DIGITAL MAPPING TECHNIQUES 2022

The following was presented at DMT'22
May 22 - 25, 2022

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2022)

http://ngmdb.usgs.gov/info/dmt/

Using ModelBuilder in ArcGIS to auto-generate sinkholes from digital elevation models

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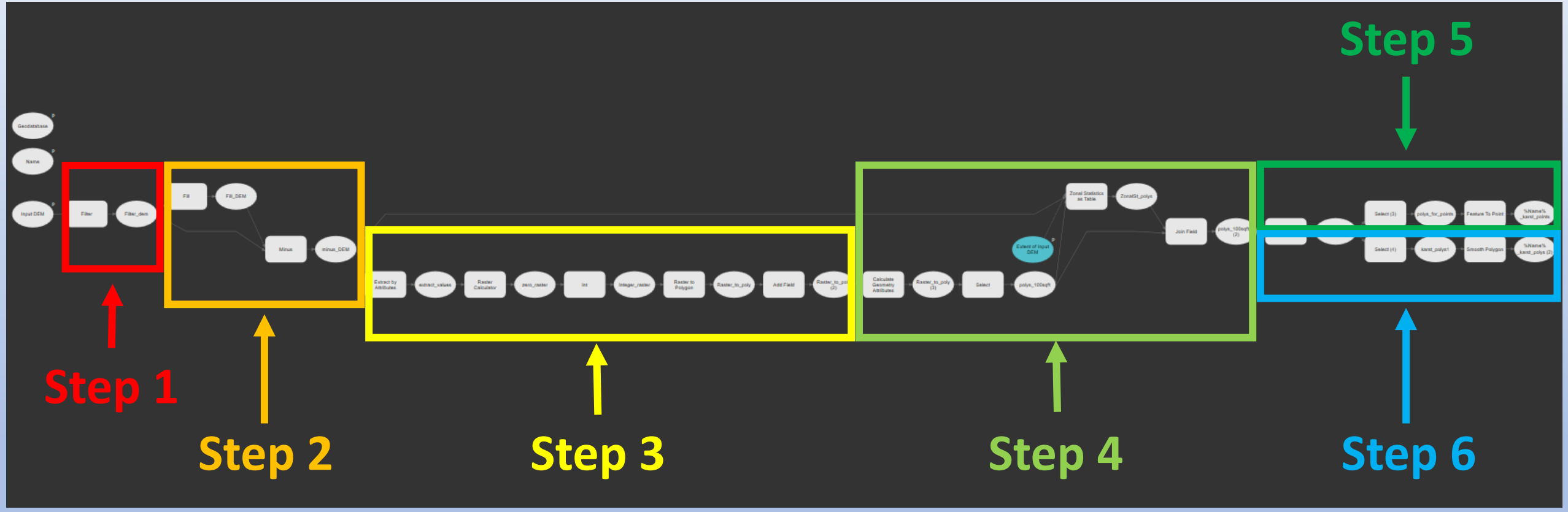
Why the model?

- To bring efficiency and consistency to the painstaking process of digitizing karst features over a large area
- We wanted to apply a Hydrocutter tool (Wall and others, 2015) to our LIDAR-derived DEMs
- We wanted to then apply the methods of Doctor and Young (2013) to automate the process of generating sinkholes in ArcGIS

→ Multiple steps involved in this process

→Some steps have a long runtime

The Model in ModelBuilder



The Process (modified from Doctor and Young, 2013)

- **Step 1: Clean up the DEM** - apply a low-pass filter (or averaging) smooths the DEM by removing noise and local variation

  → This helps to remove many “false” sinkholes within alluvium/streams

- **Step 2: Find the depressions** - Run the Fill tool and subtract from original DEM
- **Step 3: Convert the subtracted raster to polygons** - run the Extract, Times, Int, and Raster to Polygon tools
- **Step 4: Filter by depth and area** - run Calculate geometry and Zonal Statistics
- **Step 5: Convert to points for features that fit a specified criteria**
- **Step 6: Smooth remaining polygons**

