Leave it to Beavers

An Assessment of Streams Suitable for the Introduction of Beavers

Introduction

While beavers are known for building impressive dams, they have another less known superpower: combating climate change. Human activity causes many problems in watersheds, including an increase in erosion, the reduction of wetlands, the pollution of streams, and the endangerment of wildlife habitats. Introducing beavers to watersheds has proven to be a cheap and effective solution to many of these anthropogenic problems.

Non-profit Bonneville Environmental Foundation (BEF) is working to introduce beavers to the Middle and Upper Marys River sub-basins in Oregon to increase cutthroat trout populations. They have mapped out stream reaches that have high potential for beaver and cutthroat habitats, called Anchor Habitats (ACH), and are continuing to search for the most suitable reach to place beavers. One criteria for suitability is that the dams do not interfere with human structures.

When beavers build dams in streams, the land just upstream becomes inundated with water. While this is generally beneficial for the environment, flooding can be problematic if it interacts with roads and houses. This project models the extent of beaver-caused ponding around each ACH reach, and eliminates reaches that would result in problematic flooding.

Spatial question: Where is the best place to introduce beavers to while minimizing damage from flooding?

Methods

__Data Preparation:__

This project was completed in ArcMap 10.6.1, using ArcToolbox and ModelBuilder, with Spatial Analyst extension. Inputs included a line-shapefile of all ACH reaches, an elevation raster (FGDBR), a roads line-shapefile, and a polygon-shapefile of the Middle and Upper Marys Basin. These layers were provided to me by BEF. The layers came in various coordinate systems, so I projected them with coordinate system State-Plane Oregon North (NAD 1983) and projection Lambert Conformal Conic. I clipped all layers to the shape of the basin.

__Data Analysis:__

The process consisted of finding watersheds for points along each ACH reach and selecting the lowest 8 feet (the height of a beaver dam) of each. (Select Elevation ≤ minimum elevation + 8)

Generate Points Along Lines: Discretized each reach into points that are 1000 feet apart.

Flow Direction: Determined directions of flow for each cell.

Flow Accumulation: Calculated accumulated flow into cells.

Snap Pour Point: Snapped ACH points to cells of highest accumulated flow. I used a radius of 40 feet, which was large enough to snap most of the point to the stream, but small enough that the points were close enough to the original points. Some points were farther than 40 feet, which presented a challenge. To solve this issue, I converted the points to a vector, manually moved them with **Editor**, and then converted the points back to raster.

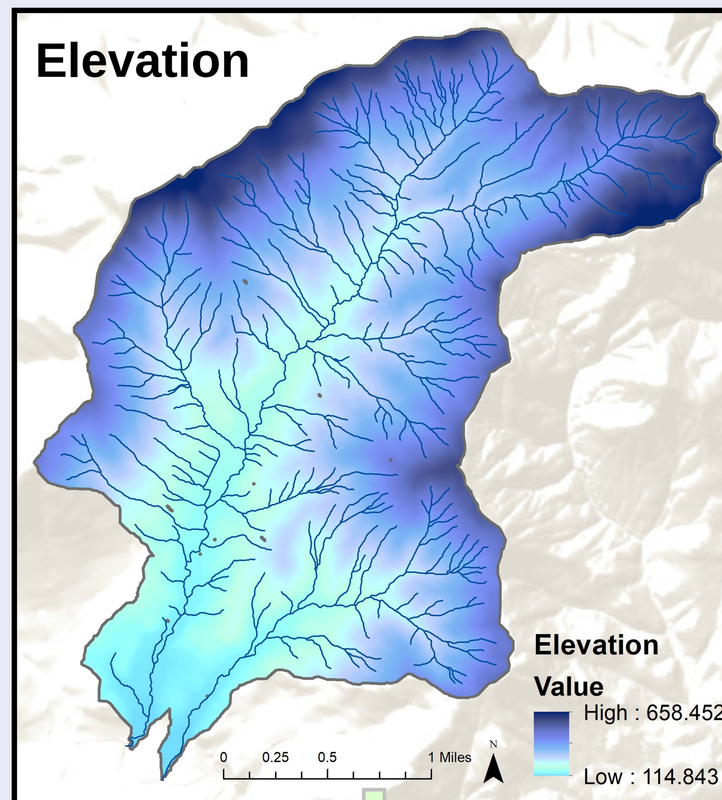
Watershed: Delineated watersheds via cells' flow into each pour point.

