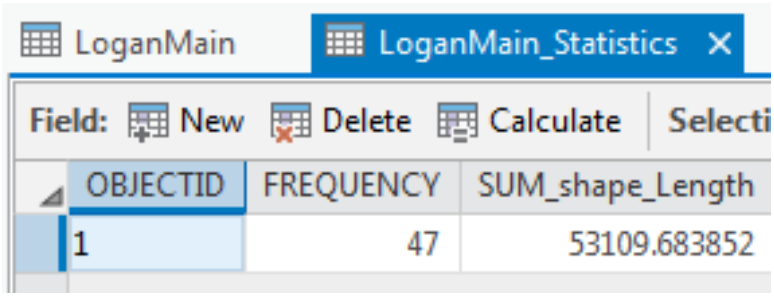
GIS in Water Resources Exercise #4 Solution

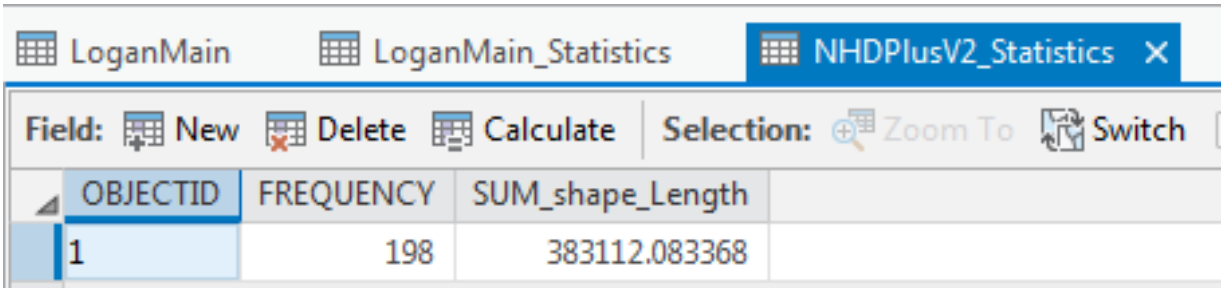
1. *Report the main stream length, total stream length, basin area and drainage density for the Logan River Basin as determined from NHDPlus flowlines. Report the total stream length and drainage density for the Logan River Basin as determined from NHD_HighRes flowlines. Comment on the differences. For each drainage density calculate the average overland flow distance water originating on a hillslope has to travel before reaching a stream. [Hint: Refer to slide 24 from TauDem WatershedDelineation.pptx in lecture 10.] Comment on the differences.*

Logan River Main Stream length is from the following

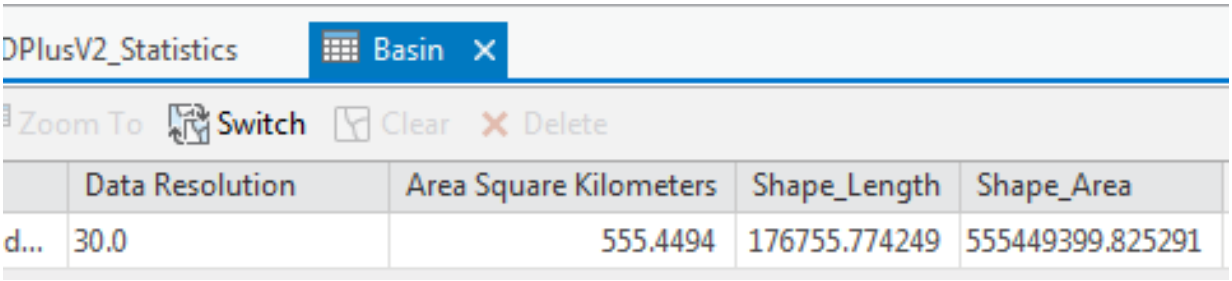


52.6 km is the sum of lengths reported by NHDPlus. 53109 m = 53.1 km is from Shape_Length evaluated using the coordinate system of the Basemap feature dataset. I will use the latter for consistency with basin area computed in this coordinate system.

