

GIS and Remote Sensing (ACNA6003)

Lecture 5: Data Creation & Manipulation

Aim

In this session, students will gain experience of creating / generating their own geospatial vector layers. During the session, students will:

- Consider the requirements of GIS datasets for field surveying
- Learn how to create new vector layers in QGIS, including creation of:
 - Point layer dataset
 - Polyline layer dataset
 - Polygon layer dataset
- Be introduced to topological errors
- Trial snapping for polygon digitisation
- Be introduced to geoprocessing tools

1. File creation

While some digital GIS layers already exist, some data will need to be created. This is especially true in fieldwork situations where new data is being collected in the field. The creation of a new GIS layer will require the generation of a blank GIS vector dataset that will subsequently be populated (with the exception of CSV data where points are already present, and automatically populated, through X and Y attributes).

There are 3 types of vector data that is commonly created in GIS; points, polylines, and polygons.

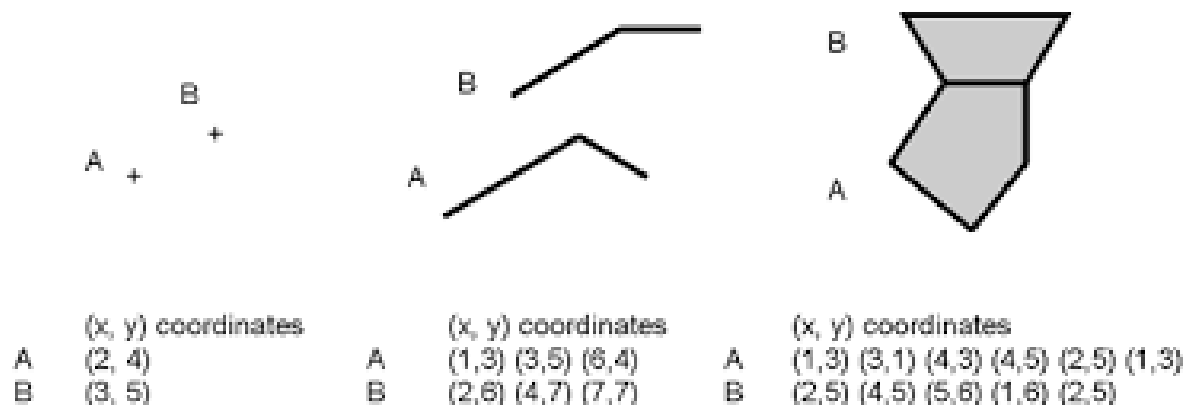


Figure 1: Illustrative examples of GIS vector data types, point (left), polyline (middle), and polygon (right)

The following are directions on how to digitise vector datasets:

Reference Base Layer

In order to facilitate the digitisation of new vector features, a reference geospatial dataset is required.

Digitisation is the process of converting geographic data from maps or images into digital form commonly represented as vector data.

Using the Quick Map Service plugin in QGIS, students will load a base map layer which contains aerial imagery, suitable as a reference for inferring surface features.

If the Quick Map Service plugin is not already installed, use the following instructions:

1. Select the 'Plugin' drop-down menu from the top of the QGIS GUI.
2. Select the first option in the drop-down, 'Manage and Install Plugins..'
3. Search for 'QuickMapServices' and from the filtered plugins list, select the 'QuickMapServices' plugin
4. Click on the 'Install' button at the bottom right of the 'Plugins' window.

Upon installation, a new toolbar will be added to the top of the GUI, and a new toolbox panel will be added to right side of the GUI, typically the bottom right (Figure 2).

