6.1 Bioretention Areas

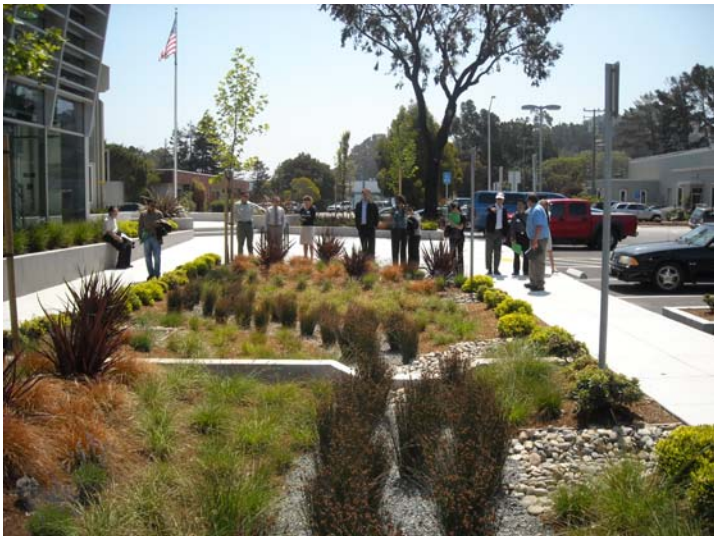

Figure 6-1. Bioretention Area.
Source: City of Brisbane

Best uses

- Any type of development
- Drainage area up to 2 acres
- Landscape design element

Advantages

- Detains low flows
- Landscape feature
- Low maintenance
- Reliable once established

Limitations

- Not appropriate where soil is unstable
- Requires irrigation
- Susceptible to clogging – especially if installed prior to construction site soil stabilization.

Bioretention areas[1], or "rain gardens," are concave landscaped areas that function as soil and plant-based filtration devices that remove pollutants through a variety of physical, biological, and chemical treatment processes. Bioretention areas can be any shape, including linear. Linear bioretention areas are sometimes referred to as bioretention swales. Bioretention areas normally consist of the following layers, starting from the top: a surface ponding area, a layer of mulch, planting soil and plants, and an underlying rock layer with an underdrain that connects to the municipal storm drain system.

Bioretention areas are designed to distribute stormwater runoff evenly within the surface ponding area. The water is temporarily stored in the ponding area and infiltrates through the planting soil, which is engineered to have a high rate of permeability. From there, the water filters down into the underlying rock layer.

The rock layer of the bioretention area may be designed to either maximize infiltration or prevent infiltration to the underlying soils. In bioretention areas that maximize infiltration, the underdrain is raised at least 6 inches above the bottom of the rock layer, and there is no liner between the rock layer or planting soil and the surrounding soils. Maximizing infiltration is only allowed where conditions are suitable for infiltration – check with the geotechnical engineer. Where infiltration is precluded, the bioretention area is fully lined with waterproof material, and the underdrain is placed at the bottom of the rock layer.

Design and Sizing Guidelines

DRAINAGE AREA AND SETBACK REQUIREMENTS

- Set back from structures 10' or as required by structural or geotechnical engineer, or local jurisdiction.

[1] A bioretention area that is unlined and has a raised underdrain in the underlying rock layer to promote infiltration may also be called a "bioinfiltration area".

- Units should be located in areas that can be accessible at any given time for the purpose of operation and maintenance and inspections. Bioretention units should not be located on inaccessible private property such as residential backyards.
- Area draining to the bioretention area should not exceed 2 acres.
- Area draining to the bioretention area should not contain a significant source of soil erosion, such as high velocity flows along slopes not stabilized with vegetation or hardscape.
- Areas immediately adjacent to bioretention area should have slopes more than 0.5% for pavement and more than 1% for vegetated areas.
- Bioretention areas, including linear treatment measures, should not be constructed in slopes greater than 4%, unless constructed as a series of bioretention cells. Separate bioretention cells by check dams up to 24 inches high and at least 25 feet apart. The slope within cells should not exceed 4%. Bioretention cells are not recommended if overall slope exceeds 8%.

