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INTRODUCTION

This guide contains instructions for viewing different types of spatial data from Digimap Ordnance Survey Collection in ArcGIS.

You will need access to ArcGIS software to complete the exercises in this guide. No prior knowledge of ArcGIS is required. However, an understanding of the basic GIS terms such as raster and vector would be good. This information can be found in the following online learning object:

http://edina.ac.uk/digimap/support/digimapelearning/index.html

The instructions and images have been prepared using ArcGIS version 10.1.

SCENARIO

Dave is studying for an MSc in Environmental Science at the University of Leeds.

His dissertation is investigating the potential impact of proposed wind farms in Cumbria on the surrounding ecology.

Dave has collected ecological data at the proposed sites to feed into his 3D GIS model of the sites and surrounding area. He also has the coordinates of each proposed site and existing wind farm sites.

What map creation and data analysis will Dave do?

- Map showing Cumbria in the context of the North of England.
- Map showing the location of the proposed wind farms.
- Create Digital Terrain Models, plus contour maps, to analyse the ecological factors for the regions around each proposed site.

WHAT WILL I LEARN?

- The key applications used in ArcGIS desktop software
- How to:
 - o Add raster and vector data to ArcMap
 - o Amend symbology of map layers
 - o Create a buffer zone around a map feature
 - Export map as an image
 - o Create a new shapefile of potential wind turbine locations
 - o Add attribute information to new shapefile
 - o Carry out viewshed analysis
 - o Create a relief map using a Digital Terrain Model from Digimap

WHAT DATA DO I HAVE?

We have downloaded data from Digimap Ordnance Survey Collection and ShareGeo.

You have a folder called Wind Farms Exercise data, with two sub-folders.

Name	Date modified	Туре
퉬 Digimap_Download_wind_farms_90380	20/08/2013 14:27	File folder
퉬 Wind Farms in Great Britain	20/08/2013 16:27	File folder

Here's a summary of the data in these folders:

1. Digimap_Download:

Vame	Date modified	Туре	Size
k raster-250k_229687	20/08/2013 11:06	File folder	
b terrain-50_229685	02/09/2013 17:33	File folder	
🃙 terrain-50-dtm_229684	23/08/2013 17:00	File folder	
citations_orders_90380.txt	20/08/2013 10:42	Text Document	3 KB
contents_order_90380.txt	20/08/2013 10:42	Text Document	17 KB

- raster-250k. 1:250000 raster backdrop map in TIFF format.
- terrain-50. OS Terrain 50, contours and spot heights.
- Terrain-50-dtm. OS Terrain 50 DTM (Digital Terrain Model), used for 3D modelling of terrain.
- 2. Wind Farms in Great Britain data on the location of wind farms in Great Britain has been collated and made available by one of our Digimap colleagues in ShareGeo¹. This is a service where academics can share their map data with others.

¹ http://www.sharegeo.ac.uk/handle/10672/294

There are Shape files (ArcGIS file format, compatible with many other software packages) in the folder on the location of operational wind farms, those consented, those proposed and wind farms under construction.

ARCGIS

ArcGIS is **Geographic Information System** software that is used to view and analyse geospatial data. There are different levels of license for ArcGIS, but all levels include two applications: ArcMap and ArcCatalog.

- **ArcMap** is the application you work with to view, explore and analyse map data and create maps for publication.
- ArcCatalog is the application you work with to manage data.



Some ArcGIS Desktop products include additional applications, such as:

1. ArcToolbox[™] - an application that contains many tools for GIS tasks, such as data management and analysis. You can access ArcToolbox from both ArcMap and ArcCatalog.



ARCMAP

The ArcMap interface consists of the table of contents on the left and the map display area, as well as a number of toolbars and menus for working with the map and its data.

In this image you can see that 4 'layers' of map data have been added to the map and are visible in the map display area on the right:



TABLE OF CONTENTS

The order of layers within the table of contents is important; the layers at the top of the table of contents draw on top of the layers below them. Therefore, you should put the layers that form the background of your map, such as the ocean, at the bottom of the table of contents.

MAP DISPLAY AREA

There are two views for working with data: data view and layout view – switch between views at bottom left of the map display area.

- 1. In **Data view**, you explore, edit, query, analyse, and symbolize data.
- 2. In **Layout view**, you arrange data frames and add other map elements, such as scale bars, titles, and legends, to create a map layout that can be published in print or digital form.

TOOLBARS

The Standard and Tools toolbars are visible in this screen. Toolbar options are available from **View > Toolbars** on the main menu. Toolbars can be floating or fixed.



ARCCATALOG

ArcCatalog is the ArcGIS application designed for browsing, managing, and documenting geographic data. Think of ArcCatalog as a window into your GIS database. From ArcCatalog you can access data stored on your computer's hard drives, local networks, and even the Internet. To access data, you create a connection to its location (such as a folder on your C: drive). Collectively, the connections you create are called the Catalog.

The Catalog tree, on the left, can be used to browse and preview data.

The preview pane on the right provides three different tabs for previewing information about the data; contents, preview and metadata.



ARCTOOLBOX

ArcToolbox provides an organised collection of tools used for GIS analysis, data management, and data conversion.

The number of tools you have depends on your ArcGIS license.



START ARCMAP

- 1. Start ArcMap from your list of programs.
- 2. Select New Maps > Blank map.
- 3. Click OK.

Q ArcMap - Getting Started				
Open existing map or make new ma	ap using a template			
- Existing Maps	My Templates		^ ^	
Recent Browse for more Browse for more New Maps My Templates G- Templates G- Standard Page Sizes				
ISO (A) Page Siz ISO (A) Page Siz North American (Blank Map			
	Architectural Page Sizes		^	
World Browse for more	9 in. x 12 in.	9 in. x 12 in.	12 in. x 18 in.	
	ARCH A Landscape	ARCH A Portrait	ARCH B Landscape	
<		·		
C:\Users\Viv\AppData\Roaming\E	SRI\Desktop10.1\ArcMap\Templates\W	ormal.mxt		
Default geodatabase for this ma	Default geodatabase for this map: What is this?			
C: \Users \Viv \Documents \ArcGI	C:\Users\Viv\Documents\ArcGIS\Default.gdb			
Do not show this dialog in the	future.		OK Cancel	

IMPORT 1:250000 MAP DATA

Let's add the 1:250000 raster map data as a background for our wind farm locations.

RASTER maps, in this instance a scanned map², are provided in TIFF image format from Digimap.

