Vermont Agency of Natural Resources

A product of the Natural Resources Mapping Project

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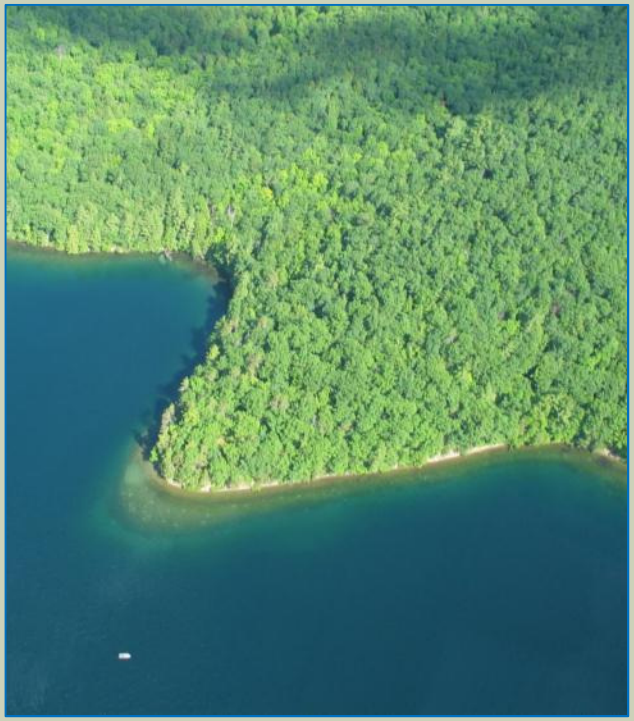
Erik Engstrom

BioFinder Goal

BioFinder
Vermont Agency of Natural Resources



- Identify the lands and waters supporting high priority ecosystems, natural communities, habitats, and species.
- Make the data broadly available through an interactive map.
- Directive of science first!

What is BioFinder?

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- A map and dataset with 5 priority tiers
- A database of 21 component datasets
- An online mapping module and website

Who Is BioFinder For?

BioFinder™

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- ANR staff
- Landowners
- Scientists & Analysts
- Planners
- Developers
- Educators

Erwin Bauer USFWS

What is New?

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- **Synthesis**
  Brings together diverse information from across the Agency
- **Balance**
  Aquatic and terrestrial, coarse and fine filter elements, core habitat and connecting lands
- **Scale**
  Landscape features to vernal pools

PARTNERS!

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- Arrowwood Environmental
- Audubon Vermont
- Lake Champlain Committee
- The Nature Conservancy
- US Forest Service
- US Fish & Wildlife Service
- University of Vermont
- Vermont Center for Ecostudies
- Vermont Center for Geographic Information
- Vermont Land Trust
- Wildlands Network

BioFinder is 21 Component Datasets

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Landscape	**Habitat Blocks**
	Grasslands & Shrublands
	Physical Landscape (Rare & Representative)
	Landscape Connectivity (3 components)
	Riparian Connectivity
	Road Crossings
Aquatic	**Surface Waters & Riparian Areas**
	Representative Lakes
	Exemplary Surface Waters
Rare Species & Natural Communities	**Rare species**
	Uncommon Species
	Rare Natural Communities
	Natural Communities (uncommon & common)
	Vernal pools (and potential pools)
	Wetlands
	Mast stands

Landscape Components

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- Habitat Blocks
- Grasslands & Shrublands
- Connecting Lands (3)
- Riparian connectivity
- Road crossings
- Physical Landscape Diversity (2)

Habitat Blocks

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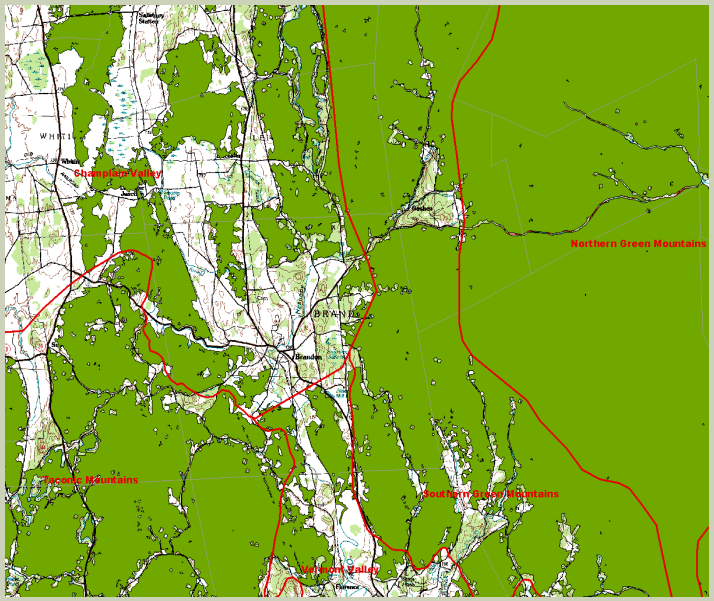
Areas of natural cover surrounded by roads, development, agriculture; ranked for 11 biological and physical factors



- Interior forest habitat and intact ecological processes
- Not all Habitat Blocks in VT were included
- Selection differed for each biophysical region

