Quantifying Impervious Surface Baseline Credit through the use of GIS

A Countywide Analysis of Rooftop and Non-Rooftop Disconnection within Howard County, MD

Presenters

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Acknowledgements

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MS4 Permit Requirements

How to achieve 20% restoration requirement?

Treated Impervious

Total Countywide Impervious

20% Restoration Requirement

Untreated Impervious
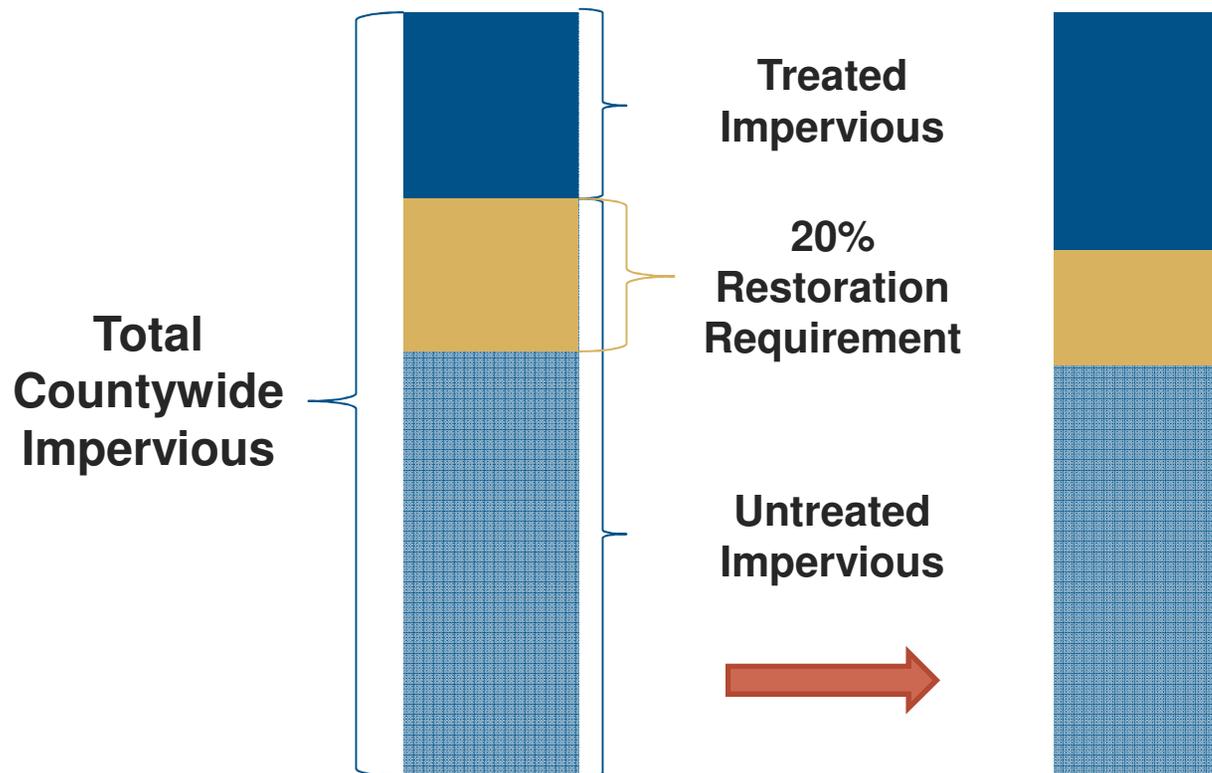
Project Background

MDE Accounting For Stormwater Wasteload Allocations (August 2014)

- A GIS desktop analysis may be used to identify areas that meet ESD requirements

- Field investigations to validate desktop analysis

- Submit analysis to MDE for approval

Types of ESD Practices

- **Rooftop Disconnection**
- **Non-Rooftop Disconnection**
- Sheetflow to Conservation Areas
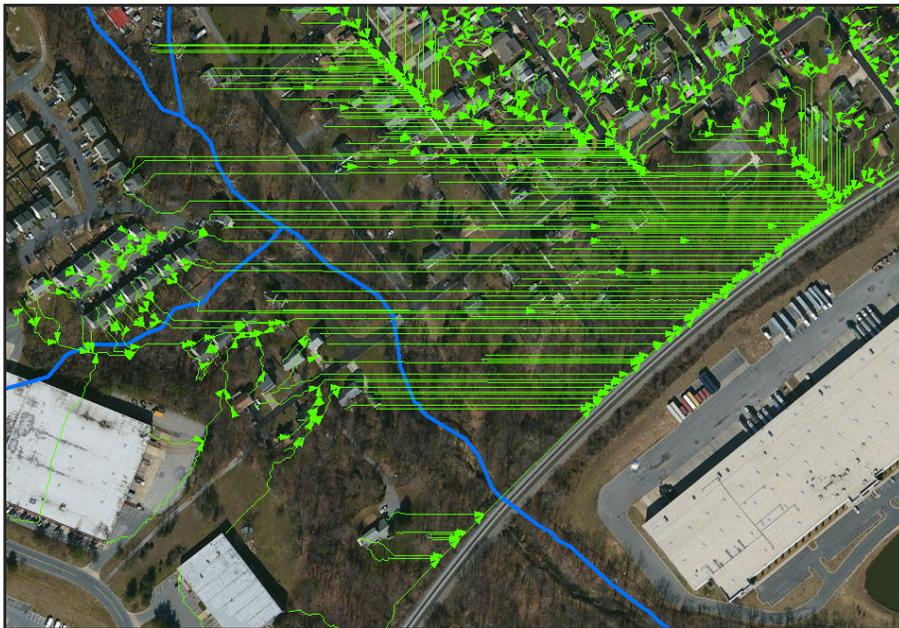- Grass Channels (Swales)

