Contents

Introduction

This exercise will show you:

1. How to create a campus map in ArcGIS, using vector map data from Digimap.

2. How to display your campus map in a web page that also displays Ordnance Survey OpenData (streamed from a Digimap Web Mapping Service).

The end result will be a web page that looks similar to this image:

The guidance notes and screenshots use ESRI ArcGIS 10 to create the map and OpenLayers to display the map in a web page.

Note: we will not actually publish maps to a website but that could easily be done given access to a suitable web server.

What steps are involved?

Here is an overview of the process:

Create your campus map

1. Open the Glasgow Uni File Geodatabase in ArcMap containing VectorMap District data
2. Set up a basic representation for the map data – change the colours and symbols, add labels etc

Improve your campus map:

3. Display the Digimap OpenStream web mapping service as a backdrop in ArcGIS
4. Delete any buildings or features you wish to improve from the Vector Map District data
5. Digitise new buildings, using Streetview data from OpenStream as a guide

Export

6. **Export the campus map** from ArcMap as a PNG image, with World File

Display

7. **Display campus map** - edit example HTML file to display campus map in webpage using OpenLayers

What is OpenStream?

OpenStream is a web mapping service, provided by Digimap. It allows **registered** users to stream maps to their GIS software or onto a webpage, without downloading and storing the map data.

5 different maps are provided, GB Overview being the least detailed and Streetview the most detailed (1:10000 scale). These maps are available to download from the Digimap Ordnance Survey Collection, or OS OpenData website[1]:

- GB Overview
- Miniscale
- 1:250000 Colour Raster
- VectorMap District Raster
- OS Streetview

What is Open Layers?

Note that the HTML files are using something called OpenLayers to display our OpenStream data and your map image. OpenLayers[2] is open source Javascript and is a simple way to display maps in webpages

Before you start

1. You will need to register with OpenStream and note your API key. Register at this link and copy and paste the API key to a text editor: http://openstream.edina.ac.uk/registration/
2. You need access to the **Glasgow_overview.gdb Geodatabase**. This is in the **Data** folder provided with this guide.
3. Check that OpenStream and OpenLayers are working. Double-click this file in the **HTML files\Ex 1 folder: 1_OpenStream_orig.html in the Data.html.**

It should load in an internet browser and display a map with some zoom controls. If it does not, right-click the file and select **Open with…Firefox,** or any internet browser you have loaded.

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[1] http://www.ordnancesurvey.co.uk/oswebsite/products/os-opendata.html

[2] http://openlayers.org/

Create your campus map

1. Load the basemap data into ArcMap

We will work with a file geodatabase, **Glasgow_overview.gdb**.

This geodatabase has been prepared for you. It contains **Vector Map District (VMD)** data, downloaded from Digimap, clipped to the Glasgow city centre area. VMD is vector data which you can style any way you want and over which you can overlay other data.
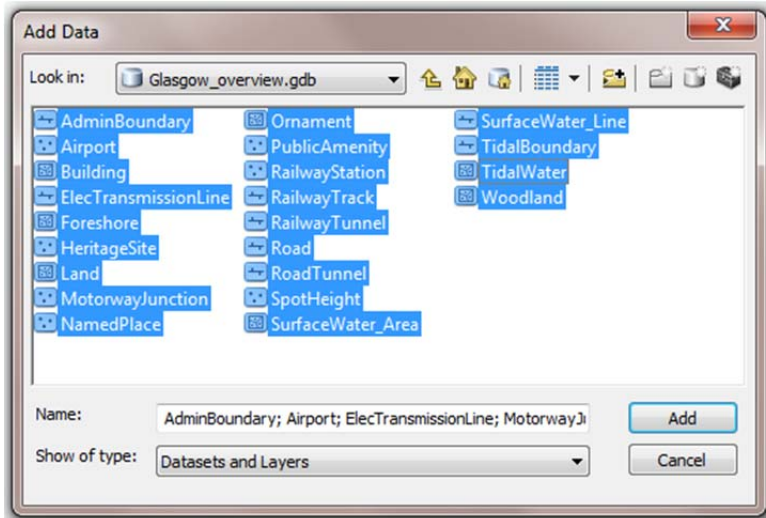
1) Open **ArcMap** with a new, blank map.

2) Click **Add Data** from the toolbar at the top of ArcMap.

3) Navigate to **Glasgow_overview.gdb**. You may need to connect to the folder containing the data by using the **Connect to Folder** button.

4) Double click Glasgow_overview.gdb.

5) **Select all the Layers** in the Geodatabase. Click **Add**.

6) **Save as an ArcMap project** (MXD file), with an appropriate name …File → Save As...

7) **Right-click** on the **University_buildings** layer in the Table of Contents panel of ArcMap, then **Zoom to layer**.

8) In the Table of Contents on the left, click and drag on the **Land** layer, and move it to the bottom of the list. If you have problems moving it, make sure you have selected **List by Drawing Order** at the top of the Table of Contents.

2. Set up Symbology and Labels of Layers

The next steps will show you how to style your map, by changing the colours and symbols of the map layers.

We want to create a campus map that will be easy for people to understand. To achieve this it is important that people can distinguish between different types of map features and that important features such as roads or key buildings stand out.

The image below shows a campus map that was created for this exercise – the university buildings stand out and the roads are labelled.

