

# Building ArcHydro using National Hydrography Dataset

Prepared by  
Venkatesh Merwade  
School of Civil Engineering, Purdue University  
[vmerwade@purdue.edu](mailto:vmerwade@purdue.edu)

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## Introduction

ArcHydro is a common ArcGIS geodatabase model for storing geospatial and temporal hydrologic data in a structural manner. A geodatabase or data model is different from simulation models (eg. HEC-RAS, HEC-HMS, and SWAT) because it does not simulate or model any physical or environmental processes. A data model is just a framework for storing data in a standard format. A data model is like a book shelf or a computer folder where books or files are organized in a specific way depending on their content, use and other factors. In a geodatabase model, the data are organized in specific feature classes, with each feature class having specific fields, and some of the feature classes are linked depending on their links in the hydrologic system. For example, a stream gauging station is linked to a particular river reach, which is then linked to the watershed. The objectives of this exercise are to (a) apply ArcHydro schema to an empty geodatabase; (b) populate the new ArcHydro geodatabase with NHD (National Hydrography Dataset) stream network, watershed boundary, and USGS gaging station, (c) build a hydro-network for tracing water, and (d) use ArcHydro toolbar to populate some ArcHydro feature attributes.

## Computer Requirements

You must have a computer with windows operating system, and the following programs installed:

1. ArcGIS 9.3 (with ArcInfo)
2. ArcHydro tools (version that works with 9.3)

Make sure the ArcHydro tools (version that works with 9.3) are installed on the system. There are lots of ArcHydro tools available on the internet. The version that is used in this tutorial, and the installation instructions are available at the following link.

<ftp://ftp.ecn.purdue.edu/vmerwade/download/data/tools.zip>

You will need to have administrative access to install these tools.

## Data Requirements and Description

The data files used in this exercise consist of NHD data for Cedar Creek in northeast Indiana, which include stream network, USGS gaging station location, watershed boundary and water

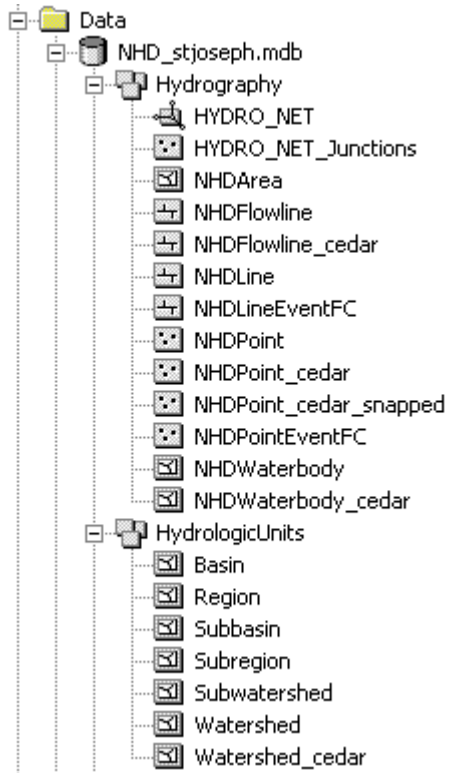
bodies. Although the data are provided with this exercise, the steps involved in downloading the NHD data from the USGS website are described in the following document: ` 1

[http://web.ics.purdue.edu/~vmerwade/education/ned\\_nhd.pdf](http://web.ics.purdue.edu/~vmerwade/education/ned_nhd.pdf)

It is highly recommended that you go through the exercise of downloading the data to make yourself aware of the procedure involved. The St. Joseph River data downloaded from the NHD website are clipped for the Cedar Creek area using the Cedar Creek watershed boundary.

**Download** the data from <ftp://ftp.ecn.purdue.edu/vmerwade/download/data/archydro.zip>

**Unzip** *archydro.zip* in your working directory. The unzipped data should contain two files: *NHD\_stjoseph.mdb* (geodatabase) containing the data and *ArcHydroFrameworkWithTimeSeries.xml* containing the ArcHydro schema. The ArcCatalog-view of the data folder with expanded view of *NHD\_stjoseph.mdb* and its featured datasets is shown below (Note: tables and relationship classes are not shown):

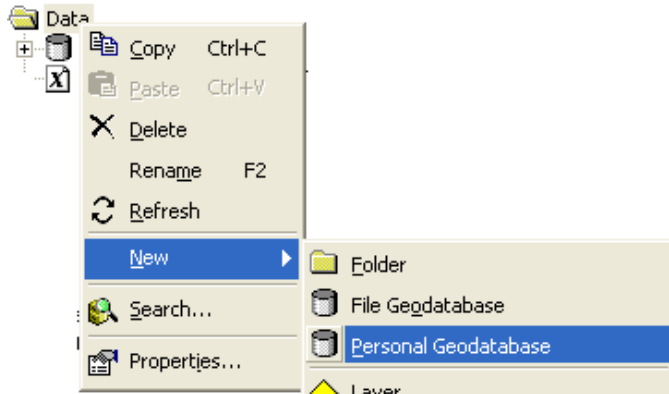


All feature classes that have “\_cedar” suffix are clipped to the Cedar Creek watershed, which is stored in Watershed\_cedar. We will use only these feature classes in creating the ArcHydro data model. *NHDFlowline\_cedar* contains the stream network, *NHDWaterbody\_cedar* contains water bodies, *NHDPoint\_cedar* contains gaging stations, *NHDPoint\_cedar\_snapped* contains the same data in *NHDPoint\_cedar*, but these points are snapped to the *NHDFlowline\_cedar* to create a network.

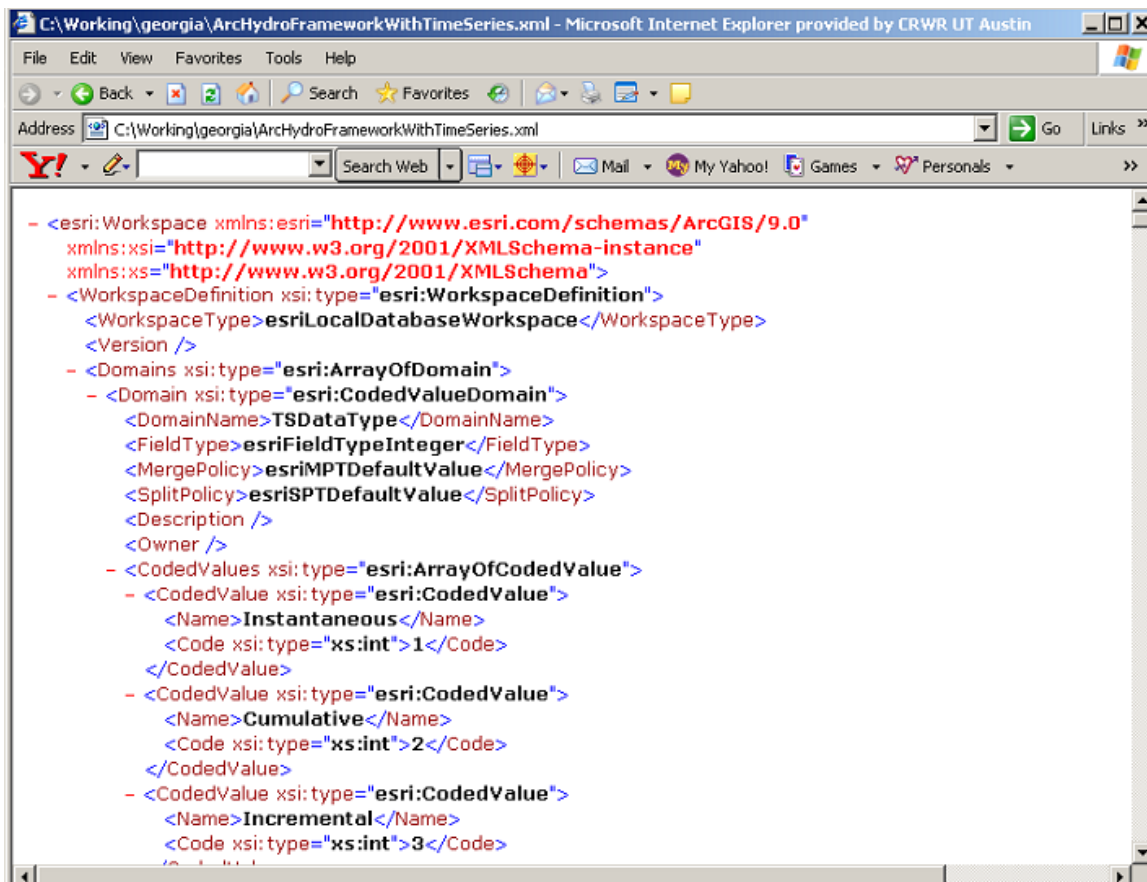
## Getting Started

### Create an empty ArcHydro geodatabase by applying ArcHydro schema

**Open** ArcCatalog. In your working folder create an empty geodatabase named *Cedar\_ArcHydro.mdb*. To do this **right-click** on your working folder, **select** *New*→*Personal Geodatabase*, and **name** it as *Cedar\_ArcHydro.mdb*.

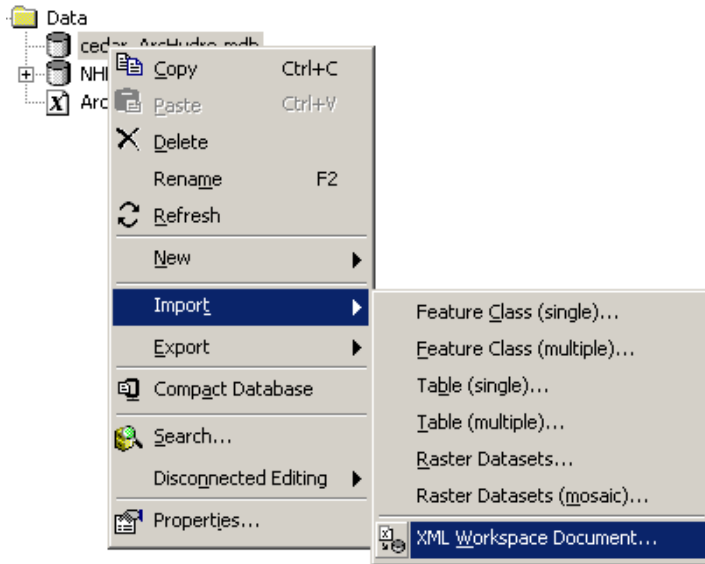


Next, we will apply the ArcHydro schema to *Cedar\_ArcHydro.mdb*. The schema is stored in the *ArcHydroFrameworkWithTimeSeries.xml* file. You should be able to see the xml file from ArcCatalog. Double click on the xml file to open the document in a web browser.

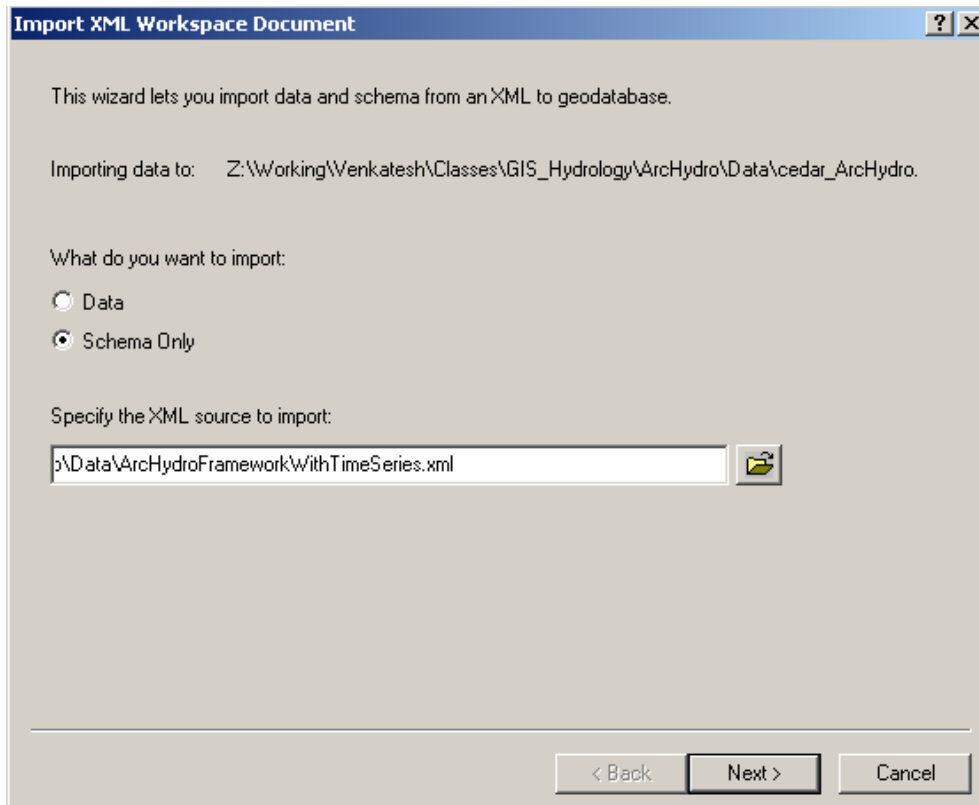


This xml file describes the feature classes, tables, fields, and relationships defined in the ArcHydro with Time Series schema as described in Chapters 2 and 7 of the ArcHydro book.

