Drainage Delineation Using GIS: A Step-by-Step Guide

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*Note: This workflow requires the Spatial Analyst extension in ArcGIS. *

These simple 8 steps will create a watershed boundary within minutes.

1. Mosaic to New Raster

This tool combines multiple DEM tiles into a single, combined raster.

- Set the projection to the blank data frame.

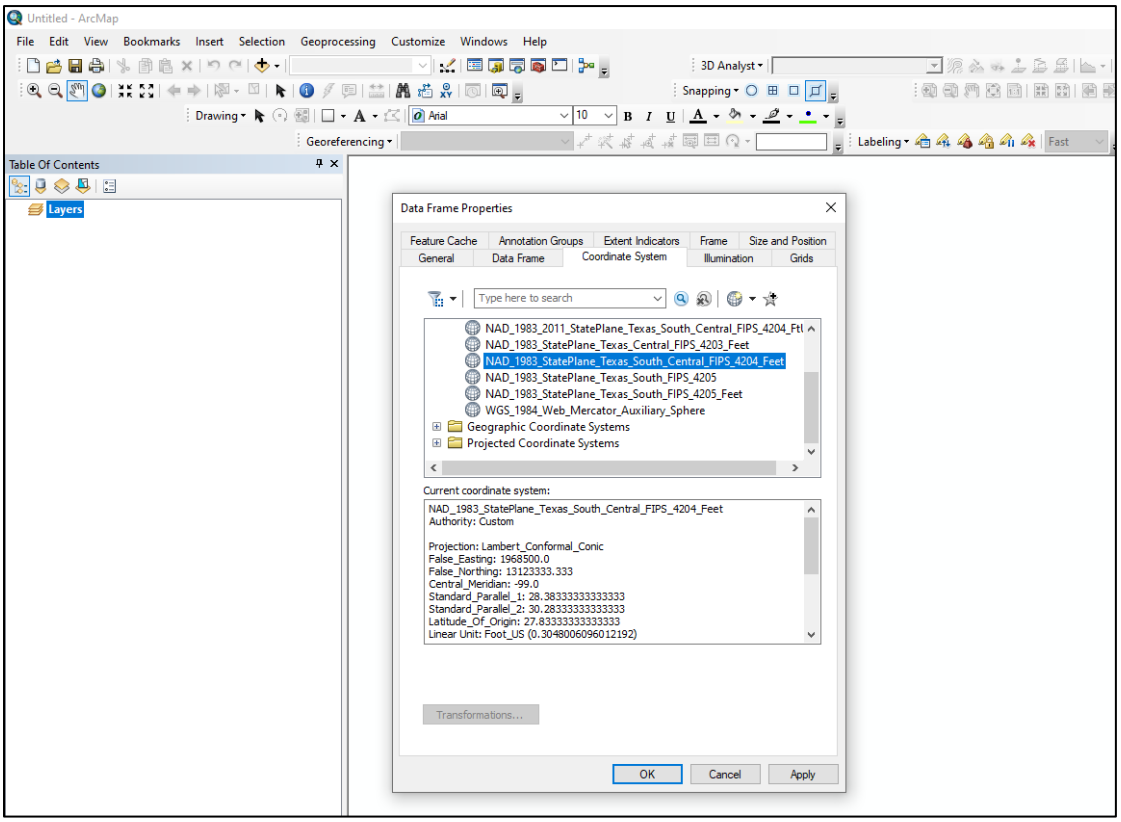

Figure 1 - Set Projection

- Navigate to: ArcToolbox > Data Management Tools > Raster > Raster Dataset > Mosaic To New Raster
- Add your DEM files as input rasters.
- Specify the output location and name.
- Set the desired pixel type and number of bands.
- Run the tool to create a unified DEM.

