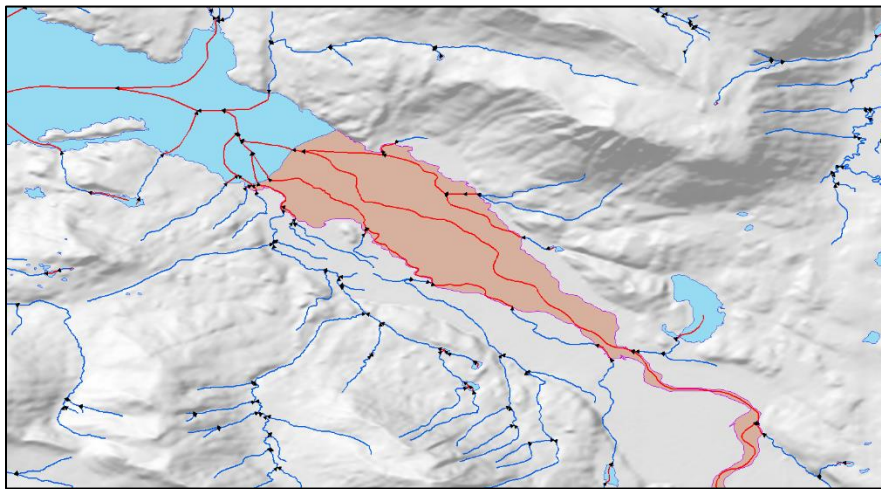


# EXERCISE 3

## Addressing conflicts between new and existing hydrographic features



### Introduction

When evaluating newly created hydrographic data that will be used to update the National Hydrographic Database (NHD), data stewards and editors have to check that a number of topologic criteria between datasets are being met. Unfortunately, for most newly derived hydrographic data sourced from LiDAR or IfSAR surfaces, those data are typically created independently of the existing NHD content and violate a number of NHD topology requirements. It then becomes the job of data stewards and editors to assess any new content against existing NHD content, and where conflicts are discovered, to bring those data into agreement with NHD requirements. This exercise builds on the datasets extracted in the previous exercise and will focus on the process of identifying and addressing gross topological errors with data proposed for use in updating the NHD.

### Objectives

- Learn about topology requirements between newly derived 1-dimensional (1D) stream flowlines and existing 2-dimensional (2D) NHD polygons.
- Learn how to batch process the splitting of newly derived 1D Flowlines at the boundary of 2D Area and Waterbody features

## Required Data

- **USFS\_Streams\_Subset.gdb** – file geodatabase that contains a number of features created in the previous exercise, as well as the primary featureclass which will be modified over the course of this exercise. The featureclasses contained within the geodatabase include the following:
  - **Streams\_Subset** – featureclass that is the primary focus for this exercise. The features within this dataset are a subset of data that were compiled by USFS staff on the Plumas National Forest for use in updating the NHD.
  - **HU10\_AOI** – featureclass that contains a bounding polygon from the Watershed Boundary Dataset (WBD) and serves as the bounding extent for the area of interest for this exercise. Dataset was created during Exercise 2 of this series.
  - **NHDArea\_Subset** – this featureclass contains a subset of polygons representing areal hydrographic landmark features that were extracted from the NHD. Any feature in this dataset intersects the HU10\_AOI dataset and was created during Exercise 2 of this series.
  - **NHDFlowline\_Subset** – this featureclass contains a subset of polylines representing 1D routes that make up a linear surface water drainage network and were extracted from the NHD. Any feature in this dataset intersects the HU10\_AOI dataset and was created during Exercise 2 of this series.
  - **NHDPoint\_Subset** – this featureclass contains a subset of points representing NHD hydrographic landmark features that were extracted from the NHD. Any feature in this dataset intersects the HU10\_AOI dataset and was created during Exercise 2 of this series.
  - **NHDWaterbody\_Subset** – this featureclass contains a subset of polygons representing areal NHD hydrographic waterbody features that were extracted from the NHD. Any feature in this dataset intersects the HU10\_AOI dataset and was created during Exercise 2 of this series.

**Note:** *not all of the datasets listed above will be used within this exercise, but they comprise the full list of content within the USFS\_Streams\_Subset geodatabase that users will encounter. Some of these datasets were used in previous exercises, some will be used in this exercise, and others will be used in later exercises.*

## Prerequisites

- ESRI ArcGIS Desktop v10.5.1 (or newer) will be installed on the user's computer
  - “Standard” or “Advanced” level ArcGIS Desktop license required – exercise will not work with “Basic” level ArcGIS Desktop license.
- User has a basic level of experience with the ArcMap interface.



