Applications of the NHD and DEM for Watershed Analysis in KY

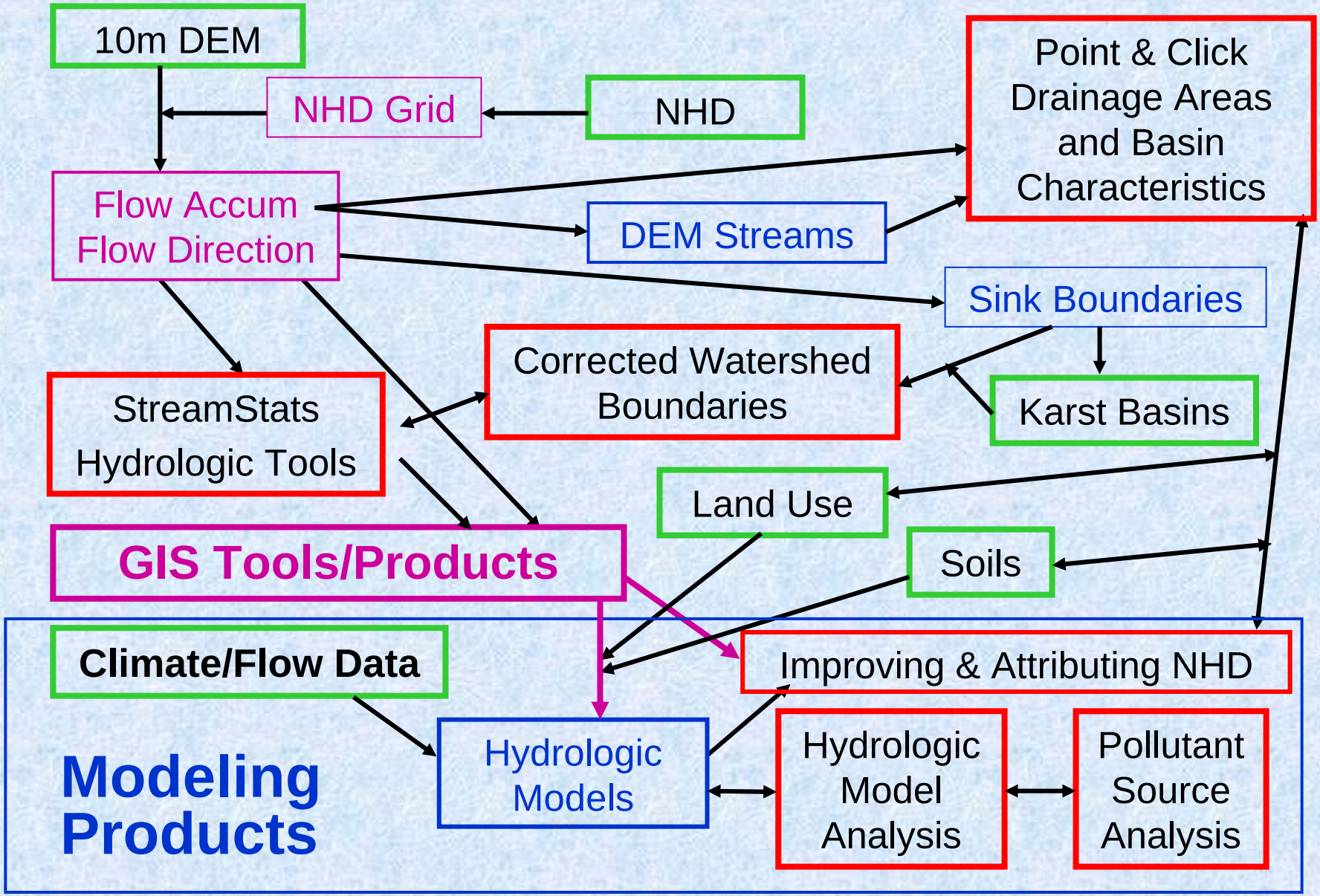
Capitalizing on the availability of new and improved GIS coverages