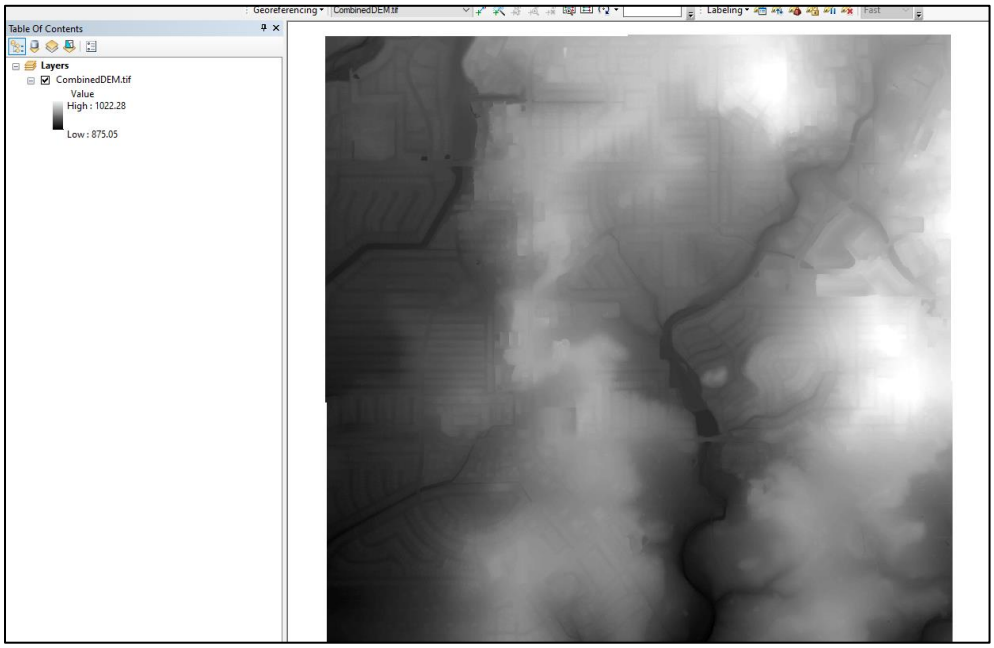

Figure 2 - Result of "Mosaic to New Raster" Tool

2. Raster Calculator (for unit conversion) -

*Skip this step if the conversion of units is not needed

This tool converts raster elevation values from meters to feet.

- Navigate to: ArcToolbox > Spatial Analyst Tools > Map Algebra > Raster Calculator
- Enter the expression: "Projected/Combined_DEM" * 3.28
- Specify the output raster name.
- Run the tool to generate a DEM with elevation in feet.

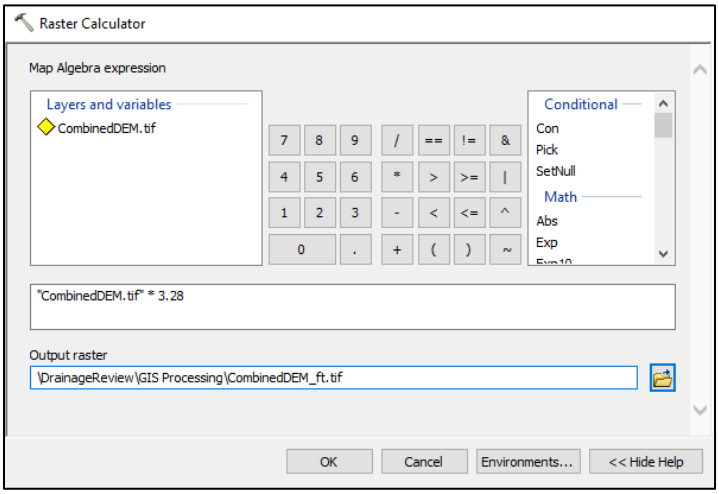

Figure 3 - Input parameters of Raster Calculator

3. Clip Raster to Study Area ("Clip Raster")

This tool extracts the area of interest from the DEM.

