Rutgers Cooperative Extension
Water Resources Program

Community-based Projects for Addressing Flooding and Improving Water Quality – Low Cost Solutions

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What is Stormwater?

Stormwater is the water from rain or melting snows that can become “runoff,” flowing over the ground surface and returning to lakes and streams.
The Impact of Development on Stormwater Runoff

More development → More impervious surfaces → More stormwater runoff
The **Urban** Hydrologic Cycle

- **Condensation**
- **Evaporation**
- ** Much less infiltration**
- **Roads and roofs stop infiltration**
- **Soil**
- **Bedrock**
- **Low groundwater flow**
- **No rain: Streams dry up**
- **Rain: Streams flood**
- **More runoff**
Water Pollution Sources

**POINT SOURCE POLLUTION**

**NONPOINT SOURCE POLLUTION**

*Environmental Health Perspective, National Institute of Health*
Nonpoint Source Pollution (NPS)

• Associated with stormwater runoff
• Runoff collects pollutants on its way to a sewer system or water body
• It cannot be traced to a direct discharge point such as a wastewater treatment facility
Examples of NPS

- Oil and grease from cars
- Fertilizers
- Animal waste
- Grass clippings
- Septic systems
- Sewage leaks
- Household cleaning products
- Litter
- Agriculture
- Sediment
TO MINIMIZE IMPACT OF STORMWATER RUNOFF, YOU MUST CONTROL RUNOFF FROM IMPERVIOUS SURFACES
We must deal with impacts from impervious cover

- Are there impervious surfaces that you can eliminate?

- If we can't eliminate it, can we reduce it?

- If we can't eliminate or reduce it, can we disconnect it?

- Are there impervious surfaces that you can harvest rainwater for reuse?

- Are there conveyance systems that can be converted to bioswales?
Eliminate it!
Reduce It!

Pervious Pavements:
- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Ideal application for porous pavement is to treat a low traffic or overflow parking area
Disconnect it!
For 1.25 inch storm, 3,811 cubic feet of runoff = 28,500 gallons
Water Resources Program

For 1.25 inch storm, 581 cubic feet of runoff = 4,360 gallons

Total drainage area = 3 acres

1 acre directly connected impervious cover

2 acres pervious cover

Runoff Direction

Stormwater Inlet
## Volume of Runoff

<table>
<thead>
<tr>
<th>Design Storm</th>
<th>Connected (gallons)</th>
<th>Disconnected (gallons)</th>
<th>Percent Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25 inches (water quality storm)</td>
<td>28,500</td>
<td>4,360</td>
<td>85%</td>
</tr>
</tbody>
</table>
WHAT IS GREEN INFRASTRUCTURE?

Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green Infrastructure management approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies.


Rain Garden in Holmdel, NJ
Native NJ Purple Coneflower
Pervious Pavers
GREEN INFRASTRUCTURE DESIGN APPROACHES

1 Green Roof
2 Rainwater Harvesting
3 Permeable Pavement
4 Vegetated Swale
5 Natural Stormwater Basin
6 Rain Garden
1 – GREEN ROOF

Basic Info:
- high quality water proofing and root repellant system
- lightweight growing medium and plants

Benefits:
- Economic benefits (savings on energy heating and cooling costs)
- Improved air quality
- Carbon dioxide/oxygen exchange
- Amenity space and aesthetics
- Sound insulation

2 – RAINWATER HARVESTING: CISTERN

Basic Info:
• Capture, diversion, and storage of rainwater

Benefits:
• Eliminates need for complex and costly distribution systems
• Provides additional water source
• Landscape irrigation
• Reduces flow to stormwater drains
• Reduces non-point source pollution
• Delays expansion of existing water treatment plants
• Reduces consumers’ utility bills
RAINWATER HARVESTING: RAIN BARREL

Basic Info:
- Capture, diversion, and storage of rainwater

Benefits:
- Saves drinking water
- Irrigates the landscape
- Reduces utility bills
- Prevents basement flooding
- Reduces pollution
So many barrels to choose from...
3 – PERMEABLE PAVEMENT

Basic Info:
• Allows runoff to flow through the surface to an underlying storage layer

Benefits:
• Manage stormwater runoff
• Alternative to costly traditional stormwater management methods
• Mitigation of urban heat island effect
• Contaminant removal as water moves through layers of system
4 – VEGETATED SWALE

