A Case Study of Suburban Infill Redevelopment, Stormwater challenges, and Partnerships

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Stormwater Management
Fairfax County, Virginia

Chesapeake Bay Watershed

Size: 395 sq. miles
Population: 1.1 million
MS4 - Phase 1 Community
Project implementation focus to date:

• Retrofits of county maintained stormwater management facilities
• Partnerships with other county agencies Park Authority and schools.
• Green building initiatives
• Outfall improvements
• Stream restorations
• Riparian buffers
• Middle Potomac Watershed Plan
• Little Pimmit Run Watershed

www.fairfaxcounty.gov/dpwes/watersheds
Franklin Park/Chesterbrook Community
Franklin Park/Chesterbrook Community
Residential Infill Redevelopment

Before

After
Residential Infill Redevelopment

Legend
- Drainage Area
- Residential Infill Lots or Remodeled Homes
- Other Complaint Types
- Erosion
- House Flooding
- Road Flooding
- Yard Flooding

Stormwater Related Easements
- Floodplain and Stormwater Easements
- Conservation/Water Quality Mgt Easements

2009 AERIAL PHOTOGRAPHY

2009

Legend

0  200  400

Feet
Changes in Imperviousness

Imperviousness:

1997 – 15%
2010 – 26%
Drainage Complaints

1846 Flooding, 2010
Erosion, 2010
1847 Flooding, 2010

1843 S/D Block, 1997
Erosion, 1998

1846 Cave-in/sinkhole, 2005

1853 S/D Cave-in, 1984
Erosion, 1990
Holes in S/D, 1990
S/S Cave-in, 1990
S/S Cave-in (2), 1991

1855 Erosion, 1998
S/D Block, 2005
Flooding, 2006

1856 Flooding, 2005
1857 Flooding, 2010
Roadside Ditches
… Problems …

Swale ‘evolution’

Filled-in ditch and collapsed culvert
Problems ...

Eroded backyards

Ad hoc stormwater management
Stream Conditions
Yard Inlet drain area = 34 Acres
Pilot Project Goals

- Improve drainage conditions
- Improve water quality and stream protection
  - MS4 Permit
  - TMDLs
  - Chesapeake Bay
- Partner with community to develop sound, cost effective solutions that can be collaboratively implemented.
- Build on lessons learned to help improve site development process for infill development.
Approach

- Partner with Virginia DOT to construct improvements within road right-of-way.
- Homeowner education and private stormwater improvement projects.
- Evaluate and improve infill redevelopment process.
- Pilot project that can be used as a model for similar communities.
First Step

Where does the water go?
What are critical areas?