These files are straightforward to work with in GIS; they require no preparation or conversion.

- 1. Click Add Data
- 2. You may need to connect to the folder that contains your Digimap data. ArcGIS does not automatically see

your data folder. Click the **Connect to folder** button and select the folder **Wind Farms Exercise data**.

3. Click **OK**.

Connect To Folder				
Choose the folder to which you want to connect:				
▲ 🎉 Wind_Farms				
Digimap_Download_wind_farms_9				
Wind Farms in Great Britain				
b 🌡 digimap emodule VMD Boundaries ex				
Electoral results 2010				
Flooding_exercise_CB				
Gazetteer_Plus_ArcGIS				
Image: Book State Accord Control Co				
🛛 🕒 Geology_data_MapInfo				
Historic data ArcGIS				
Marine_data_GIS				
Folder: Z:\User Support\Training\Geo\Training exercises\Data				
Make New Folder OK Cancel				

² <u>http://www.ordnancesurvey.co.uk/oswebsite/products/backdrop-mapping.html</u>

4. Double click on the folder **Digimap_Download_wind_farms_90380**:

Add Data	
Look in:	🚰 Z:\User Support\Training\Geo\Ti 💌 📤 🏠 🗔 🏢 🕶 🖆 🗋 🚳
C Digima C Digima	p_Download_wind_farms_90380 arms in Great Britain
Name: Show of typ	Datasets, Layers and Results

5. Double click the folder raster-250k_229687:

Add Data	×
Look in:	Digimap_Download_wind_farms 💌 🏠 🏠 🗔 🇮 👻 🔛 🗃 📚
raster-50k_2 terrain-50-c terrain-50_2	229686 dtm_229684 229685
citations_or	rders_90380.txt rder_90380.txt
Name:	raster-250k_229687 Add
Show of type:	Datasets, Layers and Results Cancel

- 6. Use CTRL-click to select all 4 .tif files in the folder.
- 7. Click Add.

Add Data	×
Look in:	raster-250k_229687 🔹 🚖 🏠 🕼 🐨 🖛
250k_raster nx.tif ny.tif os_open_co sc.tif sd.tif	_gaz_2013.txt onditions.txt
Name:	nx.tif; ny.tif; sc.tif; sd.tif Add
Show of type:	Datasets, Layers and Results Cancel

1. If you receive this error, message, click OK:

🗼 Unknown Spatial Reference	×
The following data sources you added are missing spatial refe information. This data can be drawn in ArcMap, but cannot be	erence e projected:
nx.tif ny.tif sc.tif sd.tif	^
<	+
 Don't warn me again in this session Don't warn me again ever 	ок

- 2. If asked to create pyramids, say Yes.
- 3. Tick the box 'use my choice and do not show this dialog...'

Create pyramids for nz26ne.tif (5000 x 5000)			
This raster data source does not have pyramids or contains insufficient pyramids. Pyramids allow for rapid display at varying resolutions.			
Pyramid building may take a few moments. Would you like to create pyramids?			
About pyramids Yes	No Cancel		
Pyramid resampling technique	Nearest Neighbor 🗸		
Pyramid compression type	Default 👻		
Compression quality	75		
Use my choice and do not show this dialog in the future.			

You will see the Table of Contents now has some layers:

Table Of Contents	Ţ	×
%: 📮 🧇 📮 🗄		
🖃 🎒 Layers		
🖃 🚞 Z:\User Support\Training\Geo\Training	exe	rci
🕀 🔲 nx.tif		
🕀 🔲 ny.tif		
🕀 🗖 sc.tif		
🕀 🗖 sd.tif		

8. Click the button List by Drawing Order at the top of the Table of Contents – this makes it easier to see what is going on in the table of contents:



CREATE A GROUP LAYER

In this exercise we will add several different map data files to ArcMap. The table of contents can get quite busy. Let's create a group layer to put all of our 1:250000 raster data together.

- 9. Right-click on Layers.
- 10. Select New Group Layer.

Table Of C	onten	nts	Ψ×	
🏂 🤤 🍕	> 🗳	0]	
🗆 🍠 🗔	¢	Ad	d Data	
		Ne	w Group Layer	
		Ne	New Group La	yer
· · ·	Ē	Co	Add a new, er	npty group layer to
	Ê	Pas	the active dat	a frame
	×	Rer	nove	

11. Now right click on the New Group Layer and select Properties.



- 12. Select the General Tab.
- 13. Type **1:250000 raster** in the Layer Name box.

General Group Dis	play				
Layer Name:	1:250000 raster			Visible	
Description:				*	
				-	
Credits:					
Scale Range					
You can specify th	e range of scales at whi	ich this layer will be sho	own:		
Show layer at	all scales				
On't show lay	ver when zoomed:			4	
Out beyond:	<none></none>	 (minimum scale) 			
In beyond:	<none></none>			R P	
			ок	Cancel	Apply

14. Click OK.

15. Click and drag all the1:250000 raster layers to the new group layer.

Your ArcMap window should look similar to the image below.



If you cannot see any map data, try right clicking on the 1:250000 raster group layer and select **Zoom to layer**:



SET THE COORDINATE SYSTEM

We want to set the coordinate system of our project to British National Grid.

- 1. Right click the word Layers at the top of the Table of Contents.
- 2. Select Properties.
- **3.** Select the Coordinate System tab.
- 4. Select Projected Coordinate Systems > National Grids > Europe > British National Grid.
- 5. Click Apply.
- 6. Click OK.

SAVE YOUR ARCMAP DOCUMENT

- 7. Save your ArcMap document. Click File > Save as.
- 8. Name the file and click save.

Q Save As	1.20	and a starter	142150	×
Save in:	Uind_Farms	•	3 🌶 📂 🖽 🗸	a
(Here)	Name	*	Date modified	Туре
Recent Places	뷀 Digimap_Do 퉬 Wind Farms	wnload_wind_farms_90380 in Great Britain	20/08/2013 14:27 20/08/2013 14:21	File folder File folder
Desktop				
Libraries				
Q	•	III		4
Network	File name:	wind farms.mxd		Save
	Save as type:	ArcMap Document (*.mxd)	•	Cancel

You are saving the file as an ArcMap document. If you move any of the map data from the current location, you will have to update the connections to the map data in your ArcMap document.

ADD WIND FARM DATA

Data on the location of wind farms in Great Britain has been collated and made available by one of our Digimap colleagues in ShareGeo³. This is a service where academics can share their map data with others.