Basic Info:
• Broad, shallow channel with a dense stand of vegetation covering the side slopes and bottom
• Traps pollutants

Benefits:
• Reduced peak flows
• Removal of pollutants
• Promotion of runoff infiltration
• Lower capital costs.
5 – NATURAL STORMWATER BASIN

Basic Info:
• Broad, shallow channel with a dense stand of vegetation covering the side slopes and bottom
• Traps pollutants

Benefits:
• Reduced peak flows
• Removal of pollutants
• Promotion of runoff infiltration
• Lower capital costs.
What is a rain garden?

A rain garden is a landscaped, shallow depression that captures, filters, and infiltrates stormwater runoff. The rain garden removes nonpoint source pollutants from stormwater runoff while recharging groundwater.
Lots of Rain Gardens
What is the next step for municipalities?
Plans to fix the problems

- Regional Stormwater Management Plans
- Watershed Restoration Plans
- Integrated Water Quality Plans
- Impervious Cover Assessments and Reduction Action Plans
Impervious Cover Assessment
Impervious Cover Assessment

- Analysis completed by watershed and by municipality
- Use 2007 Land Use data to determine impervious cover
- Calculate runoff volumes for water quality, 2, 10 and 100 year design storm and annual rainfall
- Contain three concept designs
<table>
<thead>
<tr>
<th>Watershed</th>
<th>Total Area (ac)</th>
<th>Impervious Cover (ac)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond Run</td>
<td>5,956</td>
<td>1,797</td>
<td>30.5</td>
</tr>
<tr>
<td>Miry Run</td>
<td>3,716</td>
<td>1,026</td>
<td>28.0</td>
</tr>
<tr>
<td>Shady Brook</td>
<td>2,838</td>
<td>822.5</td>
<td>29.5</td>
</tr>
<tr>
<td>Assunpink Creek</td>
<td>1,809</td>
<td>429.3</td>
<td>24.0</td>
</tr>
<tr>
<td>Doctors Creek</td>
<td>3,053</td>
<td>232.0</td>
<td>7.60</td>
</tr>
<tr>
<td>Back Creek</td>
<td>2,980</td>
<td>563.0</td>
<td>19.0</td>
</tr>
<tr>
<td>Delaware River and Crosswricks Creek</td>
<td>5,489</td>
<td>804.2</td>
<td>16.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>25,841</strong></td>
<td><strong>5,674</strong></td>
<td><strong>22.7</strong></td>
</tr>
<tr>
<td>Subwatershed</td>
<td>NJ Water Quality Storm (MGal)</td>
<td>Annual Rainfall of 44” (MGal)</td>
<td>2-Year Design Storm (3.3”) (MGal)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Pond Run</td>
<td>61.0</td>
<td>2,147.0</td>
<td>161.0</td>
</tr>
<tr>
<td>Miry Run</td>
<td>34.8</td>
<td>1,225.8</td>
<td>91.9</td>
</tr>
<tr>
<td>Shady Brook</td>
<td>27.9</td>
<td>982.7</td>
<td>73.7</td>
</tr>
<tr>
<td>Assunpink Creek</td>
<td>14.6</td>
<td>512.9</td>
<td>38.5</td>
</tr>
<tr>
<td>Doctors Creek</td>
<td>7.9</td>
<td>277.2</td>
<td>20.8</td>
</tr>
<tr>
<td>Back Creek</td>
<td>19.1</td>
<td>672.7</td>
<td>50.4</td>
</tr>
<tr>
<td>Delaware River and Crosswicks Creek</td>
<td>27.3</td>
<td>960.8</td>
<td>72.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>192.6</td>
<td>6,779.2</td>
<td>508.4</td>
</tr>
</tbody>
</table>
Hamilton Township
Impervious Cover Assessment
Reynolds Middle School

PROJECT LOCATION:

SITE PHOTOS:

SITE PLAN:

1. BIORETENTION SYSTEM
   - A bioretention system/rain garden should be installed on a triangular piece of lawn near the front of the building. Currently there is a connected downsput that is directing runoff to the pavement. Rain gardens also can be used to capture runoff from the parking lots in the southeast corner of the site and north side of the property. The bioretention system would also capture runoff from the asphalt in the back of the school. A bioretention system would intercept, infiltrate, and treat runoff from a portion of the school’s rooftop.
   - POROUS ASPHALT: The front drive would be replaced with porous asphalt. The area around an existing catch basin shows water pooling in the front drive.