To apply the schema to the empty geodatabase just created (Cedar\_ArcHydro.mdb), **right-click** on the geodatabase and **select** *Import*→*XML Workspace Document...*

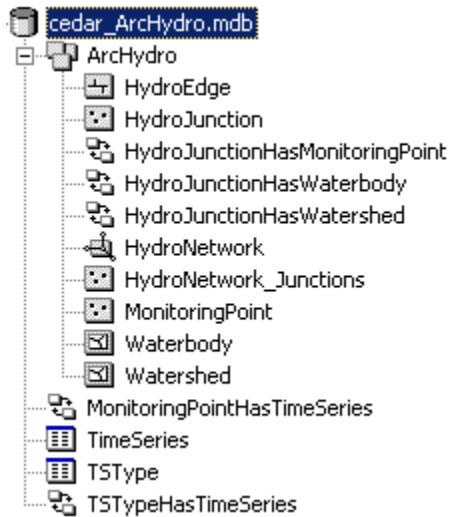


Choose the *Schema Only* option, **browse** to the *ArcHydroSchemaWithTimeSeries.xml* file, and **click** *Next*.



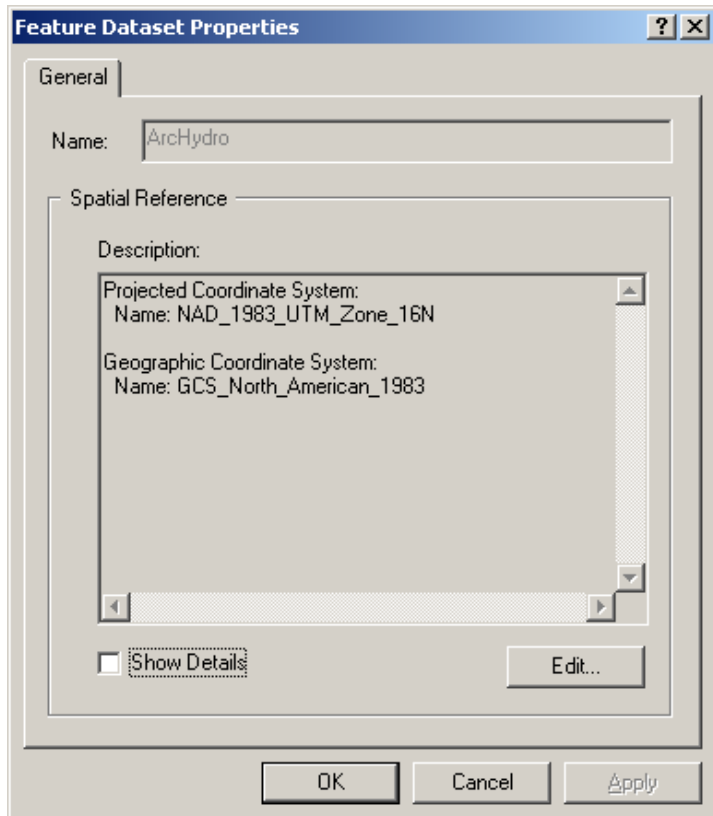
In the next window, where you see the names of different feature classes, **click** *Finish*, and you should see a progress bar importing the schema to the new geodatabase.

After the schema is imported, **select** the working directory, **refresh** ArcCatalog by **pressing F5**, and **look** at *Cedar\_ArcHydro.mdb*. Refreshing ArcCatalog is important, or you won't be able to see the ArcHydro structure applied to *Cedar\_ArcHydro.mdb*. **Expand** *Cedar\_ArcHydro.mdb* and the feature dataset inside it to see the names of feature classes that can store various types of hydrologic data. It also has relationships (*HydroJunctionHasMonitoringPoint*, *MonitoringPointHasTimeSeries*, *TSTypeHasTimeSeries*, etc.) and tables. Notice the structure of the geodatabase, different symbols that represent feature dataset, feature classes (points, lines, and polygons), relationships and tables.



To preview attribute table of any feature class, **select** the feature class, and on right hand side window of ArcCatalog, **select** the *Preview* tab. At the bottom of this tab, **choose** to preview the *Table* instead of *Geography*. You will notice that there are no features in the feature class, but the feature class has ArcHydro attributes (*HydroID*, *HydroCode*, etc).

The next critical step after a new geodatabase is created is to insure that a proper coordinate system is defined for the data. If you **right-click** on *ArcHydro* feature dataset, and **select** the *Properties* menu, you will see that the spatial reference associated with the schema is already applied to the newly created feature dataset.



We will leave this coordinate system unchanged because it is applicable to the Cedar Creek data. If the coordinate system needs to be changed, you can press the edit button, and define/import appropriate coordinate system, but we will skip this step in this exercise, and adopt the pre-defined coordinate system.

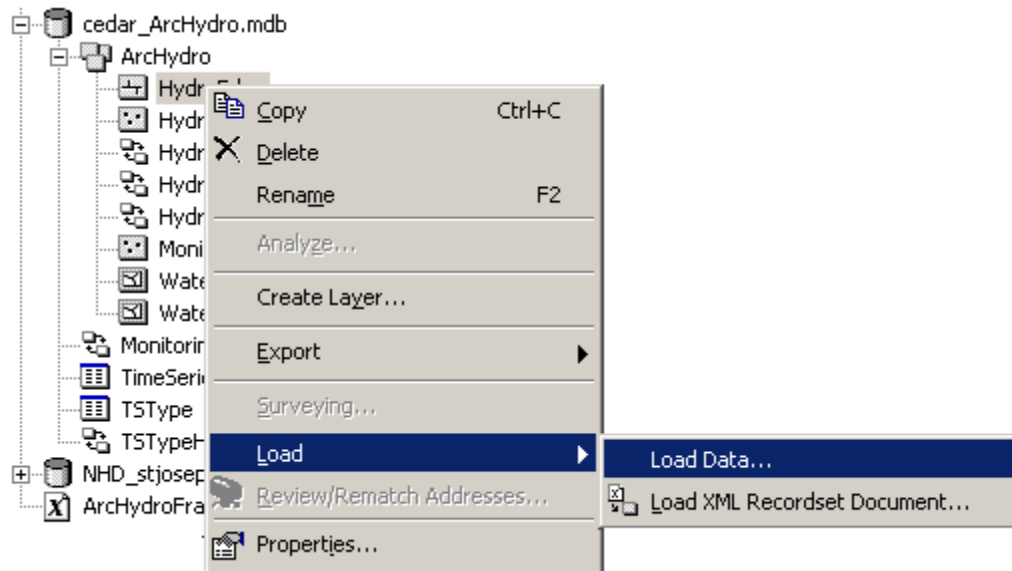
Now we have an empty ArcHydro geodatabase for Cedar Creek with an appropriate coordinate system defined. The next step is to populate this geodatabase with some data. In this exercise, we will populate *HydroEdge* with *NHDFlowline\_cedar*, *MonitoringPoint* with *NHDPoint\_Cedar*, *HydroJunction* with *NHDPoint\_cedar\_snapped*, *Watershed* with *Watershed\_cedar*, and *Waterbody* with *Waterbody\_cedar*.

## Loading data into ArcHydro database

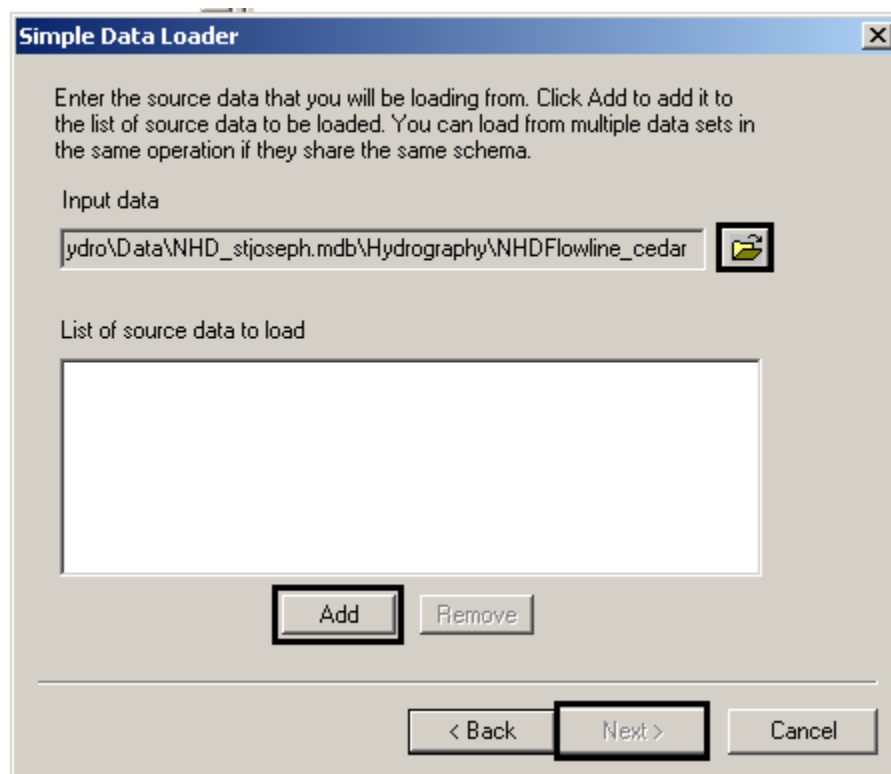
The empty *Cedar\_ArcHydro.mdb* already has an empty geometric network *HydroNetwork* in the *ArcHydro* feature dataset. *HydroNetwork* is formed from *HydroEdge* and *HydroJunction* which are also empty. To have features in *HydroNetwork*, we need to add data to *HydroEdge* and *HydroJunction* feature classes. Because *HydroNetwork* is linked to *HydroEdge* and *HydroJunction* feature classes, it will not allow adding features to these feature classes so it is necessary to delete the network, populate data into *HydroEdge* and *HydrJunction*, and then rebuild the network.

Go ahead and **delete** *HydroNetwork* from *ArcHydro* feature dataset. Now, we are ready to import data into ArcHydro.

In the ArcHydro feature dataset (inside *Cedar\_ArcHydro.mdb*), **right-click** on *HydroEdge* → *Load* → *Load Data...* (If the Load Data button inactive, you probably forgot to delete *HydroNetwork*! Delete the *HydroNetwork*, and then right-click).



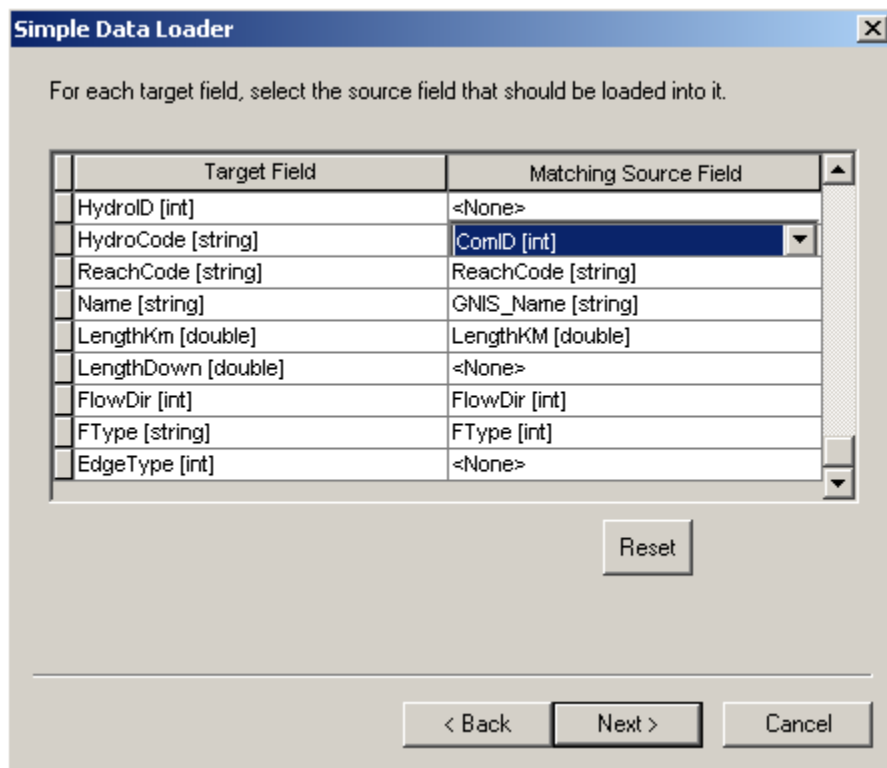
In the *Simple Data Loader* window, **browse** to *NHDFlowline\_cedar* feature class in *NHD\_stjoseph.mdb*, **click Add** (to add the data to List of source data to load window), and then **click Next**.



