# LANDSCAPE SCALE PLANNING

## INNOVATIVE TOOLS USED BY MD SHA AND TX DOT

***AASHTO TIG Project | Texas Department of Transportation | Maryland State Highway Administration***

**Maryland State Highway Administration**
**Donna Buscemi, Sandy Hertz and Heather Lowe**

**Maryland Department of Natural Resources**
**Christine Conn**

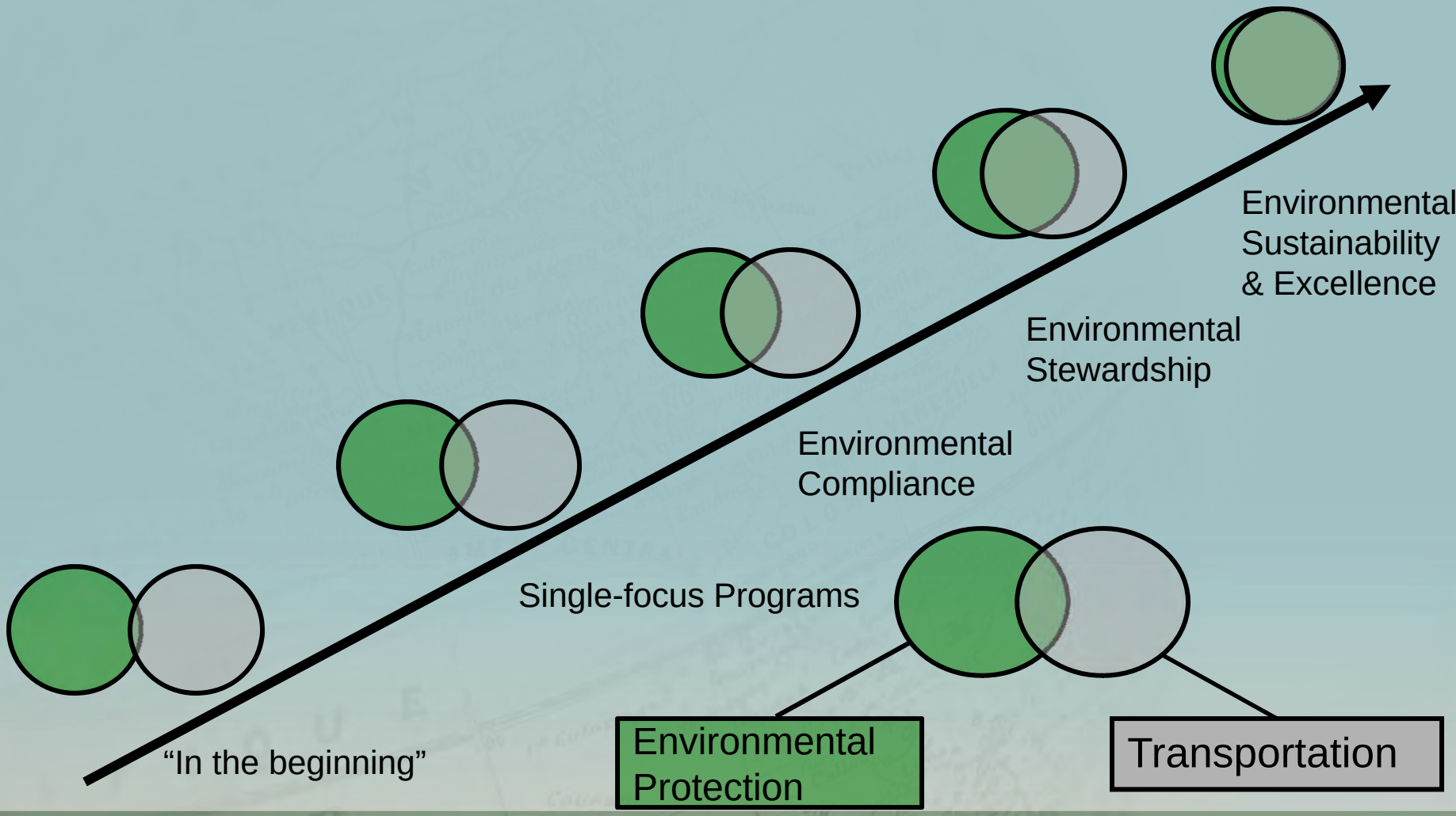
**Gannett Fleming**
**Craig Shirk**

**February 3, 2011**

# OVERVIEW

- AASHTO TIG Joint Lead States Team
- Texas DOT GIS Screening Tools
- Maryland's Green Infrastructure Assessment
- US 301: A Green Infrastructure Approach
- Looking Down the Road

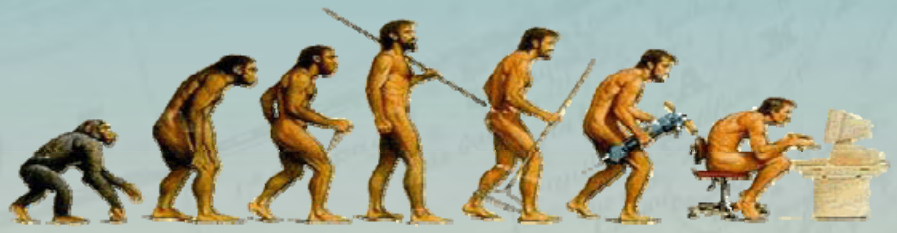
# GOALS & MISSIONS OF ENVIRONMENTAL PROTECTION AND TRANSPORTATION ARE MERGING!



# TRANSPORTATION PROJECT DEVELOPMENT IS EVOLVING

## Key Milestones:

- 1970 NEPA signed into law
- 1970's Metropolitan Planning Organizations for populations > 50,000
- CAA 1972
- ESA 1973
- 1966 Section 4(f) USDOT
- Clean Water Act 1972, 1977
- CAAA 1990
- **2002 Executive Order 13274**
- 2005 SAFETEA-LU
- **2005 Green Highways Partnership**
- **2006 ECO-LOGICAL**
- 2008 CWA 404 Compensatory Mitigation Rule
- **2008 FHWA Planning and Environment Linkages**
- 2010 Chesapeake Bay TMDL



# PROJECT DEVELOPMENT COMPARISON

## THEN

- Focused on transportation needs
- Scoped projects without 1st understanding community and natural environmental resource context
- Environmental compliance in Isolation (permit-based)
- Stakeholder involvement was reactionary

## NOW

- Transportation, environmental, social and economic needs given equal priority
- Scoped projects with the understanding of community and natural environmental resource context
- Compliance and Stewardship with a systems approach
- Stakeholder involvement throughout the transportation process

# WHY USE THESE TOOLS?

- Compliance with existing & emerging regulations
- Transparent decisions
- Accelerated project delivery
- Improved resource protection
- Scalable solution
- Sustainable planning
- Supports a watershed approach
- Can be integrated with existing GIS data

# TEXAS: A BIG STATE WITH BOTH RURAL AND URBAN POPULATIONS

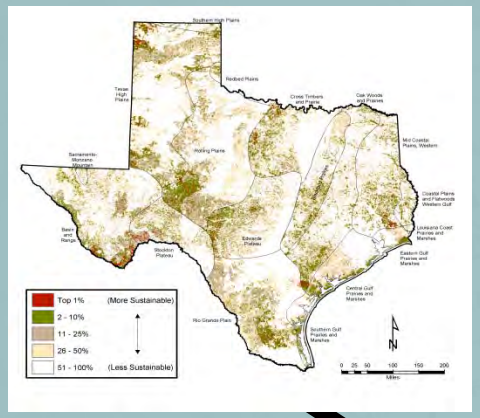
**Land Area**
- 171.1 Million Acres
- Ranks 2nd
- 84% Private Land

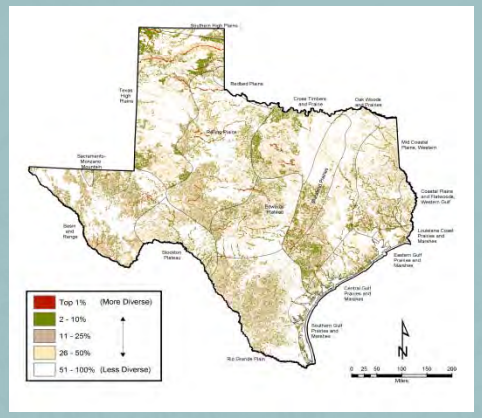
**Estimated Population**
- 25.4 Million
- Ranks 2nd
- By 2030 – 33.3 Million

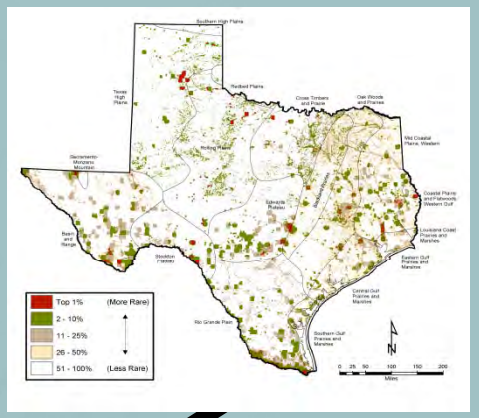
# ENVIRONMENTAL PLANNING TOOLS

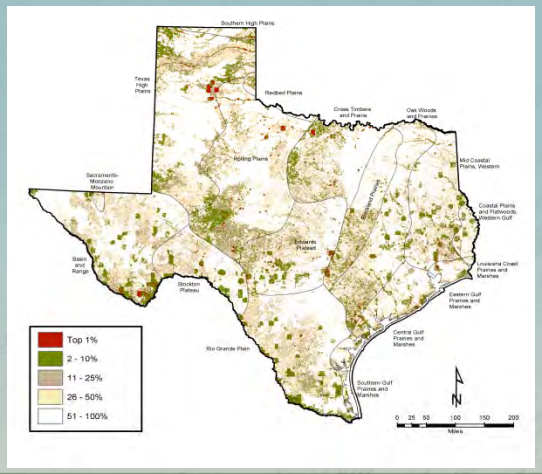
- Texas Ecological Assessment Protocol (TEAP)
- GIS Screening Tool (GISST)
- NEPAssist

# TEXAS ECOLOGICAL ASSESSMENT PROTOCOL (TEAP)



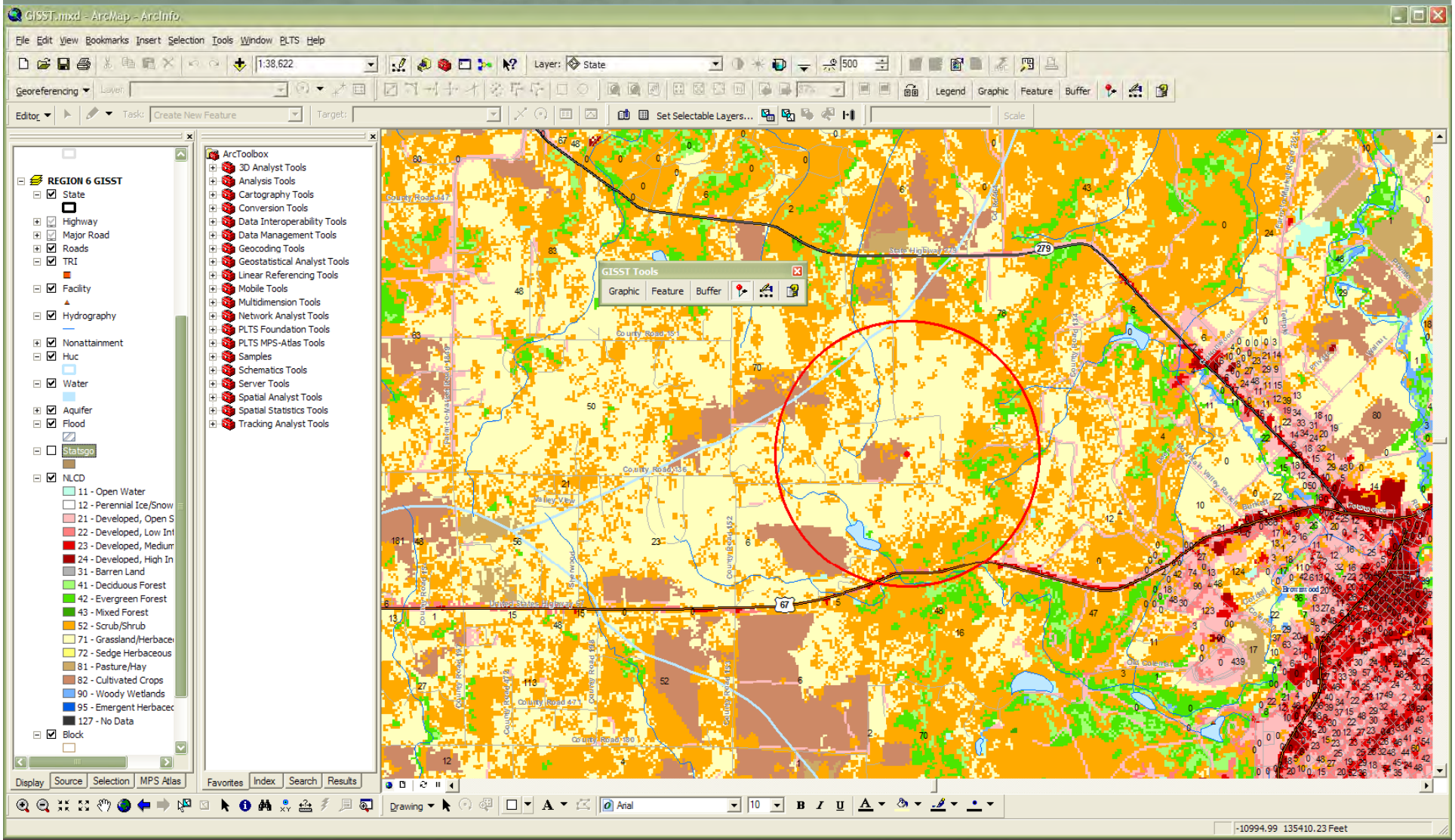



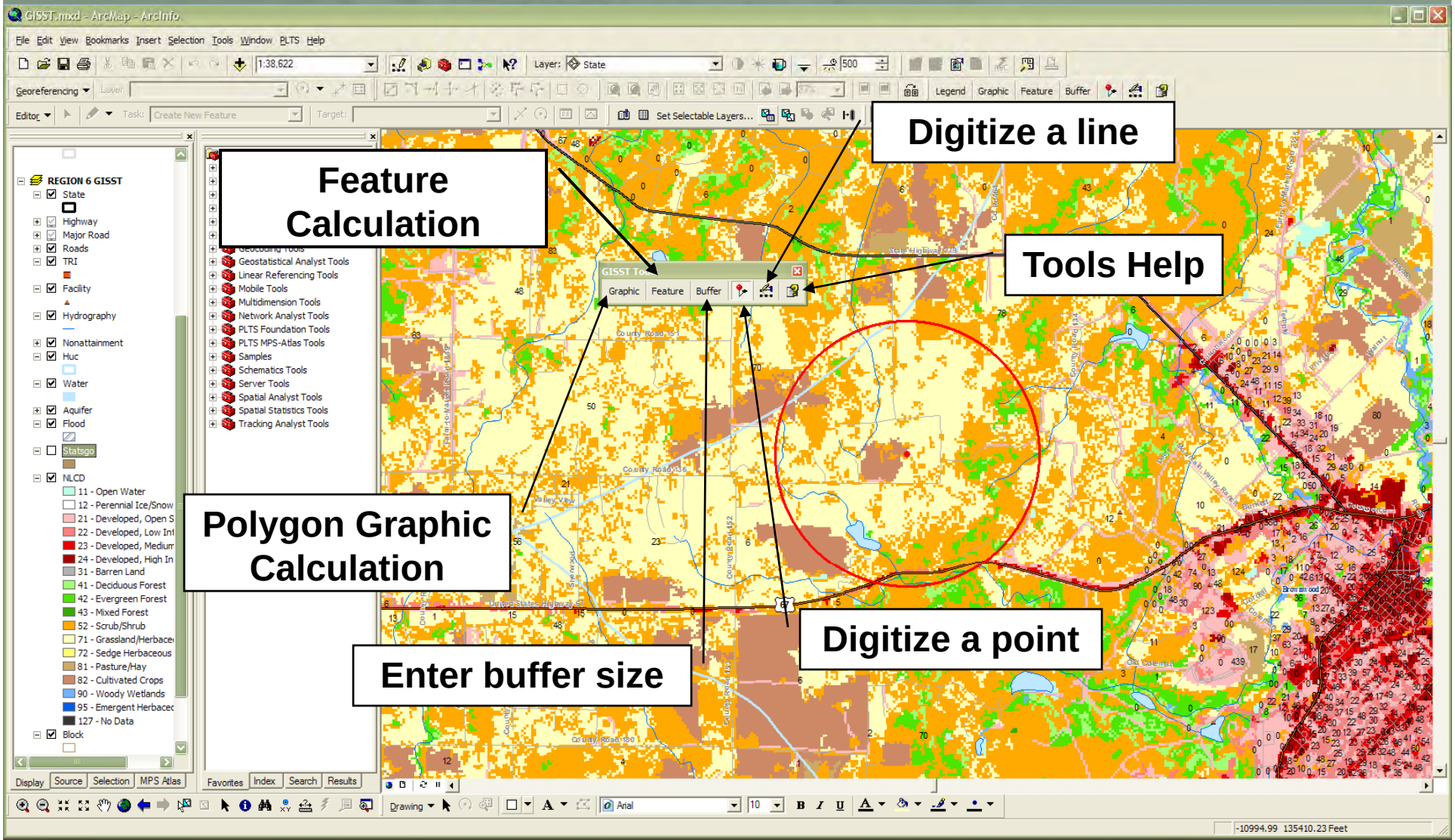




***Composite: identifies important ecological resources in each ecoregion across Texas***

# GIS SCREENING TOOL (GIST)



# GIS SCREENING TOOL (GISST)



# GISST SCORE CALCULATION

**% Wildlife**
**Percentage of cell that is identified as wildlife habitat**

| Rank | Value |
|---|---|
| 1 | < 20% of the grid cell |
| 2 | 20-29% of the grid cell |
| 3 | 30-39% of the grid cell |
| 4 | 40-49% of the grid cell |
| 5 | ≥ 50% of the grid cell |