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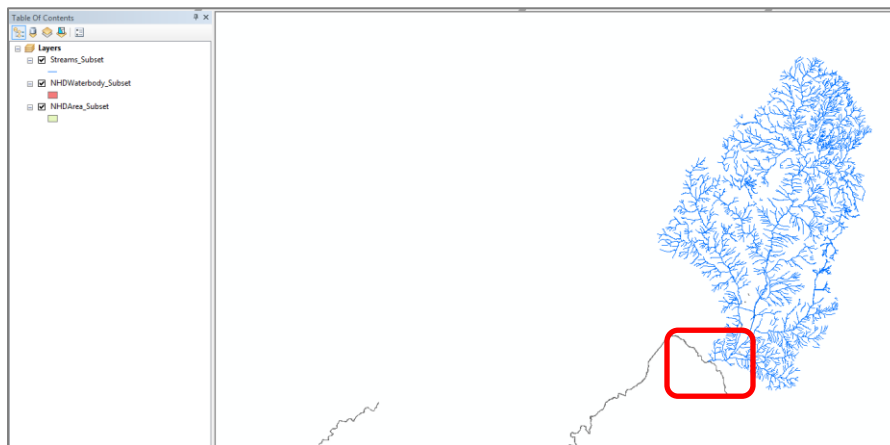



## Part 1: Identifying feature conflicts

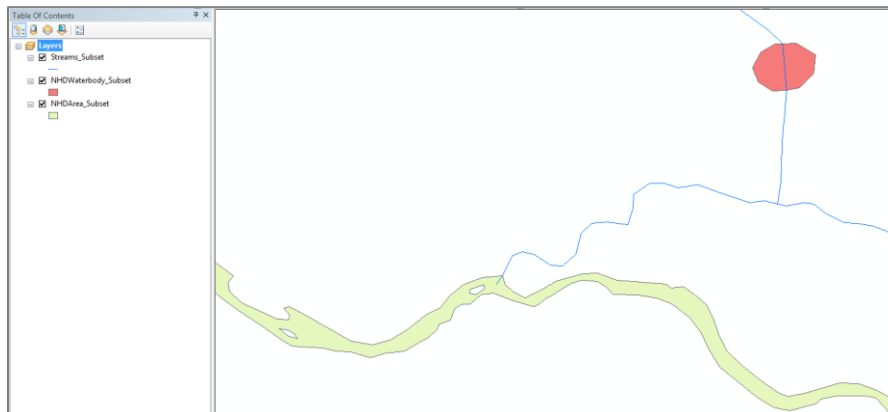
In the first part of this exercise, we'll be looking at ways to quickly identify where 1D flowline features that have recently been derived from LiDAR are in gross conflict with existing 2D NHD content (e.g. NHDArea and NHDWaterbody featureclasses). While the USGS has a series of QA/QC checks specifically designed to find these types of errors, users cannot run those checks prior to the pre-Conflation workflow or until the data have passed entirely through the GeoConflation process and are being prepared for the NHD Update process. The timing of those QA/QC checks is problematic for users wanting to make corrections prior to loading data into an NHD template (i.e. editing while the data are still unconstrained by the rulesets within the NHD data model).

### A. Demonstrating common feature conflicts

1. Launch ArcMap from the start menu by clicking **Start, Programs, ArcGIS, ArcMap 10.5**.
2. Click the **Add Data** button and navigate to where you placed the course material.
3. Open the **USFS\_Streams\_Subset** geodatabase, and while holding the "Ctrl" key, select the **Streams\_Subset**, **NHDArea\_Subset**, and **NHDWaterbody\_Subset** featureclasses. Click **Add**.
4. If they are not already, turn each of the 3 layers on within the Table of Contents (TOC). Whatever default symbology/color ArcMap assigns to those layers is acceptable for now – i.e. users are free to symbolize any of the 3 layers to their liking, but there is no requirement to alter the symbols at this point in the exercise.
5. With all 3 of the map layers turned on, notice in the map that there is a long polygon included that seems mostly unrelated to the Streams\_Subset layer – with the exception of 1 intersection between the 1D features and that polygon (a feature within the NHDArea\_Subset layer), there are no other contact points.




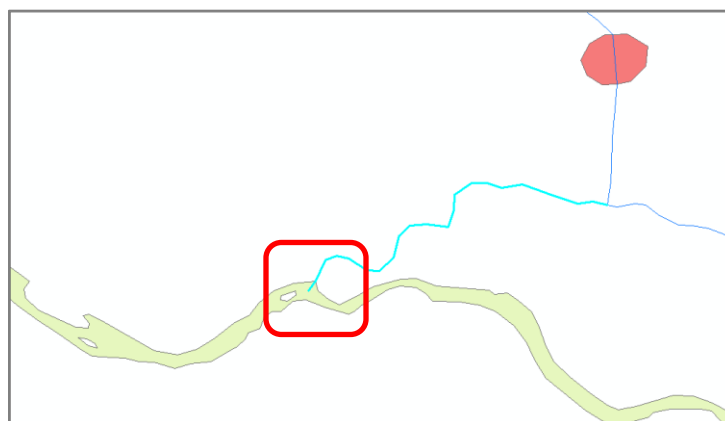
6. The example of this one intersection between differing 1D and 2D datasets illustrates a common type of spatial relationship that users have to consider when preparing data for NHD updates. Using the Zoom In tool, , located on the Tools toolbar, let's examine this intersection more closely. Left click and hold to drag a small box around the point where the **Streams\_Subset** layer intersects the long polygon feature. Zoom in to a map scale of between 1:2500 and 1:5000 of this area as shown below.



