Digital Mobile Sketch Mapping (DMSM)

How to Create a Tile Package (TPK)

Forest Service

Introduction

A tile package (.tpk) allows you to use a set of packaged tiles (images) as a basemap in ArcGIS applications. A set of tiles is known as a **tile cache**. The tiles are packaged into a single file, a **.tpk** file, so you can easily share a tile cache. Basemaps and imagery made this way typically display more quickly than other imagery and are a necessity for aerial and ground data collection. Furthermore, a TPK basemap is required for DMSM (Digital Mobile Sketch Mapping) data collection.

These instructions contain several options depending on the location and type of imagery/basemap data used. Depending on your data, you may need to do all steps or only a few steps (the **Getting Started** section provides a guide on what steps are needed). The steps for creating a raster mosaic from an ArcGIS Server Image Service are modified (and expanded) from instructions provided by GTAC (The Geospatial Technology and Applications Center). Instructions for creating a TPK for vector data (streams, roads, etc.) are included in the last part of this document.

Requirements

1. ESRI's ArcMap software 10.1 or newer. These instructions were created using 10.3.1 (other versions may behave slightly differently).

2. A single polygon shapefile or feature class of your **area of interest (AOI)** projected to the **WGS 1984 Web Mercator (Auxiliary Sphere)** projected coordinate system. For a given state, ensure the border of a state has a 10 nautical mile buffer around it and that this new buffered boundary line is your AOI polygon.

3. Enough hard drive space to save large files (probably 2 GB or more depending on the size of the area).

4. If available, use a machine that has more than 4 GB of RAM (ideally 8 GB or more).

5. If your imagery/basemap is from an ArcGIS Server Image Service online, make sure a connection to it is set-up in ArcCatalog. In the Catalog Tree, expand "**GIS Servers**" and double click **Add ArcGIS Server**. Select **Use GIS Services** and click **Next**. Enter or paste the ArcGIS Server URL into the Server URL box and click **Finish**. The service and data within it will now appear in ArcCatalog under **GIS Servers** as "arcgis on …". For the example below using public NAIP data from the Aerial Photography Field Office (APFO) it appears as "**arcgis on gis.apfo.usda.gov (user)**." The rest server URL for this NAIP Imagery Service is: https://gis.apfo.usda.gov/arcgis/rest/services
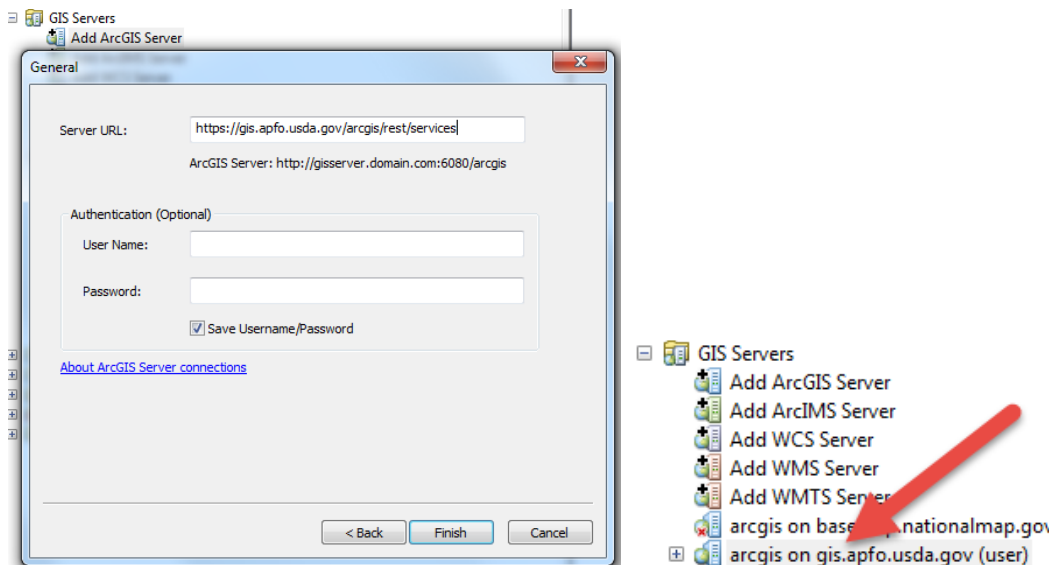
6. If your imagery/basemap is from an ArcGIS Server Image Service online, determine if the original service has cache tiles or not. To do this, add the service to ArcMap. Right click on the service in the Table of Contents. If the **Enable Cache View Mode** line is greyed out then the service does **not** have a tile cache.
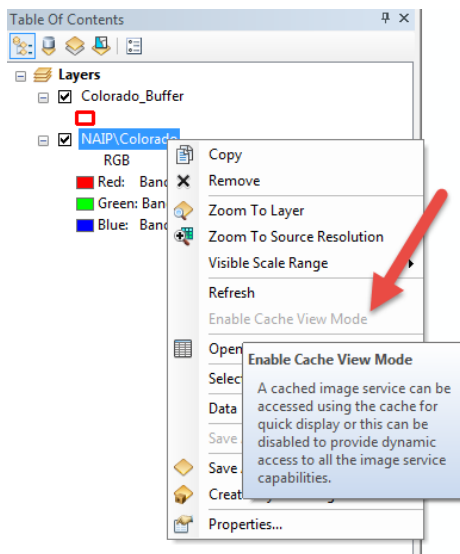
Data Sources

Rest URLs

Image Service - APFO NAIP Imagery: https://gis.apfo.usda.gov/arcgis/rest/services

Image Service - GTAC (Forest Service Access Only):
https://image-services.gtac.fs.usda.gov/arcgis/services

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Data Download

NRCS NAIP Imagery: https://nrcs.app.box.com/v/naip/folder/17936490251

Getting Started

For imagery/basemap data, please carefully choose from the options below based on your data:

→ **IF** your imagery/basemap data is saved to your local machine or network, complete Part 1: Set-Up (Pg. 3) and then skip to Part 4: TPK Creation (Pg. 9).

→ **IF** your imagery/basemap data is from an ArcGIS Server Image Service online and the service has cache tiles, complete Part 1: Set-up (Pg. 3), Part 2: Mosaic Creation (Pg. 4), and Part 4: TPK Creation (Pg. 9) in that order.

→ **IF** your imagery/basemap data is from an ArcGIS Server Image Service online and that service does NOT have a cache, complete Parts 1-4 of this document in order.

Part 5: Using the TPK as a DMSM Basemap (Pg. 10) contains instructions for setting the TPK as your Basemap in DMSM.

