**Flooding analysis methods**

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Software path for analysis

*R -> GIS -> R*

**Step 1: Data download and prep in R (DataDownload\_flood.R Script)**

1. Using the nhdplusTools package in R use the get\_nhdplus() tool to extract NHD data for the AOI
   1. Visualize data to see if there are holes. If there are holes will need to download data in pieces and then combine. Example combine by HUCs
      1. rbind() the catchment dataframe and flowline dataframe for each piece to put the pieces together
      2. If combining also remove duplicate entries due to overlap

**Step 2: Geospatial Analysis in ArcPro**

1. Wetlands in AOI
   1. Using NLCD of AOI extract cells with NLCD classification of wetland (herbaceous and emergent) which are values of 90 and 95.
2. Developed area in AOI that are in floodplain
   1. Using NLCD of AOI extract cells with NLCD classification of developed (low, medium, and high intensity) which are 22, 23, 24. Developed open space was left out of the category of developed area due to the amount of green space included in the classification.
   2. Extract by mask using the Active River Area raster from TNC as the mask data to find only developed area in the floodplain.
3. Load in catchment spatial dataframe made in data prep step
   1. If had to combine to avoid holes, then select only the catchments that intersect with the AOI using the select by location tool with your boundary as the selecting feature.
4. Wetland and Flood Risk Area in Catchments
   1. Tabulate by area with catchments as zones and developed area in flood risk zone as value raster to get the area of flood risk developed area in each catchment.
   2. Use tabulate area to get the area of wetlands in each catchment.
5. Join wetland by catchment and flood risk area by catchment to AOI catchment dataframe and save to then be loaded back into r.
   1. Recommend making a copy of the catchment data and attaching the wetland and flood risk area columns to the copy.

**Step 3: Flood Analysis in R (Flood\_clean.R Script)**

1. Use read\_sf() to load the data frame with the wetland and flood risk area by catchment.
2. Filter the flowline dataframe by only the featureids in the catchment dataframe that is now the extent of the AOI.
   1. The featureids in the catchment data lines up with comid in the flowline dataframe
      1. With going between R and GIS watch for changes in column names. For example, featureid can be changed to featurd by GIS when saving.
3. From the filtered flowline dataframe extract the comids.
4. Run analysis code making sure names of columns are correct before running (same as with 2ai).
   1. On a 2022 MacBook pro this analysis took about 2 hours to run with the AOI being NC and there being 68,992 catchments.
5. Results are a dataframe of comids and downstream flood risk area for each catchment.
6. Join results dataframe to catchment dataframe to have wetlend percent/area and downstream flood risk area for each catchment in the AOI.
7. To get percent of wetlands divide the wetland area column by the shape area column (that is in the same unit of m^2) and multiply by 100.

Rerun Step 2 Geospatial Analysis and Step 3 Flood Analysis for each NLCD year of interest.

If summarizing by HUC ->

In GIS upload output of step 3 (catchments with wetland and downstream flood risk area data) and use summarize within to get downstream flood risk area for each huc and calculate field using the area of wetland and area of huc to get percent wetland in the huc.

* Disclaimer: need all catchments that are within hucs of interest (may need more than just catchments within state, possibly those right outside).