***In general, a score of "5" indicates a high degree of concern and a "1" indicates a lower degree of concern***

# ALTERNATIVE 1: GISST REPORT DIRECT IMPACTS

## GISST Scores

*test17*

| HUC-Related | Score |
|---|---|
| Surface Water Use | 1 |
| Storet Exceedences | 1 |
| Rainfall | 3 |
| Unified Watershed Assessment | 1 |
| Average Flow | 3 |
| Aquifer Geology | 4 |

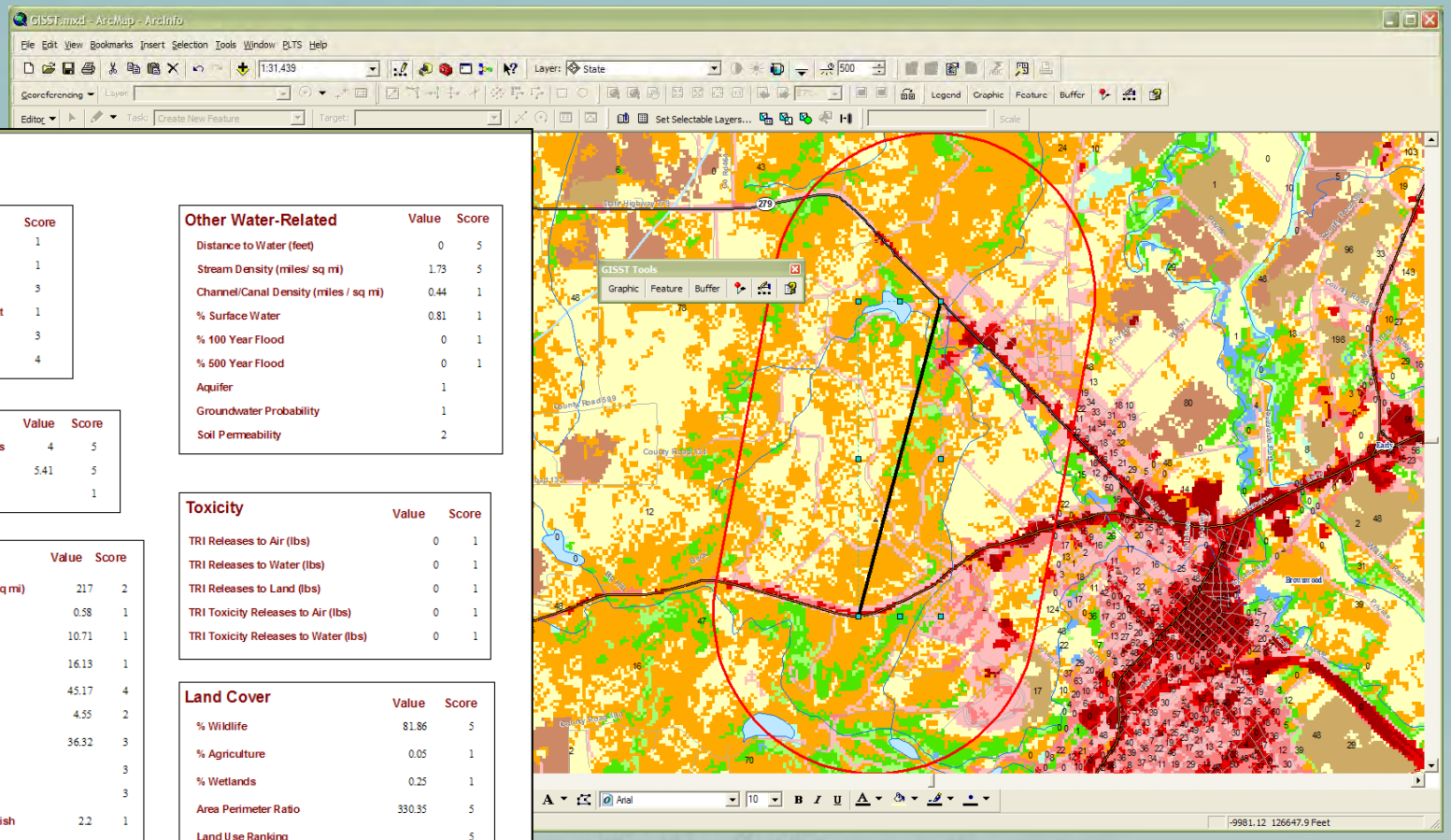
| Air | Value | Score |
|---|---|---|
| Number of Regulated Facilities | 4 | 5 |
| Road Density (miles / sq mi) | 5.41 | 5 |
| Nonattainment | | 1 |

| Socioeconomic | Value | Score |
|---|---|---|
| Population Density (persons / sq mi) | 217 | 2 |
| % Children Under 1 | 0.58 | 1 |
| % Children Under 7 | 10.71 | 1 |
| % 55 Older | 16.13 | 1 |
| % Economically Stressed | 45.17 | 4 |
| % Unemployed | 4.55 | 2 |
| % Without High School Degree | 36.32 | 3 |
| Educational Attainment | | 3 |
| Age of Housing Unit | | 3 |
| % Low/No Ability to Speak English | 2.2 | 1 |
| % Linguistically Isolated | 3.08 | 1 |
| % Foreign Born | 4.39 | 1 |

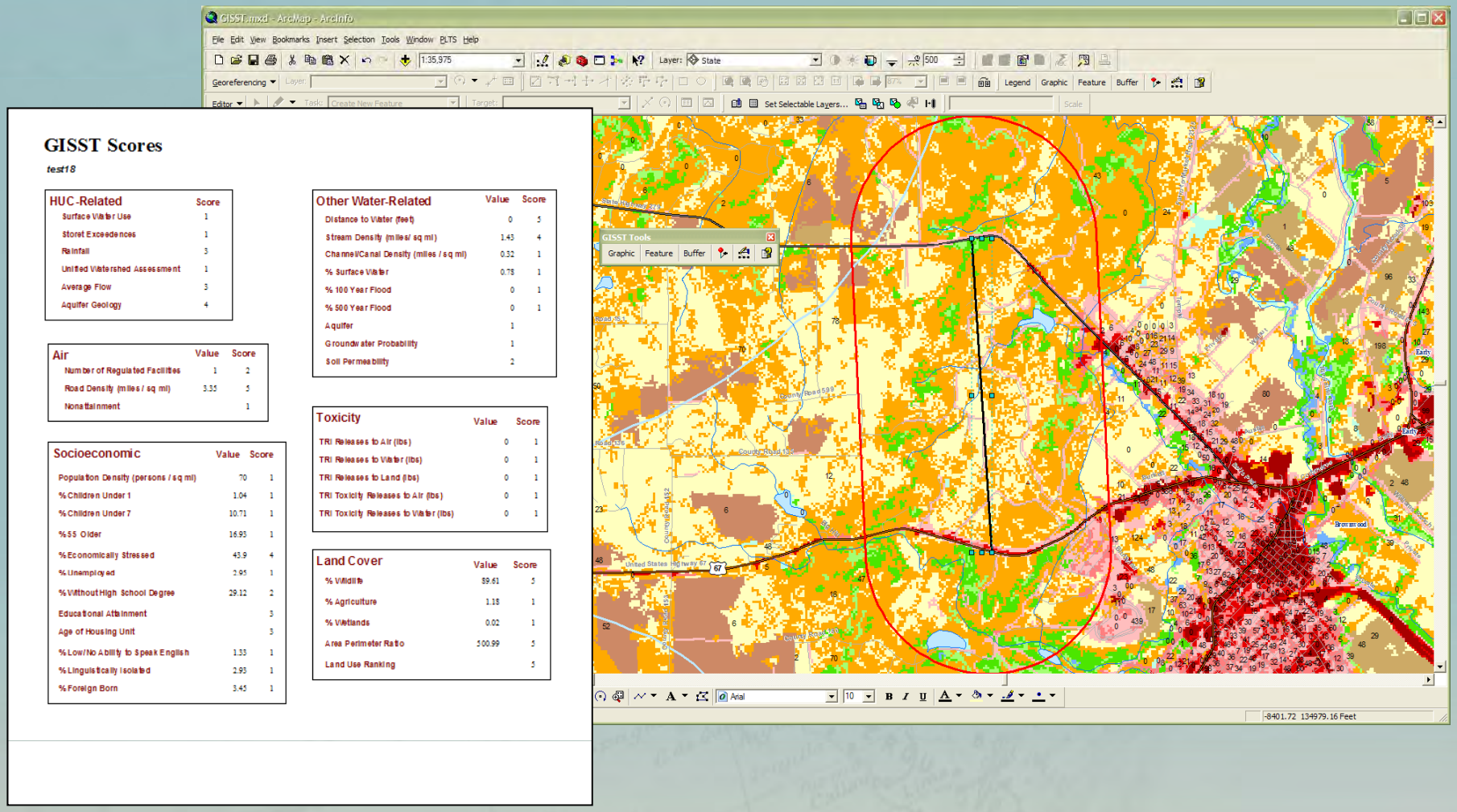
| Other Water-Related | Value | Score |
|---|---|---|
| Distance to Water (feet) | 0 | 5 |
| Stream Density (miles/ sq mi) | 1.73 | 5 |
| Channel/Canal Density (miles / sq mi) | 0.44 | 1 |
| % Surface Water | 0.81 | 1 |
| % 100 Year Flood | 0 | 1 |
| % 500 Year Flood | 0 | 1 |
| Aquifer | 1 | |
| Groundwater Probability | 1 | |
| Soil Permeability | 2 | |

| Toxicity | Value | Score |
|---|---|---|
| TRI Releases to Air (lbs) | 0 | 1 |
| TRI Releases to Water (lbs) | 0 | 1 |
| TRI Releases to Land (lbs) | 0 | 1 |
| TRI Toxicity Releases to Air (lbs) | 0 | 1 |
| TRI Toxicity Releases to Water (lbs) | 0 | 1 |

| Land Cover | Value | Score |
|---|---|---|
| % Wildlife | 81.86 | 5 |
| % Agriculture | 0.05 | 1 |
| % Wetlands | 0.25 | 1 |
| Area Perimeter Ratio | 330.35 | 5 |
| Land Use Ranking | | 5 |



# ALTERNATIVE 2: GISST REPORT DIRECT IMPACTS



## GISST Scores

*test18*

| HUC-Related | Score |
|---|---|
| Surface Water Use | 1 |
| Storet Exceedences | 1 |
| Rainfall | 3 |
| Unified Watershed Assessment | 1 |
| Average Flow | 3 |
| Aquifer Geology | 4 |

| Air | Value | Score |
|---|---|---|
| Number of Regulated Facilities | 1 | 2 |
| Road Density (miles / sq mi) | 3.35 | 5 |
| Nonattainment | | 1 |

| Socioeconomic | Value | Score |
|---|---|---|
| Population Density (persons / sq mi) | 70 | 1 |
| % Children Under 1 | 1.04 | 1 |
| % Children Under 7 | 10.71 | 1 |
| % 55 Older | 16.93 | 1 |
| % Economically Stressed | 43.9 | 4 |
| % Unemployed | 2.95 | 1 |
| % Without High School Degree | 29.12 | 2 |
| Educational Attainment | | 3 |
| Age of Housing Unit | | 3 |
| % Low/No Ability to Speak English | 1.33 | 1 |
| % Linguistically Isolated | 2.93 | 1 |
| % Foreign Born | 3.45 | 1 |

| Other Water-Related | Value | Score |
|---|---|---|
| Distance to Water (feet) | 0 | 5 |
| Stream Density (miles/ sq mi) | 1.43 | 4 |
| Channel/Canal Density (miles / sq mi) | 0.32 | 1 |
| % Surface Water | 0.78 | 1 |
| % 100 Year Flood | 0 | 1 |
| % 500 Year Flood | 0 | 1 |
| Aquifer | 1 | |
| Groundwater Probability | 1 | |
| Soil Permeability | 2 | |

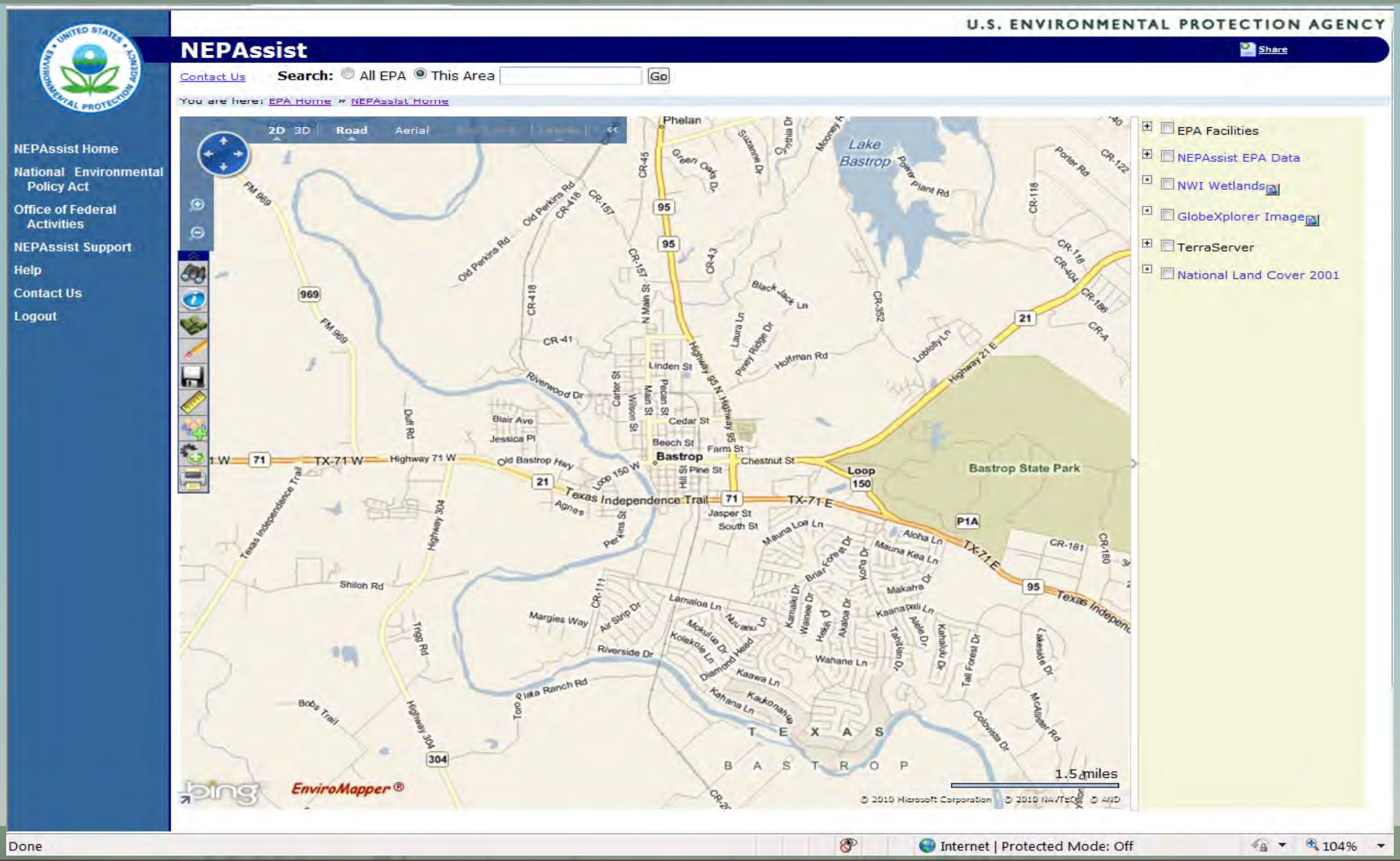
| Toxicity | Value | Score |
|---|---|---|
| TRI Releases to Air (lbs) | 0 | 1 |
| TRI Releases to Water (lbs) | 0 | 1 |
| TRI Releases to Land (lbs) | 0 | 1 |
| TRI Toxicity Releases to Air (lbs) | 0 | 1 |
| TRI Toxicity Releases to Water (lbs) | 0 | 1 |