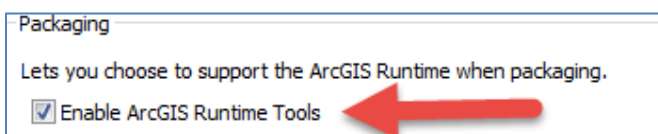**For vector data:**

Skip to Part 6: Vector TPK Creation (Pg. 11)

For NAIP false color composite imagery (Bands 4,1,2 or other band combinations):

Complete Part 1: Set-Up and then skip to Part 7: False Color Imagery TPKs (Pg. 13)

Part 1: Set-Up

1. Create a project folder.

2. In ArcMap, click **Customize**, **ArcMap Options**, **Sharing**. Under **Packaging**, check **Enable ArcGIS Runtime Tools** to select it.


3. Bring your area of interest (AOI) shapefile into ArcMap and ensure it is in **WGS 1984**

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Web Mercator (Auxiliary Sphere) coordinate system. Also, ensure that your data frame is in WGS 1984 Web Mercator (Auxiliary Sphere) by right clicking on **Layers** in the table of contents and looking at the **Coordinate System** tab.
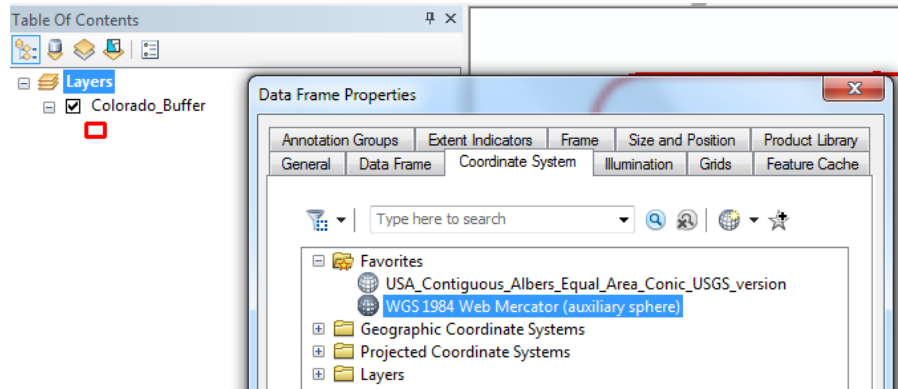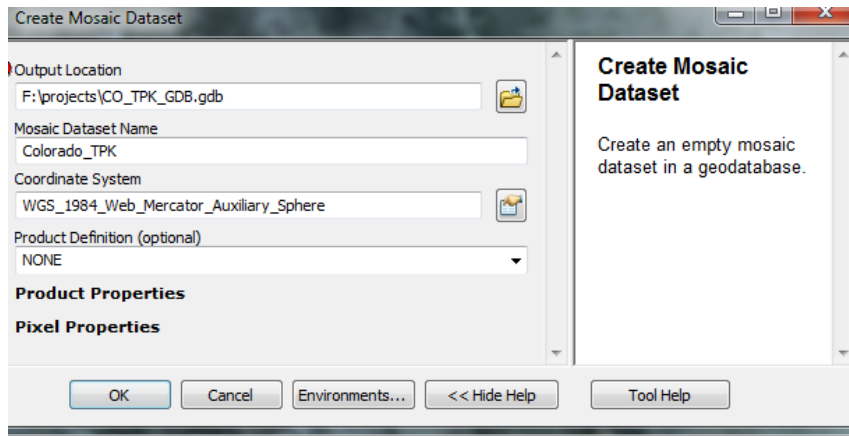

4. In ArcMap, click **File**, **Map Document Properties**. Fill out the appropriate information about your imagery/basemap and click **OK**.
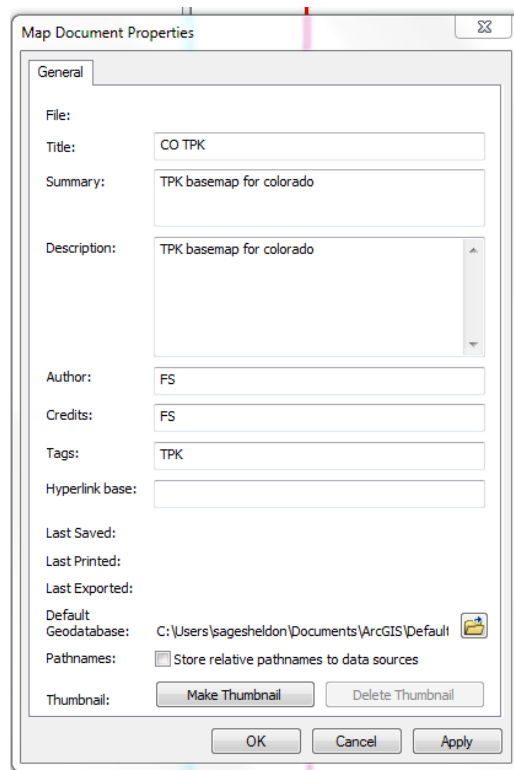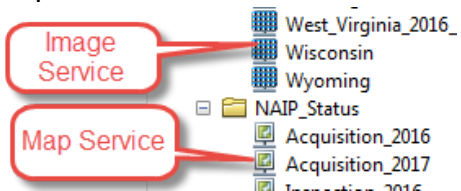

Part 2: Mosaic Creation

1. In ArcMap, open **Catalog** and navigate to your project folder.

2. Right click on your project folder and click **New**, **File Geodatabase**. Name your new file geodatabase.

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3. Right click on your newly created file geodatabase and click **New**, **Mosaic Dataset**. Name your new mosaic dataset. Select **WGS_1984_Web_Mercator_Auxiliary_Sphere** as the Coordinate System. Click **OK**.


4. To add a data service, right click on the new mosaic dataset in ArcCatalog (expand the File Geodatabase if you don't see it) and click **Add Rasters**.

5. You can determine if your service type is an Image Service or Map Service by looking at the icons next to the services in the Catalog tree (you can also right click on a service, click **Properties** and the top of the dialog box will say Image or Map service). Please note, we have found that this process does not work for all Map Services. ESRI generated Map Services do work with this process.


