Agenda

- **130 Convene, Welcome, Intro, Guiding Principles**
- **140 FTL Background—History, partners, process, curriculum**
- **150 Barriers to Implementation**
- **210 Economics of LID**
- **245 15 Minute Break**
- **300 FTL Curriculum Components**
- **305 FTL ppt + discussion**
- **340 Manual and Facilitated process+ discussion**
- **420 Adjourn**

Curriculum Elements

- **30 min PowerPoint Presentation**
  - **Delivery Guide**
  - **Facilitation Guide**
- **Resource Manual**
  - **Stand Alone Chapters**
  - **Chapter Summary Sheet**
- **Web Accessed Materials**
- **Train-the-trainer**

FORGING THE LINK

Linking the Economic Benefits of Low Impact Development and Community Decisions

Todd Janeski, Virginia Commonwealth University
Robert Roseen, PE, PhD, James Houle, CPSWQ, University of New Hampshire Stormwater Center
Michael Simpson, Antioch University New England

CICEET

ERG

UNIVERSITY of NEW HAMPSHIRE

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

VCU
Virginia Commonwealth University

ANTIOCH NEW ENGLAND GRADUATE SCHOOL

Guiding Principles

Demonstrate the value of Low Impact Development (LID) within the context of Forging the Link:

1. The ecological benefits of LID with respect to protection of water quality, aquatic habitat and watershed health
2. The economic benefits of using a combination of grey and green infrastructure to manage stormwater
3. The capability of LID to be used as a climate change adaptation planning tool to minimize the stress to urban stormwater infrastructure.


SCHOOL BUS


SCHOOL BUS


SCHOOL BUS

Slide: Chesapeake NEMO


Slide: Chesapeake NEMO

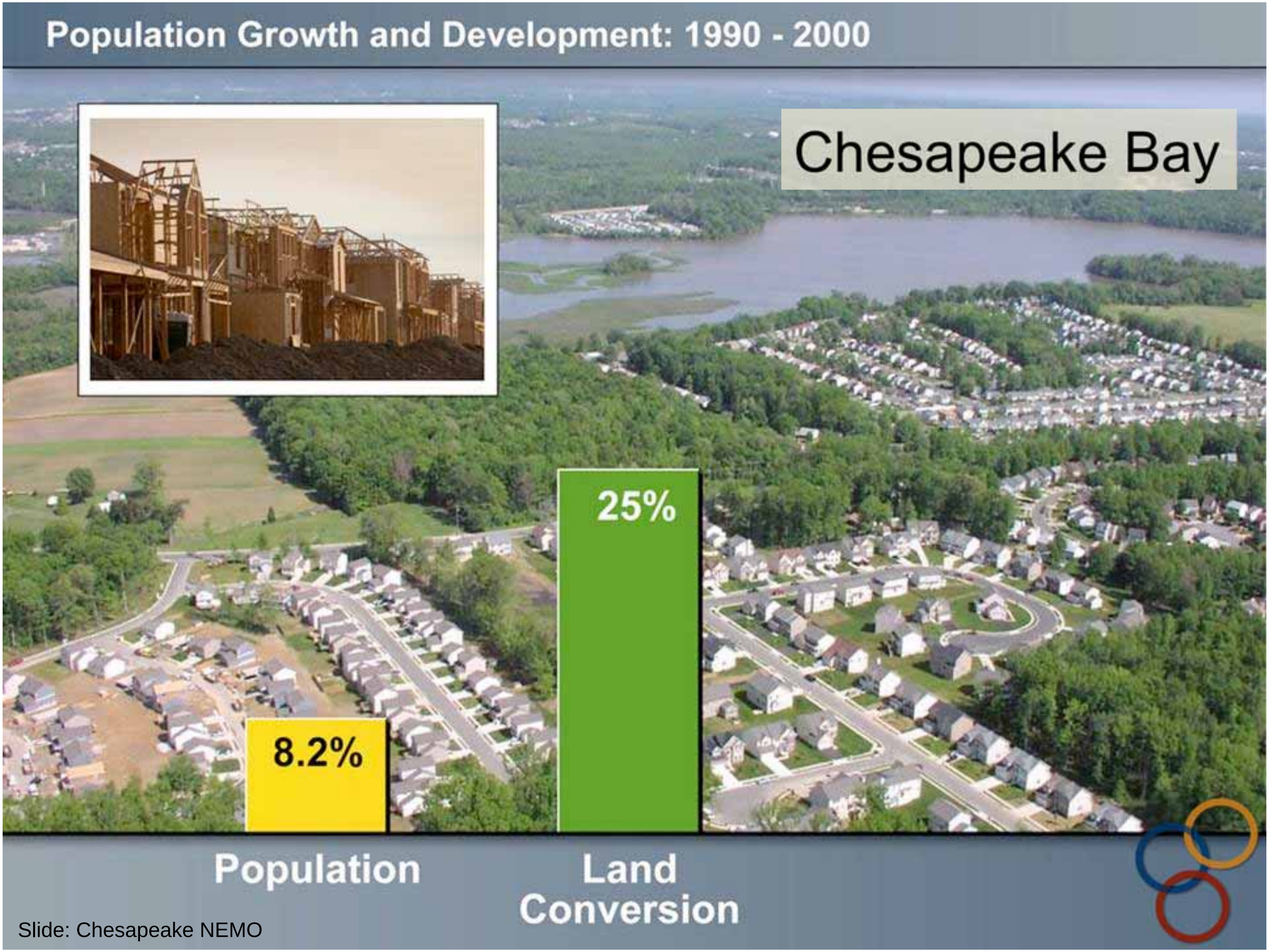
Coastal Population Changes

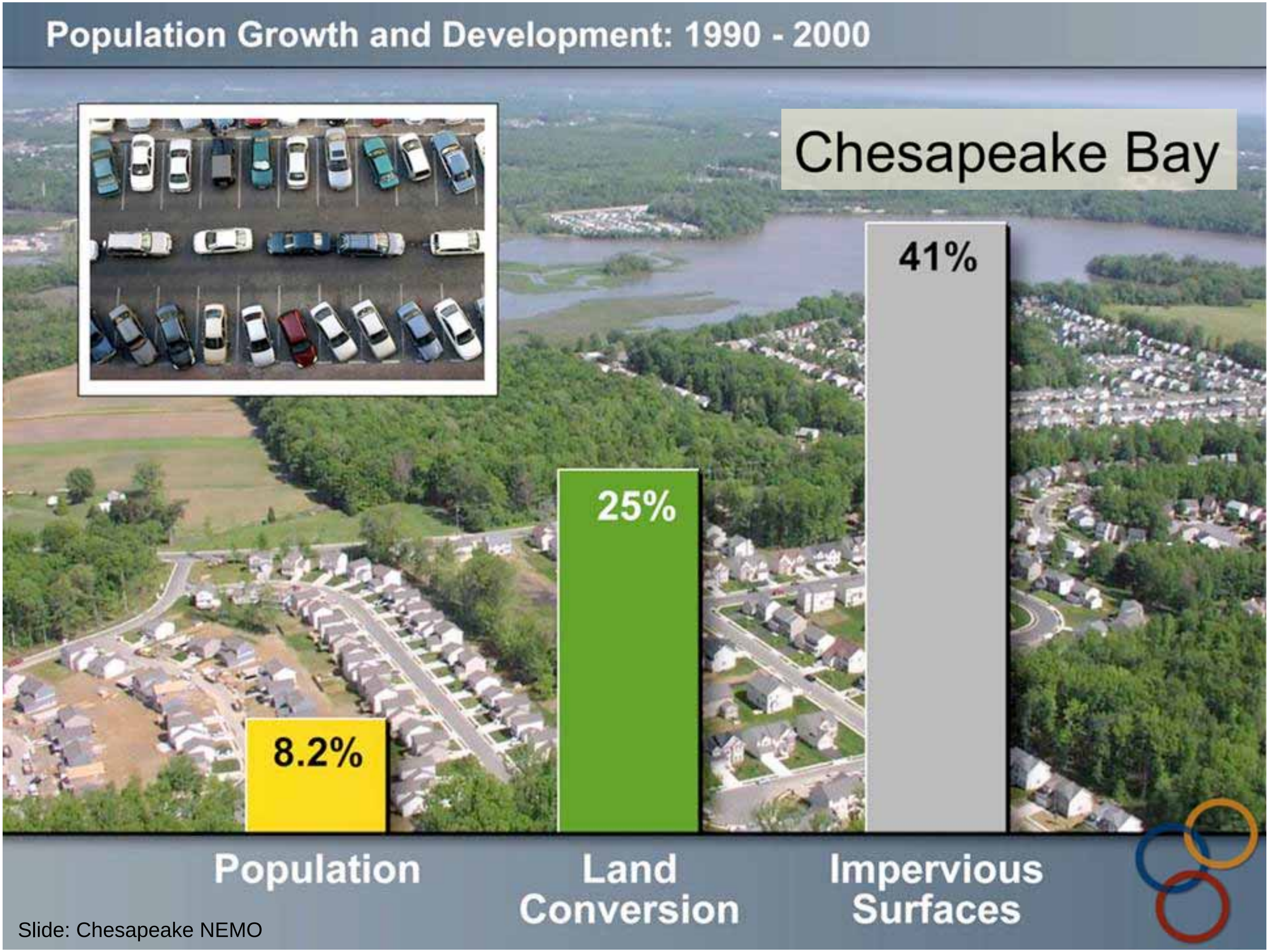
Coastal Population Changes

Population Growth and Development: 1990 - 2000

Population

Slide: Chesapeake NEMO


Population Growth and Development: 1990 - 2000
Chesapeake Bay
25%
8.2%
Population
Land Conversion
Slide: Chesapeake NEMO