Total stream length is from



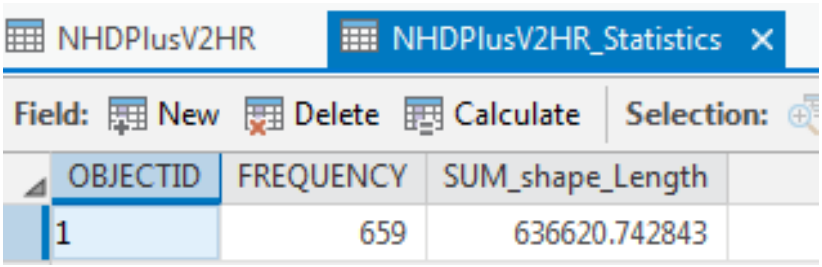
Basin area is from



Drainage density is total stream length/basin area
Overland Flow Distance is 1 /(2* Drainage density)
Summary Table using NHDPlus data

	m	km
Main stream length	53109	53.1
Total stream length (L_T)	383112	383.1
Basin area	555449399 m^2	555.45 km^2
Drainage density (L_T/A)	0.000690 m^{-1}	0.690 km^{-1}
Overland Flow Distance	724.638 m	0.725 km

Total stream length using NHD_HighRes data is from the following

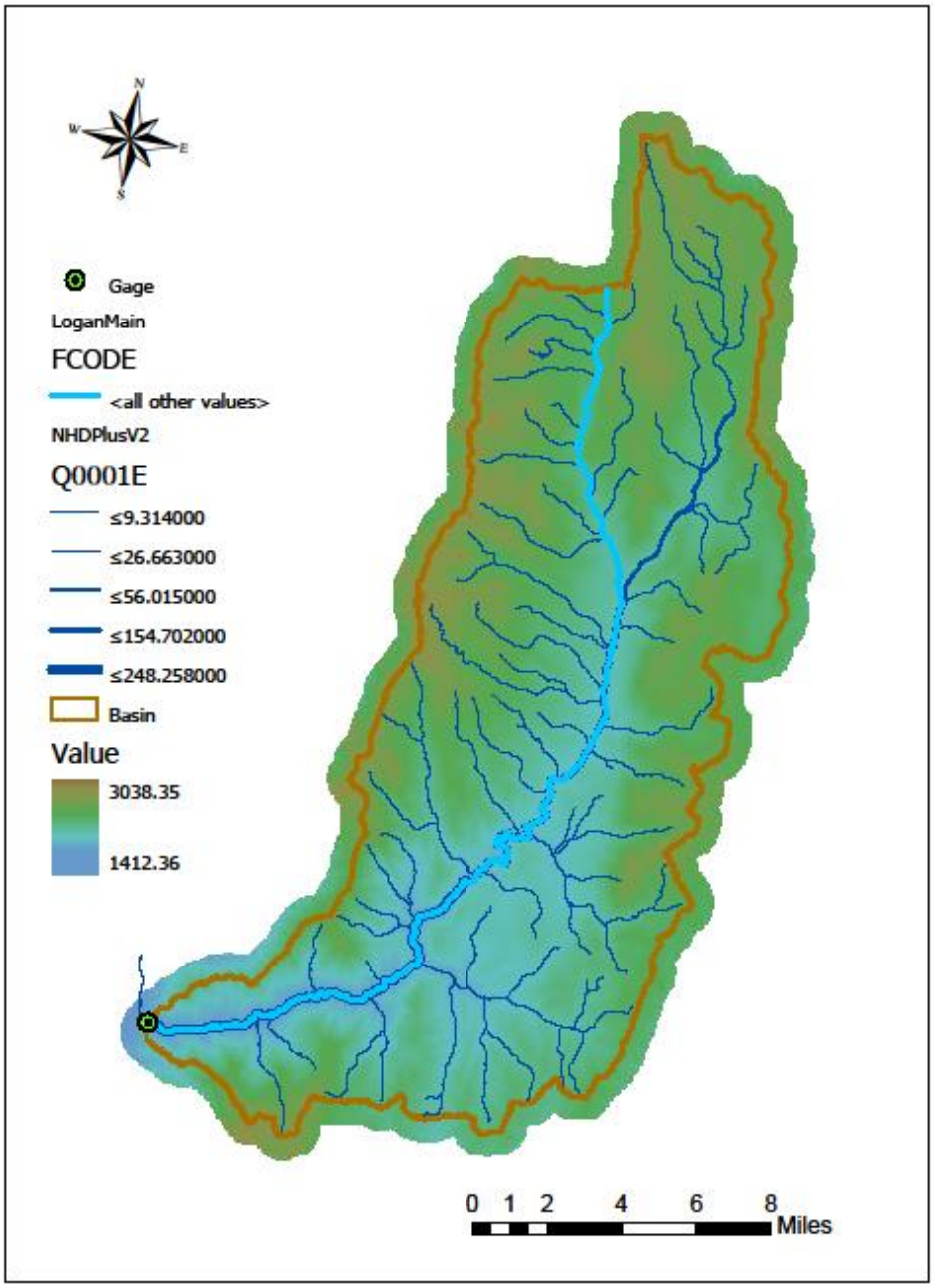


Summary Table using NHDPlusHighResolution data

	m	km
Total stream length (L_T)	636620.7	636.62
Basin area	555449399 m^2	555.45 km^2
