# GIS in Water Resources Exercise #5 Solution

1. Make a map layout of the HAND raster that illustrates it nicely. Include NHDFlowline and DEM contour feature classes in this map, together with a legend, title and scale bar. Include a map frame that depicts the full watershed extent as well as a frame that is zoomed in to an area of interest (of your choosing) to illustrate detail.

The Map of HAND raster of Onion Creek Watershed
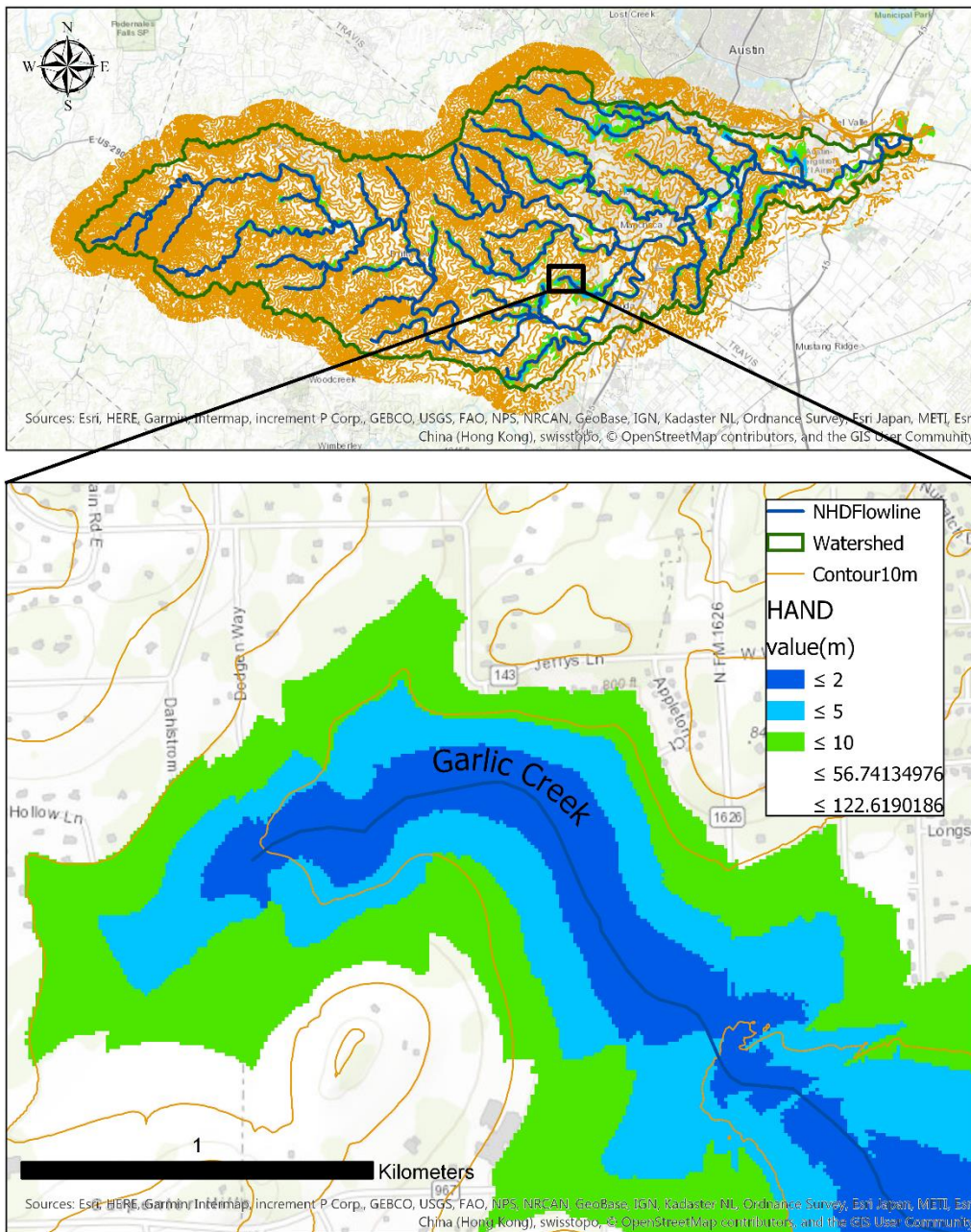
2. Make a map layout that illustrates an example of where the DEM derived stream network and NHDPlus flow network differ, and how HAND has been calculated based on the DEM derived network similar to the illustration above. Write a few sentences that describe and explain your illustration.