Keep the defaults on the next window (you do not want to load the data into a subtype). **Click Next**.

On the next window, make one change. **Set** the matching source field for *HydroCode* to be *ComID*. In ArcHydro, the *HydroCode* is the permanent public identifier of the feature that was assigned by the agency that created it. The *HydroID* is an internal ArcHydro identifier that is assigned by the ArcHydro

tools and is used for relating ArcHydro features to one another and to time series associated with them. The *ComID* is a unique identifier for NHD features, so it makes sense to use this as the *HydroCode*. **Click Next.**

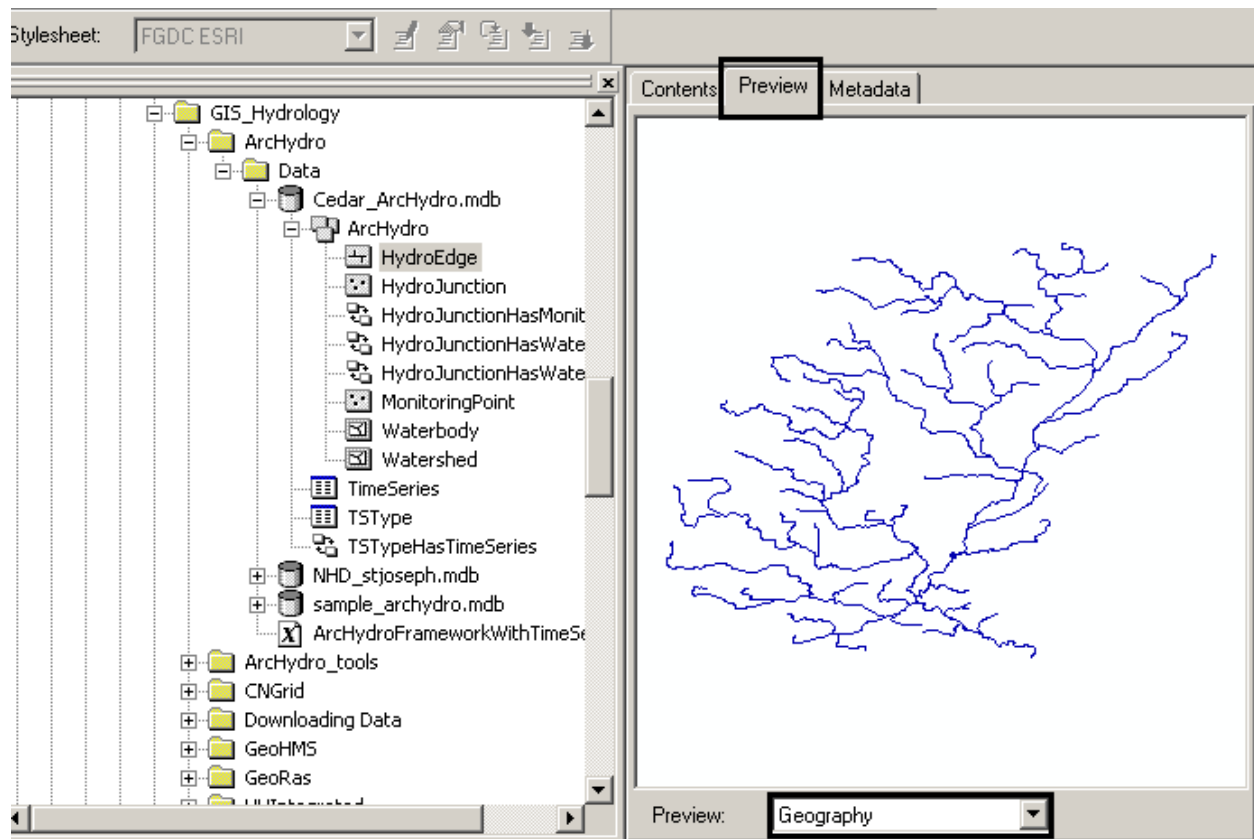


Leave the default option (Load all the source data) unchanged on the next window, and **Click Next.**

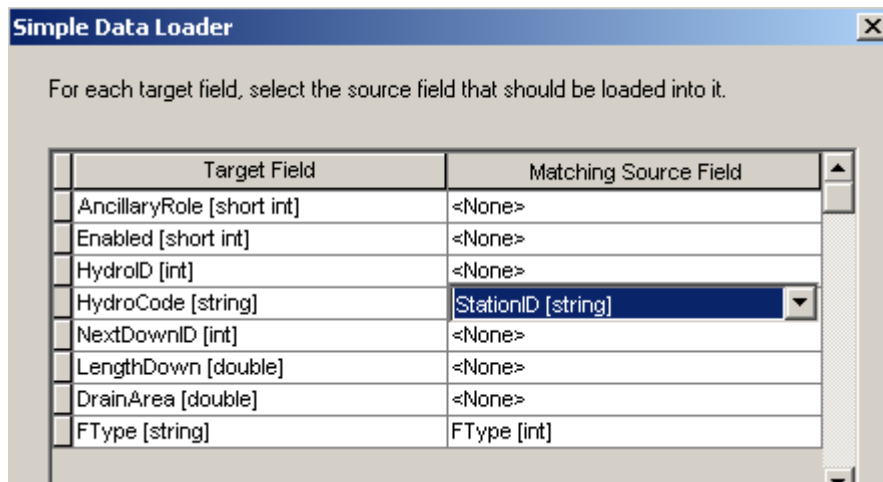
**Click Finish** on the summary window to complete the data load.

Once the process has completed, **refresh** your geodatabase (Hit F5 in ArcCatalog). You should see the *HydroEdge* feature class populated. You can see the features in the *Preview* tab by using the *Geography* view.

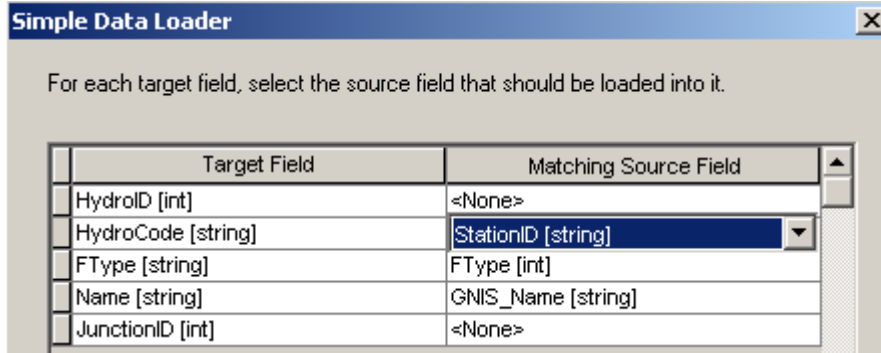




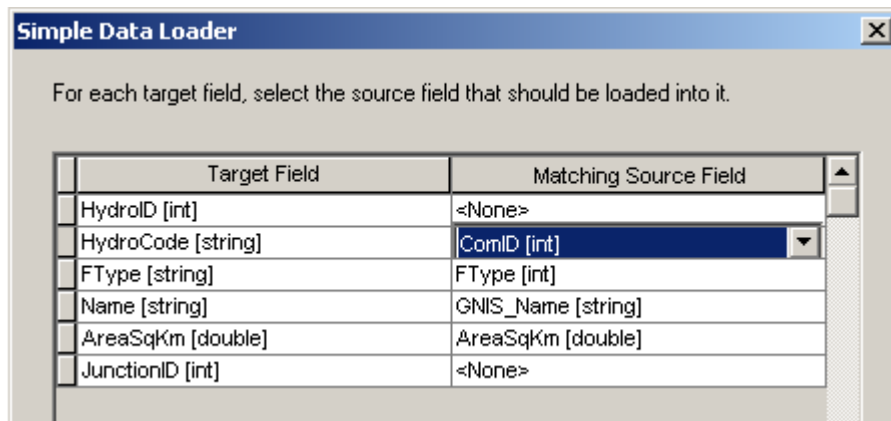
Now let us load features into *HydroJunction* feature class. **Right-click** on *HydroJunction* → **Load** → **Load Data**. In the simple data loader window, **browse** to *NHDPoint\_cedar\_snapped* feature class in *NHD\_stjoseph.mdb*, **click Add**, and then **Click Next**. **Set** the matching source field for *HydroCode* to be *StationID*, **click Next**, and then **click Finish** to complete the data import.



Similarly load data from *NHDPoint\_cedar* to *MonitoringPoint* feature class in *Cedar\_ArcHydro* by **matching** *HydroCode* to *StationID*, and *Name* to *GNIS\_Name*.



Next, load data from *NHDWaterbody\_cedar* in *NHD\_stjoseph.mdb* to *Waterbody* feature class in *Cedar\_ArcHydro* by **matching** *ComID* to *HydroCode*, *Name* to *GNIS\_Name*, and *AreaSqKm* to *AreaSqKm*.

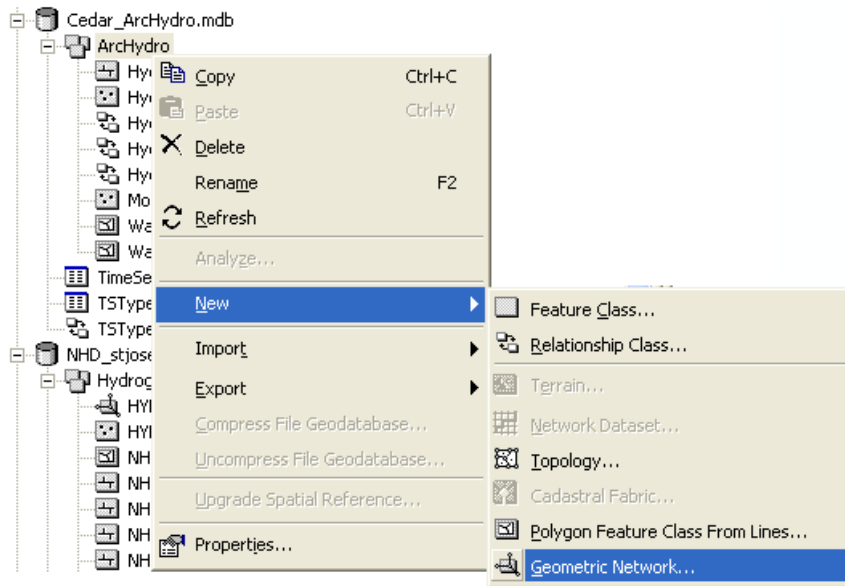


Finally **load** data from *Watershed\_cedar* feature class in *HydrologicUnits* feature dataset in *NHD\_stjoseph.mdb* to *Watershed* feature class in *Cedar\_ArcHydro.mdb* by matching *Name* field to *HydroCode*.

Now, let us build the geometric network (HydroNetwork) using the *HydroEdge* and *HydroJunction* feature classes.

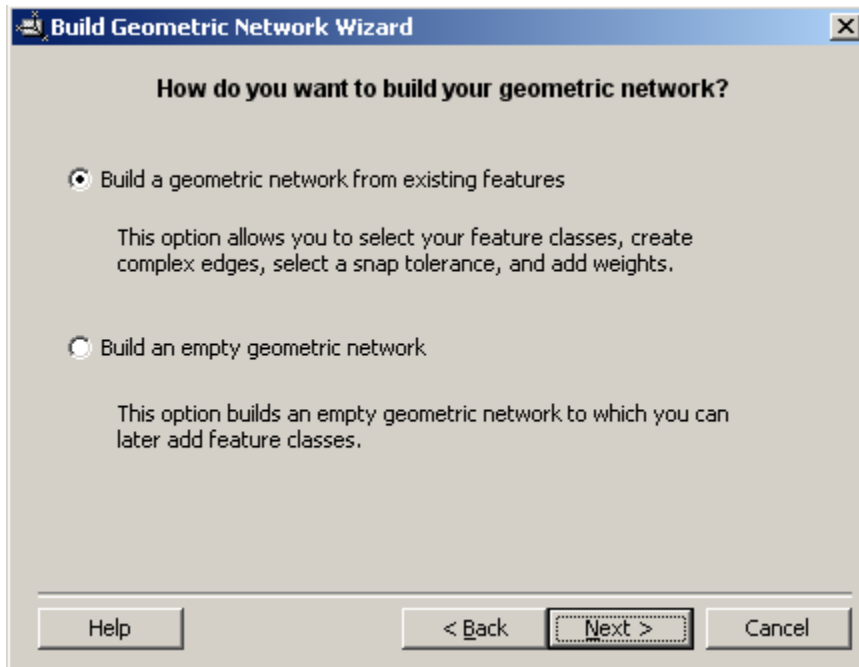
## Building the HydroNetwork

Inside *Cedar\_Archydro.mdb*, **right-click** on *ArcHydro* feature dataset, and **select** *New*→*Geometric Network*...