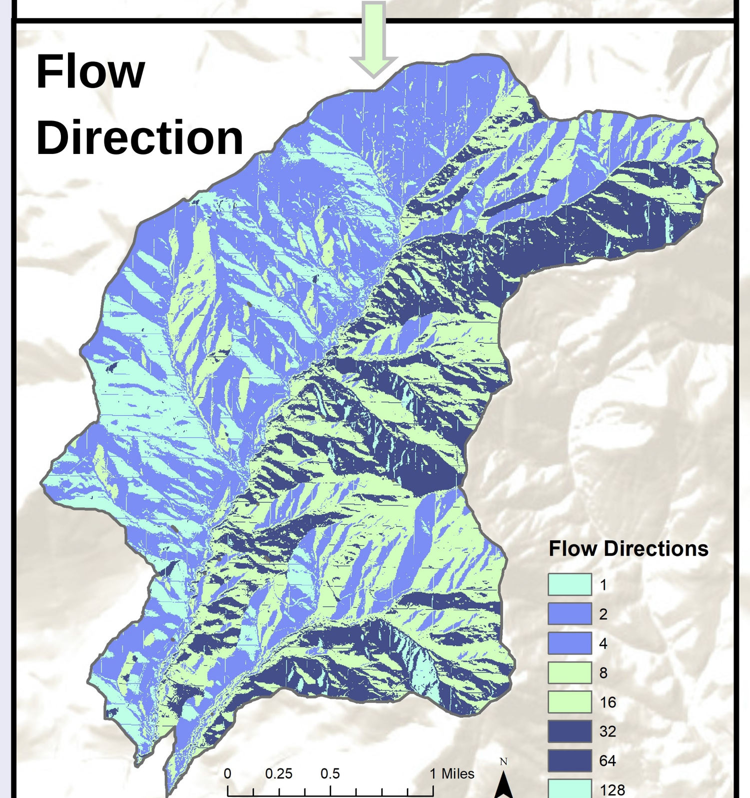
ModelBuilder: Created clipping tool to clip the elevation to each watershed.