1) Scale – your campus map is going to be exported from ArcMap at a scale of 1:5000. You should style your map at this scale, to give you confidence that the styles you apply will look sensible at this scale.
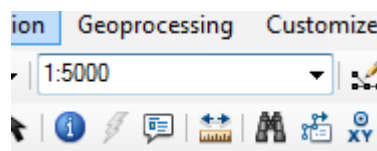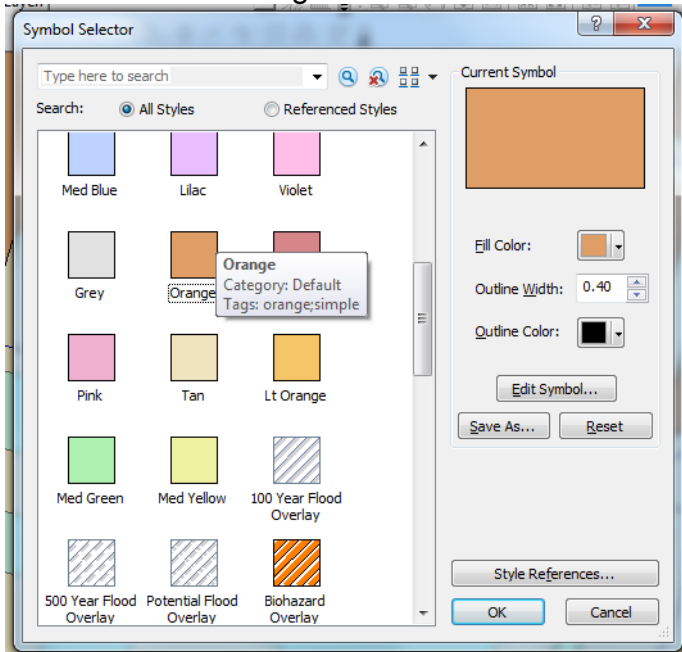

2) ArcMap loads vector map data in random colours. To change layer colours, click on the symbol below a layer name. This will bring up the **Symbol Selector window**. Change the colours of the following layers, as specified:

a. **Buildings** – orange

b. SurfaceWater_Line, SurfaceWater_Area, TidalWater and TidalBoundary – blue fill
c. **Woodland** – green

3) Multiple Category Features

In the attribute data that is provided with the vector map data, there are multiple categories of **Road,** for example A Road, B Road etc. The attribute field CLASSIFICA contains a category for each road.
We can apply different colours to each road category. To have different colours of one type of symbol for layers with multiple categories, complete the following steps for the **Road** layer:
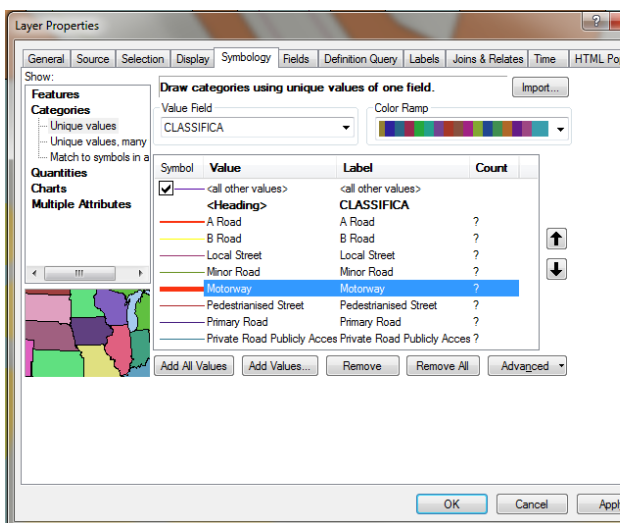
1) Right-click on **Road** → Properties.
2) Click on the **Symbology** tab.
3) **Categories** → Select **Unique** values.
4) Change the Value Field drop-down menu item to **CLASSIFICA.**
5) Click Add All Values.
6) Change the colour and thickness of different Road types by double clicking on the name and selecting a symbol colour and width.
7) Click **Apply.**
8) Click **OK.**

4) Using the steps in 3, change the Road lines – select any colours and thicknesses that make sense to you:

5) Follow the steps in 3 to change the **Public Amenities** layer - this time select a **Color Ramp.** Check that the Color Ramp results in each amenity having a unique colour. You can also choose different symbols for the different types of amenity by double clicking on the name and selecting a symbol from the Symbol Selector.

6) Labelling features in the map. It is often necessary to label features for context:

   a. **Named Place** layer – Go to Layer Properties → Labels and tick "Label features in this layer".

   b. **Roads** layer – repeat the above steps so that Road names are displayed (e.g. Byres Road)

   c. Try and set a halo behind the text to make it stand out. In the Symbology tab, click Symbol… →Edit Symbol →Mask tab →Halo).

   d. Try and get the road names in the centre of the road.

7) Continue to style your map until you are happy that it will be clear and easily understood by its users.

8) **OPTIONAL,** for those wishing to learn how to apply a cartographic style using layer files.

   NOTE that in the **Data folder**, you will find a folder named **VMD_Layers.**

   This contains layer files and instructions on how to use them. The layer files allow you to apply a style to the Vector Map District data – check the section **How to set up representation** in the instructions to learn how to use these layer files.

Improve your map

### 3. Add in OpenStream Web Mapping Service (WMS) as backdrop

The VectorMap District data we are viewing in ArcMap (from **Glasgow_overview.pgd)** is good, but it is at quite a small scale (1:25,000).

For our campus map, we would like to show more detail on some key campus buildings.

We are now going to add some larger scale OS Open Data to our map, which will show some of the key buildings in more detail.

Using Digimap OpenStream as a base map means you have access to OS maps without needing to download any data. The following steps will show you how to add Digimap OpenStream as a Web Mapping Service (WMS) in ArcMap.

1) Click on the **Add Data** button.

2) Navigate to your root folder.

3) Select GIS Server, then Add WMS Server.
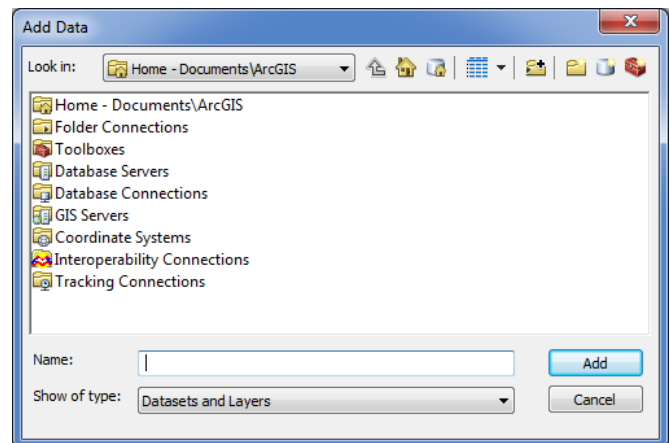
4) In **Add WMS Server**, change the URL to the following, replacing [YOUR_API_KEY] with your own API key, available after you register for OpenStream:

http://openstream.edina.ac.uk/openstream/wms?token=[YOUR_API_KEY]

Hint: it is easier to do this if you copy and paste the URL into a text editor and add your API key to it and then copy and paste the whole string into the URL field.)