hlnelson@usgs.gov
502-493-1947

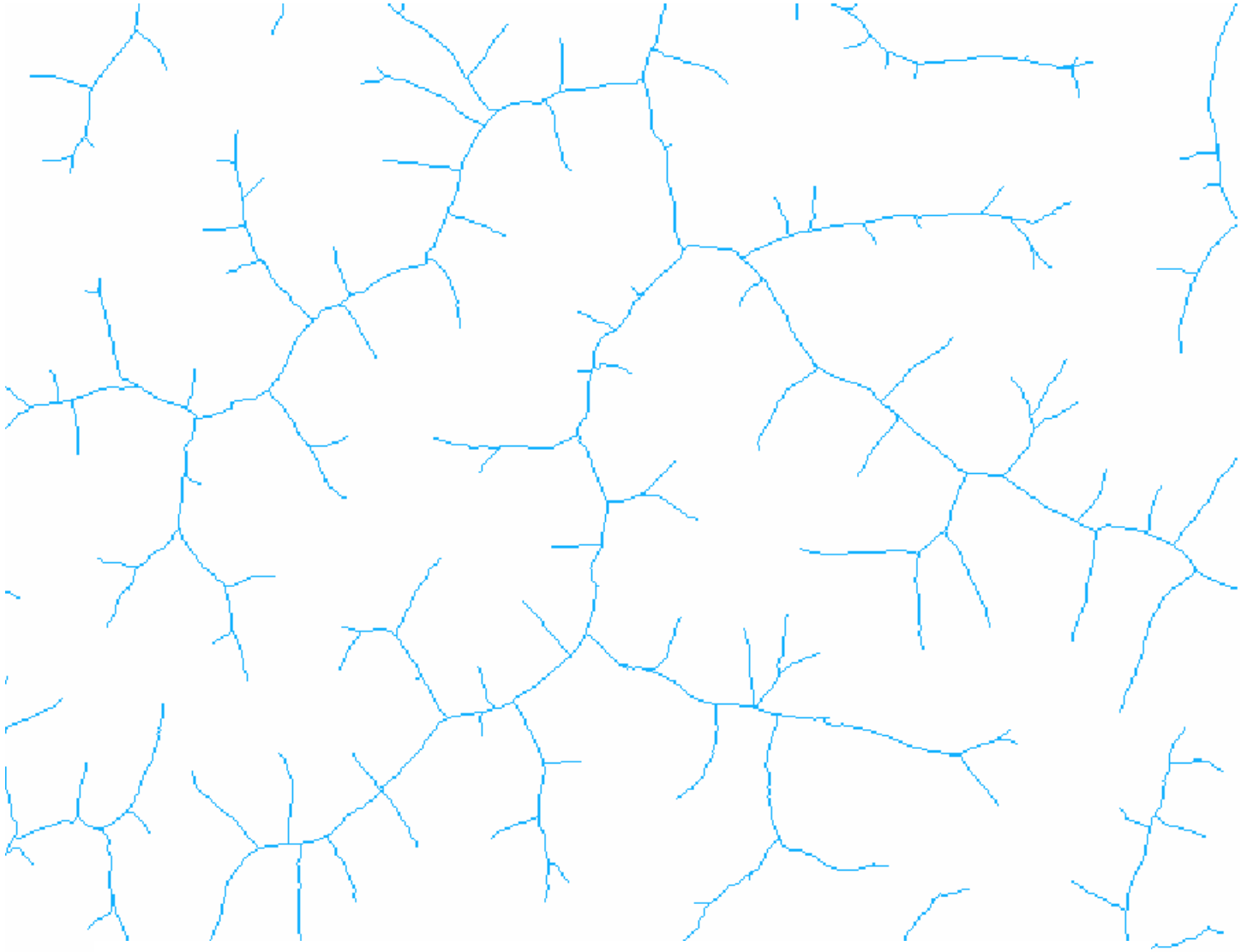
mayers@usgs.gov
502-493-1910

USGS
science for a changing world

Building GIS-Based Hydrologic Tools

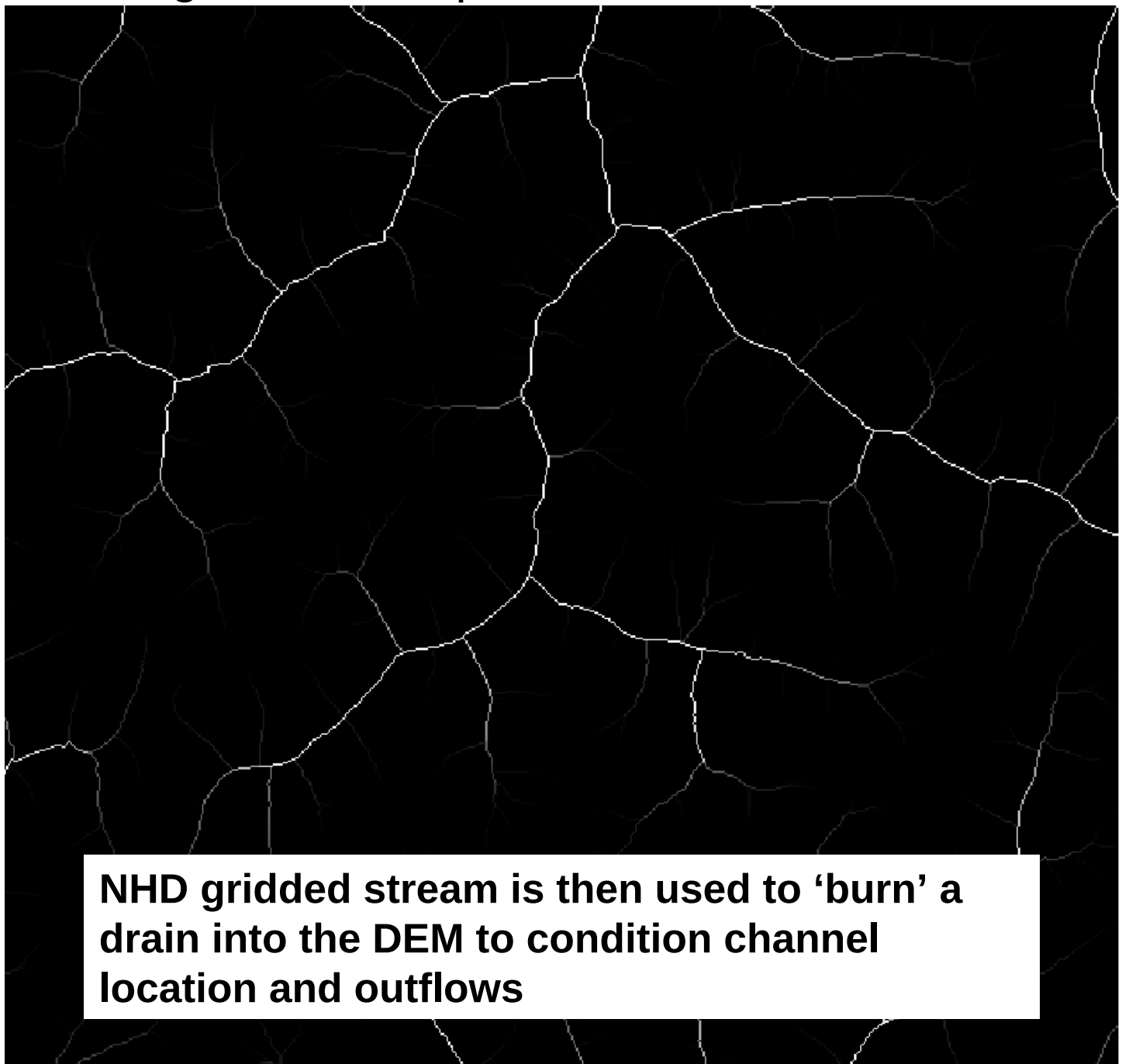


Building watershed products from NHD and DEM



NHD centerline of stream is converted to a grid

Building watershed products from NHD and DEM

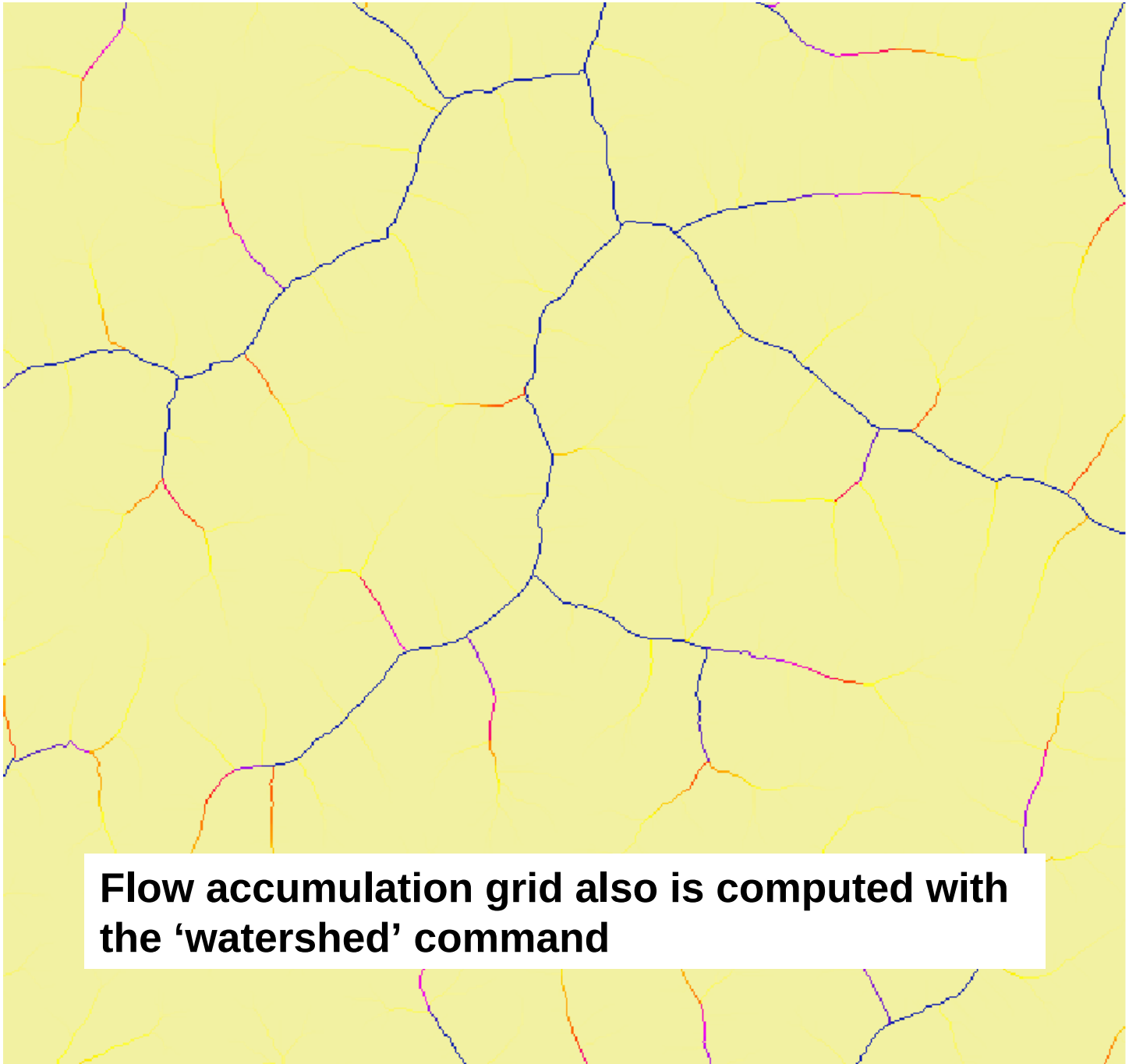


NHD gridded stream is then used to ‘burn’ a drain into the DEM to condition channel location and outflows

