NGI
NORTHERN GULF INSTITUTE

Developing a Tool for Assessing Cost Effective Best Management Practices for Resilient Communities

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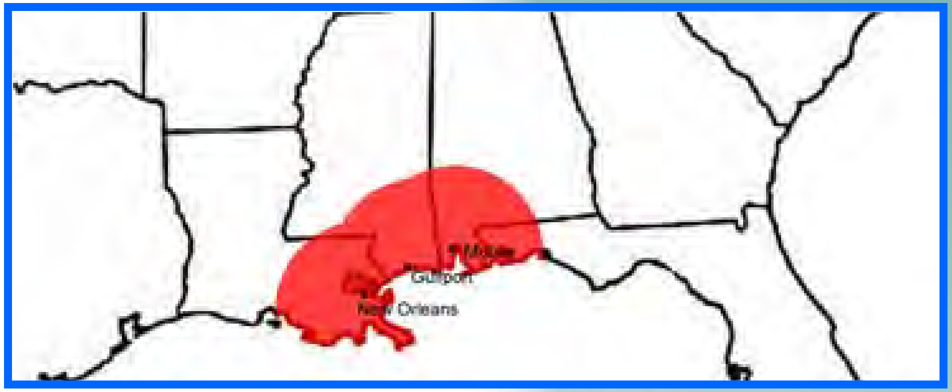
2011 NGI Proposal Objectives

- Objective 1 - Refine LIDIA Spreadsheet Interface
  - o Initial work funded from other sources
  - o Concept generated from a 2008 survey
- Objective 2 - Select Spatial Model for Linking with DB
  - o Primary choice was a public domain package
- Objective 3 -Test Linkage
- Objective 4 -Test product on an existing site

Origins

- Question: If A user-friendly site planning tool can be designed to effectively simulate pre- and post-development runoff, calculate pollutant loading rates in runoff, propose BMP/LID stormwater solutions, and compute costs of implementing such strategies for sites located in the southeastern U.S. would you use it?
- Approach: On-line survey
- Implemented: Summer 2008



Source: Austin Moore

- Survey targeted a portion of NGI region
- Distributed twice via e-mail
- Civil Engineers, Landscape Architects, Planners
- Approximately 1,200 recipients
- 141 responses received
- Results positive

Survey Results

25. If an all-inclusive, user-friendly model was available for assessing site plans that was capable of - calculating pre- and post-development runoff, - calculating pollutant loading rates, - proposing BMP/LID stormwater solutions, and - computing cost components of implementing such strategies, what is the likelihood that you would use such a model to consider these alternatives in designing stormwater solutions?

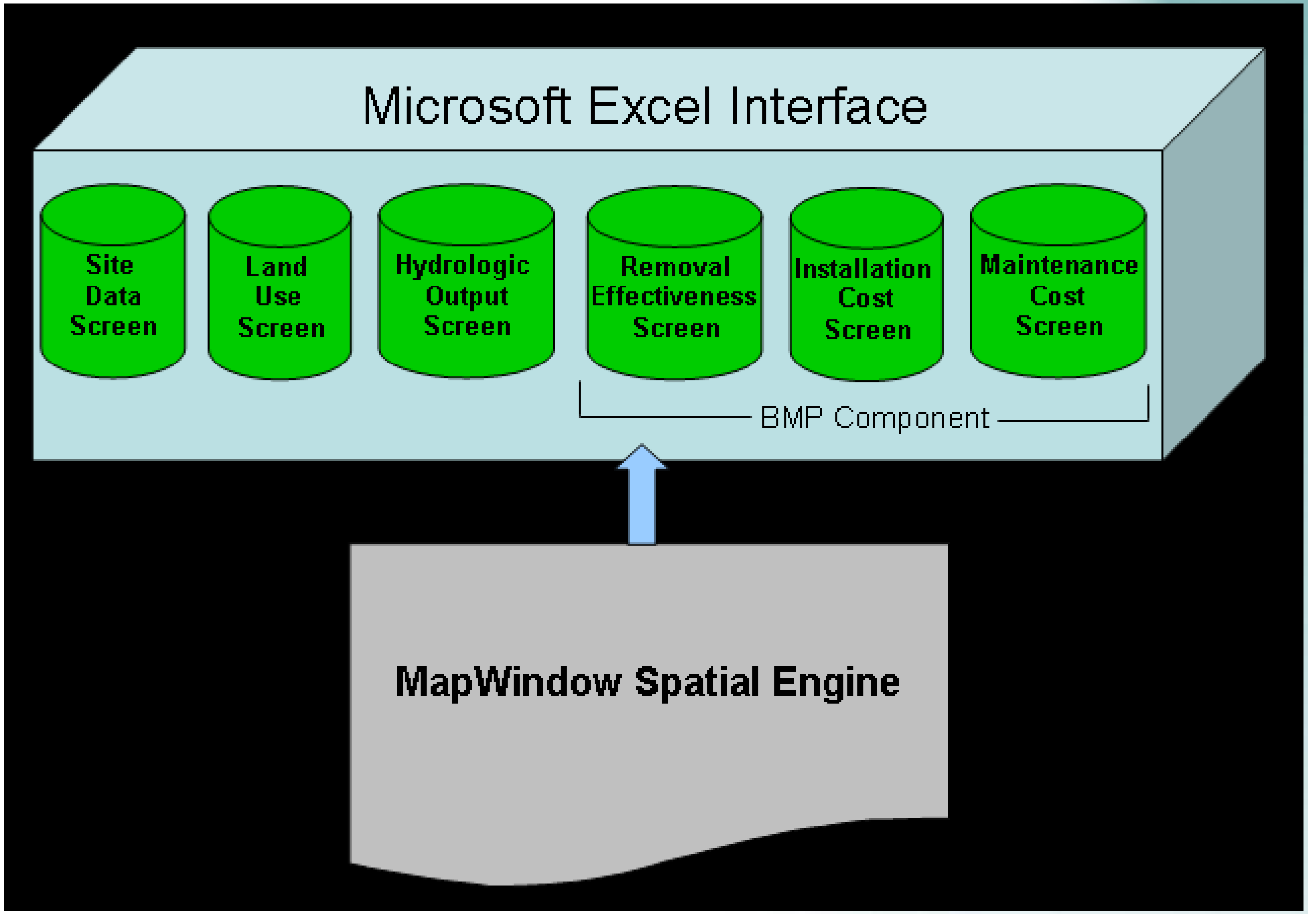
	Response Percent	Response Count
Certain	37.5%	42
Likely	31.3%	35
Possible	20.5%	23
Not likely	5.4%	6
Would not use	5.4%	6
	Comment	8
	answered question	112
	skipped question	29