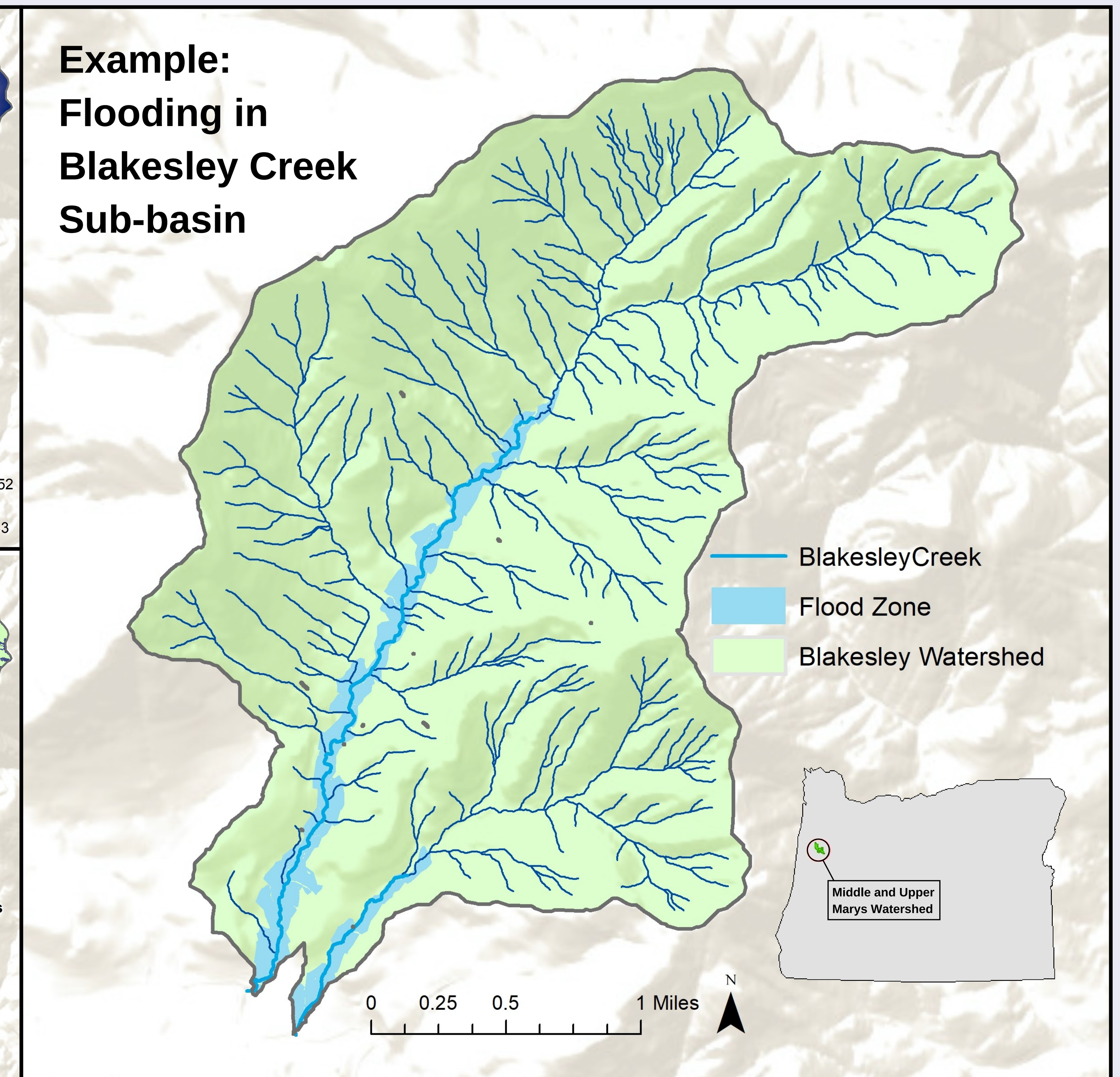
ModelBuilder: Created a Flood Zone Tool to find the minimum elevation of each raster, add 8 feet, and select all cells that had elevation less than this value. It was a challenge to recognize a different minimum for each raster, and I solved this by using Get Raster Properties to pull out this value and a conditional statement in Raster Calculator with the value.

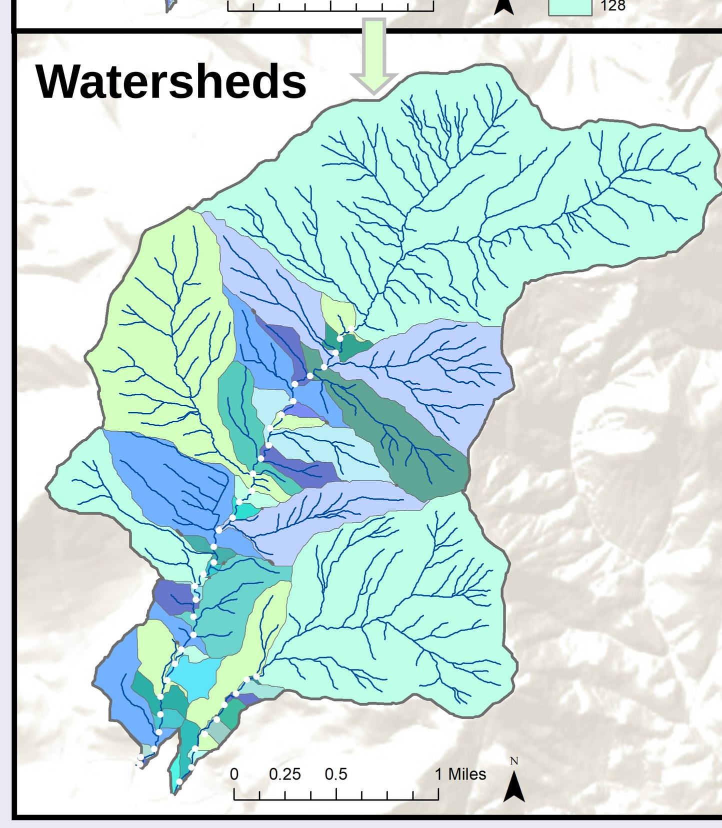
Select by location: Selected all flood zones that did not intersect with roads.