Building watershed products from NHD and DEM

The flow direction grid is computed with the ‘watershed’ command

Building watershed products from NHD and DEM

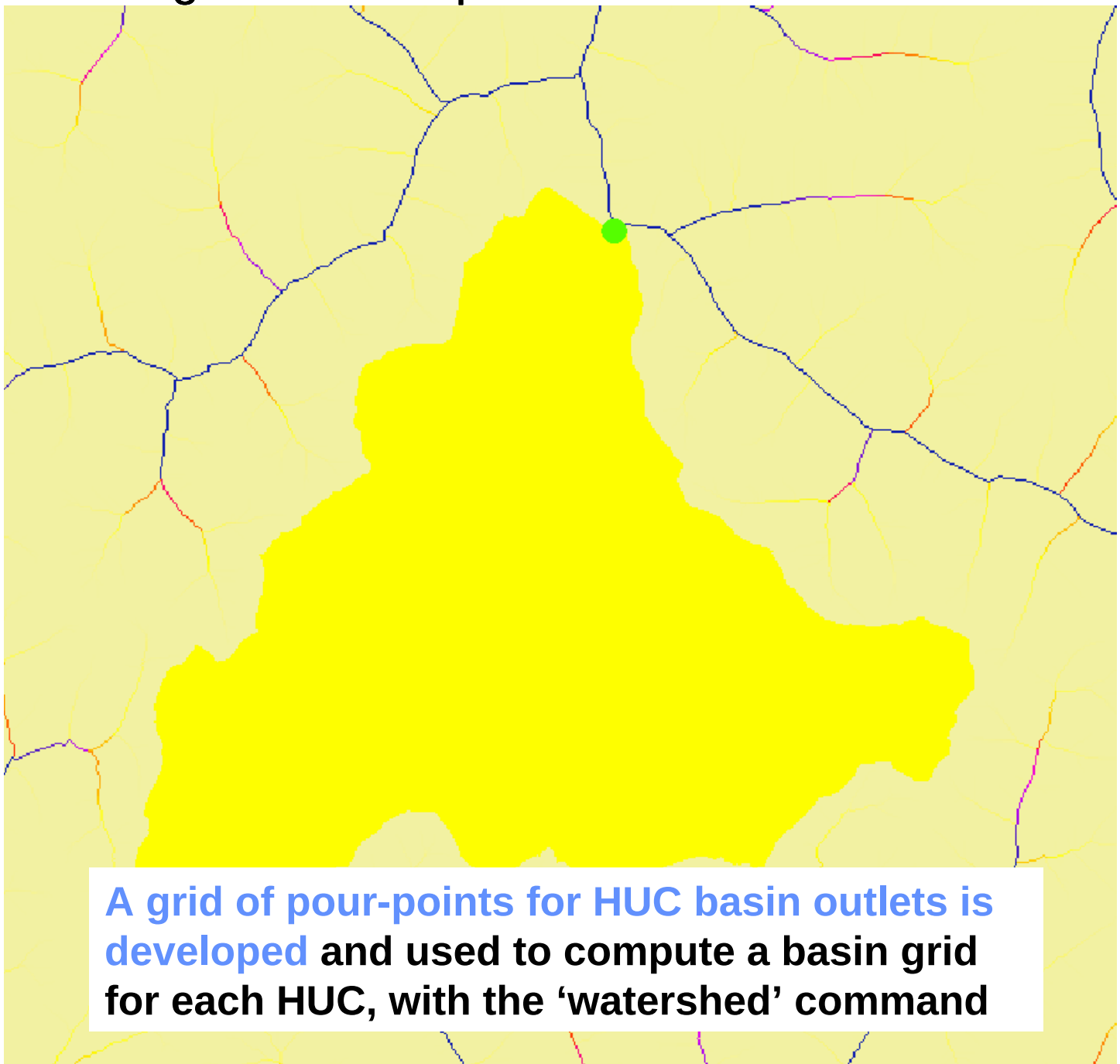


Flow accumulation grid also is computed with the ‘watershed’ command

Building watershed products from NHD and DEM

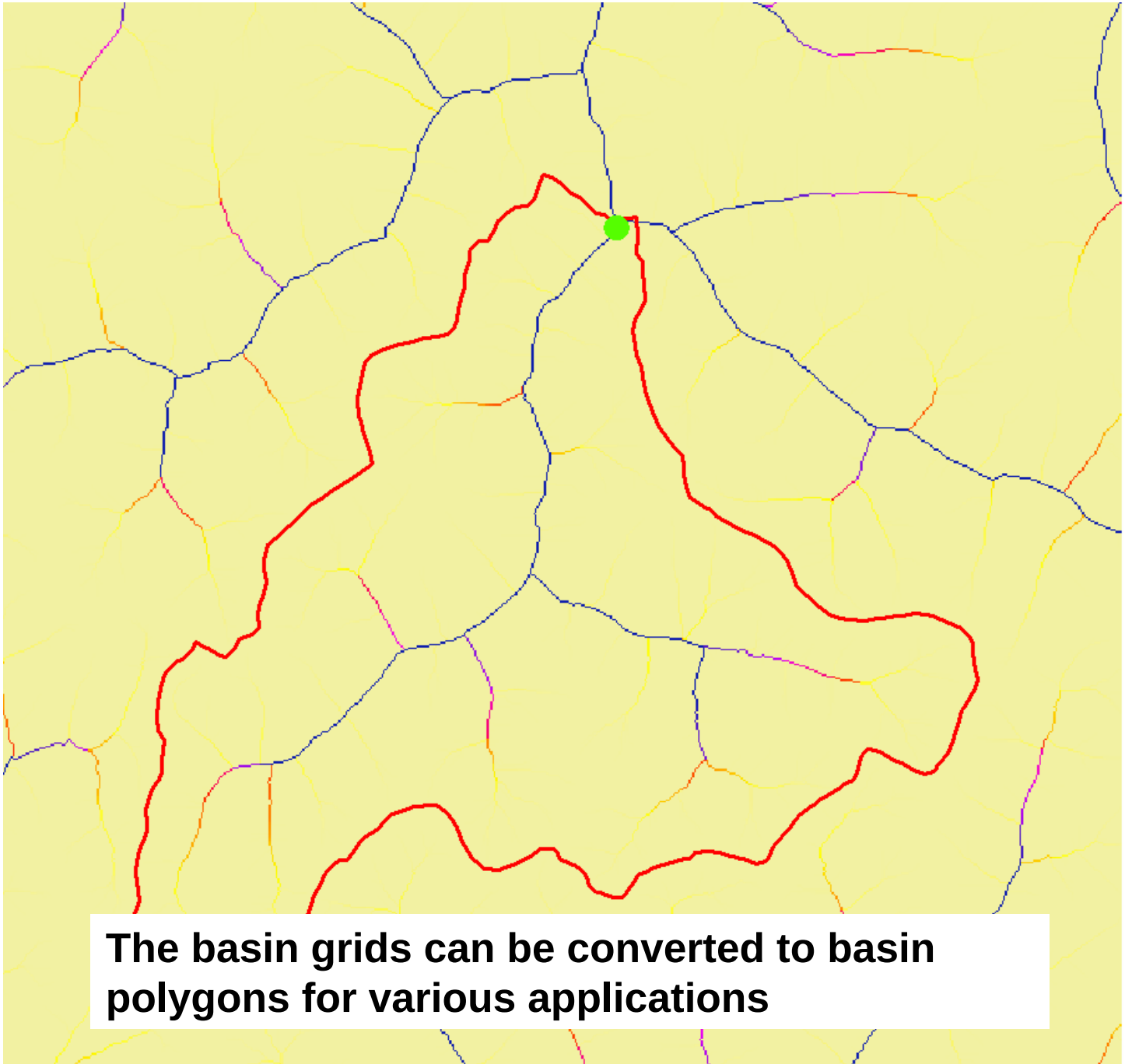
A grid of pour-points for HUC basin outlets is developed (a single green dot here)

Building watershed products from NHD and DEM



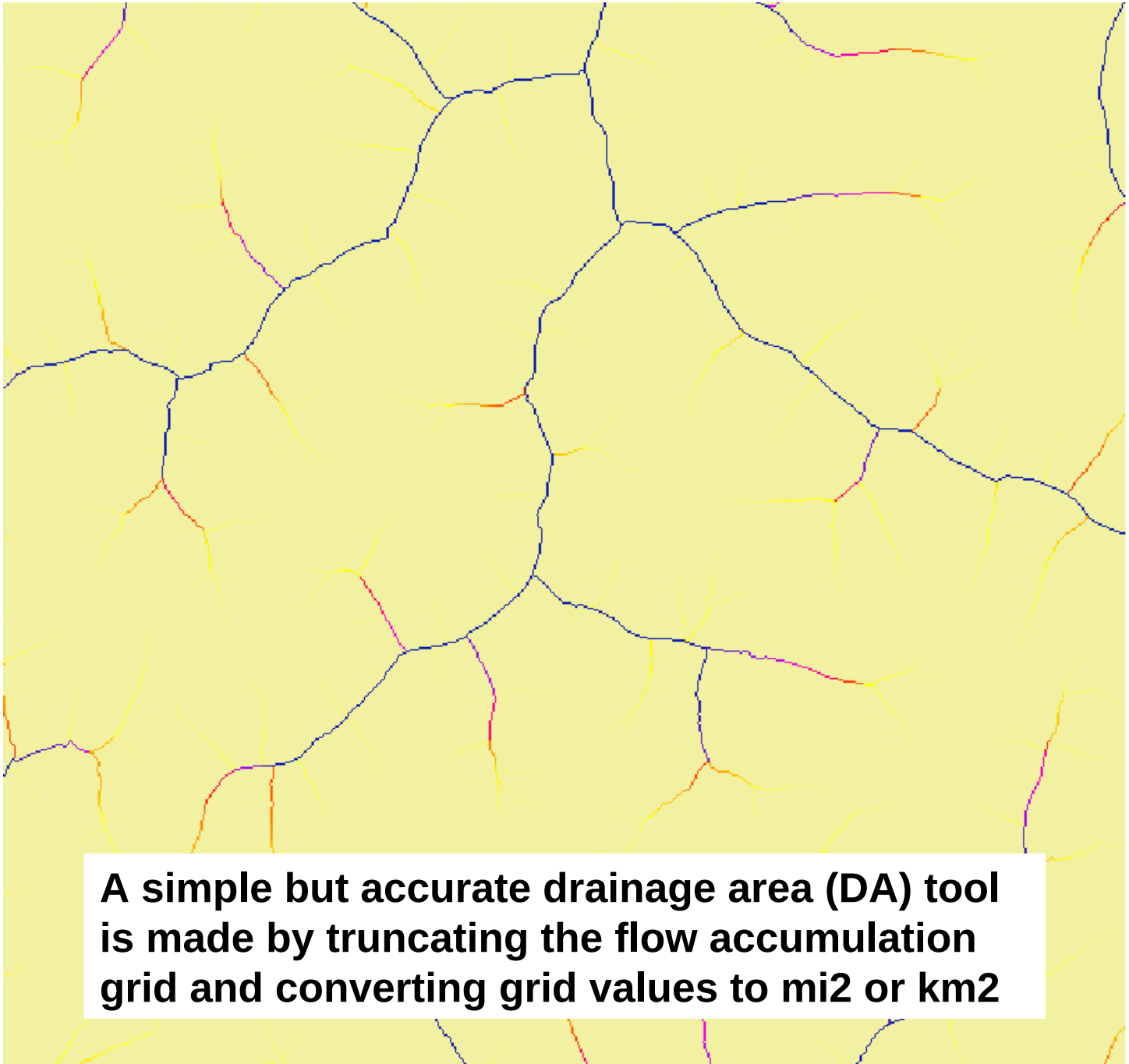
A grid of pour-points for HUC basin outlets is developed and used to compute a basin grid for each HUC, with the ‘watershed’ command