89.3%

Source: Austin Moore

The LIDIA Concept

Low Impact Development Implementation Assessment

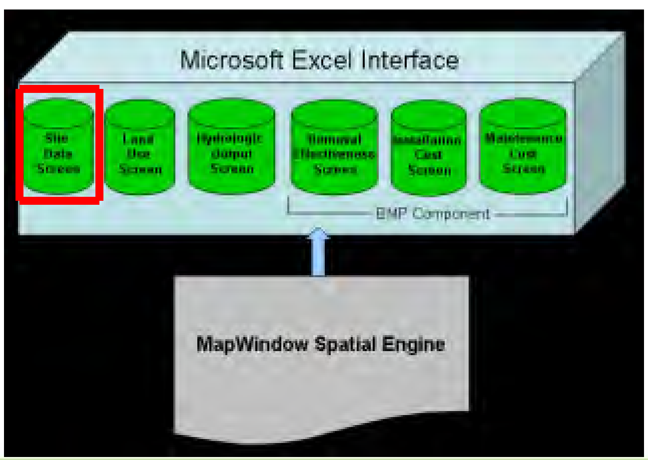


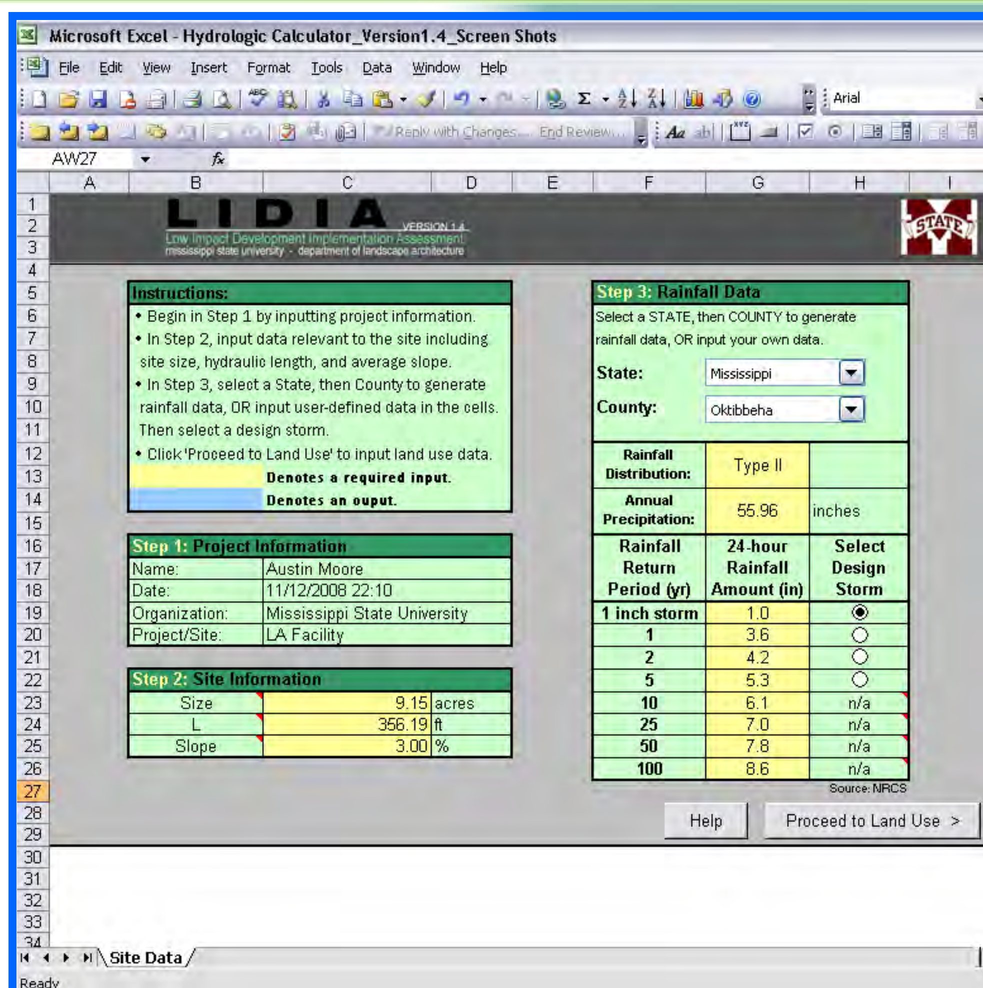
Source: Austin Moore

Initial LIDIA Screens-Site Data

Step One…

- Site Data input:
  - Project information
  - Site parameters
    - Size (acres)
    - Hydraulic Length (ft)
    - Slope (%)
  - Precipitation data
  - Design Storm Selection



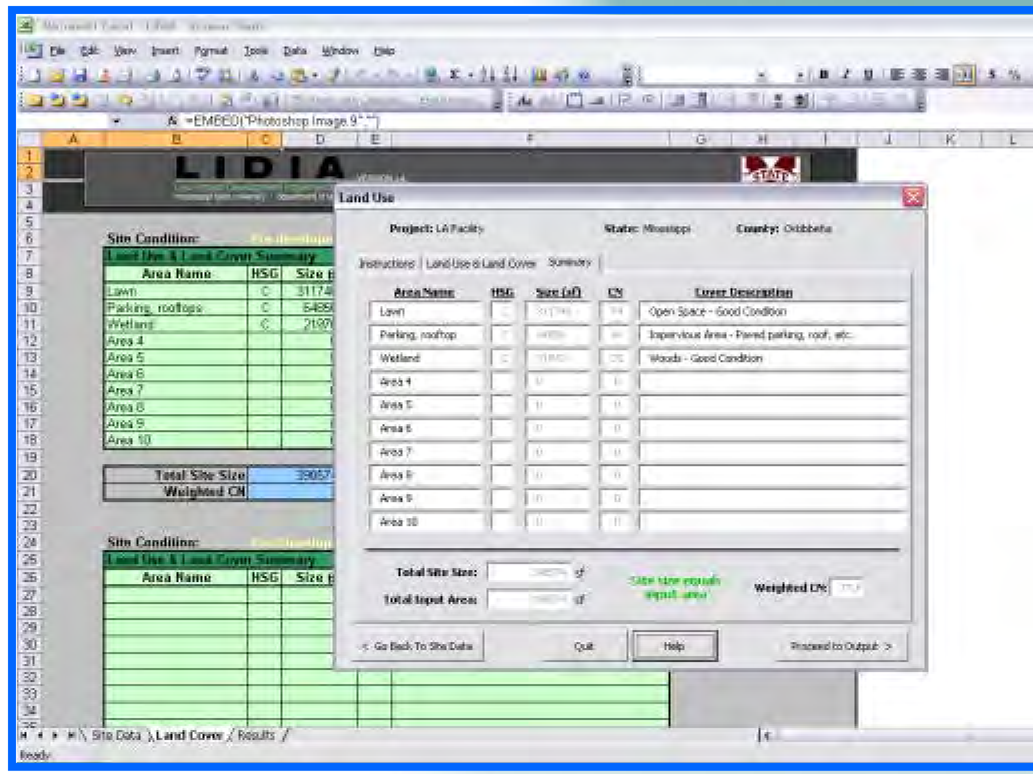


Source: Austin Moore

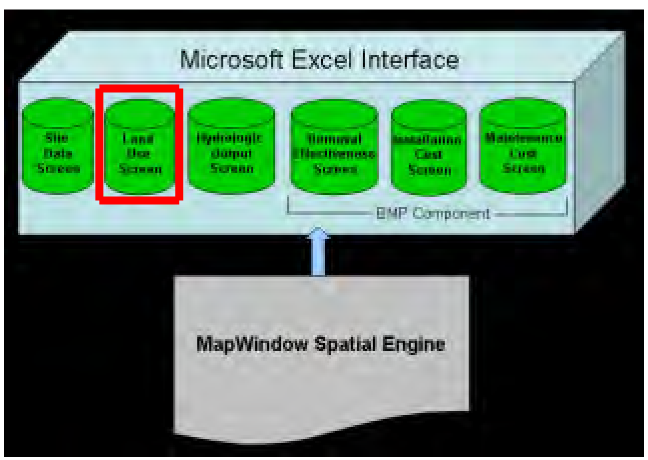
Land Use Screen

Step Two…

- Land Use/Land Cover Characterization:
  - Cover Type
  - Hydrologic Soil Group
  - Area size (ft²)
- Weighted CN generated
- Computations made via SCS Runoff CN method (USDA, 1986)



