





**INTRODUCTION TO QGIS** 

## **PRACTICAL EXERCISE 1B**

This exercise builds on Practical 1A. Its purpose is to demonstrate some of the very basic handling procedures for work sessions involving three main types of data you will be using in QGIS (i.e. vectors, rasters and ASCII-based data). The tasks that follow are designed to introduce the following:

- 1) Working with data files (vectors and rasters) from different sources and in different coordinate systems and projections
- 2) Exploring simple data selection and extraction methods
- 3) Working with data in ASCII format
- 4) Changing the properties of raster and vector data for better visualization and analysis

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## **1** INTRODUCING RASTERS

## **1.1 Looking at Raster Properties**

In this section you will be introduced to examples of raster datasets. The main raster files you will be working with are located in your workspace folder and listed below:

- 1. "CMORPH\_DLY\_025deg\_20140629\_float.tif" Provides daily global rainfall estimates (in mm) at a spatial resolution of 0.25 x 0.25 degrees.
- 2. "CPC\_GLB\_DLY\_PREC\_20140629\_float.tif" Provides daily global rainfall estimates (in mm) at a spatial resolution of 0.5 x 0.5 degrees.

Note: During this exercise we will refer to the former layer as "Layer 1" and the latter as "Layer 2".

The source of these data is the Climate Prediction Center (<u>http://www.cpc.ncep.noaa.gov/</u>). These files provide estimations of rainfall on a global scale; at the same temporal resolution but at different spatial resolutions. Data reflected in each layer is associated with a 24-hour period covering the date, June 29<sup>th</sup>, 2014.

Start a new instance of QGIS, save it as **"Practical Exercise 1B"**; import these layers through the **Browser Panel** and let's get started.







Note: With the precipitation raster files loaded, your Map Canvas and Layers Panel should resemble the previous image. In the last exercise you explored examples of Vector Data. Now we will begin by exploring Rasters.

- Disable Layer 1 ("CMORPH\_DLY\_025deg\_20140629\_float.tif") so that only Layer 2 ("CPC\_GLB\_DLY\_PREC\_20140629\_float.tif") is visible in the Map Canvas.
- 2. Right-click Layer 2; open the **{Properties}** menu and activate the **{General}** tab.

Tip: You can open the layer {Properties} menu from the Layers Panel by doubleclicking on a layer symbol or layer name.

3. Observe the **Coordinate Reference System** associated with the layer.

🏑 Layer Properties - CPC_G	SLB_DLY_PREC_20	140629_float   General			? ×
General	▼ Layer info				
	Layer name	CPC_GLB_DLY_PREC_20140629_float	displaye	d as CPC_GLB_DLY_PREC_20140629_float	
Style	Layer source	D:/GIS_Workspace/CPC_GLB_DLY_PREC	_20140629_float.tif		
Transparency	Columns: 722	Rows: 360 No-Data Value: n/a			
👜 Pyramids	▼ Coordinate	eference system			
Histogram	Selected CRS	(EPSG:4326, WGS 84)			•
Metadata	▼ Scale de	pendent visibility			
	Minimum (exclusive) 🖉	0 1:100,000,000	Maximur (indusiv	n e) 🕀 [1:0	•
	Style •			OK Cancel Apply	Help

Note: Spatial data in GIS platforms are associated with two main types of Coordinate Systems. These are known as Geographic Coordinate Systems and Projected Coordinate Systems. The former applies a method for describing the position of a geographic location on the earth's surface using what are known as datums. A datum is a system that enables accurate location of objects (via





latitudes, longitudes and altitudes) modelled on a three-dimensional surface that is representative of the earth. With Geographic Coordinate Systems, angular measurements (in degrees) are used to identify a point on the earth's surface relative to the earth's centre. However, a "Projected Coordinate System" is defined on a flat, two-dimensional surface. Unlike a Geographic Coordinate System, a Projected Coordinate System has constant lengths, angles, and areas across the two dimensions. It is important to note that Projected Coordinate Systems are always derived from Geographic Coordinate Systems which use a spheroid for their earth model. Examples of the numerous Geographic Coordinate Systems and Projected Coordinate Systems are available for use within QGIS.

The Coordinate Reference System associated with Layer 2 is "EPSG:4326, WGS 84" - (See previous image). This is a popular Geographic Coordinate System used for mapping and analysis at both local and global scales. It is commonly associated with GPS, 3D global models, web-based geospatial tools and many other types of applications.

4. Now activate the **{Metadata}** tab under the **Layer Properties** menu and refer to the **{Properties}** section as shown in the following image.

General	Description		
Style	Title		
Transparency	Abstract		
🚔 Pyramids	Keyword list		
Histogram	Data Url	Format	•
Metadata	Attribution		
	Title		
	In		
	▼ MetadataUrl		
	Type Format		
	▼ LegendUrl		
		Format	-
	Properties		
	Driver		
	GDAL provider		
	GIIT		
	GeoTIFF		

Note: The {Properties} section provides basic information about the Raster. You can scroll through the list of properties to gain useful information. For the purposes of this exercise we will focus on just five of these properties.





5. Scroll through the properties listings to the "**Pixel Size**" heading and view the information listed.

Properties	
Pixel Size	
0.5,-0.5	
No Data Value	
*NoDataValue not cet*	

Note: This section contains very important information about your Raster. The pixel size of a raster (given in two dimensions) tells us the width and height of a single cell within the raster. In turn, the dimensions or size of a cell tells us about the spatial resolution of the raster layer. From the information provided, you can see that the raster has a spatial resolution of 0.5 degrees. We know the resolution units are in degrees, since the layer uses a Geographic Coordinate System.

It is often important to know the spatial resolution of the raster you are using. Smaller cell sizes indicate higher resolutions and larger cells sizes indicate lower resolutions. This information can help you to make decisions about how the raster is applied in mapping or analyses. For example, if you are comparing two or more rasters, you may need to first ensure that they are all of the same resolution so that the validity of your comparison is not compromised. Alternatively, knowing the resolution of a raster can help you to determine its suitability for certain applications. For example, with in-depth analyses that require high levels of precision, it would be better to use a raster with a higher resolution, due to the accuracy benefits provided by small cell sizes. However, for quick preliminary analyses where high precision is not a requirement, a lower resolution may be more appropriate.

6. Next, scroll to the "Layer Spatial Reference System" heading and view the details listed.



Note: The information contained here is very useful because it tells you about the projection used to render the raster and also the datum which the coordinate system uses. Two data layers that portray the same geographic area may not necessarily line up if they use different projections. However, one may be more easily transformed to align with the other if they both use the same datum.





- 7. Switch off Layer 2 and enable Layer 1.
- 8. Repeat steps 2 to 6 with Layer 1 and compare the information.

Note: You should notice that Layer 1 and Layer 2, each use the same Geographic Coordinate System and hence, the same datum. However, they are of different spatial resolutions. Layer 1 has a spatial resolution of 0.25 degrees which is higher than the resolution of Layer 2 (0.5 degrees).

 Next, view the "Layer Extent (Layer original Source Projection)" heading under the {Metadata} → {Properties} section for each layer and compare the information.

#### Layer 1

Tprojelongiaz radametroson mo_acts	-
Layer Extent (layer original source projection)	
-180.25000000000000,-60.00000000000000000000000	
Pand	

#### Layer 2

TProj-longiar Tuatum-Waber Tho_ders	-
Layer Extent (layer original source projection)	
-180.50000000000000,-90.0000000000000000000000	
Pand	

Note: From looking at the layers in the Map Canvas, we can see that they both cover a global scale with some degree of overlap. However, Layer 2 appears to have a larger Geographic extent than Layer 1. This is confirmed by the information under the Layer Extent heading as seen above. Layer 1 covers a rectangular area that is enclosed by Latitudes, -180.25 degrees and 180.25 degrees and Longitudes -60 degrees and 60 degrees. However Layer 2 covers a wider rectangular area stretching from -180.5 to 180.5 degrees for Latitudes and from -90 to 90 degrees for Longitudes.

10. Next, locate the "Band 1" heading under the {Metadata} → {Properties} section for each layer and compare the statistical information present. Two important fields to take note of are the "Statistics\_Maximum" and "Statistics\_Minimum" fields. The former will tell you the maximum pixel value within the layer and the latter indicates the minimum pixel value.





#### Layer 1

*	Properties	
	STATISTICS_MAXIMUM=232.90625	
	STATISTICS_MEAN=2.6913935432325	
	STATISTICS_MINIMUM=0	<b>•</b>

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#### Layer 2

STATISTICS_MAXIMUM=174.0181427002	
STATISTICS_MEAN=-640.58195014949	
STATISTICS_MEDIAN=9.5509748522269e-256	
STATISTICS MINIMUM=-999	-

Note: A band may be considered to be a matrix of a specific type of data about a geographic area with a specified extent. Many rasters consist of a single band, which means only one type of data can be obtained for cell areas within a specified region. However, some rasters may contain two or more coincident bands which each provide a different type of information for the same cell locations.

Each of the layers currently loaded in QGIS are single band rasters. The "Band 1" heading shows the statistics across all the cells in the raster. From these statistics we see that the cell values in Layer 1 range from 0 to 232.9062. However in Layer 2, the minimum cell value is -999 and the maximum is 174.0181427002. While it is customary to assume that a value such as -999 or -9999 represents a code for absence of data (.i.e. a No DATA value). It is still advisable to consult the metadata for verification under the "No Data Value" section. Please note that "No DATA" values have not been officially set for either layer (see images below).

#### Layer 1







#### Layer 2

0.5,-0.5	
No Data Value	
*NoDataValue not set*	
Data Type	
Data Type	

## **1.2 Looking at Raster Cells**

In exercise 1A, you used the **Identify Tool** to obtain information about Vectors. Now you will do the same with the raster layers in your **Map Canvas**.

- 1. Disable Layer 2 in your map.
- 2. Highlight Layer 1 in your **Layers Panel**; activate the **Identify Tool** and click on a random area within the raster.

ature	Value
0	CMORPH DLY 025deg 20140629 float
E CMORPH DLY 025deg 20140629 float	
Band 1	8.600003242492676
_ (come)	
. 12	-
de Current layer	Auto open form

Note: The *Identify* table results will Under appear. the Feature Column, there should be an entry named "Band 1" and a corresponding value under the Value column. In the example (shown left), the value for the cell clicked on in Band 1 is 8.60000322492676.

You may also notice that the option to view feature results through a form is unavailable.

This function is typically only available with vectors, for displaying multiple attributes that can be arranged in columns.

Tip: Try zooming in on the raster until its cellular structure is more apparent and then click on a cell of your choice. The following image gives an example.