This map data is provided in Shape file format, which is compatible with ArcGIS and many other GIS software packages.

- 1. Click Add Data.
- 2. Navigate to the Wind Farms exercise data > Wind Farms in Great Britain folder. Double click on it.
- 3. Click the shape file WindFarm_Proposed2011 and click Add.



You should see a new layer in the Table of Contents area. Some points should also be visible on your map, e.g.:

³ <u>http://www.sharegeo.ac.uk/handle/10672/294</u>



SELECT CUMBRIA WIND FARMS

Note that the wind farm data is for the whole of Great Britain. We are only really interested in the Cumbria area.

Let's select wind farms in our area of interest, and create a new layer based on our selection.

1. First, zoom in until you can clearly see the wind farms in Cumbria, similar to the image below – you don't need to cover exactly the same area.



Now, we want to select the wind farms we can see.

- 2. Click the Select by Feature button on your toolbar.
- 3. Click Select by Rectangle.



- 4. Click on your map and draw a rectangle that covers all the visible wind farm symbols.
- 5. The rectangle will disappear, but your wind farms should be highlighted on the map.
- 6. Now go to the Table of Contents.
- 7. Click the List by Selection button.

 Layer Layer List By Selection With the selection

 ★ Instant by whether their features are selectable by the interactive selection and editing tools. Layers with features selected are listed separately. ★ Instant by whether their features are selectable by the interactive selection and editing tools. Layers with features selected are listed separately.

8. You should see that under **Selected**, it lists the WindFarm_Proposed2011 layer.

Table Of Contents	ф х
≿ 📮 📚 🗳 🗉	
Selected	
WindFarm_Proposed2011	🔽 🖸 10
 Not Selectable 	
🔷 nx.tif	
< ny.tif	
< sc.tif	
♦ sd.tif	

- 9. Right click on the wind farms layer.
- 10. Select Create Layer from Selected Features.



11. Click on List by Drawing Order.



You should see a new layer added in the Table of Contents.

- 12. Uncheck the original Wind Farms layer, so that you are only displaying the wind farm selection layer.
- 13. Let's export our new layer (of the wind farms in Cumbria), so that we have it as a separate file, should we need to use it again.
- 14. Right click on the wind farms selection layer.
- 15. Select Data > Export Data.



- 16. Ensure you have selected Export all Features.
- **17.** Check you have selected to use the same coordinate system as the original layer.
- 18. Click on the yellow folder icon, to select a location for the new file.

- **19.** Select your Wind Farms Exercise data > Wind Farms in Great Britain folder.
- 20. Now give it a name, for example WindFarms_Cumbria.
- **21.** Check that the type of file is a **Shapefile**.
- 22. Click Save.

Saving Data		3				
Look in: 🛅 🕻	Wind Farms in Great Britain 🔹 🛧 🏠 🐻 🗐 🏢 🖛 😂 💕 🕻	•				
🖻 🖻 Wind_opera	ationalIN.xls					
WindFarm_	Consented2011.shp					
WindFarm_	Construction2011.shp					
WindFarm_(Operational2011.shp					
WindFarm_	Proposed2011.shp					
J						
Name:	WindFarms Cumbrial shp					
Save as type:	Shapefile Cancel					

- 23. Click Yes to add the exported data as a layer.
- 24. Your Table of Contents should now have three Wind Farms layers. We only really need the Wind Farms Cumbria layer, so right click the other two in turn, and remove them.

NOTE: if you want to do this for multiple layers of map data, we would recommend exploring the **Clip tool in Arc Toolbox** to clip the data to your area of interest.



CHANGE WIND FARM SYMBOLS

ArcMap assigns random colours and symbols to imported map data. Let's change the symbols for the wind farms so they stand out more against our raster map:

1. Click on the symbol under the **WindFarms_Cumbria** layer:

Table Of Contents	
📚 📮 🤝 🛛	
🗆 🥩 Layers	
🖃 🗹 WindFarms_Cumbria	
•	

2. The Symbol Selector box is generated.

The current symbol is only 4.00 points in size and is a dark colour.

- 4 Select an alternative we suggest a bright colour and a size of 10 points or more.
- 5 Click **OK**.

Symbol Selector				
Type here to se	arch	- @ &		Current Symbol
Search: 💿 /	All Styles	Referenced Styles		
ESRI —				•
Cirde 1	Square 1	Triangle 1		Color:
•	•	•		Size:
Pentagon 1	Hexagon 1	Octagon 1		Angle: 0.00
Rnd Square 1	Circle 2	Square 2		Edit Symbol Save As Reset
Triangle 2	entagon 2	Hexagon 2		
•	•	•	Ŧ	Style References OK Cancel

Your symbols should now be more visible.

LABEL WIND FARMS

Now let's label the wind farms.

1. Right click on the wind farm layer and select properties:



2. Complete the Labels tab as shown in this image:

Layer Properties	1000		27.00	a la march	×
General Source Sel	ection Display Symb	ology Fields Definition	n Query Labels	Joins & Relates Time	HTML Popup
Label features in th	nis layer				
Method:	Label all the features t	he same way.	•		
All features will be la	beled using the options	specified.			
Text String					
Label Field:	Name		-	Expression	
Text Symbol				_	
	ABc	 Arial B 	+ 10 ! <u>U</u> Sym	▼	
Other Options Placement P	roperties	Scale Range	Pre-defined Labe	el Style	
				OK Cancel	Apply

If you wish to make the label stand out more, you can add a halo.

3. Click Symbol:

Name		✓ Expression
ABc	Arial	▼ 10 ▼ I I Symbol
nt Properties	Scale Range	Pre-defined Label Style Label Styles

4. Click Edit Symbol:

Current Symbol					
AaBbYyZz					
Color:					
V Anal					
Size: 10 🔻					
Style: B I U ST					
Edit Symbol					
Save As Reset					
Style References					
OK Cancel					

5. Click Mask > Halo:

Properties:				
Type: Te	xt Symbol	•	Units:	Points
General	Formatted Text	Advanced Text Ma	ask	
Style: No Hal Size:	ne lo 2.0000	Symbol		

- 6. Click OK.
- 7. Click OK.
- 8. Click OK at the Layer Properties box.

Zoom in a little to check the location of some of the proposed sites in Cumbria.

In ArcMap you can zoom in by:

- 9. Moving the scroll wheel on your mouse AWAY from the screen.
- 10. Click the Zoom in button then click on the map:





CREATE A MAP TO INSERT IN A REPORT

Now let's create a map image to export from ArcMap and insert in a report. If you already know how to do this, feel free to move on to the next section, <u>Add Contour Lines</u>.