- Navigate to: ArcToolbox > Data Management Tools > Raster > Raster Processing > Clip
- Input Raster: Your unit-converted DEM.
- Clip Feature: Your study area boundary shapefile. [This is your study limit in polygon shp]
- Check "Use Input Features for Clipping Geometry."
- Specify the output raster name.
- Run the tool to obtain the clipped DEM.

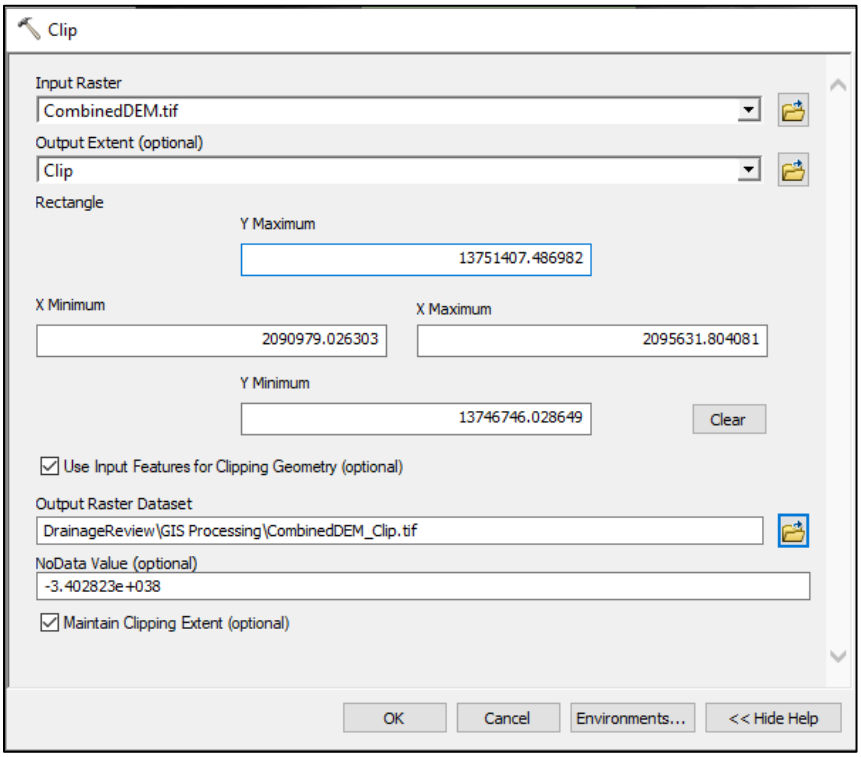

Figure 4 - Input Parameters of "Clip Raster" Tool

4. Fill Sinks in DEM (“Fill”)

This “Fill” tool removes depressions (sinks) to ensure proper flow modeling.

- Navigate to: ArcToolbox > Spatial Analyst Tools > Hydrology > Fill
- Input Surface Raster: Clipped DEM.
- Specify the output raster name.
- Run the tool to create a filled DEM.

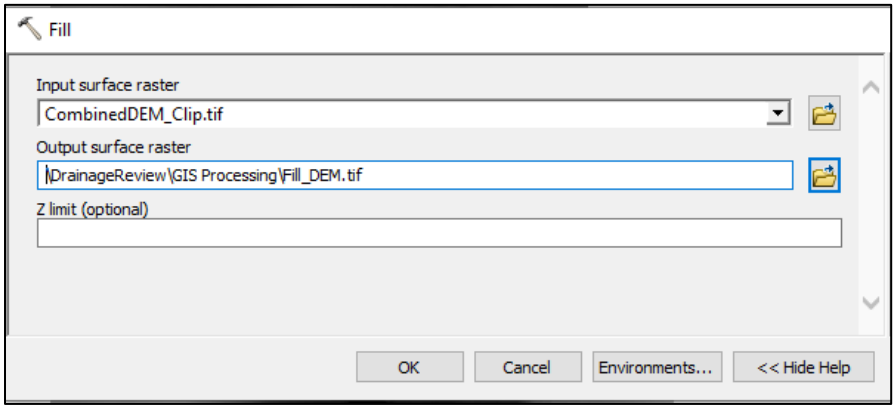

Figure 5 -Input Parameters of “Fill” Tool

5. Determine Flow Patterns (“Flow Direction”)

The “Flow Direction” tool calculates the direction of flow from each cell.

