

How to Convert USGS Topographic GeoPDF¹ Maps to GeoTIFF using ArcGIS 10.4

This tutorial assumes that you have: 1) downloaded some USGS geopdfs, 2) a pdf reader such as Adobe Acrobat, and 3) ArcGIS 10.4 software. Below are the steps I used in converting USGS topo maps from geopdfs to geotiffs with ArcGIS 10.4 using the ArcToolbox tool, PDF To TIFF. This tool is available in ArcGIS 10.3.1 but it does not work properly on USGS geopdfs.

Note 1: Pathnames and filenames cannot have spaces or reserved characters in them, otherwise the geoprocessing tool may fail without giving any error. Use underscores or combination upper and lower characters.

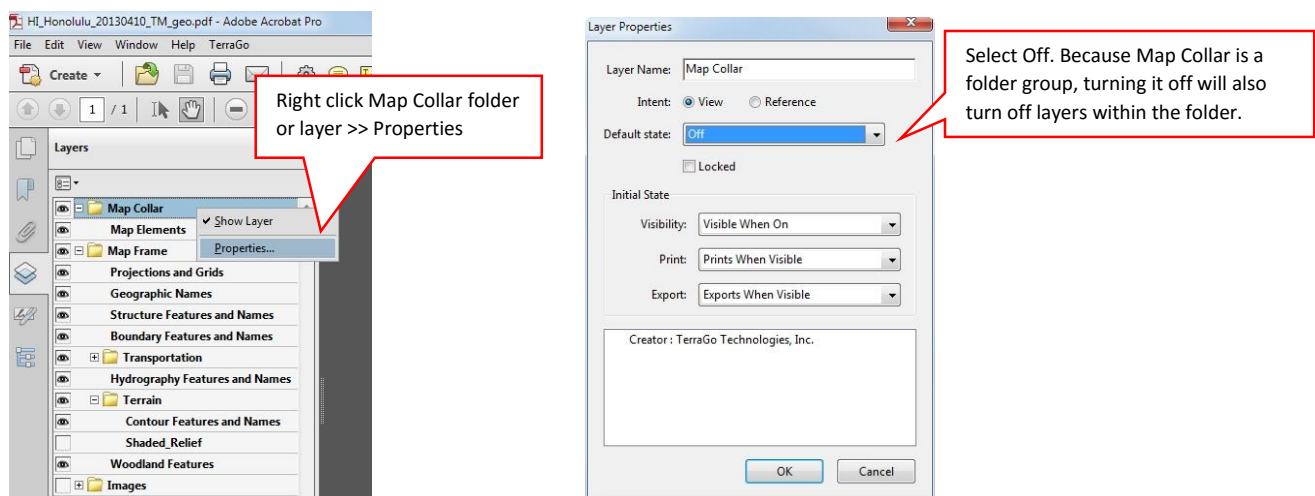
1 Set Default Visibility of Geopdf Layers

Since there is really no option to select which layers in the geopdf get converted in the PDF to Tiff tool in ArcGIS, set the initial or default state of the layers first in a pdf reader (e.g Adobe Acrobat or Bluebeam) before doing the conversion. Basically by turning on/off the default visibility state of the layers in the geopdf, you're setting up how the map should look when converted.

For this example, I want to create seamless set USGS topo quads or images for Oahu, so I want the Map Collar/Map Elements information or the Projections and Grid turned off.

Note 2: For a collarless topo image, the default state of both Map Collar (Map Element) and Projections and Grid layers in the geopdf must be set to off. With this set and clipping option checked (see Step 2 below), the collar will be clipped when converted to geotiff.

1. Open the geopdf with the Layers panel displayed.
2. Right click Map Collar >> Properties.
3. In Layer Properties window >> Change Default State: Off >> OK. Leave all other parameters as is.



¹ GeoPDF is a registered trademark of TerraGo Technologies. It is used in this document to refer to USGS digital topographic quadrangle maps in which GeoPDF is the current geospatial implementation.

4. Turn off the Projections and Grids layer by following steps 2 & 3 above.
5. Optional: Turn on the Shaded_Relief layer by doing the same steps.
6. Save the geopdf. You can double check the layers' default viewing state by opening it again.