TREATMENT DIMENSIONS AND SIZING

- It is recommended that bioretention areas be sized to 4% of the impervious surface area on the project site which corresponds to a surface loading rate of 5 inches per hour and a rainfall intensity of 0.2 inches per hour. The area of impervious surface multiplied by 0.04 sizing factor will equal the footprint of the bioretention area. Alternatively, if there are site or infiltration constraints, bioretention sizing may be calculated using the flow-based treatment standard, or the combination flow- and volume-based treatment standard described in Section 5.1 based on the flow entering the basin at the treatment flow rate over the initial hours of the storm until the treatment volume is attained.
- Where there is a positive surface overflow, bioretention areas should have freeboard of at least 0.2 feet to the lowest structural member versus the 100-year storm water level in the bioretention area, unless local jurisdiction has other requirements.
- Where the bioretention area is in a sump that depends on outflow through a catch basin, the bioretention area should have a freeboard of at least 0.5 feet to the lowest building finished floor elevation (including garage and excluding crawl space) for conditions with the outlet 50 percent clogged, unless local jurisdiction has other requirements. Where the freeboard cannot be provided, an emergency pump may be allowed on a case-by-case basis.
- Allow a minimum of 2 inches between the crest of the emergency outfall riser and elevation of the surface area.
- Side slopes should not exceed 3:1; downstream slope for overflow should not exceed 3:1.
- Bioretention areas, including linear treatment measures, should not be constructed on slopes greater than 4%, unless constructed as a series of relatively horizontal bioretention cells. A bioretention facility should be one level, shallow basin or a series of basins. As runoff enters each basin, it should flood and fill throughout before runoff overflows to the outlet or to the next downstream basin. This will help prevent movement of surface mulch and soil. In a linear bioretention area, check dams should be placed for every 4 to 6 inches of elevation change and so that the

top of each dam is at least as high as the toe of the next upstream dam. A similar principle applies to bioretention facilities built as terraced roadway shoulders[2]. The slope within cells should not exceed 2%. Bioretention cells are not recommended if overall slope exceeds 8%.

- Surface ponding depths may vary, with a recommended depth of 6 inches and a maximum depth of 12 inches. If ponding depths exceed 6 inches, the landscape architect should approve a planting palette for the desired depth.
- The inlet to the overflow catch basin should be at least 6 inches above the low point of the bioretention planting area.

INLETS TO TREATMENT MEASURE

Flow may enter the treatment measure (see example drawings in Section 5.13):

- As overland flow from landscaping (no special requirements)
- As overland flow from pavement (cutoff wall required)
- Through a curb opening (minimum 18 inches with the number and locations designed so that runoff is dispersed throughout the bioretention area or through the use of a flow spreading system)
- Through a curb drain
- With a drop structure through a stepped manhole (refer to Figure 5-3 in Chapter 5)
- Through a bubble-up manhole or storm drain emitter
- Through a roof leader or other conveyance from building roof

- Where flows enter the biotreatment measure, allow a change in elevation of 4 to 6 inches between the paved surface and biotreatment soil elevation, so that vegetation or mulch build-up does not obstruct flow.
- Cobbles or rocks should be installed to dissipate flow energy where runoff enters the treatment measure.

VEGETATION

- Plant species should be suitable to well-drained soil and occasional inundation. See planting guidance in Appendix A.
- Shrubs and small trees should be placed to anchor the bioretention area cover.
- Tree planting should be as required by the municipality. If larger trees are selected, plant them at the periphery of bioretention area.
- Underdrain trench should be offset at edge of tree planting zone, as needed, to maximize distance between tree roots and underdrain.
- Use integrated pest management (IPM) principles in the landscape design to help avoid or minimize any use of synthetic pesticides and quick-release fertilizer. Check

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[2] Contra Costa Clean Water Program. February 2012. C.3 Stormwater Guidebook, 6th Edition and Stormwater Management Handbook: Implementing Green Infrastructure in Northern Kentucky Communities, 2009. www.epa.gov/smartgrowth/publications.htm)

with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.

- Irrigation should be provided to maintain plant life.
- Trees and vegetation should not block inflow, create traffic or safety issues, or obstruct utilities.

SOIL AND DRAINAGE CONSIDERATIONS SPECIFIC TO BIORETENTION AREAS

- Consideration of groundwater level and placement of the underdrain:

    1. If there is less than a 5 foot separation between the bottom of the facility and the seasonal high groundwater level, or infiltration is not allowed due to other site constrains, an impermeable liner should be placed between the drain rock and the bottom of the facility and the underdrain placed on top of that liner.
    2. If there is at least a 5-foot separation between the bottom of the facility and the seasonal high groundwater level, and geotechnical conditions allow infiltration, the facility should be unlined and the underdrain should be raised at least 6 inches above the bottom of the drain rock to allow storage and infiltration of treated water.