Available Data Layers

- Impervious Surfaces (Roads, Buildings, Driveways, etc.)
- High Resolution Digital Elevation Model (DEM)
- Property Boundaries
- Drainage Areas to Existing BMP Facilities

Derived Data Layers

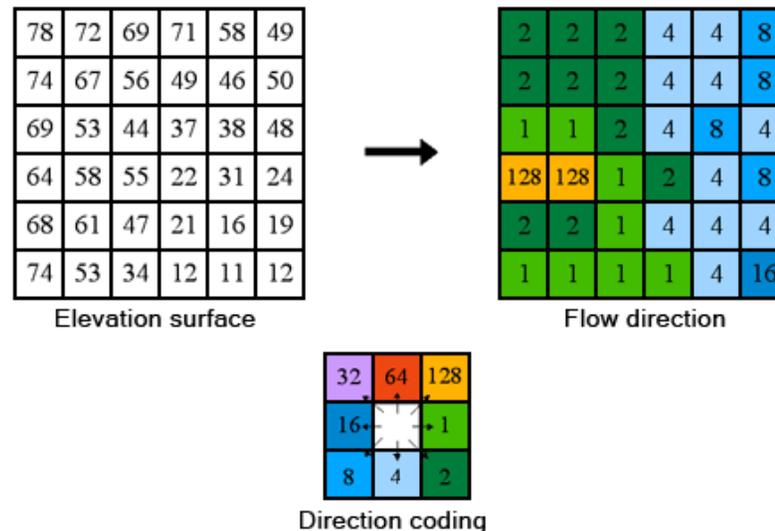# Digital Elevation Model Stream "Burn In"

Before

After

Derived Data Layers

Flow Direction Raster

- Determine flow from the DEM by steepest slope

Elevation surface

Flow direction

Direction coding

Rooftop Disconnect Analysis

MDE Stormwater Design Manual Criteria

- The length of the "disconnection" shall be 75' or greater.

- The entire vegetative "disconnection" shall be on an average slope of 5% or less.

- The contributing area of rooftop to each disconnected discharge shall be 500 square feet or less.

- In residential development applications, disconnections will only be credited for lot sizes greater than 6000 sq. ft.

Rooftop Disconnect Analysis

Criteria 1: The length of the "disconnection" shall be 75' or greater.

- The "disconnection" is from the point where storm water leaves the building's roof (a downspout) until it flows back onto another impervious surface.

Rooftop Disconnect Analysis

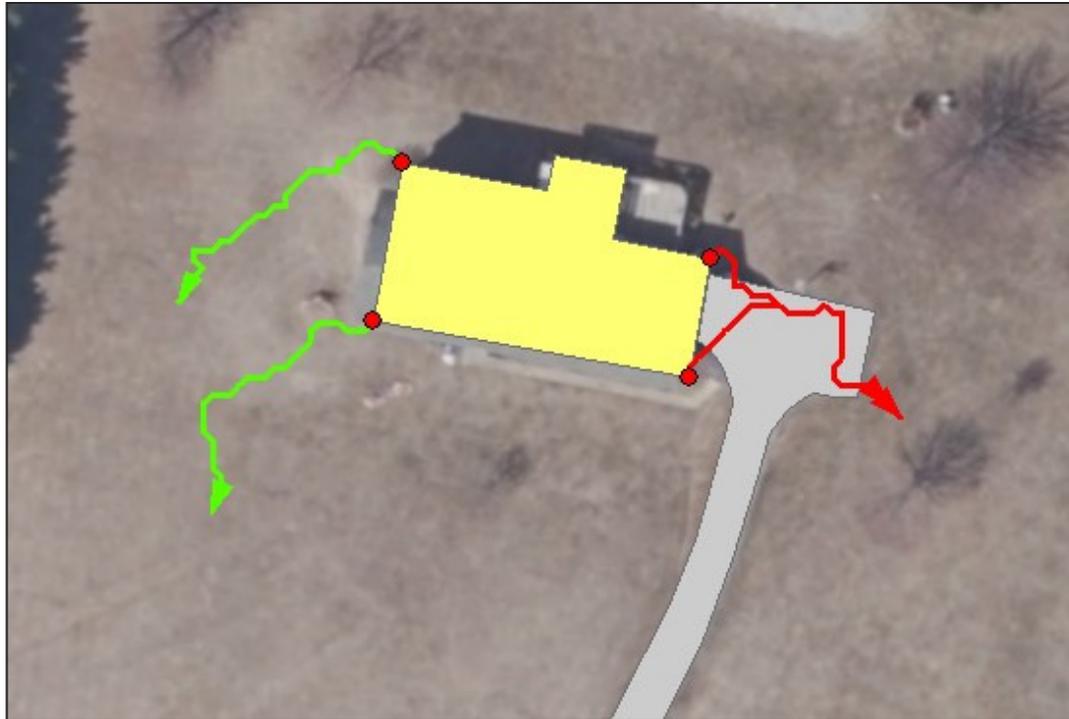**Downspout Locations (Assumption)**

- Create Minimum Bounding Rectangle (MBR) around building.

