WEST VIRGINIA WATERSHED ASSESSMENT PILOT PROJECT

Gauley River ©Kent Mason

First Expert Workshop, Oct. 25 & 26, 2011

Presentation Outline

- Project Introduction
- Methodology
- Review of Data
- Metrics
- Intended Outcomes

Project Introduction

1. Objectives
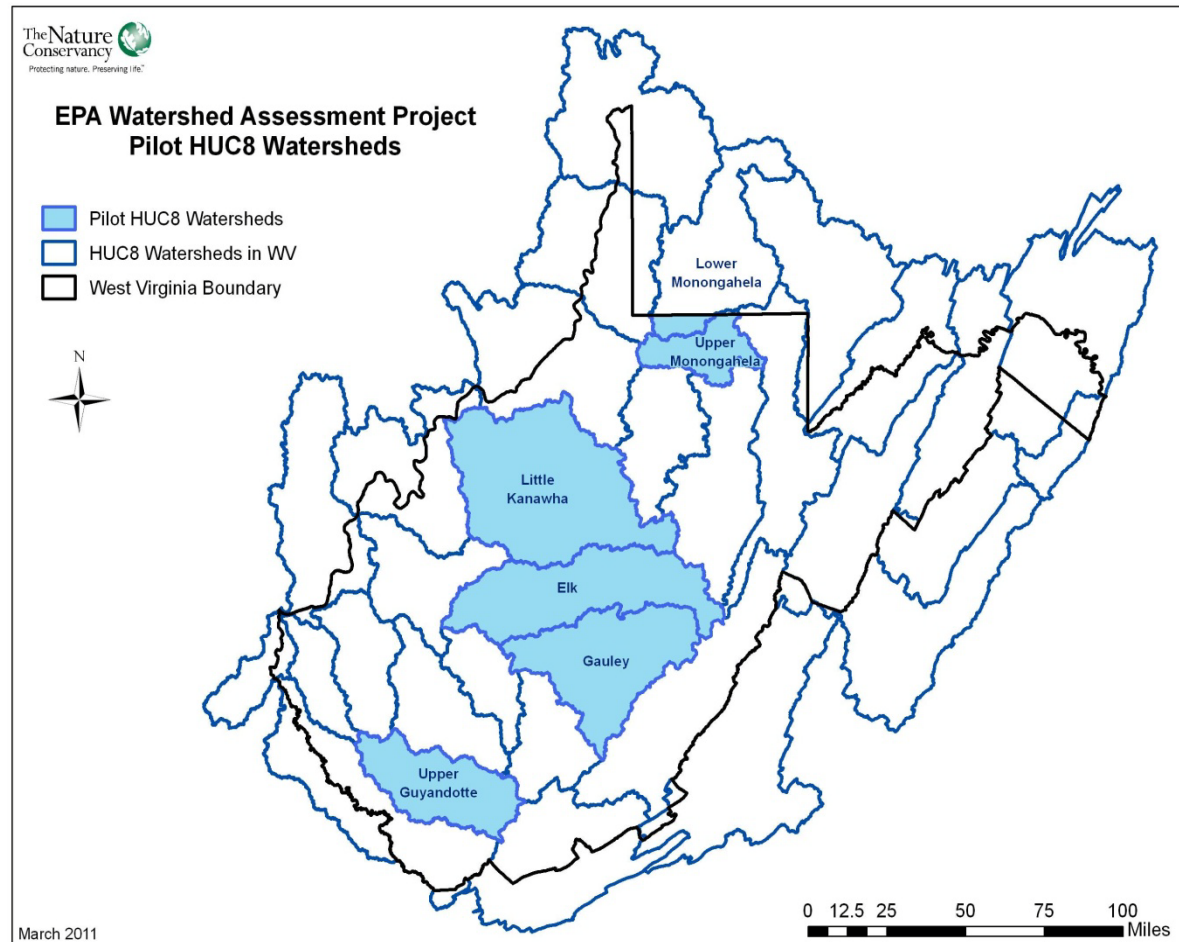2. Process
3. Study Area

Project Objectives

- Design and test a **watershed assessment process**, which includes analysis of cumulative watershed effects.

- **Establish priorities** for protection and restoration of aquatic resources and evaluate/rank areas within watersheds accordingly.

- Provide relevant information, strategies/actions, and a **decision support tool** to assist partners, stakeholders and regulatory staff with decisions affecting aquatic resources.

Project Study Area

Five WV HUC8 Watersheds:

- **Monongahela**
- **Elk**
- Gauley
- Little Kanawha
- Upper Guyandotte

The Nature Conservancy
Protecting nature. Preserving life.

EPA Watershed Assessment Project
Pilot HUC8 Watersheds

- Pilot HUC8 Watersheds
- HUC8 Watersheds in WV
- West Virginia Boundary

N

Lower Monongahela

Upper Monongahela

Little Kanawha

Elk

Gauley

Upper Guyandotte

March 2011

0 12.5 25   50   75   100 Miles

Project Process – First 2 Watersheds

- 4/1/2011 – Project Start
- Define watershed assessment methodology
- 6/13/2011 - Technical advisory team meeting
- Complete watershed characterization
- **10/25 & 10/26/2011 - Expert workshop one**
- Complete consolidated analysis
- By 2/1/2012 - Expert workshop two
- Complete draft watershed assessments
- By 4/1/2012 - Decision maker/end user workshop
- Complete final watershed assessments
- 6/1/2012 – Final reports & interactive web application completed

Project Process – Final 3 Watersheds

- ☐ Complete watershed characterization
- ☐ By 10/1/2012 - Expert workshop one
- ☐ Complete consolidated analysis
- ☐ By 12/1/2012 - Expert workshop two
- ☐ Complete draft watershed assessments
- ☐ By 2/1/2013 - Decision maker/end user workshop
- ☐ Complete final watershed assessments
- ☐ 4/1/2013 – Final reports & interactive web application completed

Methodology

1. Watershed Characterization
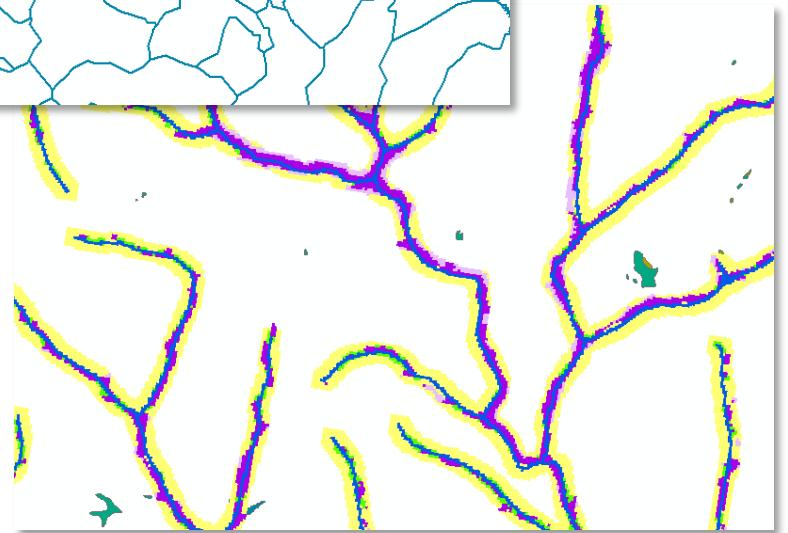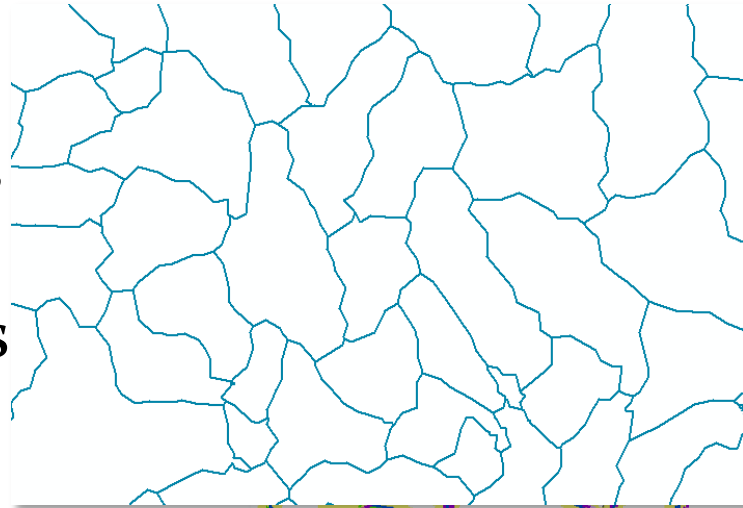2. Priority Models
3. Consolidated Analysis