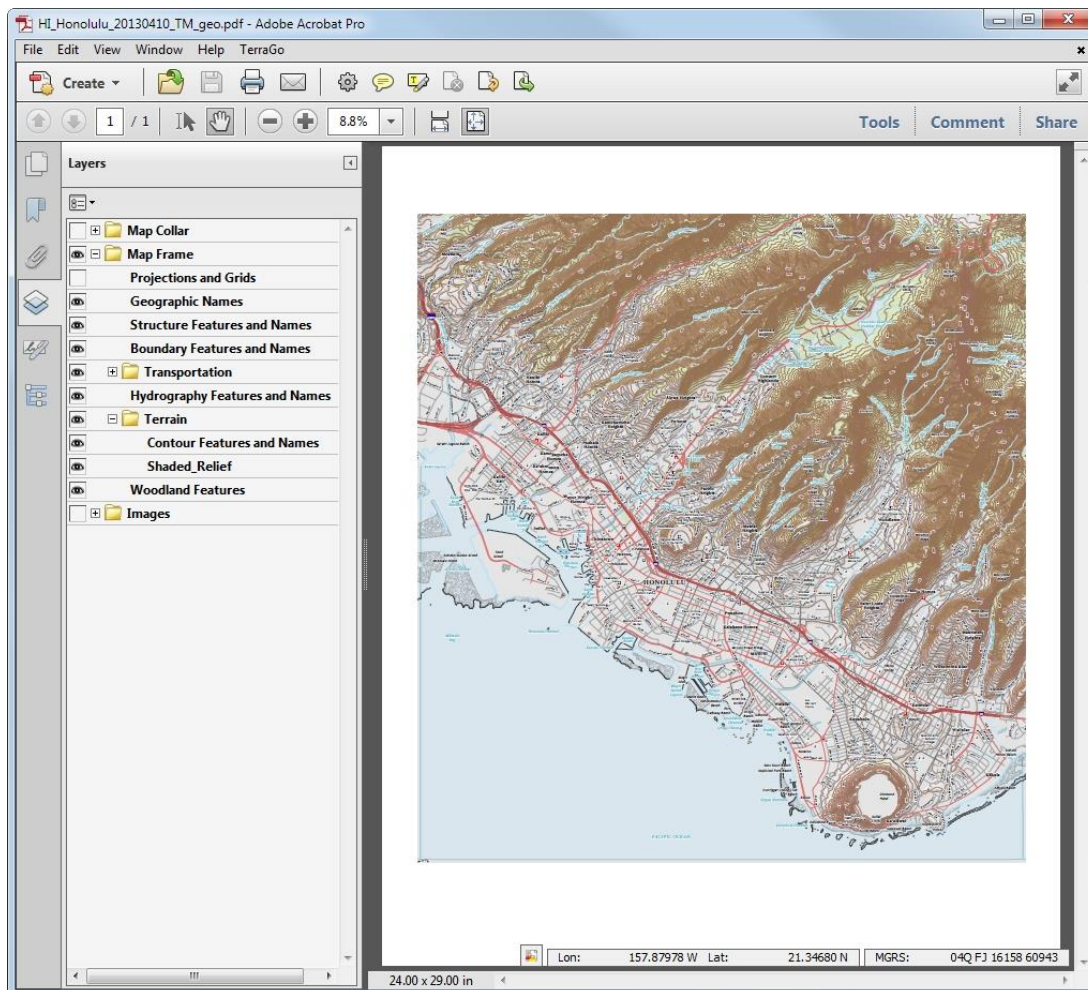
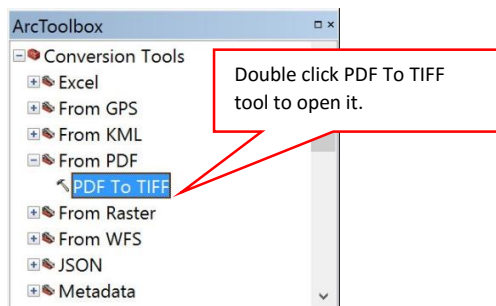


Figure 1: Geopdf with Map Collar off, Projections and Grids off, and Shaded_Relief turn on

