BIORETENTION CELLS

Green Infrastructure For Stormwater Management

WHAT ARE BIORETENTION CELLS?

Bioretention cells (or biocells) are one of the most widely used green infrastructure practices for managing stormwater. They are landscaped depressions that capture stormwater runoff from impervious surfaces such as parking lots or streets. Above ground, biocells look like a flower garden. Below ground, biocells have an engineered subgrade design to filter pollutants out of stormwater runoff.

WHY INSTALL BIORETENTION CELLS?

Bioretention cells are installed to protect water quality. In most communities, dirty stormwater goes into storm sewers and discharges into local water bodies without treatment. Sediment, heavy metals, oils and greases, and bacteria are transported directly to urban streams. Biocells capture and breakdown these pollutants and slowly release cool, clean water.

Bioretention cells can also help reduce the flashiness of flows in urban streams because they capture, treat, and slowly release the majority of runoff events. This helps to reduce stream corridor erosion, which threatens adjacent property and infrastructure. It is also a major source of sediment in our streams.

WHERE ARE BIOCELLS INSTALLED?

Biocells are installed where water can't infiltrate and percolate downward through the existing soils at an adequate rate. Large scale developments typically disturb and compact soils, which reduce their ability to infiltrate and percolate water. The engineered subgrade of biocells ensures that captured water readily moves down through a sandy soil media to filter out pollutants.

BIORETENTION CELL **COMPONENTS**

Illustration Courtesy of RDG Planning and Design, ISWMM

1 Hardwood Mulch: 2”-3” mulch

2 Curb cut or other inlet: Allows water into the bioretention cell

3 Modified Soil: 18”-30” modified soil (sand, topsoil, compost)

4 Stone Choker Layer: 2” thick washed 3/8” chip

5 Stone Base Layer: 8”-12” thick washed 1” rock

6 Subdrain: Perforated subdrain tile ensures the system never stays saturated.

7 Existing Soils: Typically altered and compacted soils with poor percolation rates.

8 Overflow Standpipe: Non-perforated pipe to ensure designed ponding depth of 6”-9”. Flows exceeding designed ponding depth exit through the standpipe.

9 Plants: Plantings provide a pleasing appearance, protect the soil surface, and take up water and nutrients.

BIORETENTION CELL **INSTALLATION**

STEP 1 Excavation and Installation of the Subdrain

STEP 2 Installation of Rock and Overflow Pipe

STEP 3 Placing the Soil Media

STEP 4 Planting and Mulching

(Notice the overflow standpipe is set 9 inches above the bioretention cell surface to pond water.)

BIORETENTION CELL **MAINTENANCE**

- Develop a maintenance plan.
- Manage vegetation to maintain a pleasing appearance.
- Perform weed control as needed.
- If native vegetation is used, consider burning annually if local code allows.
- Inspect annually for scour erosion at point of entry.
- Inspect annually for sediment accumulation. Biocells trap sediment that will need to be removed.
- Remove accumulated trash and debris.
- Mulch can float and smother small plants or plug outlets. Reposition mulch to maintain a 2" uniform layer.
- Replace mulch and dead plants until the plant community is well established.

BIORETENTION CELLS OF IOWA

1 Cedar Falls - University of Northern Iowa Campus

2 Des Moines - The Cathedral Church of St. Paul

3 West Union - Business District

4 Ames - Public Works

5 Spirit Lake - Overlooking East Okoboji Lake

6 Iowa City - Fire Station

Rainscaping Iowa Landscapes for clean water
rainscapingiowa.org

ISWEP Iowa Storm Water Education Program
iowastormwater.org

USDA United States Department of Agriculture
Natural Resources Conservation Service
ia.nrcs.usda.gov

Polk Soil & Water Conservation District
polk-swcd.org

Iowa Department of Agriculture and Land Stewardship
iowaagriculture.gov

SRF State Revolving Fund
iowasrf.com

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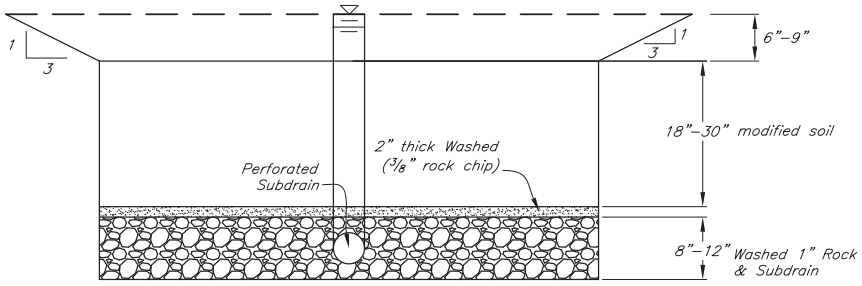
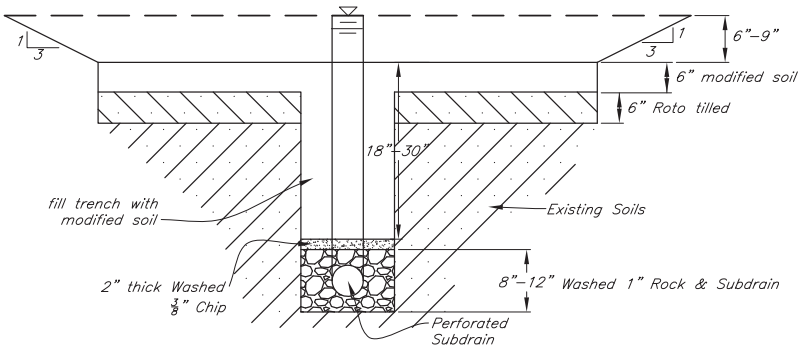
BIORETENTION **PRACTICES**