7. Once zoomed in, we can confirm that the long polygon identified above is a feature within the **NHDArea\_Subset** layer (determined via its color within the TOC). We can also see that a feature from within the **Streams\_Subset** layer does indeed intersect (touch) that feature.
8. According to the feature rules prescribed within the NHD schema, 1D features are not generally allowed to traverse the boundary of 2D features. We will need to select the Streams\_Subset feature outside of the of the NHDArea\_Subset feature to see if that line is actually a single feature which violates the boundary rule.

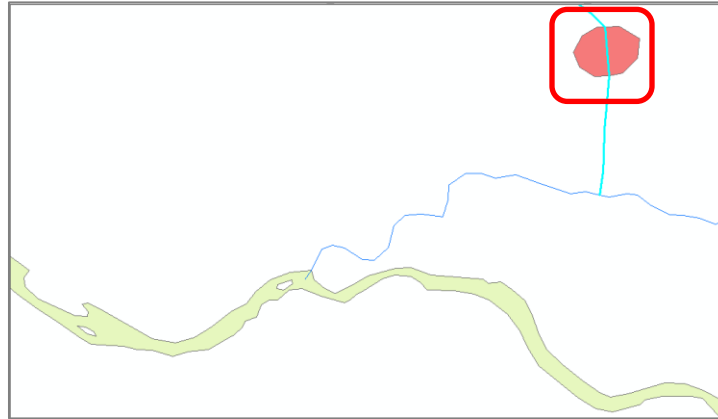
**Note:** there are a few exceptions to the aforementioned rule about 1D features not being allowed to traverse 2D features; however, those variants are not particularly common interactions across the NHD and not within scope for this exercise. For a detailed explanation of the specific “Feature to Feature” rules that are applied within the NHD, please visit the following link – <https://usgs-mrs.cr.usgs.gov/NHDHelp/FeatureRules/whnjs.htm>.

9. Using the Select Features tool,  , located on the Tools toolbar, left click and hold to drag a small box around the stream feature outside where it appears to intersect the NHDArea\_Subset polygon.



10. Notice that the selected 1D feature is a single continuous feature that traverses the boundary of the polygon – this finding confirms that the 1D stream feature violates the Feature to Feature rules that are applied within the NHD. We will address how to bring this feature into alignment with those rules later in the exercise.

11. Also notice within the map, that there is a 1D stream that appears to traverse a semi-circular polygon feature within the **NHDWaterbody\_Subset** layer (determined via its color within the TOC). Using the Select Features tool, left click and hold to drag a small box around the stream feature outside where it appears to intersect the NHDWaterbody\_Subset polygon.



12. Again, notice that the selected 1D feature is a single continuous feature that traverses the boundary of the polygon – this finding confirms that the 1D stream feature violates the Feature to Feature rules that are applied within the NHD.

**Note:** finding this type of topology error can also be automated via spatial selection and we will utilize that method later in the exercise. For the purposes of demonstration in this part of the exercise we used a manual visual method to identify features that are non-compliant with NHD Feature to Feature rules.

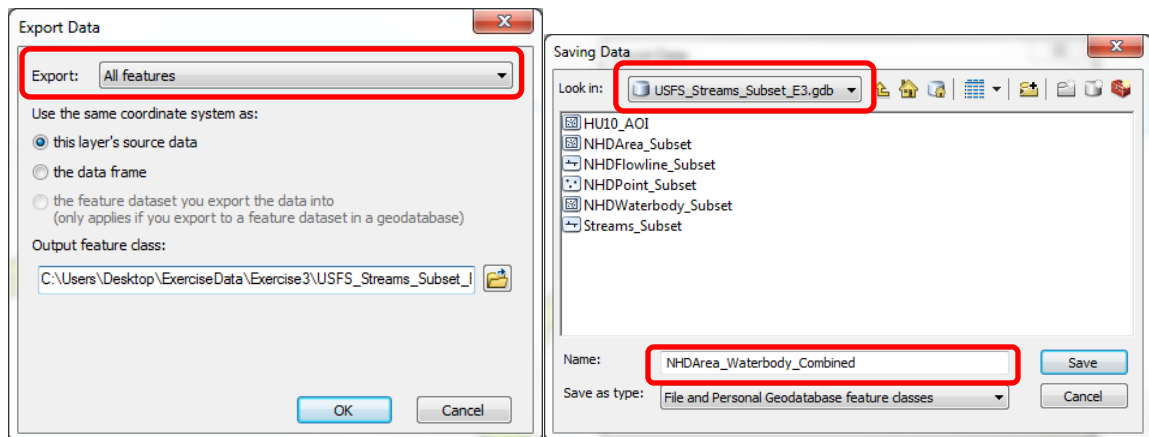
13. In the next section of the exercise, we will combine the NHDArea\_Subset features and the NHDWaterbody\_Subset features into a single layer so we can address all of the errant 1D feature in a single process.