MAP LAYOUT

First, you need to switch from Data View to Layout View.

1. Click the second button from the left, at the botton left on the map display area:



Your map display area will change. You can now select options from the **Layout toolbar** and the **Insert menu** to set up your map for printing.





- 2. Click Insert > Legend.
- 3. You only want the Wind Farms on the legend. Select all 4 tif files and click the left arrow to remove them from your legend.
- 4. Click Next.

Legend Wizard	
Choose which layers you want to inclu Map Layers: WindFam_Proposed2011 Contour_lines WindFam_Proposed_Buffer windFam_Proposed_Buffer weng50k tif nweng0Sterrain_dtm.tif 1:250000 raster nx.tif sc.tif sc.tif Set the number of columns in your lease Preview	de in your legend Legend Items WindFarm_Proposed2011 Trx.tif ny.tif sc.tif sd.tif e e e e e e e e e e e e
	< Back Next > Cancel

- 5. Change the Title to Proposed Wind Farms Cumbria.
- 6. Click Next.

Legend Wizard	Share and a second	x
Legend Title		
Proposed Wind Farms - Cumbria		
Legend Title font properties	Title Justification	
Color: Size: 14 -	You can use this to control the justification of the title with the rest	
Font: 🙆 Arial	▼	
<u>в</u> <i>I</i> <u>и</u>		
Preview		
	< Back Next > Cance	;

- 7. Select settings for the frame; we suggest a light grey background with a 1.5pt border and gap. Use the preview if you are unsure.
- 8. The next screen lets you change the size of the legend symbols. Just click Next.
- 9. The next screen is about spacing the legend items.
- 10. Click Finish.
- 11. You can now click and drag the legend box around until you are happy with its position.
- 12. Now Insert > North Arrow and select a style and position for the arrow on the map.
- 13. Insert > Scale bar and select a style and position for it on the map.

EXPORT IN LAYOUT VIEW

Now lets export the map as an image.

1. Click File > Export Map:

<u>F</u> ile	<u>E</u> dit <u>V</u> iew <u>B</u> ookmarks	Insert	<u>S</u> el
	<u>N</u> ew	Ctrl+N	
1	<u>O</u> pen	Ctrl+0	
	<u>S</u> ave	Ctrl+S	
	Save <u>A</u> s		
	Save A <u>C</u> opy		ł
	S <u>h</u> are As		۲
	Add Da <u>t</u> a		۲
	S <u>ig</u> n In		
	A <u>r</u> cGIS Online		
	Page and Print Set <u>u</u> p		
	Print Pre <u>v</u> iew		
e	<u>P</u> rint		
	<u>E</u> xport Map		
(

- 2. Select a folder to save the map.
- 3. Select a format from the dropdown box e.g. JPG.
- 4. Select a size appropriate for your print requirements, we have gone for 150dpi.
- 5. Click Save.

Q Export Map		E-17-	Section States	×
Save in:	👝 Removable D	isk (E:)	- 🕝 🏚 📂 🗔 -	
A	Name	*	Date modified	Туре
	lfseventsd]		01/08/2011 11:37	File folder
Recent Places	.Spotlight-V	100	01/08/2011 11:37	File folder
	📗 .Trashes		01/08/2011 11:37	File folder
	퉬 path		17/05/2011 11:58	File folder
Desktop	🌗 Portable Pho	otoshop CS	13/06/2011 12:45	File folder
<u> </u>	퉬 xampp		17/05/2011 12:05	File folder
	퉬 Xerte Presen	tation	17/05/2011 15:30	File folder
Libraries	🐌 Xerte Works	hop Resources	17/05/2011 15:29	File folder
Computer				
Network	•	III		•
Network	File name:	wind farms cumbria.jpg	•	Save
	Save as type:	JPEG (*.jpg)	•	Cancel
	1			
General Format				
Resolution:	150	🚖 dpi		
Width:	1241	pixels		
Height:	1753	pixels		
Write World F	File			
Clip Output to	Graphics Extent			

You should be able to double click on the JPG file to view the image of your map.



NOTE: we have exported our map while in Layout view. This has given us an image that we can use in documents. If we want to export our map and re-use it in GIS, we will need to export it in Data view – that way we can get a World file, i.e. a file with the geographic coordinates of our map.

EXPORT IN DATA VIEW

- 1. Switch back to Data View we have to switch to data view if we want to create a World file with our map.
- 2. Click File > Export Map.
- 3. Make the required settings.
- 4. Tick the Write World File box. If you think you will want to use your exported map in GIS, you will need a World File (a file containing the geographic coordinates for your map).
- 5. Finally click Save.

General Format		
Resolution:	150 🤤 dpi	
Width:	2120 pixels	
Height:	1594 pixels	
Write World File		

You should now have a JPG (or other chosen format) plus an additional file with a different file suffix, e.g. JGW (for a JPG) or TFW (for a TIF). The additional file contains the geographic coordinates of your map image.

Don't discard the other file, you will need it to use your exported map image in GIS.

ADD CONTOUR LINES

It will be useful to view the wind farms with contour lines, to get an idea of the height of the proposed locations.

We downloaded a map product called **OS Terrain 50** from Digimap's Ordnance Survey Collection. The data is supplied as **Shape files**.

NOTE: Our download from Digimap contained 52 Shape files. We merged these to create 2 new shape files (1 for contour lines and 1 for spot heights). We used a function in ArcToolbox to do this (Data Management > General > Merge).

