3.7 Guidance for Large Bioretention/Biofiltration BMP Facilities

<table>
<thead>
<tr>
<th>Applicability</th>
<th>Large sites, multi-parcel sites, BMPs treating greater than 5 acres</th>
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<tbody>
<tr>
<td></td>
<td>This fact sheet is intended to be used in combination with Fact</td>
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<td></td>
<td>Sheet 3.4, 3.5, or 3.6 to provide guidance for how to scale up the</td>
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<td>design of small scale features to larger scale basins</td>
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<tr>
<td>LID BMPs</td>
<td>Bioretention, Biofiltration with Partial Infiltration, and</td>
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<td>Biofiltration with No Infiltration</td>
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Limits on Use and Applicability

This fact sheet provides guidance for the design, installation, and maintenance of regional scale bioretention/biofiltration Best Management Practices (BMPs) for large multi-parcel projects. The requirements included in this fact sheet are in addition to, those specified in the LID BMP Handbook Fact Sheets for Bioretention (3.4), Biofiltration with Partial Infiltration (3.5), and Biofiltration with No Infiltration (3.6). The user will still need to refer to those fact sheets. This fact sheet then provides additional or overriding criteria for facilities that are designed at a larger scale. These additional criteria are necessary to address unique design challenges associated with larger facilities.

Use of regional scale facilities is at the discretion of the Copermittee. Before continuing with design of regional scale facilities, PDPs shall consult with the Copermittee with jurisdiction over the project site.

Categories of Regional Bioretention/Biofiltration Facilities

The same categories of regional bioretention/biofiltration facilities apply at a regional scale and need to be selected based on the feasibility criteria at the location.

- Bioretention (full infiltration) – Fact Sheet 3.4
- Biofiltration with partial infiltration – Fact Sheet 3.5
- Biofiltration (no infiltration/limited infiltration) – Fact Sheet 3.6

Using a regional facility does not preclude the requirement to evaluate infiltration feasibility criteria. Large facilities require a thorough and detailed assessment of the sites underlying infiltration rates and geotechnical environment. Refer to the Santa Margarita Watershed WQMP for complete feasibility analysis requirements.

Basic Design Requirements and Provisions

Basin Guidelines

All regional facilities shall be designed in accordance with the “Basin Guidelines” included in Appendix C of the LID BMP Handbook. Section 1 of the “Basin Guidelines” presents guidelines...
and standards for the design and maintenance of water quality basins used within Riverside County including provisions for:

- General Criteria
- Geotechnical Reports
- Basin Grading Parameters
- Setbacks
- Outlet Structures and Spillways
- Maintenance Access
- Landscaping
- Fencing, and
- Additional Requirements

**Site Geotechnical Investigation**

A site-specific geotechnical investigation is required to determine subsurface conditions, infiltration rates, the seasonal high ground water elevation (SHGWE), and impacts to site environs as listed in the Feasibility Criteria. The investigation must be conducted by or under direct supervision of a State of California-licensed engineering geologist, geotechnical engineer, or civil engineer with experience in geotechnical engineering, and in compliance with the *SMR WQMP*. The Geotechnical Report shall meet the minimum requirements of the “Basin Guidelines” and provide the following additional information:

- Infiltration rates (in accordance with the “Infiltration Testing Guidelines” included in Appendix A)
- Seasonal high groundwater levels
- Potential for groundwater mounding below the facility or down gradient
- Geotechnical hazards
- Other impacts to site environs, such as water balance impacts on biological resources
- Utilities

**Summary of BMP Design Parameters**

The BMP design parameters contained in the respective fact sheets for Bioretention, Biofiltration with Partial Infiltration, and Biofiltration with No Infiltration apply to the design of large scale facilities of the same type; however, additional criteria also apply. Table 1 below provides a summary of the standard and augmented design components required for large scale facilities. Where augmented components are specified, additional design criteria are provided in this fact sheet to augment the criteria in the standard fact sheets.
Table 1. Design Requirements for BMP Components

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<td>Vector Control</td>
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<td>Sizing</td>
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**Augmented Design Requirements for Regional Scale Facilities**

This section contains the augmented design parameters and requirements that are unique to Large Bioretention/Biofiltration Facilities. These provisions help to maintain BMP function and performance in larger facilities and provide additional storage and routing options that are not applicable to smaller scale facilities.