## Part 2: Collating 2D features for bulk assessment

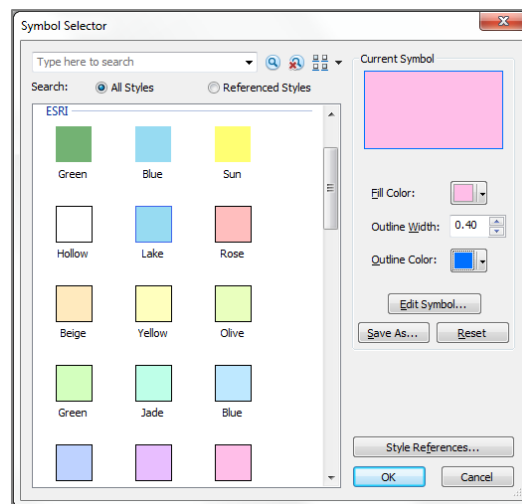
In this part of this exercise, users will be shown the process for preparing polygon features that can be used for correcting, in bulk, any errant boundary intersections within the polyline dataset. While individual polygon datasets can be used in the later correction process, combining the data into a single layer reduces the number of steps editors or data stewards need to complete later in the workflow. In step 2A, the user will export a copy of NHDArea\_Subset before conflating that dataset with the NHDWaterbody\_Subset in step 2B.

### A. Creating the new 2D featureclass

1. First, clear all selected features by clicking the **Selection** dropdown menu and selecting **Clear Selected Features**.
2. In the TOC, right click on the **NHDArea\_Subset** layer, choose **Data**, and then left click “**Export Data**”. When the resulting Export Data window opens, ensure that “**All Features**” is the option shown on the dropdown menu at the top of the menu as shown below.

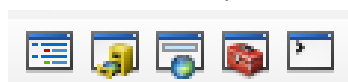


- Next, using the folder icon on the Export Data window, navigate to the **USFS\_Streams\_Subset** file geodatabase, choose to name the saved content as “**NHDArea\_Waterbody\_Combined**” (see above image to the right), click **Save** and then **OK**.
- Once saved, ArcMap will present a window asking the user whether or not to add the newly created layer to the map. Choose **Yes** so that the new **NHDArea\_Waterbody\_Combined** layer is added to the map.
- In order to readily distinguish the polygons within the new **NHDArea\_Waterbody\_Combined** layer, double click the colored box under the layer name in the TOC and select something distinct. In the example shown below, the fill color is set to “**Rodolite Rose**” (top right corner of color palate) and the outline color is set to “**Cretan Blue**” (3<sup>rd</sup> column from right and 3<sup>rd</sup> row down).

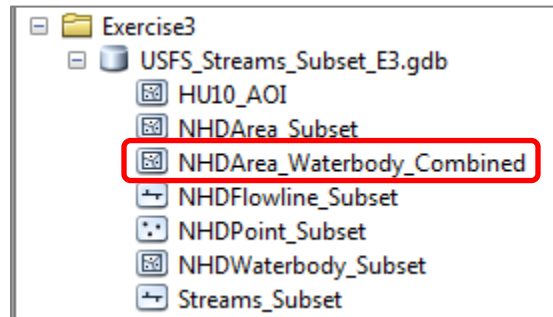


## B. Loading additional data into the new featureclass

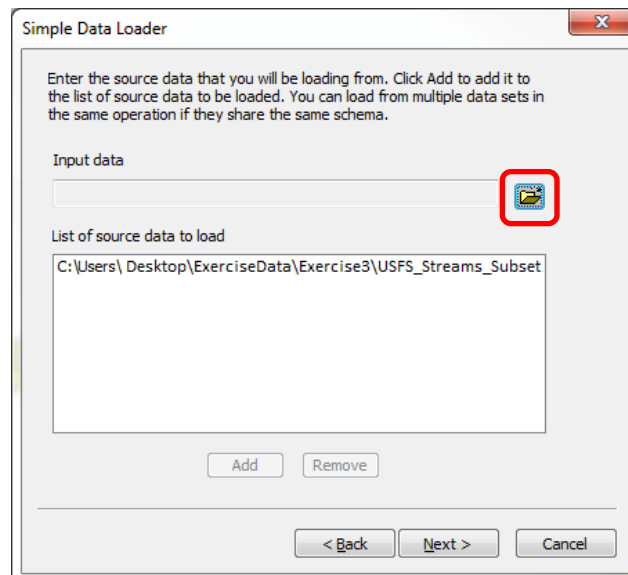
- Next, Open the ArcCatalog window within ArcMap as shown in the following graphic.