- Find nearest points on building geometry to the four corners of the MBR.

- Each downspout captures 25% of the building's surface area.
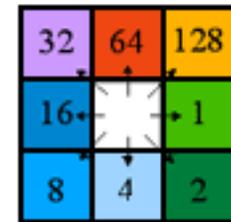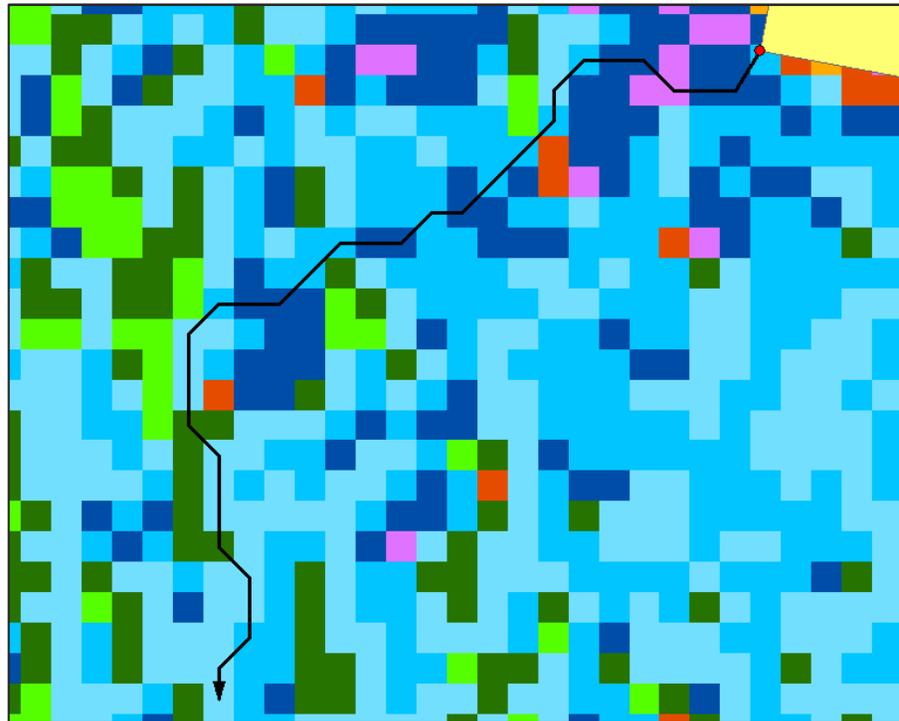
Rooftop Disconnect Analysis

Generate Flowpaths

- Generate flowpath from each downspout

Rooftop Disconnect Analysis

Flowpath Creation

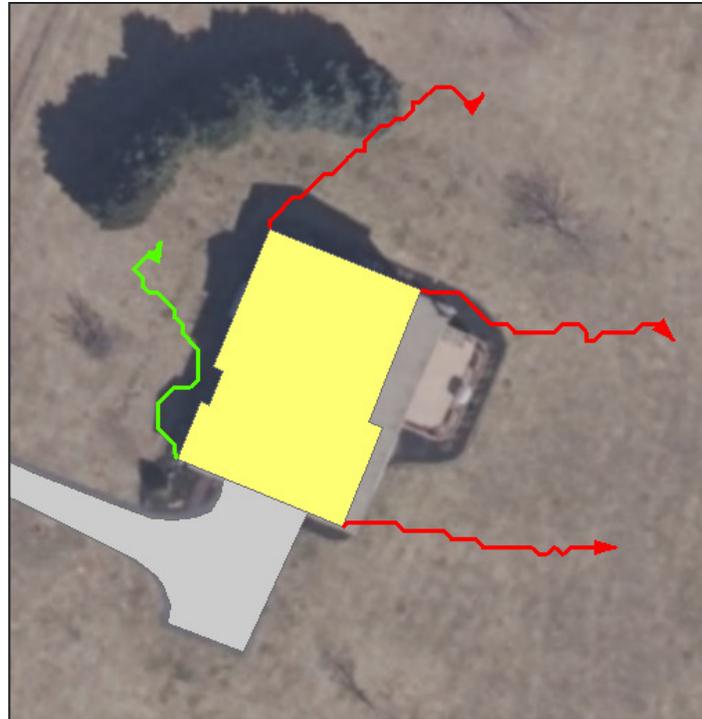- Generate new vertex for each pixel in Flow Direction raster

Direction coding

Rooftop Disconnect Analysis

Criteria 2: The entire vegetative "disconnection" shall be on an average slope of 5% or less.