Watershed Characterization

- Baseline analysis to compile, process and format datasets for use in Priority Models

- Intended to identify current watershed **Condition**/**Function** as well as existing **Threats** (ecological risk assessment)

Watershed Characterization

- Planning Units:
  - Modified NHDPlus catchments
  - HUC-12 watersheds

- Landscape types:
  - Stream/Riparian
  - Wetlands
  - Uplands

Priority Models

PROTECTION PRIORITIES	RESTORATION PRIORITIES

- Stream/Riparian
- Wetlands
- Uplands

- Stream/Riparian
- Wetlands
- Uplands

(Metrics will be individually defined for each Priority Model)

Methodology

I. Develop a **relative** ranking of planning units within a watershed

II. Develop **non-relative** index of watershed condition and threat based on pre-defined quality scale (e.g., 1-4 scale where 1= poor, 2=fair, 3= good, 4= excellent)

□ **First phase:** comparison of planning units (prior to expert workshop one)

□ **Second phase/ consolidated analysis:** detailed analysis of target areas and strategies/actions within each planning unit

Consolidated Analysis

- **Cumulative Watershed Effects**

Land use changes

Landscape losses

Ecosystem function/ service degradation

Cumulative impacts/ stresses

- **Historical and Future Conditions**

Trends analysis (water use, permitting, population growth, climate change, etc.)

Future scenarios analysis (within targeted areas and for proposed strategies/actions)

Outcomes

1. Intended Results
2. Project Outputs

Intended Results

- Develop a watershed assessment methodology that can be implemented in the remaining WV watersheds
- Rank areas of high conservation value
- Rank restoration needs, opportunities and probabilities of success
- Develop strategies/actions to address issues identified during assessment process
- Develop metrics to measure success/ improvement
- Suggest protocols for monitoring and assessment of aquatic resources as an adaptive feedback loop for resource management
- Identify data gaps & data needs

Project Outputs

- **Five watershed assessment reports**

Will include specific priorities and strategies, as well as detailed methodology, references and lessons learned

- **Interactive web mapping application**

A spatial decision support tool to assist stakeholders in identifying target areas, strategies and actions

Interactive Web Mapping Application

Desktop tool that will allow users to:

- View the various datasets in one application

- Develop customized scenarios to rank target areas for restoration and/or protection projects according to their priorities

- Manipulate weighting of different factors

Overview of Model Structure

Hierarchical Structure:

- 3 Models: Streams, Wetlands, Uplands
- 2 Categories: Condition/Function, Threats
- Several Indices in each category
- Multiple Metrics to define each index

Categories/Indices

CONDITION/ FUNCTION

- Hydrologic/Habitat connectivity
- Water quality
- Water quantity
- Biodiversity
- Physical integrity
- Protected lands & Priority interest areas

THREAT

- Resource extraction
- Development & Agriculture
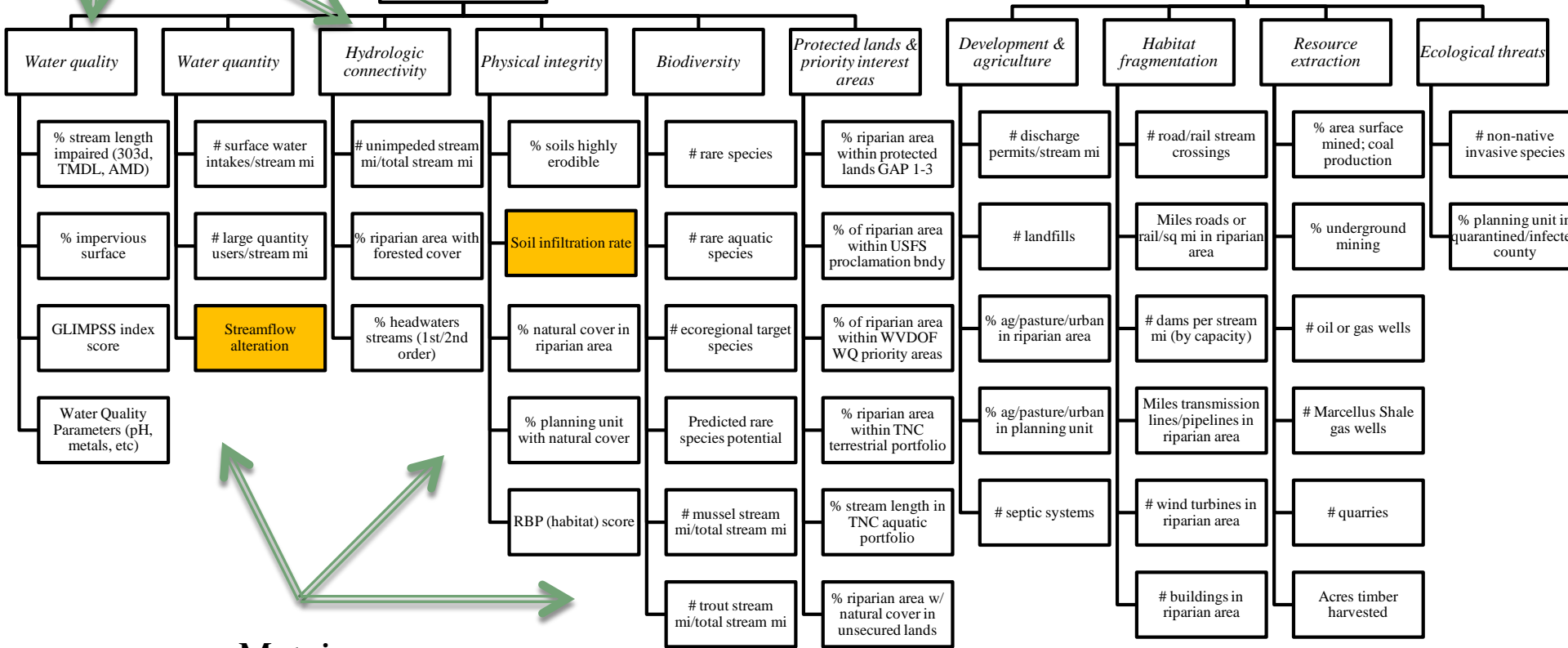- Habitat fragmentation
- Ecological threats

