Arc Soil Inference Engine (ArcSIE) and Digital Soil Mapping in MLRA SSA 12-5:

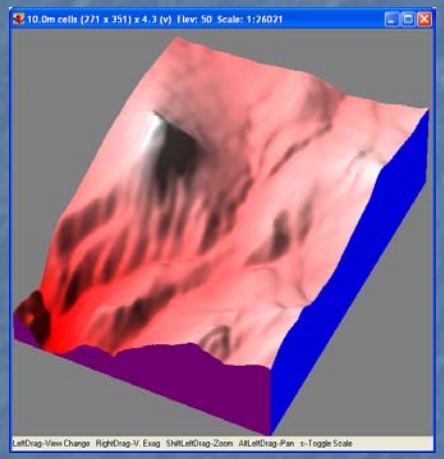
A SSURGO Success Story

Asheville, NC

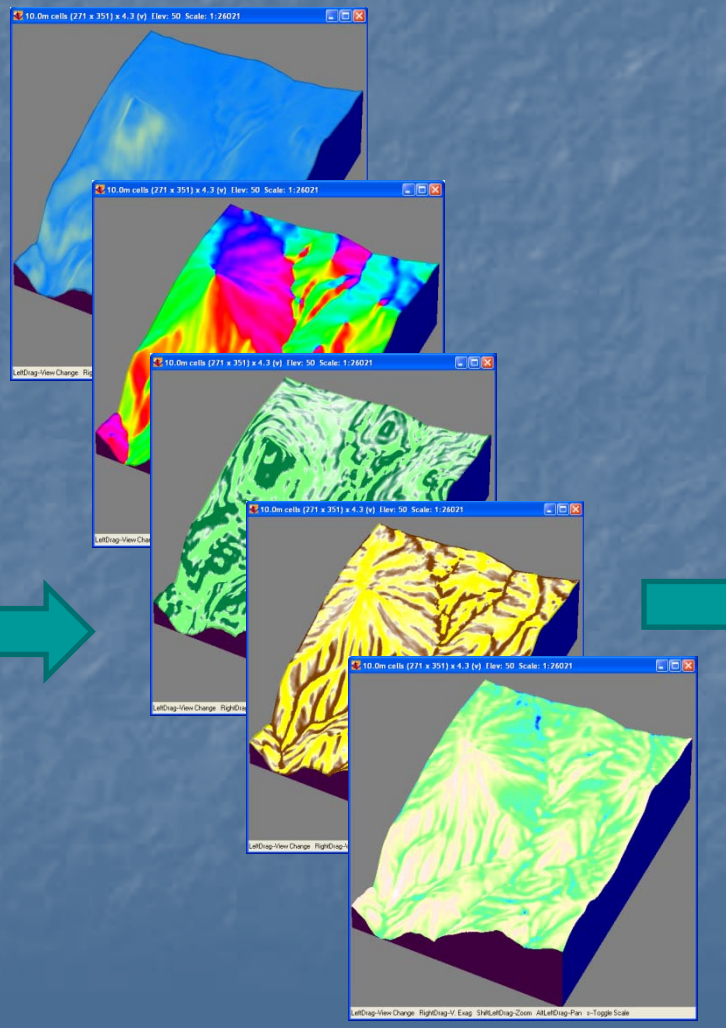
5/26/2011

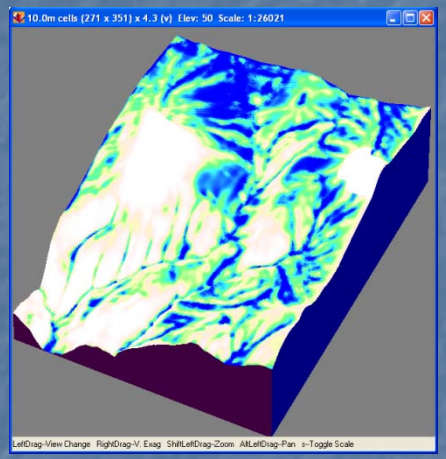
ArcSIE is a proven tool, designed for *field soil scientists* to implement knowledge-based raster soil mapping.

Raster Soil Mapping



DEM



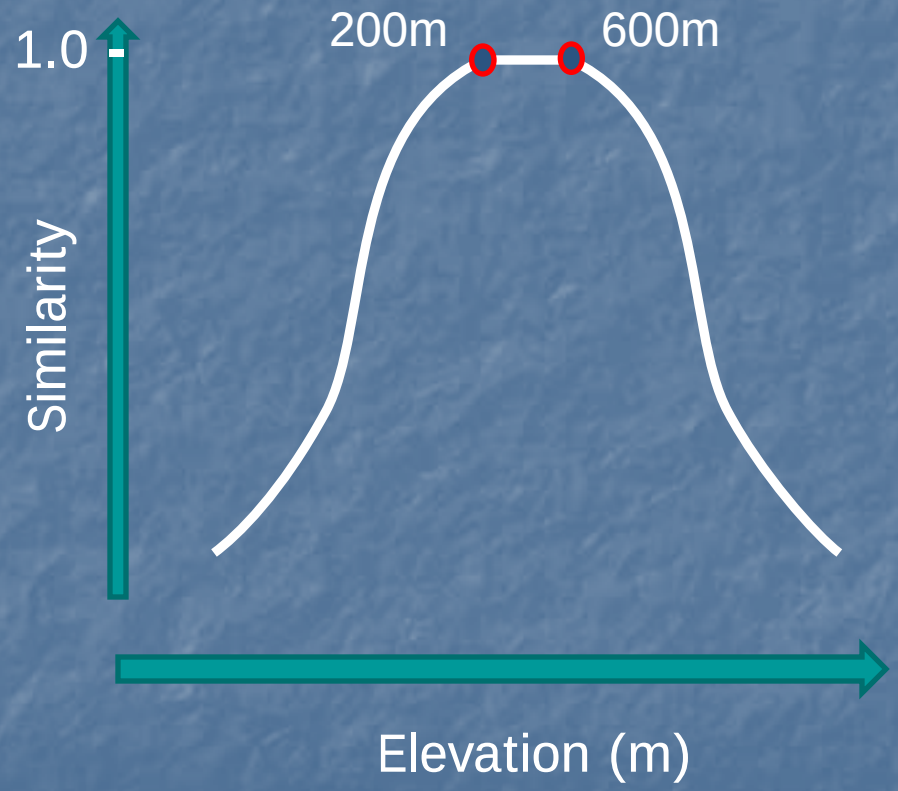


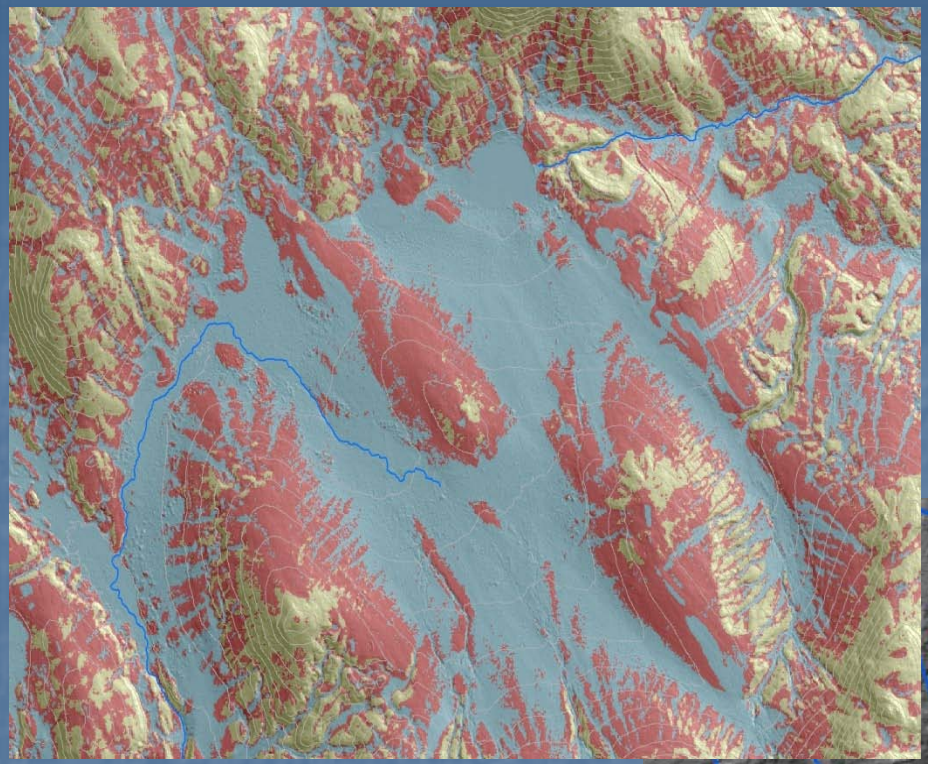
Cabot soil

Knowledge Represented as a Rule

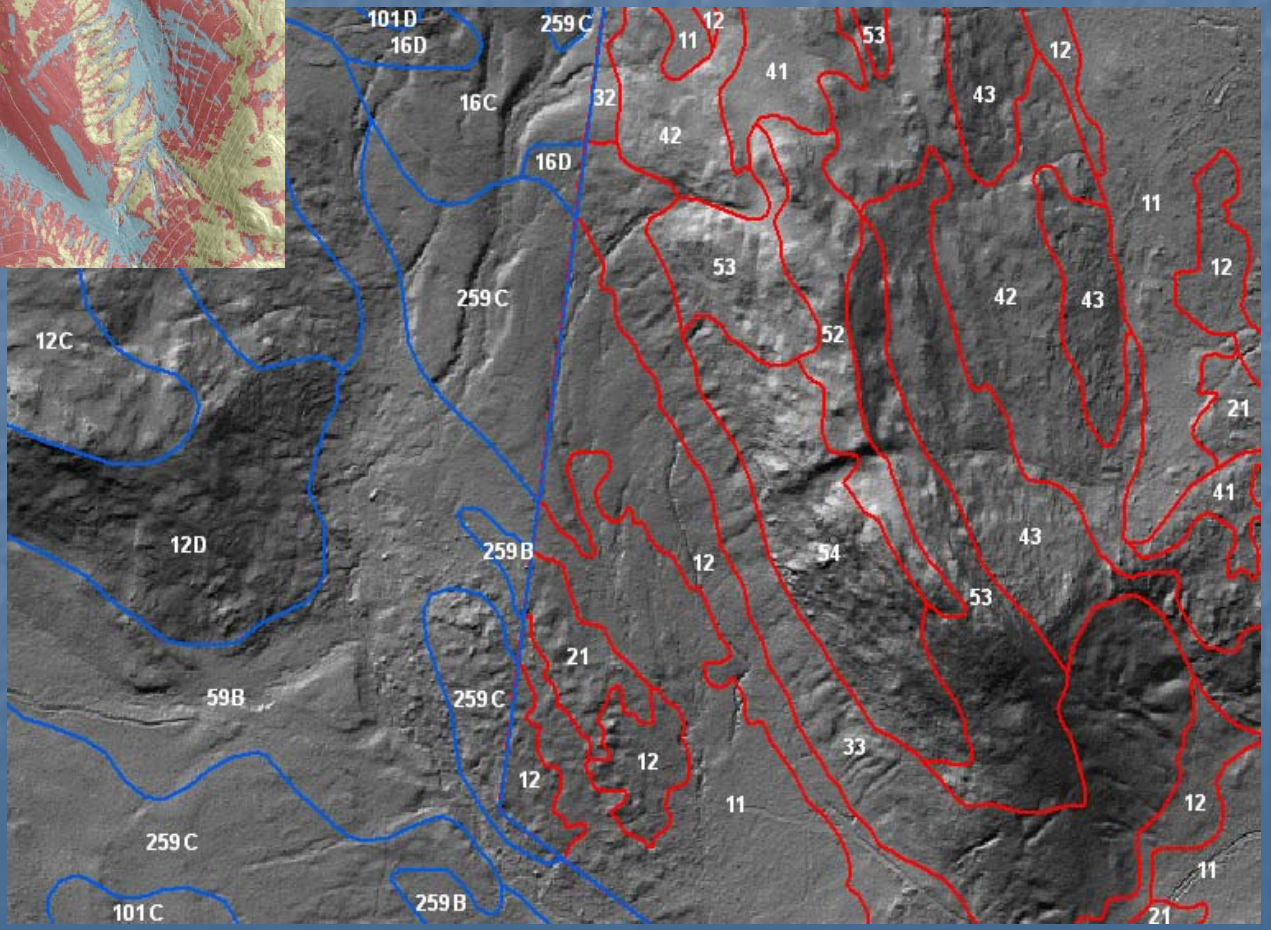
Elevation 200–600m is typical for soil A.

As elevation deviates from this range, the soil's similarity to type A gradually decreases.





Raster Values must be Logically Integrated to Create....



