areas are used for material storage or the potential for surface clogging is increased due to high traffic of construction vehicles.

ADVANTAGES

- Reduces peak flow rates and total runoff volumes.
- Significant flow attenuation and improvement in water quality.
- Can replace existing pavements eliminating the need for additional land.
- Roof runoff can be piped into the subsurface storage area directly, which would increase the level of flow attenuation.
- Sometimes more attractive than traditional pavement.
- Reduces size of downstream BMPs.

LIMITATIONS

- Can become clogged if improperly installed or maintained and may require replacement.
- Use should be limited level areas such as parking lots and other lightly trafficked or non-trafficked areas.
- Not suitable for areas of slope instability where infiltrated storm water may cause failure.
- Not suitable in locations that can negatively impact building foundation or footings.
- Not suitable for sites with high concentrations of oil & grease or potential spills.
- Not suitable in industrial and commercial applications where pavement areas are used for material storage or high traffic of construction vehicles.
- High groundwater may slow infiltration, create standing water in the subsurface storage layers and destabilize pavement and/or result in seepage to the surface.

POROUS PAVEMENTS

Fact Sheet SDM-5

KEY DESIGN FEATURES

Source: NACTO

There are several types of porous pavement available, including pervious concrete, pervious asphalt, modular block, reinforced grass, cobblestone block, and gravel. The applicability of each porous pavement type should be carefully evaluated based on land uses and site characteristics. For detailed information and design guidance on all porous pavement types, refer to the Stormwater Quality Design Manual. General siting and design recommendations for all porous pavement are as follows:

- Consult a geotechnical engineer to determine what types of porous pavement are suitable for the expected traffic load, speed, and volume.
- Consult a geotechnical engineer to determine set back from building, or use 10 feet.
- Determine site soil type and permeability before selecting porous pavement as a runoff reduction strategy.
- Porous pavements are generally not suitable for sloped areas. Low points should be carefully evaluated and underdrains must be placed appropriately to avoid flooding.
- May be used over soils with low permeability in selected situations if underdrain is provided.
- Underdrains should tie into an open landscape area or treatment control measure to quickly relieve the water pressure in the pavement section and prolong the pavement life.
- Access ports should be provided for underdrain systems to allow for routine inspection and cleaning.
- Address seasonal shrink/swell in sites with expansive subgrade. Use the expansion index test (ASTM D4828) to provide insight as to degree of surface deformation in choosing paving sections.
- Consider opportunities for directing runoff from impervious surfaces across porous pavement to achieve runoff volume reduction credits. See the Rooftop and Impervious Area Disconnection Fact Sheet included in this manual.
- Select the porous pavement type based on the type of anticipated pedestrian traffic; most types of porous pavement can be designed to be Americans with Disabilities Act (ADA) compliant.
- A water barrier or interceptor drain will be required where porous material abuts regular asphalt/concrete pavement and there is concern about water infiltrating the regular pavement sub-base. The water barrier should run down the 12-inch deep excavation and 12 inches under the drain rock.
- For manufactured products, check the manufacturer's specifications for any additional siting considerations.

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retention volume (V_{ret}) for porous pavement areas. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design storm for Regulated Projects. The equation for determining V_{ret} is as follows:

$$V_{ret} = A_{res} * D_{res} * n_{agg} * C$$

Where:

V_{ret} = storm water retention volume (ft^3);

A_{res} = area of permeable storage reservoir (ft^2);

D_{res} = depth of permeable storage reservoir (ft);

n_{agg} = porosity of aggregate; and

C = efficiency factor

Efficiency factors for different types of porous pavements are provided in Table 1 below.

Table 1. Porous Pavement Efficiency Factors

Pervious Concrete or Asphalt (15% void space)	0.60
Modular Block Pavement (20% void space)	0.75
Reinforced Grass Pavement	1.00
Cobblestone Block Pavement (8% void space)	0.40

Source: Urban Drainage and Flood Control District, Denver, CO, Urban Storm Drainage Criteria Manual Volume 3 – Best Management Practices, September, 1999 (Rev. June, 2002)

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specific inspection checklist. At a minimum, maintenance shall include the following:

- Post signs identifying porous pavement areas.
- Keep landscaped areas well-maintained and prevent soil from being transported onto the pavement.
- Clean the surface using vacuum sweeping machines.
- If routine cleaning does not restore infiltration rates, then reconstruction of part of the porous pavement may be required.
- For modular and cobblestone block, periodically add joint material (sand) to replace material that has been transported or removed.
- Monitor regularly to ensure that the paving surface drains properly after storms.
- Do not seal or repave with impermeable materials.
- Inspect the surface annually for deterioration.
- Reinforced grass requires mowing and periodic reseeding to fill in bare spots.
- Clean out underdrain systems at regular intervals.
- Inspect outlets annually and maintain as needed.

REFERENCES

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: https://www.casqa.org/sites/default/files/downloads/socallid-manual-final-040910.pdf

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2012. Pervious Pavement, Stormwater Control for Small Projects. Available online at: http://scvurppp-w2k.com/pdfs/1213/BASMAA_Pervious_Paving_Fact_Sheet_082312_APPROVED_online_ver.pdf

Urban Drainage and Flood Control District, Denver, CO, Urban Storm Drainage Criteria Manual Volume 3 – Best Management Practices, September, 1999 (Rev. June, 2002). http://udfcd.org/criteria-manual

VEGETATED SWALE

Fact Sheet SDM-6

Also known as: Bioretention Swale, Treatment Swale, and Grassed Swale

DESCRIPTION

Grassed swale. Photo Source: EPA

Vegetated swales are essentially bioretention cells that are configured as linear channels, but are typically not designed with an engineered soil matrix and underlying gravel layer below the vegetation layer to accommodate additional treatment, storage, and infiltration. They function as a soil and plant-based filtration and infiltration feature that removes pollutants through a variety of natural physical, biological, and chemical treatment processes. Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey storm water runoff to downstream discharge points. They are designed to treat runoff through vegetation filtration, biological uptake, evapotranspiration, and/or infiltration into the underlying soils. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of storm water runoff.

Vegetated swales can serve as part of a storm water drainage system and can replace curbs, gutters and storm sewer systems. They are best suited to capture runoff from small impervious areas and should not be implemented in areas with highly contaminated runoff. They can be used as part of treatment train approach and are effective at providing pretreatment for other BMPs.

ADVANTAGES

- Reduces peak flow rates and total runoff volumes.
- Provides effective pretreatment for downstream BMPs by trapping, filtering, and infiltrating particulates and associated pollutants.
- Can serve as a cost-effective alternative to traditional curb and gutter.
- Can be integrated into landscape design to improve aesthetic appeal.
- Can be designed to meet trash control requirements.

LIMITATIONS

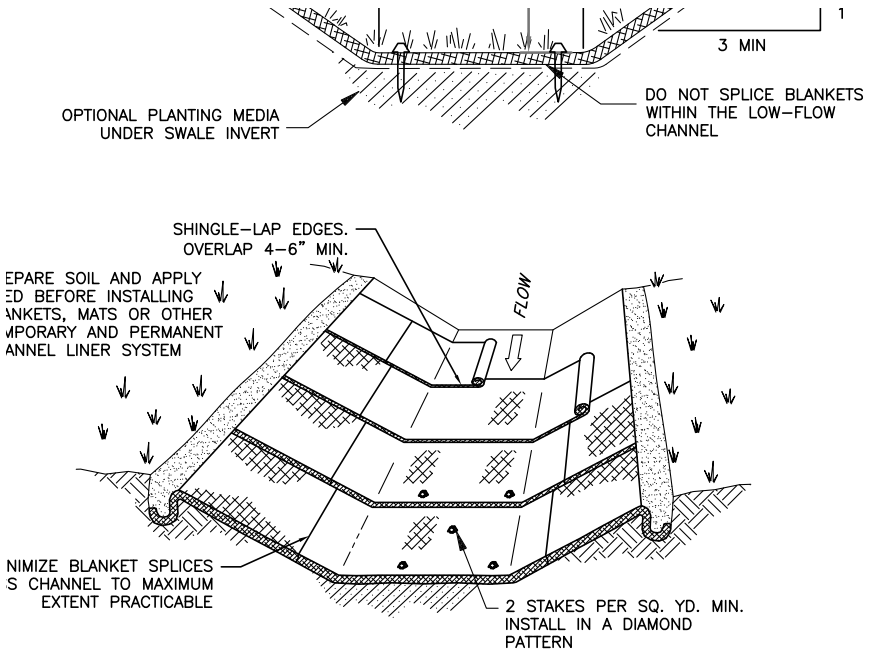
- Can be difficult to avoid channelization, which may cause erosion and limit infiltration potential.
- Not suitable for steep slopes.
- May not be appropriate for industrial sites or locations where spills may occur.
- Best suited for small drainage areas with low flow rates.
- A thick vegetative cover is needed for these features to function properly.

KEY DESIGN FEATURES (FOR TRASH CONTROL SEE BELOW)

In order to receive runoff volume reduction credits, vegetated swales must be designed in accordance with Treatment Control BMP 30 (TC-30) from the California Stormwater BMP Handbook, New Development and Redevelopment. Key design elements are summarized below:

- Maximum flow velocity from the design storm event shall not exceed 1.0 foot per second.
- Vegetated swales should be designed so that the water level does not exceed 2/3rds the height of the grass or

4 inches, whichever is less, at the design treatment rate.



VEGETATED SWALE TYPICAL INSTALLATION

- Longitudinal slopes between 0.5% and 2.5% are recommended.
- Provide sufficient length to achieve a desired treatment contact time of 10 minutes. Regardless of contact time, the swale should not be less than 100 feet in length.
- Implement check dams for longitudinal slopes > 2.5% as a means to reduce slopes and promote infiltration. Space as required to maintain maximum longitudinal bottom slope < 2.5%.
- Implement entrance/outlet energy dissipation measures to limit erosion and promote retention.
- Do not compact soils beneath vegetated swales.
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation, at the peak of the design storm, and a value of 0.25 for Manning's n.
- If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.
- Swales must be vegetated in order to provide adequate treatment and reduction of runoff. It is important to

maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. Refer to the Placer County Landscape Design Guidelines for more information.

- If possible, divert runoff (other than necessary irrigation) during the period of vegetation establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials. Diverted runoff must be managed and retained onsite to avoid violation of the Phase II MS4 Permit.
- Swales used as primary storm water conveyance facilities (i.e. without high flow bypass) must be designed according to requirements in the Placer County Stormwater Management Manual. These swales will not qualify for volume reduction credits unless the design criteria specified above are also satisfied.

DESIGN AND MAINTENANCE – TRASH CONTROL[1]

The design of a vegetated swale can be enhanced to comply with the Statewide Trash Amendments. To meet these requirements and qualify as a Multi-Benefit Trash Treatment System (MBTTS), the vegetated swale must be designed in accordance with the following five (5) requirements:

1. Trap trash particles that are 5 mm or greater, and include a screen at the inlet, overflow, or bypass outlet to trap these particles from either of the following[2]:

   a. The peak flow rate generated by the region specific one-year, one-hour storm event (0.362 inches/hour) from the applicable subdrainage area; or

   b. The peak flow rate of the corresponding storm drain (if the corresponding storm drain is designed for less than the peak flow rate generated from the one-year, one-hour storm event).

2. The vegetated swale may include either or both of the following to trap trash particles for either flow described above in section 1.a or 1.b:

   a. A screen at the system's inlet, overflow, or bypass outlet; or

   b. An up-gradient structure designed to bypass flows exceeding the flows described above in section 1.a or 1.b.

A screen is not required if the BMP has capacity to treat either of these flows through media filtration or infiltration into native or amended soils.

3. Have a minimum treatment capacity for either of the flow rates described in 1.a. or b. above. The Rational Equation method must be used to calculate the peak flow rate for runoff from a small subdrainage area that is approximately 50 acres or less. The Rational Equation is expressed as Q = CiA, where:

Q = design peak runoff rate, cfs,
C = runoff coefficient, dimensionless,
i = rainfall intensity 0.362 inches/hour, and
A = subdrainage area, acres.

Other calculation methods for drainage areas greater than 50 acres are allowed, provided a registered California licensed professional engineer documents the calculations within the design plans.

1 Also see https://www.casqa.org/sites/default/files/downloads/bioretention_mbts.pdf
2 Certified full capture devices have a design capacity to trap trash from flows not less than the peak flow rate at any time within a storm event. A Multi-benefit trash treatment system, including those that are volume-based, must have a design capacity to trap trash from flows not less than the peak flow rate at any time within a storm event to be a certified full capture system.
3 Upon approval by the appropriate Regional Water Quality Control Board Executive Officer, a 5mm screen and/or up-gradient structure may not be required if the multi-benefit trash treatment system is designed for flows generated from very large 24-hour storm events.

4. The design plans must be stamped and signed by a registered California licensed professional civil engineer (see Bus. & Prof. Code Section 6702, et seq.).

5. Regular maintenance is required to maintain adequate trash capture capacity and to ensure that captured trash does not migrate offsite. The owner shall establish a maintenance schedule based on site-specific factors, including the design trash capacity of the vegetated swale, storm frequency, and estimated or measured trash loading from the drainage area.

Trash controls shall be installed and maintained by the property owner for all storm drains, catch basins, or inlets that are located within the boundaries of the parcel and that are operated and maintained by the property owner. Trash controls shall only be installed in storm drains, catch basins, or inlets within the Public RoW if the applicable agency has agreed to enter into a maintenance agreement with the property owner. Vector breeding considerations must also be addressed in determining treatment controls because of the potential nuisance and human health effects.

The facility must meet State-sanctioned requirements detailed in the Certified Multi-Benefit Treatment Systems Complying With Trash Full Capture System Requirements, authorized March 9, 2018, and any subsequent revisions. Requirements can be accessed at https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html.

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retention volume (V_{ret}) associated with vegetated swales. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design storm for Regulated Projects. The equation for determining V_{ret} is as follows:

$$\mathbf{V_{ret} = A_{imp} * V_{85} *(1/12)}$$

Where:

V_{ret} = storm water retention volume (ft^3);

A_{imp} = impervious area draining to vegetated swale (ft^2); and

V_{85} = Runoff volume from 85th percentile, 24-hour design storm (in)

RUNOFF REDUCTION CREDIT REQUIREMENTS

- Vegetated swales must be designed in accordance with Treatment Control BMP 30 (TC-30 - Vegetated Swale) from the California Stormwater BMP Handbook, New Development and Redevelopment (available at www.cabmphandbooks.com).
- The maximum flow velocity for runoff from the design storm event must be less than or equal to 1.0 foot per second.

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specific inspection checklist. At a minimum, maintenance shall include the following:

- Inspect on a semi-annual basis to assess slope integrity, soil moisture, vegetative health, soil stability, compaction, erosion, ponding, and sedimentation.

- Mow at least once per year, but do not cut grass shorter than the design flow depth because the effectiveness of the vegetation in reducing flow velocity and pollutant removal may be reduced. Grass cuttings should be removed from the swale and composted.
- Remove accumulated sediment when it is 3 inches deep or higher than the turf to minimize potential concentrated flows and sediment resuspension.
- Irrigate only as necessary to prevent vegetation from dying.
- Integrated pest management should be used for pest control. The designer should ideally select vegetation that does not require fertilizers.
- For trash maintenance see above.
- Reseed periodically to maintain dense turf.
- Remove trash or obstructions that cause standing water.
- Prevent off-street parking or other activities that can cause rutting or soil compaction.

REFERENCES

California Department of Transportation (Caltrans). 2010. Treatment BMP Technology Report. CTSW-RT-09-239.06. Available online at: http://www.dot.ca.gov/hq/env/stormwater/pdf/CTSW-RT-09-239-06.pdf

California Stormwater Quality Association (CASQA). 2003. California Stormwater BMP Handbook – New Development and Redevelopment. BMP Factsheet TC-30: Vegetated Swale. Available online at: https://www.casqa.org/sites/default/files/BMPHandbooks/BMP_NewDevRedev_Complete.pdfhttp://www.cabmphandbooks.com/Documents/Development/TC-30.pdf

County of San Diego. 2007. Low Impact Development Handbook. Available online at: https://www.sandiegocounty.gov/content/sdc/dpw/watersheds/susmp/lid.htmlhttp://www.sdcounty.ca.gov/dplu/docs/LID-Handbook.pdf

Placer County Planning Services Division. 2013. Placer County Landscape Design Guidelines.

Available online at: https://www.placer.ca.gov/DocumentCenter/View/10131/Landscape-Design-Guidelines-PDFhttp://www.placer.ca.gov/~/media/cdr/Planning/documents/DesignGuides/Landscape%20 Design%20 Guidelines.pdf

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development and Redevelopment. BMP Fact Sheets. Available online at: http://water.epa.gov/polwaste/npdes/swbmp/PostConstruction-Stormwater-Management-in-New-Development-and-Redevelopment.cfm

RAIN BARRELS AND CISTERNS

Fact Sheet SDM-7

Also known as: Rainwater Harvesting, and Rainwater Collection

DESCRIPTION

Rainwater harvesting is the practice of collecting, conveying, and storing rainfall for future indoor and outdoor use such as landscape irrigation, toilet flushing, and vehicle washing. The purpose of this harvesting is to collect high quality runoff to offset potable water demands while simultaneously reducing storm water runoff volumes. Rooftop runoff is the storm water most often harvested for use because it typically contains lower pollutant loads than surface runoff and provides accessible locations for collection. However, runoff from other clean impervious surfaces, such as driveways, walkways, and patios, may also be harvested effectively.

Source: EPA

Rainwater harvesting typically utilizes rain barrels or cisterns:

- Rain barrels are small containers, typically ranging from 50 to 100 gallons installed adjacent to individual downspouts to capture rainwater runoff from roofs. Rain barrels are inexpensive, easy to install and maintain, and well suited to small-scale sites.
- Cisterns are typically much larger than rain barrels, ranging from 200 gallons for small installations to 10,000 gallons or more for large facilities. They can be installed above or below ground, or even on the roof, depending upon site conditions.

The irrigation of harvested rainwater may utilize a simple gravity system for small systems or use pumps for larger systems. The pump and wet well should be automated with a rainfall sensor to provide irrigation only during periods when required infiltration rates can be realized.

ADVANTAGES

- Applicable with limited space constraints and under all soil conditions.
- Reduces runoff volumes and peak flows while disconnecting impervious surfaces.
- Does not add additional pollutants to runoff.
- Cisterns can be combined with pervious parking areas.
- Helps reduce demand on municipal treated water supplies.
- Can be retrofitted into existing property.

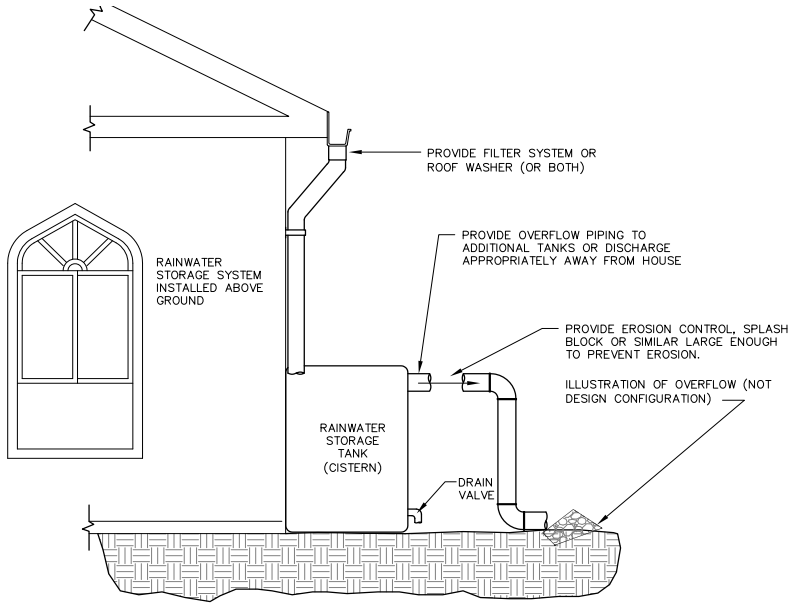
LIMITATIONS

- Rain barrels have limited storage capacity.
- Stored runoff must be used between storm events to maintain storage capacity.
- Does not provide water quality treatment.
- May require a system of pumps and valves to fill containers and reuse stored water.
- Irrigation systems may be expensive to operate and maintain.
- Inadequate maintenance can result in mosquito breeding and/or algae production.
- May require building permits. Contact the governing agency for requirements.
- Reuse of harvested rainwater may involve regulatory obstacles.
- May require screening or landscaping to improve aesthetics.