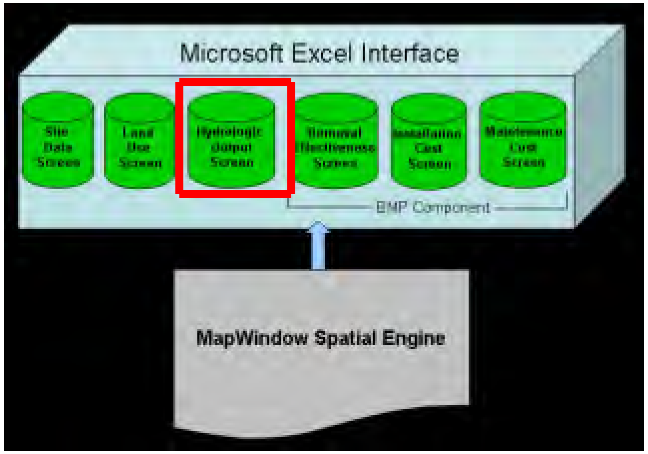
Source: Austin Moore

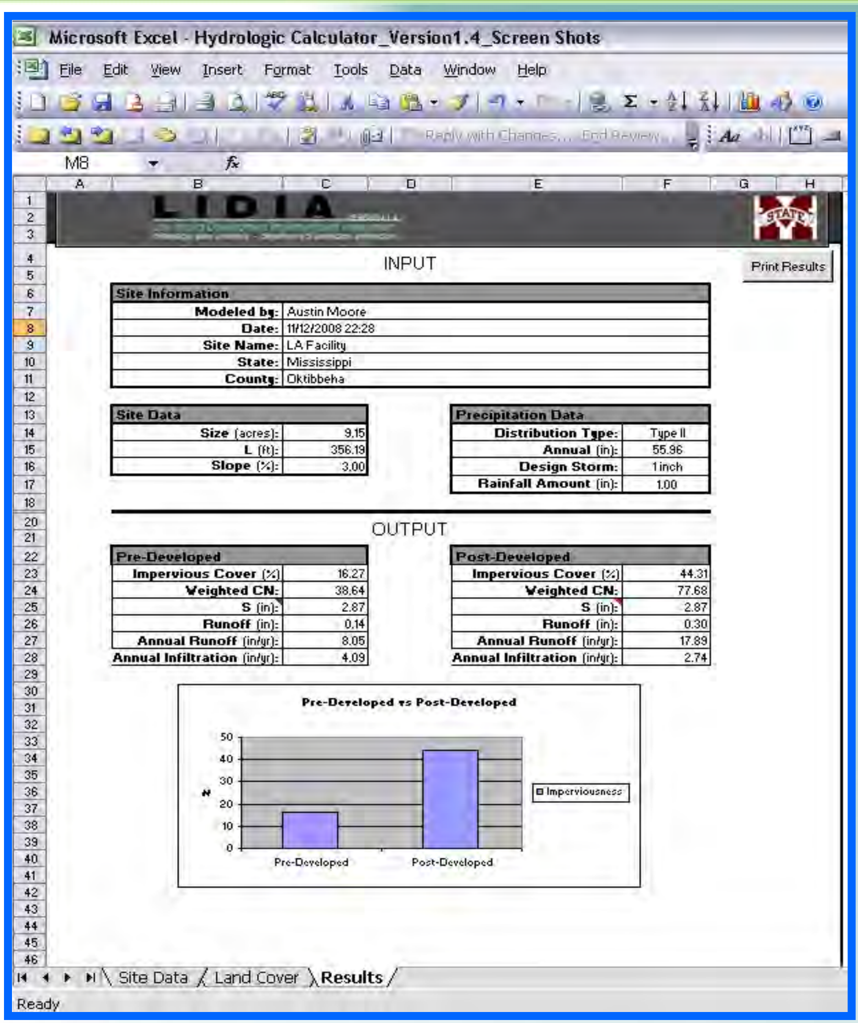


Hydrologic Calculations

Step Three…

- Pre-developed versus post-developed conditions
- Storm event:
  - Runoff volumes
  - Peak flows
  - Hydrographs
- Annual runoff and infiltration amounts





Source: Austin Moore

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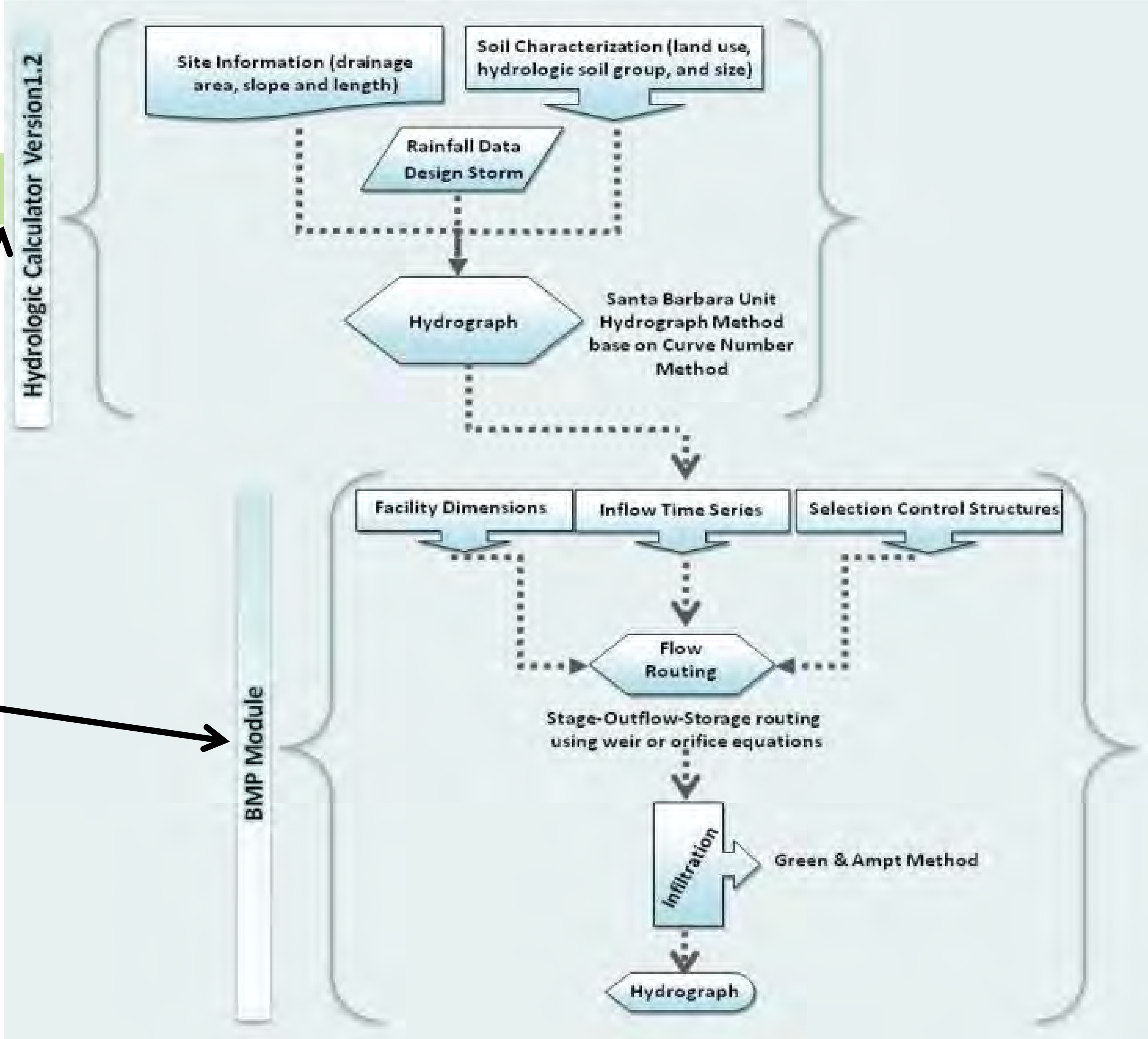
LIDIA 2011 Hydrological Components