😢 QGIS 2.8.3-Wien				
Project Edit View Layer Settings Plugins Vector Raster Database	Web MMQGIS Processing	Help		
🗅 📂 🗒 🜄 🖓 🚸 🖑 😓 🗩		A 2 Q Q - R	۰ 📑 📰 📲 -	🖵 📫 🗂 💻
Layers 🖉 🗙				
d 🤏 🔻 🖪 🖪 🔒				
CHORPH DLY 025deg 20140629 float   0 0   27.0171 CPC GLB DLY PREC_20140629 float				
-999	Identify Results	B		
8.62258	🗔 🖬 🗔 🚍 🍕	8 🖶		
	Feature	Value		
	⊖ -0 ⊖ MORPH_DLY_025deg H Band 1 ⊕ (Derived)	CMORPH_DLY_025deg_2014 9.27500057220459	67	
	Mode Current layer	Auto open form		
	View Tree 🔻	Help		
Layers Browser				
There is a plugin update available	Coordinate:	-65.620,1.620	Scale 1:2,585,097 ▼ Rotation: 0	.0 • Render @ EPSG:4326

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Note: as you click around in random spots on the raster, you may come to notice that the black areas in the raster have a cell value of zero and that values greater than 0 exist for cells ranging from very dark grey (almost black) to white.

Tip: Once zoomed in, you can use the pan tool to move the raster around and look at different cells. Also remember to return the raster to its full extent of view by using the Zoom Full tool. Alternatively, you can return to the full extent of view by right-clicking the raster in the Layers Panel and choosing {Zoom to Layer} from the menu.

3. Disable Layer 1; enable Layer 2 and explore its cell values with the Identify Tool as outlined in the previous step.





## **2 DIFFERENCES IN PROJECTIONS**

Now that you've had some practice importing and looking at some of the properties of rasters. We shall explore an example of dealing with layers that use different projections.

There are times when you will work with multiple datasets created by different entities that each use different data management and development standards. One common type of issue encountered in such scenarios is the variations seen in coordinate and projection systems applied to datasets that describe the same geographic area. This will often mean that datasets (with such differences), which should be rendered within the same geographical extent, can possibly be drawn in totally different regions of space on a two-dimensional plane. However, most GIS platforms have the ability to apply what are known as mathematical transformations to change the way data are projected onto a two-dimensional plane. These transformations allow layers with these differences (in coordinate systems and projections) to be drawn together in the same geographic space.

In QGIS there is an option within the **{Project Properties}** sub-menu of the main **[Project]** menu known as **"Enable 'on the fly' CRS Transformation"**. Once this option is selected, QGIS is then prompted to transform all incoming layers with different projection systems to match system that the Project is using to render other layers already in the **Map Canvas**. This is particularly effective when the incoming layer uses the same datum as the layer or layers already in the map. This section explores how this function works and also exposes the importance of working with layers that are in the same coordinate and projection system.

## 2.1 Layer Transformation in QGIS

- 1. Return the **Map Canvas** to the full extent of view and ensure that only Layer 2 is enabled in the **Layers Panel** and the **Map Canvas**.
- 2. Use the **Browser Panel** to locate and add the vector layer named, "Global\_Countries\_WorldMercator.shp".





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Note: You've just added the vector layer to the Map Canvas which illustrates countries on a Global Scale. Notice how it appears to line up with the enabled raster in your Map Canvas. Recall that the Coordinate System used by the raster layer is WGS 84, which is a Geographic Coordinate System. However, Geographic Coordinate Systems still need to be projected onto a 2D plane for visualisation on your screen. When drawing layers encoded with WGS 84, QGIS uses a system known as plate carée to map the angular units to linear 2-dimensional units of longitude and latitude for display in the Map Canvas.

3. Open the **{Properties}** menu for the vector layer; activate the **{Metadata}** tab and browse to the **"Layer Spatial Reference System"** heading.

Note: Here you will discover that the vector file in your Map Canvas is using a different projection system, but the same datum as your raster layers. If you return to the {Properties} menu and open the General Tab. You may also discover that it is using a Projected Coordinate System known as "EPSG: 54004, World\_Mercator".

The reason these layers line up in the Map Canvas is due to the Project Properties setting previously mentioned (i.e. "Enable 'on the fly' CRS Transformation").









4. Select the main [**Project**] menu; select {**Project Properties**} and then activate the CRS tab as shown in the following image.

General		
A.	Enable 'on the fly' CRS transformation	
CDC	Filter	
CRS	Recently used coordinate reference systems	
🕺 Identify layers	Coordinate Reference System	Authority ID
V Default styles	IGN 1972 - Lambert Nouvelle Caledonie WGS 84 / UTM zone 21N WGS 84 / Pseudo Mercator Barbados 1938 / Barbados National Grid Unknown datum based upon the Authalic Sphere	IGNF:IGN72LAM EPSG:32621 EPSG:3857 EPSG:4212 EPSG:21292 EPSG:4035
Macros	World_Mercator WGS 84	EPSG:54004 EPSG:4326
Relations		
	Coordinate reference systems of the world	
5	Coordinate Reference System	Authority ID
	Voirol 1875 (Paris)	EPSG:4811
	Voirol 1879	EPSG:4671
	Voirol 1879 (Paris)	EPSG:4821
	WGS 66	EPSG:4760
		EPSG:4322
	WGS 72BE	EPSG:4324
		EPSG:4324 EPSG:4326
		EPSG:4324 EPSG:4326

Note: The highlighted field at the bottom of the CRS menu indicates the main coordinate system deployed for the project. The project takes on the coordinate system of the first layer or layers added to the Map Canvas. Since the first two raster layers added were registered in WGS 84, then the project inherited this coordinate system from the raster layers. If layers using different types of coordinate systems and



projections are added to the Map Canvas, QGIS will automatically attempt to transform the newly added layer so that it is compatible with the pre-existing layers. In this case, the vector layer was transformed to match up with the rasters. This was made possible by the setting seen at the top of the CRS menu (i.e. "Enable 'on the fly' CRS transformation" – See previous image). If you were to disable this option, the transformation would be removed and incompatible layers would no longer align.

5. Uncheck the option ("Enable on the fly CRS transformation") in the CRS menu; Click **{OK}** and see what happens.



Note: Your vector layer, although enabled in the Layers Panel, is now missing. It has disappeared!! This happened because without the Transformation, the Projected System coordinates, which are based on metric values cannot be exchanged for coordinates in the same range used to display the rasters on your screen. The vector layer is still in your map, but simply now out of range of the geographic extent shown in the Map Canvas. To view the vector layer you will need to zoom to the extent where the layer is actually situated.

6. Right-click the vector layer in the Layers Panel and select {Zoom to Layer}.





Note: The Vector layer should now be visible in the Map Canvas while the rasters are not. You may also notice that the appearance of the layer is somewhat different from when previously transformed to line up with the rasters.



Tip: Activate the Touch Zoom and Pan Tool (shown above); pass your mouse over any area of the map and observe the coordinates in the Status Bar. You will notice that the coordinate values are far larger than those for the rasters. This is because the coordinates revealed are actually the projected system coordinates (in metres) which far exceed the range of coordinate values listed for the rasters. You can verify this by returning to the extent of one of the rasters and using the Touch Zoom and Pan Tool along with the Status Bar. You will notice huge differences in the coordinate numbers for the same general areas.

S Coordinate:	-7760204,-5987241	
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Note: The map coordinates above were taken from the vector layer for an area in a southern part of South America. However, the coordinates below were taken from one of the raster layers for an area in the same vicinity.

S Coordinate:	-71.8,- <mark>4</mark> 7.4	
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7. Zoom to the extent of the raster layer; open **{Project Properties}**, reactivate the **"Enable on the fly CRS transformations"** option and hit **OK** 

Note: This will realign the layers. Use the Zoom Full tool to reset the Map Canvas.

## 2.2 Coordinate System Compatibility

Compatibility between layers in QGIS is essential for mapping and spatial analysis. Although QGIS may be capable of performing transformations that satisfy visualization objectives, there are many spatial processes which still require that layers be in the same coordinate system for processing to yield accurate results or to even function. The next steps illustrate how to change the coordinate systems that layers are registered in. The Vector Layer, which is in a Projected Coordinate System ("World Mercator") that uses the WGS 84 datum, will be converted to a new layer that is registered in the WGS 84 Geographic Coordinate System to ensure compatibility with the raster layers.

1. Right-click the vector layer in the Layers Panel and select {Save As}.

Note: This will launch a menu with options you can configure for saving the layer. See image below.

Save as D:/GIS_Workspace/Global_Countries_2_WGS84.shp	Browse
CRS Selected CRS (EPSG:4326, WGS 84)	
Encoding System	
Save only selected features	
Skip attribute creation	2
X Add saved file to map	
Symbology export No symbol	ogy 👻
Scale 1:50000	
Extent (current: layer)	
▼ Datasource Options	







- 2. Set the following menu fields as instructed below and hit **{OK}**:
  - Format: Select "ESRI Shapefile"
  - Save as Use the Browse button to locate the workspace directory on your desktop as the location to save the save. There is already a file in your workspace folder named, "Global\_Countries\_WGS84". If you enter the same file name, the vector layer in your workspace will be overwritten. Therefore, you should name this file, "Global\_Countries\_2\_WGS84" and hit {Save}.
  - CRS This field currently reflects the World Mercator coordinate reference system. However, the new layer you are creating must instead use the WGS 84 coordinate system. Hence, you'll need to specify the change here. Hit the Select CRS button (see below) to open up the Coordinate Reference System Selector menu.

Coordinate Reference System Se	lector		and the second s
Select the coordinate reference system	n for the vector file. The data point	ts will be transforme	d from the layer coordinate
ilter ecently used coordinate reference syst	tems		
Coordinate Reference System		Authority ID	
WGS 84 / UTM zone 21N WGS 84 / Pseudo Mercator Barbados 1938 Barbados 1938 / Barbados National Gric Unknown datum based upon the Authal	d lir Sohere	EPSG:32621 EPSG:3857 EPSG:4212 EPSG:21292 EPSG:4035	
World Mercator WGS 84		EPSG:54004 EPSG:4326	1 Ē
•			
Coordinate reference systems of the wo	orld	eren en e	Hide deprecated CRSs
Coordinate Reference System		Authority ID	
🗄 🔮 Geographic Coordinate Sy	stems		
Projected Coordinate Syst	tems		
	y stems		
1	***** *****		<b>    )</b>
elected CRS: WGS 84			
elected CRS: WGS 84	e		
+proj=longlat +datum=WGS84 +no_d	efs		



Since you've already used the WGS 84 Coordinate System in your project it should be listed under "**Recently used coordinate reference systems**". You may scroll through the list and select it. The selection you make (WGS 84) should be reflected at the bottom of the menu under the "**Selected CRS:**" field. Refer to previous image.

Note: If for some reason your list of recently used coordinate reference systems is empty, you can find the WGS 84 coordinate system by using the Filter field or by searching manually under the Geographic Coordinate Systems list at the bottom of the menu. However, using the Filter field is perhaps the most effective way of locating the CRS of your choice. Simply type "WGS 84" into the Filter field exactly as stated and it will be located in the Geographic Coordinate Systems list.

Once the WGS 84 coordinate system has been selected, click **{OK}** to return to the previous menu.