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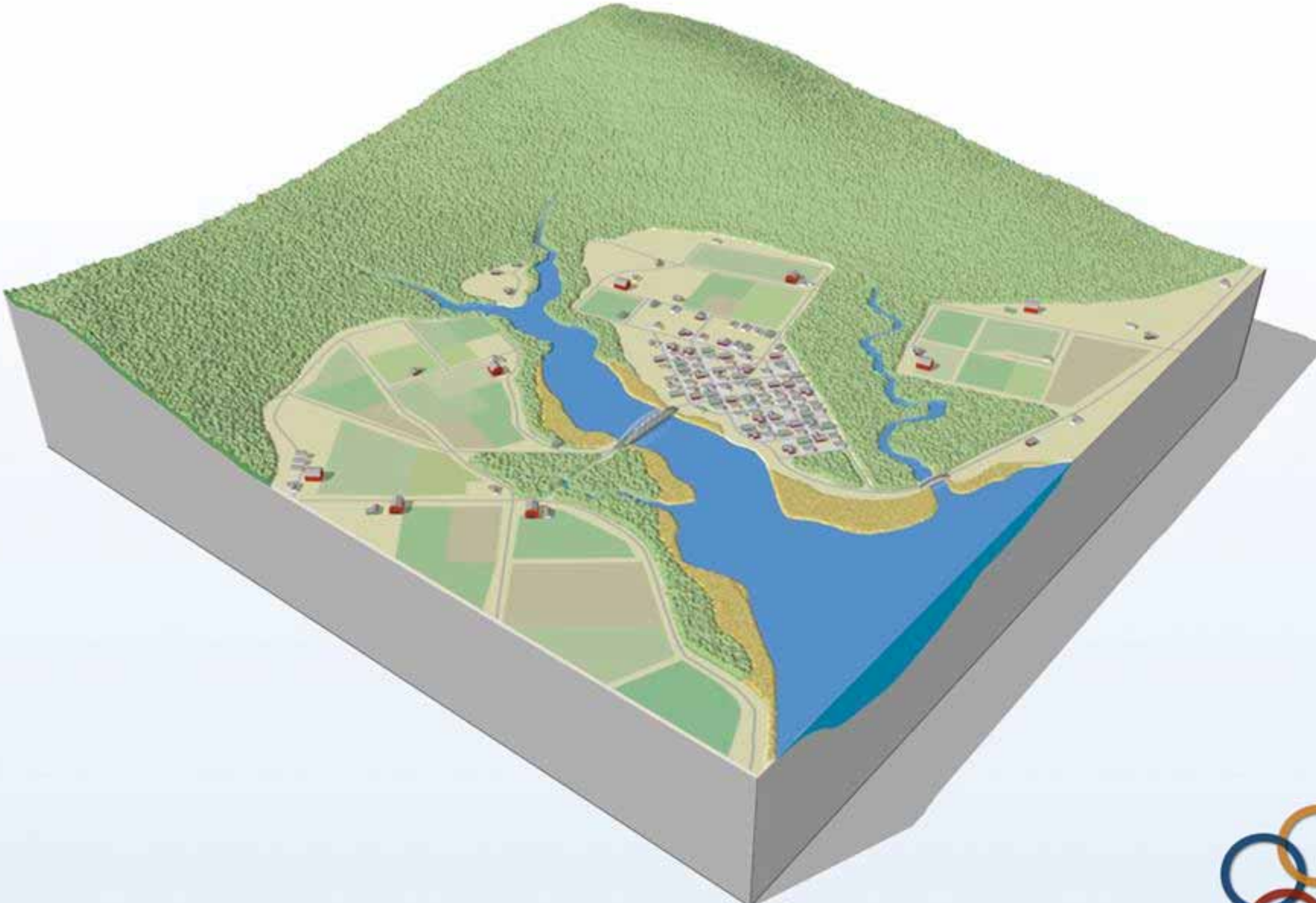
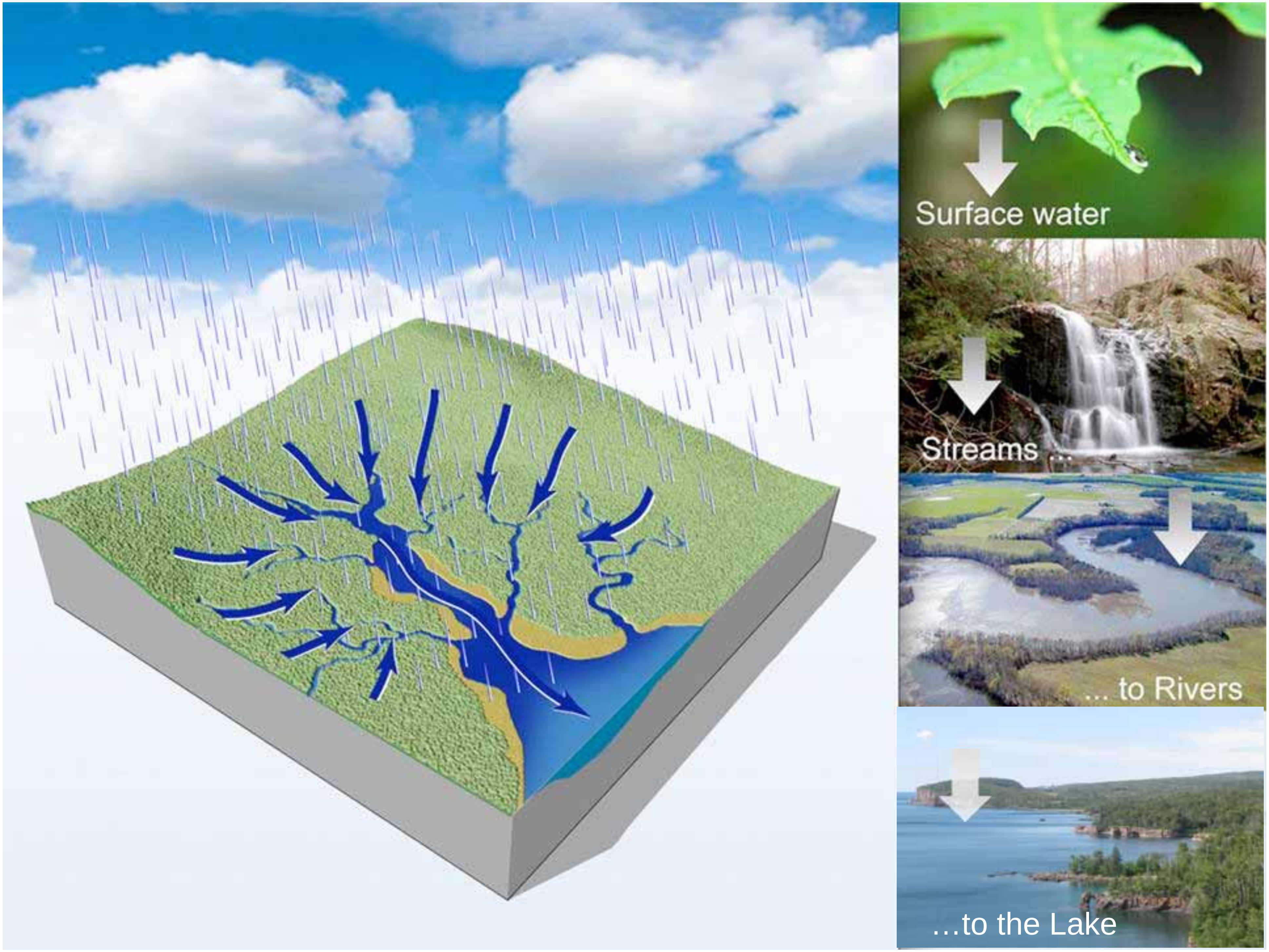
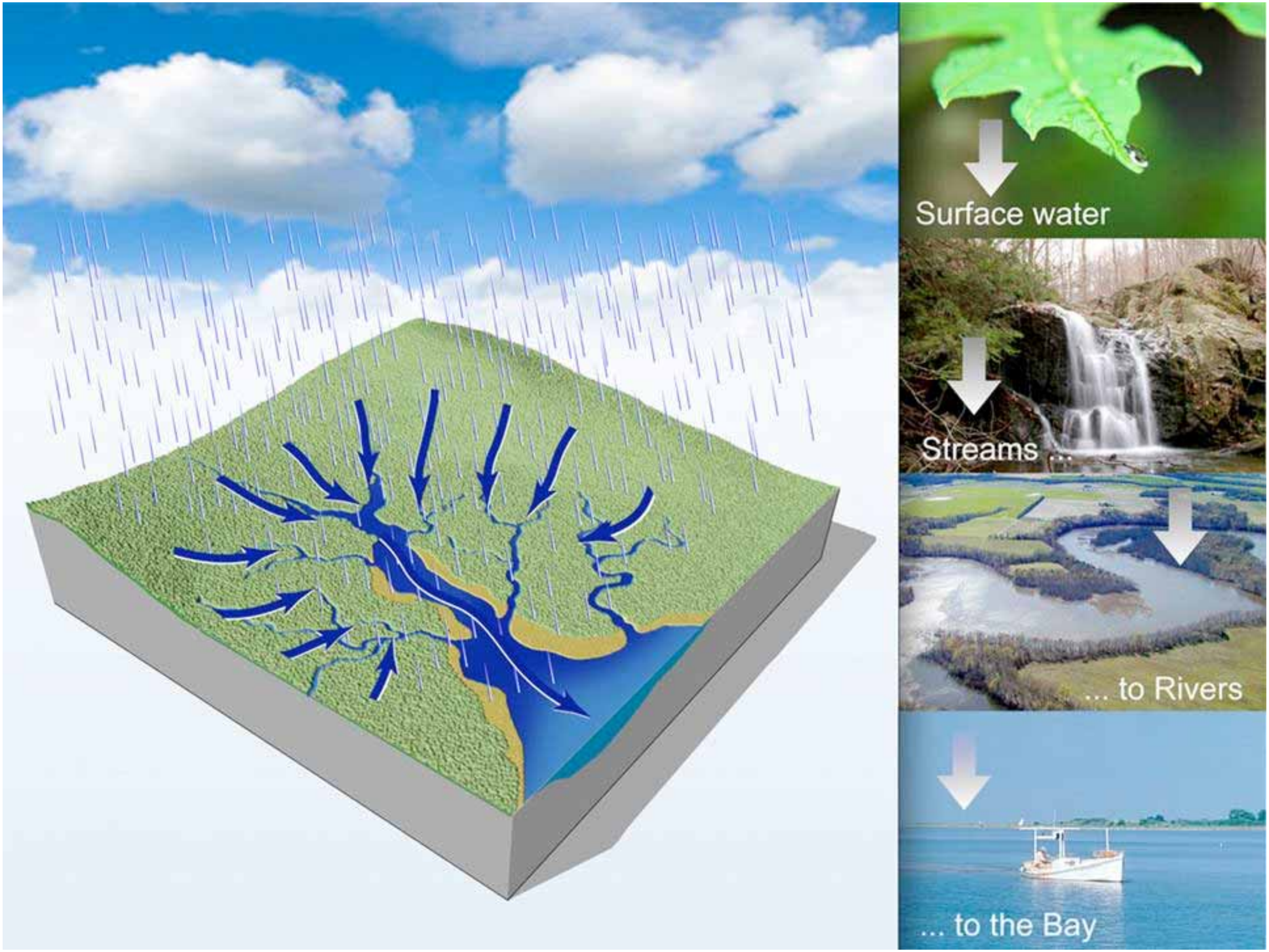
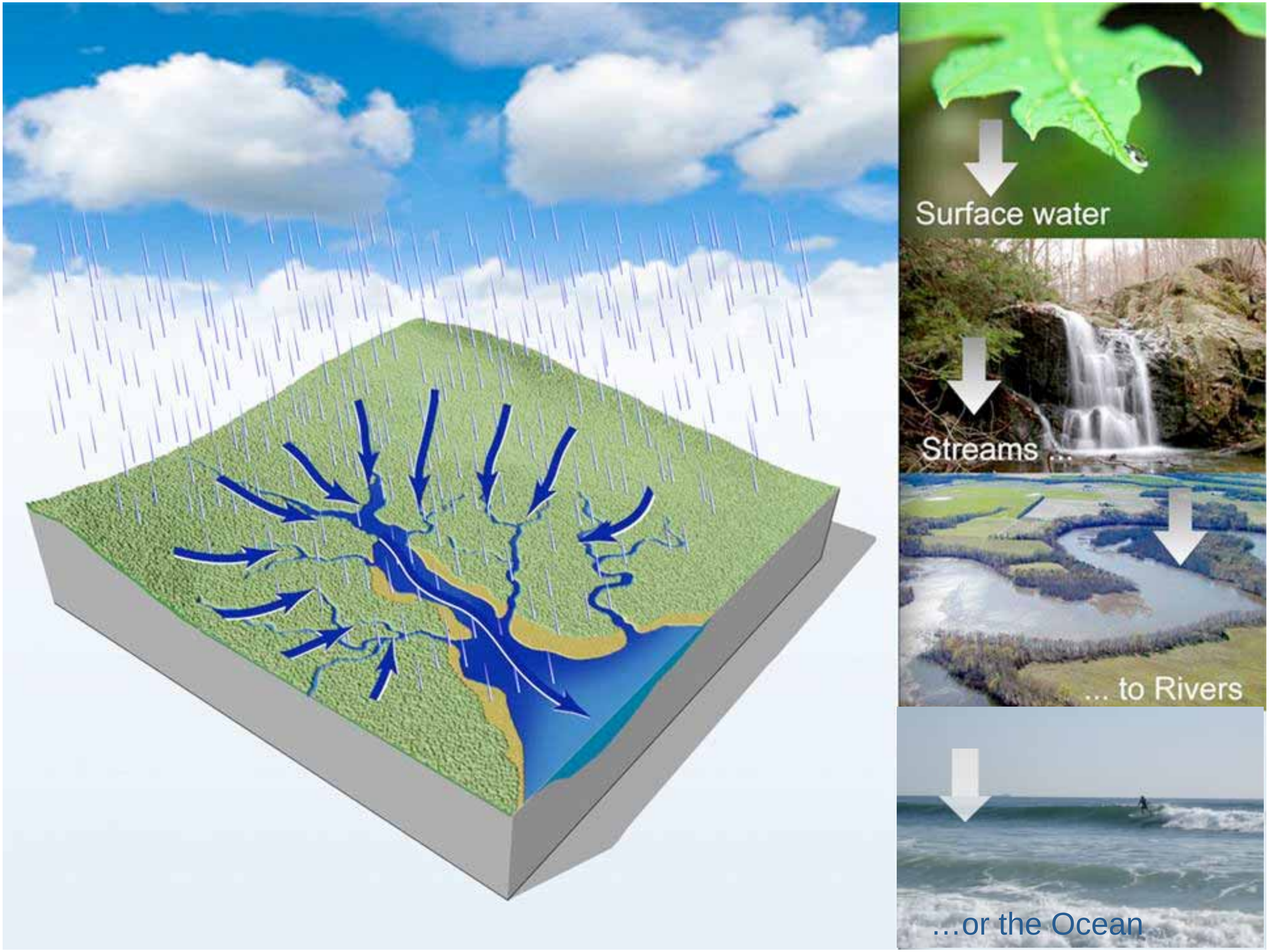
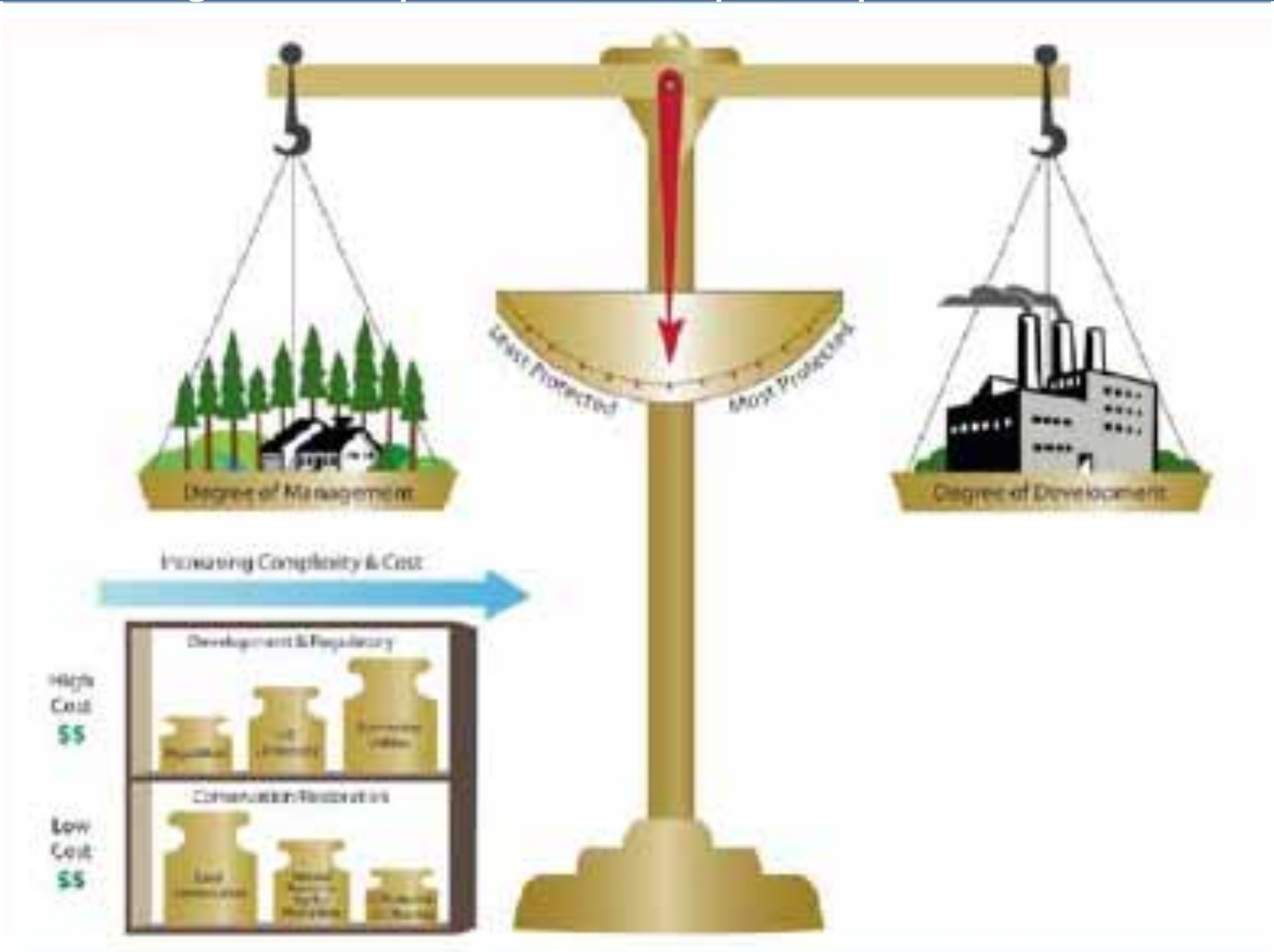