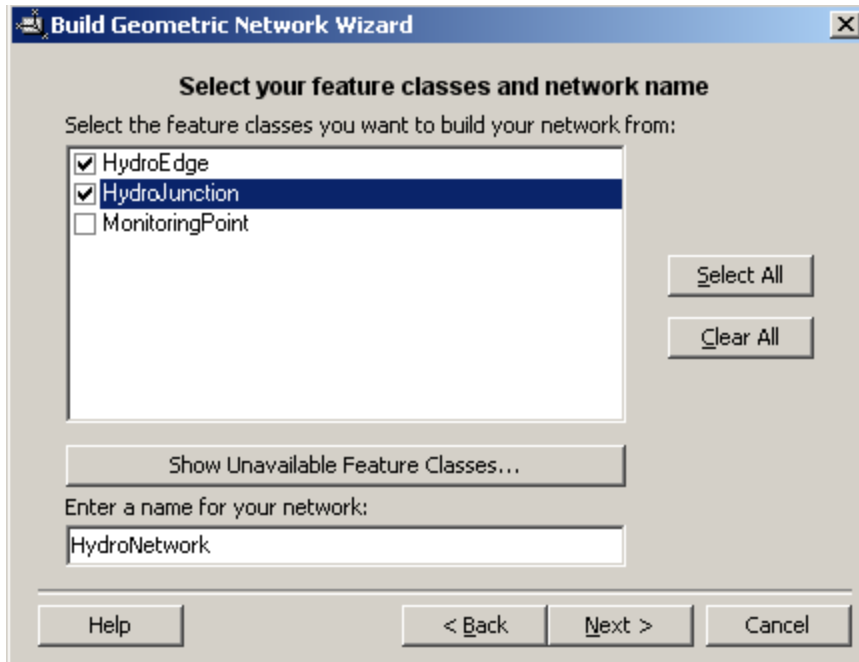


This launches a “Build Geometric Network Wizard” to help you create a network from existing feature classes in a feature dataset. **Click Next.**

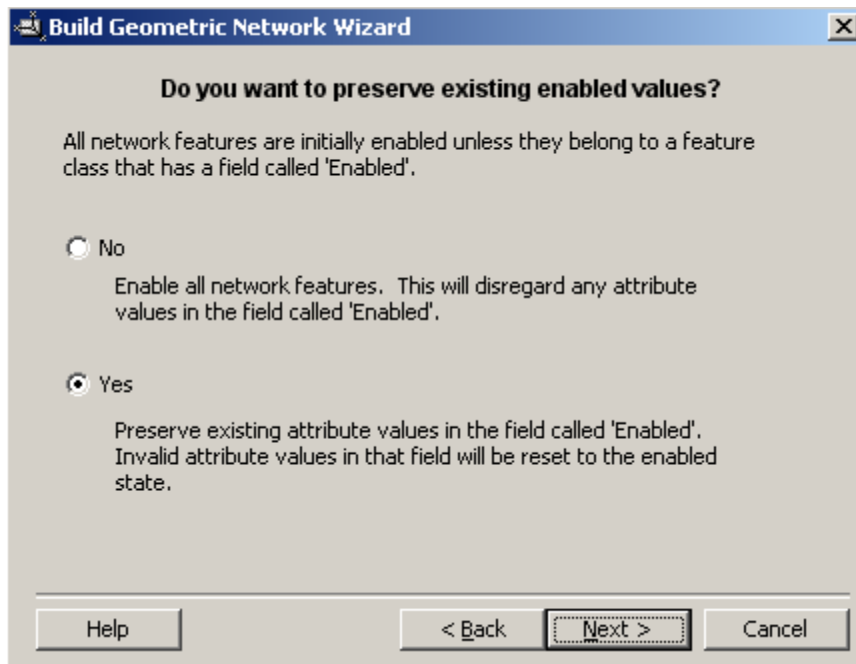
Because we are building the network from *HydroEdge* and *HydroJunction*, **choose Build a geometric network from existing features.** **Click Next.**



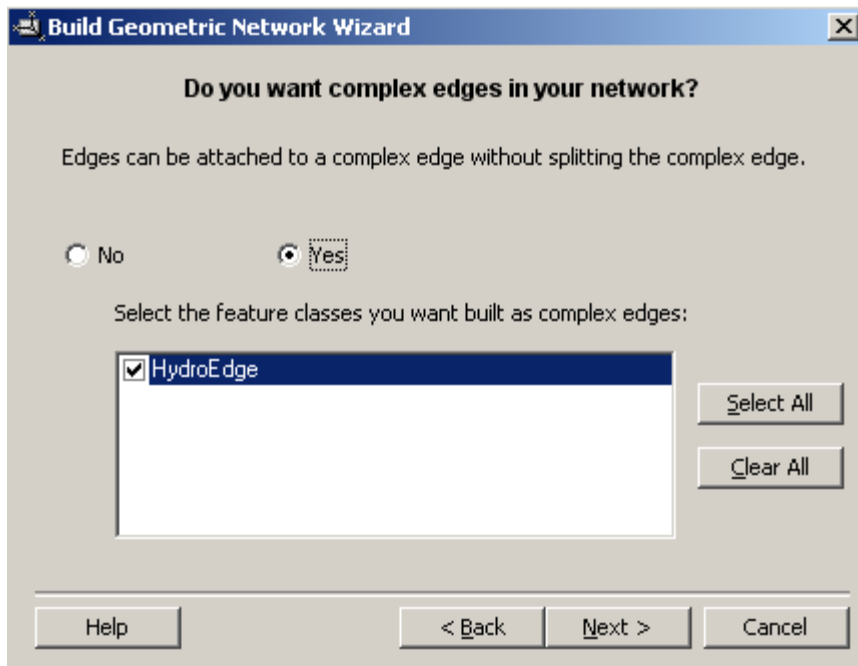
The next window enlists feature classes in the ArcHydro feature dataset that can be incorporated in the network. **Check** only *HydroEdge* and *HydroJunction* and **enter** the name for the network as *HydroNetwork*. **Click Next.**



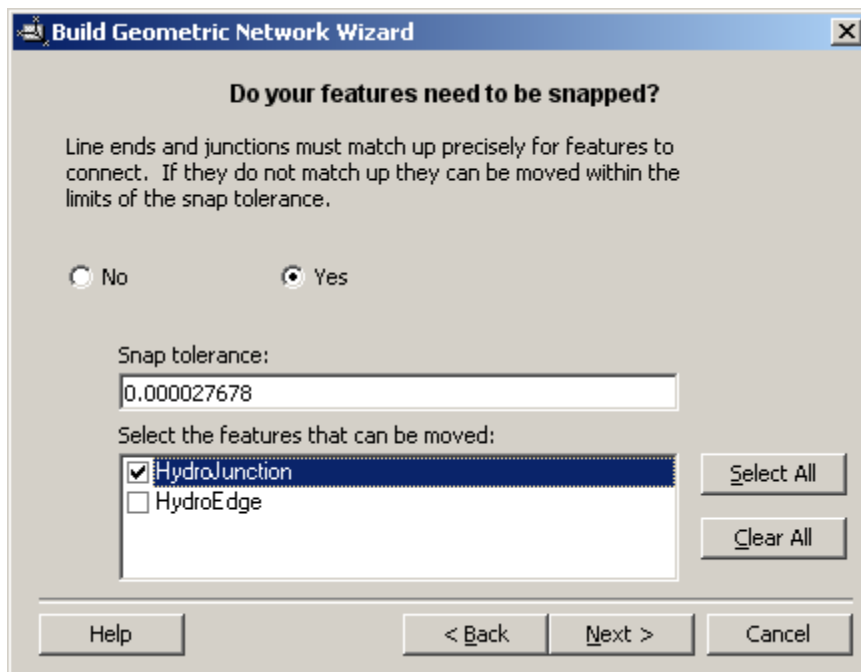
For *Do you want to preserve existing enabled values?*, **Choose Yes**, and **Click Next**.



For *Do you want complex edges in your network?*, **Choose Yes** to allow complex edges in *HydroEdge*. **Click Next**. ArcHydro uses Complex Edges so that Junctions can be added anywhere along the lengths of the edges. Simple Edges require the edge to be split when a junction is added. "Edge" and "Junction" are terms used in ArcGIS to signify lines and points that participate in a geometric network.



**Choose Yes** for *Do your features need to be snapped?* (This is not really necessary here because the point is already snapped to NHDFlowline so if you choose No, it's OK). **Click Next**.

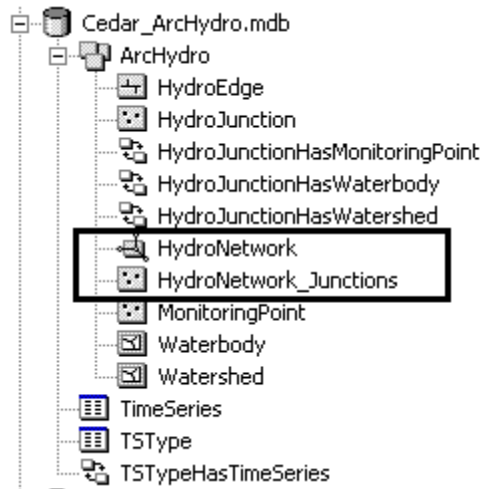


**Click Next** for remaining windows.

(Note: Although not required for this exercise, but if a HydroJunction has to be used a Source/Sink for a network (point where the network originates/drains), then the HydroJunction feature class must be selected in the *Does your network have sources or sinks* window).


You have just created a geometric network! What this means is that lines are transformed to network edges, edges meet at points called junctions (HydroNetwork\_Junctions, in this case), and the connectivity of lines and junctions is defined by an internal data structure called a *logical model* (as distinct from the *geometric model* of the lines and edges which defines where they are located in geographic space).

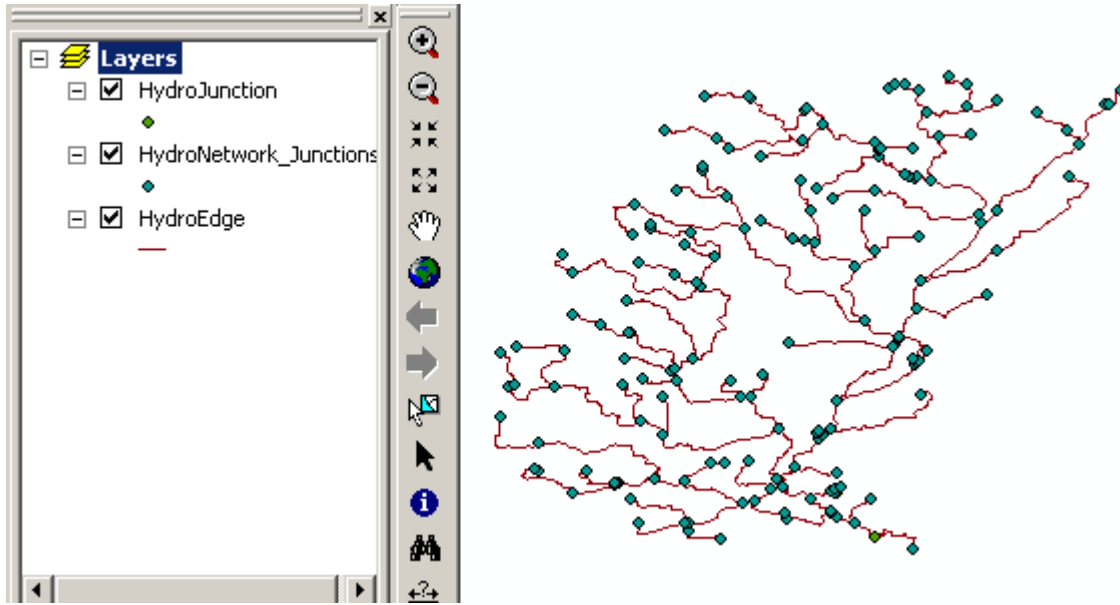
**Look** in the *ArcHydro* feature dataset. A new icon and new feature classes are added: the *HydroNetwork* network and its accompanying *HydroNetwork\_Junctions*.