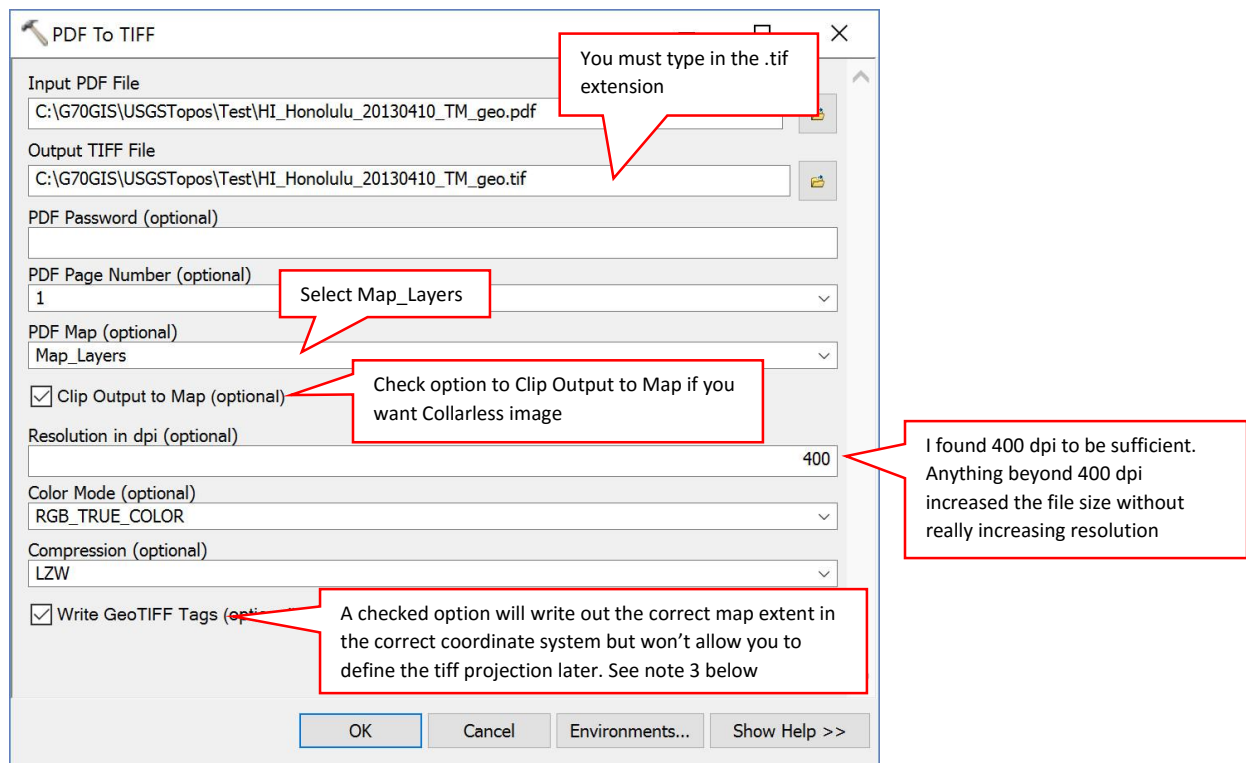
2 PDF To TIFF Using ArcGIS

The PDF to Tiff geoprocessing tool in ArcToolbox can be accessed via ArcMap or ArcCatalog, depending on which application you are using.

1. In ArcToolbox >> Conversions Tools >> PDF To TIFF



2. In PDF to Tiff dialog window: Input your parameters >> OK.



Note 3: The converted geotiff will have coordinate system information, but ArcGIS will say it is unknown or undefined, meaning you need to explicitly define the coordinate system of the converted tiff. However, ArcGIS does not provide a way to change the GeoTIFF tags that control the internal georeferencing of TIFF images. It seems that with this option checked, it will write out the correct map extent but you won't be able to change/define the spatial reference later after it has been written. Having an unknown or undefined coordinate system may cause your data to be displayed incorrectly (e.g. projection-on-the fly of different data may not display correctly in ArcMap). See steps 3 and 5 for work around solutions for getting the converted geotiffs to display correctly with other data layers.

Extent	
Top	2364207.10916
Left	613977.492522
Right	627169.127751
Bottom	2350151.39146
Spatial Reference	<Undefined>

631637.74 2354489.766 Unknown Units

Figure 2: Write Geotiff Tags option checked will write out correct map extent (NAD 83 UTM Zone 4). However, you can't edit the Spatial Reference.

Extent	
Top	29
Left	0
Right	24
Bottom	0
Spatial Reference	NAD_1983_UTM_Zone_4N
Statistics	

Figure 3: Write Geotiff Tags option unchecked doesn't write out correct map extent (instead it writes the page size) but will allow you to edit the Spatial Reference with the Edit button

3 Data Frame Coordinate System


This step is a work around solution for getting a geotiff with an undefined coordinate system to display properly with other data layers. ArcMap uses the data frame's coordinate system as the base for doing projection-on-the-fly of data layers with different coordinate systems. ArcMap cannot do projection-on-the-fly of data layers without a defined or known coordinate system, which is why you must set the data frame's coordinate system to that of the geotiff and have other datasets project-on-the-fly to that coordinate system so that they can be viewed together in the same space.

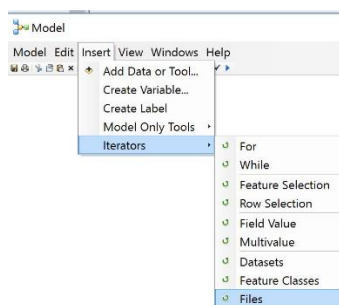
1. In ArcMap, open a blank document and set the data frame's coordinate system to that of the geotiff.
2. Right Click "Layers" Data Frame >> Properties >> Coordinate System tab >> set the coordinate system.
3. When you add the geotiff to ArcMap, the Unknown Coordinate System window will still pop up. Say OK.
4. Adding other data layers with different known coordinate systems will be reprojected to that of the data frame and geotiff.

4 Batch Convert Geopdfs to Geotiffs

There are two options to batching the geopdf conversion process. Option 1 is to create an iteration process with Model Builder, and option 2 is using the PDF To TIFF tool with a Batch grid. I prefer the model builder method for batching as it's faster and easier once you have it set up. You don't have enter each individual file and parameters as you would with the batch grid method.

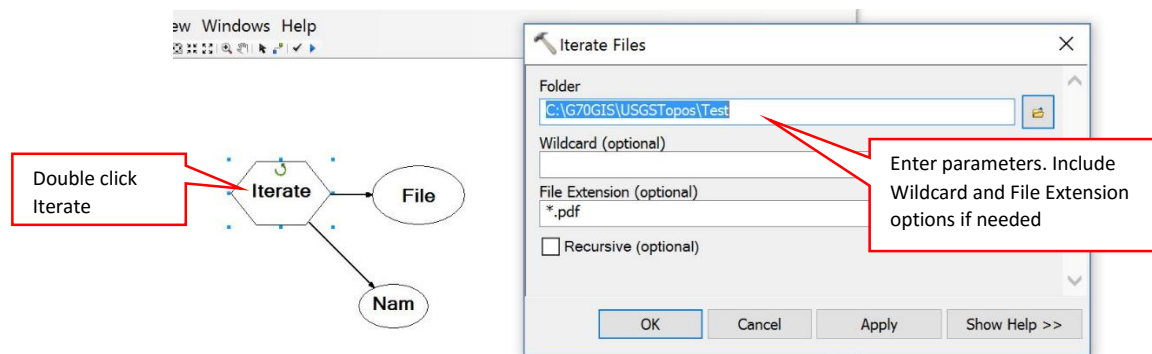
Option 1: Model Builder

1. Open Model Builder window . This can be accessed in ArcCatalog or ArcMap.
2. In the Model Builder window:
 - a. Insert menu >> Iterators >> Files

