

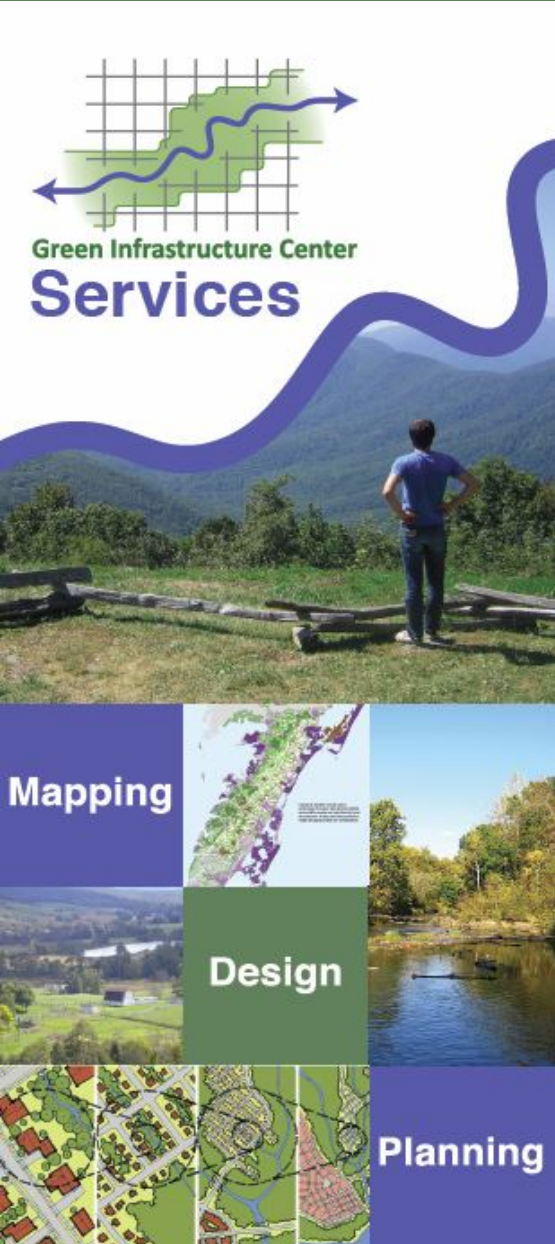
Green Infrastructure

*Planning in the Face of Change,
Urban Forestry Webinar Series*



*Presented by Karen Firehock, Executive Director
February 26, 2015 2-3:00 p.m.*





The Green Infrastructure Center's mission is to help communities evaluate their green assets and manage them to maximize ecological, economic and cultural returns.

We do this by:

Building landscape models

Teaching courses and workshops

Research into new methodologies

www.gicinc.org

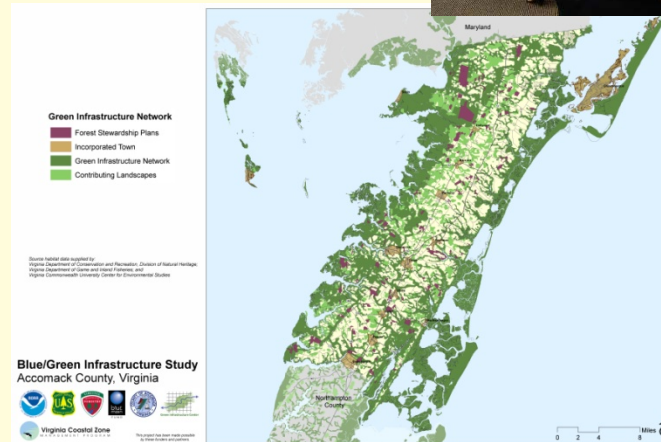
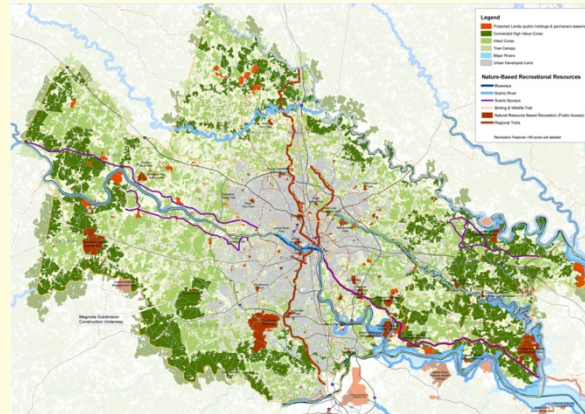
Where We Work

Launched in Virginia, the GIC has conducted 18 projects from multi-county regions, to counties, cities, towns and watersheds.

GIC also has projects in New York, New Jersey, Arkansas, North Carolina, South Carolina as well as research projects for large regions.

We can build a landscape model for any state at any scale.

To view GIC's projects and case studies visit:
www.gicinc.org/projects



Slide Show Topics

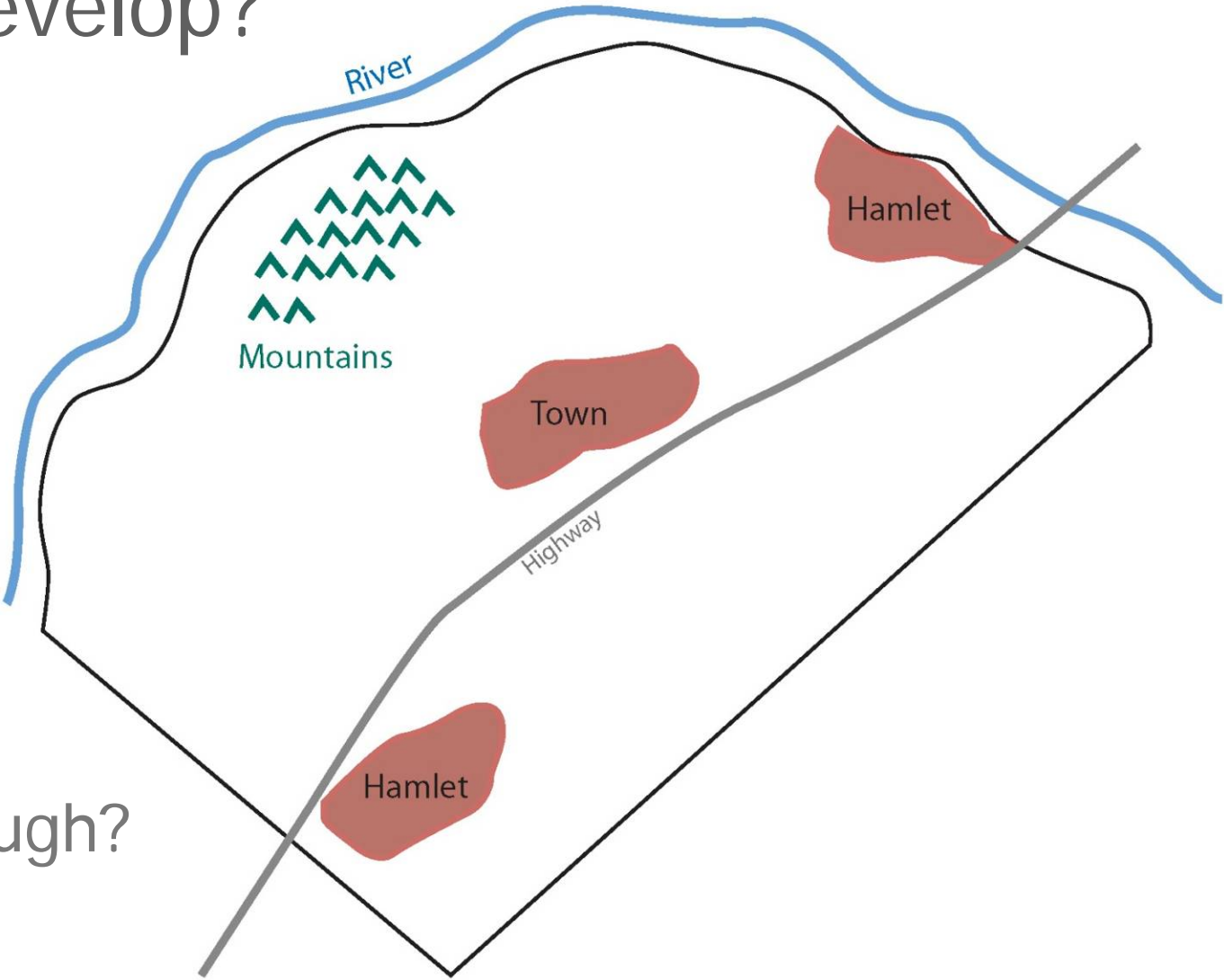
- ❑ Why we need to plan better
- ❑ Green infrastructure defined
- ❑ Green infrastructure ecology
- ❑ Planning at multiple scales
- ❑ Key messages



Where to develop?

Smart Growth =
Using Existing (grey) Infrastructure

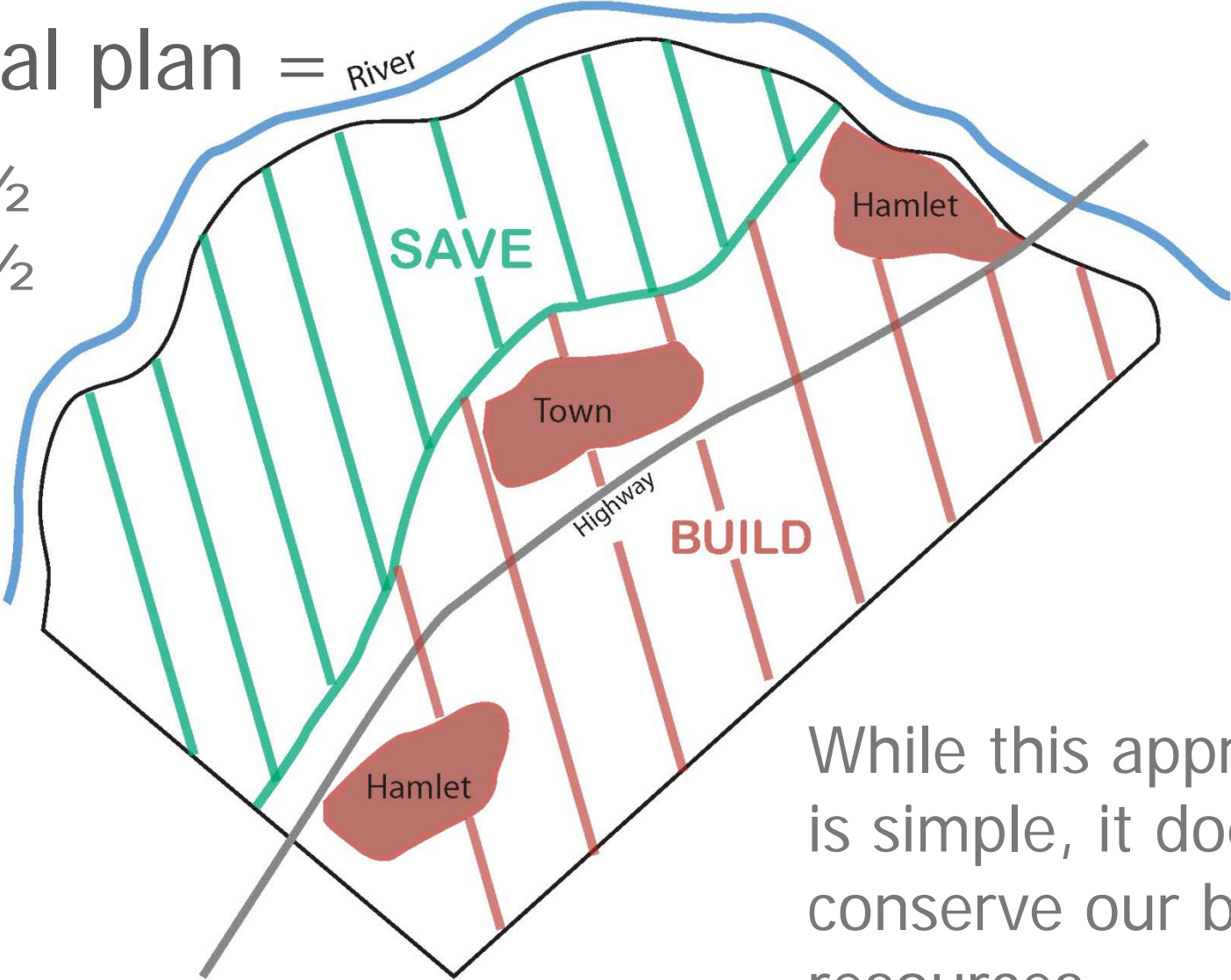
But is this enough?



Typical plan =

River

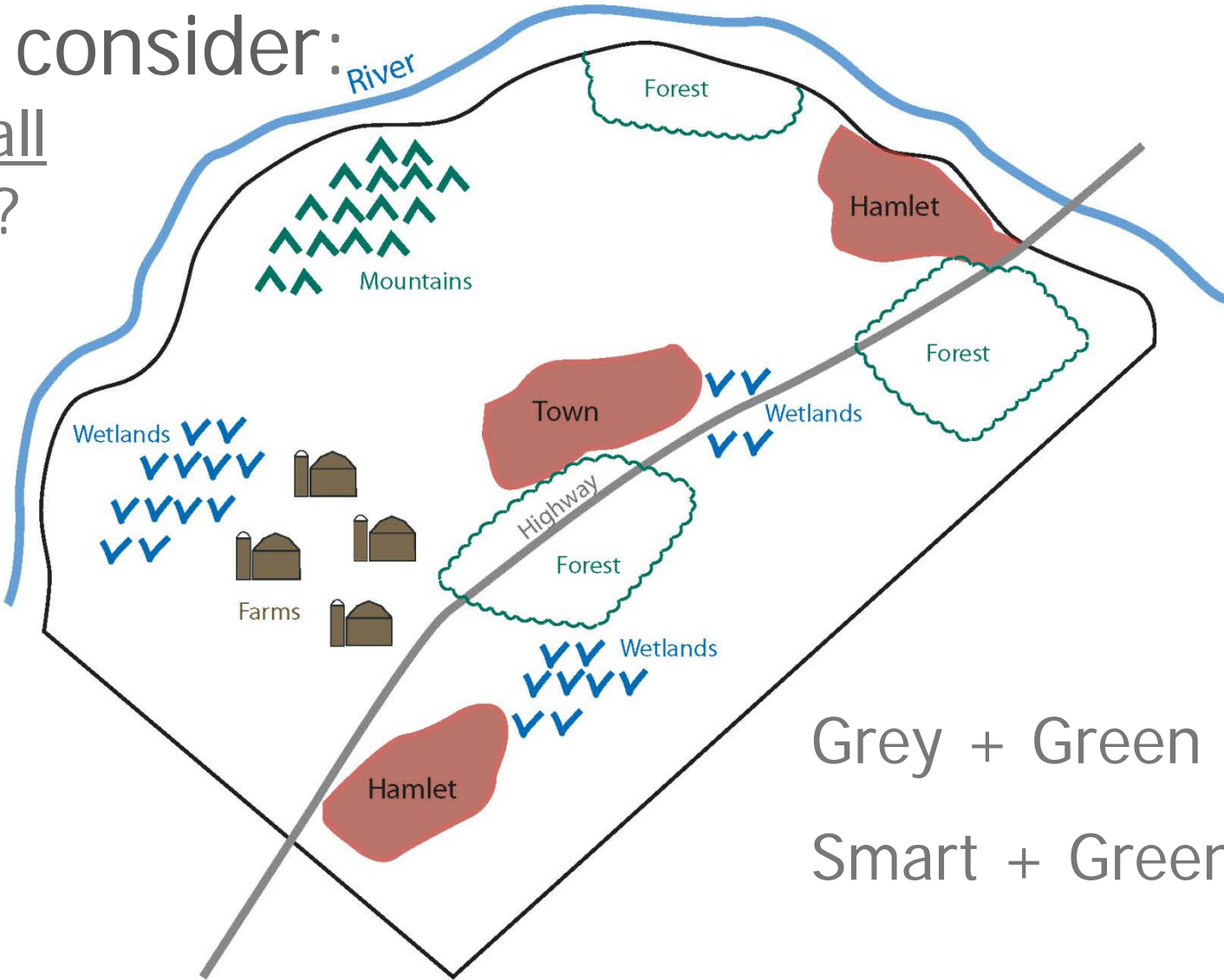
Save 1/2
Build 1/2



While this approach is simple, it does not conserve our best resources.

Need to consider:

What are all the assets?



Grey + Green =
Smart + Green

Impacts of poor/no planning on environment

Traffic congestion

Water quality

Air quality

Loss of critical habitat

Loss of working lands



Impacts of poor/no planning on environment

Traffic congestion

Water quality

Air quality

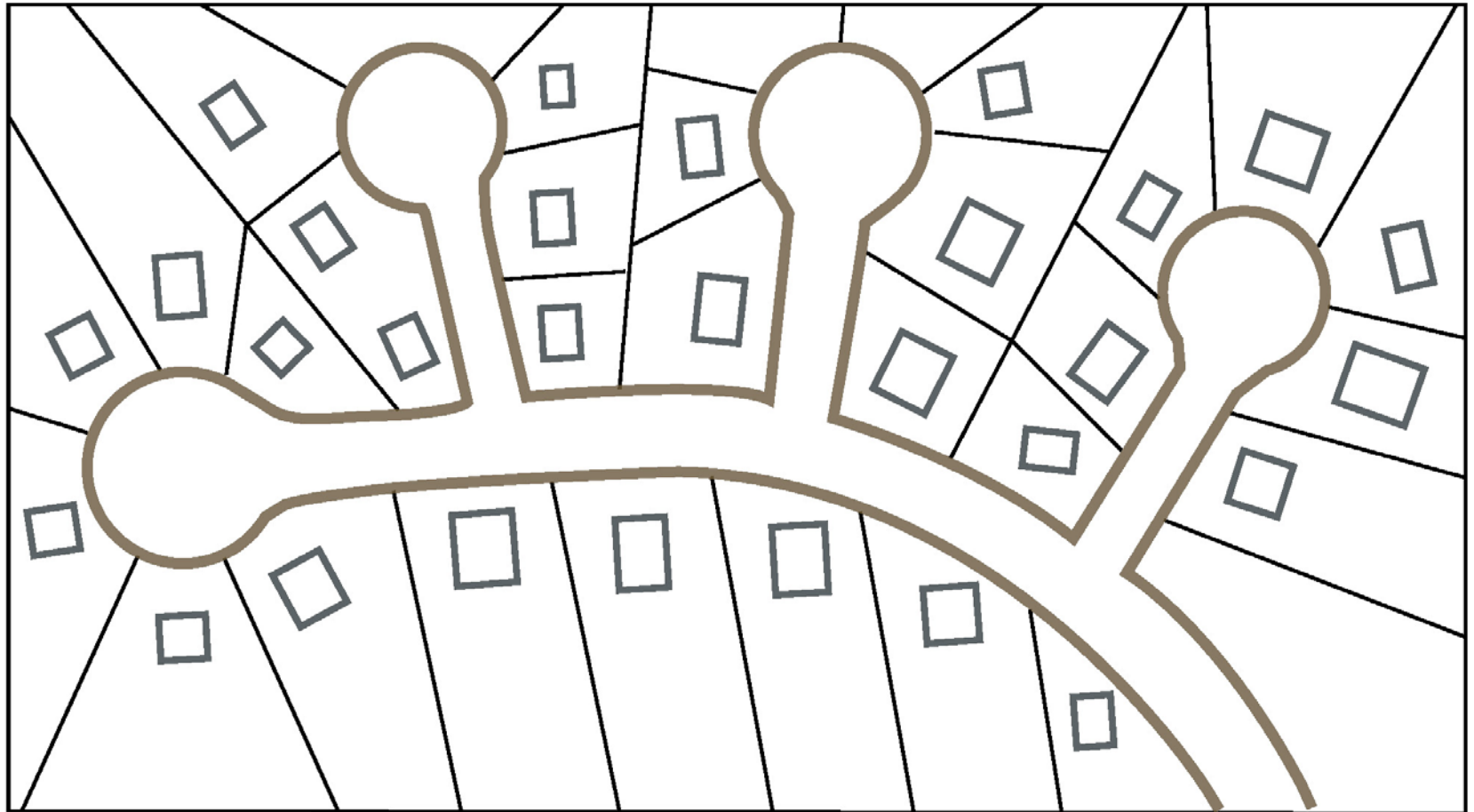
Loss of critical habitat

Loss of working lands



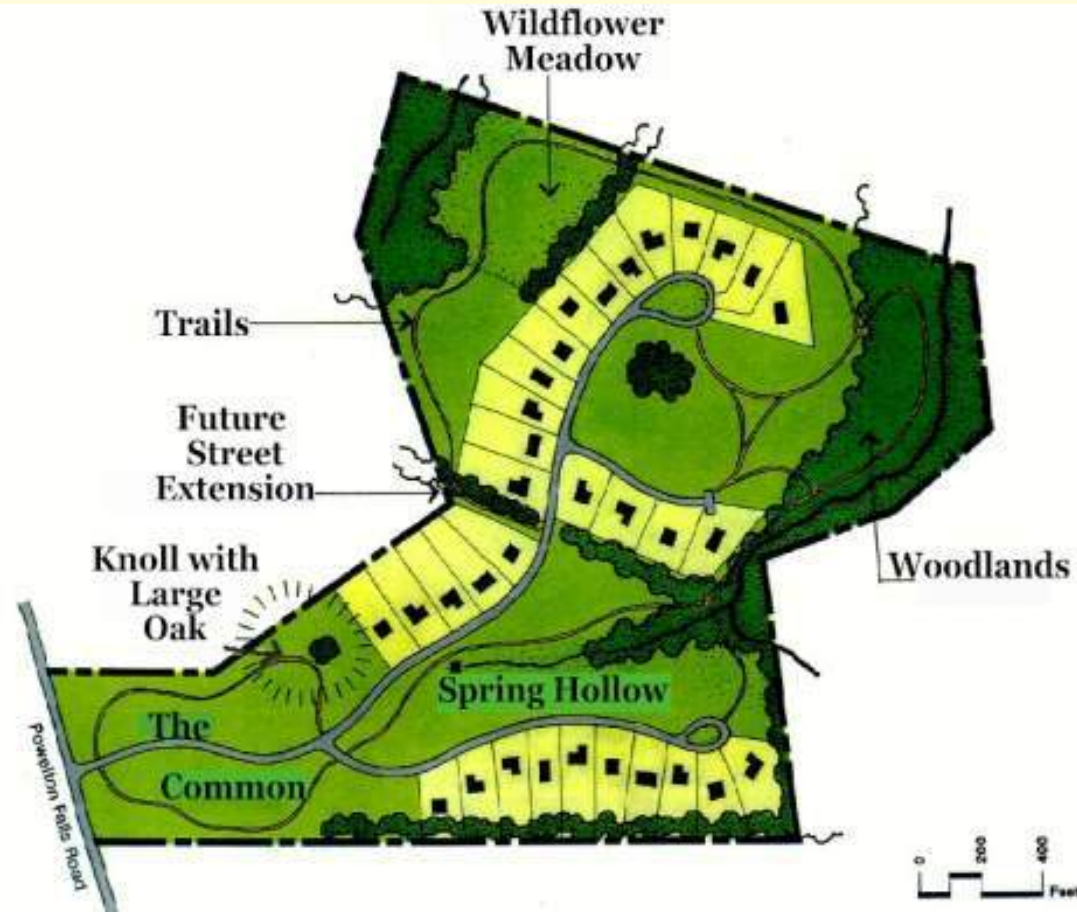
While you viewed this slide, America lost another 3 acres of open space

Traditional Development



Clustering =
setting buildings
closer together
to conserve
green space

Within a subdivision, clustering can add to open spaces and provide an amenity for wildlife and recreation. But which land is protected and how it is connected are critical.