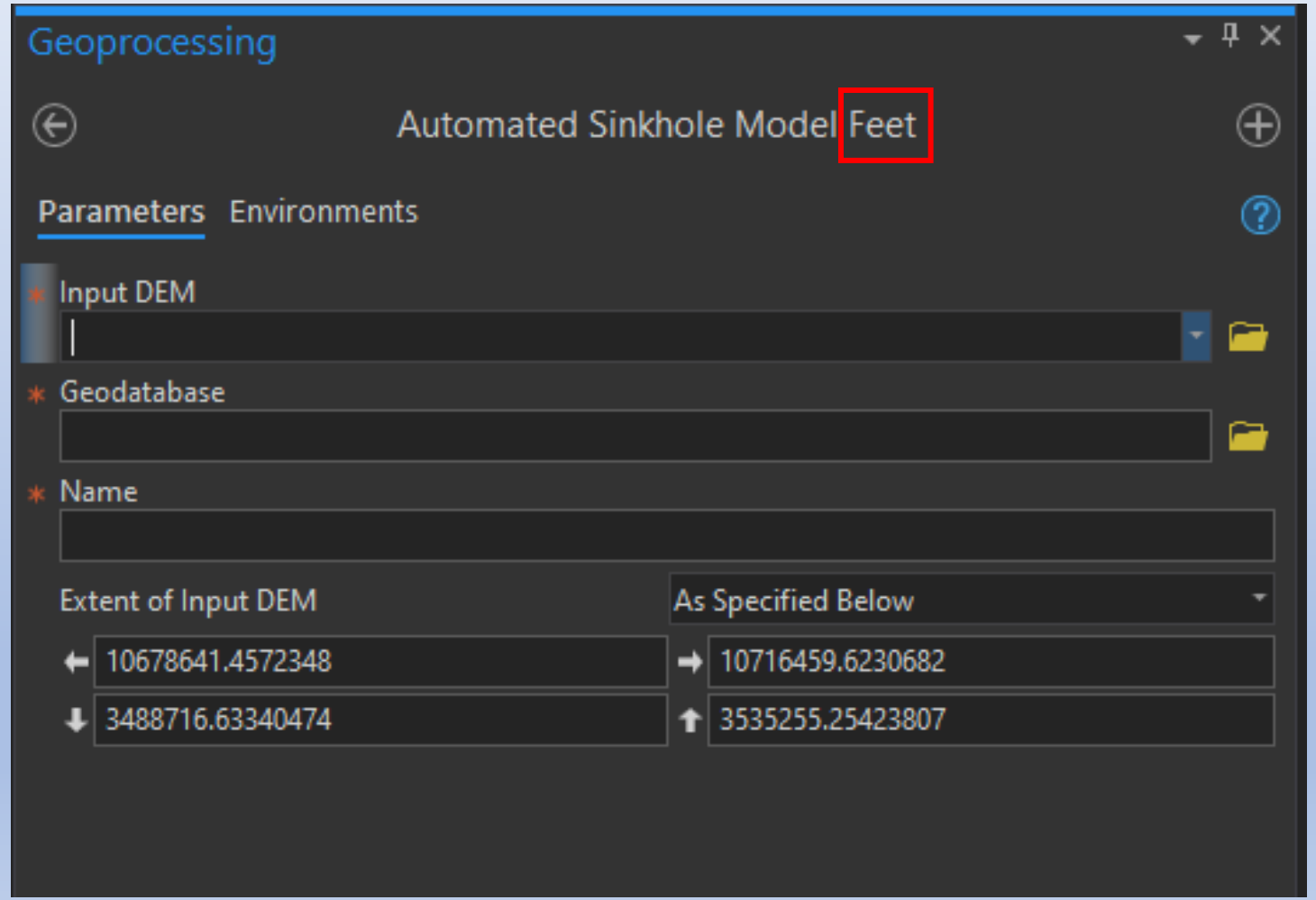
The Model in Geoprocessing View

DEM units and spatial reference should match units in the model

Create a GDB to set as the output storage

Set characters for the name (no more than five because the raster name will be too long otherwise)

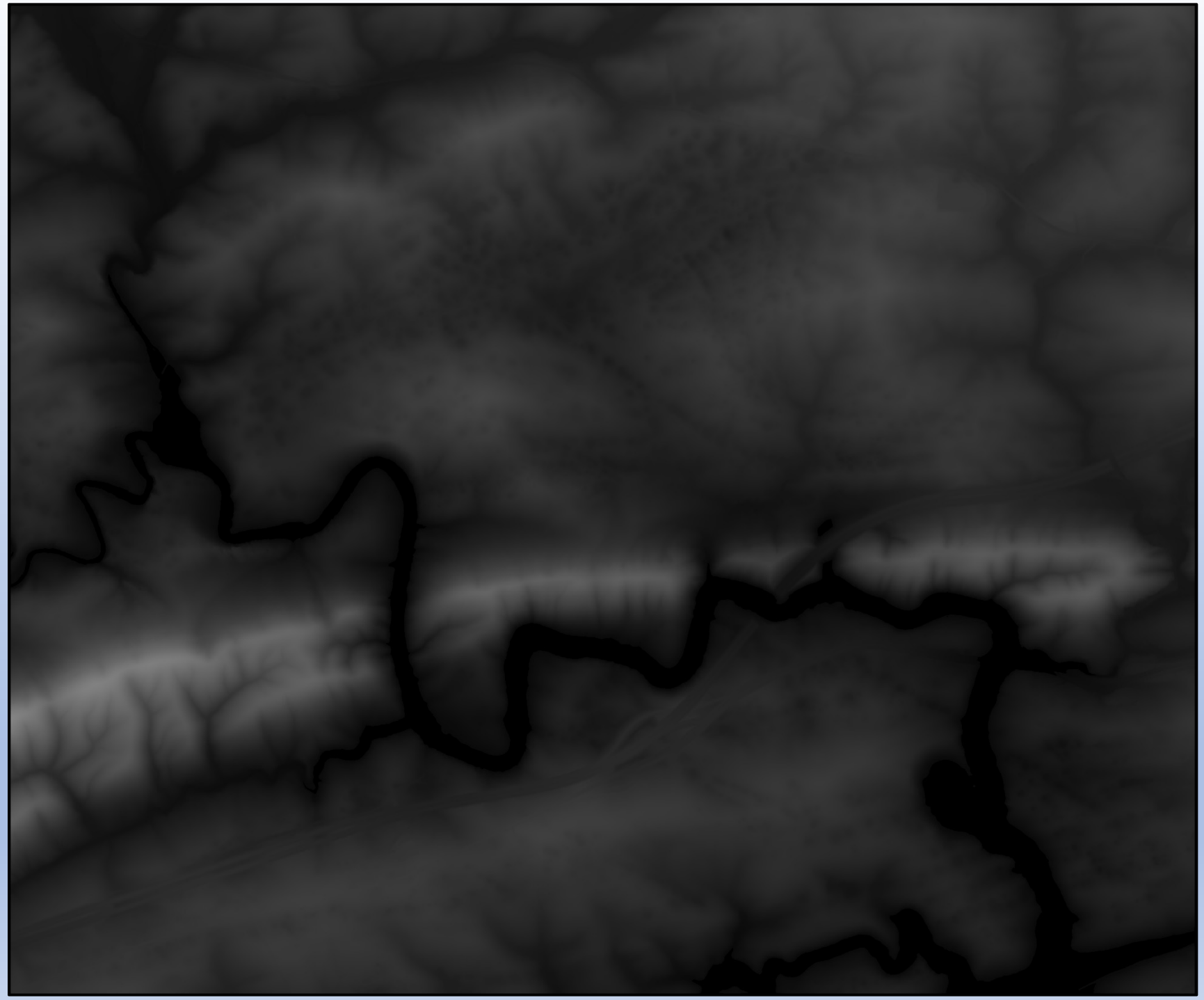
Click the “As Specified Below” dropdown menu and select your input raster to define the extent