The map showing the differences between the DEM derived stream network and NHDPlus flow network and HAND map computed based on the DEM derived stream network
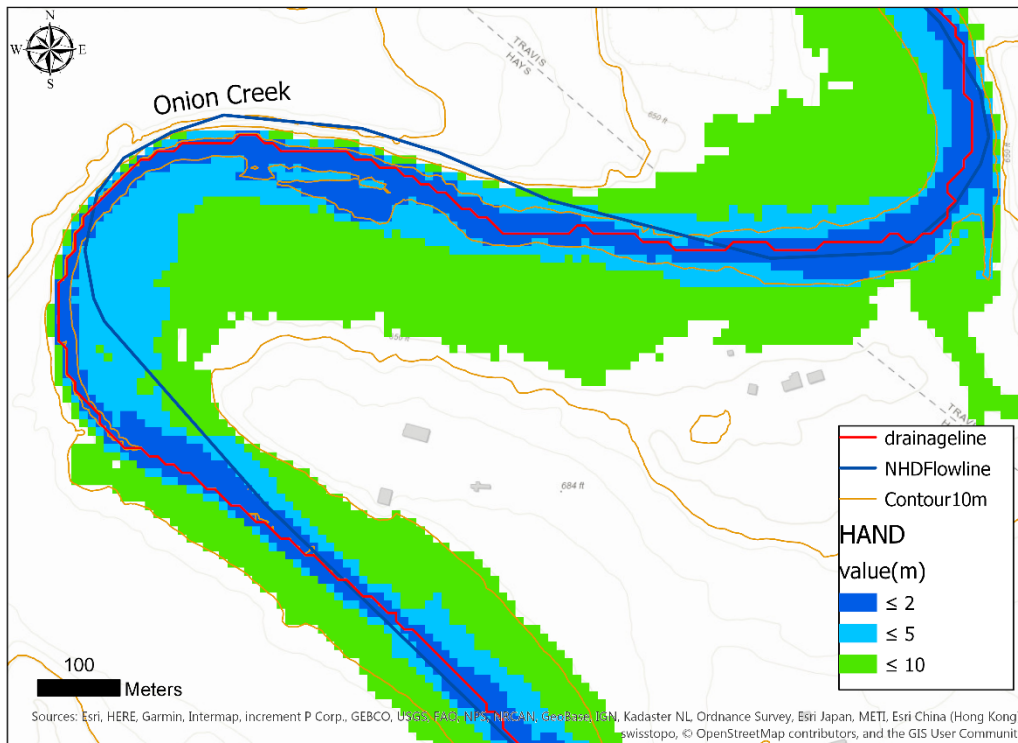

A part of the Onion Creek is selected to show the difference between the DEM derived stream network (red line in the map) and the NHDPlus flow network (blue line in the map). The HAND was calculated based on the DEM derived network such that the grid cells closer to the drainage line have smaller value and the grid cells further from the drainage line have larger HAND values. The smallest HAND value are shown as dark blue grid cells in the map. These cells follow the DEM derived network. This shows that the NHDPlus flow line does not align well with the smallest HAND values in the HAND-based flood inundation map method.

3. Table giving hydraulic properties and discharge associated with stage heights of 6, 10 and 14 m. Plot a rating curve with discharge on the x axis and stage height on the y axis (convert to ft) that has four points corresponding to depths of 1, 6, 10 and 14 m.