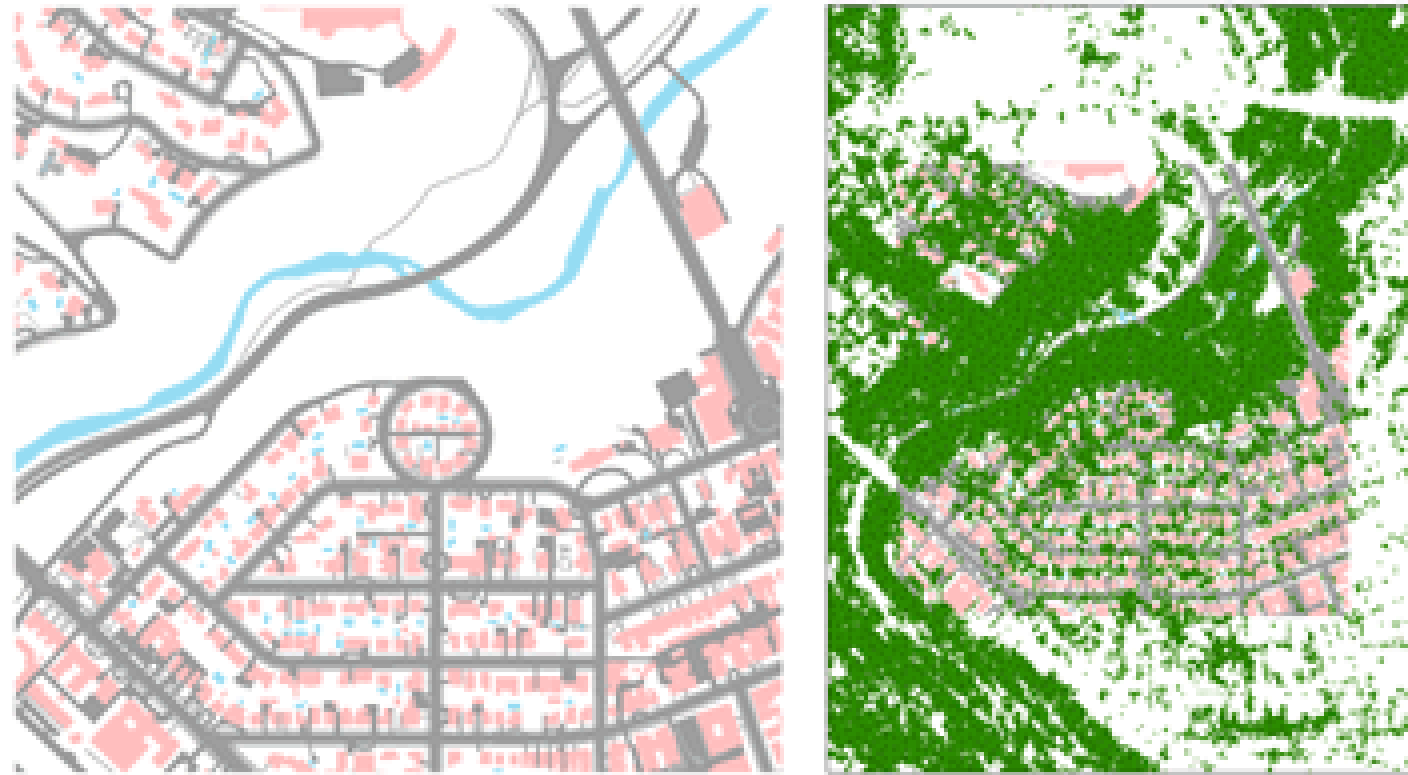
The problem of clusters that don't look beyond parcel boundaries



We can keep land connected with development but only if we plan at a larger scale.



What is Green Infrastructure?



At left, Washington DC's **gray infrastructure** including buildings and roads. Classified satellite imagery at right adds the **green infrastructure** data layer (trees and other vegetation). [Source: American Forests](#)

Origin of the Term “Green Infrastructure”

Florida coined the term “Green Infrastructure.” in a 1994 report to the governor on land conservation strategies.

It was intended to reflect the notion that natural systems are important components of our “infrastructure.”



When Did GI Definition Expand to Include BMPs?

2006: the U.S. EPA begins calling integrated best management practices -- previously referred to as **Low Impact Development** strategies -- “Green Infrastructure.” This led to confusion!



Used in concert – best management practices such as biofilters, no mow zones, permeable pavers, filterra boxes, downspout protection and green roofs can significantly reduce urban runoff impacts.

Trees: the Original Green Infrastructure!

Trees give us cleaner air, shade, beauty and stormwater benefits at a cost that is far cheaper than engineered systems!

Estimates for the amount of water a typical street tree can intercept in its crown, range from 760 gallons to 4000 gallons per tree per year, depending on species.



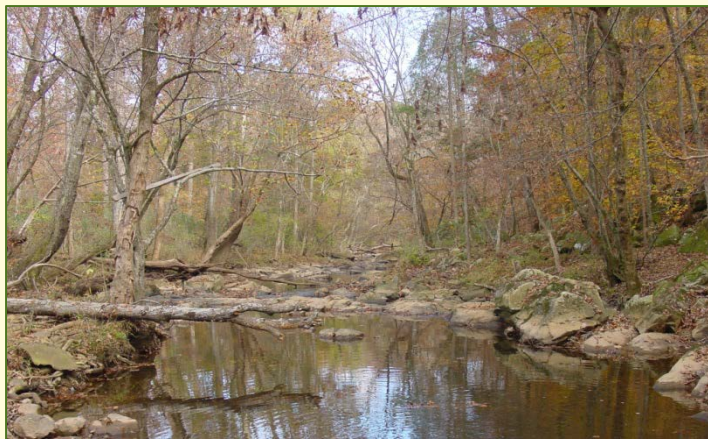
Benefits of Conserving Green Infrastructure

- Conserving working lands such as farms and forests, that contribute to the economy.
- Protecting and preserving water quality and supply.
- Providing cost-effective stormwater management and hazard mitigation.
- Preserving biodiversity and wildlife habitat.
- Improving public health, quality of life and recreation networks.



Natural Assets are Green Infrastructure

Green infrastructure includes working landscapes that support our existence.



Natural Assets Support Cultural Assets

Natural assets support the landscape context for historic and recreation features.







In conclusion, the key is to think strategically about land conservation and development

For new development:

- 1) Is this the right site to develop?
- 2) If yes, how do natural features connect to other sites?
- 3) How can I minimize my site impacts (smaller footprint...) AND keep connections?
- 4) Once I have the right site, have maximized its connections and protected sensitive landscape features, *then and only then* can I ask, how to mitigate the impacts (hint: use LID approaches with a decentralized, small footprint, integrated approach)! Also, if previously impacted, consider restoring the natural features!

In summary, first ask, how can we avoid disturbing natural resources, then second, if we must disturb some area, how can we minimize impacts and lastly, how can we mitigate the harm caused. **So first, conservation and then, mitigation.**



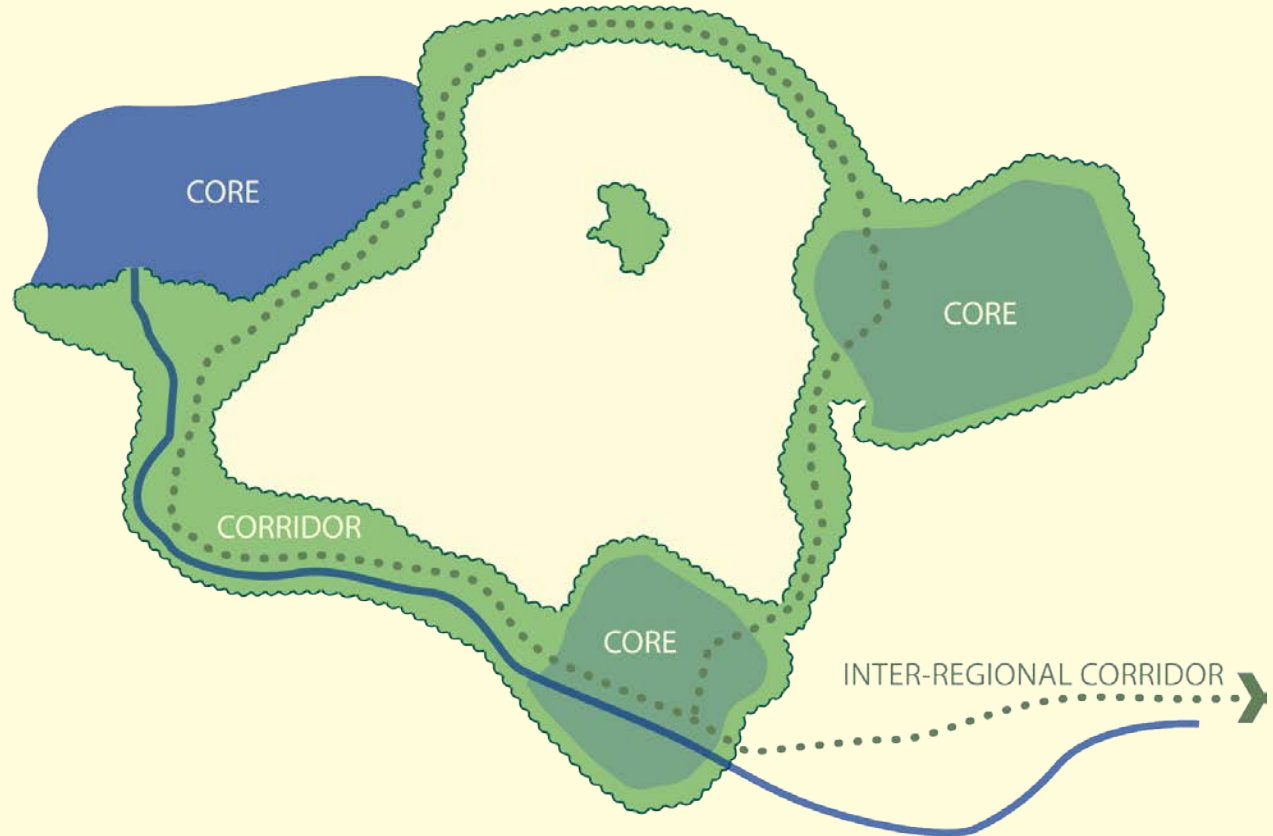
A Quick Introduction to Green Infrastructure Ecology 101



Green Infrastructure Planning For A Connected Landscape

It's about connecting the landscape!

Not just key habitats, but how we connect them counts!



How to Calculate Interior Habitat”

Is it a habitat core?

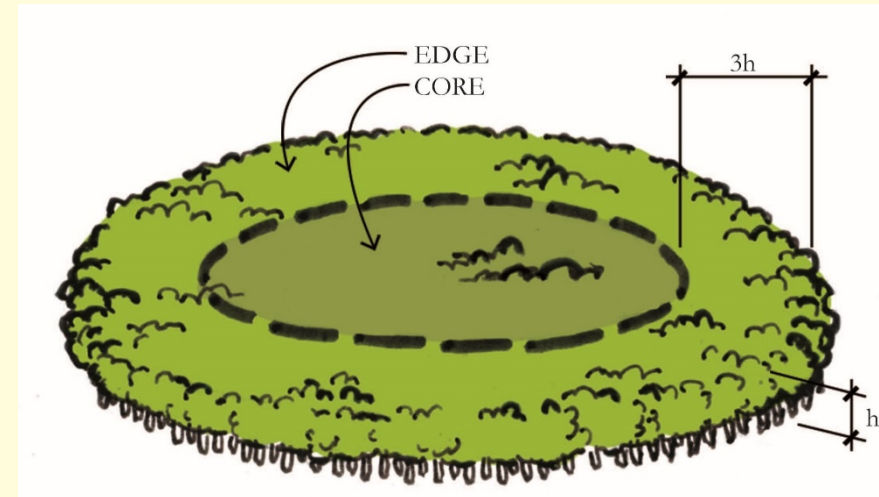
Take a distance of 2-3 “canopy heights” from the edge. Then, multiply by 3 to get edge ~ 100 feet.

Subtract the edge zone from total area to get remaining “interior habitat.” Is it enough to be a core?

If smaller, it may still be a key “patch” or “site.”

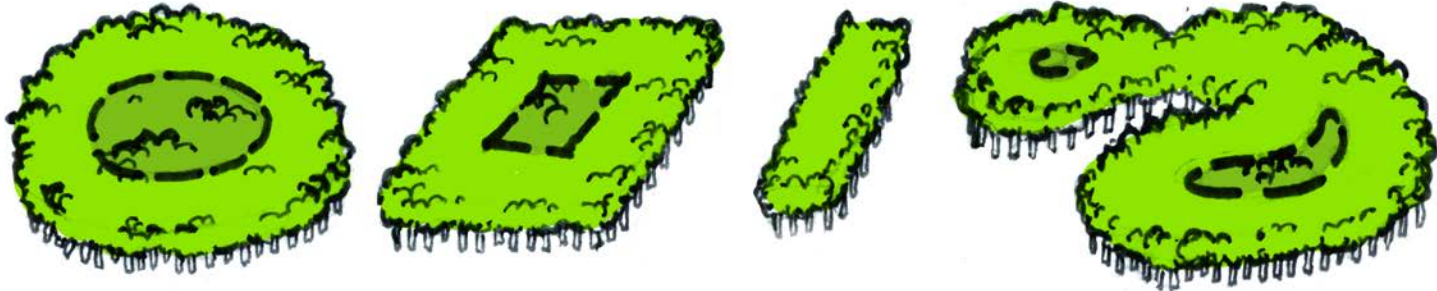
Interior = Total Area – 3(h)

Ideal interior \geq 100 acres



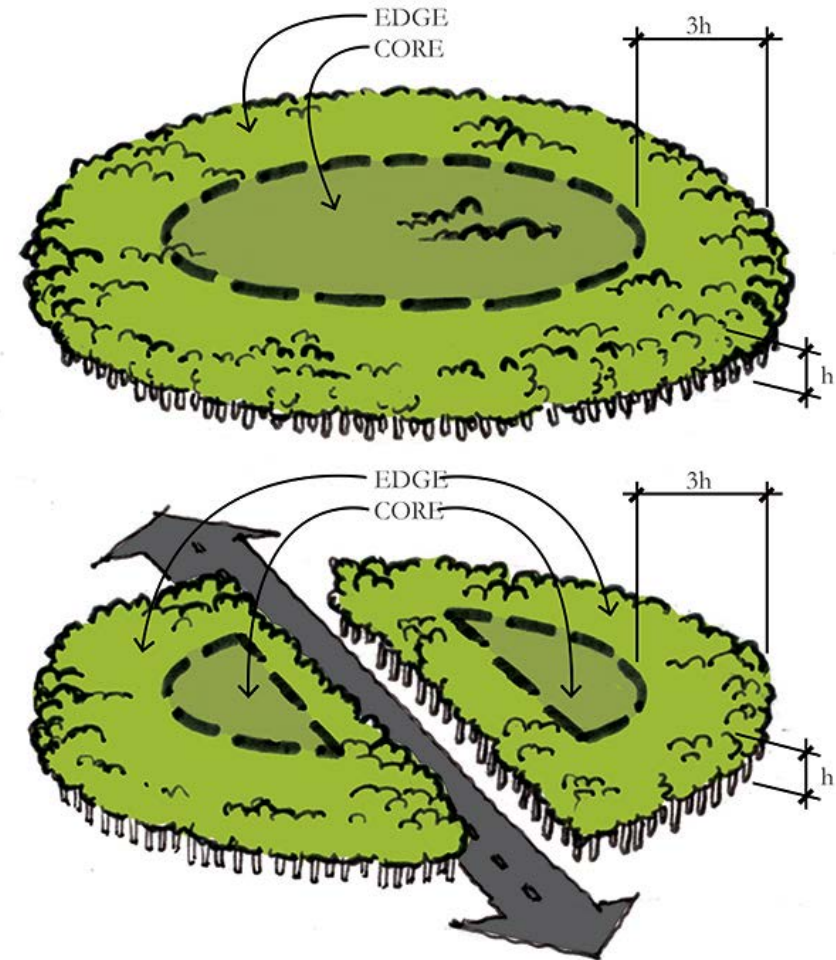
Cores, Patches, Other Habitats

Forested landscapes, wetlands, etc.



Bigger is better and shape matters too. The above images show edge area (generally 300 feet) and interior. Notice which have the most interior.

Dividing a large core into two smaller cores = less interior habitat



Edge area = Average tree height (h) X 3

Core = Total area - Edge area

Ideally, Core \geq 100 acres

Who Prefers Interior Forest Cores?

Birds, e.g. cerulean warbler,
Scarlet tanager



Mammals, e.g. black bear,
bobcat, n. flying squirrel

Amphibians, e.g. spotted
salamander



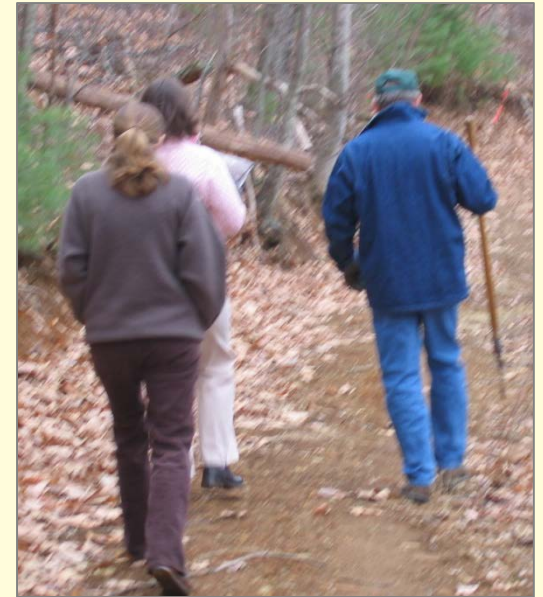
Example: Species Protection in North Carolina



- Big Eared Bat
- Saint Francis' Satyr Butterfly
- Star Nosed Mole
- Southern Hognose Snake
- Green Pitcher Plants
- Bog Turtle



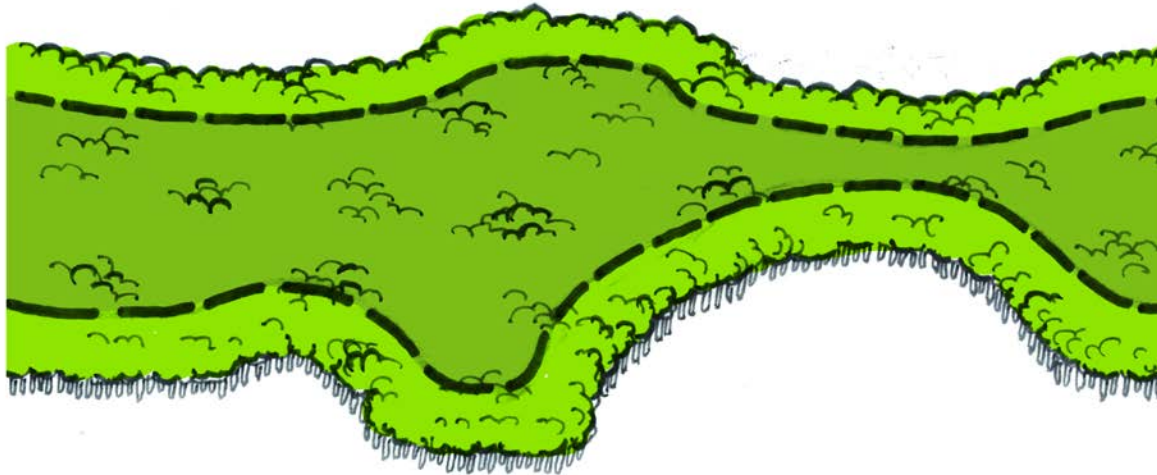
Who can use the corridors? (300 meters is ideal...)