A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Input DEM



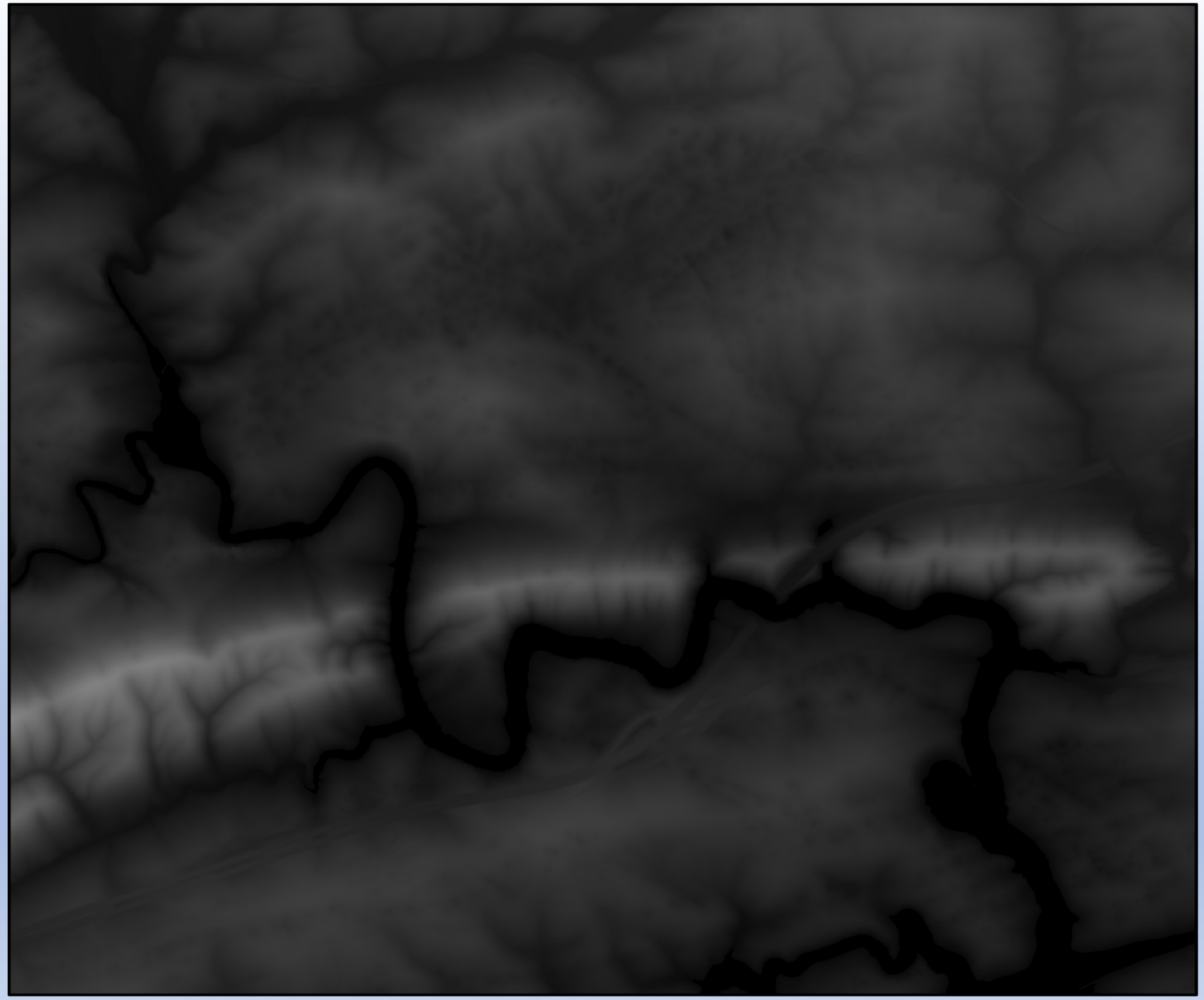
Scale: 1:24,000

A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Filtered DEM

Scale: 1:24,000

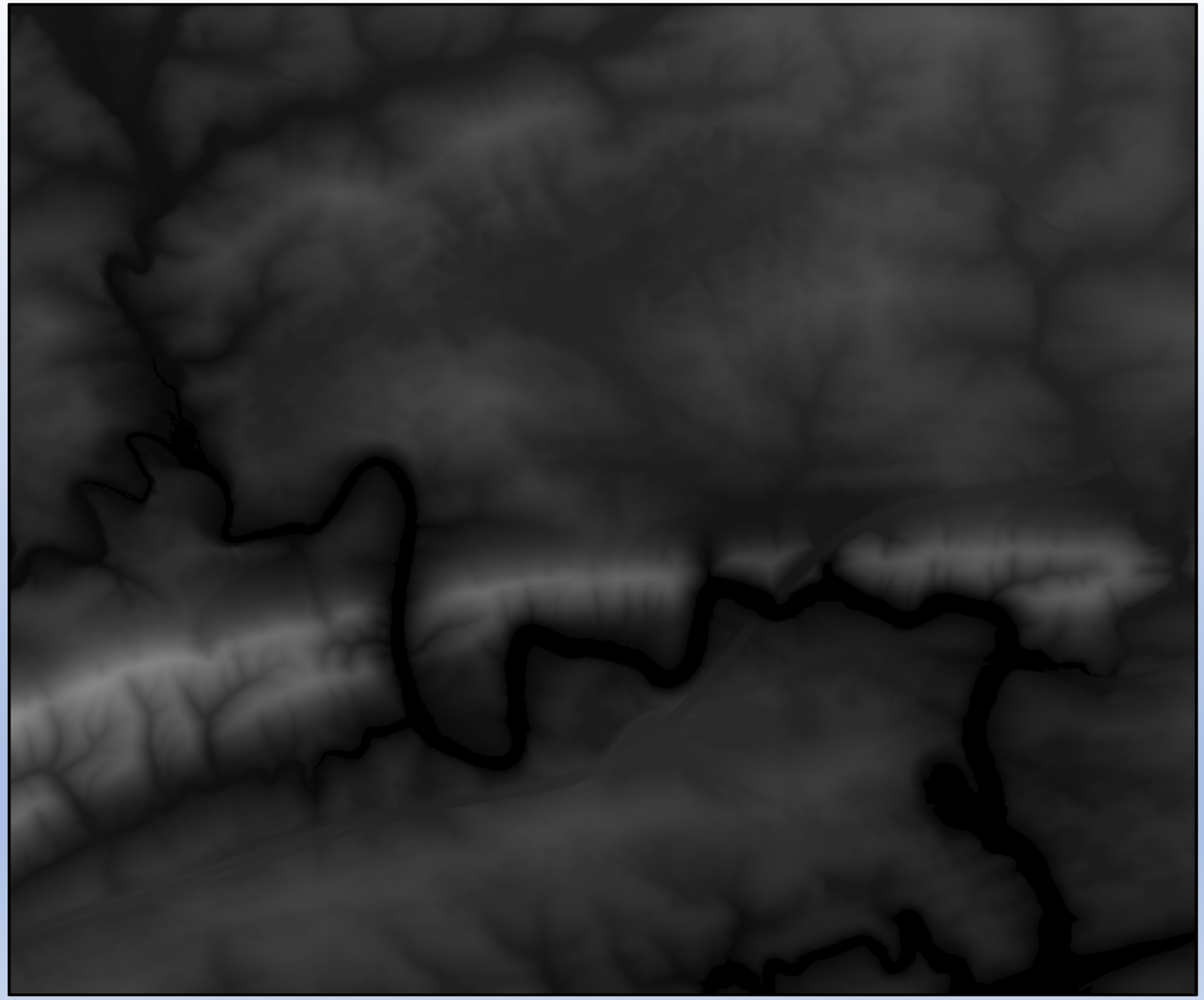


A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Filled DEM