- Calculate elevation at the beginning and end of each flowpath to determine overall flowpath slope.
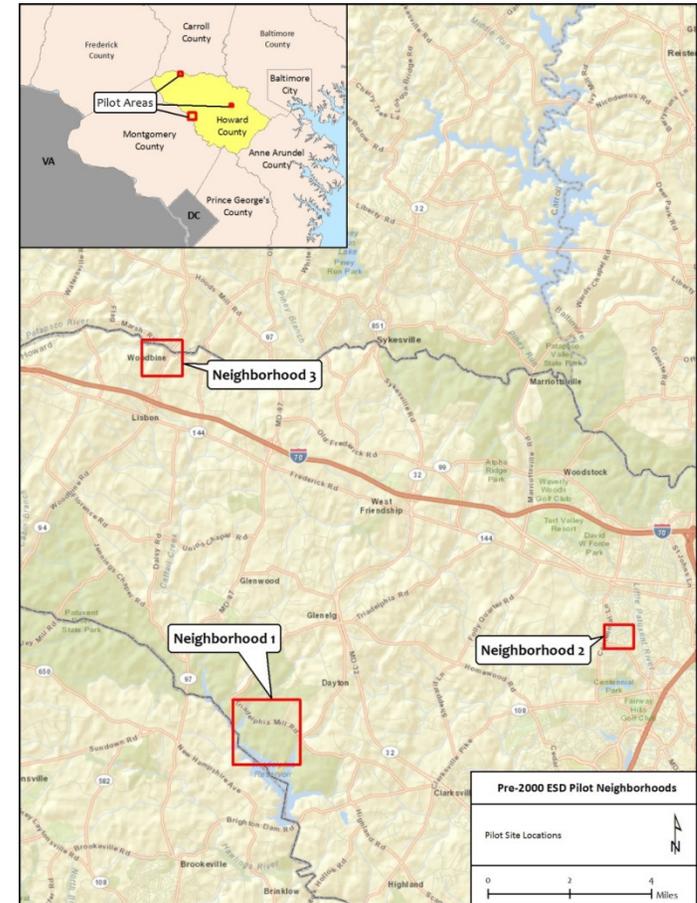
Rooftop Disconnect Analysis

Rooftop Disconnect Pilot Study and MDE Approval

- Pilot Study of three neighborhoods in Howard County
- Field verification of 10% of the evaluated buildings
- Joint MDE field review

Neighborhood	Desktop Analysis				Field Verification				
	Buildings Evaluated (Desktop)	Acres (Total)	Desktop Analysis Credit (Acres)	Post Field Verification Credit (Acres)	Buildings (Field Verified)	Acres	Desktop Analysis Credit (acres)	Post Field Verification Credit (acres)	Total Change
Neighborhood 1	102	5.34	2.07	2.06	22	1.66	0.56	0.55	-0.01
Neighborhood 2	68	2.9	0.53	0.52	16	0.69	0.27	0.26	-0.01
Neighborhood 3	43	1.81	0.27	0.29	15	1.14	0.19	0.21	0.02
Totals	213	10.05	2.87	2.87	53	3.48	1.02	1.02	0.00

Rooftop Disconnect Analysis

Countywide Automated Model Execution

- Filter countywide building layer to remove buildings less than 2,000 sq. ft. (Criteria 3)

- Filter countywide building layer to remove buildings on a parcels less than 6,000 sq. ft. (Criteria 4)

- Filter countywide building layer to remove buildings within the drainage area of an existing BMP facility.

- Generate downspouts for all buildings

- Generate and evaluate flowpaths from each downspout

Rooftop Disconnect Analysis

Countywide Results

Summary of Building Credit		
% Credit	**Analysis**	
0%	Number of buildings	30,848
	Acres of credit	-
1-25%	Number of buildings	16,757
	Acres of credit	170.54
26-50%	Number of buildings	8,143
	Acres of credit	146.57
51-75%	Number of buildings	1,606
	Acres of credit	49.92
76-100%	Number of buildings	127
	Acres of credit	6.09
Total Buildings Evaluated		**57,481**
Total Area of Evaluated Buildings (acres)		**2,676**
Total Credit Acres		**373**
Credit Percentage		**14%**

Non-Rooftop Disconnect Analysis

MDE Stormwater Design Manual Criteria

- The maximum contributing impervious flow path length shall be 75 feet.

- The length of the "disconnection" must be equal to or greater than the contributing length.

- The entire vegetative "disconnection" shall be on an average slope of 5% or less.

- The surface impervious area to any one discharge location cannot exceed 1,000 ft.

Non-Rooftop Disconnect Analysis

Example Area – Zoomed Out

- Typical rural residential area with long driveways and uncurbed 2-lane roadway.

