

# WBD QC Tool Manual

Matthew Morriss, Patrick Longley, and Brittany Gold

February 2021

## Contents

### 1 Introduction

These tools were developed by the personnel of the WBD team (Patrick Longley, Brittany Gold, and Matthew Morriss at the UT Water Science Center). They are largely written in ArcPy for use with ArcMap or ArcPro. As these two softwares use different versions of Python (2.x and 3.x respectively), we have tested these tools on both softwares.

All of these tools are packaged into a .pyt - python toolbox - which can be added to both ArcPro and ArcMap. The tools are package into a toolbox called WBD automation tools.

### 2 Requirements

These tools were developed in Python 3 and require ArcGIS PRO. All of the tools were tested with ArcGIS Pro 2.6.3 as of March 1, 2020.

TO RUN:

- At least ArcPro GIS 2.6.X
- Python 3.X (comes with ArcPro)

### 3 Download and Install

The most up to date software can be downloaded from the project GitLab page <https://code.usgs.gov/bgold/wbd-qc-tools>. As of this writing, this page is internal to the USGS and requires a USGS login to access.

## 4 General Use

## 5 Manual vs. Tutorial

This is a Manual, not a Tutorial. This is a document kept to be a reference for the various functions and tools developed to the aid the QC process of WBD products. We make limited suggestions as to a workflow for the tools, mostly with the use of a Flow Chart of the various functions (Figure ?? and ??).

## 6 Workflow

Possible workflows through the functions provided are outlined in Figures ?? and ??. In the sections that follow, descriptions of each function are provided and in some cases, possible outputs are included as figures using the example datasets.

## 7 Tools

### 7.1 Attribution Tools

#### 7.1.1 General Check

##### *Tool Description*

This tool performs simple checks on all fields that are edited during the EDH process. The following checks are performed:

- Checks that text fields match the correct regular expression (are generally in the correct format).
- Checks that Huc, TNMID, and Name fields are unique.
- Checks that the Huc and ToHUC fields match the Huc and ToHUC fields in the parent feature class.

##### *Inputs*

- Updated WBD line feature class.
- WBD polygon feature classes (more than one can be entered).

##### *Outputs* None

##### *Output Columns*

- |                         |                       |
|-------------------------|-----------------------|
| • Line: TNMID_flag      | • Line: HUMod_flag    |
| • Line: HUDigit_flag    | • Polygon: Name_flag  |
| • Line: LineSource_flag | • Polygon: TNMID_flag |