- Navigate to: ArcToolbox > Spatial Analyst Tools > Hydrology > Flow Direction
- Input Surface Raster: Filled DEM.
- Specify the output raster name.
- Run the tool to generate a flow direction raster.

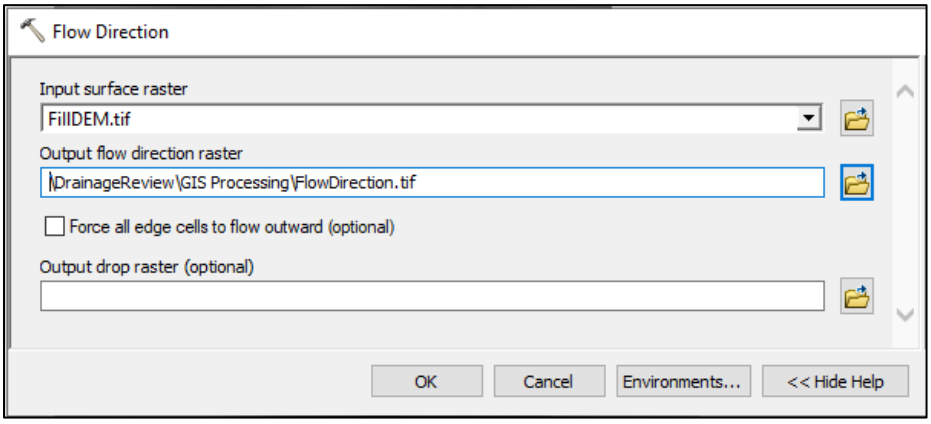

Figure 6 - Input Parameters of “Flow Direction” Tool

*The result of this tool is shown below. If you didn't get 8 sub colors, then you have missed the "Fill" step.