- Overland Drainage
- Stream Bank Erosion
- Infrastructure Capacity
Third Step

Organize and Focus!
### Potentially Applicable Stormwater Management Practices

<table>
<thead>
<tr>
<th>Technique/Technology</th>
<th>Included in VA BMP Clearinghouse?</th>
<th>Included in PFM?</th>
<th>Quantity or Quality?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rooftop disconnection</td>
<td>Yes</td>
<td>No</td>
<td>Quantity</td>
</tr>
<tr>
<td>Rooftop storage</td>
<td>No</td>
<td>Yes</td>
<td>Quantity</td>
</tr>
<tr>
<td>Sheetflow to vegetated filter</td>
<td>Yes</td>
<td>No</td>
<td>Quantity</td>
</tr>
<tr>
<td>Grass Channel</td>
<td>Yes</td>
<td>Yes(^1)</td>
<td>Both</td>
</tr>
<tr>
<td>Soil amendments</td>
<td>Yes</td>
<td>No</td>
<td>Both</td>
</tr>
<tr>
<td>Vegetated roof</td>
<td>Yes</td>
<td>Yes</td>
<td>Quantity</td>
</tr>
<tr>
<td>Rainwater harvesting</td>
<td>Yes</td>
<td>No</td>
<td>Quantity</td>
</tr>
<tr>
<td>Permeable pavement</td>
<td>Yes</td>
<td>Yes</td>
<td>Both</td>
</tr>
<tr>
<td>Infiltration</td>
<td>Yes</td>
<td>Yes(^2)</td>
<td>Both</td>
</tr>
<tr>
<td>Bioretention</td>
<td>Yes</td>
<td>Yes</td>
<td>Both</td>
</tr>
<tr>
<td>Dry swale</td>
<td>Yes</td>
<td>Yes(^1)</td>
<td>Both</td>
</tr>
<tr>
<td>Wet swale</td>
<td>Yes</td>
<td>Yes(^1)</td>
<td>Quality</td>
</tr>
<tr>
<td>Filtering practice</td>
<td>Yes</td>
<td>Yes(^3)</td>
<td>Quality</td>
</tr>
<tr>
<td>Constructed wetland</td>
<td>Yes</td>
<td>No</td>
<td>Quality</td>
</tr>
<tr>
<td>Wet pond</td>
<td>Yes</td>
<td>Yes</td>
<td>Quality</td>
</tr>
<tr>
<td>Enhanced Extended detention</td>
<td>Yes</td>
<td>Yes</td>
<td>Both</td>
</tr>
<tr>
<td>Reforestation</td>
<td>No</td>
<td>Yes</td>
<td>Both</td>
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</tbody>
</table>

\(^1\) Vegetated swales
\(^2\) Percolation trenches
\(^3\) Tree box filters
\(^a\) Rooftop storage increases time of concentration to assist in stream stabilization.
\(^b\) Soil amendments are used to decrease the runoff coefficient for turf cover.
Approximate Extent of HSG "D" soils

Patton Terrace Subcatchment
Mid-McArthur Subcatchment
Concept Plan
Example Homeowner Improvements

LID practices
• Compost Blanket
• Infiltration trench
• Rain garden
• Rain barrels

Conventional practices
• French drain
• Yard inlet
Design Goals and Considerations

- Reduced drainage complaints.
- Current and proposed Virginia stormwater regulations.
- MS4 and TMDL considerations.
- Future development and maintenance?
## Summary of Anticipated LID Performance at the Patton Terrace Neighborhood