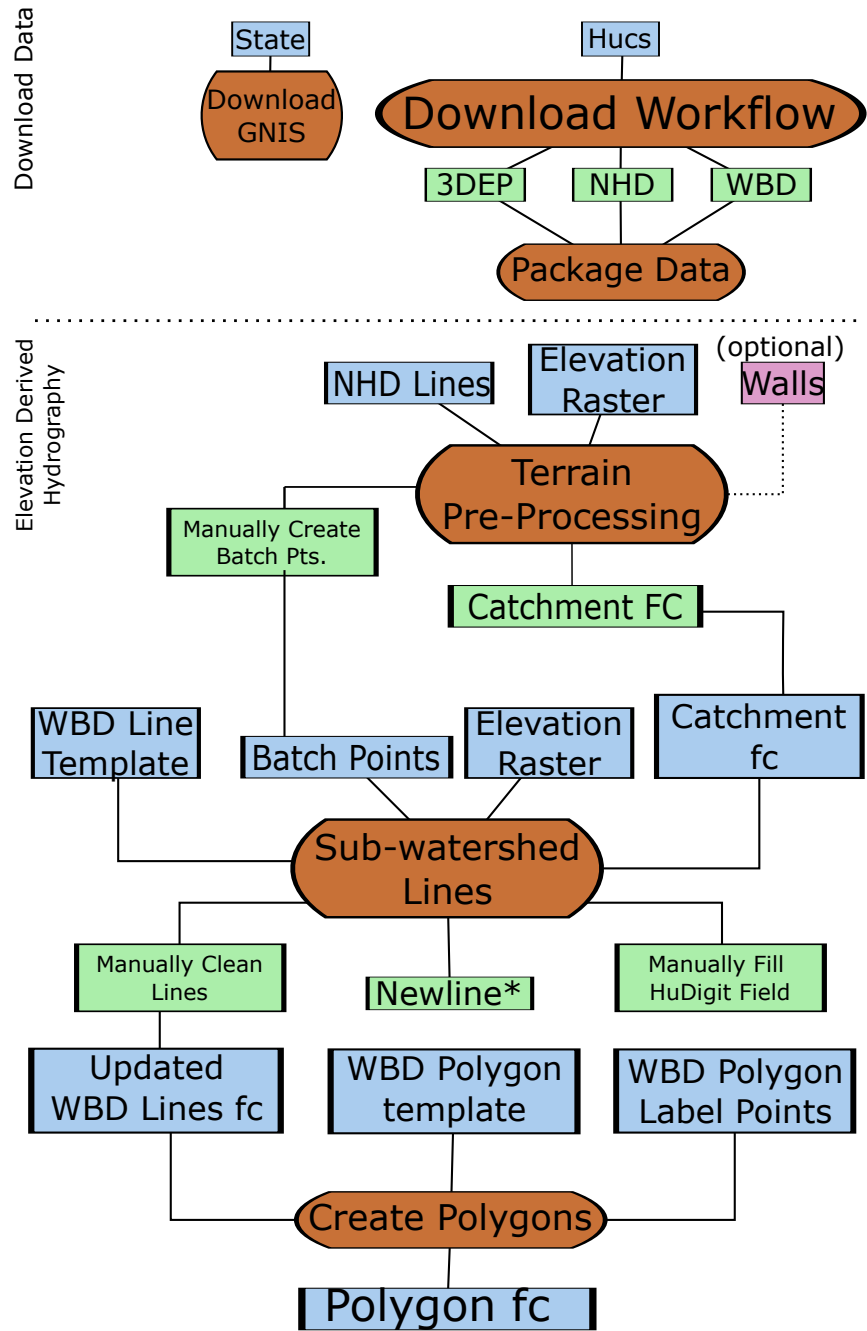


Figure 1: Two example workflows: 1) Download Data and 2) Elevation Derived Hydrography tools