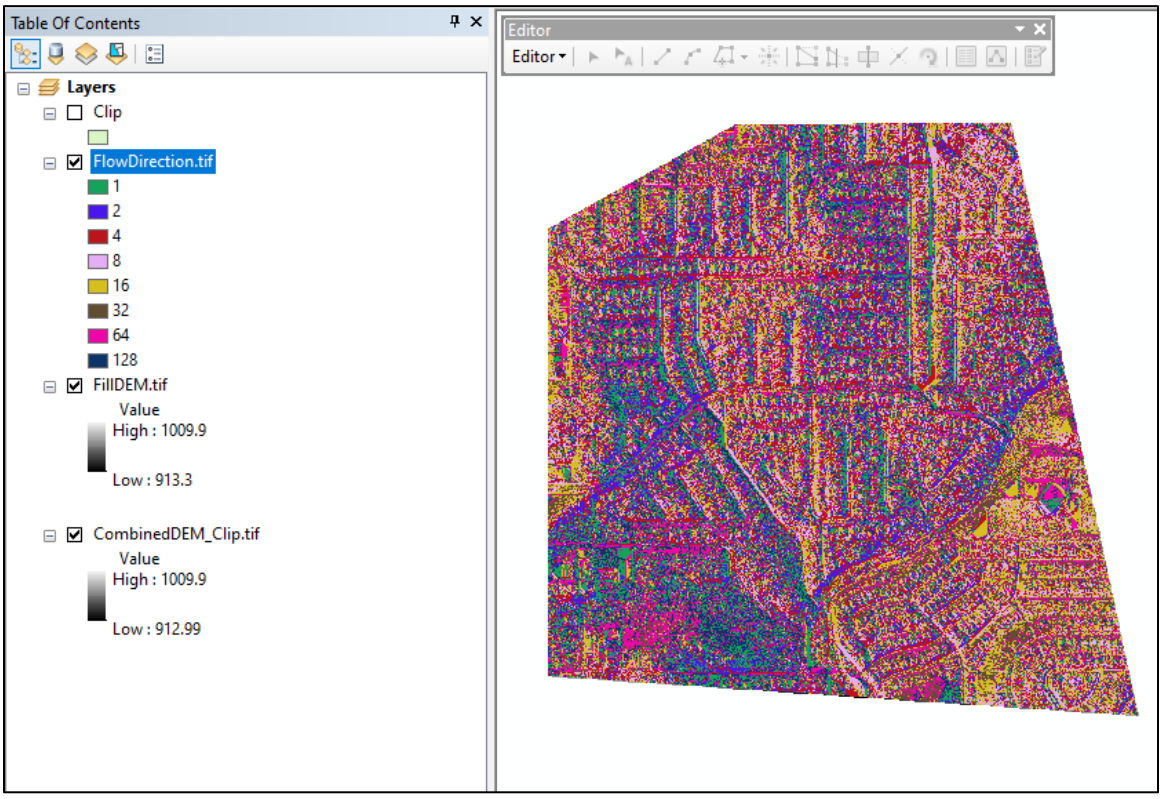

Figure 7 - Result of "Flow Direction" Tool

6. Calculate Flow Accumulation ("Flow Accumulation")

The "Flow Accumulation" tool computes the accumulated flow into each cell.

- Navigate to: ArcToolbox > Spatial Analyst Tools > Hydrology > Flow Accumulation
- Input Flow Direction Raster: Output from the previous step.
- Specify the output raster name.
- Run the tool to create a flow accumulation raster.

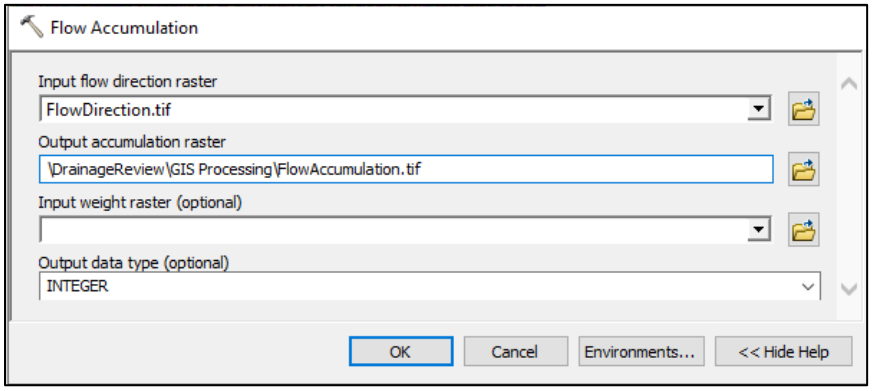

Figure 8 - Input Parameters of "Flow Accumulation" Tool

* In output type "Integer" will be faster in processing than "Float"