> Add saved file to map – Select this option



Note: After selecting {OK}, a new version of the Countries layer named, "Global\_Countries\_2\_WGS84" should appear in your map. You can check out its Metadata and General properties to confirm that the coordinate system (WGS 84) has been correctly assigned.

 Remove the previous vector layer ("Global\_Countries\_WorldMercator") from the Layers Panel.

Note: Now you can perform another test to see whether your task of changing the coordinate system of the Countries layer actually worked. If you open up the {Project Properties} menu; turn off the "Enable 'on the fly' CRS transformation" option and hit {OK}, the countries layer should not disappear this time. If it stays in view within the Map Canvas it would suggest that the layer didn't need to be



transformed because it was using the same coordinate system as the raster layers (i.e. WGS 84). You may run this test to confirm the results.

4. Try changing the coordinate system of the project, under **{Project Properties}** from WGS 84 to the World Mercator coordinate system and then convert the raster layers from the WGS 84 coordinate system to the World Mercator coordinate system.

Note: When creating the new raster layers, add the suffix, "\_WorldMercator" to the file names you choose. You should also be aware that the Save menu for rasters is a bit different from the one used with vectors. An example is shown below.

Save	raster layer as	₹ <mark>.</mark> ×
Dutput n	node 🖲 Raw data 🛛 Rendered image	
ormat	GTiff	▼ Create VRT
ave as	CMORPH_DLY_025deg_20140629_float_WorldMercator	Browse
RS EP	SG:54004 - World_Mercator	-
Exte	ent (current: layer)	
Reso	olution (current: layer)	
	Create Ontions	
	Pyramids	
	No data values	
		OK Cancel

- Output Mode Choose "Raw data"
- Format Choose "GeoTiff"
- Save as Use this field to create a new file name
- CRS Use the Select CRS menu to choose the World Mercator coordinate system



Select {OK}

Tip: Remove the WGS 84 encoded layers from the Map Canvas after you've created the new raster versions and then test that the coordinate systems have been changed correctly.





# **3 BASIC GEOPROCESSES**

This section introduces several simple methods for selecting features within a vector dataset. A selected vector feature will be exported as a separate layer and used as a mask for "clipping" the extent of a raster. Finally, you will learn how to plot ASCII data in QGIS as points. These are all useful operations which may be applied to analysis and mapping of climate data.

## 3.1 Selecting Features from the Attribute Table

- 1. Remove all layers presently in your Layers Panel.
- Load the WGS 84 versions of the precipitation rasters and either of the vector layers (i.e. "Global\_Countries\_WGS84" or "Global\_Countries\_2\_WGS84").
- 3. Disable the raster layers.
- 4. Right-click on the vector layer in the Layers Panel and select {Open Attribute Table}.





Note: This opens up a table that shows all attributes associated with the layer. There are 4 attribute columns in the layer. These are described below.

- ISO3 The values in this field are official codes for the various countries and their subdivisions as designated by the International Organization for Standardization.
- > COUNTRY– This field lists the official names of countries
- SOVEREIGN This field contains the official name of the sovereign nation for which a territory/country is a part of. For example, the SOVEREIGN attribute for the country Bermuda is listed as United Kingdom.
- CONTINENT This field lists the names of the continent that a country is a part of.

The attribute table may be used to select or highlight features of interest within a layer. Once features are selected, they may be exported as standalone features. In the next step you will demonstrate this by searching the table to make a selection for the feature in the layer that represents the country of Brazil.

5. Sort the values in your attribute table (alphabetically) using the **COUNTRY** field. Do this by clicking on the field heading.

Note: Your COUNTRY column may have already been arranged alphabetically. However, clicking on field heading will ensure that the field values are sorted so that a manual search is easier to achieve.

- 6. Scroll through the list of values under the **COUNTRY** column and locate "Brazil".
- Make a selection of this feature by clicking on the row value (34) at the left end of the table. Refer to the image on the right.

1	3 👼 🗐		🧇 🗭 🔋	
	ISO3 🗸	COUNTRY	SOVEREIGN	CONTINENT
32	BWA	Botswana	Botswana	Africa
33	BVT	Bouvet Island	Norway	Antartica
34	BRA	Brazil	Brazil	South America
35	IOT	British Indian Oc	United Kingdom	Asia
36	VGB	British Virgin Isla	United Kingdom	North America
37	BGR	Bulgaria	Bulgaria	Europe
38	BFA	Burkina Faso	Burkina Faso	Africa
39	MMR	Myanmar	Myanmar	Asia
40	BDI	Burundi	Burundi	Africa
41	КНМ	Cambodia	Cambodia	Asia



Note: When a selection is made, there are two things that happen: 1) The selected feature is highlighted in the attribute table in blue and 2) the feature is highlighted in the Map Canvas (the default colour is usually yellow, but may also be a different colour). The selection is visible in the attribute table. However, if you close the table and return to the Map Canvas, you will notice that the country feature for Brazil has also been highlighted. Be sure to zoom to the full extent of the layer (if necessary) so you can see the selection made.



8. Reopen the attribute table and locate the tool shown below.

1	3 👼 🗐	- 😼 📓 🚱	🎨 💬 🗈	
	ISO3 🗸	COUNTRY	SOVERE SOVER	ap to the selected rows (Ctrl+J)
30	BES	Bonaire, Saint Eu	Netherlands	South America
31	BIH	Bosnia and Herze	Bosnia and Herze	Europe
32	BWA	Botswana	Botswana	Africa
33	BVT	Bouvet Island	Norway	Antartica
34	BRA	Brazil	Brazil	South America
35	IOT	British Indian Oc	United Kingdom	Asia
36	VGB	British Virgin Isla	United Kingdom	North America
37	BGR	Bulgaria	Bulgaria	Europe
38	BFA	Burkina Faso	Burkina Faso	Africa
39	MMR	Myanmar	Myanmar	Asia
_		- P	0 P	



9. Select the tool highlighted above.

Note: This tool will zoom the map to the extent of the features that have been selected.

10. Close the attribute table and observe the Map Canvas.



- 11. Return to the full extent of the Map Canvas.
- 12. Use steps 4 to 11 to locate, select and view 4 or 5 other countries of your choice.

Note: Once you've finished exploring this selection method, close the attribute table and return the Map Canvas to the full extent of the countries layer.

Tip: You can make more than one selection from the table at a time by using the Ctrl key. Select one feature of your choice; press and hold the Ctrl key and then select another. You can select as many features you desire with this method. In the example below, the countries Ecuador, Colombia and Venezuela were selected via this method.



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	ISO3 🗸	COUNTRY	SOVEREIGN	CONTINENT	ſ
0	ALA	Åland	Finland	Europe	ſ
1	AFG	Afghanistan	Afghanistan	Asia	-
2	ALB	Albania	Albania	Europe	
3	DZA	Algeria	Algeria	Africa	
4	ASM	American Samoa	United States	Oceania	
5	AND	Andorra	Andorra	Europe	
6	AGO	Angola	Angola	Africa	
7	AIA	Anguilla	United Kingdom	North America	
8	ATA	Antarctica	None	Antartica	
9	ATG	Antigua and Barb	Antigua and Barb	North America	
10	ARG	Argentina	Argentina	South America	
11	ARM	Armenia	Armenia	Asia	
12	ABW	Aruba	Nederland	South America	
13	AUS	Australia	Australia	Oceania	
14	AUS	Australia	Australia	Oceania	
15	AUT	Austria	Austria	Europe	0
16	AZE	Azerbaijan	Azerbaijan	Asia	

Your attribute Tip: table currently shows all features within the layer. However, you can change the display of the table so that it only shows features that have been selected. Do this by clicking the button shown (in the image on the left) and choosing {Show Selected Features} from the options.

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🧭 A	ttribute table - Glo	bal_Countries_2_W	GS84 :: Features to	otal: 265, 💷 🖻	x
/	3 🗟 🖓		🥸 💬 💽		?
	ISO3 🗸	COUNTRY	SUVEREIGN	CONTINENT	
53	COL	Colombia	Colombia	South America	
70	ECU	Ecuador	Ecuador	South America	
255	VEN	Venezuela	Venezuela	South America	
	Show Selected Featu	res 🗸			

Tip: Any selections made may be removed from the attribute table with the tool highlighted below (i.e. Unselect all). Reset the table to {Show All Features} when complete.

## 3.2 Using the Select Tool

1. Use the **Zoom in** tool or your mouse wheel and **Pan** tool if necessary, to zoom in on an area which focuses on the African Continent.



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2. Locate the tool highlighted in the image below and activate it.

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Note: This tool allows you to select features by clicking on them in the Map Canvas.

3. Click on the feature representing Sudan to select it as illustrated in the following image.







Note: You can remove the selection from the Map Canvas with the tool highlighted in the image below. Once you've tested this out, select Sudan again with the selection tool.

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4. Open the attribute table and change the view, so that only selected records are shown.

Note: You table should now only reflect one feature (Sudan) highlighted in blue, as seen in the following image.

Sudan	Sudan	Africa	
		Annea	
		Annea	







- 5. Remove the selection; reset the attribute table to display all features; close the attribute table and then return the Map Canvas to the full extent.
- 6. Use steps 1 to 4 to make 5 selections of your choice.

Tip: Multiple features can be selected by pressing and holding the Ctrl key, while clicking with the selection tool.

Note: Once you've finished exploring this selection method, remove all selections from the Map Canvas and return the Map Canvas to the full extent.

#### **3.3 Feature Extraction with Vectors**

Selections made via the attribute table or the selection tool may be exported as separate layers. The following steps illustrate how this can be achieved.

1. Locate and select the country of Barbados.



2. Right-click the countries layer in the Layers Panel and select {Save As}.







3. Set the menu as shown below.

Format	ESRI Shapefile		-
Save as	D:/GIS_Workspace/Barbados_W	GS84.shp Browse	
CRS	Selected CRS (EPSG:4326, WGS	84)	٠
Encoding	1	System 💌	
× Save	only selected features		
Skip	attribute creation		
X Add	saved file to map		1212
Symbolo	gy export	No symbology 👻	
Scale		1:50000	
	Extent (current: layer)		
Data	asource Options		-
. 1	er Options		-

- Format Choose "ESRI Shapefile"
- Save as The new file should be named, "Barbados\_WGS84" and saved to your workspace folder
- > CRS Choose WGS 84 as the Coordinate Reference System
- > Save only selected features Select this option
- > Add saved file to map Select this option
- 4. Select **{OK}** to export the selected features.

Note: A new layer ("Barbados\_WGS84") will be added to your Map Canvas. The country of Barbados is only 166 square miles in area. Therefore if you are zoomed to the full extent of the map, the selection will be too small to see clearly. However, if you turn off the countries layer; right-click on the "Barbados\_WGS84" layer in the Layers Panel and then select {Zoom to Layer}, the new layer will be clearly visible.





- 5. Remove the **"Barbados\_WGS84"** layer from the **Map Canvas**. Switch on the countries layer and return the **Map Canvas** to the full extent of this layer.
- 6. Practise selecting and exporting 5 other countries of your choice. Make sure you save all exports to your workspace folder.