Scale: 1:24,000

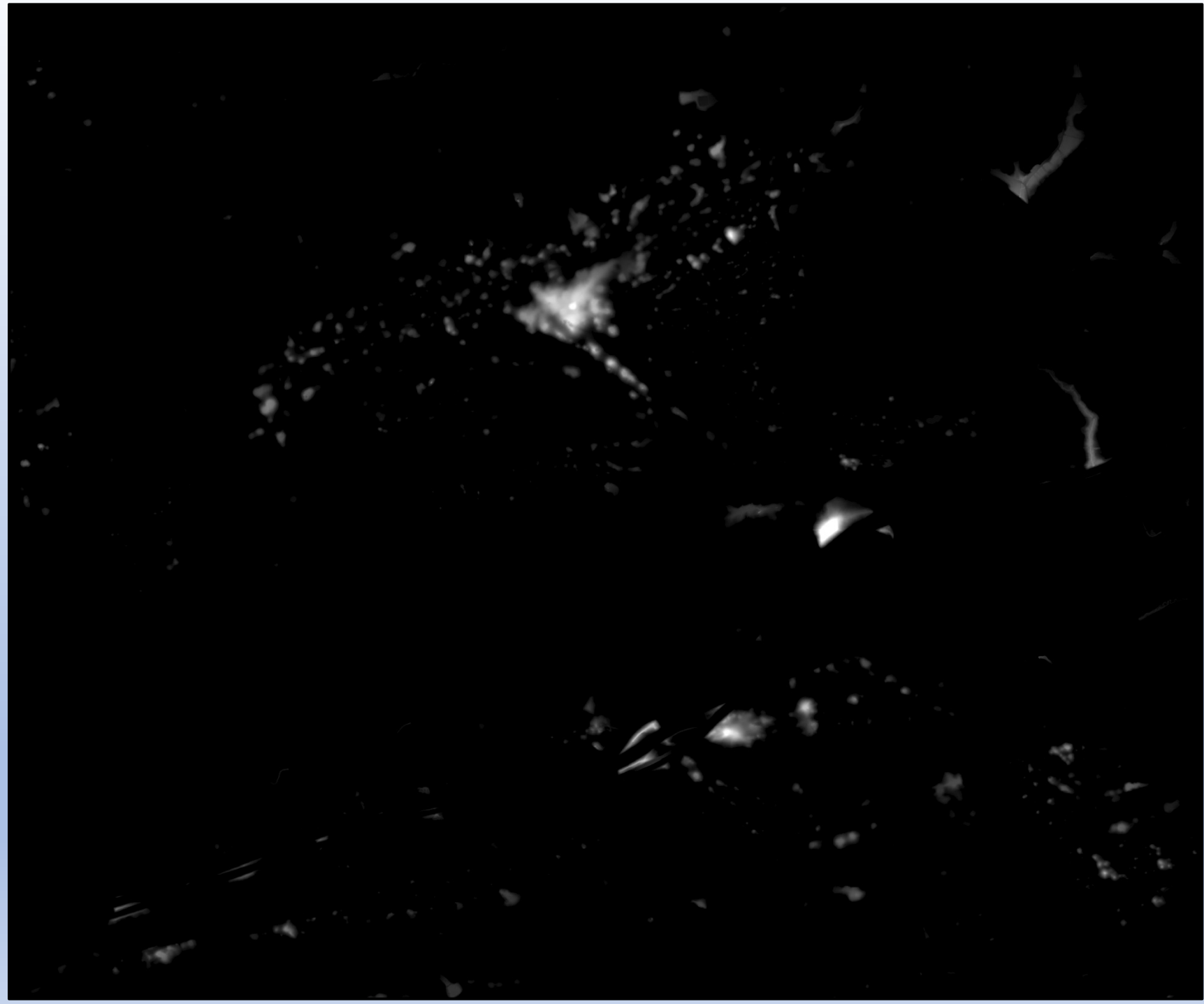


A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Minus DEM

Scale: 1:24,000



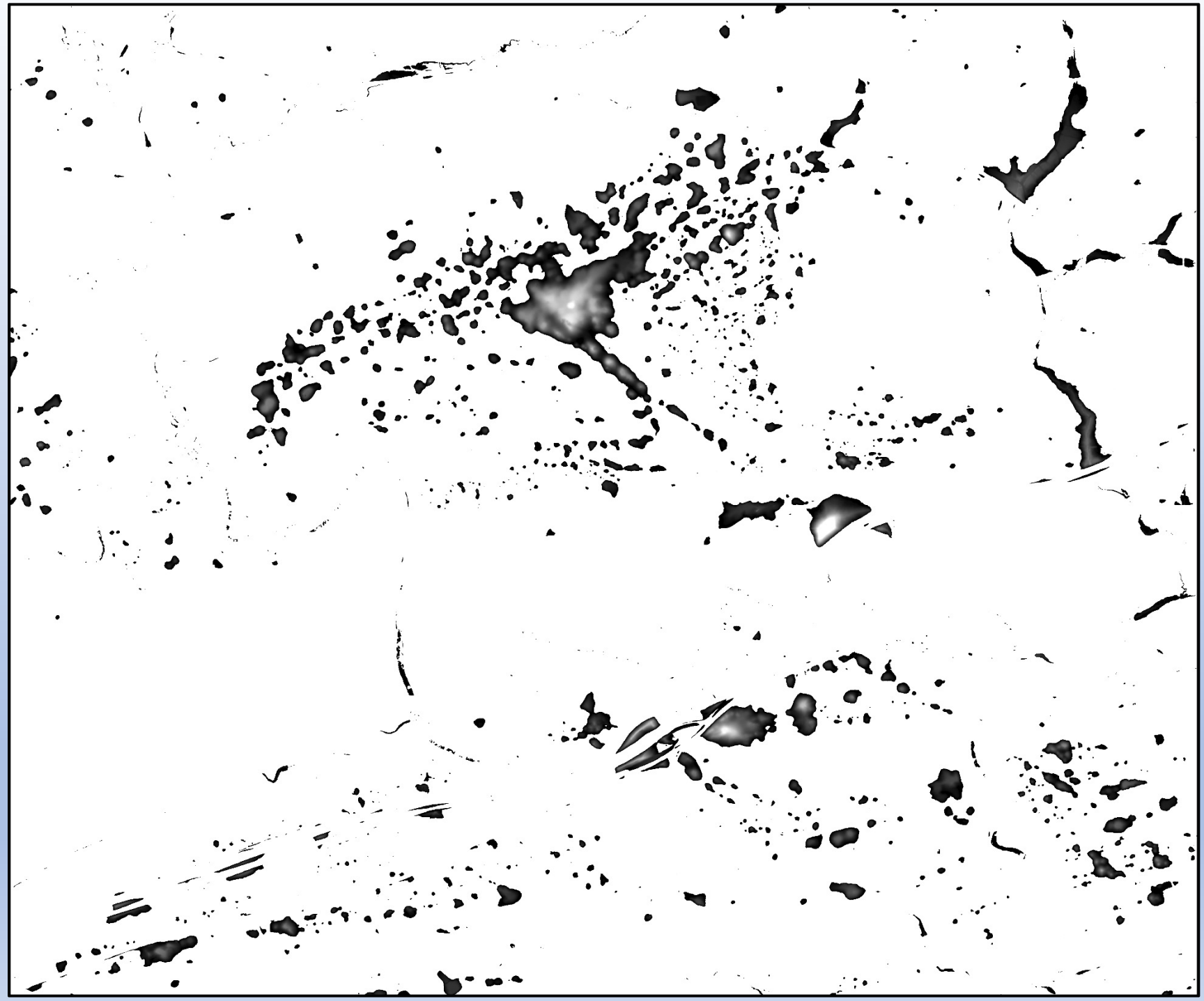
A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Extracted DEM