Stage h (m)	1	6	10	14
stage (ft)	3.28	19.68	32.8	45.92
cell size (m2)	100	100	100	100
flooding cell num	658	2607	9580	23624
sb	1.001046	1.016109	1.009072326	1.005114819
As(m2)	65800	260700	958000	2362400
Ab(m2)	65868.83	264899.7	966691.288	2374483.248
inundation depth (m)	0.713	3.189792	3.067237867	4.125310244
V (m3)	46915.4	831578.8	2938413.876	9745632.919
L (m)	4308	4308	4308	4308
z1 (m)	156.8008	156.8008	156.8008	156.8008
z2 (m)	149.8358	149.8358	149.8358	149.8358
A = V/L (m2)	10.8903	193.0313	682.0830725	2262.217484
P = Ab/L (m)	15.28989	61.49018	224.3944494	551.1799555
R = A/P (m)	0.712255	3.139222	3.039661071	4.104317403
S	0.001617	0.001617	0.00161676	0.00161676
n	0.05	0.05	0.05	0.05
$Q = (1/n)*AR^{(2/3)}S^{(1/2)}$ (m3/s)	6.9847	332.8090	1150.9950	4663.5255
Q (ft3/s) = Q(m3/s)*35.3	247.9578	11814.72	40860.32103	165555.1553

Rating Curve of the selected reach of Onion Creek
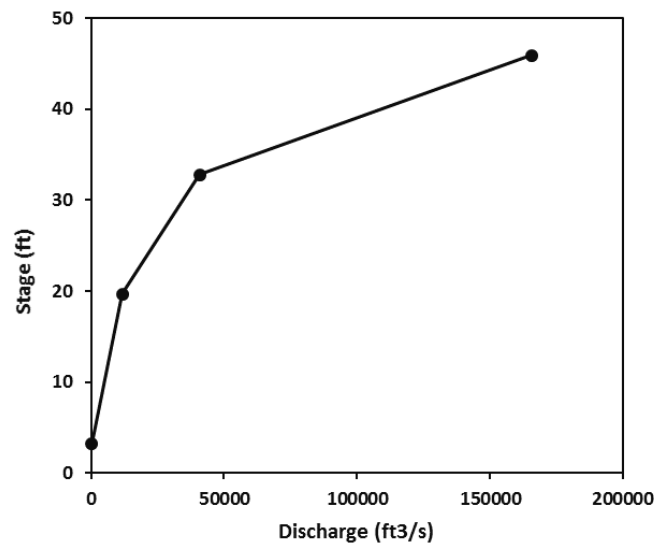
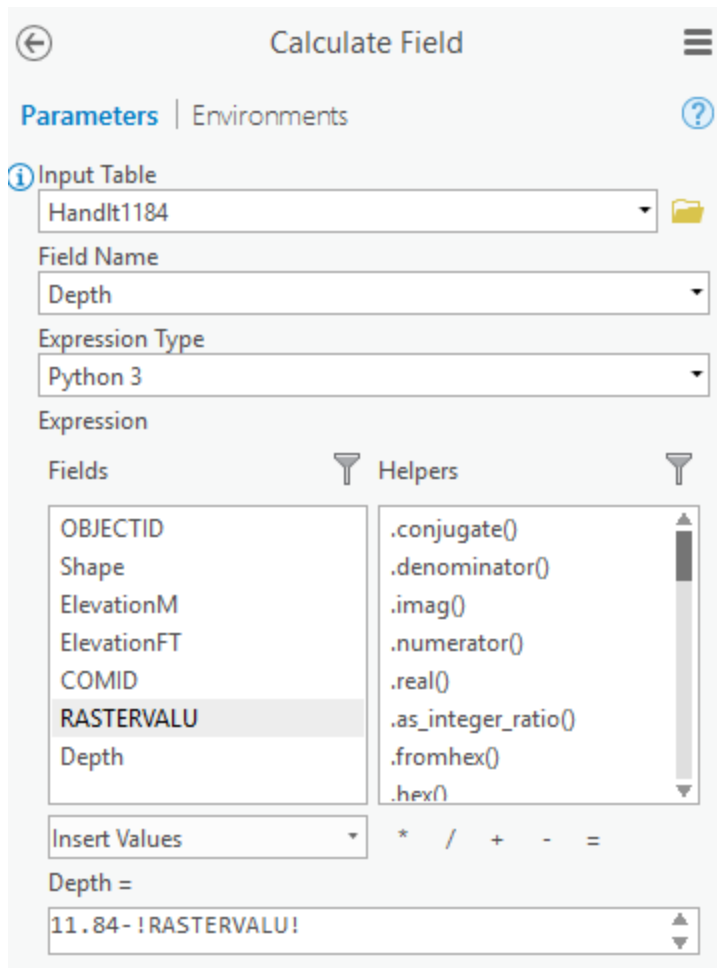4. Report the stage associated with a potential flood discharge of 98231 ft^3 /s in this catchment.