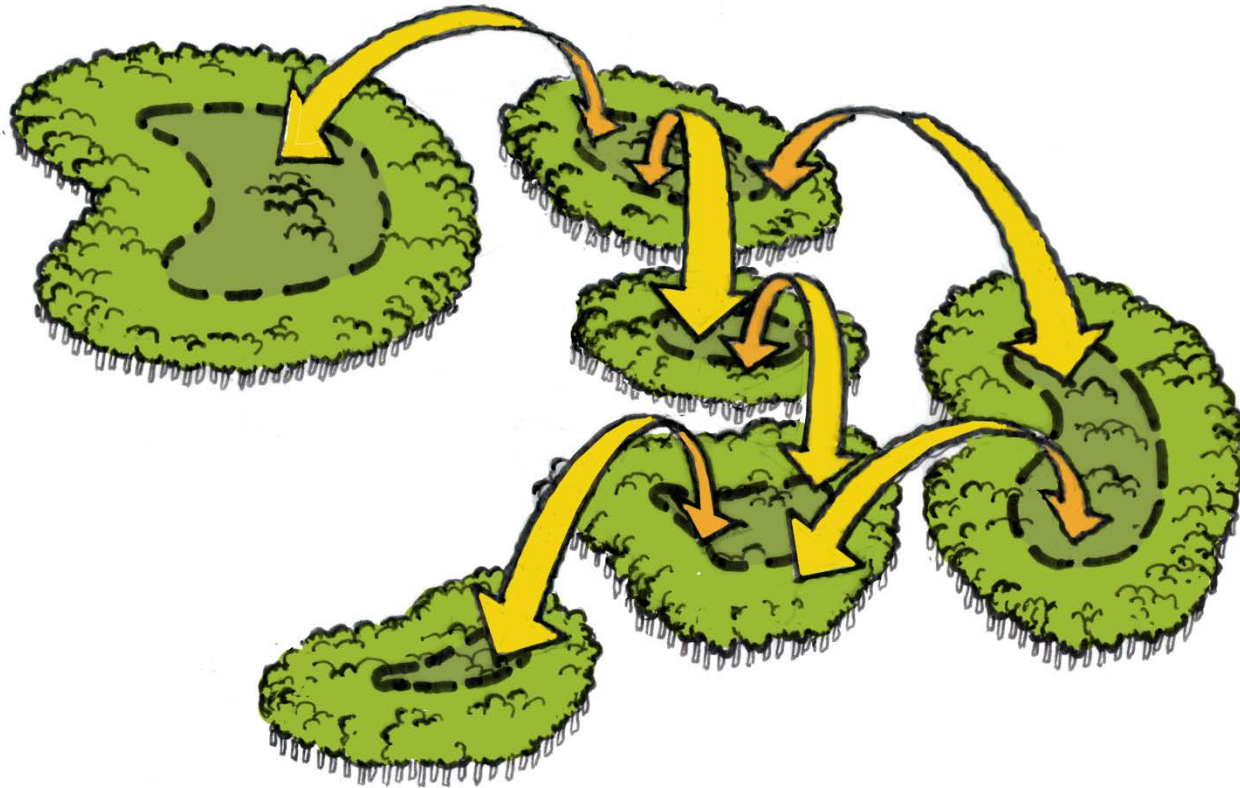
Corridors May Not Be Uniform.

The ideal is 100 meters of safe space in the middle
and 100 meters of edge.

minimum width = 300 meters wide

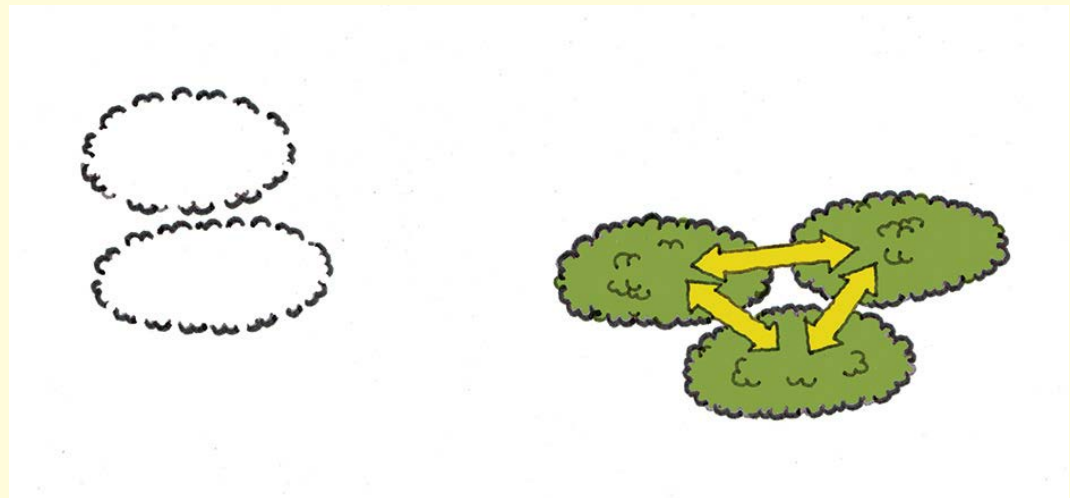
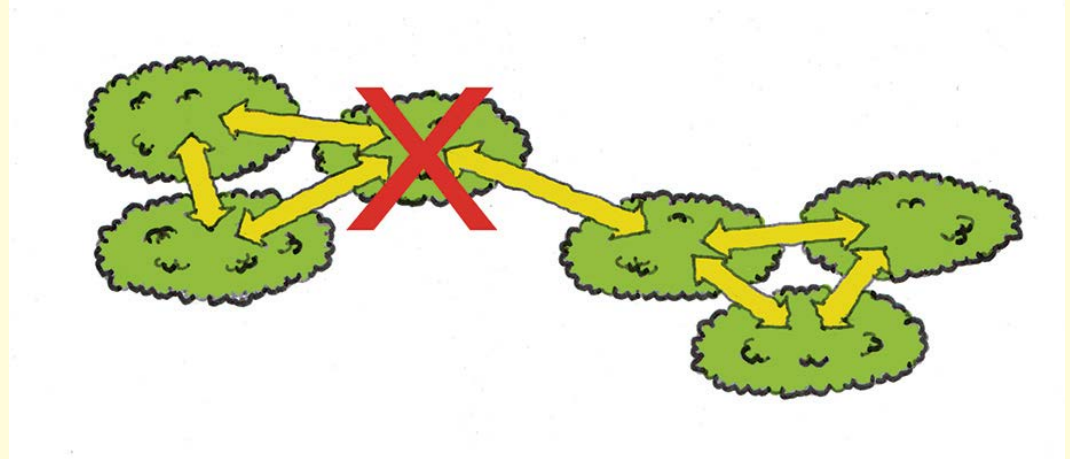


When Direct Corridors Are Lost, Some Species Can Still Hop Across.

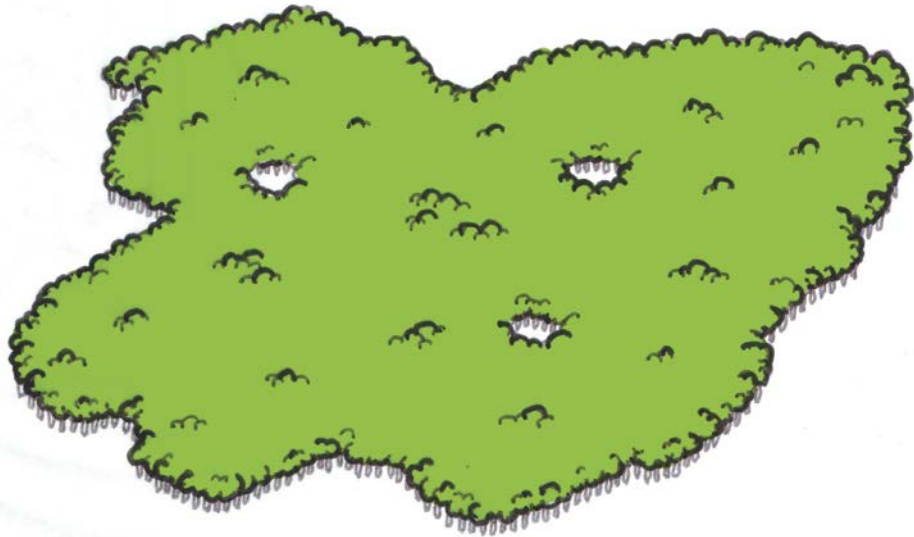


When Cores Are Lost, Species May Decline

If cores or patches are too far apart, or if a core is lost, species may become isolated and decline over time.

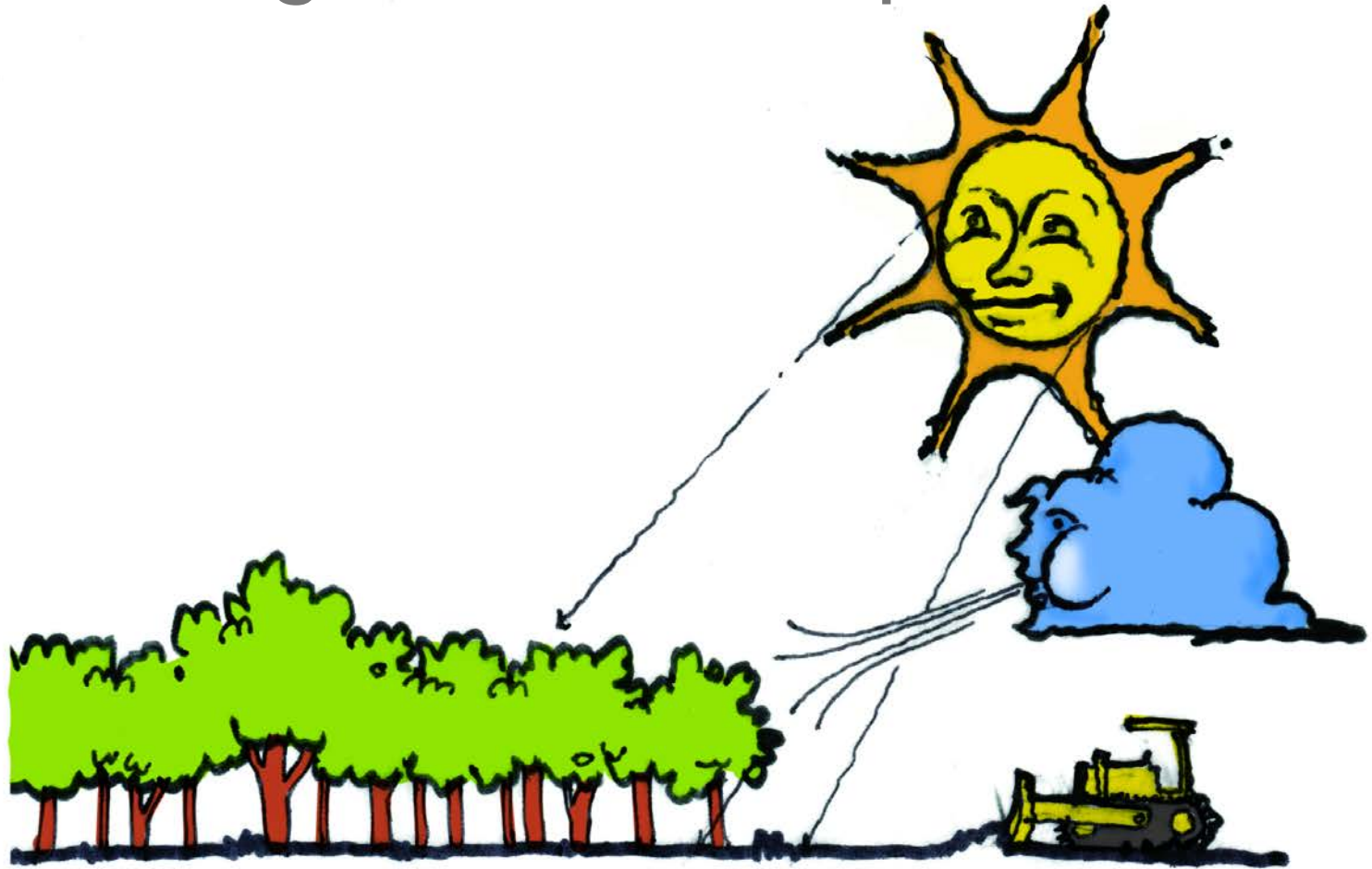


Cores May Need to Be Updated

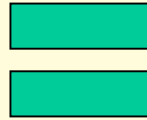
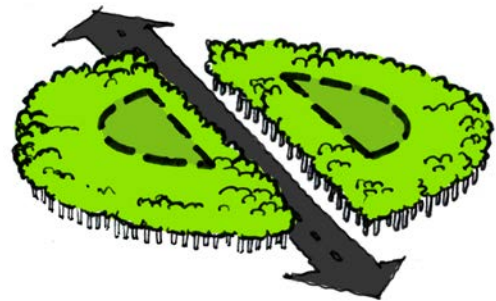
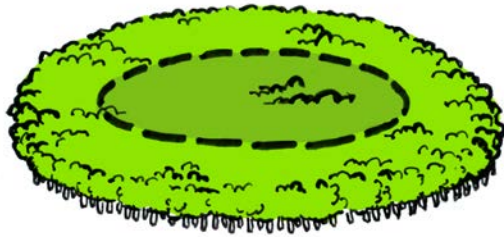


If a core is developed, the fragmented landscape may no longer constitute a core.

More Edge = More Impact Zones

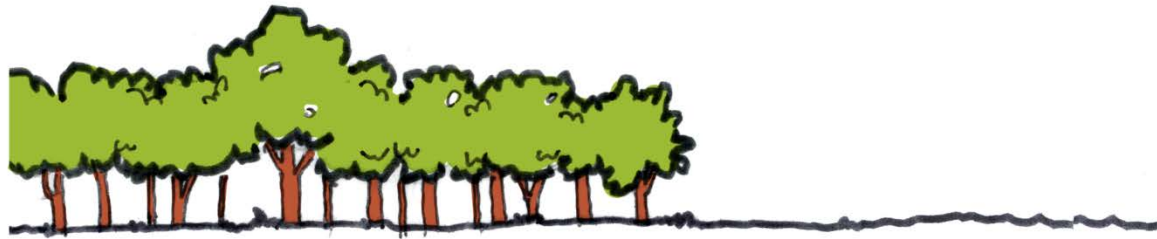


Edge allows invasive species to cause trouble. Some species take advantage of the edge area.



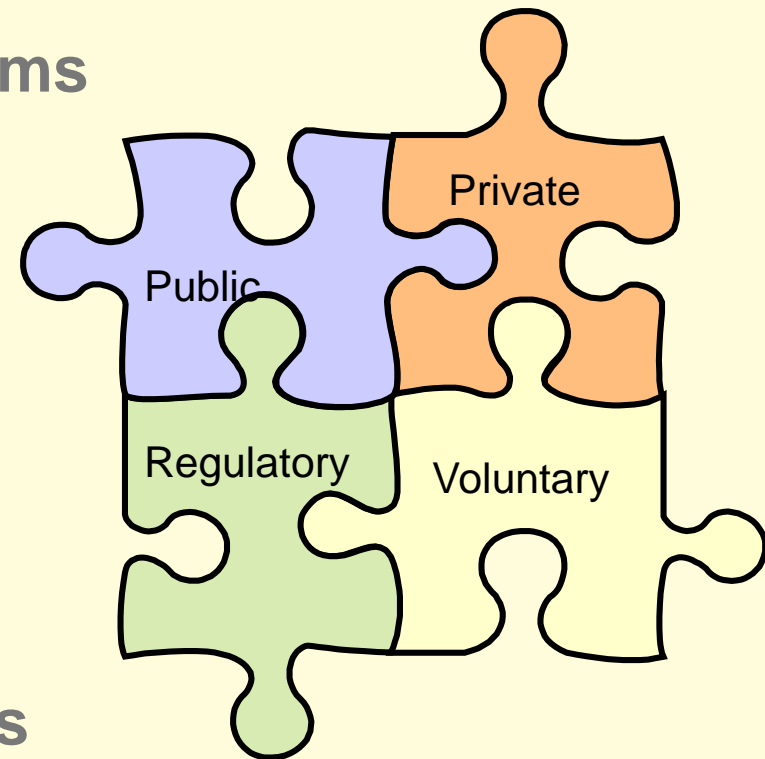
Type of Edge Matters Too!

The hard edge (top) is not as conducive to supporting species' diversity as the bottom soft (more gradual) edge.



Green Infrastructure Planning Applications

- ✓ Zoning Tools and Comp Plans
- ✓ Park and open space planning
- ✓ I.d. lands for PDR or TDR programs
- ✓ New ordinance development
- ✓ Species protection
- ✓ Heritage tourism and viewsheds
- ✓ Ag and Forestall Districts
- ✓ Easements
- ✓ Transportation plans: roads/trails
- ✓ Land management



For example, use GI assessments for Park and Open Space Planning. Where might future parks be located based on population centers, need to protect key habitats or species, opportunities to increase recreation or site interpretation?



Tools for Green Infrastructure Planning





GREEN GROWTH TOOLBOX

Wildlife & Natural Resource Stewardship in Planning

www.ncwildlife.org/greengrowth



Black-crowned night heron lives near this urban center!

The toolbox can help you incorporate habitat conservation into:

- ✓ land use plans
- ✓ policies and ordinances,
- ✓ development locations
- ✓ review and site design
- ✓ Managing parks and open space.

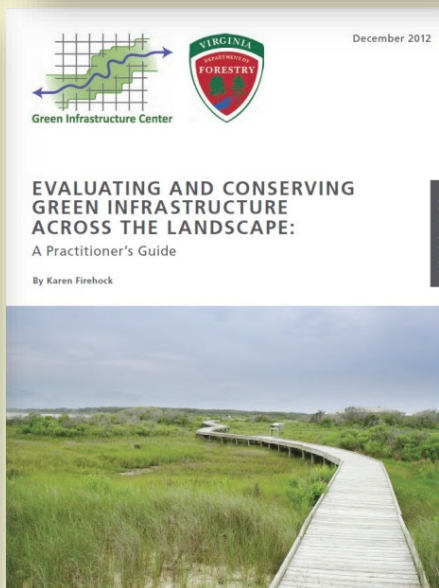
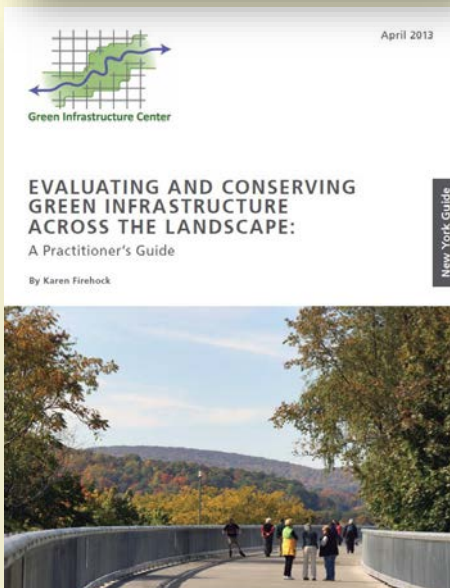
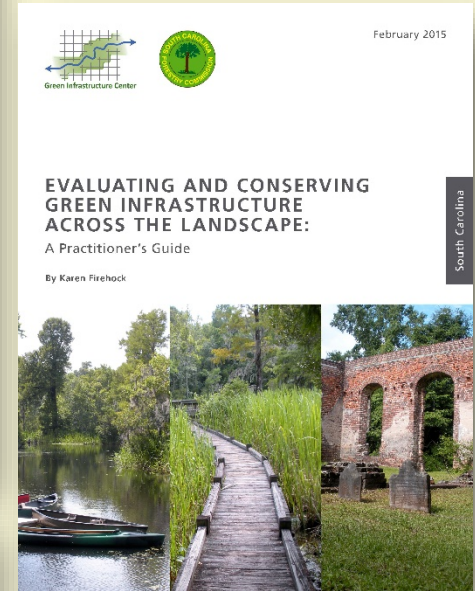
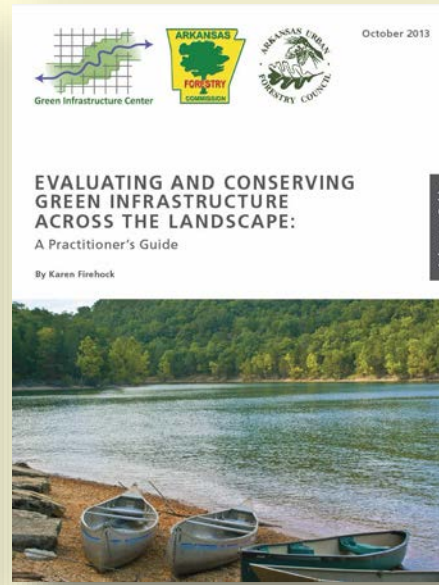
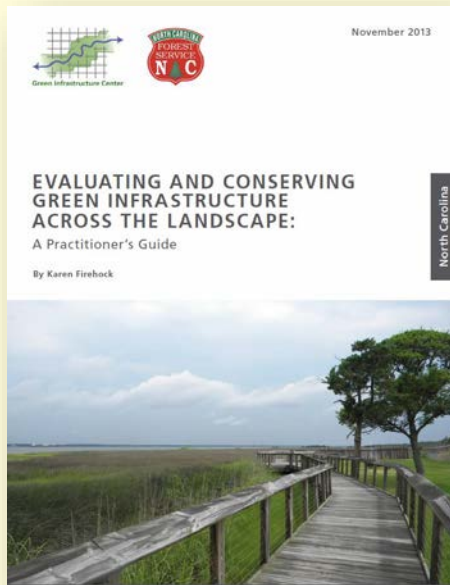


GIC Guides

GREEN INFRASTRUCTURE

Based on many years of field tests, GIC's training guides provide the steps to create and utilize a green infrastructure network.

The Appendix describes how to utilize data in each of these five states to create a green infrastructure plan. We can create a model for any state!



Coming Soon:
the National
Guidebook!

For state guides visit:
www.gicinc.org/book.htm

Six Steps for Green Infrastructure Planning

- 1) **Set Your Goals:** What does your community/organization value?
- 2) **Review Data** – What do we know or need to know, to map identified values?
- 3) **Map Your Community's Ecological and Cultural Assets** – Based on goals established in Step One and data from Step Two.
- 4) **Assess Risks** – What assets are most at risk and what could be lost if no action is taken?
- 5) **Determine Opportunities** – Based on those assets and risks you have identified, which ones should be restored or improved?
- 6) **Implement Opportunities** – Include natural asset maps in both daily and long-range planning (park planning, comp plans, zoning, tourism, economic development, easements etc).

Organizing a community initiative



Part 1: Pre-assessment: Interviews to determine key issues

Part 2: Stakeholder Review: key groups help frame the goals.

Option 1: a smaller technical committee works on data and maps.

Option 2: Review committee is planning commission or other body

Meeting 1: Introduction to Natural Asset Mapping (what, why, how) and **Discussion of Community Goals and Values** Which goals and values can be translated into a map?