RAIN BARRELS AND CISTERNS

Fact Sheet SDM-7

KEY DESIGN FEATURES



Source: City of Salinas

- Site storage tanks underground, indoors, on roofs, or adjacent to buildings, outside of existing utility easement and County right-of-way.
- Make tanks water tight to avoid ponding or saturation of soils within 10 feet of building foundations.
- Locate rain barrels or above ground cisterns with gravity distribution systems up-gradient from irrigated areas.
- Locate underground cisterns in native, rather than fill soil for stability.
- Roof surfaces shall not include copper or materials treated with fungicides or herbicides.
- Roof gutters must be fully screened and installed at continuous grade.
- Containers must be opaque, water tight, vented, completely covered and screened.
- Pretreat runoff to remove debris, dust, leaves, and other debris. Use leaf and mosquito screens (1 mm mesh size), first-flush diverter, or in-tank filter.
- Use settling compartment for tanks over 2,500 gallons.
- Use a water pump for underground cisterns. Indoor systems usually require a pump, pressure tank, back-up water supply line and backflow preventer.
- Overflow device must be equal in size to the total of all inlets and must lead to an approved discharge location with approved air gap.
- Install safety labels (non-potable, vector hazard, drowning hazard icons).
- Refer to local ordinances for siting and size constraints.
- Both rain barrels and above-ground cisterns must be sited in a stable, flat area. Rain barrels and cisterns may not block the path of travel for fire safety access.
- Overflow locations, which can include bioretention units, additional rain barrels or cisterns, or a discharge point to the storm drain system, must be designed to both direct outflow away from building foundations and prevent nuisance flows to adjacent properties.
- Tanks should be opaque and placed in a cool or shaded area to avoid algal growth.

RAIN BARRELS AND CISTERNS

Fact Sheet SDM-7

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retention volume (V_{ret}) associated with rain barrels and cisterns. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design storm for Regulated Projects. The equation for determining V_{ret} is as follows:

$$\mathbf{V_{ret} = N * Va * 0.5}$$

Where:

V_{ret} = storm water retention volume (ft^3);

N = number of rain barrels and/or cisterns; and

V_a = average volume of rain barrels and/or cisterns (ft^3)

Photo Source: City of Portland

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specific inspection checklist. Maintenance requirements for rainwater harvesting systems vary according to use. At a minimum, maintenance shall include the following:

- Perform regular inspections every six months during the spring and fall seasons for the following:
    - Confirm that all the parts, pumps, and valves are operable and not leaking;
    - Keep leaf screens, roof gutters, and downspouts free of leaves and other debris;
    - Check screens and patch holes or gaps;
    - Clean and maintain first flush diverters and filters, especially those on drip irrigation systems;
    - Inspect and clean storage tank lids, paying special attention to vents and screens on inflow and outflow spigots; and
    - Replace damaged system components as needed.
- Clean tanks annually with a non-toxic cleaner, such as vinegar and dispose of wash water in a sink, bathtub or sewer cleanout.
- Flush cisterns annually to remove sediment. For buried structures, vacuum removal of sediments is required.
- Test all backflow prevention assemblies for proper function annually.
- Regular use of the water stored in systems between rain events is critical to ensure that storage is available for the next storm event.

REFERENCES

California Stormwater Quality Association (CASQA). 2003. California Stormwater BMP Handbook – New Development and Redevelopment. BMP Factsheet TC-12: Retention/Irrigation. Available online at: https://www.casqa.org/sites/default/files/BMPHandbooks/TC-12.pdf

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: https://www.casqa.org/sites/default/files/downloads/socallid-manual-final-040910.pdf

San Francisco Public Utilities Commission, et al. 2010. San Francisco Stormwater Design Guidelines. Appendix A, Stormwater BMP Fact Sheets. Available online at: https://sfpuc.org/sites/default/files/construction-and-contracts/design-guidelines/SDG2010_ApxA-BMP-FactSheet_JAN2010.PDF

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2012. Rain Barrels and Cisterns, Stormwater Control for Small Projects. Available online at: http://www.scvurppp-w2k.com/pdfs/1213/BASMAA_Rain_Barrel_Fact_Sheet_082312_APPROVED_online_ver.pdf

BIORETENTION

Fact Sheet TR-1

Bioretention facilities, also known as rain gardens and storm water planters, are planted depressions that slow, treat, and infiltrate storm water to improve water quality and manage hydromodification. They can be located in a variety of settings such as along roadsides or incorporated into a site's landscaping but should be designed by a qualified professional. Bioretention cells receive runoff from roofs and other impervious surfaces and provide treatment through settling, filtration, and biological processes as storm water ponds and percolates through planting soil media and into a subsurface gravel storage bed. Runoff volume is reduced by evapotranspiration and, if conditions are suitable, by infiltration into the underlying soils and groundwater. Bioretention facilities are effective at removing a variety of pollutants including trash, sediment, metals, nutrients, bacteria and hydrocarbons. Bioretention areas are usually designed to allow shallow ponding, with an overflow outlet to prevent flooding during heavy storms. The overflow can be directed to a storm drain system or to another BMP.

Roadside bioretention. Source: sitephocus.com

Two general types of bioretention facilities are allowable in the Phase II Permit including infiltrating bioretention and flow-through planters. Flow-through planters are used in locations not suitable for infiltration and include impermeable liners and an underdrain pipe to collect the treated water and discharge it to the municipal storm drain or other appropriate location.

ADVANTAGES

- Protects and improves water quality by removing pollutants from storm water runoff.
- Can be designed to meet trash control requirements.
- Reduces surface runoff volumes and attenuates peak flows.
- Wide range of scales and site applicability.
- Attractive and relatively easy and inexpensive to install and maintain.
- Improves air quality and reduces heat island effects.
- Increases groundwater recharge.
- Creates habitat and increases biodiversity.

LIMITATIONS

- Infiltration of storm water can negatively impact structural foundations and increase other geological hazards. Locations shall be approved by a licensed Geotechnical Engineer.
- High groundwater can slow infiltration rates or even seep into bioretention cells and discharge as surface water. An average 10 foot separation, and a minimum of 5 feet., between the bottom of the BMP and groundwater is recommended.
- Contaminants in soil and groundwater can be mobilized by infiltrating water.
- Existing infrastructure such as underground utilities and drainage infrastructure may constrain bioretention design.
- Vegetation requires maintenance and can look overgrown or weedy; seasonally it may appear dead.

KEY DESIGN FEATURES (FOR TRASH CONTROL SEE BELOW)

The design of bioretention facilities involves many considerations and planning activities should be started at the earliest possible stage of a projects. It is critical that the facilities achieve the required performance standards

while also protecting public health and safety, infrastructure and property. Bioretention design should begin during the site assessment and layout phase when determining building and parking locations and footprints and before the site grading plan is prepared. For infiltration type planters, consult a licensed geotechnical engineer about site suitability. The site layout needs to consider access for continued maintenance of LID and trash control measures.

LID vegetated swale parking lot. Shellito Indoor Pool, Roseville. Photo: Greg Bates

The key design features and considerations for bioretention facilities include the following:

1. Topography: In appropriate conditions and with careful design, bioretention facilities can be located on slopes by incorporating check dams, terracing, or other methods to pond the water. Infiltration on slopes can create, or increase, the potential for downgradient seepage, landslides, and other geotechnical hazards. Infiltration is generally not recommended on slopes exceeding 10 percent.

2. Adjacent structures: Where bioretention facilities are located next to structures such as curb and gutter, sidewalks, buildings, additional structural support may be required between the adjacent road or parking surface and bioretention soil media. Vertical cutoff walls or impervious liners should be considered to keep storm water from migrating into structural fill or road base materials. In expansive (HSG C, D) soils, locate storm water planters far enough from structures to avoid damage to foundations (as determined by a structural or geotechnical engineer). 10 feet is a typical rule-of-thumb.

   Subsurface utilities should not be located within the bioretention facility and utility trenches should be isolated from the infiltrating areas to prevent the formation of preferential flow paths along trenches, migration of backfill materials, and flooding of utility vaults.

3. Inlet design: Inlets can include a variety of structures and configurations including curb cuts, open channels, and pipes. The design must provide the width and geometry needed to direct flows into the facility and its elevation must provide adequate hydraulic head for filtration and storage volume. To prevent storm water runoff from eroding the soil surface as it enters the facility, a concrete splash pad or rock energy dissipater (3”-5” -size rounded rock, 6” depth) should be placed at the inlets.

4. Overflow: Provisions to bypass flows that exceed the design ponding depth must be included in bioretention designs. Overflow systems should be located near the entrance of the bioretention facility to prevent scouring of the system and mobilization of the mulch layer. Overflow provisions shall not impact structures. Overflow structures may consist of a raised overflow structure connected via pipe to an approved discharge point, or a surface conveyance route (e.g., curb cuts, open channel, or pipe). Overflow structures must be sized to convey peak flood flows, per Placer County SWMM requirements, and include provisions for clogging. Elevations must be set to provide storage of the required water quality volume.

5. Surface ponding: A minimum design depth of 6 inches is required for surface ponding to provide additional storm

water storage capacity, with a maximum depth of 12 inches. Ensure that the design does not allow ponding to persist for longer than 48 hours for vector control.

6. Aggregate layer: A minimum 12-inch thick layer of ¾-inch washed aggregate below the planting media increases the facility's water storage capacity and promotes positive drainage through the underdrain system. A 3-inch layer of smaller aggregate (washed pea gravel) between the planting media and ¾-inch aggregate layer can omit the need for filter fabric, which is known to cause clogging.

7. Bioretention soil media: A minimum 18-inch thick mixture of 60-70 percent sand meeting the specifications of the American Society for Testing and Materials (ASTM) C33 and 30-40 percent compost may be used to provide filtration of runoff while supporting healthy plant growth. It may be possible in some cases to use native soil or to amend the native soil so that it is suitable. Use of native soil will depend on the evaluation of the criteria in "Section 3 - Site Assessment" as well as consideration of structural needs and may require evaluation by a licensed Geotechnical Engineer.

8. Mulch: If the area will be mulched, initial excavation depth must anticipate the total combined media depth, to avoid having to reduce soil depth during construction to accommodate mulch at final grades. If mulch is used as a top dressing, avoid wood chips or other material that will float and potentially clog overflow structures. Mulch should not be installed just before or during the rainy season.

9. Underdrain: An underdrain system should be included with the discharge elevation at the top of the aggregate layer to convey runoff not infiltrated into the native soil to the storm water system or other appropriate discharge point. The underdrain may be eliminated in areas of high groundwater, rapidly infiltrating soils or where connection of the underdrain to a surface discharge point or to a subsurface storm drain are infeasible. The perforations in the underdrain must be directed down or else water flowing through the planting media into the gravel layer will immediately be collected and discharged through the underdrain. Maintenance access and cleanout ports should be provided so that underdrain system can be routinely inspected and cleaned as needed.

10. Liners: Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate in impervious liner and may locate the underdrain discharge at the bottom of the subsurface aggregate layer.

11. Plants: A list of native plant species for the Sacramento Valley is provided in the table below. Use a variety of trees, shrubs and herbaceous plant materials. Native grass meadows are especially effective at controlling and treating storm water over a large area. Choose moisture-tolerant plants for the bottom of a bioretention swale or basin. Choose plants that can tolerate both fluctuating water conditions and drought conditions for the side edges. Guidance on planting and general landscape design is provided in the Placer County Landscape Design Guidelines (Placer County Planning Services Division, 2013).

12. Pre-treatment: Runoff from industrial sites or locations where spills may occur or areas with excessive erosion or sediment sources should be pre-treated to address pollutants of concern prior to discharging into bioretention systems.

13. Underlying soils: Soils beneath the facility must be protected from compaction during construction activities. If soils have been compacted previously they should be ripped as deeply as necessary to loosen the soils and re-establish natural infiltration rates.

Sacramento Valley Native Plant List. Provided by the California Native Plant Society, Sacramento Valley Chapter, July 2015.

Botanic name	Common name	Height	Dry	Med Water	Wet	Full Sun	Part Shade	Shade	Deciduous/ Evergreen
ANNUAL PLANTS									
Collinsia heterophylla	Chinese Houses	1-2′		X			X		D
Eschscholzia californica	California poppy	1-1.5′	X	X		X			D
Gilia capitata	Globe gilia	0.5-1′	X	X		X	X		D
GRASSES & GRASS-LIKE PLANTS									
Bouteloua gracilis	Blue gramma grass	1.5-2′	X			X			D
Deschampsia caespitosa	Tufted hair grass	1-2′		X	X		X		E
Elymus glaucus	Blue wildrye	1′	X	X		X			E
Elymus triticoides	Creeping wildrye	1-3′	X	X		X	X		D
Festuca californica 'Serpentine Blue'	Serpentine blue California fescue	2-3′	X	X		X	X		E
Festuca idahoensis	Blue Idaho fescue	1′	X	X		X	X		E
Festuca idahoensis 'Siskiyou Blue'	Siskiyou Blue Idaho fescue	2′		X		X	X		E
Leymus condensatus 'Canyon Prince'	Canyon prince lyme grass	4′	X	X		X	X		E
Leymus triticoides (Elymus triticoides)	Creeping wild rye	1.5-3′	X	X		X	X		E
Melica californica	California melic	1-3′	X				X		D
Muhlenbergia rigens	Deer grass	5′	X	X		X	X		E
Sporobolus airoides	Alkali sacaton	2′		X	X	X	X		D
Stipa cernua	Nodding needlegrass	2′	X			X	X		D
Stipa lepida	Foothill needlegrass	2-3″	X			X	X		D
Stipa pulchra	Purple needlegrass	2′	X				X		D
Carex barbarae	Santa Barbara sedge	1-3′		X	X	X	X	X	E
Carex pansa	California meadow sedge	0.5′	X			X	X		E
Carex praegracilis	Clustered field sedge	1-2′	X	X		X	X		E
Juncus balticus	Baltic rush or wire rush	1-4′		X		X	X		E
Juncus effusus	Common rush	1.5-2′		X	X		X		E
Juncus effusus var. brunneus	Common rush	3-4′		X	X	X	X		E
Juncus effusus var. pacificus	Common rush	2-3′		X		X	X		E
Juncus patens	California gray rush	1.5-2.5′	X	X		X	X		E
Juncus patens 'Carman's Gray'	Carman's California gray rush	1-2′		X	X	X	X		E
Scirpus robustus	Alkali bull rush	5-15′			X	X	X		E
Xerophyllum tenax	Bear grass	2-4′		X		X			D
PERENNIAL PLANTS									
Achillea millefolium	Common yarrow	1-3′	X	X		X	X		E
Achillea millefolium 'Island Pink'	Island pink common yarrow	2′	X	X			X		
Acmispon glaber (syn. Lotus scoparius)	Deerweed	3′	X			X			E
Aquilegia eximia	Serpentine columbine	2′	X	X			X	X	D
Aquilegia formosa	Western columbine	1.5-3′		X	X		X	X	D
Artemisia douglasiana	California mugwort	3-5′	X	X	X	X	X		E
Asarum caudatum	Wild ginger	1′		X	X		X	X	E
Asclepias cordifolia	Purple milkweed	1-3′	X	X		X	X		D
Asclepias fascicularis	Narrowleaf milkweed	2-3′		X		X	X		D

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Botanic name	Common name	Height	Dry	Med Water	Wet	Full Sun	Part Shade	Shade	Deciduous/ Evergreen
PERENNIAL PLANTS CONT.									
Asclepias speciosa	Showy milkweed	3-6'		X		X	X		D
Carex tumulicola	Foothill sedge	1.5'	X	X		X	X	X	E
Dudleya cymosa	Dudleya, liveforever	3-6"		X			X	X	E
Epilobium canum	California fuchsia	1-1.5'	X	X					D
Epilobium canum 'Carman's Grey'	Carman's grey California fuchsia	2'	X	X		X	X		D
Epilobium canum 'Catalina'	Tall California fuchsia	1.5-3'	X	X		X	X		D
Epilobium septentrionalis 'Select	Select Mattole California fuchsia	0.25-0.5'		X		X	X		D
Equisetum scirpoides	Dwarf scouring rush	0.5'		X	X	X	X		E
Erigeron glaucus 'Wayne Roderick'	Seaside daisy	0.5'		X		X	X		E
Erigeron karvinskianus	Mexican daisy, Santa Barbara daisy	1-1.5'		X		X	X		E
Eriodictyon californicum	Yerba santa	3-6'	X	X		X	X		E
Eriogonum gracile	Wild buckwheat/ slender	14-16"	X	X		X	X	X	D
Eriogonum grande var rubescens	Red-flowered buckwheat	1-3'	X			X			E
Eriogonum umbellatum var. polyanthum	Sulfur buckwheat	0.5-1'	X	X		X	X		E
Eriogonum ursinum	Bear Valley buckwheat	0.25-1'	X	x		X	X		E
Eriophyllum lanatum	Woolly sunflower	1-2'	X			X	X		E
Fragaria vesca	Wild strawberry	4-6"		X	X	X	X	E	E
Grindelia stricta venulosa	Coastal gum plant	1-2'	X	X		X	X		E
Helenium bigelovii	Bigelow's sneezeweed	2-3'		X		X	X		D
Heuchera 'Canyon Quartet'	Canyon quartet alum root	1-2'	X	X			X	X	E
Heuchera 'Lillian's Pink'	Lillian's pink alum root	1-2'	X				X	X	E
Heuchera maxima	Island alum root	2-3'	X	X			X	X	E
Heuchera micrantha	Crevice alum root	1-2'	X	X			X	X	E
Heuchera 'Rosada'	Rosada alum root	2-3	X	X			X	X	E
Hibiscus lasiocarpus	Hibiscus	4-6'		X	X	X	X		D
Iris douglasiana	Douglas iris	1-2'	X	X		X	X		E
Iris Pacific Coast Hybrid 'Canyon	White Pacific Coast hybrid iris	1-2'	X	X		X	X		E
Iris Pacific Coast Hybrid 'Dorothea's	Burgundy Pacific Coast hybrid iris	1-2'	X	X		X	X		E
Iris Pacific Coast Hybrid 'Lavender'	Lavender Pacific Coast hybrid iris	1-2'	X	X		X	X		E
Iris Pacific Coast Hybrid 'Purple and	Purple and white Pacific Coast hybrid iris	1-2'	X	X		X	X		E
Iris Pacific Coast Hybrid 'Yellow'	Yellow Pacific Coast hybrid iris	1-2'	X	X		X	X		E
Iris Pacific Coast Iris mixed	Mixed colors Pacific Coast hybrid iris	1-2'	X	X		X	X		E
Lilium pardilinum	Leopard lily	3-8'		X		X	X		D
Linum lewisii	Blue flax	2-3'	X	X			X	X	D
Lupinus polyphyllus	Streamside lupine	1-3'		X	X		X		D
Mentzelia laevicaulis	Blazing star	2-3'	X			X			D
Mimulus aurantiacus	Sticky monkeyflower	3-5'	X	X		X	X		E
Mimulus aurantiacus 'Verity'	Bush monkeyflower	1-4'		X		X	X		E
Mimulus cardinalis	Scarlet monkeyflower	1 ½ -3'			X	X	X		D
Monardella odoratissima	Mountain pennyroyal, coyote mint	0.3-2'	X			X			E