LANDSCAPE CONNECTIVITY

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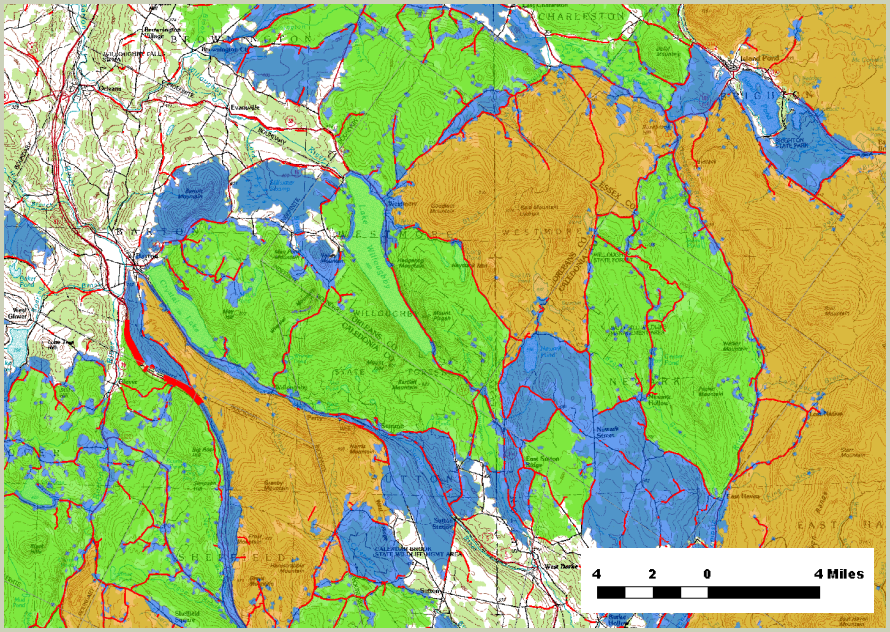
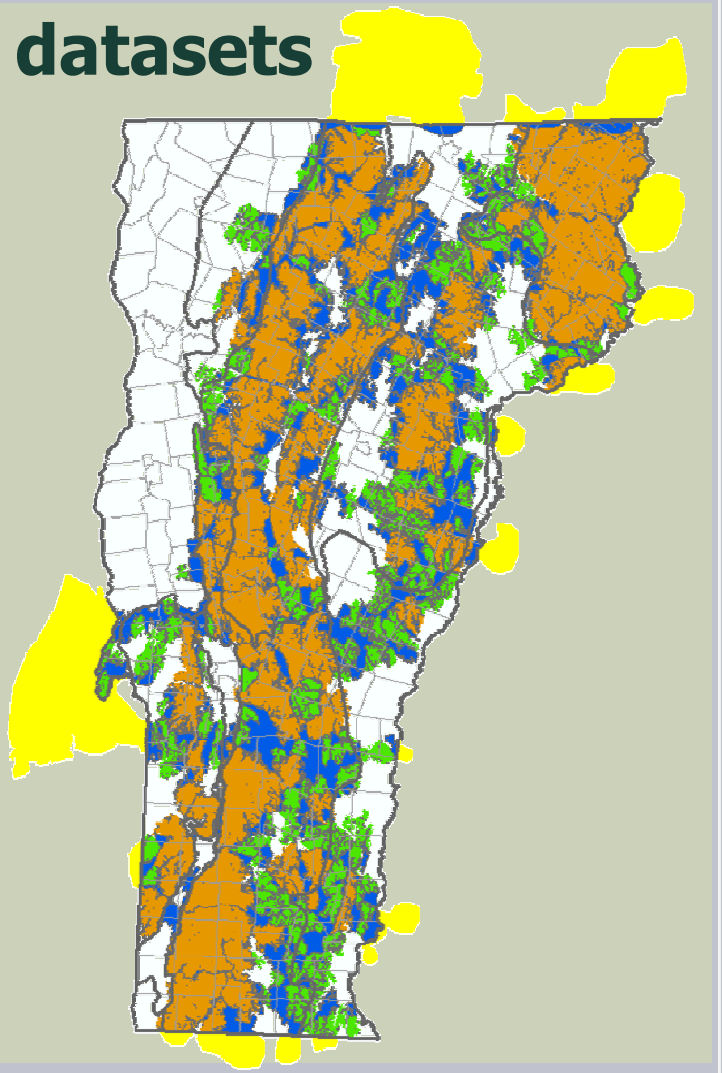
Network of Connected Lands - 3 datasets and Road Crossings

- Connecting Lands <2,000 acres
- Connecting Blocks 2,000-10,000 acres
- Anchor Blocks >10,000 acres
- Linkage Areas Outside Vermont
- Road Crossings





Rare Physical Landscapes

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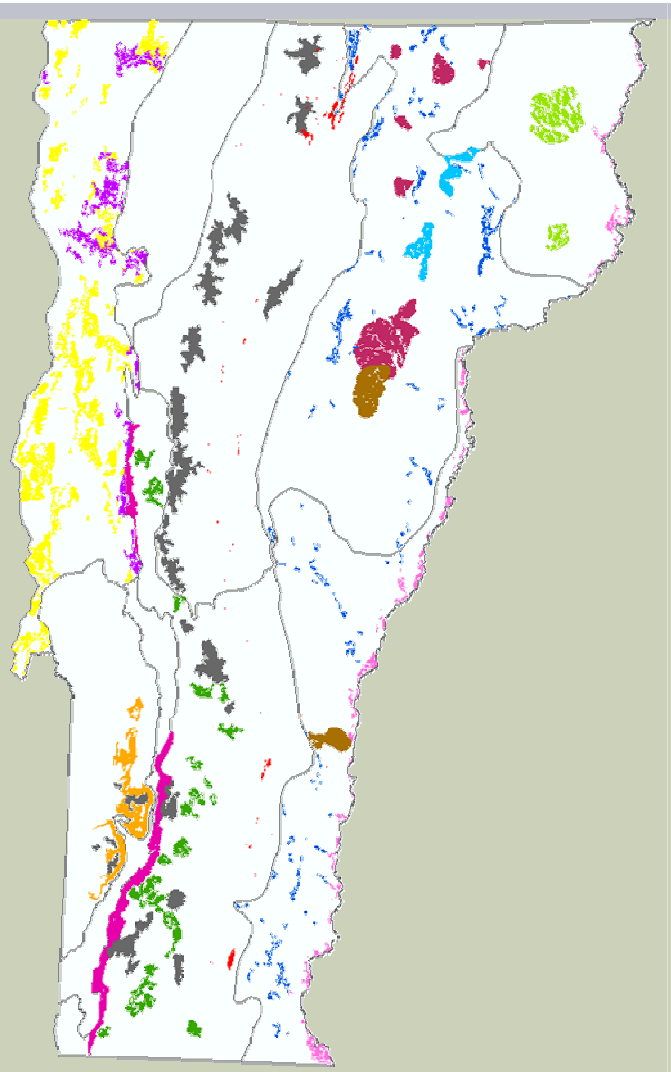

- From VT Land Type Associations (Ferree & Thompson)
- Physical landscape diversity represents potential biological diversity

- Calcareous Metamorphic High Hills/Low Mountains
- Connecticut River Valley - Lake Hitchcock Sediments
- Enriched Slopes
- Granitic Basin
- Granitic High Hills/Low Mountains
- Granitic Mid-Elevation Hills
- Marine-Lacustrine-Glaciofluvial Coarse Sediments
- Precambrian Plateau
- Serpentine Bedrock
- Upper Mtn Slopes/Mountaintops
- Valley Floor Glacial Lake/Marine Plains
- Vermont Escarpment
- Water- & Ice-Deposited Glacial Sediments Along Major Rivers

Aquatic Components

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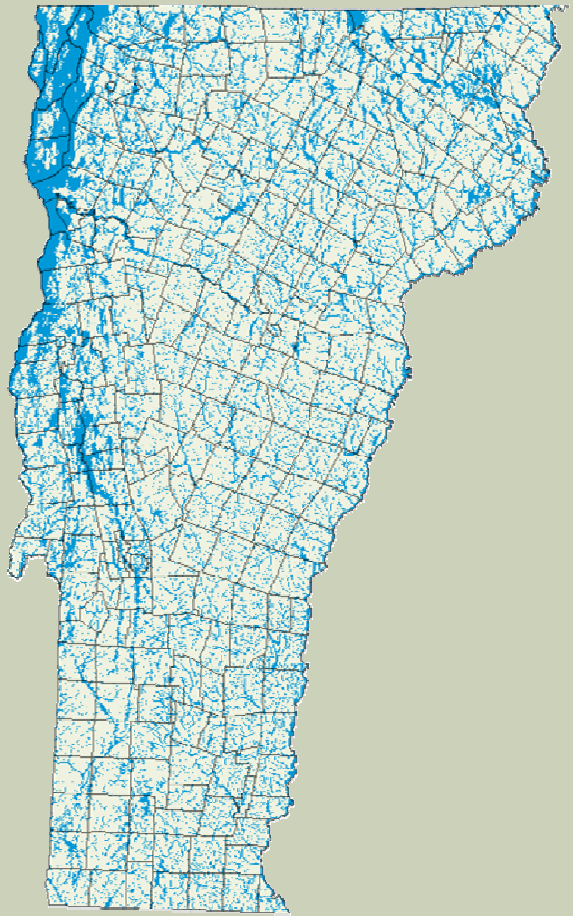