Surface water
Streams ...
... to Rivers
…to the Lake

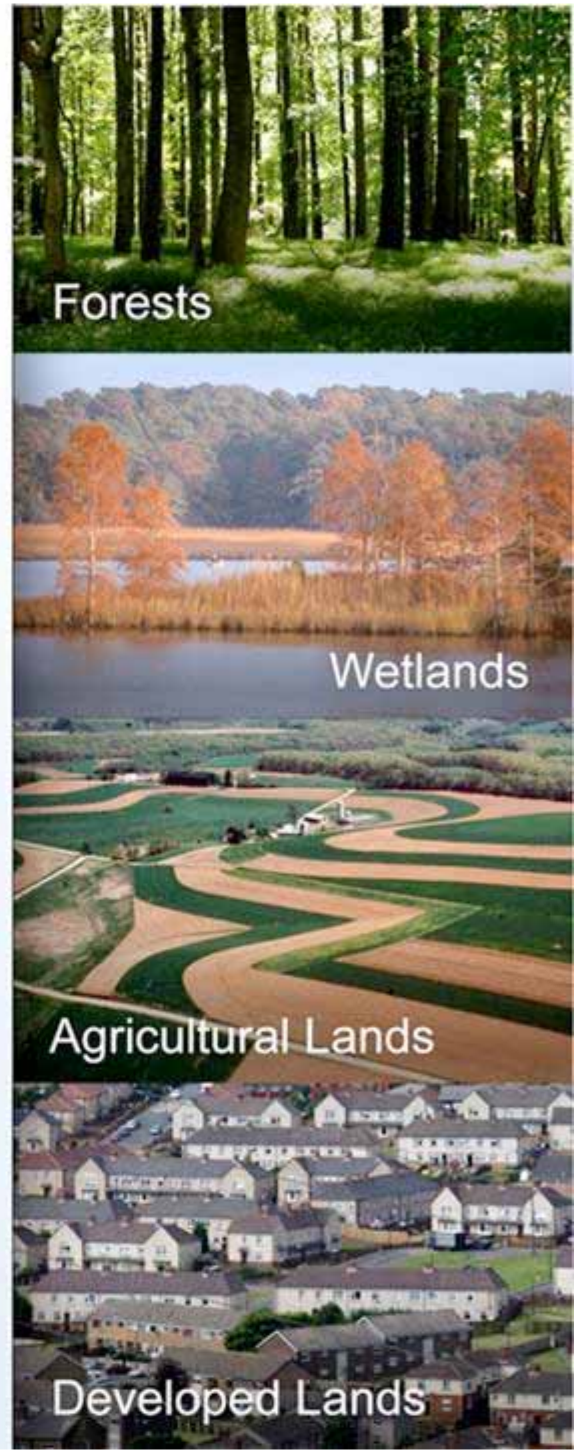

Surface water
Streams ...
... to Rivers
... to the Bay

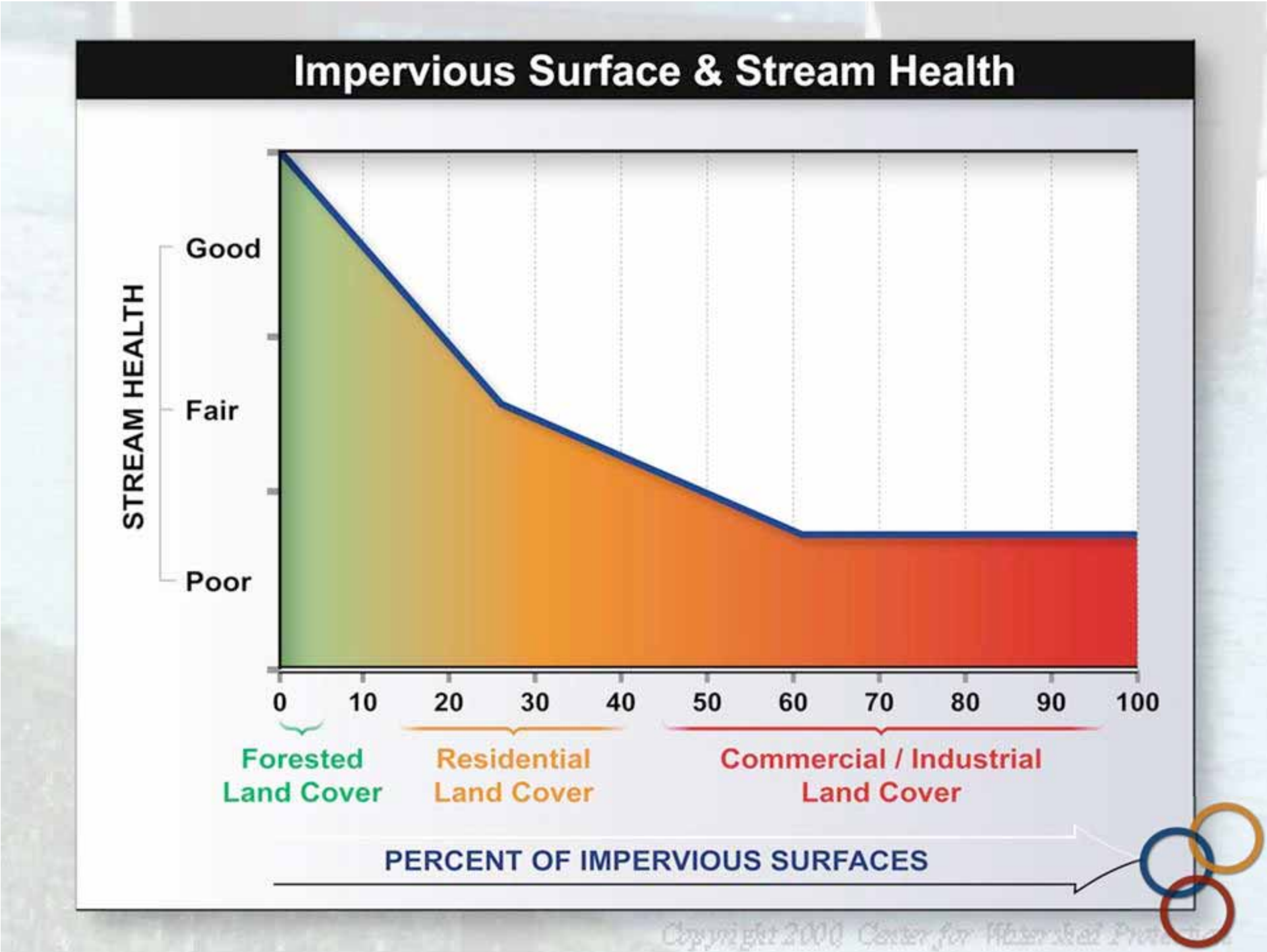

Surface water
Streams ...
... to Rivers
...or the Ocean

Balancing Development and Open Space

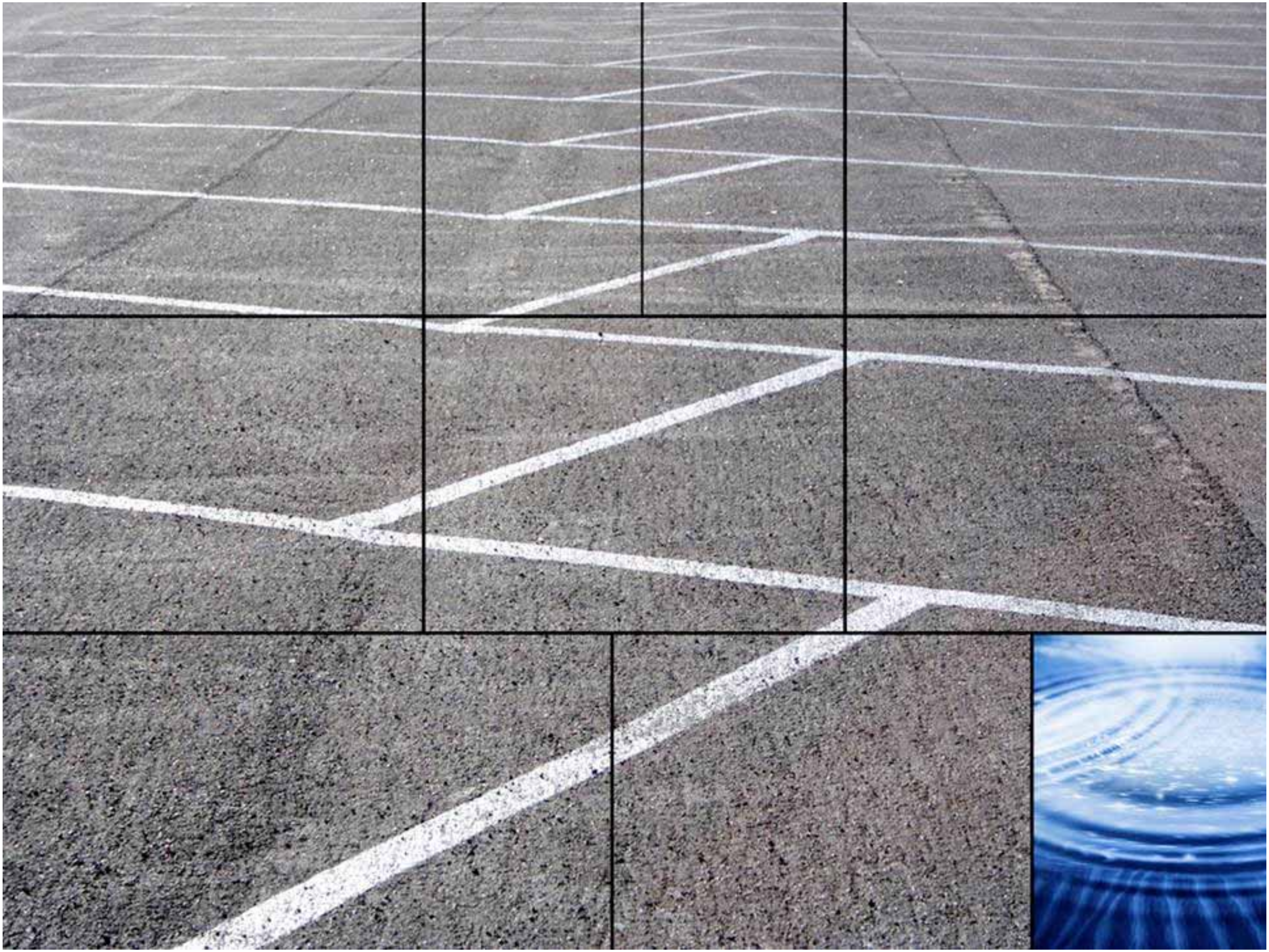


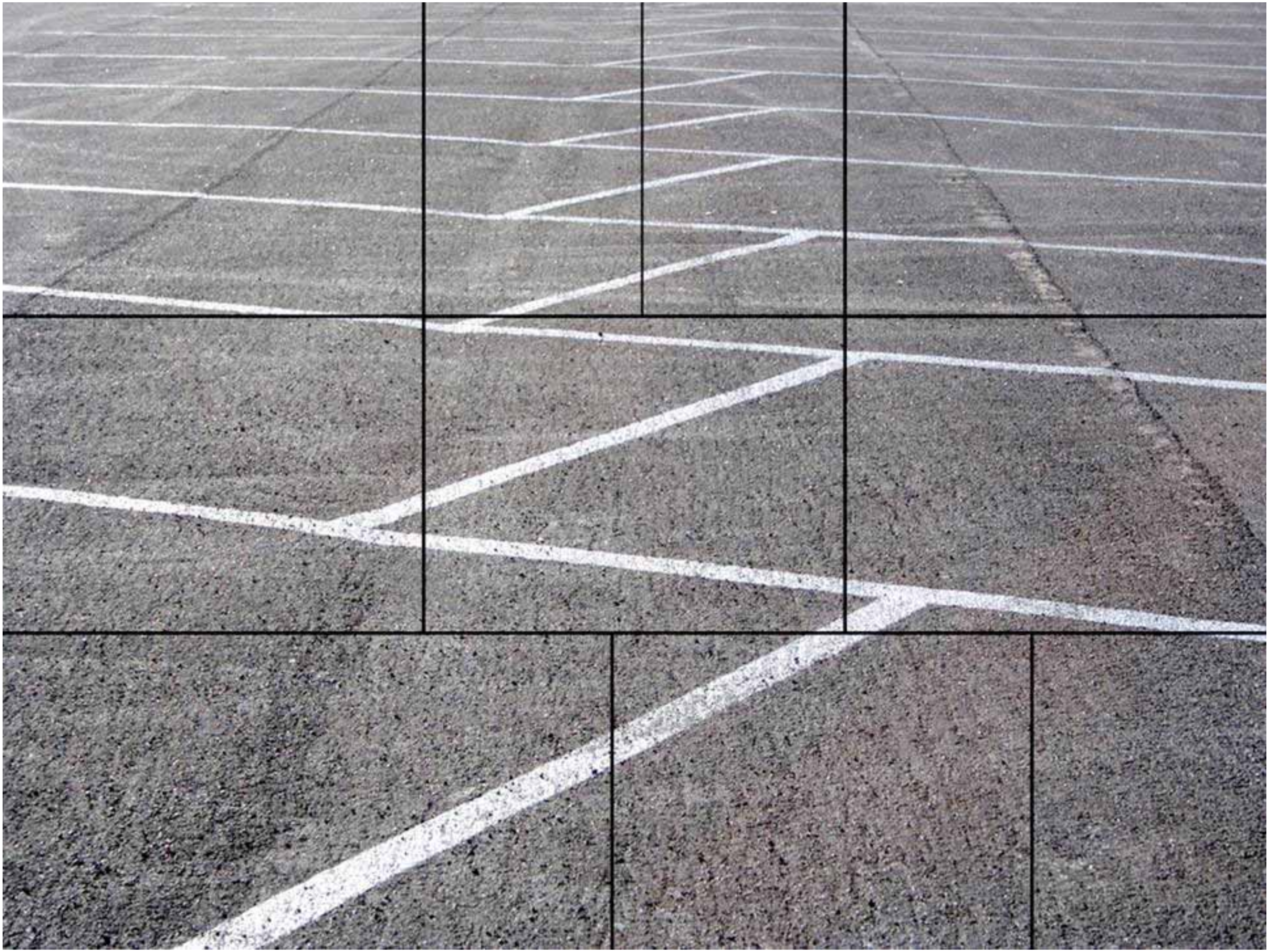
Water and Land Cover

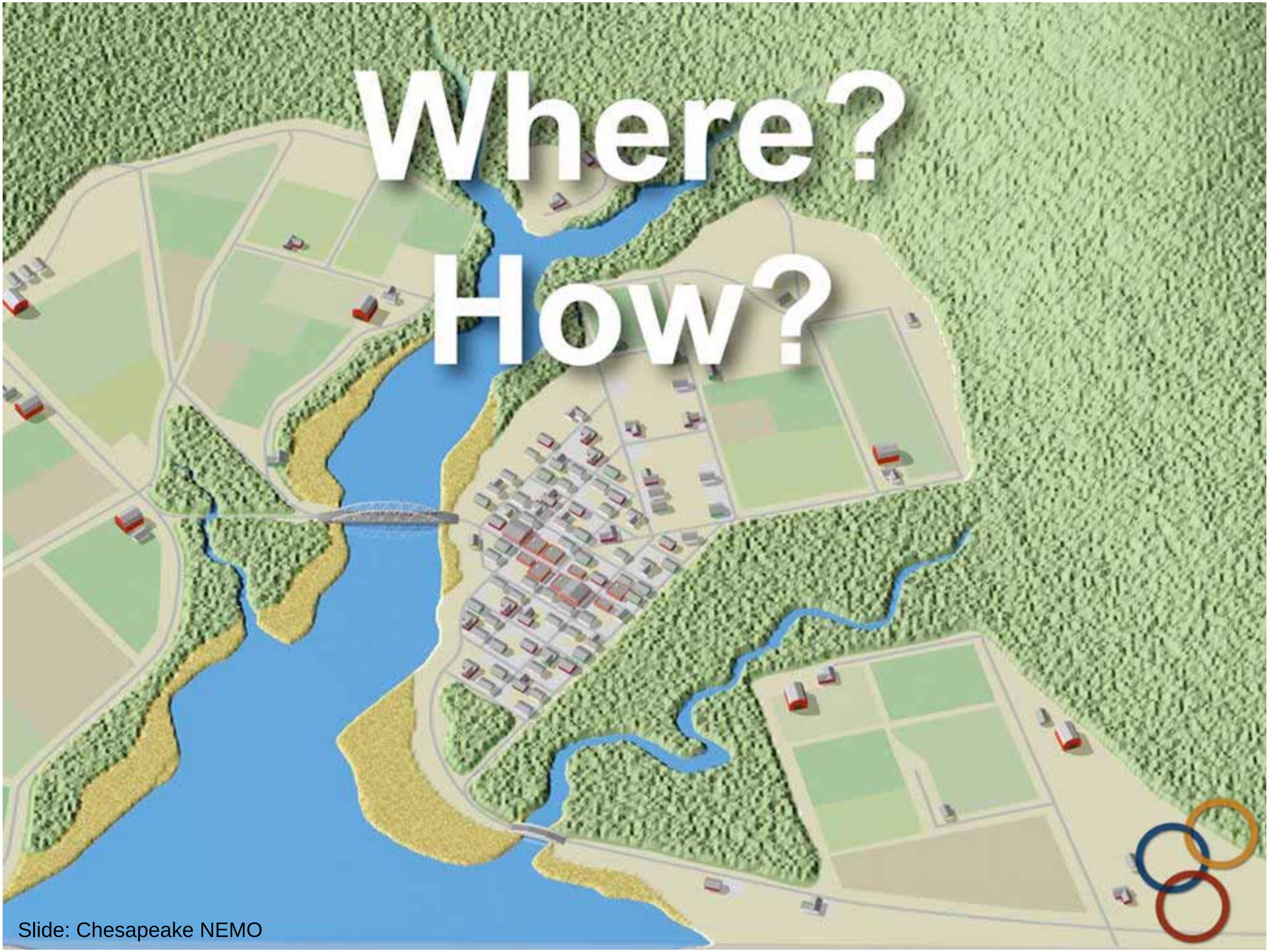




Impervious Surface & Stream Health
STREAM HEALTH
Good
Fair
Poor
0
10
20
30
40
50
60
70
80
90
100
Forested Land Cover
Residential Land Cover
Commercial / Industrial Land Cover
PERCENT OF IMPERVIOUS SURFACES



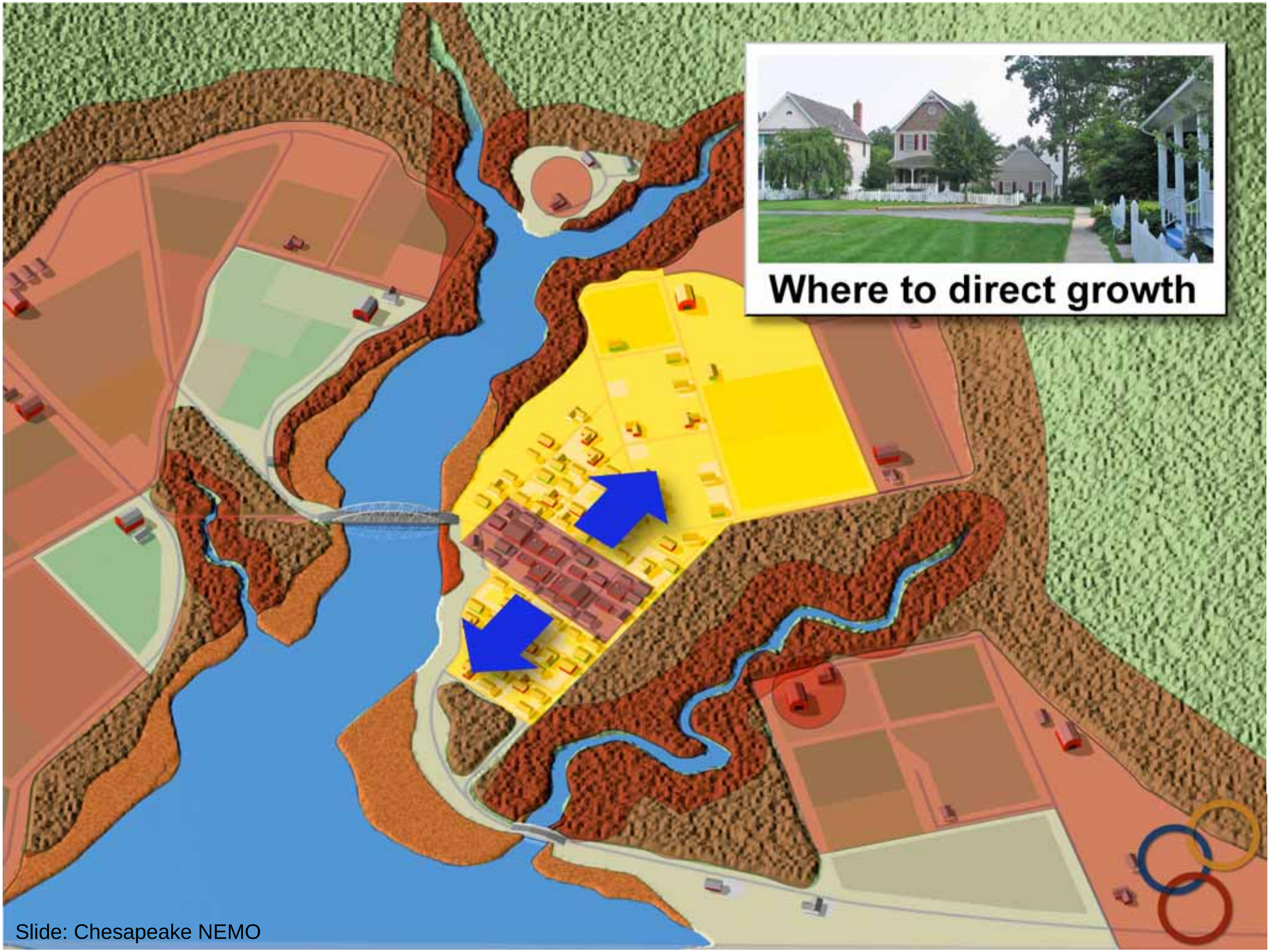




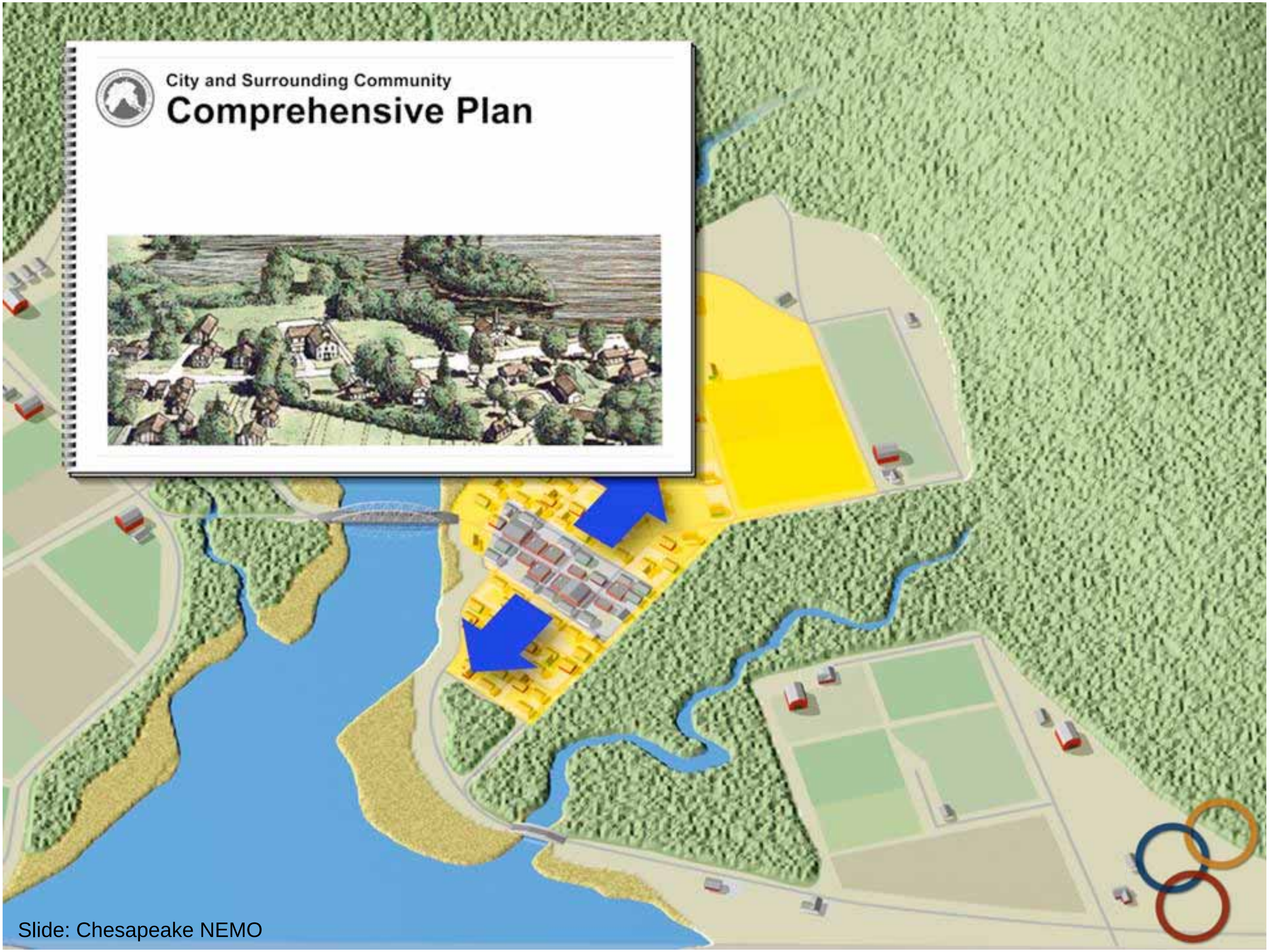
Slide: Chesapeake NEMO


Where?
Slide: Chesapeake NEMO


Where to Protect
Slide: Chesapeake NEMO

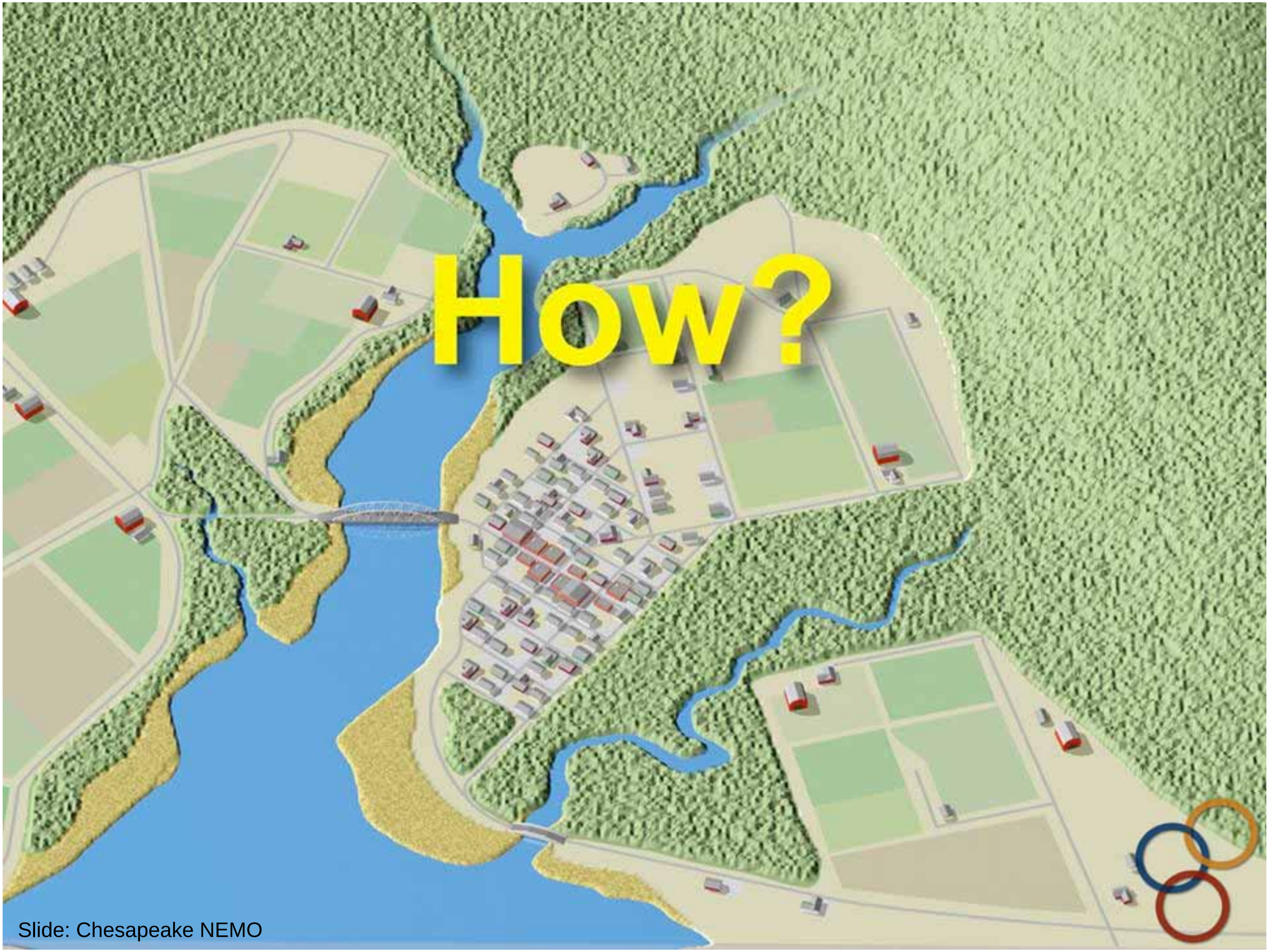


Slide: Chesapeake NEMO


City and Surrounding Community
Comprehensive Plan
Slide: Chesapeake NEMO


N
W
E
S
0
200'
Page 6 Of 7: LAND PARCEL 14-B
Prepared by: City Planning Commission
Zoning Parameters: Residential with Public Road
Date: January 2007
Land Parcel: South River Section. No 2
Drawing #: 214-1238
Slide: Chesapeake NEMO