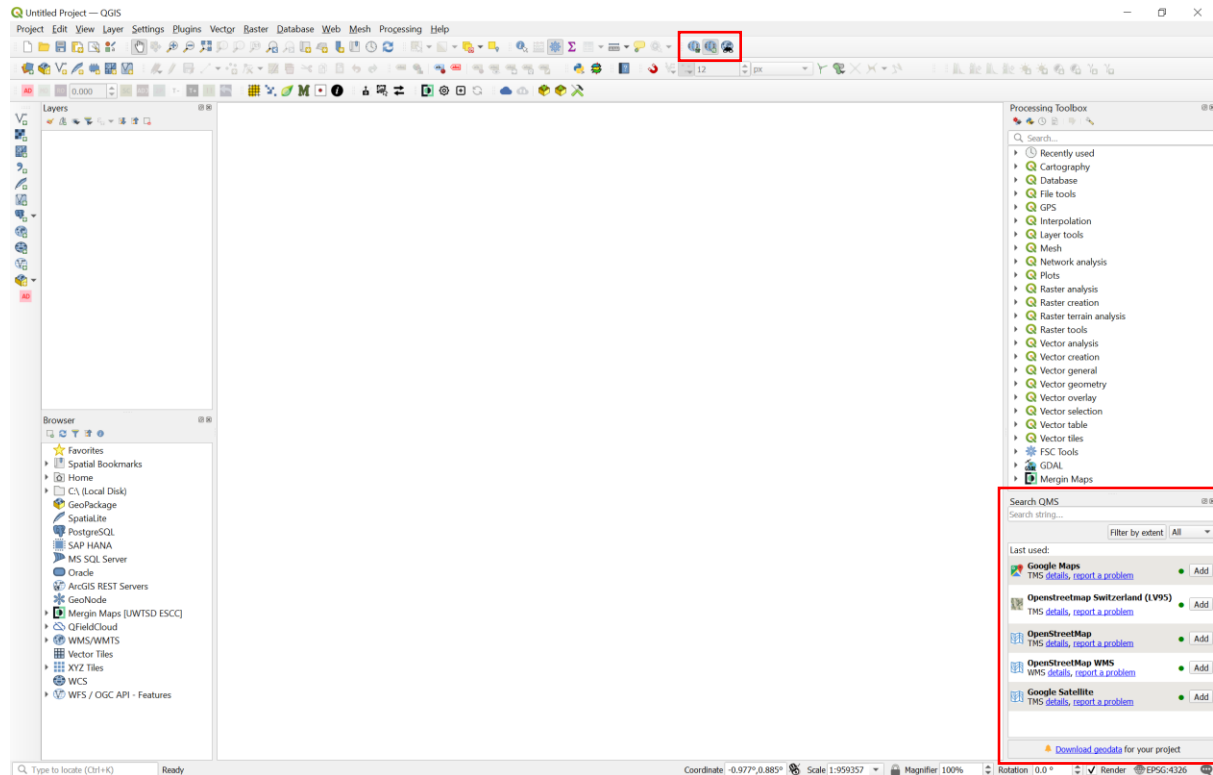


Figure 2: Quick Map Service plugin tools in QGIS GUI

Once these tools are accessible:

1. If the Quick Map Service panel is not open, it can be accessed through the search function (middle icon) on the Quick Map Services toolbar icons:

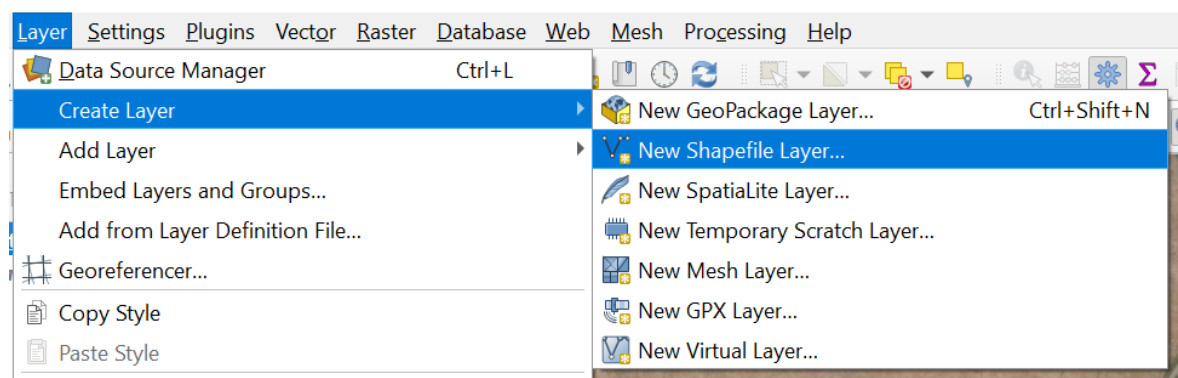


2. At the top of the 'Search QMS' panel, search for a base map containing aerial imagery:
 - a. Bing Aerial
 - b. Google Satellite
 - c. Google Hybrid
3. Scroll through the filtered options, and click the 'Add' button next to the preferred layer
4. Note, the new layer will be added to the Map Viewer, and the layer name added to the Layers panel list, always at the end of the list.