1 of 3 Models

Category

Index

Metrics

STREAMS/RIPARIAN PRIORITY MODEL

CONDITION/ FUNCTION

THREAT

Water quality
- % stream length impaired (303d, TMDL, AMD)
- % impervious surface
- GLIMPSS index score
- Water Quality Parameters (pH, metals, etc)

Water quantity
- # surface water intakes/stream mi
- # large quantity users/stream mi
- Streamflow alteration

Hydrologic connectivity
- # unimpeded stream mi/total stream mi
- % riparian area with forested cover
- % headwaters streams (1st/2nd order)

Physical integrity
- % soils highly erodible
- Soil infiltration rate
- % natural cover in riparian area
- % planning unit with natural cover
- RBP (habitat) score

Biodiversity
- # rare species
- # rare aquatic species
- # ecoregional target species
- Predicted rare species potential
- # mussel stream mi/total stream mi
- # trout stream mi/total stream mi

Protected lands & priority interest areas
- % riparian area within protected lands GAP 1-3
- % of riparian area within USFS proclamation bndy
- % of riparian area within WVDOF WQ priority areas
- % riparian area within TNC terrestrial portfolio
- % stream length in TNC aquatic portfolio
- % riparian area w/ natural cover in unsecured lands

Development & agriculture
- # discharge permits/stream mi
- # landfills
- % ag/pasture/urban in riparian area
- % ag/pasture/urban in planning unit
- # septic systems

Habitat fragmentation
- # road/rail stream crossings
- Miles roads or rail/sq mi in riparian area
- # dams per stream mi (by capacity)
- Miles transmission lines/pipelines in riparian area
- # wind turbines in riparian area
- # buildings in riparian area

Resource extraction
- % area surface mined; coal production
- % underground mining
- # oil or gas wells
- # Marcellus Shale gas wells
- # quarries
- Acres timber harvested

Ecological threats
- # non-native invasive species
- % planning unit in quarantined/infected county

WETLANDS PRIORITY MODEL

CONDITION/ FUNCTION

Wetland quantity
- % area wetlands
- % area potential wetlands
- Mean wetland size
- % area historical wetlands

Water quality
- % impervious surface in wetland buffer

Hydrologic connectivity
- Mean distance to nearest headwater stream
- Mean distance to nearest surface water/wetland

Physical integrity
- % natural cover in wetland buffer
- Soils? (infiltration rate, organic carbon, saturation index)

Biodiversity
- # rare species
- # rare aquatic species
- # ecoregional target species
- Predicted rare species potential

Protected lands & priority interest areas
- % wetland buffer within protected lands GAP 1-3
- % wetland buffer in TNC terrestrial portfolio
- % of wetland buffer within USFS proclamation bndy
- % of wetland buffer within WVDOF WQ priority areas
- % wetland buffer w/ natural cover in unsecured lands

THREAT

Development & agriculture
- # landfills
- # septic systems in wetland buffer
- % ag/pasture/urban in planning unit
- % ag/pasture/urban in wetland buffer
- # buildings in wetland buffer

Habitat fragmentation
- Miles transmission lines/pipelines in wetland buffer
- Miles roads/rail in wetland buffer
- Miles roads or rail in planning unit
- # wind turbines in wetland buffer
- # buildings in wetland buffer

Resource extraction
- % area surface mined; coal production
- % underground mining
- # oil or gas wells
- # Marcellus shale gas wells
- # quarries
- Acres timber harvested

Ecological threats
- # non-native invasive species
- % planning unit in quarantined/infect county

UPLAND FORESTS PRIORITY MODEL

CONDITION/ FUNCTION

Habitat connectivity
- Average local integrity score
- Size of largest intersecting forest block
- Average size of intersecting forest blocks

Physical Integrity
- Average heterogeneity score
- % vegetation departure from reference condition
- Soil buffering capacity

Biodiversity
- # Rare species
- # Rare terrestrial species
- # Ecoregional target species
- # Vegetation types
- Predicted rare species potential

Protected lands & priority interest areas
- % In TNC terrestrial portfolio
- % Within DOF forest resource priority areas
- % In USFS proclamation boundary
- % within protected lands GAP 1-3

THREAT

Development & agriculture
- % Agriculture
- % Pasture
- % Barren lands
- % Urban or developed lands
- # Landfills

Habitat fragmentation
- Miles roads or rail
- Miles transmission lines/pipelines
- # Wind turbines
- # Buildings

Resource extraction
- # Oil or gas wells
- # Marcellus shale gas wells
- % area surface mined (active and legacy); coal production
- % underground mining (active and legacy)
- # Quarries
- Acres timber harvested

Ecological threats
- # invasive species
- % of planning unit in an infested or quarantined county
- Basal area loss due to pests and pathogens

Data

- Federal
- State
- Organization

Datasets

FEDERAL

- NHDPlus catchments and stream network
- NWI wetlands
- NLCD 2006 land use/land cover
- USDA SSURGO soils
- Digital elevation models
- Streamflow data (USGS)
- Infrastructure (roads, railroads)

Datasets

STATE

- Impaired streams: 303(d); TMDL; AMD
- Water quality monitoring data (WAB)
- GLIMPSS Scores
- Oil/gas wells locations (WVDEP/WVGES)
- All mining activity (WVDEP/WVGES)
- Quarries
- Solid waste facilities
- Public water supply intakes/large quantity users
- NPDES sites
- Publicly owned lands
- Rare species

Datasets

ORGANIZATION

The Nature Conservancy

- Active River Area
- Aquatic & Terrestrial portfolio
- Forest blocks
- Local connectivity/integrity
- Heterogeneity
- Terrestrial Habitats

Others

- Energy infrastructure

Redundant Metrics

- Perform Correlation Analysis to find highly correlated metrics
- Done on Planning Units
- HUC12 Prioritization may give better results due to larger sample size
- Preliminary results: we may be able to eliminate some metrics

Regression Analysis

- Which Condition/Function and Threat Metrics influence water quality
- Will perform on HUC12 results due to larger sample size
- Will help inform weighting of metrics – which metrics have the greatest impact on water quality?

Relative vs. Objective Classification

- All planning units are ranked relative to each other
- Compares planning units, but gives no information on which are good quality and which need to be restored
- Need to define Thresholds for each metric to be able to assign to a category
- Literature review has only yielded a handful of objective thresholds

Threshold Categories

- Very Good: Ecologically desirable status; requires little intervention for maintenance
- Good: Indicator within acceptable range of variation; some intervention required for maintenance

----

Restoration Threshol

- Fair: Outside acceptable range of variation; requires human intervention
- Poor: Restoration increasingly difficult; may result in extirpation of target

Elk River at Birch Run, WV ©www.over-land.com

FEEDBACK/QUESTIONS?