Surface Waters & Riparian Areas

- Surface Waters & Riparian Areas
- Representative Lakes
- Exemplary Surface Waters

Surface Waters & Riparian Areas

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To capture aquatic biota, river processes, water quality, and wildlife movement

- Lakes, ponds, rivers, & streams from VHD
- Valley bottoms & riparian areas using Land Type Associations

Exemplary Surface Waters

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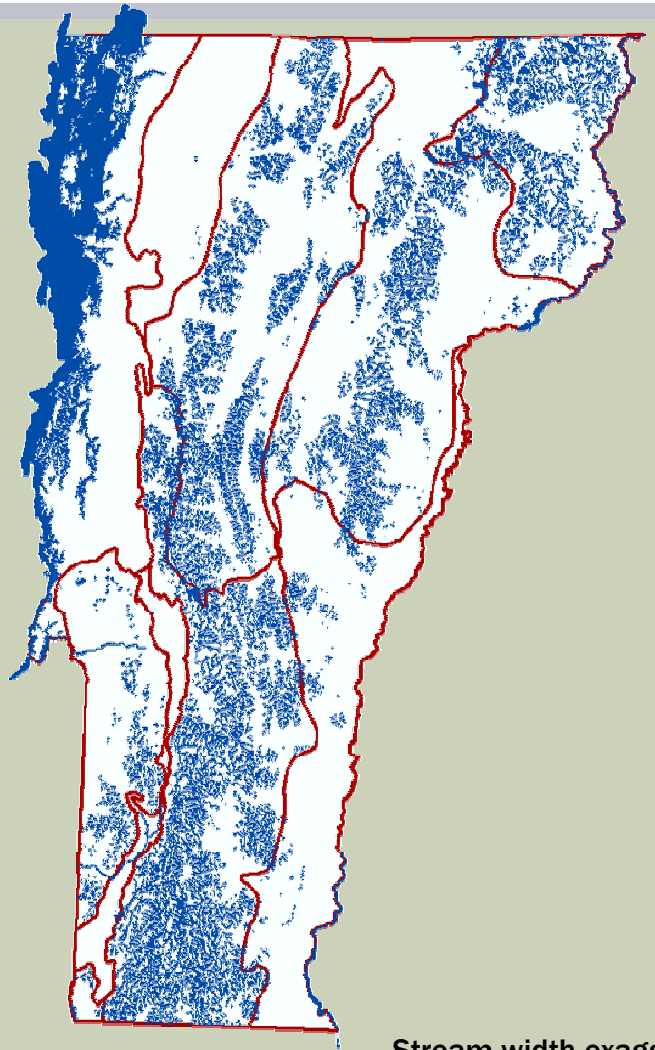

Stream width exaggerated

Includes lakes, ponds, rivers & streams supporting important aquatic habitats and species assemblages.

Lakes and Ponds

- Lake Champlain
- Oligotrophic Lakes
- Rutland County Lakes
- High elevation ponds

Rivers and Streams

- Lake Champlain tributaries to the “fall line”
- Large coldwater streams
- High elevation coldwater streams
- Connecticut River

Species & Natural Communities

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- Rare species
- Uncommon species
- Rare Natural communities
- Natural Communities (uncommon & common)
- Vernal pools
- Wetlands
- Mast stands

Rare Species

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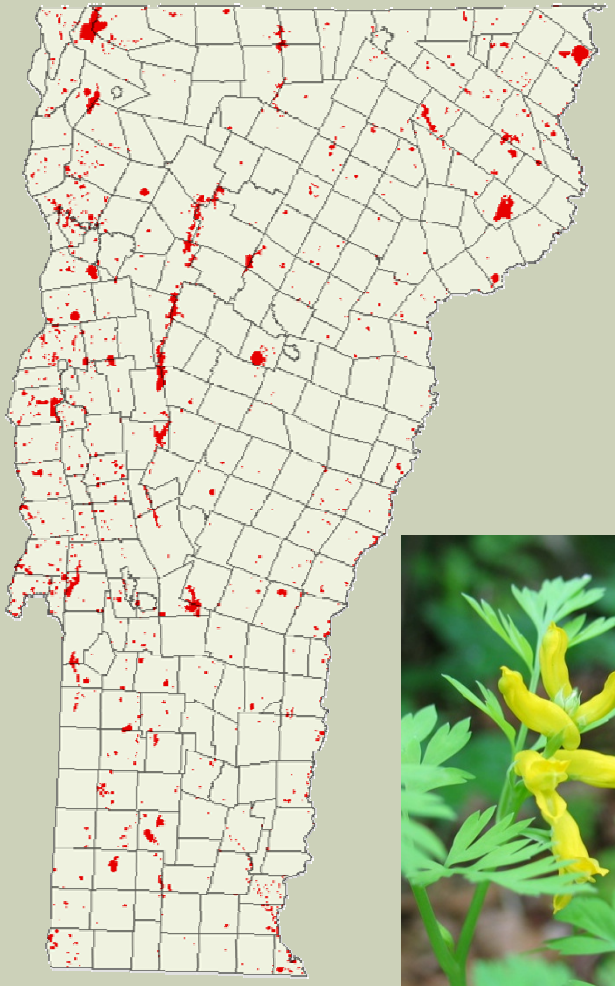

Rare, threatened, and endangered species tracked by VT Natural Heritage Inventory

- S1 & S2 Element Occurrences
- Bicknell's Thrush mapped to Montane Spruce-Fir Forest
- Vernal Pools with Jefferson Salamander

- 5,904 occurrences

Rare Natural Communities

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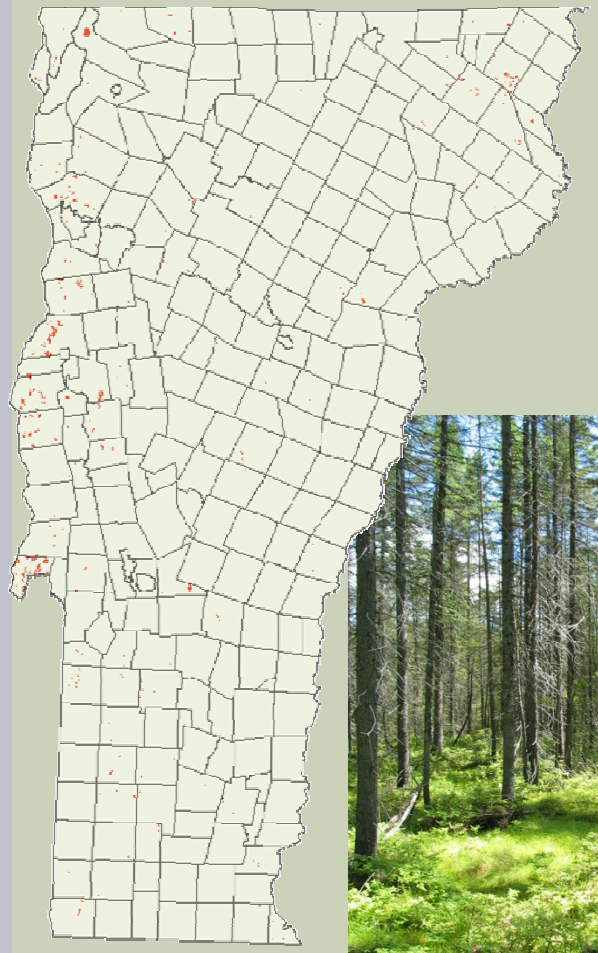