Drainage density (L_T/A)	0.001146 m^{-1}	1.146 km^{-1}
Overland Flow Distance	436.30 m	0.436 km

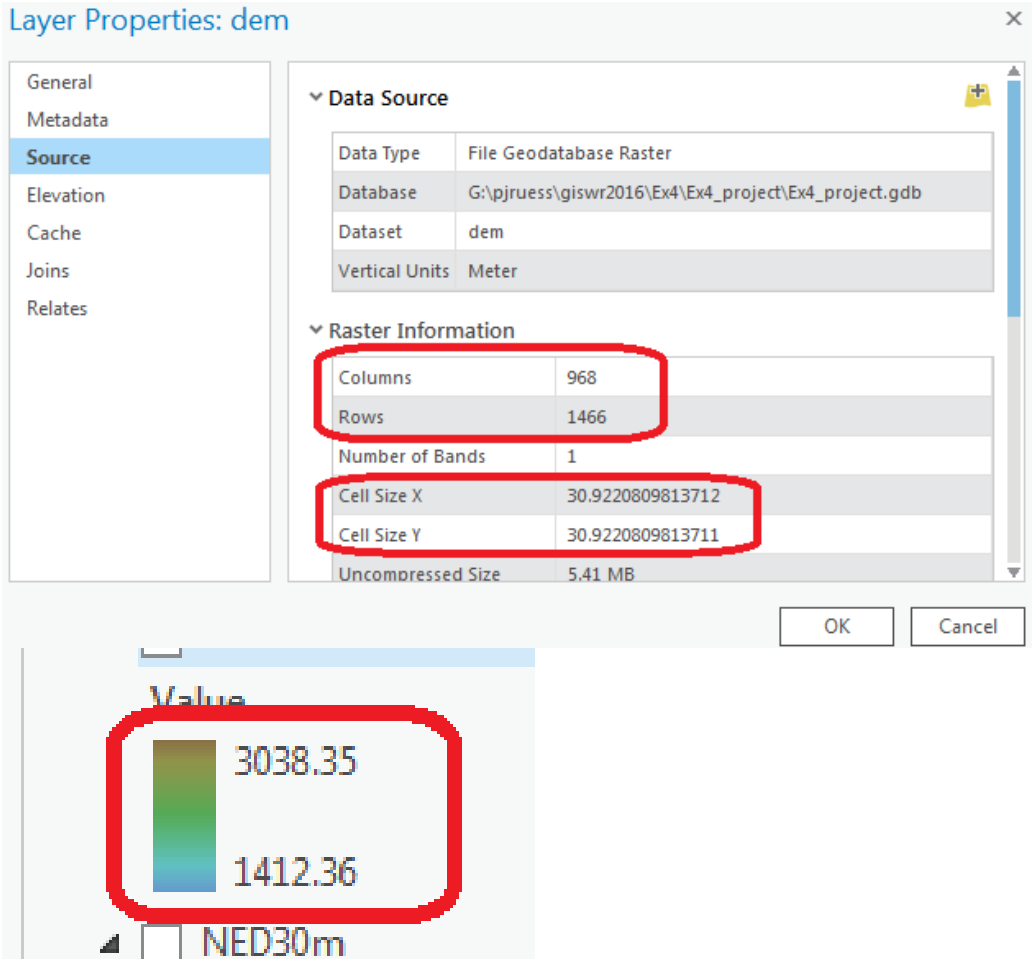
Comments:
The NHDPlus is derived from what is referred to as the medium resolution national hydrography dataset, which is generally used for coarser scale work. In contrast, the NHD_HighRes is generated from a high resolution hydrography data set which contains more detailed stream network, resulting in higher drainage density compared to NHDPlus. The overland flow distance is inversely related with the drainage density, so the higher overland flow distance in the NHD_HighRes results in a lower drainage density than in NHDPlus.