SOIL AND DRAINAGE CONSIDERATIONS FOR ALL BIOTREATMENT SYSTEMS

- Soil used in the bioretention area must meet the biotreatment soil mix specification included in Appendix K. Soil used in the bioretention area should have a long term minimum permeability of 5 inches per hour (initial permeability may exceed this to allow for tendency of permeability to reduce over time.) Check with municipality for any additional requirements.
- Bioretention areas should have a minimum planting soil depth of 18 inches.
- Install and maintain a 3-inch layer of composted mulch (also called “aged mulch”) in areas between plantings. Rock, cobble, pea gravel, or large bark mulches that resist floating may also be used. “Micro-bark” and “gorilla hair” mulches are not recommended.
- An underdrain system is generally required. Depending on the permeability of in situ soils, the local jurisdiction may allow installation without an underdrain on a case-by-case basis.
- Filter fabric should not be used in or around the underdrain trench.
- The underdrain should include a perforated pipe with cleanouts and connection to a storm drain or discharge point. Clean-out should consist of a vertical, rigid, non-perforated PVC pipe, with a minimum diameter of 4 inches and a watertight cap fit flush with the ground, or as required by municipality.
- Underdrain trench should include a 12-inch thick layer of Caltrans Standard Section 68-1.025 permeable material Class 2, or similar municipality-approved material. A minimum 4-inch diameter perforated pipe should be placed within the backfill layer. To help prevent clogging, two rows of perforation may be used. There should be adequate fall from the underdrain to the storm drain or discharge point.

CONSTRUCTION REQUIREMENTS FOR ALL BIOTREATMENT SYSTEMS

- When excavating, avoid spreading fines of the soils on bottom and side slopes. Remove any smeared soiled surfaces and provide a natural soil interface into which water may percolate.
- Minimize compaction of existing soils. Protect from construction traffic.
- Protect the area from construction site runoff. Runoff from unstabilized areas should be diverted away from biotreatment facility.

MAINTENANCE CONSIDERATIONS FOR ALL TREATMENT MEASURES

- See Chapter 8 for specific maintenance guidance.
- A Maintenance Agreement should be provided and should state the parties' responsibility for maintenance and upkeep.
- Prepare a maintenance plan and submit with Maintenance Agreement. Maintenance plan templates are in Appendix G.