It should look similar to the following:
http://openstream.edina.ac.uk/openstream/wms?token=8c0e792e28ffab921fcff0f2c717
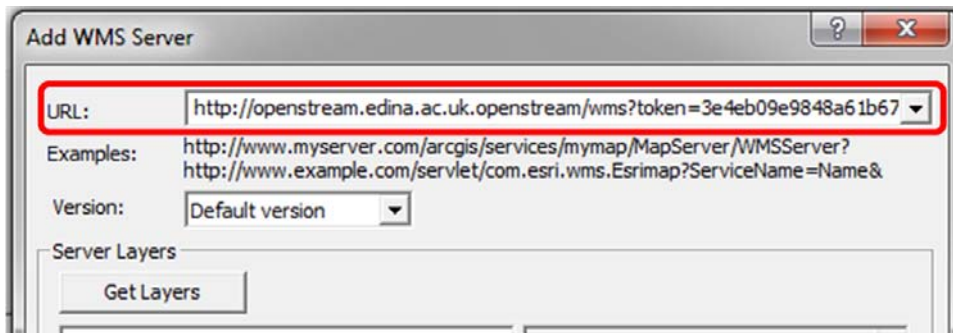
5) Click **OK**. A new server type appears in the list. If you receive an error message, select a different version in Step 4 (try 1.1.1).

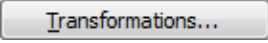6) Select OS Open Data on openstream.edina.ac.uk by double clicking on it.

7) Click **Add**.
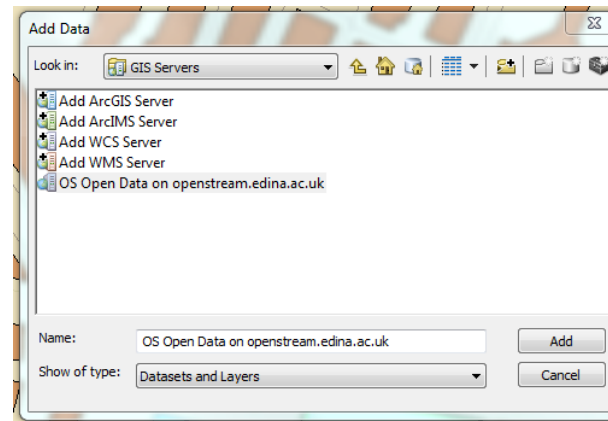
8) Select **OS Open Data**. Click **Add**. This should add the OpenStream WMS as a Layer to your map. It may initially display it in the map projection WGS 84. If it does you should change it to display in British National Grid. See below.
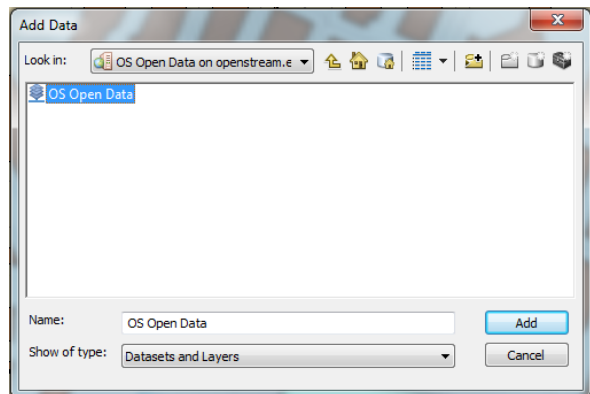

9) A **Geographic Coordinate Systems Warning** window may appear to remind you that the WMS currently displays in **GCS_WGS_1984**.

To make it match the layers in our map, they must display in **GCS_OSGB_1936** (British National Grid).

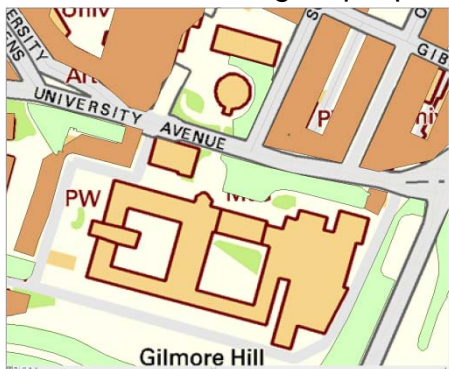To do this, click Transformations... and edit the settings as shown below:
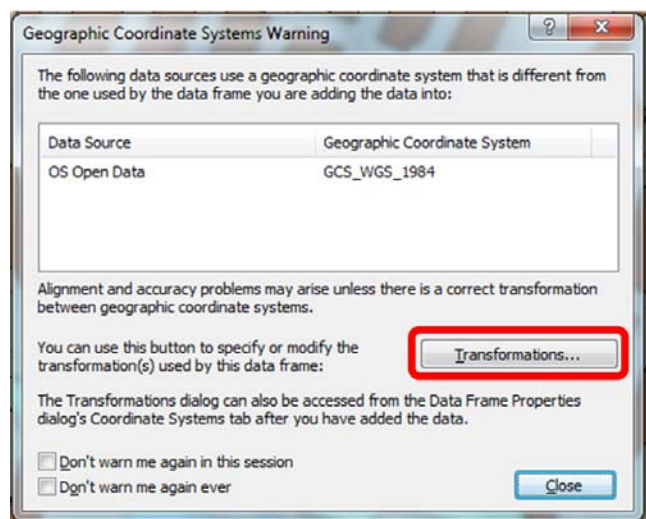
You may need to select a transformation to go from WGS 84 to OSGB 36. If you do, select the **OSGB_1936_To_WGS_1984_Petroleum** transformtion.
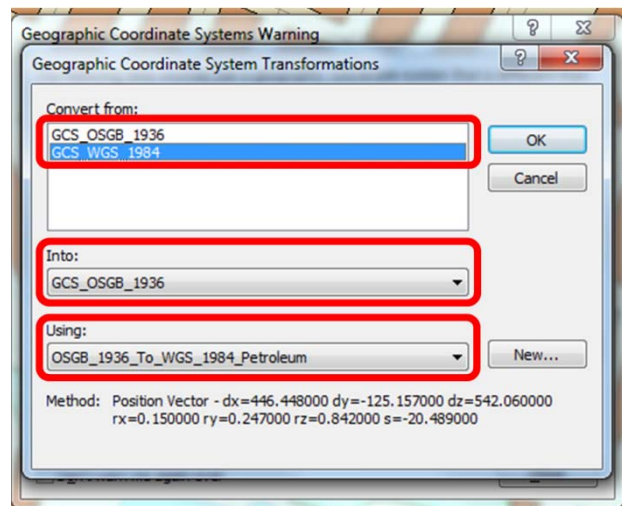
10) Click OK