**Cross Section Geometry**

The following design parameters for regional scale facilities shall be used in place of the corresponding parameters for standard facilities:

- The ponding depth above the engineered soil media shall not exceed 3 feet or the maximum depth that can be drained in 72 hours. A shorter drawdown time may be specified if necessary to support the selected vegetation.

- The engineered soil media shall be a minimum of 2 feet deep.

- Side slopes shall conform to the Basin Guidelines in Appendix C.

**Pretreatment**

Pretreatment shall be provided in order to reduce the sediment load entering the facility and to maintain the infiltration/filtration rate of the basin. This is more critical for regional facilities as they tend to be deeper and therefore have a larger sediment load per unit area of media.

Where feasible, the following pre-treatment approach is recommended:

- Stabilization or bypass of all exposed soil areas in the watershed.
GUIDANCE FOR LARGE BIORETENTION/BIOFILTRATION BMP FACILITIES


The minimum pretreatment mechanism shall be a sedimentation basin or forebay with a volume equivalent to 20 percent of the BMP volume and shall be separated by a berm with a height of at least half of the total ponding depth of the facility.

**Overflow**

Regional facilities shall conform to the requirements included in the “Basin Guidelines” (Appendix C). These guidelines provide guidance for the design of outlet structures and spillways.

**Underdrain**

Hydraulic calculations shall be used to determine necessary size of underdrains. It should not be assumed that the 6-inch diameter default for smaller systems will be adequate for larger systems. Subdrains shall be sloped with positive drainage of at least 0.5%.

Rigid non-perforated observation pipes with a diameter equal to the underdrain diameter shall be connected to the underdrain every 50 feet to provide a clean-out port as well as an observation well to monitor dewatering rates.

- The wells/cleanouts shall be connected to the underdrain with the appropriate manufactured connections.

- The wells/cleanouts shall extend 6 inches above the top elevation of the bioretention facility mulch, and shall be capped with a lockable screw cap. Cleanouts may be integrated with vents, in which case the vent should extend above the facility high water line.

- The ends of underdrain pipes not terminating in an observation well/cleanout shall be capped.

**Energy Dissipation**

Energy dissipation must be provided to prevent erosion of the engineered soil media layer. Internal erosion is a greater risk for larger BMPs due to the higher flow rates and velocities routed to them. Energy dissipation is required meeting the following provisions:

1. All significant inlets shall enter the sediment forebay, if a sediment forebay is provided as the required pretreatment device. Significant inlets include any piped, channeled or conveyed inlets. If a forebay is not provided, a stilling well is recommended.

2. Energy dissipation shall be provided at each inlet to the facility (including curb-cuts) and shall be engineered to control the velocity of inflows to less than 2 feet per second to prevent scour of the media bed.
3. Woody plants (trees, shrubs, etc.) shall not be placed directly in the entrance flow path, but may be used in other portions of the regional facility.

**Side Slope Erosion Control**

Side slopes of regional facilities can contribute large sediment loads if not fully stabilized prior to commissioning of the system. The design and construction phasing shall demonstrate how side slopes will be stabilized to minimize erosion. Example design approaches include:

- Revegetation with dense grass, including irrigation
- Flexible soil armoring grid products combined with revegetation

**Flow Distribution System**

An internal flow distribution system should be considered to convey pre-treated inflows more evenly across the media bed. This helps avoid scour caused by concentrated flow of water over the media surface near the inlet. It is also desirable to avoid short circuiting¹. Example design approaches for flow distribution include:

- Design a distribution channel or perforated pipe around a portion of the perimeter (1/2 to 2/3 of the perimeter of the system) and internal to the facility, where needed, to distribute flows within the facility.
- A distribution channel could consist of shallow swale (3 to 6 inches deep) in the media bed, armored with turf reinforcement matting, other geotextile, or cobbles, to withstand higher velocities.
- The distribution system should be designed to drain completely between storm events.

**Media Bed Hydraulics and Outlet Control**

The following design approach for media outlet control should be considered to help improve filtration processes and media longevity for systems that are designed as biofiltration (with or without partial infiltration)

1. An outlet-controlled underdrain system, consisting of an orifice or other flow control device that controls the rate at which water discharges from the system underdrain.²

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¹ Short-circuiting of flows refers to a disproportionately high fraction of the total filtration occurring in the immediate vicinity of the inlet. These conditions are undesirable as this can overwhelm biological functions and treatment processes in the areas receiving the majority of the flow and result in lower treatment performance on average.