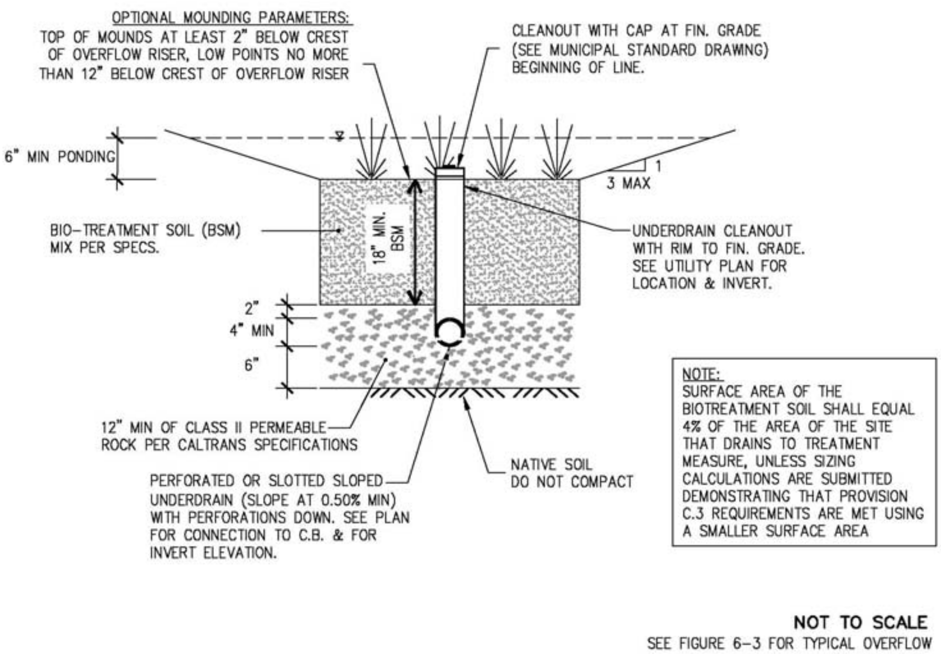

Figure 6-2: Cross Section, Bioretention Area

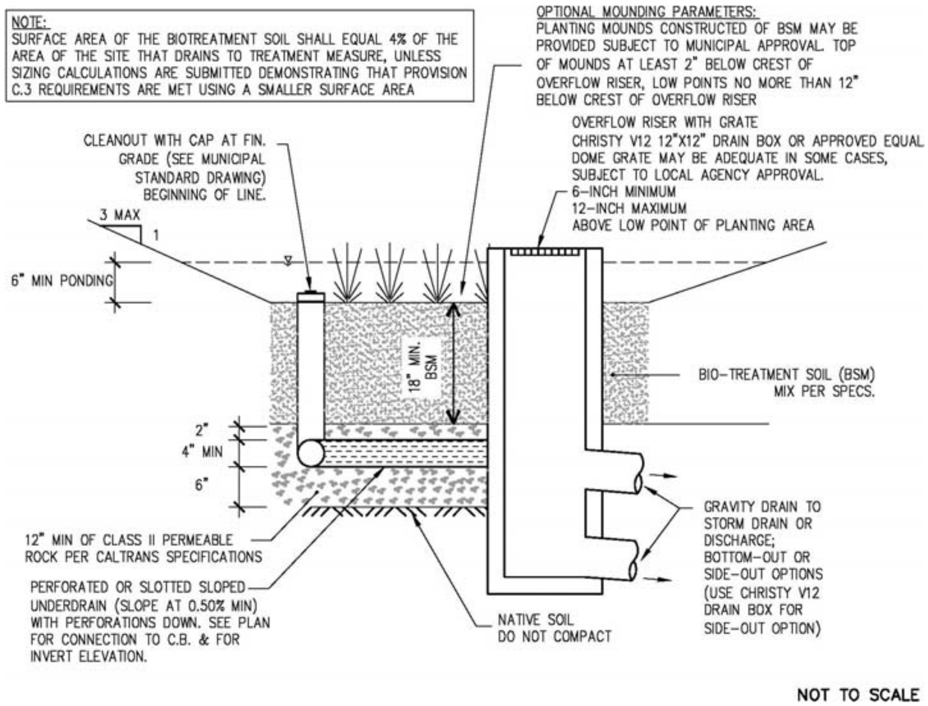

Figure 6-3: Cross Section, Bioretention Area (side view)