6. For NAIP imagery from APFO, we will select **Image Service**. Since we need a 10 nautical mile buffer around our state, we will add our state and all of the states surrounding it to our mosaic. Under **Input Data**, click the **folder button**:
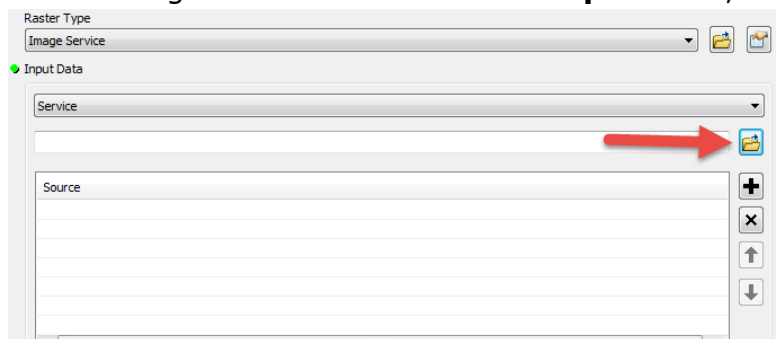

Navigate to your image service under **GIS Servers** and select all of the states you need.

If you are not using NAIP data by state, you may only need to select one image service (i.e. if it covers the whole country).

7. Once you have added your service(s), uncheck the box next to **Update Boundary**. You may have to scroll down to see this option (In ArcMap 10.4 and later, expand the **Mosaic Post Processing** section to find and uncheck the **Update Boundary** option). Click **OK**.
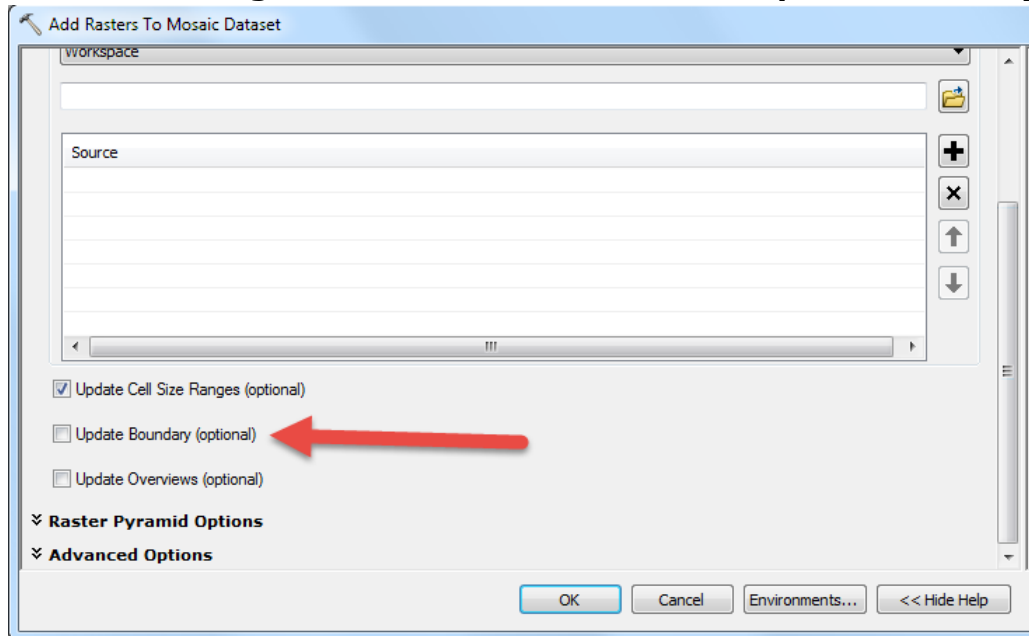

You should see Image, Boundary, and Footprint added to your table of contents and in your data view (see picture below). If you added multiple image services you will see each has a green footprint boundary in your data view. Make sure the Boundary layer under Mosaic is checked on.
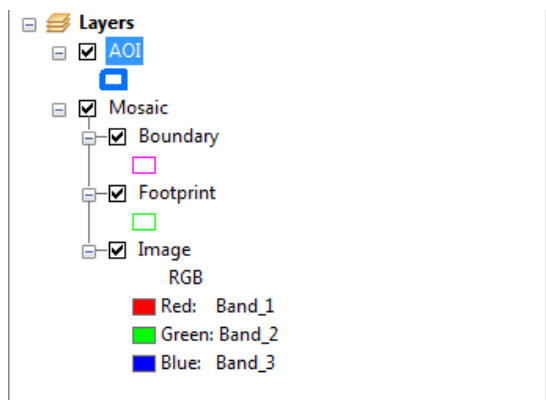
8. Update the Mosaic Footprint by right clicking on the mosaic dataset in ArcCatalog (expand the File Geodatabase if you don't see it), select **Modify**, **Import Footprint or Boundary**. **Target Feature Class** is Footprint. **Input Feature Class** is your AOI Boundary. **Target Join Field** and **Input Join Field** should both be **OBJECTID** (or one may be **ID** or **FID** – whichever is available from your dataset). Click **OK**.
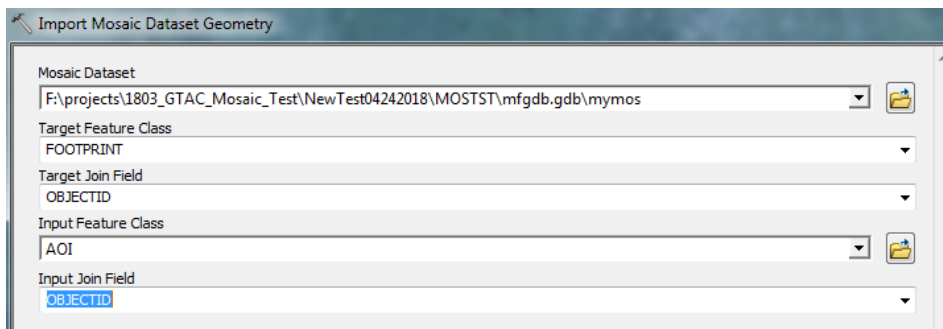
9. To update the Mosaic Boundary, start an editing session in ArcMap for the **Boundary** layer of your Mosaic. Click once in the Data View window to highlight your AOI (area of interest) polygon only (e.g. a state with a 10 nautical mile buffer around it). Right click and select **Copy**. Right click in the data view and click **Paste**. Make sure **Boundary** is selected and click **OK**.
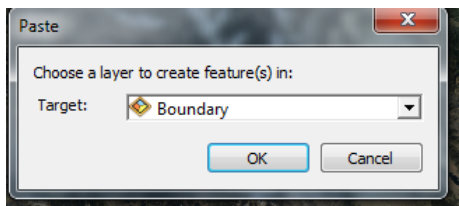
Click **Stop Editing** and **Save Edits**. Confirm that your pink Boundary line now matches your AOI and you should not see any imagery data outside of your AOI (you may need to refresh your map view to confirm this).