11) Click Close on the Systems Warning box

12) This will add the Digimap OpenStream WMS as a layer to your map:

New map data not visible?

13) In your Table of Contents, uncheck the boxes of all the polygon layers – **except Buildings, University Buildings and OS Open Data.**
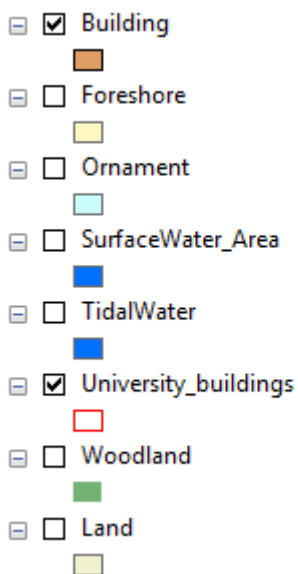
14) Switch off other layers and try zooming in and out. You should see the data change automatically. If not, try to unselect the remaining polygon layers or make them transparent (use the Symbol Selector) in order to see the OpenStream WMS data underneath.

4. Delete buildings from the VMD to be re-digitised

We can use the largest scale map data in the Digimap OpenStream WMS to improve the detail of some key buildings for our campus map.

The largest scale view in OpenStream is StreetView data which is at a scale of 1:10,000. Vector Map District (which was used to created our **Glasgow_overview.gdb** database) is nominally a 1:25,000 scale dataset.

1) First of all, we need to delete some of the features from the Vector Map District data that we are going to replace. We will delete features from the *Building* layer which are poor representations of University buildings e.g. the library and University Gardens.

2) Then we will digitise features using the StreetView data as a guide. We will create new features in the **University_Buildings** layer.

- ☑ Building
- ☐ Foreshore
- ☐ Ornament
- ☐ SurfaceWater_Area
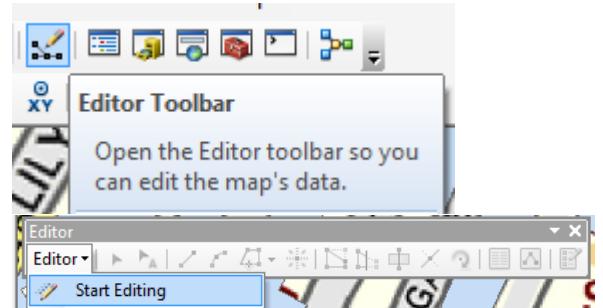- ☐ TidalWater
- ☑ University_buildings
- ☐ Woodland
- ☐ Land

Follow the instructions below to delete features from the **Building** layer:

1) Change the map scale to work at a large scale, such as 1:3000.

We will start by deleting any features that we wish to improve from the *Building* layer.

2) Click **Editor** toolbar

3) Click Editor → Start Editing.

If you do not see the Editor toolbar, go to **Customize → Toolbars → Editor**.

4) Use the **Select** tool ► from the **Editor toolbar** to select a feature from the **Building** layer you want to delete. It will highlight as shown in the first image on the right.

5) When the building you wish to delete is highlighted as shown on the image on the right, click Delete.

We suggest deleting the polygon covering the library and University Gardens as shown in the image on the right.

6) The selected polygon will disappear.

7) Click Editor → Save Edits.

8) Click Editor → Stop Editing.

Now, edit the symbology of the **University_buildings** layers so that they are more obvious.

Right-click the **University_buildings** layer, then select **Zoom to layer.**

1) Click on the fill symbol under the layer in the Table of Contents of your map.

2) Select the **Hollow** symbol. Then select a bright **Outline Colour** and a thick **Outline Width** that will make the layer features stand out against the StreetView data. Click **OK**.
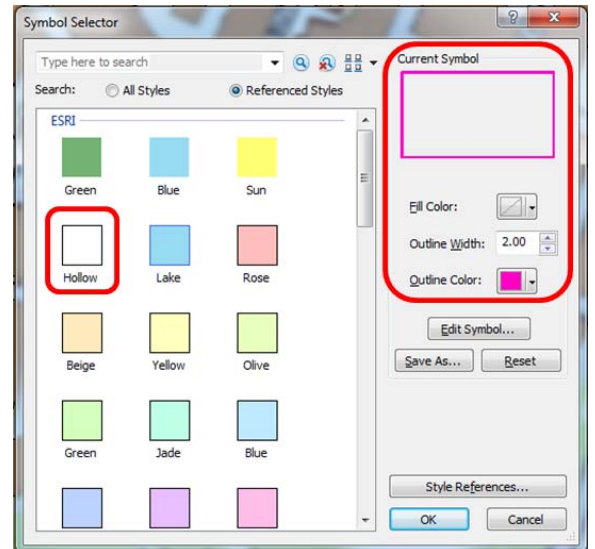
5. Digitise new buildings in the University_buildings Feature Class

Recap: we have deleted some buildings from our Buildings layer.

Now we will digitise some buildings and add them to the **University_buildings** layer, using the StreetView data as a guide. We are doing this to improve the campus map that we will publish later.

1) Click Editor → Start Editing.

2) Click Editor → Snapping → Options.

3) Set the **Tolerance** to **1 pixel**. Click **OK**.