2. POROUS ASPHALT
   - Design Guidelines for Porous Asphalt with Subsurface Infiltration
Impervious Cover Reduction Action Plan
Project Sites
1. Clover Square
2. Ibis Plaza Office Suites
3. University Plaza
4. Nottingham Volunteer Fire Company
5. St. Mark United Methodist Church
6. Morgan Elementary School
7. University Heights/H.D. Morrison Elementary School
8. Hamilton Square Baptist Church
9. Greater Victory Ministries
10. Hamilton Township School District
11. First Presbyterian Church
12. Baseball Fields
13. Our Lady of Sorrows School
15. Enterprise Volunteer Fire Co.
16. Christ Presbyterian Church
Nottingham Volunteer Company

At this site, there is a potential to replace parking lot islands with tree filter systems and install cistern to harvest rainwater from the rooftop to wash the fire trucks. According to the NRCS soil survey, the soils are suitable for infiltration at this site.

<table>
<thead>
<tr>
<th>Address</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 Mercer Street</td>
<td>40.233412</td>
<td>-74.65753</td>
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</table>

<table>
<thead>
<tr>
<th>Area (sq.ft.)</th>
<th>Lot</th>
<th>Block</th>
<th>TP</th>
<th>TN</th>
<th>TSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>153,281</td>
<td>24.01</td>
<td>1839</td>
<td>5.3</td>
<td>56.3</td>
<td>703.8</td>
</tr>
</tbody>
</table>
### Nottingham Volunteer Company (cont’d)

<table>
<thead>
<tr>
<th>Impervious Cover</th>
<th>Runoff Volume (Mgal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended BMP</th>
<th>Recharge Potential (Mgal/yr)</th>
<th>Total Suspended Solids Removal Potential (lbs/yr)</th>
<th>Maximum Volume Reduction Potential (gal/storm)</th>
<th>Peak Discharge Reduction Potential (cu.ft./second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree Filter Systems</td>
<td>0.146</td>
<td>24</td>
<td>1,541</td>
<td>0.40</td>
</tr>
<tr>
<td>Cistern</td>
<td>0.055</td>
<td>18</td>
<td>461</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Estimate cost is $16,675 for 667 square feet of tree filter systems with two feet of porous media. Estimate cost is $10,000 for 5,000 gallon cistern.
St. Mark United Methodist Church

For this site, a large portion of the parking lot can be captured in a bioretention system. According to the NRCS soil survey, the soils are suitable for infiltration at this site.

<table>
<thead>
<tr>
<th>Address</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>465 Paxson Avenue</td>
<td>40.24428</td>
<td>-74.671402</td>
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</table>

<table>
<thead>
<tr>
<th>Area (sq.ft.)</th>
<th>Lot</th>
<th>Block</th>
<th>Existing Loads (lbs/year)</th>
</tr>
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<tbody>
<tr>
<td>284,082</td>
<td>8</td>
<td>1622</td>
<td>TP 9.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TN 104.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TSS 1304.3</td>
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</table>
### St. Mark United Methodist Church (cont’d)

<table>
<thead>
<tr>
<th>Impervious Cover</th>
<th>Runoff Volume (Mgal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended BMP</th>
<th>Recharge Potential (Mgal/yr)</th>
<th>Total Suspended Solids Removal Potential (lbs/yr)</th>
<th>Maximum Volume Reduction Potential (gal/storm)</th>
<th>Peak Discharge Reduction Potential (cu.ft./second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention System</td>
<td>0.785</td>
<td>131</td>
<td>8,289</td>
<td>2.17</td>
</tr>
</tbody>
</table>

Estimate cost is $37,675 for 7,535 square feet of bioretention system.
St. Mark United Methodist Church
Lot 8 Block 1622
# Summary of Projects in the Stormwater Mitigation Plan