2. *Prepare a layout showing the topography, Basin Outline, NHDPlusv streams and Logan River Main stem stream for the Logan River Basin. Include a scale bar and North arrow and appropriate title, labeling and legend so that the map is self-describing.*



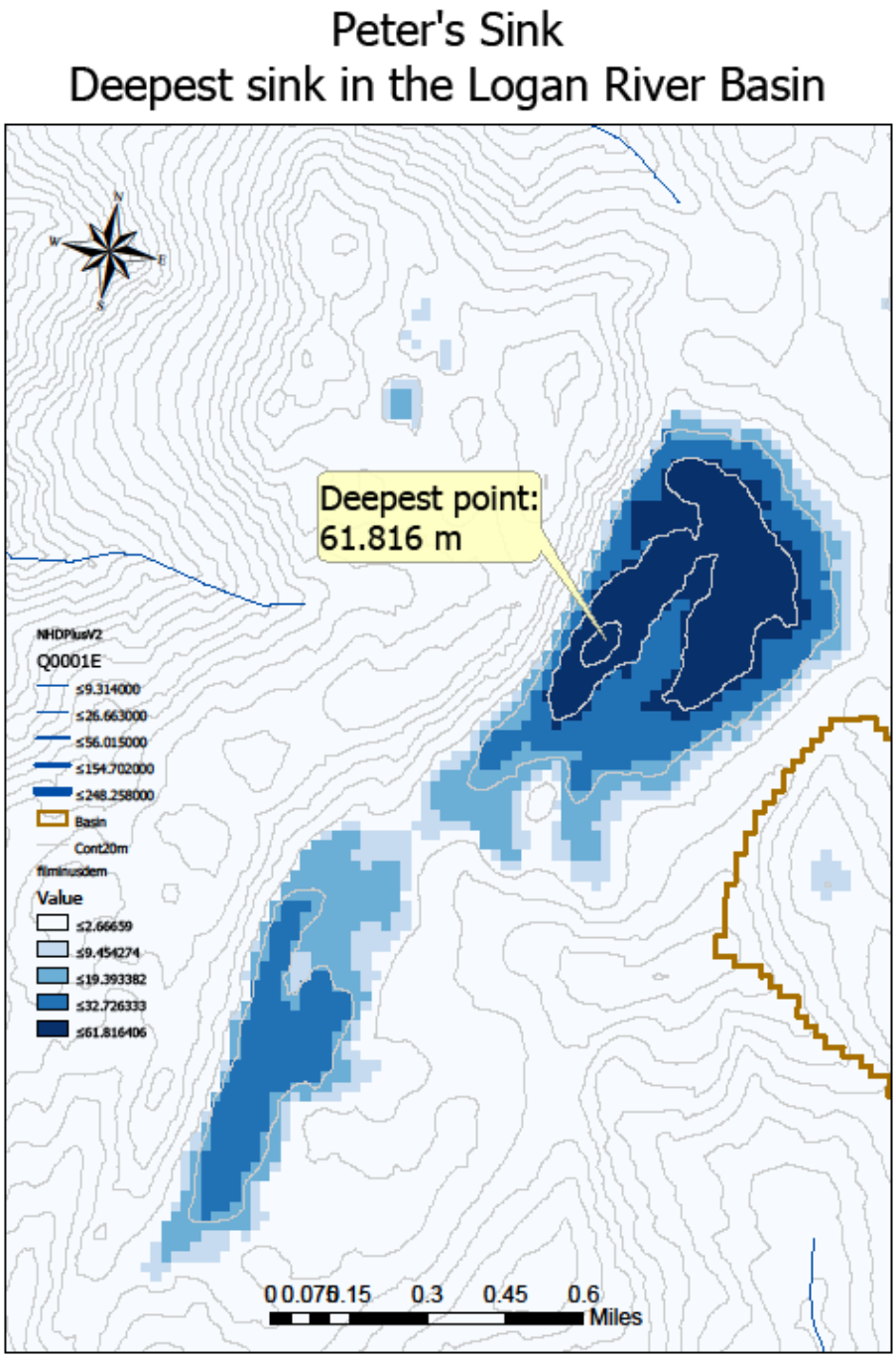
3. *The number of columns and rows, grid cell size, minimum and maximum elevation values in the Logan DEM.*