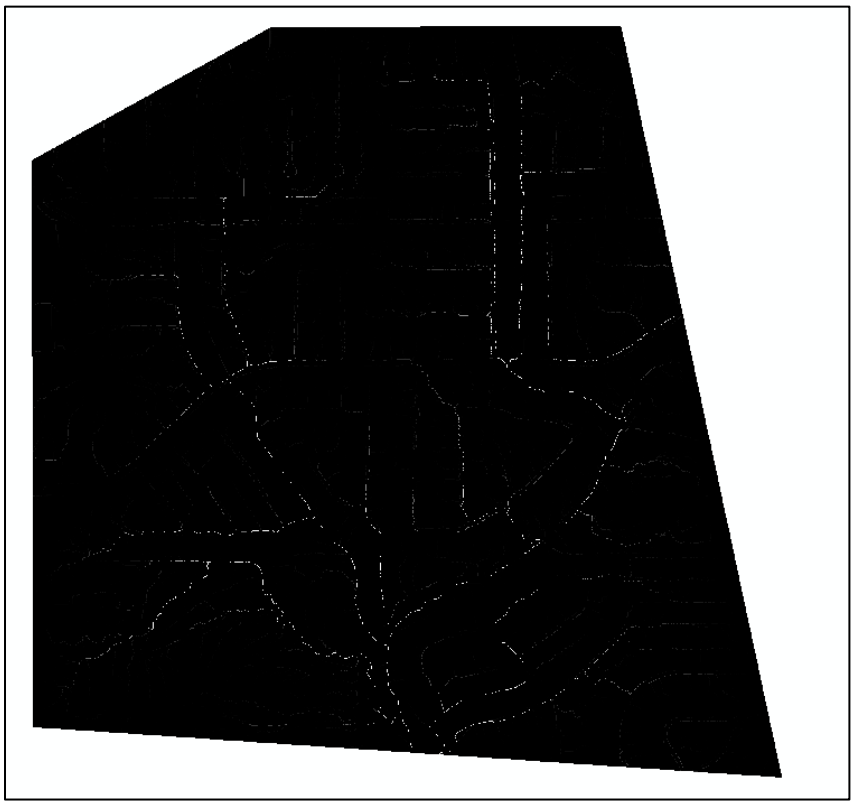

Figure 9 - Result of Flow Accumulation

7. Extract Flow Paths (“Raster Calculator”)

The “Raster Calculator” tool identifies potential stream channels based on the accumulation of flow.

- Navigate to: ArcToolbox > Spatial Analyst Tools > Map Algebra > Raster Calculator
- Enter the expression: *Con ("Flow_Accumulation" > 100, 1)*
- Specify the output raster name.
- Run the tool to delineate flow paths.