Data creation: Points

Using an accurately georeferenced base layer, students will digitise the location of point-based features in the map viewer. Google Hybrid is a good option, though Bing Aerial is a good alternative.

1. Using the Quick Map Server Plugin, add an aerial basemap (instructions above)
2. Select 'Layer' drop down
3. Select 'Create Layer', and 'New Shapefile layer'



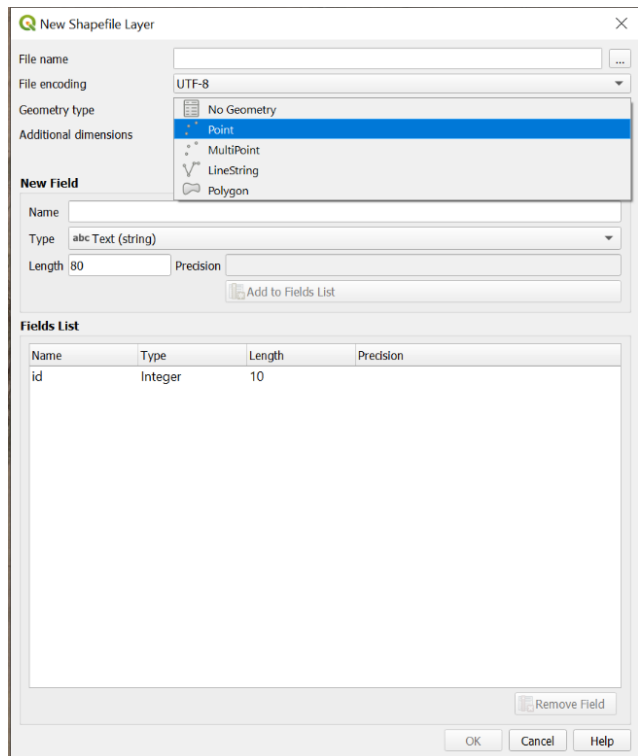
4. In the 'New Shapefile Layer' window, specify the file name and location (three

dot button next to 'Filename' text box)



- a. Save the file in a sensible location

- b. Use a filename that would aid the interpretation of the contents at a later date e.g. 'ExamplePointCreation'
5. Select the 'Geometry type' as 'Point'
6. Select your Co-ordinate reference system ('CRS')
 - a. This can be WGS84 as default, or a CRS of your choice, e.g. EPSG:27700 (British National Grid)
7. Under the 'New Field' heading, add fields to the attribute table as desired e.g. a new string field called 'Comments' with the Type as 'Text (string)' and a suitable length e.g. 100 characters.
8. To add the new field, click the 'Add to Fields List' button – the new field will be added to the 'Field List' box.
9. Once all fields have been added, click 'OK'. Note, additional fields can be added later if required.



The new blank point dataset will be added to the 'Layers' panel in the GUI.

As an example activity, navigate to Mynydd y Gwair wind farm, south of Ammanford. Using the created blank point layer, digitise the wind turbines visible in the aerial imagery. To navigate to the wind farm, use the co-ordinates "-438844,6755508" in the co-ordinate box (assuming map CRS is EPSG:3857).



To digitise new points in the blank layer:

1. Ensure the layer is selected (highlighted in the Layers window) – click on the layer name if not.
2. Toggle the 'Toggle editing' icon (yellow pencil) – this allows edits to be made to a file – See Figure 3 below.
3. Select the 'Add Point Feature' icon (three green circles and a star symbol)
4. Click on the map where you want to add a new point feature

5. Add the additional attribute information (if you have added field to the attribute table) – See Figure 4 example below.
6. Click 'OK'
7. To complete the edits, click the yellow pencil icon again to close editing mode. If there are unsaved edits, a pop-up window ('Stop Editing') will emerge prompting the user to 'Save' the edits.

