Stream Ecological Assessment in Virginia Using *INSTAR*

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Interactive **St**ream **A**ssessment **R**esource (*INSTAR*) Program Goals

- Develop a comprehensive stream and river database and use it to conduct interactive and objective, geospatial assessments of lotic ecosystem health and function
- Develop a novel decision-support tool that leverages an extensive new stream and river database with state-of-the-art information technologies

INSTAR at a glance

The Database

Aquatic resources and in-stream habitat information

>200K records representing >1,825 stream reaches (probabilistic design)

Ecological models (i.e., *virtual* reference streams) to support objective assessment and analysis of stream health

The Application

Interactive and internet based (ArcIMS; MS SQL)

High-resolution spatial data (GIS) coverages

Wide range of functions and database queries supported; new '*lite*' interface in beta testing

Accessible to anyone with a PC and modem

INSTAR Supports Two BioAssessment Protocols:

Modified Index of Biotic Integrity (mIBI)

Metrics:

1. Native species richness
2. Number of R, T, & E species
3. Number of non-indigenous species
4. Number of 'significant' species
5. Number of tolerant species
6. Number of intolerant species

-Regional Scoring Criteria
-Index ranges between 6-30
-Broad geospatial scales
(e.g. 6th order watersheds)
-Qualitative data are inputs

Virtual Stream Assessment (VSA)

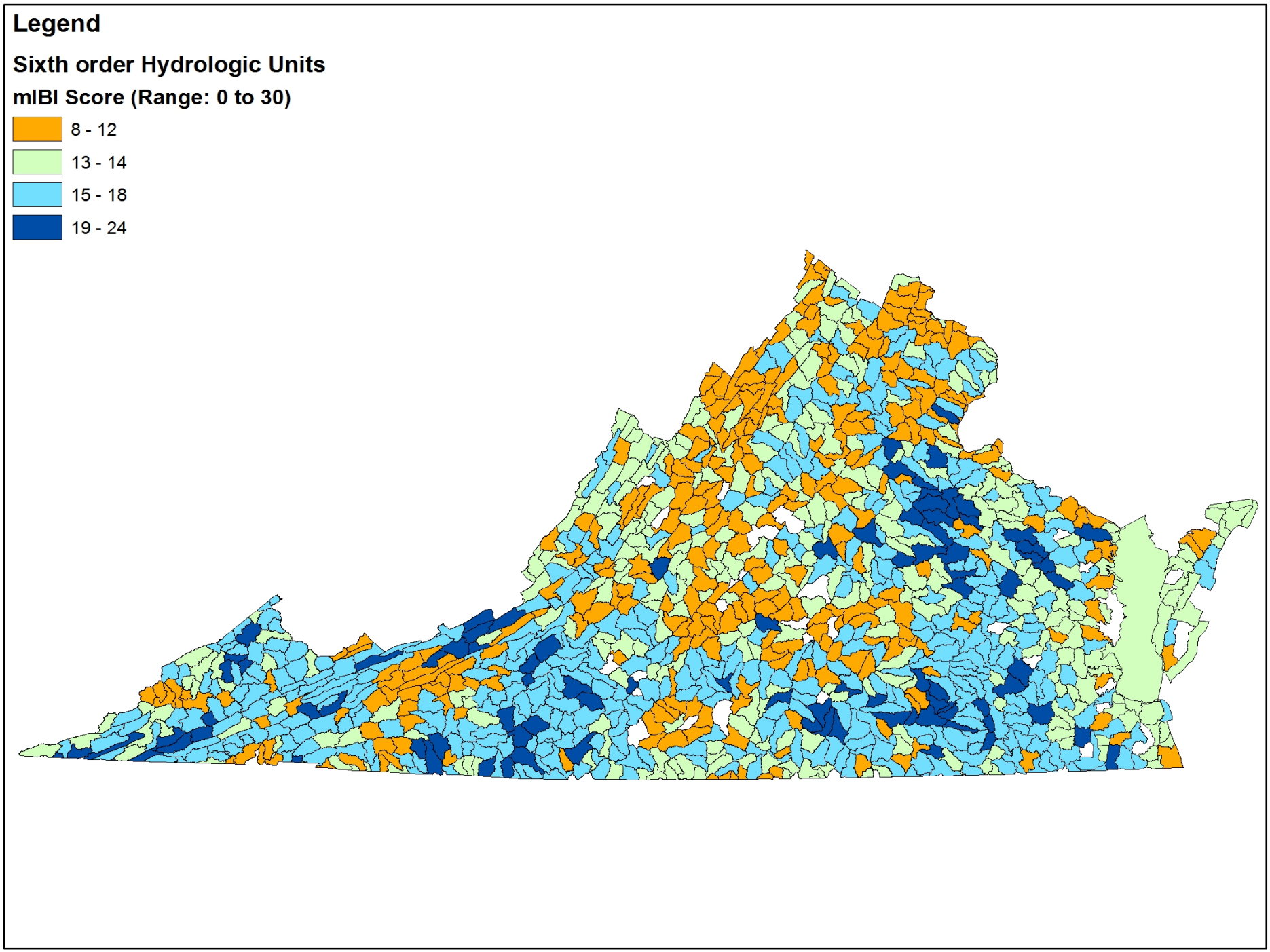
Percent comparability to virtual regional reference conditions