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PERENNIAL PLANTS CONT.									
Penstemon azureus	Azure penstemon	0.5-1.5'	X	X		X	X		D
Penstemon heterophyllus	Foothill penstemon	1-3'	X	X		X	X		E
Penstemon heterophyllus 'Margarita BOP'	Margarita BOP foothill penstemon	1.5-2'	X	X		X	X		E
Penstemon spectabilis	Showy penstemon	3-4.5'	X			X	X		E
Phacelia imbricate	Rock Phacelia, pine bee flower	1-2'	X			X			D
Phyla nodiflora	Lippia	2-4"		X			X		D
Potentilla glandulosa	Sticky cinquefoil	1-2'		X		X	X		D
Rubus leucodermis	Western raspberry	3-4'		X			X		D
Rubus parviflorus	Thimbleberry	3-6'		X			X	X	D
Salvia 'Bee's Bliss'	Bee's bliss Sonoma sage	1-1.5	X	X		X	X		E
Salvia sonomensis	Creeping Sage	1'	X			X	X		E
Scrophularia californica	California figwort, bee plant	4-6'		X			X		D
Sedum obtusatum	Sierra sedum	0.5'	X	X			X		E
Sisyrinchium bellum	Blue-eyed grass	1'		X	X	X			D
Solidago californica	California goldenrod	1'			X	X	X		D
Solidago Californica 'Cascade Creek'	Cascade Creek California goldenrod	3-4'	X			X	X		D
Symphyotrichum chilense	California aster	2'	X	X	X	X	X		D
Whipplea modesta	Western whipplea	0.25-0.75'		X			X		D
Woodwardia fimbriata	Western chain fern	4-6'		X			X	X	E
Wyethia angustifolia	Narrowleaf mule's ears	20"	X	X		X	X		D
Wyethia mollis	Mountain mule's ears	0.5-2'	X	X			X		D
SHRUBS									
Arctostaphylos bakeri 'Louis	Pink manzanita	5-6'	X	X		X	X		E
Arctostaphylos densiflora 'Howard	McMinn's manzanita	5-8'	X	X		X	X		E
Arctostaphylos densiflora 'Sentinel'	Sentinel manzanita	6-8'	X	X		X	X		E
Arctostaphylos edmundsii 'Carmel Sur'	Carmel Sur manzanita	1-1.5'	X	X		X	X		E
Arctostaphylos ' Emerald Carpet'	Emerald carpet manzanita	1'	X	X		X	X		E
Arctostaphylos glauca	Bigberry manzanita	15'	X	X		X	X		E
Arctostaphylos hookeri 'Wayside'	Wayside Monterey manzanita	4'	X	X		X	X		E
Arctostaphylos 'John Dourley'	John Dourley manzanita	2-4'	X	X		X	X		E
Arctostaphylos manzanita ' Dr. Hurd'	Dr. Hurd's manzanita	10-12'	X	X		X	X		E
Arctostaphylos uva-ursi ' Green	Green supreme bearberry	1'	X	X		X	X		E
Arctostaphylos uva-ursi 'Massachusetts'	Massachusetts bearberry	1'	X	X		X	X		E
Arctostaphylos uva-ursi 'Pacific Mist'	Pacific Mist bearberry	2-3'	X	X		X	X		E
Arctostaphylos uva-ursi ' Point Reyes'	Pt. Reyes bearberry	1'	X	X		X	X		E
Arctostaphylos uva-ursi ' Radiant'	Radiant bearberry	1'	X	X		X	X		E
Arctostaphylos viscida	Whiteleaf manzanita	4-12'	X			X			E
Atriplex lentiformis	Quail bush	3-10'	X			X			D
Baccharis pilularis	Coyote brush	4-8'	X			X			E
Baccharis pilularis 'Pigeon Point'	Pigeon Point coyote brush	1.5-3'	X	X		X			E

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SHRUBS CONT.									
Calycanthus occidentalis	Western spicebush	8-15'		X	X		X	X	D
Carpenteria californica	California bush anemone	4-8'	X	X			X	X	E
Carpenteria californica 'Elizabeth'	Dr. McClintock's bush anemone	3-5'	X	X			X	X	E
Ceanothus 'Blue Jeans'	Blue jeans wild lilac	7-9	X			X			E
Ceanothus 'Centennial'	Centennial wild lilac	2'	X			X			E
Ceanothus 'Concha'	Concha wild lilac	6-7'	X			X			E
Ceanothus cuneatus	Buck brush	5-10'	X			X			E
Ceanothus 'Dark Star'	Dark star wild lilac	5-6'	X			X			E
Ceanothus gloriosus	Pt. Reyes wild lilac	1-1.5'	X			X			E
Ceanothus gloriosus 'Anchor Bay'	Anchor Bay wild lilac	1-1.5'	X			X			E
Ceanothus gloriosus var. exaltatus	Emily Brown's hallelujah bush	1-2	X	X		X	X		E
Ceanothus griseus 'Louis Edmunds'	Louis Edmunds wild lilac	5-6'	X			X			E
Ceanothus griseus var. horizon. 'Yankee Point'	Yankee Point wild lilac	2-3'	X			X			E
Ceanothus griseus var. horizontalis	Carmel creeper wild lilac	1.5-2.5'	X			X			E
Ceanothus integerrimus	Deerbrush wild lilac	3-7'	X			X	X		D
Ceanothus 'Joan Mirov'	Joan Mirov wild lilac	3-6'	X	X		X	X		E
Ceanothus 'Joyce Coulter'	Joyce Coulter wild lilac	2-5'	X			X			E
Ceanothus 'Julia Phelps'	Julia Phelps wild lilac	5-7'	X			X			E
Ceanothus maritimus 'Point Sierra'	Pt. Sierra wild lilac	2-3'	X			X			E
Ceanothus maritimus 'Valley Violet'	Valley Violet wild lilac	2-3	X			X	X		E
Ceanothus 'Owlswood Blue'	Owlswood blue island wild lilac	10'	X	X			X		E
Ceanothus prostratus	Squaw carpet	1'	X	X			X		E
Ceanothus 'Ray Hartman'	Ray Hartman wild lilac	12-20'	X			X			E
Ceanothus thrysifolius repens 'Louis Edmunds'	Louis Edmunds prostrate blue blossom	0,5-2'	X	X		X	X		E
Ceanothus thyrsiflorus	Blue blossom	5-15'	X			X			E
Ceanothus thyrsiflorus 'Skylark'	Skylark compact blue blossom	3-6'	X			X			E
Ceanothus thyrsiflorus 'Snow Flurry'	Snow flurry wild lilac	6-10'	X			X			E
Cercocarpus betuloides	Mountain Mahogany, birchleaf mountain mahogany	10-15'	X			X	X		E
Cercocarpus betuloides var blancheae	Island mountain mahogany	10-12'	X	X		X			E
Cornus stolonifera (syn. C. sericea)	Redtwig or western dogwood	7-9'		X	X		X		D
Cornus stolonifera 'Peter's Choice'	Redtwig or western dogwood	7-9'		X	X		X		D
Eriogonum fasciculatum (E. f. var. foliolosum)	California buckwheat	1-3	X	X		X			E
Eriogonum giganteum	St. Catherine's lace	3-4'	X	X		X			E
Frangula tomentella	Hoary coffeeberry	6-10'	X	X		X	X		E
Fremontodendron 'Ken Taylor'	Ken Taylor flannel bush	4-6'	X			X			E
Fremontodendron 'Pacific Sunset'	Pacific sunset flannel bush	12-15'	X			X			E
Fremontodendron 'San Gabriel'	San Gabriel flannel bush	15-20'	X			X			E
Garrya elliptica 'Evie'	Evie coast silktassel	8-15'	X			X			E
Garrya elliptica 'James Roof'	James Roof coast silktassel	8-15'	X			X			E
Heteromeles arbutifolia	Toyon	8-15'	X			X	X		E

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Heteromeles arbutifolia 'Davis Gold'	Yellow berry toyon	8-15'	X			X	X		E
Isomeris arborea	Bladderpod	3-4'	X			X	X		E
Lupinus albifrons	Silver bush lupine	3-5'	X			X	X		E
Lupinus arboreus	Yellow flowered bush lupine	4-5'	X	X		X			E
Mahonia aquifolium	Oregon grape	3-6'	X	X		X	X		E
Mahonia aquifolium compacta	Compact Oregon grape	2-4'	X	X			X	X	E
Philadelphus lewisii 'Goose Creek'	Double flowered wild philadelphus	4-8'		X	X		X		D
Prunus andersonii	Desert peach	3-6'	X			X			D
Rhamnus californica	Coffeeberry	3-15'	X			X	X		E
Rhamnus californica 'Mound San	Mound San Bruno coffeeberry	4-6'	X			X	X	X	E
Rhamnus californica 'Eve Case'	Eve Case coffeeberry	4-8'	X			X	X		E
Rhamnus californica ssp. tomentella	Coffeeberry	6-15'	X	X		X	X		E
Rhamnus ilicifolia	Holly-leaf redberry	5-15'	X	X		X	X		E
Rhamnus purshiana	Cascara sagrada	10-15'	X	X		X	X		E
Rhus integrifolia	Lemonade berry	3-10'	X			X			E
Rhus ovata	Sugar bush	4-10'	X			X			E
Ribes aureum var. aureum	Western golden currant (mountain)	3-6'	X	X	X	X	X		D
Ribes aureum var. gracillimum	Golden currant	3-6'	X	X	X	X	X		D
Ribes californicum	Hillside gooseberry	3'		X			X		D
Ribes malvaceum	Chaparral flowering currant	3-4'	X				X		D
Ribes sanguineum	Winter current	3-6'	X	X		X	X		D
Ribes sanguineum var. glutinosum	Flowering currant	3-5'	X	X		X	X		D
Ribes sanguineum var. glutinosum	Claremont flowering currant	3-6'	X	X			X	X	D
Ribes sanguineum 'White Icicle'	White icicle flowering currant	6-8'	X	X			X	X	D
Ribes speciosum	Fuchsia flowering gooseberry	3-6'	X	X		X	X		D
Ribes viburnifolium	Evergreen currant	2-3'	X	X			X	X	E
Rosa californica	California wild rose	3'		X			X	X	D
Salvia apiana	White sage	3-5'	X	X		X			E
Salvia clevelandii	Cleveland's sage	3-5'	X			X			E
Salvia clevelandii 'Allen Chickering'	Allen Chickering Cleveland's sage	3-5 '	X			X			E
Salvia clevelandii 'Whirly Blue'	Whirly blue Cleveland's sage	3-5'	X			X	X		E
Salvia clevelandii 'Winnifred Gilman'	Winnifred Gilman Cleveland's sage	3'	X			X			E
Salvia leucophylla	Purple sage	3-7'	X			X			E
Salvia mellifera	Black sage	3-6'	X			X	X		E
Salvia mellifera 'Terra Seca'	Terra seca black sage	2'	X			X	X		E
Sambucus caerulea	Blue elderberry	6-9'		X		X	X		D
Sambucus mexicana	Mexican elderberry	6-12'	X	X		X	X		D
Spiraea douglasii	Western spiraea	4-5'	X	X		X			D
Styrax redivivus officinalis	Snow drop bush	5-7'	X	X			X		D
Symphoricarpos albus	Snowberry	6-12'		X	X		X	X	D
Trichostema lanatum	Wooly bluecurls	3-4'	X			X			E

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	SHRUBS CONT.								
Viguera parishii	Desert golden eye	1-3'	X			X	X		D
	SHRUBS/TREES								
Cephalanthus occidentalis	Buttonbush (buttonwillow)	3-15'		X	X	X	X		D
Cercis occidentalis	Western redbud	15-25'	X	X		X	X		D
Myrica californica	Pacific wax myrtle	10-30'		X		X			E
Prunus lyonii (P. ilicifolia ssp. lyonii)	Catalina cherry	15-20'	X	X		X			E
Salix exigua (Salix hindsiana)	Coyote willow	6-20'		X		X	X		D
Salix laevigata	Red willow	10-25'		X		X	X		D
Salix lasiolepsis	Arroyo willow	10-20'		X		X			D
Umbellularia californica	California bay	6-50'		X			X		E
	TREES								
Acer circinatum	Vine maple	5-35'		X	X	X	X		D
Acer macrophyllum	Big-leaf maple	30-50'		X	X	X	X		D
Aesculus californica	California buckeye	10-30'	X	X		X	X		D
Arbutus menziesii	Madrone	20-50'	X	X		X	X		E
Calocedrus decurrens	Incense cedar	50-90'	X	X		X			E
Cornus nuttallii	mountain dogwood	20-50'		X	X		X		D
Cupressus sargentii	Sargent cypress	10-40'	X				X		E
Fraxinus latifolia	Oregon ash	30-40'		X	X	X	X		D
Juglans californica var. hindsii	Northern California black walnut	30-60'	X	X		X			D
Pinus attenuata	Knobcone pine	20-40'·	X	X					E
Pinus jeffreyi	Jeffrey pine	60-120'	X						E
Pinus lambertiana	Sugar	60-200'	X						E
Pinus ponderosa	Ponderosa pine	80-100'	X						E
Pinus sabiniana	Foothill pine	40-80'	X						E
Platanus racemosa	California sycamore	40-60'		X		X			D
Quercus agrifolia	Coast live oak	20-70	X			X			E
Quercus berberidifolia	Scrub oak	6-15'	X			X			E
Quercus douglasii	Blue oak	30-50'	X	X		X	X		D
Quercus durata	Leather oak	10'	X			X			E
Quercus kelloggii	Black oak	30-80'	X			X			D
Quercus lobata	Valley oak	50-70'	X			X			D
Quercus wislizenii	Interior live oak	30-80'	X	X		X			E
	VINES								
Aristolochia californica	California pipe vine	10-40'	X	X		X	X		D
Clematis ligusticifolia	Western clematis	4-30'		X	X	X	X		D
Clematis sp.	Virgin's bower	10-30'	X	X			X		D
Lonicera hispidula	Pink honeysuckle	8-12'	x	x			x		D
Vitis californica	California wild grape	10-20'	X	X			X		D

DESIGN and MAINTENANCE – TRASH CONTROL[4]

The design of a bioretention BMP can be enhanced to comply with the Statewide Trash Amendments. To meet these requirements and qualify as a Multi-Benefit Trash Treatment System, the bioretention BMP must be designed in accordance with the following five (5) requirements:

1. Trap trash particles that are 5 mm or greater, and include a screen at the inlet, overflow, or bypass outlet to trap these particles from either of the following[5]:

   a. The peak flow rate generated by the region specific one-year, one-hour storm event (0.362 inches/hour) from the applicable subdrainage area; or

   b. The peak flow rate of the corresponding storm drain (if the corresponding storm drain is designed for less than the peak flow rate generated from the one-year, one-hour storm event).

2. The BMP may include either or both of the following to trap trash particles for either flow described above in section 1.a or 1.b:

   a. A screen at the system's inlet, overflow, or bypass outlet; or
   b. An up-gradient structure designed to bypass flows exceeding the flows described above in section 1.a or 1.b.[6]

A screen is not required if the BMP has capacity to treat either of these flows through media filtration or infiltration into native or amended soils.

3. Have a minimum treatment capacity for either of the flow rates described in 1.a. or b. above. The Rational Equation method must be used to calculate the peak flow rate for runoff from a small subdrainage area that is approximately 50 acres or less. The Rational Equation is expressed as Q = CiA, where:

Q = design peak runoff rate, cfs,
C = runoff coefficient, dimensionless,
i = rainfall intensity 0.362 inches/hour, and
A = subdrainage area, acres.

Other calculation methods for drainage areas greater than 50 acres are allowed, provided a registered California licensed professional engineer documents the calculations within the design plans.

4. The design plans must be stamped and signed by a registered California licensed professional civil engineer (see Bus. & Prof. Code Section 6702, et seq.).

5. Regular maintenance is required to maintain adequate trash capture capacity and to ensure that captured trash does not migrate offsite. The owner shall establish a maintenance schedule based on site-specific factors, including the design trash capacity of the bioretention BMP, storm frequency, and estimated or measured trash loading from the drainage area.

Trash controls shall be installed and maintained by the property owner for all storm drains, catch basins, or inlets that are located within the boundaries of the parcel and that are operated and maintained by the property owner. Trash controls shall only be installed in storm drains, catch basins, or inlets within the Public RoW if the applicable agency has agreed to enter into a maintenance agreement with the property owner. Vector breeding considerations must also be addressed in determining treatment controls because of the potential nuisance and human health effects.

4 Also see https://www.casqa.org/sites/default/files/downloads/bioretention_mbts.pdf
5 Certified full capture devices have a design capacity to trap trash from flows not less than the peak flow rate at any time within a storm event. A Multi-benefit trash treatment system, including those that are volume-based, must have a design capacity to trap trash from flows not less than the peak flow rate at any time within a storm event to be a certified full capture system.
6 Upon approval by the appropriate Regional Water Quality Control Board Executive Officer, a 5mm screen and/or upgradient structure may not be

The facility must meet State-sanctioned requirements detailed in the Certified Multi-Benefit Treatment Systems Complying With Trash Full Capture System Requirements, authorized March 9, 2018, and any subsequent revisions. Requirements can be accessed at https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html.

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-5 should be used to calculate the Water Quality Volume (WQV) of bioretention areas for Regulated Projects. This value is then used to iteratively determine the necessary bioretention area sizing to capture the remainder of the 85th percentile, 24-hour design storm not retained by Site Design Measures. The equation for determining the WQV is as follows:

$$WQV = \text{Unit WQV} * A_{imp} * R_C$$

Where:

WQV = Water Quality Volume (ft^3);

Unit WQV = design storm based on elevation and 48- hour drawdown time (see below);

A_{imp} = impervious drainage area untreated by Site Design Measures (ft^2); and

R_C = Runoff Coefficient (default 0.9).

The Unit WQV is based on the site evevation and a 48-hr. drawdown time as follows:

Project Elevation (ft. above mean sea level)	Unit Water Quality Volume (inches)
Over 1,000 ft.	0.9
500 ft – 1,000 ft.	0.75
Under 500 ft	0.65

Sites with documented high concentrations of pollutants in underlying soil or groundwater, sites located where infiltration could contribute to a geotechnical hazard, and sites located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the gravel layer to create a "Flow-Through Planter." These Flow-Through Planters must be sized according to Water Quality Flow (WQF) using Form 3-5 and Form 3-7 of the SWQP. The equation for determining the WQF for Flow-Through Planters is as follows:

$$\mathbf{WQF = A_{imp} * P_F / 43{,}200}$$

Where:

WQF = Water Quality Flow (cfs);

A_{imp} = impervious drainage area untreated by Site Design Measures (ft^2); and

P_F = flow based design storm intensity (0.2 inch/hr).

CONSTRUCTION PHASE CONSIDERATIONS

Protection and Excavation

Protecting bioretention areas during all phases of construction is a top priority. In project specifications, and during pre-bid and pre-construction meetings, communicate requirements and expectations to the contractor. From the start of construction, areas should be fenced to define limits and keep heavy equipment out. Erosion and sediment control measures should be placed so that construction sediment and wastes cannot enter the facility. Excavation activities should avoid compacting the facility base and sidewalls and should not take place during wet weather.

Inlets should be blocked until construction sediment sources are removed and plants are sufficiently established to hold up to storm water flows. Plant establishment times will depend on plant species. Storm water directed away from bioretention areas during plant establishment must be managed using temporary BMPs.

Structures and Materials

Structures such as curbs, inlets, checkdams, bypass and underdrain systems and containment walls are critical to facility function. During construction, verify that the elevations of these elements match the design drawings. For example, the raised overflow structures used in bioretention facilities may look like a plan error to contractors not experienced with LID. Clearly communicating design objectives will help avoid uninformed field adjustments.

The bioretention soil mix and aggregate layers are also key components to achieving the desired performance. During pre-bid and pre-construction meetings, explain the characteristics and purpose of these materials to contractors and follow up by thoroughly reviewing construction material submittals.

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the Final SWQP. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance, with provisions for full replacement when necessary, and provide site specific inspection checklist. For trash maintenance see above.

At a minimum the following inspections and maintenance activities should be conducted on an annual basis or more frequently if necessary:

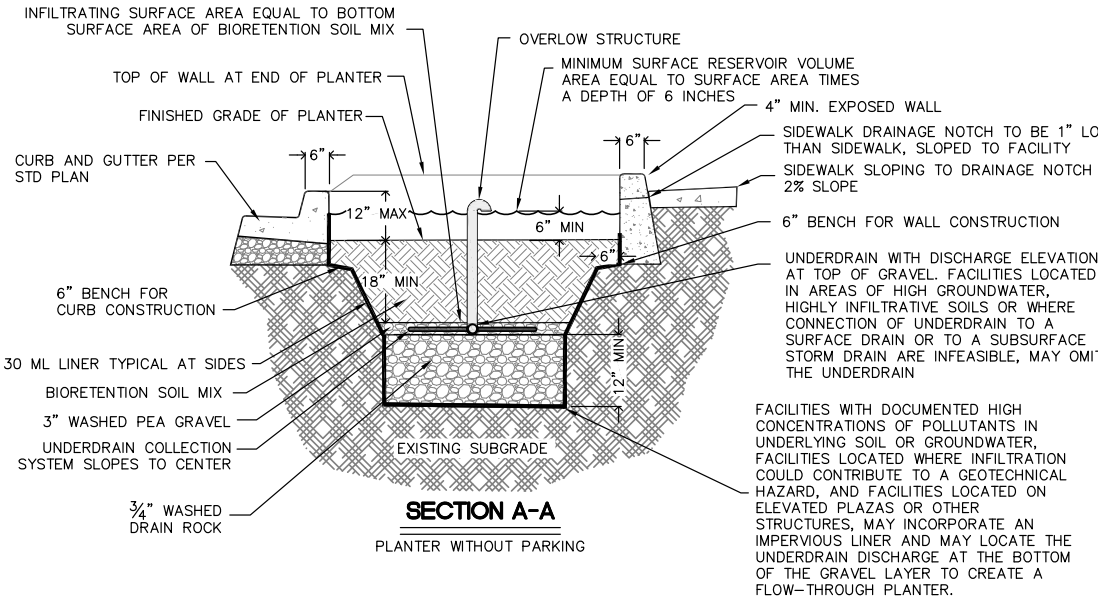
Maintenance Indicator	Required Maintenance Activity
Is litter, excess sediment or debris present in the upstream drainage or in the bioretention facility?	Remove litter, sediment/debris. Inspect the areas upstream of the bioretention facility to make sure the tributary area is properly stabilized.
Is standing water present in the facility for longer than 48 hours after a storm?	Remove any accumulated sediment and flush drainage system including underdrain. Remove and replace top few inches of soil. Remove and replace all soil, re-grade and re-plant.
Are dead plants, weeds present?	Remove dead vegetation and replace as necessary. Pull weeds and trim excess plant growth.
Is erosion occurring within the facility or drainage system?	Repair erosion and stabilize to prevent recurrence
Are holes or voids present in the facility?	Inspect underdrain and replace soil if needed.
Are unwanted rodents or other pests present?	Implement environmentally friendly pest control practices. Do not use pesticides or herbicides in the bioretention facility.