4) Editor →Editing Windows →Create Features.
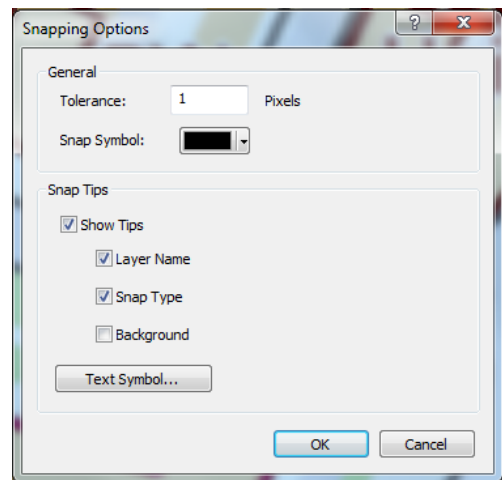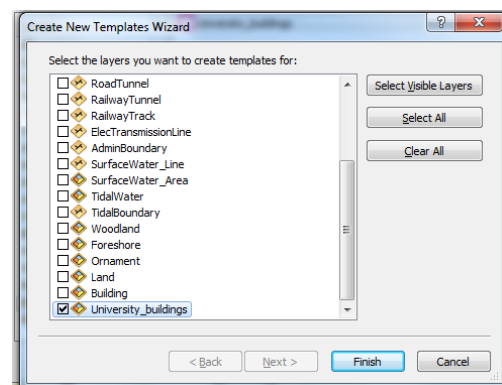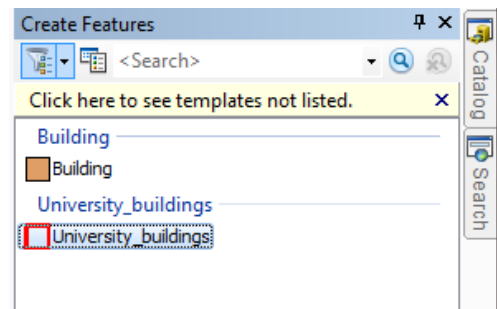
5) On the **Create Features** panel (on the right of ArcMap), select **University_buildings**, then **go to step 6**.

🔵 If **University_buildings** is missing from the list in step 5, click the **Organize Template** icon and complete the following steps.
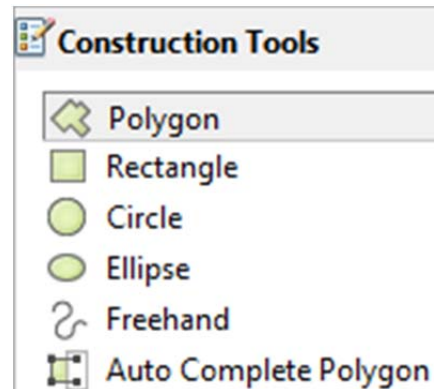
• Select ▤ New Template from the menu.

• Select **University_buildings** from the list of classes. Click **Finish**.

- You should now see **Construction Tools** at the bottom of the **Create Features** panel. Proceed to **step 6**.

6) Select the **Polygon** tool in the **Construction Tools** interface.

7) Digitise a number of building features with improved accuracy from the backdrop mapping. With the polygon tool selected, click on each point of a feature to digitise it.

For example, in the image on the right, we have digitised all the corners of the library building.

Note: to finish digitising a feature, double–click on the last point. You can then move on to digitise another building if you wish.
    When you have digitised all the buildings you wish to, move to Step 8.
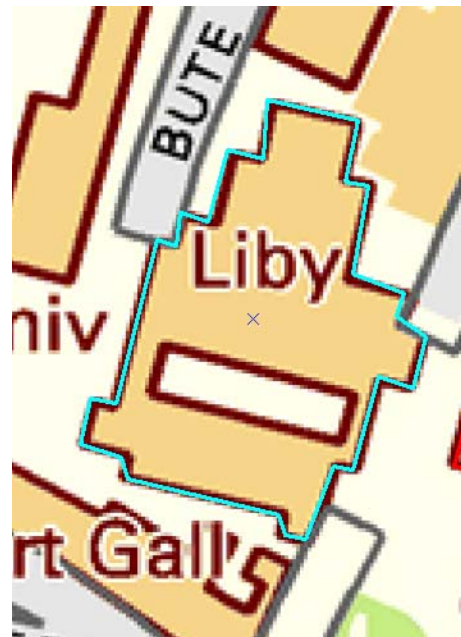
8) Use the **Select** tool ▸ from the **Editor toolbar** to select one of your newly digitised features.

9) Right-click over the feature ➜ **Attributes**.
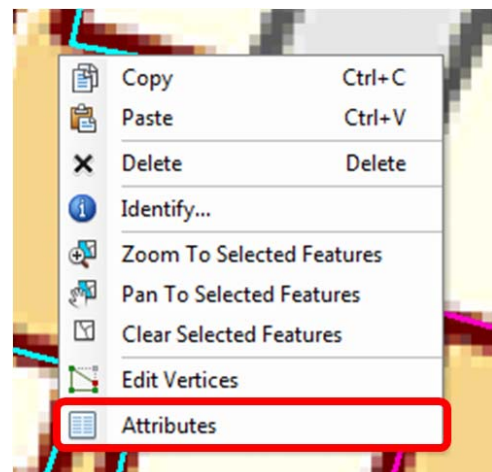
10) In the **Attributes window**, complete the **Building_name** and **Function** fields for buildings you have added.

The **Function** field can used to differentiate between student accommodation (Accom), teaching buildings (Teaching), administrative buildings (Admin), Library (Lib), etc.
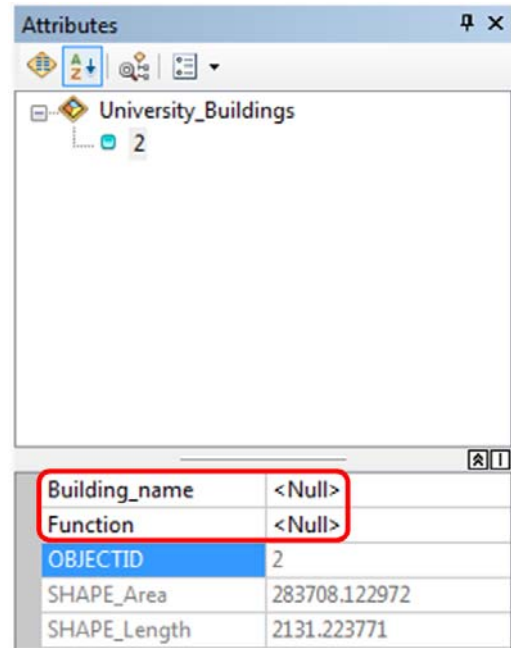
11) Editor → Save Edits.