**Close** *ArcCatalog*. We are done with *ArcCatalog* part of the exercise. Now let us look at the network in *ArcMap*, assign attributes, and use the Utility Network Analyst to do some cool stuff with *HydroNetwork*.

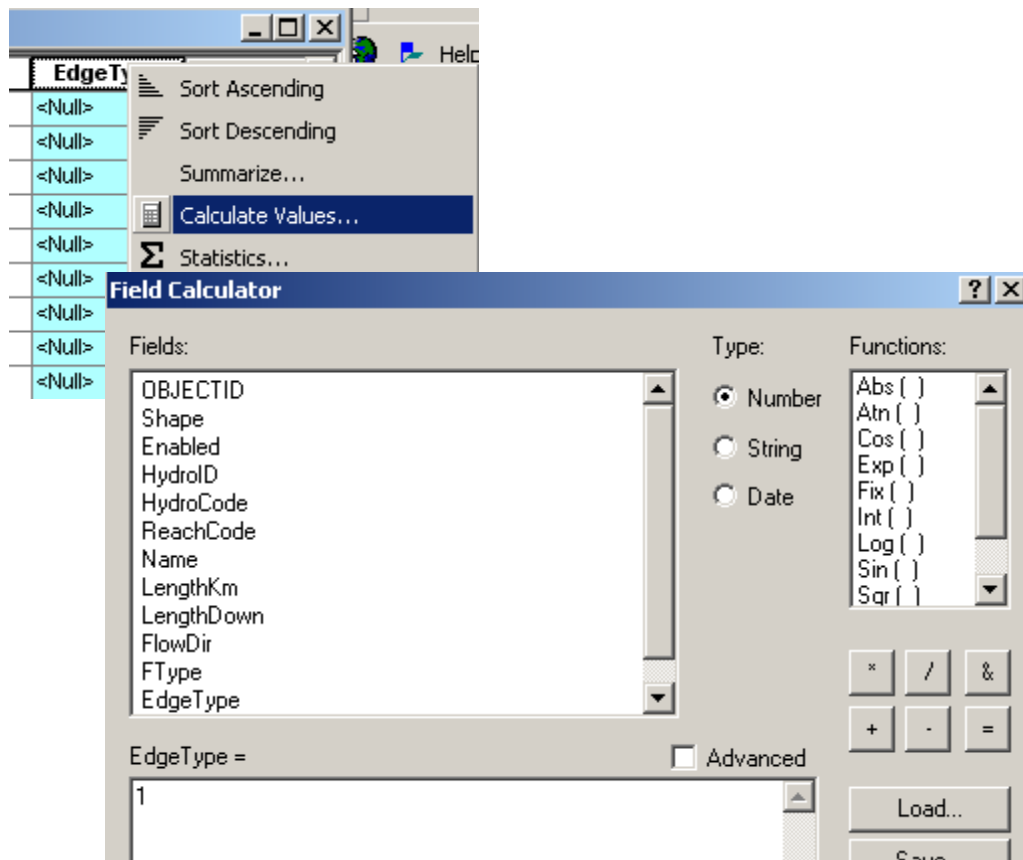
**Open** *ArcMap*, and save the document as *archydro.mxd* (or whatever name you like) in your working directory.

In the main toolbar, **press** the **Add** button , **browse** to the *ArcHydro* feature dataset in *Cedar\_ArcHydro.mdb*, **select** *HydroNetwork*, and **click** **Add**. Three feature classes associated with *HydroNetwork*: *HydroEdge*, *HydroJunction*, and *HydroNetwork\_Junctions*, will be added to the map document.



**Turn-off** the *HydroNetwork\_Junctions* feature class by **un-checking** the box next to it (do not remove the layer from the map).

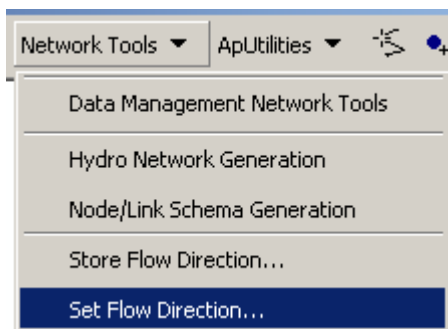
*HydroNetwork* Edges can be of two types: Flowlines ( $EdgeType = 1$ ) and Shorelines ( $EdgeType = 2$ ). To set the *HydroEdges* to be Flowlines, **start** the *Editor*, and **select** *HydroEdge* as the feature class to be edited. **Right-Click** on the *EdgeType* attribute and **select** *Calculate* to get the Field Calculator, and **set**  $EdgeType = 1$  as shown below in the Field Calculator. You'll see the *EdgeType* field goes from being <null> to "1" or "Flowline", as required.



**Save** the edits, and **stop** editing.

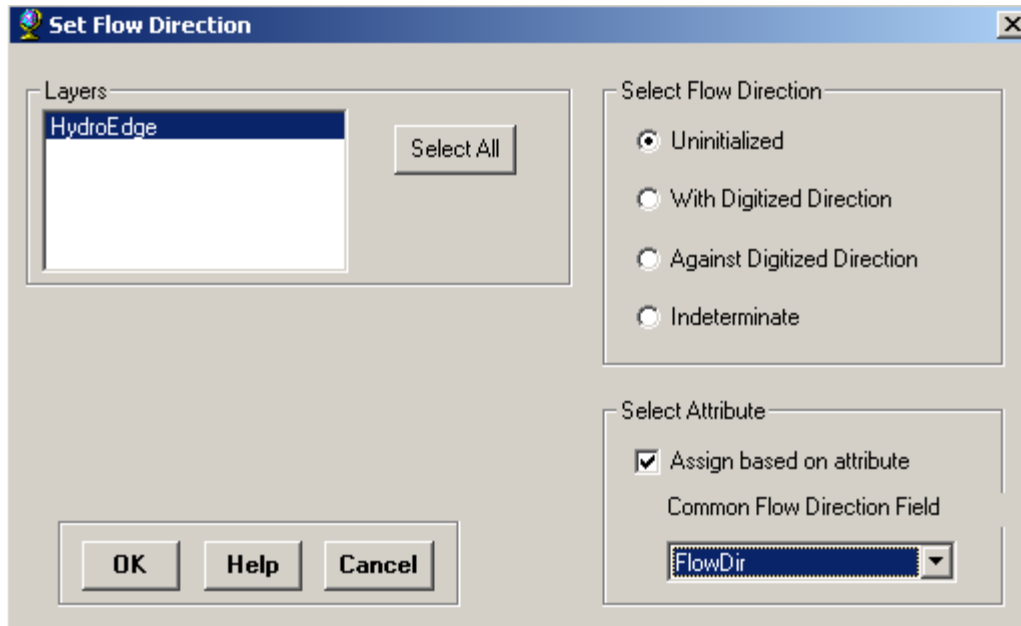
The first step in analyzing any network is assigning flow directions. Before we analyze the network, let us set the flow direction on the edges. All *NHDFlowline* features have flow direction already assigned to them and stored in *FlowDir* attribute. Let us use the *FlowDir* attributes to set the flow direction. We will do this by using the *ArcHydro* tools. It is assumed that *ArcHydro* tools are already installed on the computer. **Add** the *ArcHydro* toolbar to the map document by **selecting** *View*→*Toolbars*→*ArcHydro Tools*

In the *ArcHydro* toolbar, select *Network Tools*→*Set Flow Direction...*



In the *Set Flow Direction* window, **select** *HydroEdge* for *Layers* and *Uninitialized* for *Select Flow Direction*. **Check** the *Assign based on attribute* option, and **choose** *FlowDir* field. **Click OK**.



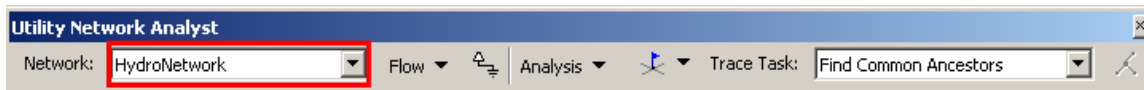


Click **OK** on the flow direction completion message box. The flow directions are now assigned to *HydroEdge* features. With flow direction assigned, the *HydroNetwork* can now be used to trace water flow. **Save** the map document.

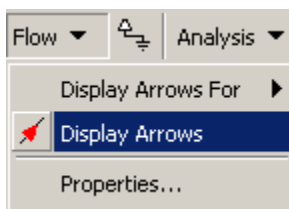
(**Note:** If the FlowDir field in NHD data is not assigned or un-initialized, no flow direction is assigned by ArcHydro to these lines and these lines will not participate in some of the ArcHydro attribute tools such as next downstream or length to watershed outlet.)

## Network Tracing

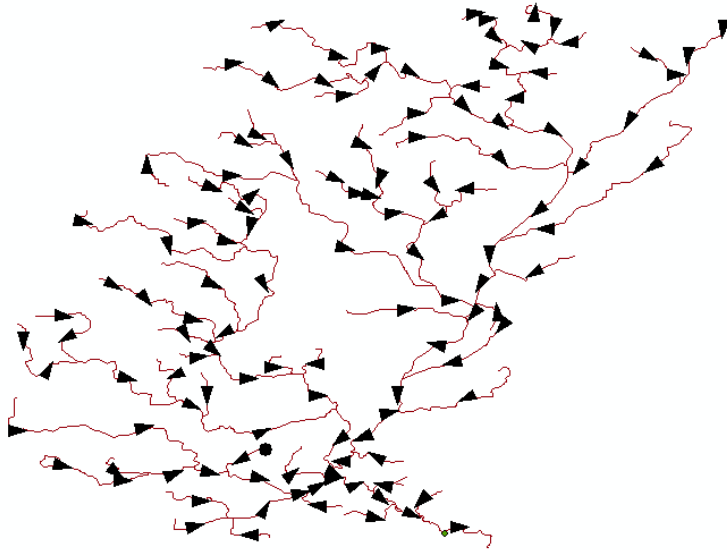
**Add** the *Utility Network Analyst* toolbar by **selecting** *View* → *Toolbars* → *Utility Network Analyst* (Do not get confused with *Network Analyst*. We need “*Utility Network Analyst*”). The *Utility Network Analyst* toolbar should identify the network in the map document, and show *HydroNetwork* in the *Network* combo-box.



With flow direction already defined, **select** *Flow* → *Display Arrows* to see the flow direction in the network.

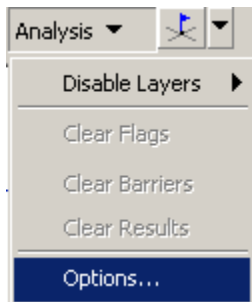


You should see the arrows displayed on the network.

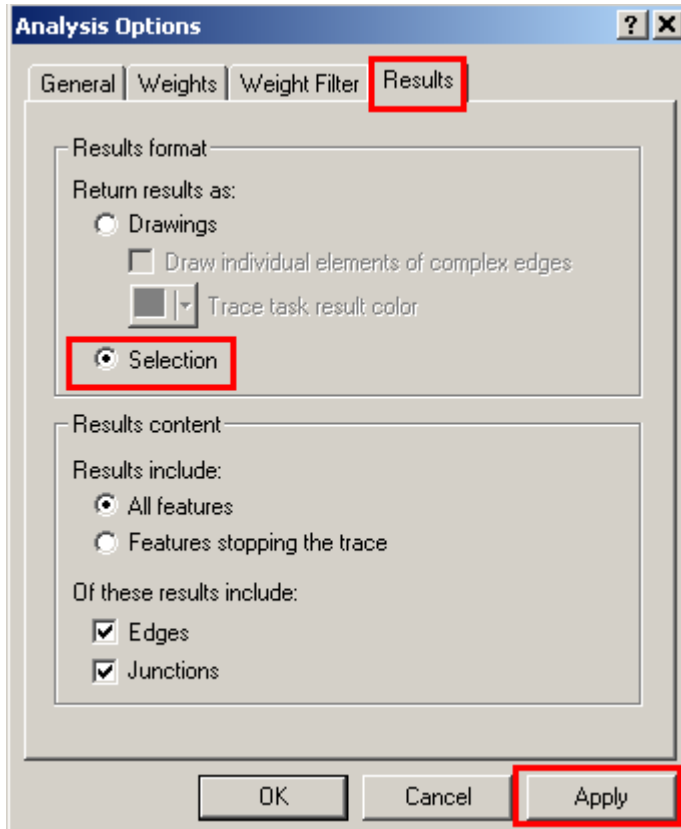


ArcGIS takes longer time to display the network with the arrows turned on. This may not be an issue with a small dataset used for this exercise, but we will still turn it off for a better display. On the utility network analyst toolbar, **click** on *Flow*→*Display Arrows* again to turn the arrows off. Now let us perform tracing along the network.