Empirical ranges: 12-88% of VSA models

Statistics supported multiple VSA models, including lower piedmont, coastal plain, and Shenandoah basin

Intermediate and fine spatial scales (stream reach)

Quantitative data are inputs


Legend
Sixth order Hydrologic Units
mIBI Score (Range: 0 to 30)
8 - 12
13 - 14
15 - 18
19 - 24

INSTAR Supports Two Bioassessment Protocols:

Modified Index of Biotic Integrity (mIBI)

Metrics:

1. Native species richness
2. Number of R, T, & E species
3. Number of non-indigenous species
4. Number of 'critical' species
5. Number of tolerant species
6. Number of intolerant species

Regional Scoring Criteria
Ranges between 6-30
Broad geospatial scales (HUCs)

Virtual Stream Assessment (VSA)

Percent comparability to *virtual* regional reference conditions

Empirical range: 8-90% of VSA region-appropriate model

Statistics currently support several regional VSA models, including lower piedmont and coastal zone; others in development (e.g. Shenandoah)

Intermediate spatial scales (reach)

Quantitative data are inputs

The INSTAR Database

Candidate Input Variables for Virtual Stream Models

Biological

18 IBI metrics

12 RBP III metrics

others

Geomorphology

4 Rosgen-type classification metrics

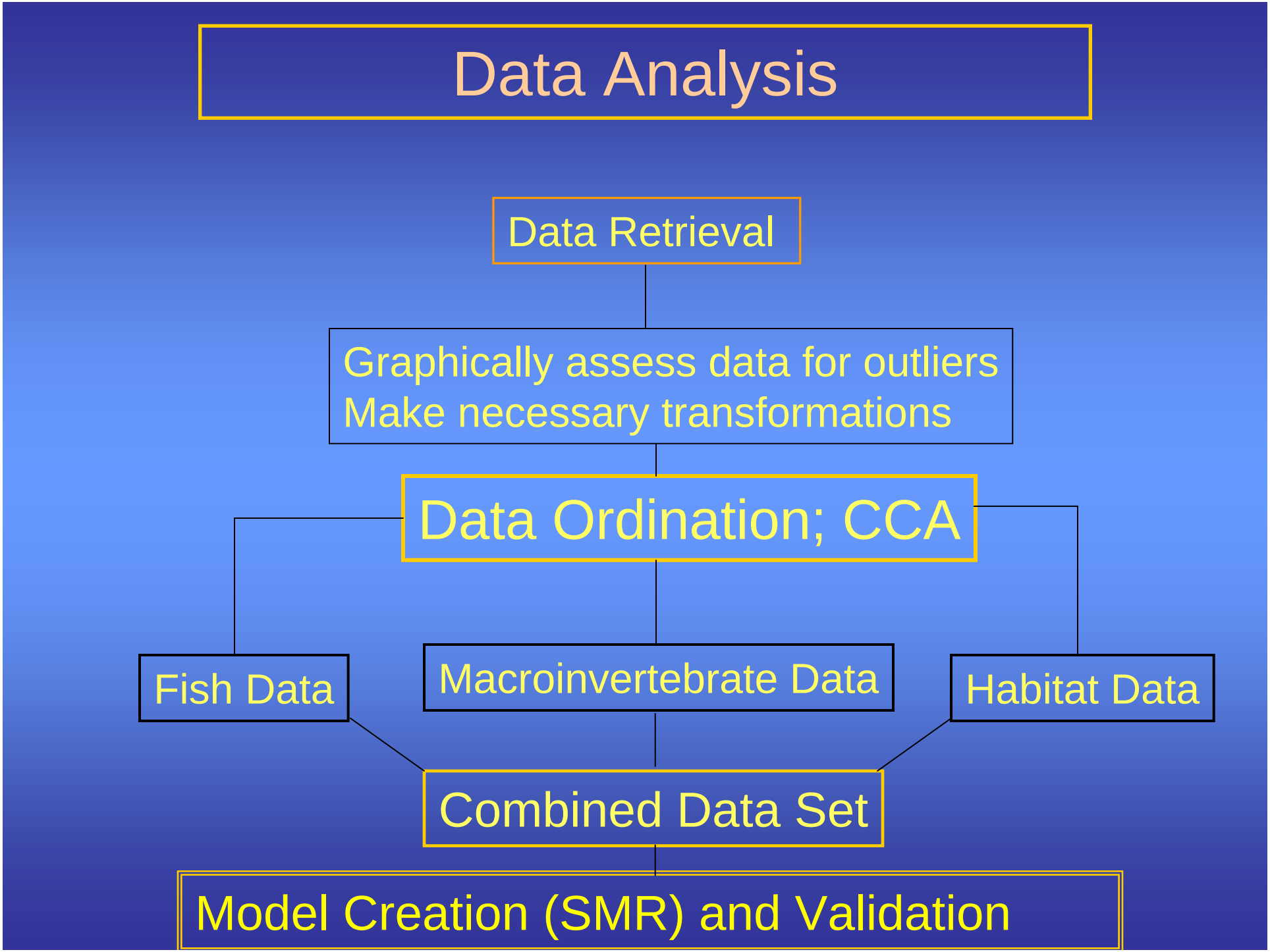
In-stream Habitat

20 RHA metrics

Landscape

Stream order, link metrics, green infrastructure

Modeling exercise to answer: Which of these ~63 stream attributes are most closely related to stream integrity, structure, and function?


Data Analysis
Data Retrieval
Graphically assess data for outliers
Make necessary transformations
Data Ordination; CCA
Fish Data
Macroinvertebrate Data
Habitat Data
Combined Data Set
Model Creation (SMR) and Validation