.....the SSURGO Product

Real advancement of SIE began in 2004 in Essex County, VT

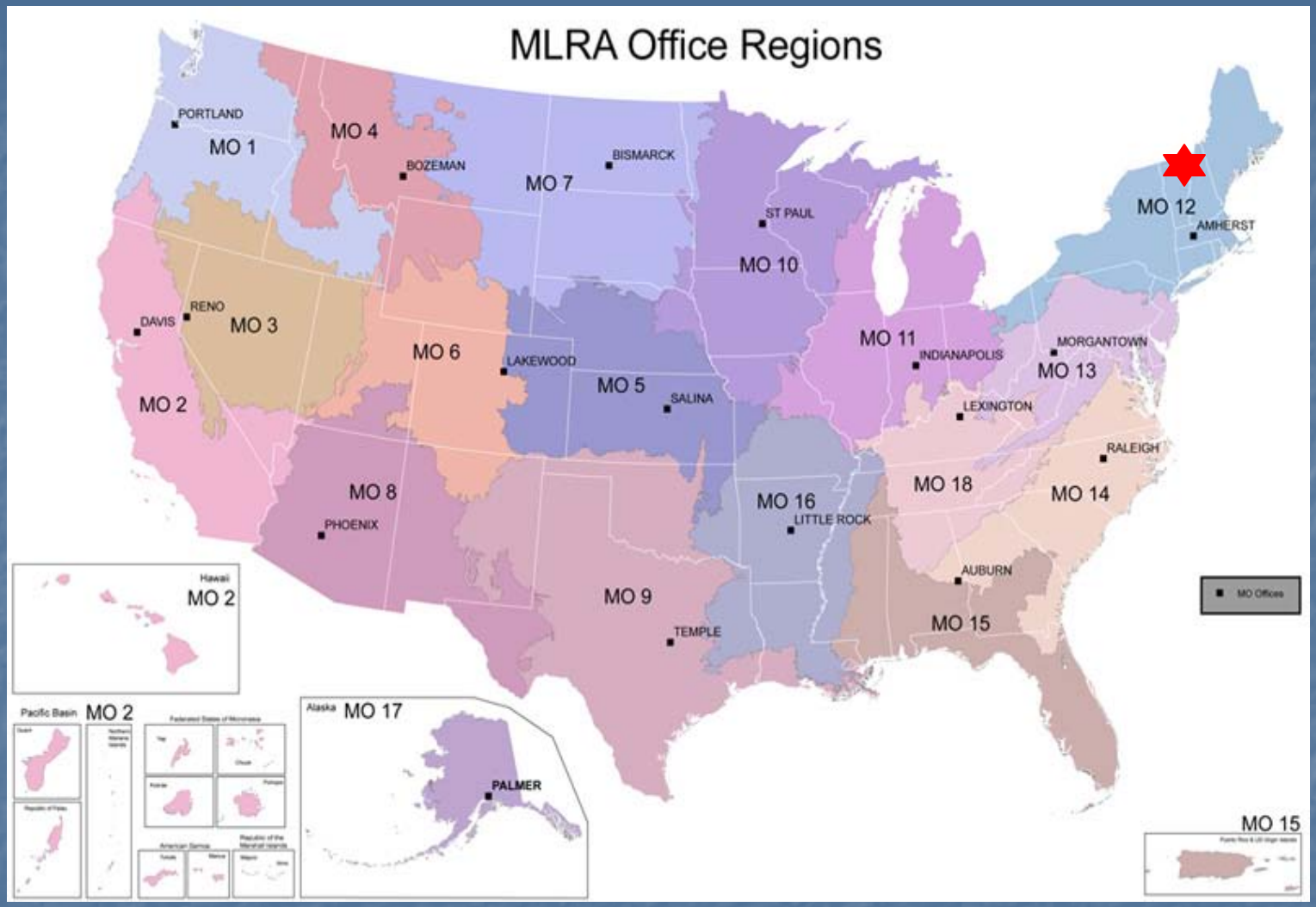
- Dr. Xun Shi, Dartmouth College
- National Geospatial Development Center* staff
- VT-NRCS Project Soil Survey Office staff

- 2007, the first version of ArcSIE, an ArcMap extension, was released and CCE certified.

* Now Geospatial Research Unit

ArcSIE in the Context of Digital Soil Mapping in Essex County, VT

- First initial soil survey in the US completed to SSURGO standards using entirely digital techniques, and (mostly) raster results from automated mapping software



MLRA Soil Survey Region 12 (Glaciated Northeast)

Essex County, Vermont

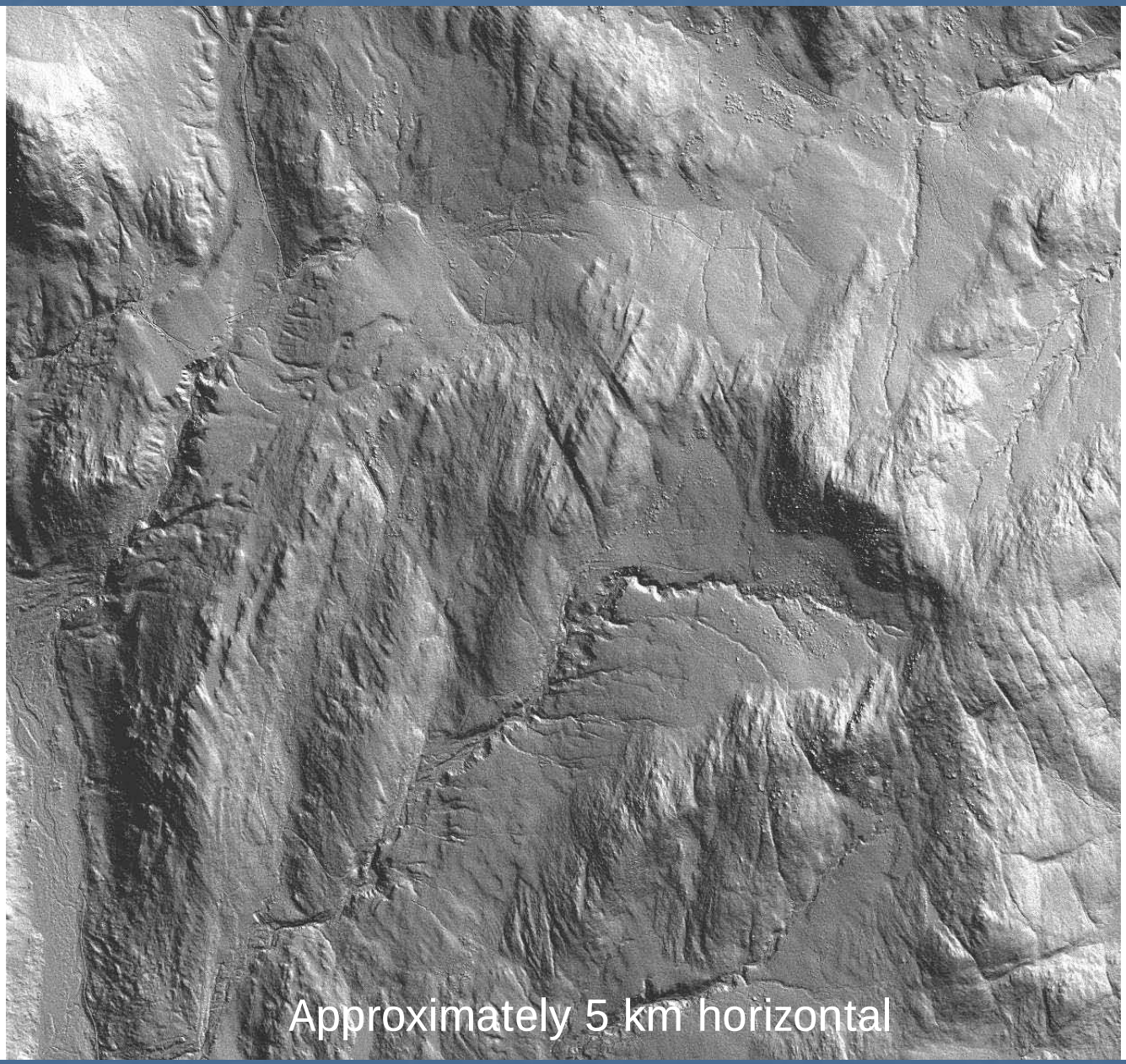
Typical Landscape and Land Use

Typical Landforms

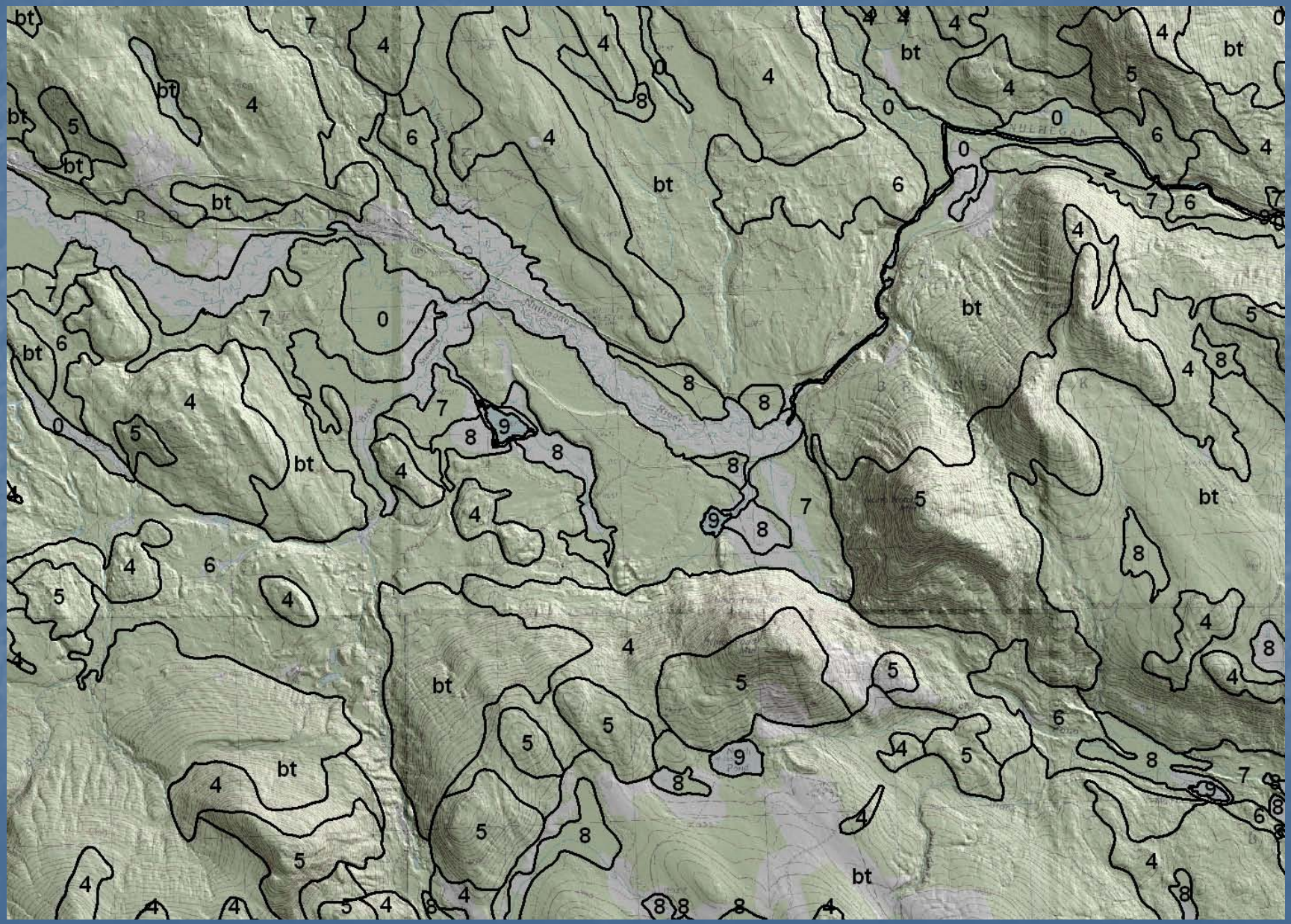
Basic Steps

- Process Environmental Data
- Delineate Landforms and Soil Parent Materials
- Perform Soil Inference in Suitable Areas
- Use other DSM Techniques as Appropriate
- Construct Polygon Map (SSURGO)