Before performing the trace, we will set some analysis options. On the utility network analyst toolbar, **select** *Analysis*→*Options...*

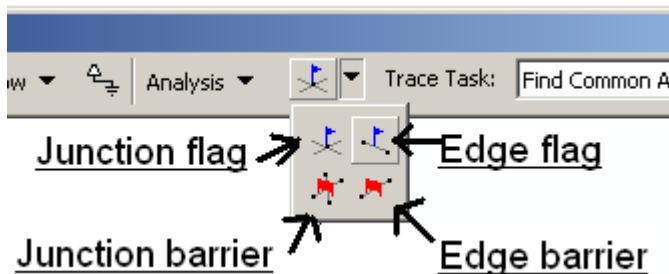


In the *Analysis Options*, **click** on the *Results* tab, and **choose** *Selection for Results* format. Leave other options with default values, **click** *Apply*, and then **press** *OK*.



After the analysis option is set, the next step is setting flags/barriers along the network to perform traces.

Flags and barriers indicate where the trace should start and stop, respectively. The  icon after the *Analysis* menu places the flags and barriers. There are four options:



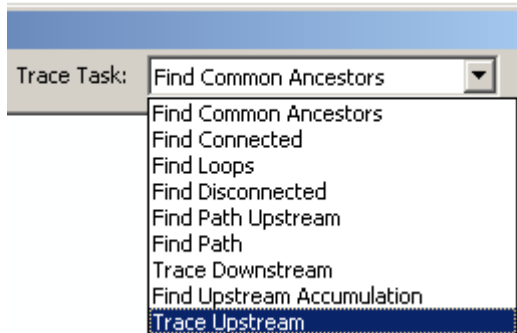
Junction flags and barriers are placed at junctions, while edge flags and barriers are placed along edges. Let's perform an upstream trace on the network from the most downstream junction in the study area. Trace upstream task helps to identify all the upstream reaches that are contributing to the flow at a given location along the stream network.


**Zoom-in** to the watershed outlet area (by using  button), **select** the edge flag and **put** it on the most downstream edge, just upstream of the *HydroJunction* as shown below:


## EdgeFlag

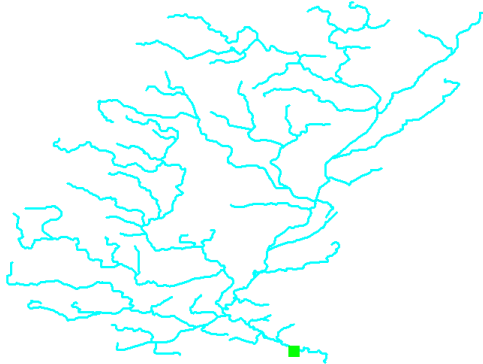


Set the Trace Task to *Trace Upstream*.



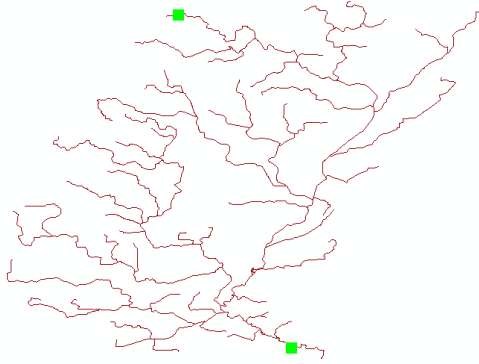
Press the Solve button  on the network analyst toolbar to perform the trace. The program will take few seconds to trace the whole network upstream of the flag, and show the results as selected features.

**Zoom** to the full extent (by using  button) to see the entire upstream features selected by the trace task.

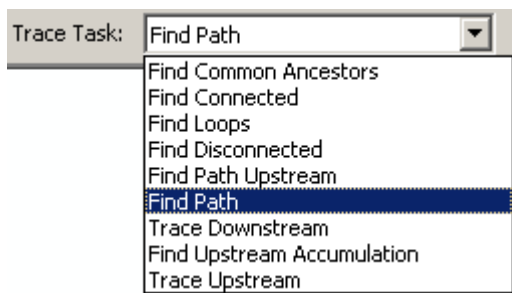


**Unselect** the *HydroEdge* features by **right-clicking** on the layer and **selecting** *Selection* → *Clear selected features* from the ArcMap window. **Save** the map document.

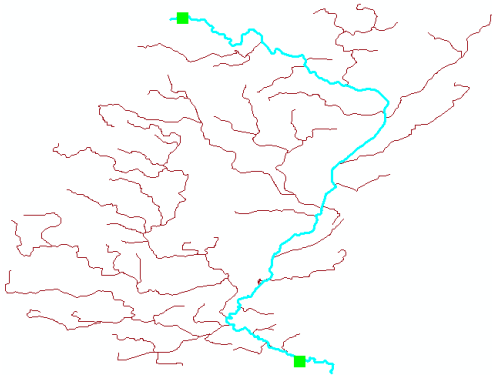
Now we will perform another trace task (Find Path). The find path trace helps find connection between any two points along a stream network, which is useful in calculating distances, travel time, etc. **Zoom-in** to an area upstream of the watershed, and **place** another edge flag as shown below (leave the downstream edge flag untouched):



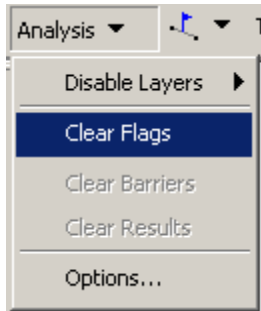
**Change** the Trace Task to *Find Path*, and **press** the solve button.



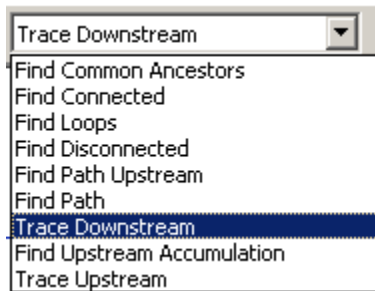
**Zoom** to the full extent, and you will the program has traced the path between the two edge flags.



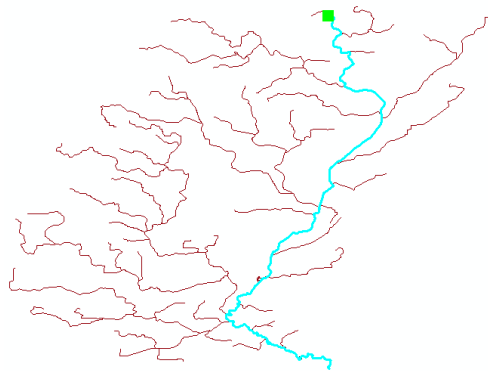
**Unselect** the HydroEdge features. Now we will perform a downstream trace task. The downstream trace task helps to trace the flow from any point in the stream network to the sink. **Clear** the existing flags by selecting *Analysis*→*Clear Flags*.



Place an edge flag along any edge in the upstream area, and **change** the Trace Task to *Trace Downstream*



The program will select all the edges downstream of the flag (including the edge that contains the flag).

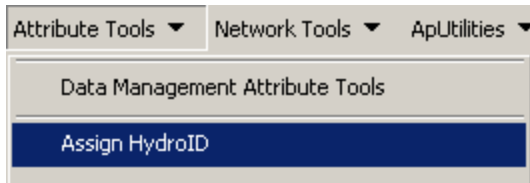


Wow, we can do lots of cool stuff once a HydroNetwork is built! Now, let us use ArcHydro tools to do some more cool stuff. **Clear** network flags, and **save** the map document.

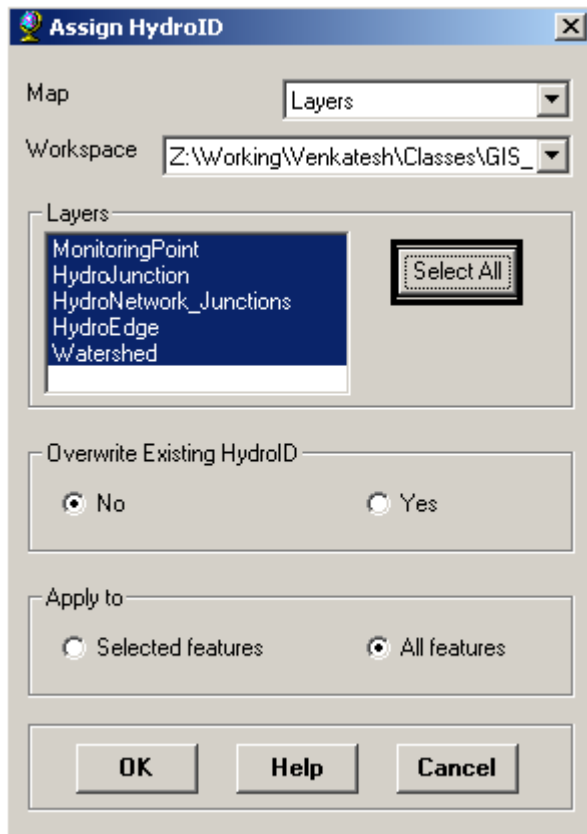
## Applying Hydrologic Attributes using ArcHydro Tools

In this section, we will explore the attribute tools available with the ArcHydro toolbar. Since we will use *MonitoringPoint* and *Watershed* feature classes, **add** them to the map document (by using the add button) because we need to assign them HydroIDs.

**Select** *Attribute Tools* → *Assign HydroID*



We will assign HydroID to all feature classes in the map document. In the *Assign HydroID* window, press *Select All* button, choose *No* for *Overwrite Existing HydroID*, and Apply to *All features*, click *OK*.



Assigning *HydroID* should take a couple of seconds (for this exercise) to finish. Click *OK* on the process completion message.

*HydroID* is a unique identifier for all features in a geodatabase. *HydroID* is used to establish relationships, which means one feature class can be linked to another feature class, feature classes can be linked to time-series, etc. **Open** the attribute table of one of the feature classes (by right clicking on the feature class, and selecting Open Attribute Table..) to see the *HydroID* field populated as shown below (Note: The HydroIDs shown in the table below may or may not match with your HydroID, it is okay if your HydroIDs are different from the ones shown here):

**Attributes of HydroJunction**

OBJECTID <sup>a</sup>	Shape <sup>a</sup>	AncillaryRol	Enabled	HydroID <sup>a</sup>	HydroCode	NextDownID	Length
1	Point	<Null>	True	1	4180000	<Null>	<Null>

**Attributes of HydroEdge**

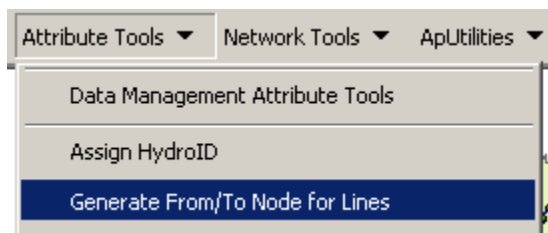
OBJECTID <sup>a</sup>	Shape <sup>a</sup>	Enabled	HydroID	HydroCode	ReachCode	Name	Length
403	Polyline M	True	168	15679173	04100003000	<Null>	
404	Polyline M	True	169	15679035	04100003000	<Null>	
405	Polyline M	True	170	15679103	04100003000	Cedar Creek	
406	Polyline M	True	171	15679149	04100003000	<Null>	

Record: 0 Show: All Selected Records (0 out of 169 Selected.) Options

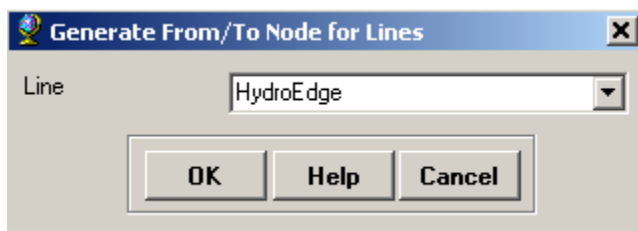
Notice how the HydroID is unique across all feature classes in the ArcHydro geodatabase. This is a critical feature of ArcHydro which does not exist in core ArcGIS.

**Close** the attribute table, and **save** the map document.

Now let us assign From/To Node to HydroEdge features. On the *ArcHydro* toolbar, **select** *Attribute Tools*→*Generate From/To Node for Lines*.