Building watershed products from NHD and DEM



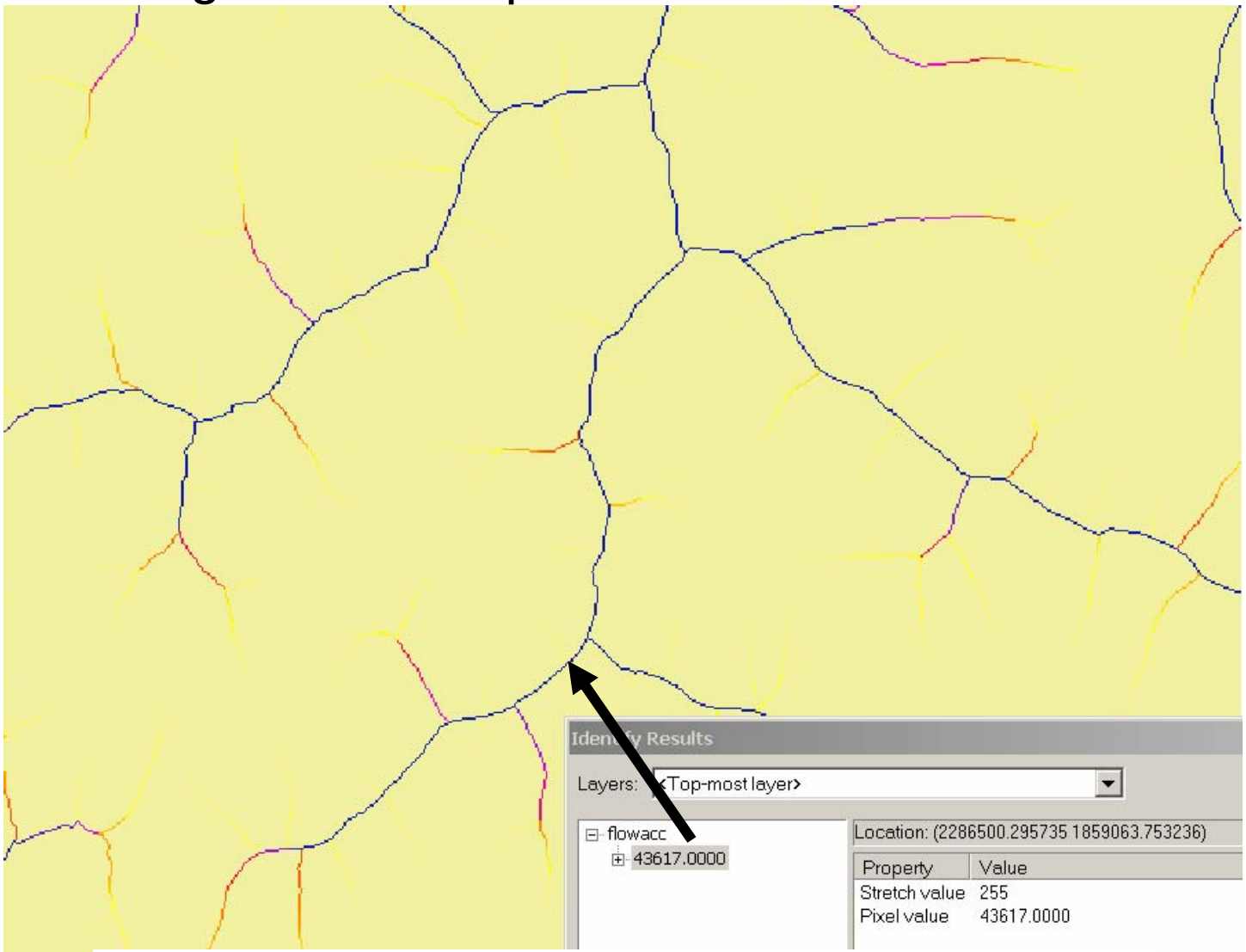
The basin grids can be converted to basin polygons for various applications

Building watershed products from NHD and DEM



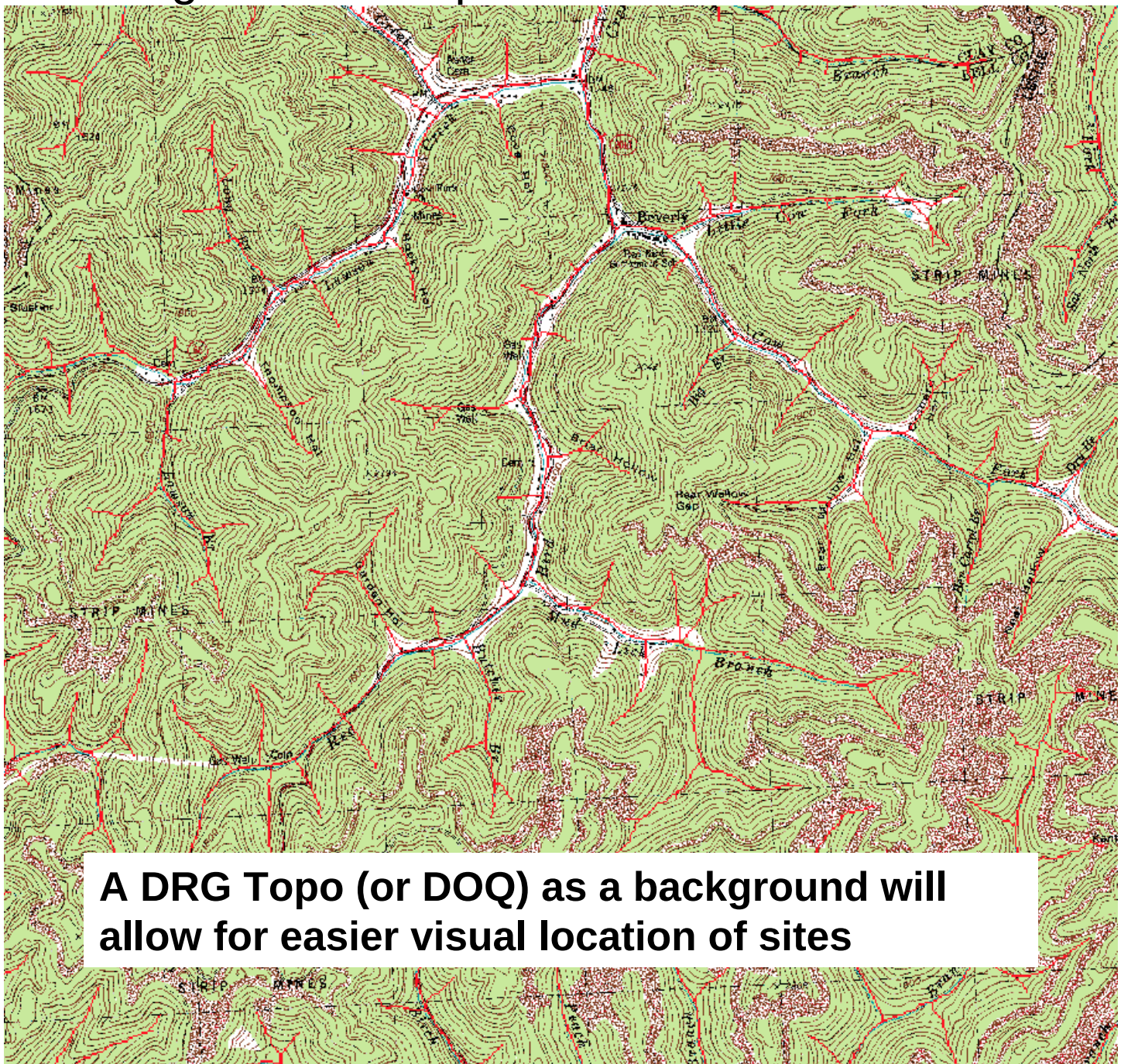
A simple but accurate drainage area (DA) tool is made by truncating the flow accumulation grid and converting grid values to mi2 or km2

Building watershed products from NHD and DEM



From the DA grid, a drainage area can be read at any point along a stream with the 'identify' command (at 30976 cells per mi2 = 1.4081 mi2)