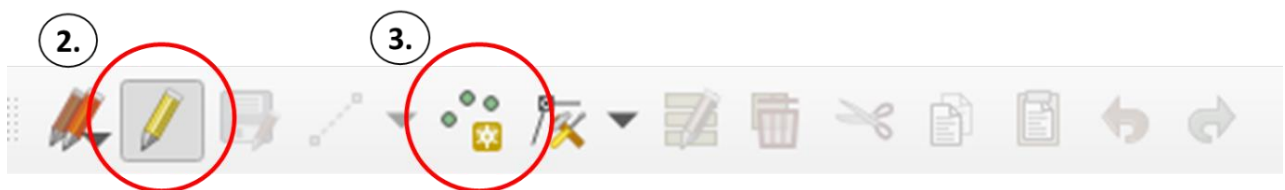
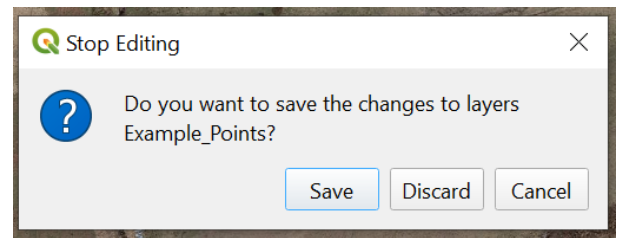


Figure 3: The Digitising toolbar - with commands 2 and 3 circled

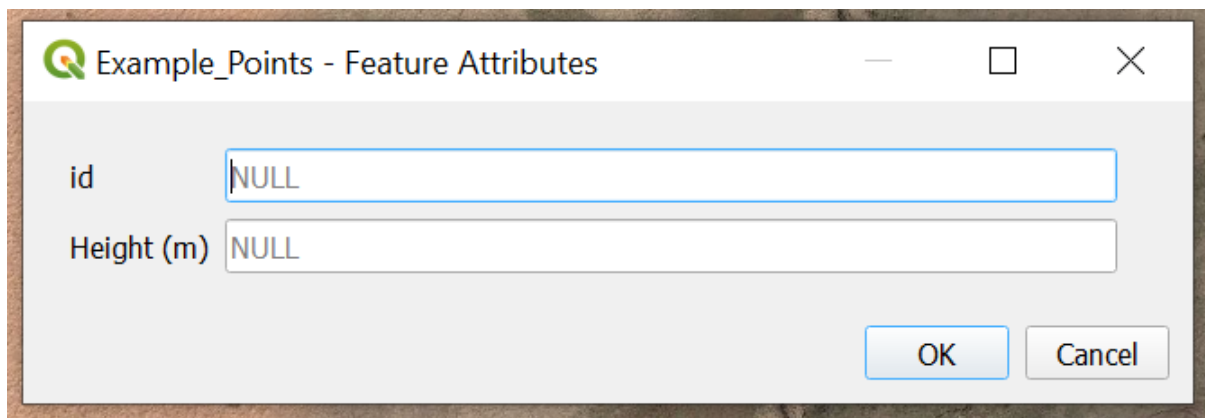


Figure 4: Example attribute generation

Using the example above, capture the locations of the wind turbines, and consider adding additional attributes like 'Height' (recommended in decimal format), entering pretend values.

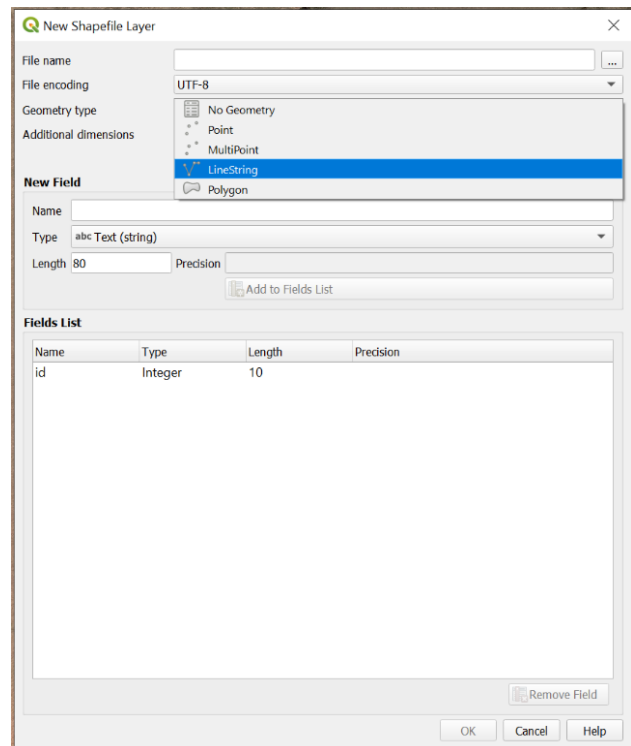
Data creation: Polylines

Repeat the above process for polylines instead of points, digitising linear features such as:

- Roads,
- Rivers,
- Railway lines
- Footpaths

When setting the parameters for the ‘New Shapefile Layer’, specify the ‘LineString’ option under the ‘Geometry type’ drop-down menu (Figure 5).