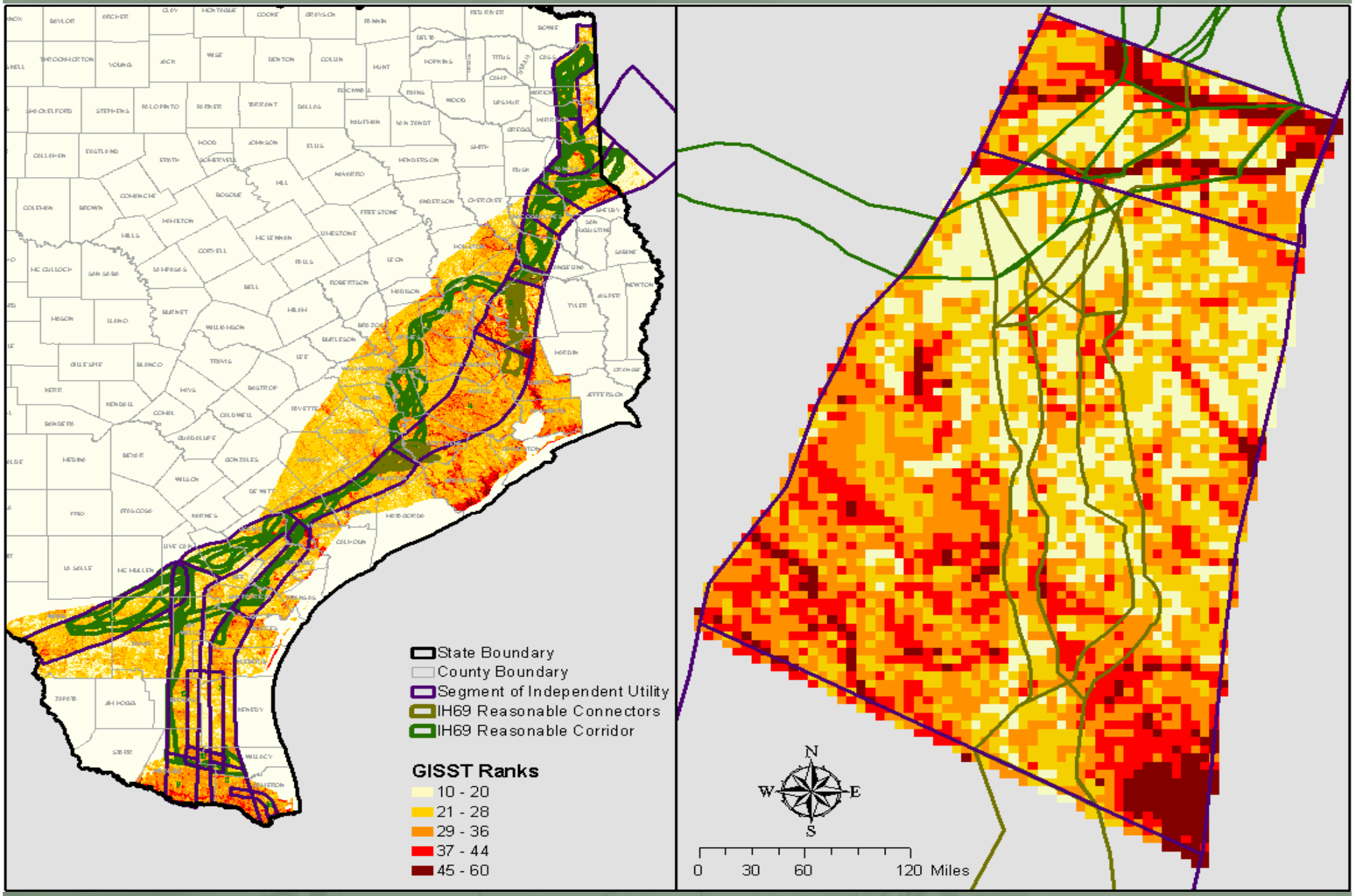
| Land Cover | Value | Score |
|---|---|---|
| % Wildlife | 89.61 | 5 |
| % Agriculture | 1.18 | 1 |
| % Wetlands | 0.02 | 1 |
| Area Perimeter Ratio | 500.99 | 5 |
| Land Use Ranking | | 5 |

# GISST DATABASE COMPARISON OF ALTERNATIVES

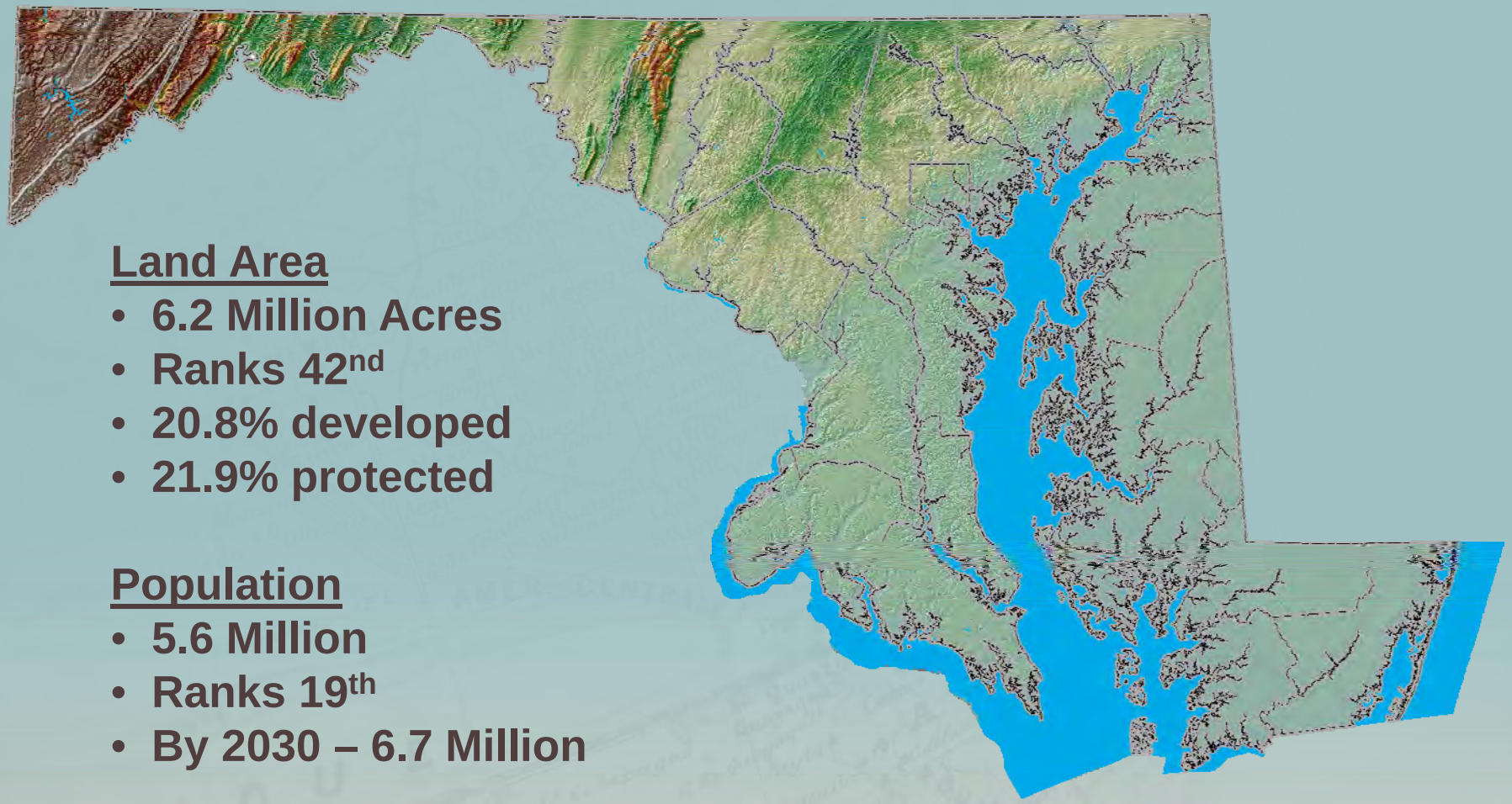
| Corridor Alternative | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | | | | |
| % Wildlife | 79.78 | 60.92 | 89.96 | 86.05 | 68.01 | 75.11 |
| | 5 | 5 | 5 | 5 | 5 | 5 |
| | | | | | | |
| % Agriculture | 10.05 | 32.16 | 3.68 | 2.56 | 25.96 | 15.42 |
| | 1 | 3 | 1 | 1 | 2 | 1 |
| | | | | | | |
| % Wetlands | 75.98 | 59.81 | 87.17 | 80.54 | 67.96 | 74.88 |
| | 5 | 5 | 5 | 5 | 5 | 5 |
| | | | | | | |
| stream density | 2.61 | 2.71 | 1.63 | 3.56 | 1.69 | 2.43 |
| | 5 | 5 | 5 | 5 | 1 | 5 |
| | | | | | | |
| % 100 year floodplain | 84.9 | 70.9 | 88.92 | 87.17 | 75.56 | 84.53 |
| | 5 | 5 | 5 | 5 | 5 | 5 |
| | | | | | | |
| % 500 year floodplain | 100 | 99.99 | 88.92 | 100 | 99.99 | 99.99 |
| | 5 | 5 | 5 | 5 | 5 | 5 |
| | | | | | | |
| Land Use Ranking | 5 | 4 | 5 | 5 | 4 | 4 |

# NEPAssist


U.S. ENVIRONMENTAL PROTECTION AGENCY
NEPAssist
Share
Contact Us
Search: All EPA This Area Go
You are here: EPA Home » NEPAssist Home
NEPAssist Home
National Environmental Policy Act
Office of Federal Activities
NEPAssist Support
Help
Contact Us
Logout
2D 3D Road Aerial
EPA Facilities
NEPAssist EPA Data
NWI Wetlands
GlobeXplorer Image
TerraServer
National Land Cover 2001
Bastrop
Bastrop State Park
Lake Bastrop
Texas Independence Trail
Highway 71 W
TX-71 E
Loop 150
Old Bastrop Hwy
Highway 21 E
Highway 95 N
Highway 304
FM 969
Phelan
Shiloh Rd
Riverside Dr
Linden St
Cedar St
Beech St
Chestnut St
Pine St
Jasper St
South St
Farm St
Hoffman Rd
Piney Ridge Dr
Black Jack Ln
Mauna Loa Ln
Mauna Kea Ln
Aloha Ln
Makaha Dr
Kaanapali Ln
Wahane Ln
Kaawa Ln
Kahana Ln
Diamond Head
Margies Way
Air Strip Dr
Toro Pinta Ranch Rd
Bobs Trail
Riverwood Dr
Blair Ave
Jessica Pl
Duff Rd
Tregg Rd
Porter Rd
Power Plant Rd
Suzanne Dr
Green Oaks Dr
Cynthia Dr
Laura Ln
Lobolly Ln
Old Perkins Rd
CR-41
CR-43
CR-118
CR-122
CR-157
CR-181
CR-186
CR-352
CR-404
CR-418
P1A
T E X A S
B A S T R O P
1.5 miles
bing
EnviroMapper®
© 2010 Microsoft Corporation © 2010 NAVTEQ © AND
Done
Internet | Protected Mode: Off
104%


State Boundary
County Boundary
Segment of Independent Utility
IH69 Reasonable Connectors
IH69 Reasonable Corridor
GISST Ranks
10 - 20
21 - 28
29 - 36
37 - 44
45 - 60
N
W
E
S
0
30
60
120 Miles

# MARYLAND



**Land Area**

- 6.2 Million Acres
- Ranks 42nd
- 20.8% developed
- 21.9% protected

**Population**

- 5.6 Million
- Ranks 19th
- By 2030 – 6.7 Million

# MARYLAND DEPARTMENT OF NATURAL RESOURCES




# Green Infrastructure

## Conserving and Restoring Maryland's Most Ecologically Important Lands

# WHAT IS INFRASTRUCTURE?

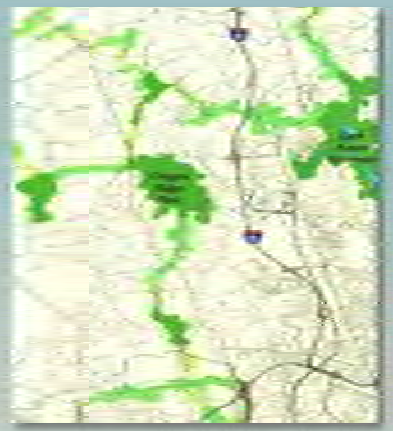
**Infrastructure – "*the substructure or underlying foundation on which the <u>continuance and growth</u> of a community depends*"**

- Webster's New World Dictionary

- A **necessity**, not an amenity
- A primary public **investment**
- Must be constantly **maintained**
- Must be developed as a **system**, not as isolated parts

# WHAT IS GREEN INFRASTRUCTURE?

"Strategically planned and managed **networks** of natural lands, working landscapes and other open spaces that **conserve ecosystem functions**, and provide associated **benefits to human populations**"

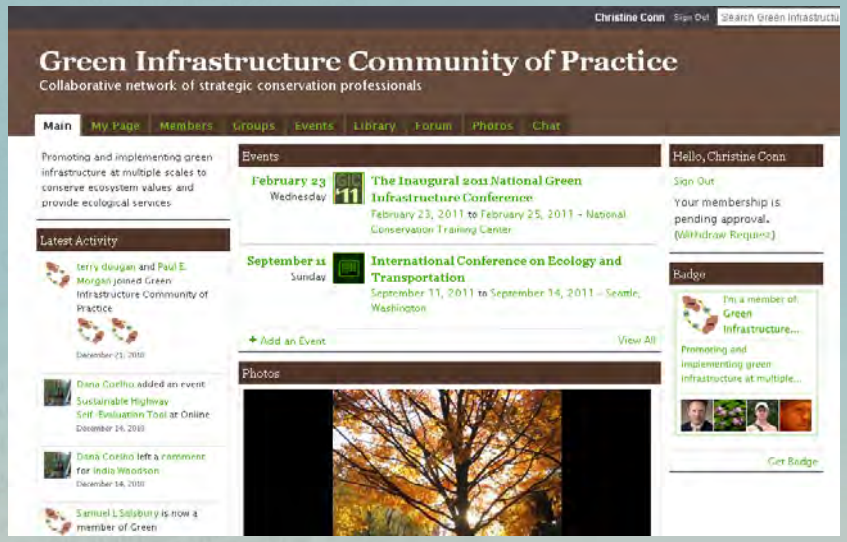


*Jane Hawkey, Jane Thomas, IAN Image Library (www.ian.umces.edu/imagelibrary/)*

# GREEN INFRASTRUCTURE IS A NATIONAL MOVEMENT ACROSS MANY SECTORS

- **National Community of Practice is a network of organizations promoting and implementing the green infrastructure approach**

- **Planning applications go far beyond land conservation…**
  - Transportation
  - Energy
  - Public Health and Air Quality
  - Food Production
  - Climate Change
  - Smart Growth
  - Green Jobs
  - Water Management
  - Natural Hazards Mitigation




*http://greeninfrastructure.ning.com*

# OUR # 1 CONSERVATION CHALLENGE

**Accelerated Consumption and Fragmentation of Natural and Working Lands**

*Source: Audubon Magazine, March/April 2000*

# HAPHAZARD CONSERVATION, RESTORATION AND LAND USE PLANNING

- Reactive
- Site-Specific
- Narrowly Focused
- Poorly Integrated with Other Efforts

# GREEN INFRASTRUCTURE IS THE LAND PLAN SCIENCE

***What is it?***

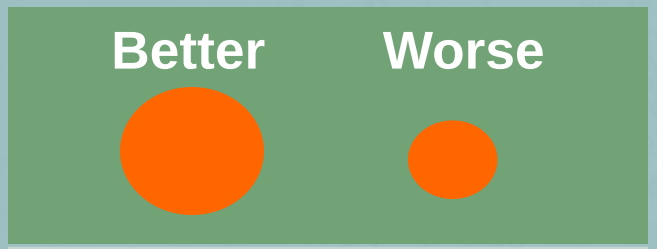
- **A GIS analysis developed to help identify and prioritize areas for**
  - **Conservation,**
  - **Restoration, and**
  - **Smart Growth**

***The Benefit:***

- **Provides a consistent, objective and defensible approach to land management decisions**