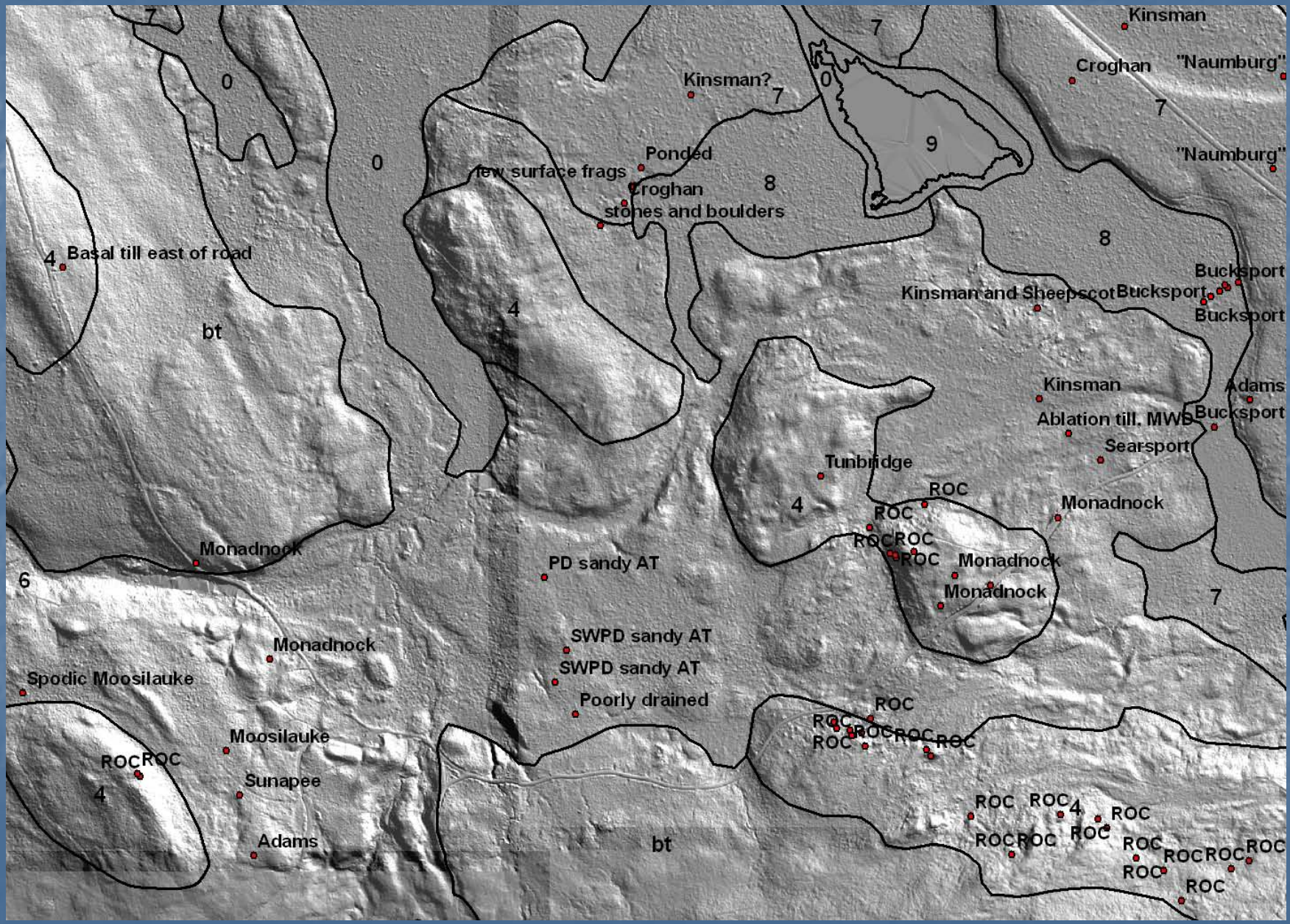
Hillshade from 1 meter LiDAR DEM- Used for Visualization and Manual Delineation of Parent Materials/Landforms



Parent Material/Landform Maps Provide the Basis for all Subsequent Soil Mapping



These Delineations are Thoroughly Critiqued and Field Checked



Basal Till Soils are Modeled with ArcSIE

Cabot (poorly drained)

Colonel (somewhat poorly drained)

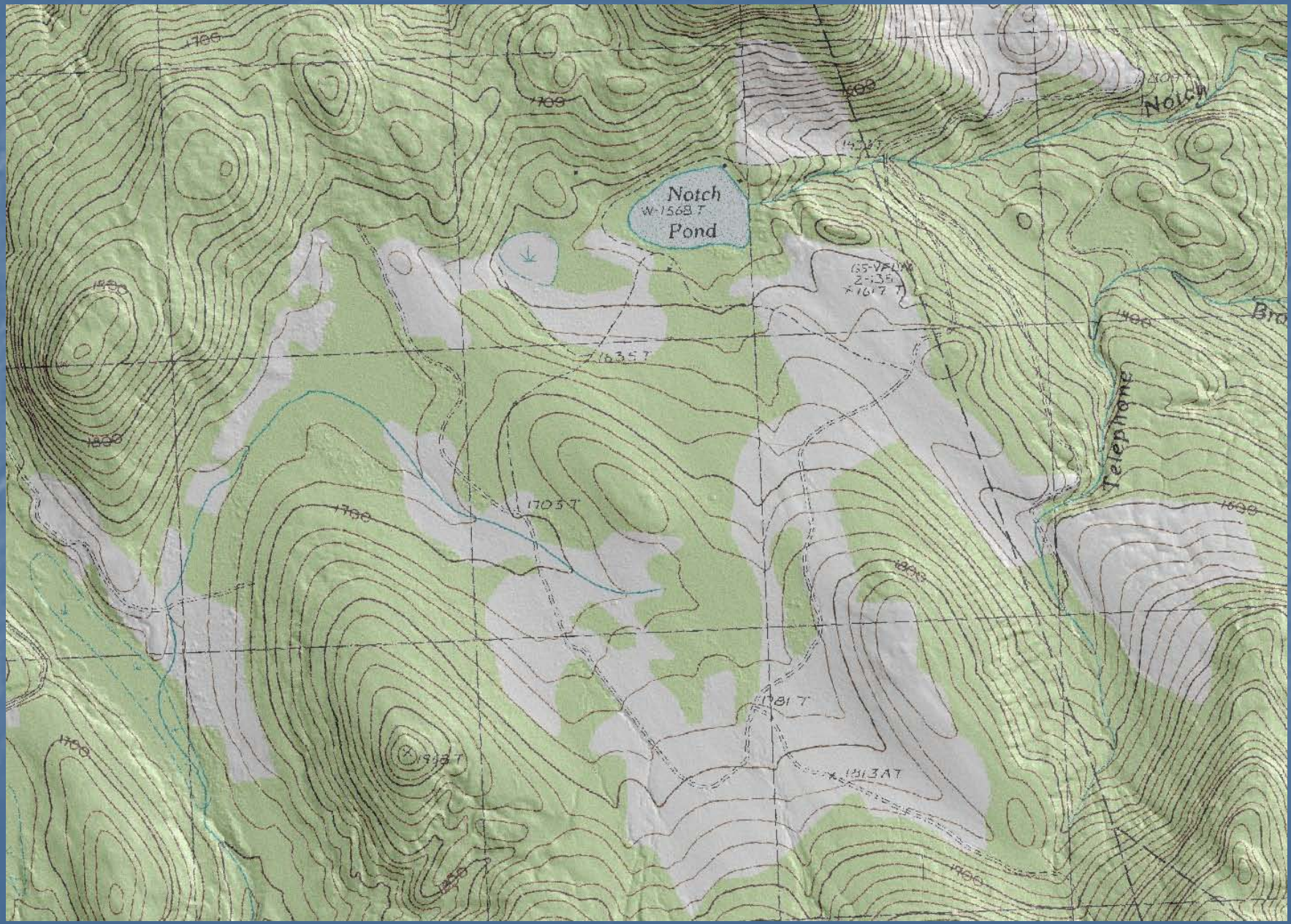
Dixfield (moderately well drained)

Bedrock Controlled Landforms – Manual Delineations, Automated Map Unit Phases

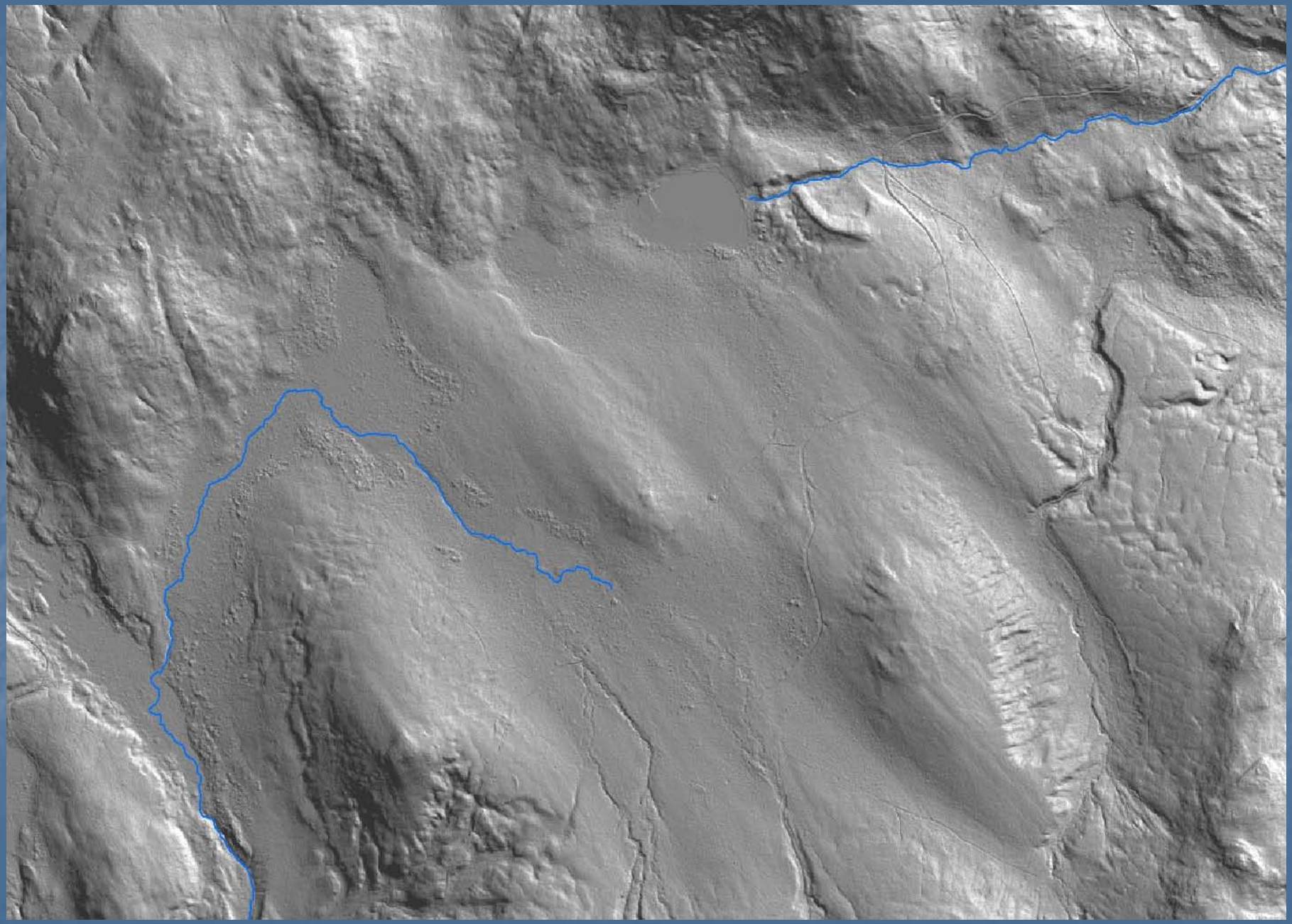
Outwash, Alluvial, and Lacustrine Soils are Mapped Using More Traditional Methods

....and organic soils are digitized on-screen.

ArcSIE Predictive Model Demo Area, Basal Till Catena (approximately 4 km by 3 km)

