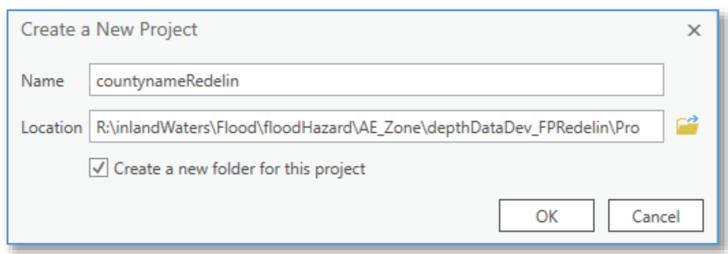
9/7/2017

Procedures for Creating Flood Depth and Flood Water Surface Elevation Data, and Redelineated Floodplains

The following methods are used by the WV GIS Technical Center (WVGISTC) to redelineate floodplains, and create flood water depth and water surface elevation data for FEMA effective areas of detailed study (typically Zone AE). The resulting depth and water surface rasters supplement model-backed Zone A (FEMA areas of approximate study) data already submitted or under contract by the WV State National Flood Insurance Program (NFIP). These datasets when combined will constitute statewide advisory flood water depth and flood water surface elevation raster data coverage. Redelineated floodplains have the potential to replace effective floodplains but are considered also of advisory status for the purposes of this work.

Raster Method (With Water Surface TIN) Compiled by the WVGISTC

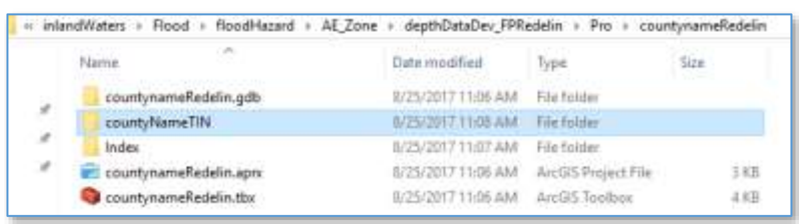
Data Prep



1. Create a new ArcGISPro project. Click “Blank” and save the project [countyNameRedelin] at following location

   “R:\inlandWaters\Flood\floodHazard\AE_Zone\depthDataDev_FPRedelin\Pro”

2. This process will create a new folder for that county with a same name geodatabase



3. Create a new folder name [countyNameRedelinTIN] under [countyNameRedelin] folder
4. Folder structure should like in the above image. You will be saving all the processed data under this folder’s geodatabase and TIN folder.
5. Before starting anything, first check projection system on DEM or LIDAR and reproject everything in the same projection.
6. Copy following layers to your specific folder
   a. "S_Fld_Hzd_Ar", "S_XS" and “S_BFE”- R:\dhsem_fema_nfip\dataStor\dfirmData\wvNFHL\NFHL_54_20161030

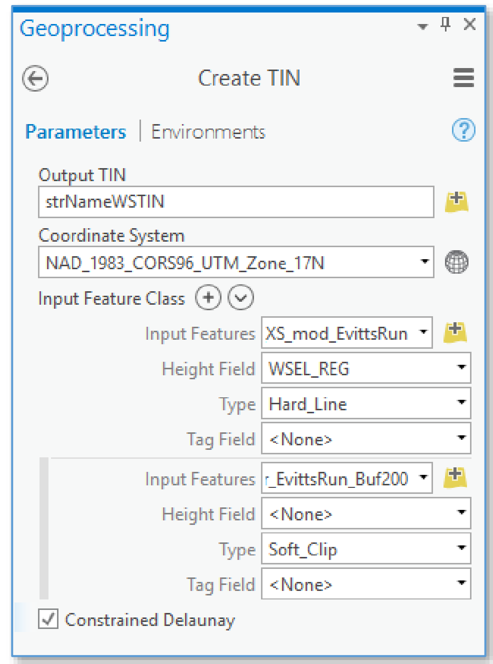
b. "S_Fld_Hzd_Ar" feature class- It is flood hazard area polygon layer. Add a definition query for your county and flood zones A, AE and AO. Flood zone codes are under column “FLD_ZONE”. Export the queried data and name it [S_Fld_Haz_Ar_CountyName].
c. "S_XS" feature class – This layer contains detailed study cross sections. We will primarily use this layer to create water surface elevation. Select cross sections by spatial selection with [S_Fld_Haz_Ar_CountyName]. Export selected cross section and name it [S_XS_CountyName]
d. “S_BFE” feature class - BFE layer is approximate Base Flood Elevation cross section layer. Add a definition query for your county using appropriate “DFIRM_ID”. Hint: DFIRM id matches FIPS code. Name the new layer [S_BFE_CountyName].