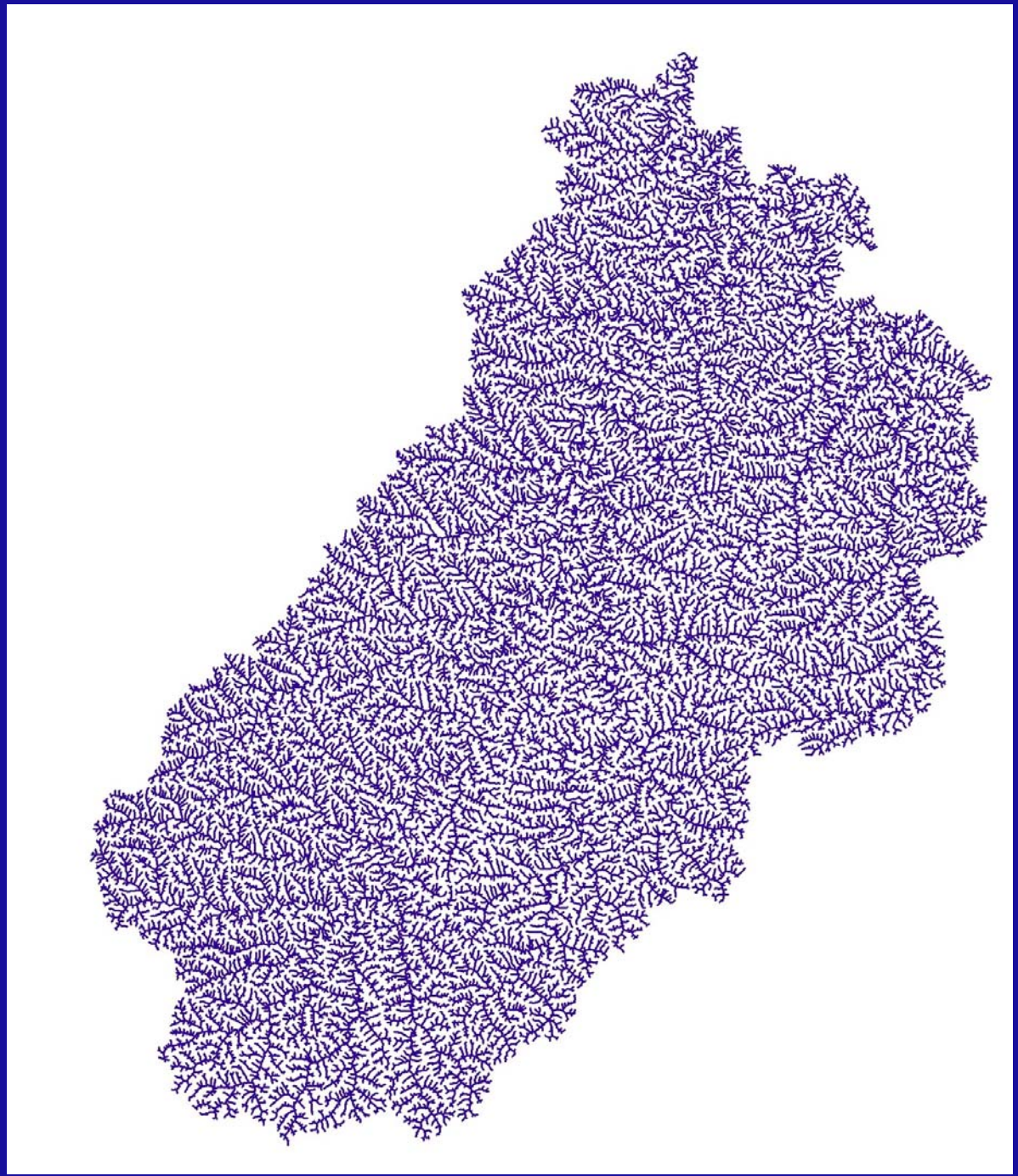
Building watershed products from NHD and DEM



A DRG Topo (or DOQ) as a background will allow for easier visual location of sites

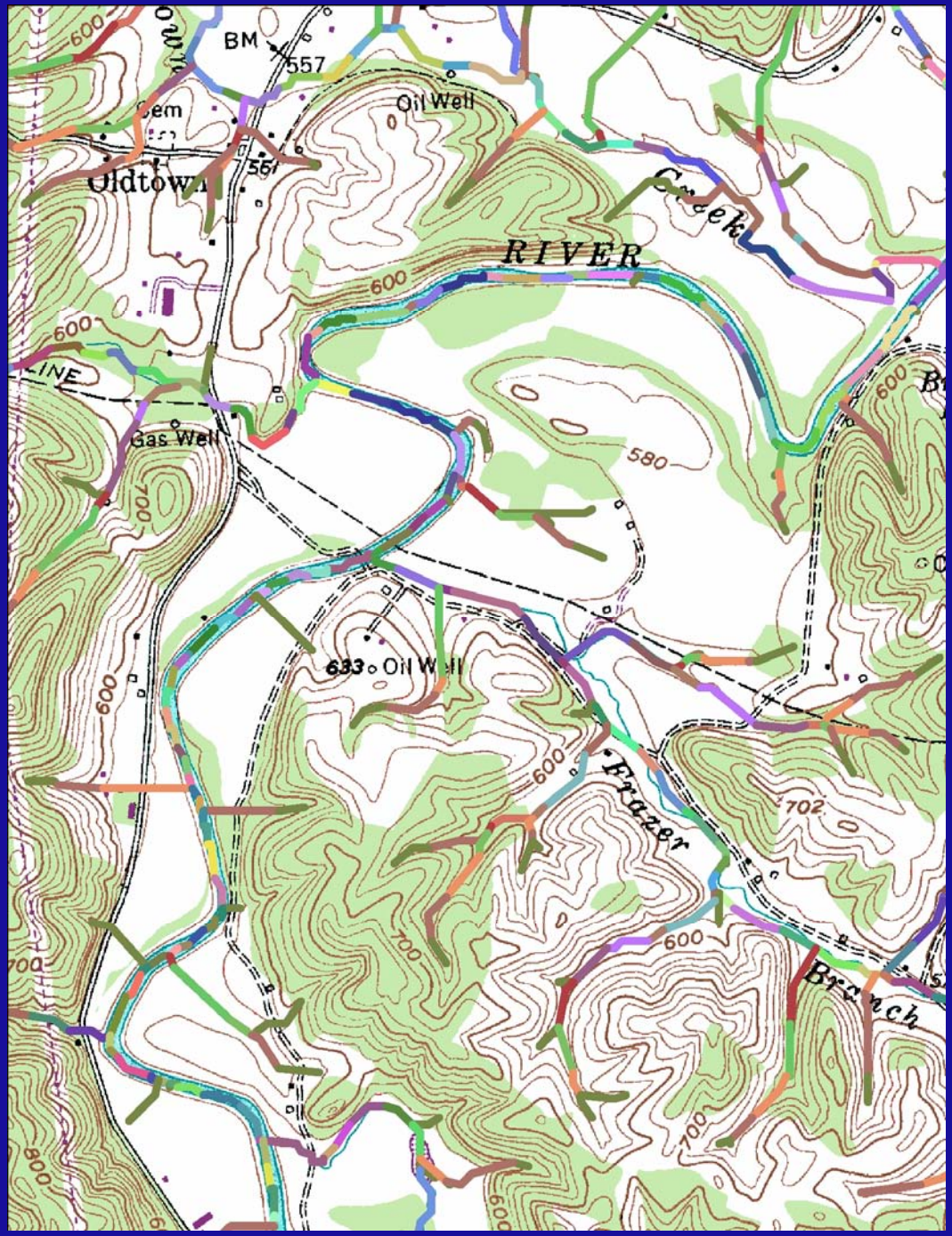
Drainage Area Tool

Flow accumulation grid truncated to a minimum of 0.01 square mile is converted to synthetic stream lines. Example for Little Sandy 8-digit HUC with all streams draining at least 0.01 square mile.



Drainage Area Tool

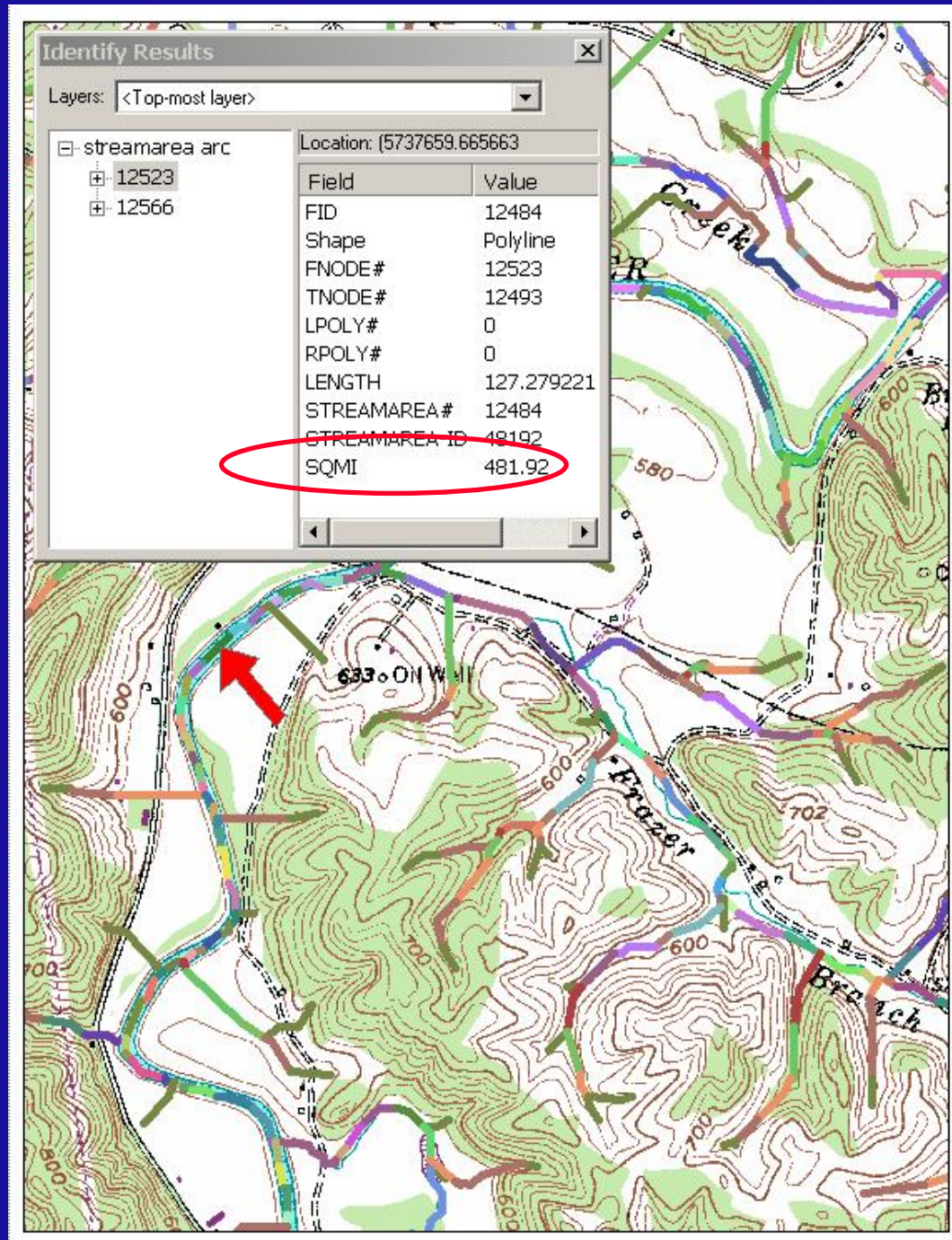
Zoomed in to show synthetic streams with different colors for each 0.01 square mile drainage area increment