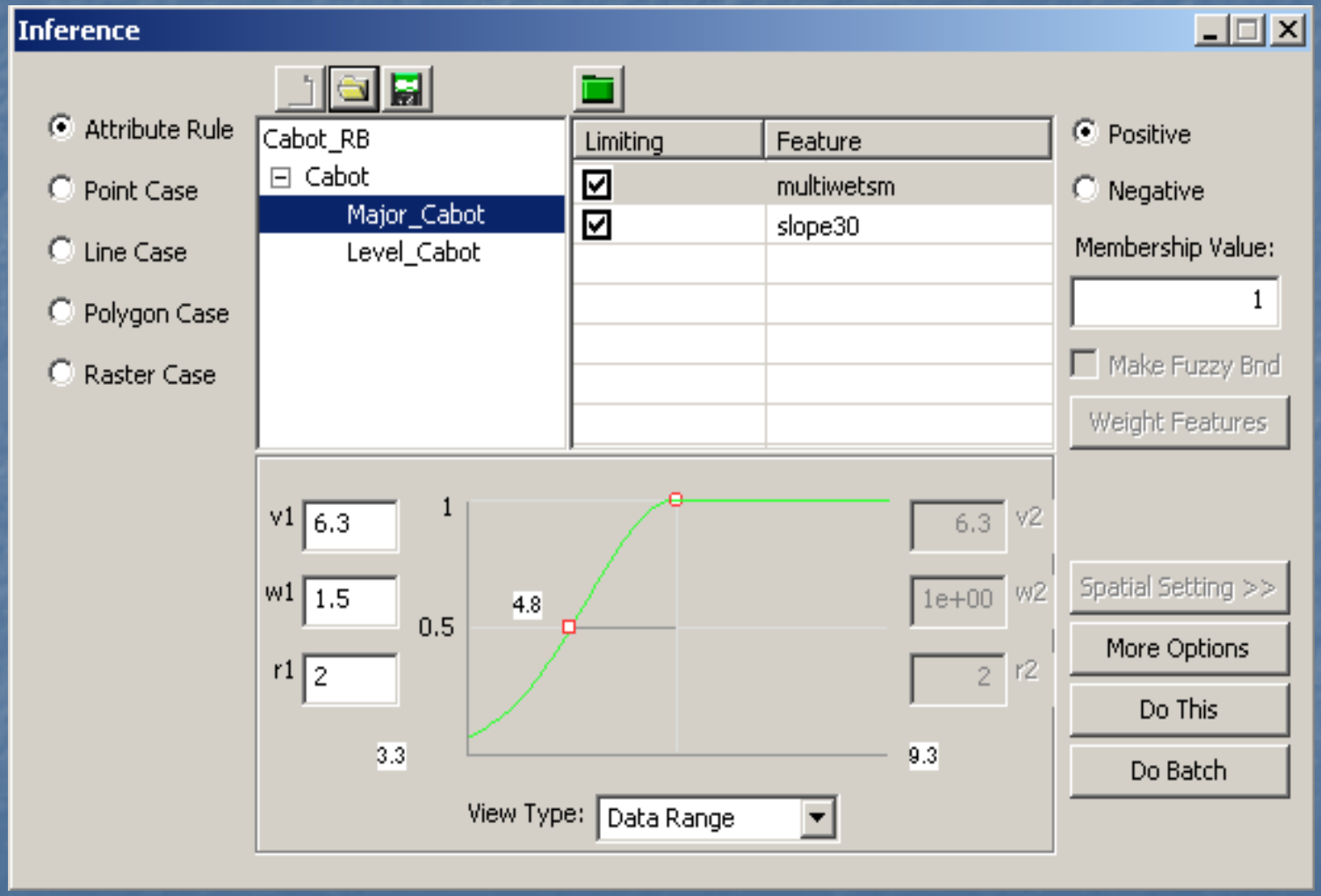


Hillshade

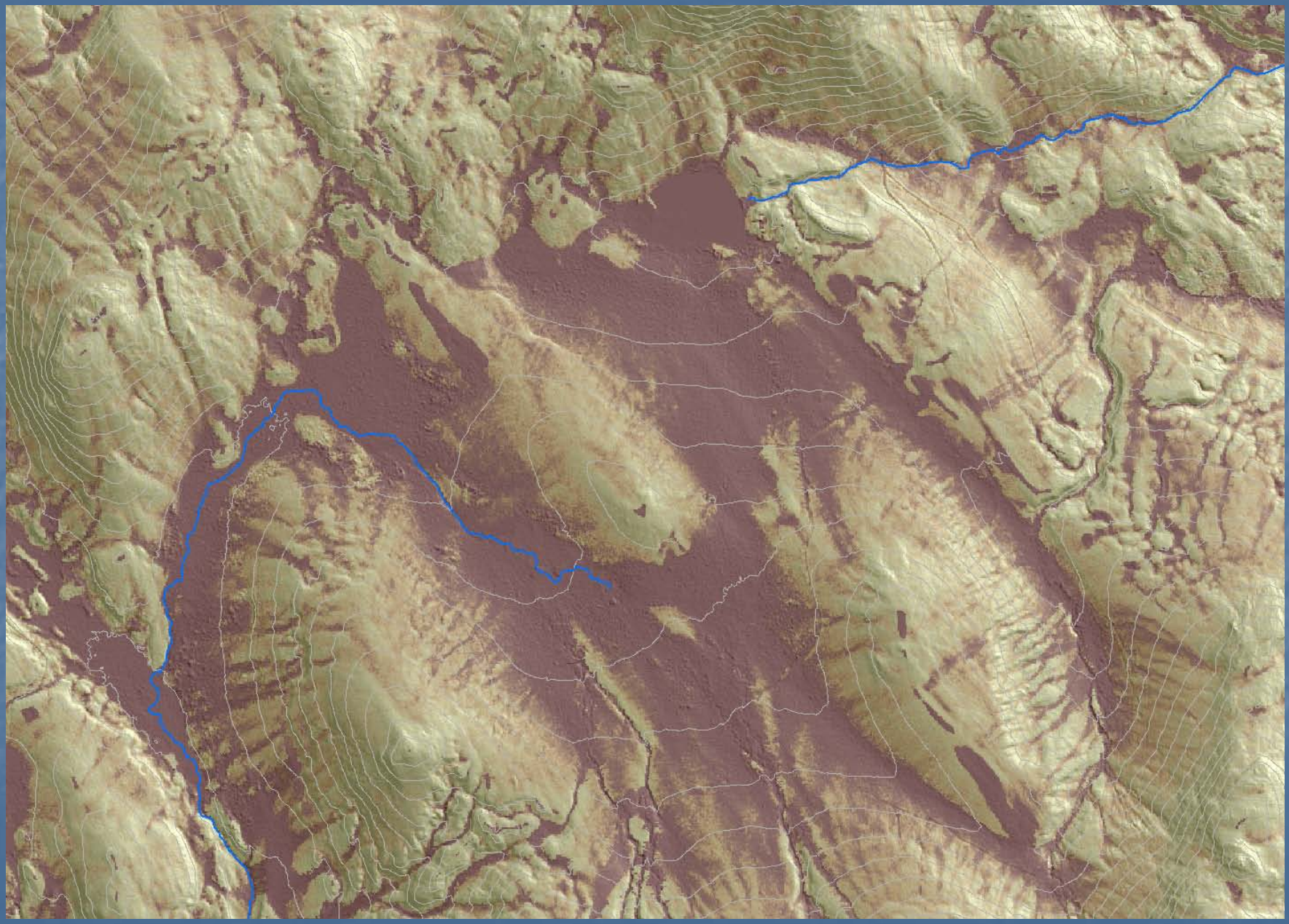


- We define the typical soil formative environment in the model, and the resulting fuzzy membership values represent the similarity of the soil at each pixel location to a particular soil series.

Wetness Index Rule for the Majority of Poorly Drained Cabot Soils

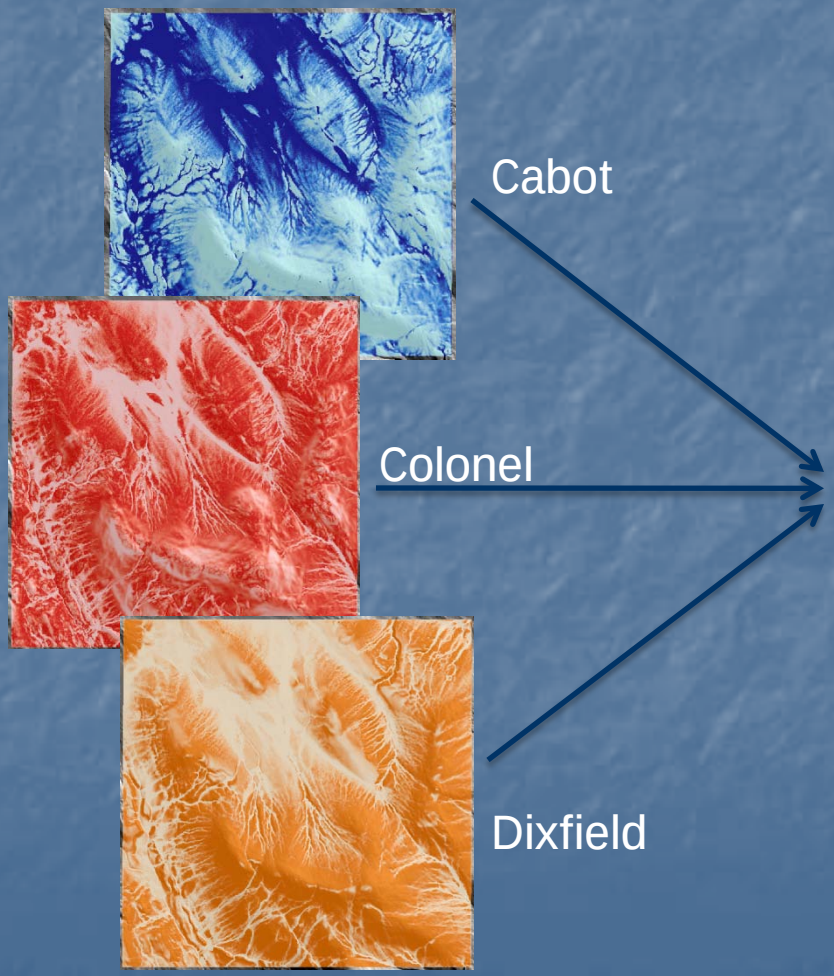


ArcSIE Fuzzy Results for Cabot Soil

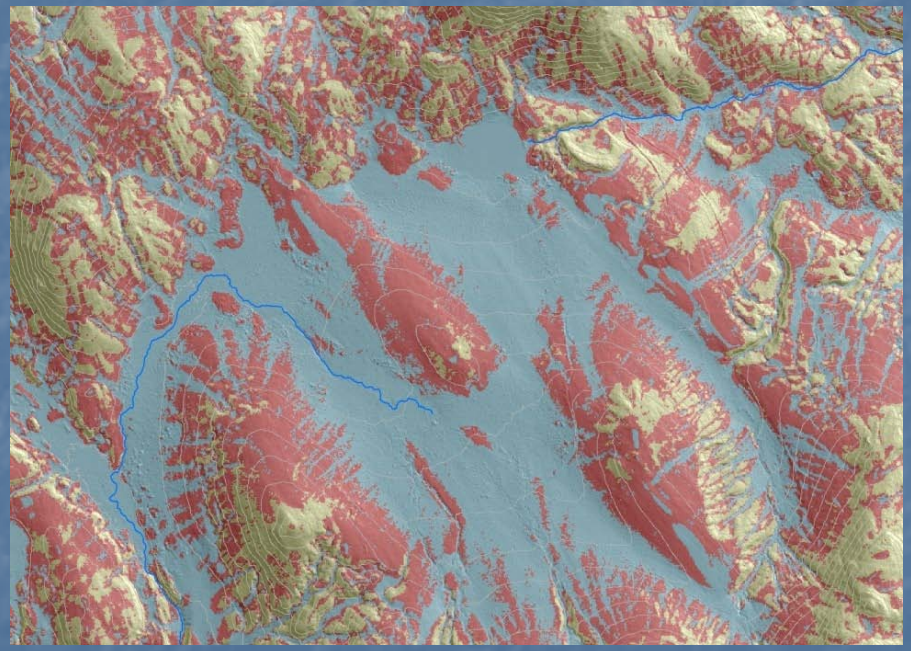


Hardening (Defuzzification)

