Stormwater Management

Low Impact Development
Construction Permitting, 1-5 Acres

Includes:

– New Construction
– Road Widening
– Complete Resurfacing
– Drain Construction and Channel Modification
Construction Permit Process

• Soil Erosion and Sedimentation Permit followed by Permit by Rule

• Permit By Rule coverage:
  ✓ 1 to 5 acres (no application)
  ✓ 5 acre or more
What is the Permit by Rule?

- Piggy Back on SESC, Not Duplicative
- Notice of Coverage (5 acres and over)
- Certified Operator
- Inspections and Logs
- Permit Fee (5 acres and over = $400)
Why Regulate Urban Stormwater Runoff?

- has a major impact on the quality of rivers and streams
- impacts are both quality and quantity of runoff
- must be controlled to clean up our waterways. It’s the “next step”
- comes from “MS4s”, but pollutants often come from land uses.
Post Construction Storm Water Management (BMPs)

- Implement regulatory programs to ensure installation of structural and non-structural BMPs for new development & redevelopment
- Ensure long-term O & M
Storm Water Pollution Prevention (Good Housekeeping)

• Develop and implement programs to prevent and reduce storm water pollution from municipal operations:
  – Fleet maintenance
  – Fertilizer, pesticide, & herbicide
  – Parking lots and drains
  – Materials storage
  – Flood control retrofits for WQ
  – Spill prevention and response

A person works to prevent a spill from entering a storm sewer (DAWG, 2000)
Construction Site Storm Water Runoff Control

- Notification requirements
  - Additional eyes and ears to boost effectiveness of local SESC and NPDES

- Protect storm sewers from sediments
Low Impact Development (LID)

- www.lid-stormwater.net
- Bioretention
- Green Roofs
- Permeable Pavers
- Rain Barrels and Cisterns
- Soil Amendments
- Tree Box Filters
Residential

1. Bioretention / Rain Garden, Low Density Residential
2. Soil Amendments, Low Density Residential
3. Bioretention / Rain Garden, Low Density Residential
4. Grassed Swale, Low Density Residential
5. Disconnectivity (Rain Barrel), Low Density Residential
6. Permeable Pavers, Low Density Residential
7. Grassed Swale, Low Density Residential
8. Bioretention / Rain Garden, Low Density Residential
9. Conservation, Low Density Residential
Residential
• Landscaped areas planted to wild flowers and other native vegetation that soak up rain water,
• mainly from the roof of a house or other building.
• Compared to a conventional patch of lawn, a rain garden allows about 30% more water to soak into the ground.
• http://clean-water.uwex.edu/pubs/raingarden/

From UWisc Ext
How rain gardens work

- Increasing the amount of water that filters into the ground, which recharges local and regional aquifers;
- Helping protect communities from flooding and drainage problems;
- Helping protect streams and lakes from pollutants carried by urban stormwater – lawn fertilizers and pesticides, oil and other fluids that leak from cars, and numerous harmful substances that wash off roofs and paved areas;
- Enhancing the beauty of yards and neighborhoods;
- Providing valuable habitat for birds, butterflies and many beneficial insects.

From UWisc Ext
Where should the rain garden go?

- The rain garden should be at least 10 feet from the house so infiltrating water doesn’t seep into the foundation.
- Do not place the rain garden directly over a septic system.
- It may be tempting to put the rain garden in a part of the yard where water already ponds. Don’t! The goal of a rain garden is to encourage infiltration, and your yard’s wet patches show where infiltration is slow.
- It is better to build the rain garden in full or partial sun, not directly under a big tree.
- Putting the rain garden in a flatter part of the yard will make digging much easier. For example, a rain garden 10 feet wide on a 10% slope must be 12 inches deep to be level, unless you import topsoil or use cut and fill.
From UWisc Ext
Figure 2 Rain gardens should be located at least 10 feet from the house, on a gentle slope that catches downspout water.
The size of the rain garden will depend on:

• how deep the garden will be,
• what type of soils the garden will be planted in, and
• how much roof and/or lawn will drain to the garden
### Table 1  Rain gardens less than 30 feet from downspout.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>3-5 in. deep</th>
<th>6-7 in. deep</th>
<th>8 in. deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy soil</td>
<td>0.19</td>
<td>0.15</td>
<td>0.08</td>
</tr>
<tr>
<td>Silty soil</td>
<td>0.34</td>
<td>0.25</td>
<td>0.16</td>
</tr>
<tr>
<td>Clayey soil</td>
<td>0.43</td>
<td>0.32</td>
<td>0.20</td>
</tr>
</tbody>
</table>

### Table 2  Rain gardens more than 30 feet from downspout.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Size Factor, for all depths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy soil</td>
<td>0.03</td>
</tr>
<tr>
<td>Silty soil</td>
<td>0.06</td>
</tr>
<tr>
<td>Clayey soil</td>
<td>0.10</td>
</tr>
</tbody>
</table>

From UWisc Ext
Runoff flows into a new rain garden (shown before plants are fully grown).
How long and how wide should the rain garden be?

