Determining Optimal Sites for Bioswales in the Richmond Neighborhood, Portland, Oregon

Amy Goodwin and Dolores Weisbaum
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Impervious Surfaces

- Comprise large percent of urban surface areas
- Increase stormwater runoff
- Increase peak discharge
- Increase pollutant loading and transportation of sediments
- Increase temperature of outflow
Bioswales

- Landscape features designed to collect and partially treat stormwater runoff
- Bioretention of pollutants and sediment from stormwater by substrate and plants
- Mitigates pollutant loading
- Recharges groundwater

Project Overview

Drainage Analysis
- Neighborhood selected at random
- Richmond (southeast Portland)

Criteria for Site Selection
- Slope < 2 degrees
- Land cover consists of shrubs or dirt
- Areas with multiple drainage points

Model Validation
- Use existing bioswales
Methods

• ESRI ArcGIS 10.1
• Raster cell size: 3 x 3 ft
• Projection: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

<table>
<thead>
<tr>
<th>Data Layer</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Cover</td>
<td>Metro</td>
</tr>
<tr>
<td>Digital Elevation Model (DEM) Grid</td>
<td>Center for Spatial Analysis and Research</td>
</tr>
<tr>
<td>Buildings, Neighborhood, Taxlot, Orthophotos</td>
<td>RLIS</td>
</tr>
</tbody>
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Methods

• Manipulate DEM using the Con Tool and Raster Calculator
  • Added average building heights to DEM
  • Digitized sewer inlets using Portland Maps and orthophotos
    • Inlet = -100

• Drainage Line, Drainage Points, and Catchments
  • ArcHydro 10.1 Beta

• Site Selection
  • Weighted Overlay and Kernel Density
DEM Manipulation

Basic Deranged Terrain Processing Workflow

- DEM grid
- Sink Evaluation
- Sink Polygon
- Fill Sinks
- HydroDEM Grid
- Flow Direction with Sinks
- Flow Direction Grid
- Flow Accumulation
- Flow Accumulation Grid
- Stream Definition
- Stream Grid
- Stream Segmentation
- Stream Segmentation Grid
- Catchment Grid Delineation
- Catchment Grid
- Catchment Polygon Processing
- Catchment Polygon Grid
- Drainage Line Processing
- Drainage Line Grid
- Adjoint Catchment Processing
- Adjoint Catchment Grid
- Drainage Point Processing
- Drainage Point Processing Grid
- Longest Flow Path for Catchments
- Longest Flow Path Grid
Drainage Lines

Catchments and Longest Flow Path
Drainage Points

Site Selection

- **Kernel Density**
  - Density of drainage points

- **Weighted Overlay**
  - Slope, landcover, and longest flow path
  - Removed taxlots from above layers
Site Selection - Kernel Density

- Site Selection
- Kernel Density

Weighted Overlay

- Slope
- Land Cover
- Flow Path
- Dissolved Flow Path
- Feature to Raster
- Reclassify
- Reclassified Slope Raster
- Reclassified Land Cover Raster
- Reclassified Flow Path
- Weight Overlay

* Slope = 25%
Land Cover = 50%
Flow Path = 25%
Site Selection - Weighted Overlay

Model Validation

- Digitized bioswale inlet points and area
- Bioswale inlet points and polygons fell along longest flow path
- Bioswales located near areas with a high density of drainage points
Model Evaluation - Kernel Density

Model Evaluation - Weighted Overlay
Model Evaluation - Weighted Overlay

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Model Evaluation

- Weighted Overlay

- Model is fairly accurate in locating sites
  - Only 4 out of 50 bioswales did not fall along a flow path
  - Kernel density is a good way to identify sites
  - Weighted overlay was a weak indicator for a bioswale placement

- Areas for improvement
  - Watershed scale instead of neighborhood
  - Inlet layer from City of Portland
  - On-site validation

Conclusions
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Questions?