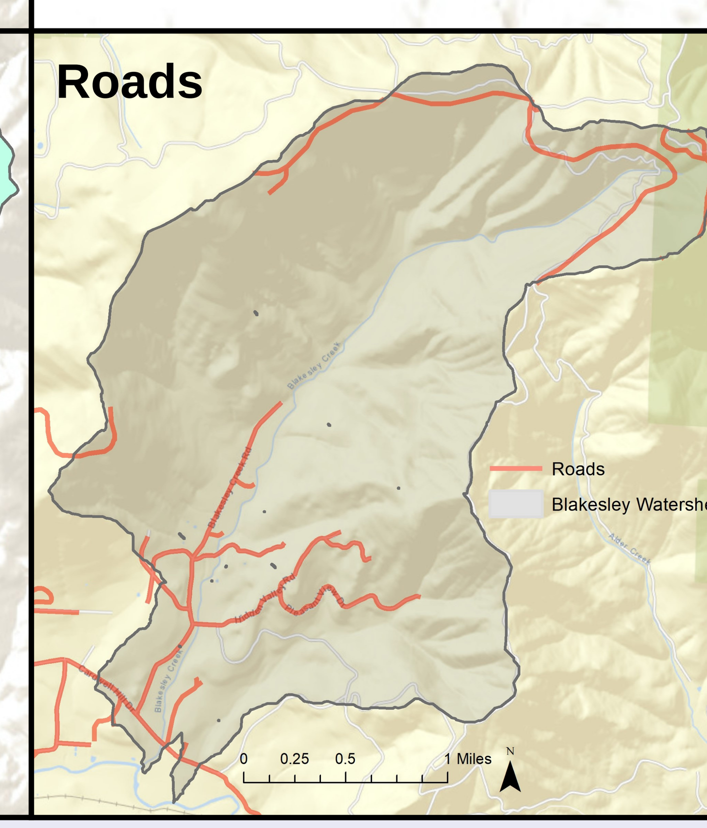
Remaining reaches were visually inspected against a basemap for intersection with buildings.

