

To Georeference an Image

This documents guides you through the basic steps in georeferencing an image in ArcGIS 9.0.

When you georeferencing an image you assign it coordinates so that it can be mapped as a layer in ArcGIS (and other GI related software packages) and combined with other information.

This is usually done in two main ways. First, you have another layer of information (e.g. a roads network for the area of interest with a coordinate system) and you can match your raster image and the layer together. Second, you have a series of control points with their coordinates and you know where on the map they correspond. We will run through the first scenario in this guide.

Step 1: Add the image you want to georeference

If you are scanning the image yourself (for example, an historic map of the area of interest) the more detail you want the higher resolution you need to set the scan. A scan of 300dpi (dots per inch) might be ok for very general detail. However the higher you set your dpi the more processing power and time it will take to use it in ArcGIS.

The file format of the image is also important. TIF, BMP and JPG extensions are the most appropriate for ArcGIS. However if you are scanning the image yourself the JPG may be less precise because of the compression it uses to store the image. If your image is not in one of these three formats, you can use Corel Draw to change it!

Open ArcMap (usually under **Start > Programs > ArcGIS > ArcMap** or some equivalent) and select **an empty map...**

Once the blank ArcMap window is open, click the **add Data**¹ button



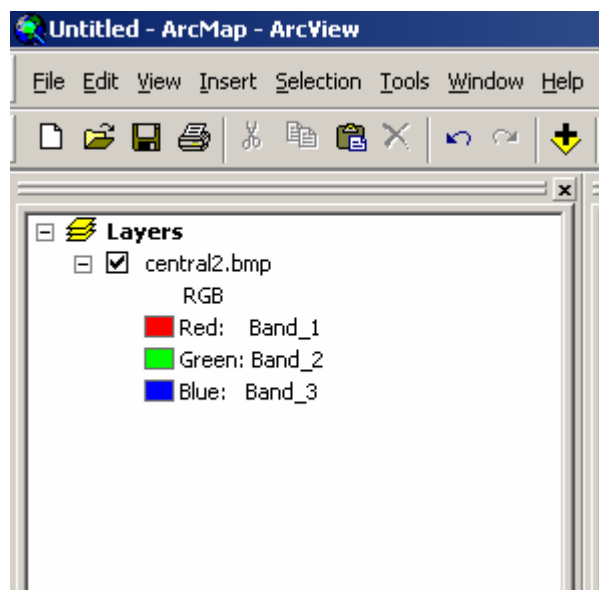
and navigate to the correct storage location on your computer. Add the layer you want to georeference the raster image against. Then add your raster image you want to georeference.

Save your progress so far by selecting **File > Save** and giving your map an appropriate title.

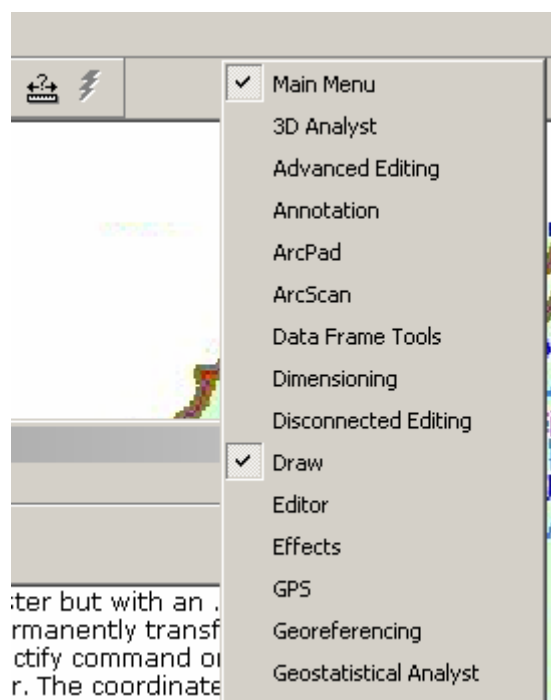
In the table of contents (see image below) the raster image will be present in three different bands (Red, Green and Blue).

¹ Note that if you hover your mouse cursor over the buttons in ArcGIS a title for what each button does will appear.