1. Switch back to Data View, if you are still in Layout View:



- 2. Click Add Data.
- 3. Navigate to the Digimap_Download folder.
- 4. Double click on the folder terrain-50_229685:

Add Data	Child man O'h	x
Look in: 🛅 [Digimap_Download_wind_farms 🔹 🏠 🏠 🎲 🗮 🕶 🔛 🛍	ji 📦
aster-250k	229687	
aster-50k_2	29686	
Eterrain-50-d	ltm_229684	
terrain-50_2	29685	
citations_or	ders_90380.txt	
contents_or	der_90380.txt	
Name:	terrain_50_220685	
Show of type:	Datasets, Layers and Results Cance	el

- 5. Click the shape file contour_lines.
- 6. Click Add:

Add Data	1	12.00	-OL	×
Look in: 🛅	terrain-50_	229685 👻	🏦 🏠 🐻 🏢 📲	• 🖆 🗊 📦
 contour_lin NX84_line.sl NX84_point NX85_line.sl NX85_point NX90_line.sl NX90_point NX91_line.sl NX91_point 	es.shp hp ashp hp ashp hp ashp hp tashp	 NX92_line.shp NX92_point.shp NX93_line.shp NX93_point.shp NX94_line.shp NX95_line.shp NX95_point.shp NX95_point.shp NY00_line.shp NY00_point.shp 	 NY01_line.shp NY01_point.sh NY02_line.shp NY02_point.sh NY03_line.shp NY03_point.sh NY04_line.shp NY04_point.sh NY05_line.shp 	
Name: Show of type:	contour_ Datasets,	ines.shp Layers and Results	▼	Add Cancel

Your map probably now looks quite busy! Switch off the 1:250000 raster maps to make it clearer:



ATTRIBUTE TABLES

Our contour lines are vector map data, i.e. we have the geography of each individual contour line. Our wind farm data is also vector map data.

One feature of vector map data is that information can be stored on its attributes. Let's have a look at the attribute table:

1. Right click the **contour_lines** layer.

2. Click Open Attribute Table.

There are several fields in the contour line attribute table. The field **Prop_value** contains the height in metres of the contour.

Nata that there are two	different tunes a	of faatura in the field F	ant Turne Contourling	and Land Matar Doundary
Note that there are two) different types o	n leature în the heid F	eat ivpe – contourtine	and Landwater Boundary.

31	Polyline	os.t50.nx84.38	ContourLine	ordinary	40
32	Polyline	os.t50.nx84.39	ContourLine	ordinary	40
33	Polyline	os.t50.nx84.40	LandWaterBoundary	meanLowWater	-3
34	Polyline	os.t50.nx84.41	LandWaterBoundary	meanHighWater	2.11
35	Polyline	os.t50.nx84.42	LandWaterBoundary	meanLowWater	-3
36	Polyline	os.t50.nx84.43	LandWaterBoundary	meanLowWater	-3
37	Polyline	os.t50.nx84.44	LandWaterBoundary	meanLowWater	-3
38	Polyline	os.t50.nx84.45	LandWaterBoundary	meanLowWater	-3
39	Polyline	os.t50.nx84.46	LandWaterBoundary	meanLowWater	-3
40	Polyline	os.t50.nx84.47	LandWaterBoundary	meanLowWater	-3

Whilst not necessary for this exercise, you could use the different feature types to create a different style of line for each. The steps below could be applied to other vector data and would be useful in creating different symbols for different types of road if you were using road data, for example.

If you would like to try this, follow steps 3 to 10. If not, skip on to the next section.

- 3. Right click on the contour lines layer and select properties.
- 4. Click the **Symbology** tab.
- 5. Click **Categories > Unique Values** on the left.
- 6. Click the drop down box Value Field.
- 7. Select FEAT_TYPE.
- 8. Click Add All Values.

General Source Selection Display Symbology Fields Definition Query Labels Joins & Relates Time HTML Pop Show: Features Categories using unique values of one field. Import Value Field Color Ramp EAT_TYPE Color Ramp Unique values, many Match to symbols in a Symbol Value Label Count Quantities Charts Symbol Value Label Count Image: Call other values> <all other="" values=""> <all other="" values=""> Image: Multiple Attributes Add All Values Add Values Remove Remove All Advanced •</all></all>	Layer Properties	1.35-39	and an	LEAR	×
Show: Features Categories Unique values Unique values Unique values, many Match to symbols in a Cuantities Charts Multiple Attributes Image: Color Ramp Color Ramp	General Source Selection	ion Display Symbology Fiel	ds Definition Query Labels	Joins & Relates Time	HTML Popup
Features Import Categories Unique values, mary Unique values, mary Match to symbols in a cuantities Charts Symbol Value Label Count Import Import Import Import Import Symbol Value Label Count Import Import Import Import Import Import Impo	Show:	D	:		л — — — — — — — — — — — — — — — — — — —
Categories Unique values, many Match to symbols in a Cuartities Charts Multiple Attributes Add All Values Add All Values Add Values Add Values Add Values Remove All Advanced •	Features	Draw categories using un	ique values or one rield.	_import	
Unique values Unique values, mary Match to symbols in Cuantities Charts Multiple Attributes Add All Values Add Values Add Values Remove All Advanced	Categories	Value Field	Color Ramp		a
Origide Values, marry Match to symbols in a Quantities Charts Multiple Attributes Image: Charts Image: Charts Multiple Attributes Image: Charts Image: Charts Symbol Value Count Count Image: Charts Multiple Attributes Image: Charts Image: Charts Symbol Value Image: Charts Image: Charts <	Unique values	FEAT_TYPE		-	·
Symbol Value Charts Multiple Attributes Image: Symbol Image: Symbol Symbol Value Label Count Image: Symbol Symbol Value Image: Symbol Symbol Value Image: Symbol Add All Values Add Values Remove Remove Advalues	Match to symbols in a				-
Charts Multiple Attributes	Quantities	Symbol Value	Label	Count	
Multiple Attributes	Charts	all other values>	<all other="" values=""></all>		
Add All Values Add Values Remove All Advanced •	Multiple Attributes				
		Add All Values Add Values	Remove Remov	re All Advanced	

You should now see the Symbology tab populated with different symbols for each type of feature.

Symbol	Value	Label	Count
_	- <all other="" values=""></all>	<all other="" values=""></all>	0
	<heading></heading>	FEAT_TYPE	24259
	-ContourLine	ContourLine	23272
	-LandWaterBoundary	LandWaterBoundary	987

- 9. Accept the symbols by clicking Apply and OK.
- 10. Remember you can edit the line styles by by clicking on them one-by-one and selecting new symbols.

VIEW DIGITAL TERRAIN MODEL

Now let's have a look at Digital Terrain Model map data. This type of map data is used for 3D modelling and is very useful in visualising landscapes.

We downloaded **OS Terrain 50 DTM** from Digimap Ordnance Survey Collection. The map data was provided in ASC format, a raster format. For our area, we needed 52 tiles. We have merged the 52 tiles into 1 TIFF file. We did this using Arc Toolbox (Raster > Raster Dataset > Mosaic to new raster).