1. **Upland Catchment**
2. **Receiving BMP Facility**



LIDIA 2011Hydrological Components

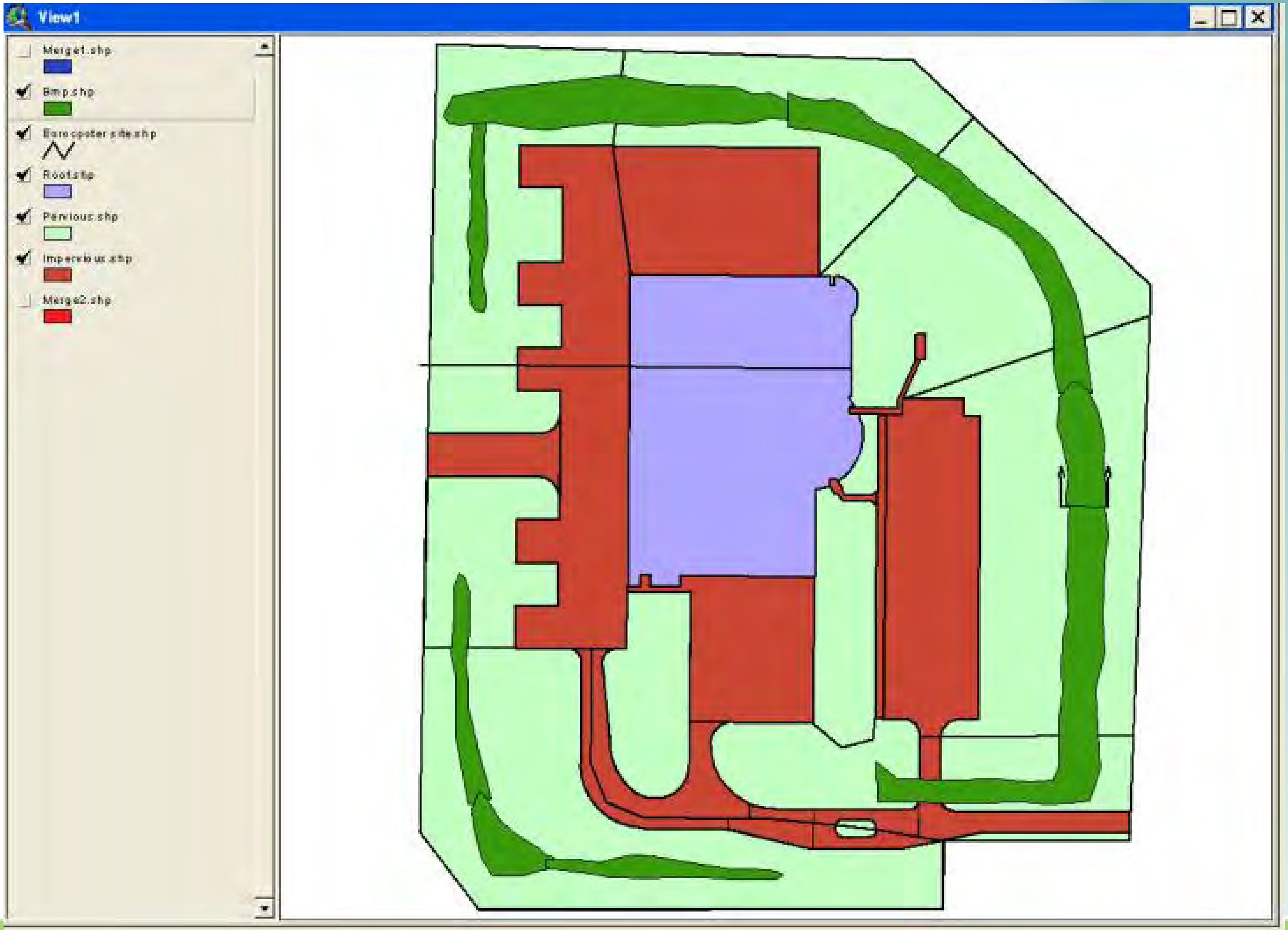
- Upland Catchment
  - o Computes runoff at different time steps.
- Receiving BMP Facility
  - o Estimates flow routing, water infiltration losses, and output hydrograph.
  - o User can select design storms in 10 minute intervals.
  - o Calculations done using Santa Barbara Urban Hydrograph which is based on SCS curve number approach.
  - o Water infiltration based on Green & Ampt method.

Graphical Interface

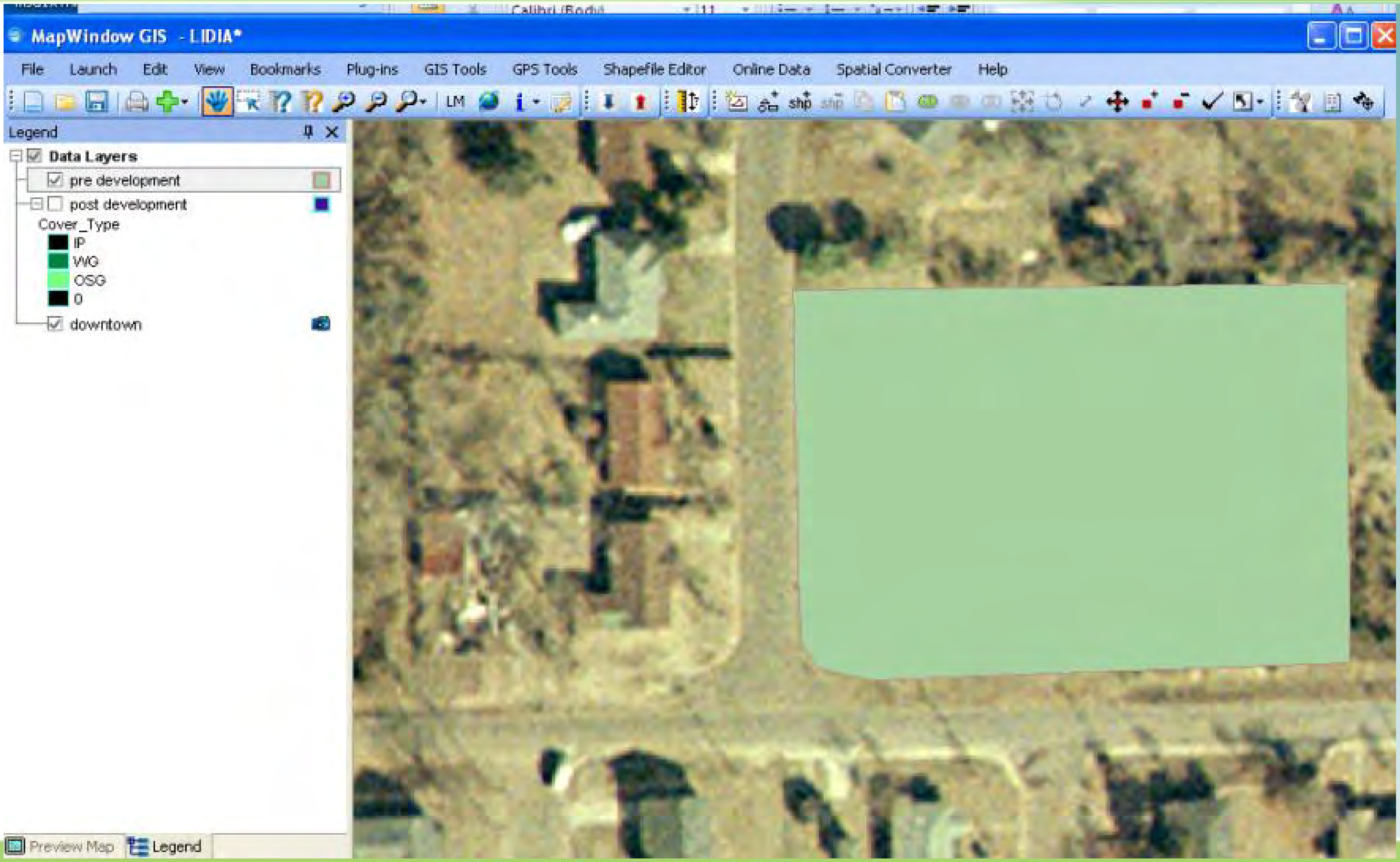
MapWindows™ v.4.8.1

- MapWinGIS ActiveX Control
  - Open Source Component
  - Complete GIS API for Shapefile and Grid Data
  - Built in GIS features