7. Create a reasonable buffer around the effective SFHA (queried [S_Fld_Haz_Ar_CountyName] layer) that you think would capture the redelineated SFHA (sort of an art, but you get used to it.) --Same as in TIN method. Most of the time 200 ft buffer works fine.
8. Select each river segment in layer [S_Fld_Haz_Ar_CountyName]. Export the feature class and save as [S_Fld_Haz_Ar_riverNmae_Buf200]
9. Query [S_XS_CountyName] layer using attributes in column “WTR_NM” and save individual river segments as [S_XS_riverName]
10. Now is the time to check for cross section density in each river section. Zoom in on individual stream segments and check for cross sections in [S_XS_riverName] layer. If cross section lines are rare, check [S_BFE] layer.
11. Cross section in missing area need to be added by either digitization or
    a. Select segments from BFE; export it and load exported layer in [S_XS_StreamName] featureclass.
    b. Make sure BFE elevation data gets added to “WSEL_REG” column
12. After needed segments are added, extend the segments to the buffer boundary in order to support TIN creation in new areas as indicated by updated ground surface elevation (DEM, etc.) using “extend or trim” tool (in editing mode)
    a. Do NOT alter existing XS line segments.
    b. Use Extend tool where practicable, i.e. XS line will NOT intersect one another before reaching buffer, etc.
    c. Create new line features when necessary, and then merge them to the existing XS features, preserving the segment with original attributes.
    d. Effective BFE lines may be used when appropriate, if XS lines are too few to accurately capture, e.g. stream curvature or confluences. Snap to BFEs in FP then extend as with XS lines.
    e. Delete extraneous XS lines that conflict with the overall trend in elevation values.
    f. Use care to define XS lines around stream confluences in order to properly represent backwater areas.
    g. NOTE: Sometime extend stops working in ArcPro. You might have to close and reopen your map for it to start working again

13. Option: Intersect XS with FP boundaries and stream lines; Create points from intersections to use as additional control in TIN creation.