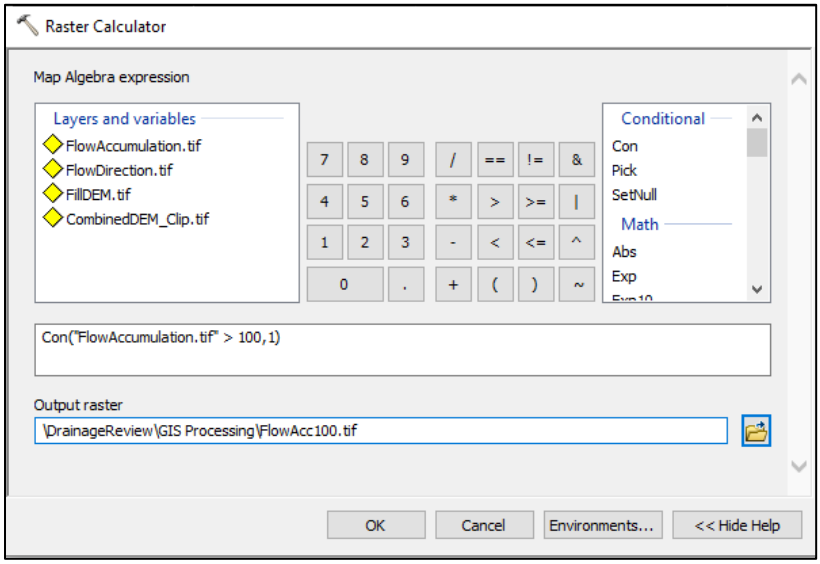

Figure 10 - Input Parameters of “Raster Calculator” Tool

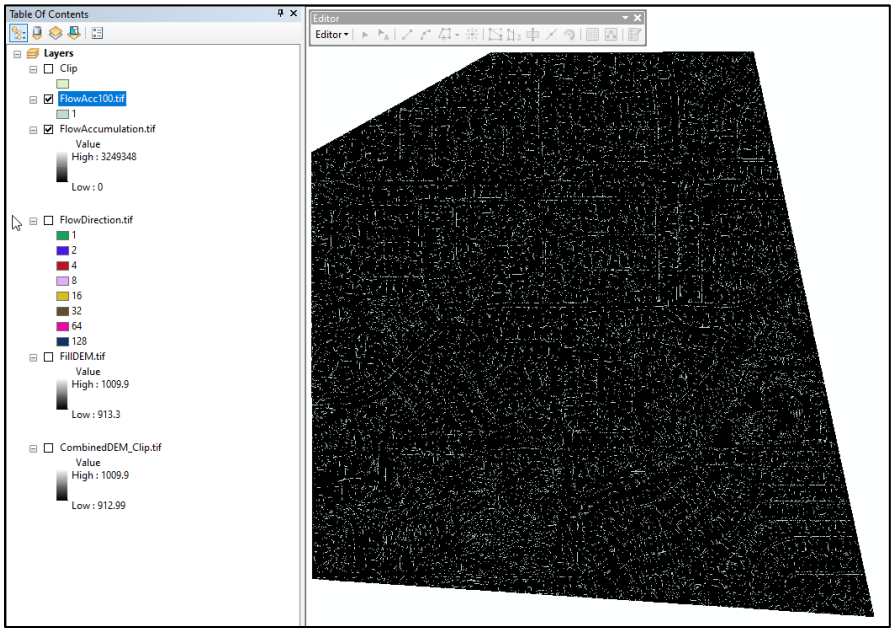

Figure 11 - Result of Raster Calculator

8. Delineate Watersheds Boundary ("Watershed")

"Watershed" tool defines drainage areas contributing to specific points. The point must be on the stream.

- Navigate to: ArcToolbox > Spatial Analyst Tools > Hydrology > Watershed
- Input Flow Direction Raster: Output from Step 5.
- Create a new point shapefile with the location at the project outfall.

Figure 12 - Create a point file at the project outfall

- Input Pour Point Feature: Shapefile containing points of interest.
- Specify the output raster name.
- Run the tool to generate watershed boundaries.

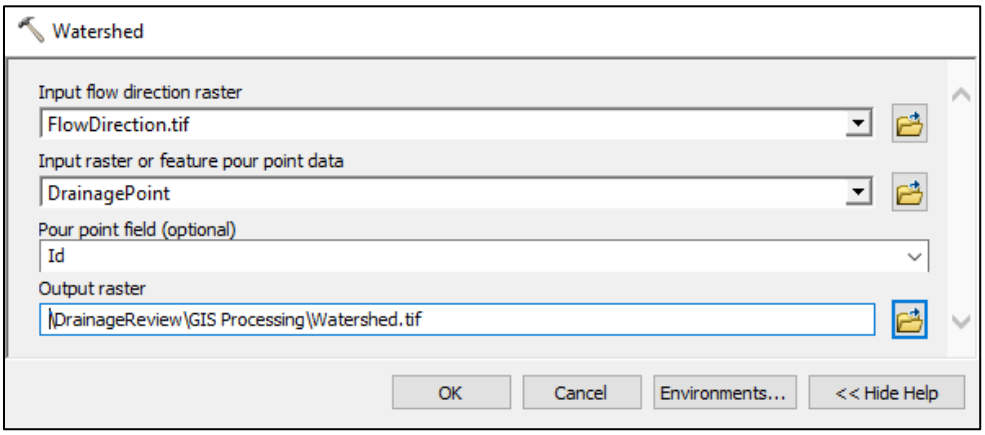

Figure 13 - Input Parameters of "Watershed" Tool

The following is your watershed boundary at the given drainage computation point.