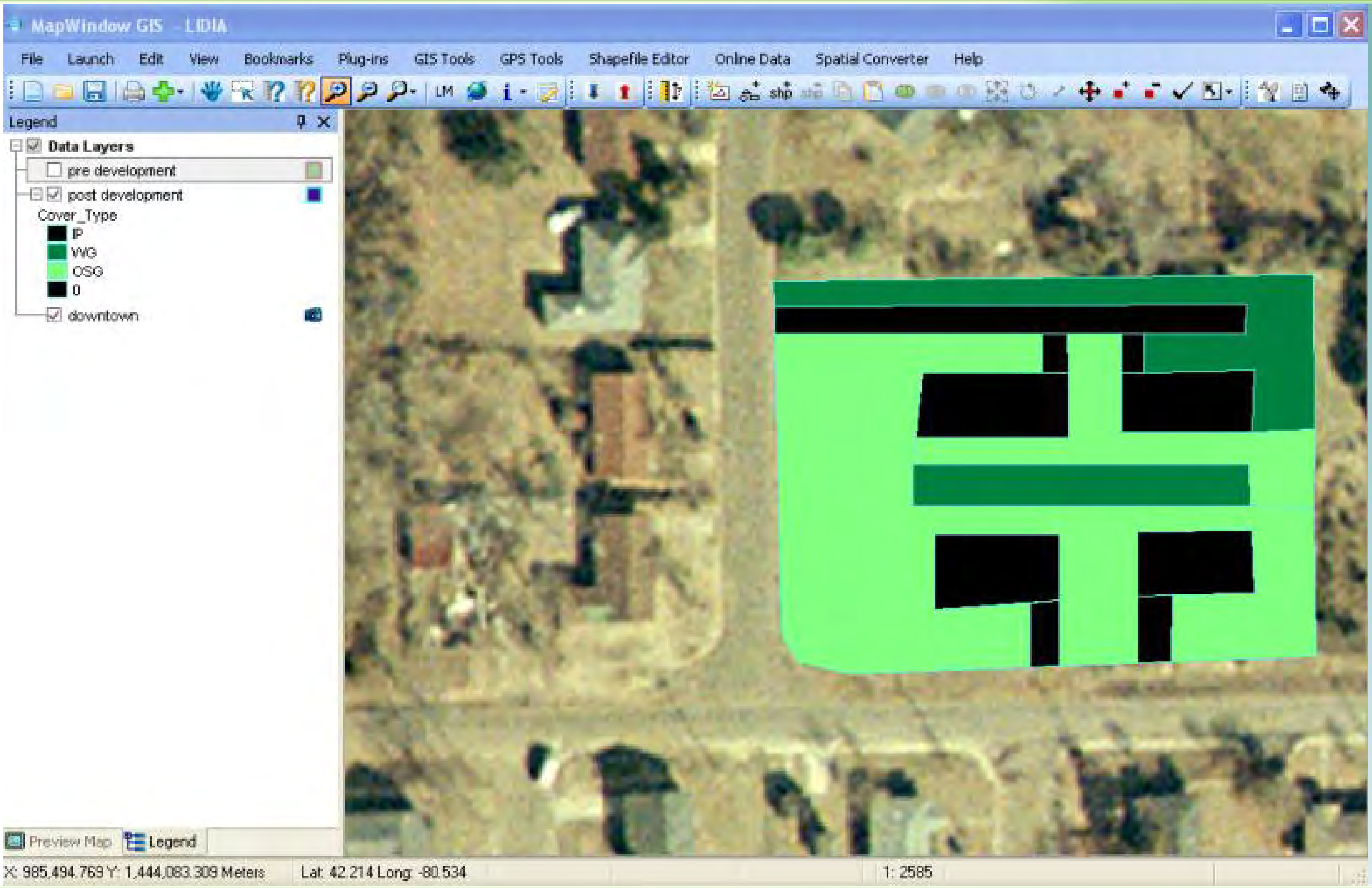
ArcView™ Interface



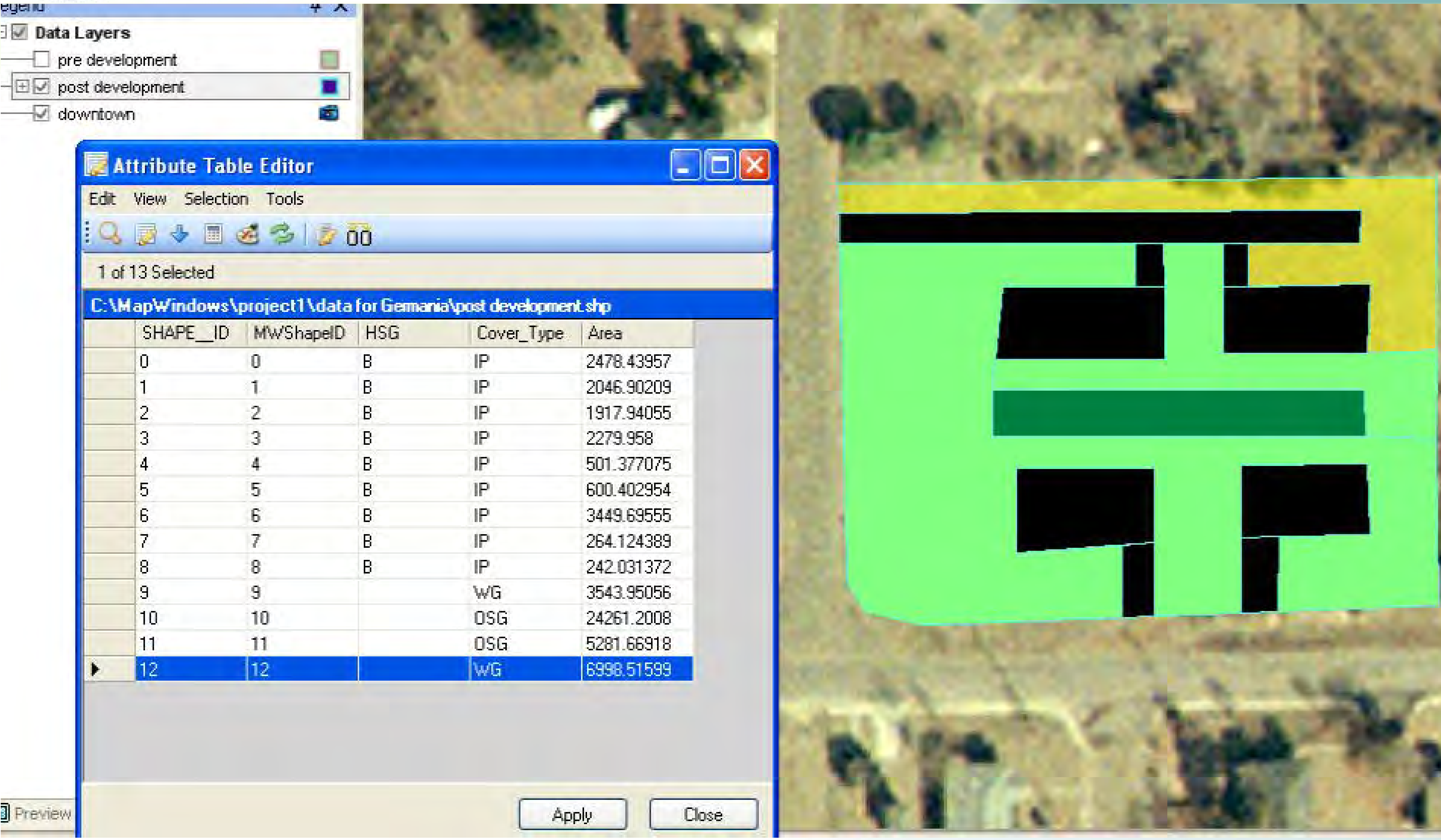
MapWindow™ Interface
Pre Development



MapWindow™ Interface
Post Development

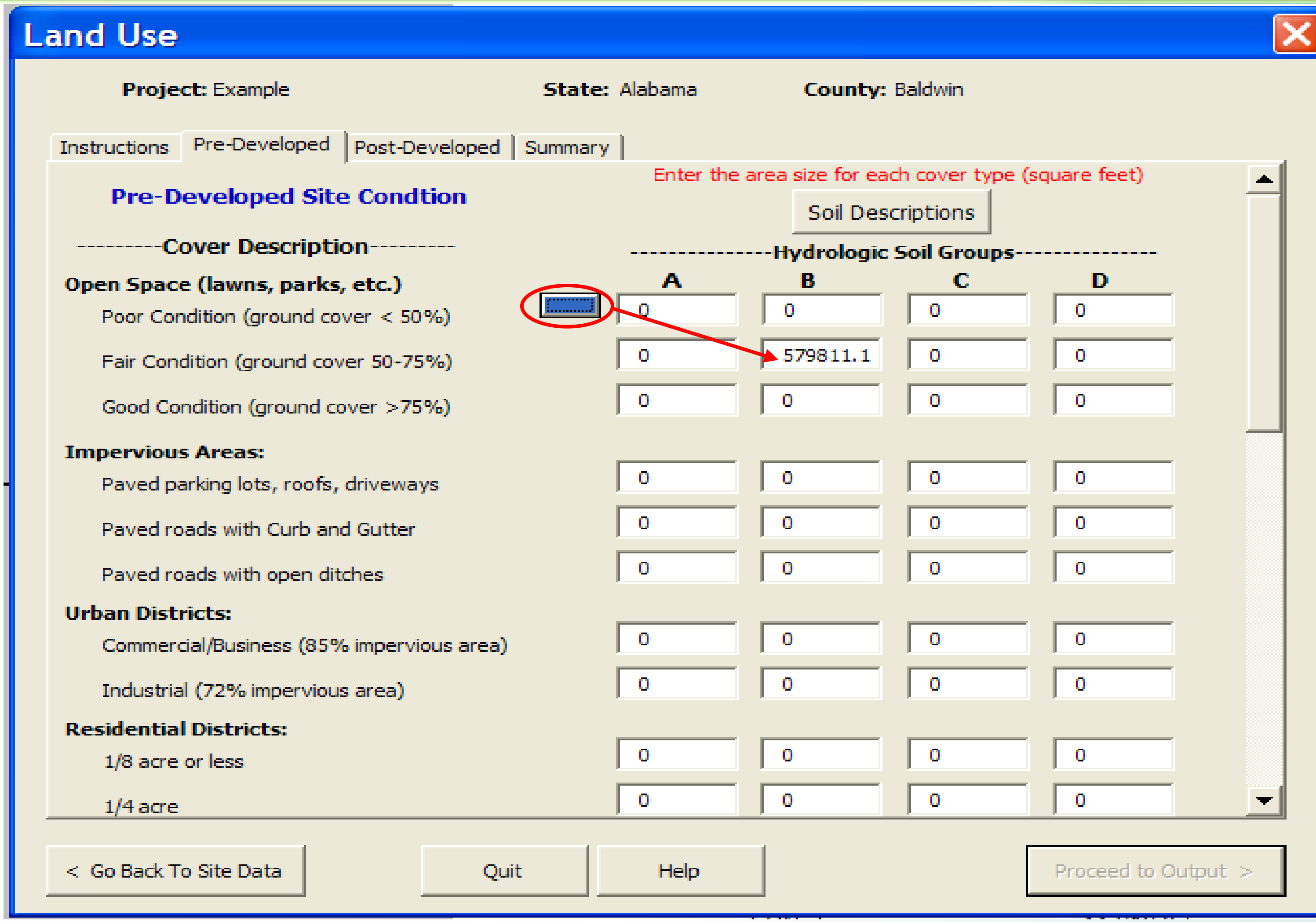


Database Structure



SHAPE__ID	MWShapeID	HSG	Cover_Type	Area
0	0	B	IP	2478.43957
1	1	B	IP	2046.90209
2	2	B	IP	1917.94055
3	3	B	IP	2279.958
4	4	B	IP	501.377075
5	5	B	IP	600.402954
6	6	B	IP	3449.69555
7	7	B	IP	264.124389
8	8	B	IP	242.031372
9	9		WG	3543.95056
10	10		OSG	24261.2008
11	11		OSG	5281.66918
12	12		WG	6998.51599

Land Use Summary



Land Use/Land Cover Sheet

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Hydrologic Calculator
Version 1.2

Developer: Austin Moore
Date: August 2008
For: Department of Landscape Architecture

STATE

Site Condition: Pre-developed

Land Use & Land Cover Summary				
Area Name	**HSG**	**Size (sf)**	**CN**	**Cover Description**
Area 1	B	579811.10	69	Open Space - Fair Condition
Area 2		0.00	0	
Area 3		0.00	0	
Area 4		0.00	0	
Area 5		0.00	0	
Area 6		0.00	0	
Area 7		0.00	0	
Area 8		0.00	0	
Area 9		0.00	0	
Area 10		0.00	0	

Total Site Size	579811.10	sf
Weighted CN	69.0	

	Pervious	**Impervious**
Area	13.31	0.00
CN	69.0	98.0
S	4.493	0.204
I_a	0.899	0.041

Site Condition: Post-Developed

Land Use & Land Cover Summary				
Area Name	**HSG**	**Size (sf)**	**CN**	**Cover Description**
Area 1	B	317996.80	61	Open Space - Good Condition
Area 2	B	148336.10	98	Impervious Area - Paved parking, roof, etc.
Area 3	B	113478.20	55	Woods - Good Condition
Area 4		0.00	0	
Area 5		0.00	0	
Area 6		0.00	0	
Area 7		0.00	0	
Area 8		0.00	0	
Area 9		0.00	0	
Area 10		0.00	0	

Total Site Size	579811.10	sf
Weighted CN	69.3	

	Pervious	**Impervious**
Area	9.91	3.41
CN	44.2	25.1
S	12.614	29.885
I_a	2.523	5.977

Proceed to Hydrographs >

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Post Developed Sheet

Hydrologic Calculator
Version 1.2

Post-Developed Hydrograph

Developer: Austin Moore
Date: August 2008
For: Department of Landscape Page: 2 of 3

Location:	Alabama
	Baldwin
Storm Type:	Type III
Storm Event:	1-yr, 24-hr
Total Area	13.31 acres
P	4.80 in
dt	10 min

Tt	14.03 minutes
Tc	14.03 minutes
w	0.26

Peak Q	12.747 cfs

	Pervious	Impervious	
Area	9.91	3.41	acres
CN	44.2	25.1	
S	12.61	29.89	
I_a	2.52	5.98	

					PERVIOUS		IMPERVIOUS				