Non-Rooftop Disconnect Analysis
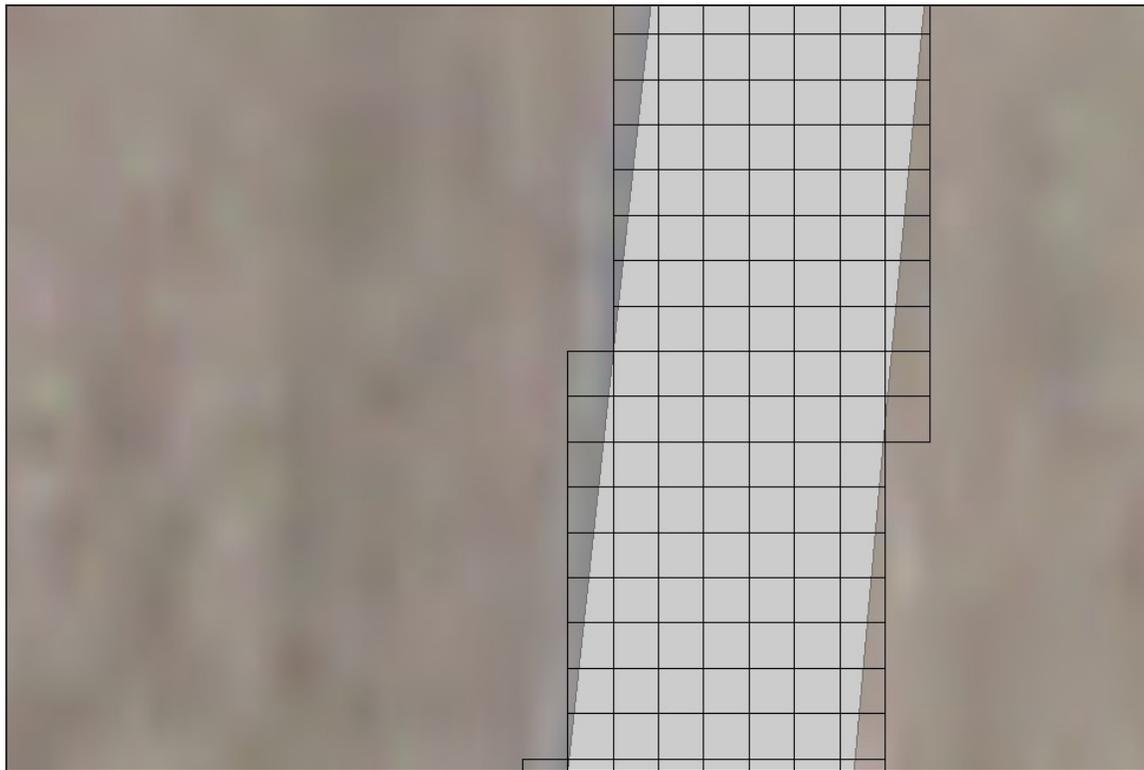
Example Area – Zoomed In