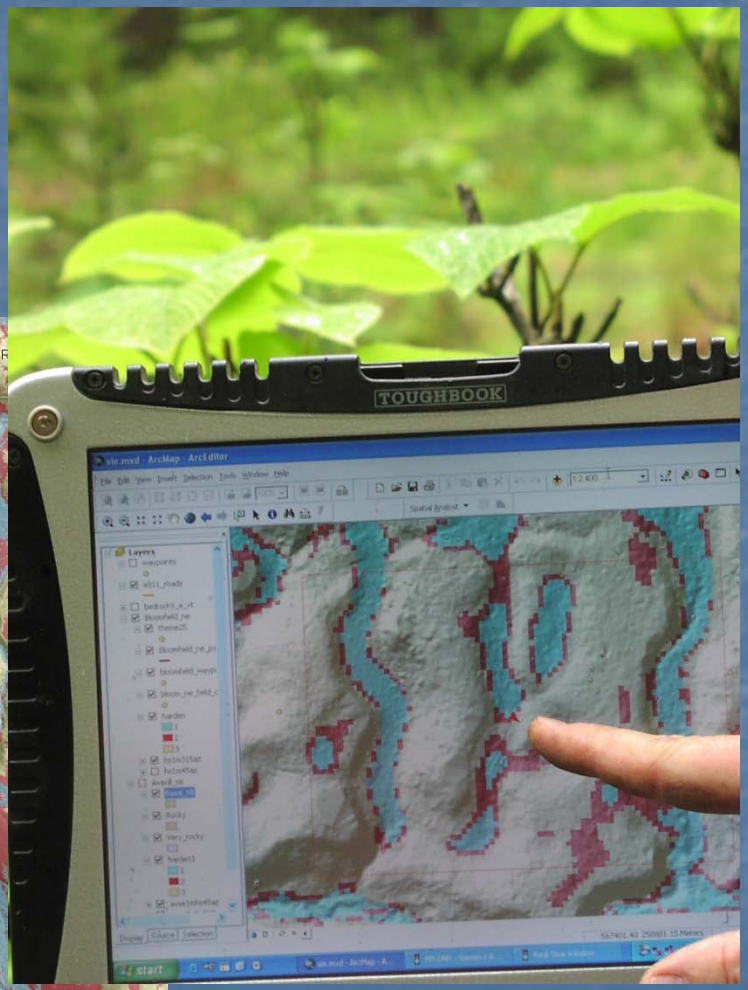
Fuzzy Results Maps

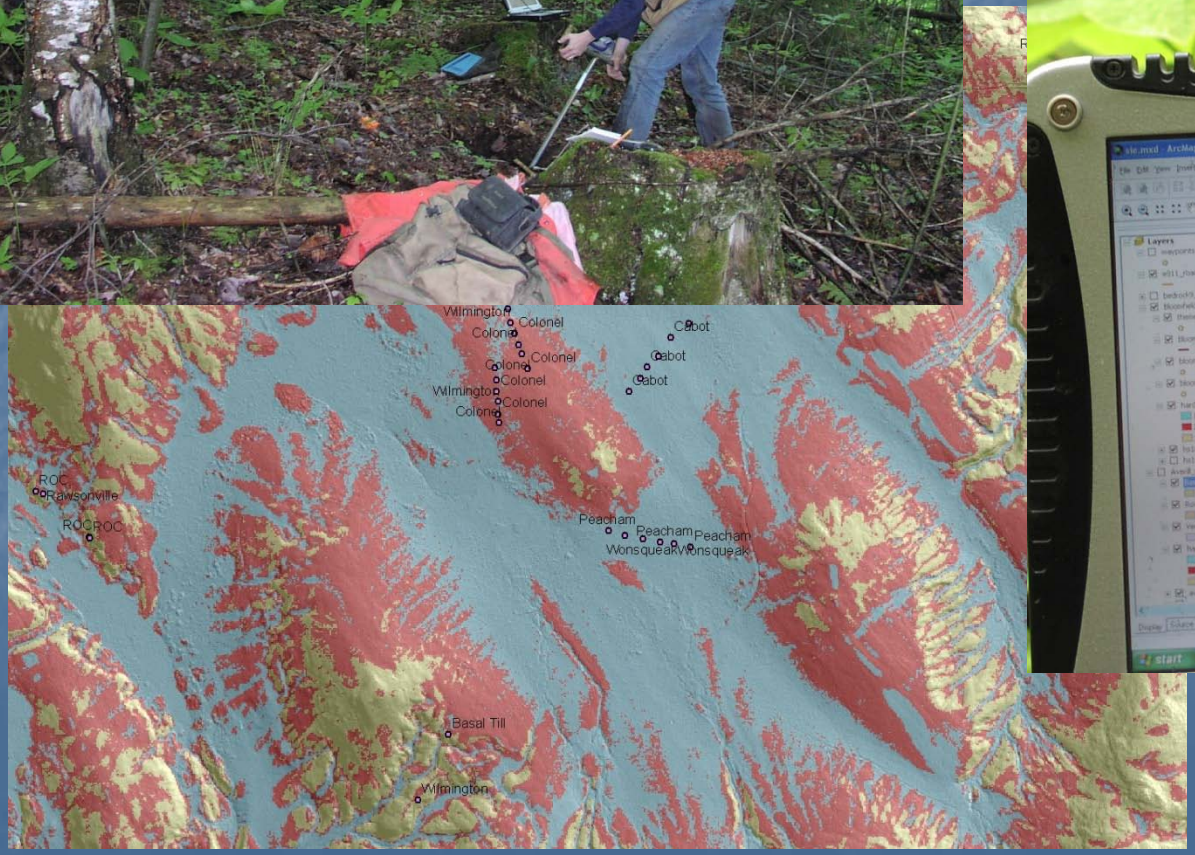


Hardened Map

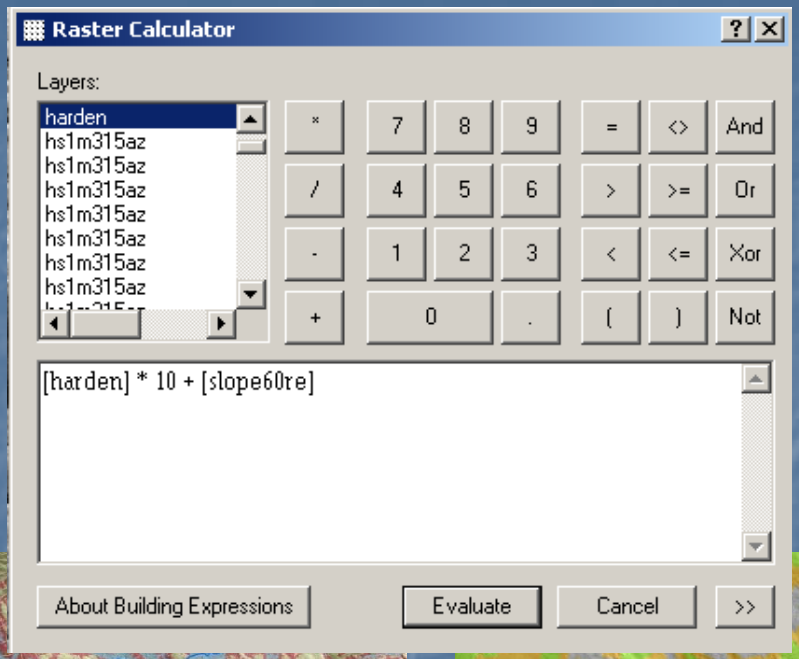


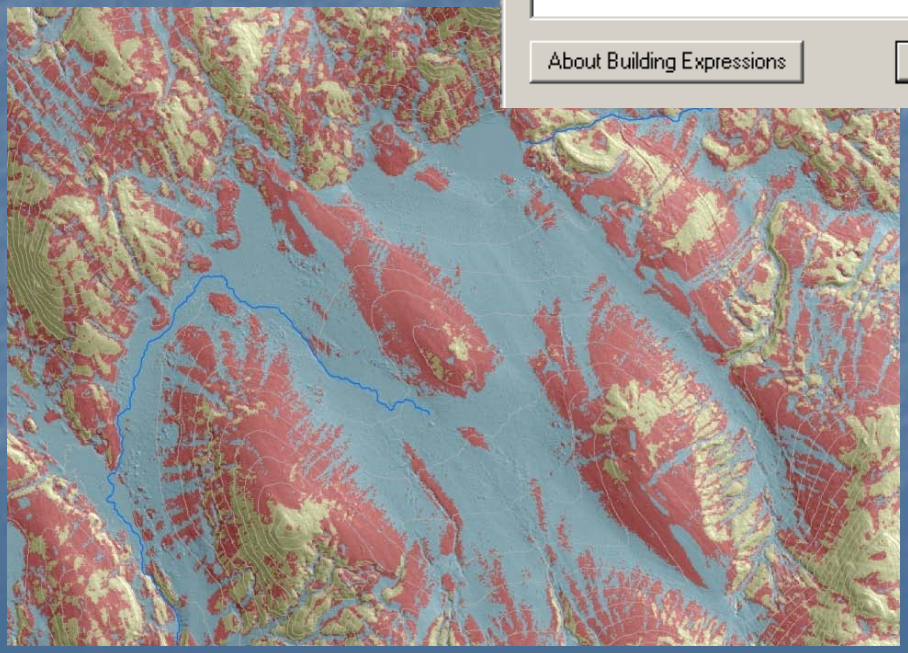
SIE Results are Validated in the Field



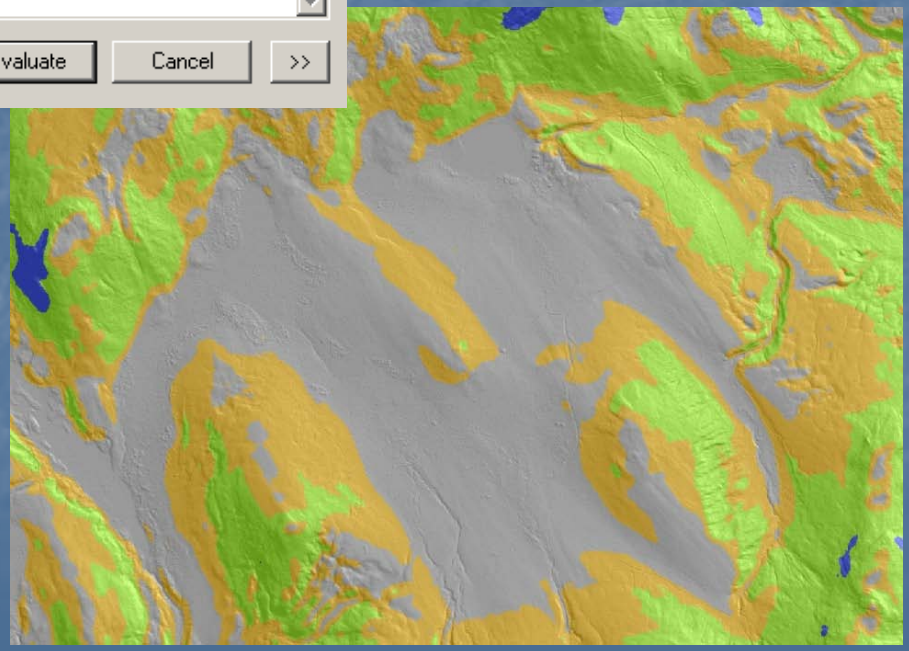


Integrate Slope Phases with Hardened Results