2. In the ArcCatalog window, navigate to and open the **USFS\_Streams\_Subset** file geodatabase, right click on the **NHDArea\_Waterbody\_Combined** layer, select Load, and left click **Load Data**.

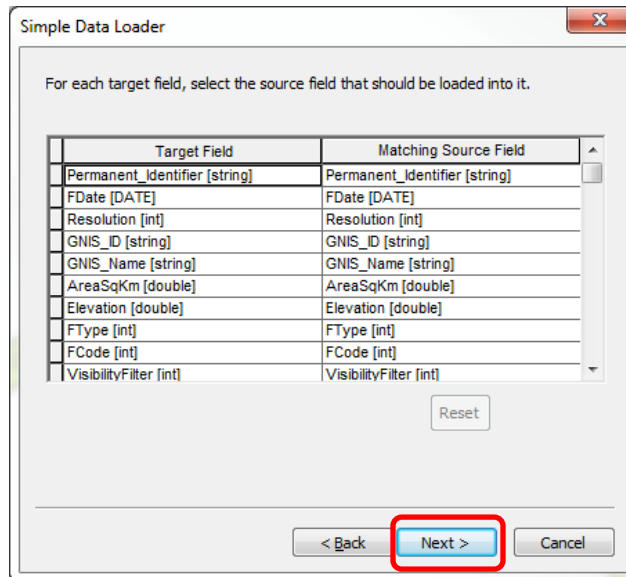


3. When the Simple Data Loader window opens, click **Next**. Using the folder icon on the subsequent screen, navigate to and select the **NHDWaterbody\_Subset** layer within the **USFS\_Streams\_Subset** file geodatabase. Click **Open**.



4. Click **Add**, then **Next**. Make sure the input on this screen is set to “**I do not want to load all the features into a subtype**” and then click Next.
5. On the following screen, make no changes to the attribute matches and click **Next**.





Simple Data Loader

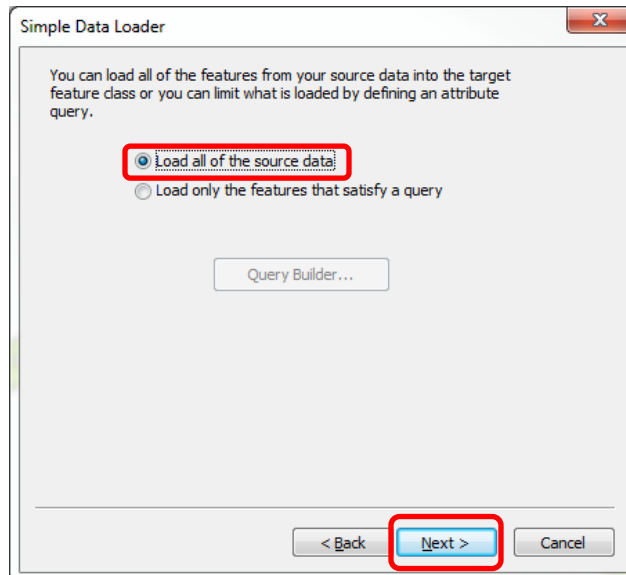
For each target field, select the source field that should be loaded into it.

Target Field	Matching Source Field
Permanent_Identifier [string]	Permanent_Identifier [string]
FDate [DATE]	FDate [DATE]
Resolution [int]	Resolution [int]
GNIS_ID [string]	GNIS_ID [string]
GNIS_Name [string]	GNIS_Name [string]
AreaSqKm [double]	AreaSqKm [double]
Elevation [double]	Elevation [double]
FType [int]	FType [int]
FCode [int]	FCode [int]
VisibilityFilter [int]	VisibilityFilter [int]

Reset

< Back Next > Cancel

6. On the following screen, make sure the selection is set to “load all of the source data” and click **Next**.



Simple Data Loader

You can load all of the features from your source data into the target feature class or you can limit what is loaded by defining an attribute query.