- 1. First, switch off the contour lines by unchecking the box next to them in the Table of Contents.
- 2. Click Add Data.
- 3. Navigate to the Digimap_Download folder.
- 4. Double click on the folder terrain-50-dtm_229684:

Add Data	
Look in: 🛅	Digimap_Download_wind_farms 👻 🏠 🏠 🗔 🏢 👻 😂 📑 🚳
aster-250k	_229687
raster-50k_2	29686
terrain-50-d	itm_229684
terrain-50_2	29685
citations_or	ders_90380.txt
contents_or	'der_90380.txt
Name:	terrain 50 day 200694
Show of type:	Datasets, Layers and Results Cancel

5. Click on the file nweng_dtm.tif.

Add Data			×
Look in: 🛅 te	errain-50-dtm_229684	- 📤 🏠 🗔 🏥 - 🖴	🖆 🗊 📚
nweng_dtm NX84.asc NX84.asc NX85.asc NX85.asc NX85.asc NX90.asc	NX92.asc NX92.asc NX93.asc NX93.asc NX94.asc NX94.asc NX94.asc	NY00.asc NY01.asc NY01.asc NY02.asc NY02.asc NY03.asc NY03.asc	
NX91.asc	NX95.asc	NY04.asc	III N'
<			4
Name: Show of type:	nweng_dtm Datasets, Layers and Results	▼	Add Cancel

A new layer has been added. Things to note:

• Lighter areas are higher. You should be able to see valleys quite clearly as they are darker.



OPTIONAL: play around with the symbology for your DTM layer. You can find symbology options by right clicking the layer, select Properties then Symbology.

MAP DATA ANALYSIS

Let's imagine we want to find out about the potential impact on areas surrounding the proposed wind farms. One way to start the analysis is to create a buffer zone around each wind farm.

ArcToolbox contains a Buffer tool.

1. Click GeoProcessing > Buffer:

Ge	oprocessing	Customize	Windov
1: 🔨	Buffer		1
5	Clip		Ð
, ~	Intersect		-
5	Union		
- ~	Merge		
5	Dissolve		
5	Search For	Tools	-
	ArcToolbox	¢	
R	Environme	nts	
×	Results		
3	ModelBuild	ler	_
>	Python		n
	Geoprocess	sing Options	.
E	Geoprocess	sing Options	

Alternatively click Arc Toolbox and select Analysis > Proximity > Buffer:



You need to complete the Input Features, Output Feature Class and Distance fields.

N Buffer	
Input Features	Buffer
Output Feature Class	Creates buffer polygons around input features to a specified distance.
Distance [value or field] Oitear unit Meters	INPUT
© Field	· ·
Side Type (optional)	•
End Type (optional) ROUND	OUTPUT DISSOLVE TYPE: NONE
Dissolve Type (optional) NONE Dissolve Field(s) (optional)	
	-
OK Cancel Environments << Hide Help	Tool Help

- 2. Input Features click the yellow folder next to Input Features.
- 3. Navigate to your Wind Farms in Great Britain folder.
- 4. Click the **WindFarm Cumbria shapefile** that you exported earlier (when we selected the Cumbria wind farms).
- 5. Click Add.



- 6. Click on the yellow folder next to Output Feature Class.
- 7. Type the name of a new feature class in the **Name** box we have used **WindFarms_Proposed_Buffer.** This will create a new shape file containing the buffer information.
- 8. Click Save.

Output Fe	eature Class	×
Look in:	🔁 Wind Farms in Great Britain 🔹 🛧 🏠 🗔 🛛 🎫 🗲 🖆 👔	5
Wind Windf Windf Windf Windf	_operationalIN.xls Farm_Consented2011.shp Farm_Operational2011.shp Farm_Proposed2011.shp Farms_Cumbria.shp	
Name:	Wind_Farm_Proposed_Buffer Save	
Save as t	cype: Feature classes Cancel	

- 9. Type **3 and select Kilometers** in the Distance field.
- 10. Click OK.

Input Features	nining avariant/Wind Forms Combrid)	Evenning alata \ \ \ \ \ \ \
2:\User Support\Training\Geo\Tr	aining exercises (wind Farms Cumbria)	
Output Feature Class		
2: User Support (Training (Geo (Training	ng exercises (Wind Farms Cumbria (Exercise	data Wind Farms in Gre
Distance [value or field] Linear unit		
	3	Kilometers 👻
Field		
		*
Side Type (optional)		
FULL		· · ·
End Type (optional)		
ROUND		· · · · · · · · · · · · · · · · · · ·
Dissolve Type (optional)		
NONE		•
Dissolve Field(s) (optional)		

Your buffer zones will automatically be added to the table of contents and your map, for example as shown in the image below:



NEXT STEPS

What could Dave do next?

• He needs to better understand the areas around the proposed sites. His first step could be to view the sites in ArcGIS with more detailed backdrop mapping, e.g. 1:50000 raster data from Digimap.



- He may want to create viewsheds, i.e. establish what can be seen from a particular vantage point, so he can understand if the wind farms block the view of any landmarks. Viewsheds allow you to specify the height above the ground of a target (in this case the turbine) and then analyse the surrounding topography to calculate where the target is visible and not visible.
- Combine the raster data with the DTM. This would help people interpret the output from his models as they will be able to see both the topography (DTM) and the built environment (raster map).
- He will want to integrate his ecological data into his model and assess the impact the development might have on groups such as raptors.

CREATE VIEWSHED

Let's try and create a viewshed. There are several proposed sites in Cumbria on our map, let's do this analysis for one of them, Former Broughton Lodge:



First, we need to create a new shapefile representing the position of the proposed windfarm. Ideally we need some more detailed backdrop data to allow us to do this.

- 1. We recommend you go to the Data Download service and download the **1:50000 raster** data from the Backdrop Mapping category, for the approximate area shown in the image below of the Data Download service.
- 2. Note that we cannot supply you with this data directly as this map data is covered by the Digimap licence and you must be a registered user of Digimap to access it.

	viiioau		
Digimap Home > Data D	ownload		
Step 1. Select Area	0	Pan & Zoom Map 💠 Search 🔍	
Use Coordinates 🔲	Draw Rectangle 📃	Showing: 1:250 000 Raster	
Use Tile Name	Select Visible Area	Deatham	
Step 2. Select Data		Moola Hill	200
Product	Allowance	Tallentire	Diadarala
OS MasterMap (0 selected	d)	Broughton Standard Bridebick	Blindcrake
Backdrop Mapping (1 sele	ected)	Flimby	
MasterMap 1:1000 Raster	(59/200) tiles	Great A595	River 00
MasterMap 1:2000 Raster	(59/200) tiles	Broughton	Den
1:10 000 Raster	(3/200) tiles	Papcastle	
OS Street View	(3/200) tiles	Camerton COGK	ERMOUTH=
1:25 000 Raster	(1/100) tiles		
VectorMap District Raster	(1/100) tiles	ireat	Embleton
1:50 000 Raster	(1/50) tiles	Righam O	
1:250 000 Raster	No limit	um Grevsouthen	
MiniScale	No limit	A66	
Land and Height Data (0 s	selected)	Bridgetoot	01 200
Vector Data (0 selected)		A595	- K
Boundary and Location Da	ata (0 selected)		High Lorto
		Winscales	BS
1			JPh (