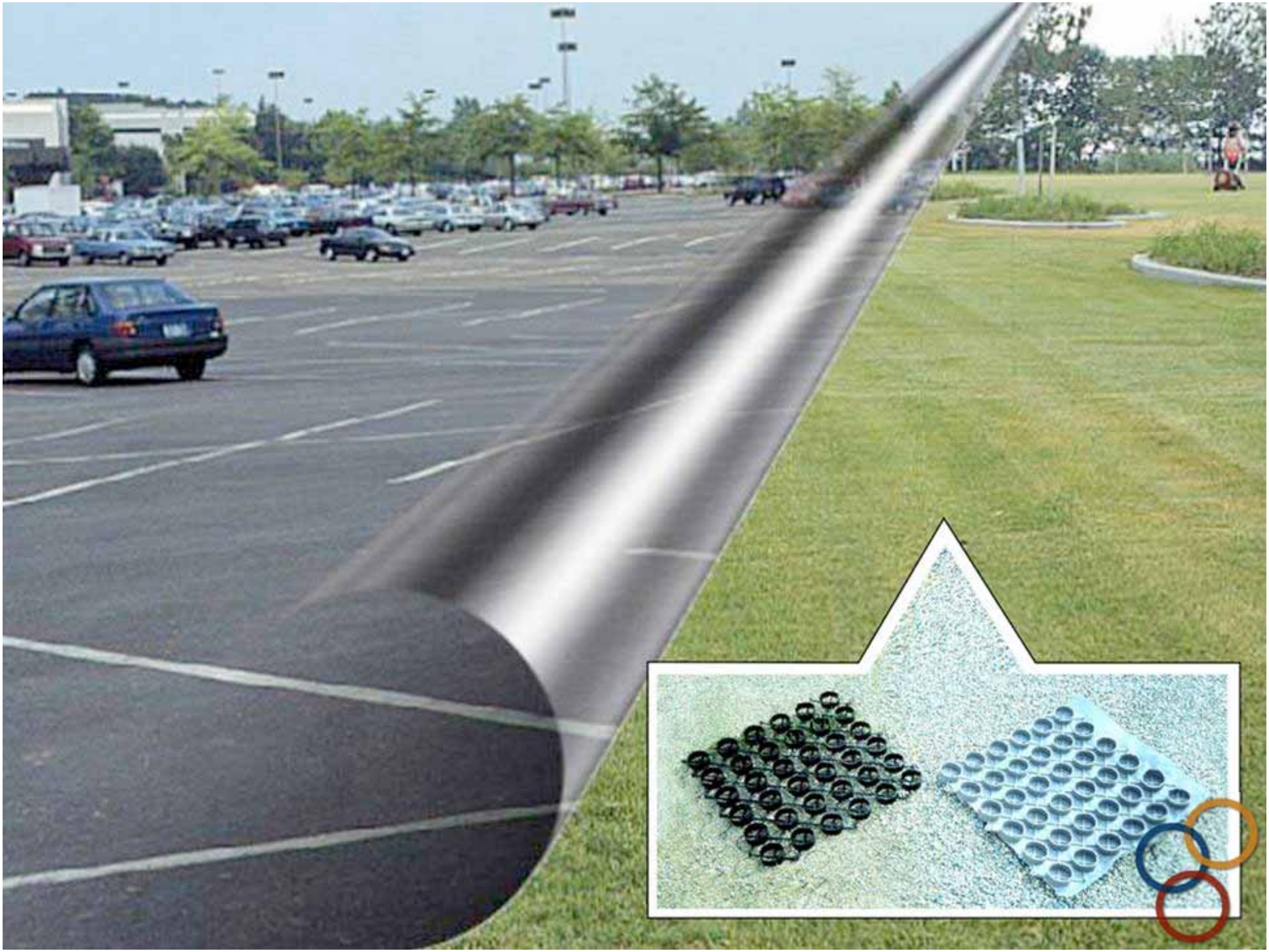
Slide: Chesapeake NEMO

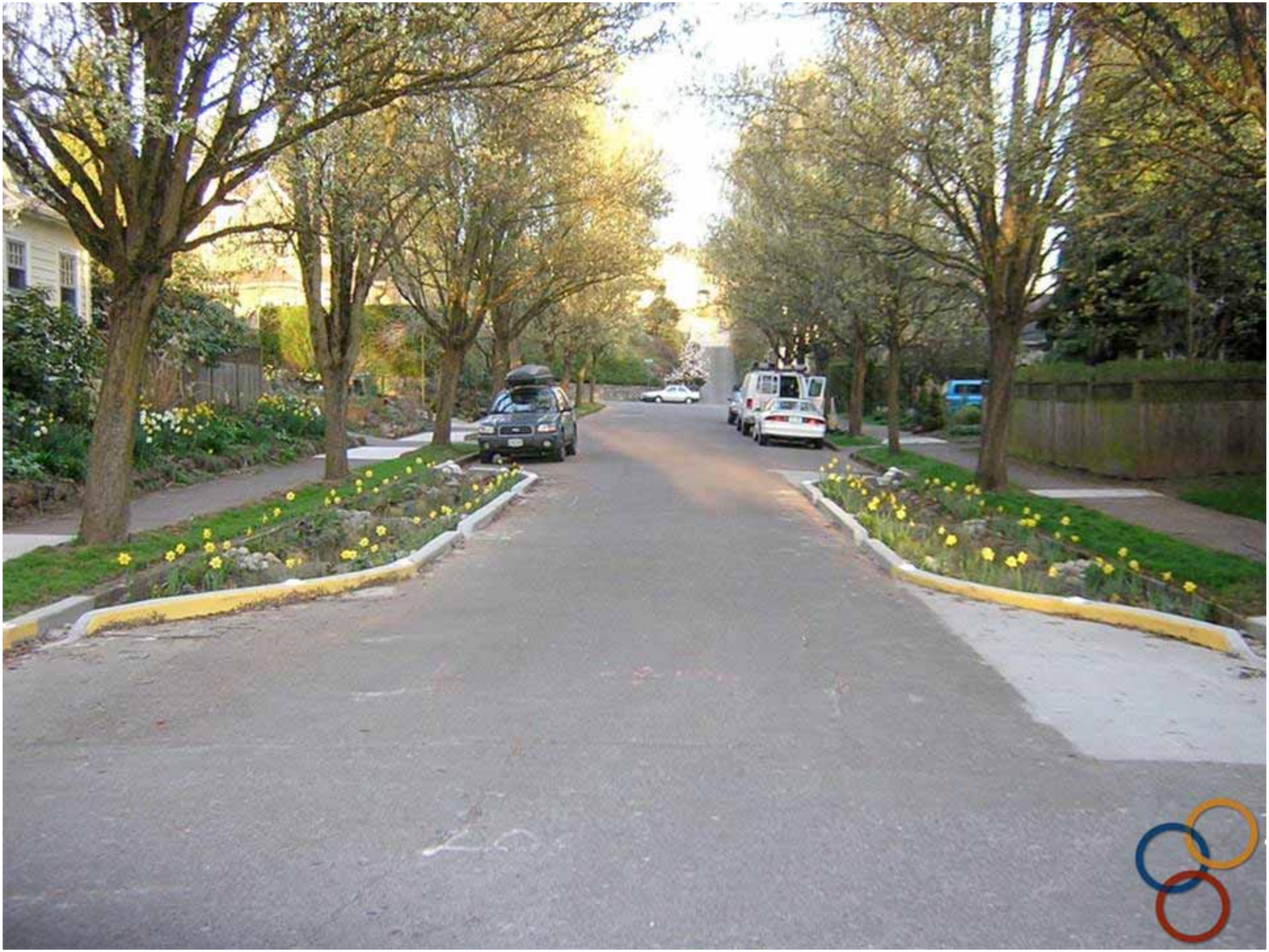


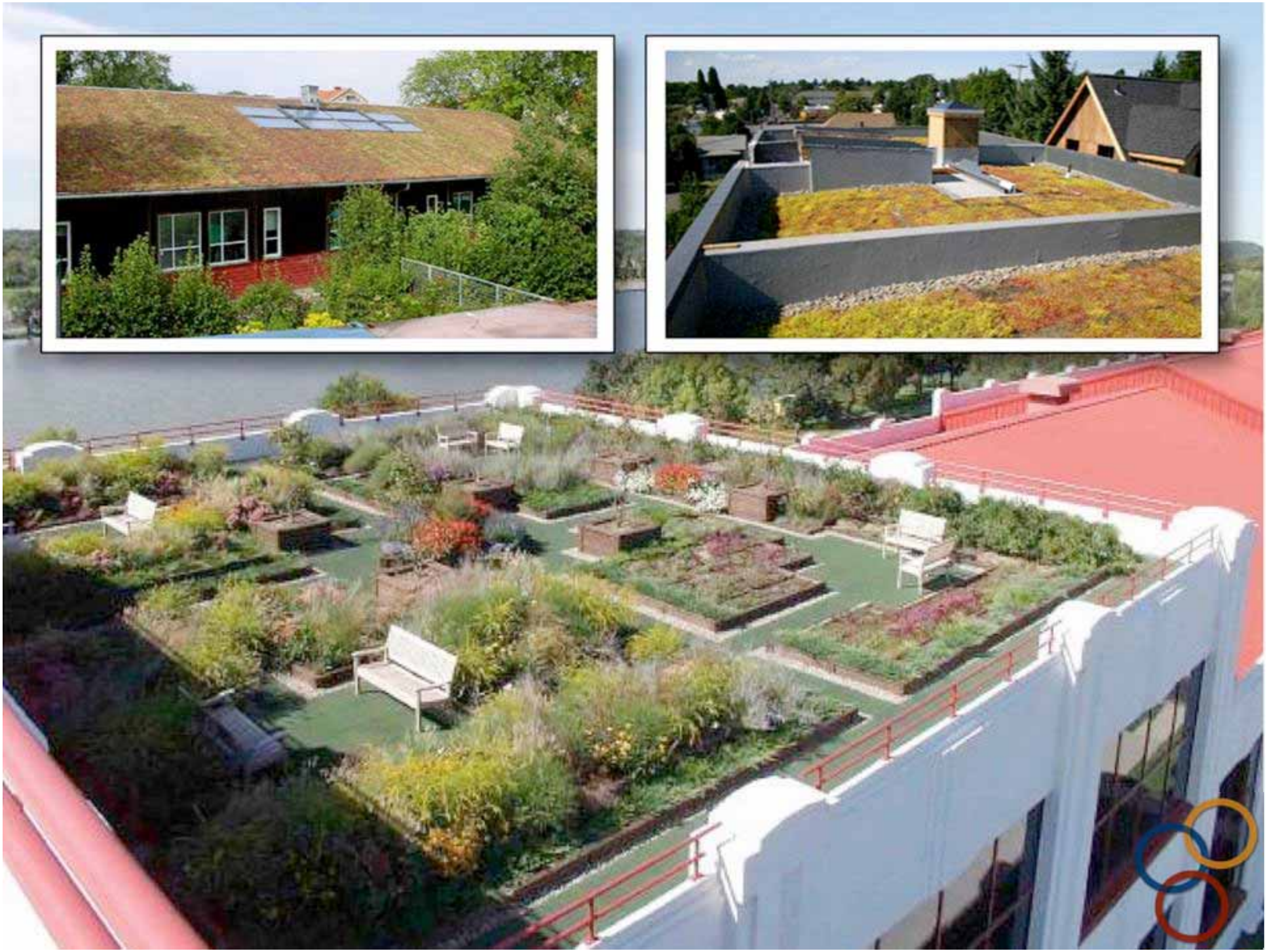
Slide: Chesapeake NEMO


How?
Low Impact Development
Slide: Chesapeake NEMO


Welcome to the
Glencoe
Rain Garden
Please stay on the path
and out of the garden







Bottom Line?

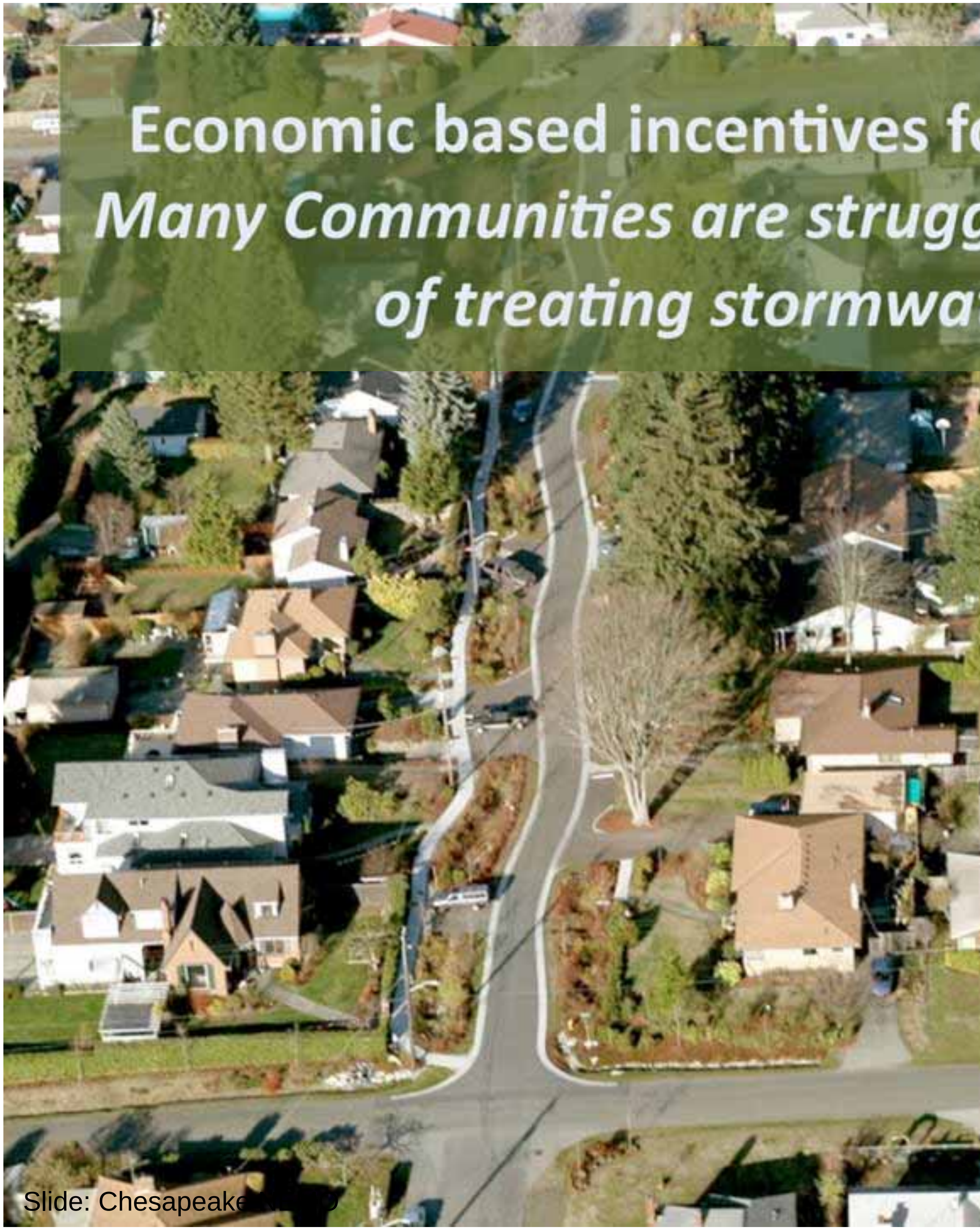
Economic based incentives for early adoption:

Many Communities are struggling with the costs of treating stormwater runoff

Slide: Chesapeake NEMO

Economic based incentives for early adoption:

Many Communities are struggling with the costs of treating stormwater runoff



25% Savings

Slide: Chesapeake

Lower Development Cost *($7,000 avg)*

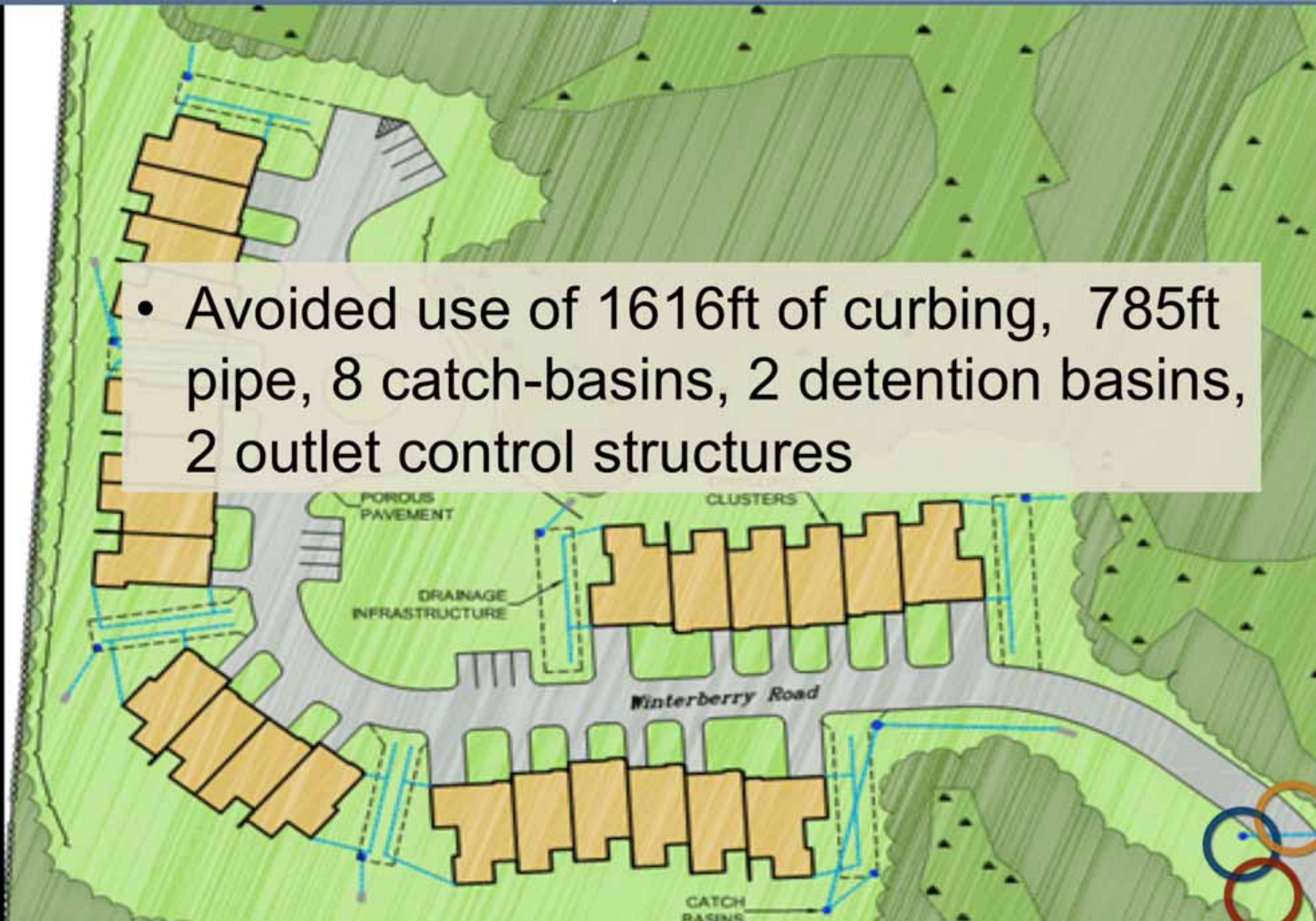
Quicker Sales *(50% Faster)*

Higher Home Values *(12-16%)*

Slide: Chesapeake NEMO

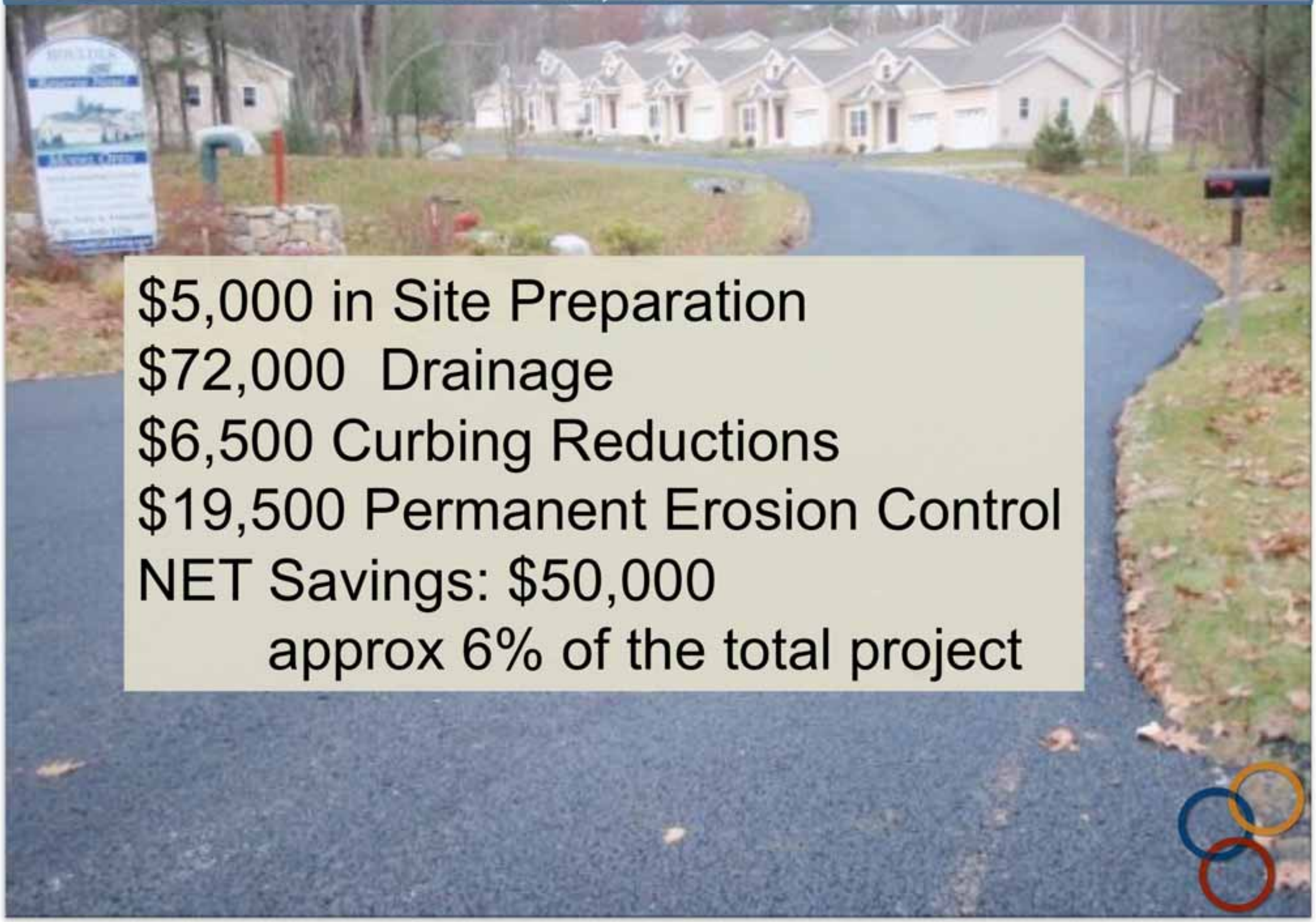
Boulder Hills Subdivision, NH

Boulder Hills Subdivision, NH



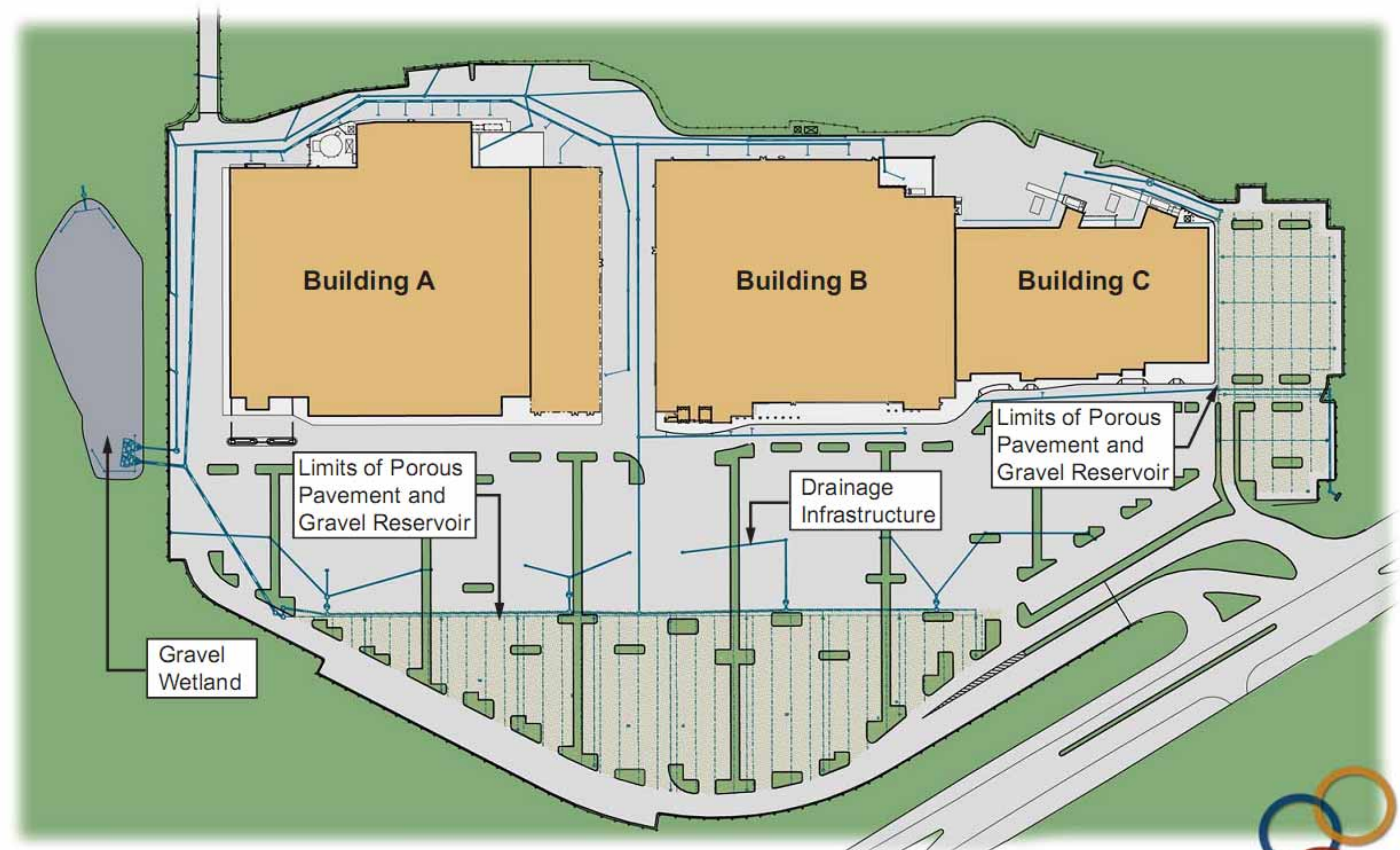
- Avoided use of 1616ft of curbing, 785ft pipe, 8 catch-basins, 2 detention basins, 2 outlet control structures

Boulder Hills Subdivision, NH

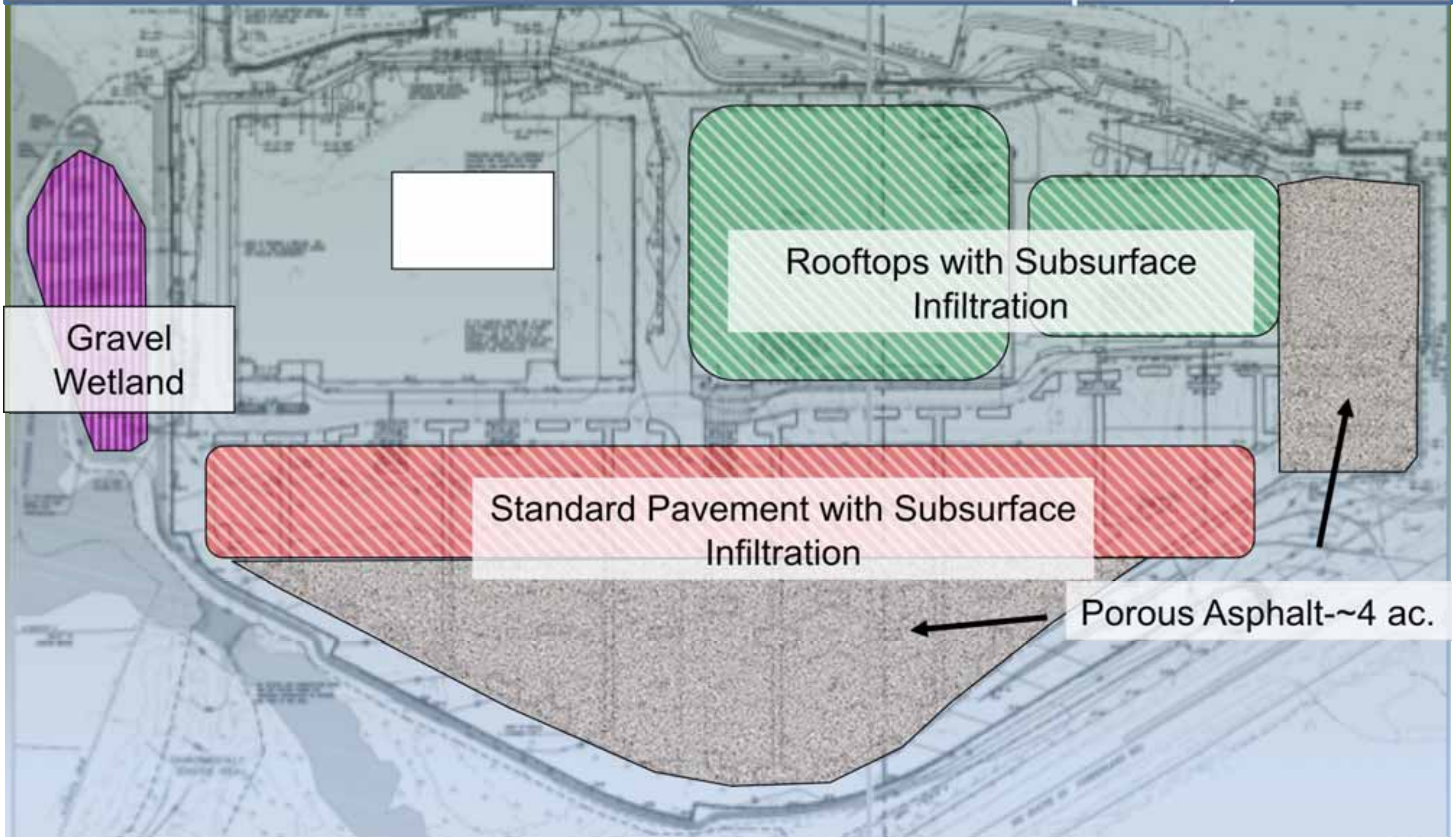


$5,000 in Site Preparation
$72,000 Drainage
$6,500 Curbing Reductions
$19,500 Permanent Erosion Control
NET Savings: $50,000
approx 6% of the total project

Greenland Meadows Commercial Development, NH

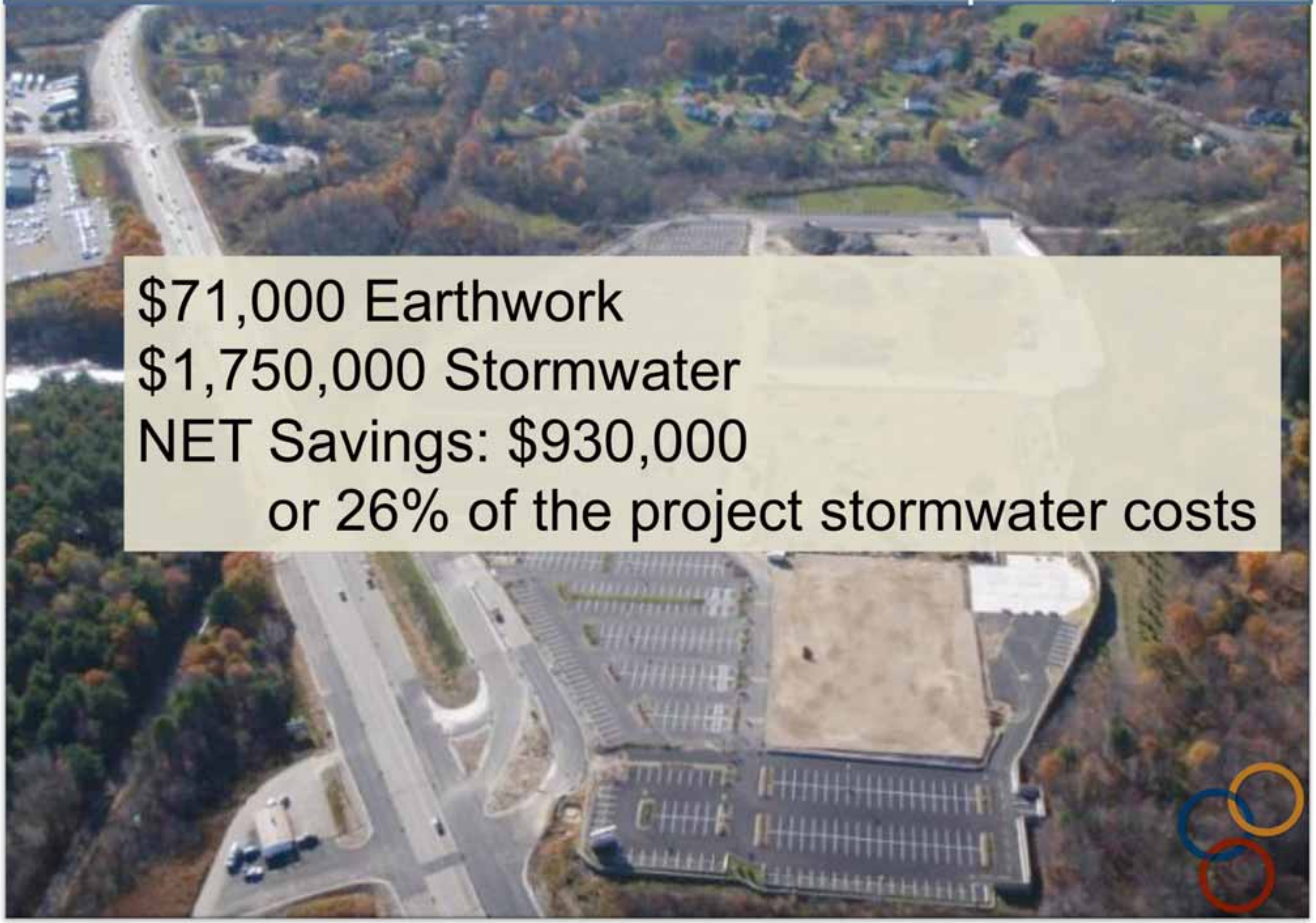


Greenland Meadows Commercial Development, NH



Greenland Meadows Commercial Development, NH

Greenland Meadows Commercial Development, NH



$71,000 Earthwork

$1,750,000 Stormwater

NET Savings: $930,000

or 26% of the project stormwater costs

Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

Table 1. Cost Comparisons Between Conventional and LID Approaches

Capital savings ranged from 15-80%

Project	Conventional			cent ence[b]
2nd Ave				%
Auburn				%
Belling				%
Bellingham Bloedel Donovan Park	$52,800	$12,800	$40,000	76%
Gap Creek	$4,620,600	$3,942,100	$678,500	15%
Garden Valley	$324,400	$260,700	$63,700	20%
Kensington Estates	$765,700	$1,502,900	–$737,200	-96%
Laurel Springs	$1,654,021	$1,149,552	$504,469	30%
Mill Creek[c]	$12,510	$9,099	$3,411	27%
Prairie Glen	$1,004,848	$599,536	$405,312	40%
Somerset	$2,456,843	$1,671,461	$785,382	32%
Tellabs Corporate Campus	$3,162,160	$2,700,650	$461,510	15%

[a] Some of the case study results do not lend themselves to display in the format of this table (Central Park Commercial Redesigns, Crown Street, Poplar Street Apartments, Prairie Crossing, Portland Downspout Disconnection, and Toronto Green Roofs). [b] Negative values denote increased cost for the LID design over conventional development costs. [c] Mill Creek costs are reported on a per-lot basis.