Note: Once you've finished experimenting with selecting and exporting countries of your choice, remove all newly extracted layers from the Layers Panel so that you are left with only the countries layer and the precipitation rasters. Ensure that you zoom to the full extent.

### 3.4 Clipping the Extent of Rasters

You've learnt two simple methods for making feature selections and also how to extract selected vector features as separate layers. You will now investigate how to use a vector layer as a mask for extracting a region within a raster layer.

1. Locate the country of India within the countries layer and export the representative feature as a separate layer.

Note: Ensure that you save the selected features under the name, "India\_WGS84", to your workspace. Also make sure the exported layer is added to the Map Canvas.

 Switch off the countries layer; switch on the precipitation raster layer named, "CMORPH\_DLY\_025deg\_20140629\_float"; then zoom to the full extent of your layer for India.





Note: Now you will execute a function that extracts an area of the raster that covers the country of India only.

3. Browse through the main menu options and select **[Raster]** → **{Extraction}** → **{Clipper}.** 



Note: This launches the {Clipper} function which supports extraction of a raster area according to the boundaries of a specified vector.

4. Configure the raster clipper menu as shown below and click **{OK}**.

<u>I</u> nput file (raster)	CMORPH_DLY_025deg_20140629_float ▼ Select					
<u>O</u> utput file	rkspace/CMC	CMORPH_DLY_20140629_India_WGS84.tif Select				
<u>N</u> o data value	0					
Clipping mode						
O Extent		Mask laye	r			
Mask layer		India WGS84	Select			
X Create an ou	tput alpha ban	d				
Create an ou	tput alpha ban	d				
Load into canvas dalwarp -q -cutine rop_to_cutine -ds t;/GIS_Workspace, u:/GIS_Workspace,	tput alpha ban when finished 'D:/QGIS Trair talpha -of GTiff (CMORPH_DLY_ (CMORPH_DLY_	d ning in Madrid/Data/India_1 025deg_20140629_float.1 20140629_India_WGS84.1	WGS84.shp" - tif			







- Input file (raster) Select the raster file to be clipped. In this case we want to clip the raster layer named, "CMORPH\_DLY\_025deg\_20140629\_float.tif"
- Output file Name the output file, "CMORPH\_DLY\_20140629\_India\_WGS84.tif" and save it to your workspace folder.
- No data value A "no data" value has not been set for the raster layer you are about to clip. Therefore the "No data value" option should not be enabled.
- Mask Layer Enable this option under the Clipping mode section and select "India\_WGS84" from the drop-list.
- Create an output alpha band Enable this option. It will ensure that areas outside of the mask are not visible in the output. However, it will add another band to your raster which you will see listed if you use the Identify Tool, or view the raster's properties.
- > Load into canvas when finished Enable this option
- 5. Select **{OK}**.

Note: A new raster named, "CMORPH\_DLY\_20140629\_India\_WGS84.tif", should have been added to the Map Canvas. Disable all other layers in your Map





Canvas and zoom to the full extent of the clipped raster. You will notice that the area covered by the new raster is consistent with the vector layer for India.

- 6. Close the **{Clipper}** function menu.
- 7. Select and extract two more countries of your choosing, from the "Global\_Countries\_WGS84" vector layer and then use these extracted data layers to create new rainfall rasters as demonstrated in steps 1 to 6 above. Your new raster layers should be extracted from each of the global rasters provided:
  - "CMORPH\_DLY\_025deg\_20140629\_float.tif"
  - > "CPC\_GLB\_DLY\_PREC\_20140629\_float"

Note: Try zooming in to observe the differences between the clipped rasters for the regions you selected.

#### 3.5 Importing ASCII Data with Spatial Details

In this final section of the chapter, you will learn how to import spatial details stored in ASCII format and display these data as plotted vector points. In this exercise, you will do the following:

- Use methods from the previous sections to extract a specified country layer from the global countries vector file
- Use the extracted country layer to clip a raster providing temperature forecast information
- Prepare text-based data on cities within the extracted country for import
- Import city data to QGIS
- Plot cities as vector points on top of the temperature raster and country vector.
- 1. Remove all layers from the Layers Panel except for the countries.
- 2. Zoom to the full extent of this layer
- 3. Locate and extract the feature for the country of Australia.



Tip: There is more than one feature in the attribute table with the value, "Australia" under the COUNTRY field. Therefore you will need to select more than one feature in the layer.

1	3 6 8	- 😼 🔝 🔞	: 🏶 🎾 🗈		
	ISO3 🗸	COUNTRY	SOVEREIGN	CONTINENT	
11	ARM	Armenia	Armenia	Asia	
12	ABW	Aruba	Nederland	South America	
13	AUS	Australia Australia		Oceania	
14	AUS	Australia	Australia	Oceania	
15	AUT	Austria	Austria	Europe	
16	AZE	Azerbaijan	Azerbaijan	Asia	

Note: Name the extracted feature, "Australia\_WGS84.shp".



4. Use the **Browser Panel** to add the raster layer named, "gfs375\_tmax\_gis\_24\_20140717.tif" to the Layers Panel.



Note: The source of this raster layer is the Climate Prediction Center. The layer is essentially a maximum temperature output from the Global Forecast Model. It was developed for use as a 24-hour global temperature forecast, associated with the date July 17<sup>th</sup>, 2014. Zoom to the full extent of the map and proceed.



Tip: Observe the details within the General and Metadata tabs under the {Properties} menu for this raster layer. You will notice that it uses a different Coordinate Reference System from the other layers in your map (which use WGS 84). The datum it uses is unknown but based on a spherical model. However, you should note that the Coordinate Reference System used by the temperature layer is also a Geographic Coordinate System (like WGS 84) and that its spatial extent is very similar to the extent of the countries layer. This suggests that these two layers are lining up without the need for a transformation. However, it is still advisable to convert the temperatures layer to WGS 84 to ensure full compatibility.

Try creating a new version of this temperature layer that is registered in the WGS 84 CRS to ensure that it is fully compatible with your other map layers. Save the converted layer to your workspace folder under the name, "Global Temperatures 24Fcast 20140717 WGS84.tif". Add the new temperature layer to the map and remove the originally imported version.

5. Use the **{Clipper}** function under the **[Raster]** menu to extract a region of the global temperature layer that is specific to Australia.

Note: Name the newly extracted raster layer, "Australia\_Temperatures\_24Fcast\_20140717\_WGS84.tif". Save it to your



workspace folder and make sure it is imported to the map when the operation is complete.

6. Remove the global temperature and the countries layers and then zoom to the full extent of the newly extracted temperature raster for Australia.



7. Visit your desktop; open the workspace folder and launch a text file named, "Australia\_Cities. txt". The file may viewed with be any text editor application on your system.

File Edit	Format View Help							
Dank	City Populat:	ion (200	1)	Latitude	(00)	Longitude	(00)	
1	Sydney 4277200	-33 870	151 210	Latitude		Longitude		
2	Melhourne	3666000	37 810	144 060				
2	Brichane	1598600	-27 460	153 020				
1	Bonth 1412000	31 060	115 840	199.020				
5	Adelaide	1089700	-34 930	138 600				
6	Newcastle	502300	-32 920	151 750				
7	Gold coast	457900	-28 070	153 440				
R	Capherra	323100	-35 310	149 130				
a l	Wallongong	262500	34 420	150 870				
10	Sunshine coast	254700	-25 880	152 560				
11	Hobart 201000	_12 850	147 200	192.900				
12	Geelong 161500	-38 140	144 320					
13	Townswille	152400	10 260	146 780				
14	Cairps 128500	-16 920	145 750	140.700				
15	Launceston	99400	-41 450	147 130				
16	Albury-wodonga	97300	-36,060	146 920				
17	Darwin 95000	-12 430	130 850	140.520				
18	Toowoomba	91800	-27 560	151 960				
19	Ballarat	85300	-37 560	143 840				
20	Shoalbayen	81600	-34 880	150 590				
21	Bendiao 80400	-36 760	144 280	190.990				
22	Burnie-devonport	+ 50.700	78400	-41 060	145 890			
23	Bathurst-orange	76600	-33 420	149 570	145.050			
24	Mackay 72700	-21 140	149 180	145.570				
25	Hastings	68000	-38 310	145 190				
26	Rockhampton	66100	-23 370	150 510				
27	Coffs harbour	62600	-30 300	153 120				
28	Bundaberg	60300	-24 870	152 350				
29	Wagga wagga	56400	-35,120	147.350				
30	Mildura 46900	-34 190	142 160	1				
Ĩ1	Shepparton-moor	oonna	45300	-36 370	145 400			
32	Maroochydore-mod	loolaha	45100	-26,680	153,120			
33	Taree 44900	-31,900	152,470	20.000	199.120			
34	Lismore 43200	-28 810	153 290					
35	Gladstone	42900	-23 850	151 250				
36	Mandurah	40800	-32,530	115.750				
37	Hervey bay	39700	-25 200	152 840				




Note: This is a text file which lists cities in Australia and ranks them by population size. The data was obtained from, <u>http://www.tageo.com</u>. There are a few things about the file that allow it to be imported into QGIS as data which can be plotted. These are as follows:

- *i.* It is organized in columns with headings that can be interpreted as attribute field headings
- ii. The data within each row is delimited by tab spaces. These uniform gaps between values in rows can be used to correctly assign values to columns in an attribute table. Different types of delimiters such as commas, spaces, colons, semicolons and other symbols may also provide the same advantage. Without the presence of uniformly applied delimiters in textdata, import into QGIS would not be possible without some degree of preformatting.
- iii. The file contains a column of data with latitude values (in units of decimal degrees) and a corresponding column of data with longitude values (also in units of decimal degrees). These coordinate values can be used to draw/plot reference points in the Map Canvas according to a specified coordinate system.
- 8. Close the Text file in your system and return to QGIS.
- Open [Layer] from the main menu options and select {Add Layer} → {Add Delimited Layer}