- 1 inch = 5 feet

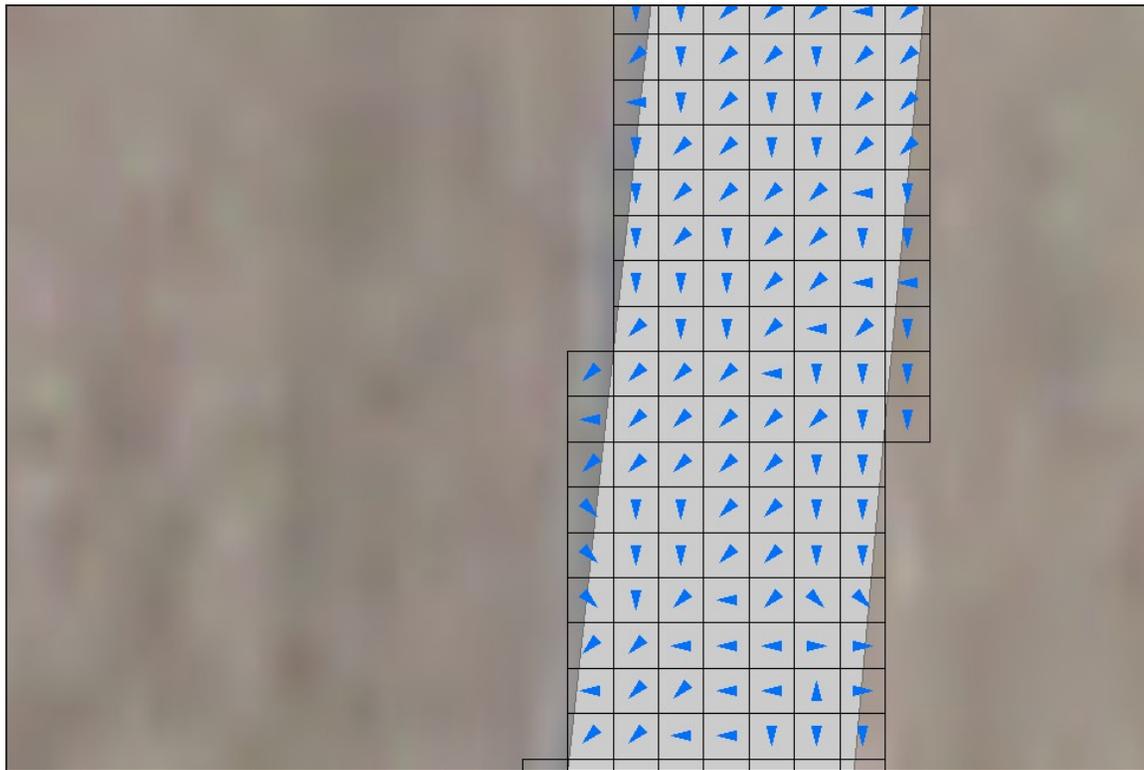# Non-Rooftop Disconnect Analysis

Cut Impervious Into 2' x 2' Tiles

- Same dimensions as the Flow Direction raster pixels

Non-Rooftop Disconnect Analysis

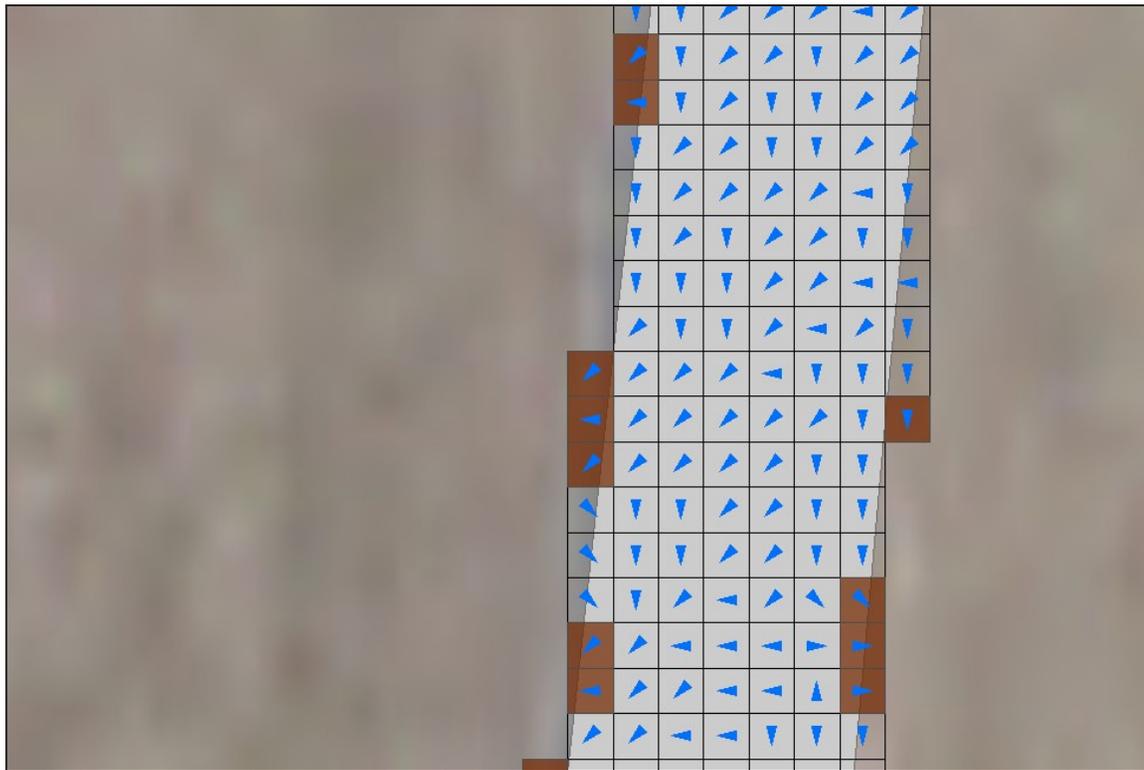## Determine Flow Direction Between Tiles

- Use the Flow Direction raster to determine flow direction for each tile

Non-Rooftop Disconnect Analysis
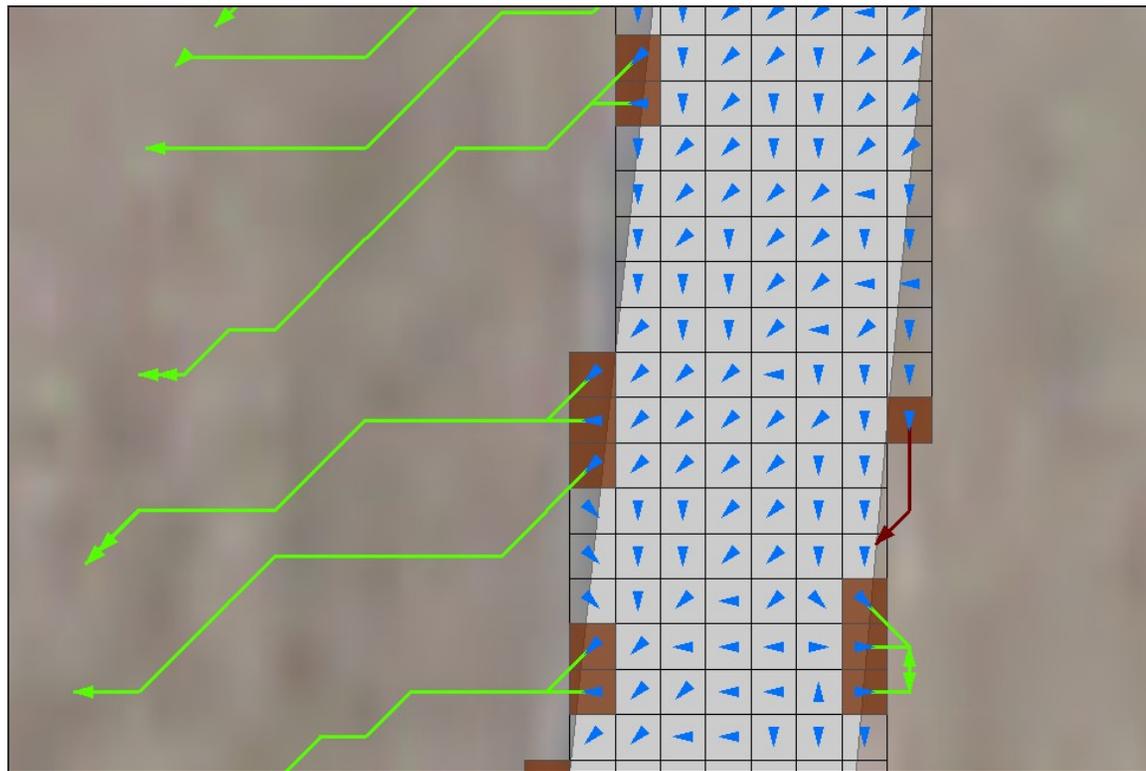
Determine Discharge Points

- Tiles where flow leaves the impervious surface

Non-Rooftop Disconnect Analysis

Generate Flowpaths from the Discharge Points

- Use the Flow Direction raster to determine flowpaths

Non-Rooftop Disconnect Analysis

Evaluate Each Flowpath for Credit

- Generate a 75' flowpath from the discharge point.