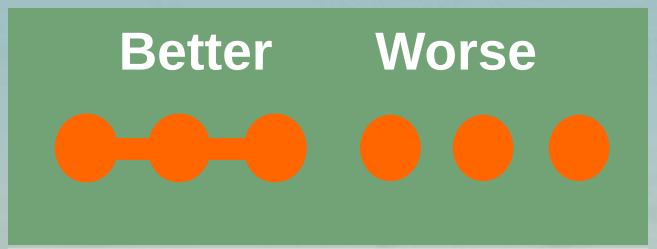
# DESIGN PRINCIPLES

- **Conservation Biology**




Larger vs. smaller

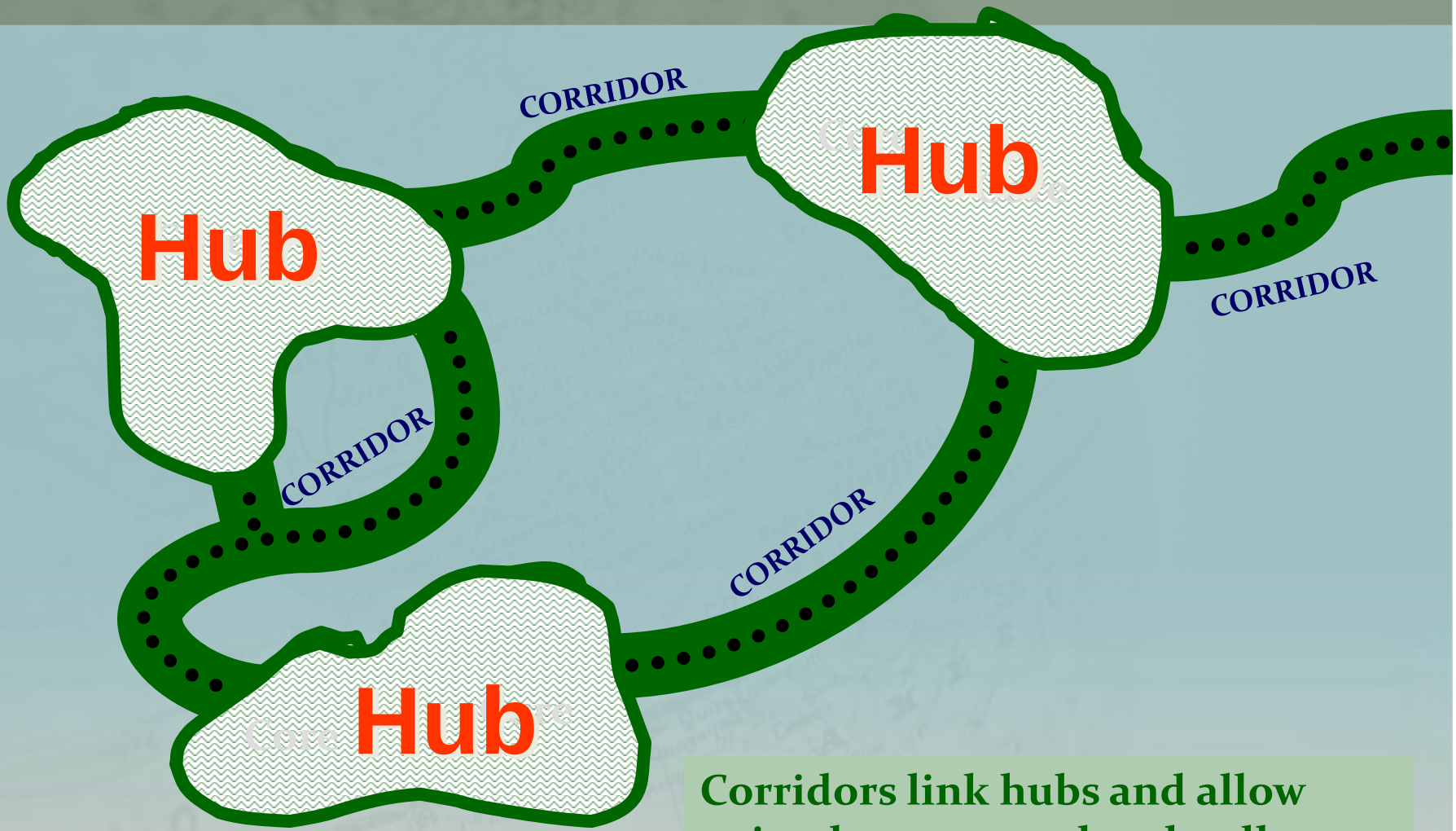
- **Landscape Ecology**




Connections are better

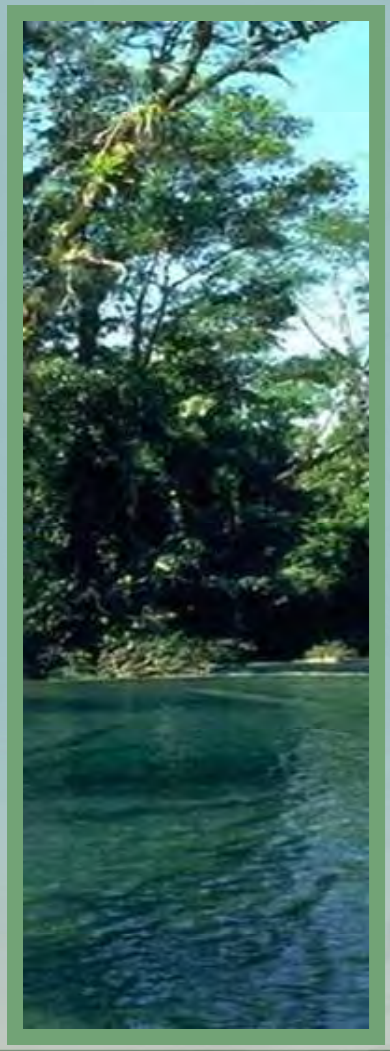
**Forest Interior Dependent Species (FIDS)**

# THE NETWORK CONCEPT




Corridors link hubs and allow animal, water, seed and pollen movement between hubs

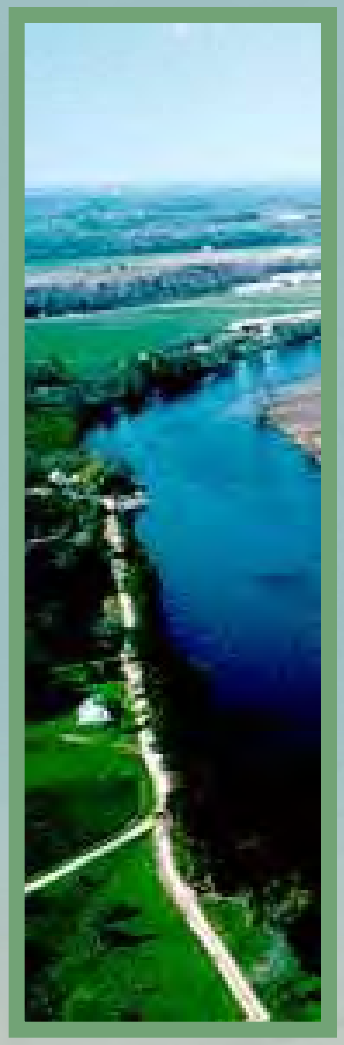
# MARYLAND'S GREEN INFRASTRUCTURE ASSESSMENT



## *Identification of Hubs*

- **Large, contiguous blocks of forests and unmodified wetlands**
  ***(250 acres and up)***
- **Other important plant/wildlife habitats**
  ***(100 ac. Minimum)***
- **Existing protected conservation lands with at least 100ac**

# MARYLAND'S GREEN INFRASTRUCTURE ASSESSMENT



## *Identification of Corridors*

- **Assess landscape between hubs for best ecological linkage**

- **Includes riparian, upland, and "mixed" connections**
- **Width based on 1100' or FEMA flood plain, whichever is greater**

# GEOGRAPHIC INFORMATION SYSTEMS (GIS) ANALYSIS

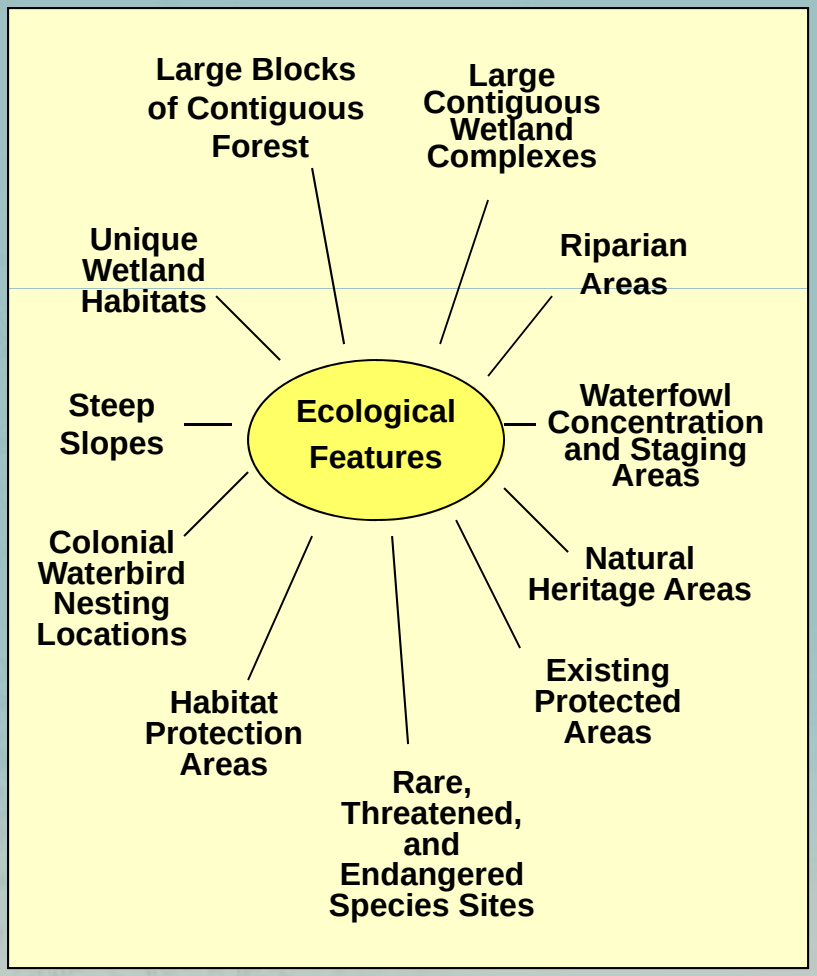
## SELECTION OF ECOLOGICAL COMPONENTS

Strive to include full range of ecosystem elements vs. single species focus

Consultation with

- MD Biological Stream Survey
- Wildlife and Heritage
- Forest Service
- Scientific Community

Limited to features with GIS data available statewide



# MARYLAND'S GREEN INFRASTRUCTURE ASSESSMENT

## Hubs

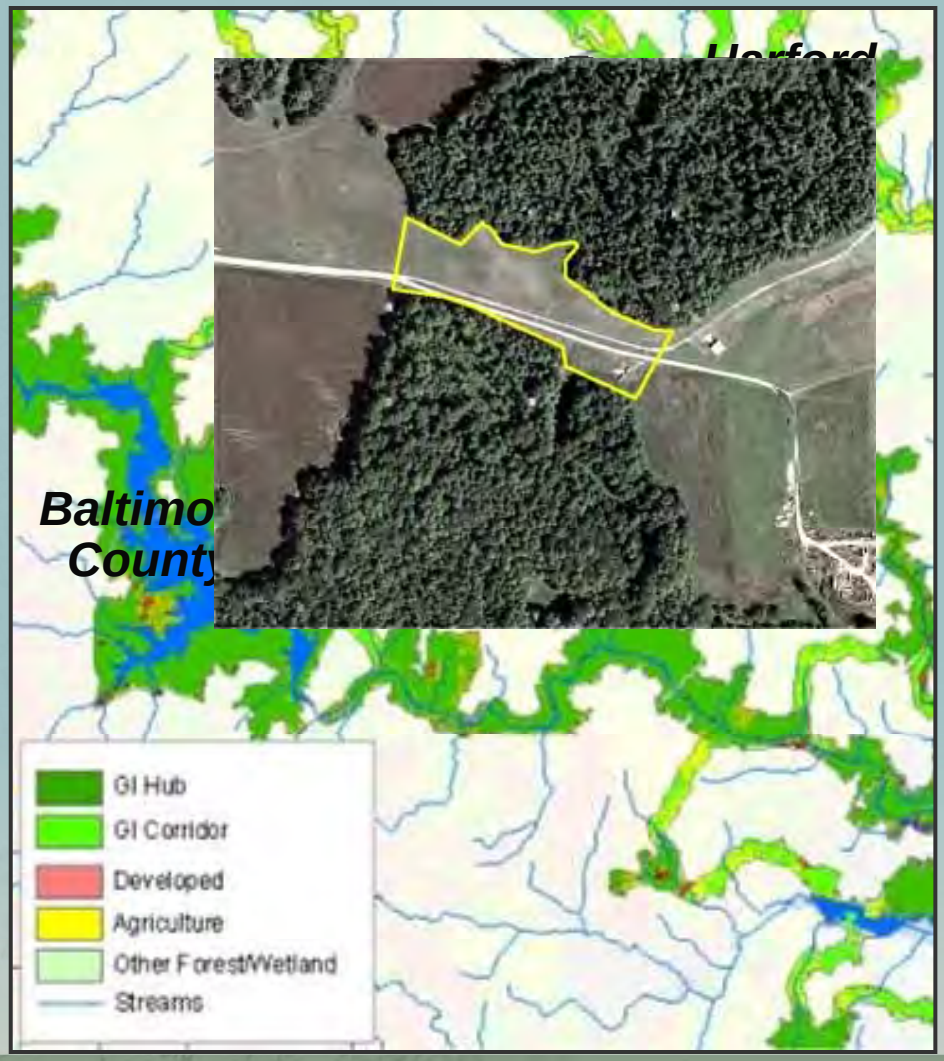
**250 acres or Important habitat > 100 acres**