<table>
<thead>
<tr>
<th>Watersheds</th>
<th>Number of Projects</th>
<th>Total Area of Project Sites (ac)</th>
<th>Impervious Cover (ac)</th>
<th>Potential Management Area (ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assunpink Creek</td>
<td>4</td>
<td>61.62</td>
<td>37.73</td>
<td>9.48</td>
</tr>
<tr>
<td>Back Creek</td>
<td>8</td>
<td>88.18</td>
<td>44.95</td>
<td>12.13</td>
</tr>
<tr>
<td>Crosswicks Creek</td>
<td>8</td>
<td>145.08</td>
<td>94.30</td>
<td>3.50</td>
</tr>
<tr>
<td>Doctors Creek</td>
<td>2</td>
<td>14.71</td>
<td>3.64</td>
<td>0.47</td>
</tr>
<tr>
<td>Miry Run</td>
<td>16</td>
<td>122.73</td>
<td>57.21</td>
<td>7.52</td>
</tr>
<tr>
<td>Pond Run</td>
<td>16</td>
<td>214.82</td>
<td>79.88</td>
<td>7.79</td>
</tr>
<tr>
<td>Shady Brook</td>
<td>15</td>
<td>98.13</td>
<td>65.17</td>
<td>4.17</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>69</strong></td>
<td><strong>745.28</strong></td>
<td><strong>382.88</strong></td>
<td><strong>45.06</strong></td>
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Summary of Projects in the Stormwater Mitigation Plan

<table>
<thead>
<tr>
<th>Watersheds</th>
<th>Recharge Potential (Mgal/yr)</th>
<th>TSS Removal Potential (lbs/yr)</th>
<th>Max Volume Reduction Potential (gal/storm)</th>
<th>Peak Discharge Reduction Potential (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assunpink Creek</td>
<td>10.760</td>
<td>1,801</td>
<td>113,570</td>
<td>29.67</td>
</tr>
<tr>
<td>Back Creek</td>
<td>13.763</td>
<td>2,304</td>
<td>145,258</td>
<td>37.97</td>
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<tr>
<td>Crosswicks Creek</td>
<td>3.967</td>
<td>664</td>
<td>41,870</td>
<td>10.94</td>
</tr>
<tr>
<td>Doctors Creek</td>
<td>0.536</td>
<td>90</td>
<td>5661</td>
<td>1.48</td>
</tr>
<tr>
<td>Miry Run</td>
<td>7.280</td>
<td>1,428</td>
<td>76,724</td>
<td>23.56</td>
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<tr>
<td>Pond Run</td>
<td>8.755</td>
<td>1,479</td>
<td>92,233</td>
<td>26.40</td>
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<tr>
<td>Shady Brook</td>
<td>4.694</td>
<td>792</td>
<td>49,474</td>
<td>13.05</td>
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<tr>
<td>TOTALS</td>
<td>49.756</td>
<td>8,558</td>
<td>524,790</td>
<td>143.07</td>
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</tbody>
</table>
### Summary of Projects in the Stormwater Mitigation Plan

<table>
<thead>
<tr>
<th>Watersheds</th>
<th>Total Cost ($)</th>
<th>Impervious Cover Treated %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assunpink Creek</td>
<td>$963,199</td>
<td>25.1%</td>
</tr>
<tr>
<td>Back Creek</td>
<td>$701,594</td>
<td>27.0%</td>
</tr>
<tr>
<td>Crosswicks Creek</td>
<td>$492,689</td>
<td>3.7%</td>
</tr>
<tr>
<td>Doctors Creek</td>
<td>$25,731</td>
<td>13.0%</td>
</tr>
<tr>
<td>Miry Run</td>
<td>955,314</td>
<td>13.2%</td>
</tr>
<tr>
<td>Pond Run</td>
<td>$975,080</td>
<td>9.8%</td>
</tr>
<tr>
<td>Shady Brook</td>
<td>$550,861</td>
<td>6.4%</td>
</tr>
<tr>
<td>TOTALS</td>
<td>$4,664,468</td>
<td>11.8%</td>
</tr>
</tbody>
</table>
Conclusion

• Plans are a conduit for funding
• Impervious Cover Reduction Action Plan can easily be converted into a Stormwater Mitigation Plan
• Wide range in cost of projects (Eagle Scout Projects to Stimulus Money Projects)
• Foundation for stormwater utilities, watershed restoration plans, and integrated water quality plans,
• Plans are quick and easy to develop
Questions?

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