Watershed and Stream Network Delineation Exercise
Synopsis of Class 10, GIS in Water Resources

The purpose of this exercise is to illustrate watershed and stream network delineation based on digital elevation models using the Hydrology tools in ArcGIS and online services for Hydrology and Hydrologic data. In this exercise, you will select a stream gage location and use online tools to delineate the watershed draining to the gage. National Hydrography and Digital Elevation Model data will be retrieved for this area (Logan River Basin) from online services. You will then perform drainage analysis on a terrain model for this area. The Hydrology tools are used to derive several data sets that collectively describe the drainage patterns of the basin. Geoprocessing analysis is performed to fill sinks and generate data on flow direction, flow accumulation, streams, stream segments, and watersheds. These data are then used to develop a vector representation of catchments and drainage lines from selected points that can then be used in network analysis. This exercise shows how detailed information on the connectivity of the landscape and watersheds can be developed starting from raw digital elevation data, and that this enriched information can be used to compute watershed attributes commonly used in hydrologic and water resources analyses.

Learning objectives

- Do an online watershed delineation and then extract the data for that watershed to perform a more detailed analysis.
- Identify and properly execute the sequence of Hydrology tools required to delineate streams, catchments and watersheds from a DEM.
- Evaluate and interpret drainage area, stream length and stream order properties from Terrain Analysis results.
- Develop a Geometric Network representation of the stream network from the products of terrain analysis.
- Use Network Analysis to select connected catchments and determine their properties.

Synopsis

The exercise is divided into the following activities:

1. Online Watershed Delineation and Data Retrieval.
2. Hydrologic Terrain Analysis
3. Network analysis

Online Watershed Delineation and Data Retrieval

Software as a service is a trend in the modern information technology industry. This involves data and computational functionality available from remote servers in large data centers "in the cloud" optimally configured for the data and functionality they provide. GIS is also following this trend and ArcGIS 10.2 provides the capability to access a number of cloud services that are supported by ESRI and accessible to licensed ArcGIS users with ArcGIS.com accounts. Watershed delineation based on the US National Elevation Dataset is supported by ESRI elevation services. Landscape services provide access to the

National Hydrography Dataset. The first part of this exercise uses these services to delineate a watershed and retrieve elevation and hydrography data for this watershed from the online services. Some online geoprocessing functionality is also used to determine the elevation profile of the main stream. The base data retrieved in this section serves to support the hydrologic terrain analysis and network analysis that follow.

Hydrologic Terrain Analysis

This activity will first guide you through the hydrologic terrain analysis steps of Fill Pits, calculate Flow Direction, and calculate Flow Accumulation. The resulting flow accumulation raster then allows you to identify the contributing area at each grid cell in the domain, a very useful quantity fundamental to hydrologic analysis. Streams will then be defined using a flow accumulation. Hydrology functions will be used to define separate links (stream segments) and the catchments that drain to them. Next the streams will be converted into a vector representation. The result is quite a comprehensive set of information about the hydrology of this watershed, all derived from the DEM.

Network Analysis

Some of the real power of GIS comes through its use for Network Analysis. A Geometric Network is an ArcGIS data structure that facilitates the identification of upstream and downstream connectivity. Here we step through the process of creating a geometric network from the vector stream network representation obtained above, and then use it to determine some simple aggregate information such as length and contributing area of parts of the stream network. This serves to expose you to some of the analysis enabled by having a geometric network.