Portland, Oregon

Portland, Oregon

Estimated $144M for Grey Solution

Portland, Oregon

$11M in Green Infrastructure

Reduced cost estimate by $63M

Portland, Oregon

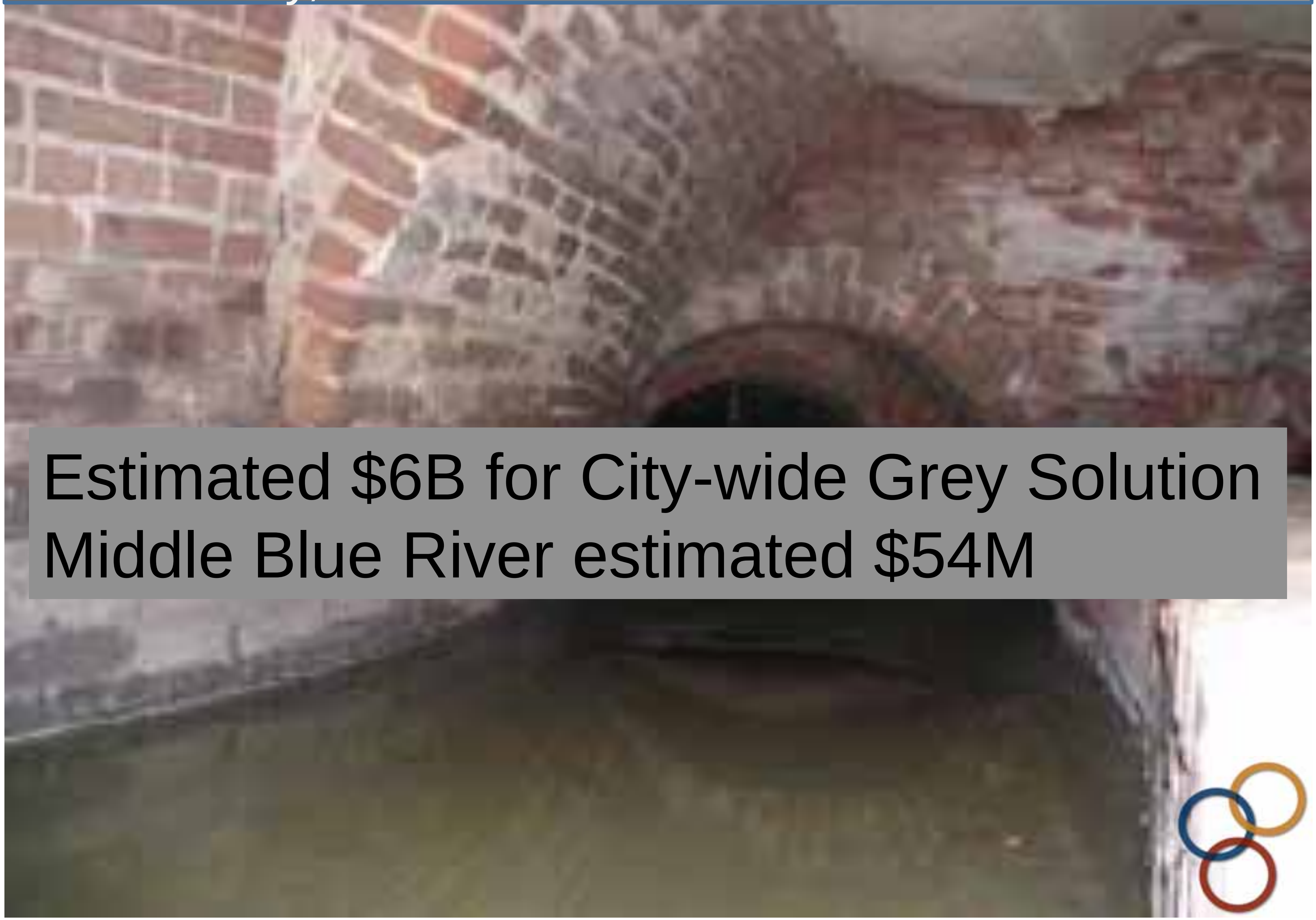
Estimated $81M budget

Portland, Oregon

Portland, Oregon

Kansas City, Kansas

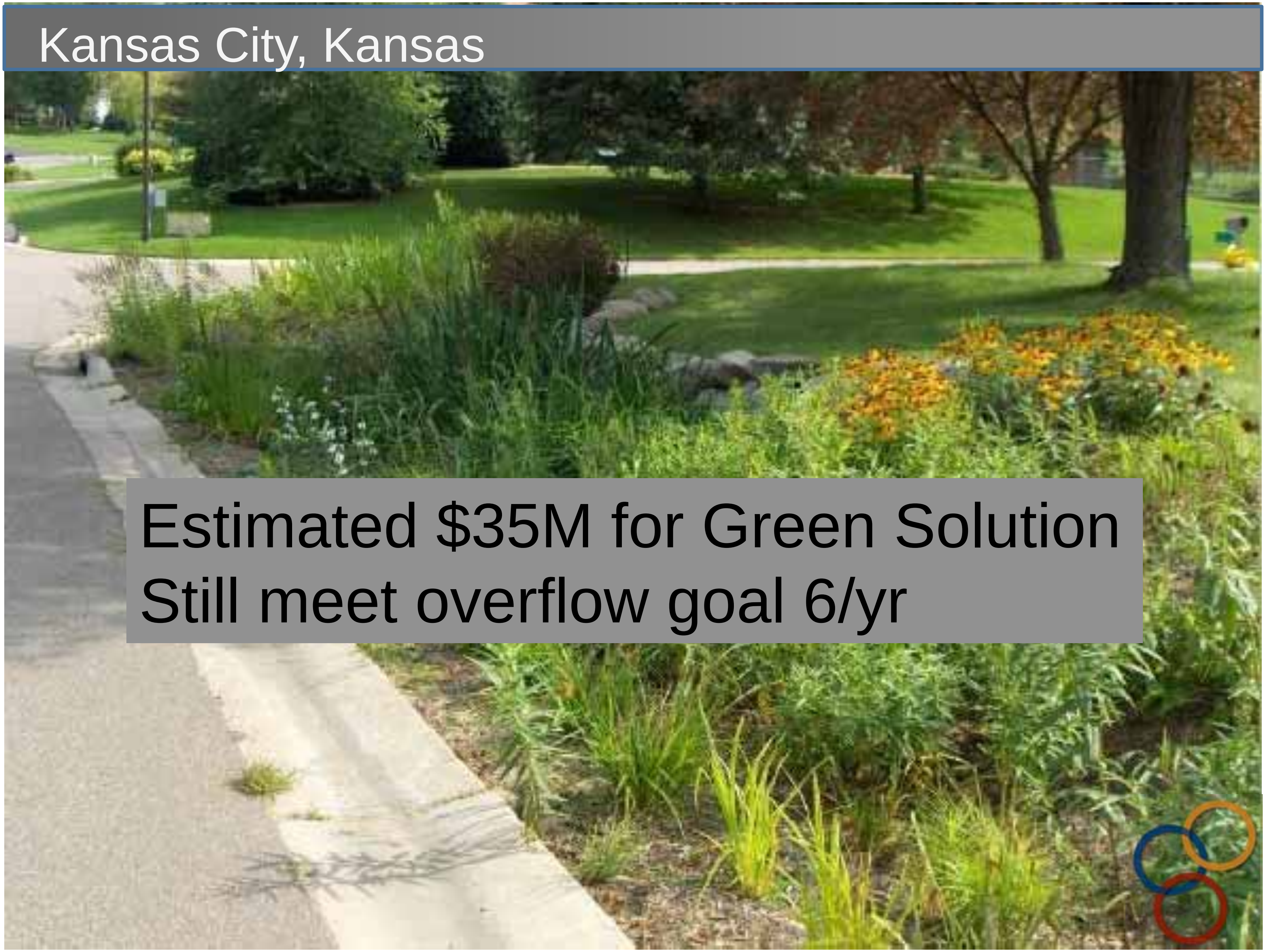
Kansas City, Kansas



Estimated $6B for City-wide Grey Solution

Middle Blue River estimated $54M

Kansas City, Kansas



Estimated $35M for Green Solution

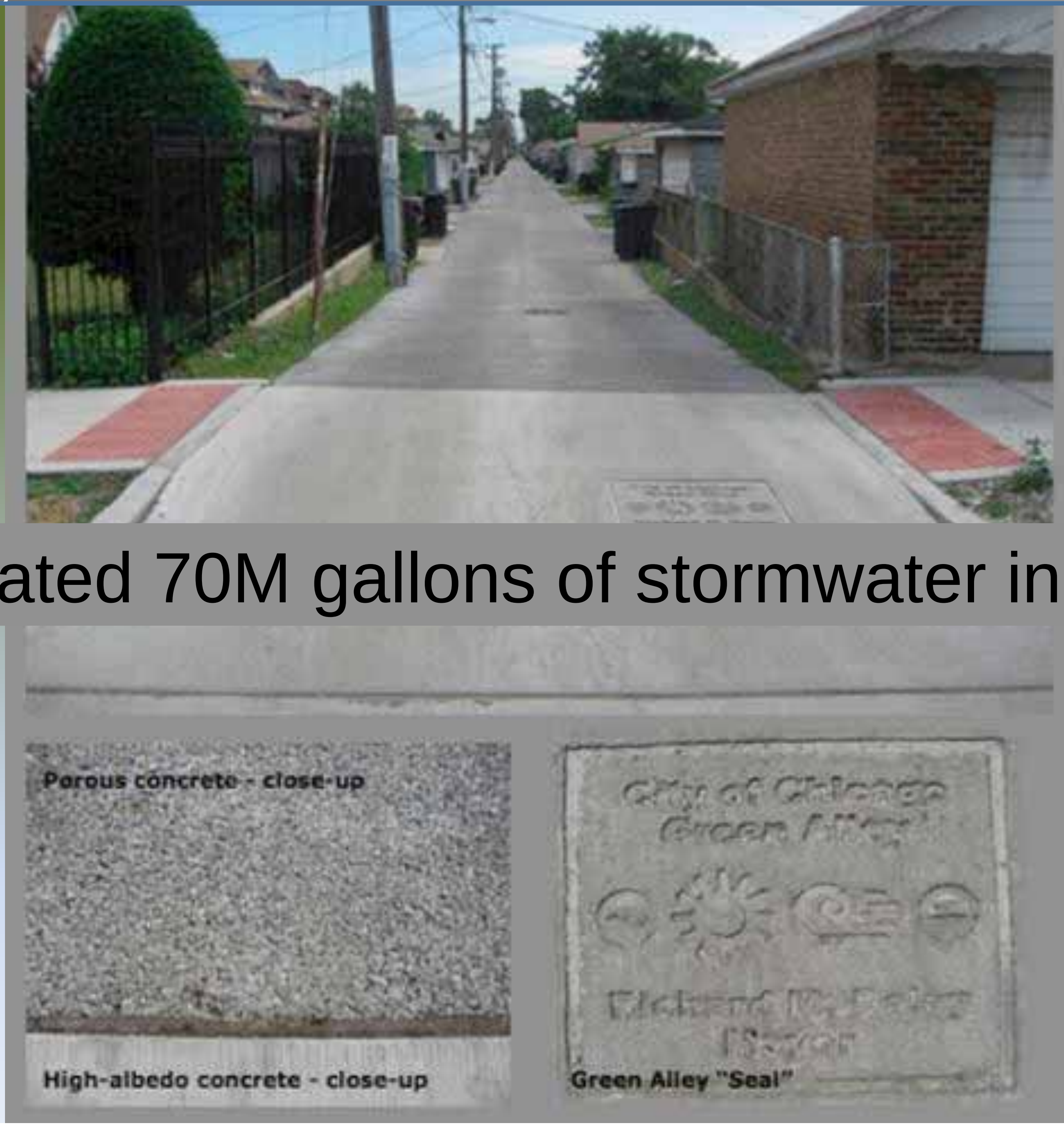
Still meet overflow goal 6/yr

Kansas City, Kansas

Chicago, Illinois

Chicago, Illinois

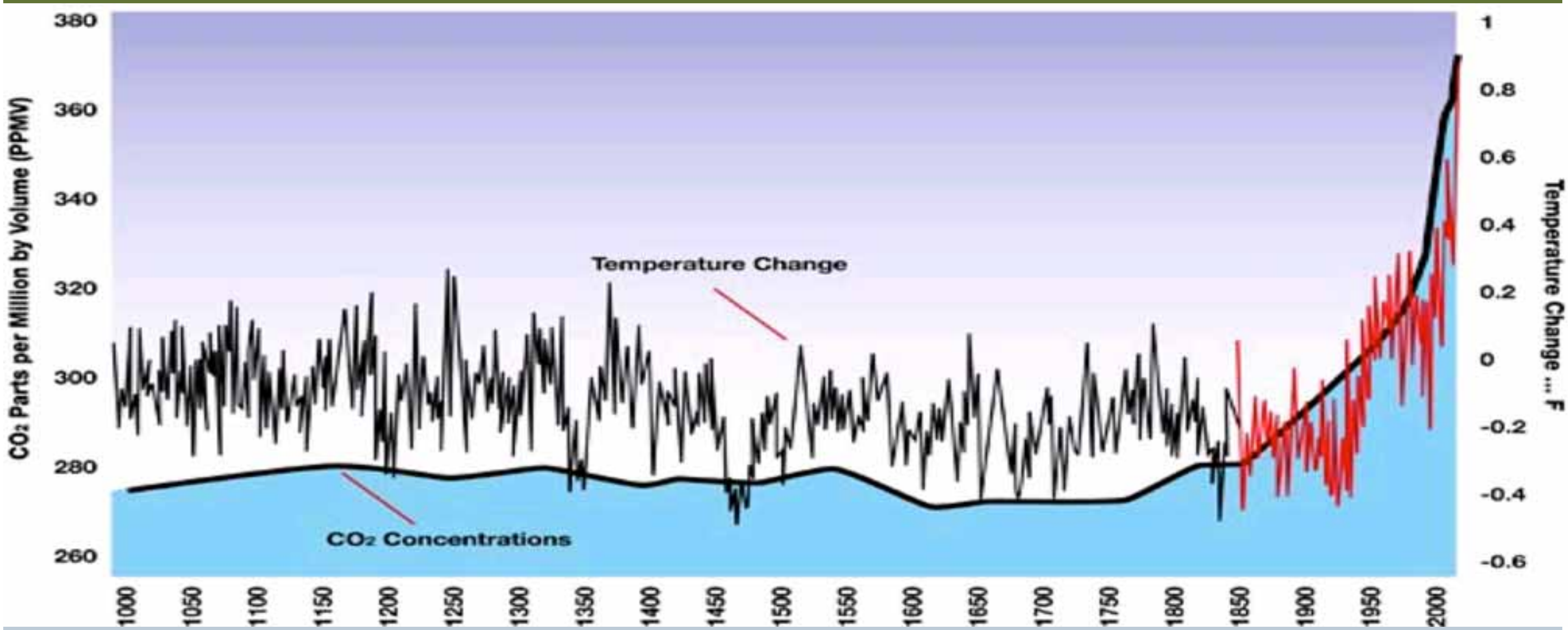
Chicago, Illinois



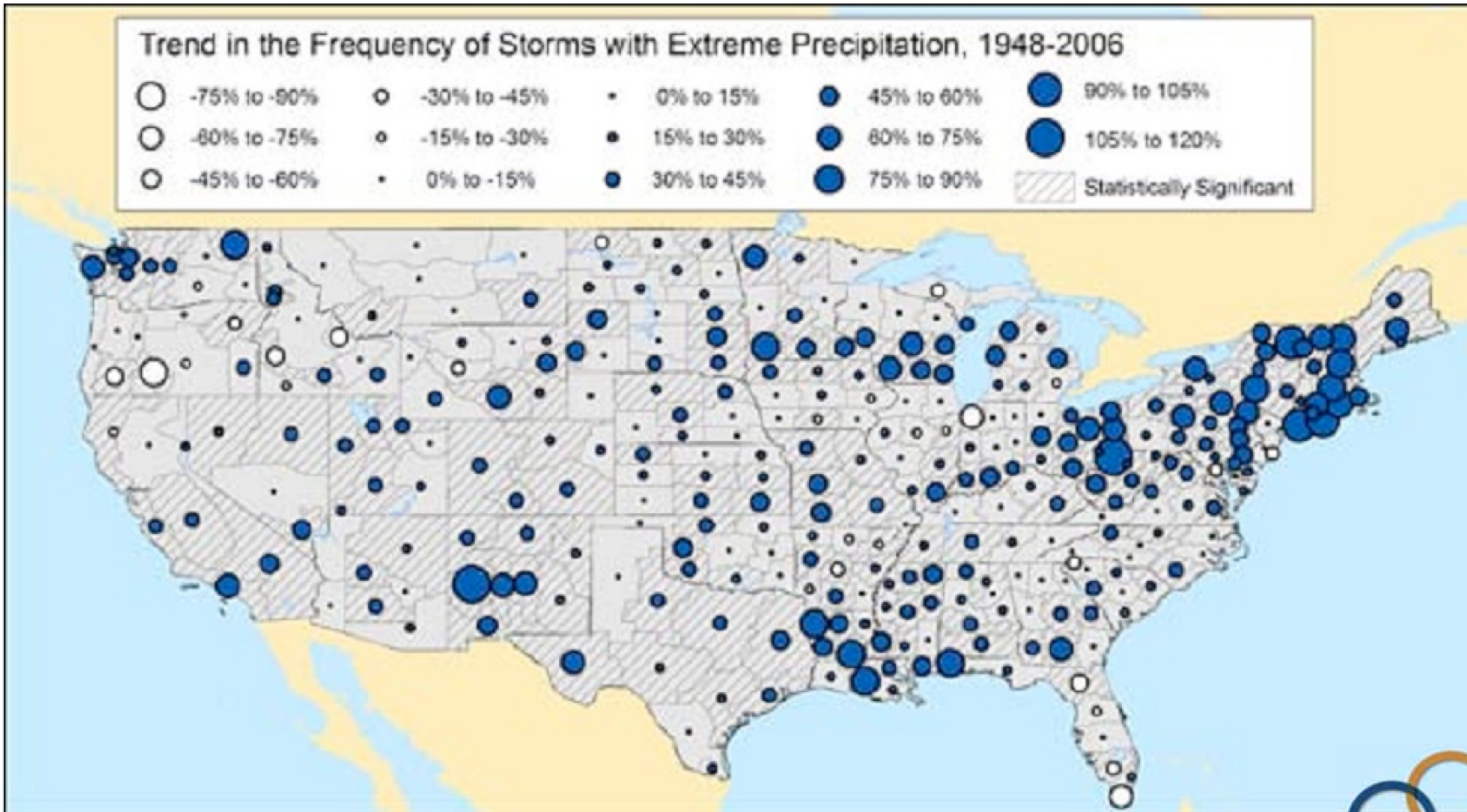
Eliminated 70M gallons of stormwater in 2009

