2016 MGIS Geog564 – Lab 3 - Process models

Assigned date: 1/14/16

Due date: 1/25/16

Introduction – The practical side of salmon habitat restoration, protection of economic assets and improving quality of life in a sustainable manner are all linked to a physical model for drainage and flooding. Flooding is the key and only process that will be modeled in this geodesign lab project. This lab introduces a method to estimate the area that might be affected by a flood event. Other works to estimate the effect of flood events are available in the form of 100 year flood and 500 year flood maps (see hydro.gdb). These results are useful and frustrating because they treat the landscape in a unitary manner and don't support local events like a levee breech or the outcome from remediation efforts.

The goal at this time it to learn the mechanics of some of the flood zone tool and the parameters that affect its performance and output. Products from the flood zone tool will aid your investigation of the study area because it sets up a polygon that delineates areas/parcels likely to experience flood events and by extension the stakeholders with a vested interests. It also supports comparison and evaluation of the landscape attributes and how they are uniform across the landscape or may have different patterns of occurrence in the flood risk area.

The flood zone polygons you create in this lab will be used directly to evaluate the state of the study area on Lab04 Landscape Evaluation.

Topic – Where gets flooded? Who/what's at risk? What are we going to evaluate?

Let's (re)consider strategies and actions in the study area:

- Department of Ecology: Floodplains by design
  - https://fortress.wa.gov/ecy/publications/publications/1406033.pdf
  - See the projects that are located in the Duwamish/Green watershed. Do a find for 'Green' to get to them easy.
- Tukwila's inventory
  - http://www.tukwilawa.gov/dcd/shoreline/Pentec%20Tukwila%20Inventory_r.pdf
  - Note their methods/strategy to divide the landscape for analysis: EMU and AU

Carving up any landscape for assessment must be done in a manner that is consistent and contributes to answering the need to know questions. Tukwila's approach is to divide the landscape into homogeneous areas and then evaluate their potential for remediation/restoration. The floodplain maps in the Course data hydro.gdb show the results of an analysis that treats the landscape as a whole rather than many moving and interrelated parts. The exploration in this lab fits in between these two approaches where flood relationships along the waterway iteratively contribute to a larger picture of flood exposure in the Duwamish/Green lowland area.

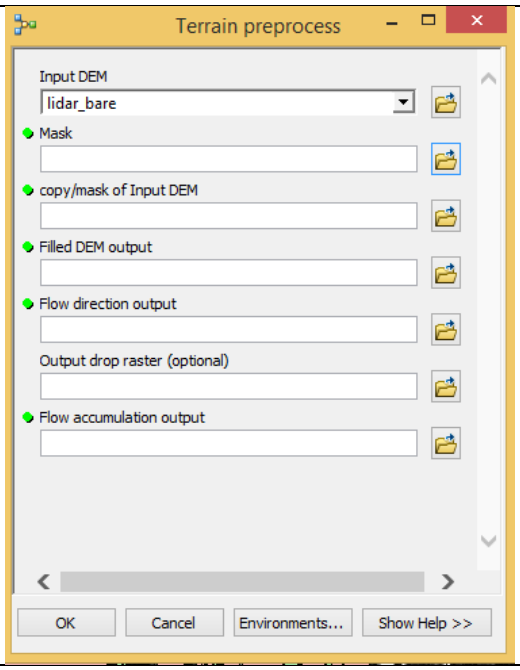
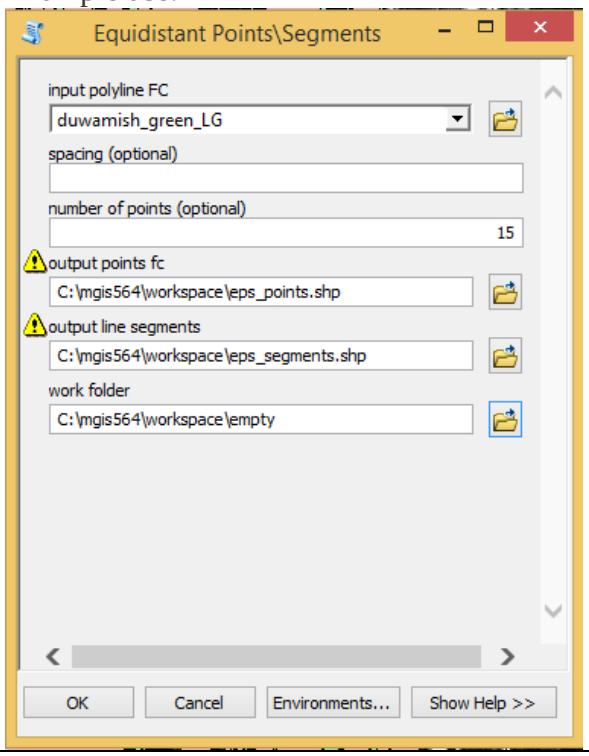
Techniques and tools –