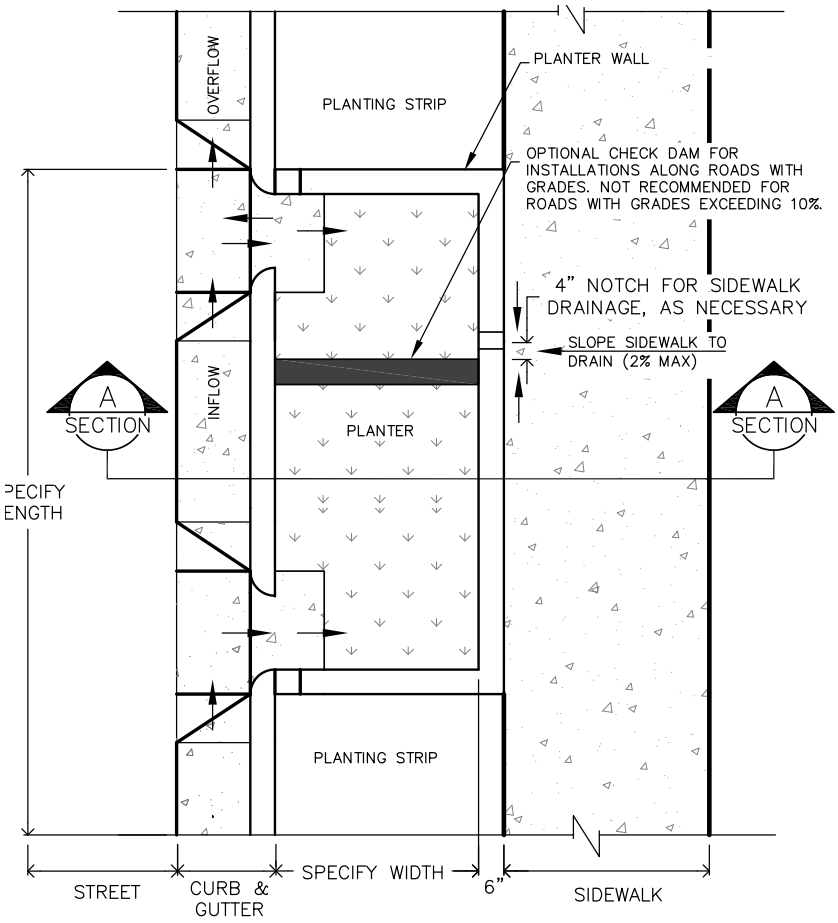
REFERENCES

City of Salinas Department of Engineering and Transportation. 2014. Stormwater Standard Plans (SWSPs). Available online at: https://www.cityofsalinas.org/our-city-services/public-works/development-engineering/document-lists/stormwater-standard-plans-swsp

Placer County Planning Services Division. 2013. Placer County Landscape Design Guidelines.

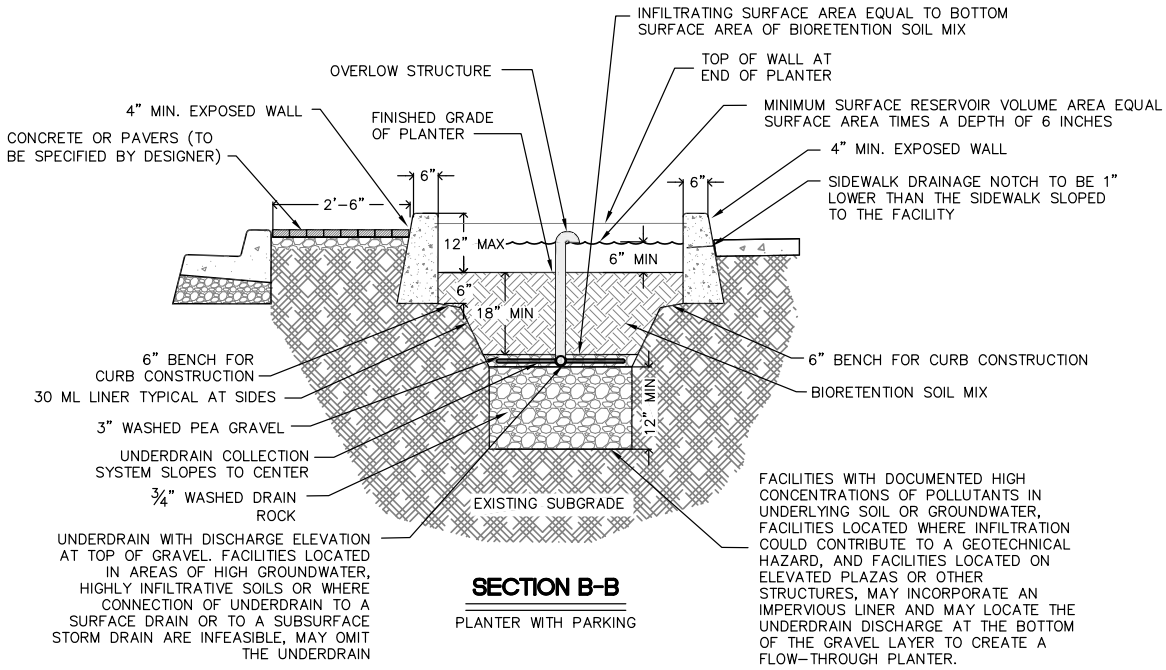
Available online at: http://www.placer.ca.gov/~/media/cdr/Planning/documents/DesignGuides/Landscape%20Design%20Guidelines.pdf

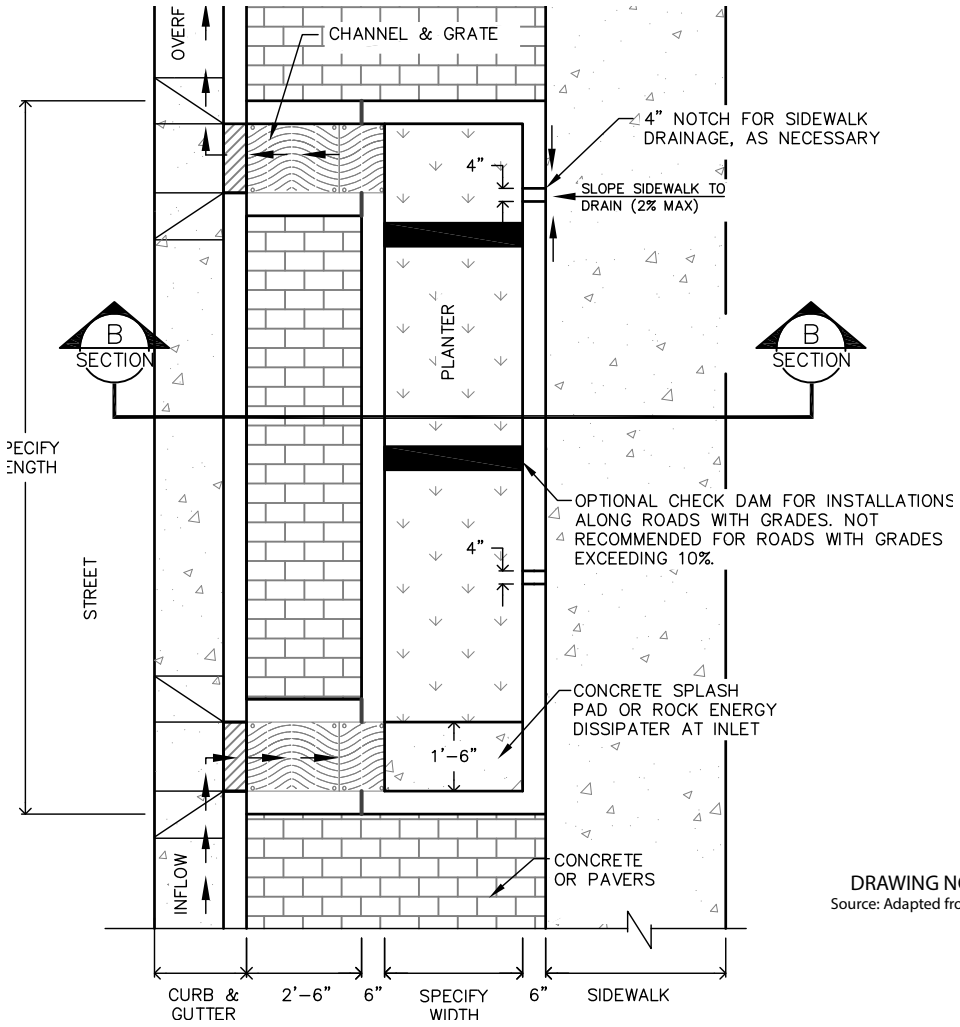




DRAWING NOT TO SCALE
Source: Adapted from City of Salinas

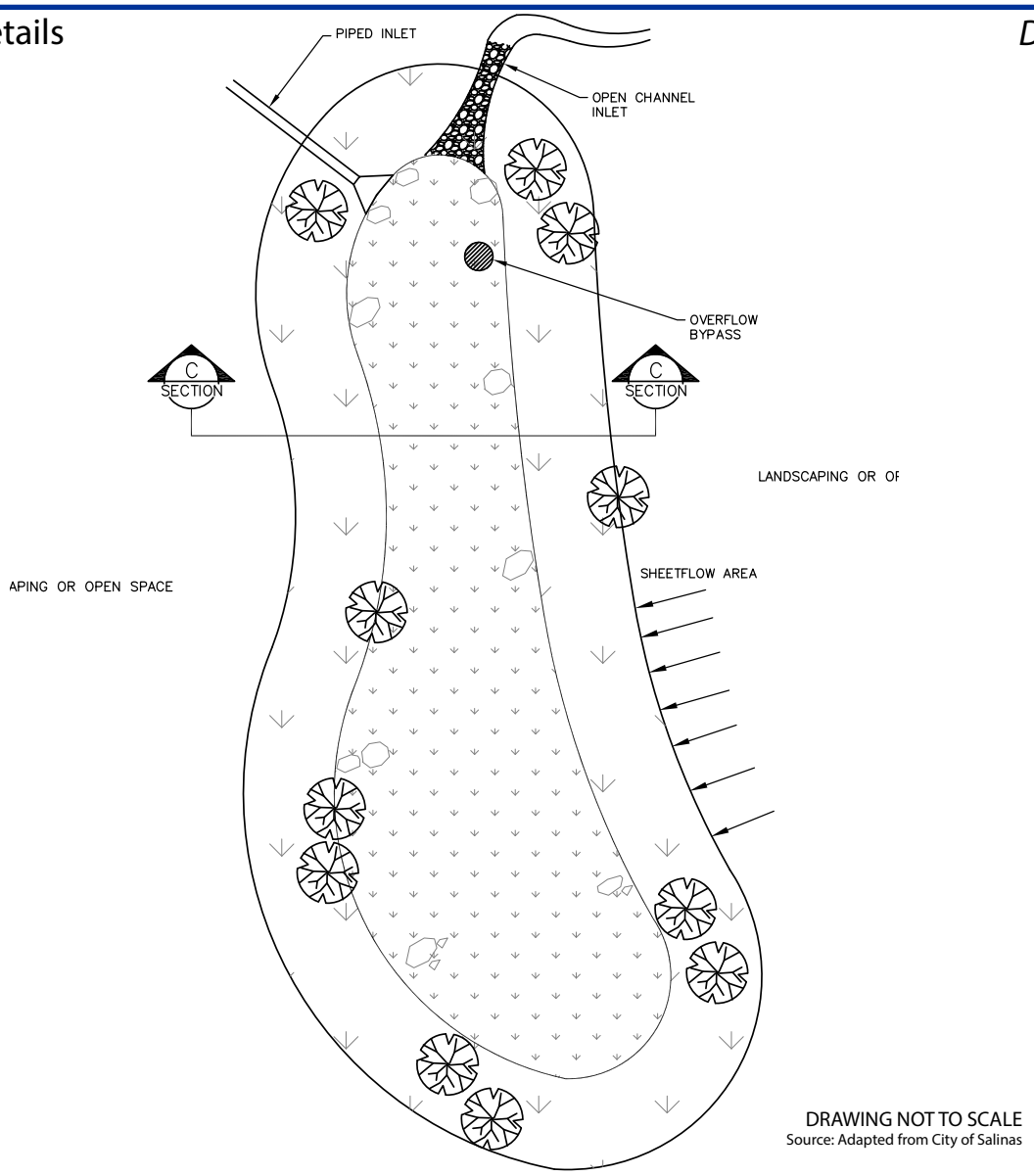
IN STREET BIORETENTION - WITHOUT PARKING
Plan & Section Views



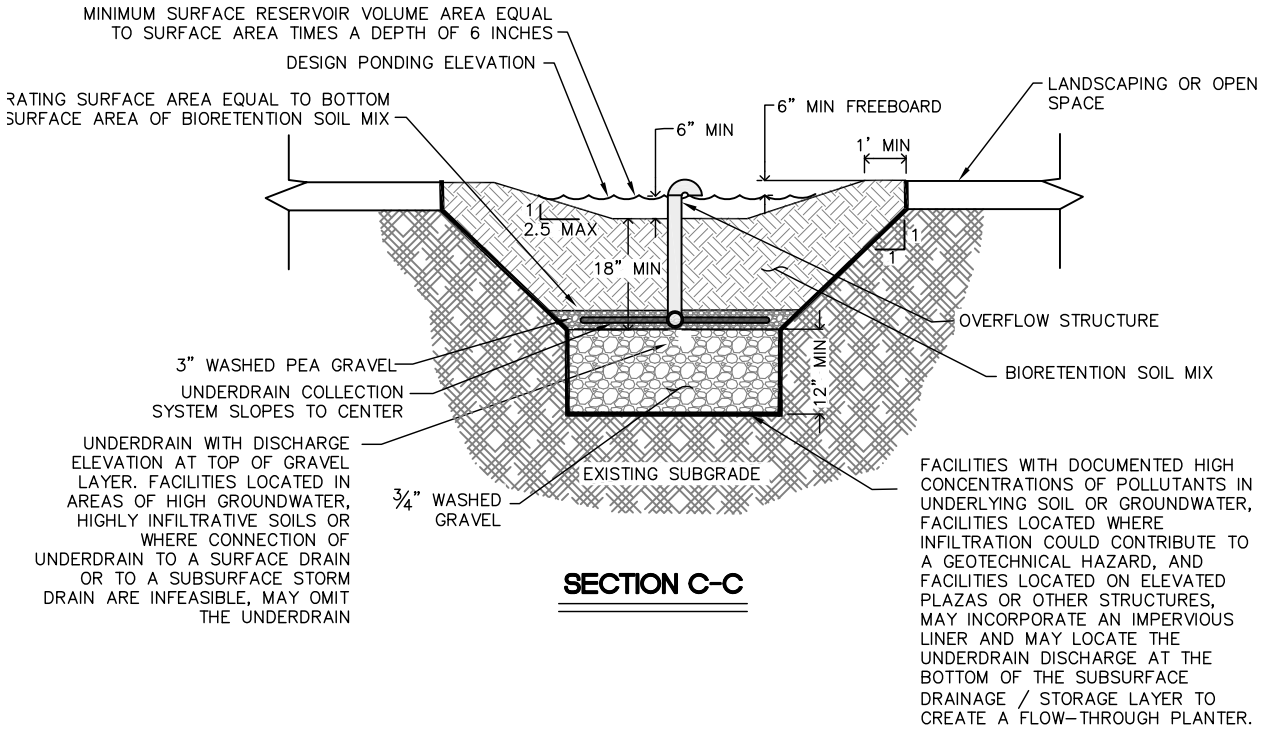


IN STREET BIORETENTION - WITH PARKING
Plan and Section Views

DRAWING NOT TO SCALE
Source: Adapted from City of Salinas



BIORETENTION IN LANDSCAPE OR OPEN SPACE AREAS
Plan and Section Views



BIORETENTION IN LANDSCAPE OR OPEN SPACE AREAS
Plan and Section Views

DRAWING NOT TO SCALE
Source: Adapted from City of Salinas

MEDIA FILTER

Fact Sheet TR-2

DESCRIPTION

Storm water media filters are typically two-chambered including a pretreatment settling basin and a filter consisting of sand, gravel, or other adsorptive filtering media. As storm water flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as storm water flows through the filtering media in the second chamber. There are a number of design variations including the Austin sand filter, Delaware sand filter, multi-chambered treatment train (MCTT), and manufactured storm water filters. Treated storm water is collected in an effluent chamber or underdrain, and subsequently discharged to a storm water conveyance system or other appropriate location.

Photo Source: Portland BES

Manufactured storm water filters are typically underground systems that utilize membranes of various materials or cartridges filled with different types of media to filter storm water runoff. For cartridge systems, the media used can be inert, such as sand, or adsorptive, such as peat or manufactured media. The effectiveness of these systems depends on the type of membrane or media being implemented, the filter loading rate, and the characteristics of the influent storm water. For some systems, the water chemistry will also determine the effectiveness of the filter in removing dissolved constituents.

ADVANTAGES

- Protects and improves water quality by removing pollutants from storm runoff.
- Customizable sizing (small footprint).
- Customizable filter media to target key site pollutants.
- May be located underground.
- Does not require irrigation.
- Can be designed to meet trash control requirements.

LIMITATIONS

- Minimal reduction in runoff volume in comparison to other systems that promote infiltration, evaporation, or evapotranspiration.
- Designs that maintain permanent standing water may create vector concerns.
- Confined space training may be required for maintenance on vault systems.
- Failure to maintain media filter may result in clogging and system failure.
- Significant head loss through filters may limit use on flat sites.
- High installation and maintenance costs.

KEY DESIGN FEATURES

Media filters may only be implemented for Regulated Projects that demonstrate use of bioretention facilities to be infeasible. Regulated Projects implementing media filters must meet the following requirements:

1. Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85 percent of the entire project site covered

by permanent structures;
2. Facilities receiving runoff solely from existing (pre-project) impervious areas; and
3. Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

The performance of any media filter is governed primarily by the following factors which should be carefully evaluated when designing the facility:

- Hydraulic Loading Rate – The application rate of untreated water to the surface of the filter media usually expressed as a flow rate per filter surface area (i.e. gpm/ft^2);
- Filter Media Gradation – A finer media gradation reduces hydraulic conductivity and increases the capture efficiency for fine particulate pollutants. Finer media also has a greater surface area which increases sorption rates for chemically active media. A more homogenous media gradation increases voids volume in a media bed. Finer media is more susceptible to surface clogging.
- Residence Time - Residence time is a function of media gradation, hydraulic loading rate and the media bed depth and configuration. A longer residence time generally improves pollutant removal performance.
- Media Chemical Properties – Filter media can be inert (i.e. sand) or can be selected to target specific pollutants of concern (i.e. activated carbon for trace organics). Chemically active options may be organic, mineral or synthetic or a combination of types. Media should be selected with consideration of the type and load of pollutants requiring removal.
- Pretreatment – Integrate adequate pretreatment facilities into media filter designs to reduce sediment loading and maintenance frequency. The level of pretreatment required is dependent on the tributary drainage area, but typical pretreatment consists of a sedimentation chambers, hydrodynamic separator, vegetated buffer strips, and vegetated swales.
- Hydraulic Head – Different media filters types have varying hydraulic head requirements that must be considered during design. Certain media filter configurations may not be suitable for flat sites.

DESIGN AND MAINTENANCE - TRASH CONTROL[7]

The design of a media filter BMP can be enhanced to comply with the Statewide Trash Amendments. To meet these requirements and qualify as a Multi-Benefit Trash Treatment System, the media filter must be designed in accordance with the following five (5) requirements:

1. Trap trash particles that are 5 mm or greater, and include a screen at the inlet, overflow, or bypass outlet to trap these particles from either of the following[8]:

   a. The peak flow rate generated by the region specific one-year, one-hour storm event (0.362 inches/hour) from the applicable subdrainage area; or

   b. The peak flow rate of the corresponding storm drain (if the corresponding storm drain is designed for less than the peak flow rate generated from the one-year, one-hour storm event).