Figure 5: LineString geometry type selection



To begin digitising lines:

1. Ensure the layer is selected (highlighted in the Layers window) – click on the layer name if not.
2. Toggle the ‘Toggle editing’ icon (yellow pencil) – this allows edits to be made to a file – See Figure 3 below.
3. Select the ‘Add Line Feature’ icon (green line with square vertices and a yellow star symbol)
4. Click on the map where you want to add a new point feature
5. Add the additional attribute information (if you have added field to the attribute table) – See Figure 4 example below.
6. Click ‘OK’
7. To complete the edits, click the yellow pencil icon again to close editing mode. If there are unsaved edits, a pop-up window (‘Stop Editing’) will emerge prompting the user to ‘Save’ the edits.



Note, while point digitisation only required a single click to specify the X,Y co-ordinates, polylines will require multiple points for each new feature. To do this, when digitising a feature:

1. Click the location of the start co-ordinate
2. Move the mouse to the point where the linear feature changes direction / orientation (note a dashed red line will connect the first point and the cursor)
3. Click again, and a new vertex will be added in the line
4. Repeat the above step until the full feature has been digitised
5. To complete the line and end the digitisation of the line, right click on the last location.

Data creation: Polygons

Polygons are enclosed areas. While the perimeter of the digitised shapes are still composed of lines with vertices (points that indicate a change in direction), the last and first vertex are the same location, thereby closing the loop and creating an enclosed shape. A polygon can have as few as 3 vertices, and form a triangle, or thousands, depending on the complexity of the perimeter of the shape being digitised.

Repeat the process of creating a new, blank, Shapefile layer, and set the Geometry Type to 'Polygon' (Figure 6).

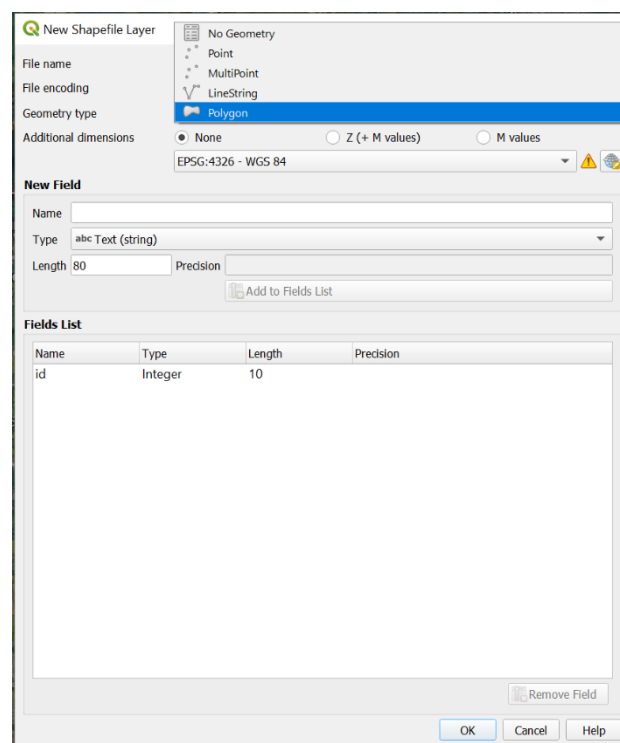


Figure 6: Polygon geometry type selection

The 'Add Polygon Feature' icon in the Digitizing toolbar contains a green blob and a yellow star symbol:



When digitising features, note that the area of the shape being digitised is indicated through a semi-transparent red within the perimeter, using the cursor location as a guide (see an example in Figure 7) By right-clicking on the last location, the user specifies the last vertex and closes the digitisation for that feature.



Figure 7: Example semi-transparent highlighting to inform the user of the expected area of the digitised polygon shape

Practice digitising suitable area features, such as fields, woodland blocks, and buildings.