# WBD QC Automation Tool Workflows

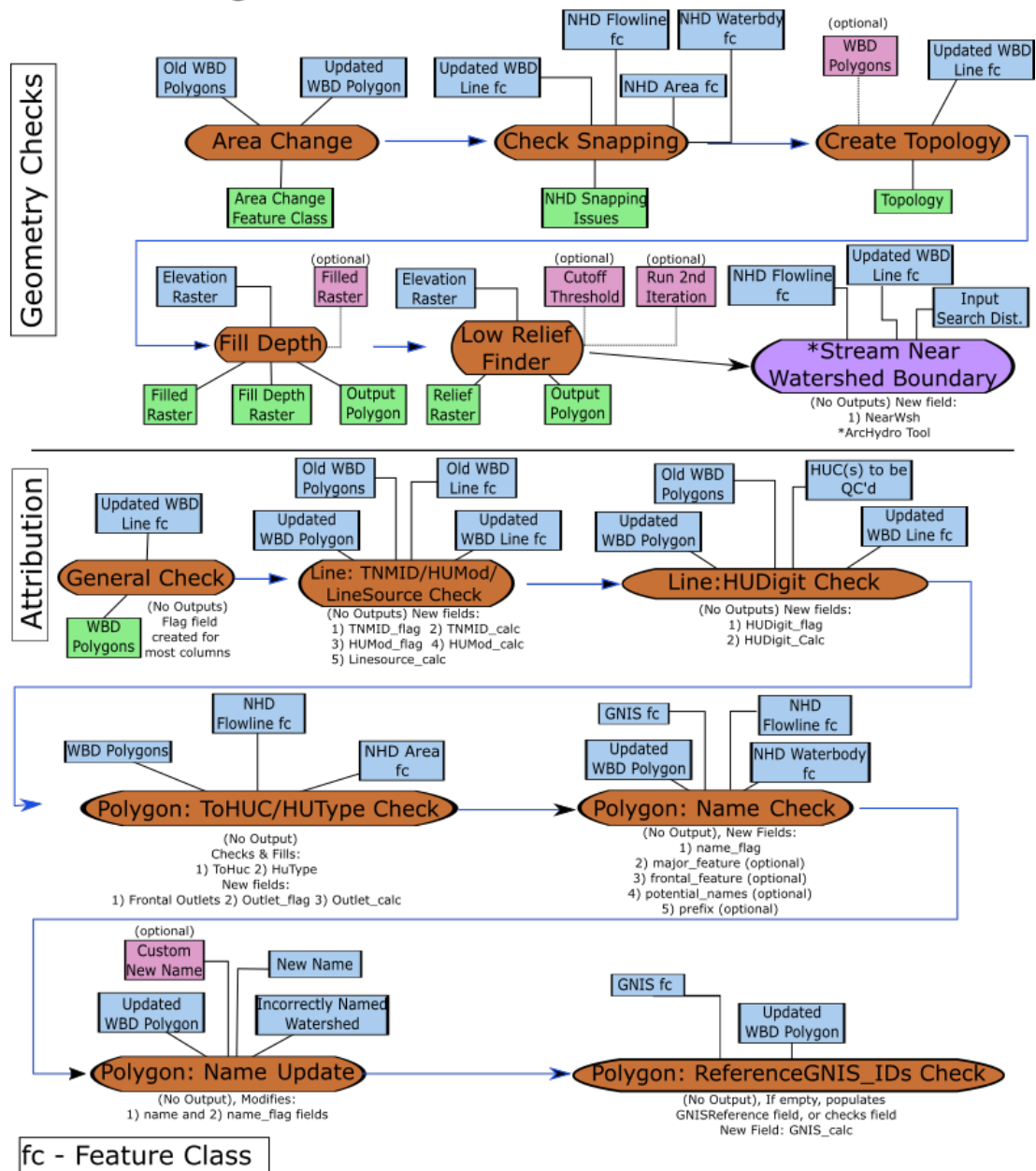


Figure 2: Two example workflows: 1) Geometry Checks and 2) Attribution Check tools

Table 1: Summary of Attribution Tools.

Tool name	Input datasets	Ouput datasets	New columns
1) General Check	WBD line fc WBD polygon fc(s)	NA	"_flag" columns
2) Line: TN-MID/HUMod/LineSource Check	Old WBD line fc New WBD line fc Old WBD polygon fc New WBD line fc	NA	TNMID_calc HUMod_calc LineSource_calc
3) Line: HUDigit Check	New WBD polygon fc(s) Reference WBD polygon fc(s) New WBD Line fc	NA	HUDigit_calc
4) Polygon: ToHUC/HUType Check	New WBD polygon fc NHD flowline fc NHD area fc	Outlets Frontal Outlets	ToHUC_calc
5) Polygon: Name Check	New WBD polygon fc GNIS fc NHD waterbody fc NHD flowline fc	NA	optional
6) Polygon: Name Update	New WBD polygon fc	NA	NA
7) Polygon: ReferenceGNIS_IDs Check	New WBD polygon fc GNIS fc	NA	ReferenceGNIS_IDs_calc

- Polygon: ReferenceGNIS\_IDs\_flag
- Polygon: States\_flag
- Polygon: Huc\_flag
- ToHUC\_flag
- AreaSqKm\_flag
- AreaAcres\_flag
- NonContributingAreaAcres\_flag
- NonContributingAreaSqKm\_flag

Each of these new "\_flag" columns will have one of three flags:

- **CORRECT:** the field is the correct format.
- **INCORRECT:** the field is not the correct format.
- **NODATA:** the field is blank or Null

### 7.1.2 Polygon: TNMID/HUMod/LineSource Check

*Tool Description*

This tool compares the TNMID, HUMod, and LineSource fields from the original WBD Line featureclass to the updated WBD line featureclass. If the values in the new featureclass are different from the original, they are flagged as incorrect.