2. The BMP may include either or both of the following to trap trash particles for either flow described above in section 1.a or 1.b:

7 Also see https://www.casqa.org/sites/default/files/downloads/bioretention_mbts.pdf
8 Certified full capture devices have a design capacity to trap trash from flows not less than the peak flow rate at any time within a storm event. A Multi-benefit trash treatme system, including those that are volume-based, must have a design capacity to trap trash from flows not less than the peak flow rate at any time within a storm event to be a certified full capture system.

a. A screen at the system's inlet, overflow, or bypass outlet; or

b. An up-gradient structure designed to bypass flows exceeding the flows described above in section 1.a or 1.b.

A screen is not required if the BMP has capacity to treat either of these flows through media filtration or infiltration into native or amended soils.

3. Have a minimum treatment capacity for either of the flow rates described in 1.a. or b. above. The Rational Equation method must be used to calculate the peak flow rate for runoff from a small subdrainage area that is approximately 50 acres or less. The Rational Equation is expressed as Q = CiA, where:

Q = design peak runoff rate, cfs,

C = runoff coefficient, dimensionless,

i = rainfall intensity 0.362 inches/hour, and

A = subdrainage area, acres.

Other calculation methods for drainage areas greater than 50 acres are allowed, provided a registered California licensed professional engineer documents the calculations within the design plans.

4. The design plans must be stamped and signed by a registered California licensed professional civil engineer (see Bus. & Prof. Code Section 6702, et seq.).

5. Regular maintenance is required to maintain adequate trash capture capacity and to ensure that captured trash does not migrate offsite. The owner shall establish a maintenance schedule based on site-specific factors including the design trash capture capacity of the Media Filter Multi-Benefit Trash Treatment System, storm frequency, and characterization of upstream trash and vegetation accumulation.

Trash controls shall be installed and maintained by the property owner for all storm drains, catch basins, or inlets that are located within the boundaries of the parcel and that are operated and maintained by the property owner. Trash controls shall only be installed in storm drains, catch basins, or inlets within the Public RoW if the applicable agency has agreed to enter into a maintenance agreement with the property owner. Vector breeding considerations must also be addressed in determining treatment controls because of the potential nuisance and human health effects.

The facility must meet State-sanctioned requirements detailed in the Certified Multi-Benefit Trash Treatment Systems Complying With Trash Full Capture System Requirements, authorized March 9, 2018, and any subsequent revisions. Requirements can be accessed at https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-5 should be used to calculate the Water Quality Flow (WQF) of media filters for Regulated Projects. This value is then used in Form 3-7 to iteratively determine the necessary media filter sizing to capture the remainder of the 85th percentile, 24-hour design storm not retained by Site Design Measures. The equation for determining the WQF for media filters is as follows:

$$\mathbf{WQF = A_{imp} * P_F / 43{,}200}$$

Where:

WQF = Water Quality Flow (cfs);

A_{imp} = impervious drainage area untreated by Site Design Measures (ft^2); and

P_F = flow based design storm intensity (0.2 inch/hr).

9 Upon approval by the appropriate Regional Water Quality Control Board Executive Officer, a 5mm screen and/or upgradient structure may not be required if the multi-benefit trash treatment system is designed for flows generated from very large 24-hour storm events.

MEDIA FILTER

Fact Sheet TR-2

CONSTRUCTION PHASE CONSIDERATIONS

- Divert flow around the sand filter to protect it from sediment loads during construction. If sediment does enter the facility during construction, the sediment will require removal after the tributary area has been stabilized. Diverted flow must be managed using temporary BMPs.
- Where underdrains are used, ensure that the minimum slope of the pipe is 0.5 (one half) percent.
- Ensure that the inverts of notches, orifices, or weirs dividing chambers correspond with design elevations to ensure proper function.
- The surface of bed filters should be completely level to promote uniform filtration.
- If precast concrete lids are used, provide lifting rings or threaded sockets to allow easy removal with standard lifting equipment.
- Once construction is complete, stabilize the entire tributary area to the media filter before allowing runoff to enter the unit.

MAINTENANCE CONSIDERATIONS

As with other LID features, the site layout needs to consider access for inspection and maintenance of the media filters for the life of the project. Media filters may exhibit decreased effectiveness after a single year of operation, depending on the activities occurring in the drainage area and filter loading. They clog easily when subjected to high sediment loads, and sediment reducing pretreatment practices placed upstream of the filter should be maintained properly to reduce sediment loads into the filter.

Maintenance efforts will need to focus on basic housekeeping practices such as removal of sediment and debris accumulations to prevent clogs and/or ponds of standing water. To minimize the potential for clogging, frequent maintenance and inspection practices are required. Waste sand, gravel, membranes, or filter media must be disposed of properly and in accordance with all applicable laws.

Media filters can become a nuisance due to mosquito or midge breeding if not properly designed and maintained. Installations should dewater completely (recommended 48 hour or less residence time) to prevent creating mosquito and other vector habitats.

For trash maintenance see above.

AVAILABLE VENDOR PRODUCTS

The vendor products listed below may not be present in the list of certified full capture systems maintained by the SWRCB. Projects required to comply with Trash Requirements should consider the list of approved devices when developing a treatment control measure plan Their appearance here is not an endorsement of the products or manufacturers by Placer County.

- BayFilter™
- Fabco Filter Cartridges
- Jellyfish®
- Media Filtration System (MFS)
- Perk Filter™
- Puristorm™
- Up-Flo™
- StormFilter®
- VortFilter™

REFERENCES

California Department of Transportation (Caltrans). 2010. Treatment BMP Technology Report. CTSW-RT-09-239.06. Available online at: http://www.dot.ca.gov/hq/env/stormwater/pdf/CTSW-RT-09-239-06.pdf

California Stormwater Quality Association (CASQA). 2003. California Stormwater BMP Handbook – New Development and Redevelopment. BMP Fact Sheet TC-40: Media Filter and BMP Fact Sheet MP-40: Media Filter. Available online at:

https://www.casqa.org/resources/bmp-handbooks/new-development-redevelopment-bmp-handbook

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: https://www.casqa.org/sites/default/files/downloads/socallid-manual-final-040910.pdf

Sacramento County, et al. 2014. Stormwater Quality Design Manual for the Sacramento Region. Available online at: http://www.beriverfriendly.net/docs/files/Master%20Stormwater%20Quality%20Manual%202014_FINAL_W%20APPEND_W%20COVER.pdf

TREE BOX FILTER

Fact Sheet TR-3

DESCRIPTION

Tree box filters are typically manufactured systems that provide biofiltration and media filtration to treat storm water runoff. Storm water typically flows into a pretreatment chamber to remove large sediment, debris and trash before passing into the biotreatment chamber where physical straining, and biological and chemical reactions in the mulch, root zone, and soil matrix occurs. Tree box filters are similar in concept to bioretention areas in function and application, with the major distinction that a tree box filter has been optimized for high volume/flow treatment, therefore the ratio of impervious area to treatment area is less. A tree box filter takes up little space and may be used on highly developed sites in areas such as landscaping, green space, parking lots and streetscapes.

Photo Source: Oldcastle Stormwater Solutions ™

An underdrain in the tree box filter collects treated storm water to be discharged to the storm water conveyance system or other appropriate location. Manufactured tree box filters typically incorporate a high flow bypass to prevent scouring in the bioretention basin and mobilization of treated pollutants. The overflow can be directed to another treatment system or the municipal storm system.

ADVANTAGES

- Protects and improves water quality by removing pollutants from storm runoff.
- Customizable sizing (small footprint).
- Trees can reduce heat island effects.
- Can be integrated into landscaping and is aesthetically pleasing.
- Customizable vegetation.

LIMITATIONS

- Minimal reduction in runoff volume in comparison to other systems that promote infiltration.
- Designs that maintain permanent standing water may create vector concerns
- Vegetation may develop slowly, though treatment is still provided.
- Confined space training may be required for maintenance.
- Failure to maintain may result in clogging and system failure.
- High installation and maintenance costs.

KEY DESIGN FEATURES

Tree box filters may only be implemented for Regulated Projects that demonstrate use of bioretention facilities to be infeasible. Regulated Projects implementing tree box filters must meet the following requirements:

1. Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85% of the entire project site covered by permanent structures;
2. Facilities receiving runoff solely from existing (pre-project) impervious areas; and
3. Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

The performance of a tree box filter is governed primarily by the following factors which should be carefully evaluated when designing the facility:

- Hydraulic Loading Rate – The application rate of untreated water to the surface of the filter media usually expressed as a flow rate per filter surface area (i.e. gpm/ft^2);
- Filter Media Gradation – A finer media gradation reduces hydraulic conductivity and increases the capture efficiency for fine particulate pollutants. Finer media also has a greater surface area which increases sorption rates for chemically active media. A more homogenous media gradation increases voids volume in a media bed. Finer media is more susceptible to surface clogging.
- Residence Time - Residence time is a function of media gradation, hydraulic loading rate and the media bed depth and configuration. A longer residence time generally improves pollutant removal performance.
- Media Chemical Properties – Filter media can be inert (i.e. sand) or can be selected to target specific pollutants of concern (i.e. activated carbon for trace organics). Chemically active options may be organic, mineral or synthetic or a combination of types. Media should be selected with consideration of the type and load of pollutants requiring removal.
- Pretreatment – Integrate adequate pretreatment facilities into media filter designs to reduce sediment loading and maintenance frequency. The level of pretreatment required is dependent on the tributary drainage area, but typical pretreatment consists of a sedimentation chambers, hydrodynamic separator, vegetated buffer strips, and vegetated swales.
- Vegetation – Choose moisture-tolerant plants that can tolerate both fluctuating water conditions and drought conditions. Guidance on planting and general landscape design is provided in the Placer County Landscape Design Guidelines (Placer County Planning Services Division, 2013). Refer to fact sheet TR-1 for more information on recommended plant species.

CONSTRUCTION PHASE CONSIDERATIONS

- Divert flow around the tree box filter to protect it from sediment loads during construction. If sediment does enter the facility during construction, the sediment will require removal after the tributary area has been stabilized. Diverted flow must be managed using temporary BMPs.
- Where underdrains are used, ensure that the minimum slope of the pipe is 0.5 (1/2) percent.
- Once construction is complete, stabilize the entire tributary area to the media filter before allowing runoff to enter the unit.

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction Storm Water Quality Plan (SWQP) Form 3-5 should be used to calculate the Water Quality Flow (WQF) of tree box filters for Regulated Projects. This value is then used in Form 3-7 to iteratively determine the necessary tree box filter sizing to capture the remainder of the 85th percentile, 24-hour design storm not retained by Site Design Measures. The equation for determining the WQF for tree box filters is as follows:

$$\mathbf{WQF = A_{imp} * P_F / 43{,}200}$$

Where:

WQF = Water Quality Flow (cfs);

A_{imp} = impervious drainage area untreated by Site Design Measures (ft^2); and

P_F = flow based design storm intensity (0.2 inch/hr).

MAINTENANCE CONSIDERATIONS

As with other LID features, the site layout needs to consider access for inspection and maintenance of the tree

box filters for the life of the project. Maintenance activities and frequencies are specific to each manufactured product. Semiannual maintenance is typical and should be performed per manufacturer specifications. Maintenance agreements are available from some manufacturers.

Tree box filters may exhibit decreased effectiveness after a single year of operation, depending on the activities occurring in the drainage area and filter loading. They clog easily when subjected to high sediment loads, and sediment reducing pretreatment practices placed upstream of the filter should be maintained properly to reduce sediment loads into the filter.

Maintenance efforts will need to focus on basic housekeeping practices such as removal of sediment and debris accumulations to prevent clogs and/or ponds of standing water. To minimize the potential for clogging, frequent maintenance and inspection practices are required. Waste sand, gravel, soil, mulch, or filter media must be disposed of properly and in accordance with all applicable laws.

Tree box filters can become a nuisance due to mosquito or midge breeding if not properly designed and maintained. Installations should dewater completely (recommended 48 hour or less residence time) to prevent creating mosquito and other vector habitats.

AVAILABLE VENDOR PRODUCTS

The names of vendor products listed below are for informational purposes only. Their appearance here is not an endorsement of the products or manufacturers by Placer County.

- DeepRoot® Silva Cell
- Filterra® Bioretention System
- TreePod® Biofilter
- UrbanGreen™ Biofilter

Photo Source: Contech®

REFERENCES

Alameda Countywide Clean Water Program. C.3 Stormwater Technical Guidance, A Handbook for Developers, Builders, and Project Applicants, Version 3.1. 2012. Available online at: https://www.cccleanwater.org/userfiles/kcfinder/files/Stormwater_C3_Guidebook_7th_Edition_2017-05-12%281%29.pdf

California Department of Transportation (Caltrans). 2010. Treatment BMP Technology Report. CTSW-RT-09-239.06. Available online at: http://www.dot.ca.gov/hq/env/stormwater/pdf/CTSW-RT-09-239-06.pdf

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: https://www.casqa.org/sites/default/files/downloads/socallid-manual-final-040910.pdf

TRASH CAPTURE DEVICE

Fact Sheet TR-4

DESCRIPTION

A Trash Capture Device is a type of treatment control that either (a) removes pollutants and/or solids from storm water runoff or (b) captures, infiltrates, and/or reuses storm water runoff. A Trash Capture Device can include Full Capture Systems (FCS) or Low Impact Development (LID) controls.

A Trash Capture Device that is an FCS is a treatment control, or series of treatment controls, including but not limited to, a multi-benefit project (e.g., a bioretention facility that meets volume reduction and trash control requirements) or an LID control measure that traps all particles that are 5 mm or greater, and has a design treatment capacity that is either:

a) of not less than the peak flow rate, Q, resulting from a one-year, one-hour storm in the subdrainage area, or

b) appropriately sized to, and designed to carry at least the same flows as, the corresponding storm drain.

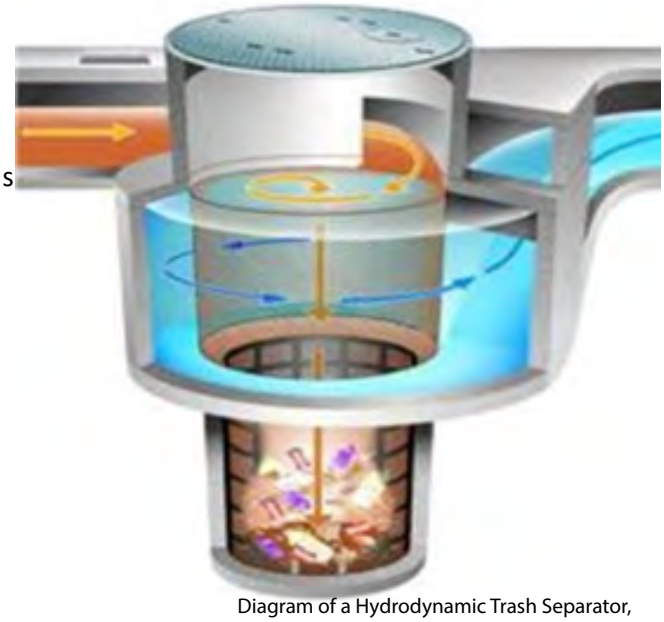


Diagram of a Hydrodynamic Trash Separator, an example trash capture device

Trash Capture Devices are typically proprietary based controls that meet the design and maintenance criteria of the Statewide Trash Amendments[10]. Only those devices that have been approved by the State Water Resources Control Board may be implemented to meet the Statewide Trash Amendment requirements.

ADVANTAGES

- Prevents trash from being transported into and through the storm drain system (for trash particles >5 mm) into the receiving waters.
- A wide range of proprietary devices provide options and flexibility to allow for site-specific conditions.
- Devices may be sized and custom fit to existing storm water infrastructure.
- Some devices may be selected or configured to provide additional benefits, such as metal sorption or sediment capture.

LIMITATIONS

- Existing storm drain infrastructure may limit the types, size, and/or treatment capacity of some trash capture devices.
- Optimal device performance requires routine maintenance consistent with the manufacturer specifications.
- Some devices have not been widely used or tested in the field which could increase the risk for flooding or infrastructure issues.

PLANNING AND SITING CONSIDERATIONS

- Land area and size of the upstream catchment area draining to the trash capture device.
- Dimensions and/or condition of the catch basin/vault where the device will be installed.
- The degree to which the proposed catch basin is connected to other catch basins.
- Other requirements such as permitting, construction, utility clearance (especially for retrofits).
- Cost of construction and long-term maintenance.

10 https://www.waterboards.ca.gov/water_issues/programs/trash_control/documentation.html

1. Be appropriately sized to treat not less than the peak flowrate resulting from a 1-year, 1-hour storm event (design storm) or at least the same peak flows from the corresponding storm drain;

2. Not bypass trash below the design storm under maximum operational loading conditions; and

3. Trap all particles that are 5 mm or greater up to the design flow[11] or at least the same peak flows from the corresponding storm drain; and do not have a diversion structure present upstream such that a portion of the peak flow is not treated to trap all particles 5 mm or greater.

Depending on its design, certain Devices may impede the mosquito or vector control agency's ability to (1) visually inspect the Device and/or storm vault for mosquito breeding, and (2) apply the appropriate chemical treatment. Moreover, some Devices may create a habitat for mosquitoes.

The Trash Provisions prohibit the installation of any non-certified full capture Device. The State Water Board will not certify a Device if it has not been verified by the Mosquito and Vector Control Association of California (MVCAC). In addition, the local mosquito or vector control agency should be contacted prior to installation of any certified Device to ensure the installation conforms with local inspection and treatment guidelines. Questions should be directed to the local vector control agency or to the MVCAC Review Team via email at: Trashtreatment@mvcac.org.

The right-hand column of the Certified Full Capture System List of Trash Treatment Control Devices[12] provides the MVCAC verification date for each certified Device. The Device manufacturers that have not received MVCAC Review Team verification have been notified that their Device(s) will be removed (de-certified) from the certification list without such verification. As a result of a Device de-certification, municipalities that are considering purchasing, or have already purchased, such a Device are prohibited from installing the device as of the date of de-certification.

Trash controls shall be installed and maintained by the property owner for all storm drains, catch basins, or inlets that are located within the boundaries of the parcel and that are operated and maintained by the property owner. Trash controls shall only be installed in storm drains, catch basins, or inlets within the Public RoW if the applicable agency has agreed to enter into a maintenance agreement with the property owner. The owner shall establish a maintenance schedule based on site-specific factors, including the design trash capacity of the trash capture device, storm frequency, and estimated or measured trash loading from the drainage area.

DESIGN PROCEDURE

While the design procedure for a given project may vary, a general process for the design of Trash Capture Devices has been outlined below.

- Step 1 – Evaluate maps and site location.
  Evaluate the site location for storm water infrastructure connectivity (i.e., storm drain lines, inlets, outfalls, and catchments) and identify the potential locations for the installation of a Trash Capture Device.
- Step 2 – Delineate catchment drainage areas.
  Conduct a GIS Desktop analysis or field visit to define the boundary of each stormwater catchment associated with a potential Trash Capture Device.
- Step 3 – Identify appropriate Trash Capture Devices for catchment drainage areas.
  Obtain the list of certified and/or agency-approved Trash Capture Device and identify the number and type of devices needed to treat the catchment drainage areas.

11 The region specific one-year, one-hour storm (or design flow) may be obtained from this document of National Oceanic and Atmospheric Precipitation Estimates.
12 https://www.casqa.org/resources/trash/certified-full-capture-system-trash-treatment-control-devices

- Step 4 – Conduct field evaluations/surveys to further identify site constraints and design criteria required by manufacturer of the selected Trash Capture Device.

Using design criteria and specifications for the selected Trash Capture Devices, conduct a field evaluation to identify any potential site constraints and to obtain the design criteria specified.

CONSTRUCTION CONSIDERATIONS

- If a site is deemed to be technically infeasible for installation, the relocation of a Trash Capture Device up-stream may be able to account for site-specific constraints.
- Trash Capture Devices shall be installed within the boundary of the project site location, and not within the public right-of-way, unless a prior agreement with the applicable agency has been reached.

LONG-TERM MAINTENANCE

Maintenance requirements are expected to be specific to each device and based on the manufacturer's recommendations. The property owner or his/her designee is responsible for compliance with a maintenance agreement. The maintenance agreement and plan will provide the applicable agency with complete access to the device and its immediate vicinity at any time. Maintenance of the device is the sole responsibility of the owner.