Part 3: Cache Creation

Some imagery or map services do not already have a cache such as NAIP data by state from the APFO (Aerial Photography Field Office). We must first create a cache in order to successfully create a packaged cache, aka a TPK. In 10.3.1 and later, we can simultaneously create a tile cache and a TPK (packaged tile cache).

1. In ArcMap's Catalog window, right click on the mosaic created in Part 2 above, and select **Generate Tile Cache**.

2. Select a folder and name for the tile cache under "**Tile cache name:**" Additionally, to simultaneously create your TPK, select the checkbox next to "**Create tile package:**" and select a location and name for your TPK. Do not use the word "grid" in any TPK names or

tile cache names.
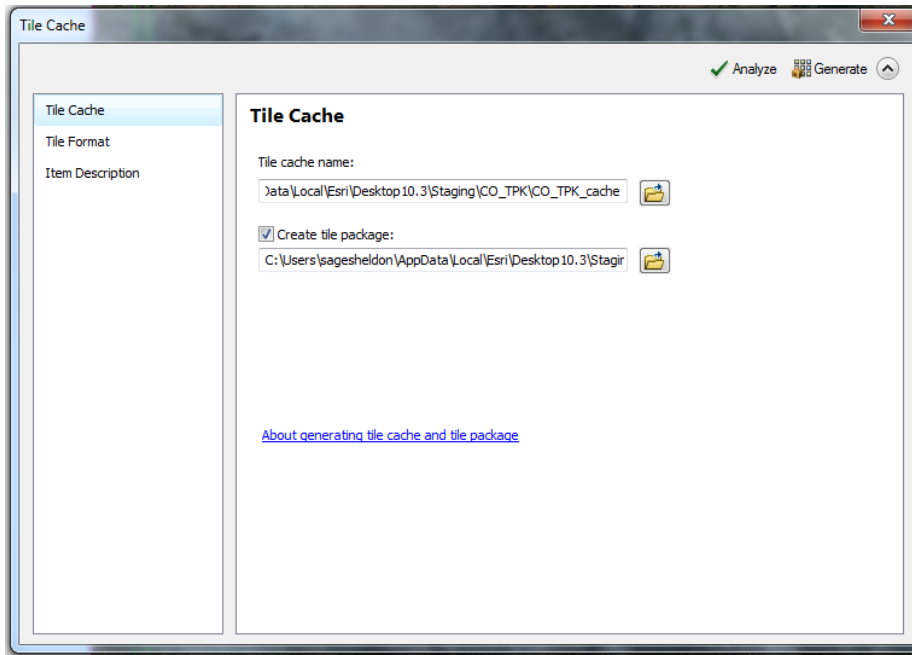
3. On the left select the **Tile Format** option. **Tiling Scheme** should be **ArcGIS Online/Bing Maps/Google Maps**. The **Tile Format** should be **JPEG** for imagery and basemaps. For DMSM aerial surveys, **Level of Detail** (LOD) should be set to **15 of 20** using the slider. LOD 15 allows users to zoom-in to the TPK no further than approximately 1:18,500 scale. If creating TPKs for field applications like Collector or Survey 123 you may want to use a greater LOD. Each additional LOD level doubles the maximum zoom-in resolution (e.g. LOD 16 allows a max zoom –in scale of ~ 1:9,250 scale), but quadruples the size of the TPK and proportionately increases processing time.
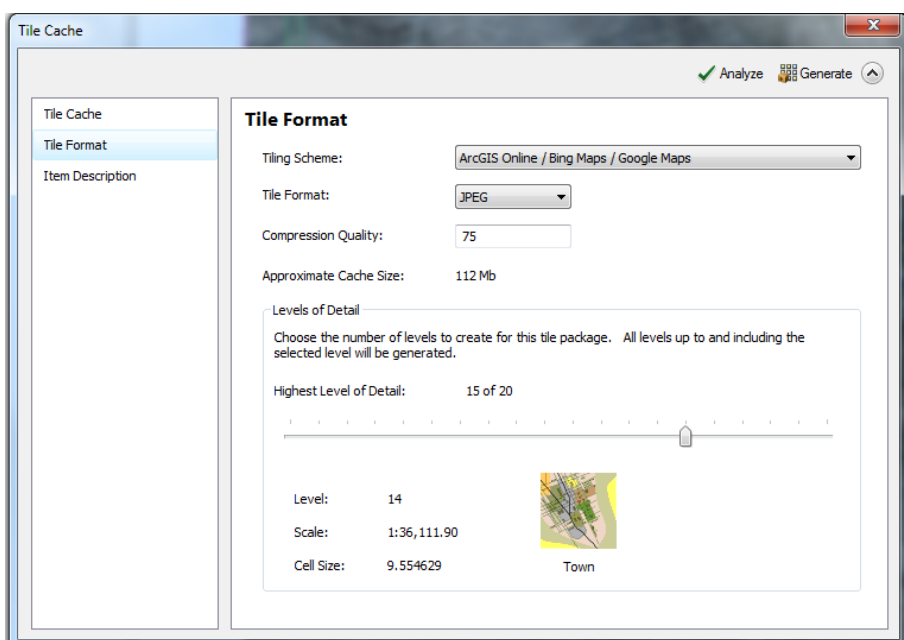
4. If you chose to make a TPK at this step in addition to a tile cache, then the **Item Description** page will have appeared under "Tile Format" on the left. Select **Item Description** and fill out all of the boxes for your TPK. If you did not choose to make a TPK at this time, then Item Description will not appear.

5. Click **Analyze**. If you have no high ranking errors, then click **Generate**.

Part 4: TPK Creation

For the following steps, any visible layers in your MXD will be exported as part of the TPK. Any visible vector layers will be "burned" into the imagery. **If you chose to create a TPK in Part 3, you do not need to complete this section.**

1. With imagery/basemap data open and visible in your MXD (and any other data you want merged into this TPK), make sure you have saved your MXD to your hard drive.