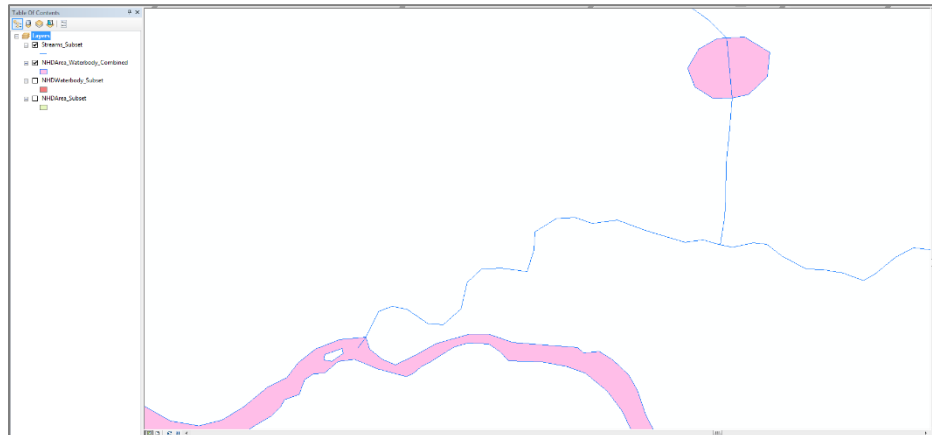
☒ Load all of the source data

☐ Load only the features that satisfy a query

Query Builder...

< Back Next > Cancel

7. On the final Summary screen, click **Finish**. When the user clicks Finish, ArcMap then loads a copy of all the features currently in the NHDWaterbody\_Subset into the same dataset that already contains a full copy of the NHDArea\_Subset features.
8. In the TOC, turn off the **NHDArea\_Subset** and **NHDWaterbody\_Subset** layers and turn on the **NHDArea\_Waterbody\_Combined** dataset. The resulting map should now look similar to the screenshot below.



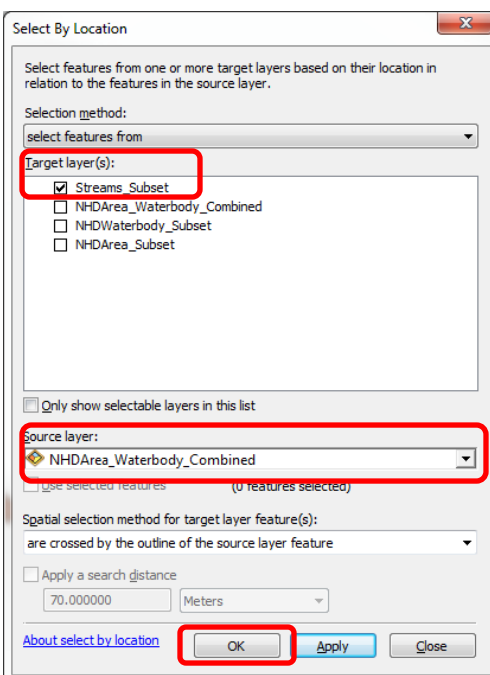
9. We now have a single dataset with all of the original NHD polygon content that intersects our area of interest. In the next portion of the exercise, we'll use the newly combined data to modify the 1D stream features so they more closely conform to the NHD Feature to Feature ruleset and can subsequently be used to update the NHD.

## Part 3: Addressing feature conflicts

In this portion of the exercise, users will assess the number of 1D features having errant intersections with 2D boundaries, as well as processing those features within ArcToolbox so they split at the corresponding 2D boundaries.

### A. Assessing the scope of 1D features with errant boundary intersections

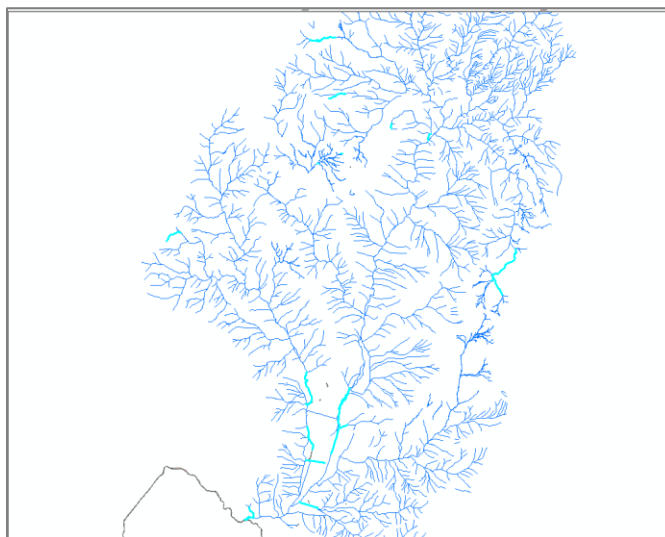
1. In ArcMap, click on the **Selection** tab (near the top left corner in ArcMap) and choose **Select by Location**.
2. When the **Select By Location** window opens, choose the **Streams\_Subset** dataset as the Target layer, and set the **NHDArea\_Waterbody\_Combined** dataset as the Source layer. Then set the spatial selection method to "**are crossed by the outline of the source layer feature**" and click **OK**.