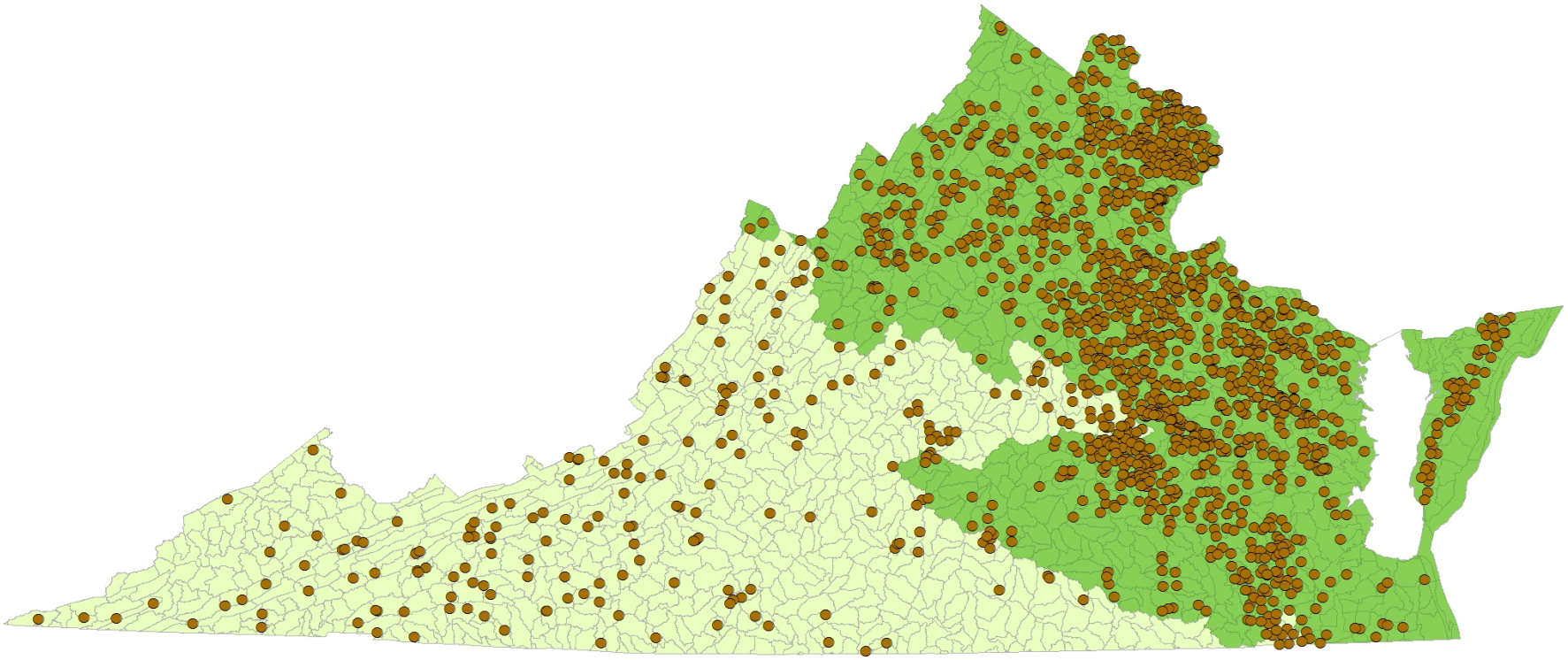
Virtual Stream Model—Lower Coastal Plain

Virtual Reference Stream (100%) = 0.05(*EP*) + 0.02(*Rich*) - 0.19(*Chnlalt*) - 0.1(*Intol*) + 0.18(*Toler*) - 0.05(*HBI*) + 5.67

EP = Ephemeroptera & Plecoptera taxa
Rich = fish species richness (native)
Chnalt = percent channel alteration
Intol = percent intolerant species
Toler = number tolerant species
HBI = Hilsenhoff Biotic Index

adjusted R square = 0.72

Current and Planned Model Regions



Legend

- Instar Sites
- VSA Model Areas
- Hydrologic Units (6th Order)