Category: Condition/Function

Water Quality

Metric: Impaired Streams

- Includes all 303(d) listed streams, those with TMDLs and AMD (acid mine drainage) streams
- Thresholds (Best Guess)

Very good: 0%

Good: 1-10%

Fair: 11-50%

Poor: 51-100%
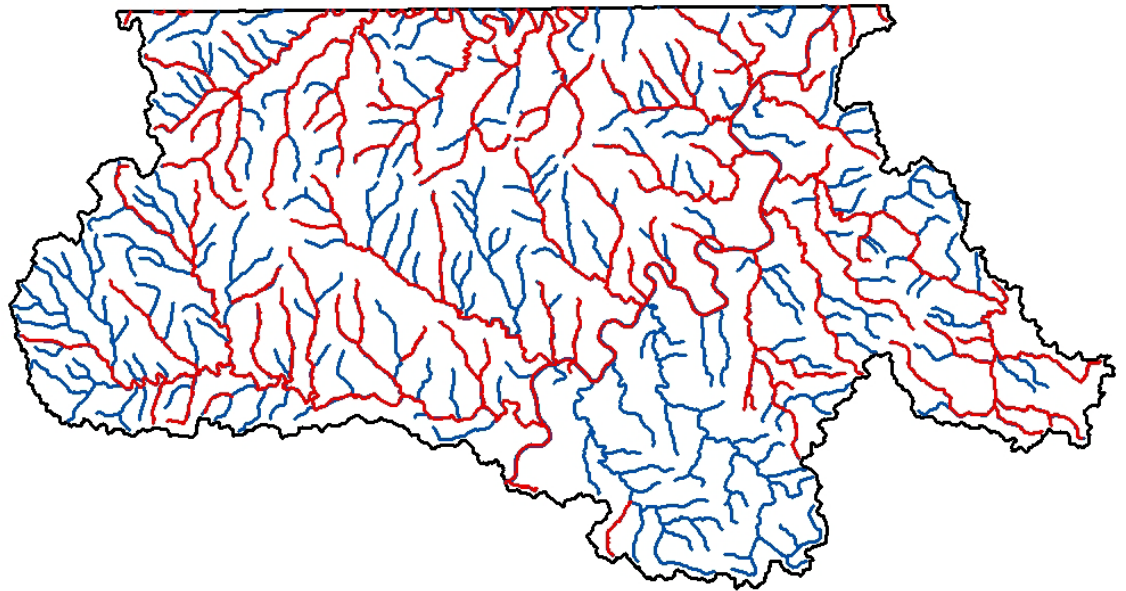
Metric: Water Quality Parameters

Water Quality measurements from DEP Watershed Assessment Branch.

- Developed Index for Sulfate, GLIMPSS scores, and Reference Points:
  - Index based on 4 categories: Fair – Very Good, scored 100 – 400, respectively.
- Nitrate/Nitrites, Metals, pH based on percentage of points not attaining
- Percentage of points "Stressed" – adapted from DEP definition, used pH, Specific Conductivity, several RBP (habitat score) parameters

Metric: GLIMPSS (CF)

Used calculated index based on GLIMPSS Percentage of Threshold

- 400 = Very Good: >125% (corresponds roughly to 25th percentile of reference site GLIMPSS scores)

- 300 = Good: 100 – 125% (considered "attaining")

- 200 = Fair: 50 – 99% (considered "impaired")

- 100 = Poor: 0 – 49% (considered "severely impaired")

Water/Wetland Quantity

Metric: Streamflow alteration

- Degree of alteration from average high or low streamflow values; environmental flow
- Would need to be calculated/modeled
- Possible versions of modeling software:

TNC - Indicators of Hydrologic Alteration (IHA)

USGS- National Hydrologic Assessment Tool (NATHAT)

- Opinions? Suggestions? Thresholds?

Metric: PWS & LQU

- Public water supply intakes (PWS)
- Large quantity users (LQU) >750,000 gallon withdrawal; self-reporting
- Thresholds (Best Guess)

Very good: 0

Good: 1 or more?

Fair: ?

Poor: ?

Metric: Wetland size/extent

- Percent of area with wetlands; mean wetland size
- Generated 150 ft wetland buffer
- Historical wetlands taken from topos (~1910-1930's)
- Potential wetlands generated using WARPT analysis (based on hydric soils, floodplain and elevation sinks)
- Thresholds: ?

Hydrologic Connectivity– Streams & Wetlands

Metric: Unimpeded streams

- Developed based on TNC-ERO Functional River Network, which identifies stream lengths without impoundments or waterfalls (impediments to hydrologic connectivity)
- Thresholds (by ERO Stream Size Class)

Very good: 5/6 (100-<250 mi)

Good: 3/4 (25-<100 mi)

Fair: 2 (10-<25 mi)

Poor: 1 (<10 mi)

Functional River Network (ERO)
SIZE CL
1. <10 mi.
2. >=10 mi. <25 mi.
3. >=25 mi. <50 mi.
4. >=50 mi. <100 mi.
5. >=100 mi. <250 mi.
6. >=250 mi. <500 mi.
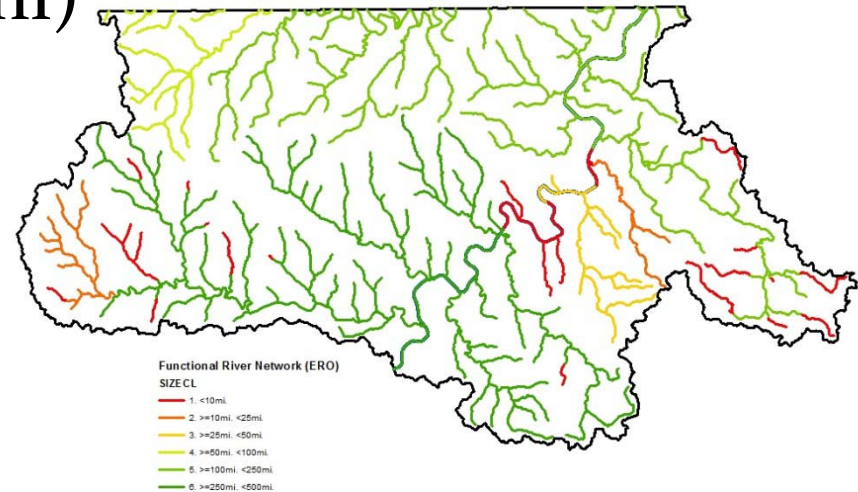
Wetland Hydrologic connectivity index

- Distance to nearest headwaters streams
- Distance to nearest surface water features
- Thresholds:

Very good: <100 ft

Good: 100-200 ft

Fair: 200-300 ft

Poor: >300 ft

Habitat Connectivity - Uplands

Metric: Forest Block Sizes

- TNC-ERO generated maps of forest blocks greater than 100 acres
- Calculated largest and mean intersecting block size
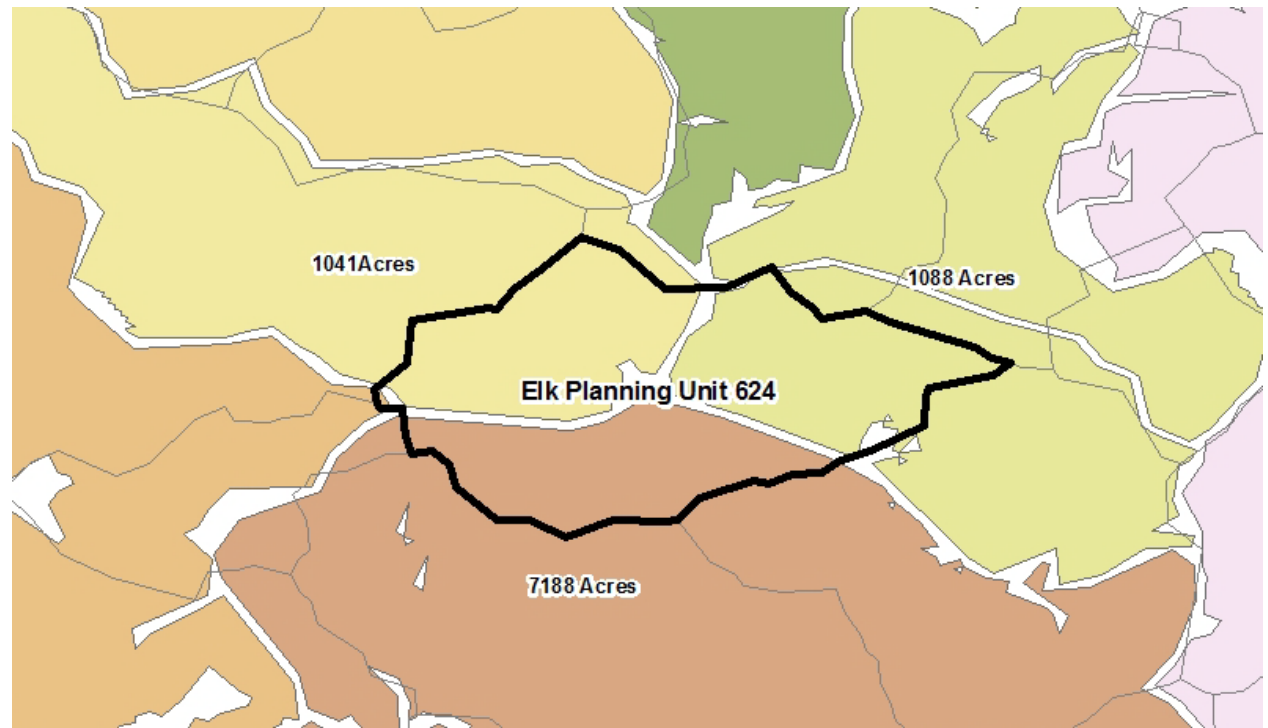
Metric: Local Integrity

- A measure of connectivity of natural cover in the landscape
- Metric developed for Conservation Assessment & Prioritization System at UMass Amherst
- Average score per
  planning unit
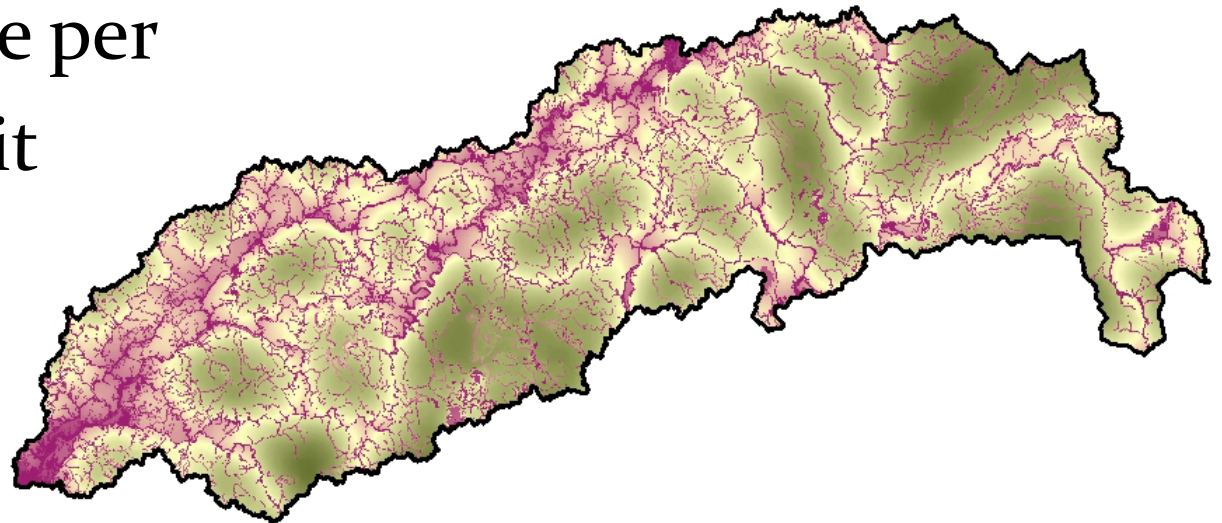
Physical Integrity

Metric: Highly Erodible Soils

- SSURGO soils data, by county
- Used NRCS Soil Data Viewer ArcMap extension to generate Erosion Hazard data (based on K factor, slope and content of rock fragments)
- Possible additional soils metrics?
- Better erosion metric? (T factor?)
- Thresholds: ?

Metric: Wetland soils

- Many possible soils metrics for wetlands (soil saturation index, soil infiltration capacity, soil organic carbon content)

- Suggestions/opinions for wetland soils metrics? Also, possible sources of such data or what information is relevant from SSURGO data…

- Thresholds?

Metric: Landscape Heterogeneity

- Landform variety + Elevation range within 100 acres of each cell, normalized and summed
- Higher heterogeneity = higher habitat diversity
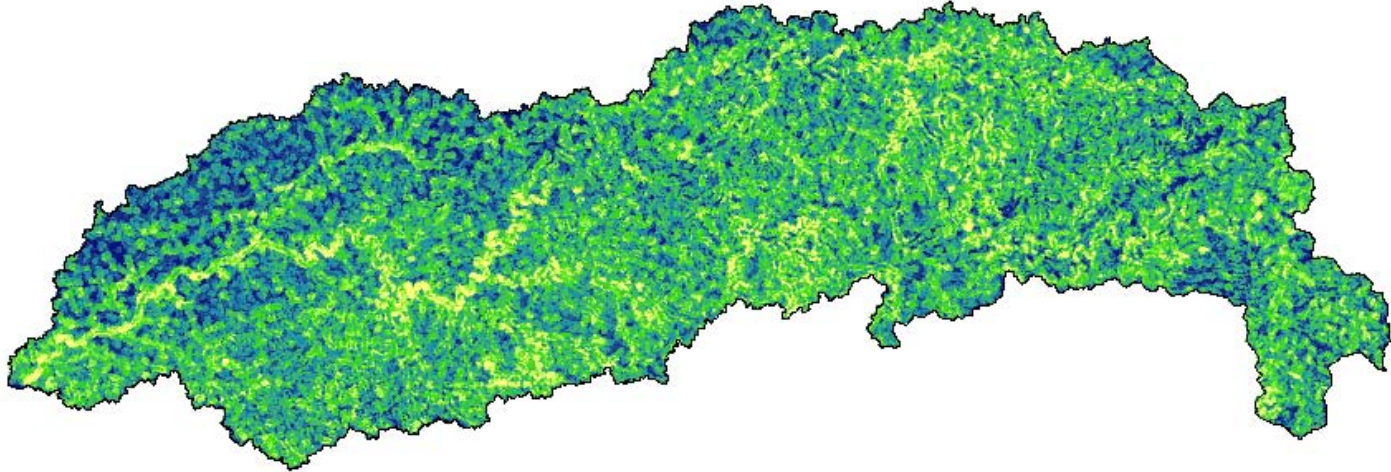
Metric: FRCC

- Percent of planning unit with Fire Regime Condition Class I

- A measure of vegetation altered from reference condition (intending to take least altered lands)