    Using interpolation between 10 and 14 m

    $$h = 10 + (14 - 10) * \frac{98231 - 40860}{165555 - 40860} = 11.84 \, m = 38.84 \, ft$$

5. A layout showing the catchment from CatchPoly that you used for this HAND analysis. On this layout include HAND, potential flood inundation depth based on your calculate flood stage. Include address points using a separate symbol for address points subject to flooding in this potential flood. Include your plot that shows the distribution of inundation depths for address points potentially subject to flooding in this catchment at this discharge.

Step to create the map and plot:

-   Generate d11-84.tif as the potential inundation depth (blue area in the map)
-   Use Select by Attributes tool to create a new feature class that is just address points capable of being flooded for this discharge. I selected points from HandPt that had RASTERVALU (the HAND value) less than 11.84 m.
-   I used Data Export features to save these as a separate feature class Handlt1184. This is symbolized in red below.
-   I added a new field (column) to the table for this feature class and calculated inundation depth as 11.84-RASTERVALU

Calculate Field

Parameters | Environments

Input Table
Handlt1184

Field Name
Depth

Expression Type
Python 3

Expression

Fields   Helpers

OBJECTID   .conjugate()
Shape   .denominator()
ElevationM   .imag()
ElevationFT   .numerator()
COMID   .real()
RASTERVALU   .as_integer_ratio()
Depth   .fromhex()
                                  .hex()

Insert Values   *   /   +   -   =
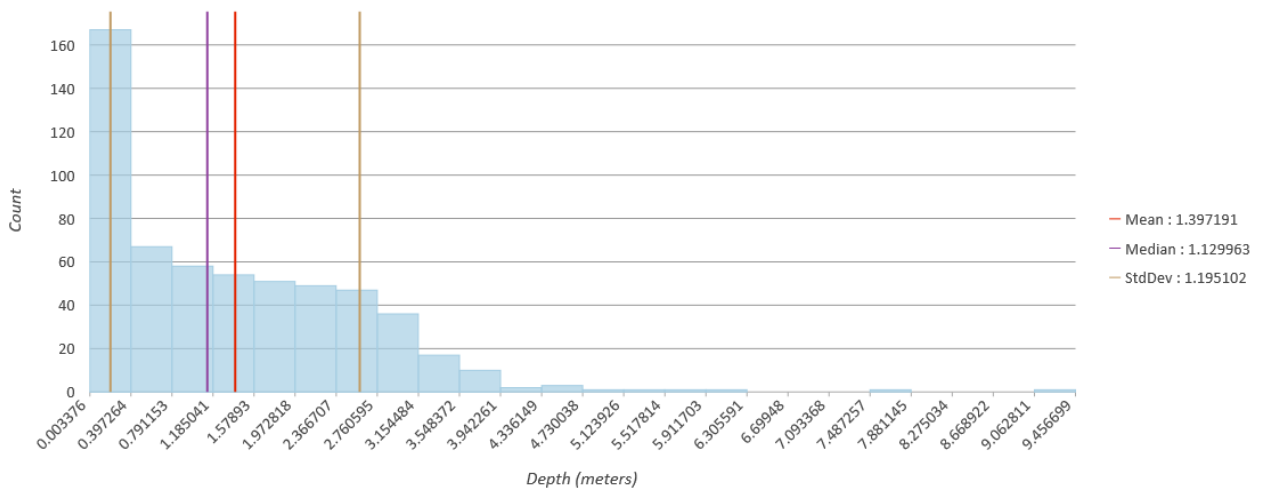
Depth =

```
11.84-!RASTERVALU!
```

- Then, right click on the Depth column and select Statistics to generate the histogram of the distribution of inundation depths for address points potentially subject to flooding in this

The HAND and the Potential Flood inundation maps of the selected catchment for the stage height of 11.84 m