12) Editor → Stop Editing.

13) **Save** the project.

Continue using the Editor to make any other improvements you wish to make.
For example, try digitizing some smaller roads not visible on your data.

Export your map

6. Export your map from ArcMap as an image

Now we have improved our university buildings, we want to publish our campus map.

First, we will export our map as an image. Later we will use an HTML file to publish it.

1) **Deselect** the **Digimap OpenStream WMS** layer from the **Table of Contents** so it is not visible in the map.

2) Select a scale of 1:5000. Check that you are happy with the appearance of your map at this scale. You may need to change the size of labels, road and building outline thicknesses etc.

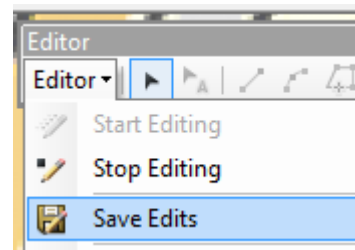3) Follow the instructions below to export a map image:

   a. Ensure your area of interest is centred in the screen. When exporting, ArcGIS will use the visible extent of the map in the current window.

   b. Select File → Export Map…

   c. Select Write World File and Save as type: PNG.

   d. Specify a resolution of 300dpi.

   e. Remember where you save the file to!

   🛈 **Note**: High resolutions equal large numbers of pixels that will increase load times on a website.

   f. Save your image as **Glasgow_campus.png.** See our example map in the image on the right.
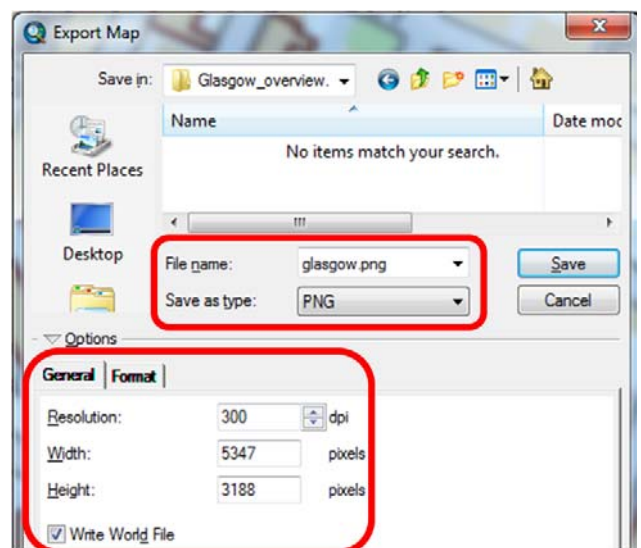
Now we need to **find the geographic extents** of your PNG map image. These are required for the next exercise where you load the map image into a website.

4) Click on the **Add Data** button.
   Add your **Glasgow_campus.png** map image.

5) **Right click** on the image layer in the table of contents → **Zoom to Layer** and view the saved image.
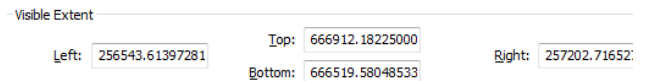
6) **Right click** on the image layer in the table of contents → **Properties** → **Extent**.

Visible Extent

Left: 256543.61397281   Top: 666912.18225000   Right: 257202.71652

Bottom: 666519.58048533

7) Write down the coordinates of the extents. You will need these later:

Bottom left of map image:

Left (x):
Bottom (y):

Top right of map image:

Right (x):
Top (y)

These coordinates are for the bottom left and top right of your map image. You will enter them in the order left (x), bottom (y), right (x), top (y).

Display your map

7. Display map in OpenLayers

Recap, you should have created a map image in ArcGIS. The image was of the Glasgow University campus area, was captured at 1:5,000 scale and was called **Glasgow_campus.png**

What now?

1. We will edit some HTML files that Digimap have provided for you, to add your map image to a map with OS OpenStream data.

Note that the HTML files are using something called OpenLayers[3] to display our OpenStream data and your map image. OpenLayers is open source and is a simple way to display maps in webpages.

The followings steps will show you how to display your map image.
We will edit the HTML file **3_Glasgow_campus_with_1_image.html.** Find this file in the folder HTML Files/Ex 1.

1. Double click the file to open it in Firefox, Internet Explorer or any other browser. It should look similar to this image.

A campus map image is being displayed in the centre of the screen. If we zoom in and out we would see the OS OpenData that is displayed in the background change:

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[3] http://openlayers.org/

2. We will now edit the file so that it displays YOUR campus map image.

3. Open the HTML file in Textpad or similar.

4. Replace the API key with your own.

```
var apikey =
"INSERT_YOU
R_KEY_HERE";
```

5. Edit the variable **bounds2** so that they are the same as your saved campus map image. Remember the order left (x), bottom (y), right (x), top (y).