**Select** *HydroEdge* for *Line*, and **click** *OK*.

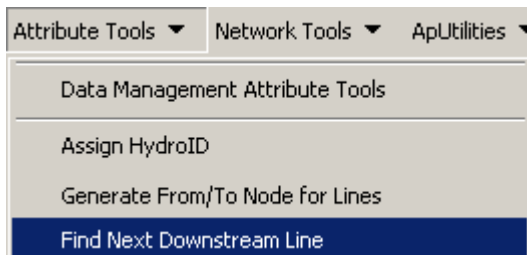


**Click** *OK* on the process completion window. **Open** the attribute table for *HydroEdge*, and **look** at the *FROM\_NODE* and *TO\_NODE* attributes. These attributes store the topological connectivity between lines in case you want to use that in an application program outside of ArcGIS (this connectivity is used in the preprocessing programs for the HEC models). The numbers assigned are not based on *OBJECTID* or *HydroID*.



LengthKm	LengthDow	FlowDir	FType	EdgeType	FROM_NODE	TO_NODE
0.133	<Null>	WithDigitized	460	1	1	2
4.584	<Null>	WithDigitized	460	1	3	4
2.234	<Null>	WithDigitized	460	1	5	6
2.452	<Null>	WithDigitized	460	1	7	8
1.643	<Null>	WithDigitized	336	1	9	10
0.239	<Null>	WithDigitized	336	1	11	12
2.431	<Null>	WithDigitized	460	1	13	14
0.204	<Null>	WithDigitized	558	1	15	16
1.465	<Null>	WithDigitized	460	1	17	18
0.505	<Null>	WithDigitized	460	1	19	20

Now let us find next downstream line for each feature in the *HydroEdge* feature class. On the *ArchHydro* toolbar, **select** *Attribute Tools* → *Find Next Downstream Line*.



**Select** *HydroEdge* for line, and **click** *OK*. After the process is complete, **dismiss** the message box, and **open** the attribute table for *HydroEdge*.

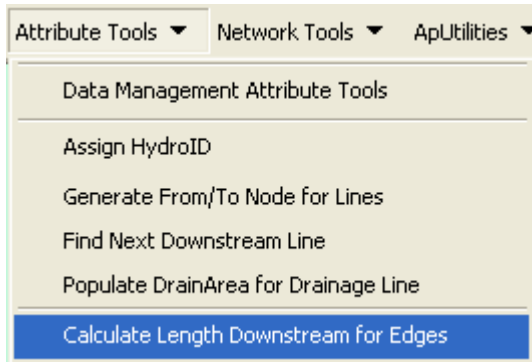
LengthDow	FlowDir	FType	EdgeType	FROM_NODE	TO_NODE	NextDownID
<Null>	WithDigitized	460	1	1	2	247
<Null>	WithDigitized	460	1	3	4	202
<Null>	WithDigitized	460	1	5	6	211
<Null>	WithDigitized	460	1	7	8	179
<Null>	WithDigitized	336	1	9	10	219
<Null>	WithDigitized	336	1	11	12	256
<Null>	WithDigitized	460	1	13	14	330
<Null>	WithDigitized	558	1	15	16	222
<Null>	WithDigitized	460	1	17	18	263
<Null>	WithDigitized	460	1	19	20	259

The *NextDownID* attribute for each *HydroEdge* feature is the *HydroID* of the downstream feature.

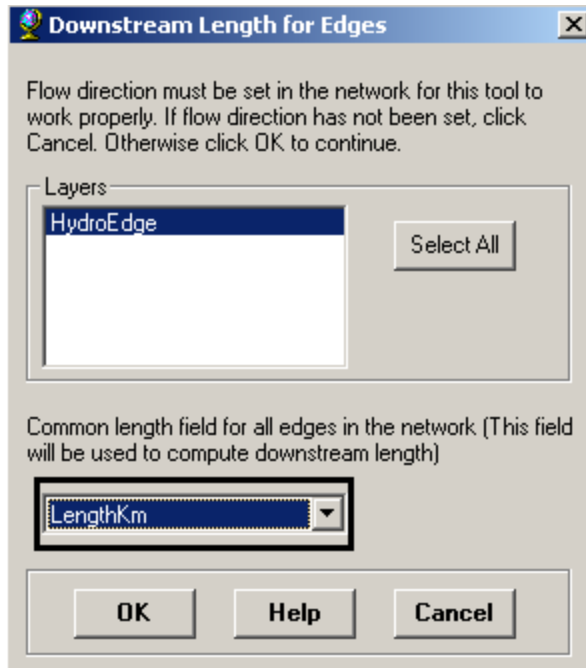
Now, let us calculate the downstream length (distance to the watershed outlet) for edges. NHD has the Length in Kilometers *LengthKm* computed for each network edge. In ArcHydro, this was inherited when the NHD data were loaded into ArcHydro at the beginning of the Exercise. (Note: If you are working with a larger dataset, assigning downstream distance may take several minutes to run.)

ReachCode	Name	LengthKm	LengthDown	FlowDir	FType
04100003000887	<Null>	0.133	<Null>	WithDigitized	460
04100003000772	<Null>	4.584	<Null>	WithDigitized	460
04100003000184	Cedar Creek	2.234	<Null>	WithDigitized	460
04100003000798	<Null>	2.452	<Null>	WithDigitized	460
04100003000776	<Null>	1.643	<Null>	WithDigitized	336

On the *ArcHydro* toolbar, **select** *Attribute Tools* → *Calculate Length Downstream for Edges*



**Select** *HydroEdge* for *Layers*, and *LengthKm* field for calculating lengths.

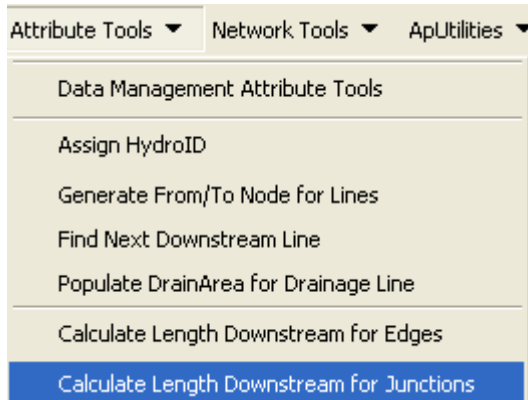


Click **OK**. Dismiss the final message box, and **look** at the *LengthDown* field. *LengthDown* field gives the distance in kilometers from each *HydroEdge* feature to the watershed outlet. **Save** the map document.

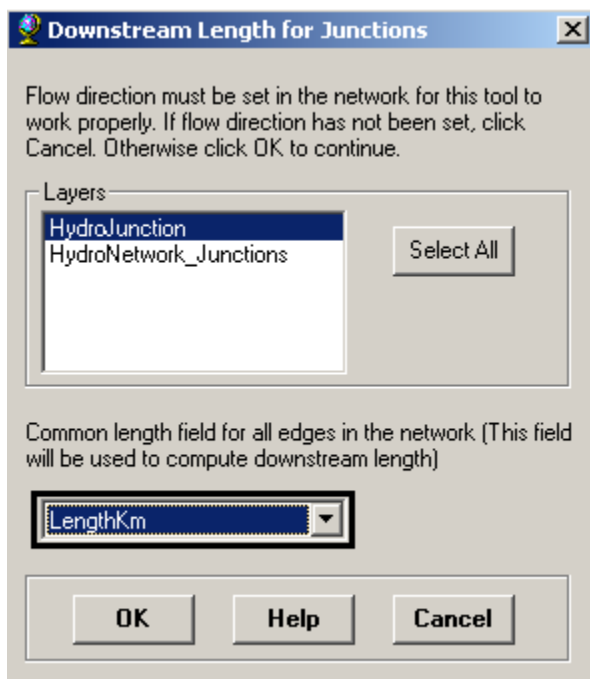
Name	LengthKm	LengthDown	FlowDir	FType	EdgeType	FROM_NOI
<Null>	0.133	17.276	WithDigitized	460	1	
<Null>	4.584	44.676	WithDigitized	460	1	
Cedar Creek	2.234	26.288	WithDigitized	460	1	
<Null>	2.452	19.578	WithDigitized	460	1	
<Null>	1.643	33.182	WithDigitized	336	1	
<Null>	0.239	17.073	WithDigitized	336	1	

Record: 1 Show: All Selected Records (0 out of 169 Selected.)

Now, let us assign some network attributes to the *HydroJunction* feature class. On the *ArcHydro* toolbar, **select** *Attribute Tools* → *Calculate Length Downstream for Junctions*.



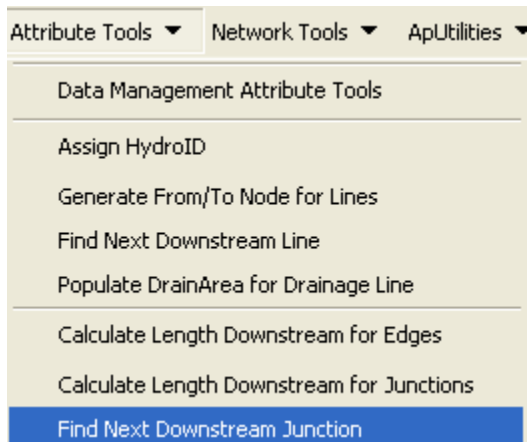
Select *HydroJunction* for *Layers*, *LengthKm* for the common length field for edges, and **click OK**.



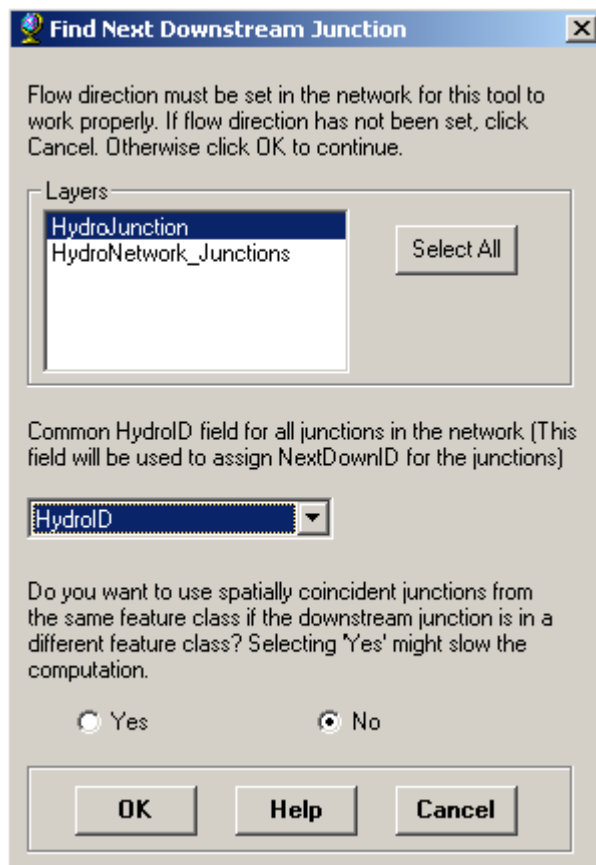
**Open** the attribute table for *HydroJunction*, and **look** at the *LengthDown* field to see the distance from each junction to the watershed outlet. Because we have only one point (junction) in our network, which is very close to the watershed outlet, the *LengthDown* should be very close or equal to zero.

HydroCode	NextDownID	LengthDown	DrainArea
0418000	<Null>	0 <Null>	367

Similar to finding next downstream line, we can also find next downstream junction. Because we have only one junction, its attribute will be -1, but we will still go ahead and run the next downstream junction tool. On the *ArcHydro toolbar*, **select** *Attribute Tools* → *Find Next Downstream Junction*.



In the *Find Next Downstream Junction* window, **select** the *HydroJunction* layer and *HydroID* as the common identifier field. **Choose No** for “Do you want to use spatially...”, and **click OK**.



**Click OK** on the process completion message. **Open** the attribute table for *HydroJunction*, and **look** at the *NextDownID* field, which is equal to -1 because no junction is present downstream.


HydroID*	HydroCode	NextDownID	LengthDown	DrainArea	F1
503	0418000	-1	0	<Null>	367

Record: 1 Show: All Selected Records (0 out of 1 Selected.) Options

OK, we are done with assigning network attributes to *HydroEdge* and *HydroJunction*. In the next section, we will establish relationship between *HydroJunction* and *Watershed*, and *HydroJunction* and *MonitoringPoint*. **Save** the map document.