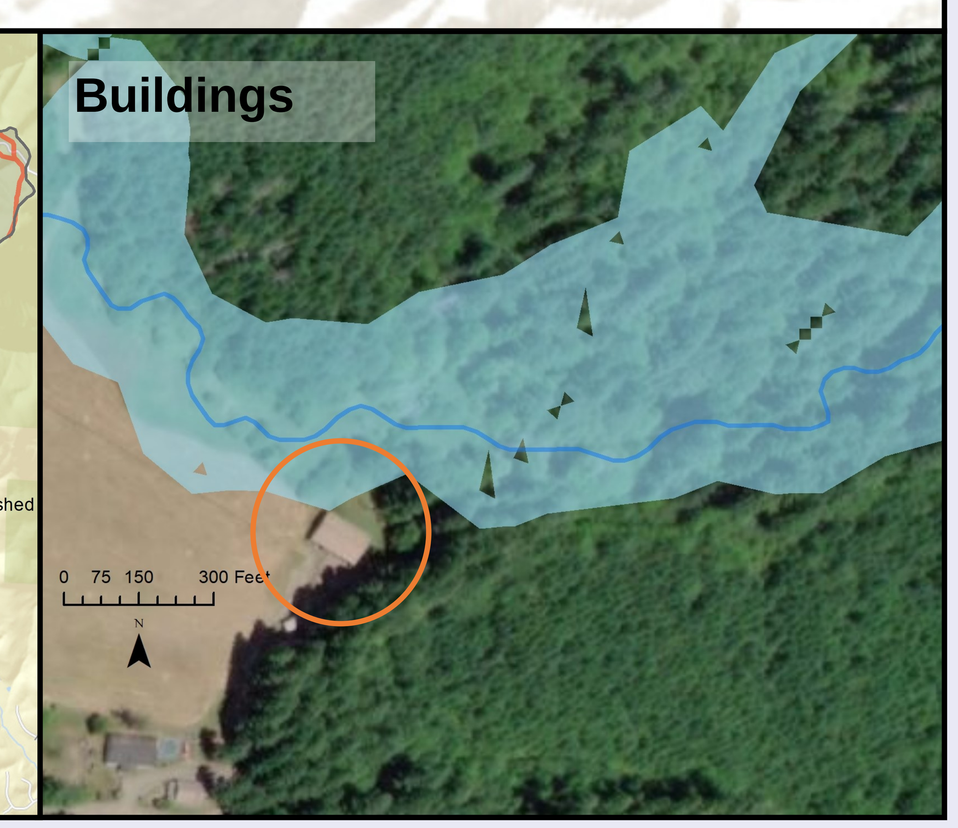


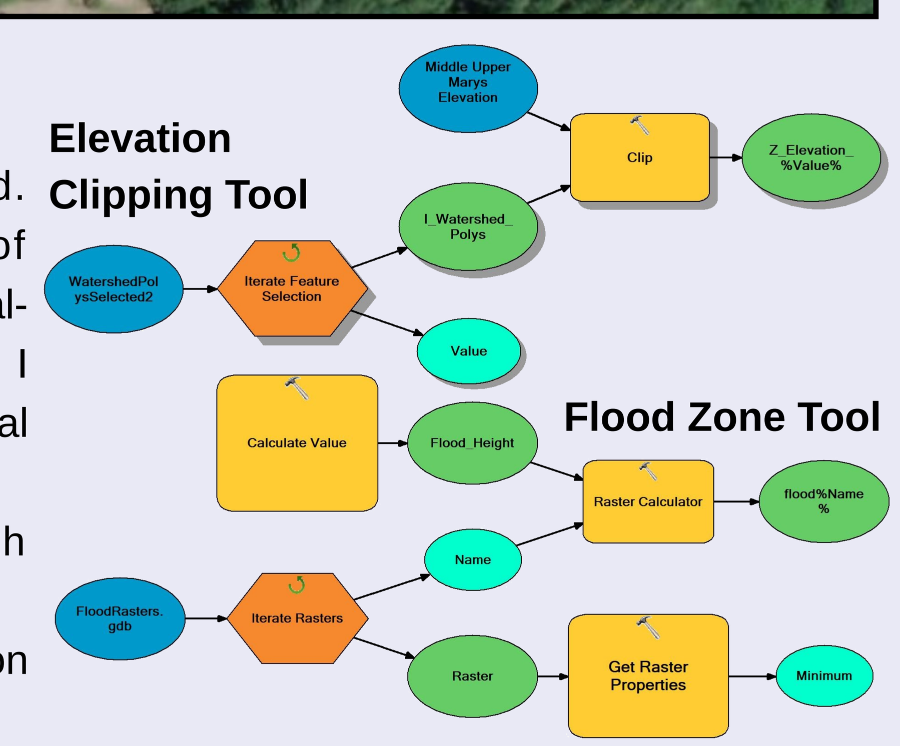










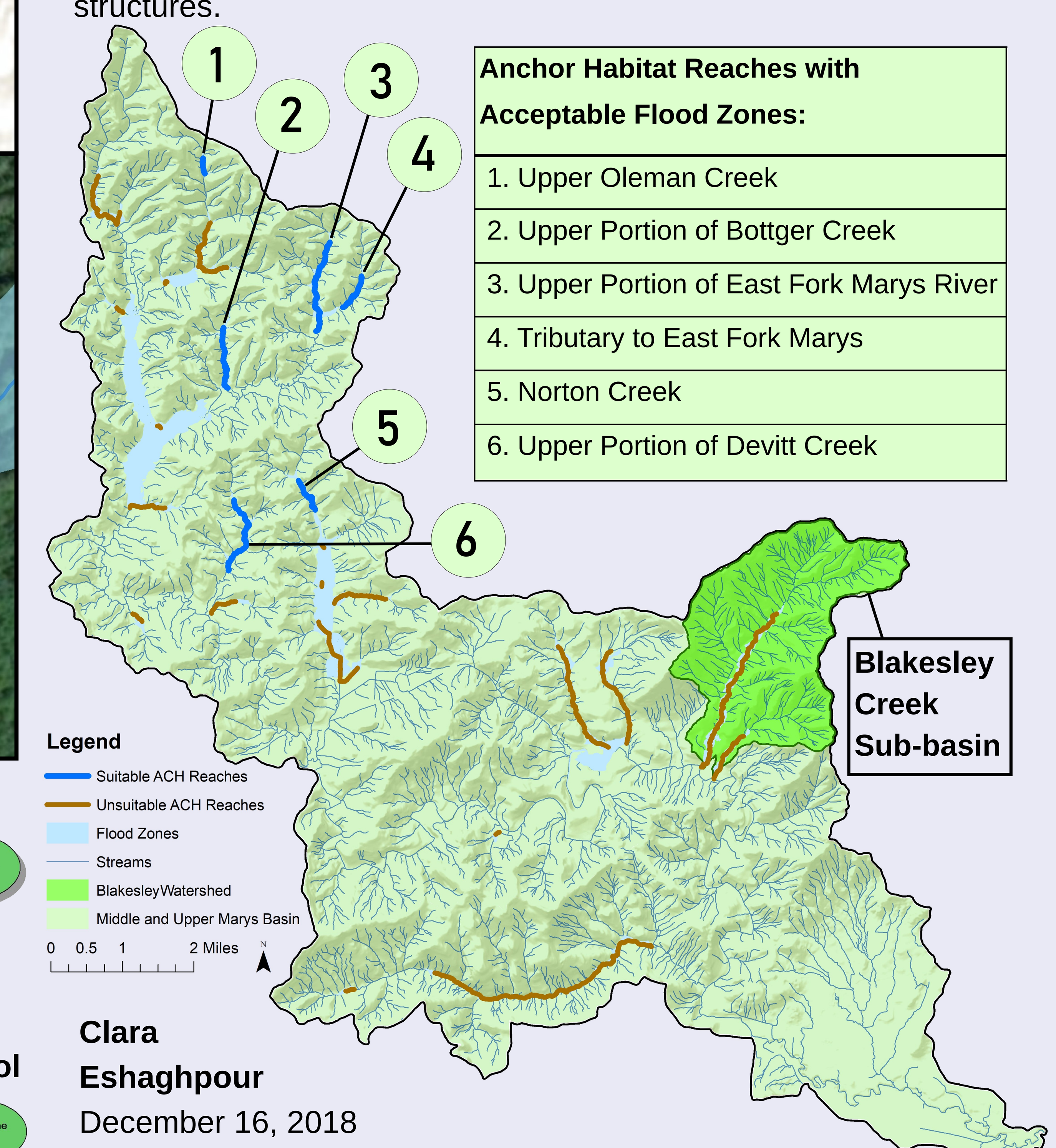


Limitations

This analysis does little to account for migration of beavers within these streams. Additionally, there are some instances of data error, where the ACH reaches do not coincide with accumulated flow. Further data collection could be used to validate where the streams are. Furthermore, it is possible that some structures not very visible, and I may have missed some buildings during my inspection. Lastly, this analysis does not account for a buffer strip around logging lands, which are required to protect water quality.

Conclusion

There are six ACH reaches that are the most suitable for the introduction of beavers because they exhibit limited flooding and are far away from roads and structures. Upper Oleman Creek, Tributary to East Fork Marys, Norton Creek passed the criteria and were sufficiently far away from structures. The upper portions of Devitt Creek, Bottger Creek, and East Fork Marys River did not pass the criteria, but had portions of the stream that were far enough from structures, so I considered them acceptable. Oleman Creek and Tributary to Norton Creek passed my criteria, but were eliminated because their flood zones were too close to structures.



Anchor Habitat Reaches with Acceptable Flood Zones:
1. Upper Oleman Creek
2. Upper Portion of Bottger Creek
3. Upper Portion of East Fork Marys River
4. Tributary to East Fork Marys
5. Norton Creek
6. Upper Portion of Devitt Creek

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