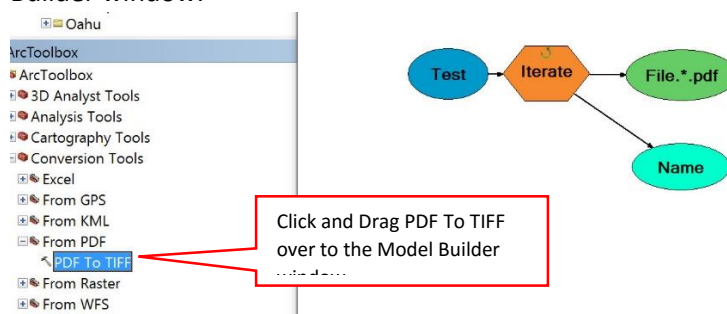


Insert an iterator in the model to loop through the geopdfs. Only one iterator can be used per model. Once you add one, the options will be grayed out.

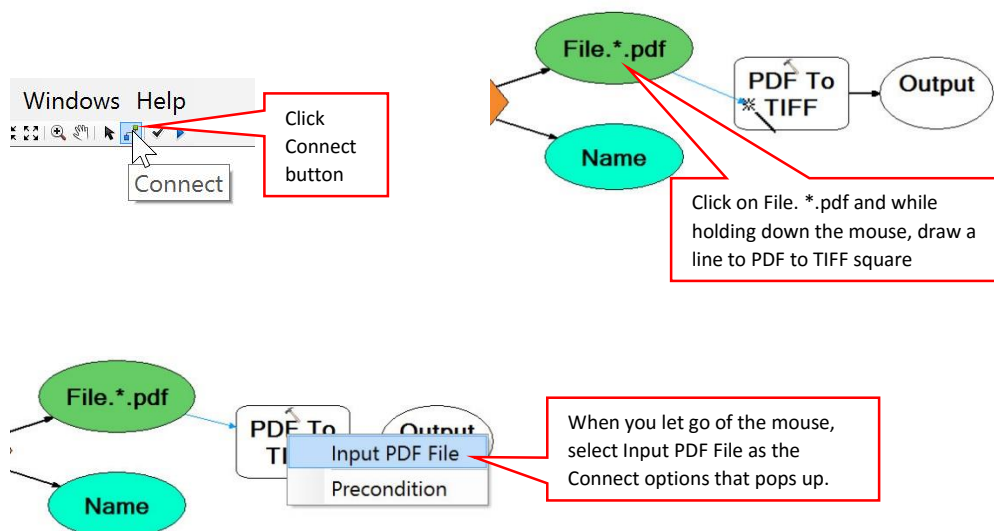
- b. Double click the Iterate hexagon >> Enter input parameters >> OK. The shapes should be colored after you enter input parameters.



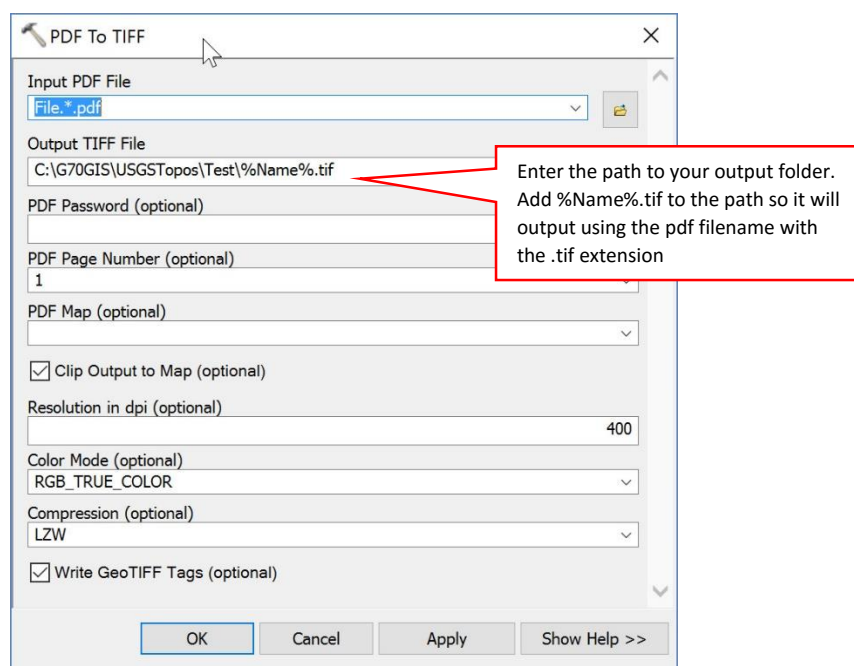
- c. From ArcToolbox >> Conversion Tools >> From PDF >> Drag and drop PDF To TIFF tool to the Model Builder window.



- d. In the Model Builder window: Click the Connect button. With the "magic baton" click the File *.pdf oval and draw a line to PDF To TIFF square >> Select Input PDF.