Rare natural communities tracked by Natural Heritage Inventory (VFWD)

S1 and S2 state-significant natural communities (1,138 EOs)

- Clayplain Forest
- Alpine Meadow
- Pine-Oak-Heath Sandplain Forest
- Rich Fen
- Boreal Calcareous Cliff
- Black Spruce Swamp

VERNAL POOLS

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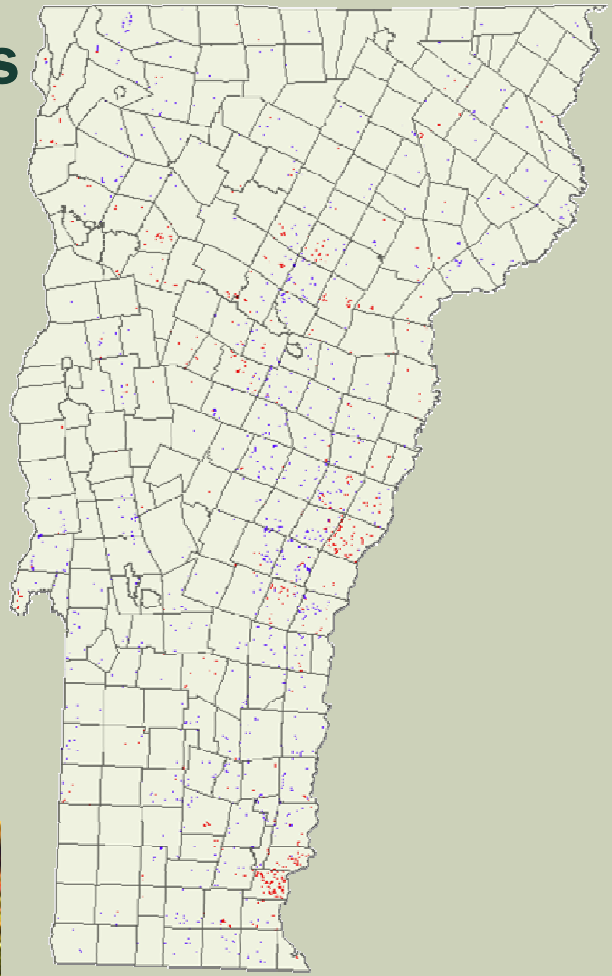
Two datasets describe vernal pools

- **Vernal Pools**
  Mapped & confirmed pools
- **Potential Vernal Pools**
  Mapped pools that have not been field verified. Assessments suggest 80% accuracy



Each site includes amphibian breeding habitat and surrounding 600 foot life-zone.

Preparing the Data

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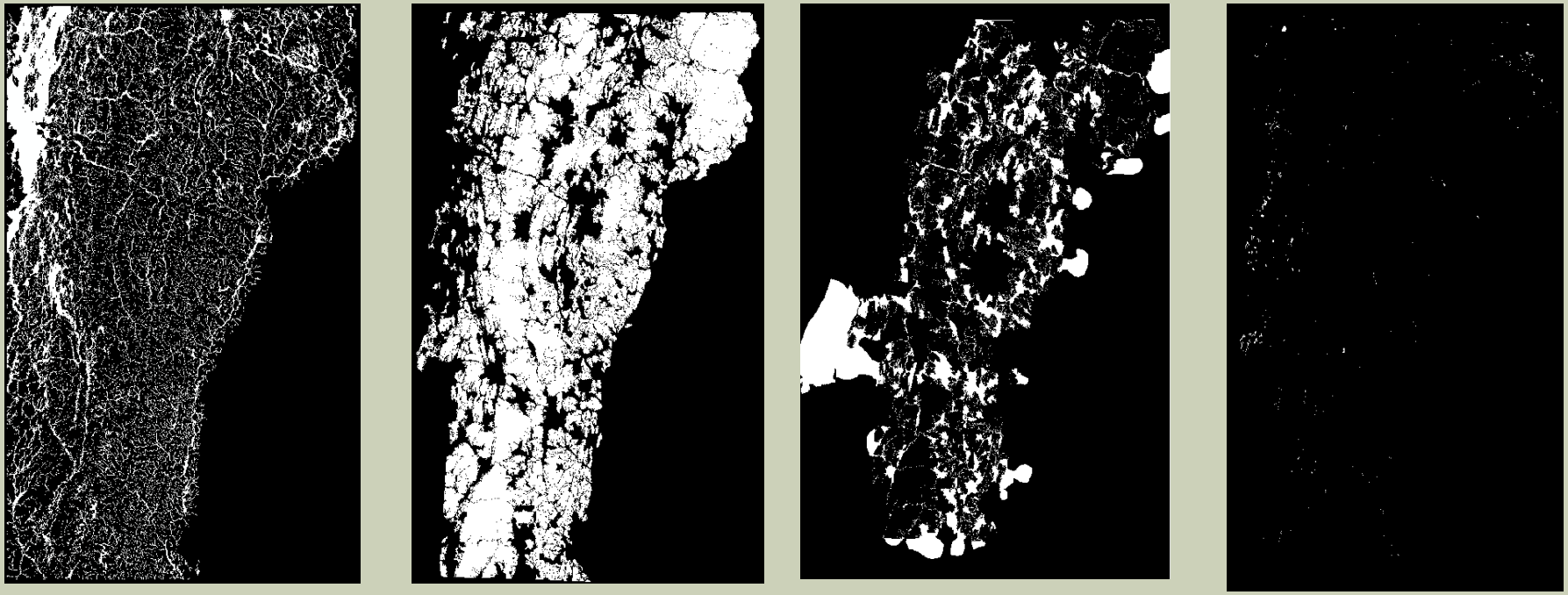
1. Analysis Extent was set to State Boundary + the extent of the VHD.
2. All components were converted from features to 10m raster.
3. Each Raster was reclassified into Boolean.
   0=NoData Component Data= 1



Weighting the 21 Components

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7	Habitat Blocks
3	Grasslands & Shrublands
9, 4	Physical Landscape (Rare & Representative)
7, 4, 3	Landscape Connectivity
8	Riparian Connectivity
4	Road Crossings
6	Surface Waters & Riparian Areas
4	Representative Lakes
8	Exemplary Surface Waters
Tier 1	Rare species
6	Uncommon Species
Tier 1	Rare Natural Communities
6, 3	Natural Communities (uncommon/common)
7, 5	Vernal pools (and potential pools)
8	Wetlands
4	Mast stands