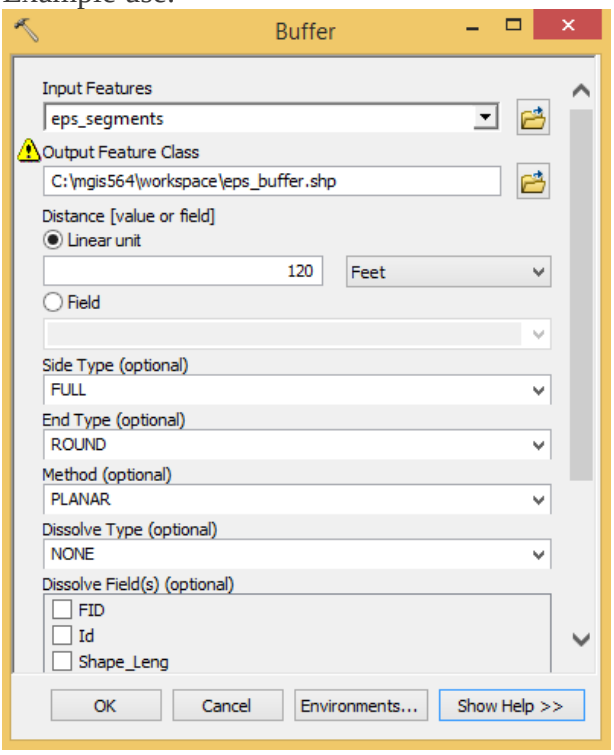
Walking through the toolbox/tools will help you to master the concepts and workflows. Once you have an appreciation for the process you will be able to explore the parameters that control flood zone delineation and use the results to evaluate the landscape using the parcel attributes you addressed in Lab 2. Below is a step-by-step (SBS) guide through the tools to create Flood zones.

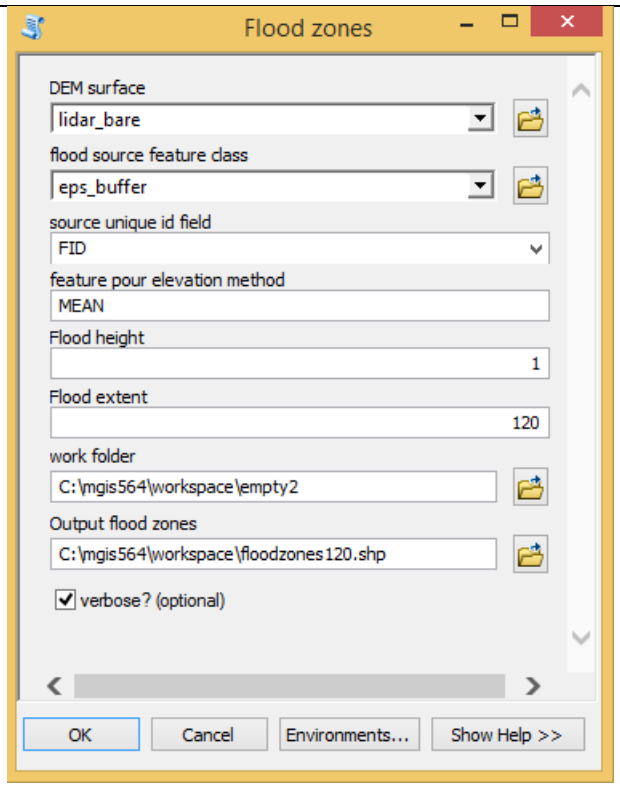
Before you begin make sure you set ArcMap to 'Overwrite the outputs of geoprocessing operations' in the Geoprocessing >> Geoprocessing options dialog. Also note that the dialog screen shots are examples only and you will need to change the input/output filenames and folders to match your working environment. Read and understand how to use workspaces and note that some of the tools ask for separate folders for intermediate files that are not workspaces.