2. Click **File**, **Share As**, **Tile Package**.

3. Select the location and name of the TPK. Do not use the word "grid" in any TPK names or tile cache names.

4. Click **Tile Format** in the left panel. **Tiling Scheme** should be **ArcGIS Online/Bing Maps/Google** maps. Tile Format should be **JPEG** for imagery/basemaps. Use **PNG** for vector layers such as roads and rivers that require transparency. **Mixed** should be use if you have raster imagery and vector layers together. For DMSM aerial surveys, **Level of Detail** (LOD) should be set to **15 of 20** using the slider. LOD 15 allows users to zoom-in to the TPK no further than approximately 1:18,500 scale. If creating TPKs for field applications like Collector or Survey 123 you may want to use a higher LOD. Each additional LOD level doubles the maximum zoom-in resolution (e.g. LOD 16 allows a max zoom –in scale of ~ 1:9,250 scale), but quadruples the size of the TPK and proportionately increases processing time.
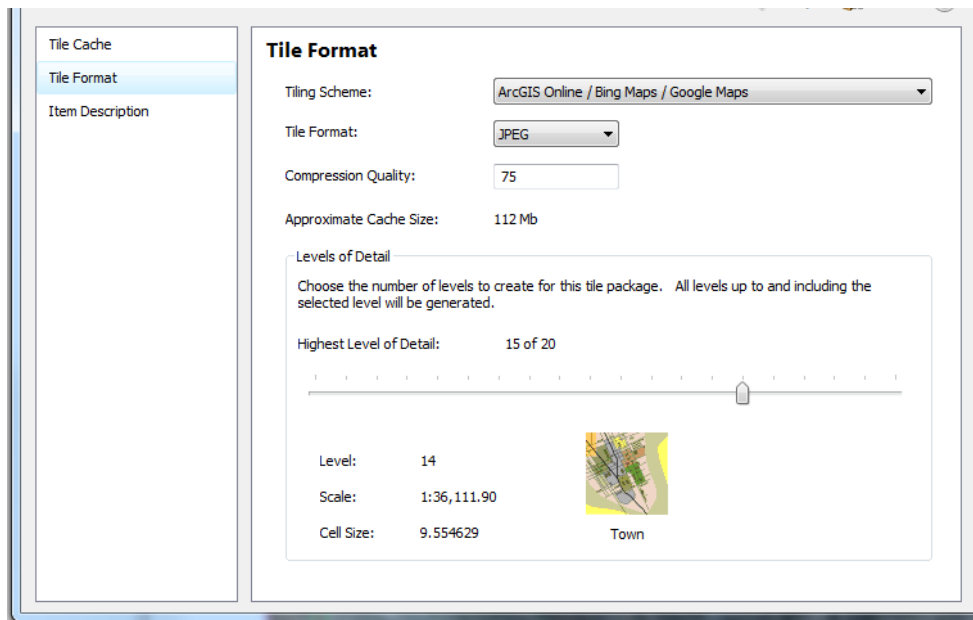
5. Select **Item Description** on the left and fill out all of the boxes for your TPK.

6. Click **Analyze**. If you have no high ranking errors, then click **Share**.

TIP: If you are making multiple TPKs, go to **Customize** in ArcMap, select **ArcMap Options** and go to the **Display Cache** tab. Click **Clear Cache**. Do this step between each TPK you create.

# Part 5: Using the TPK as a DMSM Basemap

DMSM Folder Structure--

- 'TPK'
  - Contains grid layers and all other informational layers
- 'CompactTileCache'
  - Contains data for Basemap
- 'SHP'
  - Contains shapefiles

In order for DMSM to run properly, you must have grids in your **TPK** folder and an imagery basemap in your **CompactTileCache** folder.

To unpack a TPK file, make sure that your computer does not have the hide file extensions option turned on (to check: open **Control Panel**, **Folder Options**, and on the **View** tab make sure there is not a check next to "**Hide extensions for known file types**"). Then simply change the file name from *.tpk to *.zip and unzip the file using a

tool such as WinZip or WinRAR. Double-click on your zip file and go down into the folder **v101**. Copy the resulting "**Layers**" folder and "**Layers**" file into the **CompactTileCache** folder on the SD card. If the folder and the layer file inside of **V101** are called something other than "**Layers**" and "**Layers.lyr**" rename them to be called **Layers**.
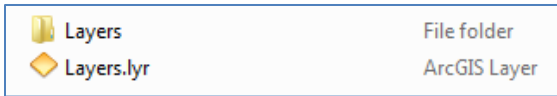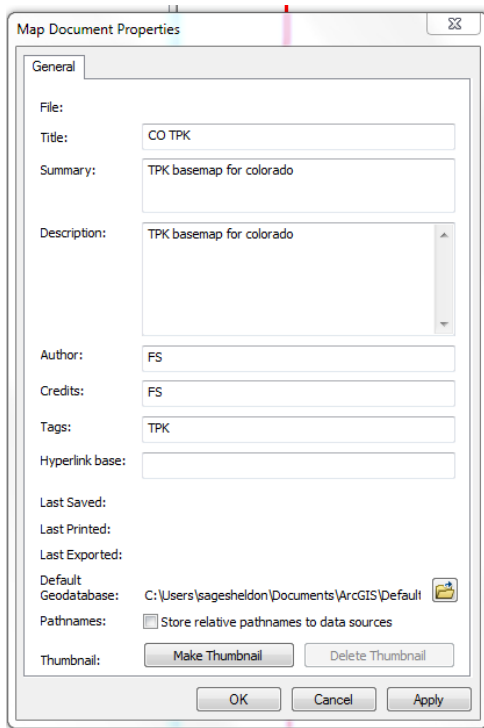

Part 6: Vector TPK Creation

1. Create a project folder.

2. Open **ArcMap**, click **Customize**, **ArcMap Options**, **Sharing** tab. Under **Packaging**, check **Enable ArcGIS Runtime Tools** to select it.
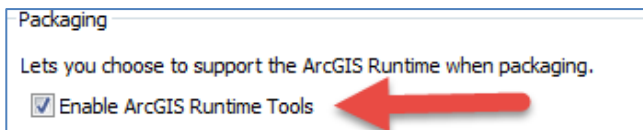
3. Bring your vector file(s) into the ArcMap document and ensure it is in **WGS 1984 Web Mercator (Auxiliary Sphere)** coordinate system. Also, ensure that your data frame is in **WGS 1984 Web Mercator (Auxiliary Sphere)** by right clicking on **Layers** in the table of contents and looking at the **Coordinate System** tab.
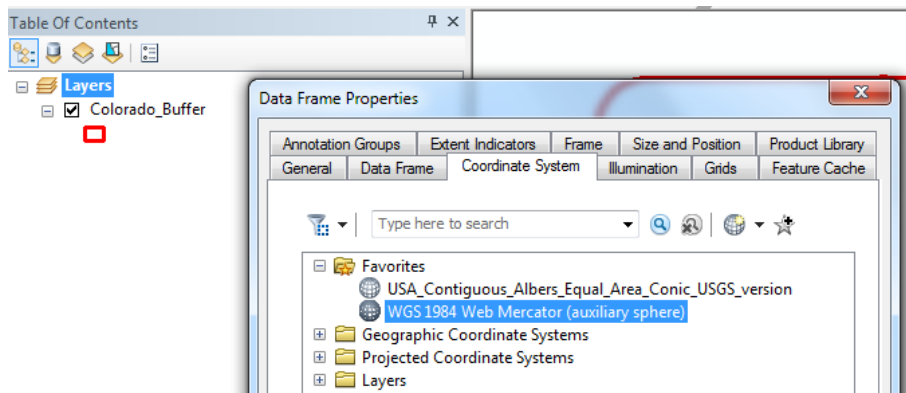
4. Set the symbology for the vector data exactly as you would like to see it on the tablet. If you would like your vector layer to only been seen when you have zoomed in our out to a certain extent, set this now in the layer's **Properties**.