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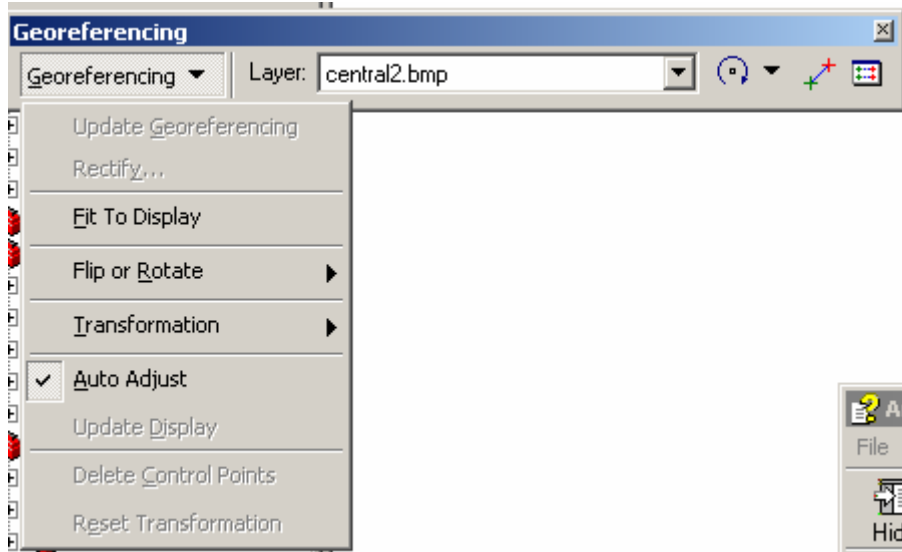
Open the Georeferencing toolbar by clicking on the grey area to the right of the main toolbars at the top of the window. Select **Georeferencing**.




In the Georeferencing toolbar make sure the layer selected is the raster image you want to georeference (see below) and in the georeferencing drop down menu select **Fit to Display**. "This will display the raster dataset in the same area as the target layers. You can also use the Shift and Rotate tools to move the raster dataset as needed. To see all the datasets, you may have to adjust their order in the table of contents."²


² From ArcGIS Help

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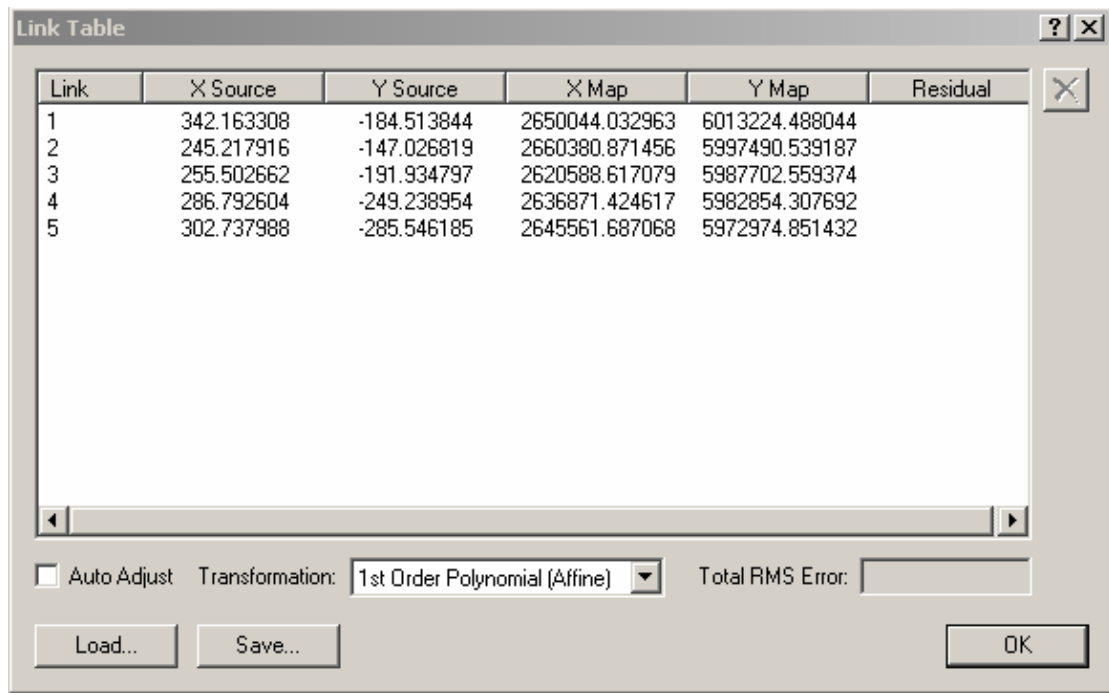


You may have to change the symbology on the vector layer (e.g. roads or a coastline) so you can see through it to the raster image behind it.