Information is from dem properties



Number of rows: 968
Number of columns: 1466
Cell Size: 30.922 m
Min Elevation: 1412.4 m
Max Elevation 3038.35 m

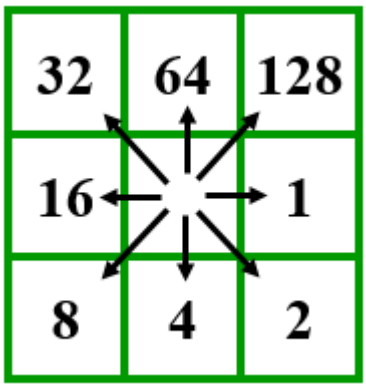
4. *A layout showing the deepest sink in the Logan River basin. Report the depth of the deepest sink as determined by fil-dem.*



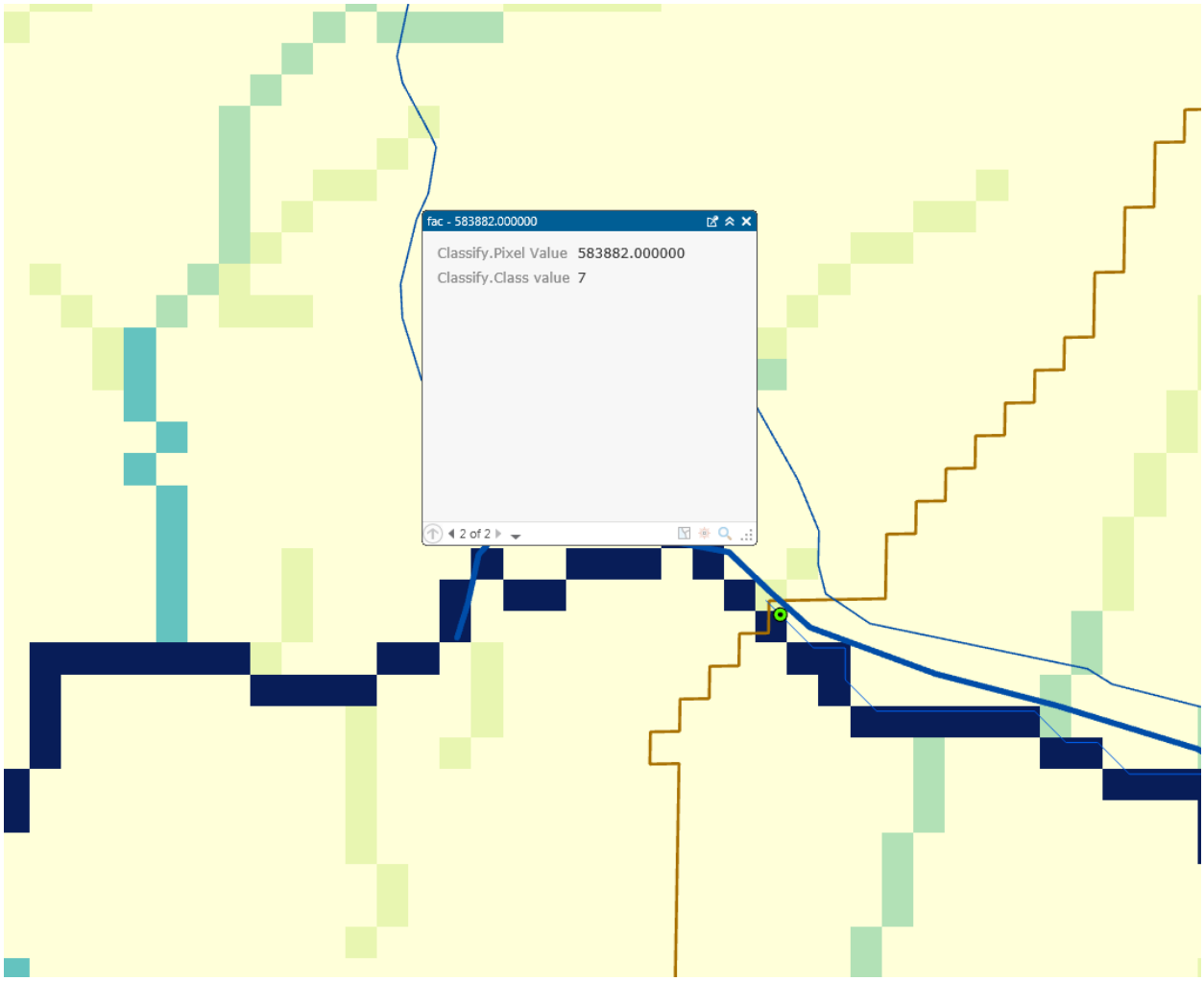
The depth of Peter Sink, the deepest sink is 61.82 m

5. *Make a screen capture of the attribute table of fdr and give an interpretation for the values in the Value field using a sketch.*

OBJECTID	Value	Count
1	1	120956
2	2	89371
3	4	94949
4	8	79385
5	16	112715
6	32	74291
7	64	71737
8	128	79816



6. *Report the drainage area of the Logan River basin in both number of 30.92 m grid cells and km^2 as estimated by flow accumulation. Report the area of the Logan River basin in km^2 as calculated by the arcgis.com watershed function. Report the area of the Logan River basin in km^2 as reported by the USGS for the Logan River stream site. Discuss reasons for any differences.*