5. In ArcMap, click **File** and select **Map Document Properties**. Fill out information about your vector file (**Title, Summary, Description,** and **Tags**).
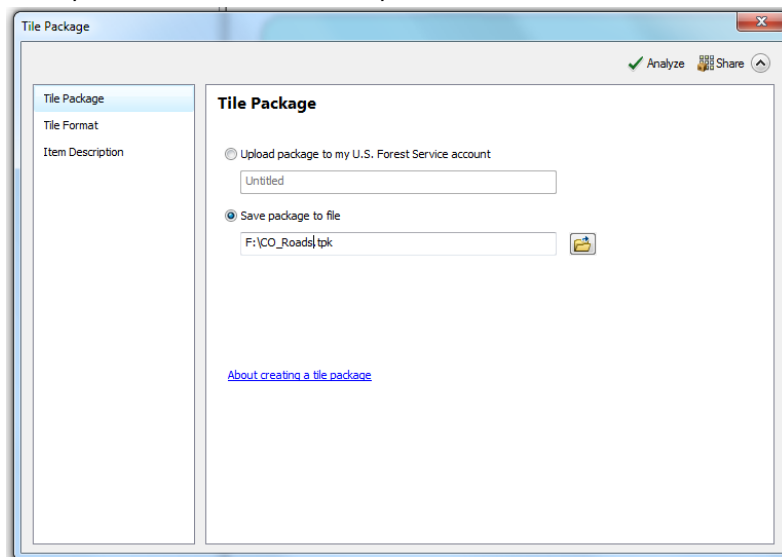
6. Save your MXD. Then click **File**, **Share As**, **Tile Package**. Select "**Save package to file**", click the folder icon, and select a location to save your Vector TPK.

7. Click **Tile Format** on the left. **Tiling Scheme** should be **ArcGIS Online/Bing Maps/Google Maps**. Tile format should be **PNG** for vector features. For DMSM aerial surveys, **Level of Detail** (LOD) should be set to **15 of 20** using the slider. LOD 15 allows users to zoom-in to the TPK no further than approximately 1:18,500 scale. Each additional LOD level doubles the maximum zoom-in resolution (e.g. LOD 16 allows a max zoom –in scale of ~ 1:9,250 scale), but quadruples the size of the TPK and proportionately increases the processing time to generate that TPK.
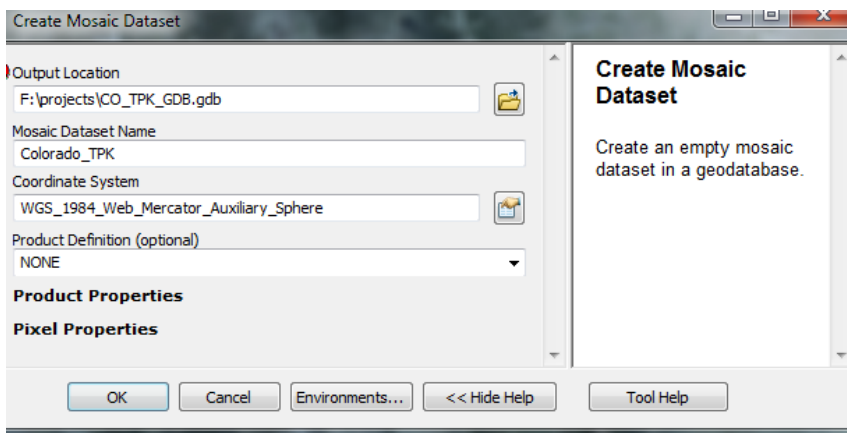
The **Item Description** will be automatically filled from the input in Map Document Properties.
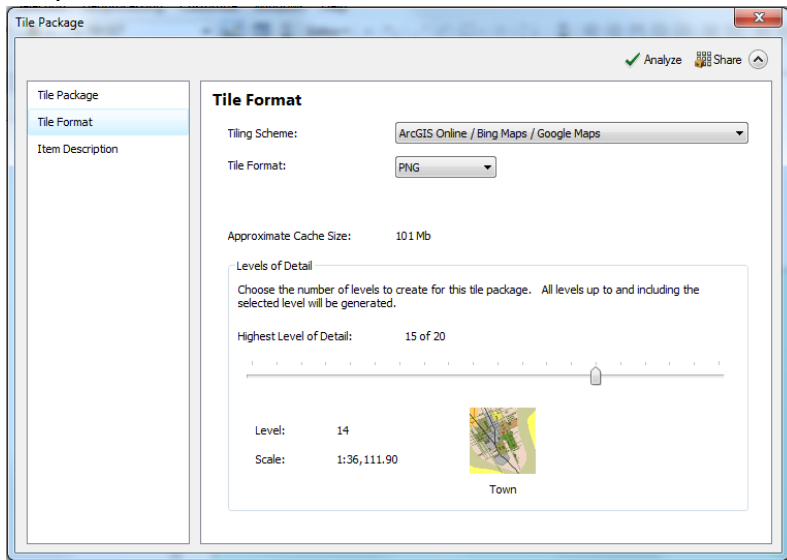
8. Click **Analyze**. If you have no High Severity errors or warnings, click **Share** and your Vector TPK will be created. You can then move it to the TPK folder in your DMSM folder.
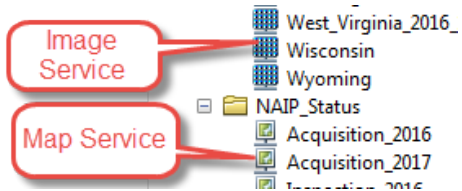
Part 7: False Color Imagery TPKs

1. In ArcMap, open **Catalog** and navigate to your project folder.

2. Right click on your project folder and click **New**, **File Geodatabase**. Name your new file geodatabase.

3. Right click on your newly created file geodatabase and click **New**, **Mosaic Dataset**. Name your new mosaic dataset. Select **WGS_1984_Web_Mercator_Auxiliary_Sphere** as the Coordinate System. Click **OK**.