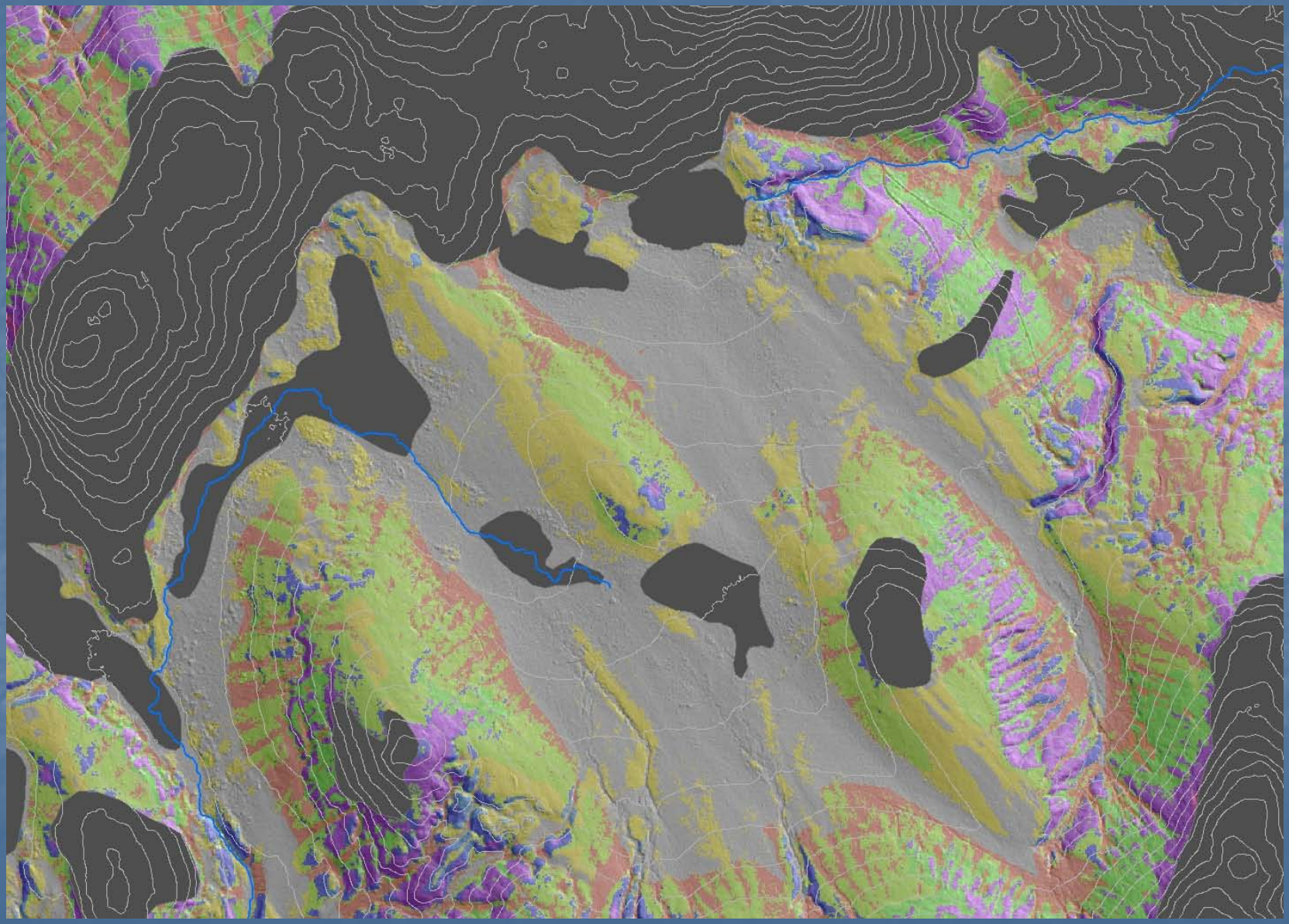


Hardened Results

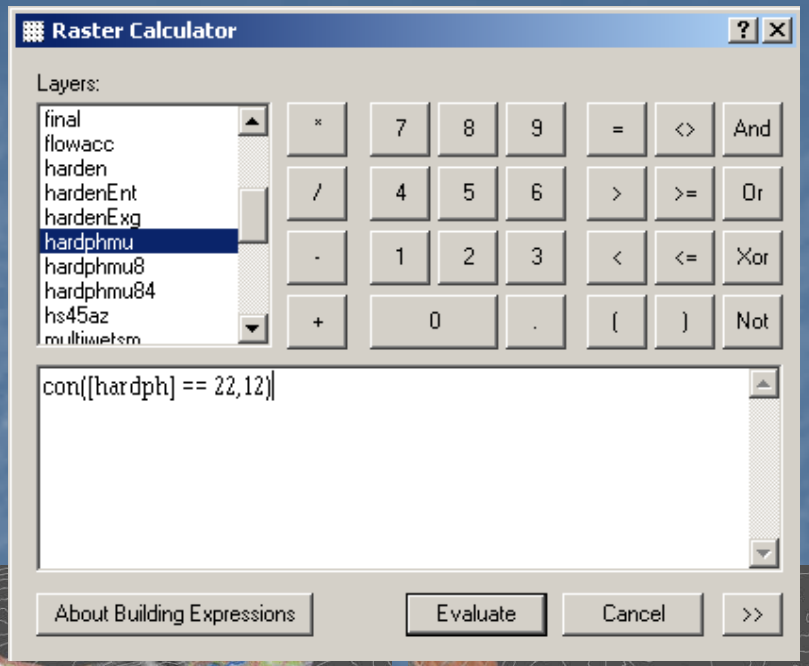


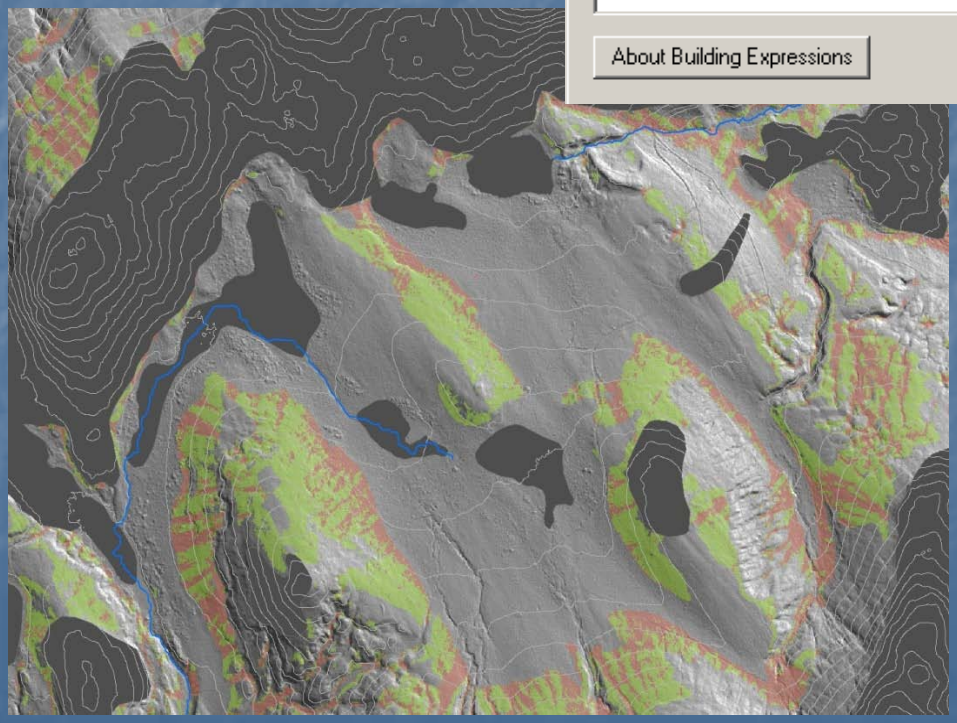
Slope Phases

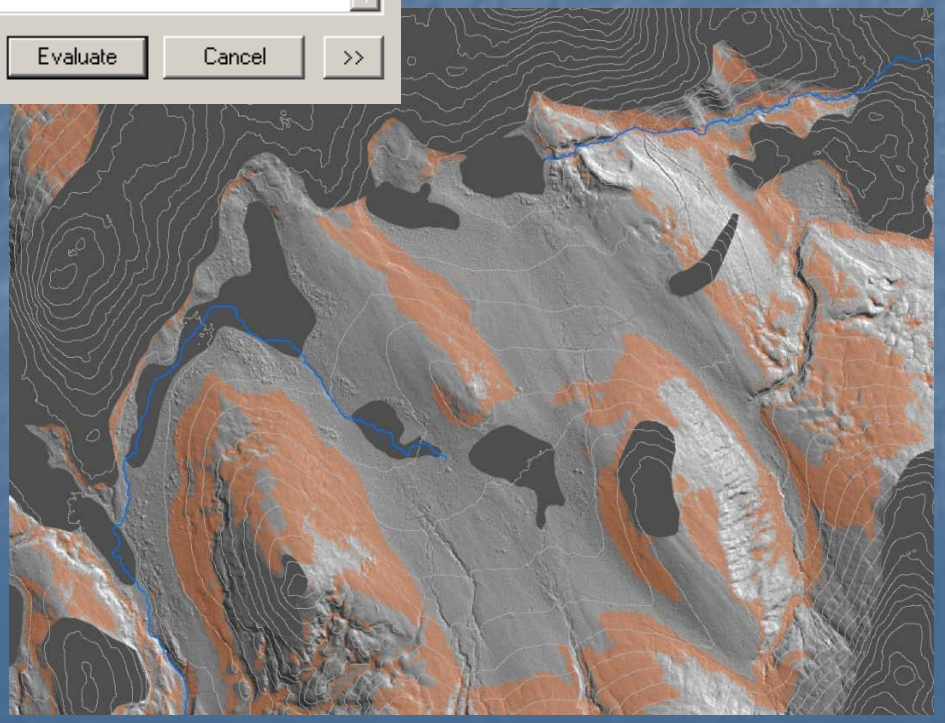
Hardened Results by Slope Phase



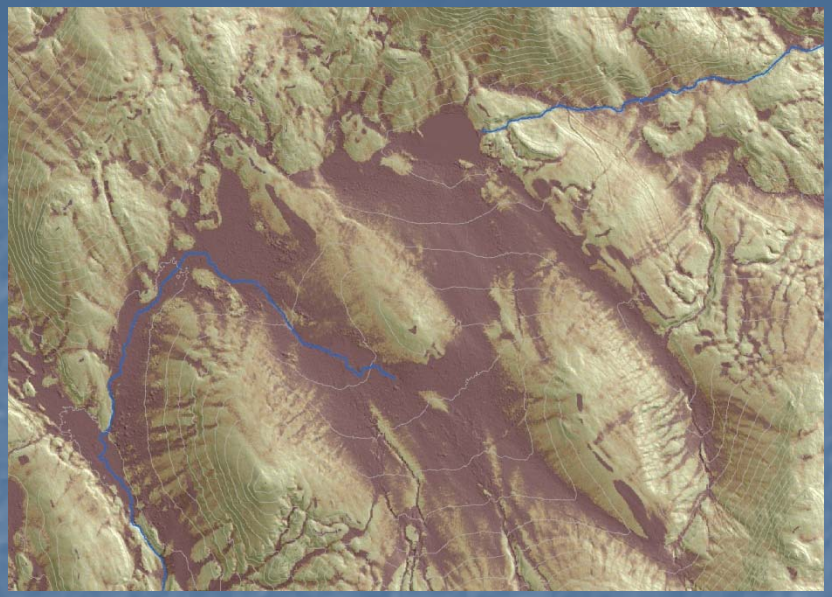
Combine Some Results to Form Logical Map Units