Time Increment	Time (minute)	Rainfall Distrib. (fraction)	Increm. Rainfall (inches)	Accum. Rainfall (inches)	Accum. Runoff (inches)	Increm. Runoff (inches)	Accum. Runoff (inches)	Increm. Runoff (inches)	Total Runoff (inches)	Instant Flowrate (cfs)	Design Flowrate (cfs)
1	0	0	0.000	0.000	0.000	0	0.000	0	0	0	0
2	10	0.00167	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	20	0.00167	0.008	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	30	0.00167	0.008	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	40	0.00167	0.008	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	50	0.00167	0.008	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	60	0.00167	0.008	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	70	0.00167	0.008	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	80	0.00167	0.008	0.064	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	90	0.00167	0.008	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	100	0.00167	0.008	0.080	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	110	0.00167	0.008	0.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	120	0.00167	0.008	0.096	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	130	0.00173	0.008	0.104	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	140	0.00173	0.008	0.113	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	150	0.00173	0.008	0.121	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	160	0.00185	0.009	0.130	0.000	0.000	0.000	0.000	0.000	0.000	0.000

BMP Design Module

Project Information	
Name:	Germania Salazar
Date:	4/16/2010 9:31
Organization:	MSU
Project/Site:	

General Storage Design Procedure		
Maximum Depth	5.00	ft
Bottom Width	20.00	ft
Length	100.00	ft
Side Slope (H:V)	2.00	ft/ft

Consider Underdrain Outlet

Orifice Diameter	6.00	(inches)
Discharge Coeficient	0.61	(ft)

Weir configuration

Sharp-Crested Weir

Weir Crest Width	10.00	(ft)
Weir Invert	0.50	(ft)
Discharge Coefficient		

Broad-Crested Weir

Weir Crest Width	20.00	(ft)
Weir Invert	0.50	(ft)
Discharge coefficient	3.09	

V-Notch

Vertex angle	90.00	(deg)
Weir Invert	0.50	
Discharge Coeficient	0.58	

Select Soil Type

- Sand
- Loamy Sand
- Sandy Loam
- Loam
- Silt Loam
- Sandy Clay Loam

Green & Ampt Method

Initial Water Content	0.30	
Underlying Soil Depth	7.00	ft
Hydraulic conductivity	0.27	in/hr
Average Suction Head	6.57	in
Effective Porosity	0.486	