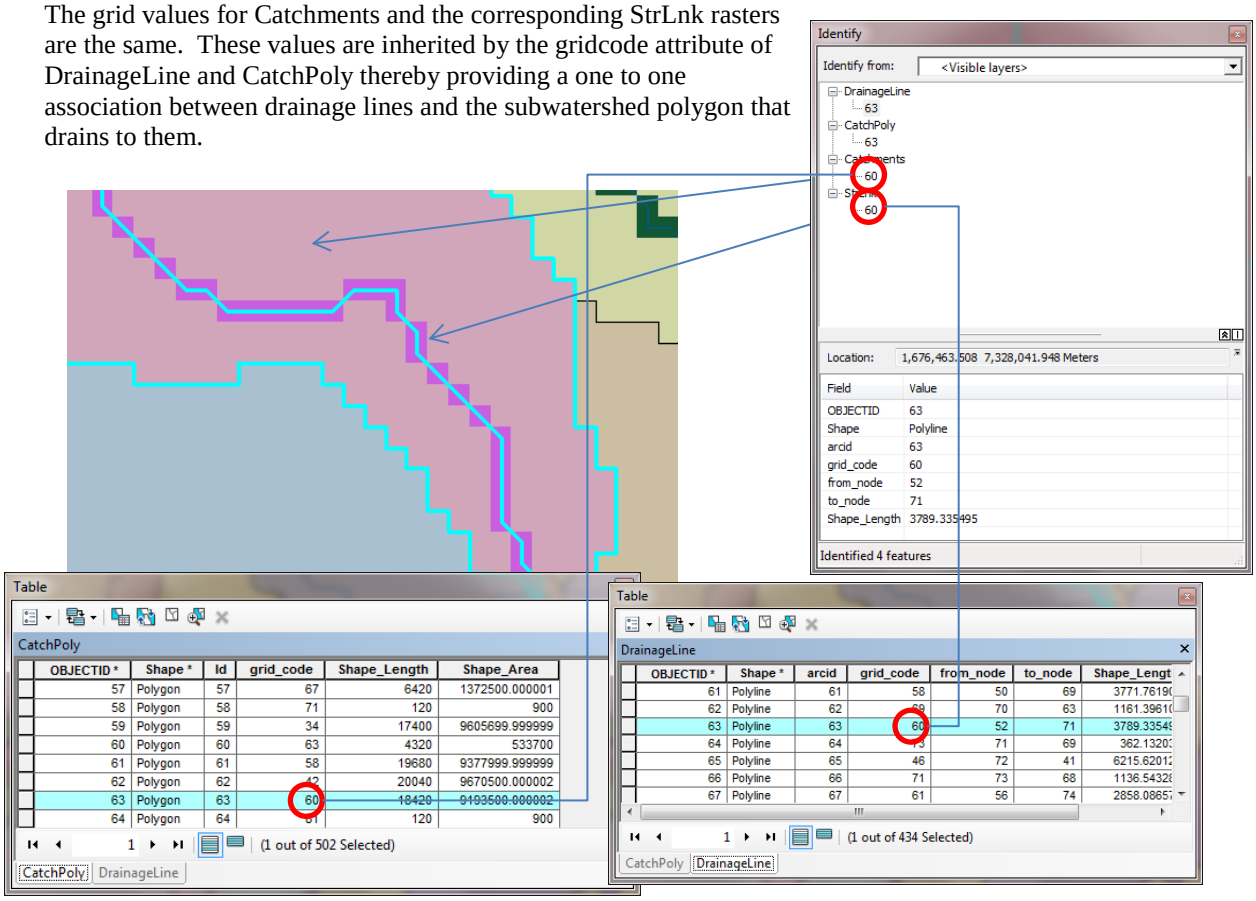


Flow accumulation: 583882 grid cells = 558.2 km^2
AreaSqKm reported by ArcGIS.com watershed function = 555.45 km^2
USGS Area 214 mi^2 = 554 km^2

These differences are small and arise due to rounding and small difference in flow directions along the edges of the watershed.

7. *Describe (with simple illustrations) the relationship between StrLnk, DrainageLine, Catchment and CatchPoly attribute and grid values. What is the unique identifier in each that allows them to be relationally associated?*