Meeting 2: Proposed Mapping Strategy From Meeting 1 Outcomes. Review what to map and why. Create maps.

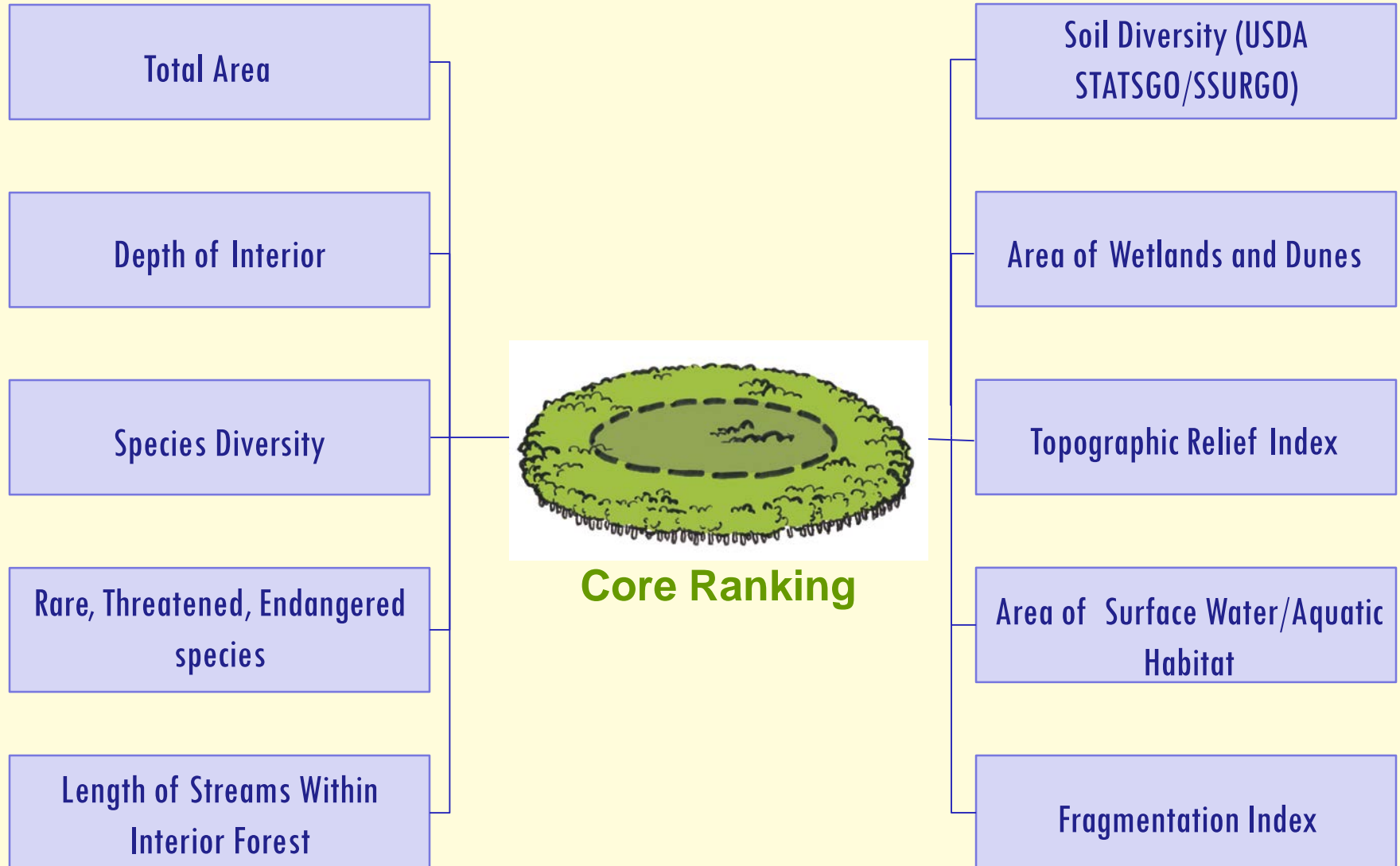
Meeting 3: Review Maps Present several options, review accuracy, prioritize assets, critique graphics. Revise and finalize.

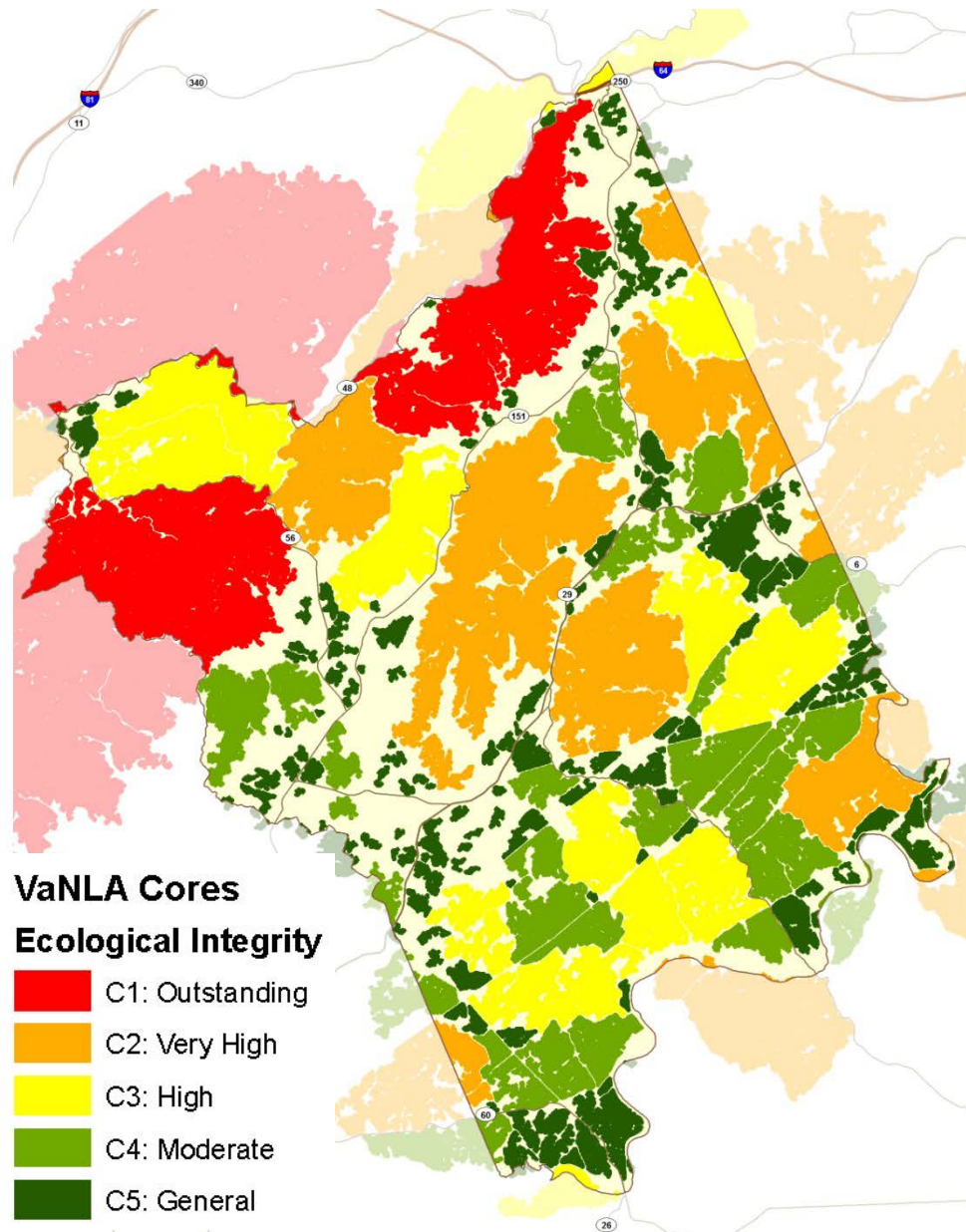
Part 3: Finalize maps, based on feedback, present to decision makers.
Make revisions as needed.

Part 4: Create a conservation/restoration strategy for natural assets.

Option 1: Consider forming an implementation committee to track progress.

Review Data: All cores are not equal. We also rank them.



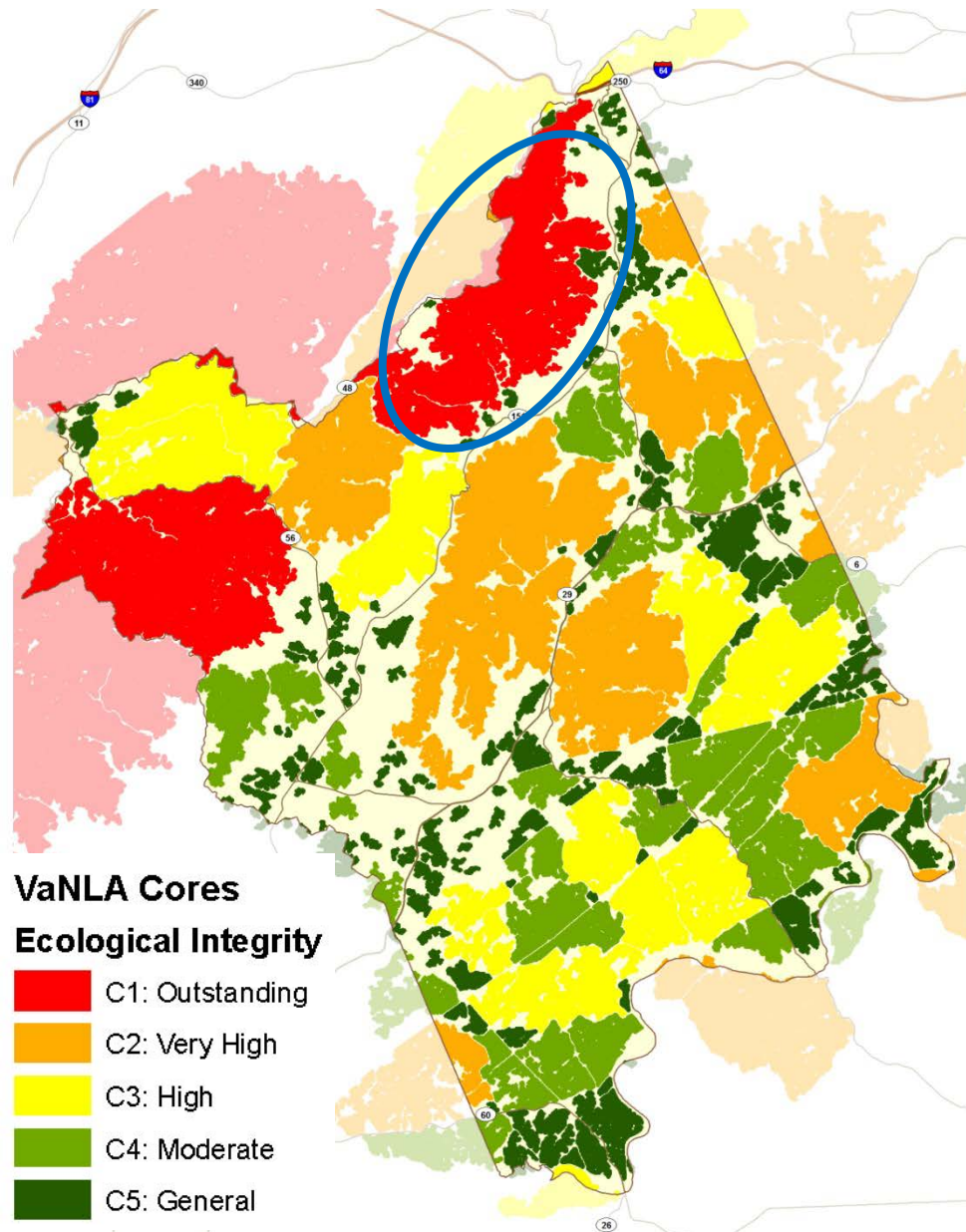


County Example: Use the data table for each core.

i tool

311,784 acres of habitat cores

249,274 acres are outstanding (red) to very high quality (orange).



County Example: Use the data table for each core.

i tool

311,784 acres of habitat cores

249,274 acres are outstanding (red) to very high quality (orange).

See example core at left (red core) has:

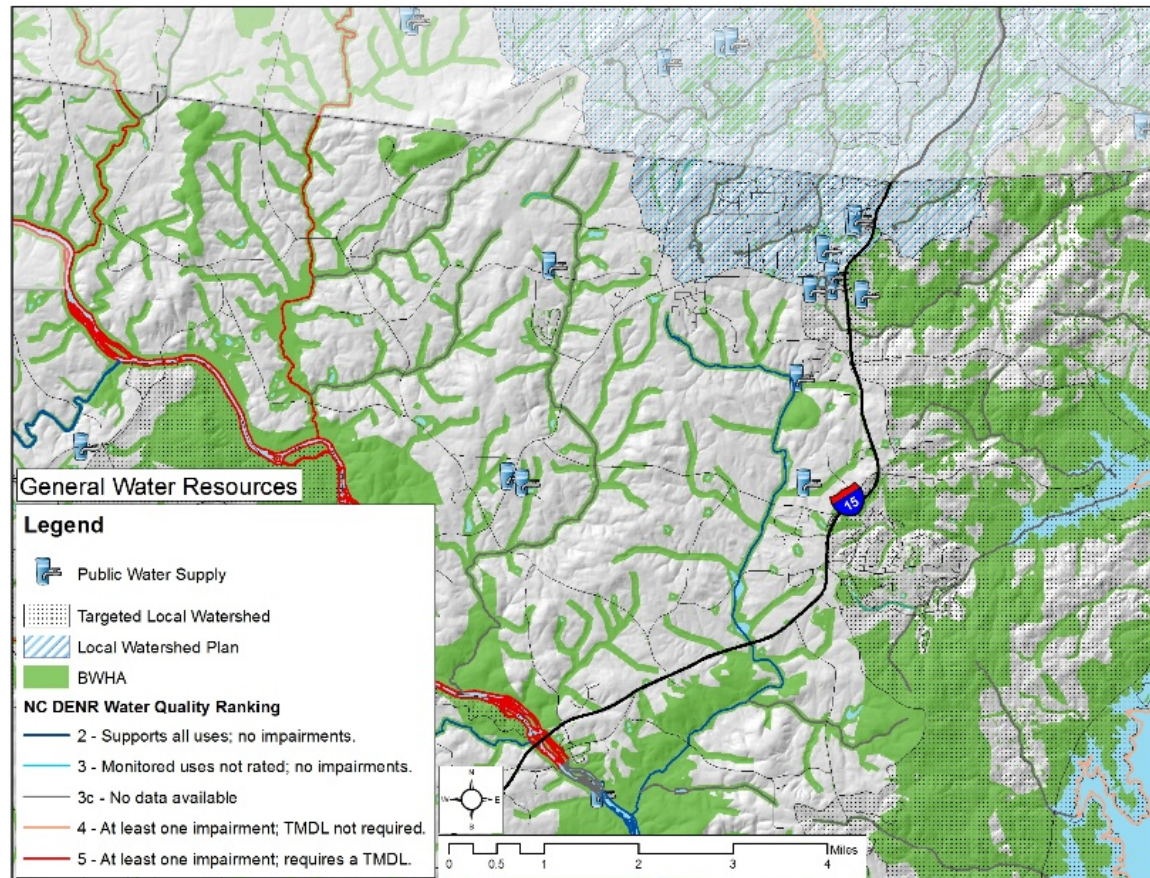
✓ 20,406 acres

✓ 14 element occurrences

✓ 5,523 drinking water acreage

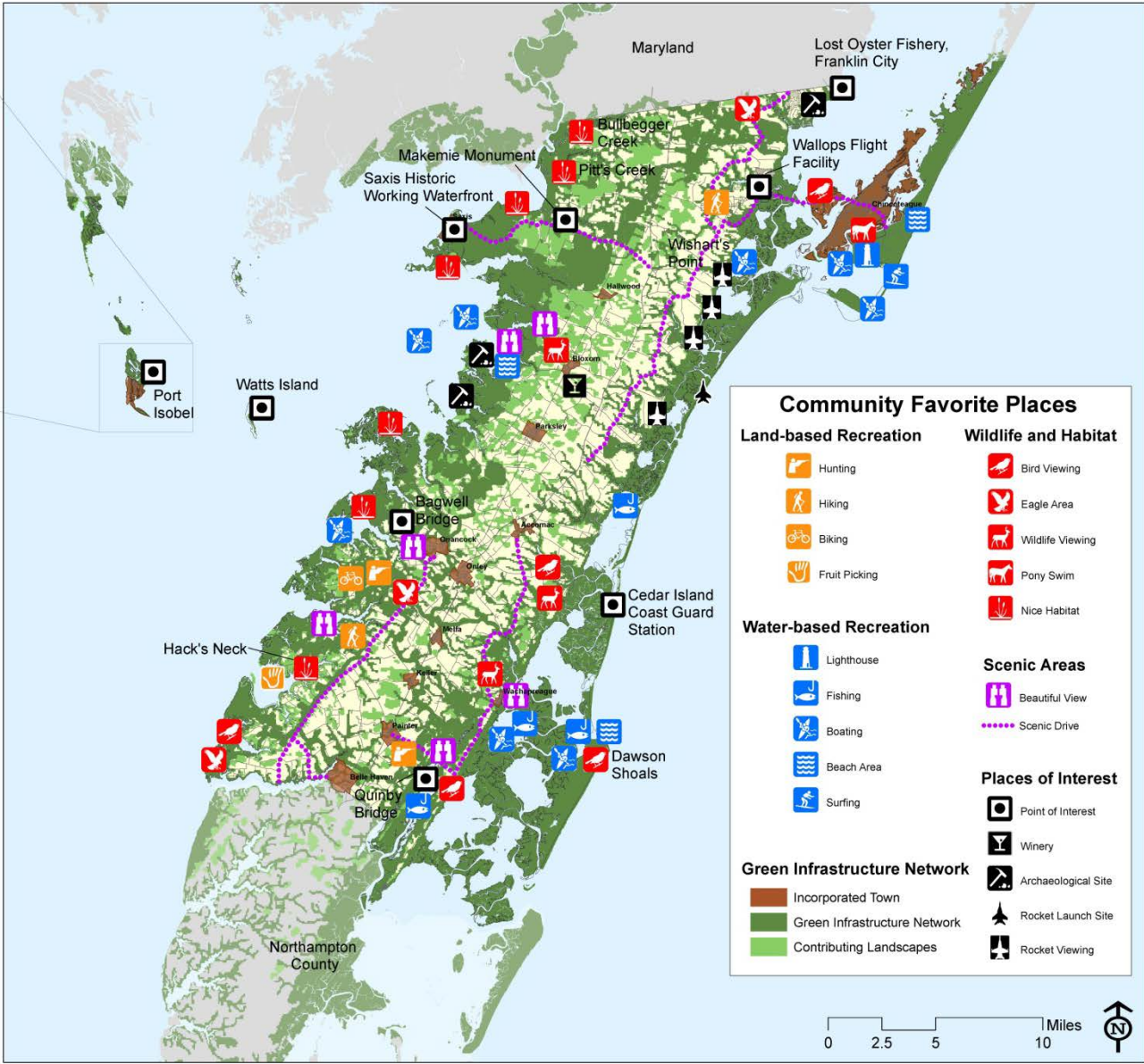
Creating Thematic Resource Maps

Example: Water Resources Theme Map

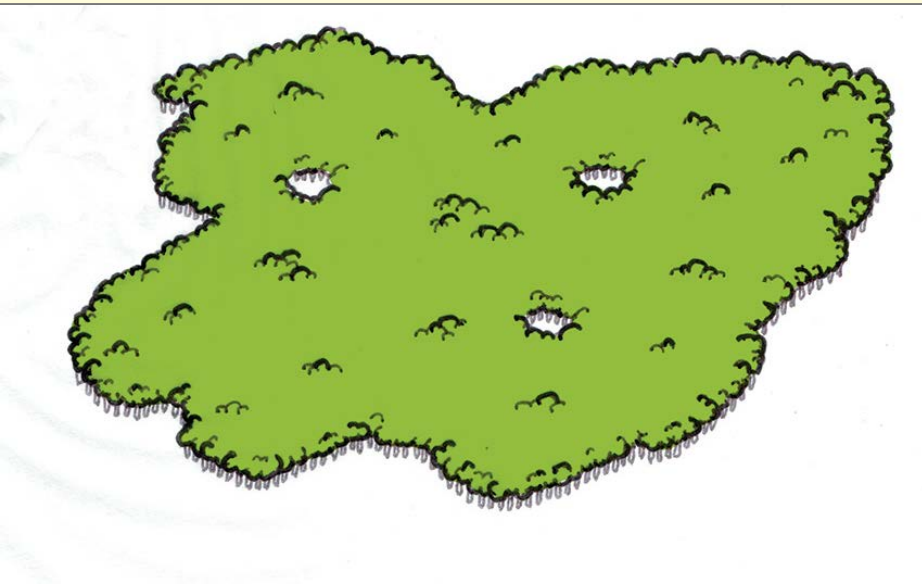


Community Maps

Data collected should be uniformly available – to add local knowledge make a separate overlay and have people share their favorite landscape and cultural features – then code them.



Cores May Need to Be Updated



If a core is developed, the fragmented landscape may no longer constitute a core.

Application Examples at Multiple Scales: region to city to site



To See All
Scales ...