Calculate Outflow

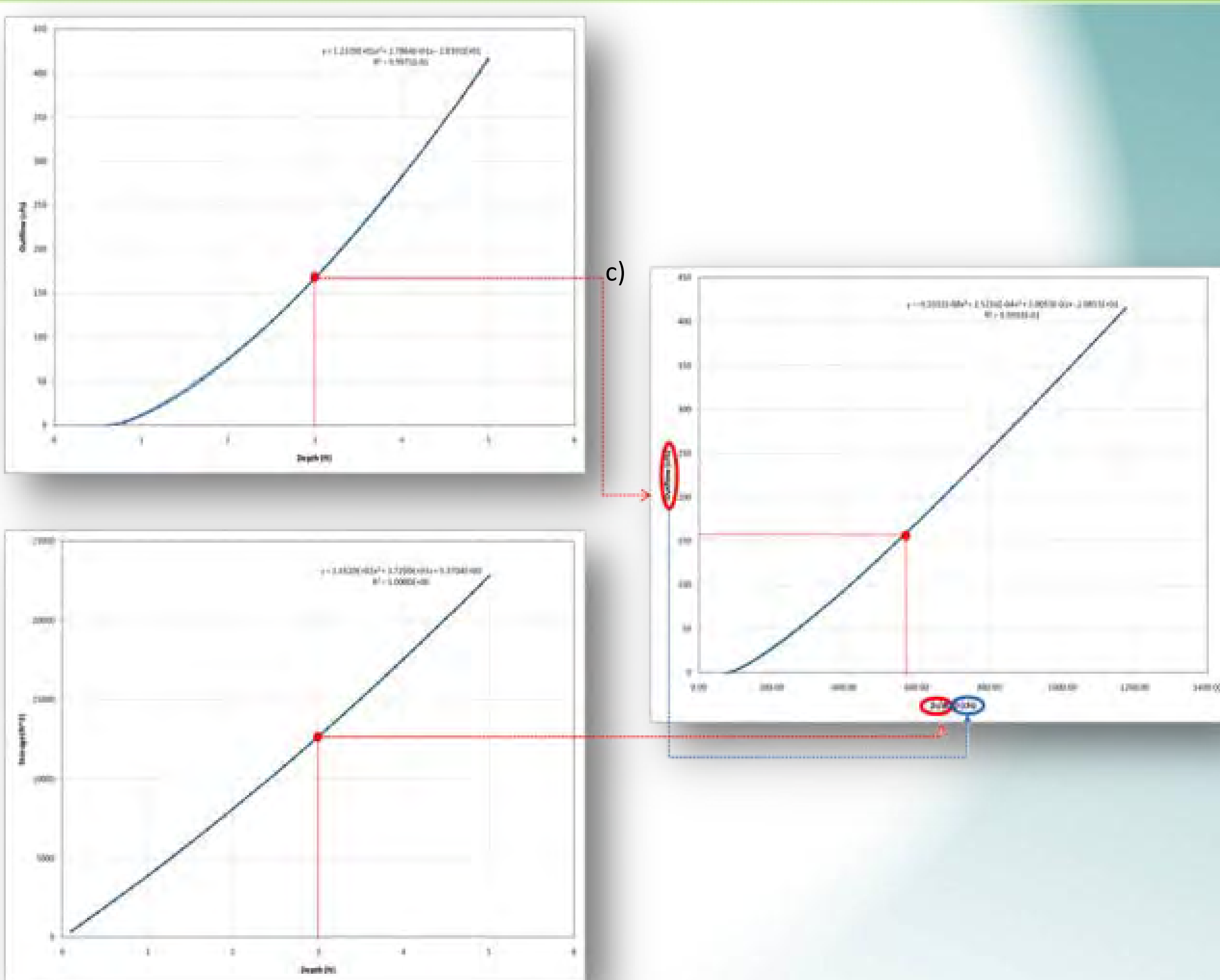
Calculate Infiltration

Storage Outflow Function

a)

b)

c)



Results

Hydrologic Calculator

Version 1.2

Developer: Austin Moore
Date: August 2008
For: Department of Landscape Architecture

INPUT

Site Information	
Modeled by:	Austin Moore
Date:	11/5/2010 10:55
Site Name:	Example
State:	Alabama
County:	Baldwin

Site Data	
Size (acres):	13.31
L (ft):	429.60
Slope (ft/ft):	0.001

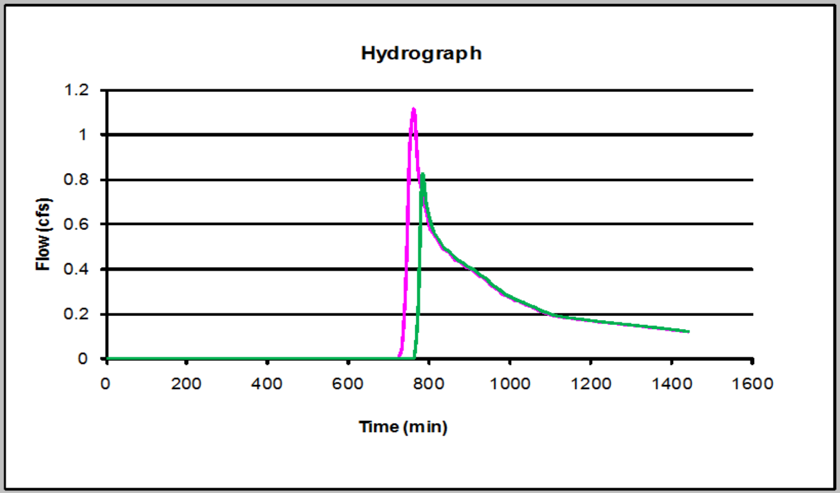
Precipitation Data	
Distribution Type:	Type III
Annual (in):	50.00
Design Storm:	1-yr, 24-hr
Rainfall Amount (in):	4.80

OUTPUT

Post-Developed	
Weighted CN:	69.00
S (in):	4.49
Runoff (in):	1.81
Q-peak (cfs):	12.747

Pre-Developed	
Weighted CN:	69.29
S (in):	4.43
Runoff (in):	1.82
Q-peak (cfs):	1.117

Post-Developed w/ Basin	
Weighted CN:	
S (in):	
Runoff (in):	
Q-peak (cfs):	



Current Model Capabilities

•Entering site size, land cover and soil type descriptions either manually or through spatial mapping.
•Estimating runoff based on pre- and post-developed site conditions using the widely-accepted Soil Conservation Science (SCS) runoff curve number (CN) method.
•Setting up open channel/pond facilities.
•Calculating flow routing throughout a channel and/or pond facility.
•Estimating channel/pond infiltration losses using the Green-Ampt method.
•Generating tables and figures of selected model results at the inlet and outlet of the BMP facility.

LIDIA Going Forward

- Algorithm verification.
- Field evaluation.
- Removal effectiveness.
- Include function for computing cost associated with installation and maintenance.
- Spatial linkage options should be evaluated.
- Review of Excel™ problems.
- Outreach.

So What?

- Why is it important to the NGI?

NGI Research Themes

Ecosystem Management

Climate

"Research focuses on four themes that provide a framework for the activities of NGI aligned with NOAA's research and operational focuses. The NGI Research Themes are: Ecosystem-based Management, Geospatial Data/Information and Visualization in Environmental Science, Climate Change and Climate Variability Effects on Regional Ecosystems, Coastal Hazards and Resiliency."

Source: NGI Website

"Integration is a guiding principle for NGI - integration of upland, waterway, coastal and coastal ocean processes; integration of scientific and technical disciplines and institutions; integration of physical, biological, and social sciences data; and harvesting value from integrating NOAA and NGI strengths and resources."