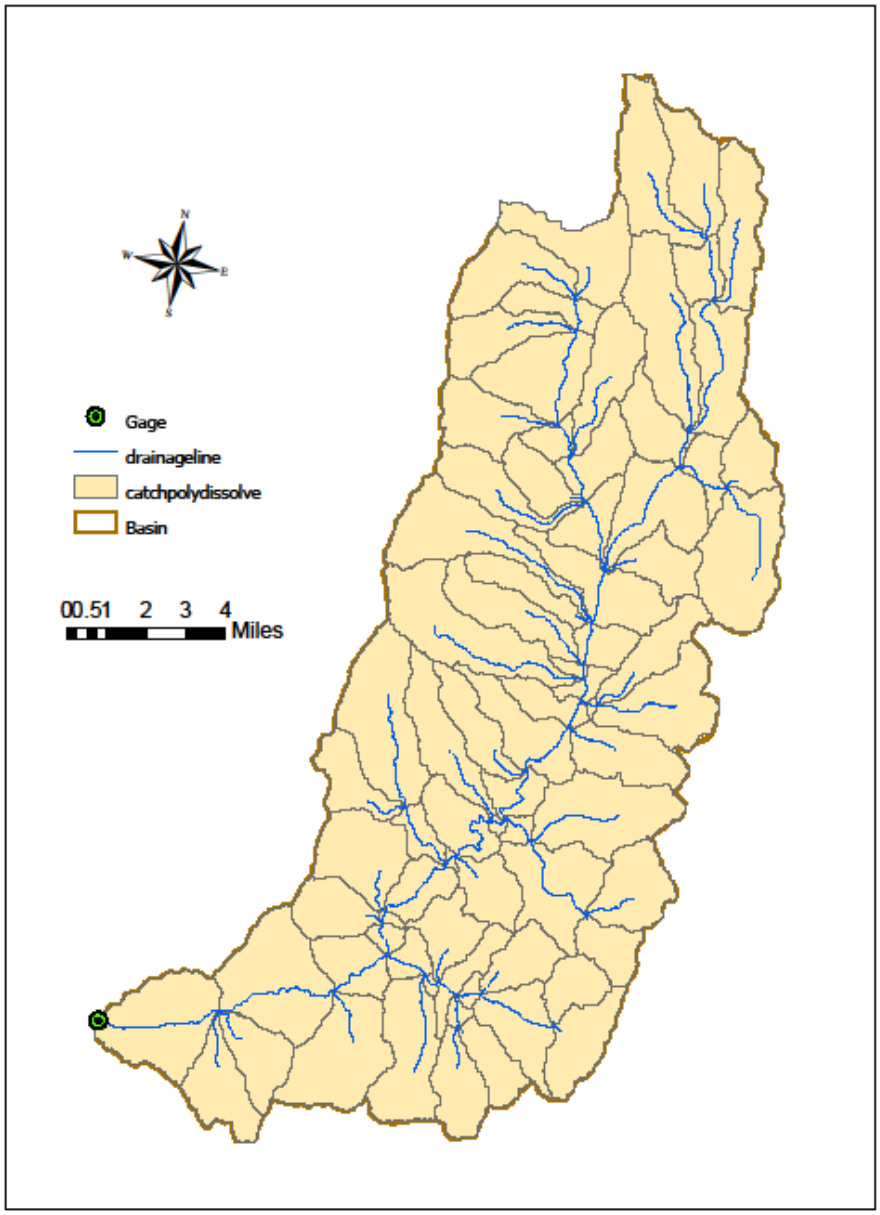
The grid values for Catchments and the corresponding StrLnk rasters are the same. These values are inherited by the gridcode attribute of DrainageLine and CatchPoly thereby providing a one to one association between drainage lines and the subwatershed polygon that drains to them.



8. *Prepare a layout showing the stream network and catchments delineated directly from the DEM.*

DEM-derived Stream Network and Catchments

Prepared by Paul Ruess, October 6, 2016



9. *Report the total stream length, basin area, and drainage density for the Logan River Basin as determined from the DEM delineated streams. Comment on the differences between this drainage density and the NHD/NHDPlus drainage densities.*

Stream Length:

OBJECTID	FREQUENCY	SUM_Shape_Length
1	81	208453.968901

Basin Area:

OBJECTID	FREQUENCY	SUM_Shape_Area
1	81	558272389.136529

Drainage Density:

0.000373 m^{-1}

Summary:

Source	Shape Length (km)	Shape Area (km^2)	Drainage Density (km^{-1})
DEM	208.453	558.272	0.373
NHDPlus	383.11	555.45	0.690
NHDPlus_HighRes	636.62	555.45	1.146

Comment:

The sum of lengths for the DEM-derived stream network is smaller than that of the NHDPlus datasets due to the flow accumulation threshold of 5000 used to define the streams. The area, in contrast, is slightly larger, and these differences together result in a significantly lower drainage density for the Logan River Basin. Note that if the stream definition threshold were lowered, the stream length would increase, subsequently increasing the drainage density as well.