le l	Name []	D:/GIS_Worl	kspace/Australia_Cities	s.txt			Browse
aye	er name	Australia_	Cities_WGS84			Encoding	UTF-8
ile f	format	0	CSV (comma separate	ed values) 🛛 🔘 C	Custom delimiters	🔘 Regula	ar expression delimiter
		6	Comma 🗶	Tab	Space	Colon	Semicolon
		Ot	her delimiters	ç	Quote "	Escape *	
ield	doptions		Trim fields Discar	rd empty fields	Decimal separator is	comma	
ield Geor	l options metry de er settin	s 📄 efinition 👁 X fi gs	Trim fields Discar Point coordinates eld Longitude (DD) Use spatial index	rd empty fields 0 W	Decimal separator is fell known text (WKT) atitude (DD)	comma No geom DMS coordinates Watch	etry (attribute only table) s file
Field	d options metry de er setting Rank	s  cfinition  X fir gs City	Trim fields Discar Point coordinates eld Longitude (DD) Use spatial index Population (2000)	rd empty fields W V field L Latitude (DD)	Decimal separator is iell known text (WKT) atitude (DD) Jse subset index Longitude (DD)	comma No geom DMS coordinate: Watch	etry (attribute only table) s file
ield Geor	d options metry de er settine Rank	s  inition  inition	Trim fields Discar Point coordinates eld Longitude (DD) Use spatial index Population (2000) 4277200	rd empty fields W W V field L Latitude (DD) -33.870	Decimal separator is 'ell known text (WKT) atitude (DD) Jse subset index Longitude (DD) 151.210	comma No geom DMS coordinate: Watch	etry (attribute only table) s file
ield Geor aye	d options metry de er settine Rank 1 2	s inition • X finition s gs City Sydney Melbourne	Trim fields Discar Point coordinates eld Longitude (DD) Use spatial index Population (2000) 4277200 3666000	rd empty fields W V field L Latitude (DD) -33.870 -37.810	Decimal separator is 'ell known text (WKT) atitude (DD) Jse subset index Longitude (DD) 151.210 144.960	comma No geom DMS coordinate:	etry (attribute only table) s file
ield Geor aye 1 2 3	d options metry de er settine Rank 1 2 3	s  finition  X fir gs City Sydney Melbourne Brisbane	Trim fields Discar Point coordinates eld Longitude (DD) Use spatial index Population (2000) 4277200 3666000 1598600	rd empty fields W V field L Latitude (DD) -33.870 -37.810 -27.460	Decimal separator is iell known text (WKT) atitude (DD) Jse subset index Longitude (DD) 151.210 144.960 153.020	comma No geom DMS coordinates Watch	etry (attribute only table) s file
Field Geor aye	r setting Rank 1 2 3 4	s Strings Sydney Melbourne Perth	Trim fields Discar Point coordinates eld Longitude (DD) Use spatial index Population (2000) 4277200 3666000 1598600 1412900	rd empty fields	Decimal separator is tell known text (WKT) atitude (DD) Use subset index Longitude (DD) 151.210 144.960 153.020 115.840	comma No geom DMS coordinate: Watch	etry (attribute only table) s file
ield Geor aye 1 2 3 4 5	r setting Rank 1 2 3 4 5	efinition • x finition gs City Sydney Melbourne Brisbane Perth Adelaide	Trim fields Discar Point coordinates eld Longitude (DD) Use spatial index Population (2000) 4277200 3666000 1598600 1412900 1089700	rd empty fields W V field L U Latitude (DD) -33.870 -37.810 -27.460 -31.960 -34.930	Decimal separator is 'ell known text (WKT) atitude (DD) Use subset index Longitude (DD) 151.210 144.960 153.020 115.840 138.600	comma No geom DMS coordinate:	etry (attribute only table) s file

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- i. File Name: Browse to your workspace folder and select the text file ("Australia\_Cities.txt")
- ii. Layer Name: Enter a name for the imported layer here. The name "Australia\_Cities\_WGS84" is recommended.
- iii. **File Format:** Choose the **"Custom delimiters"** option and then select the **"Tab"** option beneath.
- iv. Record Options: Select the "First record has field names" option.
- v. Geometry Definition: Select the "Point coordinates" option
- vi. X field: Make sure that "Longitude (DD)" is selected
- vii. Y Field: Make sure that "Latitude (DD)" is selected

10. Hit **{OK}.** 



Authority ID	4
EPSG:32621	
EPSG:3857	25
EPSG:4212	22
EPSG:21292	_
EPSG:4035	-
EPSG:4326	
EDCC-E4004	(
🗌 Hide	deprecated CRS
Authority ID	-
EPSG:4821	
EPSG:4760	
EPSG:4322	
EPSG:4324	
EPSG:4326	2
IGNE-WGS72G	
	Authority ID EPSG:32621 EPSG:3857 EPSG:4212 EPSG:4035 EPSG:4326 FDCC-E4004 Hide Authority ID EPSG:4821 EPSG:4821 EPSG:4822 EPSG:4322 EPSG:4322 EPSG:4324 EPSG:4326 IGNE-WGS72G

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Note: This launches the Coordinate Reference System Selector menu. You may use this menu to set a coordinate system for the points layer that will be created from this text-data import.

11. Select the WGS 84 coordinate system and hit {OK}.

Note: You should now see points plotted in your Map Canvas distributed across various regions of Australia. You may view the attribute table of this layer to have a look at the data. Five data columns are listed. These are described below:

- *i.* Rank The rank of cities by their population size
- ii. City The official names of the cities in Australia
- iii. Population (2000) The population sizes of cities in Australia
- *iv.* Latitude (DD) The latitude coordinates associated with approximate locations of cities in Australia



v. Longitude (DD) – The longitude coordinates associated with approximate locations of cities in Australia



1	3 6	🧏 🖪 🚱	🏶 🗭 📑 🛛	16 II II		?
	Rank 🗸	City	Population (2000)	Latitude (DD)	Longitude (DD)	2
0	1	Sydney	4277200	-33.87	151.21	
1	2	Melbourne	3666000	-37.81	144.96	
2	3	Brisbane	1598600	-27.46	153.02	
3	4	Perth	1412900	-31.96	<mark>115.84</mark>	
4	5	Adelaide	1089700	-34.93	138.6	
5	6	Newcastle	502300	-32.92	151.75	
6	7	Gold coast	457900	-28.07	153.44	
7	8	Canberra	323100	-35.31	149.13	
8	9	Wollongong	262500	-34.42	150.87	
9	10	Sunshine coast	254700	-25.88	152.56	
10	11	Hobart	201000	-42.85	147.29	
11	12	Geelong	161500	-38.14	144.32	
12	13	Townsville	152400	-19.26	146.78	
13	14	Cairns	128500	-16.92	145.75	
14	15	Launceston	99400	-41.45	147.13	1
	16	Albury-wodonga	07300	-36.06	146 07	0



Although the file you've imported has been displayed as vector points in the Map Canvas, you should note that they are still stored as text data. Therefore, it is perhaps best to convert the imported layer to an official shapefile format.

12. Right-click the imported text layer (in the Layers Panel) and select {Save As} to launch the save (Save vector layer as...) menu.

Format	ESRI Shapefile			
Save as	D:/QGIS Training in Madrid/GIS_V	Vorkspace/Australia_Cities_WGS84.shp Bro	wse	
CRS	Selected CRS (EPSG:4326, WGS 84)			
Encoding	3	System	D	
Save	only selected features			
Skip	attribute creation			
X Add	saved file to map		100	
Symbolo	gy export	No symbology	•	
Scale		1:50000	*	
	Extent (current: layer)			
Dat	asource Options		[	
	er Ontions		- 5	

Note: Make sure that the option selected for the Format field is "ESRI Shapefile". You should also save the output to your workspace folder under the name, "Australia\_Cities\_WGS84.shp". Set the CRS as WGS 84; select "Add saved file to map" and then hit {OK}. After completing this step you will have two layers in your map with the same name (i.e. "Australia\_Cities\_WGS84.shp"see image on the right). However, one is an actual vector shapefile and the other is a tab-delimited





text file displayed as a point vector. Remove the delimited text-file layer from the map.

Tip: If you are unsure which layer is the actual shapefile, you can use the Metadata tab under the {Properties} menu of the layers to help you figure it out.

13. In this final step, your task will be to select and extract 35 cities from the total list of cities in the layer ("Australia\_Cities\_WGS84").

Note: Notice how many of the points in the newly generated cities layer appear tightly clustered when viewed at the full extent of the map. This is especially evident on the eastern coast of the country. In the following illustration, 35 cities were selected and extracted from the original cities list. Notice how the selected cities are distributed across the north, south, east, west and central parts of the country and that they are not tightly clustered. Five of these selected cities have populations greater than 1 million and one of them is the capital city.



Use your knowledge of feature selection to create a new layer of 35 selected cities that is similar to the illustration above. Ensure that your final selection includes the five cities with populations over 1 million and also the capital city of **Canberra**. Export the selected cities to your workspace folder under the name "Australia\_Cities\_Selected\_WGS84".



Note: Remove the original cities layer ("Australia\_Cities\_WGS84") from the map. Save your QGIS project and proceed to the next chapter. You will be using the layers presently in your map to conduct a lesson on styling for effective visualization of data.





# **4 STYLING DATA FOR VISUALIZATION**

So far you've used a few basic handling procedures for vector and raster data in QGIS. However, the data has not been styled appropriately for effective visualization and analysis. This is especially the case for the raster data you have experimented with so far. In this final chapter, you will learn ways of styling data so that it can be better interpreted by viewers. You will continue working with the data for Australia from the previous section

#### 4.1 Styling the Points Layer

Note: If your cities layer ("Australia\_Cities\_Selected\_WGS84") is beneath other layers in the Layers Panel list then bring it to the top position, so that the changes you are about to make to it can be clearly visualized.

1. Open the {Properties} menu for the cities layer.

🥖 Layer Properties - Austra	alia_Cities_Selected_WGS84   Style	2 <b>×</b>
General	🔰 Single Symbol 🔻	
😻 Style		Unit Millmeter  Size 2.20000
abc Labels	<b>│</b>	Color Rotation 0.00 °
Fields		Symbols in group Open Library
Display	Marker     Simple marker	± î ⊙ • • •
Joins		airport arrow capital circle city diamond
Diagrams		
🥡 Metadata		ellipse pentagon square star star2 star3
		triangle triangle2
	€ ■ ₽ ₽ ₽	Save Advanced *
	▼ Layer rendering	
	Layer transparency	mal   Feature blending mode Normal
	•	
	Style 🔻	OK Cancel Apply Help

2. Select the **Style** tab from the left-panel.

Note: Options for styling your points should now be visible.





3. Locate the section of the menu with the caption, "Marker" - see the previous image.

Note: Under this part of the menu you will see an entry named, "Simple marker". This tells you the category of symbol/marker currently being used to represent the points in the layer. The adjacent pane contains a list of marker options that may be used in place of the default style currently applied to your points.

4. Choose any one of the marker options from this pane (see previous image) and then select **{Apply}** to change the type of symbol used to represent points.

Note: The point symbols on your Map Canvas should have changed to the option you applied. If your menu is blocking the Map Canvas, you will need to temporarily shift it out of the way to observe the change. Try changing the type of point symbol a few more times before proceeding.

5. Select the "city" marker from the pane and apply it (see next illustration).

Note: Now that you have chosen the "city" marker to represent your point objects, you can adjust their final colour, size and even degree of transparency.

6. Locate the "Size" field in the section above (see next illustration).

*Note: The default size of the "city" marker option should be 2.2 and the units should be millimetres.* 

7. Change the size entered in the field from 2.2 to 1.75 and select **{Apply}** to see the change.



🕺 Layer Properties - Aust	tralia_Cities_Selected_WGS84   Style	?
General	E Single Symbol	
😻 Style		Unit Milimeter Size 1.75000
(abc) Labels	o	Color Rotation 0.00 °
Fields		
Display		Symbols in group Open Library
Actions		<b>★</b> ĵ ○ ○ ○ ◆
Joins		airport arrow capital circle city diamond
Diagrams		◇ ● ■ ★ ☆ *
Metadata		ellipse pentagon square star star2 star3
		triangle triangle?
	Save	city Advanced *
	▼ Layer rendering	
	Layer transparency	0 🗘
	Layer blending mode Normal	Feature blending mode     Normal     V
	Style 🔻	OK Cancel Apply Help

Note: You may experiment with different sizes to see how they look, but be sure to apply a final size of 2.2. Next you will try changing the colour of the "city" markers.