Snapping tool

After digitising a number of neighbouring polygon features (adjoining fields perhaps), users will note that it is very tricky to match the boundaries exactly, specifically down to the precision of the exact vertices used in the neighbouring boundary. This will either result in an overlap, or a gap between polygon shapes (Figure 8).

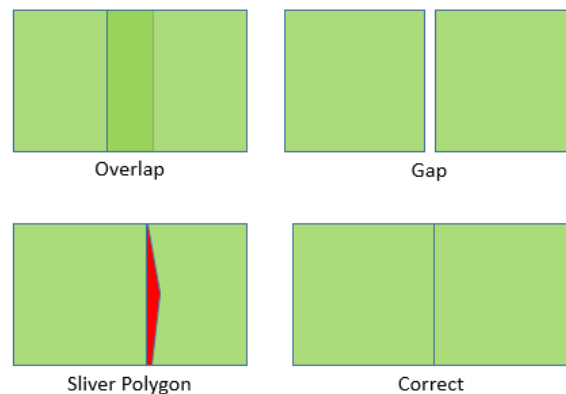


Figure 8: Illustration of potential topology issues with neighbouring polygons

This has implications for analysis of this datasets under certain circumstances, such as total area coverage. Gaps or overlaps will lead to under or over estimates respectively. Network analysis will be inaccurate where gaps are assumed to be valid channels. As a result, there will be instances where users wish to utilise the same boundary vertices for neighbouring features; one shared boundary.

This is nearly impossible to do free-hand, as the precision of the digitisation is very high, and therefore two points that seem co-located can actually be several units (metres, centimetres, millimetres etc.) apart even when the gap is not visibly apparent to the user. However, there is a tool within QGIS that allows new vertices to be ‘snapped’ to the nearest existing vertex in a dataset, based on a buffer ‘snapping tolerance’ distance, defined by the user (Figure 9).

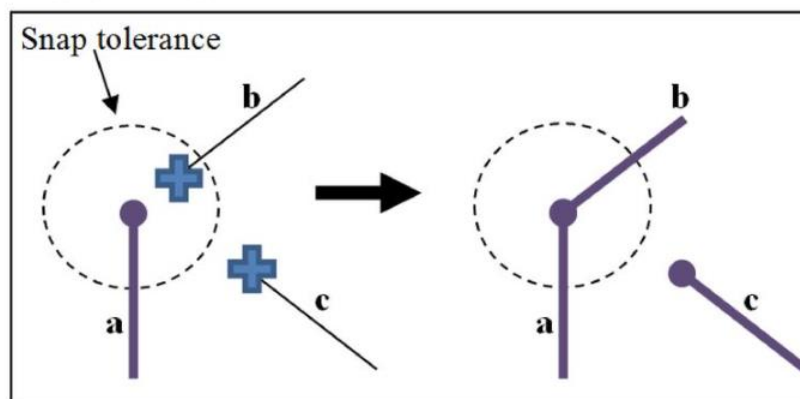
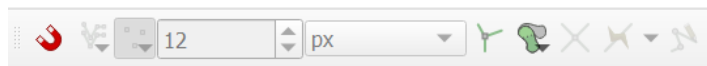


Figure 9: Illustration of the snapping tolerance in action, linking the end vertex on line A to the end of line B, which is within the snapping tolerance distance (dotted line), as opposed to line C which is outside the snapping tolerance

The user can select to enable snapping to digitisation as follows:

First enable the Snapping Toolbar:

1. Right click on a grey open space in the toolbar at the top of QGIS
2. Under the lower 'Toolbars' menu, toggle on the 'Snapping Toolbar' by checking the empty box next to the function name (if this is already checked, the toolbar is already open at the top of the QGIS GUI).
3. The new toolbar will emerge in the toolbar section at the top of the GUI (the magnet symbol makes it distinctive):



The layer the user is digitising (creating new shapes), must be highlighted in the layers panel, and editing must be toggled on (yellow pencil), and 'Add Polygon Feature' enabled, as with the previous exercise above.



To begin snapping, click the red magnet icon () on the Snapping Toolbar and begin digitising new polygons.

The user can specify (see Figure below):

1. Which layers the snapping relates to (single layer, or all layers)
2. Which geometries to snap to (vertices, segments, etc.)
3. The tolerance (threshold distance) to snap to, in either pixels or map units (metres or degrees)
4. Whether to avoid polygon overlap (automatically matches edges and vertices when digitising overlapping polygons).