Geospatial/ Visualization

Hazards/ Resiliency

Spatial Area Impacting NGI

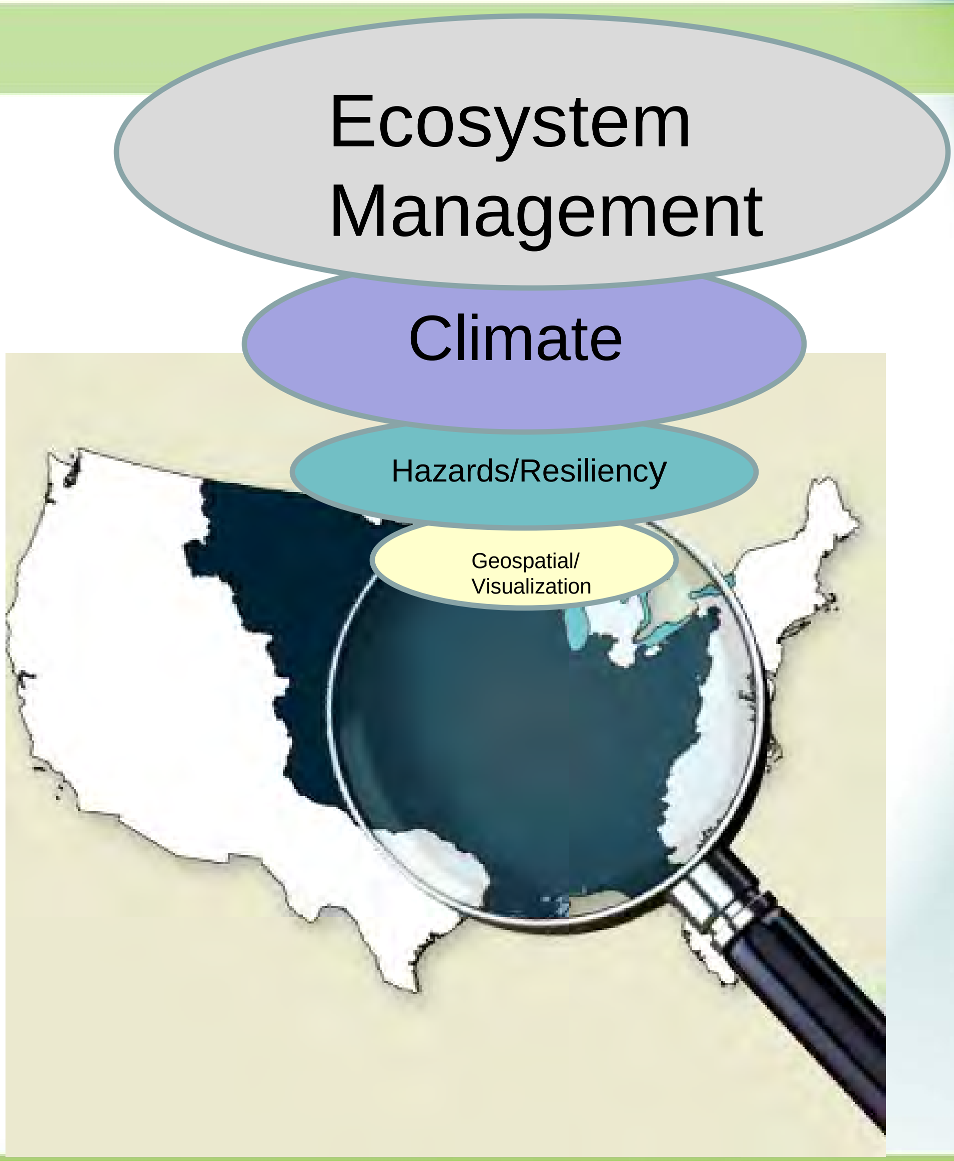
Ecosystem Management

Climate

Geospatial/ Visualization

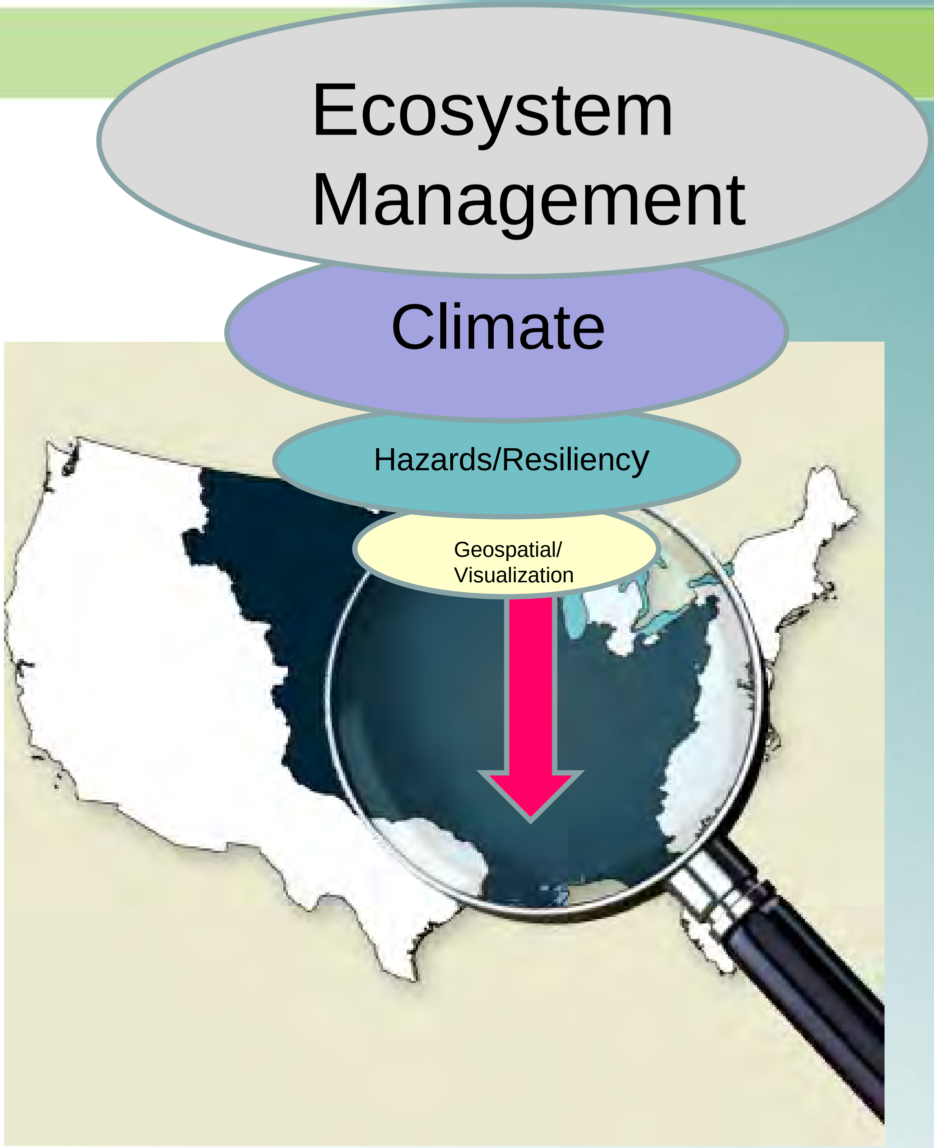
Hazards/ Resiliency

Integration? Then What?



How Do We Harvest Value?

- By solving site specific problems using the expertise and resources of the NGI, identified in the four research areas.
- This research initiative (NGI) has reached a maturity where there should be outcomes (value) that solve problems encountered by the general public in a way that improves their quality of life.



How can NGI Address Current Issues ?

Research World

- Hydrologist
- Biologist
- Ag Economist
- Environmental Engineer
- Climatologist

General Public

- Engineers
- Planners (Public Sector)
- Landscape Architects
- Construction Industry
- Sustainability Experts

Case Study: LIDIA

- Problem:
  - How to improve water quality and reduce infrastructure costs (resiliency) for new construction in the NGI service area.
- Solution:
  - Use LIDIA to make a pre-assessment of the construction approach .
  - Assess alternative water quality BMPs.
  - Assess cost factors.
  - Assess sizing constraints.
  - Implement solution.
  - Aimed at the design/construction industry.

Why have BMPs not been embraced?

- 2008 survey result

21. For projects in which BMPs were NOT designed, what was the reasoning for the design decision? Check all that apply.	Response Percent	Response Count
Not required in past	31.8%	35
Too costly	**37.3%**	41
Client opposition	30.0%	33
Lack of knowledge and/or experience	16.4%	18
Lack of tools and technology	4.5%	5
Unknown	7.3%	8
N/A	18.2%	20
Other (please specify)	9.1%	10
	answered question	110
	skipped question	31

Source: Austin Moore

How to modify behavior?

- Data
  - More test sites
  - More types of BMPs tested
  - Improved data collections
- Education
  - Modified university curriculums
  - Workshops
  - Continuing education credits
  - Include in local ordinances