<table>
<thead>
<tr>
<th>Drainage Area (ft²)</th>
<th>RUNOFF GENERATED BEFORE LID PRACTICES (ft³)</th>
<th>Infiltration Area</th>
<th>Runoff Potentially</th>
<th>NET RUNOFF (ft³)</th>
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<tbody>
<tr>
<td></td>
<td>Proposed (ft³)</td>
<td>Infiltrated (ft³)</td>
<td>1&quot; 2-YR 10-YR</td>
<td>1&quot; 2-YR 10-YR</td>
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<tr>
<td>LM-1</td>
<td>49,413</td>
<td>289</td>
<td>5,504 13,328 1,321</td>
<td>3,303 0 2,202 10,026</td>
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<tr>
<td>LM-2</td>
<td>18,929</td>
<td>111</td>
<td>2,109 5,106 409</td>
<td>1,023 0 0 1,804</td>
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<tr>
<td>LM-3</td>
<td>53,966</td>
<td>316</td>
<td>6,011 14,556 775</td>
<td>1,938 0 2,709 11,254</td>
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<tr>
<td>LM-4</td>
<td>52,167</td>
<td>305</td>
<td>5,811 14,071 1,592</td>
<td>3,980 0 2,509 10,769</td>
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<tr>
<td>Totals</td>
<td>174,475</td>
<td>1,021</td>
<td>19,435 47,061 4,097</td>
<td>10,243 0 7419 33,851</td>
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<tr>
<td>% Reduction</td>
<td></td>
<td></td>
<td>100% 62% 28%</td>
<td></td>
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<tr>
<td>MM-1</td>
<td>5,614</td>
<td>33</td>
<td>625 1,514 0</td>
<td>0 0 0 0</td>
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<tr>
<td>MM-2</td>
<td>17,734</td>
<td>104</td>
<td>1,975 4,783 450</td>
<td>1,125 0 0 1,481</td>
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<tr>
<td>MM-3</td>
<td>27,796</td>
<td>163</td>
<td>3,096 7,497 50</td>
<td>125 0 0 4,195</td>
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<tr>
<td>MM-4</td>
<td>45,263</td>
<td>265</td>
<td>5,042 12,208 650</td>
<td>1,625 0 1,740 8,906</td>
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<tr>
<td>MM-5</td>
<td>19,678</td>
<td>115</td>
<td>2,192 5,308 525</td>
<td>1,313 0 0 2,006</td>
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<tr>
<td>MM-6</td>
<td>51,235</td>
<td>300</td>
<td>5,707 13,819 850</td>
<td>2,125 0 2,405 10,517</td>
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<tr>
<td>Totals</td>
<td>167,320</td>
<td>980</td>
<td>18,637 45,129 2,525</td>
<td>6,313 0 4,144 27,103</td>
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<tr>
<td>% Reduction</td>
<td></td>
<td></td>
<td>100% 78% 40%</td>
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<tr>
<td>UP-1</td>
<td>57,063</td>
<td>334</td>
<td>6,356 15,391 840</td>
<td>2,100 0 3,054 12,089</td>
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<tr>
<td>UP-2</td>
<td>33,307</td>
<td>195</td>
<td>3,710 8,984 1,534</td>
<td>3,835 0 408 5,682</td>
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<tr>
<td>UP-3</td>
<td>23,726</td>
<td>139</td>
<td>2,643 6,399 223</td>
<td>558 0 0 3,097</td>
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<tr>
<td>UP-4</td>
<td>16,334</td>
<td>95</td>
<td>1,819 4,406 447</td>
<td>1,118 0 0 1,104</td>
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<tr>
<td>UP-5</td>
<td>8,482</td>
<td>50</td>
<td>945 2,288 790</td>
<td>1,975 0 0 0</td>
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<tr>
<td>UP-6</td>
<td>6,099</td>
<td>36</td>
<td>679 1,645 360</td>
<td>900 0 0 0</td>
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<tr>
<td>Totals</td>
<td>145,011</td>
<td>849</td>
<td>16,152 39,113 4,194</td>
<td>10,485 0 3,461 21,970</td>
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<tr>
<td>% Reduction</td>
<td></td>
<td></td>
<td>100% 79% 44%</td>
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<tr>
<td>Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Totals</td>
<td>2,850</td>
<td>54,224</td>
<td>131,303 10,816 27,040</td>
<td>0 15,024 82,924</td>
</tr>
<tr>
<td>% Reduction</td>
<td></td>
<td></td>
<td>100% 72% 37%</td>
<td></td>
</tr>
</tbody>
</table>
Regulatory Improvements

- 2000 Infill and Residential Development Study
  - Site Compatibility
  - Stormwater
  - Tree Preservation
  - Traffic and Transportation
- 2003 Chesapeake Bay Preservation Act amendments
- 2006 Adequate outfall analysis
- 2007 Addition of Low Impact Development (LID) techniques to Public Facility Manual (PFM)
- 2009 Tree Conservation Ordinance and Amendments
- Land Development Services Letters to Industry
- County agency coordination
- May 2011 Virginia DCR adopted new State Stormwater Regulations
BMP Requirements

Bioretention.

Infiltration Trench

Bioretention.
• Meeting goals will take both county and homeowner LID retrofits.

• Challenges to make projects sustainable.
  – County has limited land rights in these older neighborhoods
  – Site feasibility
  – Maintenance responsibility
  – Cost: Benefit

• Partnerships, partnerships, partnerships
  – Neighborhood
  – Virginia DOT
  – Utilities
  – Development community
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Poster Session:
Indian Run: A Government and Community Partnership
Chad Crawford and Catherine Torgersen