Chicago, Illinois

Changing Trends



Changing Trends



Changing Trends

Spring
1971 -2000
24hr

return period (years)	P	**baseline -95% conf**	**baseline**	**baseline +95% conf**
1	0.1	2.44	2.68	2.94
2.5	0.6	4.14	4.78	5.45
5	0.8	5.12	6.21	7.43
7.5	0.8667	5.66	7.06	8.73
10	0.9	6.04	7.69	9.73
25	0.96	7.25	9.88	13.52
50	0.98	8.19	11.76	17.15
75	0.98667	8.74	12.96	19.66
100	0.99	9.14	13.87	21.64
250	0.996	10.45	17.09	29.27
500	0.998	11.47	19.90	36.67
750	0.99866 7	12.08	21.71	41.81
1000	0.999	12.52	23.07	45.87

Compared to 1926-1955

28% increase in amount
1% decrease in rainy days

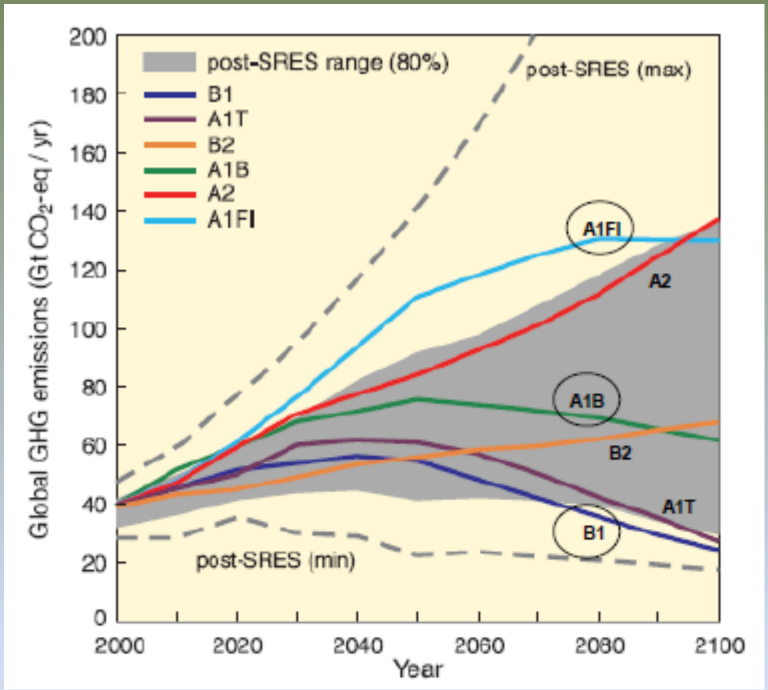
Previous 75yr
now 25yr

Previous 25yr
Now 10yr

New England Floods, Spring 2005

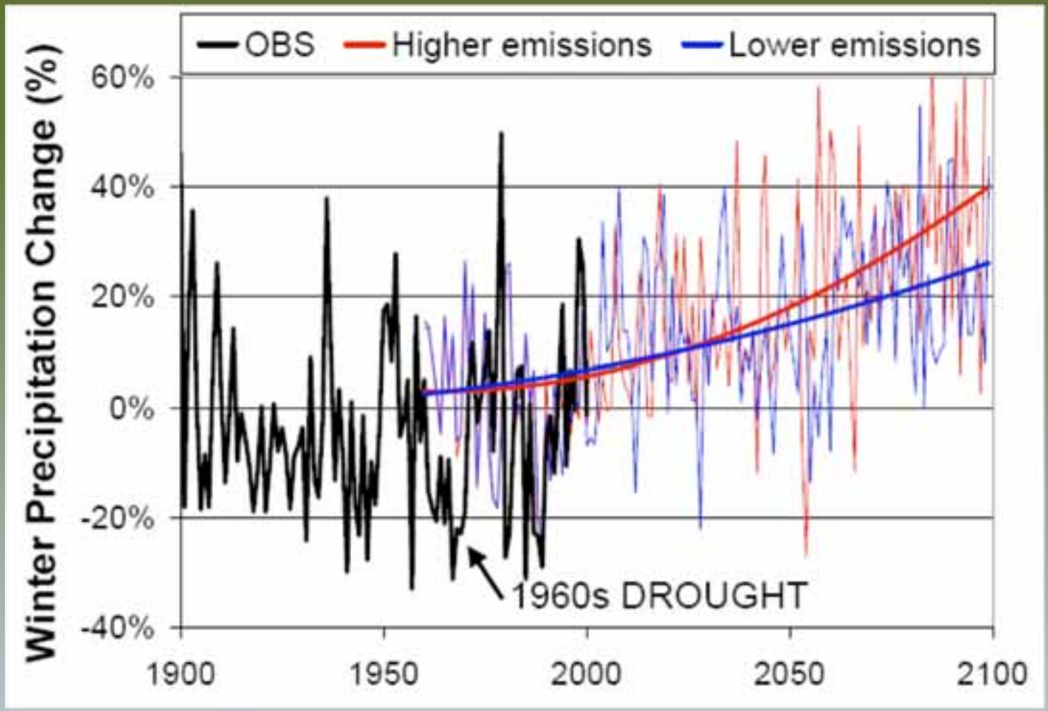
Predicting Future Changes: Greenhouse Gas Emissions Scenarios

"Scenario Family"	Description
A1 – Rapid Growth A1FI - Fossil Intensive A1T - Non-fossil A1B – Balanced	Second Highest Greenhouse Emissions
A2 – Heterogeneous High Population Growth Slow Economic and Technology Change	Highest Greenhouse Emissions
B1 – Convergent World Same Population as A1, more service and information technology.	Lowest Greenhouse Emissions
B2 – Intermediate Population growth, local solutions.	Second Lowest Greenhouse Emission



Special Report on Emissions Scenarios, IPCC 2000

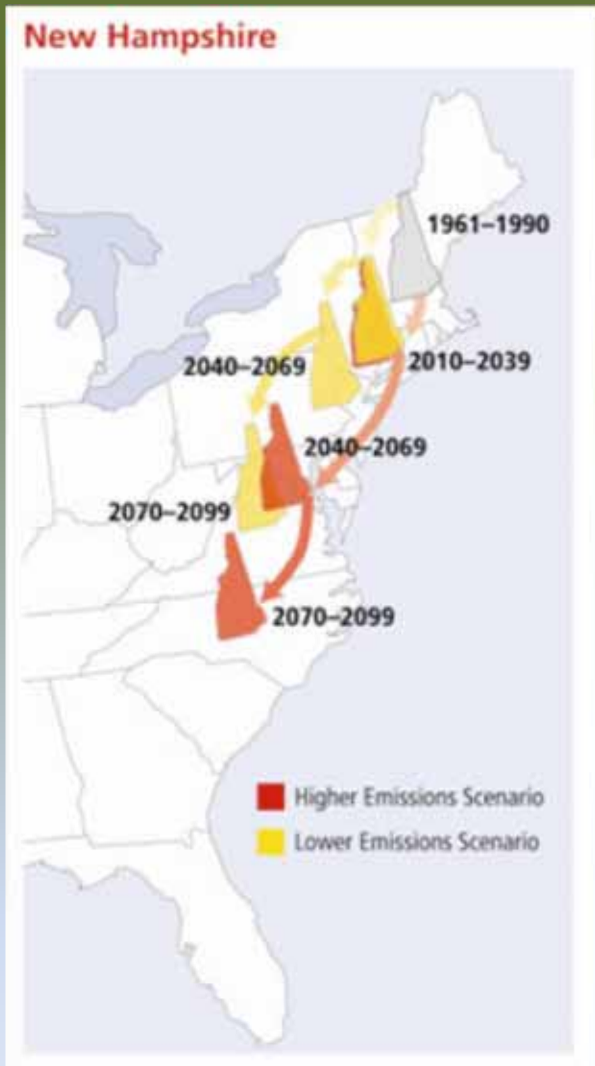
Changing Trends



- Winter precipitation is projected to increase more dramatically increasing between 20 to 30 percent by the end of the century.
- Compared with the past few decades, a greater proportion would be expected to fall as rain rather than as snow.

Source: NECIA climate report 2006

Changing Trends

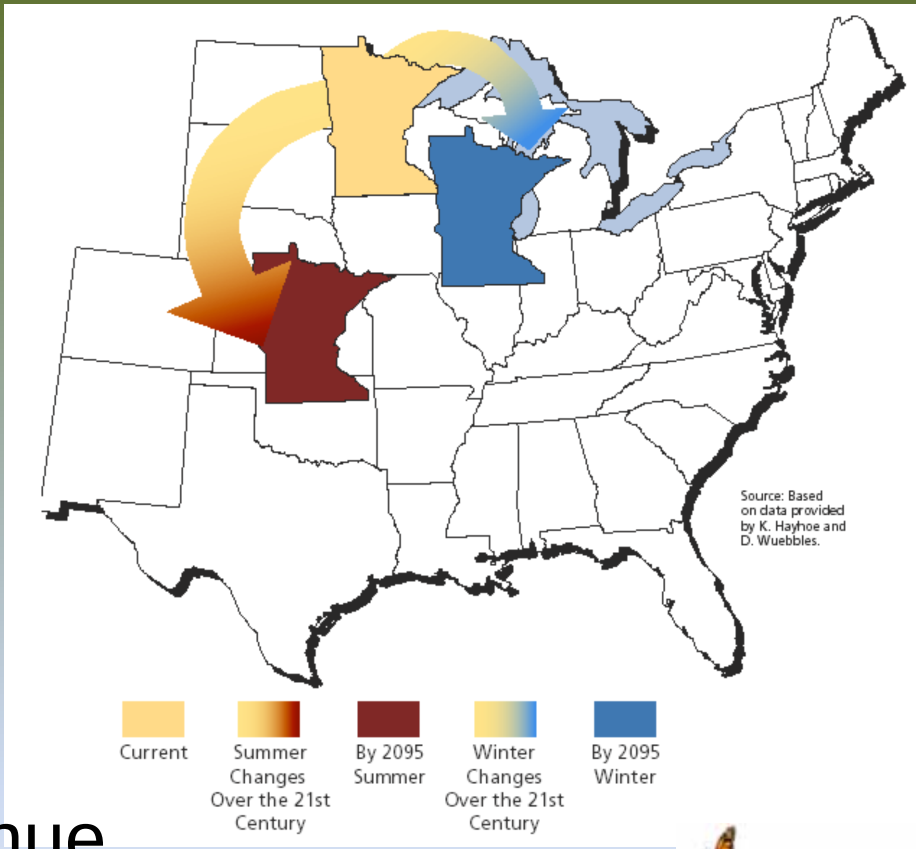


- Average temperatures across the Northeast have risen more than 1.5 degrees (°F) since 1970,
- winters have warmed most rapidly —4°F between 1970 and 2000.
- If higher emissions models project average temperatures across New Hampshire are to rise 9°F to 13°F above historic levels in winter and 6°F to 14°F in summer by late-century,

Source: NECIA climate report 2006

Projected Climate Changes in the Great Lakes Region by 2100

- Temperature
  - 40+ days exceeding 90
  - 10-25 days exceeding 97
- Precipitation
  - Winter, spring increasing
  - Summer, fall decreasing
  - Drier soils, more droughts



- Ice cover decline will continue

Union of Concerned Scientists

esa The Ecological Society of America

Changing Trends

Transportation Networks:
Low lying roads or bridges

Changing Trends

Changing Trends


LAND ROVER

Changing Trends

Dealing with Climate Change

Make your community more **climate resilient**

- ***Protect resources/systems*** from climate change impacts
- ***Accommodate or adapt*** to expected changes
- ***Abandon or retreat*** when accommodation and protection are not feasible

Sequence of Key Climate Change Questions

1. What changes in climate are expected?
2. How will these changes impact the watershed environments in which managers operate?
3. How vulnerable are communities and managers to these changes in the watershed environment?
4. What can and should communities do to manage the high risk vulnerabilities?

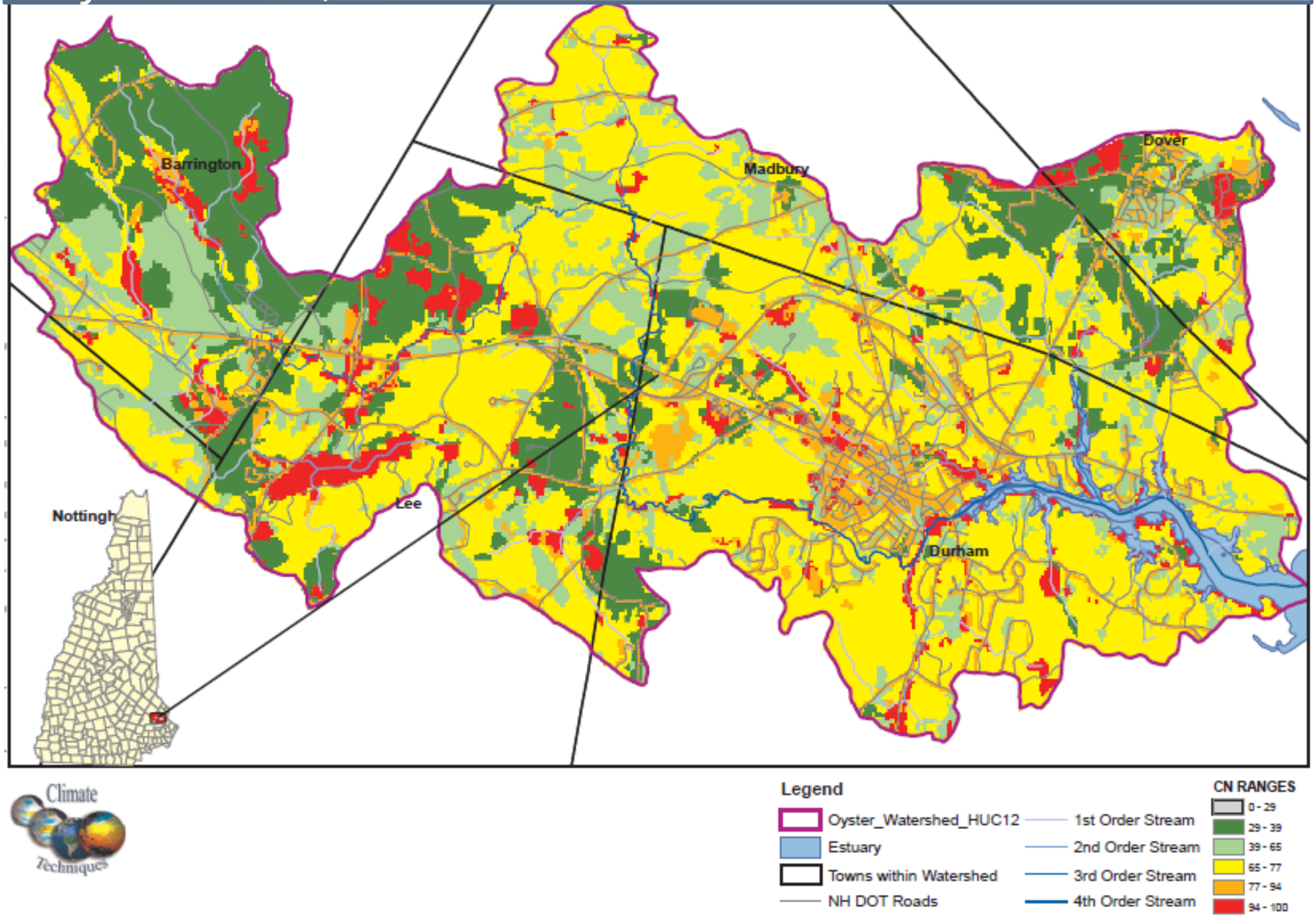
What is Adaptation?

Definition – ***Adaptation*** is any action or strategy that reduces vulnerability to the impacts of climate change. The main goal of adaptation strategies is to improve local community ***resilience***, or the ability of a community to bounce back quickly from climate impacts

Community Resiliency and Infrastructure

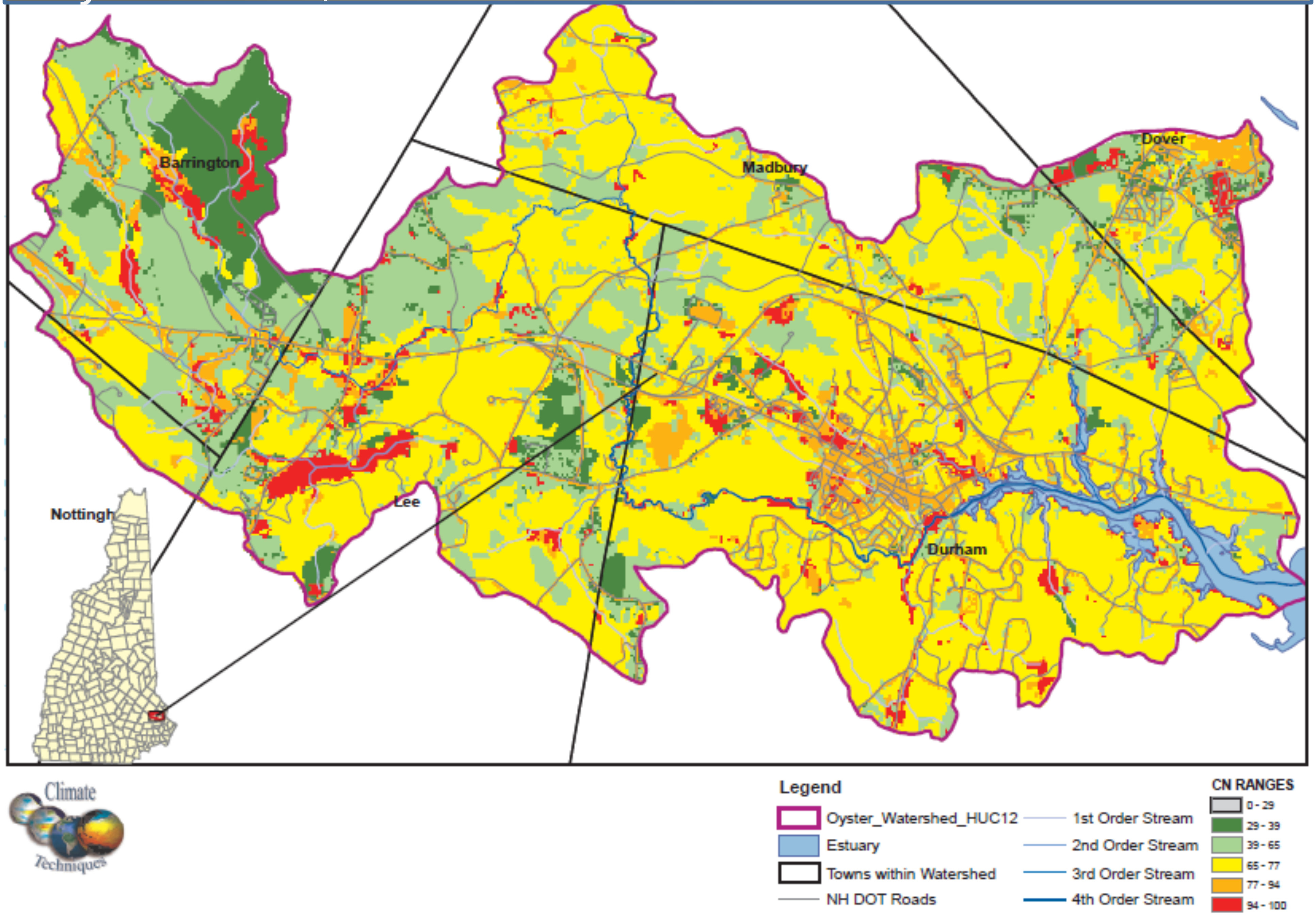
Source: Antioch University of New England, 2009