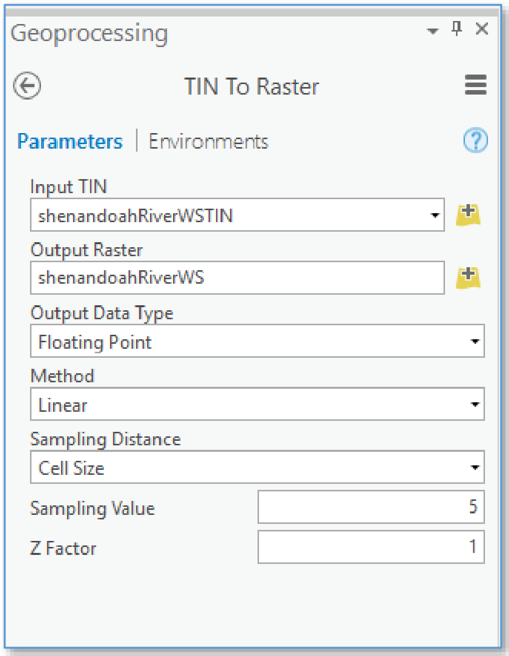
Water Surface TIN

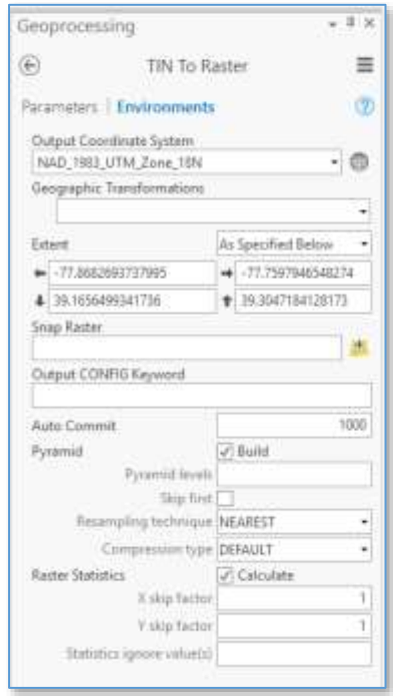
1. Process to create water surface TIN. Open tool *Create TIN* (3D Analysis → Data Management → Create TIN)
2. Check output destination, name [e.g. strNameWSTIN]
3. Set correct coordinate system. Check from DEM or LIDAR about the correct coordinate system and use the same coordinate system to create water surface TIN [e.g. WVDEP lidar is NAD83 CORS96 UTM17N]
4. Input Features
    a. Use XS Lines extended to/beyond adjusted buffer;
        i. Elevation source field: WSEL_REG (vertical units in Feet)
        ii.
        iii. *Hard Line*
    b. Floodplain Buffer boundary, soft clip
    c. XS/stream/FPB intersection points (parameters?)
    d. Constrained Delauney CHECKED
5. Output: Water Surface TIN with values in Feet
6. If geoprocessing crashes and you might have to create another field ass float and name it "WSEL_REG_float".
7. Calculate the filed WSEL_REG values.
8. Now create TIN should work fine.



Convert Water Surface TIN to Raster

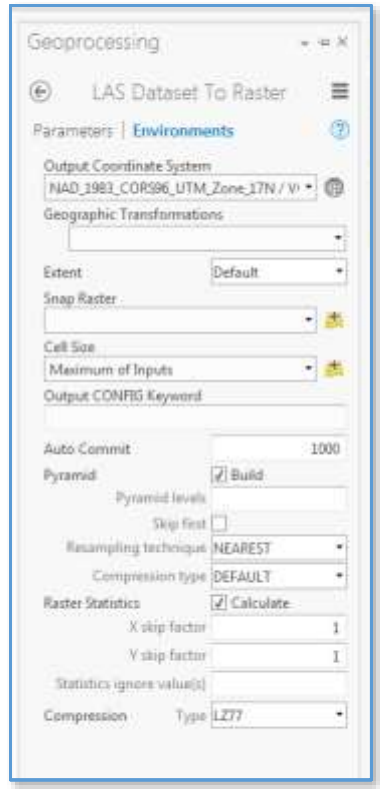
1. Open tool *TIN to Raster* (Geoprocessing →3D Analyst Tools →Conversion → From TIN → TIN to Raster)
2. TIN to Raster, 1.524 m Cell Size, projection system as in ground surface DEM, horizontal units in meters
3. Output: Water Surface Raster; layer name [riverNameWS]





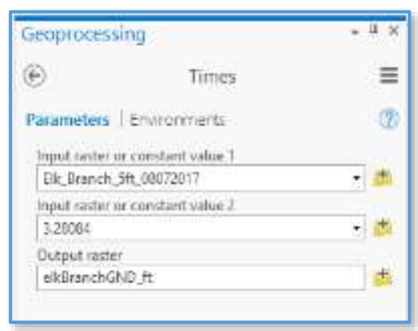
Ground Surface Lidar

1. Create LAS Dataset covering bounding box of Floodplain
    a. Create new LAS Dataset
    b. Locate lidar tiles using www.MapWV.gov/lidar
    c. Download tile data and add to LAS Dataset
    d. Coordinate System (for DEP lidar: NAD83 CORS96 UTM17N)
2. Clip LASD points using Extract
3. Convert clipped LASD to Raster:
    a. LASD to Raster, 1.524 m Cell Size (= 5 feet)



b. Convert raster values from meters to feet:

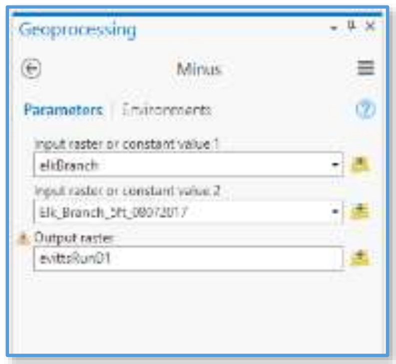
i. Use *TIMES* (Spatial Analyst Tools → Math → TIMES) tool to convert DEM which is in meters to ft. Use 3.28084 (Affects vertical units only) as constant value to convert vertical values to ft. Name your new raster [riverNameGND_ft]