Since WBD updates affect both the geometry and attribution of the WBD line feature class, it is difficult to determine exactly which lines to compare when testing if the updated attribution is different from the original attribution. This tool overcomes this problem by performing a kind of "best guess" spatial join that minimizes the sum of the euclidean distance between line centroids. This determine which lines in the original featureclass should be compared to the lines in the new featureclass. This calculation is performed on a per huc basis. It should be noted that this algorithm is not perfect and will not work where:

- a huc code is retired,
- a new huc code is retired,
- the number of line segments that make up a polygon changes,
- along the outer boundary (if the boundary has not been subdivided into the correct number of line segments yet).

#### *Inputs*

- Old WBD line featureclass
- Updated WBD line featureclass
- Old WBD polygon featureclass: (smallest possible HUC subdivisions. Generally HUC12; unless HUC14s or HUC16s exist for the given area.)
- Updated WBD polygon featureclass: (smallest possible HUC subdivisions. Generally HUC12; unless HUC14s or HUC16s exist for the given area.)
- Fields to check: Which fields to check. By default LineSource is not checked since this value is likely to change and still be correct.
- New subdivisions: This option should be selected when new subdivisions are created (for example if there are newly created HUC14s or HUC16s).
- Fill missing values: Controls if missing values are filled (and flagged with "FILLED") or left empty and flagged with "NODATA"

#### *Outputs None*

##### *Output Columns*

- TNMID\_calc: TNMID value transferred from the original WBD line featureclass (if selected in "Fields to check").
- HUMod\_calc: HUMod value transferred from the original WBD line featureclass (if selected in "Fields to check").

- **LineSource\_calc:** LineSource value transferred from the original WBD line featureclass (if selected in "Fields to check").

This tool also updates the `TNMID_flag`, `HUMod_flag`, and `LineSource_flag` fields generated by the General Check tool. If these fields are not present in the dataset they will be added by this tool.

This tool uses the following flags in the "\_flag" columns:

- **CORRECT:** the updated data matches the original data.
- **FILLED:** the field was filled by the tool (only applicable if "Fill missing values" is selected).
- **NOTCHECKED:** the field was not checked by this tool.
- **INCORRECT:** the updated data does not match the original data.
- **NODATA:** the field is blank or Null.

It should be noted that this tool compliments the general check tool and performs a more in depth check that builds upon the checks performed by the general check tool. This tool will not overwrite preexisting **WRONG** or **NODATA** flags but can change **CORRECT** to **WRONG** or **NOTCHECKED**. Additionally if the user has added notes to one of the "\_flag" fields the tool will not overwrite their notes (or the flag).

## 7.2 Download Data Tools

## 7.3 Elevation Derived Hydrography Tools

## 7.4 Geometry Checks

### 7.4.1 Fill Depth and Polygon

#### *Tool Description*

This tool was written out of necessity to identify areas where the Arc **Fill** tool would create errors in the eventual **ArcHydro** processes. The primary case considered in this work was the presence of culverts, where filling an area upstream of a road would erroneously send the flowline around the culvert, when in actuality the flowline should go beneath the road. There are other instances wherein excessive filling could change the course of flowlines across a natural landscape (e.g. karst topography or very low relief wetland areas).

#### *Inputs*

- Input Raster - Unfilled (projected with meters as linear unit)
- **Checkbox:** Providing Filled Raster? If providing an already filled raster (e.g. from NHDPlus HR)
- Filled Raster Location

#### *Outputs*

- Filled Raster. A duplicate if a filled raster is provided.
- Fill-Depth Raster. The difference between original unfilled raster and the filled raster.
- Polygon. Polygon feature class of the areas that were filled in the original raster.

### **7.4.2 Low Relief Finder**

#### *Tool Description*

This tool was developed out of a need while conducting plumbing reviews to identify areas of very low-relief where the Arc Hydro tools may not function well in their typically automated fashion. By finding areas that are significantly low-relief, this tool can guide the reviewers eyes to areas that could be problematic and need a closer inspection. This does not replace the need for the reviewer to be on the lookout for areas where Arc Hydro either crosses water-bodies or deviates from what the review determines is the drainage divide.

This tool operates through a moving window, which calculates relief across a DEM. The *default* behavior of the tool identifies areas that are 1-standard deviation below the mean relief in the landscape. This would equate to the areas with the lowest 15% of relief in the landscape. The User can provide their own custom thresholds in units of standard deviation. The tools puts out a relief raster and a polygon feature class

#### *Inputs*

- Input Raster (projected with meters as linear unit)
- Moving Window Radius (m)
- **Checkbox:** Providing Custom Threshold?
- Cutoff Threshold (standard deviations; e.g. 1, 2, 3) below the mean
- **Checkbox:** Run Second Iteration? Identify areas with even lower relief with a second pass of the tool.