## Corridors

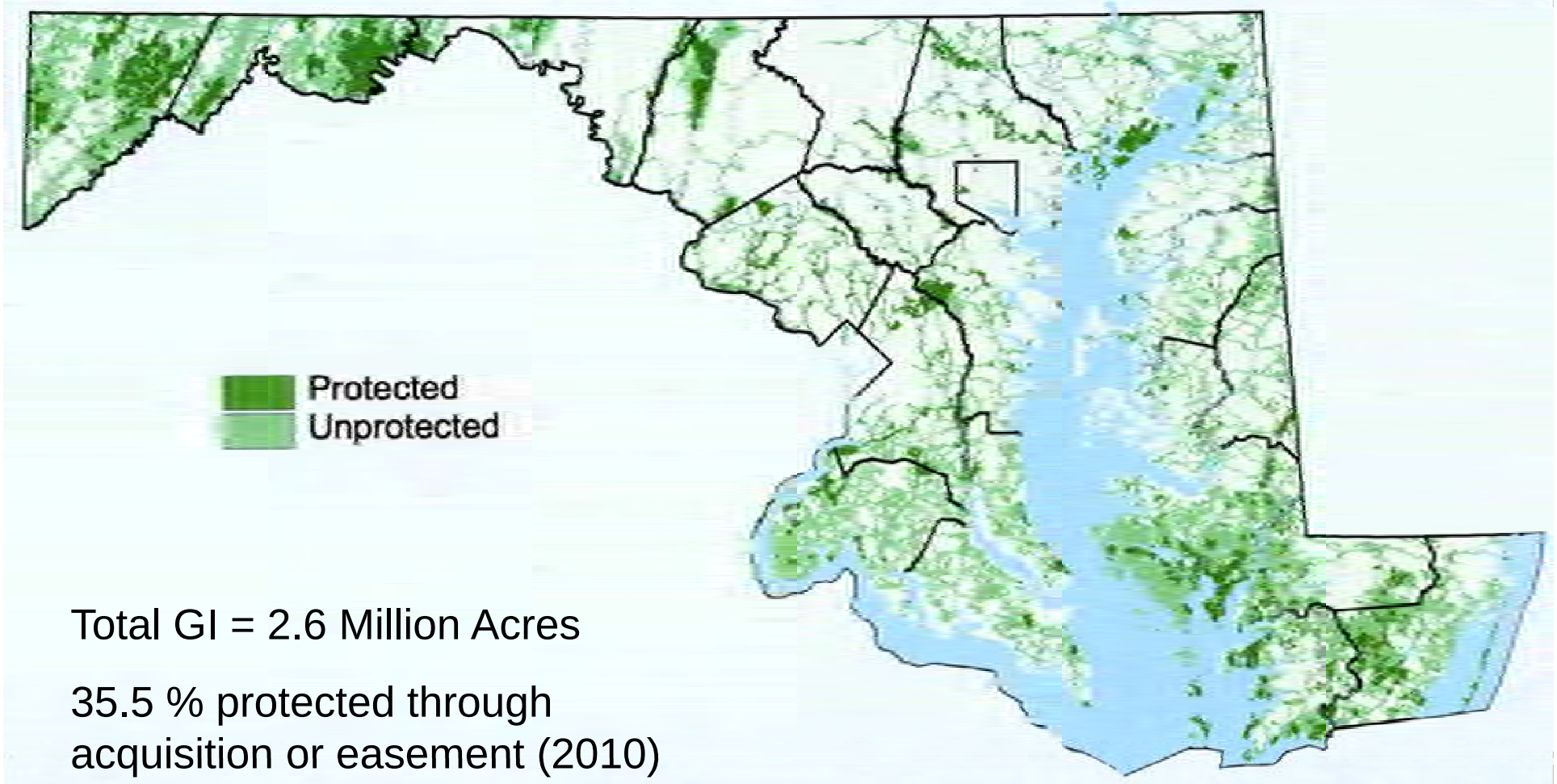
**1100 feet or FEMA floodplain**

## Gaps

**Restoration opportunities**



# A STATEWIDE NETWORK

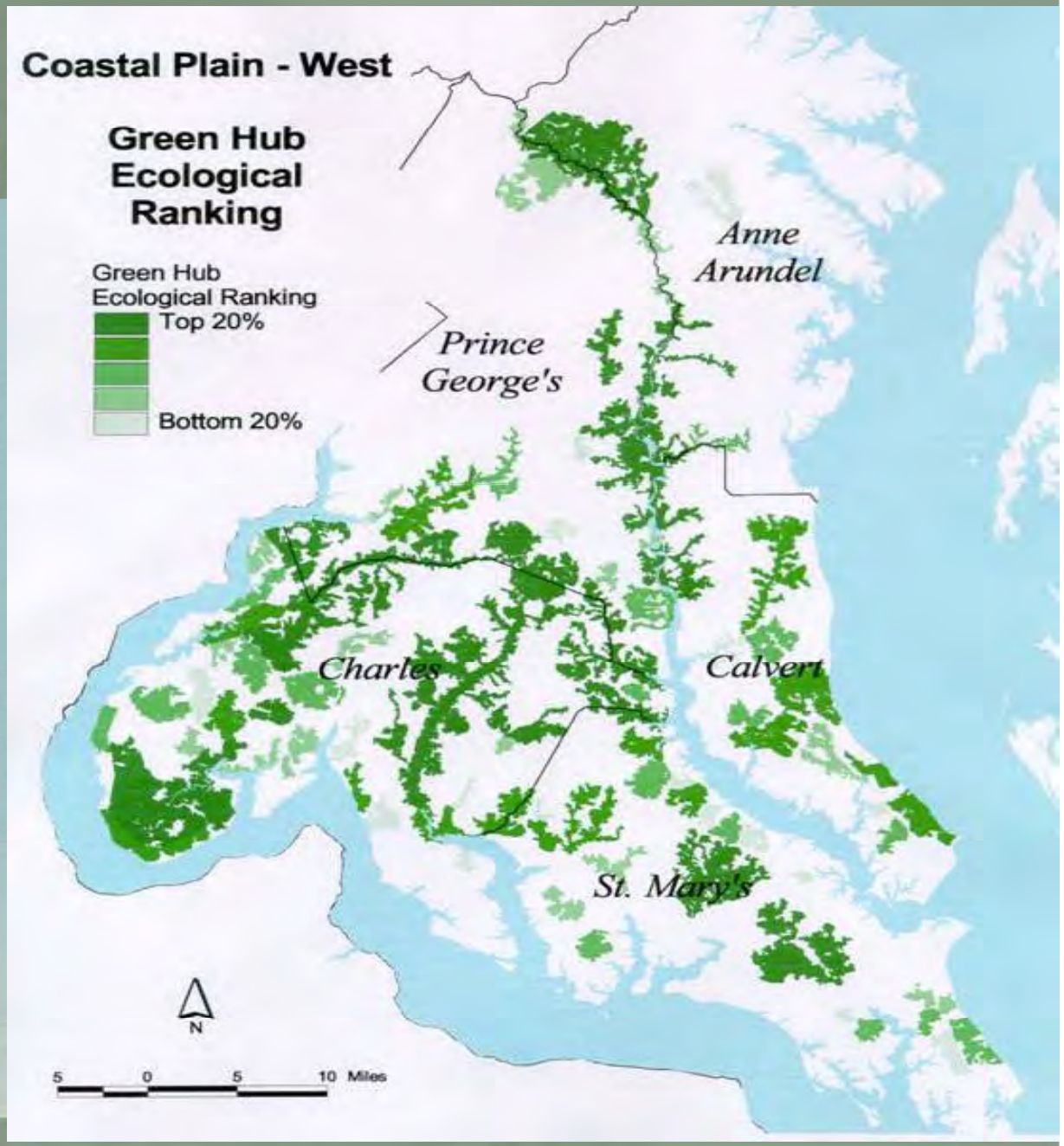



Total GI = 2.6 Million Acres

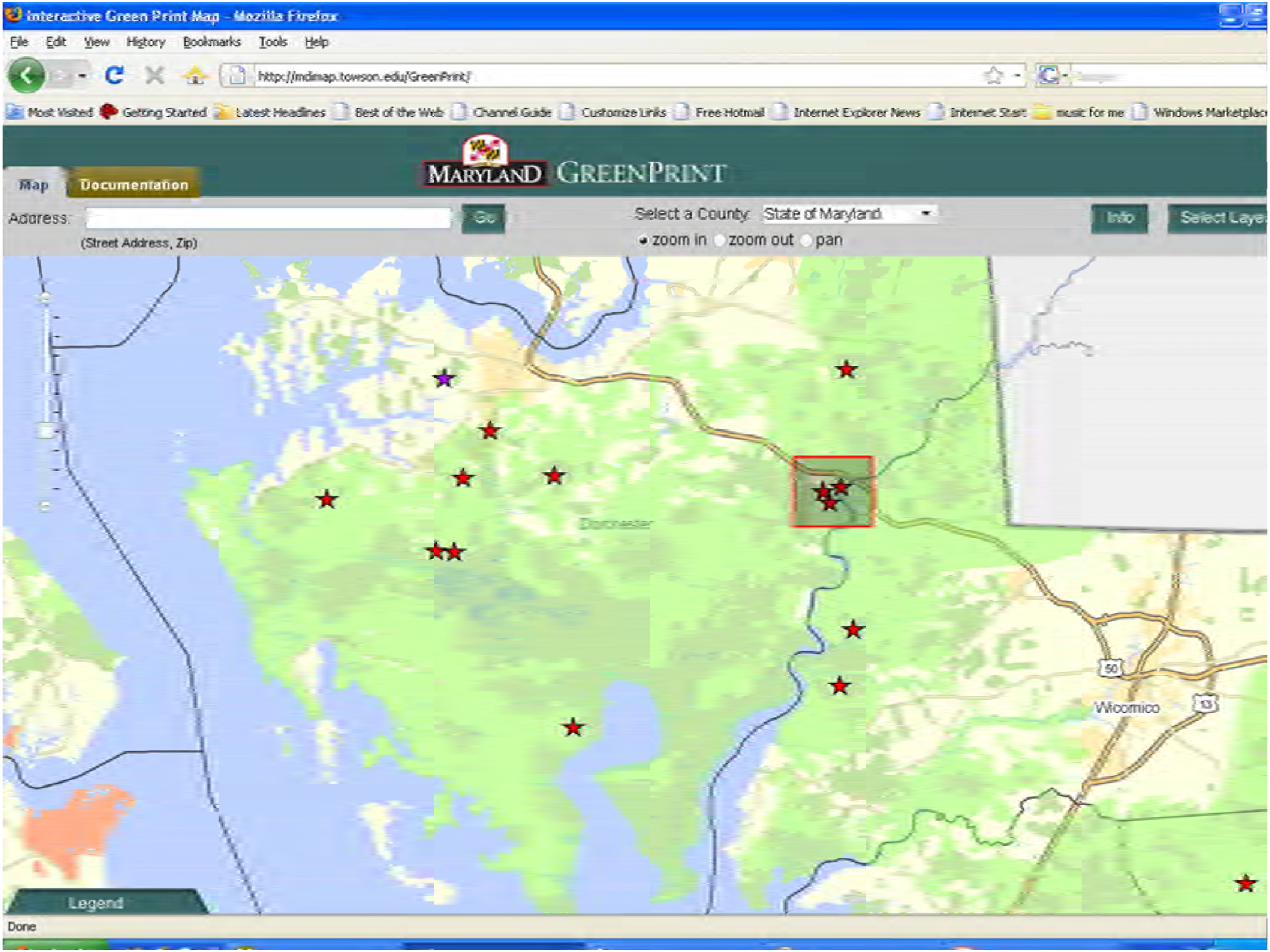
35.5 % protected through acquisition or easement (2010)

# Ecological Importance of Hubs

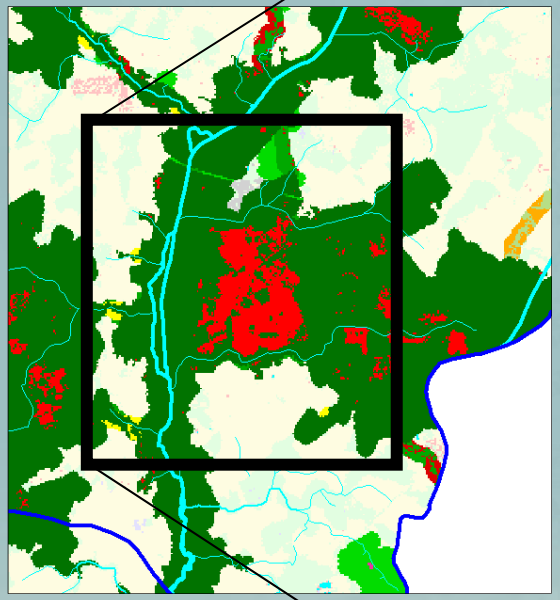
***Hubs ranked using multiple ecological factors***



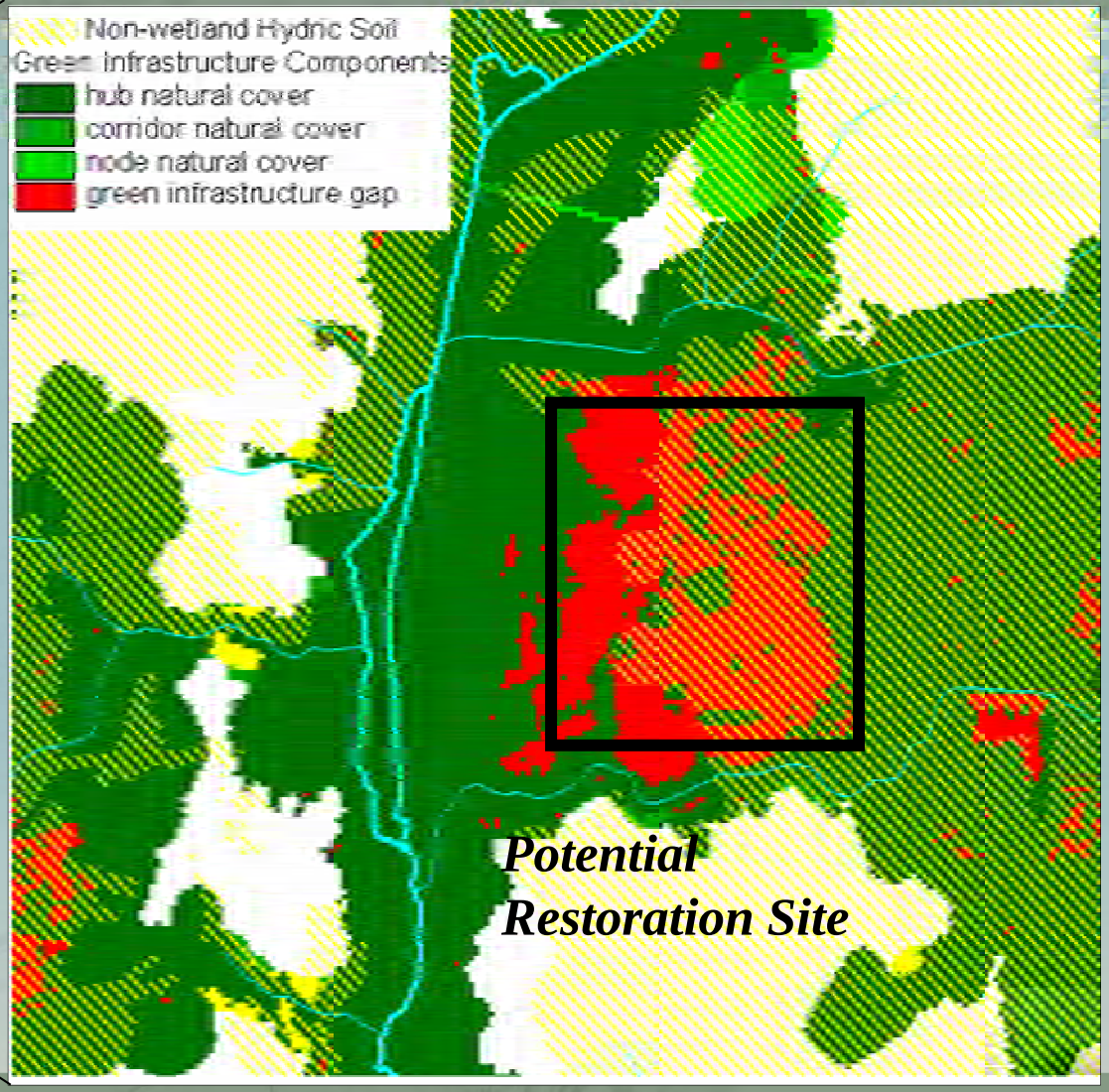
# GREENPRINT IS MARYLAND'S LAND CONSERVATION VISION


Interactive Green Print Map - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://mdmap.towson.edu/GreenPrint/
Most Visited Getting Started Latest Headlines Best of the Web Channel Guide Customize Links Free Hotmail Internet Explorer News Internet Start music for me Windows Marketplace
Map
Documentation
MARYLAND GREENPRINT
Address:
(Street Address, Zip)
Go
Select a County: State of Maryland
zoom in zoom out pan
Info
Select Layer
Dorchester
Wicomico
50
Legend
Done