3. Notice the resulting message in the lower left corner of the ArcMap window that says "Number of features selected: 26". See following example. This lets us know that 26 features met the spatial selection criteria above.


Number of features selected: 26

4. In the TOC, right click on the Stream\_Subset layer, choose Selection, and left click on Zoom To Selected Features. You can now see all of the 26 selected features within the map.



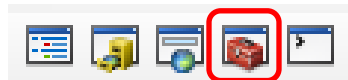
5. We've now identified each of the features within the Streams\_Subset layer that errantly crosses a polygon boundary within the corresponding NHD content. Editors or data stewards could then zoom to individual stream segments and manually fix the conflicts on a feature by feature basis. However, depending on the scope of problems identified in the dataset, manual

repairs can be time intensive. In the next section of the exercise users will see how corrections to the polylines can be made in bulk using the features we compiled in part 2 of the exercise.

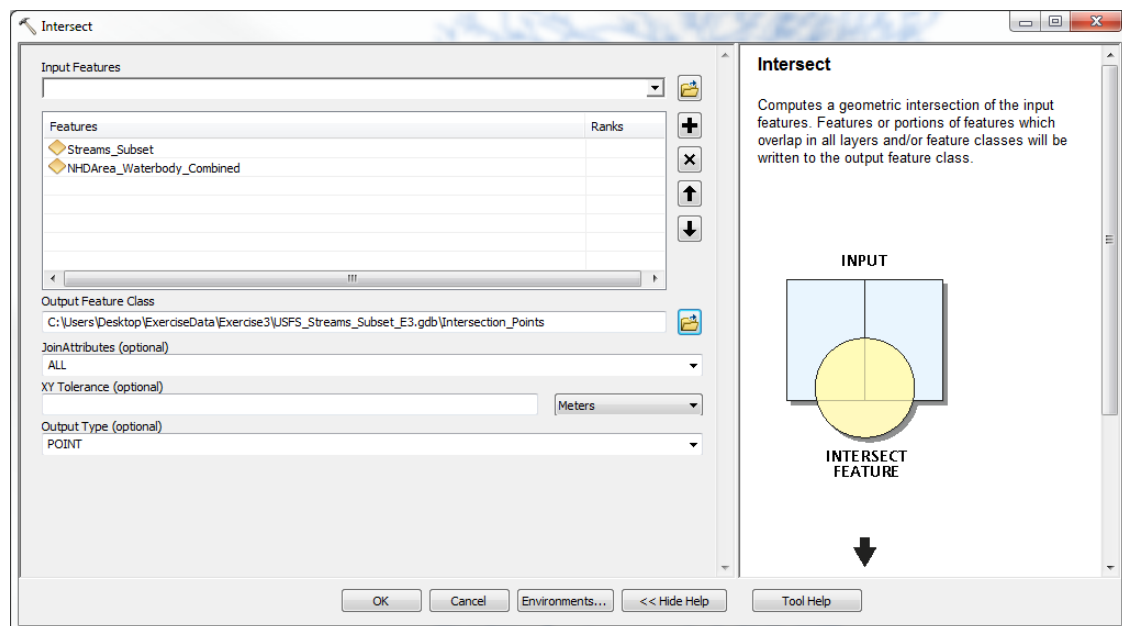
- At this point users are encouraged to examine or zoom into any of the highlighted features within the map so they can see where common intersection issues occur. Once completed, click on the Clear Selected Features button, , on the Tools toolbar and proceed to the next section.

## B. Using the Intersect tool to create intersection points

- In ArcMap, open ArcToolbox as shown via the following graphic. Note: it often takes several seconds for the ArcToolbox to open in ArcMap.



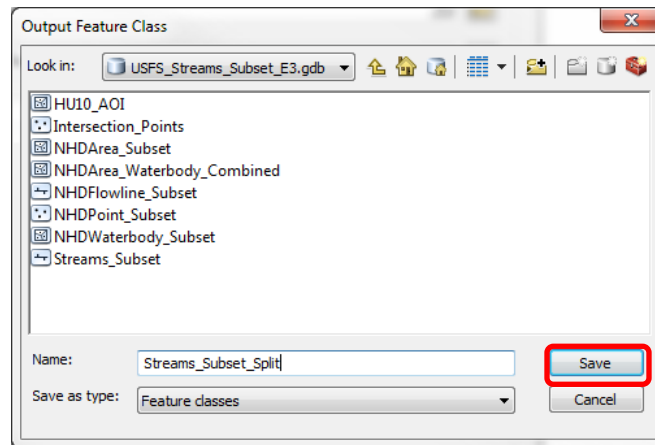
- Within ArcToolbox, open the Analysis Tools, open the Overlay tools, and double click on the **Intersect** tool. When the Intersect window opens, select from the Input Features dropdown list both the **Streams\_Subset** layer and the **NHDArea\_Waterbody\_Combined** layer as shown below.
- Next, using the folder icon associated with the **Output Feature Class** parameter, navigate to the file geodatabase containing the exercise data and name the new dataset "**Intersection\_Points**".
- Leave the Join Attributes parameter set to ALL, leave the XY Tolerance parameter blank, and then set the **Output Type** parameter to **POINT** via the associated dropdown list. The tool should now look like the below image.