² When an outlet-controlled underdrain is used, the rate of flow through the media is controlled by the rate that water can discharge from the underdrain orifice rather than the filtration rate of the media. The filtration rate of the media may vary spatially and will change with time. The use of an outlet controlled underdrain promotes more uniform infiltration across the media bed and longer average contact time with the biofiltration media. It also allows
2. When an outlet control is used, the initial media permeability may be higher (20 to 80 in/hr).

3. The outlet control is then designed such that the average infiltration rate through the media (i.e., the rate at which water passes through the media; as controlled by the outlet, not by the saturated hydraulic conductivity of the media) is approximately 2.5 to 5 in/hr.

4. The facility must drain freely to an acceptable discharge point.

5. If the design configuration has potential for trapped air in the underdrain system to interfere with infiltration through the media bed (i.e., an “airlock”), it may be necessary to vent at an elevation above the high water line.

**Figure 1. Example Outlet Control Structure**

**Design for LID and Hydromodification Control**

Large bioretention/biofiltration basins can be designed for both LID and hydromodification control. Figure 2 shows schematics of how LID and hydromodification designs can be integrated.

the biofiltration media to be designed with a higher initial saturated hydraulic conductivity, such that a greater degree of clogging can occur before maintenance of the media bed is required.
**Figure 2. Example Schematic of Combination LID/Hydmomodification Basin**

**Maintenance Access**
Access for maintenance activities shall be provided as outlined in the “Basin Guidelines.”
Hydromod/Flood Capture WSL

Orifice and notch above DCV do not require treatment

Vent to reduce potential for capillary break air gap

Hydromod/Flood Capture WSL

LID/WQ Capture WSL

Orifice control for flow through biofiltration and low flow threshold
Construction Considerations

The following factors should be considered in construction of regional facilities. These criteria are not intended to be comprehensive or replace the need for complete construction specifications consistent with standard engineering practices and applicable standards.

1. Irrigation should be considered to provide for robust plant establishment and growth and help improve long term permeability of the soil

2. Regional bioretention/biofiltration facilities should not be hydraulically connected to the storm drain system until all contributing drainage areas are stabilized (e.g., with stable vegetative cover or pavement) or are controlled with robust erosion and sediment controls. For phased projects, where interim conditions include sediment producing open space and/or graded pads that will be under construction after the facility is brought online, a high level of sediment control must be provided. It is preferred to bypass any areas that are still under construction or otherwise not stabilized.

3. To preserve and avoid the loss of infiltration capacity, the following construction guidelines should be specified:
   - Provisions address sedimentation, per above.
   - Compaction of the subgrade with heavy equipment should be minimized to the maximum extent possible. If the use of heavy equipment on the base of the facility cannot be avoided, the infiltrative capacity should be restored by tilling or aerating prior to placing the infiltrative bed.
   - If a full infiltration design is proposed, the exposed soils should be inspected by a geotechnical engineer after excavation to confirm that soil conditions are suitable.

4. Batch-level testing of bioretention soil media should be considered. For regional systems including large quantities of soil, batch level testing can help control variability between batches.

5. In-situ testing of bioretention soil media, such as with a single ring infiltrometer, should be considered on a specified interval. This can help confirm that placement methods are not resulting in significant loss of permeability.

6. The use of treated wood or galvanized metal anywhere inside the facility is prohibited.

7. As discussed above, side slopes of the basin should be well stabilized to avoid erosion onto the media bed.

8. An establishment period for vegetation should be specified in the construction plans or landscape contractor agreements.

Sizing Methodologies

In general, the sizing methods described in Fact Sheet 3.4, 3.5, and 3.6 are applicable.
Augmented Maintenance Considerations

Maintenance activities described in Fact Sheet 3.4, 3.5, and 3.6 are generally applicable. When developing the O&M Plan for regional facilities, additional consideration should be given to the scale of the regional facilities. For example:

- Maintenance may require larger or specialized equipment compared to normal bioretention/biofiltration maintenance.
- Access drive isles within the media bed may be needed. These drive isles could be reinforced with geotextiles, such as grid paver filled with gravel or BSM, to maintain permeability while supporting maintenance vehicle access.
- Methods that are allowable for maintenance may need to be specified (e.g., limitations on vehicle traffic on the media bed)
- A rotating maintenance cycle across different parts of the facility may be appropriate. This helps limit the impact to overall treatment processes when vegetation or media needs to be periodically replaced. For example, one third of the system could experience more intensive maintenance each year.