Drainage Area Tool

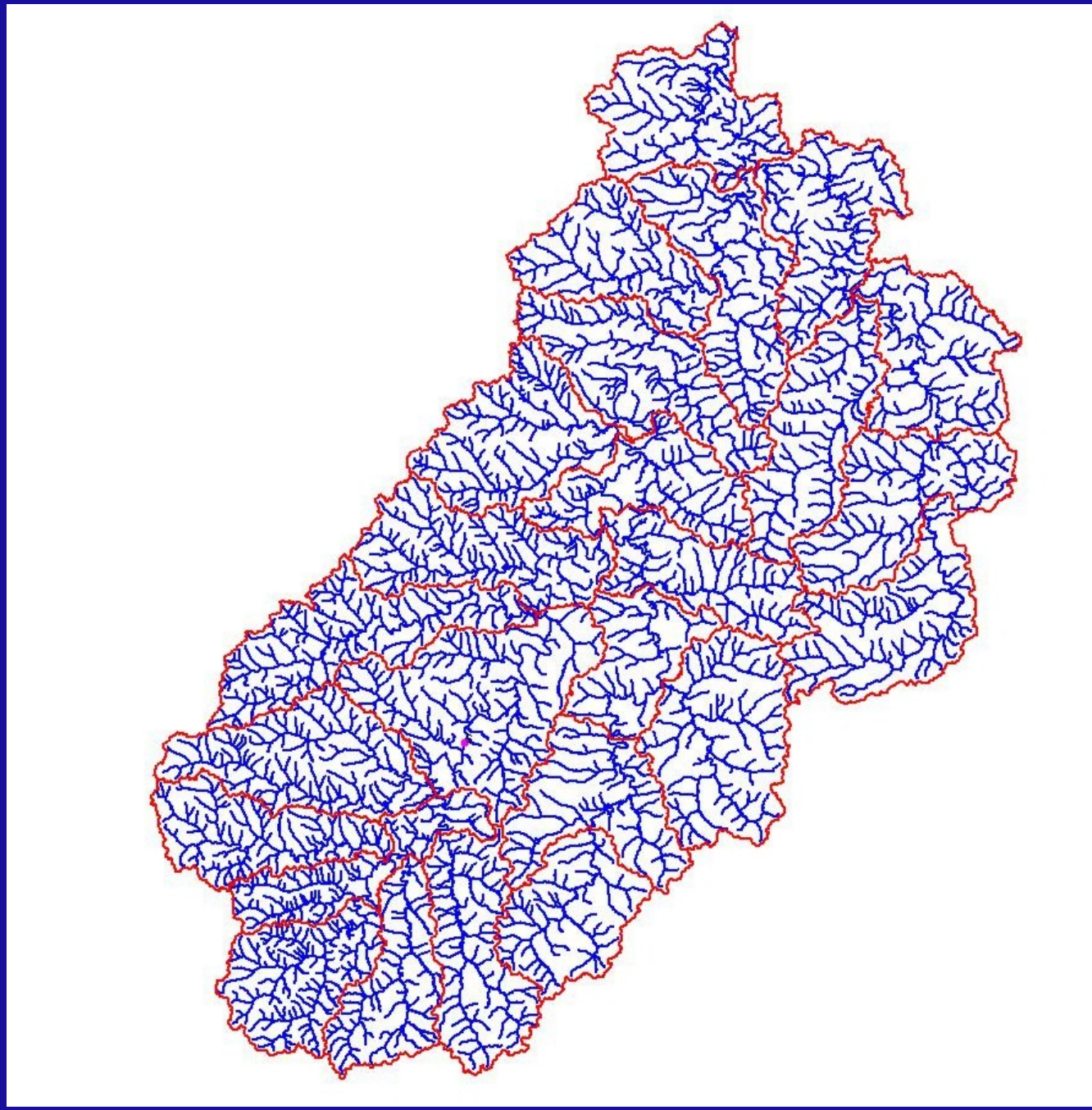
Shows results of using the Identify tool, giving drainage area for the indicated stream segment