Weighting adjusts for

- Scale differences
- Ecological importance
- Some concepts in several component datasets

Co-Occurring Features (Weighted Sum)

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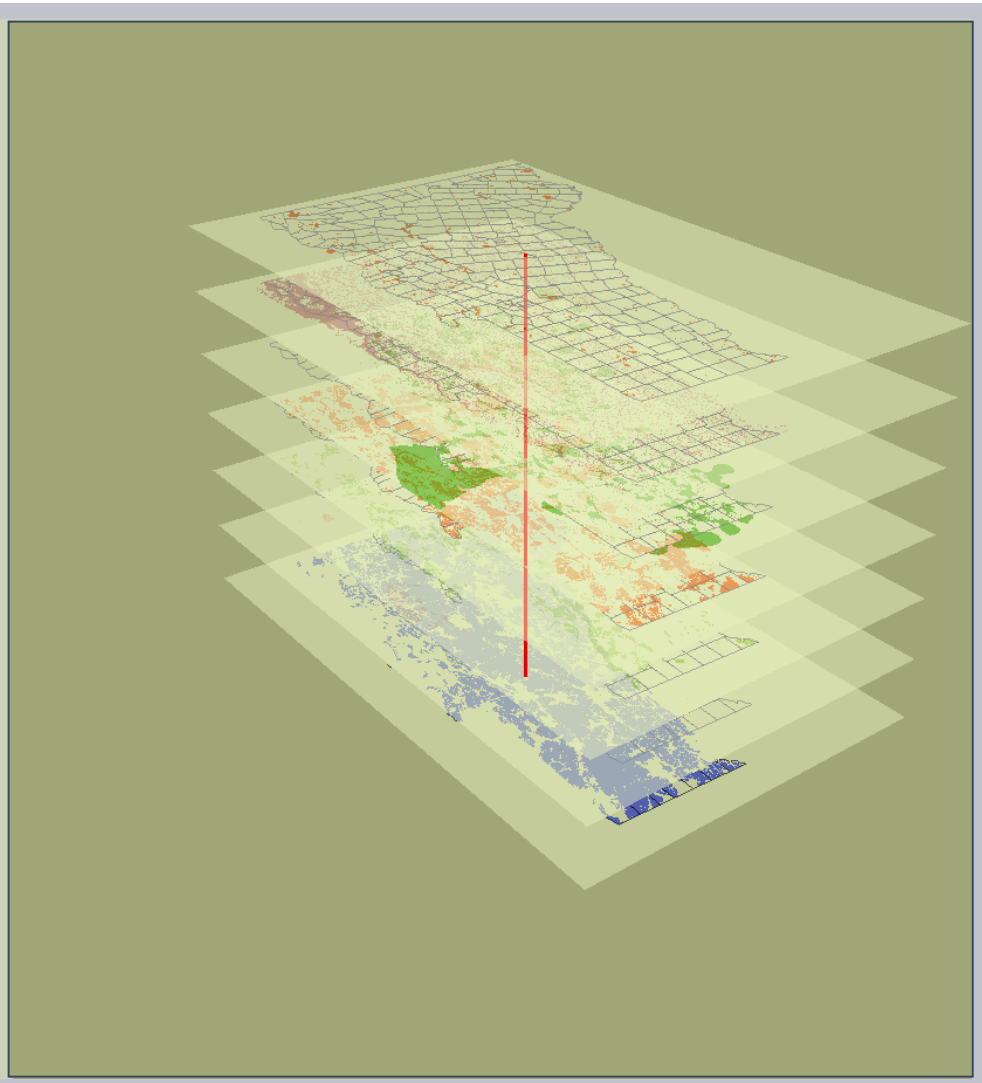
1. "Stack" all 21 Component datasets
2. For each pixel in a given component raster, multiply the assigned weight by its value (0/1) and sum each pixel in all 21 datasets



Co-Occurring Features (weighted Sum)

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Weighted Sum (Spatial Analyst)

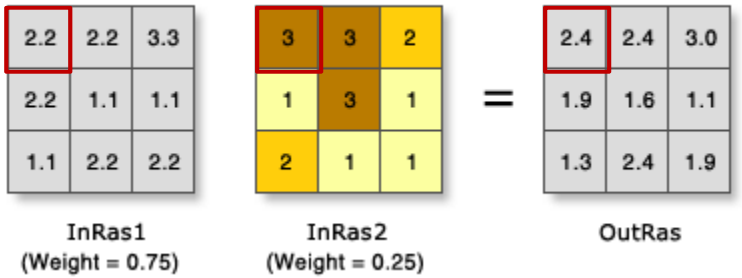
ArcGIS 10

Summary

Overlays several rasters, multiplying each by their given weight and summing them together.

Learn more about how Weighted Sum works

Illustration



(2.2 * .75) + (3 * .25) = 2.4

1.65 .75

Co-Occurring Features (weighted Sum)

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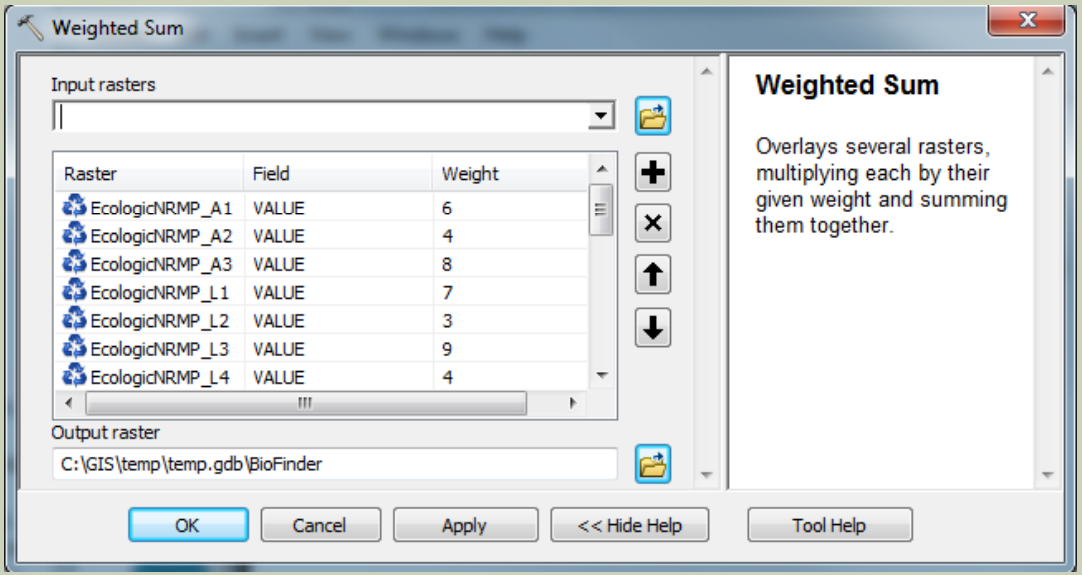