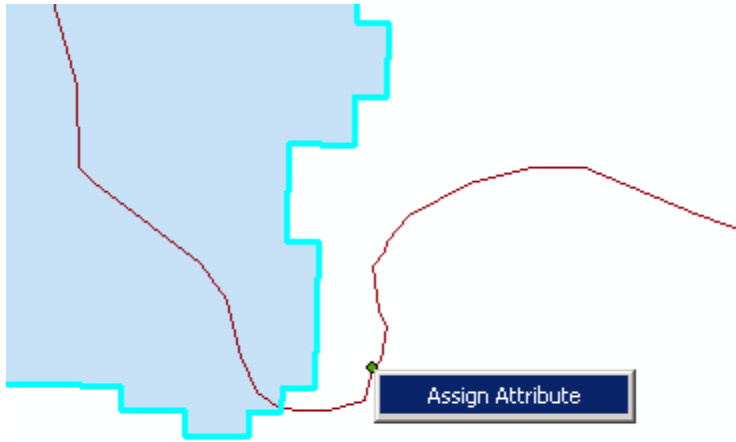
## Establishing Relationship Between ArcHydro Features

First we will establish relationship between *HydroJunction* and *Watershed* features. The *HydroID* of a junction that serves as the watershed outlet will be stored as the *JunctionID* in the watershed feature class. First, **zoom-in** to the *HydroJunction* (watershed outlet), with both *Watershed* and *HydroJunction* visible.

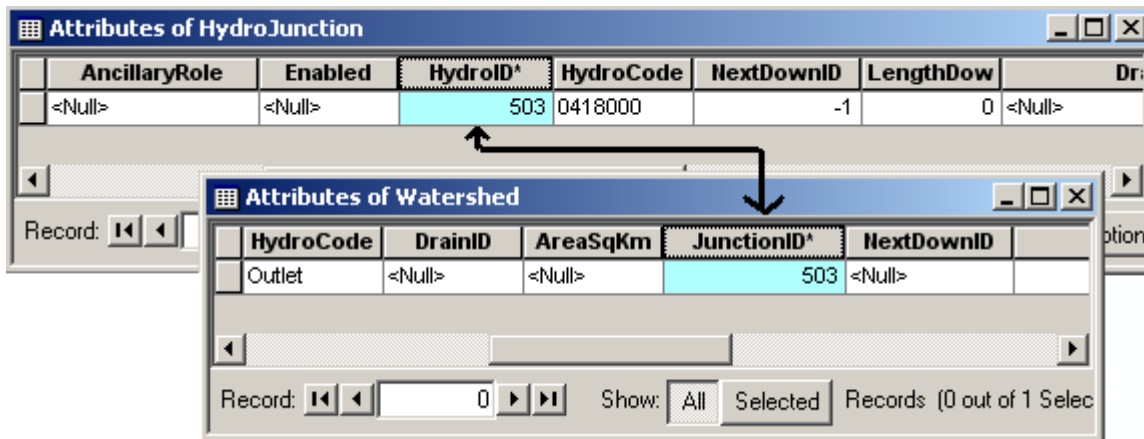
Next, on the *ArcHydro toolbar*, **select** the *Assign Related Identifier* tool . **Select** the *Source Layer* as *HydroJunction*, and its field as *HydroID*. Similarly, select the *Target Layer* as *Watershed* and its field as *JunctionID*, and **Click OK**.

Assign Related Identifier	
Source	Target
Layer HydroJunction	Layer Watershed
Field HydroID	Field JunctionID
<input type="button" value="OK"/> <input type="button" value="Help"/> <input type="button" value="Cancel"/>	

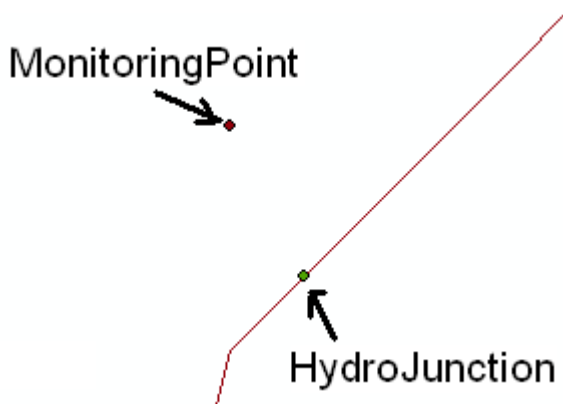
Now **click** on the *Watershed* feature (it should get selected), and with your cursor on the nearest *HydroJunction* feature, **right-click** to get *Assign Attribute* menu as shown below. Then **click** on the *Assign Attribute* menu. Both *Watershed* and *HydroJunction* features should flash, and the *HydroID* of the *HydroJunction* will be copied as *JunctionID* of the *watershed*.




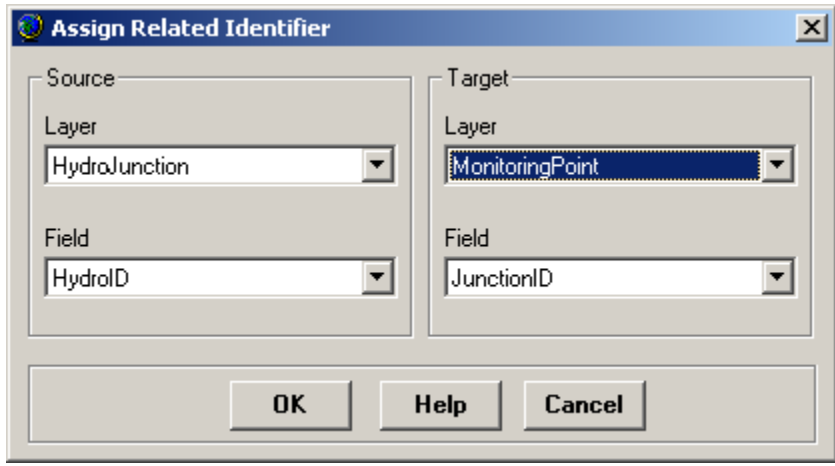
Open the attribute tables of *HydroJunction* and *Watershed* to see the link between *HydroID* and *JunctionID*.



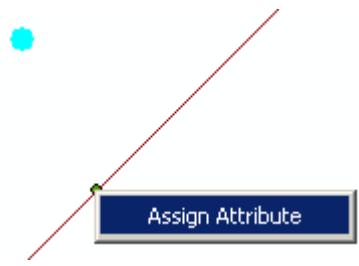
Now we will establish relationship between *HydroJunction* and *MonitoringPoint*. Zoom-in to the single *MonitoringPoint* feature such that it can be seen apart from the corresponding *HydroJunction* feature.



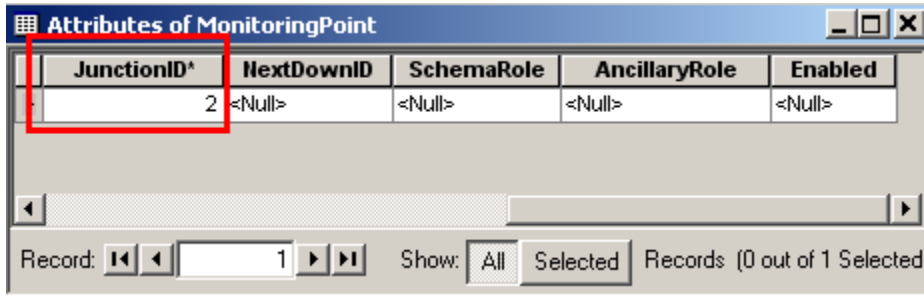
Select the related identifier button , and select appropriate *Source* (HydroJunction) and *Target* (MonitoringPoint) layers, and their corresponding fields (HydroID and JunctionID). This will assign the *HydroID* of the *HydroJunction* as *JunctionID* of the corresponding *MonitoringPoint* feature. Click *OK*.



Now click on the *MonitoringPoint* feature (target feature), and then right-click on the adjacent *HydroJunction* feature (source feature). Click the *Assign Attribute* menu, and both *MonitoringPoint* and *HydroJunction* should flash.

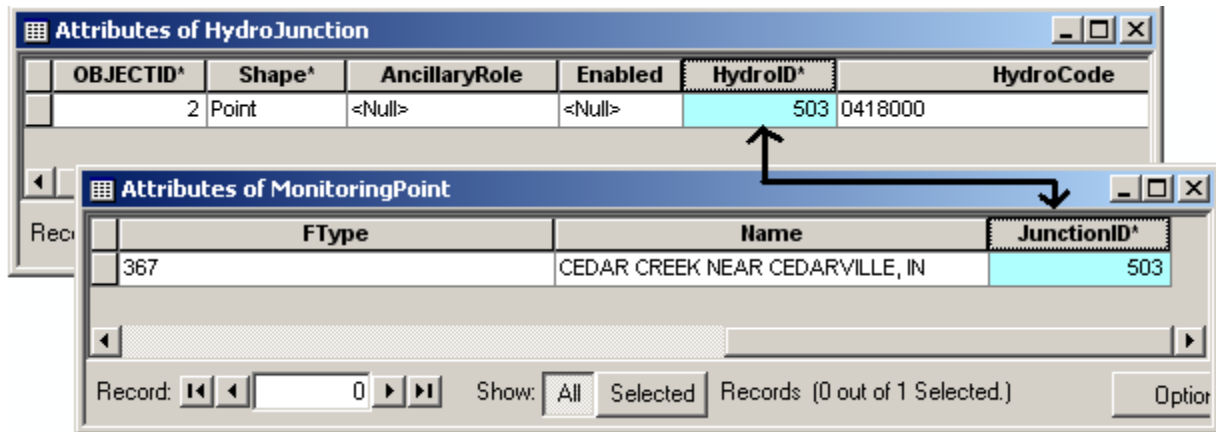


Open the attribute table for *MonitoringPoint* to see the *JunctionID* field populated with the *HydroID* of the corresponding *HydroJunction*.




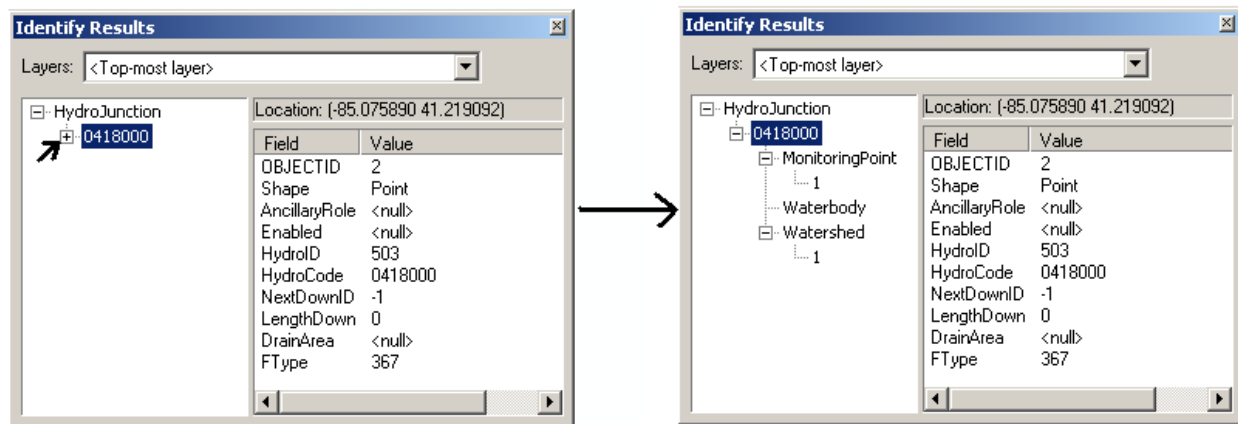
Close the attribute table, and save the map document.





Now that we have assigned related attributes to *Watershed* and *MonitoringPoint*, let's see how the relationships stored in the ArcHydro (*HydroJunctionHasWatershed* and *HydroJunctionHasMonitoringPoint*) can be verified. In other words, we will see how the information stored in relationship classes is picked-up by GIS tools when they are used.

If the map display is changed (not zoomed on *HydroJunction*), **zoom** again to the *HydroJunction* feature, or if the display is zoomed on the *HydroJunction* feature, **select** the identifier tool , and **click** on the *HydroJunction* feature. **Expand** the identifier results by **clicking** at the plus sign next to the *HydroJunction* Identifier Number (which is 0418000 in this case) to see what features are related to it as shown below:



Because we have three relationship classes in the dataset (*HydroJunctionHas – MonitoringPoint*, *Watershed*, and *Waterbody*), all three names will appear, but we did not relate *Waterbody* feature/s to *HydroJunction* so there is no information associated with *Waterbody*. When you **expand** and **click** on numbers associated with *MonitoringPoint* and *Watershed* (which is 1 in this case), you can see attribute information about these features as well. You will also see the features flash when you switch from one feature to the other. Pretty cool!!

OK, you are done!!