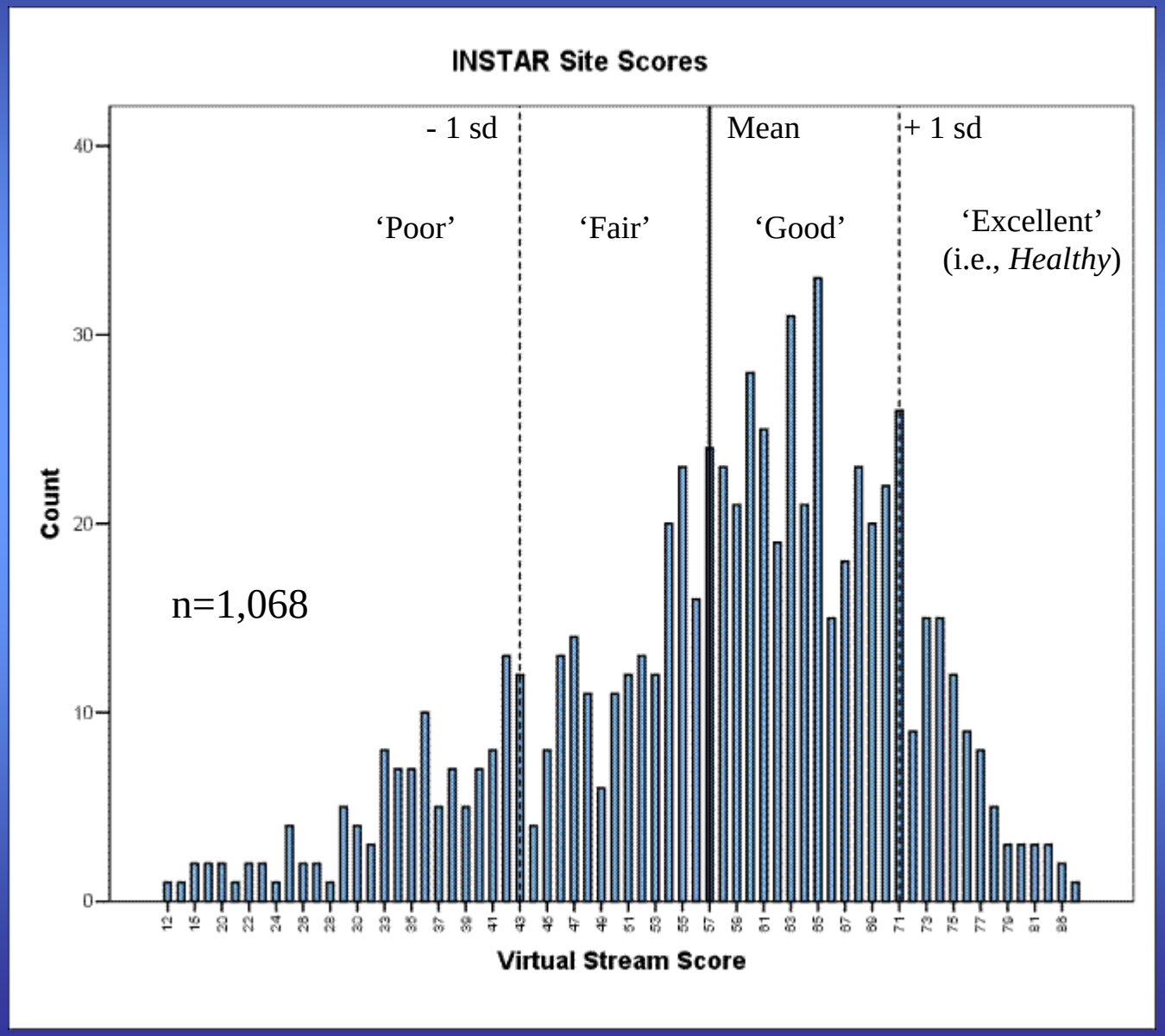
0 25 50 100 Kilometers

VCU

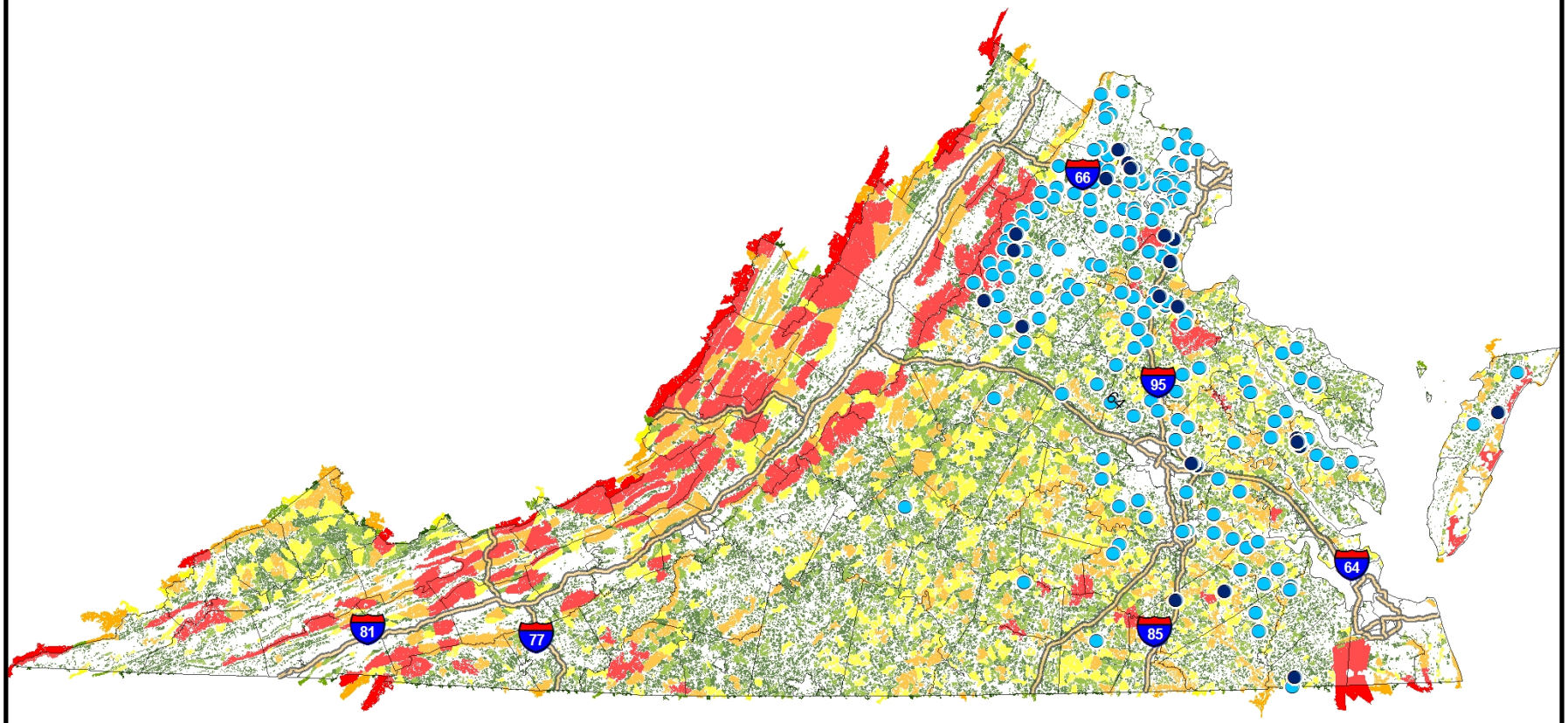
DCR

Virginia Coastal Zone MANAGEMENT PROGRAM

Stream Ecological Integrity Classes



Virginia's Healthy Waters



Legend

- Healthy Streams - (VSA 70 to 80)
- Extraordinary Streams: (VSA > 80)
- Highways
- Counties

1:2,897,125
0 20 40 80
Kilometers

VCLNA - VA DCR - DRAFT 2007

Rank

- C1 : Outstanding
- C2 : Very High
- C3 : High
- C4 : Moderate
- C5 : General

This map was produced by the
Center for Environmental Studies at
Virginia Commonwealth University.
Data courtesy of VCU and DCR-NH.
http://instar.vcu.edu