# RESTORATION TARGETING

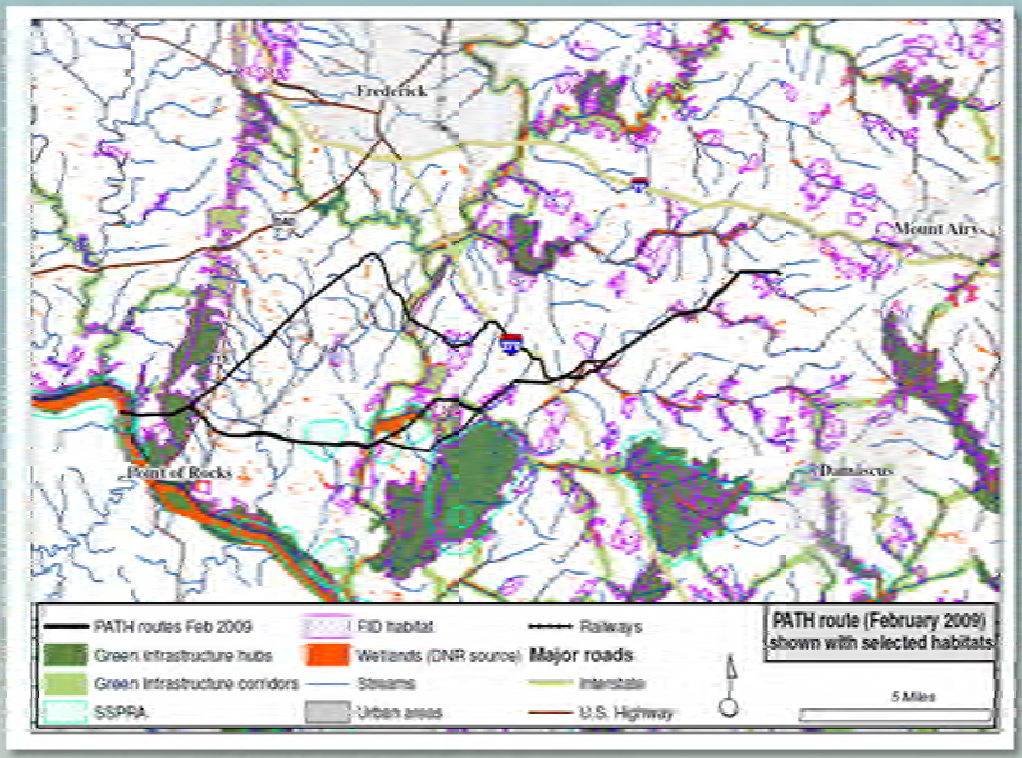


***Unvegetated Gap in High Ranking Hub***

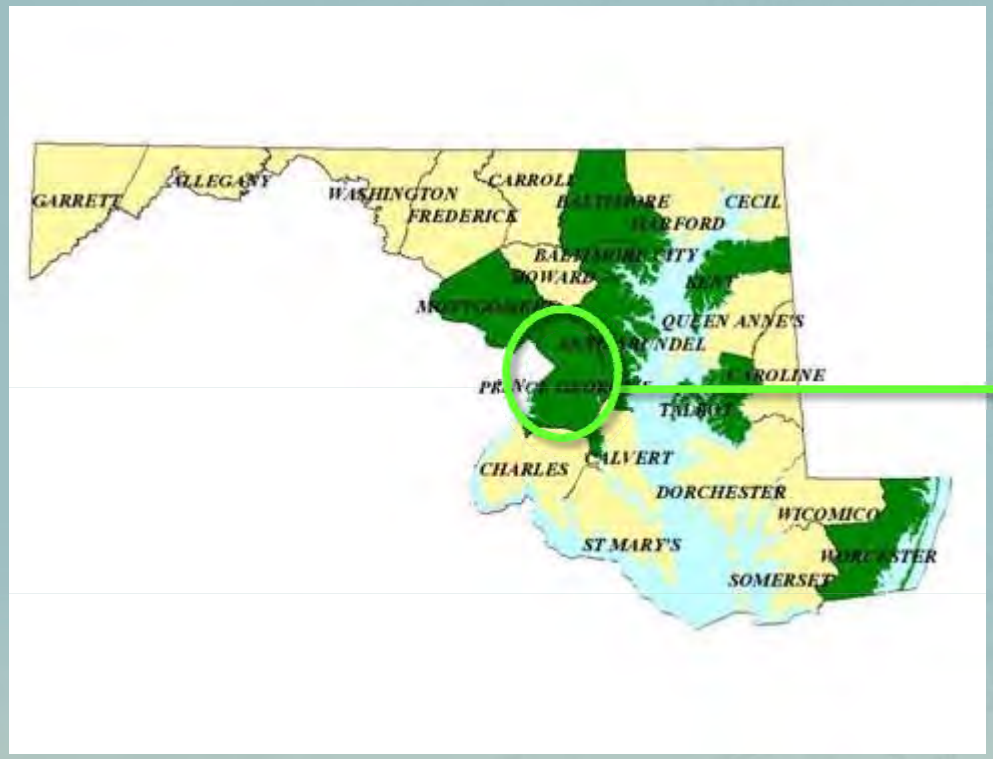


# ENERGY AND TRANSPORTATION PLANNING
## AVOIDANCE, MINIMIZATION, MITIGATION

**American Electric Power**
765-kilovolt transmission line
275 miles from Putnam County, W.Va., to New Market, Md

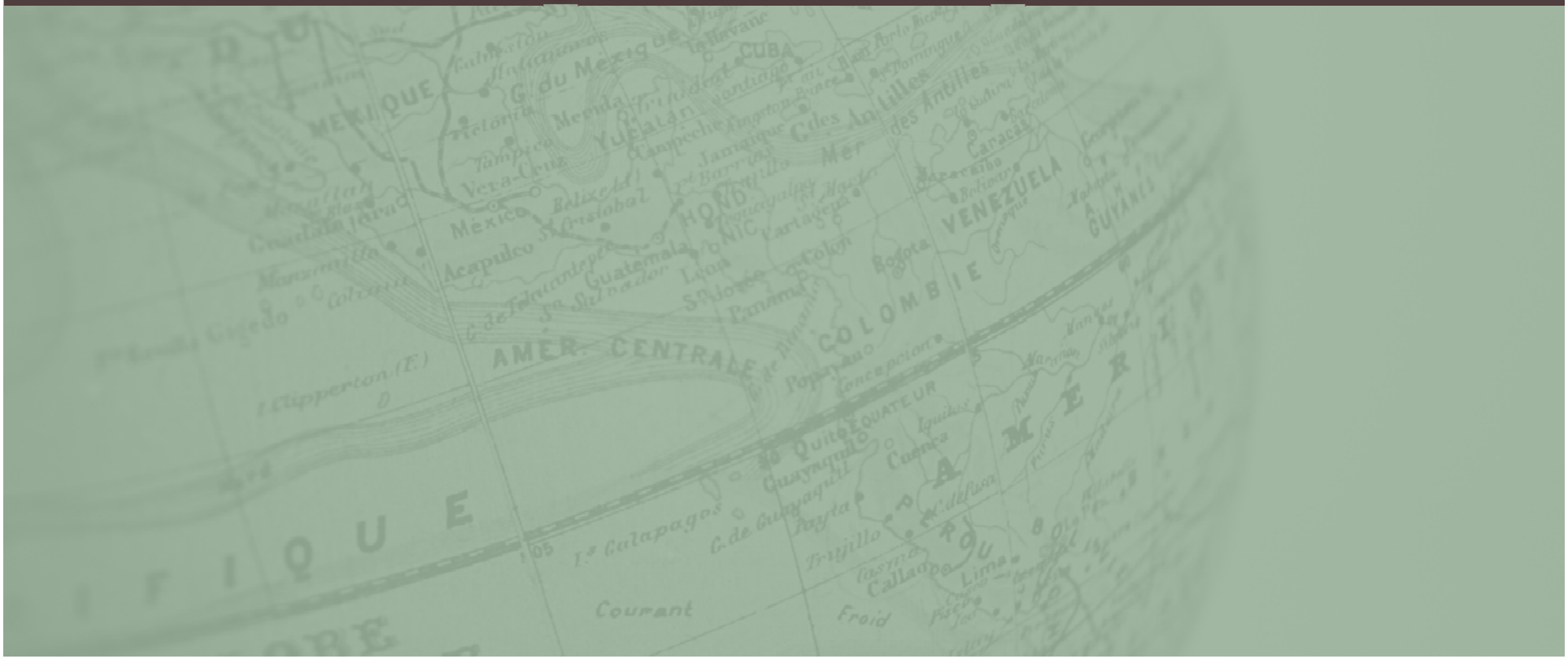


# COMPREHENSIVE PLANNING AND ZONING




# GREEN INFRASTRUCTURE STRATEGIC APPROACH

## *Maryland's Case Study*

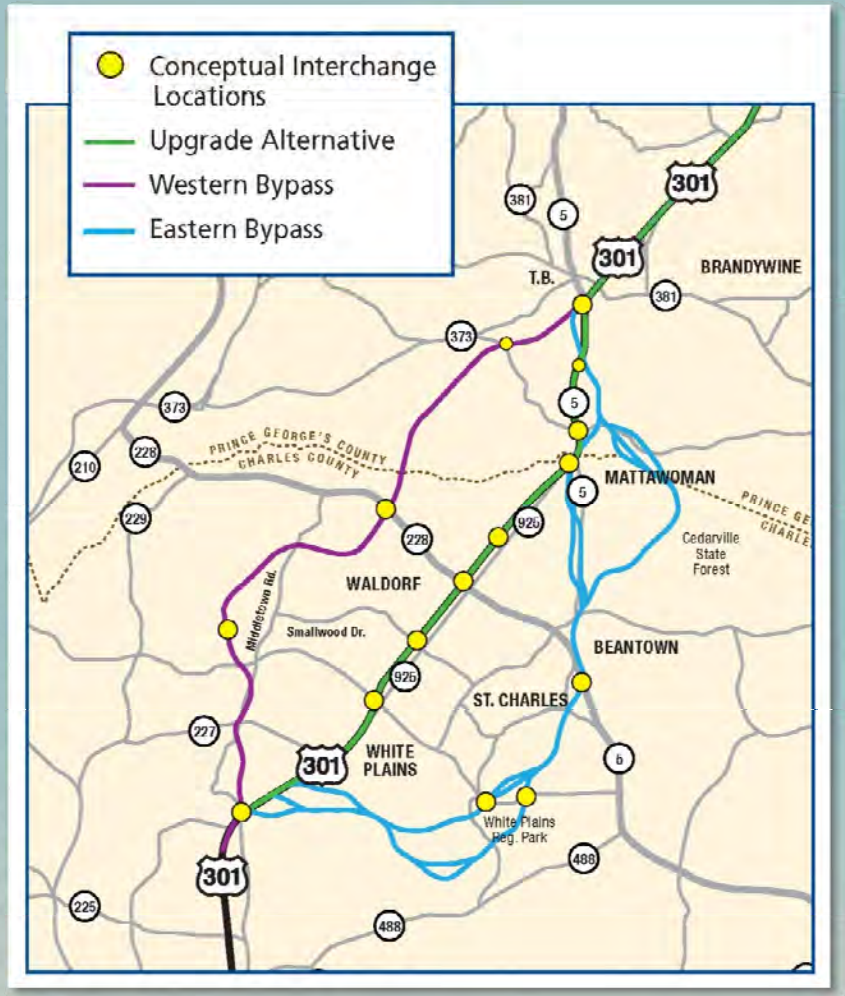


# A GREEN INFRASTRUCTURE APPROACH

**Address current and projected traffic congestion around the Waldorf, MD area**

**Three major alternatives:**

- **Upgrade US 301**
- **Eastern Bypass**
- **Western Bypass**



# PARTNERSHIPS

# Conceptual Environmental Stewardship Process

**1. Stewardship Team Meeting Workshop**
Establish and confirm
- Process
- Roles
- Responsibilities
- Schedule

**2. IAWG ES Kick-off Workshop**
Establish and confirm
- Process
- Roles
- Responsibilities
- Schedule

**3. Identify ES Needs (ES Team and IAWG)**
Identify ES needs based on county policies and objectives and resource agency priorities

**4. Develop ES Process (ES Team and IAWG)**
a. Reevaluate green infrastructure parameters
   i. reassess applicable target species/ habitat
   ii. identify, define and incorporate additional parameters, as needed
   iii. finalize parameter ecological weighting factor
b. Identify process for identifying community opportunities with Community Resource Work Group
c. Assess existing data and identify data gaps and process for filling gaps
d. Update data gaps and baseline mapping
e. Define technical assessment protocols to rank opportunities by broad groups

**5. Perform ES Opportunity Identification**

**Natural Resources (Natural Resource Work Group with SHA oversight)**
a. Perform green infrastructure evaluation for US 301 Waldorf Area
b. Identify strategic opportunities based on gaps, important corridors, etc.
c. Categorize opportunities into broad groups tied to technical assessment protocols

**Community Resources (Community Resource Work Group with SHA oversight)**
a. Identify potential community opportunities for US 301 Waldorf Area
b. Categorize opportunities into broad groups tied to established protocols

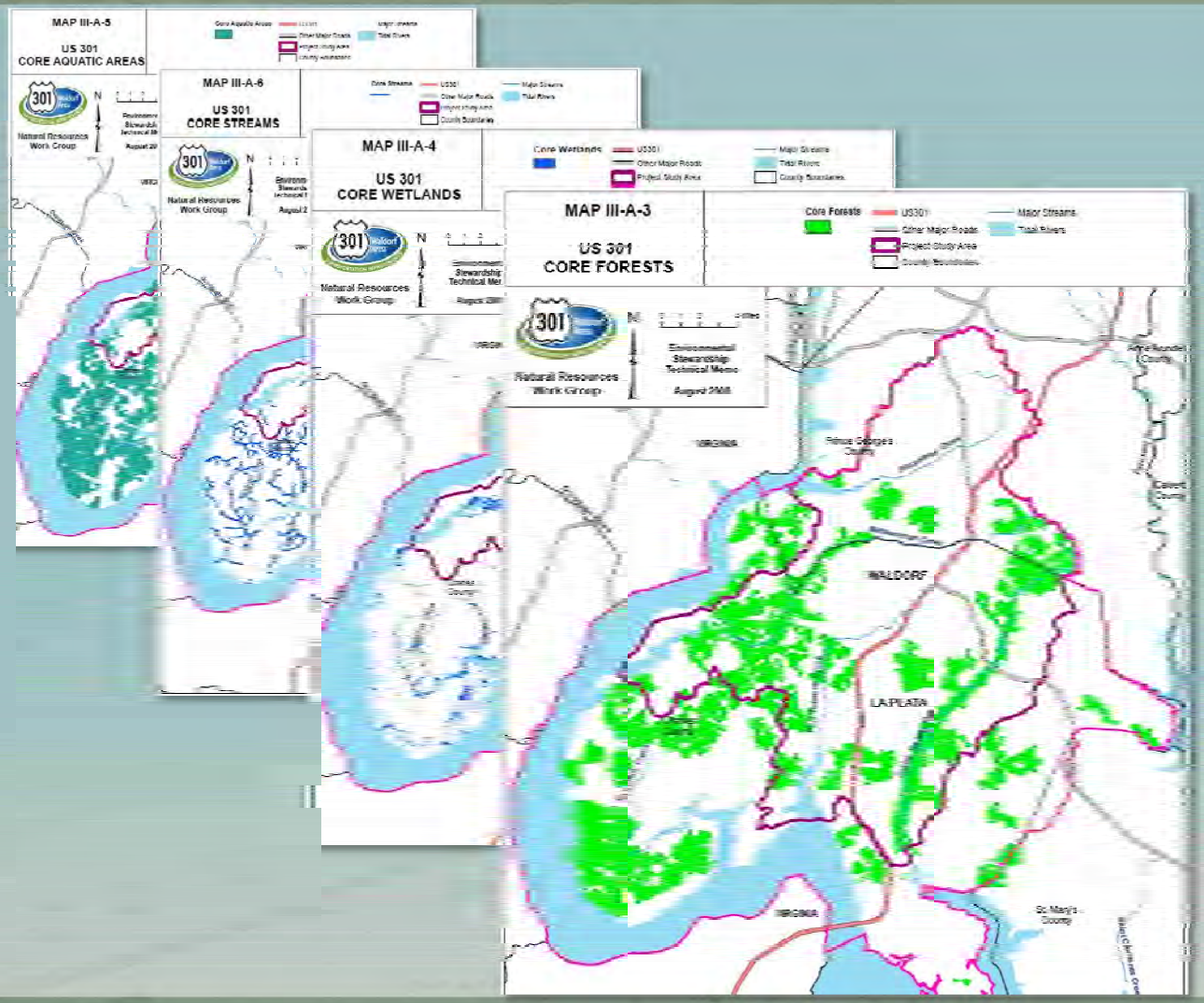
**6. Technical Assessment of ES Opportunities (ES Team with SHA oversight/assistance)**
a. Perform field assessment of opportunities based on established protocols
b. Rank opportunities based on scoring criteria

**7. Feasibility and Benefit/Cost Comparison of ES opportunities (SHA with IAWG oversight)**
a. Develop conceptual approach for implementation (construction, management, preservation, technical assistance, etc.)
b. Develop conceptual cost
c. Compare costs with ranking score to determine overall benefit effectiveness

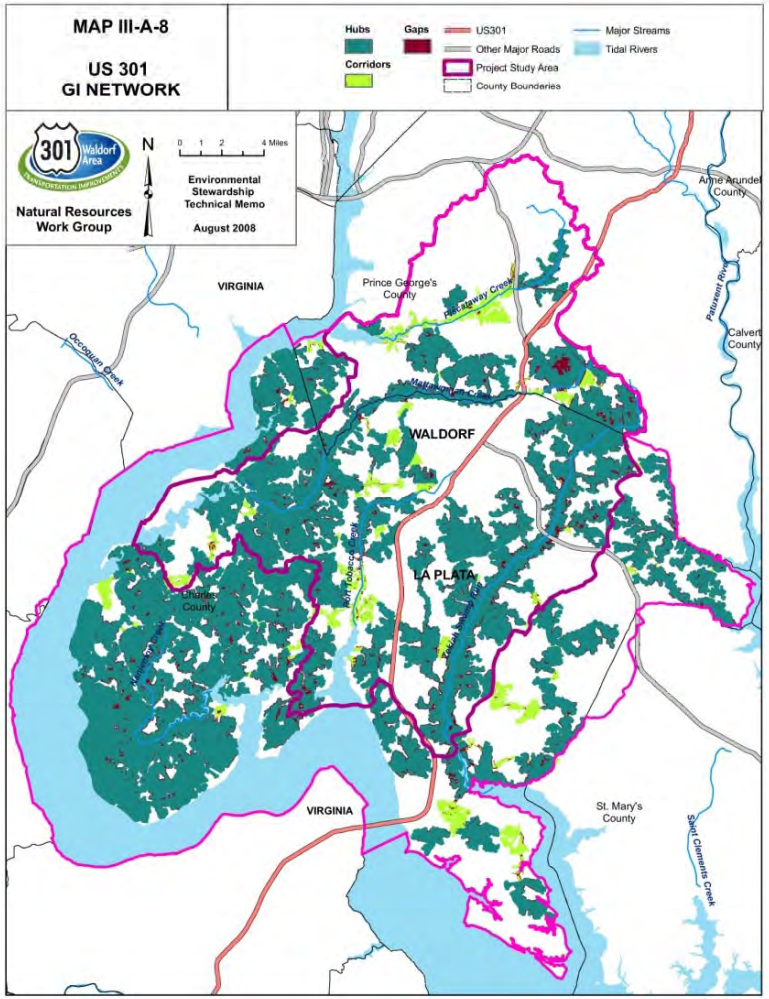
**8. Field View of ES Opportunities with IAWG**

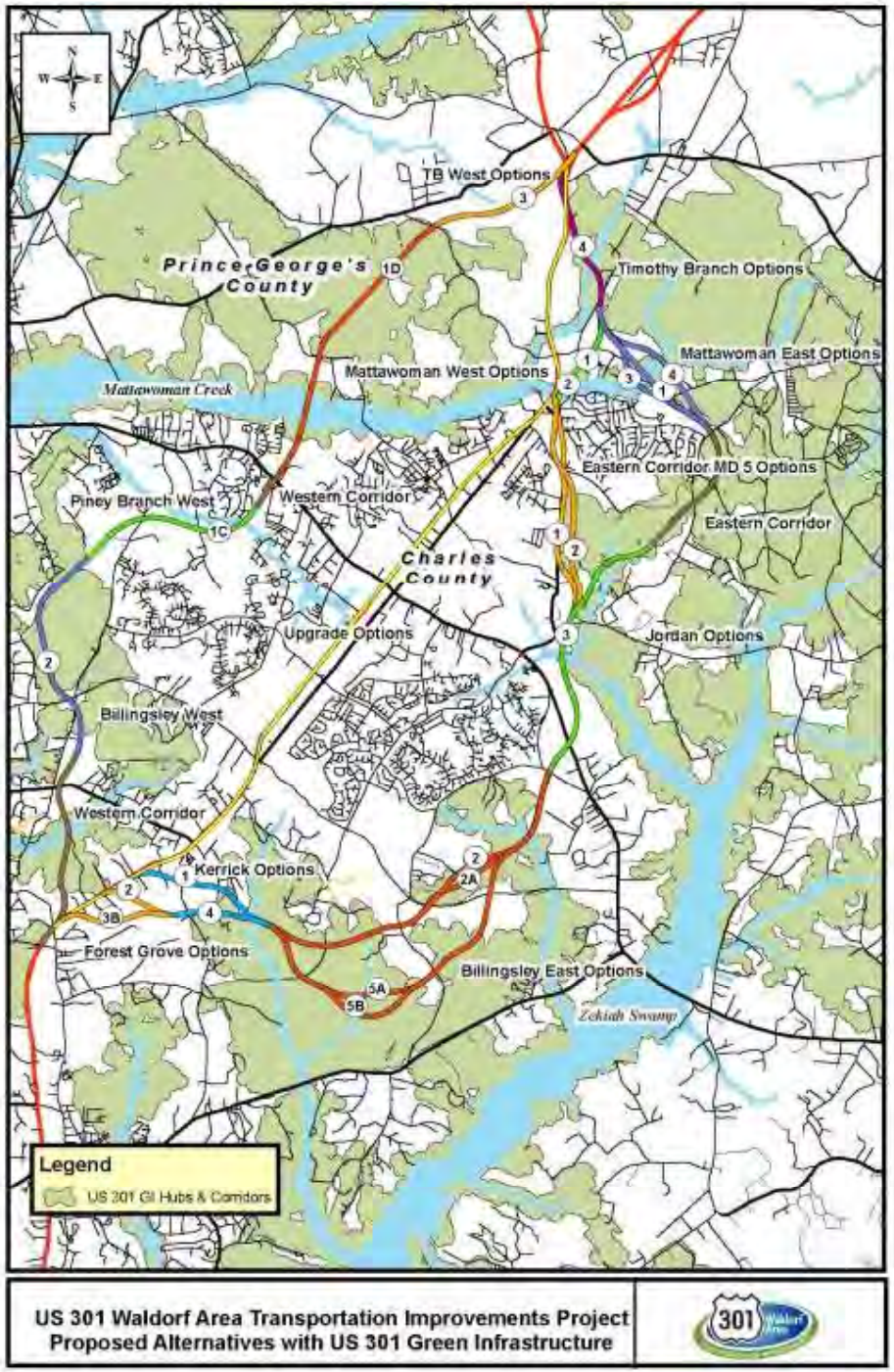
**9. Prioritization of ES Opportunities (IAWG with SHA oversight)**
a. Compare ES opportunities with ES needs
b. Develop Prioritized list of recommended ES opportunities based on ES needs and benefit effectiveness