- Determine if that flowpath crosses another impervious surface before 75'. If so, cut the flowpath at that point. Determine new flowpath length.

- Evaluate slope of the flowpath. If too steep, determine if any distance along the flowpath is under 5% slope and cut the line there.

MDE Criteria
- The maximum contributing impervious flow path length shall be 75 feet.
- The length of the "disconnection" must be equal to or greater than the contributing length.
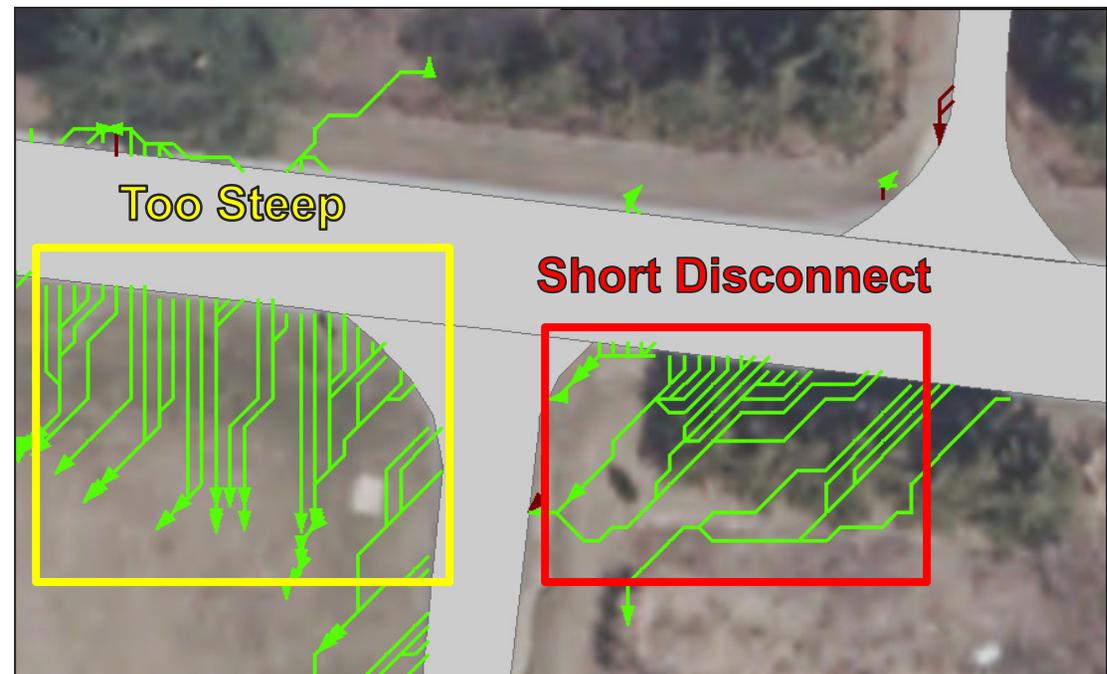
Non-Rooftop Disconnect Analysis

Determining Credit

- Grab all tiles that flow to the discharge point whose distance from the discharge point is less than or equal to the length of the flowpath.

- Limit credited area to any discharge point to 1000 sq. ft. maximum.
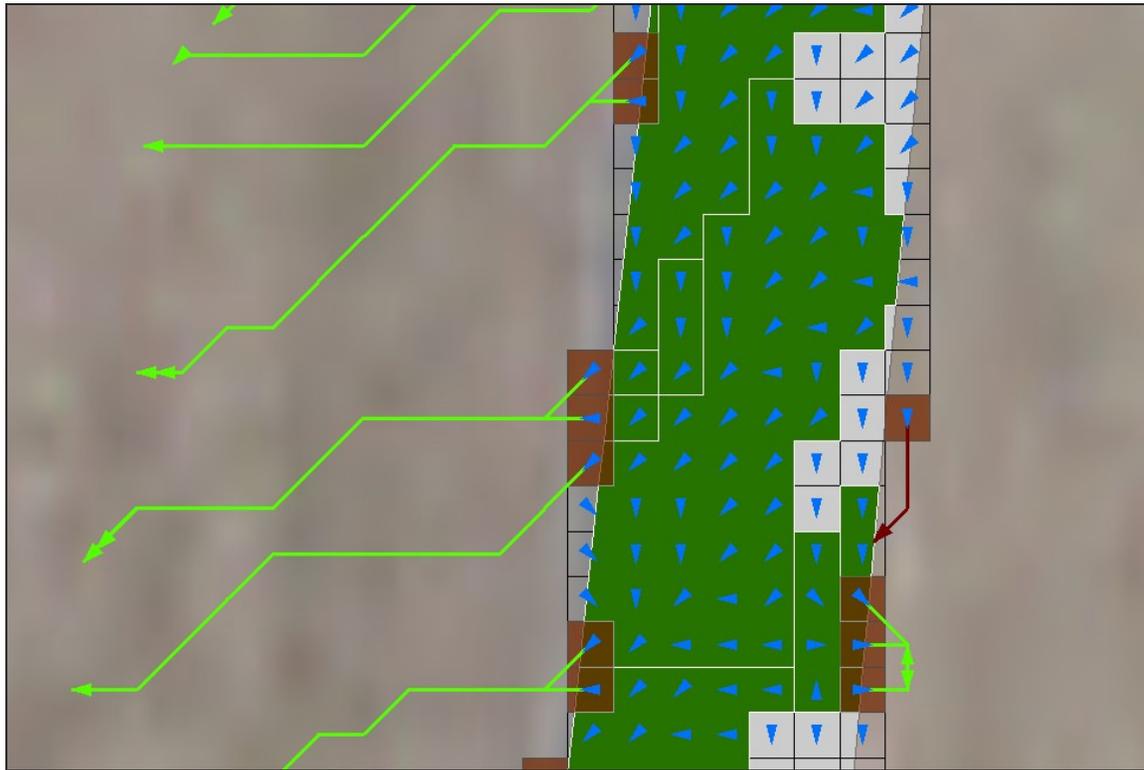
Non-Rooftop Disconnect Analysis