4. To add a data service, right click on the new mosaic dataset in ArcCatalog (expand the File Geodatabase if you don't see it) and click **Add Rasters**.

5. You can determine if your service type is an Image Service or Map Service by looking at the icons next to the services in the Catalog tree (you can also right click on a service, click **Properties** and the top of the dialog box will say Image or Map service). Please note, we have found that this process does not work for all Map Services. ESRI generated Map Services do work with this process.


6. For four band NAIP imagery (https://naip.arcgis.com/arcgis/rest/services/NAIP/ImageServer), we will select **Image Service**. Under **Input Data**, click the **folder button**:
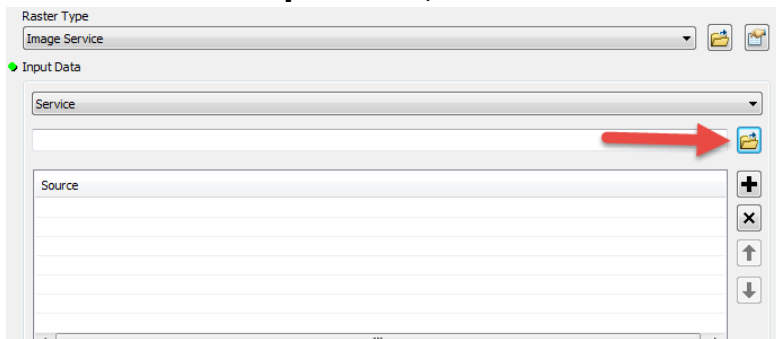
Navigate to your image service under **GIS Servers** and select the NAIP imagery service.

7. Once you have added your service(s), uncheck the box next to **Update Boundary**. You may have to scroll down to see this option (In ArcMap 10.4 and later, expand the **Mosaic**

Post Processing section to find and uncheck the **Update Boundary** option). Click **OK**.
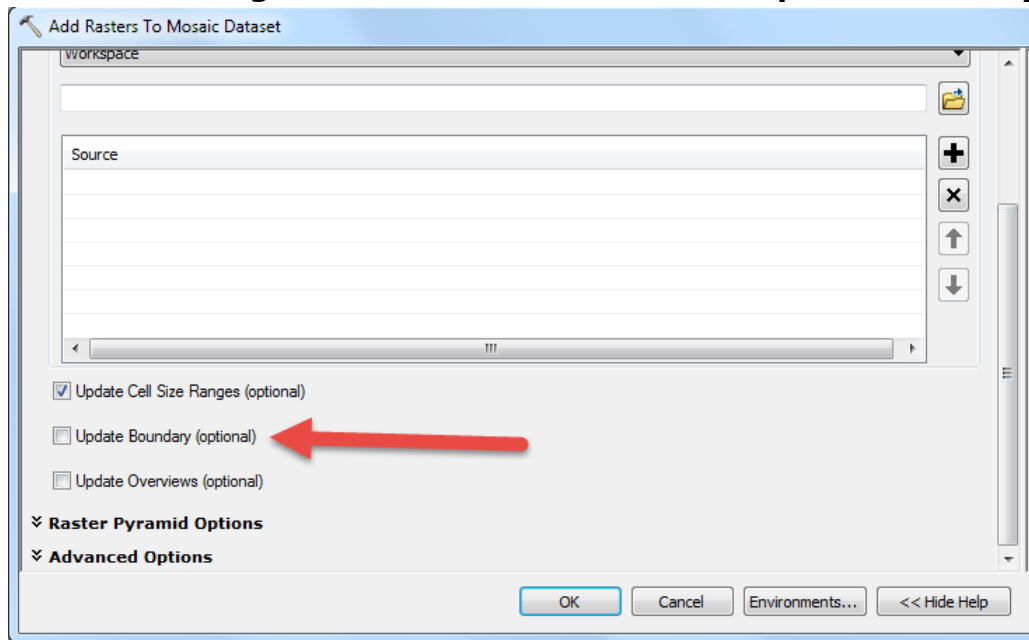

You should see Image, Boundary, and Footprint added to your table of contents and in your data view (see picture below). If you added multiple image services you will see each has a green footprint boundary in your data view. Make sure the Boundary layer under Mosaic is checked on.