Co-Occurring Features

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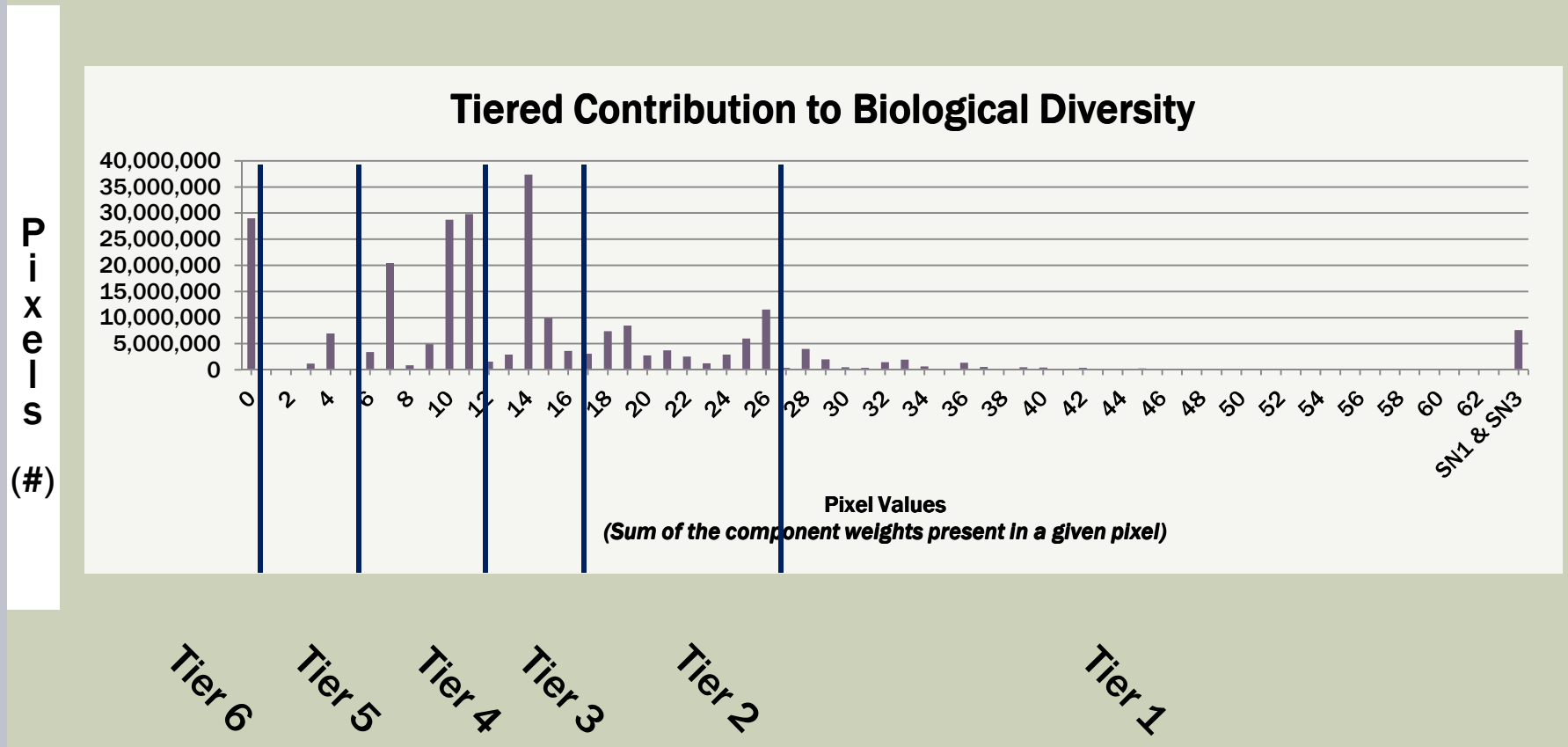

Tiers set at natural breaks in the distribution

Tiered Contribution to Biodiversity

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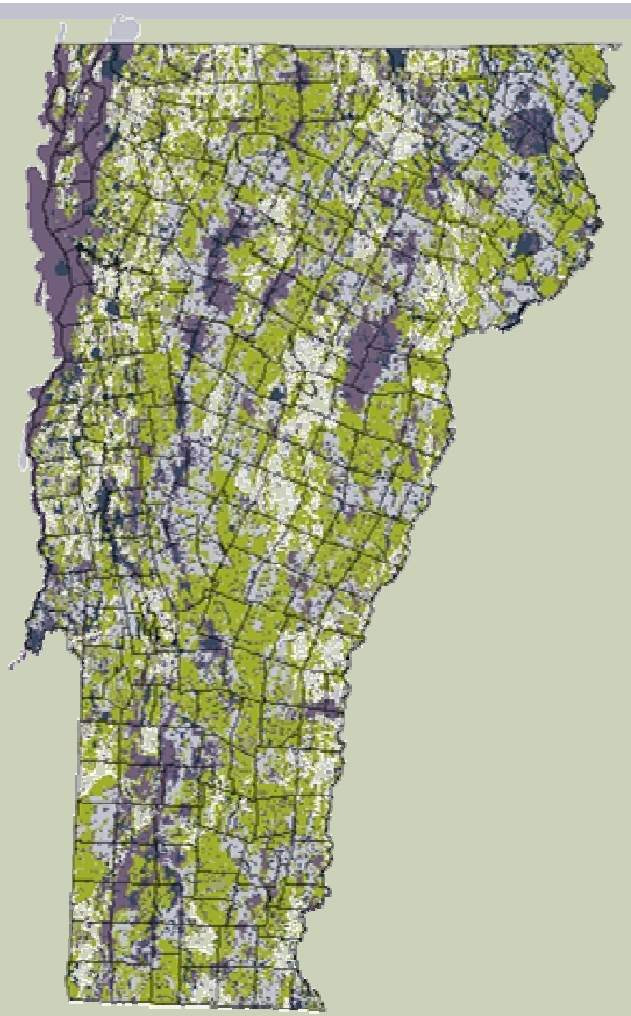

Component Concentration

- Tier 1-Greatest
- Tier 2-Very High
- Tier 3-High
- Tier 4-Moderate
- Tier 5-Low
- Tier 6: Insufficient data