🛞 Data Download

Once you have downloaded your data and extracted it from its zip file:

- 3. In ArcMap, click Add data.
- 4. Navigate to the folder containing your newly downloaded 1:50000 raster map data:

Add Data		x
Look in:	Digimap_Download_wind_farms ▼	
Name: Show of type:	Download_broughton+1+50000+raster_91519 Add Datasets, Layers and Results Cancel	

- 5. Double click on the folder and sub-folder.
- 6. Select the TIF file(s) within the sub- folder. Note that your folder may contain additional TIF files, depending on the area you downloaded.
- 7. Click Add.

Add Data	Contraction of the local division of the loc					/			x
Look in: 🛅 r	aster-50k_233299	•	仓		•	2	P	Ũ	
my02.tif									
os_condition	ns.txt								
Name:	ny02.tif						A	dd	
Show of type:	Datasets, Layers and Results				•		Ca	ncel	
		_							

- 8. Ensure your 1:50000 raster data is in your Table of Contents.
- 9. Uncheck all layers EXCEPT 1:50000 raster data and the Wind Farms Cumbria layer.
- 10. Zoom in to the site of the Former Broughton Lodge proposed wind farm:



CREATE SHAPE FILE AND ADD POINTS

Now let's create a new, empty shape file.

- 1. Start **ArcCatalog** on the right of ArcMap.
- 2. Navigate to the folder Wind Farms exercise data > Wind Farms in Great Britain.
- 3. Right click on Wind Farms in Great Britain, select New > Shapefile.



- 4. Give your file a name e.g. former broughton lodge.
- 5. Select **point** as feature type (we are going to add the points where wind turbines will be located).
- Select British National Grid Edit > Projected Coordinate Systems > National Grids > Europe > British National Grid.
- 7. Click OK.

Create New Shapefile	X					
Name:	former_broughton_lodge					
Feature Type:	Point					
Spatial Reference						
Description:						
Projected Coordinat Name: British_Nati	ie System:					
Geographic Coordin Name: GCS_OSG	iate System: B_1936					
4						
Show Details	Edit					
 Coordinates will contain M values. Used to store route data. Coordinates will contain Z values. Used to store 3D data. 						
	OK Cancel					

- 8. Now we want to add some data to our Shapefile the points where wind turbines will be located.
- 9. Click on the Editor Toolbar button:

Cus	tomi	ize	Windows Help					
	-1	2	😑 🇊 🗟 🚳 🖸 📴 🖕					
M	÷,	e Ed	itor Toolbar					
		c	Open the Editor toolbar so you can edit the map's data.					
	Press F1 for more help.							

The Editor toolbar should appear, to the right or below your exisiting toolbar display - some of the buttons may be greyed out:



10. Click Editor > Start Editing:

÷	Editor •	1	► _A	2	\mathcal{L}^{*}	$I_{\!\!\underline{k}}$	Ŧ	
	🧳 St	art Ed	liting				1	

- 11. Select the former broughton lodge shape file.
- 12. Click OK.

Start Editing	
This map contains data from more than one database Please choose the layer or workspace to edit.	e or folder.
Source	Туре
 Z:\User Support\Training\Geo\Training exer Z:\User Support\Training\Geo\Training exer Z:\User Support\Training\Geo\Training exer 	Shapefiles / dBase Files Shapefiles / dBase Files Shapefiles / dBase Files
About editing and workspaces	OK Cancel

We can now start editing.

- 13. Let's open the Create Features window.
- 14. Click Editor > Editing Windows > Create Features.



A **Create Features** window will open on the right of ArcMap. You should see an area Construction Tools at the bottom.



We need to select what type of feature we want to add. This is done in the Constructions Tools area, but it may be empty.

- 15. Click on the arrange templates button under Create Features (looks like a funnel).
- 16. Click Filter by > Point.

Create Features	Ψ×
Search>	• 🔍 🔊
Filter By	
Group By	
_	
	Create Features ▼ < Search> Show All Templates Filter By Group By

- 17. You should see a symbol for point appear in the Construction tools area.
- 18. Click on Point.

Construction Tools
E Point
🥕 Point at end of line

Your cursor will chage – you should see a dot on the end of it.

19. Click on the map at each point where you want the wind turbines to be located, e.g. see our 4 blue points on the image below.



20. Once you are finished adding points, click Editor > Stop Editing.



21. Click Editor > Save Edits.



We have now added new points to our shapefile.

ADD ATTRIBUTE INFORMATION TO SHAPEFILE

The next thing we want to do is add some attribute information to our shapefile – the height of the wind turbines (OFFSETA) and the height of the observer (OFFSETB).

- 1. Right click former broughton lodge in the Table of Contents.
- 2. Select Open Attribute Table.
- 3. Click the icon in the top left.

Tal	ble			
0		a - 🔓 🧕	3 🗹	🚭 🗙
for	mer_l	proughton_lo	dge	
	FID	Shape *	ld	
F	0	Point	0	
	1	Point	0	
	2	Point	0	
	3	Point	0	

4. Select Add Field.



Complete the box as follows:

- 5. Name OFFSETA.
- 6. Type Float.
- 7. Precision 5. This specifies the number of digits that can be stored in a number field. For example, the number 56.78 has a precision of 4.

- Scale 2. This is the number of digits to the right of the decimal point in a number in a field of type float or double. For example, the number 56.78 has a scale of 2. Scale is only used for Float and Double field types.
- 9. Click OK.

Add Field	
Name:	OFFSETA
Type:	Float 💌
- Field Prop	erties
Precisio	n 5
Scale	2
	OK Cancel

10. Add a new field with the same settings, naming it OFFSETB.

Now we need to set the values of OFFSETA and OFFSETB.

OFFSETA is the height of the turbines (to the top of the blades) and commercial towers seem to be about 120m high.