Appendix C
Source Control Measures Selection Table

Source Control Measures Selection Table

Potential Pollutant Source or Activity	Source Control Measure and General Implementation Protocols	CASQA BMP Handbook with Additional Information	CASQA Fact Sheet No.
Accidental spills or leaks	**Spill Prevention, Control and Cleanup** ▪ Develop procedures to prevent/mitigate spills to storm drain systems. ▪ Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures. ▪ Establish procedures and/or controls to minimize spills and leaks. ▪ Recycle, reclaim, or reuse materials whenever possible.	Industrial and Commercial (2014)	SC-11
Interior floor drains	**Non-Stormwater Discharges** ▪ Visually inspect and inventory all interior floor drains. ▪ Do not connect to MS4. Floor drains should discharge to sumps for pumping and disposal or to the sanitary sewer in compliance with local agency requirements. ▪ For redevelopment, identify and disconnect interior floor drains from the MS4. ▪ Isolate problem areas and plug illicit discharge points.	Industrial and Commercial (2014)	SC-10
Parking/Storage Areas and Maintenance	**Parking/Storage Area Maintenance** ▪ Encourage advanced designs and maintenance strategies for impervious parking lots. ▪ Keep accurate maintenance logs to evaluate BMP implementation.	Industrial and Commercial (2014)	SC-43
Indoor and structural pest control	**Building and Grounds Maintenance** ▪ Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of pesticides. ▪ Do not mix, prepare, or apply pesticides near storm drain inlets. ▪ Encourage use of Integrated Pest Management techniques for pest control.	Industrial and Commercial (2014)	SC-41
	Safer Alternative Products ▪ Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.	Industrial and Commercial (2014)	SC-35
Pools, spas, ponds, decorative fountains, and other water features	**Mobile Cleaning - Swimming Pools and Spas** ▪ Never discharge wash water or wastewater from cleaning swimming pools and spas to the driveway, street, gutter, or near a storm drain.	Industrial and Commercial (2014)	BG-63

Potential Pollutant Source or Activity	Source Control Measure and General Implementation Protocols	CASQA BMP Handbook with Additional Information	CASQA Fact Sheet No.
	▪ Follow local regulations for draining swimming pools and spas into the sanitary sewer system.		
	Fountains and Pools Maintenance ▪ Prevent algae problems with regular cleaning, consistent adequate chlorine levels, and well-maintained water filtration and circulation systems. ▪ Manage pH and water hardness to minimize corrosion of copper pipes. ▪ Do not use copper-based algaecides. Control algae with chlorine or other alternatives, such as sodium bromide. ▪ Reduce fertilizer use in areas around the water body. High nitrogen fertilizers may contribute to excessive algae growth.	Municipal (2003)	SC-72
Landscaping/outdoor pesticide use	**Building and Grounds Maintenance** ▪ Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides. ▪ Use non-toxic chemicals to the maximum extent possible. ▪ Encourage use of Integrated Pest Management techniques for pest control. ▪ Encourage proper onsite recycling of yard trimmings. ▪ Do not use pesticides if rain is expected. ▪ Do not mix, prepare, or apply fertilizers and pesticides near storm drain inlets. ▪ Use the minimum amount of fertilizer and pesticides needed for the job. ▪ Calibrate fertilizer distributors to avoid excessive application. ▪ Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques. ▪ Apply pesticides only when wind speeds are low.	Industrial and Commercial (2014)	SC-41
	Safer Alternative Products ▪ Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.	Industrial and Commercial (2014)	SC-35
	Site Design and Landscape Planning ▪ Integrate and incorporate appropriate landscape planning methodologies into the project design to minimize surface and groundwater contamination from stormwater.	New Development and Redevelopment (2003)	SD-10

Potential Pollutant Source or Activity	Source Control Measure and General Implementation Protocols	CASQA BMP Handbook with Additional Information	CASQA Fact Sheet No.
	Efficient Irrigation ▪ Design and implement irrigation methods that minimize runoff of excess irrigation water into the stormwater conveyance system.	New Development and Redevelopment (2003)	SD-12
Restaurants, grocery stores, and other food service operations	**Food Service Facilities** ▪ Minimize exposure of rain and runoff to outdoor cleaning and storage areas by using cover and containment. ▪ Use good housekeeping to minimize the generation of pollutants. ▪ Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. ▪ Provide employee education materials in the first language of employees.	Industrial and Commercial (2014)	BG-30
	Mobile Cleaning – Food Service Related ▪ Perform dry cleanup before washing with water. ▪ Wash without soaps and solvents. ▪ Keep polluted water out of storm drains. ▪ Dispose of wastewater correctly and legally	Industrial and Commercial (2014)	BG-61
Refuse areas	**Waste Handling and Disposal** ▪ Cover storage containers with leak proof lids. ▪ Cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. ▪ Recycle materials whenever possible. ▪ Use the entire product before disposing of the container. ▪ Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss. ▪ Use dry methods when possible (e.g., sweeping, use of absorbents. If water must be used after sweeping, collect water and discharge through grease interceptor to the sanitary sewer.	Industrial and Commercial (2014)	SC-34

Potential Pollutant Source or Activity	Source Control Measure and General Implementation Protocols	CASQA BMP Handbook with Additional Information	CASQA Fact Sheet No.
Industrial Processes	**Non-Stormwater Discharges** ▪ Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. ▪ Stencil or demarcate storm drains, where applicable, to prevent ignorant, unintentional, and illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" or similar. ▪ Manage and control sources of water such as hose bibs, faucets, wash racks, irrigation heads, etc. Identify hoses and faucets in the SWPPP, and post signage for appropriate use.	Industrial and Commercial (2014)	SC-10
Outdoor storage of equipment or materials	**Outdoor Loading/Unloading** ▪ Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained. ▪ Limit exposure of material to rainfall whenever possible. ▪ Prevent stormwater run-on. ▪ Check equipment regularly for leaks.	Industrial and Commercial (2014)	SC-30
	Outdoor Liquid Container Storage ▪ Educate employees about pollution prevention measures and goals. ▪ Keep an accurate, up-to-date inventory of the materials delivered and stored onsite. ▪ Try to keep chemicals in their original containers, and keep them well labeled. ▪ Develop an operations plan that describes procedures for loading and/or unloading. ▪ Protect materials from rainfall, run-on, runoff, and wind dispersal.	Industrial and Commercial (2014)	SC-31
	Outdoor Equipment Operations ▪ Perform the activity during dry periods whenever possible. ▪ Install secondary containment measures where leaks and spills may occur. ▪ Use non-toxic chemicals for maintenance and minimize or eliminate the use of solvents. ▪ Connect process equipment area to public sanitary sewer or facility wastewater treatment system. Do not connect drains from secondary containment areas to the storm drain.	Industrial and Commercial (2014)	SC-32

Potential Pollutant Source or Activity	Source Control Measure and General Implementation Protocols	CASQA BMP Handbook with Additional Information	CASQA Fact Sheet No.
Outdoor storage of equipment or materials (cont.)	**Outdoor Storage of Raw Materials** ▪ Emphasize employee education for successful BMP implementation. ▪ Store materials that could contaminate stormwater inside or under permanent cover and bermed to prevent stormwater contact. ▪ Elevate and tarp solid materials such as beams, metal, etc. ▪ Minimize the inventory of raw materials kept outside. ▪ Keep an accurate, up-to-date inventory of the materials delivered and stored on-site. ▪ Stormwater runoff that could potentially be contaminated by materials stored outdoors should be drained to the sanitary sewer. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.	Industrial and Commercial (2014)	SC-33
Vehicle and equipment cleaning	**Vehicle and Equipment Cleaning** ▪ If possible, use properly maintained off-site commercial washing and steam cleaning businesses whenever possible. ▪ Use dry cleaning methods to remove debris and sweep area when possible. ▪ Good housekeeping practices can minimize the risk of contamination from wash water discharges. ▪ Use biodegradable, phosphate-free detergents for washing vehicles as appropriate. ▪ Emphasize the connection between the storm drain system and runoff, help reinforce that vehicle and equipment washing activities affect local water quality through storm drain stenciling programs. ▪ Map on-site storm drain locations to avoid discharges to the storm drain system. ▪ Designate specific wash area with clarifier or place wash areas away from storm drain connections.	Industrial and Commercial (2014)	SC-21
Vehicle and equipment repair and maintenance	**Vehicle and Equipment Repair** ▪ Designate a vehicle maintenance area designed to prevent stormwater pollution. ▪ Minimize contact of stormwater with outside operations through berming and appropriate drainage routing. ▪ Keep accurate maintenance logs to evaluate materials removed and improvements made.	Industrial and Commercial (2014)	SC-22

Potential Pollutant Source or Activity	Source Control Measure and General Implementation Protocols	CASQA BMP Handbook with Additional Information	CASQA Fact Sheet No.
	▪ Switch to non-toxic chemicals for maintenance when possible. ▪ Choose cleaning agents that can be recycled. ▪ Use drop cloths and drip pans.		
Fuel dispensing areas	**Vehicle and Equipment Fueling** ▪ Use properly maintained off-site fueling stations whenever possible. ▪ Focus pollution prevention activities on containment of spills and leaks, most of which may occur during liquid transfers.	Industrial and Commercial (2014)	SC-20
Loading docks	**Outdoor Loading/Unloading** ▪ Develop an operations plan that describes procedures for loading and/or unloading. ▪ Conduct loading and unloading in dry weather if possible. ▪ Cover designated loading/unloading areas to reduce exposure of materials to rain. ▪ Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain. ▪ Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas. ▪ Pave loading areas with concrete instead of asphalt. ▪ Avoid placing storm drains inlets in the area. ▪ Grade and/or berm the loading/unloading area with drainage to sump; regularly remove materials accumulated in sump.	Industrial and Commercial (2014)	SC-30
Fire sprinkler test water	**Non-Stormwater Discharges** ▪ Develop a plan to eliminate discharge to the storm drain system.	Industrial and Commercial (2014)	SC-10
	Building and Grounds Maintenance ▪ Dispose fire sprinkler line test water into the sanitary sewer. ▪ Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.	Industrial and Commercial (2014)	SC-41
Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources	**Non-Stormwater Discharges** ▪ Manage and control sources of water from drain lines. ▪ Eliminate discharge of water from drain lines to the storm drain system. ▪ Repair drain line leaks immediately.	Industrial and Commercial (2014)	SC-10

Potential Pollutant Source or Activity	Source Control Measure and General Implementation Protocols	CASQA BMP Handbook with Additional Information	CASQA Fact Sheet No.
Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources (cont.)	**Building and Grounds Maintenance** ▪ In situations where soaps or detergents are used and the surrounding area is paved, use a water collection device that enables collection of wash water and associated solids for subsequent removal and proper disposal. ▪ If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. ▪ If washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.	Industrial and Commercial (2014)	SC-41
Unauthorized non-storm water discharges	**Non-Stormwater Discharges** ▪ Effectively eliminate unauthorized non-stormwater discharges to the storm water drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants onto streets and into the storm drain system and downstream water bodies.	Industrial and Commercial (2014)	SC-10
Building and grounds maintenance	**Building and Grounds Maintenance** ▪ Switch to non-toxic chemicals for maintenance to the maximum extent possible. ▪ Choose cleaning agents that can be recycled. ▪ Encourage proper lawn management and landscaping, including use of native vegetation. ▪ Encourage use of Integrated Pest Management techniques for pest control. ▪ Encourage proper onsite recycling of yard trimmings. ▪ Recycle residual paints, solvents, lumber, and other material as much as possible.	Industrial and Commercial (2014)	SC-41

Appendix D
SWQP Examples

Small Project

Post-Construction
Storm Water Quality Plan

For:

Jones Residence
Placer County

APN: 000-0000-000

Prepared for:

Joe Jones
Owner
Not Applicable - Private Residence
12345 X St
Placer County, CA 99999
999-999-9999

Prepared by:

Stormwater Inc.
12345 Y St
City, CA 99999
999-999-9999

Preparation Date: March 12, 2016

Approval Date:_____

Section 1 General Project Information

The undersigned owner of the subject property, is responsible for the implementation of the provisions of this plan, including ongoing operations and maintenance (O&M), consistent with the requirements of the West Placer Storm Water Quality Design Manual and the State of California Phase II Small MS4 General Permit (Order No: 2013-0001-DWQ). If the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement the SWQP.

For all Regulated Projects (As identified in Form 1-2 below), the undersigned owner hereby grants access to all representatives of the Jurisdictional Agency for the sole purpose of performing O&M inspections of the installed treatment system(s) and hydromodification control(s) if any.

A copy of the final signed and fully approved SWQP shall be available on the subject site for the duration of construction and then stored with the project approval documentation and improvement plans in perpetuity.

Form 1-1 Project Identification and Owner's Certification

Project Site Address:	12345 X St, Placer County, CA 99999	
Owner Name:	Joe Jones	
Title	Owner	
Company	Not Applicable - Private Residence	
Address	12345 X St	
City, State, Zip Code	Placer County, CA 99999	
Email		
Telephone #	999-999-9999	
Signature	Date	
Engineer:*	NA - Small Project	PE Stamp* (Required for all Regulated Projects)
Title		
Company	Stormwater Inc.	
Address	12345 Y St	
City, State, Zip Code	City, CA 99999	
Email		
Telephone #	999-999-9999	
Signature		
Brief Description of Project: (Attach additional sheets as necessary)	3,000 sq ft residential home.	

* Not required for Small Projects as determined in Form 1-2 below. Project owners are responsible for ensuring that all storm water facilities are designed by an appropriately licensed and qualified professional.

Form 1-2 Project Category	
Development Category (Select all that apply)	
[1]**Small Project** – All projects, except LUPs, that create and/or replace between 2,500-5,000 ft^2 of impervious surface or detached single family homes that create and/or replace 2,500 ft^2 or more of impervious surface and are not part of a larger plan of development.	X
[2]Enter total new and/or replaced impervious surface (ft^2)	3000
[3]**Regulated Project** – All projects that create and/or replace 5,000 ft^2 or more of impervious surface.	
[4]**Regulated Redevelopment Project** with equal to, or greater than 50 percent increase in impervious area	
[5]**Regulated Redevelopment Project** with less than 50 percent increase in impervious area	
[6]Enter total pre-project impervious surface (ft^2)	
[7]Enter total new and/or replaced impervious surface (ft^2)	
[8]**Regulated Road or linear underground/overhead project (LUP)** creating 5,000 ft^2 or more of newly constructed contiguous impervious surface.	
[9]Enter total new and/or replaced impervious surface (ft^2)	
[10]**Regulated Hydromodification Management Project** – Regulated projects that create and/or replace 1 acre or more of impervious surface. A project that does not increase impervious surface area over the pre-project condition is not a hydromodification management project.	
[11]Enter total new and/or replaced impervious surface (ft^2)	

Section 2 Small Projects

Form 2-1 Site Assessment and Layout Documentation

	Has this Item been considered in the Site Layout and depicted in the Site Plan?	
	Yes	**Not Applicable (Include brief explaination)**
Define the development envelope and protected areas, identifying areas that are most suitable for development and areas to be landscaped , or left undisturbed, and used for infiltration.	X	
Minimize overall impervious coverage (paving and roofs) of the site.	X	
Set back development from creeks, wetlands, and riparian habitats in accordance with local ordinances.		No creeks on sites
Preserve significant trees and native vegetation.	X	
Conform site layout along natural landforms.	X	
Avoid excessive grading and disturbance of vegetation and soils and stabilize disturbed areas.	X	
Replicate the site's natural drainage patterns.	X	

Attach a Site Plan that incorporates the applicable considerations above. Ensure that the following items are included in the Site Plan:

Site Boundary
Topographic data with 1 ft. contours (5 ft.contours are acceptable on steeper sites).
Existing natural hydrologic features (depressions, watercourses, wetlands, riparian corridors)
Environmentally sensitive areas and areas to be preserved.
Proposed locations and footprints of improvements creating new, or replaced, impervious surfaces
Proposed site drainage with flow directions and site run-on and discharge locations
Proposed Site Design Measures to reduce runoff

Form 2-2 Runoff Reduction Calculator for Site Design Measures on Small Projects

[1] Project Site Elevation (ft. above seal level)	500			
Site Design Measure	**Runoff Reduction Parameters**			**Runoff Reduction (ft^3)**
[2] Adjacent/On-Site Stream Setbacks and Buffers	A_{imp} (ft^2)	*impervious drainage area*		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	0.8	
[3] Soil Quality Improvement and Maintenance	A_{pond} (ft^2)	*ponding area*		0
	D_{pond} (ft)	*ponding depth*		
	A_{sa} (ft^2)	*soil amendment area*		
	D_{sa} (ft)	*depth of amended soil*		
	n	*porosity of amended soil*		
[4] Tree Planting and Preservation	n_e	*number of new evergreen trees*	5	137
	n_d	*number of new deciduous trees*	4	
	A_{tc} (ft^2)	*Canopy area of existing trees to remain on the property*	500	
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	0.8	
[5] Rooftop and Impervious Area Disconnection	A_{imp} (ft^2)	*impervious drainage area*		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	0.8	
[6] Porous Pavement	A_{res} (ft^2)	*area of gravel storage layer*		0
	D_{res} (ft)	*depth of gravel storage layer*		
	n_{agg}	*porosity of aggregate*		
	C	*efficiency factor*		
[7] Vegetated Swales	A_{imp} (ft^2)	*impervious drainage area*		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	0.8	
[8] Rain Barrels and Cisterns	N	*number of rain barrels and/or cisterns*		0
	V_a (ft^3)	*volume of each rain barrel and/or cistern*		
[9] Total Volume Reduction (ft^3)				**137**
[10] Effective Treated Impervious Area (ft^2)				**2026**

85th Percentile, 24 Hour Design Storm Depth

Elevation <500 feet = 0.9 inch

Elevation 500-1,000 feet = 1.0 inch

Elevation 1,000-1,500 feet = 1.1 inch

Regulated Project

Post-Construction
Storm Water Quality Plan

For:

Project XYZ
Placer County

Planning Permit No. 1, Improvement Plan No. 1, Grading Permit No. 1, Building Permit No. 1
Lot No. 1

Prepared for:

Joe Jones
President
Development Inc.
XX C St.
Sacramento, CA 99999
999-999-9999

Prepared by:

Development Inc.
XX C St.
Sacramento, CA 99999
999-999-9999

Preparation Date: March 15, 2016

Approval Date:_____

Section 1 General Project Information

The undersigned owner of the subject property, is responsible for the implementation of the provisions of this plan, including ongoing operations and maintenance (O&M), consistent with the requirements of the West Placer Storm Water Quality Design Manual and the State of California Phase II Small MS4 General Permit (Order No: 2013-0001-DWQ). If the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement the SWQP.

For all Regulated Projects (As identified in Form 1-2 below), the undersigned owner hereby grants access to all representatives of the Jurisdictional Agency for the sole purpose of performing O&M inspections of the installed treatment system(s) and hydromodification control(s) if any.

A copy of the final signed and fully approved SWQP shall be available on the subject site for the duration of construction and then stored with the project approval documentation and improvement plans in perpetuity.

Form 1-1 Project Identification and Owner's Certification

Project Site Address:	123 C Steet, Placer County, CA 99999	
Owner Name:	Joe Jones	
Title	President	
Company	Development Inc.	
Address	XX C St.	
City, State, Zip Code	Sacramento, CA 99999	
Email	Joe@email.com	
Telephone #	999-999-9999	
Signature	Date	
Engineer:*	Frank T. Storm	PE Stamp* (Required for all Regulated Projects)
Title	Civil Engineer	
Company	Development Inc.	
Address	XX C St.	
City, State, Zip Code	Sacramento, CA 99999	
Email	Frank@email.com	
Telephone #	999-999-9999	
Signature		
Brief Description of Project: (Attach additional sheets as necessary)	New office building and parking lot.	

* Not required for Small Projects as determined in Form 1-2 below. Project owners are responsible for ensuring that all storm water facilities are designed by an appropriately licensed and qualified professional.

Form 1-2 Project Category	
Development Category (Select all that apply)	
[1]**Small Project** – All projects, except LUPs, that create and/or replace between 2,500-5,000 ft^2 of impervious surface or detached single family homes that create and/or replace 2,500 ft^2 or more of impervious surface and are not part of a larger plan of development.	
[2]Enter total new and/or replaced impervious surface (ft^2)	
[3]**Regulated Project** – All projects that create and/or replace 5,000 ft^2 or more of impervious surface.	X
[4]**Regulated Redevelopment Project** with equal to, or greater than 50 percent increase in impervious area	
[5]**Regulated Redevelopment Project** with less than 50 percent increase in impervious area	
[6]Enter total pre-project impervious surface (ft^2)	0
[7]Enter total new and/or replaced impervious surface (ft^2)	9225
[8]**Regulated Road or linear underground/overhead project (LUP)** creating 5,000 ft^2 or more of newly constructed contiguous impervious surface.	
[9]Enter total new and/or replaced impervious surface (ft^2)	
[10]**Regulated Hydromodification Management Project** – Regulated projects that create and/or replace 1 acre or more of impervious surface. A project that does not increase impervious surface area over the pre-project condition is not a hydromodification management project.	
[11]Enter total new and/or replaced impervious surface (ft^2)	

Section 3 Regulated Projects

Section 3 forms are to be completed for all Regulated Projects.