481.92 square miles



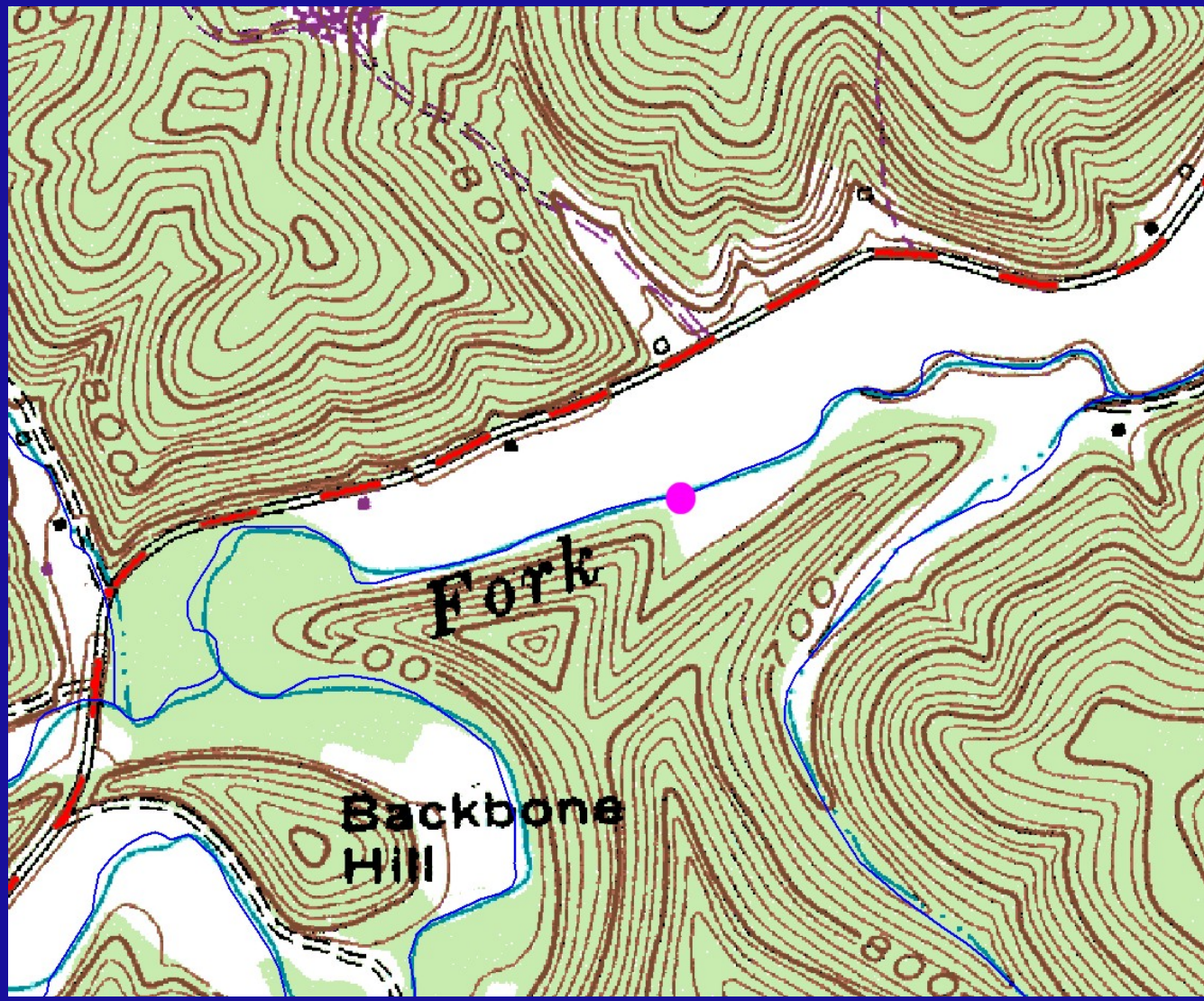
NHD Watershed Tool

Little Sandy 8-digit HUC with NHD streams and internal 10-digit HUCs



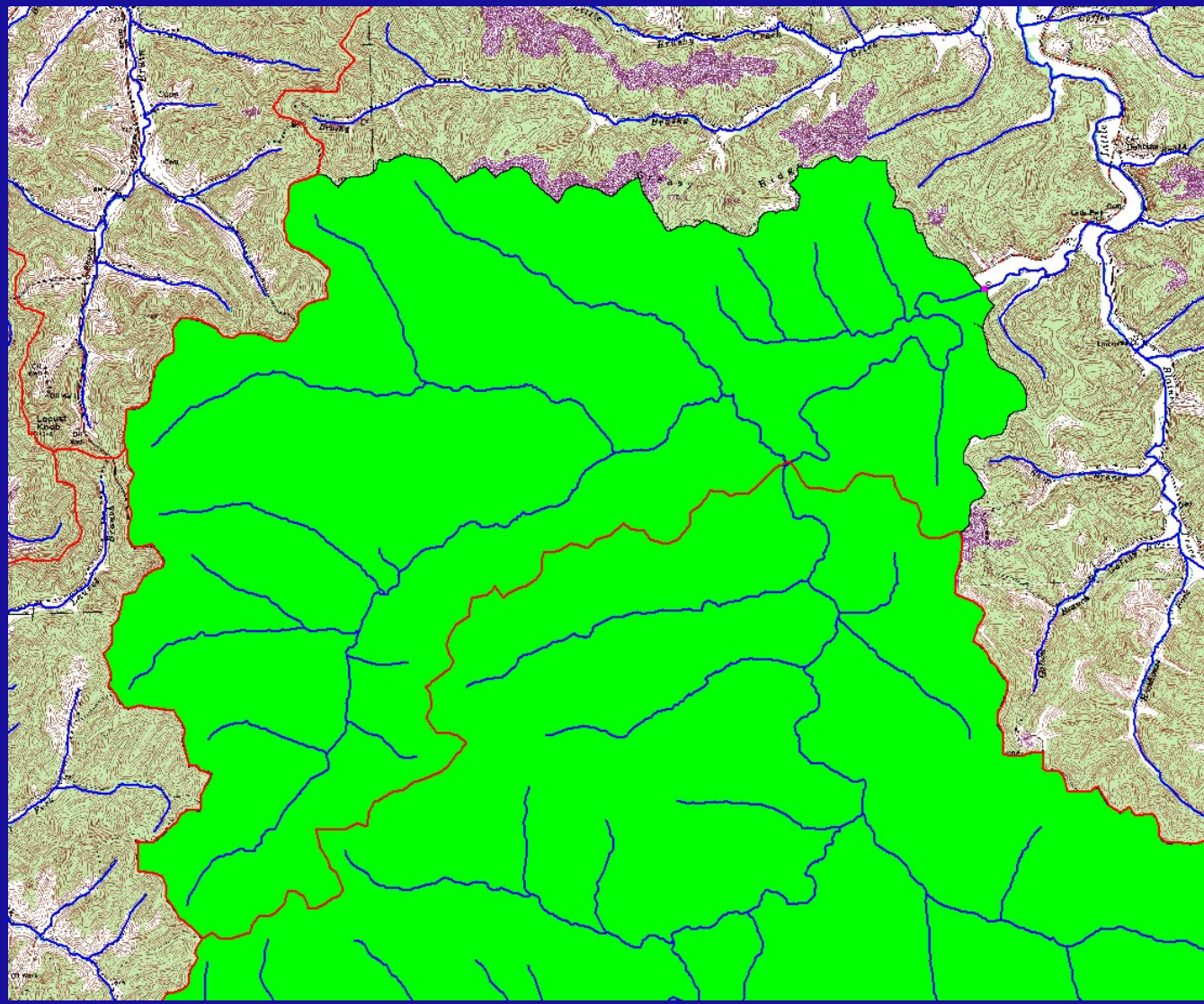
NHD Watershed Tool

Zoomed in to show point selected for watershed delineation



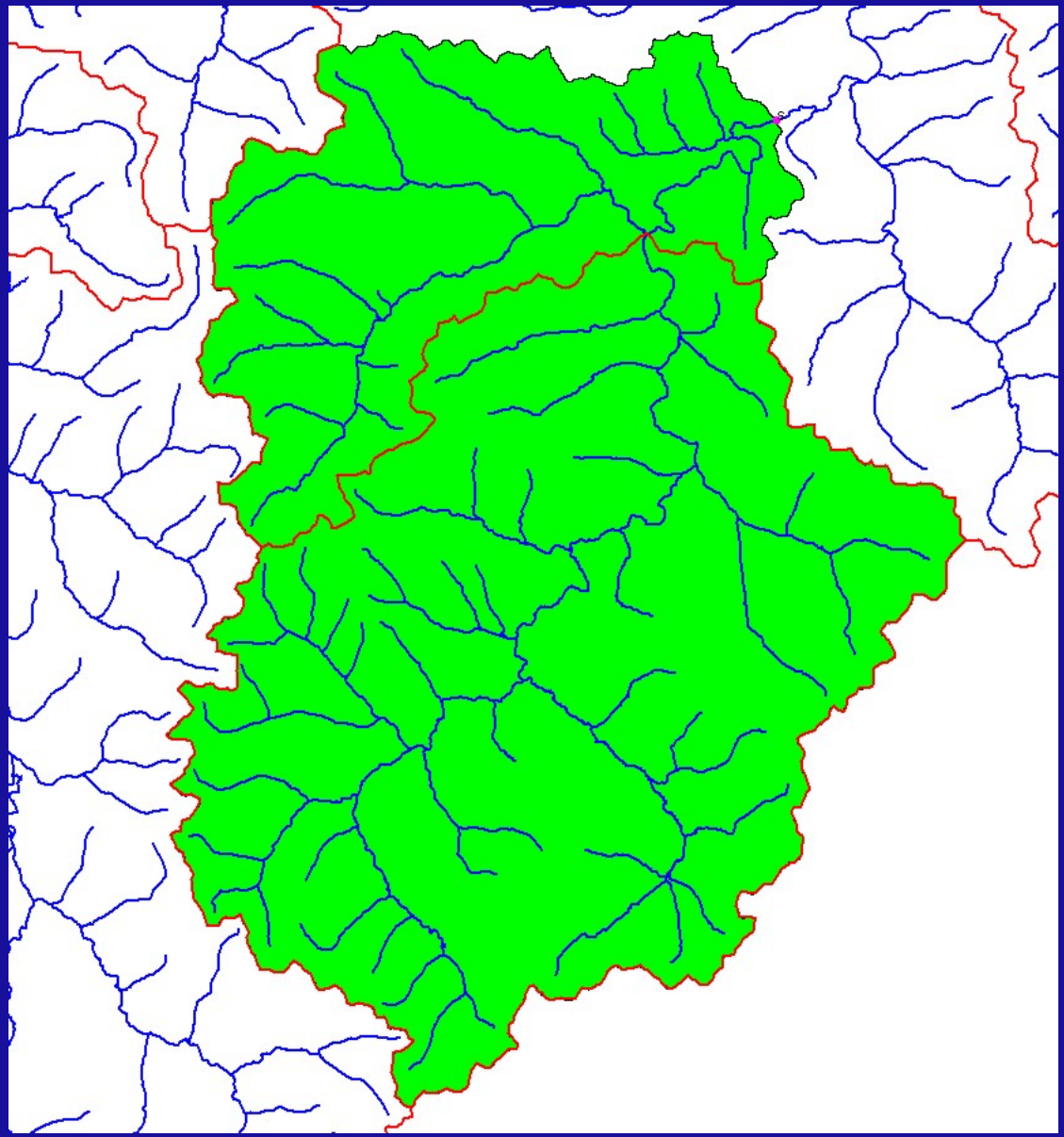
NHD Watershed Tool

Shows how the tool delineates new boundary out to the existing 10-digit HUC boundary