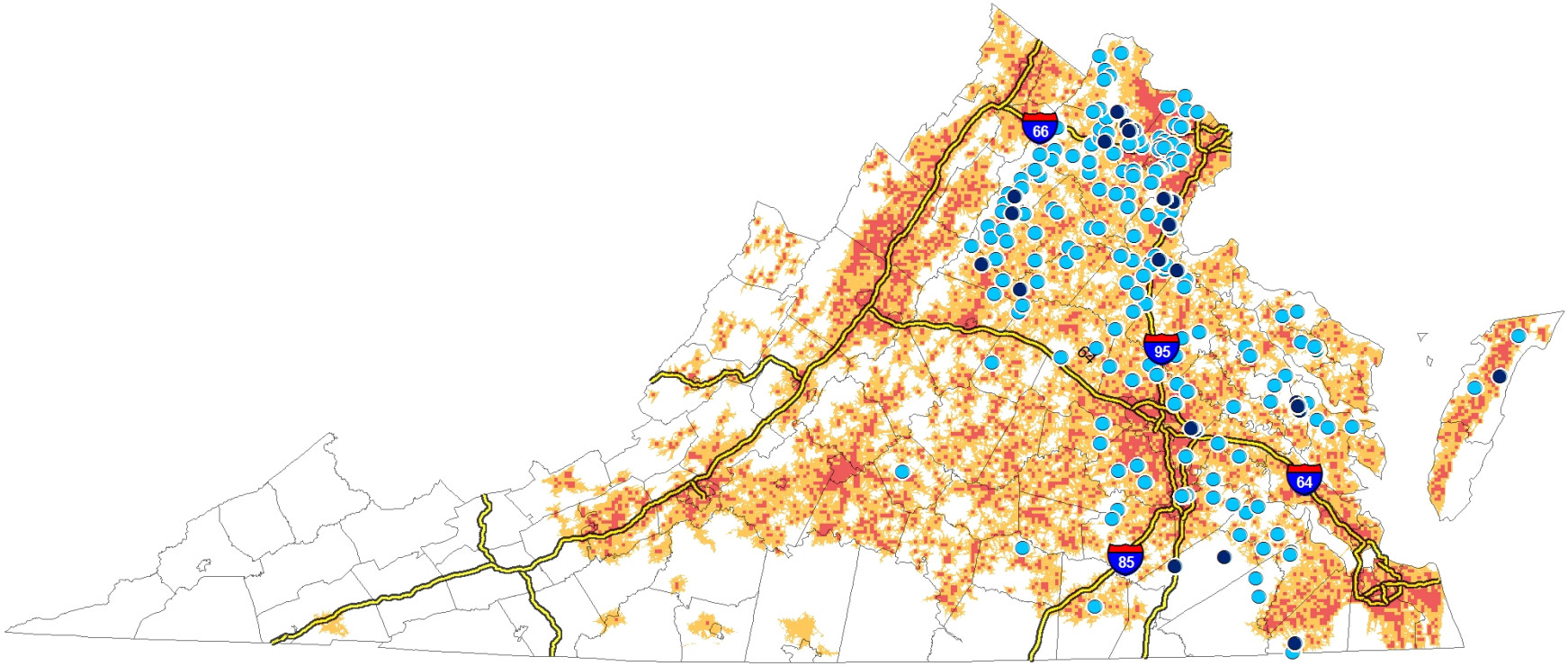
Healthy Streams: n=172
Extraordinary Streams: n=24

VCU

DCR

Virginia Coastal Zone
MANAGEMENT PROGRAM

Virginia's Healthy Waters



Legend

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- Extraordinary Streams: (VSA > 80)
- Highways
- Counties

