**Input Files**

**Watercourse**: shapefile or feature class

The fields don’t matter because it will be altered in the following steps

**Barriers**: shapefile or feature class. Has the following fields at a minimum, other fields can be added for additional information

BARRIER\_CO: Unique identifier for the barrier

PermPass: The upstream permeability of the barrier

**Data pre-processing (ArcGIS)**

**\_\_\_\_ 1. Select watercourse**: Process data so that all NorWeST or FlowMet flowlines for the associated watershed and barriers are included. In symbology, plot lines with ‘Arrow at End’ in Gallery to determine line direction and determine whether flowlines need to be reversed.

* NOTE: This section requires checking barriers to make sure they snap to the correct flowlines.
* NOTE: If segments are not draining to a single, unambiguous point you can reverse the line drawing order in Edit/Modify Feautres/Select and Right Click/Reverse Direction (<https://pro.arcgis.com/en/pro-app/latest/help/editing/reverse-the-direction-of-a-polyline.htm>).
* NOTE: No stream order or discharge thresholds were appropriate for spring-fed systems surrounding Bear Lake (Swan Crk, Indian Crk, North Eden Crk), so network editing was largely based on JD directions and satellite imagery.

**\_\_\_\_ 2. Snap barriers to watercourse**: Use *Snap* to join barriers to watercourse. Set search radius to default of 100 meters OR to distance exceeding largest distance between barrier and stream segment.

* NOTE: Create a separate point feature here (ex. CONN\_Barriers…)

**\_\_\_\_ 3. Remove duplicate points**: Use *Find Identical* with Field(s) set to ‘Shape’ and ‘Output only duplicated records’ checked. Use this list to remove points with identical geometry, as identical or near-identical barriers will snap to the same location.

**\_\_\_\_ 4. Split segments at barriers**: Use *Split Line at Point* to create individual segments between barriers and confluences. Set search radius to 0.0001 Meters.

* NOTE: This function creates the connectivity flowlines (ex. CONN\_NorWeST...)

**\_\_\_\_ 5. Remove dangling segments**: In *Catalog*, right click the feature class containing the stream network and select *New*/*Topology*. Add the stream network feature class, then add the rule ‘Must Not Have Dangles (Line)’ and finish the setup. Right click the feature class topology and select *Validate*, which will produce a point topology of every dangle end. Search network for any dangles that do not represent either the outlet or headwaters.

* NOTE: This is also an appropriate place to refine the stream network by removing flowlines.

**\_\_\_\_ 6. Calculate stream length**: Use *Calculate Geometry Attributes* to create a field (‘Length\_km’) that is the feature length in kilometers.

* NOTE: If network contains lakes/reservoir flowlines, set their stream length to 0 km.

**\_\_\_\_ 7. Add To/From Node Fields**: Use ArcHydro tool *Generate To/From Node for Lines*.

* NOTE: The ‘To\_Node’ at the terminus is the only node that shouldn’t appear in the ‘From\_Node’ list.

**\_\_\_\_ 8. Convert watercourse to point layer**: Use *Feature Vertices to Points* to convert the watercourse to a points layer. Vertice type == ‘End’.

**\_\_\_\_ 9. Join barrier data to stream network points**: Use *Spatial Join* to join the barrier layer to the point-stream layer. This creates a point layer with upstream (Fnode), downstream (Tnode), and barrier attributes in one file.

**\_\_\_\_ 10. Export shapefile to .csv**: Use *Export Table* tool to convert the barrier-joined points attribute table to a .csv file for use in R.