#### *Outputs*

- Output Raster - Raster and location
- Output Polygon - Polygon feature class name and location for areas of low relief.

## **7.5 Job Checkout**

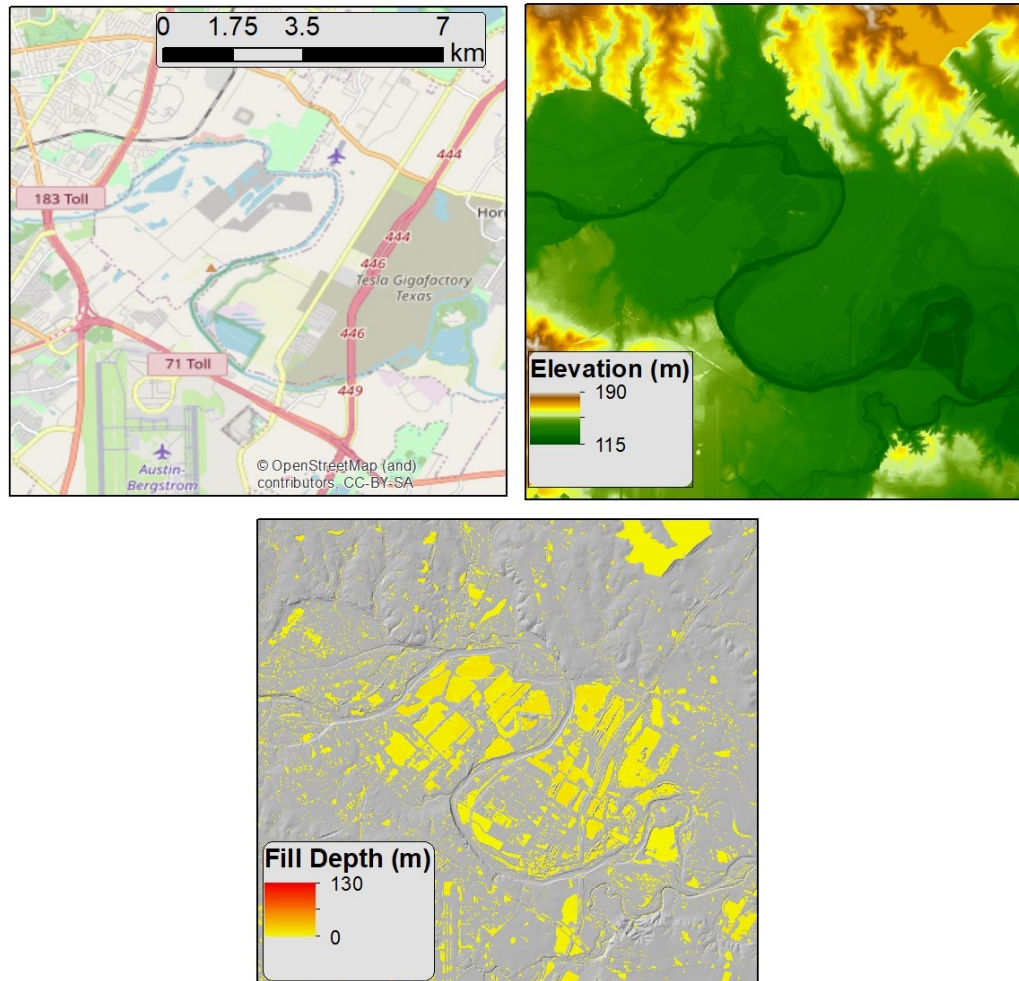


Figure 3: Fill Depth Tool Example. **First Panel**) Open Street Map view of meanders on the Colorado River near Austin, Texas **Second Panel**) Elevations of the unfilled DEM. **Third Panel**) Fill Depth result from tool across study area. The areas highlighted in this figure will also become the polygons outlined in the polygon layer output.