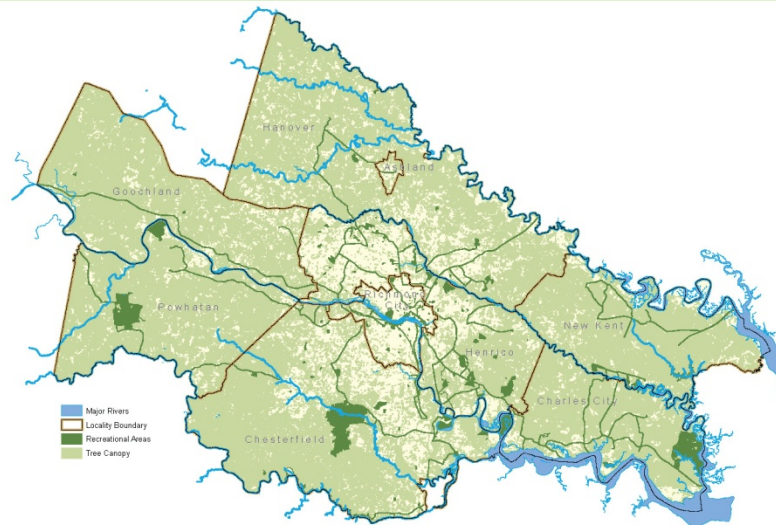


A Virginia Case
Study

THE RICHMOND REGION GREEN INFRASTRUCTURE PROJECT

First:

Region

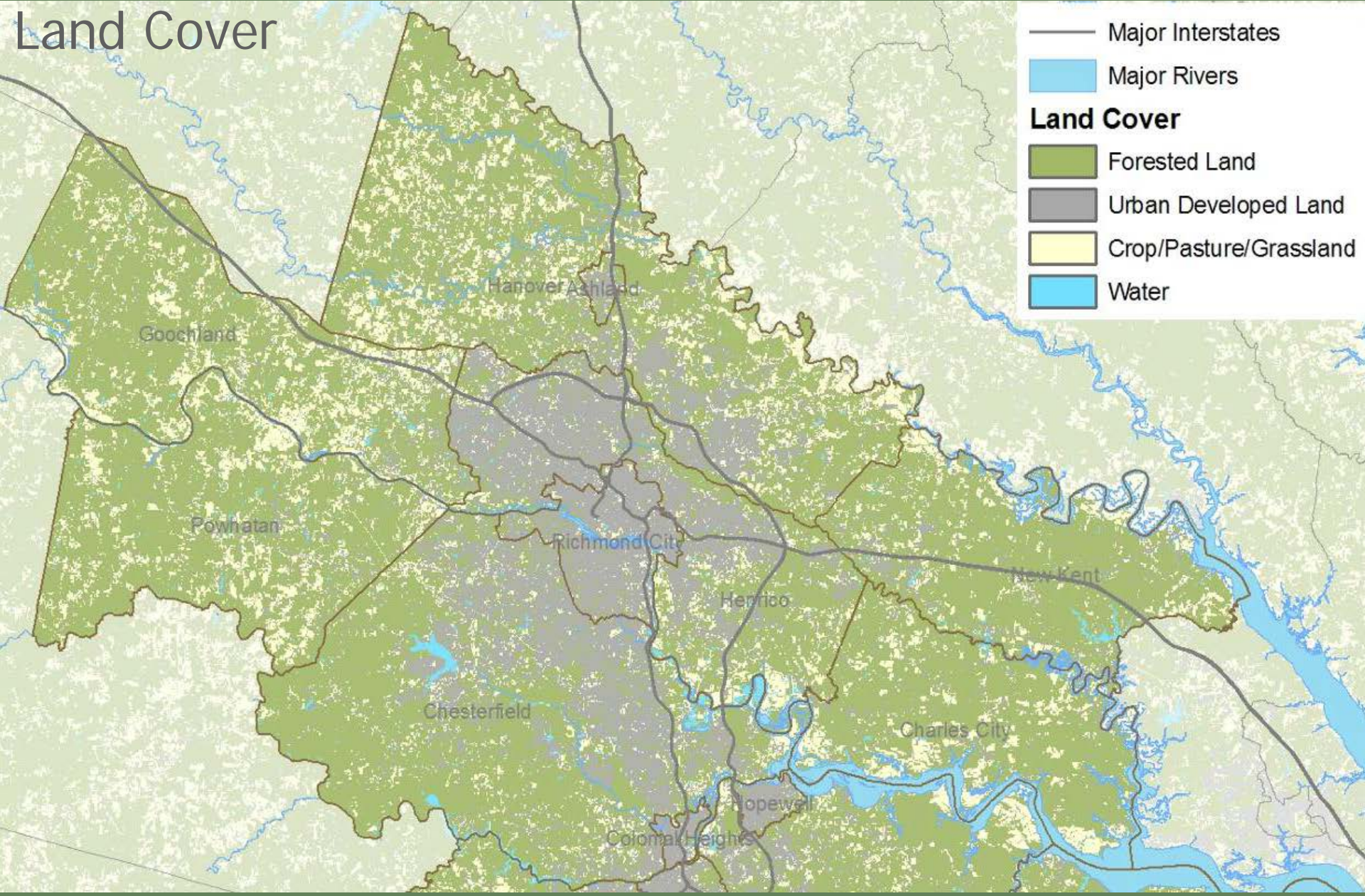


*Building a regional
green infrastructure network
for our communities*

SPRING 2009

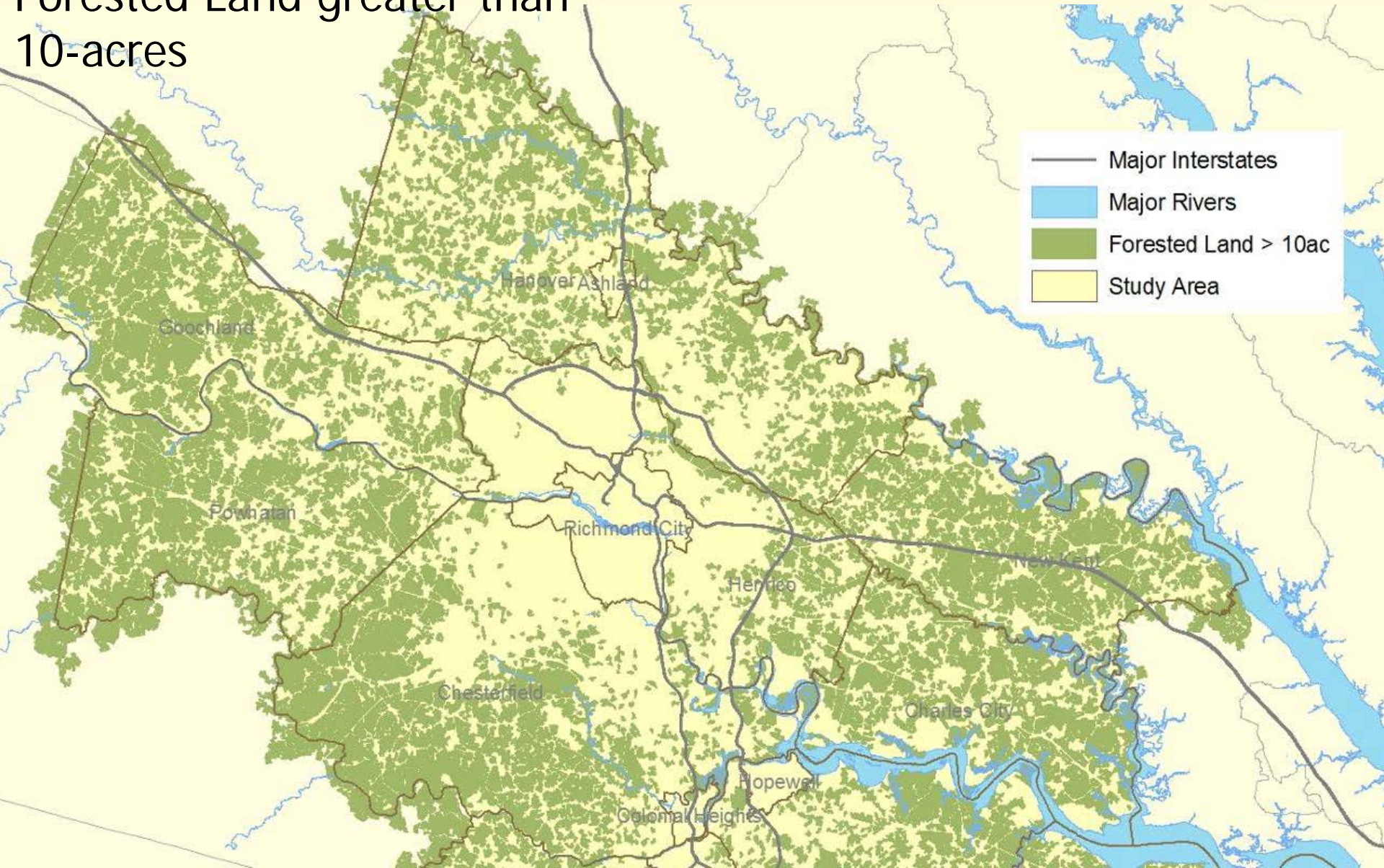
GREEN INFRASTRUCTURE

Land Cover

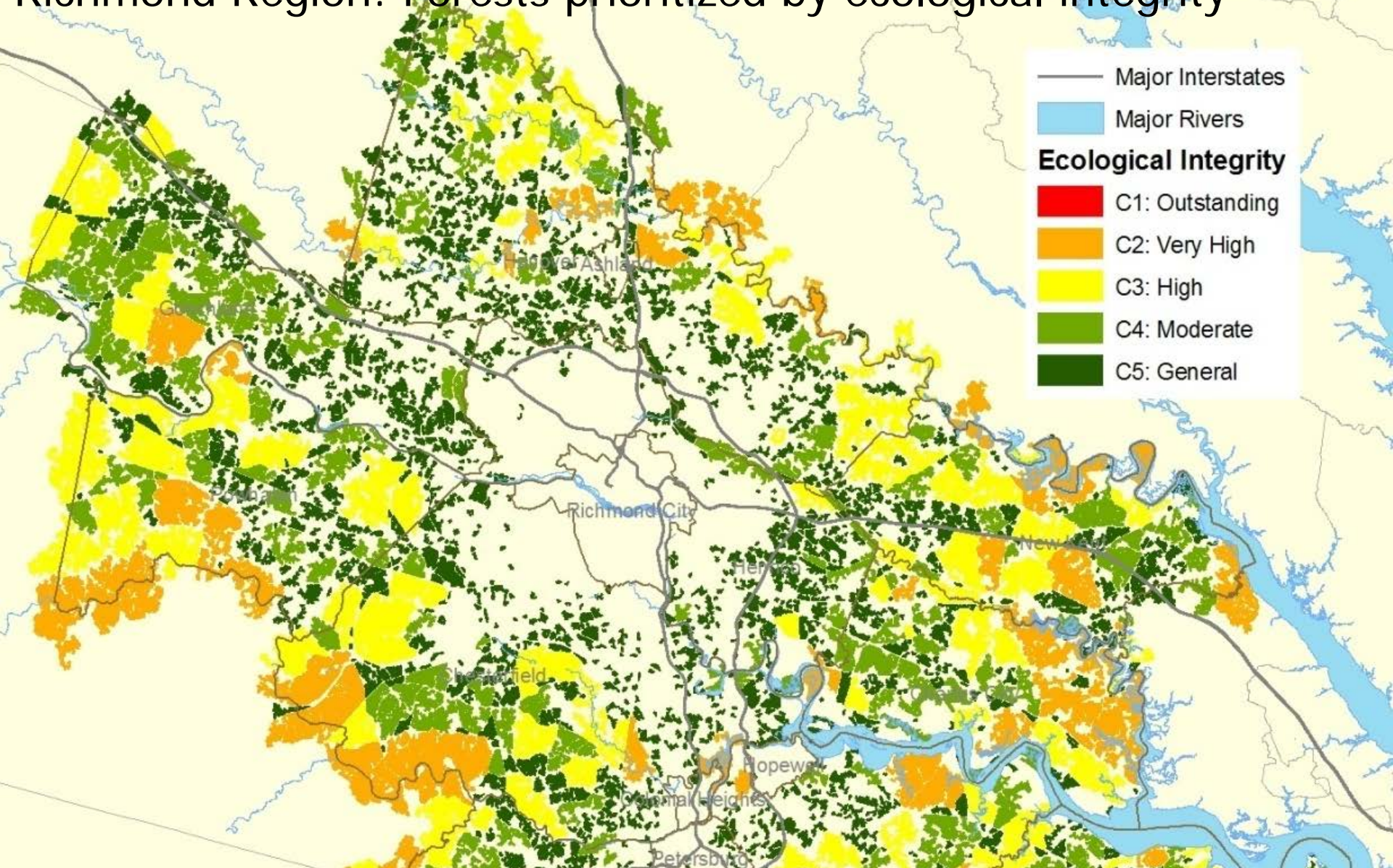


- Major Interstates
- Major Rivers
- Land Cover**
- Forested Land
- Urban Developed Land
- Crop/Pasture/Grassland
- Water

Forested Land greater than 10-acres



Richmond Region: Forests prioritized by ecological integrity

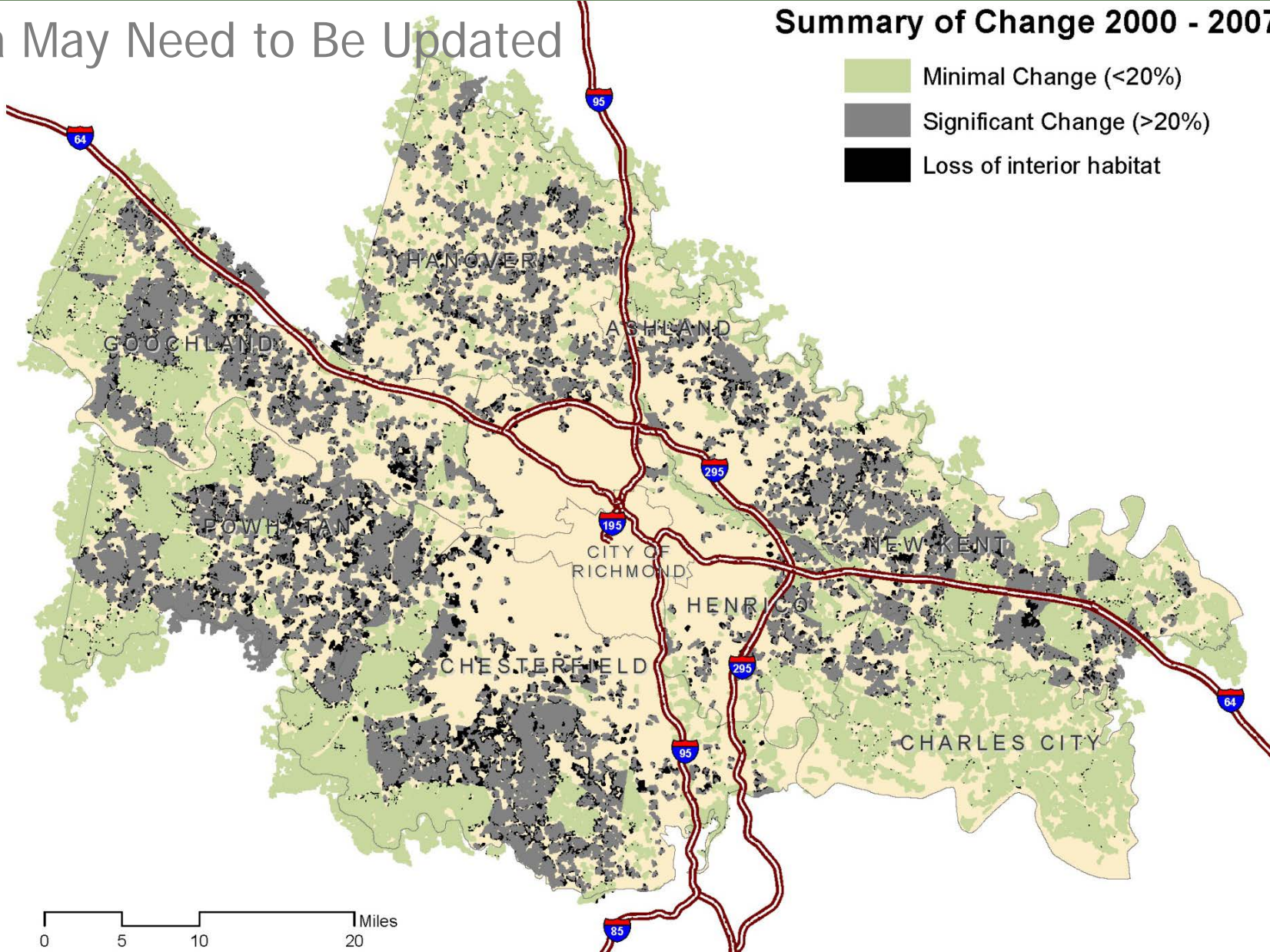


GREEN INFRASTRUCTURE

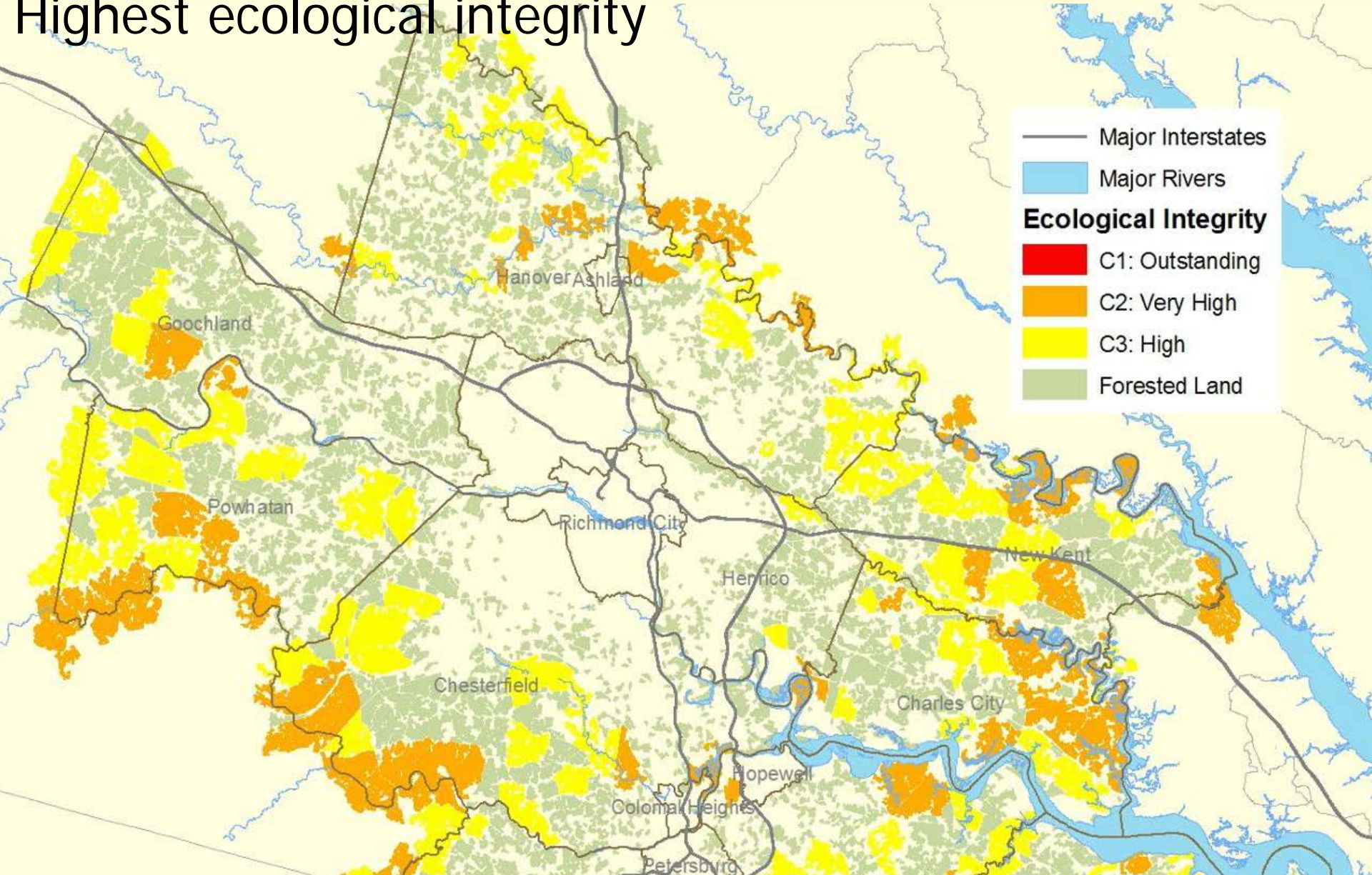
Data May Need to Be Updated

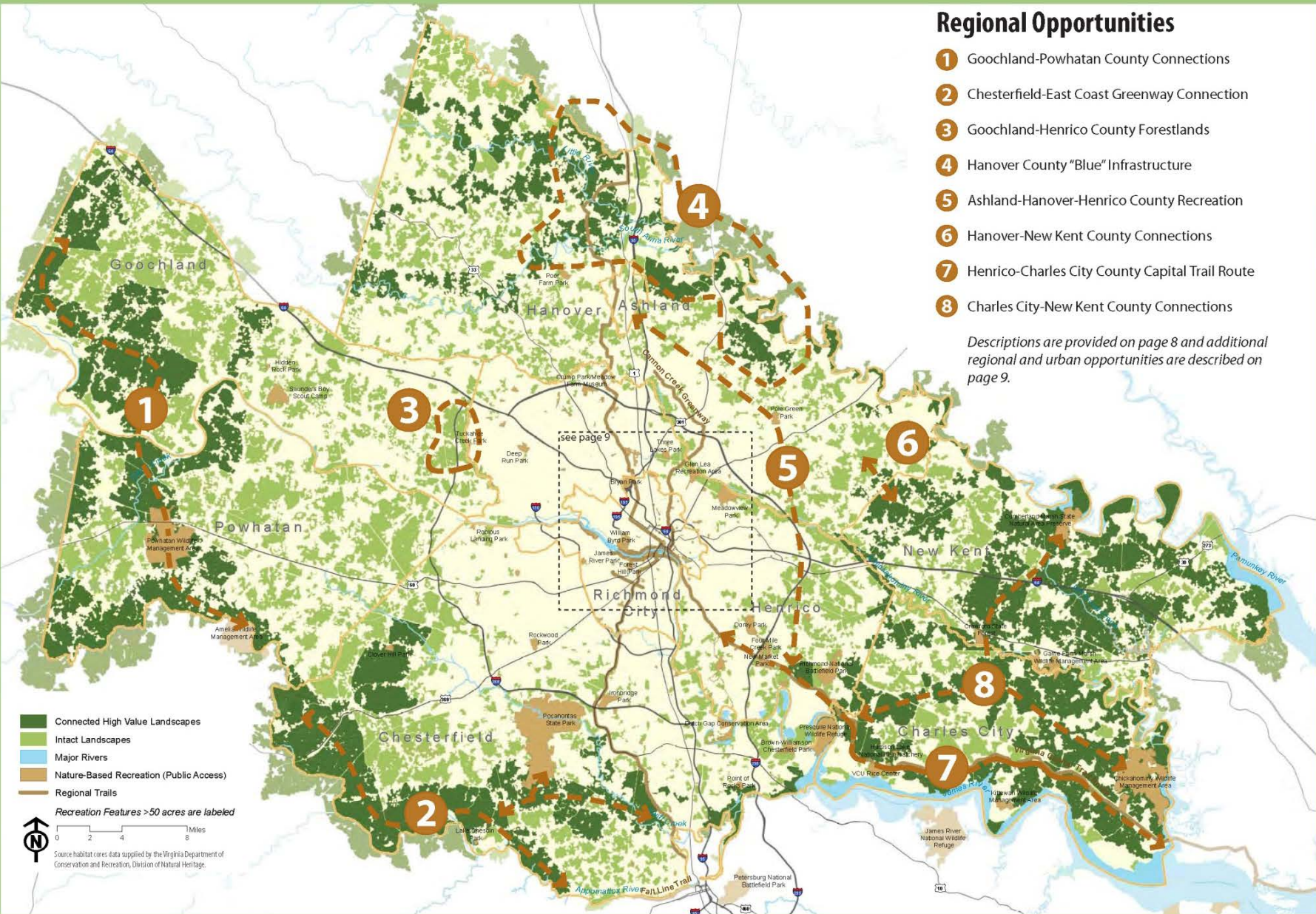
Summary of Change 2000 - 2007

- Minimal Change (<20%)
- Significant Change (>20%)
- Loss of interior habitat



Highest ecological integrity





Regional Opportunities

- 1 Goochland-Powhatan County Connections
- 2 Chesterfield-East Coast Greenway Connection
- 3 Goochland-Henrico County Forestlands
- 4 Hanover County "Blue" Infrastructure
- 5 Ashland-Hanover-Henrico County Recreation
- 6 Hanover-New Kent County Connections
- 7 Henrico-Charles City County Capital Trail Route
- 8 Charles City-New Kent County Connections

Descriptions are provided on page 8 and additional regional and urban opportunities are described on page 9.