Co-Occurring Features

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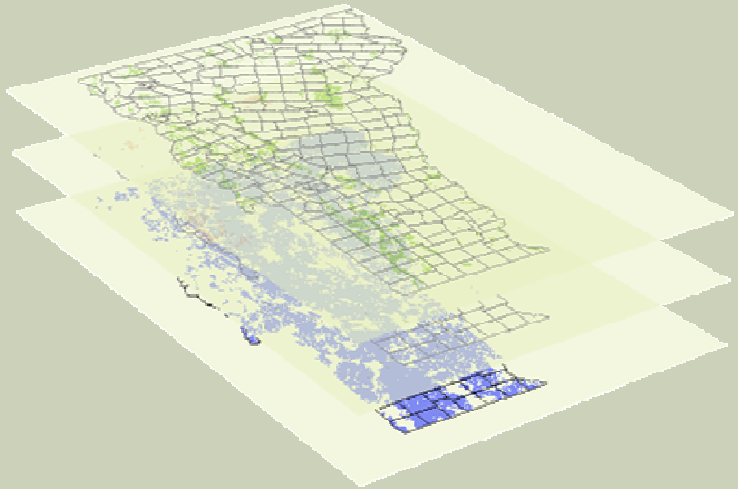
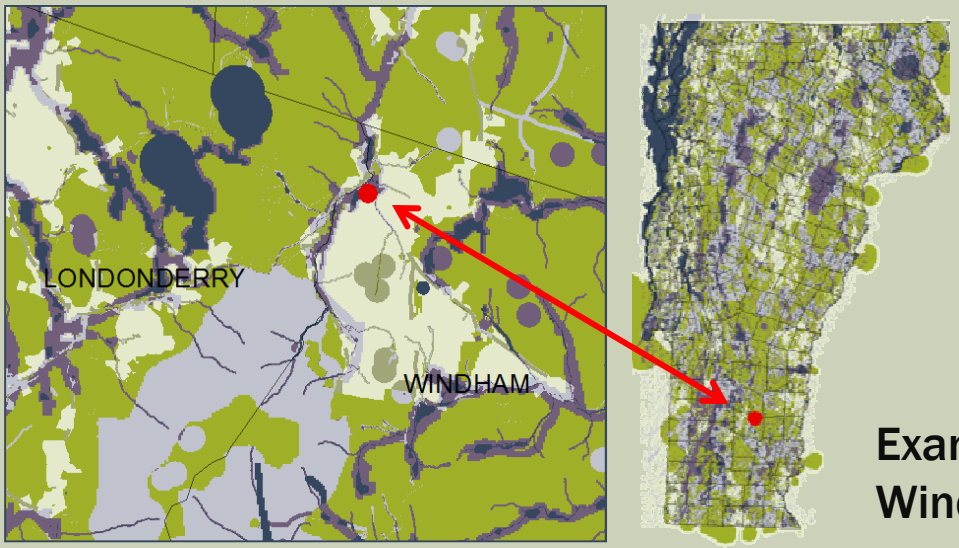
Pixel value = The sum of the component weights

Riparian Connectivity	8
Road Crossings	4
Surface Waters & Riparian Areas	6
Total Pixel Score =	**18**





Example:
Windham, VT

Tiered Contribution to Biodiversity

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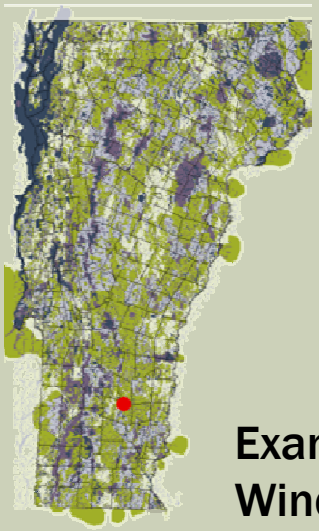
Riparian Connectivity	8
Road Crossings	4
Surface Waters & Riparian Areas	6
Total Pixel Score =	**18**

→ **Tier 2-Very High concentration of components contributing to biological diversity**



Example: Windham, VT

Mapping Website

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Goals:

- Maps available on the website. Both interactively and downloadable.
- Using the website had to be easy.
- Mechanisms for creating reports for the customer.
- High performance.

Issues/Challenges

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- 10x10m grid cells statewide = A LOT of data.
- Convert raster to features = 2.25 MILLION features.
- Dissolving on the Gridcode and combining into multipart features = TERRIBLE MAP PERFORMANCE.
- Caching the raster map meant not being able to identify rasters through a cached map service.
- Could only identify layers that were visible in the map.
- Wanted to identify not only the BioFinder value, but also the components that went into the value.
- Wanted reports that would summarize data by acres.

The Solution…

Mapping Solution

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- BioFinder Raster Layer was published to ArcGIS Server 10.1 as a cached map service. The cached service also included a vector version, not drawn but used for identification purposes.
- BioFinder component layers published as a separate map service.
- Map services consumed by Latitude Geographics Geocortex Essentials web mapping software.
- Silverlight Viewer, requires the Silverlight Plugin.
- Reporting done using a combination of Geoprocessing Services and Workflows.

GeoProcessing Service Model

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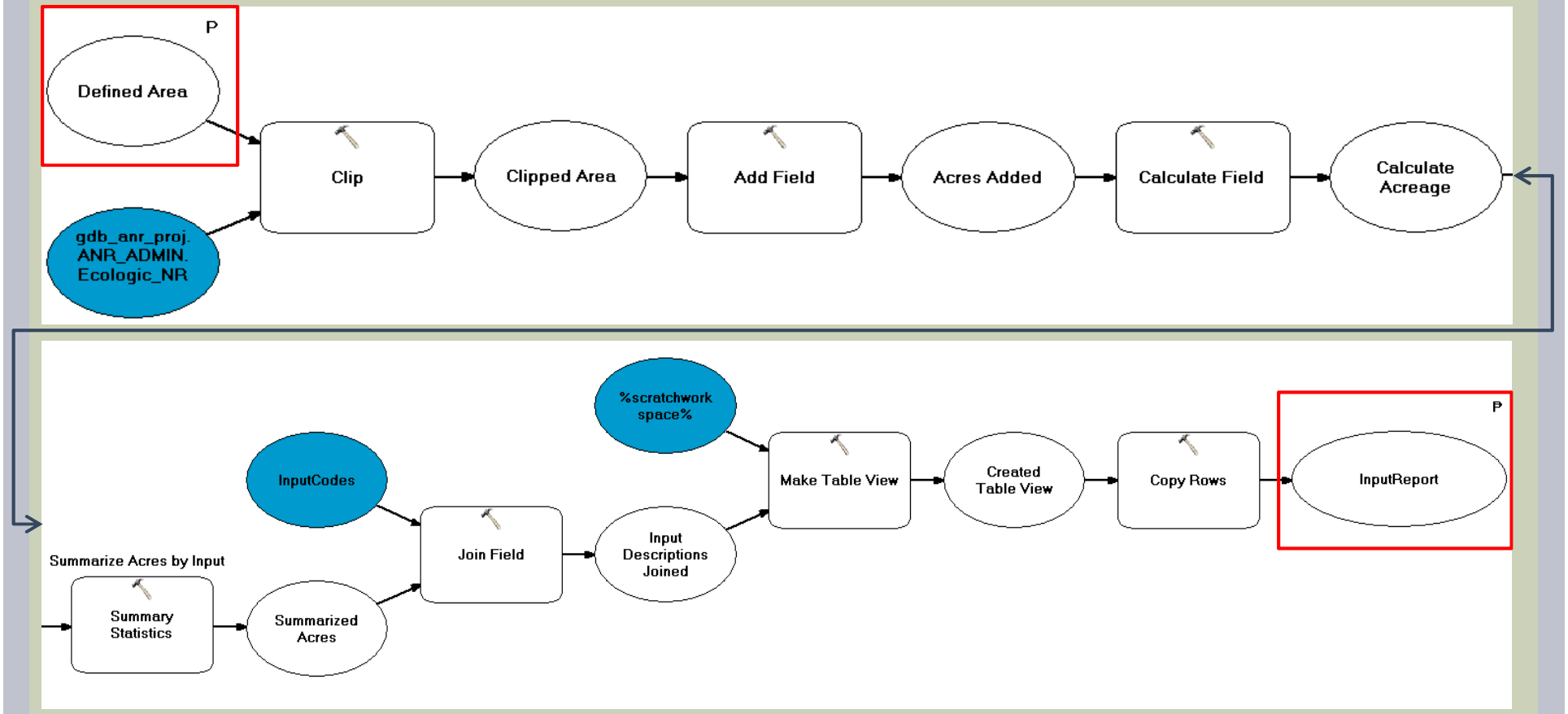