• The longer side of the rain garden should face upslope; that is, the length of the rain garden should be perpendicular to the slope and the downspout.

• A good rule of thumb is that the rain garden should be about twice as long as it is wide.
On a gentle slope, soil from digging out the garden can be used to create the berm. This rain garden is 4 inches deep.
Bioretention

- Bioretention utilizes soils and both woody and herbaceous plants to remove pollutants from storm water runoff
- Bioretention is an ideal storm water management BMP for median strips, parking lot islands, and swales
FIGURE 1 BIORETENTION AREA

ADVANTAGES

• enhances the quality of downstream water bodies.

• runoff is temporarily stored in the BMP and released over a period of days to the receiving water.

• provides shade and wind breaks, absorbs noise, and improves an area's landscape.
Limitations

• Clogging may be a problem, particularly if the BMP receives runoff with high sediment loads.
• May freeze, preventing runoff from infiltrating into the planting soil.
• Water table must be below 6 feet.
DESIGN CRITERIA

• Each of the components of the bioretention area is designed to perform a specific function.
• The grass buffer strip reduces incoming runoff velocity and filters particulates from the runoff.
• The sand bed also reduces the velocity, filters particulates, and spreads flow over the length of the bioretention area.
• The organic or mulch layer also filters pollutants and provides an environment conducive to the growth of microorganisms, which degrade organic pollutants.
Size of the bioretention area

• a function of the drainage area and the runoff generated from the area
• The size should be 5 to 7 percent of the drainage area multiplied by the rational method runoff coefficient, "c," determined for the site.
• minimum dimensions of the bioretention area are 15 feet wide by 40 feet in length
Size of the bioretention area (cont)

• The length should be at least twice the width.
• The minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established that replicates natural forest and creates a microclimate.
• The length requirement promotes the distribution of flow and decreases the chances of concentrated flow.
### BIORETENTION AREA SIZING COMPUTATION

<table>
<thead>
<tr>
<th>DEVELOPMENT</th>
<th>AREA SQ. FT.</th>
<th>&quot;C&quot; FACTOR</th>
<th>C X AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAVEMENT</td>
<td>23,600</td>
<td>0.90</td>
<td>21,400</td>
</tr>
<tr>
<td>GRASS</td>
<td>10,100</td>
<td>0.25</td>
<td>2,500</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>33,900</strong></td>
<td></td>
<td><strong>23,900</strong></td>
</tr>
</tbody>
</table>

### BIOTENTION AREA SIZE

1. With Sand Bed (5% Sum of C x Area)
   \[= 0.05 \times 23,900 = 1,195 \text{ OR SAY } 1,200 \text{ sq. ft.}\]
2. Without Sand Bed (7% Sum of C x Area)
   \[= 0.07 \times 23,900 = 1,1673 \text{ OR SAY } 1,700 \text{ sq. ft.}\]
PERFORMANCE

• Bioretention removes storm water pollutants through physical and biological processes including:
  • Adsorption and filtration
  • plant uptake
  • microbial activity
  • decomposition, and volatilization
<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Removal Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus</td>
<td>70%-83%</td>
</tr>
<tr>
<td>Metals (Cu, Zn, Pb)</td>
<td>93%-98%</td>
</tr>
<tr>
<td>TKN</td>
<td>68%-80%</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>90%</td>
</tr>
<tr>
<td>Organics</td>
<td>90%</td>
</tr>
<tr>
<td>Bacteria</td>
<td>90%</td>
</tr>
</tbody>
</table>

Source:  
1Davis et al. (1998)  
2PGDER (1993)
Planting requirements

• The bioretention area should be vegetated to resemble a terrestrial forest community ecosystem, which is dominated by understory trees.
• A shrub layer, and herbaceous ground covers.
• Three species each of both trees and shrubs are recommended with 1000 trees and shrubs per acre.
Sites using LID

• Washtenaw County
• http://www.ewashtenaw.org/government/drain_commissioner/dc_lid.html
• Phizer
• Ann Arbor
• Steelcase
• Others – you find
Low Impact Design Fact Sheets

Water quality is important to all of us. Protecting our lakes, rivers, and streams is critical to preserving the natural character of our rural areas, and maintaining a high quality of life in our villages and cities.

Lately, we are seeing more innovative design techniques employed in Washtenaw County that serve to better protect our waters. Low Impact Development, or LID, is a more environmentally friendly approach to land development and stormwater runoff management, which balances growth with environmental integrity.

Many examples of Low Impact Design have been constructed here in Washtenaw County. These Fact Sheets compile information about these practices in a format that I hope you will find convenient and useful.