Click the **control points** button  to add the control points. Click on your raster image on one of the points that are common to both layers of information. Then click the corresponding point on your vector layer (e.g. roads). The image will automatically realign itself. Repeat this process for the remainder of your control points. Remember to click on the raster image first otherwise your georeferencing will be incorrect.

If you insert a control point incorrectly you can click the **Link Table** button  and select the relevant control point in the table and press the **Delete** button on your keyboard.

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Link	X Source	Y Source	X Map	Y Map	Residual
1	342.163308	-184.513844	2650044.032963	6013224.488044	
2	245.217916	-147.026819	2660380.871456	5997490.539187	
3	255.502662	-191.934797	2620588.617079	5987702.559374	
4	286.792604	-249.238954	2636871.424617	5982854.307692	
5	302.737988	-285.546185	2645561.687068	5972974.851432	

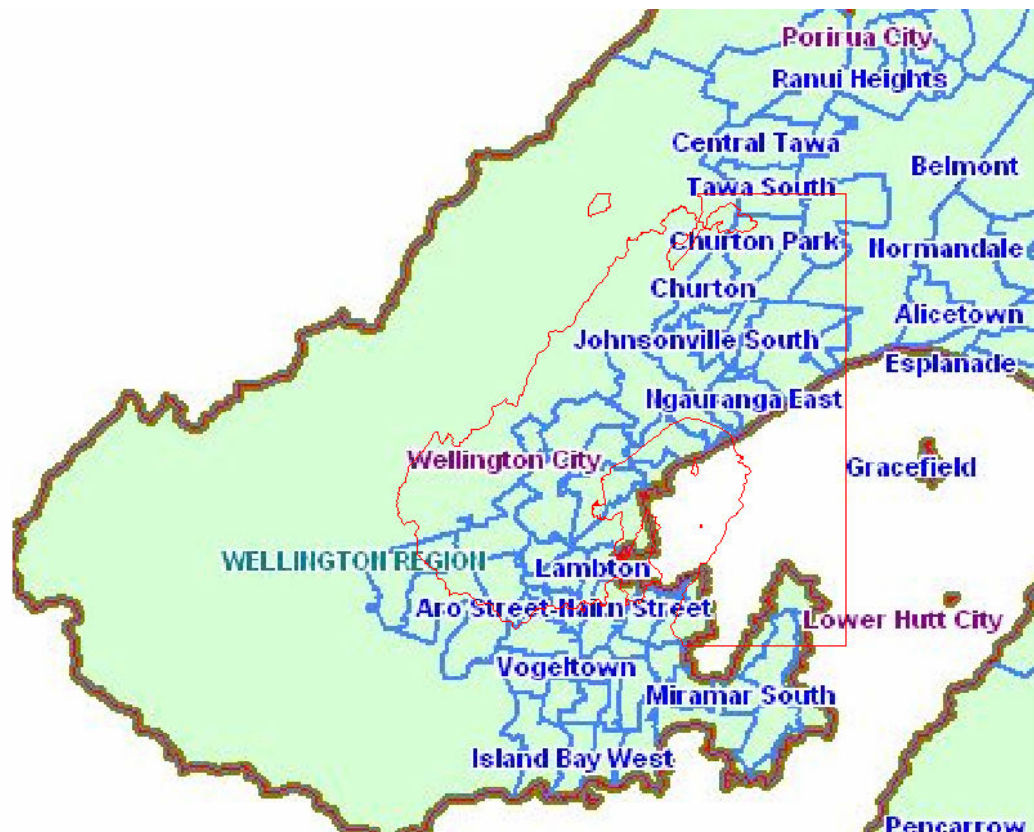
Auto Adjust Transformation: 1st Order Polynomial (Affine) Total RMS Error:

Load... Save... OK

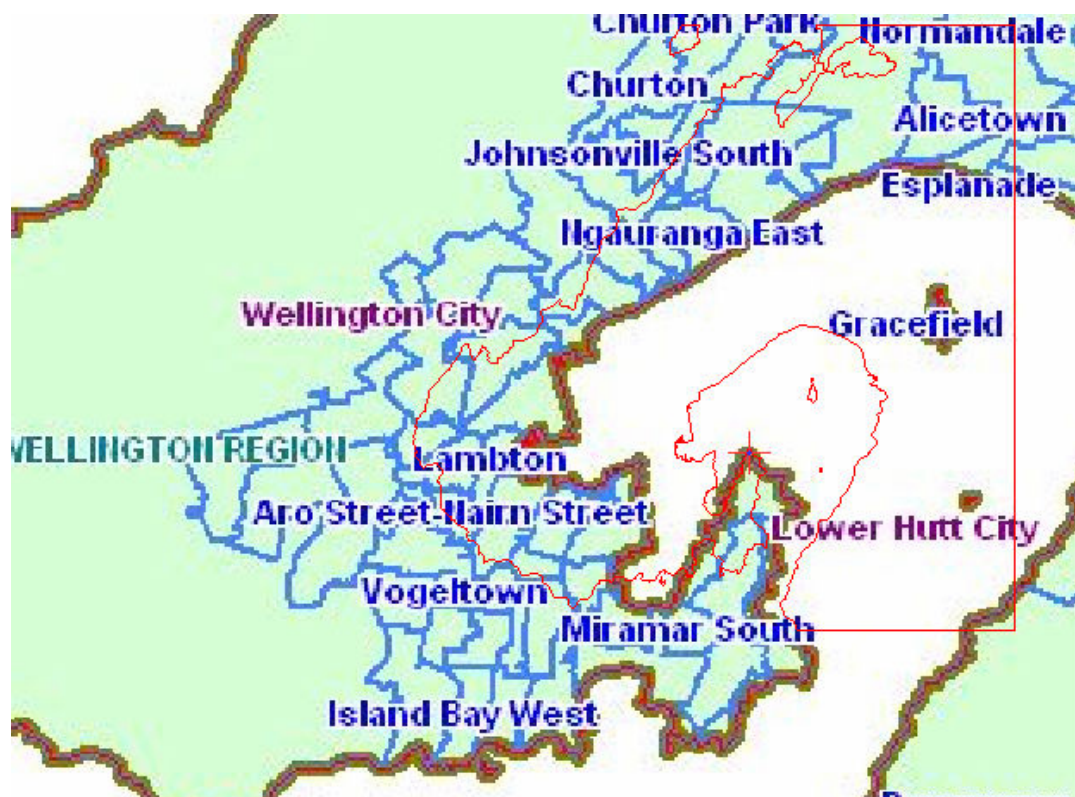
You will need to add enough links between the two layers for each of the types of transformations in the drop down menu. For the 1st order polynomial you need a minimum of 3 links. The help system in ArcGIS can give you further guidance in this. There will be an error associated with each of the points. Provided you are happy with these values, you can permanently georeference the image by selecting **georeferencing > rectify**.

The next few images are based on an unreferenced bmp raster map of Wellington and the coastline vector layer. If you want to practise this technique on "practise" data, find the coastal area of Wellington in the gis_data folder and find a map of Wellington region on the internet.

Georeferencing an Image



No control points added. Just the two layers displayed.