Bioretention practices in Iowa include bioretention cells, enhanced rain gardens, rain gardens and bioswales. Biocells, enhanced rain gardens and rain gardens are constructed with a level bottom. They capture and infiltrate runoff, but they do not have a conveyance function. Large runoff events either bypass biocells or exit via the outlet standpipe. Bioswales have a conveyance function, and are constructed with a sloping bottom. Bioswales capture and infiltrate small rains and convey large rains.



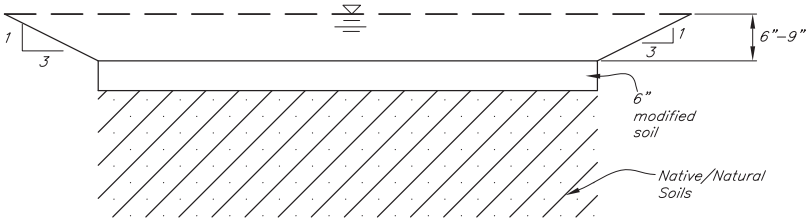
BIORETENTION CELLS

- recommended when percolation rates are less than 0.5 inches/hour
- feature a fully engineered subgrade.
- rely on specified soil media to filter stormwater
- design guidelines are in Chapter 2E-4 of the Iowa Stormwater Management Manual



ENHANCED RAIN GARDENS

- recommended when percolation rates are at or near 0.5 inches/hour
- have a partially engineered subgrade
- rely on specified soil media and native soils to filter stormwater
- design guidelines are in the Iowa Rain Garden Design and Installation Manual



RAIN GARDENS

- recommended when percolation rates are 1 inch/hour or greater
- rely on native soils to filter stormwater
- 6 inches of amended soil may be specified
- design guidelines are in the Iowa Rain Garden Design and Installation Manual

BIOSWALES

- Recommended where there is concentrated flow of water, positive grade, and larger drainage areas
- Use below ground cross section of an enhanced rain garden
- Relies on rock or earth berms to hold and infiltrate small rains
- Provides alternative to storm sewers
- Design guidelines are in Chapter 2I-3 of the Iowa Stormwater Management Manual

Dickinson County Bioswale

BIORETENTION CELL **DESIGN CONSIDERATIONS**

WATER QUALITY VOLUME CALCULATION

WQv = P x Rv x DA x 43,560 SF/ac x 1ft/12 in

REQUIRED SURFACE AREA CALCULATION

Af = WQv x df / {K x (hf + df) tf}

SOIL MEDIA

Research continues to refine the best blend for bioretention media to capture pollutants. Current recommendations include the blending of the three components within allowable material ranges:

75%-90% Sand **0 – 25% Topsoil** **0 – 10% Compost**

Additional Considerations:

- Biocells are typically designed to manage the WQv (1.25" of rain) but can be designed to manage larger rainfall events.
- Biocells must be installed downslope at least 10 ft away from buildings with basements (30-40 ft preferred).
- There must be 2 feet of separation between the bottom of the cell and normal high water table.
- Provide pretreatment of runoff to minimize sediment loading within the biocell.
- Native plants are recommended for their deep roots that make then drought resistant. The deep roots of native plants also help maintain high organic matter levels and high porosity.
- Modified soil percolates at 1" per hour, so water shouldn't pond more than 6-9 hours before moving into the soil media.

Pre-treatment swale for Ankeny biocell

- Do not use bioretention on brownfield sites or adjacent to hotspots or other sensitive areas unless special precautions are used to overcome risk of groundwater contamination.

Biocell Design Highlights:

- Follow the guidelines in the Iowa Stormwater Management Manual (ISWMM) Chapter 2E-4.
- Delineate drainage areas into two acres of impervious surface per biocell.
- Identify the subdrain outlet location.
- Calculate the WQv in cubic feet.
- Determine the ponding depth (6"-9").
- Calculate the required surface area.
- Determine subdrain and overflow pipe size.
- Determine the elevation of the top of the overflow pipe.
- Calculate the quantities of materials (rock, chip, sand, compost, topsoil, mulch, tile, etc.).
- Develop a planting plan.