Connected High Value Landscapes
 Intact Landscapes
 Major Rivers
 Nature-Based Recreation (Public Access)
 Regional Trails

Recreation Features >50 acres are labeled

Source: habitat cores data supplied by the Virginia Department of Conservation and Recreation, Division of Natural Heritage.

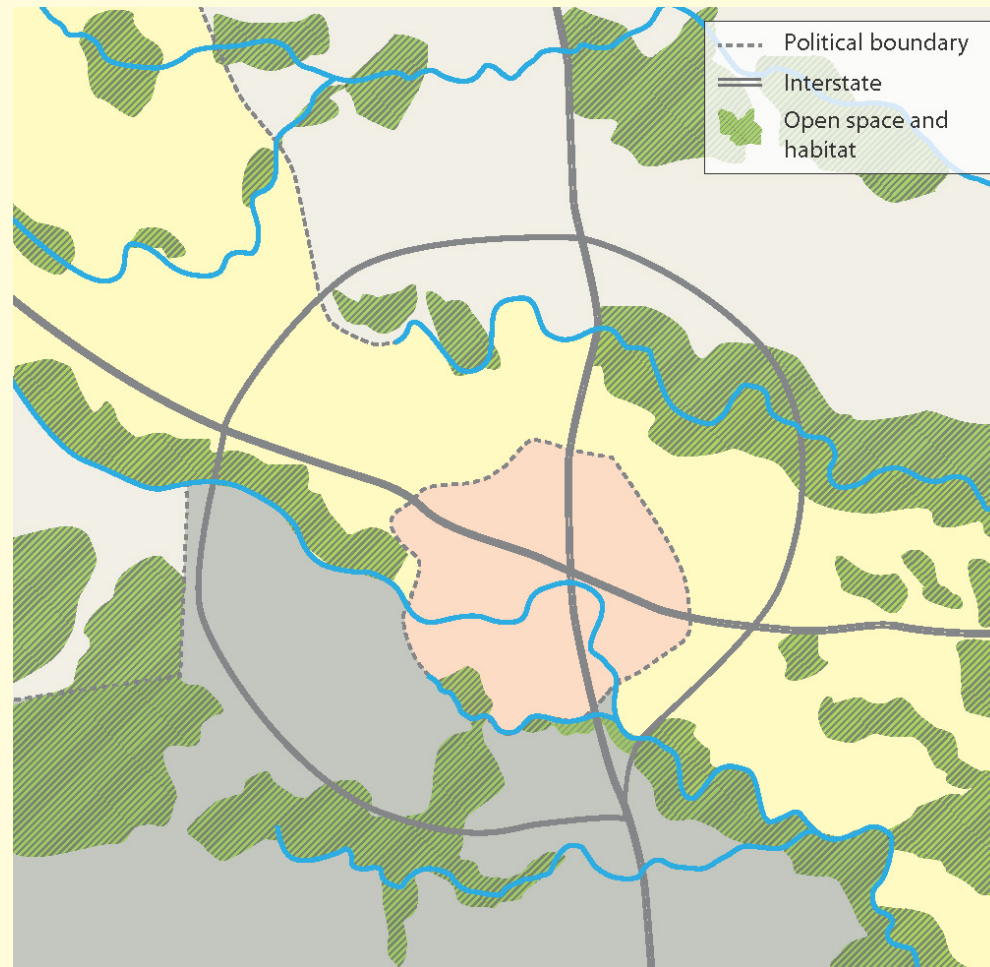
New Kent County Map Links Culture and Recreation to Network



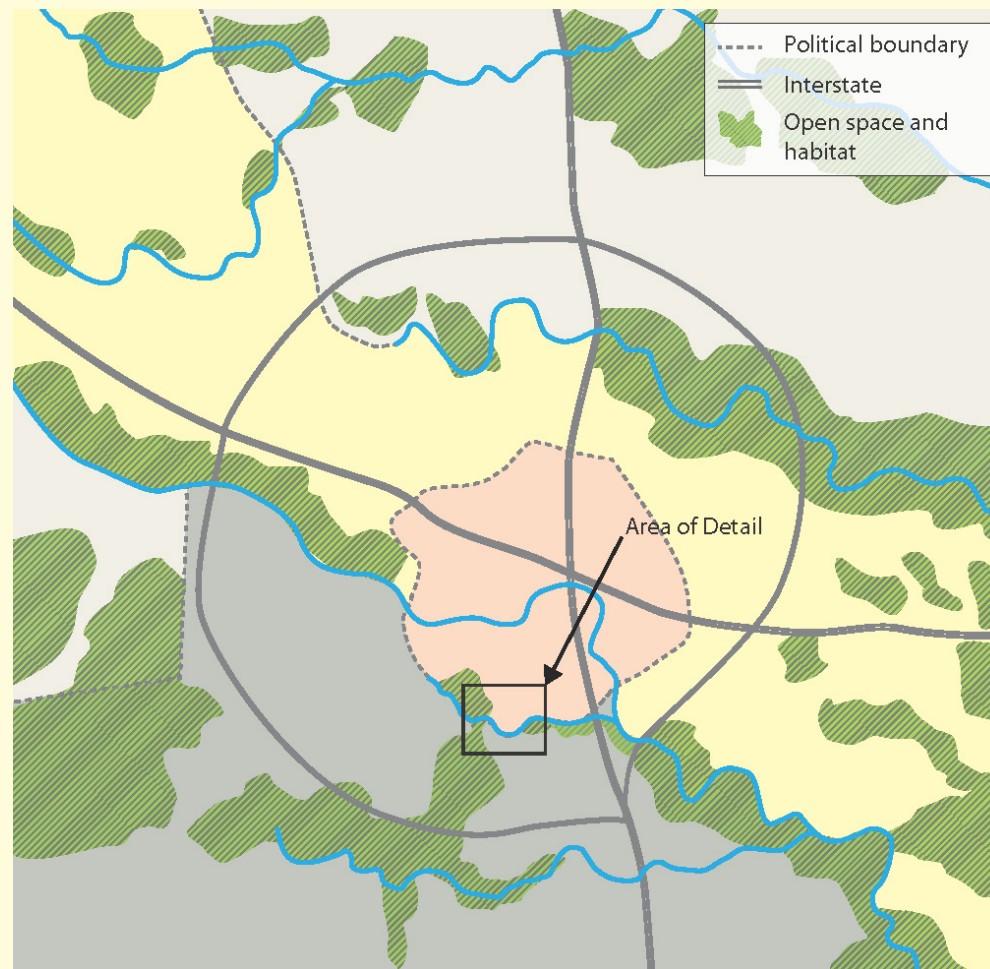
HERITAGE AND NATURAL RESOURCES



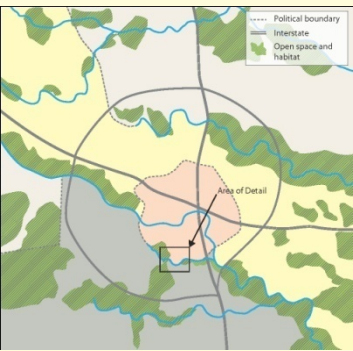
How can we link regional green infrastructure to local projects?



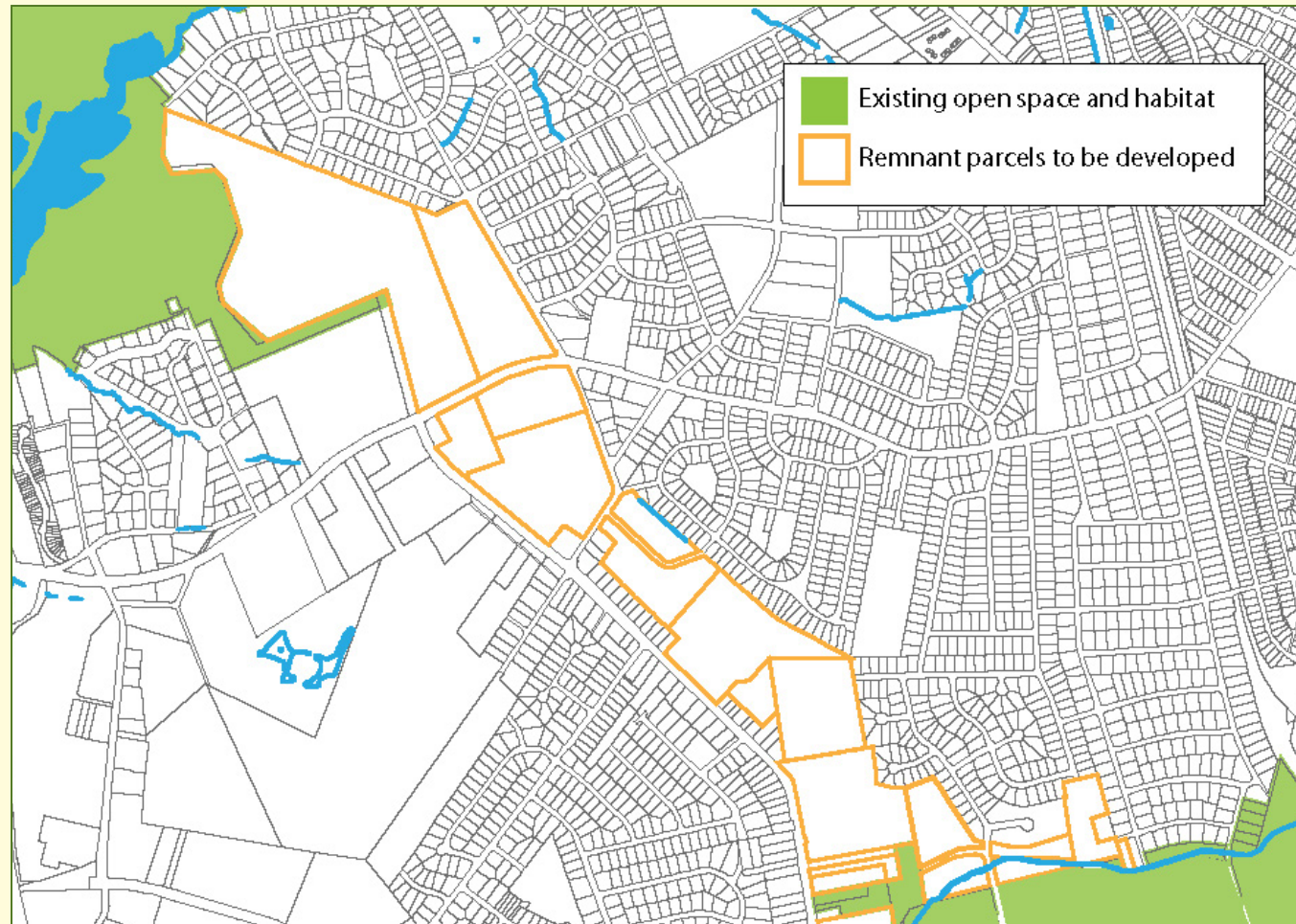
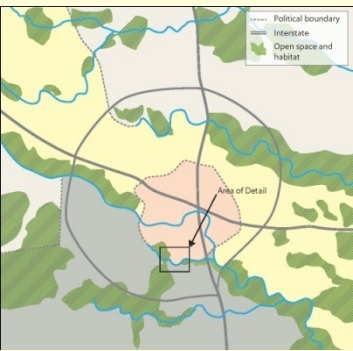
How can we link regional green infrastructure to local projects?



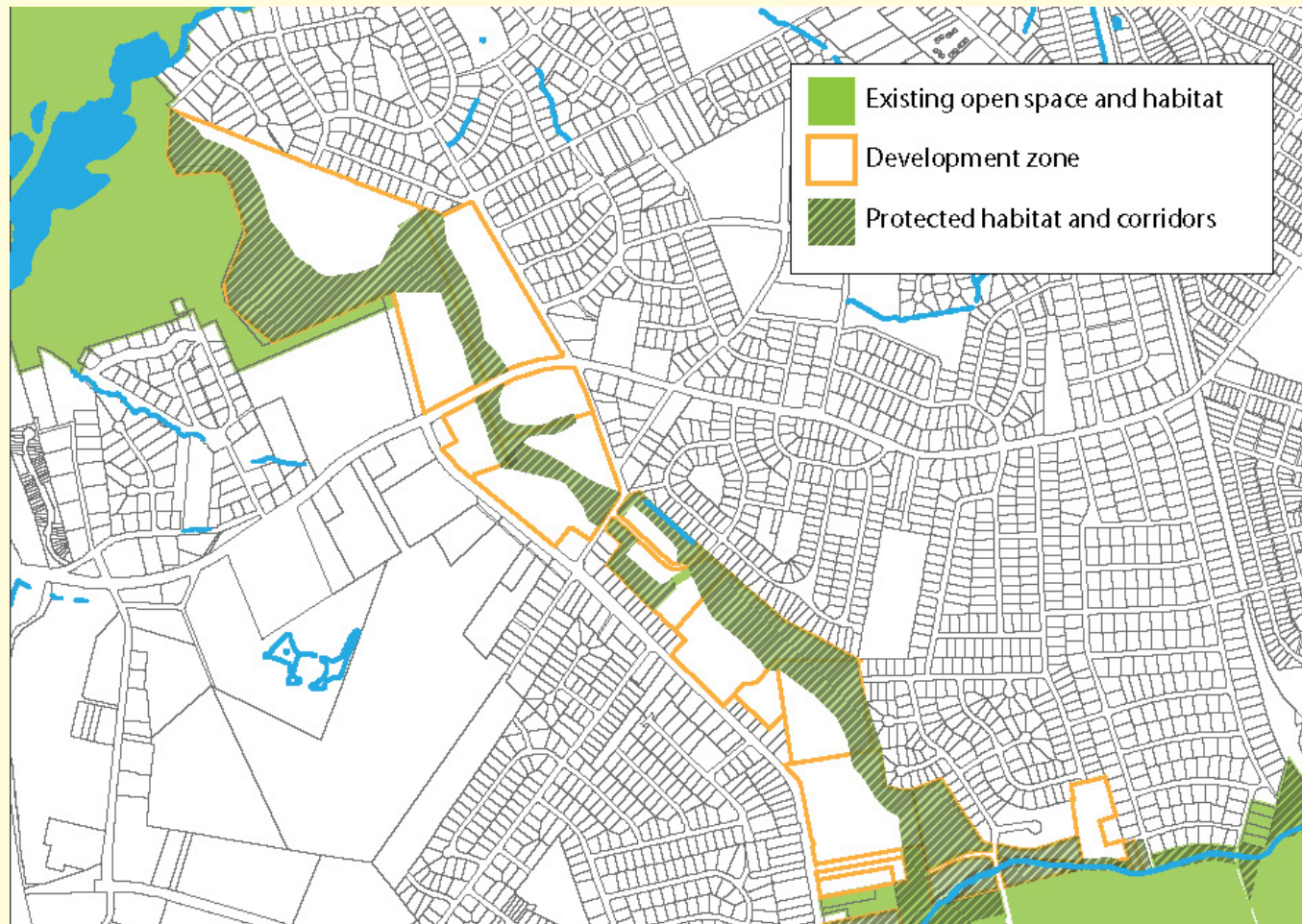
How can we link regional green infrastructure to local projects?



Vacant parcels can provide corridor opportunities to re-green and reconnect the urban landscape.



If each parcel leaves or replants a green strip, they can be connected for form a corridor – urban greenway trails can be created within an urban fabric.



Look for other ways for existing parcels to link to greenways.

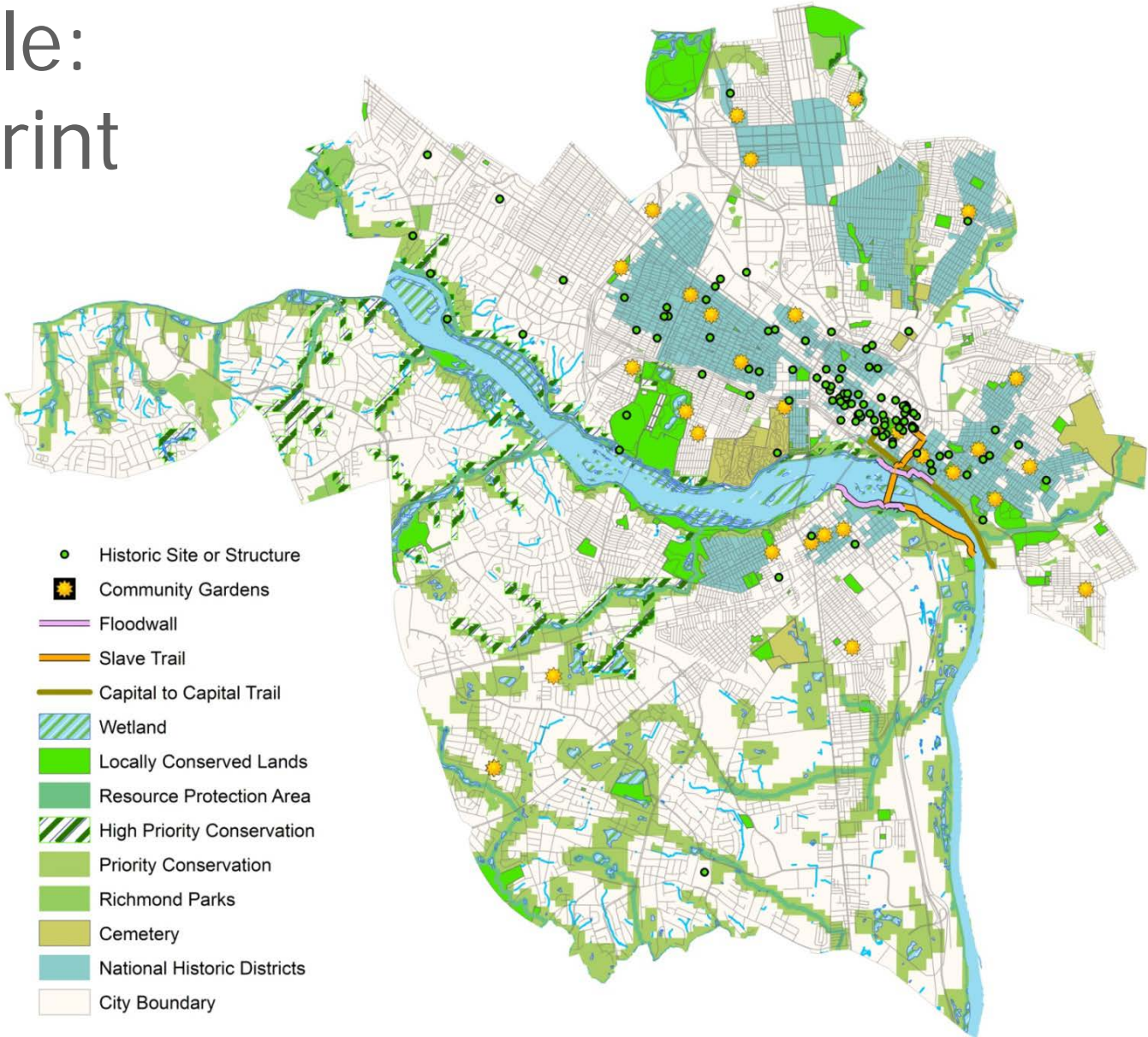


Scaling down to the city ...

Richmond City Green Infrastructure Assessment



City Scale: Green Print



What are opportunities to re-green Richmond?

- The 2009 regional green infrastructure assessment revealed a significant decline of green infrastructure over the last decade due to sprawling development outside the city.
- The City of Richmond includes over 9,000 vacant parcels.
- Many of these sites can become a resource for expanding the green infrastructure network and enhancing neighborhoods.