Oyster River, NH



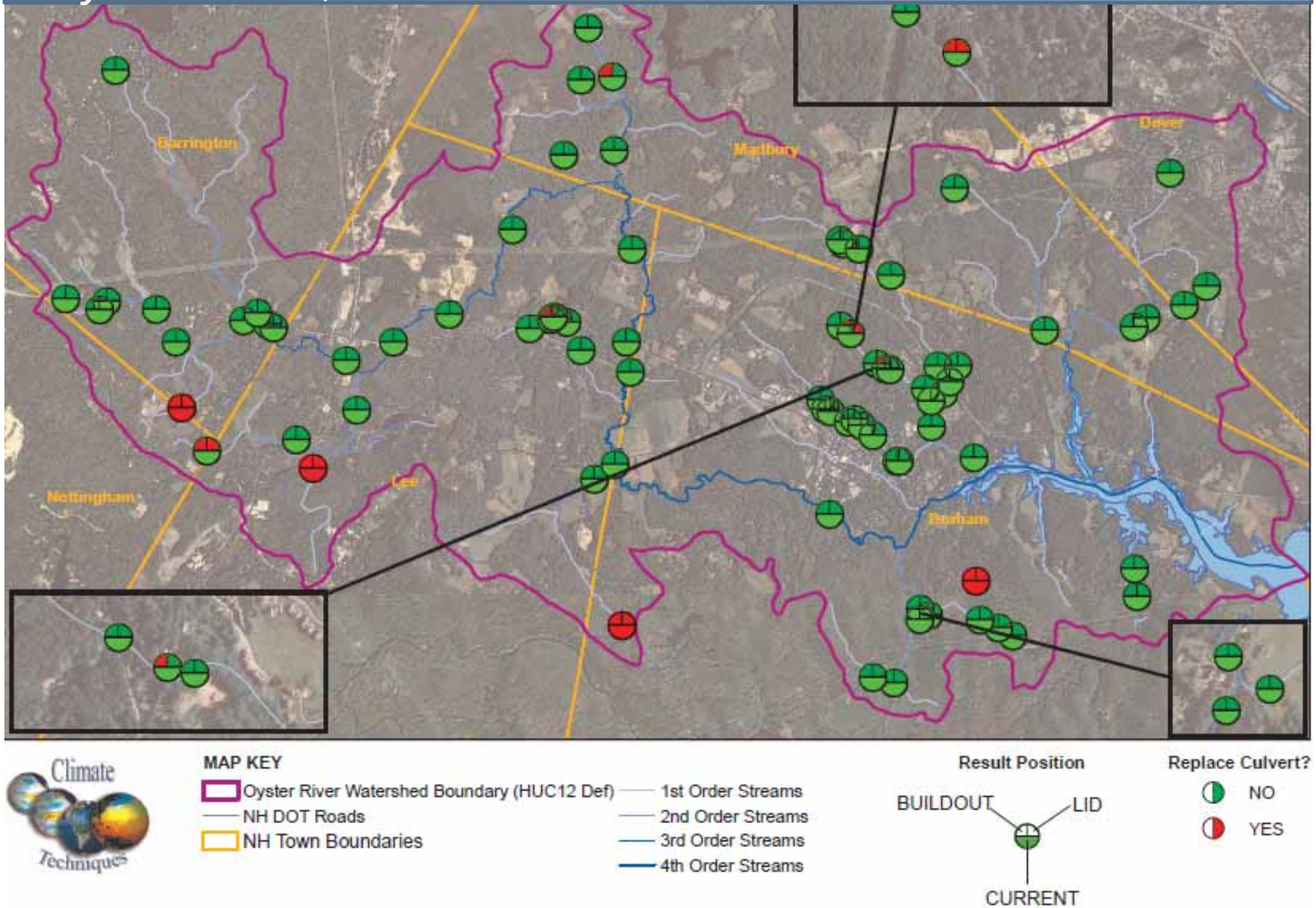
Climate Techniques

Oyster River, NH

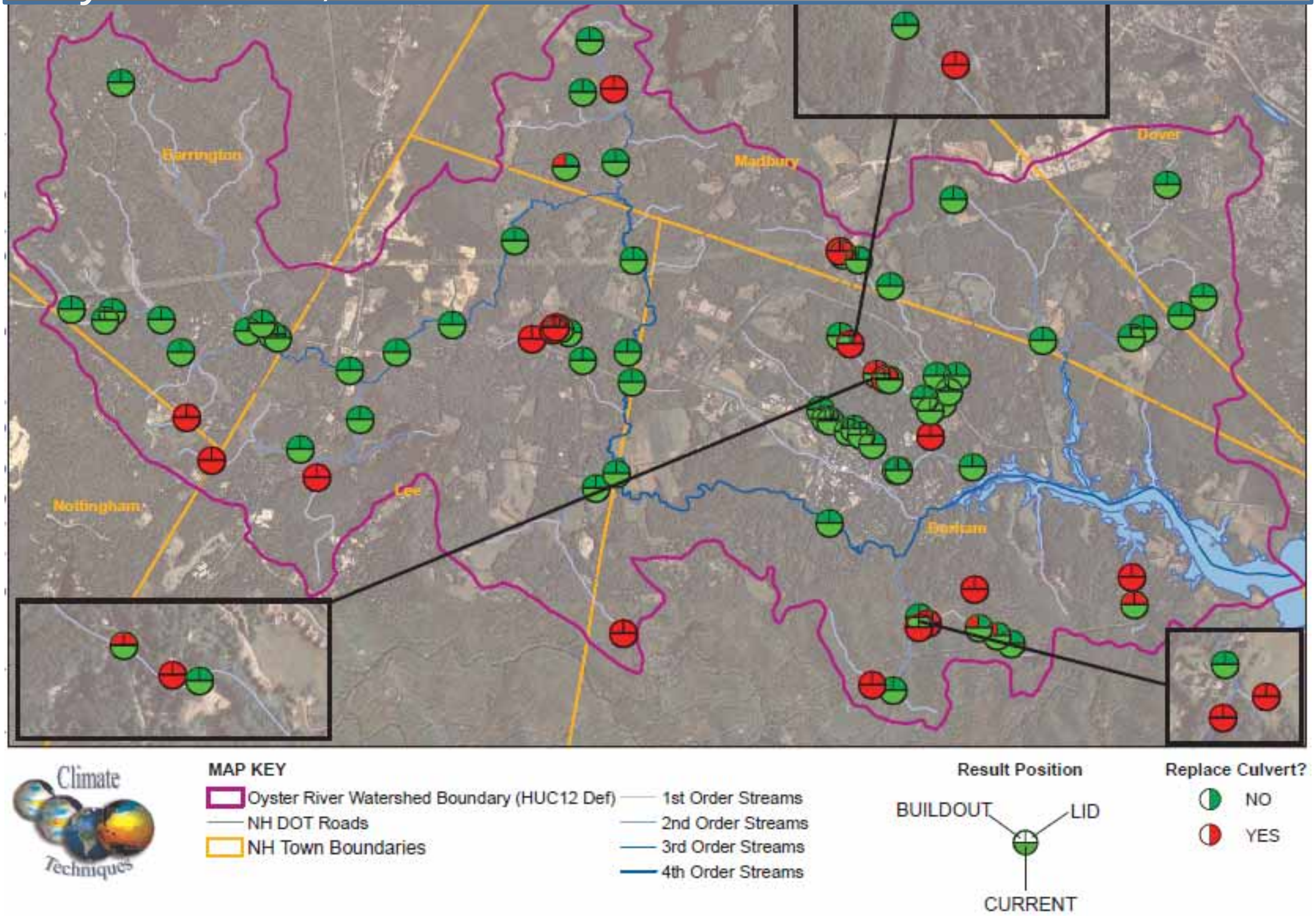


Climate Techniques

Oyster River, NH



Oyster River, NH

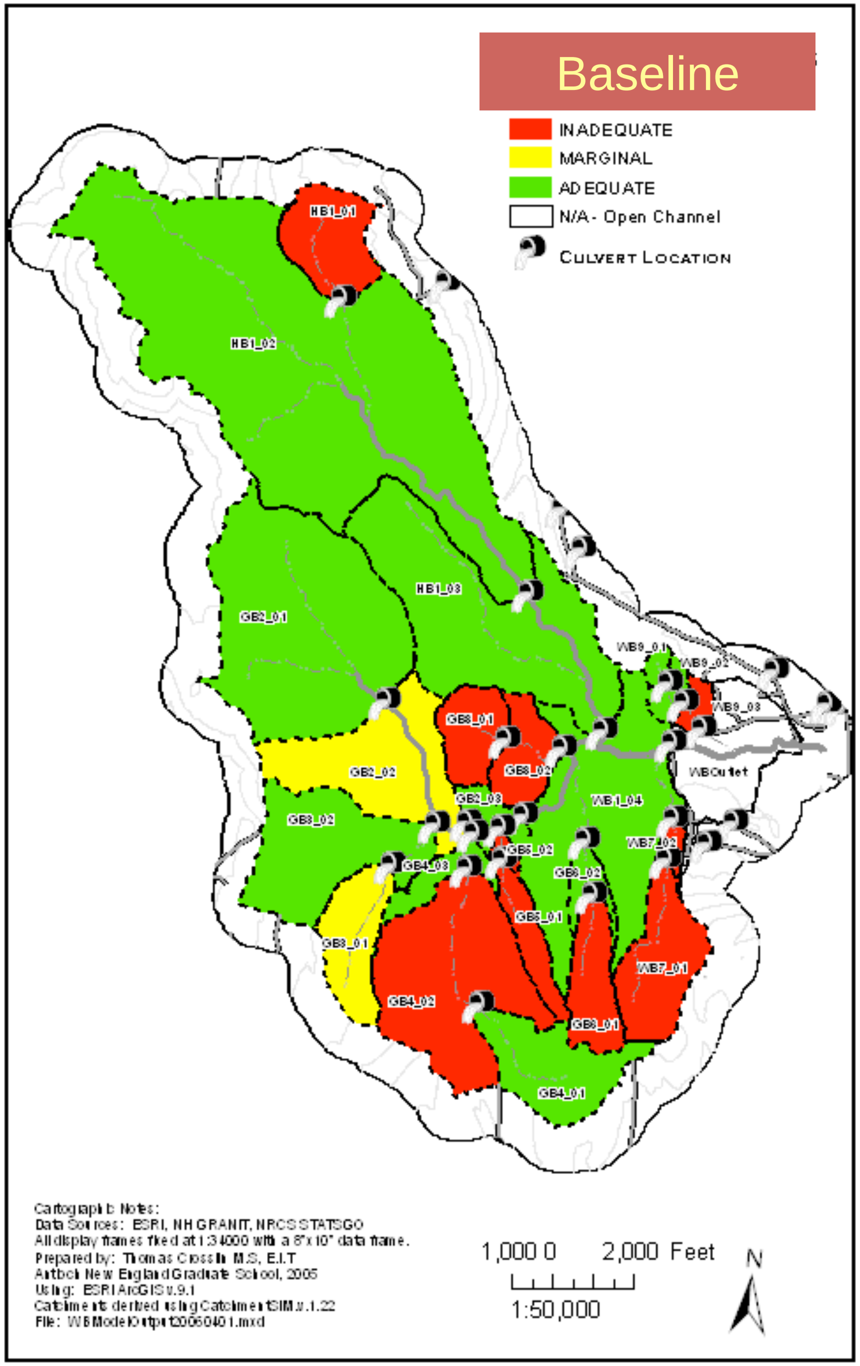


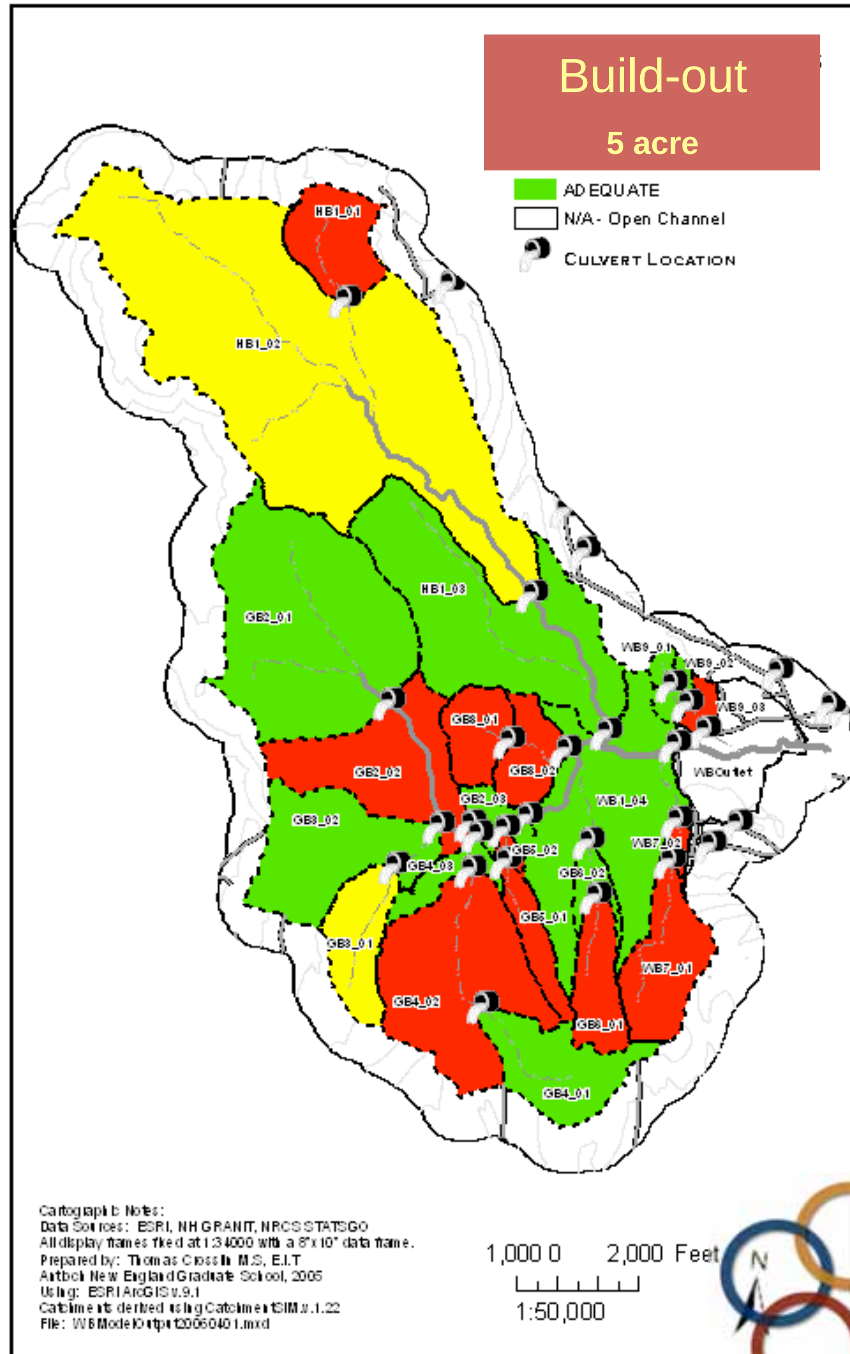
Community Resiliency and Infrastructure

LID analysis

	scenario	total cost for upgrade	upgrade Cost w/ LID	Avoided Cost	% Change (decrease)	
SPRING	BASE SP Current Ant 2	$ 36,016	$ -	$ 36,016	100%	
	A1B SP Current Ant 2	$ 36,016	$ 21,242	$ 14,773	41%	
	A1Fi SP Current Ant 2	$ 57,063	$ 41,180	$ 15,883	28%	
	[illegible]	$ [illegible]	$ [illegible],899	$ 38,576	37%	
	A1Fi SP Current Ant 3	$ [illegible]	$ [illegible]	$ 48,793	24%	
					mean	**46%**
FALL	BASE FA Current Ant 2	$ 88,264	$ 50,446	$ 37,818	43%	
	A1B FA Current Ant 2	$ 204,293	$ 152,590	$ 51,703	25%	
	[illegible]	$ [illegible]	$ 222,267	$ 12,089	5%	
	[illegible]	$ [illegible]	$ [illegible]	$ 12,089	5%	
	[illegible]	$ [illegible]	$ [illegible]	$ 51,537	16%	
					mean	**20%**
				mean (total)	**32%**	

Implementing LID could save over 30% in Municipal Infrastructure costs


Baseline
INADEQUATE
MARGINAL
ADEQUATE
N/A - Open Channel
Culvert Location
HB1_01
HB1_02
HB1_03
GB2_01
GB2_02
GB4_01
GB4_02
WB1_04
WB7_01
WB Outlet
Cartographic Notes:
Data Sources: ESRI, NH GRANIT, NRCS STATSGO
All display frames fixed at 1:34000 with a 8"x10" data frame.
Prepared by: Thomas Crossin M.S, E.I.T
Antioch New England Graduate School, 2005
Using: ESRI ArcGIS v.9.1
Catchments derived using CatchmentSIM v.1.22
File: WBModelOutput20060401.mxd
1,000 0 2,000 Feet
1:50,000
N


Build-out
5 acre
ADEQUATE
N/A - Open Channel
Culvert Location
HB1_01
HB1_02
HB1_03
GB2_01
GB2_02
GB4_01
GB4_02
WB1_04
WB7_01
WB Outlet
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File: WBModelOutput20060401.mxd
1,000 0 2,000 Feet
1:50,000
N



Cost Development

Quantities and costs of culverts to be upgraded

Culver… (m…	… 2 ha Cost
0.	11,500
0.	25,500
1.	44,900
1.	
1.	
1.	70,000
Tot…	51,900
Increme…	06,900

Annual Municipal Budget: $ 48,000,000

Population: 23,000

30 year municipal bond at 8%

$ 6.75 / capita / year

Extrapolated to entire community, would be approximately

$ 2 million to upgrade all culverts

peake NEMO

[redacted]


HILLS
DRUGS
SODA


HILL'S
DRUGS
SODA


HILLS
DRUGS
SODA

FORGING THE LINK

Linking the Economic Benefits of Low Impact Development and Community Decisions

Todd Janeski, Virginia Commonwealth University
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