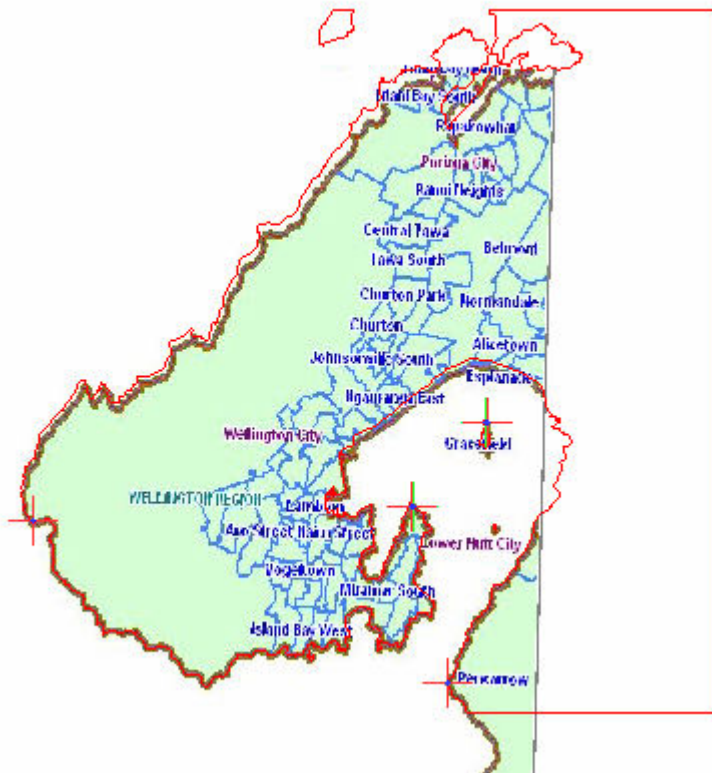


First control point added. Raster image has realigned itself.

Georeferencing an Image



Second control point added.



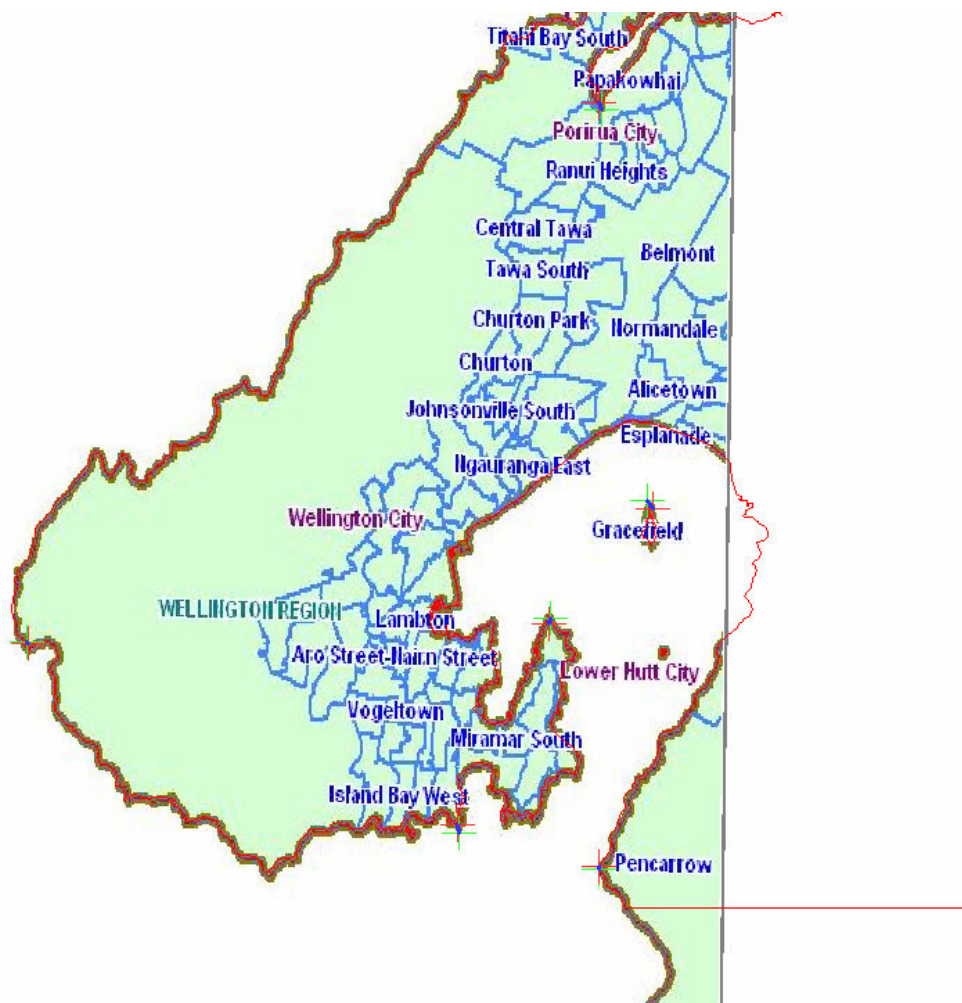
Four control points added (signified by the cross hairs in the image above).