Richmond Green Infrastructure Assessment

Produced by the Green Infrastructure Center and E² Inc. for the City of Richmond, Virginia
December 2010

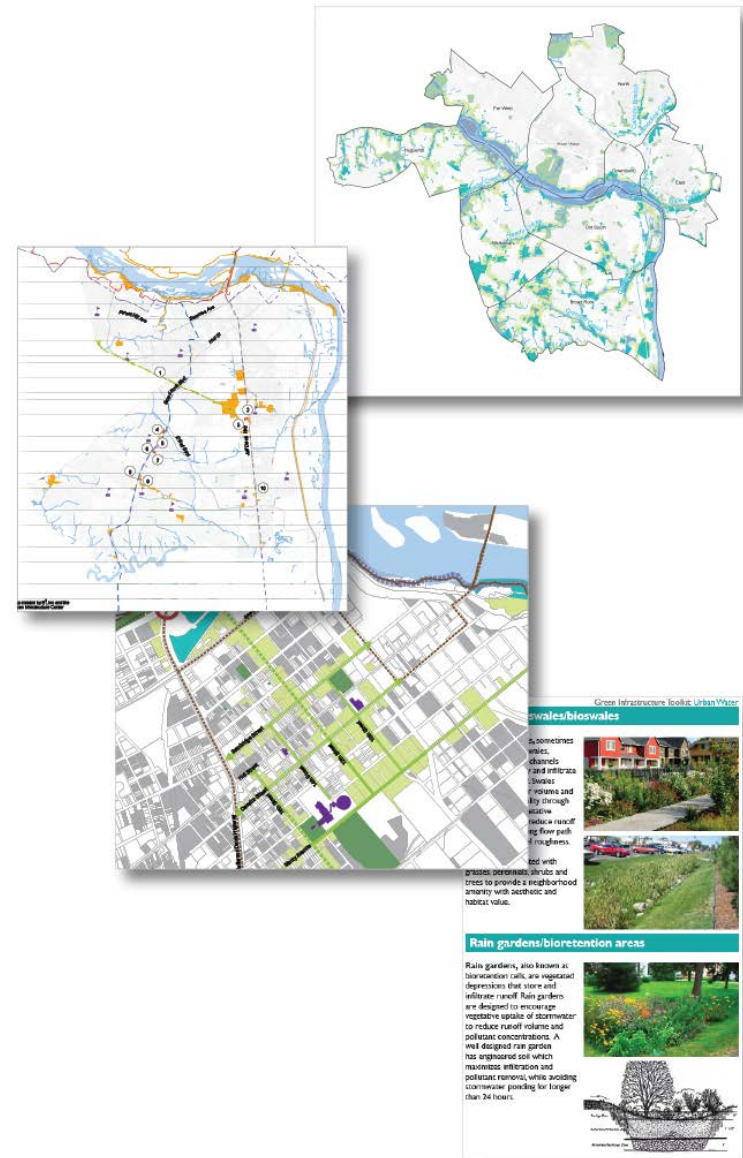
Implementation Approach: Planning Across Scales

City: Develop citywide green infrastructure network based on suitability of vacant parcels.

Planning District: Create interactive database to evaluate suitability of vacant parcels for various goals.

Neighborhood: Develop concept plans and prototypes to connect neighborhoods to the city's green infrastructure network.

Project: Provide case studies and strategies that can be implemented to enhance Richmond's green infrastructure network.



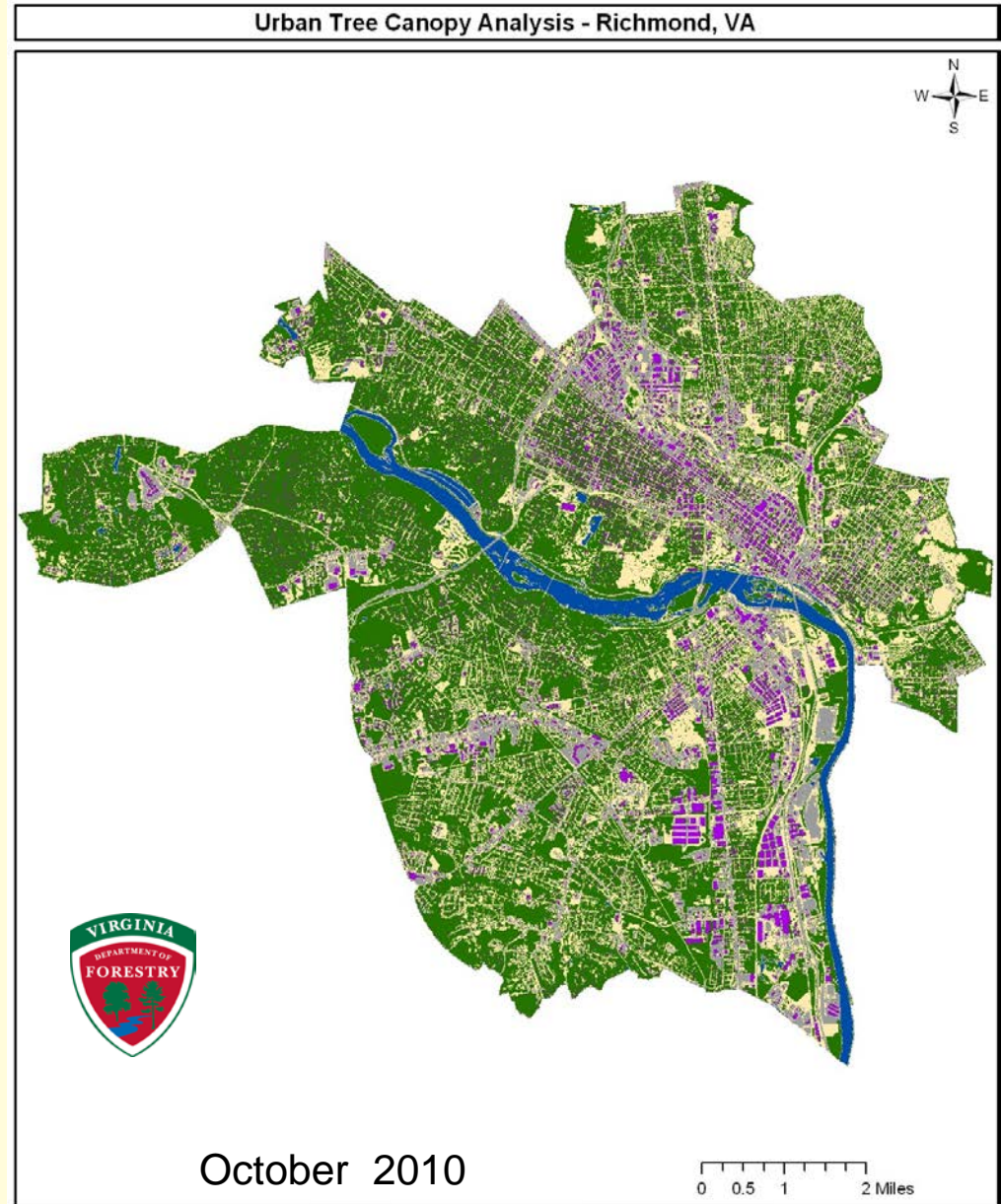
City: Land Cover

42% Tree Canopy

23% Other Vegetation

24% Non-Building
Impervious

11% Building
Impervious

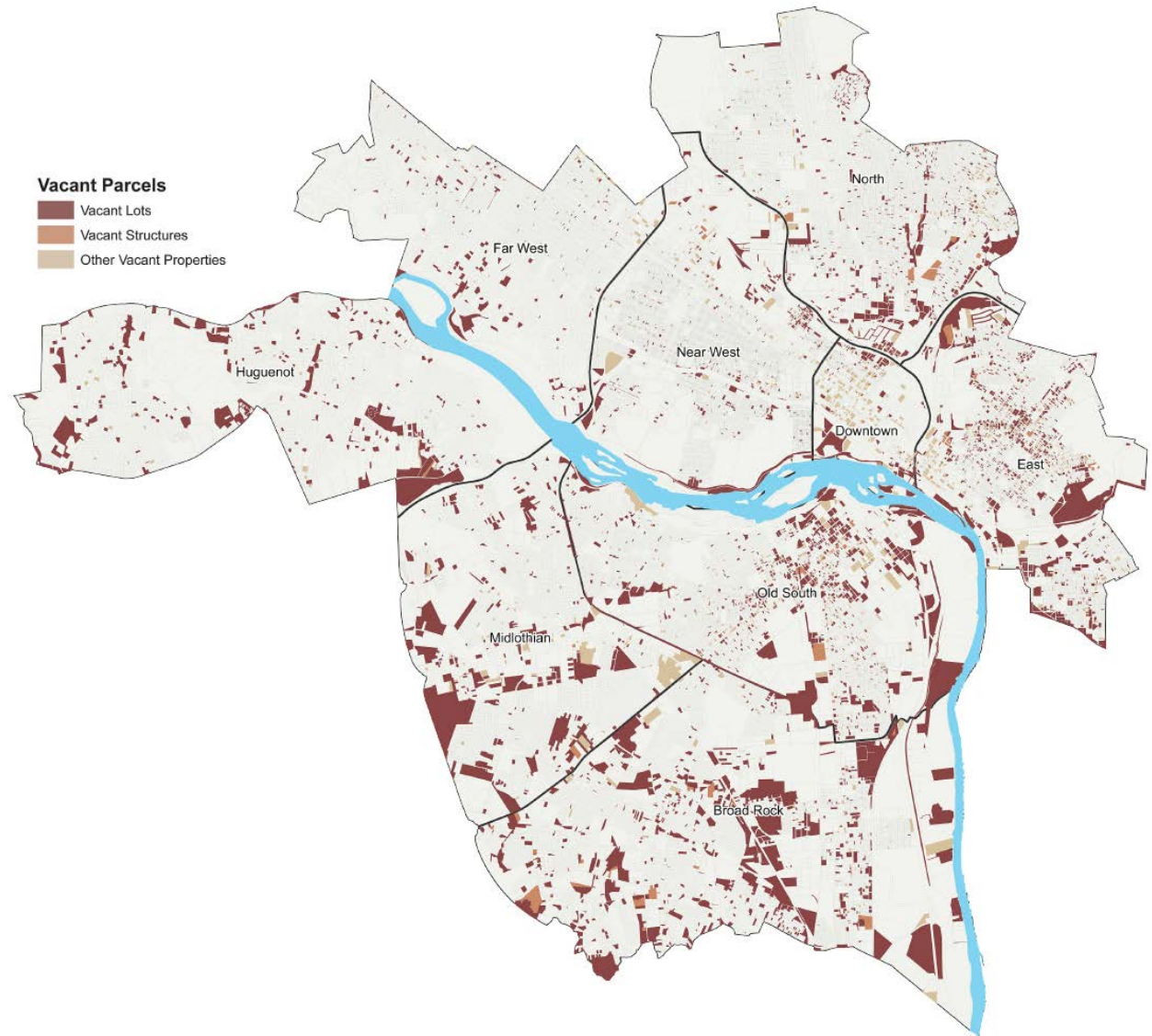


City: Vacancy

Vacant parcel inventory,
grouped by:

- vacant lots
- vacant structures
- vacant properties
(parcels that have
unknown status)

= 9000 vacant parcels

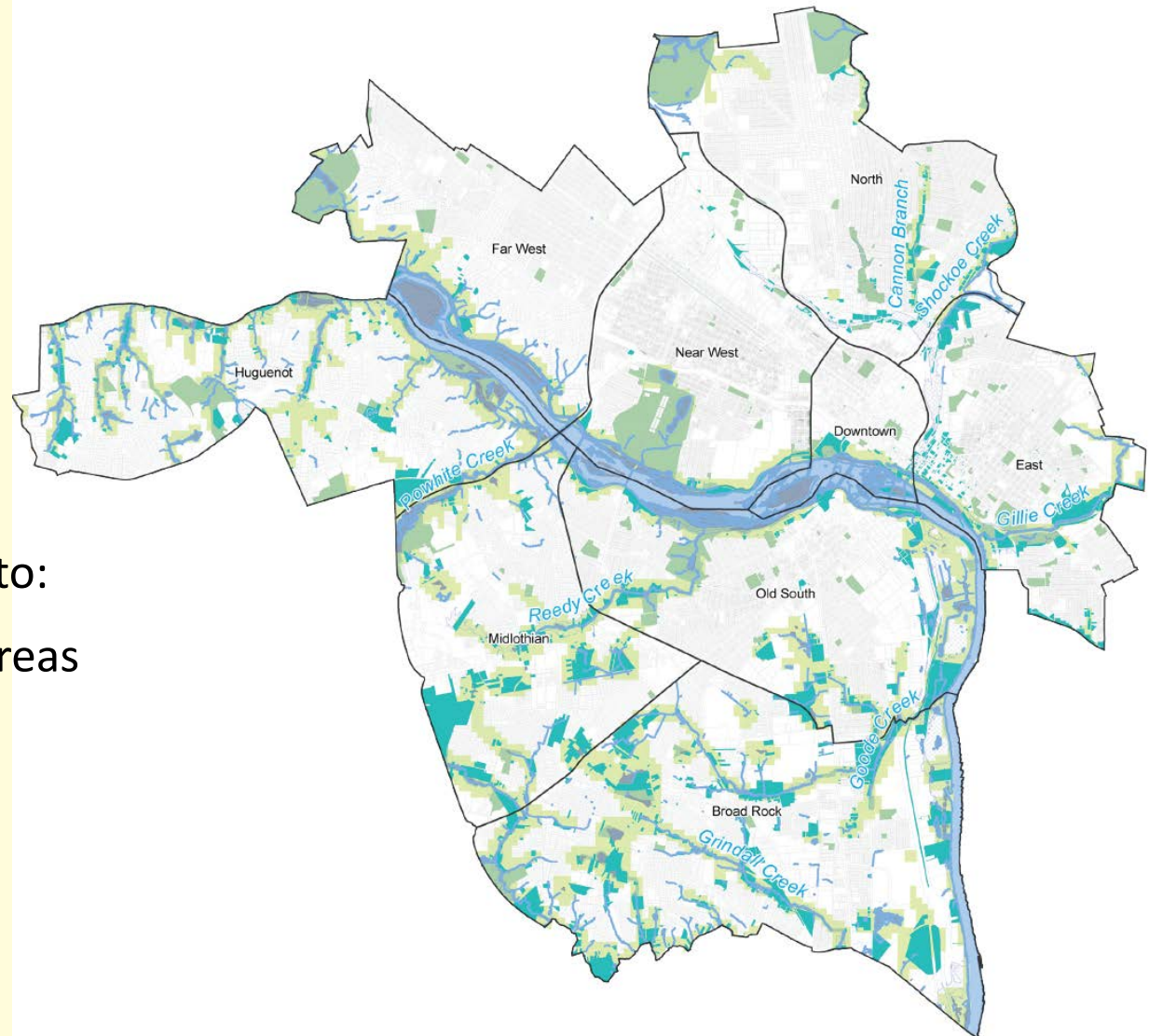


City: Water GI

Ecological suitability of vacant parcels through the city to contribute to water quality.

These parcels met criteria to:

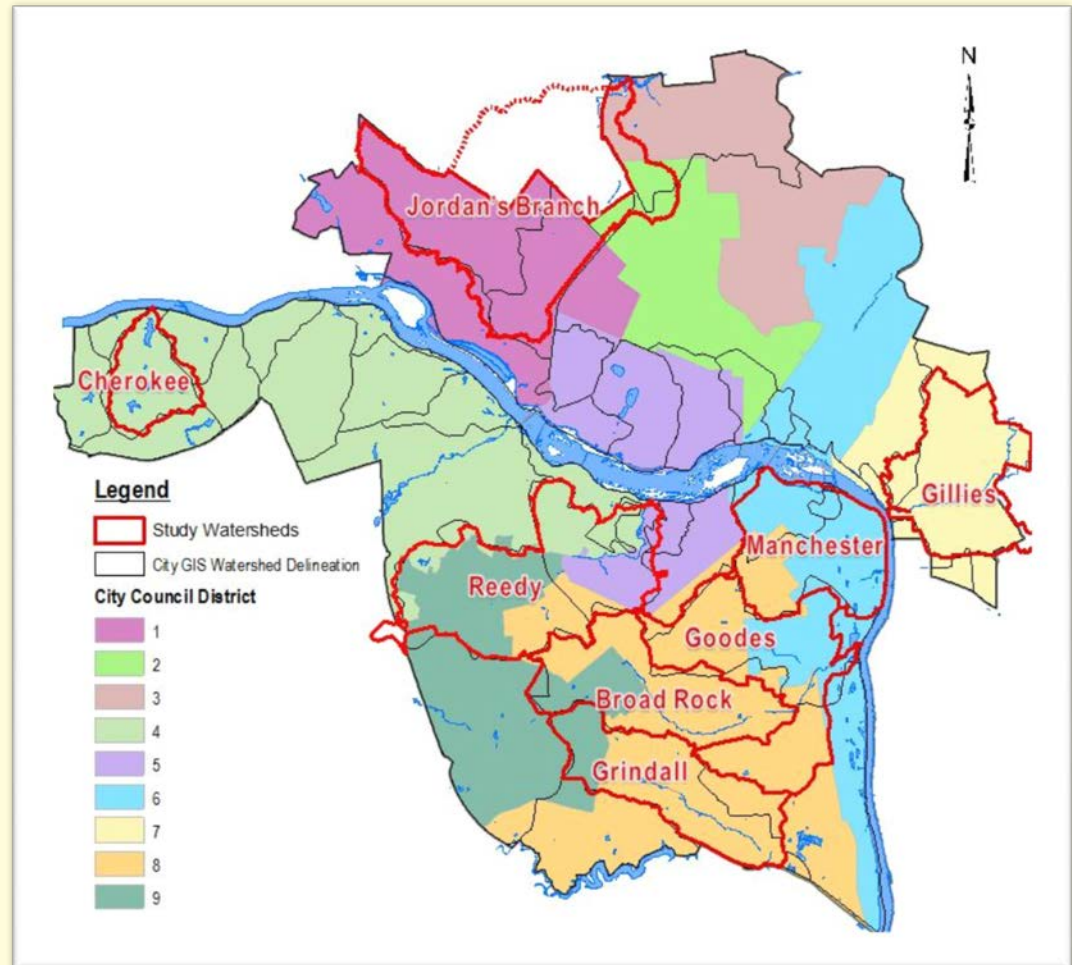
- Prioritize Conservation Areas
- Improve water quality
- Increase park access
- Develop greenways
- Connect the network



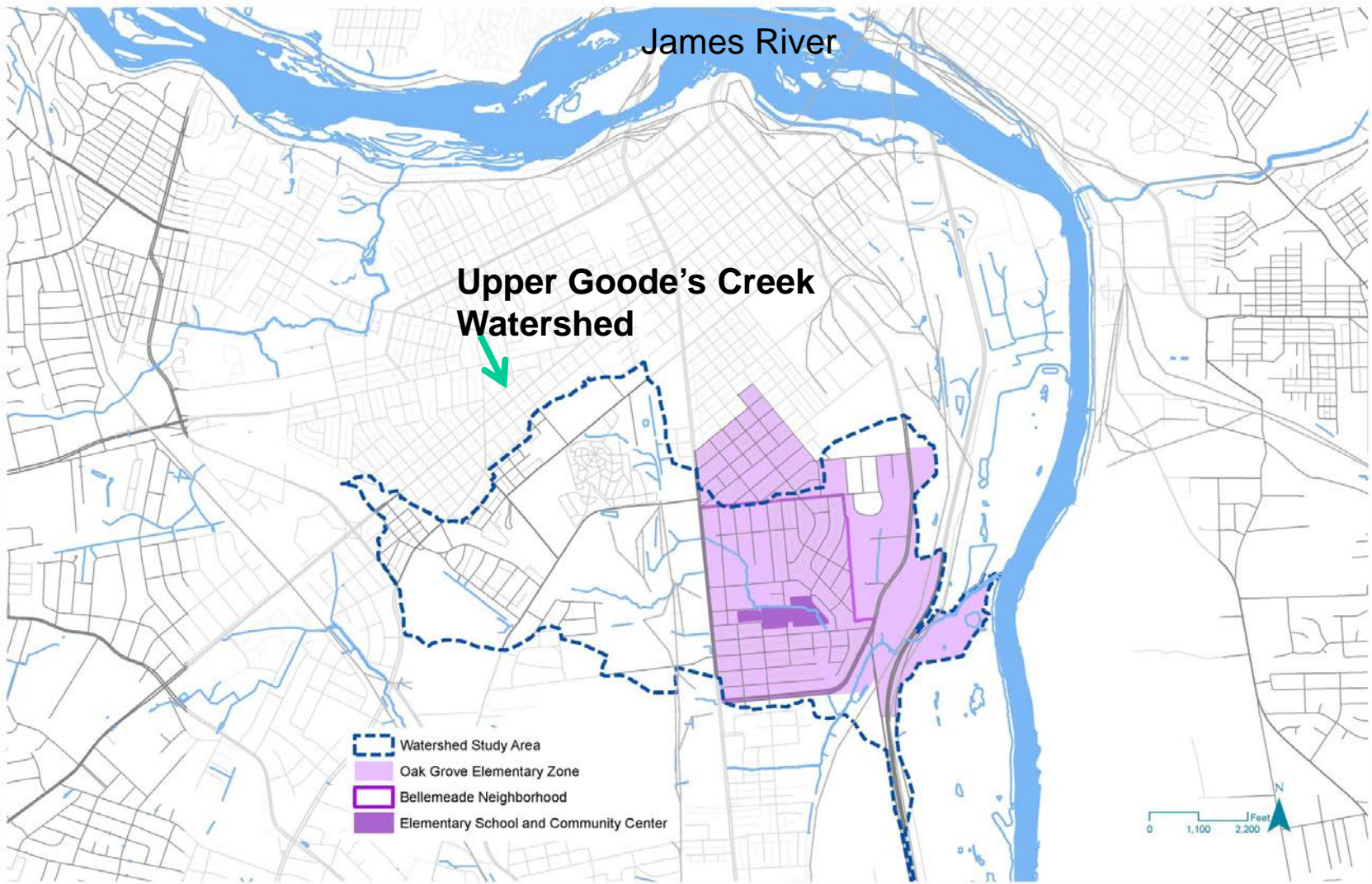
Richmond City Master Plans

Watershed Plans

- Mitigate flooding
- Prevent stream bank erosion
- Improve in-stream water quality
- Maintain assets
- Comply with mandates to end Combines Sewer Overflows

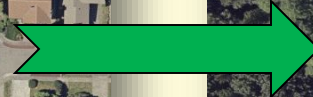


Demonstration Watershed: Goode's Creek Watershed



Water flow strategies

How do we make this...



function like this?