GEOPROCESSING SERVICE (GPSERVER)

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Task: NRMPinputAcresJoin

Display Name: NRMPinputAcresJoin

Category:

Help URL:
http://anrmaps.vermont.gov/arcgis/rest/directories/arcgisoutput/gps_services/GPS_ANR_NRMPInputR

Execution Type: esriExecutionTypeAsynchronous

Parameters:

Parameter: Defined_Area
Data Type: GPFeatureRecordSetLayer
Display Name Defined_Area
Direction: esriGPParameterDirectionInput
Default Value:
Geometry Type: esriGeometryPolygon
HasZ: false
HasM: false
Spatial Reference: 32145 (32145)

Fields:
- FID *(type: esriFieldTypeOID , alias: FID)*
- OBJECTID *(type: esriFieldTypeDouble , alias: OBJECTID)*
- PARCELNUM *(type: esriFieldTypeString , alias: PARCELNUM , length: 50)*
- Shape_Length *(type: esriFieldTypeDouble , alias: Shape_Length)*
- Shape_Area *(type: esriFieldTypeDouble , alias: Shape_Area)*

Features: *None.*

Parameter Type: esriGPParameterTypeRequired
Category:

Parameter: InputReport
Data Type: GPRecordSet
Display Name InputReport
Direction: esriGPParameterDirectionOutput
Default Value:
Fields:
- OBJECTID *(type: esriFieldTypeOID , alias: OBJECTID)*
- CODE *(type: esriFieldTypeString , alias: INPUT , length: 5)*
- ACRES *(type: esriFieldTypeDouble , alias: SUM_ACRES)*
- COMPONENT *(type: esriFieldTypeString , alias: INPUT_DESC , length: 250)*
- DESCRIPTION *(type: esriFieldTypeString , alias: SHRT_DESC , length: 250)*

Features: *None.*

Parameter Type: esriGPParameterTypeRequired
Category:

Latitude Geographics Workflow

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- Based on the Microsoft Workflow Foundation
- Sequence of Activities/Tasks
- Takes several inputs, performs an operation on the inputs, from which it produces the output.
- Much in the same way Modelbuilder is to ArcGIS, Workflow is to Geocortex Essentials and our Silverlight Viewer.

BIOFINDER.VERMONT.GOV

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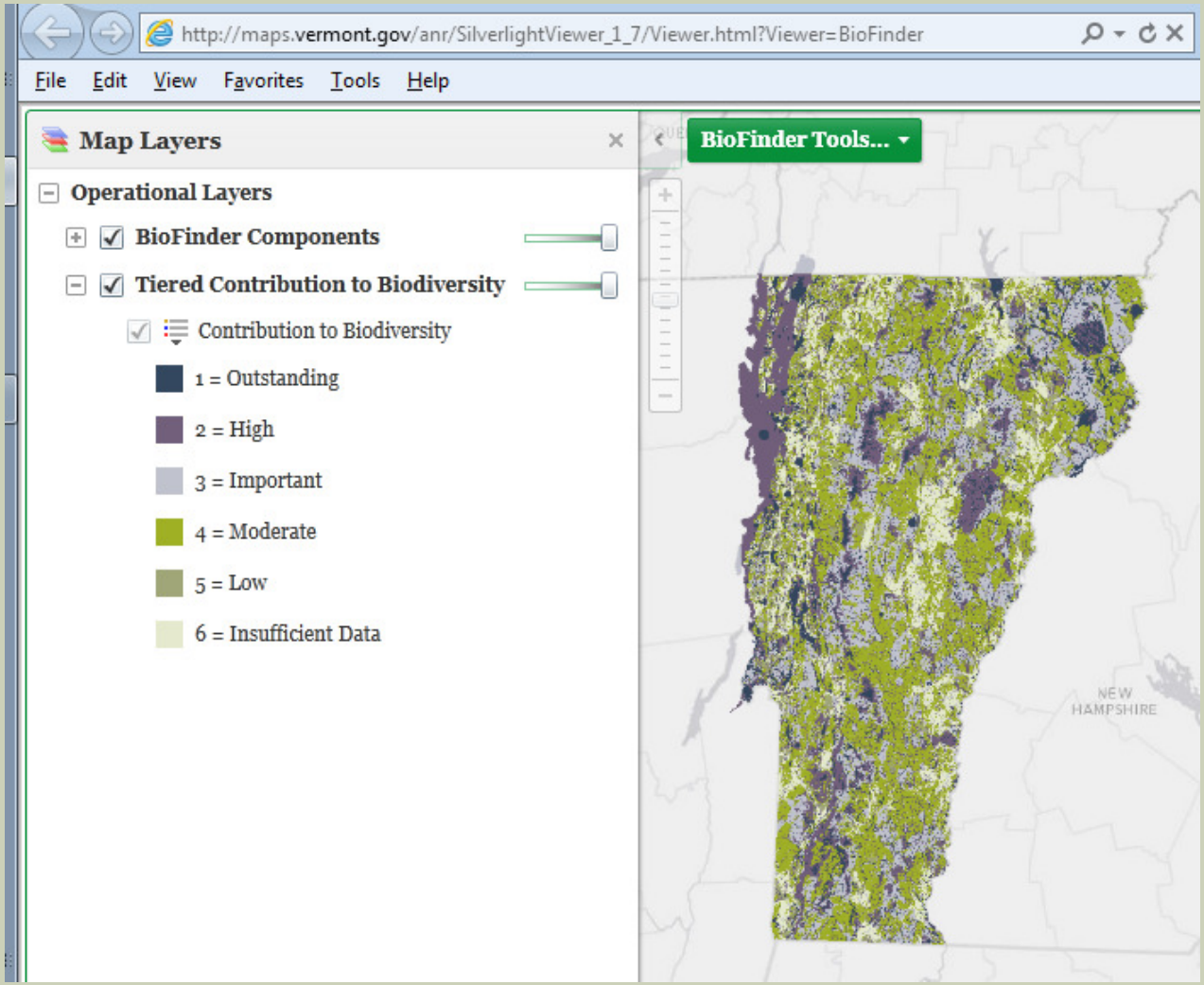

QUESTIONS?

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