Distribution of Inundation Depth

Mean : 1.397191
Median : 1.129963
StdDev : 1.195102
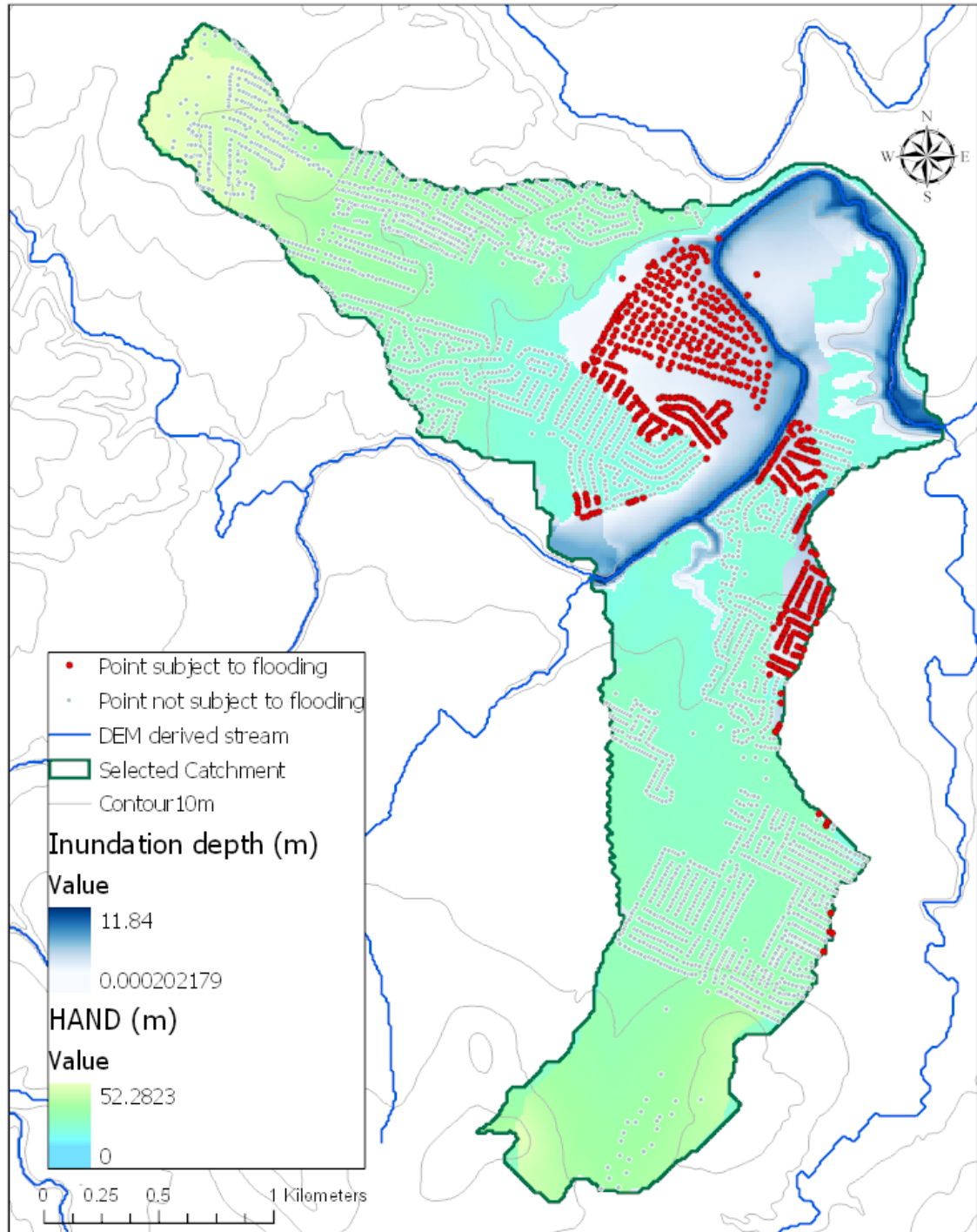
Note: Even though the raster layer of the inundation depth has the maximum value of 11.84 the histogram does not include this value because the histogram is plotted only for the discrete address points subject to flooding. In this case the, there are not be any address points at the grid cells where the potential inundation depth is greater than 9.45 m (which is the maximum value shown on the histogram plot). This is consistent with the HAND value at the lowest address point being 2.38 m (11.84-9.46).