8. Select "Simple marker"; locate the "Fill" menu option and click on the



drop-button next to the field.



Note: There are different ways to set colours for symbols in QGIS 2.8. Some of these are discussed below:

*i.* Choosing from the "Standard Colors" list.

Note: Simply click on one of the colours shown in this row.

Transparent fill	
Recent colors	
Standard colors	
Copy color	
Paste color	
Pick color	
Choose color	

ii. Using the "Color Ramp" or "Color Wheel"

Note: To access the "Color Ramp" or "Color Wheel", you must first click on the "Fill" menu option to open up the "Select fill color" menu. See illustration below.











• To use the "Color Ramp" you must first activate it via the tab (as shown on the left).



In the menu, you will see controls on the right (section A above) for the HSV (Hue, Saturation and Value) and RGB (Red, Green and Blue) colour scales. These dials will be automatically set for the colour that is currently applied to your symbol. However, you can shift them around or enter numbers into the various scale fields to change the colour seen at (section B above). This will create a ramp (section C above) based on the combinations you chose. You can slide the dial up and down the



ramp to settle on a colour or intensity of your choice. Alternatively, the ramp can be set using the colour pane to its left (section D above). Simply click on a different area within this pane to change the colour range of the ramp. Once you've decided on a colour, hit **{OK}** to choose it.

 To use the "Color Wheel" you must first activate it via the tab previously illustrated



In the menu, you will again see the HSV and RGB controls on the right (section A above) which you can shift around. Doing this will change the colour selected (see section B) and will also change the position of the colour wheel (see Section C). Alternatively, you may rotate the colour wheel to the colour range of your choice and then select the level of colour intensity within the range by clicking on a desired area inside the triangle. Once you've decided on a colour, hit **{OK}** to choose it.

9. Locate the **"Border**" option (**see image below**) and use any of the methods described in the previous step to choose a different colour for your border.



Note: You can change the colour of the borders for your symbols in QGIS. However, in most cases it is better to have a black or very dark border on your symbols to create a very sharp contrast. Experiment with different border colours at your leisure.

10. Change the width of the symbol border by adjusting the value in the "Outline Width" field (see image below).





#### Note: Try changing this value from 0 to 0.4.

Your point markers should now all be rendered in the "city" style with a size of 2.2 millimetres, a fill colour and border colour of your choosing and a border outline width of 0.4 millimetres. Feel free to experiment with different symbols, sizes, colours and border settings. By default, the transparency of data layers is set to zero. However, if you want to experiment with this setting, you may do so by shifting the transparency bar to the right and left to increase and decrease transparency (**see image below**).

🕺 Layer Properties - Austr	alia_Cities_Selected_WGS84   Style				? ×
General	🔰 Single Symbol 🔻				
😻 Style		Symbol layer typ	pe	Simple marker	<b></b>
(abc) Labels		Colors	Fil 📃 🛡 🍕	Border	
Fields		Size	2.000000		Millimeter 💌
Display		Outline style	Solid Line		•
Actions	⊡ O Marker	Outline width	0.000000	: 4	Millimeter 💌
	Simple marker	Angle	0.00 °		: 4
Director		Offset X,Y	0.000000	00000	Millimeter 💌
Diagrams		Anchor point	HCenter 🔹	VCenter	•
Wetadata		Save	$\diamond \diamond + \times \land$		¢,
	Layer transparency				0 🛊
	Layer blending mode	iormal	<ul> <li>Feature blending mode</li> </ul>	Normal	•
	Style -		ок	Cancel Apply	Help

The styling exercise for the cities layer is now complete. You may now proceed with styling the country (polygon) layer. Close the **Layer Properties** menu before continuing.

### 4.2 Styling the Polygon Layer

Note: Before proceeding, shift the polygon ("Australia\_WGS84") layer's position in the Layers Panel so that it is above the raster layer ("Australia\_Temperatures\_24Fcast\_20140717\_WGS84") and beneath the points layer ("Australia\_Cities\_WGS84"). Now turn the temperatures (raster) layer off.

1. Open the {Properties} menu for the polygon layer ("Australia\_WGS84").



2. Locate the "Fill" and "Simple Fill" menu section (see next illustration).

🕺 Layer Properties - Austra	alia_WGS84   Style		2 X
General	Single Symbol		
🥳 Style		Unit Milimeter V	
abc Labels		Color	
Fields		Symbols in group	▼ Open Library
🞸 Rendering	⊨ <b>Fill</b>		10000
🧭 Display	Simple fill		
Actions		<ul> <li>corners diagonal dotted green land wat</li> </ul>	er wine
• Joins			
Diagrams			
🥡 Metadata			
	Save		Advanced 🔻
	▼ Layer rendering		
	Layer transparency	Feature blending mode     Normal	
	Style •	OK Cancel Apply	Help

3. Highlight the "Simple Fill" entry.

Note: This reveals a new section with options to change the "Fill Style", "Border Style" and other properties.

4. Experiment by changing the Fill colour and Border properties for the polygon by using the "Fill", "Border" and "Border Width" menu options as described in the previous section (see next image). Remember to hit {Apply} after you've made a change to see how it looks in the Map Canvas.



🦸 Layer Properties - Austra	alia_WGS84   Style				? ×
🤆 General	Single Symbol				
Style		Symbol layer ty	pe	Simple fill	•
abc Labels		Colors	Fill	Border	
Fields		Fill style	Solid		• 🗣
Rendering		Border style			• 🗣
	En Fill	Join style	Bevel		• 🖶
	Simple fil	Border width	0.260000	-	Aillimeter 💌
Actions		Offset X,Y	0.000000	0.000000	▲ Millimeter ▼
Joins					
Diagrams					
🧃 Metadata					
		Save			
	▼ Layer rendering				
	Layer transparency	Normal	East va blanding med	Normal	
		Norma		Norma	
	Style 🔻		ОК	Cancel Apply	/ Help

Note: Once you've finished experimenting with colours, select "Fill Style" (see image below) and choose the "No Brush" option. Then change the "Border" colour to black if you've previously set it to a different colour. Select {OK} to complete the change.

🕺 Layer Properties - Austr	alia_WGS84   Style			? ×
General	🔰 Single Symbol 🔻			
😻 Style		Symbol layer type	Simple fill	•
abc Labels		Colors Fill	💌 🖶 Border 🚺	
Fields		Fill style		• 🗣
Kendering		Border style No Brush		
		Join style		. €
Actions	Simple fill	Border width		ter 💌
		Offset X,Y Diagonal X		ter 💌
Diagrams		Dense 1 Dense 2		Ē
Metadata				
- Madda				
	🛞 🗐 🔒 🖾 🔝 Save			
	▼ Layer rendering			
	Layer transparency			- 0 🜩
	Layer blending mode Normal	▼ Feature blending n	node Normal	
	Style -	ОК	Cancel Apply	Help





When you view the Map Canvas, you will notice that the polygon layer is now colourless with a black border. If you try turning back on the raster layer in the Layers Panel then it should be visible although it is positioned underneath the polygon.



This completes the styling exercise for the polygon layer. Remember to close the **Layer Properties** menu before proceeding. Next you will experiment with options for styling a raster. Ensure the raster layer is enabled before proceeding.

#### 4.3 Styling the Raster

1. Open the **{Properties}** from the menu for the raster layer.

Note: the default styling for your raster uses a "stretched" method, where only a sample of the full range of values in the layer is depicted. This sample is rendered using a black-to-white theme where the range starts with black (the minimum value) and progresses to white (the maximum value). You are about to change this styling method to reflect the entire range of values in the raster using a "classified" method. The range of raster values will be divided into ten classes.

2. Locate the "Render type" field under the section with the caption, "Band rendering" (see next image) and select "Singleband psuedocolor" from the drop-list.



🧭 Layer Properties - Australi	ia_Temperatures_24Fcast_20140717_WGS84   Style	2 ×
General	Band rendering     Render type     Singleband pseudocolor     Multiband color     Pand     Pand	Generate new color map
Pyramids	Color interpola Singleband gray	PiYG     Invert       Mode     Continuous     Classes       Min     8,7287     Max
(j) Metadata	Value Color Label	Classify Min / max origin: Estimated cumulative cut of full extent.
		Load min/max values Cumulative count cut Min / max
		riean +/- standard deviation ×     2.00 ♀       Extent     Accuracy       ● Full     Estimate (faster)       ○ Current     ● Actual (slower)
	Clip	Load
	Color rendering Blending mode Normal Style	

3. Locate the section of the map labelled, "Load min/max values"; select the "Min/max" (see previous image).

Note: This step identifies the minimum and maximum temperature values from the grid. These values will be used in the following steps to classify the cells of the raster layer into ten groups beginning with the lowest temperature value and ending with the highest.

- 4. Under "Extent", select the "Full" option (see previous image).
- 5. Under "Accuracy", select "Actual (Slower)" (see previous image).
- 6. Hit **{Load}**.

Note: You should now notice that the Min and Max values have changed from their previous range to reflect the full range within the layer (see next image).