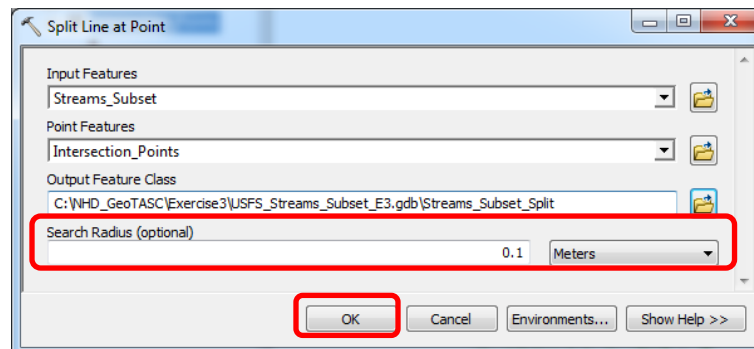
- Click **OK** to run the tool. When completed, the output layer is automatically added to the map. Users do not need to turn the new Intersection\_Points layer on or change its symbology – the layers only use is as an input for the next section.

## C. Use the Split Line at Point tool to break streams where they intersect 2D features

1. Within ArcToolbox, open the Data Management Tools, open the Features tools, and double click on the **Split Line at Point** tool. When the Split Line at Point window opens, select from the Input Features dropdown list the **Streams\_Subset** layer. Then, select the **Intersection\_Points** layer from the Point Features dropdown list.
2. Using the folder icon associated with **Output Feature Class** parameter, navigate to the file geodatabase containing the exercise data and name the new dataset "**Streams\_Subset\_Split**" as shown below.



3. In the Search Radius parameter, set the value to **0.1 Meters**. When the tool inputs appear as per below, click **OK** to run the tool.



4. When the tool completes its process, the new Streams\_Subset\_Split layer is added to the TOC. Whatever default symbology/color ArcMap assigns to those layers is acceptable for now – i.e. users are free to symbolize the new layer to their liking, but there is no requirement to alter the symbology at this point in the exercise.
5. Let's now confirm that the process has resolved any issues relating to 1D streams errantly crossing the boundaries of the 2D NHD features. Returning to the **Selection** tab (near the top left corner in ArcMap), choose **Select by Location**.
6. When the **Select By Location** window opens, choose the **Streams\_Subset\_Split** dataset as the Target layer, and set the **NHDArea\_Waterbody\_Combined** dataset as the Source layer. Then set the spatial selection method to "**are crossed by the outline of the source layer feature**" and click **OK**.

7. Once the selection process is complete, there should not be any selected features within the **Streams\_Subset\_Split** layer. We can confirm this by right clicking the **Streams\_Subset\_Split** layer in the TOC and choosing **Open Attribute Table**.
8. When the attribute table opens, there is a dialog box at the bottom of the attribute which should now read “0 of 3346 Selected”. See the following graphic.



**Note:** occasionally Select By Location will return a handful of errors even after running the above processes. This is acceptable and simply indicates that there is likely a geometry issue with one or more of the 2D boundaries that have been used for processing. Any remaining issues can quickly be addressed during the formal pre-Conflation workflow by adding or removing vertices to the 2D features. That process is out of scope for this exercise, but is addressed in the related USGS documentation.

9. We have now corrected the spatial relationships between the 1D stream features and the existing 2D NHD content. Without closing the attribute table for the Streams\_Subset\_Split layer, let's save the current ArcMap document for use with the next exercise.
10. Right click on the **Streams\_Subset\_Split** layer in the TOC and select **Zoom to Layer**.
11. Next, in the TOC, right click on the **Streams\_Subset** layer and click **Remove**. Repeat the right click and remove process for both the NHDWaterbody\_Subset and NHDArea\_Subset layers.
12. Once that layer is removed from the TOC, the only layers that should remain visible in the map are the **Streams\_Subset\_Split** and **NHDArea\_Waterbody\_Combined** layers.
13. In the upper left corner of the ArcMap window, click **File** and choose **Save As**. Navigate to a directory of your choosing (one that you will be able to easily locate later), name the file as “**Streams\_4\_NHD\_Update**”, and click **Save**.
14. Once the map document has been saved, users may either close ArcMap or choose to proceed with the next exercise.

**Congratulations!** You have successfully completed this exercise and have been introduced to methods used for correcting the spatial relationship of newly derived 1D features relative to existing NHD content.