Visible Extent
Left: 256543.61397281   Top: 666912.18225000   Right: 257202.71652718
Bottom: 666519.58048533

```
var bounds2 = new OpenLayers.Bounds
(256543, 666519, 257202, 666912);
```

6. Edit the **name** and **coordinates** of your **campus image**. (Note the default name is Glasgow_campus.png)

7. **Note**: Ensure the image you created in the previous exercise is in **the same folder as the HTML** file you are editing!

```
//3) EDIT image name and bounds for the different
image layers

    var options = {isBaseLayer: false};
    var graphic = new OpenLayers.Layer.Image(
        'Campus Map',
        'Glasgow_campus.png',
        new OpenLayers.Bounds(256543, 666519,
257202, 666912),
        new OpenLayers.Size(56,42),
        options
        );
```

8. Save the edited file and open it in a browser.

9. Click the + sign at the right hand side of the map.

Base Layer
⊙ EDINA OS OpenData WMS
Overlays
☑ Campus Map

10. Uncheck Campus Map, to display the OS OpenData without your image. NOTE: we exported a map image. You can also export vector data so that users can identify individual features on your map, rather than just the flat image.
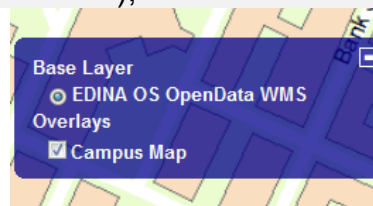
Further exercises with OpenLayers

1. In the folder Ex1, you will find a HTML file **4_Glasgow_campus_with_2_images.html.** This HTML file is designed to display 2 images; your campus map, plus an overview map of Glasgow, as shown in this image:
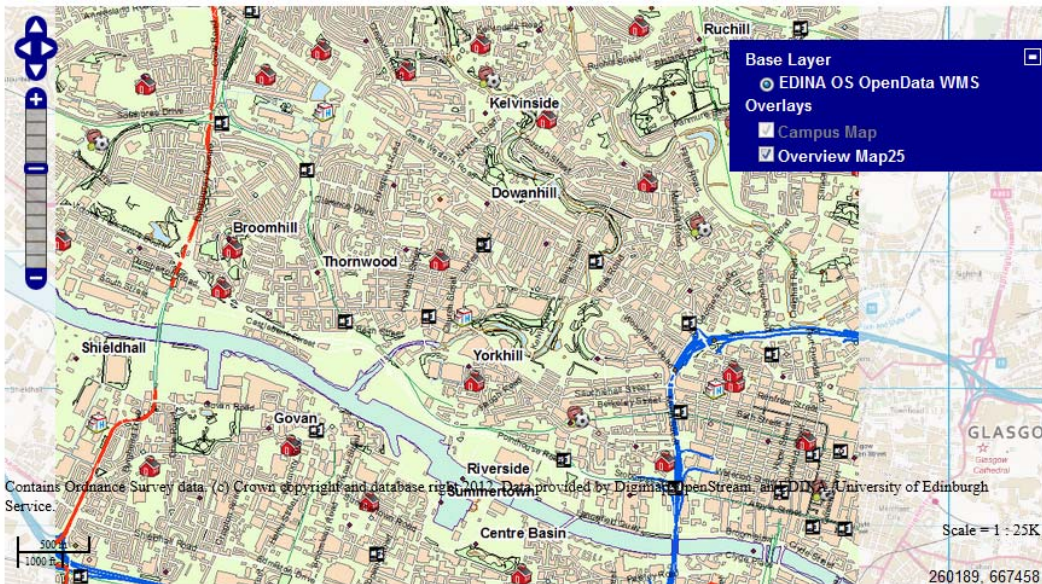
To use this file to display 2 map images, you need to:

   a. Go back to ArcMap and change the scale to 1:25000. Style your map with labels, colours etc, that make sense at that scale.

   b. Export a map image as you did in Step 6.

   c. Edit the HTML file **4_Glasgow_campus_with_2_images.html,** to match the names and geographic coordinates of your two images@

```
//3) EDIT image name and bounds for the different image layers and possibly the scale bands

   var options = {isBaseLayer: false, minScale: 20000};
   var campus = new OpenLayers.Layer.Image(
            'Campus Map',
            'Glasgow_campus.png',
            new OpenLayers.Bounds(256236, 666256, 257563, 667091), //bottom left, top right
            new OpenLayers.Size(1,1),
            options
        );


   var options = {isBaseLayer: false, maxScale: 20000, minScale: 50000};
   var overview25 = new OpenLayers.Layer.Image(
            'Overview Map25',
            'Glasgow_overview_25k.png',
            new OpenLayers.Bounds(253474, 664201, 259335, 669129), //bottom left, top right
            new OpenLayers.Size(1,1),
            options
        );
```
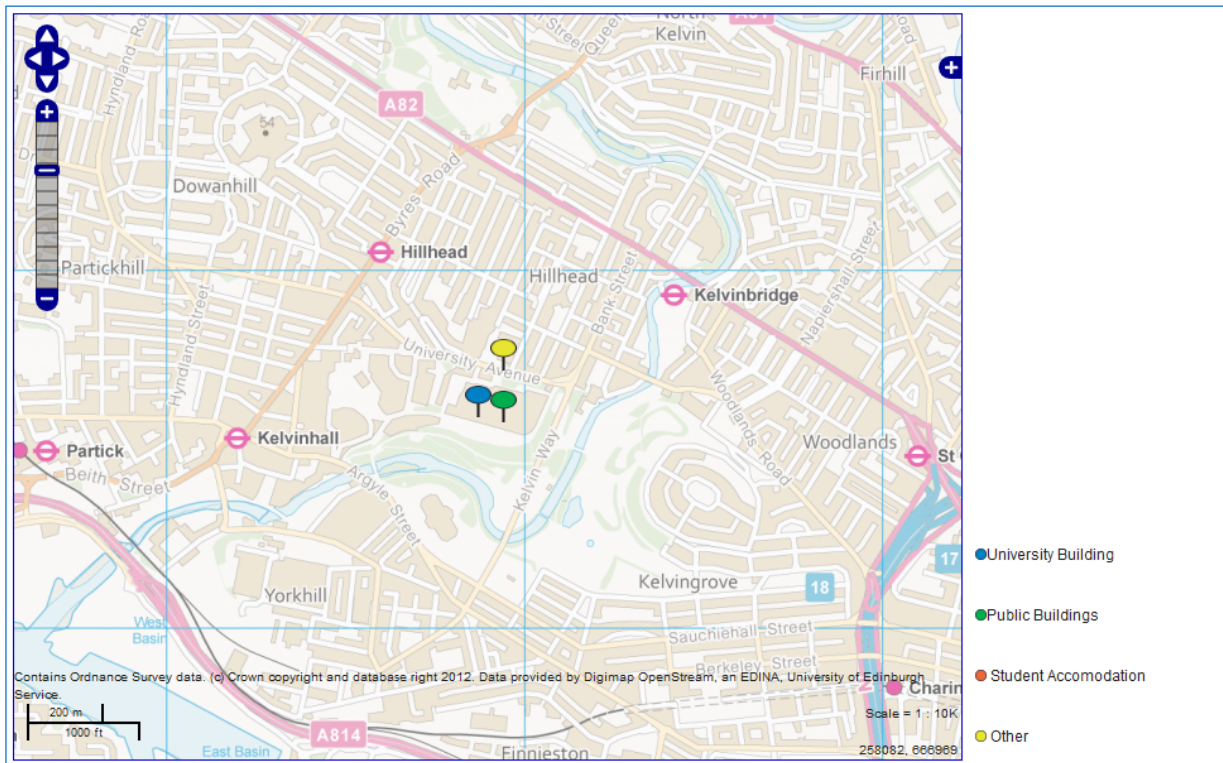
    d. Load the file in a browser to view the two images.