C Layer Properties - Aus	Band rendering     Render type Singleband pee	0717_WGS84   Style		
Image: Transparency         Image: Pyramids         Image: Histogram         Image: Transparency         Image: Histogram         Image: Transparency         Image: Transparency	Band Color interpolation	Band 1 (Gray)	Generate new color map PYYG Mode Continuous V Cla Min 2.04 Min / max origin: Exact min / max of full exten Load min/max values Cumulative 2.0 V Min / max Mean +/- standard deviation x 2.0 Extent Full Current	<ul> <li>✓ Invert sses 5 ★</li> <li>ax 33.74</li> <li>Classify</li> <li>nt.</li> <li>98.0 ♀ %</li> <li>00 ♀</li> <li>Accuracy</li> <li>Estimate (faster)</li> <li>Actual (slower)</li> </ul>
	Clip Color rendering Blending mode Normal Style		▼ OK	Cancel Apply Help

7. Scroll up to the section of the menu labelled, "Generate new color map" (see next image) and hit the drop-list.

🧭 Layer Properties - Australia	a_Temperatures_24Fcast_2014	0717_WGS84   Style		2 ×	
General	▼ Band rendering				
😻 Style	Render type Singleband pse	udocolor 💌			
Transparency	Band	Band 1 (Gray) 🔻	Generate new color map	<b></b>	
👜 Pyramids	Color interpolation	Linear 👻	PiYG 👻	Invert	
Histogram			RdYIGn Address	5	
(i) Metadata	Value Color	Label	Spectral Ylon YlonBu YlorBu YlorBr YlorRa temperature Random colors New color rang New color rang Cumulative Coundative Coundative Coundative Coundative Min / max Mean +/- standard deviation × Extent	33.74 ssfy .0 ♥ % Accuracy C Extracts (featral)	
			Ful     Current	Estimate (faster)     Actual (slower)	
	Clip			Load	
	Color rendering     Blending mode Normal		•	( Deret	<u> </u>
	Style +			Cancel Apply Help	
	Juyie .			Appry Help	9





Note: This presents a series of colour templates which can be applied to a classified raster. You can either pick from the drop-list or scroll to the bottom and select {New color ramp}. Selecting the {New color ramp} option will launch a submenu as shown below:

Color ramp type	? ×
Please select color ram	p type:
Gradient	-
Gradient Random ColorBrewer	
cot-city	

From this menu you can select from four 4 different group templates. For this exercise, it is recommended that you choose the "cpt-city" option. This will in turn launch a new menu as shown below:

Selections by theme	All by author	
Name	Palettes for temperature (4)	
All Ramps Bathymetry Blues Discord Diverging Greens Greys QGIS Precipitation Reds Temperature Topography Topography/bathymetry Top of the (cpt) palettes Top of the (svg) palettes	celsius temperature temp_19lev temp-c	
Selection and preview Information		
Palette temperature		
Path jjg/misc/temperature		
License Public domain (2004)		

This menu provides a series of colour schemes arranged by theme. Under the "Selections by theme" tab, there is a listing for temperatures. Select the Temperature option to view the list of templates; choose a template and then hit {OK} (Refer to the image above).



- 8. Locate the "Mode" field and select "Equal Interval" (*illustrated in next image*).
- 9. Locate the adjacent field **(Classes)** and change the number of classes from 5 to 10.
- 10. Hit the "Classify" button.

Ceneral	iia_Temperatures_24Fcast_201 ▼ Band rendering Render type Singleband ps	40717_WGS84   Style			
Image: Transparency         Image: Pyramids         Image: Histogram         Image: Transparency         Image: Histogram         Image: Transparency         Image: Histogram         Image: Transparency         Image: Transparency     <	Band Color interpolation Value 2.040000 5.562222 9.084444 12.606667 16.128899 19.651111 23.173333 26.695555 30.217778 33.740000	Band 1 (Gray)         Linear         Label         2.040000         5.62222         9.084444         12.606667         16.128889         19.651111         23.173333         26.695566         30.217778         33.740000	<ul> <li>Generate new color map</li> <li>temperature</li> <li>Mode Equal interval &lt; Class</li> <li>Min 2.04</li> <li>Max origin:</li> <li>Exact min / max of full extent</li> <li>Load min/max values</li> <li>Cumulative 2.0 </li> <li>- (</li> <li>Min / max</li> <li>Mean +/- standard deviation x</li> <li>Extent</li> <li>Full</li> <li>Current</li> </ul>	<ul> <li>✓ Invert</li> <li>iss 10 ✓</li> <li>(33.74</li> <li>classify</li> <li>98.0 ♀ %</li> <li>♀</li> <li>Accuracy</li> <li>Estimate (faster)</li> <li>Actual (slower)</li> </ul>	
	Clip			Load	<u> </u>
	Color rendering Blending mode Normal Style		V OK	Cancel Apply	et 🔹

Note: You will notice a change in the menu. The temperature classes can now be seen in the menu as illustrated below. The upper limit of each temperature class is now marked by a value and a corresponding class colour.

11. Hit **{Apply}** and view the **Map Canvas** to observe the change in your raster layer.





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Note: Collapse the raster layer entry in the Layers Panel to see the symbol Legend. With the raster in this styling format, it is much easier to appreciate the spatial differences in temperatures across the country. However, there are a few more styling changes that you can make to further improve the appearance of your raster and the information it is trying to convey.

12. Return to the Style menu; locate the "Color interpolation" option and open

		J Exact	
Value - 2.040000 - 5.562222 - 9.084444 - 12.606667 - 16.128889 - 19.651111 - 23.173333 - 26.695556 - 30.217778 - 33.740000	Color	Label 2.040000 5.562222 9.084444 12.606667 16.128889 19.651111 23.173333 26.695556 30.217778 33.740000	

the drop-list as seen in the following image.

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Note: At present, your raster is rendered using a linear colour interpolation method. This method displays classes in a linear or continuous fashion by averaging the boundaries of neighbouring cells so that they appear to flow into each other. Change the setting to "Discrete"; hit {Apply} and see the difference in the Map Canvas.





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With a discrete colour interpolation method, the boundaries between the colour classes are more obvious. However, the appearance is far coarser. There are many examples which may be found that demonstrate the use of both these methods for conveying raster data. However, for this exercise, you are advised to apply the linear method for your colour interpolation

13. Scroll down to the **Resampling** menu section and open the drop-list as shown below:





Note: At present your raster is being rendered using a "Nearest Neighbour" resampling method. This method renders a resampled grid that illustrates actual cell values. Hence it is ideal for representing data that is discrete in nature.

Change the resample method to "Bilinear"; hit {Apply} and see what happens to the raster.



The Bilinear Resampling method renders a resampled grid with cells that contain averages calculated from neighbouring cells. This essentially creates a much smoother appearance with a compromise of precision. You should note that this new setting will render the data using a Bilinear resampling method when the

map is zoomed in.

The final change you will make to your raster is associated with labelling. The label column as illustrated in the image on the left, lists the class values that will be displayed in your raster Legend. These values may be edited so that they describe the data in a more viewer-friendly fashion. Each class group is associated with a number that represents the upper limit of a temperature class (in degrees celsius) and the range starts from 2.04. Therefore, the second colour class contains temperature values 2.04 to



15.

Hit {OK}

Panel as shown above.

*Note: The changes you've just* made to the raster legend labels should now be visible in the Layers

5.5622 and the third class contains values between 5.5622 and 9.0844 etc. However, it would perhaps be better to present this information without the high precision in decimal values and instead as rounded ranges.

14. Double-click the fields in the Label column to access the class labels and make changes to the entries until they all match the image below.

Value	Color	Label	_
2.040000	10,00	2.0	
5.562222 9.084444 12.606667 16.128889 19.651111 23.173333 26.695556 30.217778 33.740000		2.0 - 5.5 5.5 - 9.0 9.0 - 12.6 12.6 - 16.1 16.1 - 19.6 19.6 - 23.1 23.1 - 26.6 26.6 - 30.2 30.2 - 33.7	

× (	Australia_Cities_Selected_WGS84 Australia_WGS84
- *	Australia Temperatures 24Fcast 20140
	2.0
·····	2.0 - 5.5
	5.5 - 9.0
	9.0 - 12.6
	12.6 - 16.1
	16.1 - 19.6
	19.6 - 23.1
	23.1 - 26.6
	26.6 - 30.2
1	30.2 - 33.7

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## 4.4 Adding Labels

There are perhaps a few more things you can do to improve the conveyance of the information. Would it help to communicate the story a bit better if the cities were labelled? What if you could also, change the symbol sizes and styles for some of the cities? - Perhaps the larger cities with populations over 1 million. Maybe you would want the country's capital (**Canberra**) to be symbolized differently. Theses final modifications can be achieved and are explored below.

1. Open the **{Properties}** menu for the cities layer and activate the **Labels** tab.

🕺 Layer Properties - Australia_Cities_Selected_W	3584   Labels	? ×
General Cabel this layer wi	h 🖉 🐨	
abels         Lorem Ipsum           Fields         Lorem Ipsum		4
- 💭 Display	[\$] =()	F
Actions Text	Text style           Font         MS Shell Dlg 2	) (5
Diagrams Diagrams Shadow	Style Normal	] 🗣
Metadata     Metadata     Metadata     Metadata     Metadata     Metadata     Metadata     Metadata     Nendering	U         Size         B         I         I           Size         8.2500         I         I	] (5   ] (5   ] (5
		e,
	Type case No change	
	Spacing letter 0.0000	] 🕒
	word 0.0000	] 🗣 🛛
	Blend mode Normal 💌	] 🗣
Style 🔻	OK Cancel Apply	Help

2. Enable the option shown in the next image (captioned, "Label this layer with") and hit the drop-list to reveal the layer attribute field names.



<ul> <li>Text/Buffer sample</li> </ul>	_ Rank	3 -	
Lorem Ipsum	Population Latitude ( Longitude		
Lorem Ipsum		<u>الم</u>	 
abc Text	Text style		
ebc Buffer	Font	MS Shell Dlg 2	
Background	Style	Normal	-
Shadow Placement		U 🖶 🖻 🖶	B 🖶 [I
A Rendering	Size	8.2500	
		points	
	Color		
	Transparency	0	 - 0%
	Type case	No change	
	Spacing	letter 0.0000	
		word 0.0000	

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Note: Attribute values may be used to label features. By choosing "City" from this list, QGIS will be instructed to use the values (i.e. city names) in the "City" column of the layer attributes to label the points. Click {Apply} to see results.

Next you'll determine the characteristics of the font used to label the cities.

3. Activate the **"Text"** option from the left pane **(see next image)**; select the **"Font"** drop-list on the right and then choose **Arial** as the font type.



General	<ul> <li>Label this layer with</li> <li>Text/Buffer sample</li> </ul>	City E	4
Style Labels Fields	Lorem Ipsum		
Display	Lorem Ipsum	<b>(b)</b> -()	
Joins Diagrams Metadata	**b Formatting abs Buffer Background Shadow ∲ Placement ✓ Rendering	Font     Anial       T Agency HB       Style     T Aharoni או דוא אלא אלא אלא אלא אלא אלא אלא אלא אלא א	
		Type case No change Spacing letter 0.0000 word 0.0000 Blend mode Normal	

4. Set the "Style" field to **Bold Italic** and then set the "Size" field to 7.

*Note: Click {Apply} to see the effects of changing the font.* 

5. Activate the "**Placement**" option from the left pane and choose "**Offset** from centroid"; locate the portion of the menu with the caption, "**Quadrant**", and then select the upper-right option as indicated in the following image. All other default settings should remain.

abc Text	Placement	G
abc Buffer Background	Around point   Offset from point	
Placement Rendering	Quadrant abc	
	Offset X,Y 0.0000	
	Rotation 0.00°	
	Coordinate X + Y + Alignment horizontal + vertical +	



Note: This step determines the positioning of your labels. In this case, labels will be offset from the centre of the points and positioned to the upper-right. These positions can be further offset by changing the X and Y offset values in the fields below.

Set the Y field to a value of -1 as shown below and hit {Apply} to see the shift in position of the font.

abc Text +ab Formatting abc Buffer Background Shadow	<u>Placement</u>	d point	• Offse	t from po	int				
Placement	Quadrant	abc	abc	abc	e.				
Rendering		abc	abc	abc					
	11111	abc	abc	abc					
	Offset X,Y	0.0000			🛓 🔢 1.0000 🖉 🖨				
		mm			▼ 🚭				
	Rotation	tation 0.00°							
	▼ Data o Coordina Alignmer	lefined - ate X <	J Y ∢	📑 verti	cal (E)				

The next step is to place a buffer or "halo" around the text to make it stand out more.