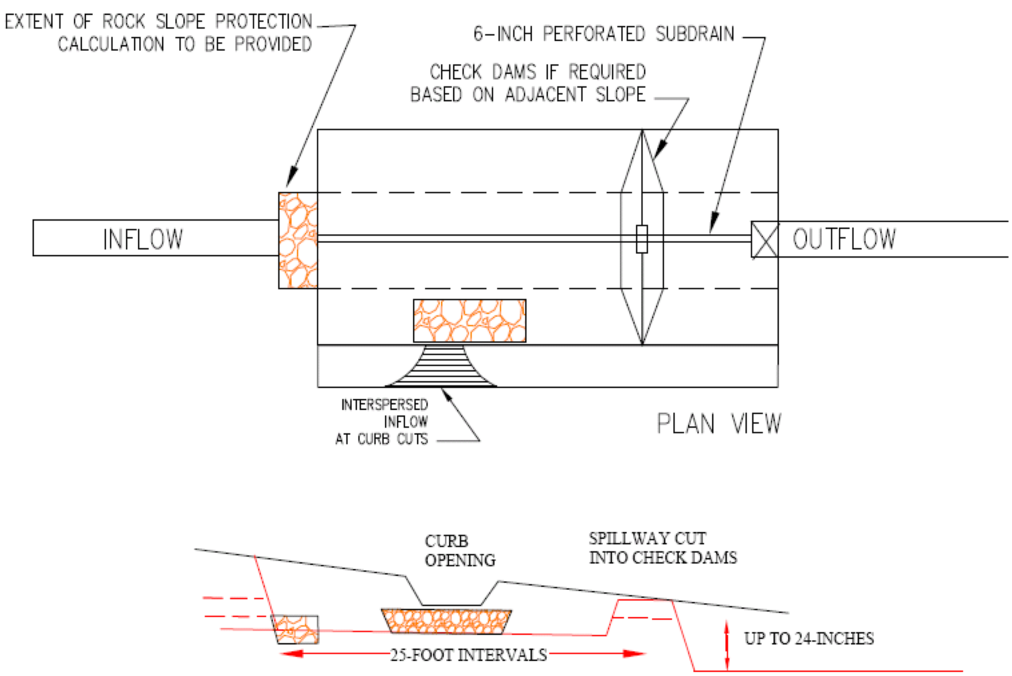

Figure 6-4: Check dam (plan view and profile) for installing a series of linear bioretention cells in sloped area

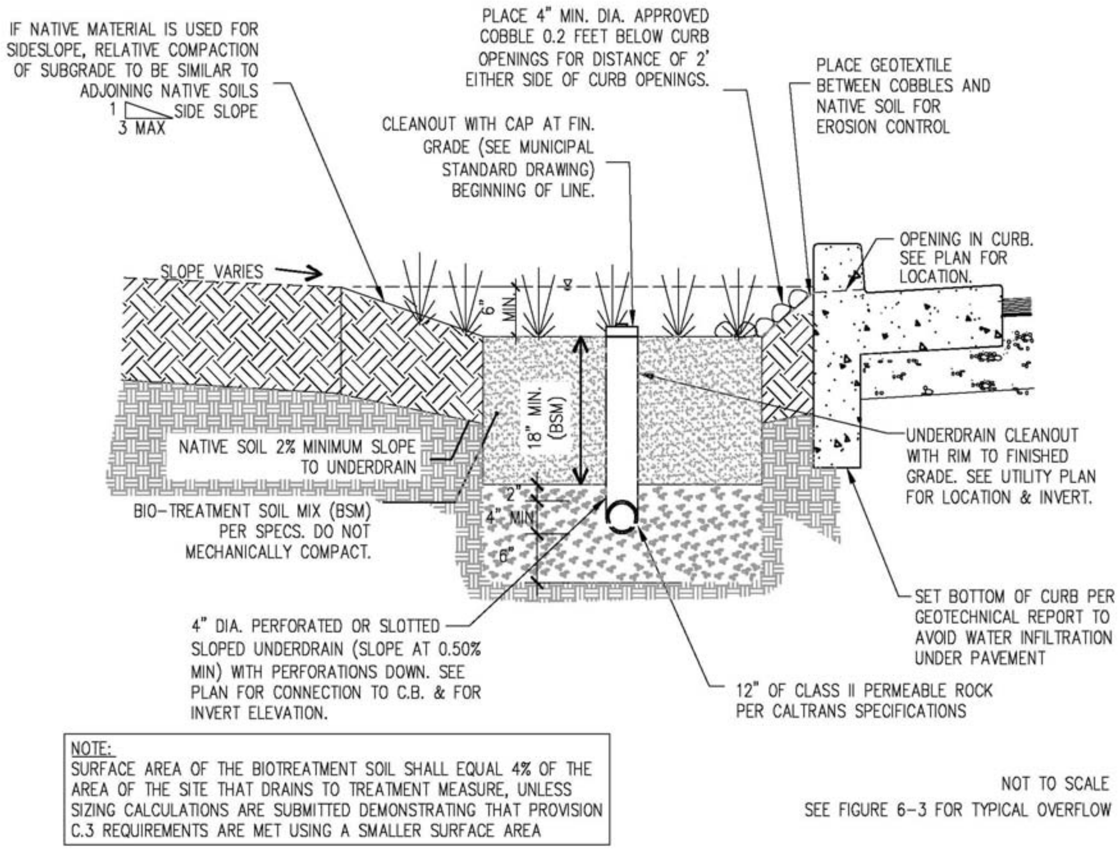

Figure 6-5: Cross section of bioretention area showing inlet from pavement.