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Five control points added. Zoomed in to better find the matching locations on the raster and vector layers. The differences between the red and green cross hairs is the error in the georeferencing. The image and the vector layers are unlikely to match exactly.

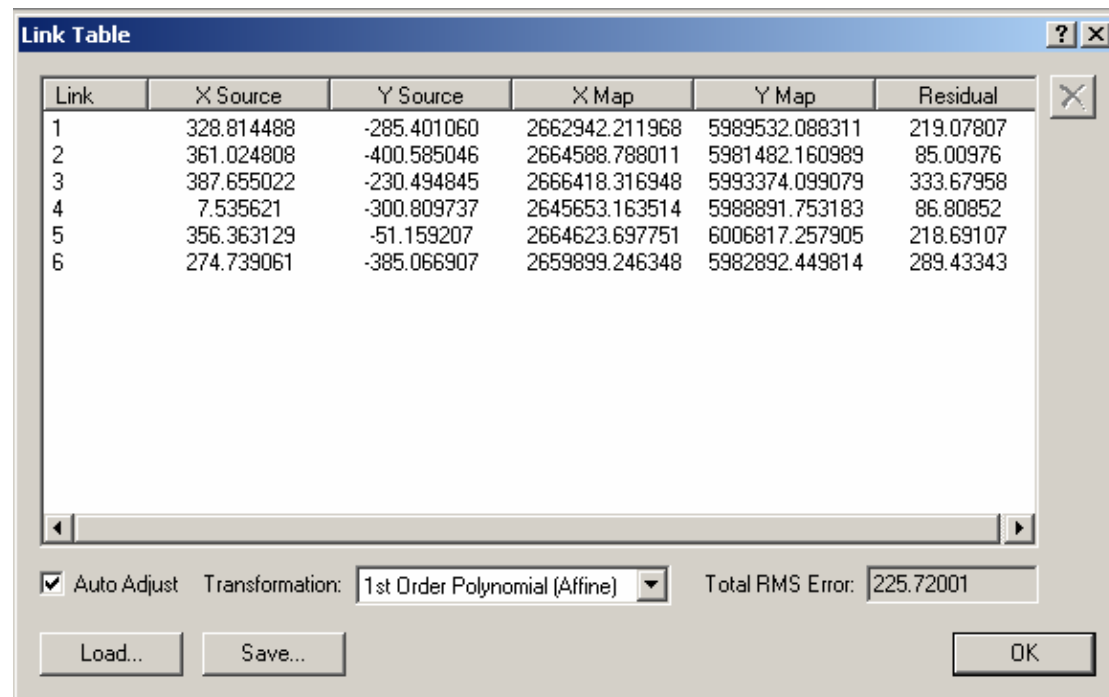
The more control points you add, may not drastically reduce the errors in the link table after a certain number (there may be incompatibilities with the data).



Georeferencing an Image

The raster image has been realigned and elongated or squashed where required to fit as closely with the vector (coastline) layer as possible.

The link table now looks like the image below.



Link	X Source	Y Source	X Map	Y Map	Residual
1	328.814488	-285.401060	2662942.211968	5989532.088311	219.07807
2	361.024808	-400.585046	2664588.788011	5981482.160989	85.00976
3	387.655022	-230.494845	2666418.316948	5993374.099079	333.67958
4	7.535621	-300.809737	2645653.163514	5988891.753183	86.80852
5	356.363129	-51.159207	2664623.697751	6006817.257905	218.69107
6	274.739061	-385.066907	2659899.246348	5982892.449814	289.43343

Auto Adjust Transformation: 1st Order Polynomial (Affine) Total RMS Error: 225.72001

Load... Save... OK

The total RMS error is 225.72 and the individual residuals vary between 333.68 and 85.01. (This is where knowing your statistics comes in about what are acceptable errors or not.)

This handout was created by Mairéad de Róiste (mairiad.deroiste@vuw.ac.nz) in the School of Geography, Environment and Earth Sciences in Victoria University of Wellington. If you notice any inaccuracies in the methods used, or steps you think need clarification, please contact me and let me know!