 Activate the "Buffer" option from the left pane; enable the "Draw text buffer" option; set the "Size" field to 1 and then set the "Color" field to white. These settings are illustrated below.

Formatting Suffer	Draw text buff	er 🖶	
Background	Size	1.0000	
Shadow Placement		mm	•
Rendering	Color		e.
	Transparency	Color buffer's fill	₽ @
	Pen join style	Bevel	• 🗣
	Blend mode	Normal	

7. Click **{OK}** to complete the process and view the labelling results.







Now we'll introduce some variation to the city symbols.

- 8. Open the **{Properties}** menu for the cities layer and activate the **Style** tab.
- 9. Locate the menu drop-list highlighted in the following image and change the option from "Single Symbol" to "Categorized".

🕺 Layer Properties - Austra	alia_Cities_Selected_WGS84   Style			? ×
General Style (abc) Labels	Single Symbol	Unit Millimeter Transparency 0% 🕽	▼         Size         2.00000           ▼         Rotation         0.00 °	• •
Fields	Heatmap	Symbols in group		Open Library
<ul> <li>Display</li> <li>Actions</li> <li>Joins</li> <li>Diagrams</li> <li>Metadata</li> </ul>	Marker      Simple marker	<ul> <li>Image: Point of the second sec</li></ul>	<ul> <li>O</li> <li>♦</li> <li>circle city diamo</li> <li>★</li> <li>★</li> <li>★</li> <li>star</li> <li>star2</li> <li>star2</li> </ul>	nd 3
	Save	]		Advanced 🔻
	Layer transparency     Layer blending mode     Normal	▼ Feature blending mod	e Normal	0 🔹
	Style	ОК	Cancel Apply	Help

10. Select "City" form the drop-list next to the "Column" field; then hit the Classify button as shown next.



🕺 Layer Properties - A	ustralia_Cities_Selected_WGS84   Style	? ×
General	Categorized V	
😻 Style	Column City V E	
(abc) Labels	Symbol City Random colors	Invert
Fields	Symbol Latitude ( Longitude	<u> </u>
T TELOD		
Diselau	Albany Albany	
Display	🗶 📀 Brisbane Brisbane	
<b>~</b>	🗶 💿 Broken hill Broken hill	
Actions	Revenue Broome Broome	775
1 A	🗙 💿 🛛 Bundaberg Bundaberg	7.05 7.05 7.05
Joins	Burnie-de Burnie-devonport	
	🗶 💿 Canberra Canberra	
Diagrams	🗙 💿 Carnarvon Carnarvon	
	Charters t Charters towers	
Matadata	🗶 💿 Dubbo Dubbo	
	🗶 💿 Emerald Emerald	
	X Esperance Esperance	
	🕱 💿 Geraldton Geraldton	
	X O Helensvale Helensvale	
		<b>T</b>
	Classify Add Delete Delete all	Advanced 🔻
	▼ Layer rendering	î
	Layer transparency	0 🗘
	Layer blending mode Normal   Feature blending mode Normal	<b>\</b>
	Style	Help

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Note: A list of city items will be generated and styled according to the default colour ramp. However, given our aim, which is to change the symbol styles of only the 5 cities with populations over 1 million and also the capital city, perhaps you should first change all the symbol style colours back to white.

11. Highlight/Select all points in the list as shown below; right-click on any selected row and select **{Change color}**. You can make the selections by holding the Ctrl key and clicking to select multiple rows.

Symbo	7 lo	Value	Legend		
X O X O X O	) ) )	Emerald Geraldton Adelaide	Emerald Geraldton Adelaide	Copy Paste	Ctrl+C Ctrl+V
X O X O X O X O	) ) )	Brisbane Broken hill Broome Bundaberg	Brisbane Broken hill Broome Bundaberg	Change colo Change trans Change outp Change size	parency ut unit
X O X O X O		Burnie-de Canberra Carnarvon Charters t Dubbo	Burnie-devonport Canberra Carnarvon Charters towers Durbo		
X 0 X 0 X 0 X 0	, ) ) ) )	Esperance Helensvale Kalgoorlie Kununurra	Esperance Helensvale Kalgoorlie-boulder Kununurra		
X O X O X O	) ) )	Melbourne Moree Mount isa New norfolk	Melbourne Moree Mount isa New norfolk Newine		



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Use the following menu to set the colour back to white.



Note: Now you will locate the 5 cities with populations over 1 million and increase their symbol sizes.

Tip: Hit {OK} and then open the attribute table for the cities layer. Sort the table on the "Rank" field to list the cities in the order of their size. The first five cities in the list are the ones you will need to change the symbol sizes for. These are Sydney, Melbourne, Brisbane, Perth and Adelaide.

12. Return to the **Style** properties menu and locate Adelaide. This city should be the first in the list (**see image below**). You can sort the list by clicking on the **"Value"** column heading.

Sy	mbol	Value /	Legend
	0		
×	0	Adelaide	Adelaide
×	0	Albany	Albany
×	0	Brisbane	Brisbane
×	0	Broken hill	Broken hill
×	0	Broome	Broome
×	0	Bundaberg	Bundaberg
×	0	Burnie-de	Burnie-devonport
×	0	Canberra	Canberra
×	0	Carnarvon	Carnarvon
×	0	Charters t	Charters towers
×	0	Dubbo	Dubbo
×	0	Emerald	Emerald
×	0	Esperance	Esperance
×	0	Geraldton	Geraldton
×	0	Helensvale	Helensvale
×	0	Kalgoorlie	Kalgoorlie-boulder
×	0	Kununurra	Kununurra
×	0	Melbourne	Melbourne
×	0	Moree	Moree
×	0	Mount isa	Mount isa
	0	New porfolk	New portalk





13. Double-click the symbol for Adelaide and change the size from 2.2 to 3.0 and the colour to green.

Syr	7 lodm	Value	Legend	1
	0			
×	0	Adelaide	Adelaide	
×	0	Albany	Albany	
×	0	Brisbane	Brisbane	
×	0	Broken hill	Broken hill	
×	0	Broome	Broome	1111
×	0	Bundaberg	Bundaberg	1
×	0	Burnie-devonport	Burnie-devonport	
×	0	Canberra	Canberra	
×	0	Carnarvon	Carnarvon	
×	0	Charters towers	Charters towers	
×	0	Dubbo	Dubbo	
×	0	Emerald	Emerald	
×	0	Esperance	Esperance	
×	0	Geraldton	Geraldton	
×	0	Helensvale	Helensvale	
×	0	Kalgoorlie-boulder	Kalgoorlie-boulder	
×	0	Kununurra	Kununurra	
×	0	Melbourne	Melbourne	
×	0	Moree	Moree	c
×	0	Mount isa	Mount isa	
	0	New parfalk	New porfelk	

Note: Click {Apply} to see the change in the Map Canvas. You will notice that the symbol for the city of Adelaide (which is east of Port Lincoln) is now larger than all other symbols on the map. The label for Adelaide in the example shown below is not visible because it clashes with another label. You may have experienced a similar outcome with your map based on the cities you selected and their proximity. However, a solution to this issue will be illustrated soon.

14. Return to the **Style** properties menu and repeat steps 12 and 13 for the cities **Sydney**, **Melbourne**, **Brisbane and Perth**.





15. Change the symbol style used for the capital, **Canberra**, so that it stands apart from all others.



Your final step will be to manually adjust some of the labels so that there are no clashes and all of the labels can be seen.

16. Activate the **Labels** tab in the **{Properties}** menu and then open the **Placement** menu as seen below.

abc Text + ab - c Formatting abc Buffer	Placement	(abc)	abc	(abc)								(	•
Shadow	Offset X,Y	0.0000				•	-1.0000			¢		€,	
Rendering	i.	mm									•	€.	
	Rotation 0	).00°										-	
	<ul> <li>Data de Coordina</li> <li>Alignment</li> <li>Rotation</li> </ul>	efined te X (E thorizor	r Y 🗲 tal 🕞	vertical	e rotation v	alues							2.2.2.2 2.2.2.2.2 2.2.2.2.2
	▼ Priority		1	1	1	-0	1	1	1	1	H	ligh	•




17. Locate the "Data defined" section; activate the Coordinate X option; select {Field type: string, int, double} and then select {Longitude (double)} as shown below.

abc Text +ab < c Formatting abc Buffer Background Shadow	Placement abc abc abc abc abc abc	
Placement		1
Rendering	mm 💌 🖶	•
	Rotation       0.00° <ul> <li>Data defined</li> </ul> Coordinate X       Y         Alignment       Pata defined override         Description       Description         Rotation       Attribute field	
	Field type: string, int, double *     Rank (integer)       ♥ Priority     Expression     City (string)       Low     Edit     Population (integer)       Paste     Latitude ( (double)     ' ' ' High	

18. Repeat the step above for the **Y** coordinate, but select **{Latitude (double)}** as shown below.

abc Text	Placement							
Buffer		abc abc	(abc)					
Shadow Placement	Offset X,Y	0.0000		•	-1.0000			•
Rendering	2	mm					-	) 🗗
	Rotation 0	).00°						-
	121							
	▼ Data de Coordinat Alignment	efined e X ( Y	Data defined	l override				
	➡ Data de Coordinat Alignment Rotation	efined e X (= Y horizontal	Data defined Description Attribute field	l override d	_		1	
	Data de Coordinat Alignment Rotation     Priority	efined e X ( Y ( horizontal ( ( X	Data defined Description Attribute field Field type: st Expression Edit	<i>l override</i> d ring, int, doub	le P Rani City Popu	(integer) (string) Jation (integer)		• LEak





19. Select {OK} and return to the Map Canvas.

Note: With this change made, you are now free to move labels around manually to ensure that they are all visible. However, you will need to use the Label toolbar to do this.

20. Open the [View] menu; select {Toolbars} and then activate the Label toolbar.





21. Right-click the cities layer and select **{Toggle Editing}**.

Note: This step enables more functions on the Label toolbar. The tool you will need to shift the labels around is the {Move Label} tool as shown below.



22. Activate the **Move Label** tool; click on any label of your choice and drag it to its new position.

23. Shift around the labels on your map until you are satisfied with the new positions.

Note: Make sure they do not clash and that all labels are visible in the end. When you are finished, return to the Layers Panel; right-click the cities layer and deactivate {Toggle Editing}. When the following menu appears, click {Save} to keep the changes made for the Label positions.

🌠 Stop	editing X
1	Do you want to save the changes to layer Australia_Cities_Selected_WGS84?
	Save Discard Cancel

1<sup>st</sup> MedCOF Training Workshop. Madrid, 26-30 October 2015



Also remember to save your project.



This completes Practical 1B. Feel free to experiment with the styled layers at your leisure using what you've learnt. In the next practical, you will learn how to compose and publish a map using the data from this exercise.