8. If the imagery has more than one band, it will have defaulted in ArcMap to have Red as Band 1, Green as Band 2, and Blue as Band 3. Right click on the Image layer in your mosaic dataset in the Table of Contents. Select the Symbology tab and RGB Composite. For false color infrared composites from NAIP, change Red to Band 4, Green to Band 1, and Blue to Band 2. Click Okay.
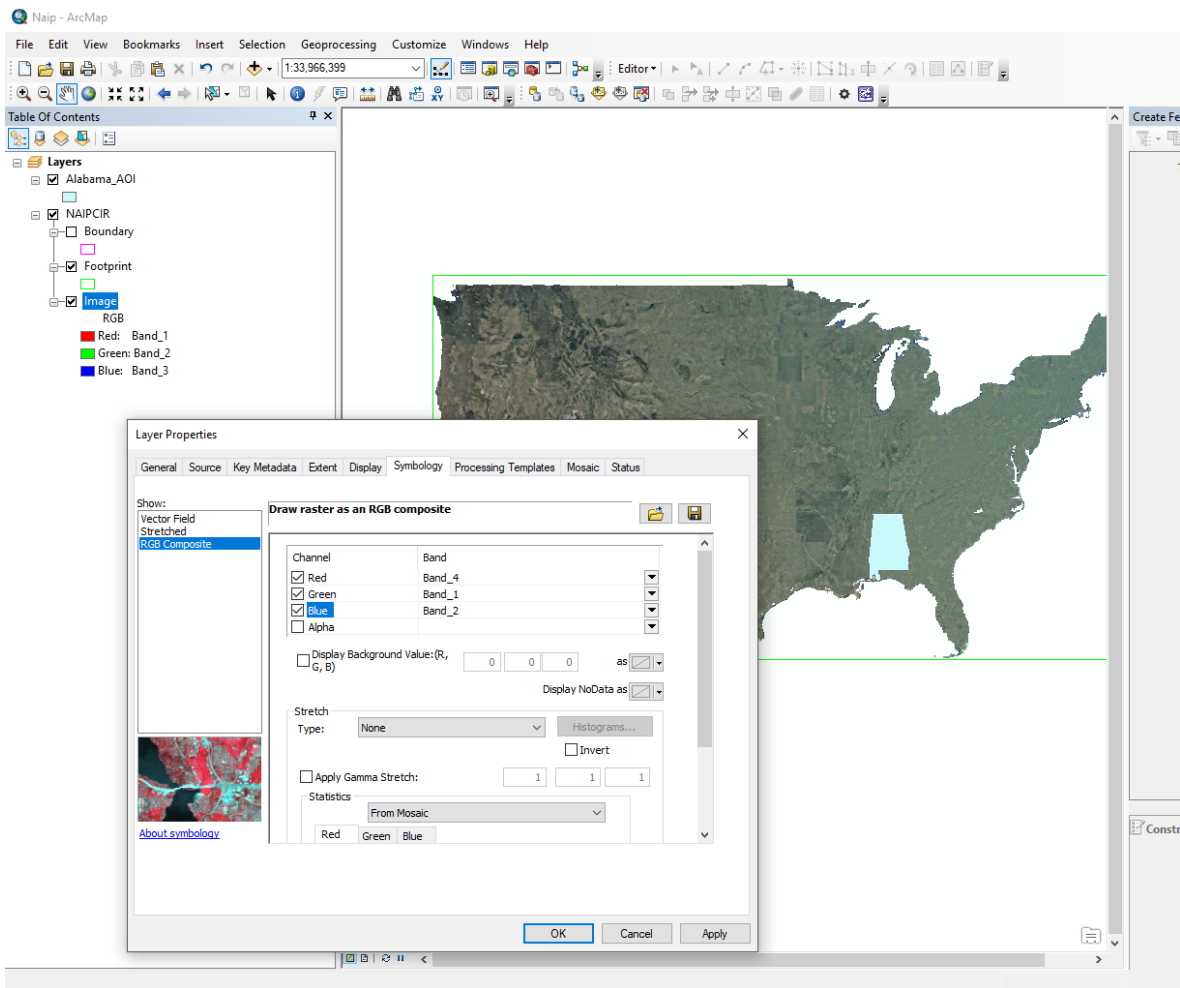
Your imagery should now have a false color composite with the infrared band.
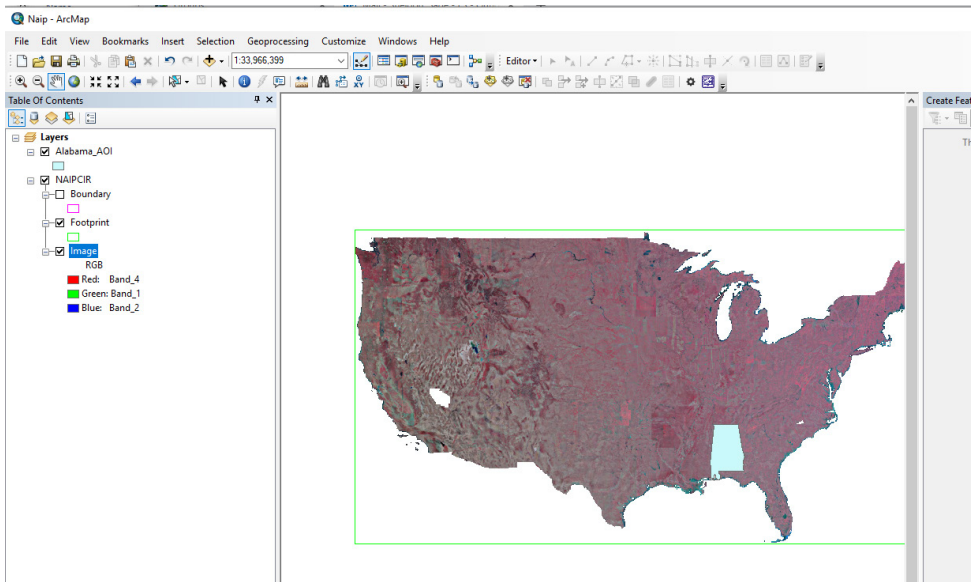
9. Update the Mosaic Footprint by right clicking on the mosaic dataset in ArcCatalog (expand the File Geodatabase if you don't see it), select **Modify**, **Import Footprint or Boundary**. **Target Feature Class** is Footprint. **Input Feature Class** is your AOI Boundary. **Target Join Field** and **Input Join Field** should both be **OBJECTID** (or one may be **ID** or **FID** – whichever is available from your dataset). Click **OK**.
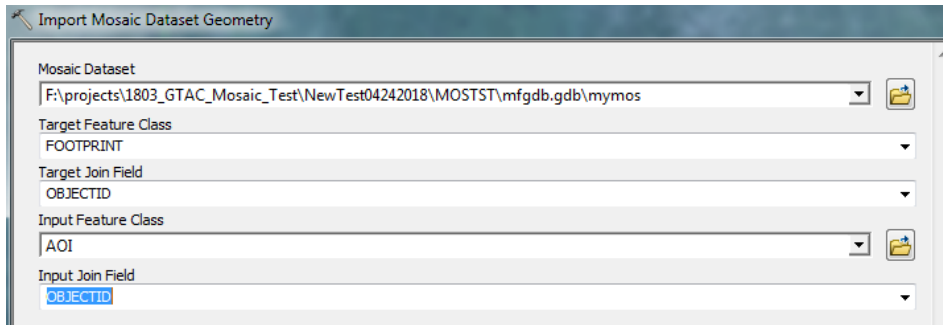
10. To update the Mosaic Boundary, start an editing session in ArcMap for the **Boundary** layer of your Mosaic. Click once in the Data View window to highlight your AOI (area of interest) polygon only (e.g. a state with a 10 nautical mile buffer around it). Right click and select **Copy**. Right click in the data view and click **Paste**. Make sure **Boundary** is selected and click **OK**.
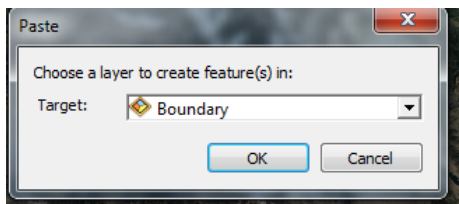
Click **Stop Editing** and **Save Edits**. Confirm that your pink Boundary line now matches your AOI and you should not see any imagery data outside of your AOI (you may need to refresh your map view to confirm this).

11. Complete Part 3: Cache Creation on Pg 7 of this document and then Part 4: TPK Creation on Pg. 9. If you have newer versions of ArcGIS you can instead create a cache and TPK in one step by going to File, Share as TPK Package in ArcMap. Settings should be selected, such as JPEG for imagery, the appropriate level of detail, and a description of the data.