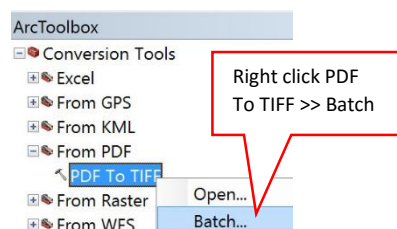
- e. Double click PDF To TIFF square and enter your parameters >> OK



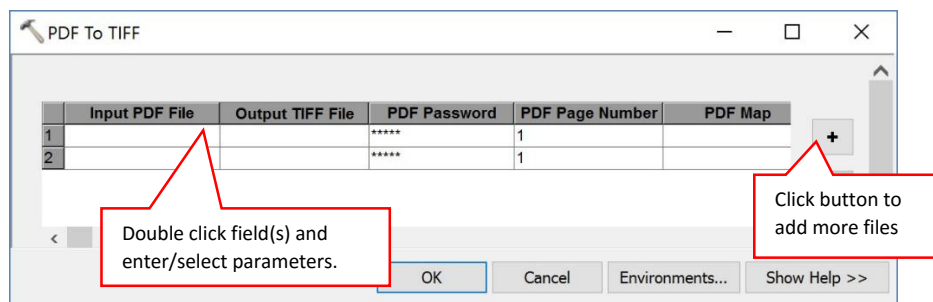
- f. You can validate your model. If no errors, then save your model. It will save it as a tool in your personal Toolbox, which can then be shared and/or used again.

Option 2: PDF To TIFF Batch Grid

1. In ArcToolbox >> Conversion Tools >> PDF >> Right click PDF To TIFF tool >> Batch



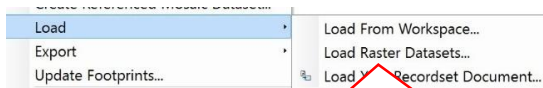
2. In the Batch Grid window: Add the files you want to convert and the parameters.



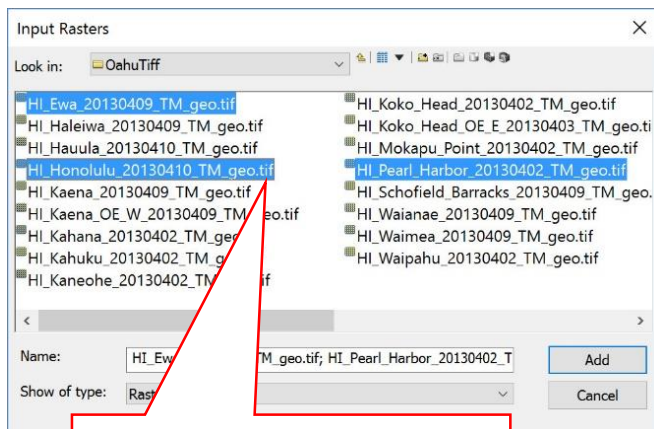
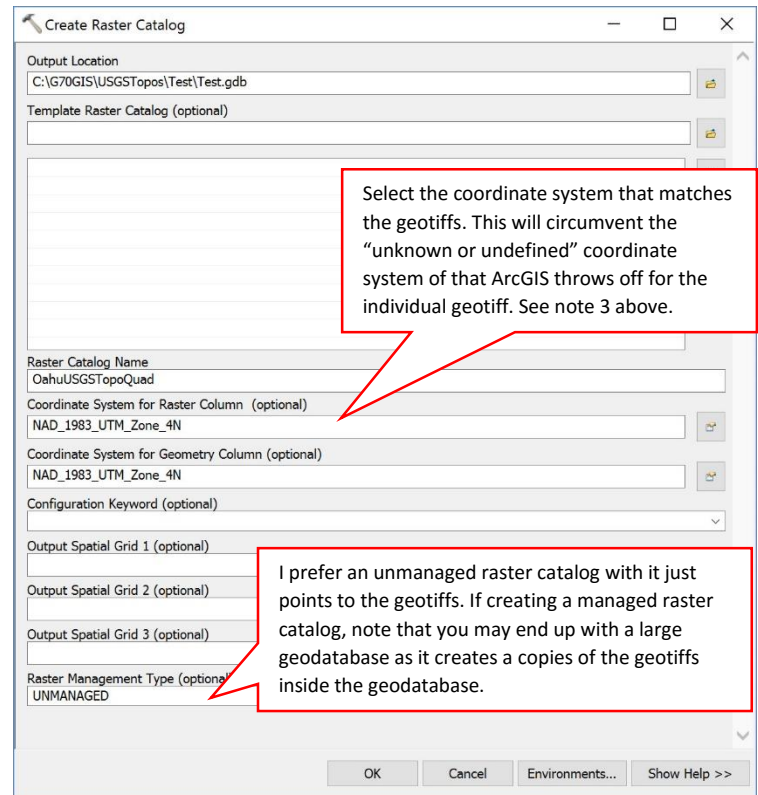
5 Creating Raster Catalog of Geotiffs

To create a seamless set of images from the converted geotiffs, you can either create a raster catalog or a mosaic. I found that creating an unreferenced raster catalog pointing to the geotiffs was sufficient for my purpose. The converted geotiffs should each have some edge overlap that fits nicely together.

1. In an existing or new file geodatabase, create an unreferenced raster catalog. Right click geodatabase >> New >> Raster Catalog.
2. In the Raster Catalog window: enter your parameters.
3. Right click on the raster catalog just created >> Load >> Select a loading option.