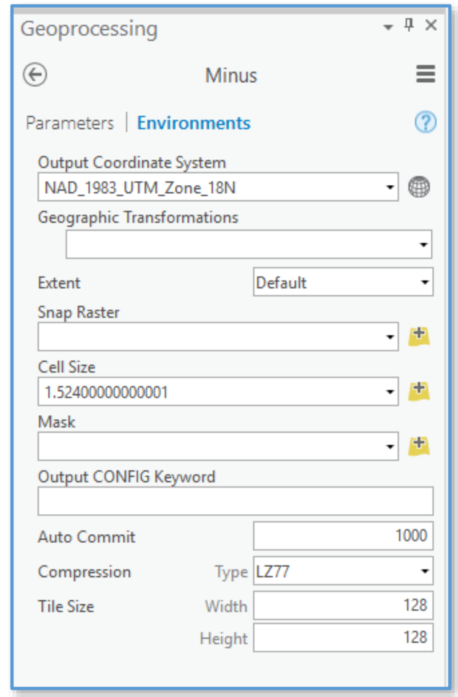


4. Clip ground surface to floodplain buffer
5. Output: Ground Surface Raster (GND)

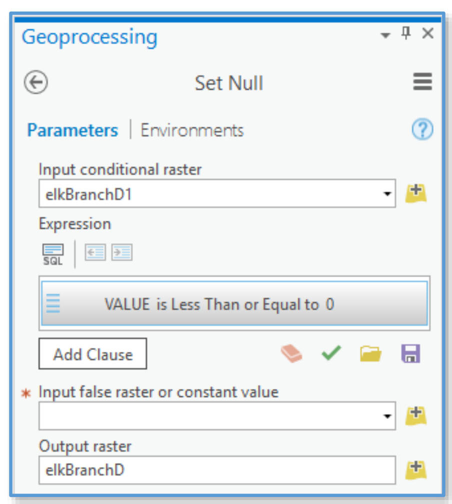
Flood Water Depth

1. MINUS tool
    a. Use *MINUS* tool (3D Analyst Tools → Raster Math → MINUS) to calculate depth grid. WS – GND = Depth (D). Name the output [riverNameDnumber]. Use some number after D like D1. We will save final output depth raster as [riverNameD]. Under environments, make sure to use cell size as the size of ground DEM raster.



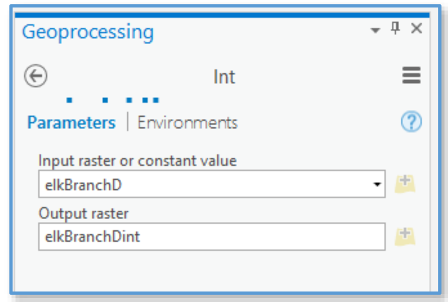


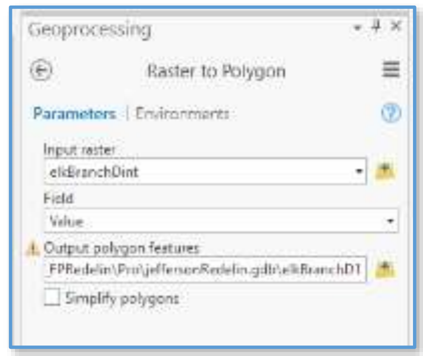
2. **Sanity check depth values**. Some values will show up as negative. We need to set values less than Zero as NULL.
3. Trim buffer, if necessary, to CLIP out anomalies outside XS line range
4. Clip to floodplain buffer
5. Remove negative depth values using *SETNULL* (Spatial Analyst Tools → Conditional → Set Null)
    a. SETNULL <= 0
6. Output: Depth (D), Values in Feet



Depth raster grid to polygon

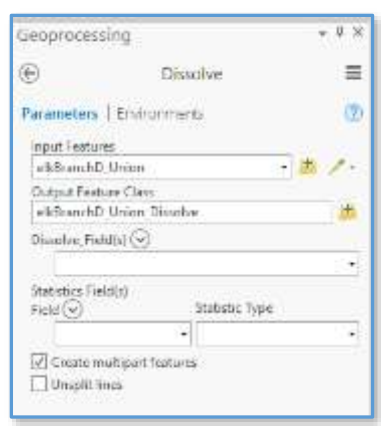
1. Input depth grid is float. First, we need to convert it integer raster. To convert raster grid to polygon.
2. Use *Int* tool (Spatial Analyst Tools → Math → Int) to convert to integer raster. Name output raster as [riverNameDint]
3. Use tool *Raster to Polygon* (Conversion Tools → From Raster → Raster to Polygon)
4. Switch off “Simplify Polygon” check box. Name output as [riverNameD1].