Vulnerability Model - VA DCR 2007 - Draft

Threat

- 7
- 8 - Hotspot

0 20 40 80 Kilometers

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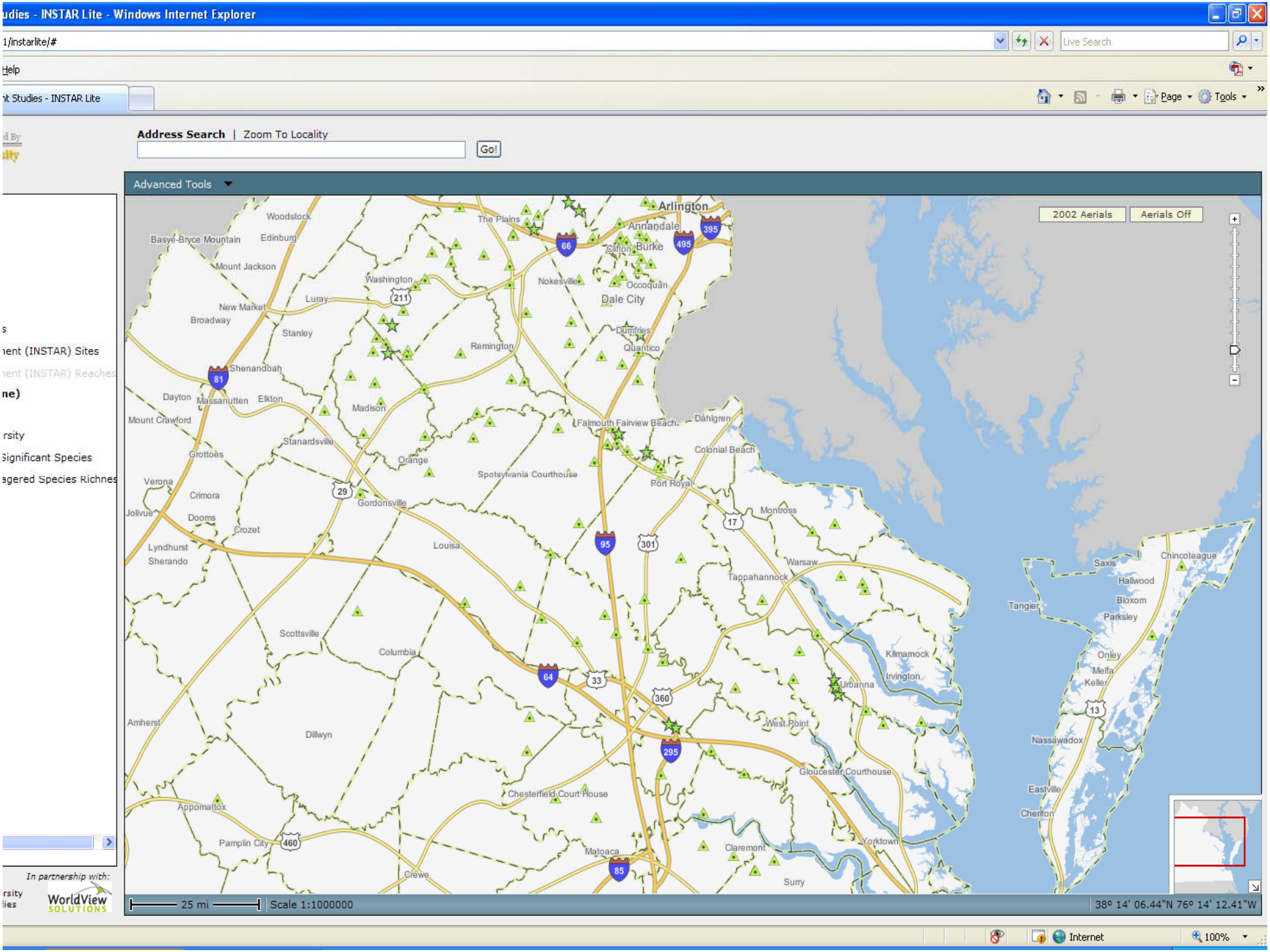
Virginia Coastal Zone MANAGEMENT PROGRAM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Washington
Luray
New Market
Broadway
Stanley
Shenandoah
Dayton
Massanutten
Elkton
Mount Crawford
Grottoes
Verona
Crimora
Jolivue
Dooms
Crozet
Lyndhurst
Sherando
Scottsville
Amherst
Dillwyn
Appomattox
Pamplin City
Crewe
Madison
Remington
Dumfries
Quantico
Falmouth
Fairview Beach
Dahlgren
Colonial Beach
Port Royal
Stanardsville
Orange
Spotsylvania Courthouse
Gordonsville
Louisa
Columbia
Chesterfield Court House
Matoaca
Claremont
Surry
Yorktown
Gloucester Courthouse
West Point
Montross
Warsaw
Tappahannock
Kilmarnock
Irvington
Urbanna
Tangier
Saxis
Chincoteague
Hallwood
Bloxom
Parksley
Onley
Melfa
Keller
Nassawadox
Eastville
Cheriton
66
395
495
211
81
29
95
301
17
64
33
360
295
460
85
13
25 mi
Scale 1:1000000
38° 14' 06.44"N 76° 14' 12.41"W
Internet
100%

Selected *INSTAR* Applications:

1. Integrate Excellent/Extraordinary (i.e., ‘healthy’) into Stream Conservation Units (VNH)

2. Expand mitigation credits (stream bank) for protection and conservation of ‘healthy’ streams (TNC/DEQ/COE)

3. Target resource protection activities (TNC’s freshwater portfolio)

4. Target development activities (UDAs; Coastal GEMS)

5. Enhance existing state programs and policies (NPS assessment; Shenandoah fish kills; Richmond County NFWF program; DEQ ProbMon program)

6. Healthy Waters Pilot Initiative in Virginia