Values > 10cm

Scale: 1:24,000

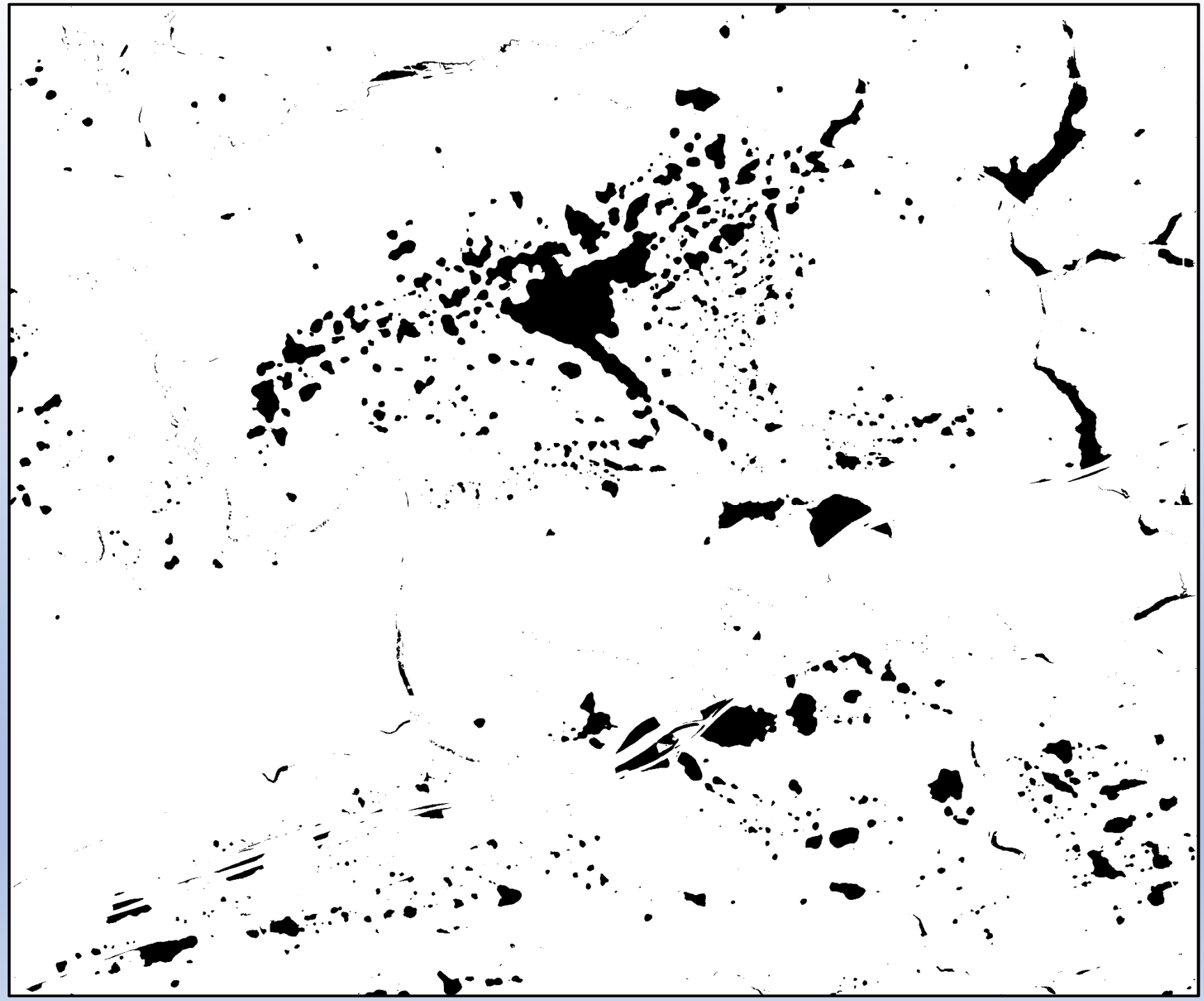


A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Zeroed DEM

Scale: 1:24,000

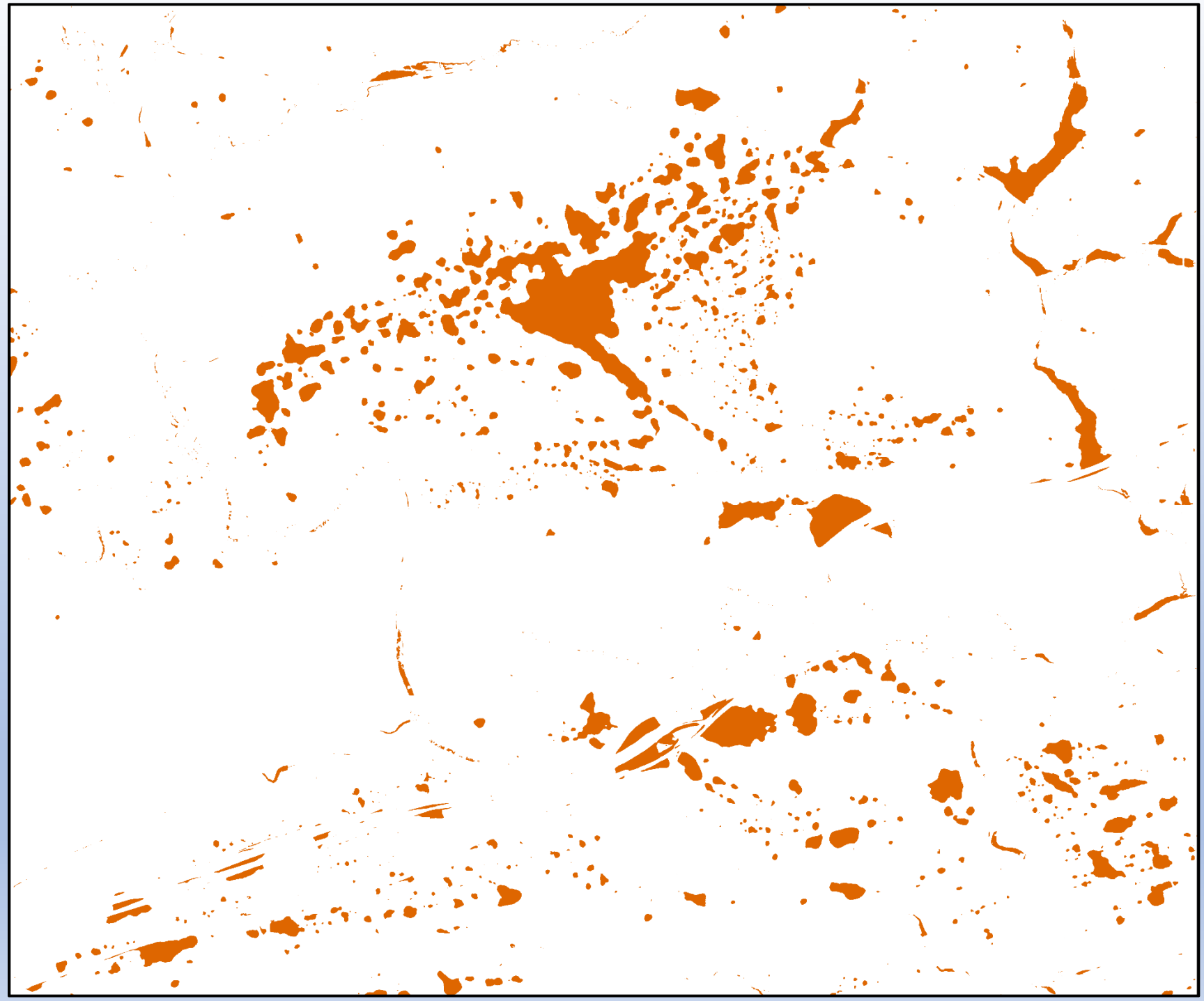