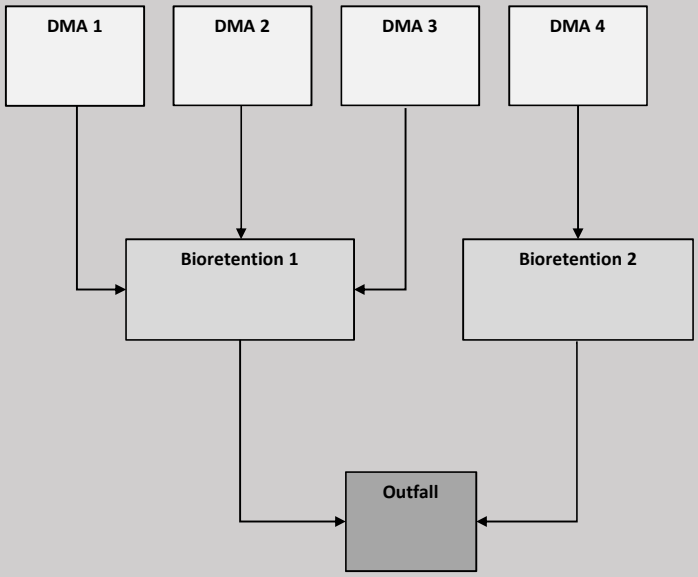
Form 3-1 Site Location and Hydrologic Features

Site coordinates: *Take GPS measurement at approximate center of site*	[1] Latitude	[2] Longitude	[3] Elevation (ft. above sea level)	[4] 85th Percentile, 24 Hour Design Storm Depth (in):
	xx	xx	1200	1.1

[5] Receiving waters *Name of stream, lake or other downstream waterbody to which the site runoff eventually drains*	Folsom Reservoir
[6] 303(d) listed pollutants of concern *Refer to State Water Resources Control Board website* www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/#impaired	Mercury
[7] Is Project going to be phased? *If yes, ensure that the SWQP evaluates each phase with distinct DMAs, requiring LID BMPs to address runoff at time of completion.*	No

[8] *Use this form to show a conceptual schematic depicting DMAs and conveyance features connecting DMAs to the site outlet(s). An example is provided below that can be modified for the proposed project or a drawing clearly showing DMAs and flow routing may be attached.*

Example only
Modify for project specific SWQP
Use separate sheet if necessary

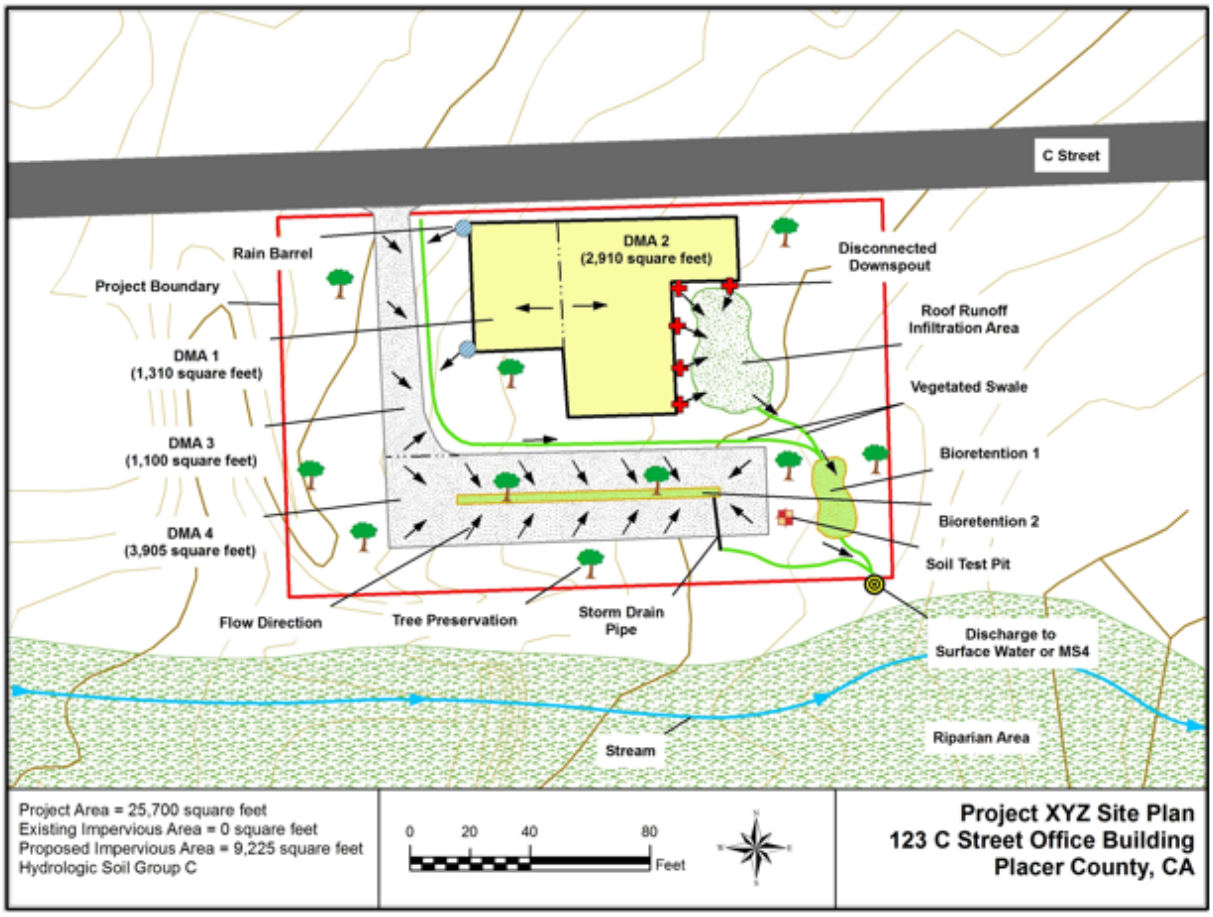


Form 3-2 Site Assessment and Layout Documentation

	Has this Item been considered in the Site Layout and depicted in the Site Plan?	
	Yes	**Not Applicable (Include brief explanation)**
Define the development envelope and protected areas, identifying areas that are most suitable for development areas to be left undisturbed.	X	
Concentrate development on portions of the site with less permeable soils and preserve areas that can promote infiltration.	X	
Limit overall impervious coverage of the site with paving and roofs.	X	
Set back development from creeks, wetlands, and riparian habitats.		NA Existing stream is too close to provide 500 ft setback
Preserve significant trees.	X	
Conform site layout along natural landforms.	X	
Avoid excessive grading and disturbance of vegetation and soils.	X	
Replicate the site's natural drainage patterns.	X	
Detain and retain runoff throughout the site.	X	

Attach a Site Plan that incorporates the applicable considerations above. Ensure that the following items are included in the Site Plan:

Site Boundary
Soil types and areal extents, test pit and infiltration test locations
Topographic data with 1 ft. contours
Existing natural hydrologic features (depressions, watercourses, wetlands, riparian corridors)
Environmentally sensitive areas and areas to be preserved.
Proposed locations and footprints of improvements creating new, or replaced, impervious surfaces
Potential pollutant sources and locations
Entire site divided into separate DMAs with unique identifiers
Existing and proposed site drainage network with flow directions and site run-on and discharge locations
Proposed design features and surface treatments used to minimize imperviousness and reduce runoff
Proposed locations and footprints of treatment and hydromodification management facilities
Design features for managing authorized non-stormwater discharges
Areas of soil and/or groundwater contamination
Existing utilities and easements
Maintenance areas


C Street
Rain Barrel
Project Boundary
DMA 1
(1,310 square feet)
DMA 3
(1,100 square feet)
DMA 4
(3,905 square feet)
DMA 2
(2,910 square feet)
Disconnected
Downspout
Roof Runoff
Infiltration Area
Vegetated Swale
Bioretention 1
Bioretention 2
Soil Test Pit
Flow Direction
Tree Preservation
Storm Drain
Pipe
Discharge to
Surface Water or MS4
Stream
Riparian Area
Project Area = 25,700 square feet
Existing Impervious Area = 0 square feet
Proposed Impervious Area = 9,225 square feet
Hydrologic Soil Group C
0
20
40
80
Feet
Project XYZ Site Plan
123 C Street Office Building
Placer County, CA

Form 3-3 Source Control Measures

Potential Pollutant Generating Activity or Source	Check One		Describe the source control measures to be implemented for each potential pollutant generating activity or source present on the project as listed in Appendix C and in the CASQA Fact Sheets. Include any special features, materials, or methods of construction that will be used.
	Present	Not Applicable	
Accidental spills or leaks	☑	☐	All materials will be stored inside and properly sealed.
Interior floor drains	☑	☐	Floor drains in basement connect to sanitary sewer.
Parking/storage areas and maintenance	☑	☐	Parking lot to be swept monthly.
Indoor and structural pest control	☑	☐	All materials will be stored inside and properly sealed.
Pools, spas, ponds, decorative fountains, and other water features	☐	☑	
Landscape/outdoor pesticide use	☑	☐	All manufacturer recommendations and regulations will be followed. Minimum amounts will be used.
Restaurants, grocery stores, and other food service operations	☐	☑	
Refuse areas	☑	☐	Trash bins to be closed and locked.
Industrial Processes	☐	☑	
Outdoor storage of equipment or materials	☐	☑	
Vehicle and equipment cleaning	☐	☑	
Vehicle and equipment repair and maintenance	☐	☑	
Fuel dispensing areas	☐	☑	
Loading docks	☐	☑	
Fire sprinkler test water	☑	☐	To be disposed in sanitary sewer.
Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources	☑	☐	To be disposed in sanitary sewer.
Unauthorized non-storm water discharges	☐	☑	
Building and grounds maintenance	☑	☐	Landscape maintenace to use minimal fertilizers.

The source control measures identified in this table shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment[1], or from another equivalent manual.

[1] California Stormwater BMP Handbook New Development and Redevelopment. California Stormwater Quality Association (CASQA). January 2003.

Form 3-4 Runoff Reduction Calculator for Site Design Measures on Regulated Projects

[1]DMA ID No.			1		2		3		4	
Site Design Measure	**Runoff Reduction Parameters**			**Runoff Reduction (ft^3)**		**Runoff Reduction (ft^3)**		**Runoff Reduction (ft^3)**		**Runoff Reduction (ft^3)**
[2] Adjacent/On-Site Stream Setbacks and Buffers	A_{imp} (ft^2)	*impervious drainage area*		0		0		0		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	1.0		1.0		1.0		1.0	
[3] Soil Quality Improvement and Maintenance	A_{pond} (ft^2)	*ponding area*		0		0		0		
	D_{pond} (ft)	*ponding depth*								
	A_{sa} (ft^2)	*soil amendment area*								
	D_{sa} (ft)	*depth of amended soil*								
	n	*porosity of amended soil*								
[4] Tree Planting and Preservation	n_e	*number of new evergreen trees*		0		0		0	2	36
	n_d	*number of new deciduous trees*								
	A_{tc} (ft^2)	*canopy area of existing trees to remain on the property*								
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	1.0		1.0		1.0		1.0	
[5] Rooftop and Impervious Area Disconnection	A_{imp} (ft^2)	*impervious drainage area*		0	2910	240		0		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	1.0		1.0		1.0		1.0	
[6] Porous Pavement	A_{res} (ft^2)	*area of gravel storage layer*		0		0		0		0
	D_{res} (ft)	*depth of gravel storage layer*								
	n_{agg}	*porosity of aggregate*								
	C	*efficiency factor*								
[7] Vegetated Swales	A_{imp} (ft^2)	*impervious drainage area*	1310	108		0	1100	91		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	1.0		1.0		1.0		1.0	
[8] Rain Barrels and Cisterns	N	*number of rain barrels and/or cisterns*	10	250		0		0		0
	V_a (ft^3)	*volume of each rain barrel and/or cistern*	50							
[9] Do all Site Design Measures meet the design requirements outlined in the Fact Sheets?					Yes	X	No			
[10] Total Volume Reduction (ft^3)			**358**		**240**		**91**		**36**	
[11] Effective Treated Impervious Area (ft^2)			**3906**		**2619**		**990**		**392**	

Form 3-5 Computation of Water Quality Design Criteria for Stormwater Treatment and Baseline Hydromodification Measures

DMA ID No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
[1]Total impervious area requiring treatment	1310	2910	1100	3905																	
[2] Impervious area untreated by Site Design Measures (ft^2) *Item 1 – Form 3-4 Item 11*	0	291	110	3513	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[3]Additional pervious area draining to BMP (ft^2)	0	800	1200	500																	
[4] Composite DMA Runoff Coefficient (Rc) *Enter area weighted composite runoff coefficient representing entire DMA*	0.90	0.70	0.50	0.80																	
[5] Water Quality Volume (WQV) (ft^3) *WQV = 1/12 * [Item 2 + Item 3) *Item 4] * Unit WQV*	0	57	49	241	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[6] Water Quality Flow (WQF) (cfs) *WQF = 1/43,200 * [0.2* (Item 2 + Item 3) * Item4]*	0.000	0.004	0.003	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

DMA ID No.	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
[1]Total impervious area requiring treatment																					
[2] Impervious area untreated by Site Design Measures (ft^2) *Item 1 – Form 3-4 Item 11*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[3]Additional pervious area draining to BMP (ft^2)																					
[4] Composite DMA Runoff Coefficient (Rc) *Enter area weighted composite runoff coefficient representing entire DMA*																					
[5] Water Quality Volume (WQV) (ft^3) *WQV = 1/12 * [Item 2 + Item 3) *Item 4] * Unit WQV*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[6] Water Quality Flow (WQF) (cfs) *WQF = 1/43,200 * [0.2* (Item 2 + Item 3) * Item4]*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Form 3-6 Volume-Based Infiltrating Bioretention Measures				
[1]**DMA ID No.** *If combining multiple DMAs from Form 3-5, enter a new unique DMA ID No.*	**DMA1-3**	**DMA4**		
[2]WQV (ft^3) *Item 5 in Form 3-5* *If combining multiple DMAs from Form 3-5, enter the sum of their respective WQVs.*	87	262		
[3]Surface Loading Rate *Maximum 5.0 in/hr*	5	5		
[4]BMP Surface Area (ft^2) *Top of BMP*	150	225		
[5]Infiltration rate of underlying soils (in/hr)	0.12	0.12		
[6]Maximum ponding depth (ft) *BMP specific, see BMP design details*	0.5	0.5		
[7]Ponding Depth (ft) *d_{BMP} = Minimum of (1/12 * Item 5 * 48 hrs) or Item 6*	0.5	0.5	-	-
[8]Infiltrating surface area, *SA_{BMP}* (ft^2) *Bottom of BMP*	75	225		
[9]Planting media depth, *d_{media}* (ft)	1.5	1.5		
[10]Planting media porosity	0.30	0.30		
[11]Gravel depth, *d_{media}* (ft) *Only included in certain BMP types*	1.0	1.0		
[12]Gravel porosity	0.30	0.30		
[13]Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (1.5* (Item 5 / 12))]*	92.3	276.8	-	-
[14]Untreated Volume (ft^3) *$V_{untreated}$ = Item 2 – Item 13* *If greater than zero, adjust BMP sizing variables and re-compute retention volume*	0	0	0	0
[15] Treated Flow Rate (ft^3/s) *$Q_{treated}$ = 1/43,200*(Item 3 * Item 4)*	0.0174	0.0260	0.0000	0.0000
[16]Total Treated Flow Rate for Project (ft^3/s) *Q_{total} = Sum of Item 15 for all DMAs*	0.043			
[17]Is WQV for each DMA treated on-site?	**Yes**	**X**	**No**	

Form 5-1 BMP Inspection and Maintenance

BMP	Inspection Point and Frequency	Maintenance Activity Required
Rain Barrels	Roof drains/Annual	Remove debris
	Barrels/Annual	Repair leaks
	Irrigation piping/Annual	Repair leaks
Veg Swale	Embankments and channel invert/Annual or as needed	Repair erosion problems, remove debris and sediment.
Bioretention facility in parking lot	Inlets and Outlets/Twice a year	Remove debris
	Plants/Monthly	Irrigate, weed control, replace dead plants
	Overflow structure/Twice a year	Remove debris to unclog

Form 6-1 Post-Construction Stormwater BMPs

Following is a summary of all BMPs included in the Project design. This checklist must be included on the cover sheet of the Improvement Plans for all Regulated Projects.

BMP		Plan Sheet Number(s)
Structural Source Controls (list BMPs)	**Refuse bins**	**C3**
	Floor drains	**C6**
Site Design Measures	Stream Setbacks and Buffers	
	Soil Quality Improvement and Maintenance	
	Tree Planting and Preservation	**C4**
	Rooftop and Impervious Area Disconnection	**C4**
	Porous Pavement	
	Vegetated Swales	**C5**
	Rain Barrels and Cisterns	**C2**
Stormwater Treatment and Baseline Hydromodification Measures	Bioretention with Infiltration	**C8 and Detail 1**
	Flow-Through Planters, Tree Box Filters and Media Filters	
Hydromodification Management Measures	Supplemental Detention	

Hydromodification Management Project

Post-Construction
Storm Water Quality Plan

For:

Big Box Store #3
Placer County

Planning Permit No. 2

Prepared for:

Joe Jones
CEO
Big Box Inc
2000000 Baseline Rd
Placer, CA 99999
999-999-9999

Prepared by:

Stormwater Nomore Inc
1 Water Way
Placer, CA 99999
888-888-8888

Preparation Date: March 15, 2016

Approval Date:_____

Section 1 General Project Information

The undersigned owner of the subject property, is responsible for the implementation of the provisions of this plan, including ongoing operations and maintenance (O&M), consistent with the requirements of the West Placer Storm Water Quality Design Manual and the State of California Phase II Small MS4 General Permit (Order No: 2013-0001-DWQ). If the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement the SWQP.

For all Regulated Projects (As identified in Form 1-2 below), the undersigned owner hereby grants access to all representatives of the Jurisdictional Agency for the sole purpose of performing O&M inspections of the installed treatment system(s) and hydromodification control(s) if any.

A copy of the final signed and fully approved SWQP shall be available on the subject site for the duration of construction and then stored with the project approval documentation and improvement plans in perpetuity.

Form 1-1 Project Identification and Owner's Certification

Project Site Address:	2000000 Baseline Rd	
Owner Name:	Joe Jones	
Title	CEO	
Company	Big Box Inc	
Address	2000000 Baseline Rd	
City, State, Zip Code	Placer, CA 99999	
Email	Joe@emailcom	
Telephone #	999-999-9999	
Signature	Date	
Engineer:*	Phillip Waters, P.E.	PE Stamp* (Required for all Regulated Projects)
Title	Lead Engineer	
Company	Stormwater Nomore Inc	
Address	1 Water Way	
City, State, Zip Code	Placer, CA 99999	
Email	Phil@email.com	
Telephone #	888-888-8888	
Signature		
Brief Description of Project: (Attach additional sheets as necessary)	New big box store and parting lot.	

* Not required for Small Projects as determined in Form 1-2 below. Project owners are responsible for ensuring that all storm water facilities are designed by an appropriately licensed and qualified professional.

Form 1-2 Project Category	
Development Category (Select all that apply)	
[1]**Small Project** – All projects, except LUPs, that create and/or replace between 2,500-5,000 ft^2 of impervious surface or detached single family homes that create and/or replace 2,500 ft^2 or more of impervious surface and are not part of a larger plan of development.	
[2]Enter total new and/or replaced impervious surface (ft^2)	
[3]**Regulated Project** – All projects that create and/or replace 5,000 ft^2 or more of impervious surface.	
[4]**Regulated Redevelopment Project** with equal to, or greater than 50 percent increase in impervious area	
[5]**Regulated Redevelopment Project** with less than 50 percent increase in impervious area	
[6]Enter total pre-project impervious surface (ft^2)	
[7]Enter total new and/or replaced impervious surface (ft^2)	
[8]**Regulated Road or linear underground/overhead project (LUP)** creating 5,000 ft^2 or more of newly constructed contiguous impervious surface.	
[9]Enter total new and/or replaced impervious surface (ft^2)	
[10]**Regulated Hydromodification Management Project** – Regulated projects that create and/or replace 1 acre or more of impervious surface. A project that does not increase impervious surface area over the pre-project condition is not a hydromodification management project.	X
[11]Enter total new and/or replaced impervious surface (ft^2)	392,040

Section 3 Regulated Projects

Section 3 forms are to be completed for all Regulated Projects.