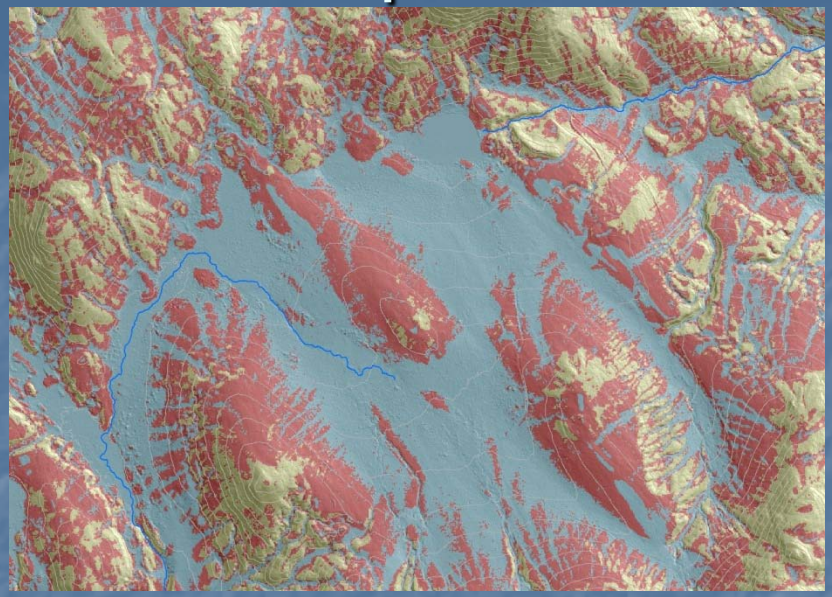




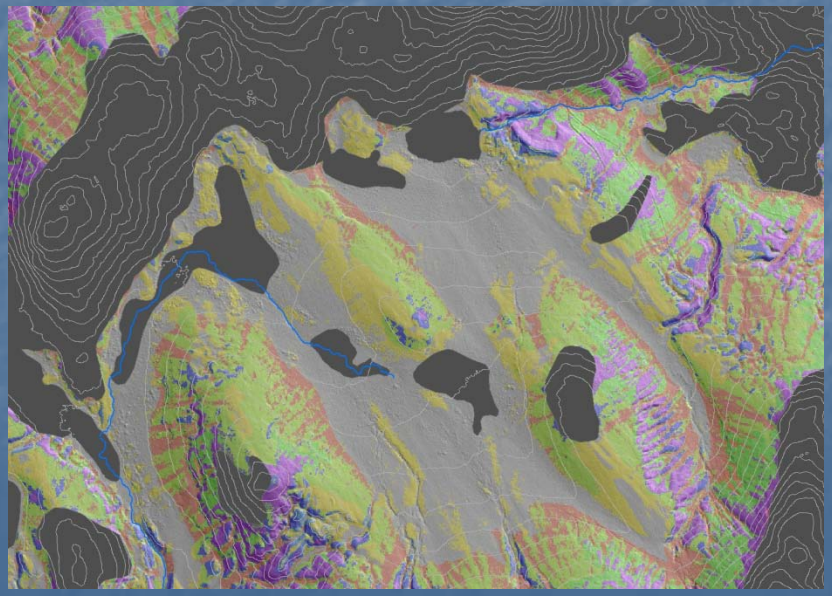
Review of ArcSIE Process Steps



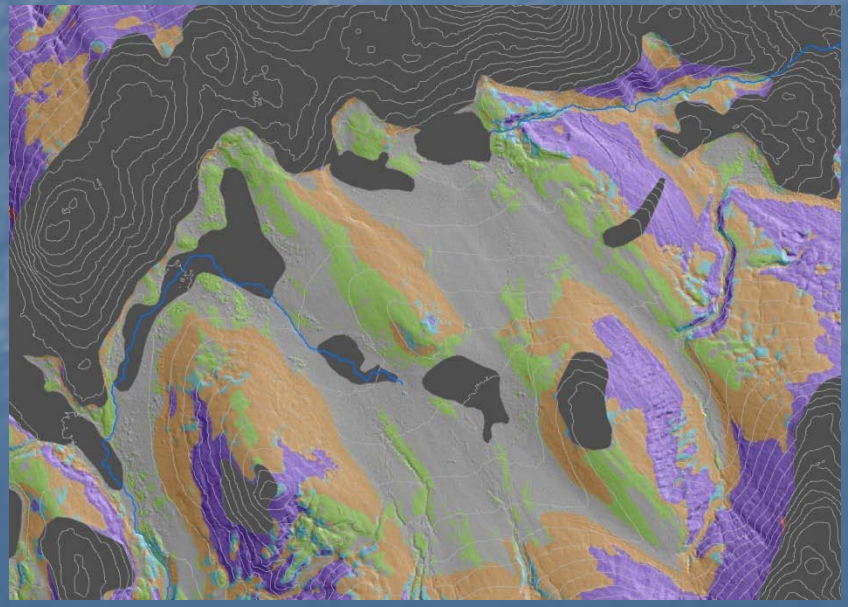
Inference by Soil Series



Harden Results

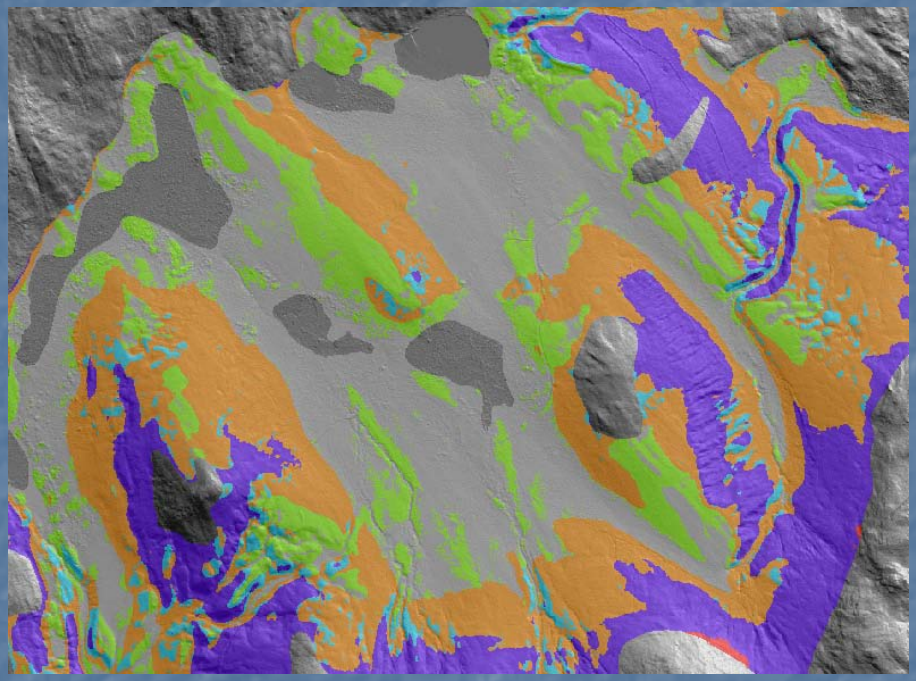


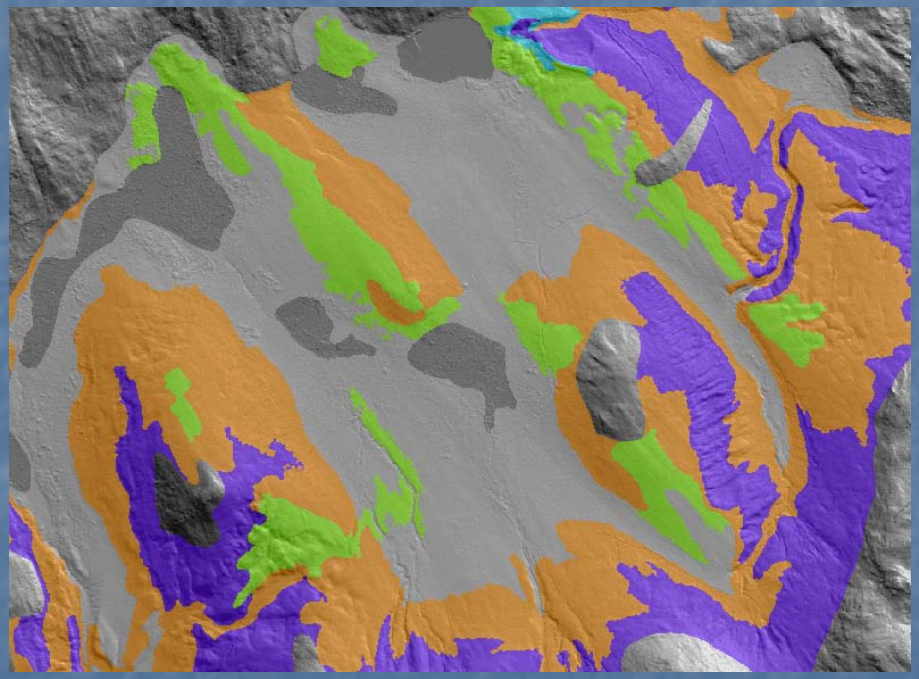
Integrate Slope Phases



Create Logical Map Units

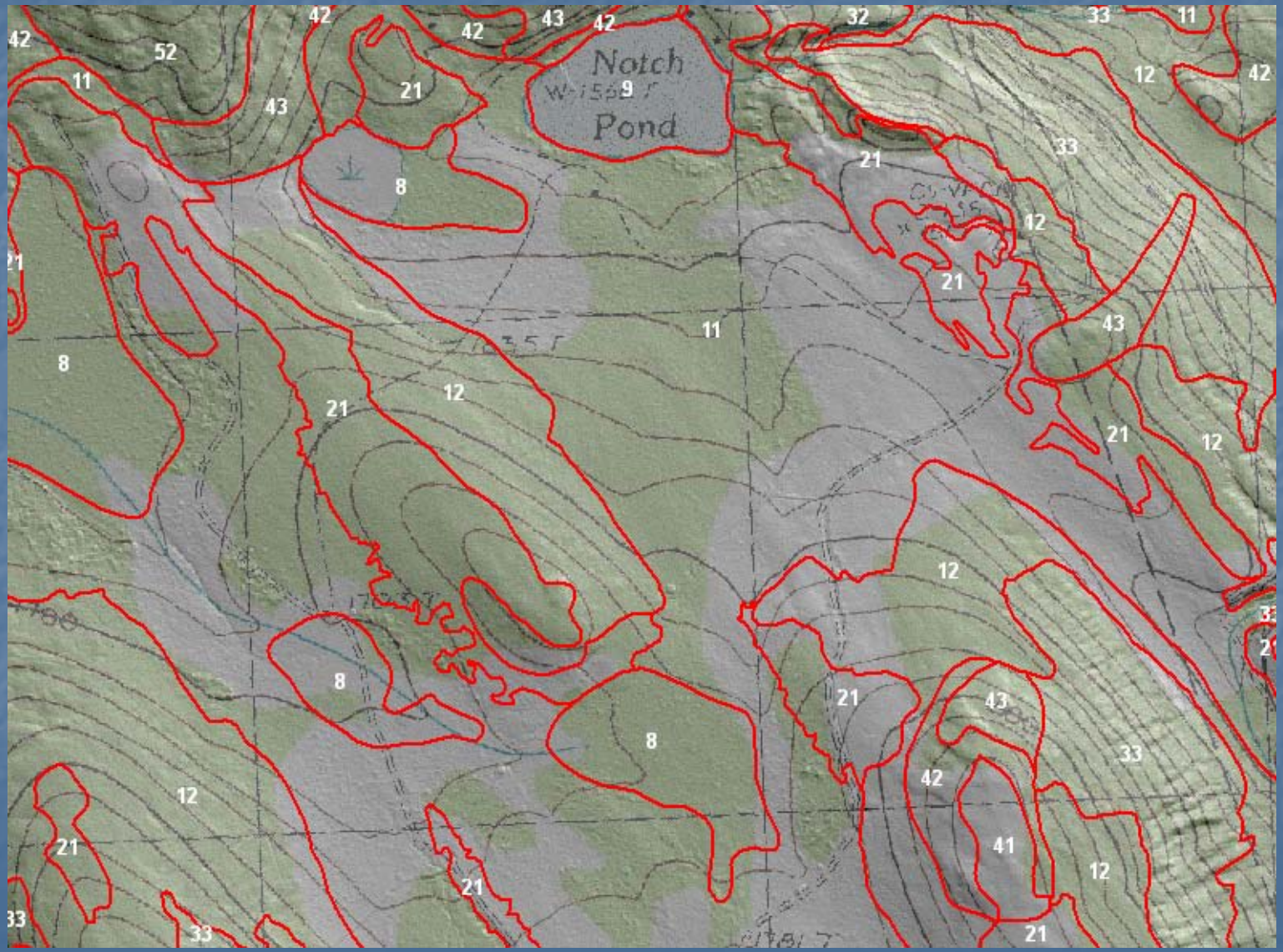
Create Minimum-size Delineations Using the "Remove Slivers" Tool



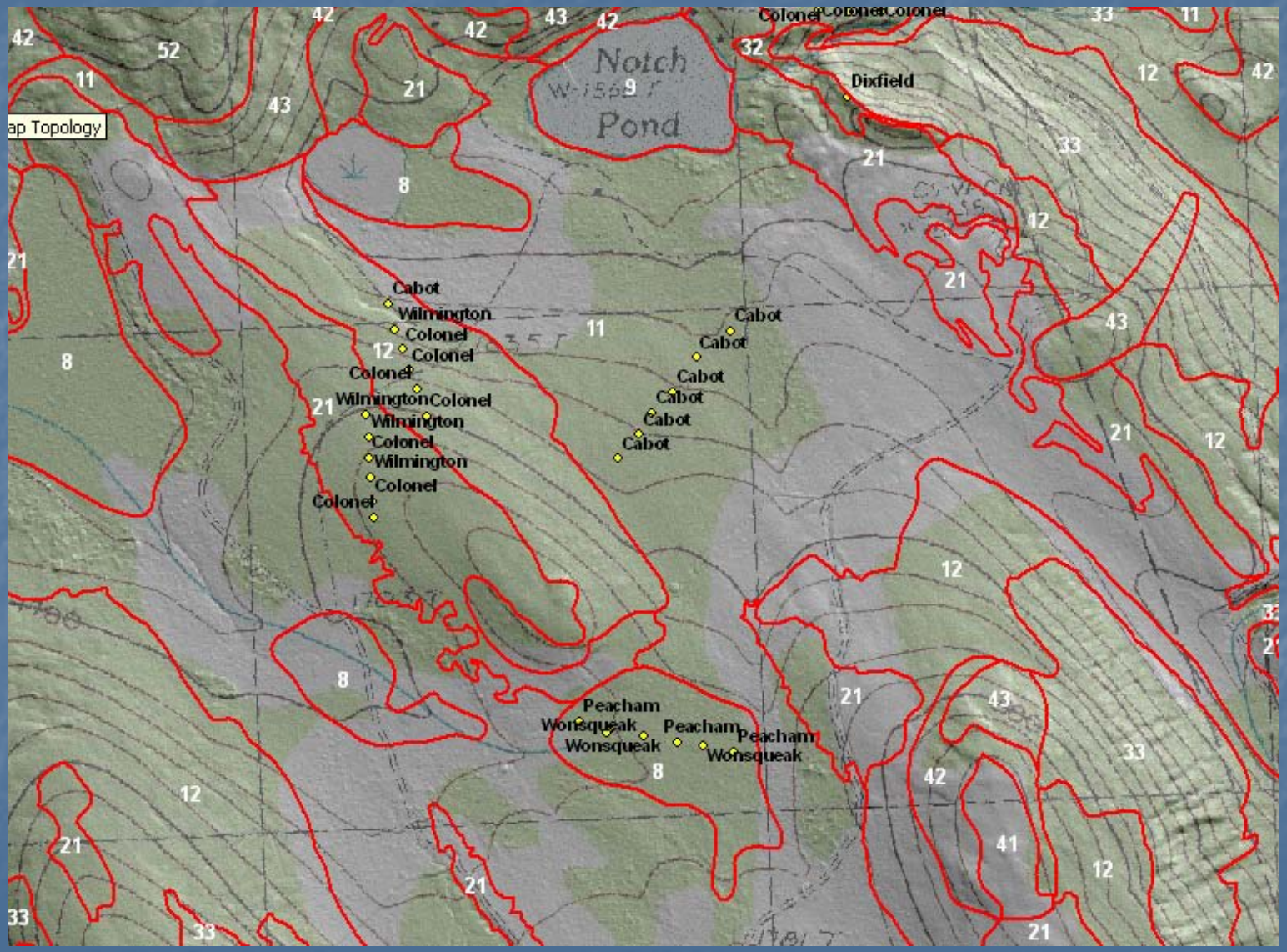


In Essex County, VT, 5 acres.

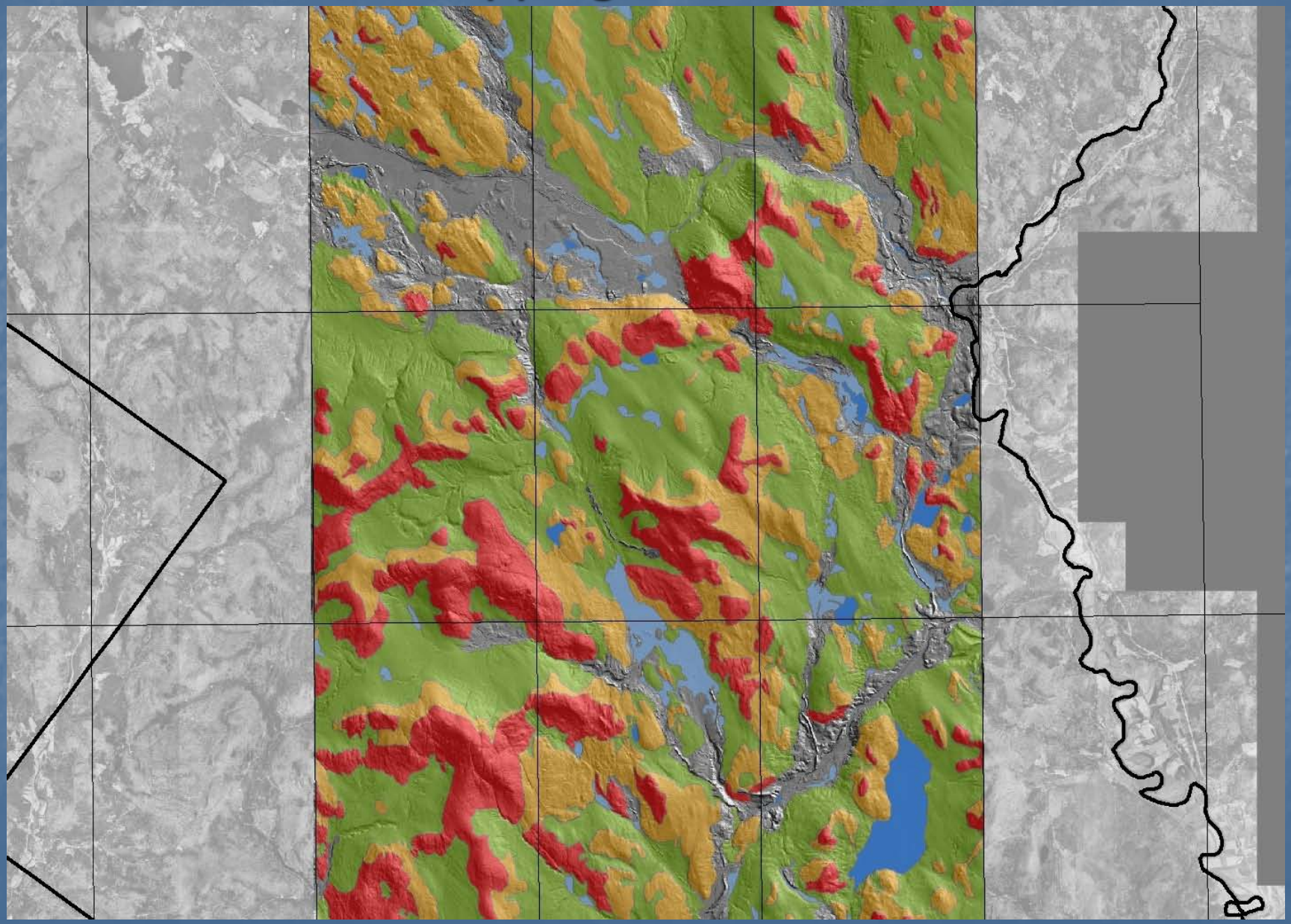
Raster Results are Further Processed and then Vectorized