- Data from USDA/

  USDOI LANDFIRE
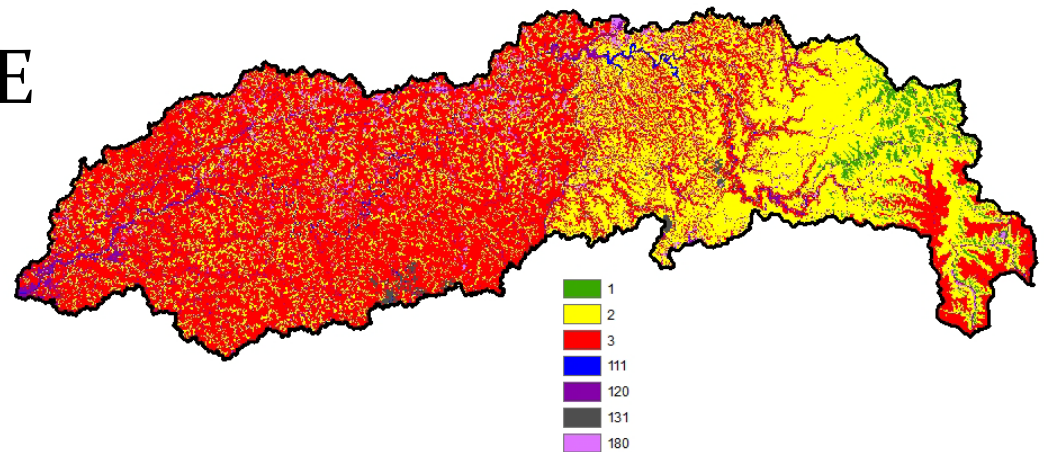
Biodiversity

Metric: SGNC-RTE

- **S**pecies in **G**reatest **N**eed of **C**onservation
- S1, S2, S3
- G1, G2, G3
- T1, T2, T3
- Federally listed threatened
- Federally listed endangered
- Use of all Element Occurrences vs. only observations 1991 and later

- 20,726 Element occurrences statewide from WV Natural Heritage Program

Metric: Ecoregional Target Species

- TNC defined ecoregional priorities
- Target species defined during TNC Ecoregional Planning

Western Allegheny Plateau

Central Appalachian Forest

Cumberlands and Southern Ridge and Valley
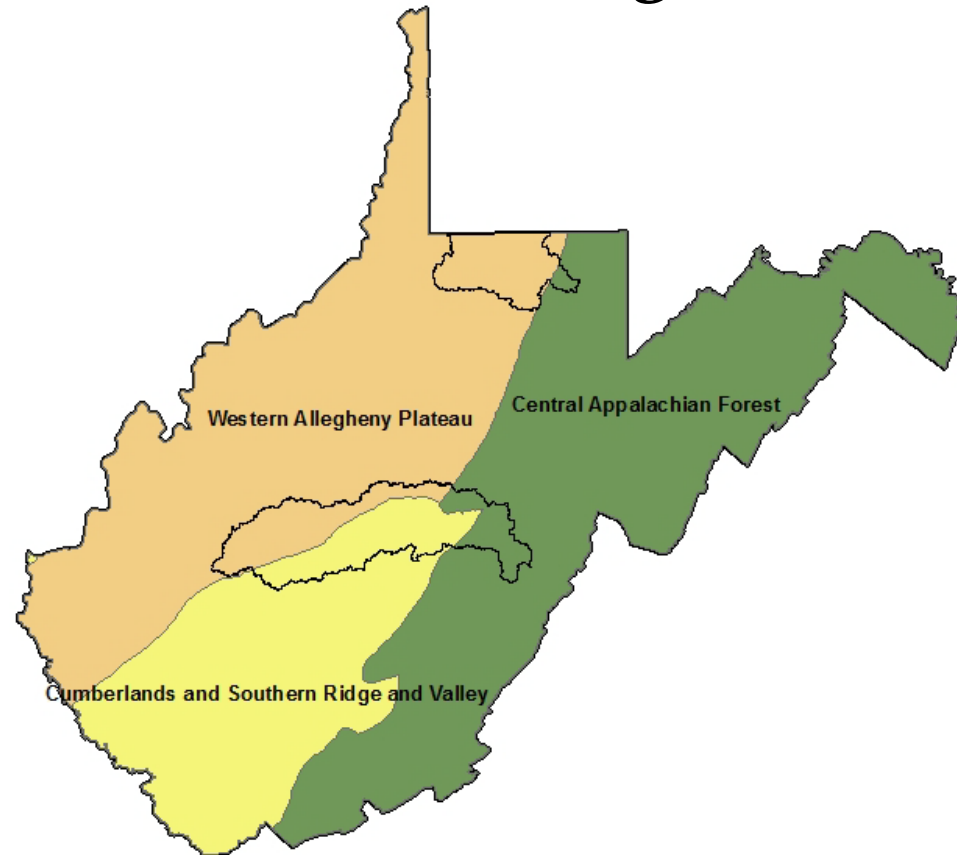
Metric: Mussel Streams