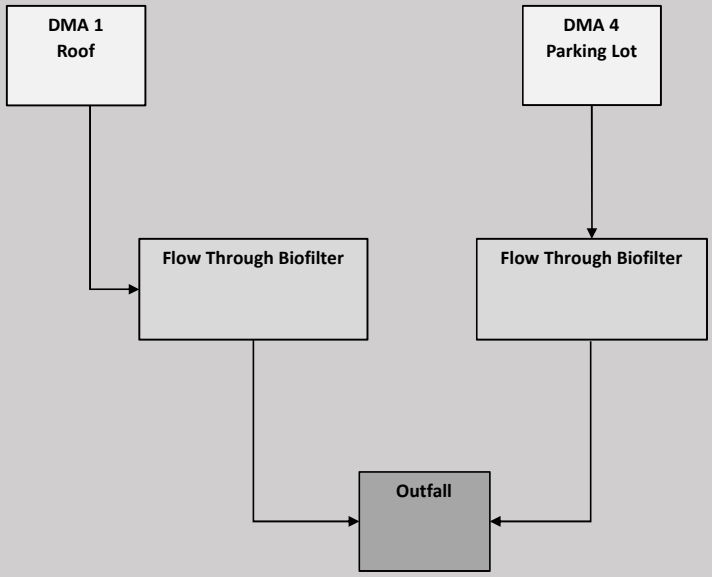
Form 3-1 Site Location and Hydrologic Features

Site coordinates: *Take GPS measurement at approximate center of site*	[1] Latitude	[2] Longitude	[3] Elevation (ft. above sea level)	[4] 85th Percentile, 24 Hour Design Storm Depth (in):
	xx	xx	500	0.9

[5] Receiving waters *Name of stream, lake or other downstream waterbody to which the site runoff eventually drains*	Folsom Lake
[6] 303(d) listed pollutants of concern *Refer to State Water Resources Control Board website* www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/#impaired	Mercury
[7] Is Project going to be phased? *If yes, ensure that the SWQP evaluates each phase with distinct DMAs, requiring LID BMPs to address runoff at time of completion.*	No

[8] *Use this form to show a conceptual schematic depicting DMAs and conveyance features connecting DMAs to the site outlet(s). An example is provided below that can be modified for the proposed project or a drawing clearly showing DMAs and flow routing may be attached.*

Example only
Modify for project specific SWQP
Use separate sheet if necessary



Form 3-2 Site Assessment and Layout Documentation

	Has this Item been considered in the Site Layout and depicted in the Site Plan?	
	Yes	**Not Applicable (Include brief explanation)**
Define the development envelope and protected areas, identifying areas that are most suitable for development areas to be left undisturbed.		NA, previous ag land. All areas are similar
Concentrate development on portions of the site with less permeable soils and preserve areas that can promote infiltration.		NA, conforming to local impervious coverage ordinances
Limit overall impervious coverage of the site with paving and roofs.		NA, no creeks or wetlands nearby
Set back development from creeks, wetlands, and riparian habitats.		NA, no trees or native vegetation present
Preserve significant trees.		NA, site is graded flat from previous use
Conform site layout along natural landforms.		NA, previously graded for ag use.
Avoid excessive grading and disturbance of vegetation and soils.		NA, previously graded flat for ag use.
Replicate the site's natural drainage patterns.	x	
Detain and retain runoff throughout the site.	x	

Attach a Site Plan that incorporates the applicable considerations above. Ensure that the following items are included in the Site Plan:

Site Boundary
Soil types and areal extents, test pit and infiltration test locations
Topographic data with 1 ft. contours
Existing natural hydrologic features (depressions, watercourses, wetlands, riparian corridors)
Environmentally sensitive areas and areas to be preserved.
Proposed locations and footprints of improvements creating new, or replaced, impervious surfaces
Potential pollutant sources and locations
Entire site divided into separate DMAs with unique identifiers
Existing and proposed site drainage network with flow directions and site run-on and discharge locations
Proposed design features and surface treatments used to minimize imperviousness and reduce runoff
Proposed locations and footprints of treatment and hydromodification management facilities
Design features for managing authorized non-stormwater discharges
Areas of soil and/or groundwater contamination
Existing utilities and easements
Maintenance areas


500'x 19'
Biofilter
300'x 17'
Biofilter
Project Outlet
Building Footprint
(DMA 1)
6 acres
Parking Lot
(DMA 2)
3 acres
Legend
Storm Drain
Proposed Project Area
Feet
0
200
400

Form 3-3 Source Control Measures			
Potential Pollutant Generating Activity or Source	Check One		Describe the source control measures to be implemented for each potential pollutant generating activity or source present on the project as listed in Appendix C and in the CASQA Fact Sheets. Include any special features, materials, or methods of construction that will be used.
	Present	Not Applicable	
Accidental spills or leaks	☑	☐	All materials will be stored inside and properly sealed.
Interior floor drains	☑	☐	Floor drains in basement connect to sanitary sewer.
Parking/storage areas and maintenance	☑	☐	Parking lot to be swept monthly.
Indoor and structural pest control	☑	☐	All materials will be stored inside and properly sealed.
Pools, spas, ponds, decorative fountains, and other water features	☐	☑	
Landscape/outdoor pesticide use	☑	☐	All manufacturer recommendations and regulations will be followed. Minimum amounts will be used.
Restaurants, grocery stores, and other food service operations	☐	☑	
Refuse areas	☑	☐	Trash bins to be closed and locked.
Industrial Processes	☑	☐	Lumber processing and storage yard. No direct drains to storm drainage system. Outdoor areas swept daily. Staining activities
Outdoor storage of equipment or materials	☑	☐	All material storage areas are covered with secondary containment.
Vehicle and equipment cleaning	☐	☑	
Vehicle and equipment repair and maintenance	☐	☑	
Fuel dispensing areas	☐	☑	
Loading docks	☑	☐	Drains to sump. Sump is cleaned as needed and materials disposed of at landfill, or in sanitary sewer.
Fire sprinkler test water	☑	☐	To be disposed in sanitary sewer.
Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources	☑	☐	To be disposed in sanitary sewer.
Unauthorized non-storm water discharges	☐	☑	
Building and grounds maintenance	☑	☐	Landscape maintenace to use minimal fertilizers.

The source control measures identified in this table shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment[1], or from another equivalent manual.

[1] California Stormwater BMP Handbook New Development and Redevelopment. California Stormwater Quality Association (CASQA). January 2003.

Form 3-4 Runoff Reduction Calculator for Site Design Measures on Regulated Projects

[1]DMA ID No.			1		2		3		4	
Site Design Measure	**Runoff Reduction Parameters**			**Runoff Reduction (ft^3)**		**Runoff Reduction (ft^3)**		**Runoff Reduction (ft^3)**		**Runoff Reduction (ft^3)**
[2] Adjacent/On-Site Stream Setbacks and Buffers	A_{imp} (ft^2)	*impervious drainage area*		0		0		0		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	0.8		0.8		0.8		0.8	
[3] Soil Quality Improvement and Maintenance	A_{pond} (ft^2)	*ponding area*		0		0		0		
	D_{pond} (ft)	*ponding depth*								
	A_{sa} (ft^2)	*soil amendment area*								
	D_{sa} (ft)	*depth of amended soil*								
	n	*porosity of amended soil*								
[4] Tree Planting and Preservation	n_e	*number of new evergreen trees*		0		0		0		0
	n_d	*number of new deciduous trees*								
	A_{tc} (ft^2)	*canopy area of existing trees to remain on the property*								
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	0.8		0.8		0.8		0.8	
[5] Rooftop and Impervious Area Disconnection	A_{imp} (ft^2)	*impervious drainage area*		0		0		0		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	0.8		0.8		0.8		0.8	
[6] Porous Pavement	A_{res} (ft^2)	*area of gravel storage layer*		0		0		0		0
	D_{res} (ft)	*depth of gravel storage layer*								
	n_{agg}	*porosity of aggregate*								
	C	*efficiency factor*								
[7] Vegetated Swales	A_{imp} (ft^2)	*impervious drainage area*		0		0		0		0
	V_{85} (in)	*runoff volume from 85th percentile, 24-hour storm*	0.8		0.8		0.8		0.8	
[8] Rain Barrels and Cisterns	N	*number of rain barrels and/or cisterns*		0		0		0		0
	V_a (ft^3)	*volume of each rain barrel and/or cistern*								
[9] Do all Site Design Measures meet the design requirements outlined in the Fact Sheets?					**Yes**		**No**	**X**		
[10] Total Volume Reduction (ft^3)			**0**		**0**		**0**		**0**	
[11] Effective Treated Impervious Area (ft^2)			**0**		**0**		**0**		**0**	

Form 3-5 Computation of Water Quality Design Criteria for Stormwater Treatment and Baseline Hydromodification Measures																						
DMA ID No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
[1]Total impervious area requiring treatment	261360	130680																				
[2] Impervious area untreated by Site Design Measures (ft^2) *Item 1 – Form 3-4 Item 11*	261360	130680	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[3]Additional pervious area draining to BMP (ft^2)	0	0																				
[4] Composite DMA Runoff Coefficient (Rc) *Enter area weighted composite runoff coefficient representing entire DMA*	0.90	0.90																				
[5] Water Quality Volume (WQV) (ft^3) *WQV = 1/12 * [Item 2 + Item 3) *Item 4] * Unit WQV*	14702	7351	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[6] Water Quality Flow (WQF) (cfs) *WQF = 1/43,200 * [0.2* (Item 2 + Item 3) * Item4]*	1.089	0.545	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

DMA ID No.	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**
[1]Total impervious area requiring treatment																						
[2] Impervious area untreated by Site Design Measures (ft^2) *Item 1 – Form 3-4 Item 11*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[3]Additional pervious area draining to BMP (ft^2)																						
[4] Composite DMA Runoff Coefficient (Rc) *Enter area weighted composite runoff coefficient representing entire DMA*																						
[5] Water Quality Volume (WQV) (ft^3) *WQV = 1/12 * [Item 2 + Item 3) *Item 4] * Unit WQV*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[6] Water Quality Flow (WQF) (cfs) *WQF = 1/43,200 * [0.2* (Item 2 + Item 3) * Item4]*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Form 3-6 Volume-Based Infiltrating Bioretention Measures				
[1]**DMA ID No.** *If combining multiple DMAs from Form 3-5, enter a new unique DMA ID No.*				
[2]WQV (ft^3) *Item 5 in Form 3-5* *If combining multiple DMAs from Form 3-5, enter the sum of their respective WQVs.*				
[3]Surface Loading Rate *Maximum 5.0 in/hr*				
[4]BMP Surface Area (ft^2) *Top of BMP*				
[5]Infiltration rate of underlying soils (in/hr)				
[6]Maximum ponding depth (ft) *BMP specific, see BMP design details*				
[7]Ponding Depth (ft) *d_{BMP} = Minimum of (1/12 * Item 5 * 48 hrs) or Item 6*	-	-	-	-
[8]Infiltrating surface area, *SA_{BMP}* (ft^2) *Bottom of BMP*				
[9]Planting media depth, *d_{media}* (ft)				
[10]Planting media porosity				
[11]Gravel depth, *d_{media}* (ft) *Only included in certain BMP types*				
[12]Gravel porosity				
[13]Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (1.5* (Item 5 / 12))]*	-	-	-	-
[14]Untreated Volume (ft^3) *$V_{untreated}$ = Item 2 – Item 13* *If greater than zero, adjust BMP sizing variables and re-compute retention volume*	0	0	0	0
[15] Treated Flow Rate (ft^3/s) *$Q_{treated}$ = 1/43,200*(Item 3 * Item 4)*	0.0000	0.0000	0.0000	0.0000
[16]Total Treated Flow Rate for Project (ft^3/s) *Q_{total} = Sum of Item 15 for all DMAs*				
[17]Is WQV for each DMA treated on-site?	**Yes**		**No**	**X**

Form 3-7 Flow-Through Planters, Tree Box and Media Filters				
[1]**DMA ID No.** *If combining multiple DMAs from Form 3-5, enter a new unique DMA ID No.*	**DMA 1**	**DMA 2**		
[2]WQF (ft3/s) *Item 6 in Form 3-5* *If combining multiple DMAs from Form 3-5, enter the sum of their respective WQFs.*	1.0890	0.5450		
[3]Surface Loading Rate *Maximum 5.0 in/hr*	5.0	5.0		
[4]Maximum Ponding Depth (ft) *BMP Specific, see BMP design details*	0.5	0.5		
[5]Soil/Media Surface Area (ft^2) *Top of BMP*	9410	4750		
[6]Soil/Media Depth (ft)	1.50	1.50		
[7]Soil/Media porosity	0.30	0.30		
[8]Gravel Depth (ft)	1.00	1.00		
[9]Gravel porosity	0.30	0.30		
[10]Detention Volume (ft^3) *Vd = Item 5 * [Item4 + (Item 6 * Item 7) + (Item 8 * Item 9) + (3* (Item 3 / 12))]*	23,525.00	11,875.00	0.00	0.00
[11]Manufacturers' specified flow rate for proprietary devices (ft3/s) (attach a copy of the product specifications)				
[12] Treated Flow Rate (ft^3/s) $Q_{treated}$ *= 1/43,200*(Item 3 * Item 5) or Item 11*	1.0891	0.5498	0.0000	0.0000
[13]Untreated Flow Rate (ft^3/s) $Q_{untreated}$ *= Item 2 - Item 12* *If greater than zero, adjust BMP sizing variables and re-compute treated flow*	0.0000	0.0000	0.0000	0.0000
[14]Total Treated Flow Rate for Project (ft^3/s) Q_{total} *= Sum of Item 12 for all DMAs*	1.64			
[15] Is WQF for each DMA treated on-site?	**Yes**	**X**	**No**	

Section 4
Regulated Hydromodification Management Projects

Form 4-1 Peak Runoff Response Time

(Complete Section 4 forms for Regulated Hydromodification Projects only)

Determine total runoff response time for pre- and post-construction conditions at each project outlet.

Variables	Pre-construction DMAs to Project Outlet				Post-construction DMAs to Project Outlet			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
[1]Length of longest overland flow path *Not to exceed 100 ft*	100				0			
[2]Slope of overland flow path (ft/ft)	0.0050							
[3]Manning's roughness coefficient for overland flow surface *See Table 5-5 of the Placer County SWMM*	0.4000							
[4]Overland flow response time (min) (0.355*(Item 1*Item 3)$^{0.6}$)/(Item 2$^{0.3}$)	16	-	-	-	-	-	-	-
[5]Hydrologic Soil Group *Refer to Section 3.1.1. or NRCS Web Soil Survey*	D							
[6]Current Land Cover Type(s) *Select from categories shown in Table 5-3 of the SWMM*	Fallow							
[7]Pervious Area Condition: *Based on the extent of vegetated cover Good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Poor							
[8]Infiltration Rate (in/hr) *Refer to Table 5-3 of the SWMM using Items 3, 4, and 5 above or obtain site specific field measurements (See Section 3.1.1)*	0.03							
[9]Length of collector flow (ft)	700				800			
[10]Cross-sectional area of collector flow facility (ft^2)	1.00				7.00			
[11]Wetted perimeter of collector flow facility (ft)	3.50				9.40			
[12]Manning's roughness of collector flow facility	0.0400				0.0100			
[13]Slope of collector flow facility (ft/ft)	0.0050				0.0050			
[14]Channel flow velocity (ft/sec) *V = (1.49 / Item 12) * (Item 10/Item 11)$^{\wedge 0.67}$ * (Item 13)$^{\wedge 0.5}$*	1.1	-	-	-	8.7	-	-	-
[15]Collector flow facility response time (min) *T_c = Item 9 /(Item 14 * 60)*	10.2	-	-	-	1.5	-	-	-
[16]Total runoff response time or T_t (min) *T_t = Item 4 + Item 15*	26.1	-	-	-	1.5	-	-	-

Form 4-2 Hydromodification Target for Peak Runoff

Variables	Pre-construction DMAs to Project Outlet				Post-construction DMAs to Project Outlet			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
[1] Drainage Area (ft^2) *Sum of all outlet level DMAs should equal total project area.*	392,040				392,040			
[2] Impervious Area (ft^2) *Sum of all outlet level DMAs should equal total project impervious area.*	0				392,040			
[3] Rainfall depth for 2yr storm with duration equal to response time (in) *See Placer County SWMM Table 5-A-1 for elevation of site and duration equal to response time*	0.32				0.13			
[4] Unit peak runoff (cfs/acre) *q = 60/Form 4-1 Item 16 * Item 3*	0.73	-	-	-	5.06	-	-	-
[5] Infiltration factor (cfs/acre) *F_i = Form 4-1 Item 8 * (1 + 1 /(1.3 + 0.0005 * Form 3-1 Item 3))*	0.05	-	-	-	-	-	-	-
[6] Peak runoff from DMAs (cfs) *Q_p = Item 1 * Item 4 – Item 5 * (Item 1 - Item 2)*	6.22	-	-	-	45.95	-	-	-
[7] Total Pre-Project Peak Runof (ft^3/s) *Q_{total} = Sum of Item 6 for all Pre-construction DMAs*	6.22							
[8] Is the total post-project peak runoff equal to or less than the total pre-project peak runoff? *Yes, if Item 7 is greater than or equal to the sum of the Total Treated Flow Rates from Form 3-6 Item 16 and 3-7 Item 12.*	**YES**							

Form 4-3 Detention Volumes for Hydromodification Management

	Post-construction DMAs to Project Outlet			
	1	**2**	**3**	**4**
[1] Land cover and hydrologic condition *See NRCD TR-55 Manual Table 2-2 for types*	Industrial			
[2] Hydrologic Soil Group *Refer to Section 3.1.1. or NRCS Web Soil Survey*	-	-	-	-
[3] Drainage Area (A) (ft^2)	392,040	-	-	-
[4] Curve Number (CN) *Use Items 1 and 2 to select curve number from NRCS TR-55 Manual Table 2-2*	98			
[5] Post-development soil storage capacity, S (in): *S = (1000 / Item 4) – 10*	0.2	#DIV/0!	#DIV/0!	#DIV/0!
[6] Precipitation for 2-yr, 24-hr storm (in) *See Placer County SWMM Table 5-A-1 for elevation of site and 24-hr duration depths*	1.90			
[7] Post-developed runoff volume for 2-yr – 24-hour storm, V_{runoff} (ft^3): *V_{runoff} = Item 3 * (1 / 12) * [(Item 6 – 0.2 * Item 5)^2 / (Item 6 + 0.8 * Item 5)]*	54,732	#DIV/0!	#DIV/0!	#DIV/0!
[8] Attenuation Factor, $q_{out/in}$ (ratio of target outflow rate to peak inflow rate): *$q_{out/in}$ = Form 4-2 Item 6 Pre-Construction / Form 4-2 Item 6 Post-Construction*	0.14	#DIV/0!	#DIV/0!	#DIV/0!
[9] Equalization Factor, Vs/Vr (ratio of storage capacity to runoff volume) *Vs/Vr obtained using Item 8 and nomograph in Figure 6-1 of NRCS TR-55 Manual for Rainfall Type IA*	0.40			
[10] Runoff detention capacity to achieve hydromodification management criteria (ft^3) *$D_{hydromod}$ = Item 7 * Item 9*	21893	#DIV/0!	#DIV/0!	#DIV/0!
[11] Site Design Measure (SDM) Volume (ft^3): *Sum of Item 10 in Form 3-4 for all SDMs in this DMA.*	0			
[12] Bioretention Volume (ft3): *Sum of Item 14 in Form 3-6 for all bioretention measures in this DMA.*	0			
[13] Flow-Through Detention Volume (ft3): *Sum of Item 10 in Form 3-7 for all flow-through facilities in this DMA.*	35400			
[14] Supplemental Detention Volume (ft^3):	0			
[15] Combined Detention Volume in this DMA (ft^3): *Sum of Items 11 through 14*	35,400	-	-	-
[16] Is detention capacity to achieve hydromodification management criteria achieved at all project outlets? *Yes, if Item 10 is less than or equal to Item 15. If not provide additional storage capacity*	**Yes**	**X**	**No**	

Form 5-1 BMP Inspection and Maintenance		
BMP	**Inspection Point and Frequency**	**Maintenance Activity Required**
Biofilters	Inlets and outlets/annually	Remove debris as needed
	Surface of filter bed/annually and after large storms	Remove accumulations to restore filtration rate as needed
	Vegetation	Remove weeds, replace dead plants

Form 6-1 Post-Construction Stormwater BMPs

Following is a summary of all BMPs included in the Project design. This checklist must be included on the cover sheet of the Improvement Plans for all Regulated Projects.

BMP		Plan Sheet Number(s)
Structural Source Controls (list BMPs)	**Loading dock containment**	**C1**
	Refuse area cover	**C2**
	Floor drain sump	**C3**
Site Design Measures	Stream Setbacks and Buffers	
	Soil Quality Improvement and Maintenance	
	Tree Planting and Preservation	
	Rooftop and Impervious Area Disconnection	
	Porous Pavement	
	Vegetated Swales	
	Rain Barrels and Cisterns	
Stormwater Treatment and Baseline Hydromodification Measures	Bioretention with Infiltration	
	Flow-Through Planters, Tree Box Filters and Media Filters	**C5 and D 5**
Hydromodification Management Measures	Supplemental Detention	**C6 and D6**