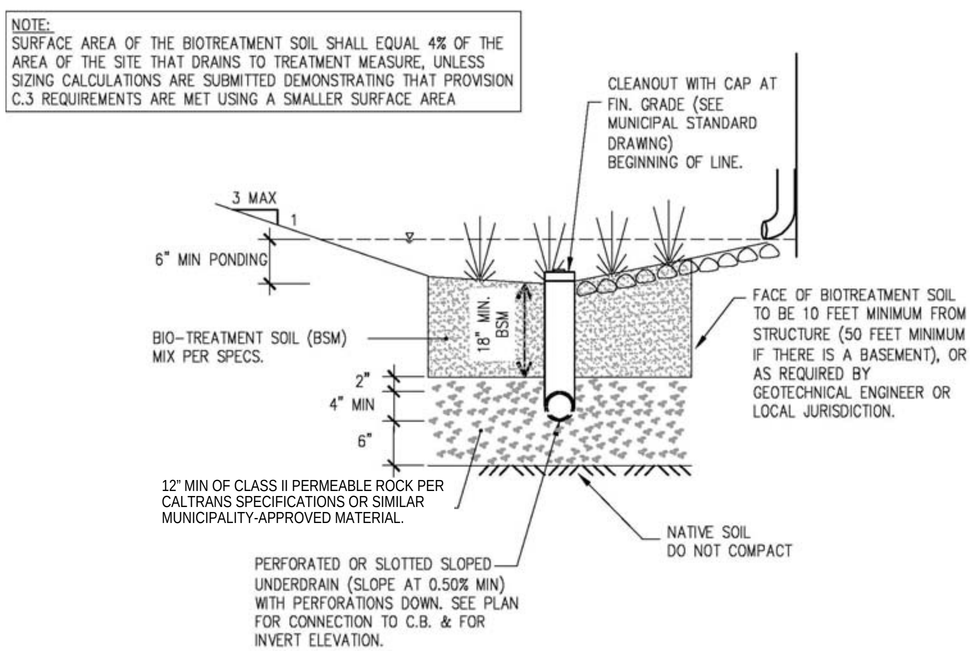

Figure 6-6: Bioretention area in landscaping to treat runoff from rainwater leaders (Not to Scale)

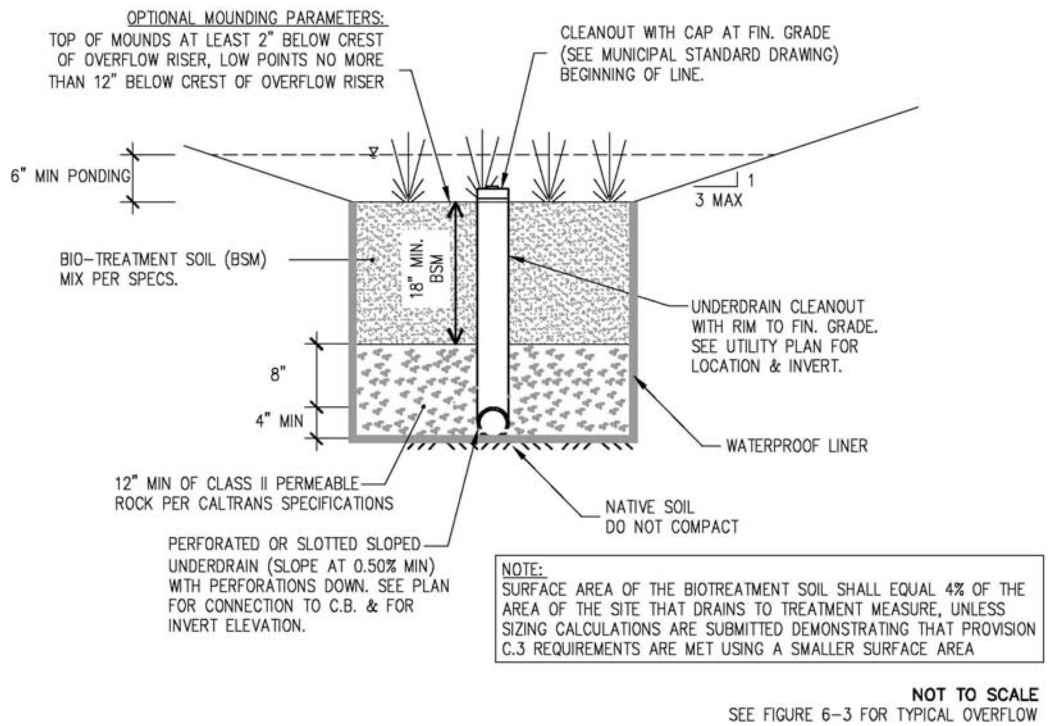

Figure 6-7: Cross section of lined bioretention area, for locations where infiltration is precluded.

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