A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Integer DEM

Scale: 1:24,000

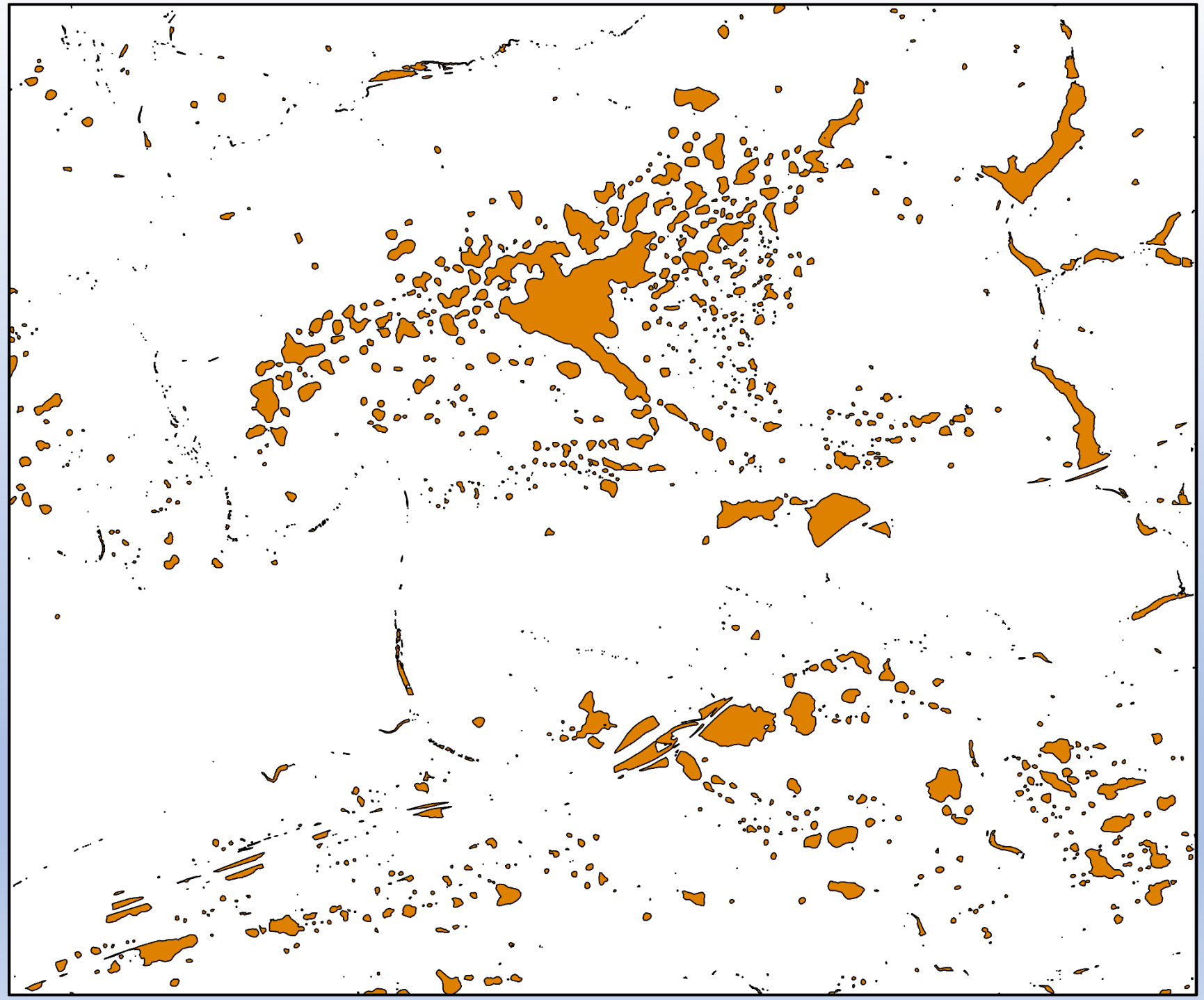


A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

DEM to Polygon

Scale: 1:24,000



A glimpse from input to each output:

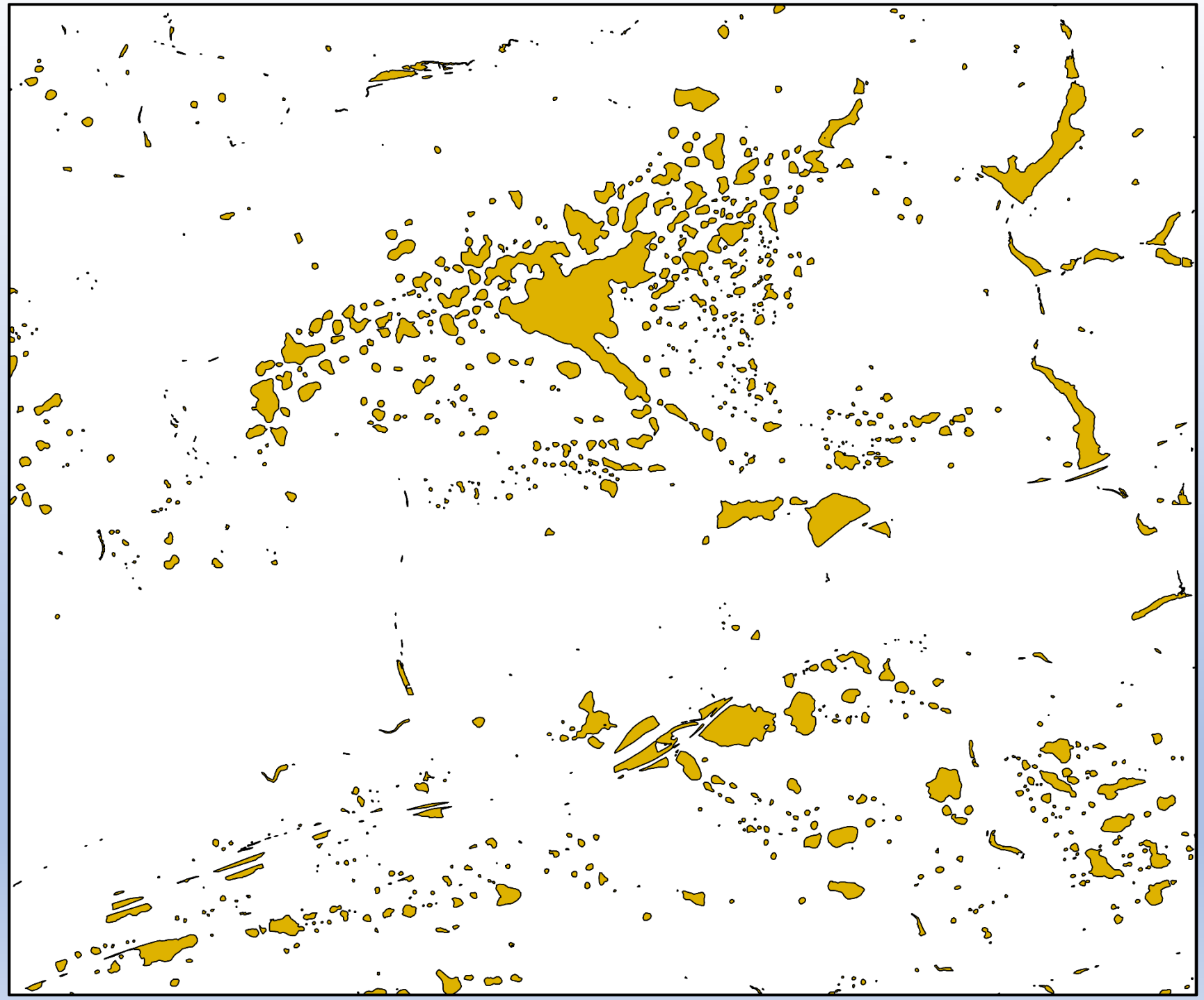
Crockett 1:24K quadrangle, VA

Queried Polygons

Depth > 0.59ft

Area > 100ft^2

Scale: 1:24,000

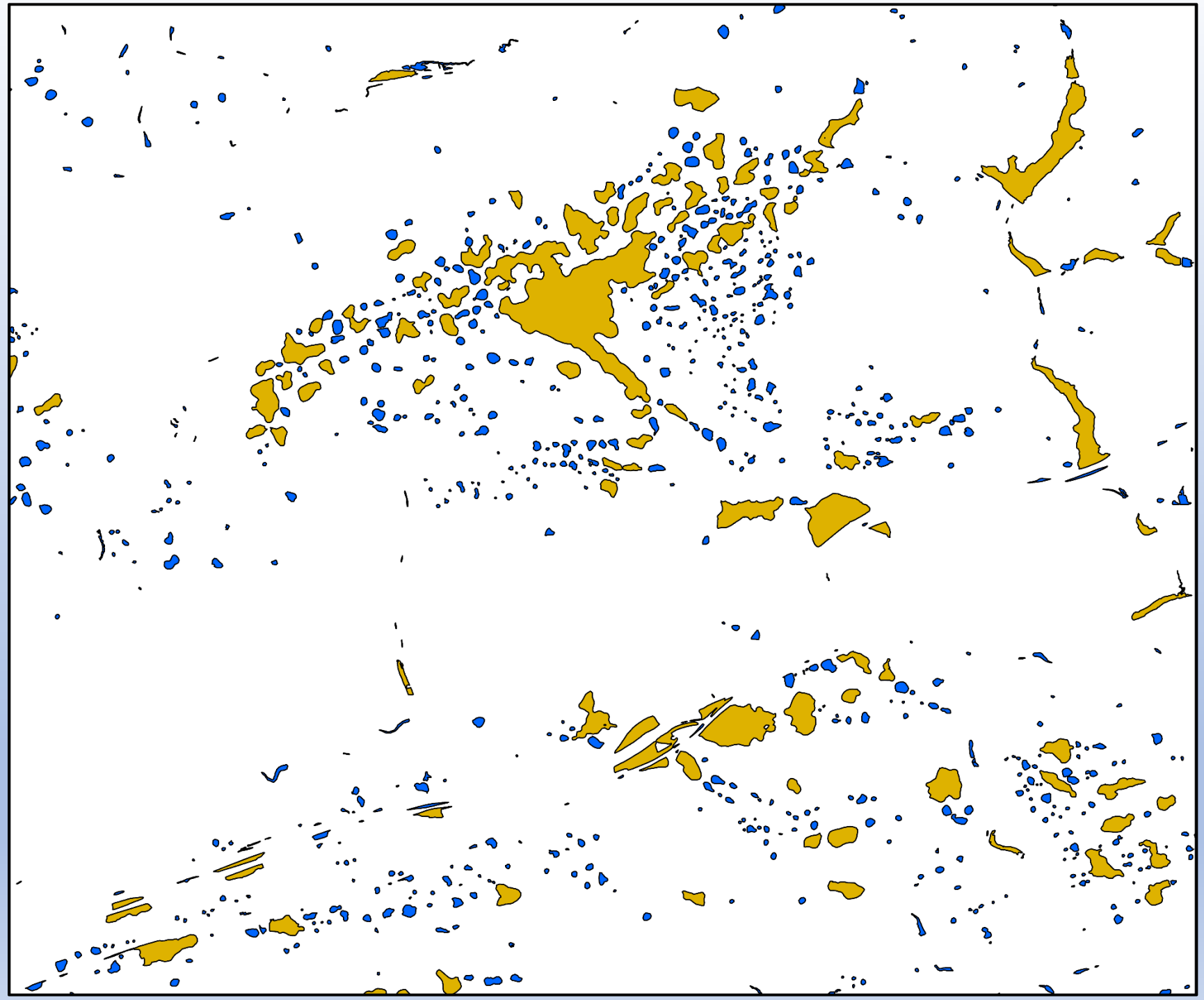


A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Polygons and polygons for points

Scale: 1:24,000

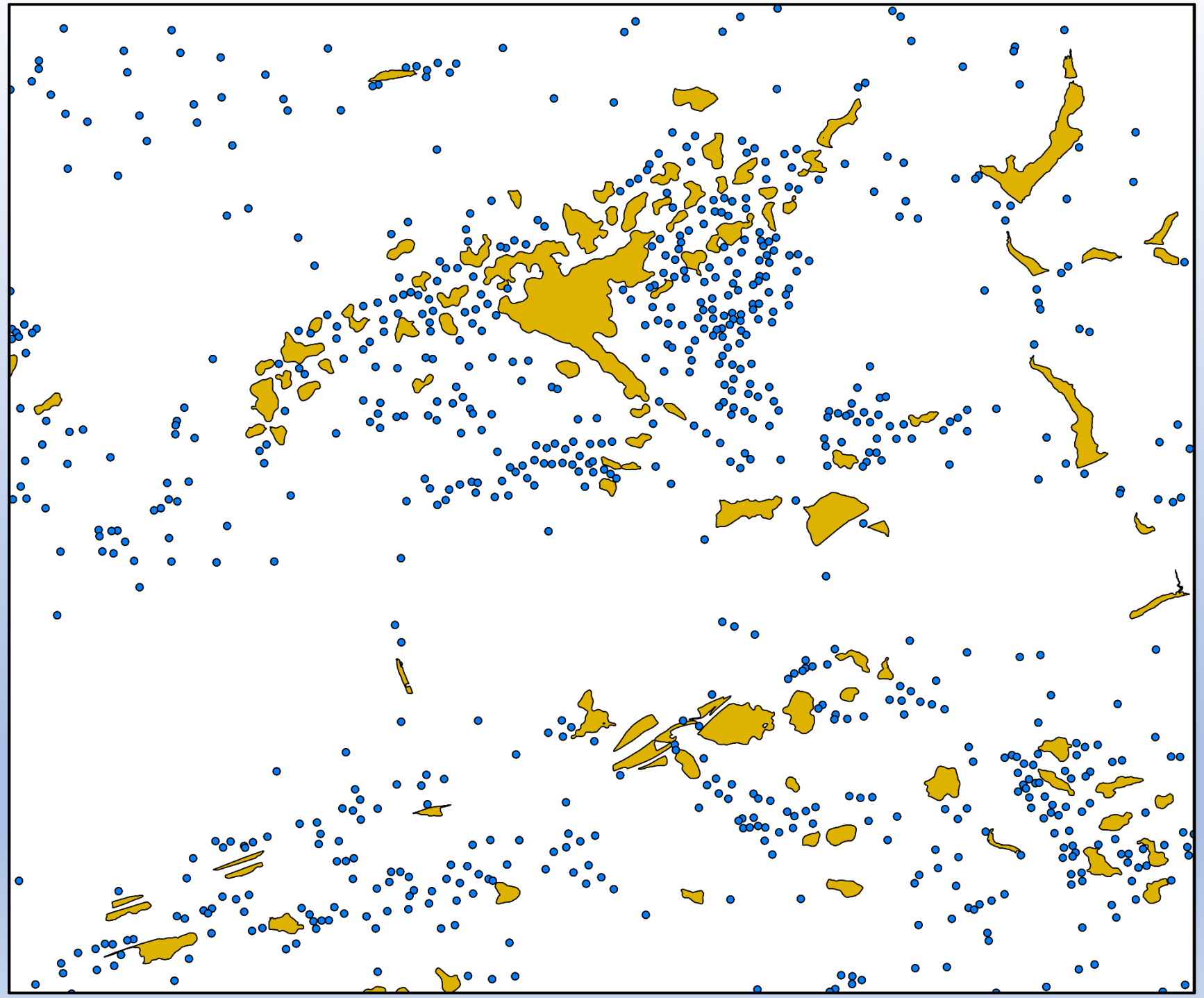


A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Polygons (smoothed) and Points

Scale: 1:24,000



A glimpse from input to each output:

Crockett 1:24K quadrangle, VA

Final Results with GeMS symbology

Scale: 1:24,000

Pros

1. A one step process
2. Reproducibility and consistency
3. Customizable
4. User friendly
5. Steps of the process are mapped out from A to Z

Cons

1. Can be error-prone
2. Long runtime for large datasets
3. Must know ModelBuilder or coding to customize
4. Many outputs are “false” sinkholes
5. Misses some open-ended depressions
6. Points are not placed in deepest part of depression

Lessons Learned

- Need to consider resolution of contract-delivered LIDAR
  - →will higher resolution LIDAR really work for your needs?
- Need to understand resolution of final product (large- vs. small-scale project)
  - →Do the outputs fit your scale? Parameters need to be adjusted as needed
- Check the unit and spatial reference in all parts of project
  - →Mixing these (i.e. feet and meters) will impact the model/outputs
- Can take advantage of ArcGIS Pro 64-bit processing speeds
  - →The processing speed and improved tools can reduce runtime

Questions