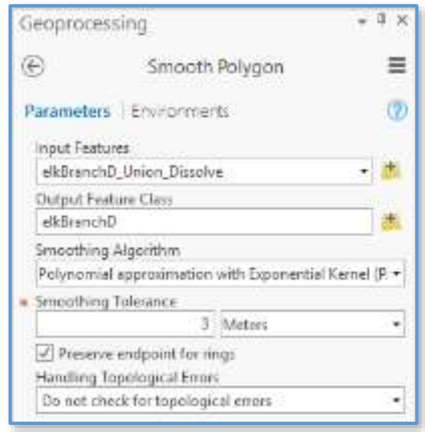


5. Use tool *Union* with polygon as input layer.
6. Switch off Gaps allowed.
7. Name the output [rivernameD_union]

8. Use tool *Dissolve* (Data management tools →Generalization →Dissolve)
9. Name output layer as[rivernameD_union_Dissolve]
10. Leave other as default

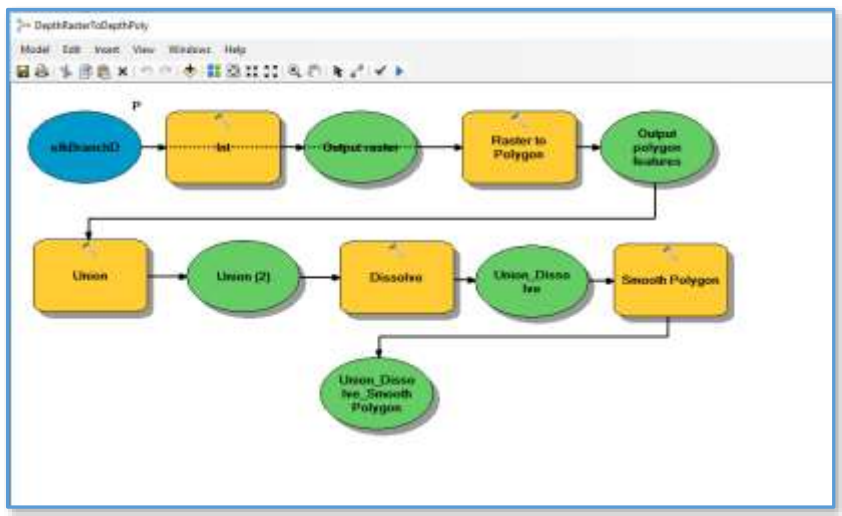


11. Use tool Simplify Polygon (Cartography Tools → Generalizations → Smooth Polygon)
12. Use dissolved layer as input feature. Name output feature as [rivernameD]
13. Smoothing algorithm should be PAEK. Smoothing tolerance as 3 meters.



Depth raster grid to polygon Tool

1. WVGISTC created model builder tool to automate the process of depth polygon from depth raster grid
2. Add a toolbox FloodRedelinTools; open tool *DepthRasterToPoly*
3. Modify workspace as needed.
4. Run the tool with depth grid raster [riverNameD] as input



Appendix A

cFloodplain Redelineation

Ground Surface TIN form LASD contours (From Lee Brancheau)

0. LAS to contours, 2-meter

1. Create a reasonable buffer around the effective SFHA that you think would capture the redelineated SFHA (sort of an art, but you get used to it.

2. Find the highest XS WSEL for that stream, i.e. <WSEL_REG> = n.

3. Query the contours for anything equal to or below “n”and the next highest contour above “n”. For example, if cross section Z = 453.2’, then <Elevation> <=454.

4. Clip the selected contours on your buffer polygon

5. Then build your ground TIN.

If this fails due to memory limitations, then you need to break your reach into smaller sections (that overlap).

Appendix B

A method for displaying Index Contours in ArcGIS 10.x

Display only index contours (may introduce rounding errors; see code following):

```
Mod(Round("ELEVATION", 0)*10, 10)=0
```

To get Index contours I use this on Field Calculator:

In ARCMAP

```
dim dIndexInterval
dim dCont
dim i
dim j
dim k
dim c

dIndexInterval = 200 ' set to interval of index contours
dCont = [level] ' Set to contour height field
```

```
i = ROUND(dCont, 0) * 10
j = dIndexInterval * 10
k = i MOD j

if k = 0 then
 c = 1 ' is an index contour
else
 c = 0 ' is not an index contour
end if
```

'Type "c" (without quotes) in the text input field at the bottom of the dialog box and click OK.