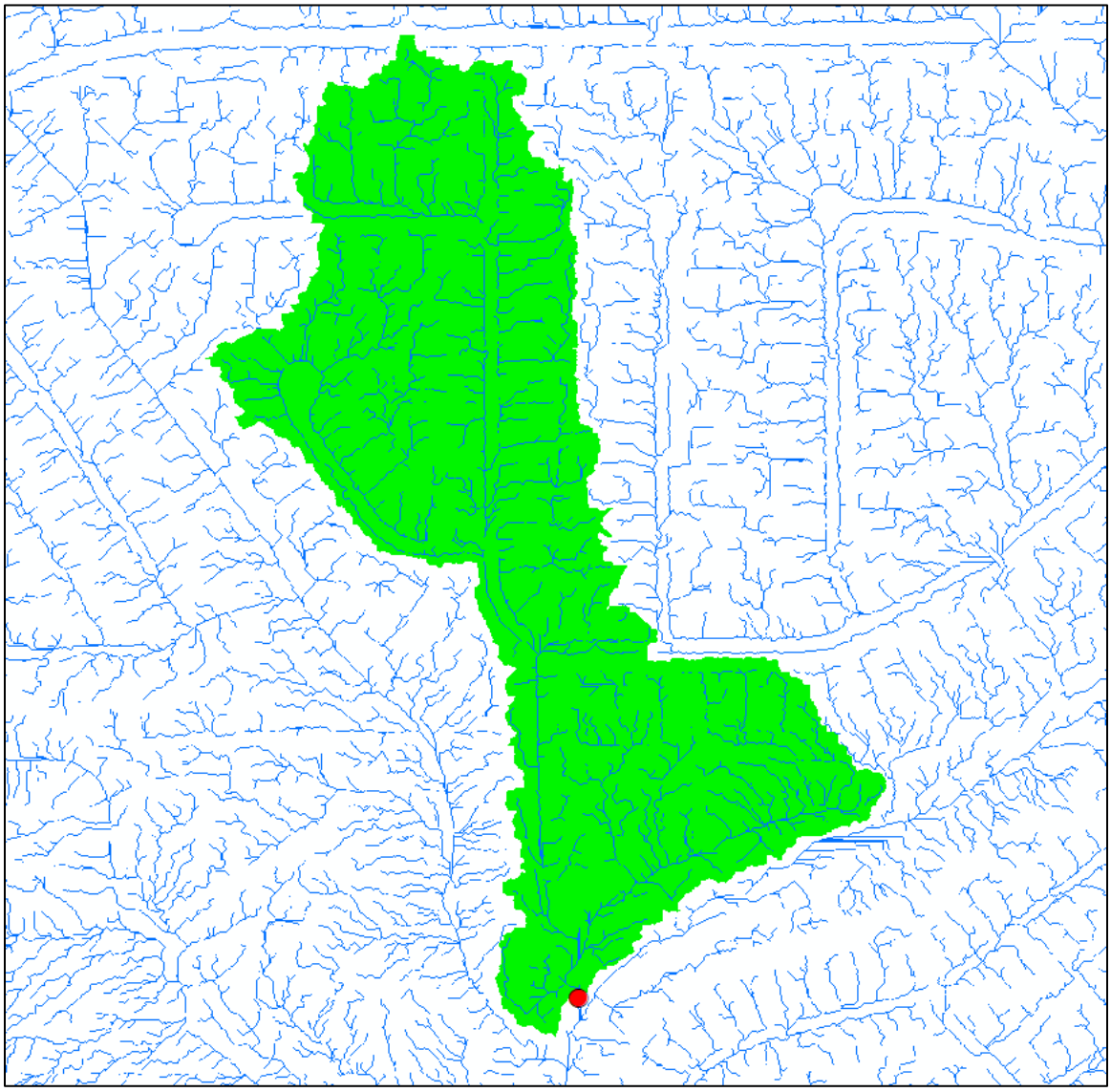

Figure 14 - Watershed boundary at Study Outfall

The accuracy of the watershed boundary heavily depends on the precision of the elevation dataset. Furthermore, this watershed boundary is entirely based on topography, which should be revised to reflect on-the-ground drainage system components, including curb inlets, grate inlets, and underground drainage systems.