2. In the folder **Ex2**, there is an example of a campus map with markers that are read from a text file (textfile.txt), as seen in this image:


You can edit this text file to create your own markers. The settings enable the user to click on the campus map to cause a popup window with information to appear. This example also uses stylesheets and has more of a design, including a legend. Modify this to reflect your own map.

3. In the folder, **Ex3**, there is an example that shows how you can read a GML (Geographic Mark-up Language) file as a vector overlay. You can click on the features and get a popup with information about the feature.

There are 2 HTML files;

     i. **Glasgow_campus_gml.html** – use this to add a vector overlay of university buildings, as seen in the image below.

    ii. **Glasgow_campus_pois_gml.html** – use this to add a vector overlay of points of interest.
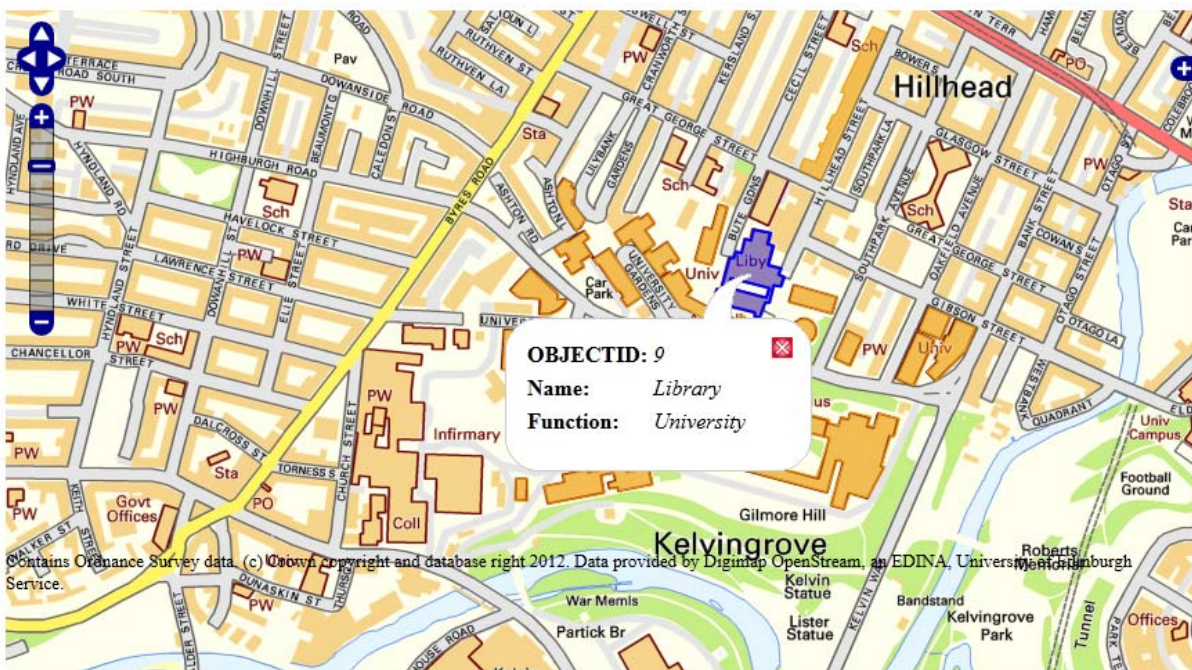
You need to create a GML file – process is as follows:

A) For the first HTML file, export **University_buildings** feature class from ArcGIS by right clicking on the layer name in the Table of Contents and selecting **Data → Export Data**. Save it as a Shapefile.

NOTE: for the points of interest HTML file, you could export any of the points layers – we recommend trying the Named Place layer or the Railway Station layer.

B) **Convert** the Shapefile to **GML** format using **ogr2ogr**. This can be done either in **QGIS** using the **Save As...** command, downloading and using **FWTools,** or using an online tool[4] which will convert the Shapefile to GML.

C) **Edit** the HTML file as appropriate including **changing the API key**, **changing the name of the GML** file to read, and **editing the name of the attributes to display** in the popups (by default these are Name and Function).

What is QGIS?

'Quantum GIS (QGIS) is a user friendly Open Source Geographic Information System (GIS) licensed under the GNU General Public License.

QGIS is an official project of the Open Source Geospatial Foundation (OSGeo). It runs on Linux, Unix, Mac OSX, Windows and Android and supports numerous vector, raster, and database formats and functionalities.'

http://www.qgis.org/

What is ogr2ogr?

Ogr2Ogr - this is a command line tool that converts one Ogr defined data source to another Ogr data source.

Ogr supports multiple data formats: ESRI Shapefile, MapInfo Tab file, TIGER, s57, DGN, CSV, DBF, GML, KML, Interlis, SQLite, ODBC, ESRI GeoDatabase (MDB format), PostGIS/PostgreSQL, MySQL.

1. Install the FW Tools tool kit:

   http://fwtools.maptools.org/

2. Launch the **FW Tools Shell** - in windows this is found under **Start->Programs->FW Tools ..**

3. From the shell - cd into your directory that has the data you want to convert.

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[4] Note: the Vector Map District map data is covered by the OS Open Data licence, so you can convert it using online tools. You should not use any Digimap licensed data with online tools.