Map Unit Composition is Determined Through Field Investigations



Typical Applicability of Automated Digital Soil Mapping Processes

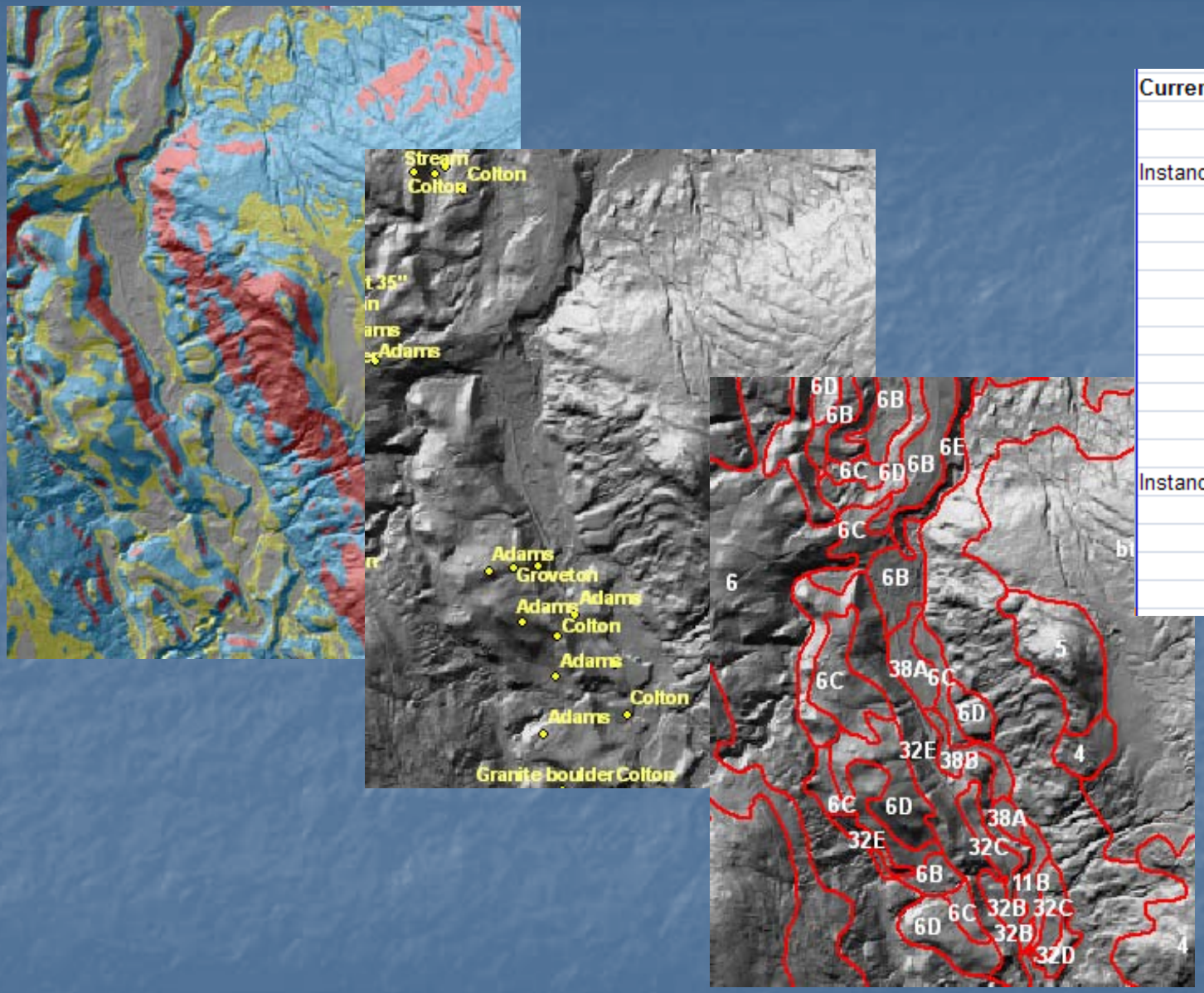


Positives-

- Mapping production increased by approximately 100%
- Maps are of consistently better quality

Negatives-

- Requires well trained and equipped staff
- Dependent on LiDAR elevation data (for order 2 surveys in the glaciated NE)



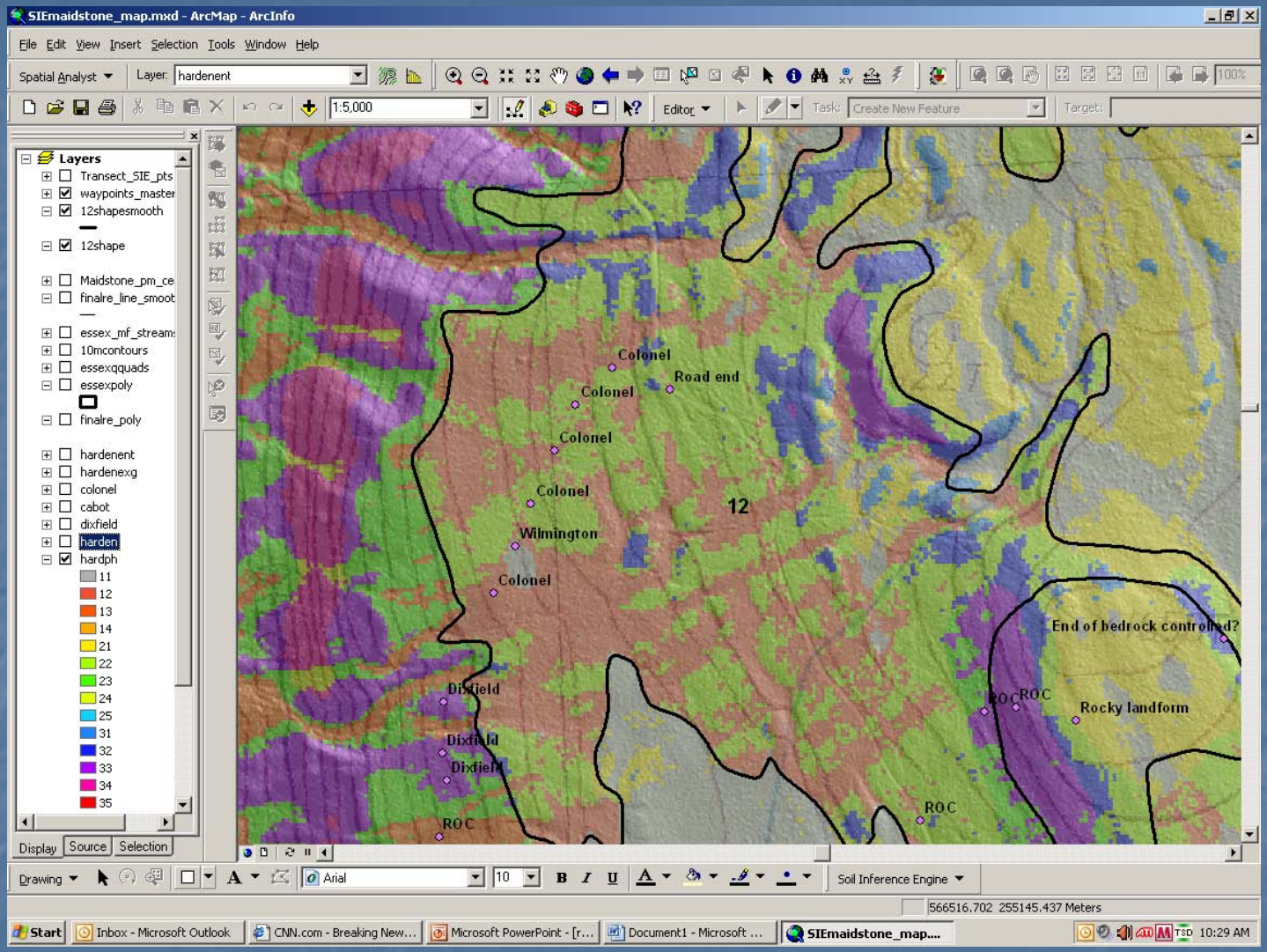
Current Rules		
		Cabot
Instance 1		limiting factor
		Wetness
	V1	6.3
	W1	1.5
		Slope
	V2	8
	W2	12
		Cabot
Instance 2		limiting factor
		Slope
	V2	1.9
	W2	0.1

We can now preserve and communicate most of the knowledge and data about the survey area.

Future Direction……

DSMII “Processes with ArcSIE” FY2011 Pilot

Continued technical support and formal training



Delivery of raster products to enhance SSURGO

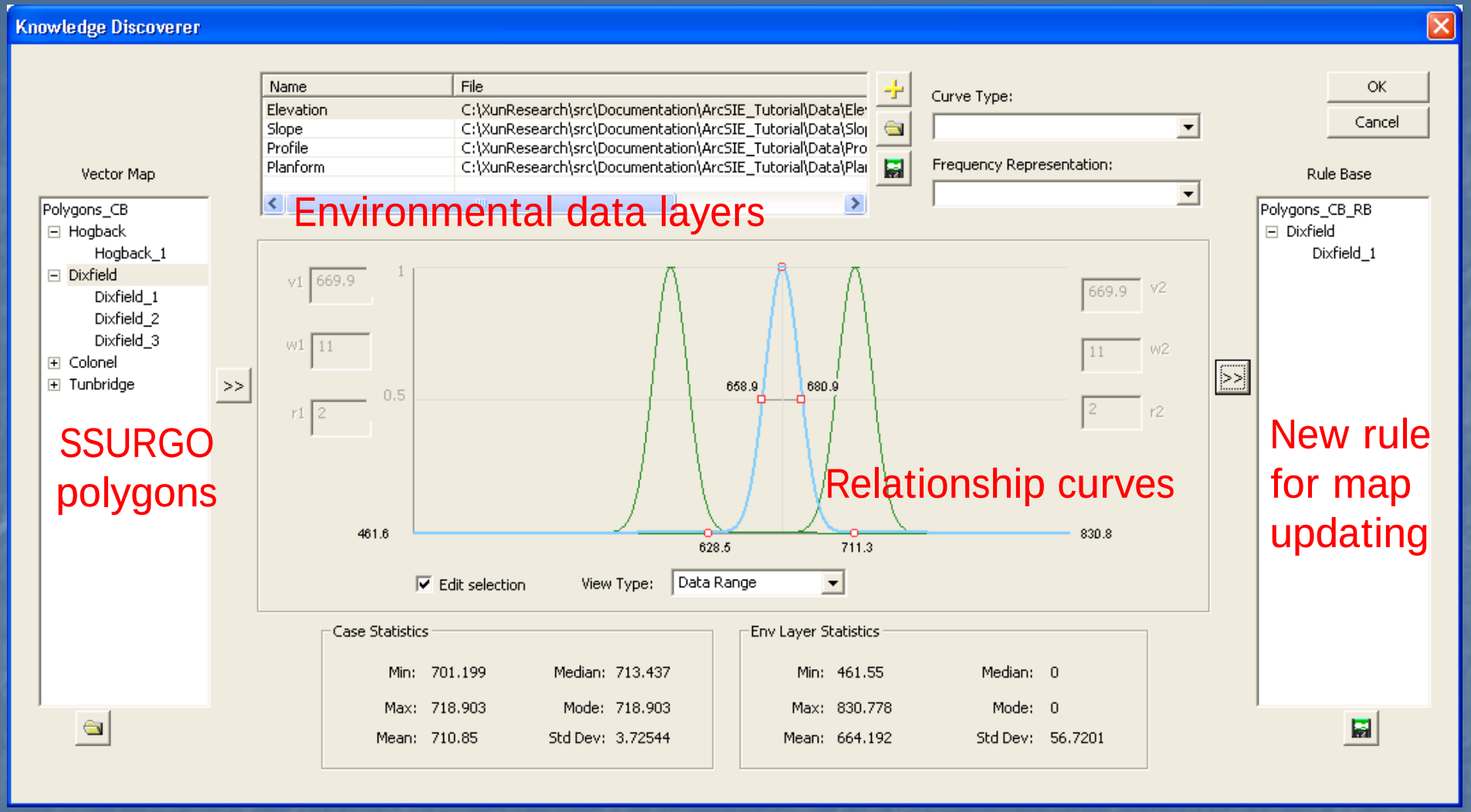
DRAFT PROJECT PLAN

Automated Soil Survey Update Utilizing Arc Soil Inference Engine (ArcSIE), May 3, 2011

Objective: To test a knowledge-based digital process for soil survey map updating. The process is supported by “Knowledge Discoverer”, a new component of ArcSIE.

Development of tools for map updating

Knowledge Discoverer Interface



Discover, verify, and revise the soil-landscape model implicit in the existing soil map. Then apply the revised model to create updated polygons.

Want to Know More?

Soil Inference Engine (SIE) Progress Report

USDA- Natural Resources Conservation Service
Geography Department, Dartmouth College
March, 2009

Shi, X., Long, R., DeKett, R., Philippe, J., 2009. Integrating different types of knowledge for digital soil mapping. Soil Science Society of America Journal. 73:1682–1692.

Philippe, J.M., 2008. Utilizing a knowledge-based system to test the transferability of a soil-landscape model in northeastern Vermont. Masters Thesis, University of Florida.

ArcSIE User's Guide, and Vermont Digital Soil Mapping Cookbook

Contact Bob Long- robert.long@vt.usda.gov