NHD Watershed Tool

Shows new boundary plus upstream watershed as a new watershed



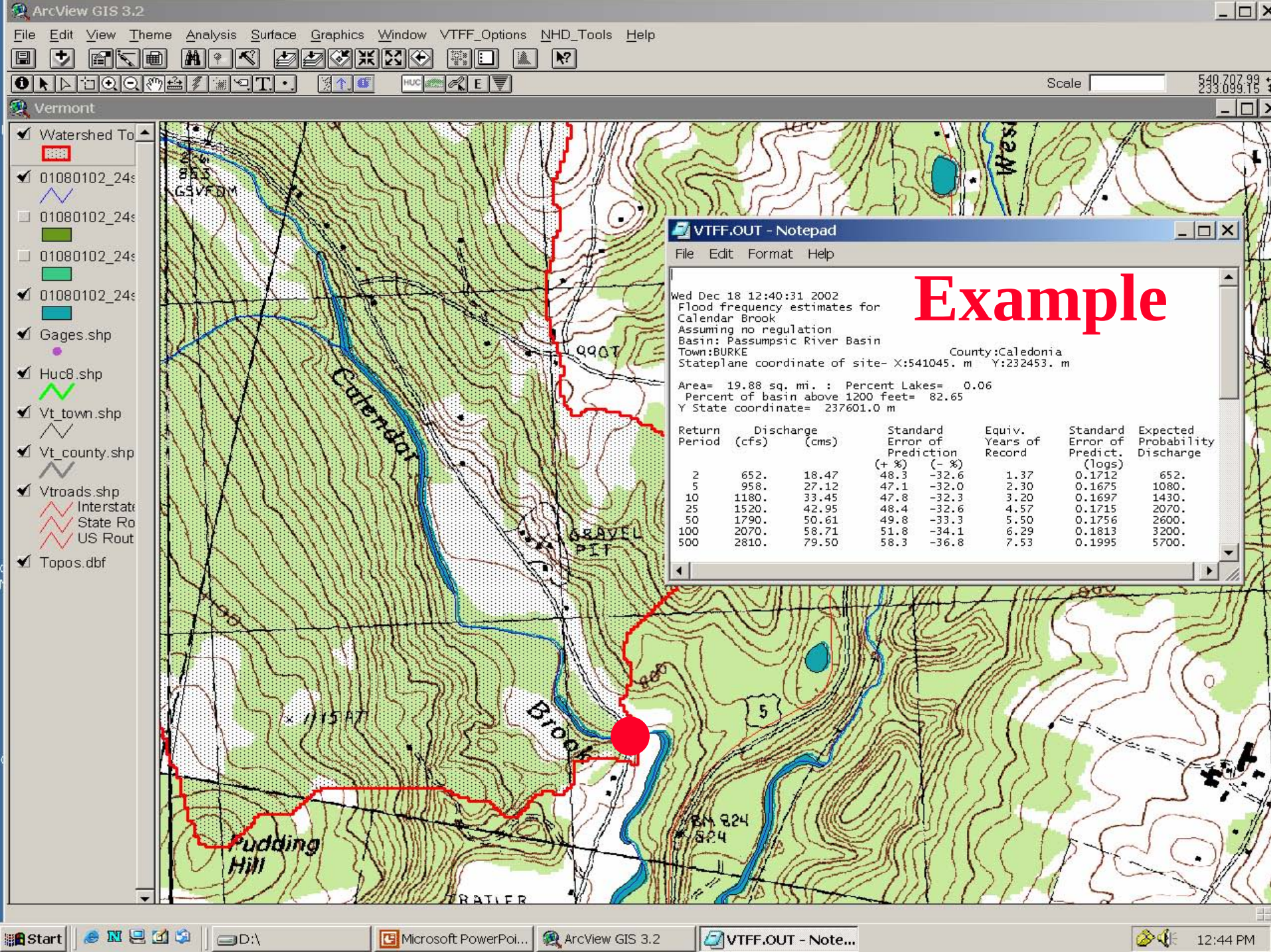
Automated Flow Frequency Data or Streamstats

- Design of structures such as roads, bridges, culverts, dams, locks, and levees
- Permits and permit reviews
- Operation of flood control structures
- Effective mitigation of flood hazards and management of flood prone areas
- However, determining stream flow frequency characteristics can be a time consuming process

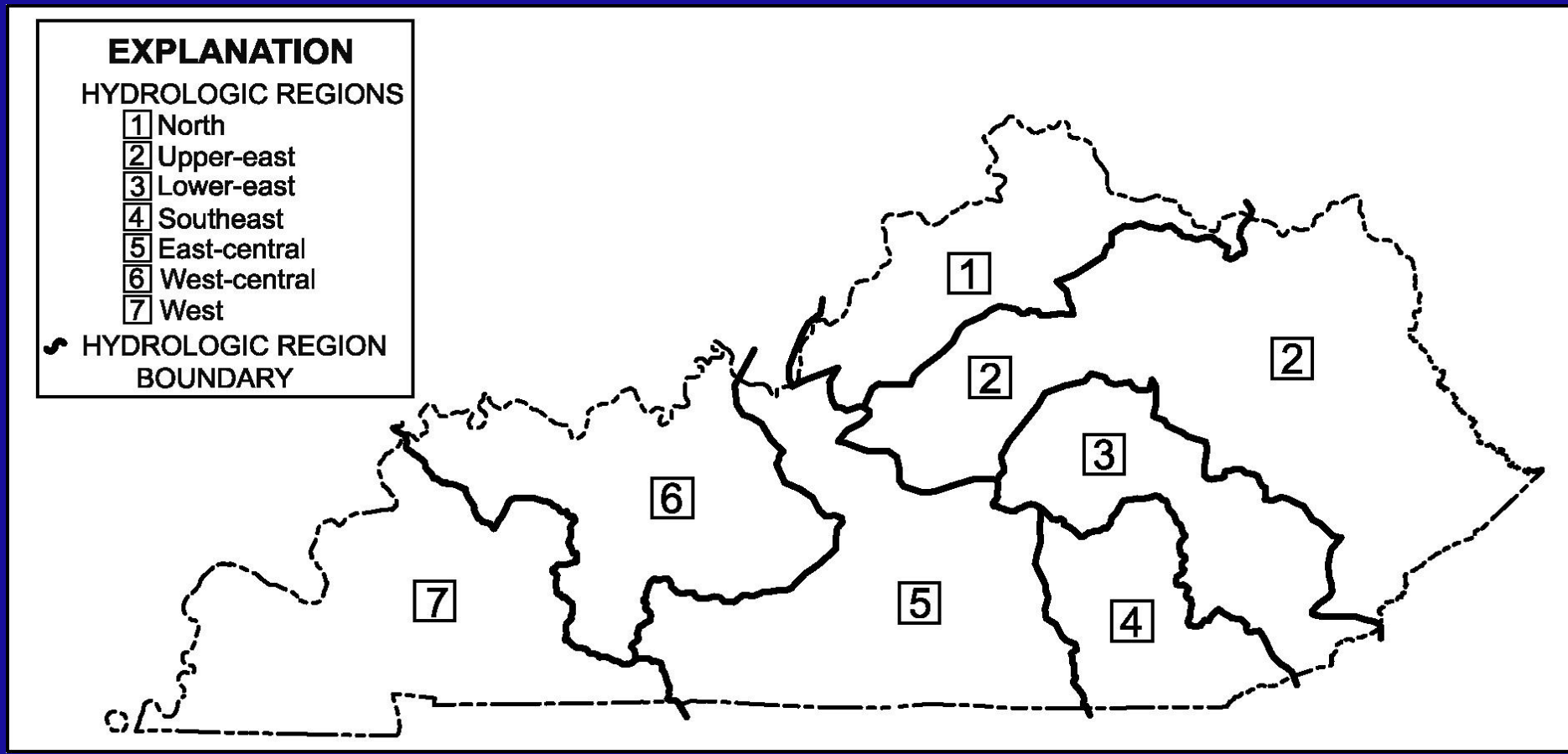
Example Peak Flow Equation (Vermont)

$$Q_{50} = 129\ A^{0.874}\ L^{-0.327}\ E^{0.115}$$

- Q_{50} = Peak discharge with a recurrence interval of 50 years
- A = Drainage area , mi^2
- L = 1 plus the % of basin covered by lakes or ponds
- E = 1 plus the % of basin at or above 1200 feet


ArcView GIS 3.2
File Edit View Theme Analysis Surface Graphics Window VTFF_Options NHD_Tools Help
Scale
Vermont
Watershed To
01080102_24s
01080102_24s
01080102_24s
01080102_24s
Gages.shp
Huc8.shp
Vt_town.shp
Vt_county.shp
Vtroads.shp
Interstate
State Ro
US Rout
Topos.dbf
VTFF.OUT - Notepad
File Edit Format Help
Example
Wed Dec 18 12:40:31 2002
Flood frequency estimates for
Calendar Brook
Assuming no regulation
Basin: Passumpsic River Basin
Town:BURKE County:Caledonia
Stateplane coordinate of site- X:541045. m Y:232453. m
Area= 19.88 sq. mi. : Percent Lakes= 0.06
Percent of basin above 1200 feet= 82.65
Y State coordinate= 237601.0 m
Return Period | Discharge (cfs) | Discharge (cms) | Standard Error of Prediction (+ %) | Standard Error of Prediction (- %) | Equiv. Years of Record | Standard Error of Predict. (logs) | Expected Probability Discharge
2 652. 18.47 48.3 -32.6 1.37 0.1712 652.
5 958. 27.12 47.1 -32.0 2.30 0.1675 1080.
10 1180. 33.45 47.8 -32.3 3.20 0.1697 1430.
25 1520. 42.95 48.4 -32.6 4.57 0.1715 2070.
50 1790. 50.61 49.8 -33.3 5.50 0.1756 2600.
100 2070. 58.71 51.8 -34.1 6.29 0.1813 3200.
500 2810. 79.50 58.3 -36.8 7.53 0.1995 5700.
Calendar
GRAVEL PIT
Brook
Pudding Hill
Start
D:\
Microsoft PowerPoi...
ArcView GIS 3.2
VTFF.OUT - Note...
12:44 PM

KY streamstats will incorporate published low & high flow statistics and estimates of N & P loads (SPARROW)



HUC Basins