Select Load From Workspace if all geotiffs are in one folder and you don't care in what order they are added/displayed. Select Load Raster Datasets if geotiffs are in different folders or if you only want certain geotiffs in the raster catalog or if you want them to be displayed in a certain order.



Here I used Select Load Raster Datasets option and loaded the geotiffs in the order I want them to be added and displayed. Use Ctrl key while selecting to select multiple files for loading.

Name	OBJECTID
HI_Ewa_20130409_TM_geo.tif	1
HI_Pearl_Harbor_20130402_TM_geo.tif	2
HI_Honolulu_20130410_TM_geo.tif	3
HI_Koko_Head_20130402_TM_geo.tif	4
HI_Koko_Head_OE_E_20130403_TM_geo.tif	5
HI_Waiana_20130409_TM_geo.tif	6
HI_Schofield_Barracks_20130409_TM_geo.tif	7
HI_Waipahu_20130402_TM_geo.tif	8
HI_Kanehoe_20130402_TM_geo.tif	9
HI_Mokapu_Point_20130402_TM_geo.tif	10
HI_Kaena_20130409_TM_geo.tif	11
HI_Kaena_OE_W_20130409_TM_geo.tif	12
HI_Haleiwa_20130409_TM_geo.tif	13
HI_Hauula_20130410_TM_geo.tif	14
HI_Kahana_20130402_TM_geo.tif	15
HI_Waimea_20130409_TM_geo.tif	16
HI_Kahuku_20130402_TM_geo.tif	17

This is the order in which the geotiffs will be displayed when using the raster catalog. In ArcMap, you may also add or select another field to use for the display order via Layer Properties >> Display tab.

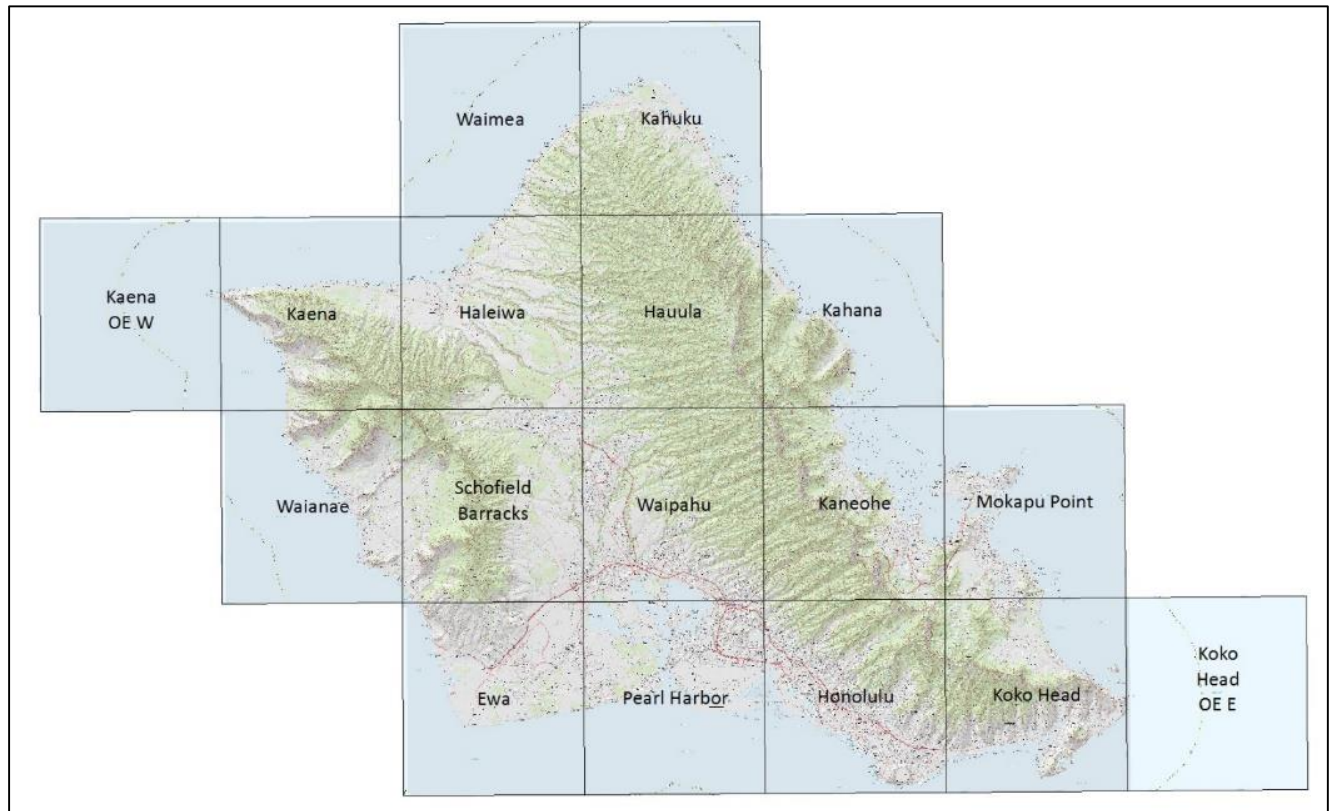


Figure 4: Raster catalog of Oahu topo quads. Geotiffs in raster catalog are displayed from left to right starting from the bottom with Ewa quad