# US 301 CORE AREAS



# US 301 STUDY AREA GREEN INFRASTRUCTURE

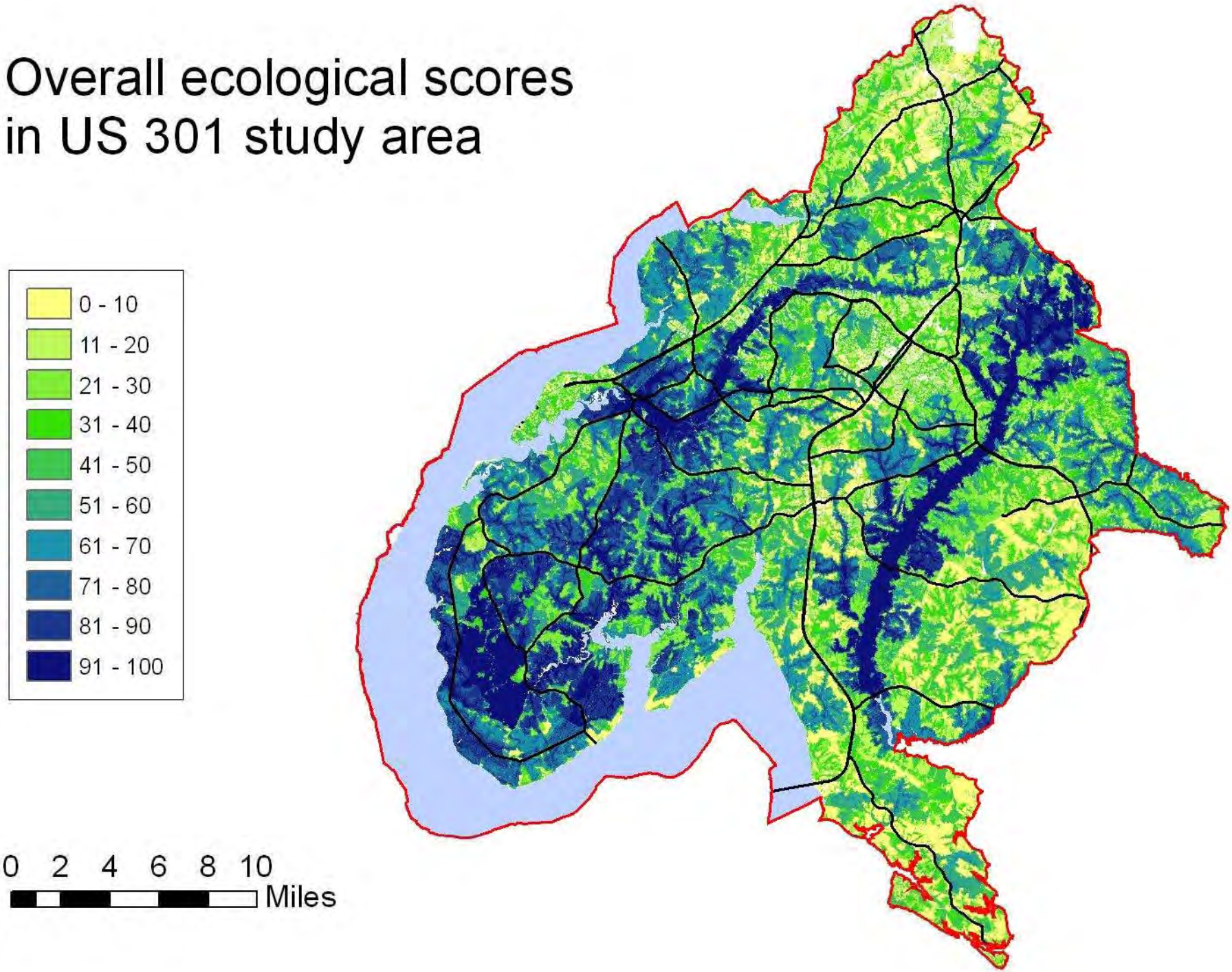


# US 301 PROJECT OVERALL ECOLOGICAL SCORE

| Scale | Variable | Scale weight | Variable weight within scale | Total weight |
|---|---|---|---|---|
| Core area/Site | Hub area | 20.0 | 0.100 | 2.0 |
| | ESA area | | 0.100 | 2.0 |
| | Area of mature interior forest | | 0.100 | 2.0 |
| | Area of unimpacted wetlands | | 0.100 | 2.0 |
| | Length of core streams | | 0.100 | 2.0 |
| | Maximum depth of core or site | | 0.100 | 2.0 |
| | Distance to major roads | | 0.100 | 2.0 |
| | Distance to development | | 0.100 | 2.0 |
| | Proximity index | | 0.100 | 2.0 |
| | Connectivity index | | 0.100 | 2.0 |
| Hub | ESA area | 20.0 | 0.182 | 3.6 |
| | Area of mature interior forest | | 0.182 | 3.6 |
| | Area of unimpacted wetlands | | 0.091 | 1.8 |
| | Length of core streams | | 0.091 | 1.8 |
| | Maximum depth of hub | | 0.091 | 1.8 |
| | Distance to major roads | | 0.091 | 1.8 |
| | Distance to development | | 0.091 | 1.8 |
| | Proximity index | | 0.091 | 1.8 |
| | Connectivity index | | 0.091 | 1.8 |
| Corridor | Average rank of linked hubs | 10.0 | 0.333 | 3.3 |
| | Number of hubs linked | | 0.333 | 3.3 |
| | Major road crossings without bridges | | 0.333 | 3.3 |
| 8-digit watershed | Anadromous fish spawning habitat use | 10.0 | 0.500 | 5.0 |
| | Percent core streams in watershed | | 0.500 | 5.0 |
| 12-digit watershed | Stronghold watershed (Tier 1/Tier 2/neither) | 10.0 | 0.500 | 5.0 |
| | Mean combined IBI score | | 0.500 | 5.0 |
| Grid cell (36 $m^2$) | ESA presence and rank | 40.0 | 0.071 | 2.9 |
| | Ecological Community Group rank | | 0.071 | 2.9 |
| | Forest maturity | | 0.286 | 11.4 |
| | Wetland condition and proximity | | 0.143 | 5.7 |
| | Proximity to core streams | | 0.143 | 5.7 |
| | Proximity to water | | 0.143 | 5.7 |
| | Distance to edge of forest, wetland, or water | | 0.143 | 5.7 |
| | Distance to development | | 0.000 | 0.0 |
| **TOTAL** | | **100.0** | | **100.0** |

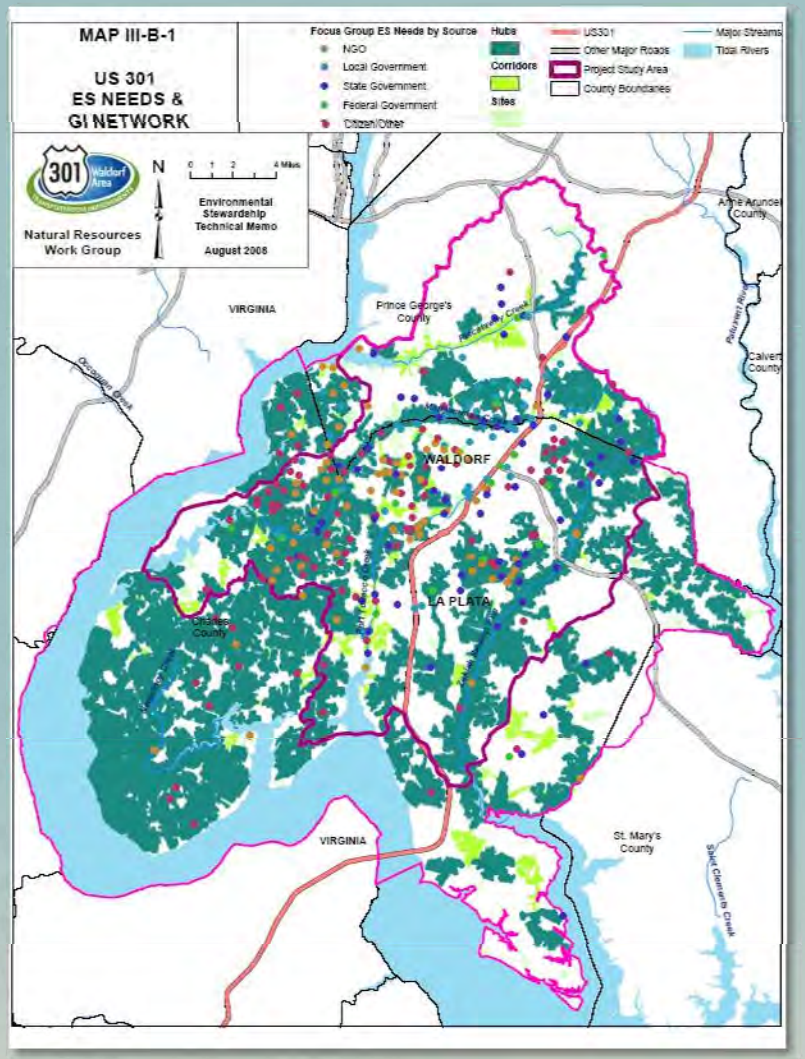
# Overall ecological scores in US 301 study area



# GREEN INFRASTRUCTURE NETWORK & STAKEHOLDER PRIORITIES

| Environmental Stewardship Activities | |
|---|---|
| Conservation / Preservation | 60% |
| Restoration / Creation | 18% |
| Management Actions | 11% |
| Recreation / Public Access to Open Space | 11% |

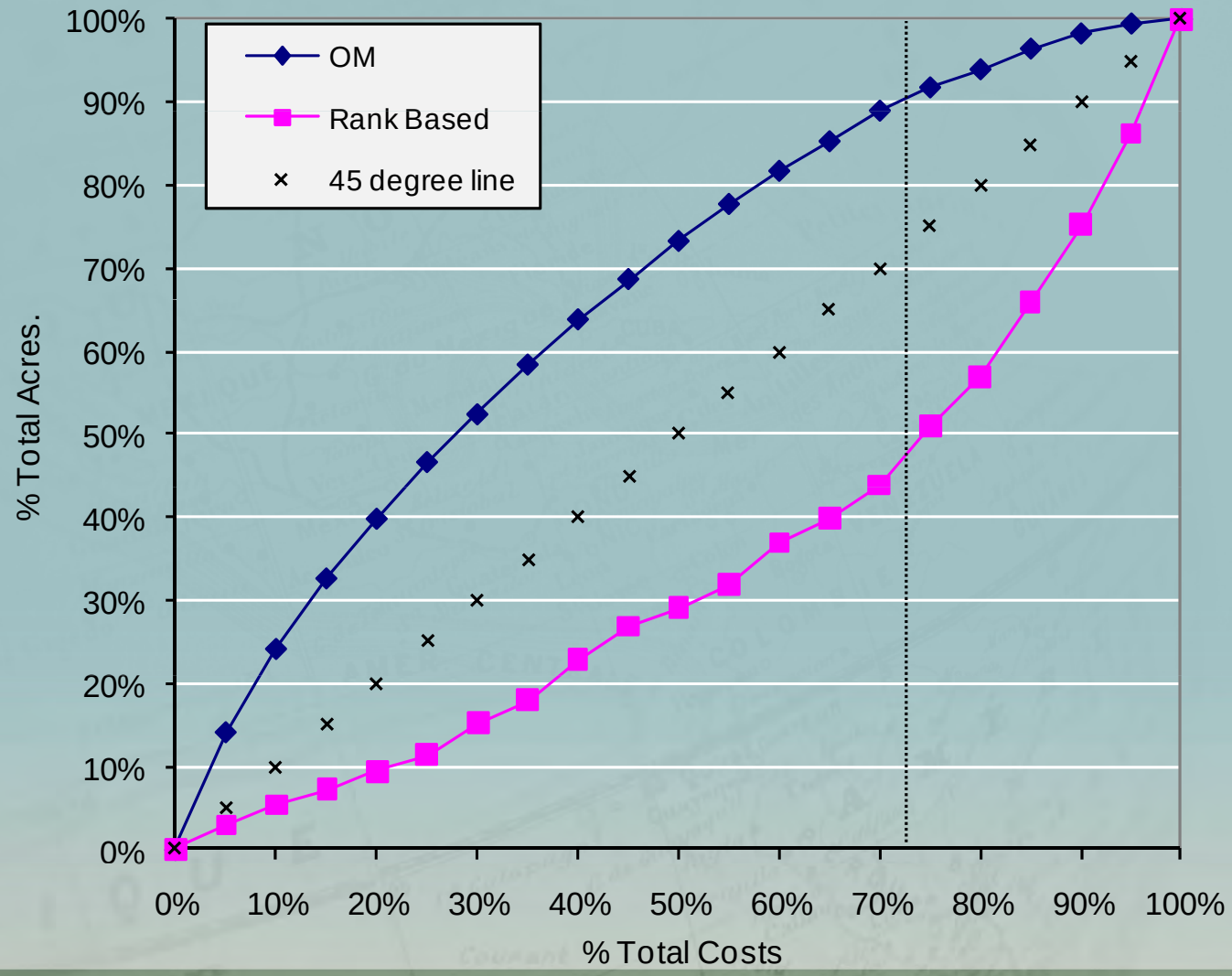
| Priority Natural Resources | |
|---|---|
| Forests | 22% |
| Streams and Aquatic Resources | 19% |
| Wetlands | 17% |
| Marine Fisheries | 10% |
| Species Habitat | 11% |
| Passive Recreation Areas | 5% |
| Historic/Archeological | 6% |
| Agriculture | 9% |



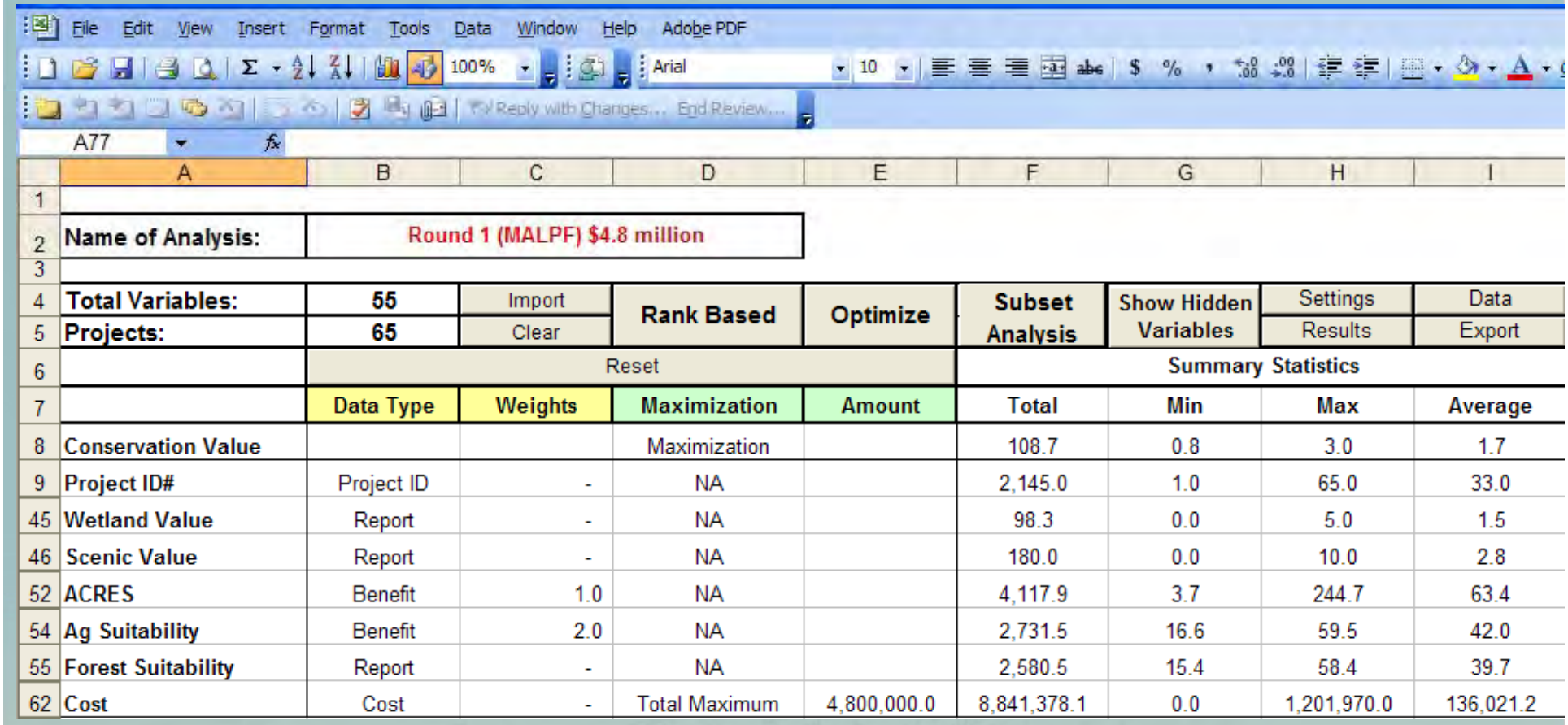
# DIFFERENCES IN SELECTION MODELS

| Rank-Based Models | Optimization Models |
| --- | --- |
| **Rank-order projects from highest benefit to lowest** | **Seeks to maximize aggregate benefits** |
| **Invest in highest ranked projects until the budget is expended, ignores "good buys"** | **Considers user's constraints (e.g. budget, project type, etc.)** |
| **Guarantees selection of the highest rated projects** | **Selects "best buys" or projects with greatest value per dollar** |