Curbed Areas

- Countywide curb layer was developed.
- No flowpaths generated from discharge points that touch a curb.
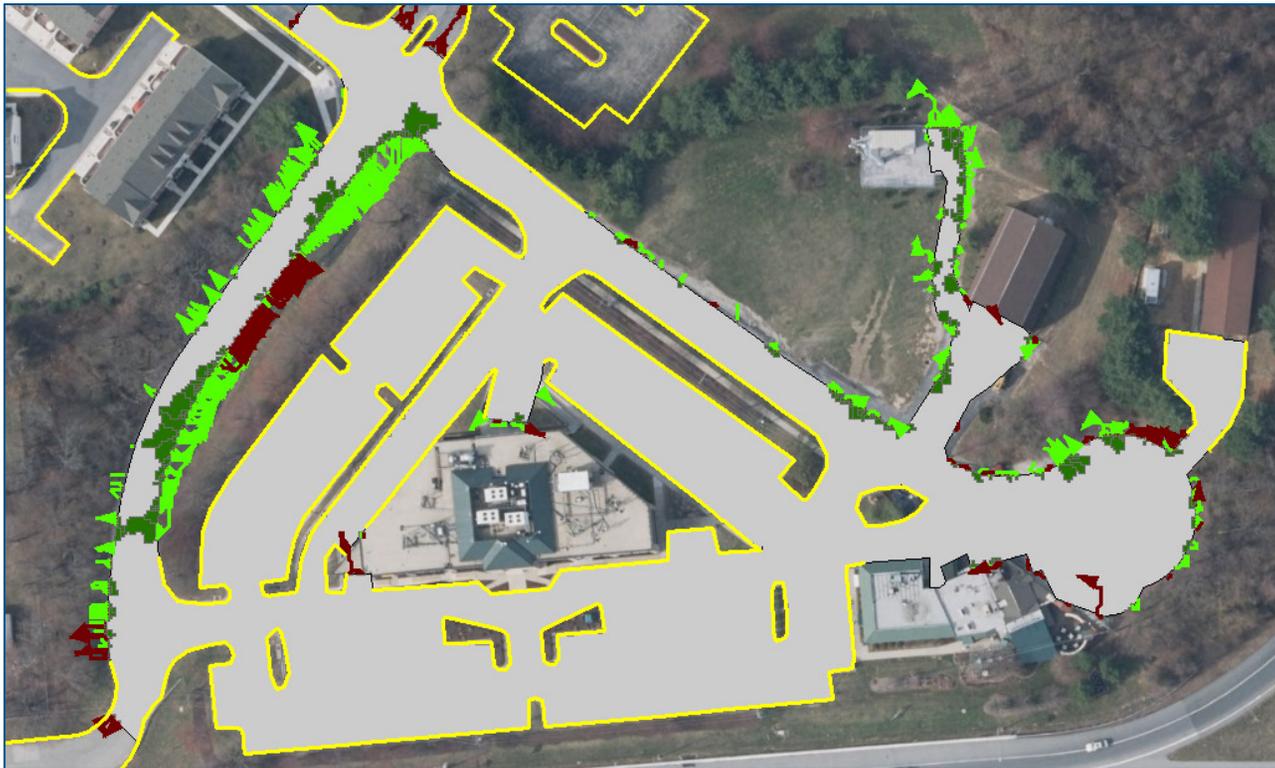
Non-Rooftop Disconnect Analysis

Draft Results

- 14,000 acres of roads, driveways, and parking lots within the County.

- 9,000 of these acres are currently untreated by existing BMPs.

- Model processing to date shows ~8% credit.

- Projected countywide credit is ~700 acres.

Results Summary

Rooftop Disconnect Credit	373
Non-Rooftop Disconnect Credit	700
Total Amount Now Treated	1073
Reduction of 20% Restoration Goal	215

Questions?