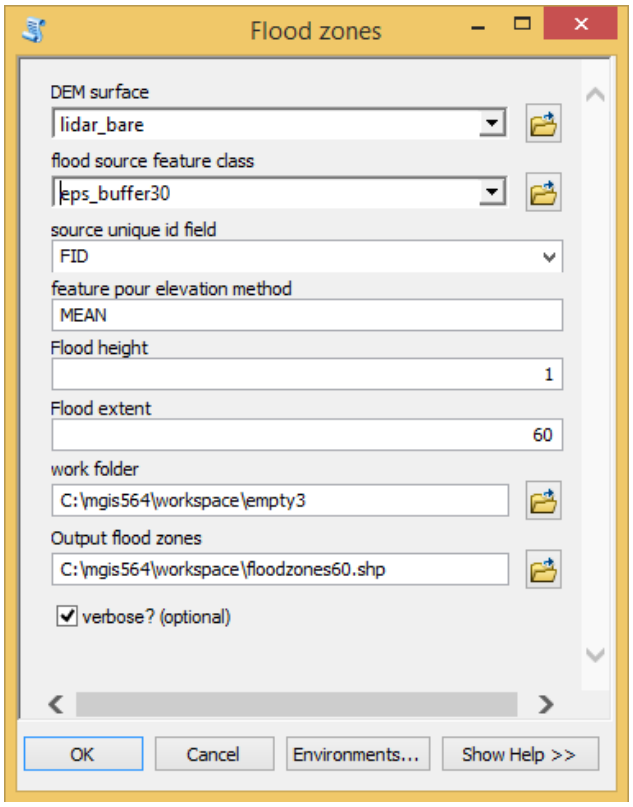
It will be advantageous to be familiar with the 'Questions and deliverables' section below before you work through the steps that follow.

Steps	Detail
Step 1- Add course toolbox	The distribution archive is Levee_tools_v4a.zip. Expand it into a meaningful location and load it into the ArcToolbox ..\Levee_tool_v4a\levee tools 4a.tbx Note the docx metadata document. It is a compilation of the tool help for each tool. Levee Tools being used in Lab 3 in order of appearance: Terrain preprocess Equidistant points/segments Flood zones
Step 2- Add data	– See the Course Geodatabase(s) metadata document on Google Drive for information about these layers. Hydro.gdb\duwamish_green_LG Hydro.gdb\floodplain_100 Hydro.gdb\floodplain_500 Surface.gdb\lidar_bare
Step 3- levee tools 4.tbx >> Terrain preprocess'	Aside from conditioning a surface for flow modeling the preprocess outputs are useful for visualization and evaluation of data quality. This step isn't required for the Levee tools to function but it is valued for interpretation of the outputs. You want to inspect the *flow accumulation* and *drop* output rasters and later compare them with the Levee tools' results. Example dialog, rename the output to meet your needs:

	
Step 4- levee tools 4.tbx >> Equidistant points\segments	The river centerline needs to be broken into pieces to evaluate the extent of a flood / inundation event area. The output can be a shapefile or feature class in a geodatabase. Example use: 
Step 5- ArcToolbox >> Analysis Tools >> Proximity >> Buffer	levee tools 4.tbx >> Flood zones works best with polygon input features so it will be helpful to buffer the output segment layer created above. The buffered polygons must be big enough so they will be at least three pixels wide when they are

	converted to a raster in the Flood Zones tool. The buffer output can be a shapefile in a folder of feature class in a geodatabase. Example use: 
Step 6- levee tools 4.tbx >> Flood zones	This tool takes each input polygon feature in turn, determines the lip or pour point elevation then uses a cost surface analysis to spread the flood into the downstream floodable area. The variables that influence generation of the flood output are the elevation method, flood height and flood extent in addition to the resolution of the equidistant segments created above. It is good practice to set the workspace to an empty folder each time you use this tool. Consult the tool help for descriptions of each parameter. The final flood zone output file can be a shapefile stored in a folder or a feature class in a geodatabase. Don't try to write shapefiles to geodatabases… Example use:

	 Note: The 'verbose' option turns on all the feedback messaging used to develop the tool and troubleshooting. We will revisit the information available from the verbose setting in a later lab.
Step 7- ArcToolbox >> Data Management tools >> Generalization >> Dissolve	To create a single polygon of the flood zone results use the dissolve tool.
Step 8- Evaluate the outcome	Investigate the output. Is there a lot/little of redundant overlap among adjacent flow zones and do the overlapping polygons agree/disagree along the borders of the flood area? Compare your results with the floodplain data and ask the same questions: do they agree/disagree? Get some air photo data from http://guides.lib.uw.edu/c.php?g=341497&p=2299097 so you can see some ground truth about the built environment and likely contribution to flooded areas, look for places where the floodplain polygons disagree with the Flood zones output. Overlay your output on the 'drop' raster to help visualize the terrain that confines a flood event.
Step 9- Run Flood zones a second time with more source features and shorter extent	Changing the parameters and running Flood zones again will help illustrate how these changes affect the output. The steps below will create a Flood zones output with twice as many source features and half the flood extent limit. 1. Run 'Equidistant points' on 'duwamish_green_LG.shp with the 'number of points' set to 30. 2. Use the same unique id field as before.

	3. Buffer the output segments by 120 feet. 4. Flood zones:  5. Dissolve the Flood zones

Questions and deliverables – The important part of this exercise is to discern which parts of the landscape have relationships with the floodplain dynamics and bear on choices for restoration of river function and riparian habitats. The 'Flood zones' tool isn't very sophisticated but it is sufficient to identify areas downstream from the source polygons. More importantly, when we come to the impact models, it will support comparison of the costs and benefits to levee offsets in different locations along the river channel. The first deliverable is a description of the Flood zones tool results and the second is to reevaluate the maps of landscape attributes you prepared for Lab 2.

Deliverable 1 - Describe Flood zones output - You have at least two results from the Flood zones tool, maybe more if you chose to experiment further. Present a description of each result that includes the choice of parameters and observations on how well they agree/disagree with the landscape. You can report the tool parameters with a screenshot of the tool dialog. Interpret the results in terms of the relationship between neighboring flood zones from adjacent source polygons and how the zones match with the topography and built landscape features. Finally, compare the two (or more) outputs and describe how the differences in source polygon density, flood height and flood extent made a difference in the output.

Deliverable 2 - Map and describe the flooded/upland landscape attributes – Choose one of the dissolved Flood zone polygon outputs to overlay on the three landscape attribute maps you made in Lab 2. Make the flood polygon appear hollow with a clearly visible boundary so you can easily demarcate the areas that are at risk from flood events from upland areas. Describe the differences in abundance and distribution of the landscape attributes inside and outside the at risk flood area. You'll want to note cases where there is an abundance of features inside the flood area in contrast with the upland areas. The same goes for concentrations of features in/out of the floodable area, are features clumped together or not. Another that is harder to discern is relative proximity or colocation among two or more features found inside/outside the floodable areas, are there types of features that are only found together in/outside the floodable area. Present your revised maps with the floodable polygon overlay together with your observations of the landscape attributes.

Expectations and grading –

Performance	Credit	Description
No deliverable	0 points (0%)	No deliverable
Minimal engagement	15 points (60%)	Less than two Flood zone outputs described - or - Less than three maps and descriptions of flooded area landscape attributes
Incomplete	20 points (80%)	Descriptions of the expected Flood zone outputs and flooded area landscape attributes are incomplete or demonstrate some clear misunderstanding of the material
Complete	25 points (100%)	Complete descriptions of the expected Flood zone outputs and flooded area landscape attributes that demonstrate critical thinking skills in an interpretive or argumentative manner.
Beyond complete	25 points (100%) with up to five future points	Report includes more than two Flood zone outputs or three flooded landscape attribute assessment that further illustrate understanding or critical engagement with the tools and landscape.