

# Georeference an image in ArcGIS

Georeferencing is the process of aligning spatial data (layers that are shape files: polygons, points, etc.) to an image file such as an historical map, satellite image, or aerial photograph. This document describes the basic steps for georeferencing an image using ArcGIS.

## Preparation

- Prepare the Software  
Add the Georeferencing toolbar if it is not already showing by selecting:  
View > Toolbars > Georeferencing



- Prepare all the spatial layers
  - Open all spatial layers you will use to georeference the image.
  - Zoom in to the approximate area that is covered by the image to which these layers will be added. This does not have to be exact as it is done just to provide you with an easier workspace.
  - Adjust the color and shape of any points so that they will be visible when displayed on the image.
  - Polygons will be easier to use if you make them "hollow" (hollow is a choice in the list of fill colors for symbols). Also choose a color and width for the line around the shape that can be seen against the image layer.
- Prepare the Image Layer
  - Open the image layer.
  - Rescale the image to fit within the window; select from the Georeferencing tool bar:  
Georeferencing > Fit to Display

## Adding control points

This is the process of matching points on the image layer to corresponding points on the shape layers. From the Georeferencing toolbar select the *Add Control Points* icon



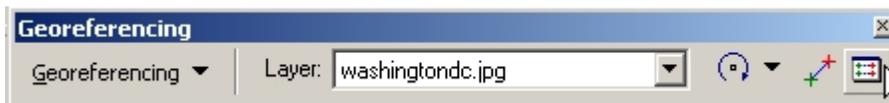
This tool allows you to georeference the image:

- First, using your mouse, left click on a known point on the image. This will place a cross mark on that location
- Next, left click on the matching control point in another layer. This will 'move' the image and better aligning the control points
- repeat this step with each control point

If you would like to input x and y coordinates as an alternative to the method mentioned above, after placing a cross mark on a location right click on it and enter in the coordinates.

**Note:** it is a good idea to zoom in on your image when adding control points for better accuracy.

For every set of control points you create, an entry is created in a table that records the original coordinates, the control point coordinates, and the residual error. Access the table by choosing the *View Link Table* icon from the Georeferencing toolbar



Entries in this table can be deleted one at a time (highlight the entry in the table and click the delete icon) thus making corrections is easy.

## Adjusting the Final Product

Residual error is the measure of the fit between the true locations and the transformed locations of the output control points. If there is a link with a high level of error, consider deleting it by highlighting the point in the link table and clicking the delete icon.

Depending on the number of control points you have, from the Georeferencing table you can perform either a 1st, 2nd, or 3rd order transformation. The transformations compare the coordinates of the source image with the control points creating two least-square-fit equations to translate the image coordinates into map coordinates.

A 1st order transformation shifts the image up, down, right, or left, stretches the image larger or smaller, or rotates the entire image

The 2nd and 3rd order transformations fit higher order polynomial equations to the data, allowing points to be shifted in a non-uniform manner

Most of the time either a 1st or 2nd order will suffice, try all three and choose the one that works best

## **Saving changes**

When you are satisfied with the georeferencing process, three options for saving changes are offered:

- As a text file - you can load the text file when you need to have the image georeferenced again:  
From the Link Table select Save
- As a .aux file - this saves the changes in a file readable by ESRI products  
From the Georeferencing toolbar select Update Georeferencing

As a World File - this creates a new image (either TIFF, ESRI Grid, or ERDAS Imagine) with the coordinates stored. Use this option if you plan on using the image with other software  
From the Georeferencing toolbar select Rectify