☐ Stream reaches of
High Quality or
Endangered Species
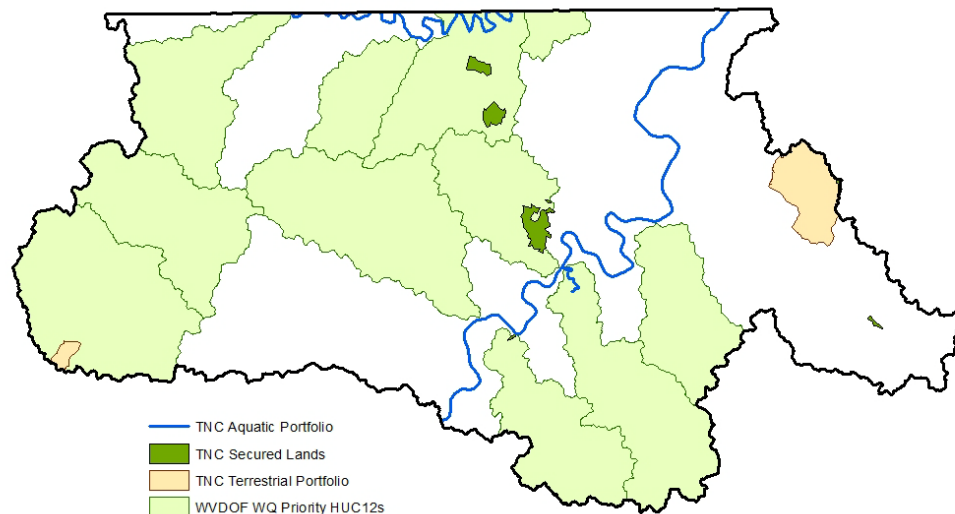Present
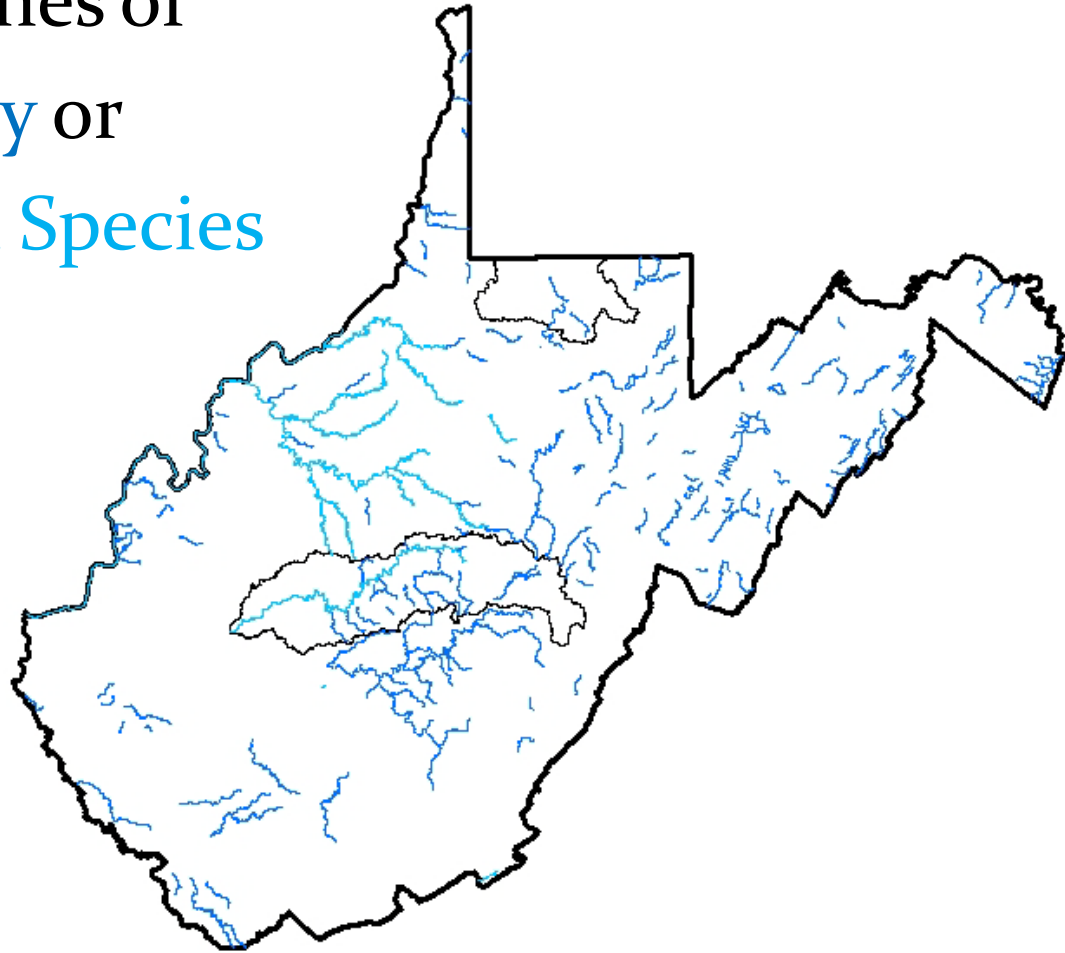
Metric: Predicted rare species potential

- Developed based on methodology from Anderson and Ferree 2010
- Predictive datasets: # of geology classes, range of elevation, % of calcareous bedrock
- Were ranked and scored by planning unit to indicate relative rare species habitat probability
- Thresholds?

Protected Lands & Priority Interest Areas

Metric: Priority interest areas

- USFS Forest Proclamation Boundary
- WV Division of Forestry water quality priority HUC12s
- TNC aquatic and terrestrial portfolios
- Thresholds: by quartile percentiles?

— TNC Aquatic Portfolio
■ TNC Secured Lands
■ TNC Terrestrial Portfolio
■ WVDOF WQ Priority HUC12s

GROUP DISCUSSION

**Please split up into assigned Groups to discuss metrics.
Questions to consider:**

➢ Do the Indices describe the Condition/Function adequately?

➢ Do the metrics describe the condition of the indices?

➢ Are we missing important metrics?

➢ Do we have duplicate/redundant metrics?

➢ Which metrics are most important in describing each index?

➢ How should they be weighted?

➢ Are the datasets for each metric appropriate?

➢ Are we missing important datasets?

➢ Are the defined thresholds appropriate?

➢ Do you have suggestions for thresholds we're missing?

Category: Threats

Development & Agriculture

Metric: Septic systems

- Generated based on number of buildings which fall outside of city limits
- Need sewage line data for urban areas, otherwise a very conservative (high) estimate
- Thresholds?

Metric: Landuse/Landcover

- % Agriculture
- % Pasture
- % Natural cover
- % Development

- In Planning Unit vs. Riparian/wetland buffers

Habitat Fragmentation

Metric: Infrastructure

- Roads/railroads (density per planning unit as well as number of stream crossings)
- Energy transmission lines and pipelines (density per planning unit)
- Wind turbines
- Dams (# per stream mi and by storage capacity)
- Thresholds?

Resource Extraction

Metric: Mining

- SURFACE: A combination of abandoned mine lands, GES mining footprint, DEP valley fills and refuse structures, Appalachian Voices surface mining digitization, TNC-generated surface mining from topos and aerial imagery
- UNDERGROUND: GES underground mining footprint
- Thresholds?

Metric: Coal production

- Total coal production in thousand short tons, by county (surface, underground and overall)
- Distributed amongst planning units based on percent existing mining area (by county)
- Need the best way to link state mining permit IDs to the federal MSHA IDs
- Thresholds: ?

Metric: Wells

- Active oil and gas wells, new and completed Marcellus shale gas wells

- Thresholds: is there a specific number of wells above which there are known significant impairments? 1? Or more?

Metrics: Mineral Operations & Timber Harvesting

- Active quarrying operations and timber harvest points with permitted acreage
- Not polygon data, so timber removal acreage summed by planning unit
- Thresholds?

Mineral Operations (USGS)

Timber Harvest (WVDOF)
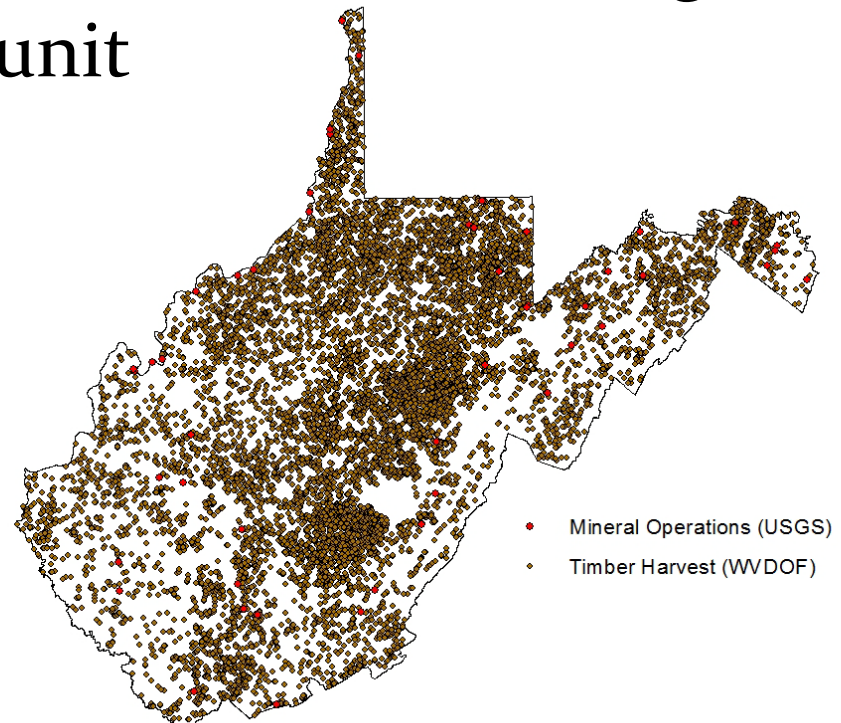
Ecological Threats