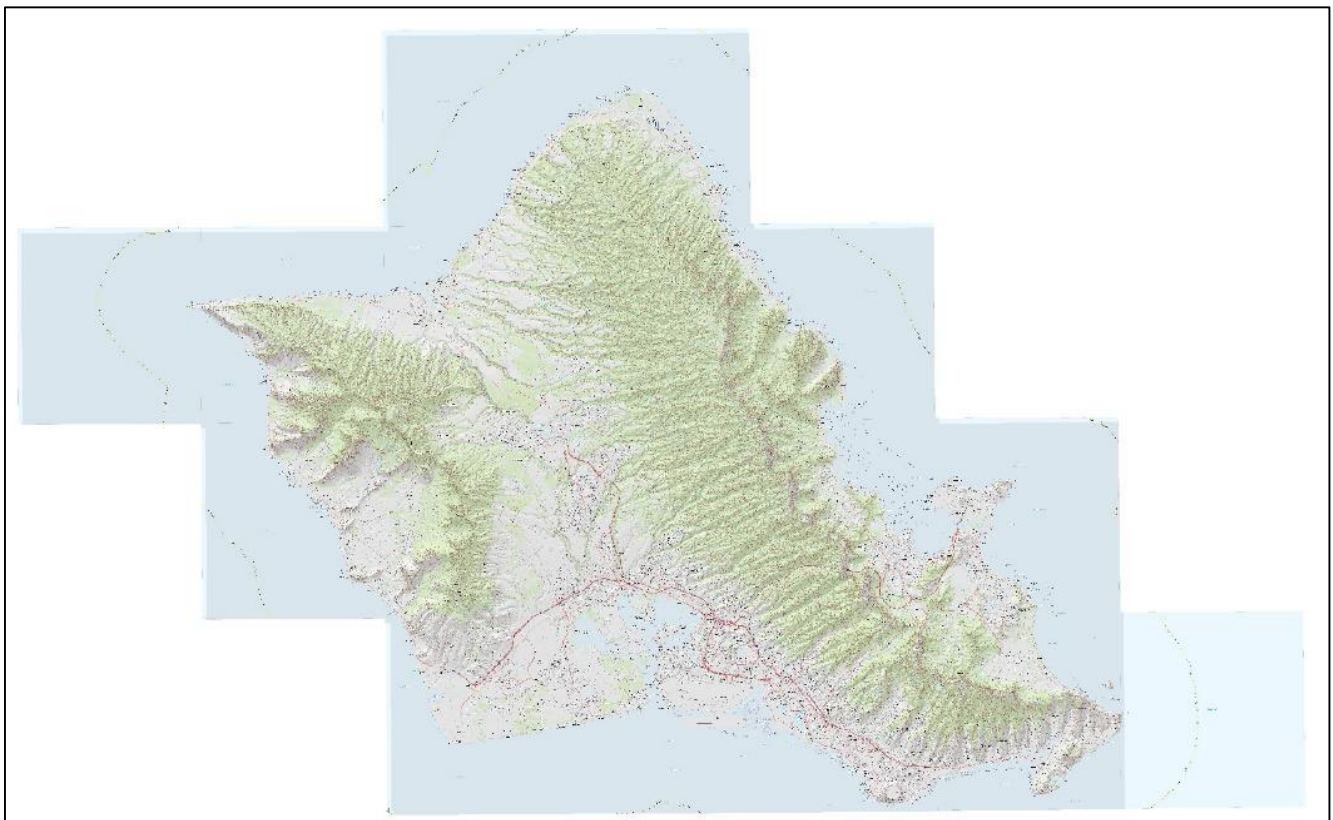


Figure 5: A seamless raster catalog of Oahu topo quads

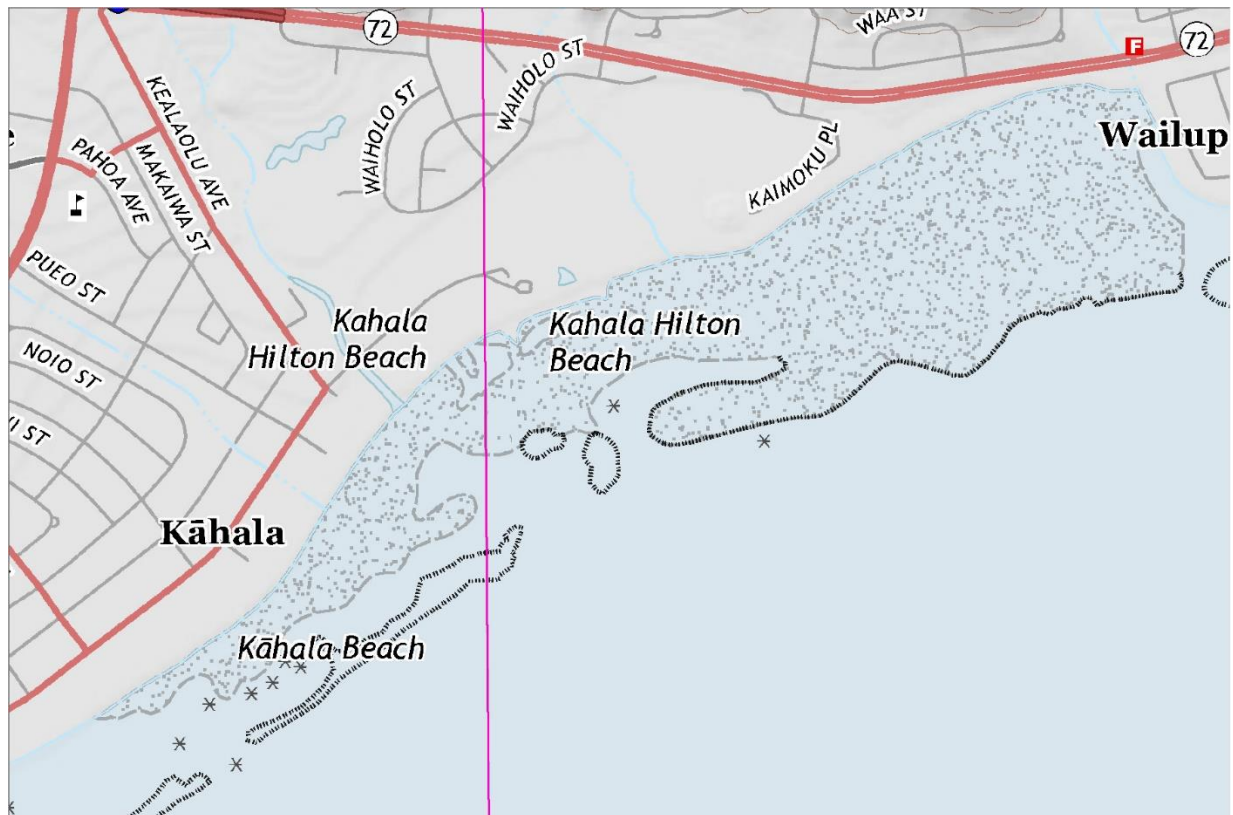


Figure 6: Raster Catalog showing a close up view of two topo quad edges. The USGS 7.5 minute cell