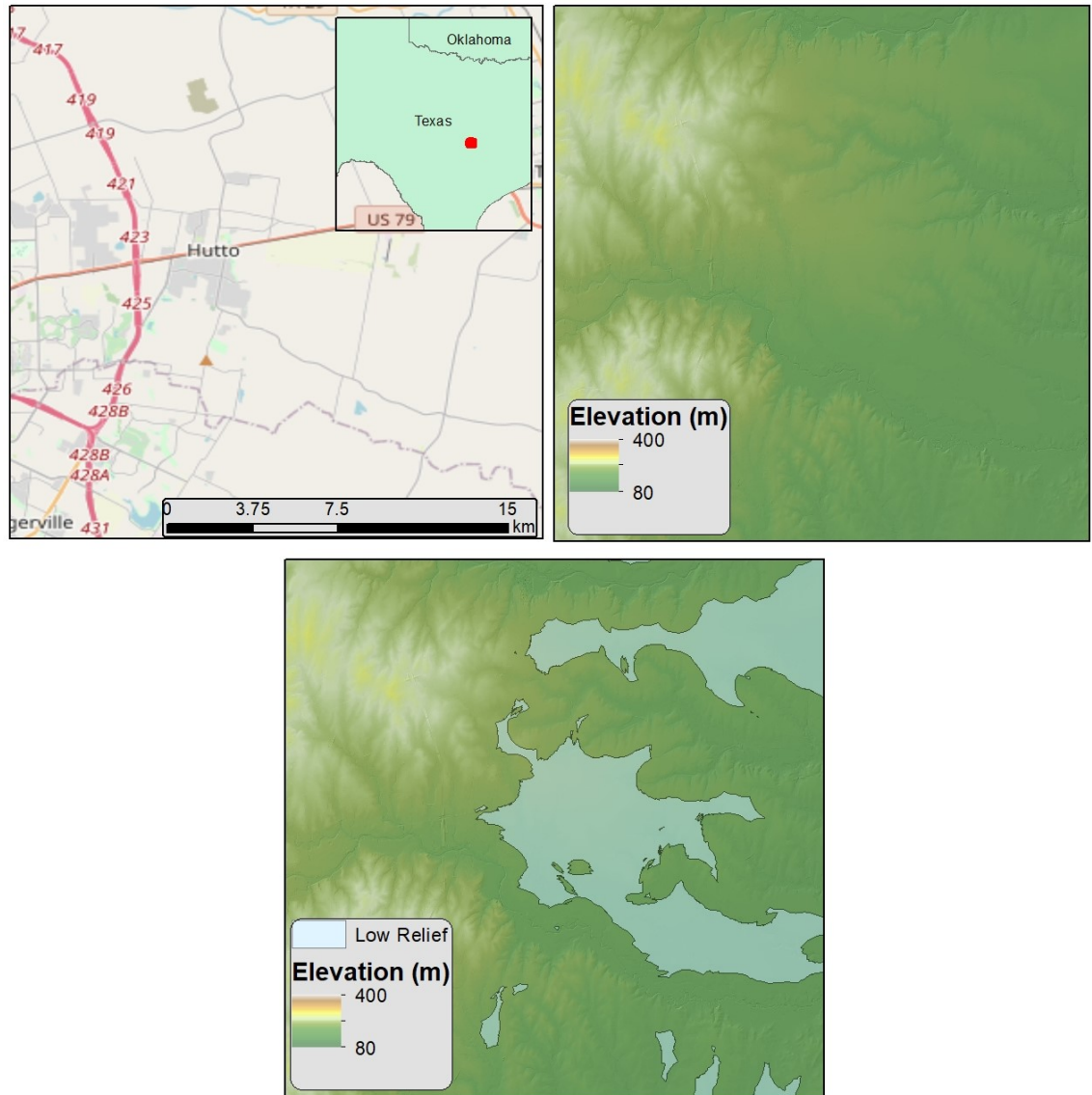


Figure 4: Low Relief Tool Example **First Panel)** Open Street Map view of example area in Central Texas, USA **Second Panel)** Elevations of DEM across example area **Third Panel)** Low Relief tool results. Areas identified as meeting tool qualifications highlighted in teal.