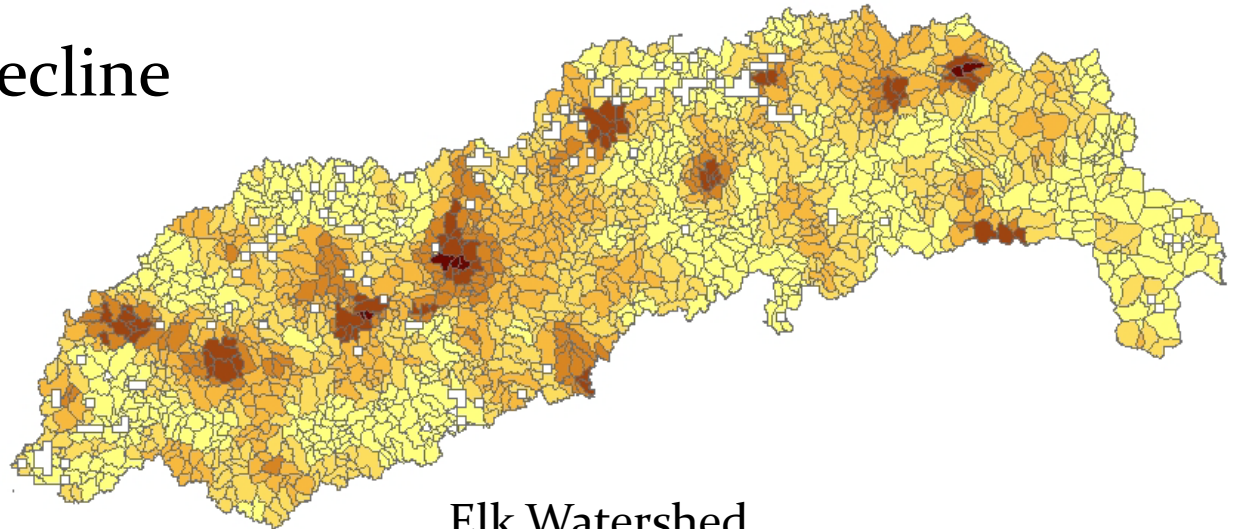# Metric: Invasive Species

- 9818 occurrences
- 62 Species
  - Japanese knotweed,
  - Tree-of-heaven
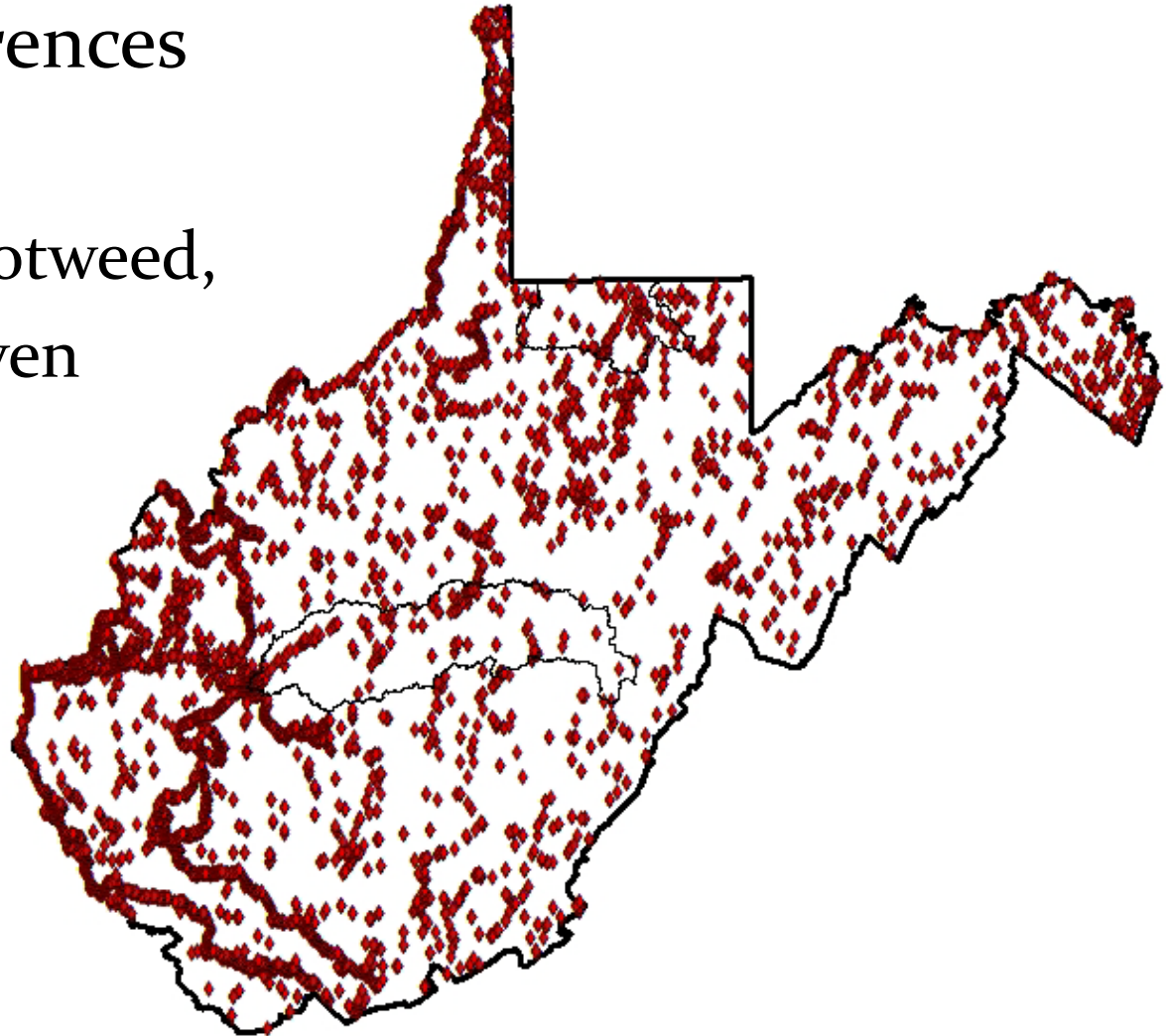
Metric: Pests

- Projected % basal area loss to pests over 15 years
- Specific pests modeled:
  - Gypsy Moth
  - Hardwood decline
  - Red oak decline

Elk Watershed

GROUP DISCUSSION

Please split up into assigned Groups to discuss metrics.
Questions to consider:

➢ Do the Indices describe the Threats adequately?

➢ Do the metrics describe the condition of the indices?

➢ Are we missing important metrics?

➢ Do we have duplicate/redundant metrics?

➢ Which metrics are most important in describing each index?

➢ How should they be weighted?

➢ Are the datasets for each metric appropriate?

➢ Are we missing important datasets?

➢ Are the defined thresholds appropriate?

➢ Do you have suggestions for thresholds we're missing?

Elk River at Birch Run, WV ©www.over-land.com

FEEDBACK/QUESTIONS?