boundary is also shown in magenta where the quad edges meet.

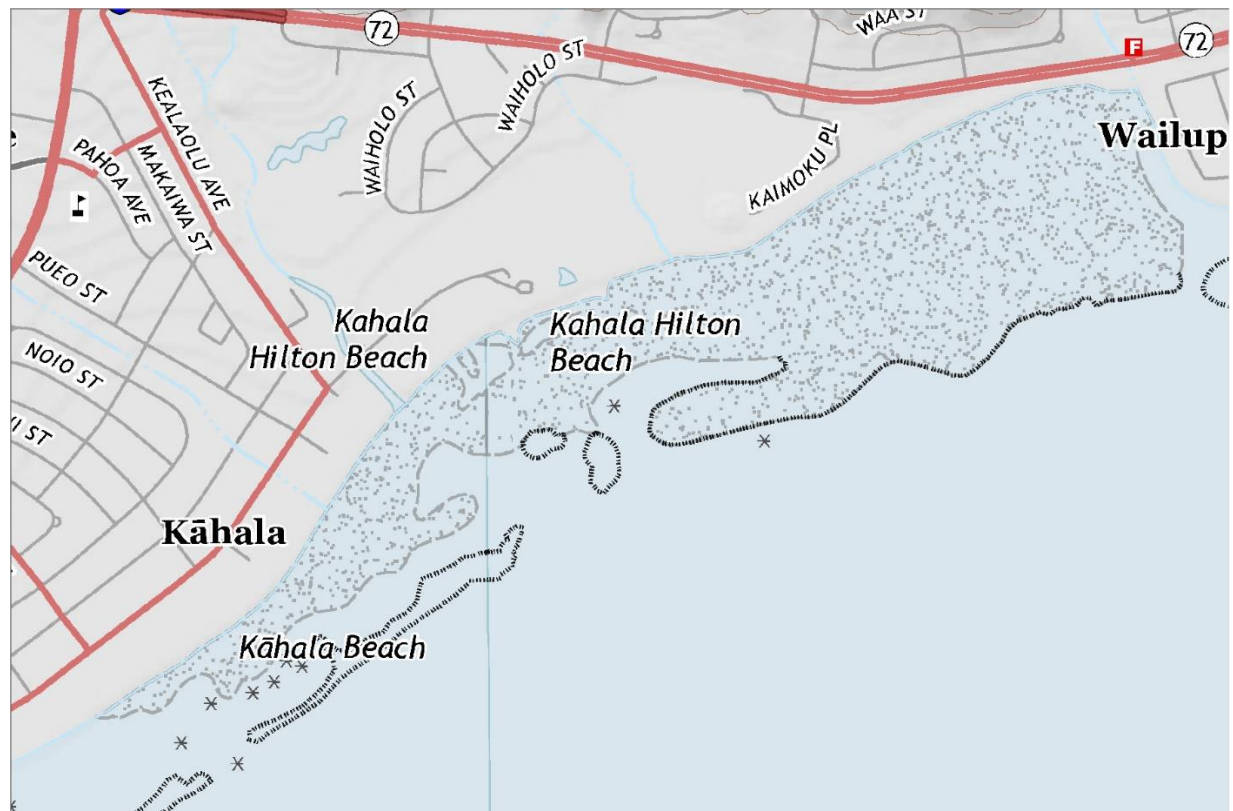


Figure 7: Raster Catalog showing a close up view as Figure 4 but without the magenta 7.5 minute cell boundary. The appearance is seamless.