# DIFFERENCES IN SELECTION MODELS



# OPTIMIZATION TOOL



File Edit View Insert Format Tools Data Window Help Adobe PDF

100% Arial 10

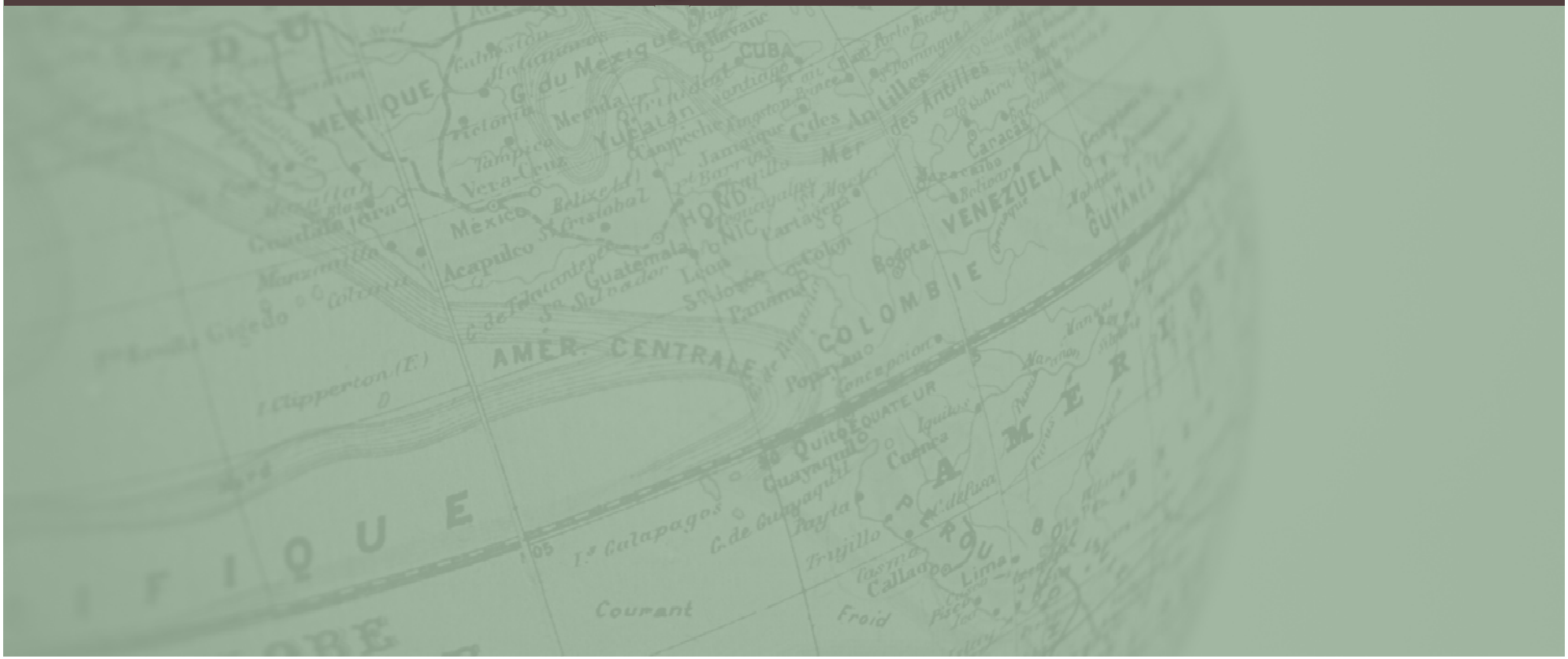
Reply with Changes... End Review...

A77

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | **Name of Analysis:** | Round 1 (MALPF) $4.8 million | | | | | | | |
| 3 | | | | | | | | | |
| 4 | **Total Variables:** | **55** | Import | **Rank Based** | **Optimize** | **Subset Analysis** | **Show Hidden Variables** | Settings | Data |
| 5 | **Projects:** | **65** | Clear | | | | | Results | Export |
| 6 | | Reset | | | | **Summary Statistics** | | | |
| 7 | | **Data Type** | **Weights** | **Maximization** | **Amount** | **Total** | **Min** | **Max** | **Average** |
| 8 | **Conservation Value** | | | Maximization | | 108.7 | 0.8 | 3.0 | 1.7 |
| 9 | **Project ID#** | Project ID | - | NA | | 2,145.0 | 1.0 | 65.0 | 33.0 |
| 45 | **Wetland Value** | Report | - | NA | | 98.3 | 0.0 | 5.0 | 1.5 |
| 46 | **Scenic Value** | Report | - | NA | | 180.0 | 0.0 | 10.0 | 2.8 |
| 52 | **ACRES** | Benefit | 1.0 | NA | | 4,117.9 | 3.7 | 244.7 | 63.4 |
| 54 | **Ag Suitability** | Benefit | 2.0 | NA | | 2,731.5 | 16.6 | 59.5 | 42.0 |
| 55 | **Forest Suitability** | Report | - | NA | | 2,580.5 | 15.4 | 58.4 | 39.7 |
| 62 | **Cost** | Cost | - | Total Maximum | 4,800,000.0 | 8,841,378.1 | 0.0 | 1,201,970.0 | 136,021.2 |

# THE GREEN INFRASTRUCTURE APPROACH

## *Looking Down the Road*



# ENVIRONMENTAL RESEARCH PROJECTS

- **CO6A - Integration of Conservation, Highway Planning, and Environmental Permitting Using an Outcome-Based Ecosystem Approach**

- **CO6B - Integration of Conservation, Highway Planning, and Environmental Permitting Through development of an Outcome-based Ecosystem-scale Approach and Corresponding Credit System**

# C06A: INTEGRATION OF CONSERVATION, HIGHWAY PLANNING, AND ENVIRONMENTAL PERMITTING

**Development of Regional Ecosystems Framework and processes and business cases (FHWA & DOTs, USFWS, Corps, EPA, State DNRs) for integration of conservation and transportation planning, especially in the 404 permitting and ESA section 7 consultation processes**

SHRP2
STRATEGIC HIGHWAY RESEARCH PROGRAM

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

# C06B:ECOLOGICAL PROCESSES AND CREDITS SYSTEM

**Three areas of focus for tools developed by the 6B team, placed within the context of the step-wise Framework developed by 6A:**

**(1) Cumulative Effects and Alternatives Analysis**
**(2) Regulatory Assurances**
**(3) Ecosystem Crediting**

**Interactive database of methods, tools, systems and case studies that support the Ecological Assessment methods**

SHRP2
STRATEGIC HIGHWAY RESEARCH PROGRAM

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

# THE WATERSHED RESOURCES REGISTRY (WRR)

A National Pilot To Integrate Land-use Planning, Regulatory, and Non-regulatory Decision Making Using the Watershed Approach

# WRR POTENTIAL COST SAVINGS

| | Costs | Time | Cost Savings w/WRR | Time Savings w/WRR |
|---|---|---|---|---|
| **Site Search** | $50,000 | 4 months | $37,500 | 3 months |
| **Design** | $210,000 | 18 months | $70,000 | 6 months |
| **Agency Coordination/MDE Consultant Review** | $10,000 | 12 months | $2,500 | 3 months |
| **Total** | $365,000 | 2.5 years | **$110,000** | **1 year** |

- *Estimates for a single project; potentially ~10 projects/year*
- *Estimates do not account for decreased employee time*

# THE CHESAPEAKE BAY TMDL AND MD STATE HIGHWAY ADMINISTRATION GOALS

**Total Maximum Daily Load (TMDL) goal - finalized December 2010**

- **Set load limits for N, P, Sediment**
- **Jurisdictional sub-basins = 58 allocations**

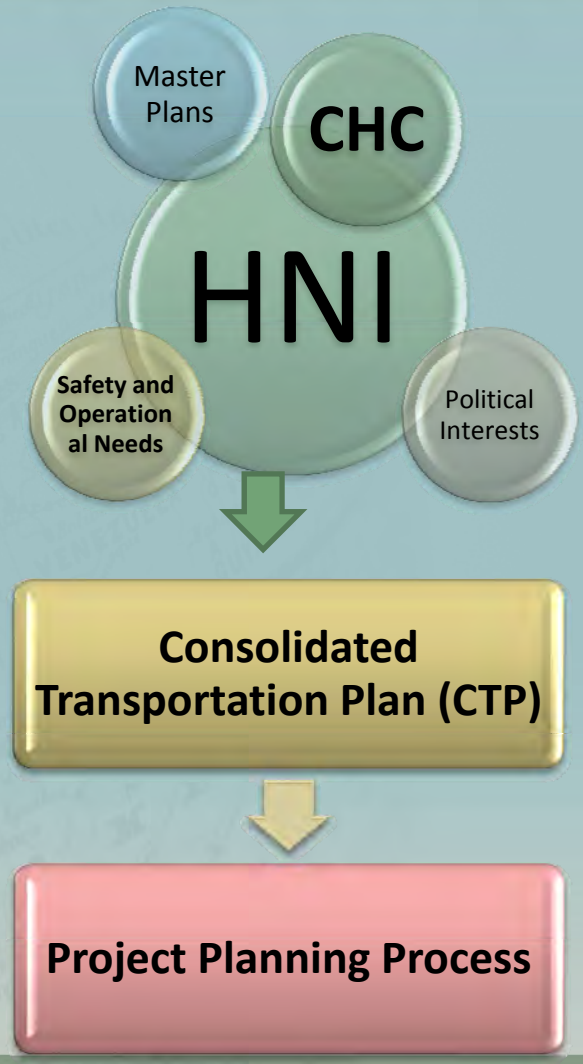
**Target Water Quality retrofits through:**

- **Stormwater Management**
- **Urban Tree Plantings**
- **Stream Buffer Plantings**
- **Wetland Restoration**
- **Stream Restoration**
- **Innovative Methods**
- **Improved Operations – street sweeping, inlet cleaning**

**Use of Watershed Resources Registry will allow us to concentrate efforts to get the biggest benefit**

# COMPREHENSIVE HIGHWAY CORRIDORS

- **Incorporate Sustainable practices (Environmental, Social, and Economic)**
- **Develop a strategy based on technical criteria and analysis that addresses future needs on major highway corridors across the State**
- **Serves as a conduit for the Highway Needs Inventory (HNI) and as a tool to guide SHA programming and funding priorities**

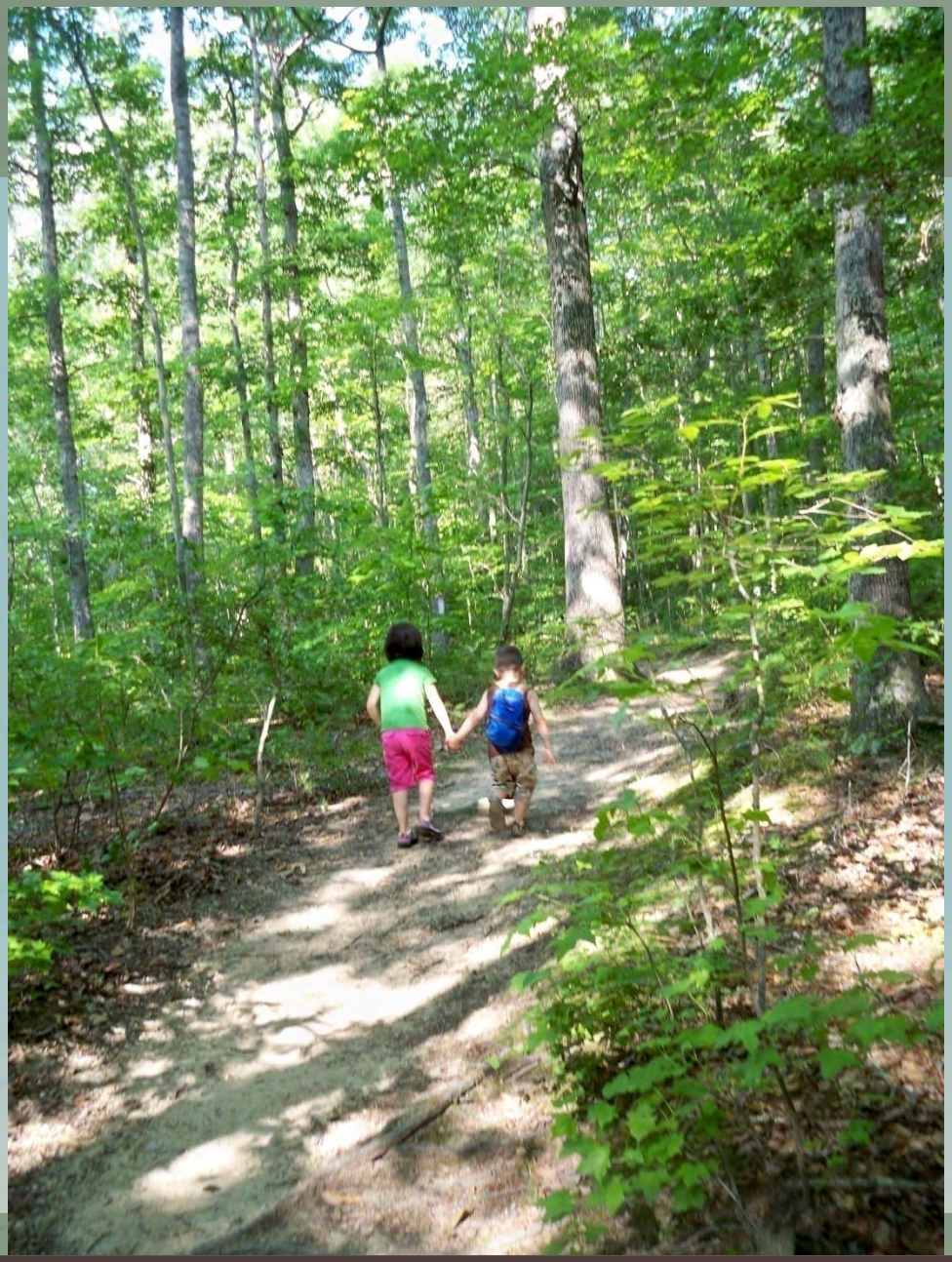


# GREEN INFRASTRUCTURE AND SUSTAINABLE TRANSPORTATION PLANNING

- **Project Planning - Scoping through Location Approval**
  - **Environmental inventory**
  - **NEPA analysis/assessment,**
  - **Identification of mitigation and stewardship opportunities**
- **Final Design and Mitigation Plan**
- **System Preservation /Maintenance**

# WHY USE THESE TOOLS?

**Can we afford not to?**



# CONTACT INFORMATION:


Christine Conn
Director, Strategic Land Planning
Office for a Sustainable Future
cconn@dnr.state.md.us
(410) 260-8785

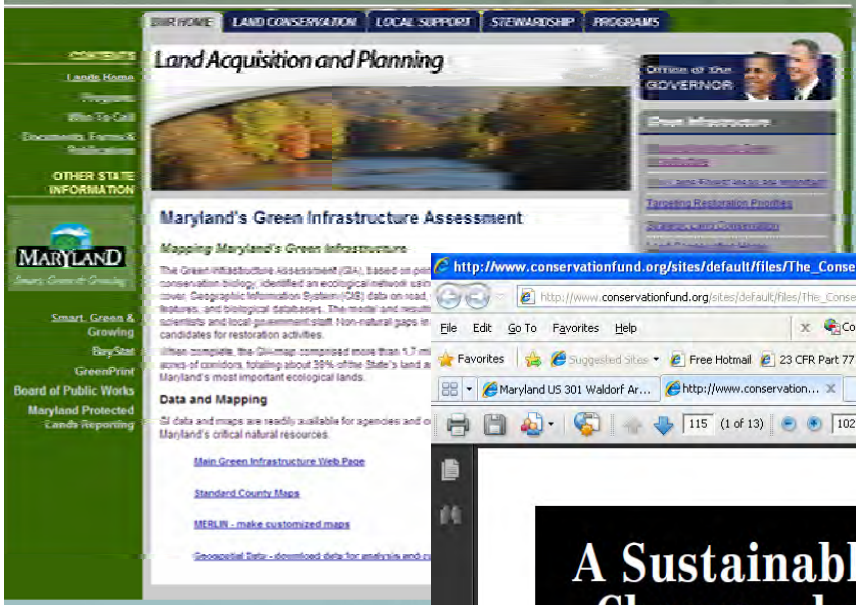
Craig Shirk
NEPA Project Manager
Gannett Fleming, Inc.
cshirk@gfnet.com
(717) 763-7212

Sandy Hertz
Deputy Director
Office of Environmental Design
shertz@sha.state.md.us
(410) 545-8609

Heather Lowe
Team Leader, Environmental
Planning Division
hlowe@sha.state.md.us
(410)545-8526

Donna Buscemi
Team Leader, Environmental
Planning Division
dbuscemi@sha.state.md.us
(410)545-8558

# FOR MORE INFORMATION






***An American Planning Association memo titled, "Green Infrastructure Planning: Recent Advances and Applications" and the case study on the US 301 Waldorf project is available for download at:***
http://www.conservationfund.org/

http://www.dnr.state.md.us/land/green_infra_mapping.asp