We use GIS to identify high quality areas and opportunities to restore the watershed



Vacant Parcels with Ecological Value



Vacant Parcels with Urban Tree Canopy



GREEN INFRASTRUCTURE

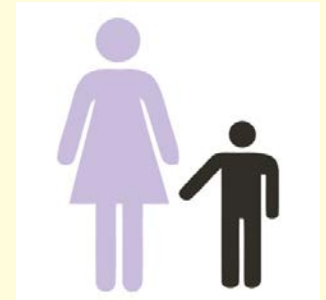
We formed a Watershed Coalition to focus the efforts.



Clean Environment
and Healthy Waters



Green Streets



Safe Walkable Communities



Blight to Beautification



Parks and Green Spaces



Urban Forest

Green Infrastructure Toolkit:

Remember there are many options at the site scale



Urban Water

- Vegetated swales/bioswales
- Rain gardens/bioretention areas
- Vegetated filter strips
- Stormwater wetland



Community Spaces

- Pocket park
- Informal recreation
- Meadow/native habitat
- Outdoor classroom
- Community garden



Site Planning

- Green street design
- Reducing impervious surfaces
- Vegetated landscaping
- Urban forestry
- Urban stream restoration
- Riparian buffers



Community Stewardship

- Green space grant programs
- Land banking
- Mow-to-own
- Adopt-a-block

Site Scale Demo Project Example

City Owned Land Adjacent to New School

- ✓ Restore the stream channel
- ✓ Redirect runoff into a bioswale
- ✓ Replant the understory and stream buffer
- ✓ Remove invasive species
- ✓ Provide nature trail



Upper Goodes Creek



GREEN INFRASTRUCTURE



Park Concept Plan
Bellemeade Neighborhood - Richmond, VA



GIC and the Coalition Coordinated tree plantings, building the nature trail, replanting buffers

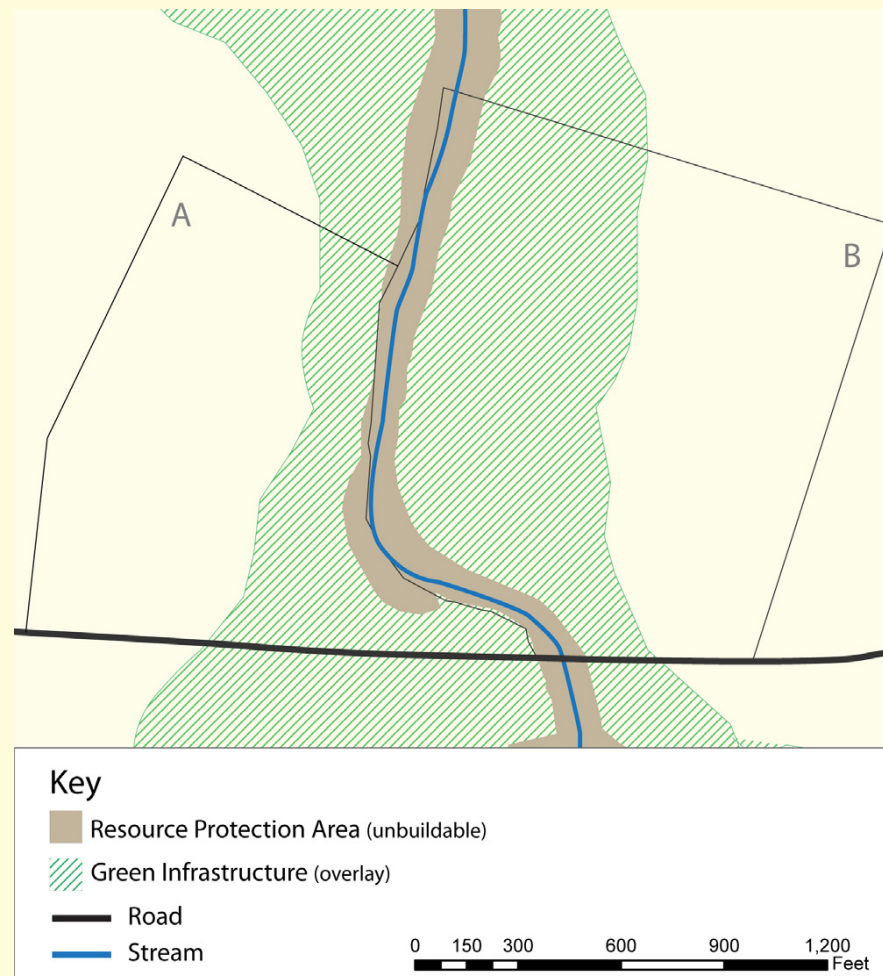


Rethinking Development Plans



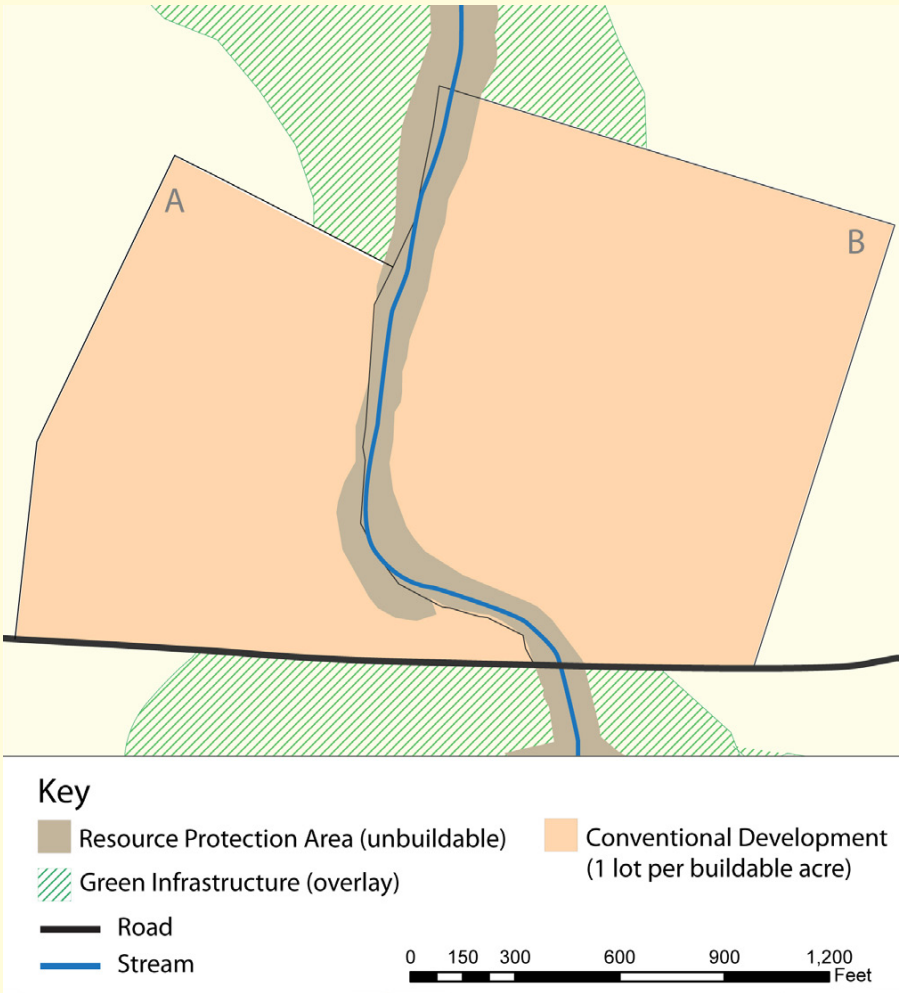
Example Parcel Strategy: strategic conservation

Existing
riparian
buffer



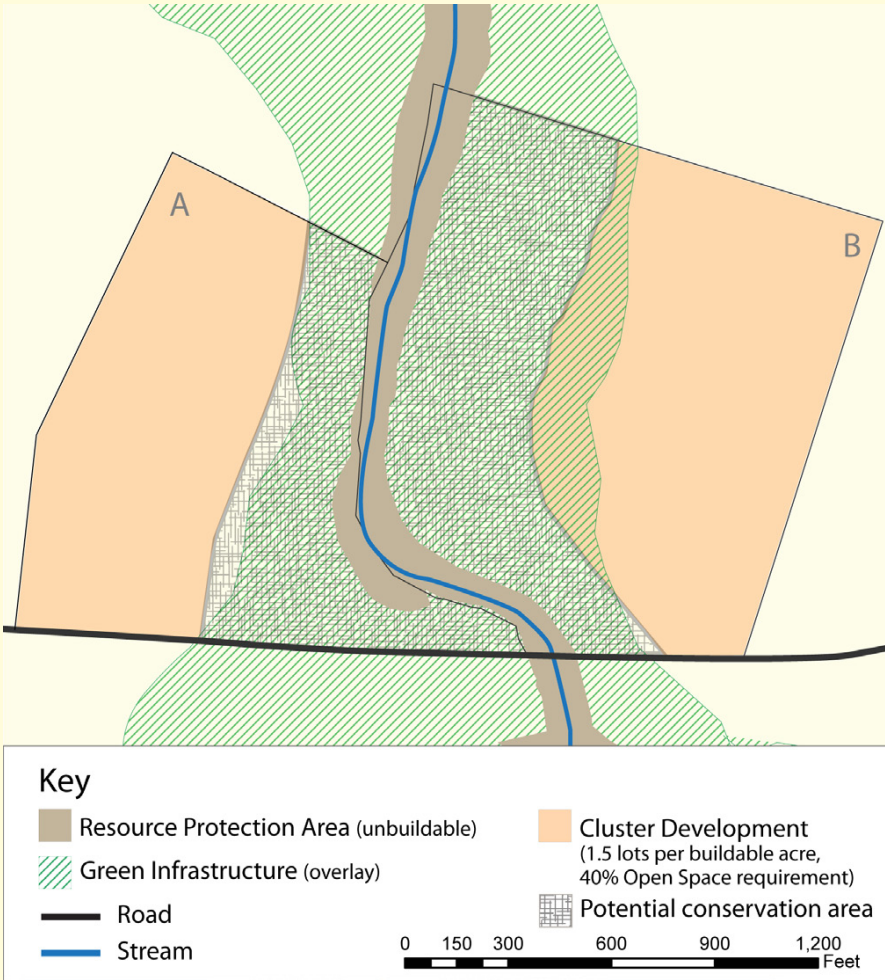
Parcel Strategy: strategic conservation

Conventional
Development

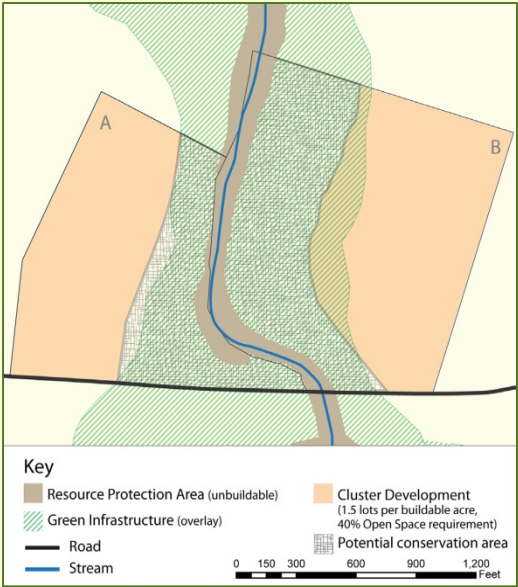
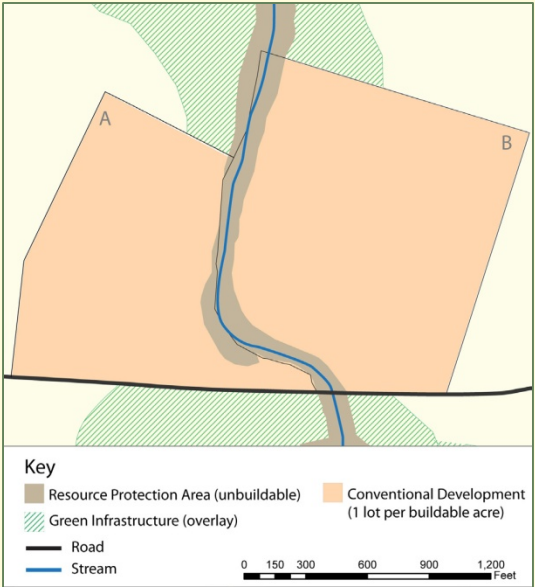


Parcel Strategy Example

Existing riparian buffer preserved by clustering development



Parcel Strategy: Comparison



	# of Lots	# of Lots
Parcel (acres)	Conventional Development (1 lot/acre)	Clustered Development (1.5 lots acre)
A (32)	26	39
B (38)	30	45
Total	56	84

Take Away Points

Need to think at multiple scales (up and down in scales and connections)

Need to think about the landscape context for trails and parks including views, animal and people movement, connections and role within a larger network

Think of systems and nested landscape elements

Making the Case

How to sell the importance of natural asset mapping and conservation



Social Marketing

Social marketing arose as a discipline in the 1970s, when Philip Kotler and Gerald Zaltman applied the same marketing principles used to sell products to consumers to now *sell ideas, attitudes and behaviors*. Social marketing seeks to influence social behaviors to benefit the target audience and the general society.

Adapted from "What is Social Marketing", by Nedra Kline Weinreich, <http://www.social-marketing.com/Whatis.html>

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Positive Messages

Positive messages sell while negatives do not.

So if you want to save a forest, it would be more effective to say, “Conserve large connected tracts of forest whenever possible to ensure the best possible wildlife conservation” rather than saying things such as,

“Don’t fragment the forest.” or “Stop building in the woods.”



Meet or Avoid Regulations

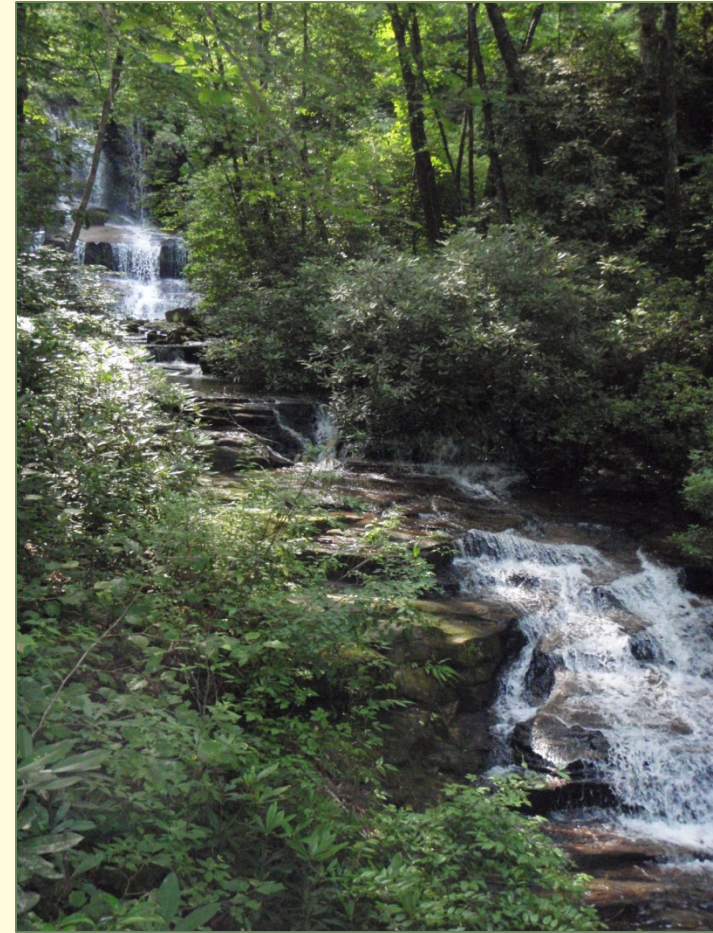
TMDLs: Identify areas that may be subject to impairment and protect them to prevent future TMDL's. Use your natural assets maps to identify areas to restore to mitigate the pollution loadings. Choose practices that will affect runoff such as retain or restore forested stream buffers etc.

Stormwater Programs: Prevent new stormwater problems and erosion by identifying sensitive landscapes, steep slopes as well as natural assets to retain on site.

Save Water Treatment Costs

Forest cover protects surface water sources and aquifer recharge zones and reduces the cost of drinking water treatment. American Water Works Association found a 10% increase in forest cover reduced chemical and treatment costs for drinking water by 20%. (Ernst et al. 2004)

Key Message: Trees = cheaper water treatment



Canopy Values

Trees provide more attractive areas for development, historic districts, commercial areas opportunities for people to interact with nature.

A study by the University of Washington found that people shopped longer and more often in tree-lined retail areas and spent about 12 percent more money.

Key message: Trees = more tax revenue even in developed commercial districts!

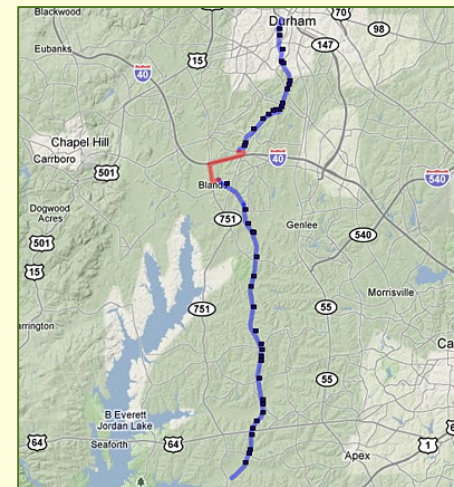
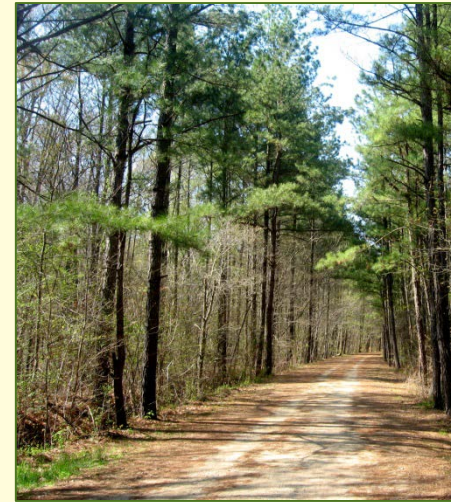


Green Assets = Real Estate \$\$\$

Green spaces increase home value. For instance, homes in the Shepherd's Vineyard development adjacent to the American Tobacco Trail in NC sold for \$5,000 more than other homes in the neighborhood.

The larger a park, the more significant the property value increase.

Key message: Parks = better tax base = \$!



Green Assets = Real Estate \$\$\$

Large natural forest areas have a greater positive impact on nearby property prices than smaller urban parks or developed parks such as playgrounds, skate parks or golf courses. In North Carolina, natural parks in Mecklenburg County generate five times more economic benefits (annually valued at \$15 million) than they cost.

Key message: Bigger intact forests/natural areas = more \$!



Real Estate \$\$\$

\$ National Association of Realtors Study (NAR) of homebuyers: 1-2% golfed, 5-6% swim and more than 50% use paths.

Key message: paths are most desired landscape feature.

\$ NAR says 57% of voters are more likely to purchase a home near to green space and 50% are willing to pay 10% more!

Key message: keeping some green space allows same or better profit.



Job development

Small companies, especially those that are have well paid and skilled workforce place a strong importance on the “green” of the local environment.

Crompton Love and Moore, 1997

The creative class: artists, media, lawyers, analysts, make up 30 percent of the U.S. workforce and they place a premium on outdoor recreation and access to nature. Florida, 2002

Key message: Natural assets attract better paid jobs and thus a better tax base = \$



Trees: for Health

- ❑ Access to fitness opportunities. (addresses obesity, nature deficit disorders)
- ❑ Clean air – trees absorb pollutants, VOCs, filter runoff, cool the city. (combat asthma)
- ❑ Well being and mental health - -people heal faster when they can see or access green. (hospitals need this for patients, reduces absenteeism of workers)
- ❑ Less crime occurs near trees. (issue especially for downtowns and public housing areas)
- ❑ Employees will exercise if they can access green where they work and on the way to work. (addresses employee health)



GIC's crew plants trees at the McGuire Veterans Center Hospital. We're also planting healing gardens!

Key Message: Treed areas = healthy safer communities!

All of these values can be sold to planners as Ecosystem Services: things we can have for **FREE** if only we identify them and work to conserve them!

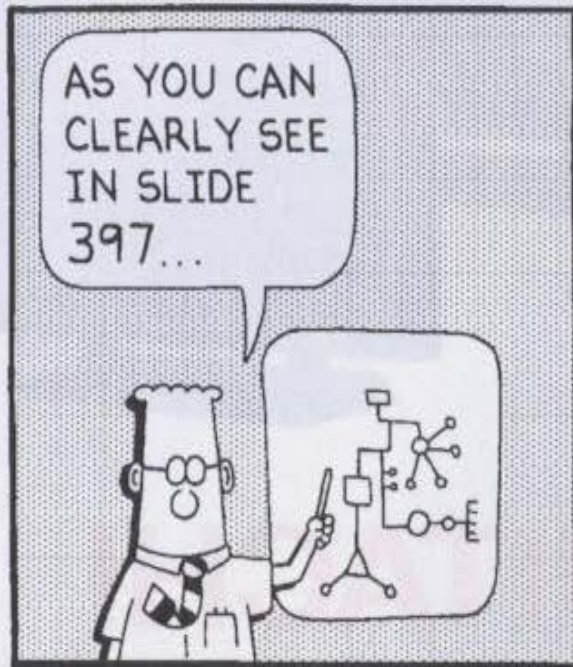
What are the meta messages here?

Green infrastructure plans can...

- ❑ Create good decisions since good decisions start with good data
- ❑ Create and sustain a strong economy
- ❑ Make you healthy and wealthy
- ❑ Link everything you do together – it's about integration -- not making more work
- ❑ Make your locality smart AND green

Hope you've made it this far...

DILBERT



www.dilbert.com scottadams@aol.com



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because, we are done!

Green Infrastructure Center Inc.

P.O, Box 317

Charlottesville, VA, 22902

434-244-0322

Firehock@gicinc.org

www.gicinc.org

We'll answer questions now, but if time is short, feel free to contact speaker by email with additional questions. Visit our website to obtain a guide, register for a workshop or learn more about green infrastructure planning!