OFFSETB is the observer. An average person's eyes are about 1.6m off the ground. To set these values:

11. Right click OFFSETA and select Field Calculator:



12. Say Yes.

Field Calculator	×
You are about to do a calculate outside of an edit session. This method is faster than calculating session, but there is no way to undo your results once the calculation begins. Do you wish to con	in an edit tinue?
Don't warn me again Yes No	

- 13. The lower box should have OFFSETA = above it.
- 14. Type 120 in the box.
- 15. Click OK.

Field Calculator			×
Parser VB Script Python Fields: FID Shape Id OFFSETA OFFSETB	Type: Numb String Date	Functions: Abs () Atn () Cos () Exp () Fix () Int () Log () Sin () Sqr () Tan ()	
Show Codeblock OFFSETA =		* / & (+ - =
120			*
About calculating fields		ear <u>L</u> oad	<u>S</u> ave
		ОК	Cancel

- 16. Right click OFFSETB and click Field Calculator.
- 17. Enter 1.6 in the bottom box.
- 18. Click OK.

Your table should now look like this:

Ta	Table				
🗉 • 🖶 • 🏪 🌄 🖄 🐠 🗶					
former_broughton_lodge					
	FID	Shape *	ld	OFFSETA	OFFSETB
	0	Point	0	120	1.6
	1	Point	0	120	1.6
	2	Point	0	120	1.6
	2	Doint	0	120	16

19. Close the Attribute table.

CONDUCT VIEWSHED ANALYSIS

- 1. Open ArcToolbox.
- 2. Select 3D Analyst Tools > Visibility > Viewshed.



NOTE if you get a message telling you that you need Spatial Analyst ,follow these steps:

- 3. Customise > Toolbars > Spatial Analyst.
- 4. Customise > Extensions > Spatial Analyst.

Extensions
Select the extensions you want to use. Image: Select the extension you want t
Description: 3D Analyst 10.1 Copyright ©1999-2012 Esti Inc. All Bights Reserved
Provides tools for surface modeling and 3D visualization.
Close

After clicking Viewshed, complete the box:

- 5. Input raster connect to the DTM data file **nweng_dtm** (look in Digimap Download > terrain-50-dtm folder).
- 6. Input point features connect to your new shapefile.
- 7. Output raster name it something meaningful e.g. broughton_viewshed.
- 8. Curvature of Earth will be a factor for large areas leave it for this example.
- 9. Click OK.

Input raster Z:\User Support\Training\Geo\Training exercises\Data Download\Wind Farms\Digimap_Do 🗾 📴 Input point or polyline observer features	Use earth curvature corrections (optional)
Z:\User Support\Training\Geo\Training exercises\Data Download\Wind Farms\former_brou 🖆 Dutput raster Z:\User Support\Training\Geo\Training exercises\Data Download\Wind Farms\broughtonVS	Allows correction for the earth's curvature.
Z factor (optional) Use earth curvature corrections (optional) Refractivity coefficient (optional)	 Unchecked—No curvature correction will be applied. This is the default. Checked—Curvature
0.13	correction will be applied.

If it works, your map will change and you will see a green tick in the bottom right of the screen:



What you are seeing on your map is a binary image showing areas where the wind turbines are visible and where they are not visible.



The next task is to take this output file and present it in a meaningful way.

DISPLAY VIEWSHED ANALYSIS VISUALLY

Ideally we want to be able to see the viewshed data with one of the raster maps, to understand from what points the turbines are visible. It would be really useful to combine this with a relief map which shows us hills more clearly.

Let's create a relief map, using our DTM data.

- 1. Open ArcToolbox.
- 2. Select 3D Analyst > Raster Surface > Hillshade.



- 3. The input raster is the DTM file **nweng_dtm.**
- 4. Select a folder and a name for the output relief map e.g. reliefshade.
- 5. Set the Azimuth at 250 this will give us shading at late afternoon.
- 6. Keep the default value of 45 for the altitude.
- 7. Click Save.

M Hillshade	
Input raster	Azimuth (optional)
Z:\User Support\Training\Geo\Training exercises\Data Download\Wind Farms\Digimap_Do 🔽 👩	
Output raster	Azimuth angle of the light
Z:\User Support\Training\Geo\Training exercises\Data Download\Wind Farms\Viewshed\reliefshade	source.
Azimuth (optional)	The azimuth is expressed
250	in positive degrees from 0
Altitude (optional)	clockwise from north
CtH CtH	
Model shadows (optional)	The default is 315 degrees.
Z factor (optional)	
1	
	Ŧ
OK Cancel Environments << Hide Help	Tool Help

Your map should change to show a relief map.



Now we can display different map data to try and convey the viewshed information more meaningfully.

- 1. First, tick the following map layers to ensure they are switched on:
 - 1. 1:250000 raster.
 - 2. broughtonVS (or whatever you called your viewshed layer).

- 3. former broughton lodge (or whatever you called your new shape file with the wind turbine locations).
- 4. Reliefshade, your new relief map
- 2. Change their order in the table of contents by clicking and dragging on them. We recommend this order from top to bottom shapefile of wind farm locations, viewshed layer, 1:250000 raster map, relief map:

former_broughton_lodge
broughtonVS
Not Visible
Visible
I:250000 raster
🗄 🗹 nx.tif
🗄 🗹 ny.tif
🗄 🗹 sc.tif
🛨 🗹 sd.tif
🖃 🗹 reliefshade
Value
High : 254
Low:0

Play around with the transparencies of different layers.

- 3. Right click broughtonVS > Properties > Display and change the transparency to 50%.
- 4. Click OK.
- 5. Try a similar, or higher, transparency number for your raster map.

Layer Properties	×
General Source Key Metadata Extent Displa	ay Symbology Fields Joins & Relates
Show MapTips	
Display raster resolution in table of contents	
Allow interactive display for Effects toolbar	
Resample during display using:	
Nearest Neighbor (for discrete data)	▼
	Orthorectification
Contrast: 0 %	Orthorectification using elevation
Brightness: 0 %	Constant elevation: 0
Transparency: 50 %	○ DEM nweng50k.tif
	Elevation adjustment
Coarse Medium Normal	Z Factor: 1
······	Z offset: 0
	Geoid:
	OK Cancel Apply

Hopefully your map will now display your viewshed data with the raster map and your relief map underneath, to help those reading your research understand where the turbines are visible.



NOTE: the viewshed analysis does not take account of buildings. So whilst your map makes it look as if the turbines are visible from the centre of Cockermouth, this may not be the case from every angle.