SRA_Ch4: Creating preliminary spatial risk layers

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Introduction

"**The goal of SRA is to create a final spatial risk layer (or surface) on a map of the study area (Figure 4.1). Because the final spatial risk layer is in a raster format, we need to convert the vector risk layers to the same raster format to enable them to be combined. The objective of this section is to create these preliminary raster risk layers.**"

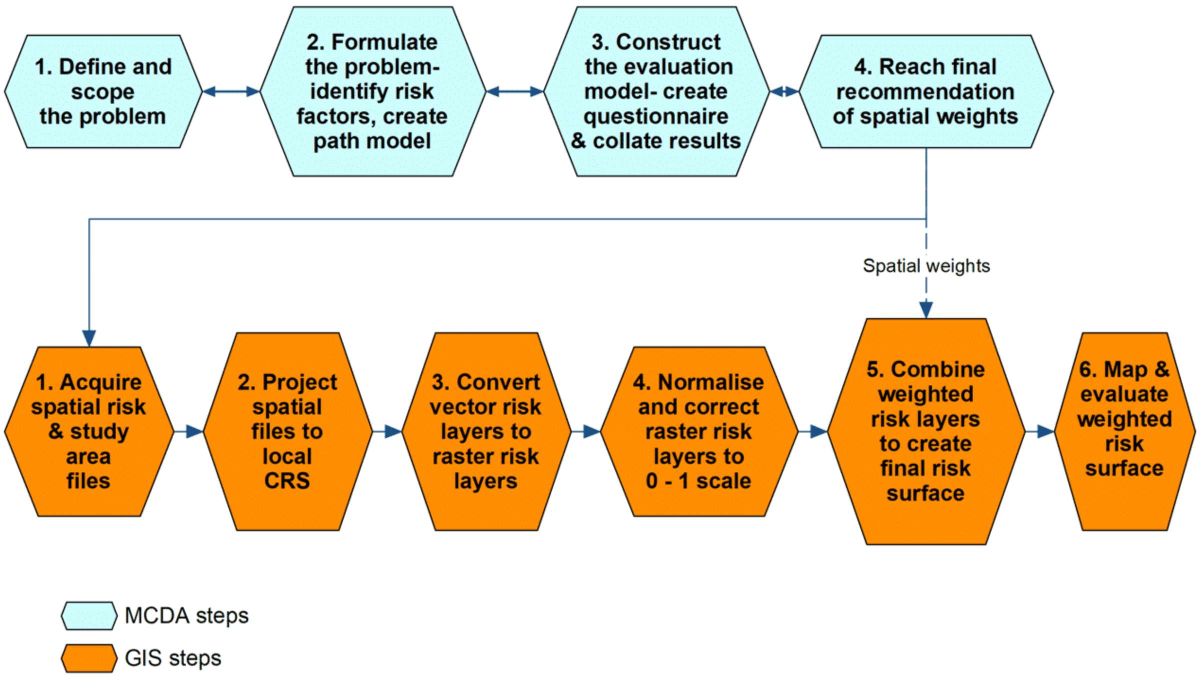

Figure 4.1: Spatial risk assessment steps

CONTINUE

4.1 Spatial areal risk factors

"No areal risk factors were investigated in our example, but if there were, the goal of preparing an areal risk factor layer is to create a heat map of risk factor density attributes from centroids of spatial polygons. These might optionally be weighted by an attribute variable that is associated with the risk. For example, if animal movements into a region were only available as aggregated counts for a region instead of to point locations, the attribute of number of animal movements into a region could provide a weighting for that region, as described in the next section."

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4.2 Spatial points risk factors

"Create a kernel-smoothed surface of distance from points. This surface can optionally be weighted by an attribute e.g. no. of animal movements, but these data are not available for this example:"

- In the Layers Pane highlight spatial point data file MMRMarketsActv
- Menu bar -> Processing -> Toolbox -> (Type "Heatmap" search bar) -> Interpolation -> Heatmap (Kernel Density Estimation)
- Double click to open dialog box (Figure 4.2)
- Parameters tab:

1. Point layer: MMRMarketsActv [EPSG:32646]
2. Radius: set to a maximum distance e.g. 50000m (50 km) over which the locations might affect the risk of disease within that radius
3. Output raster size (set Rows to 200 and columns will set to appropriate number)
4. Click Run
5. Click Close (when finished)

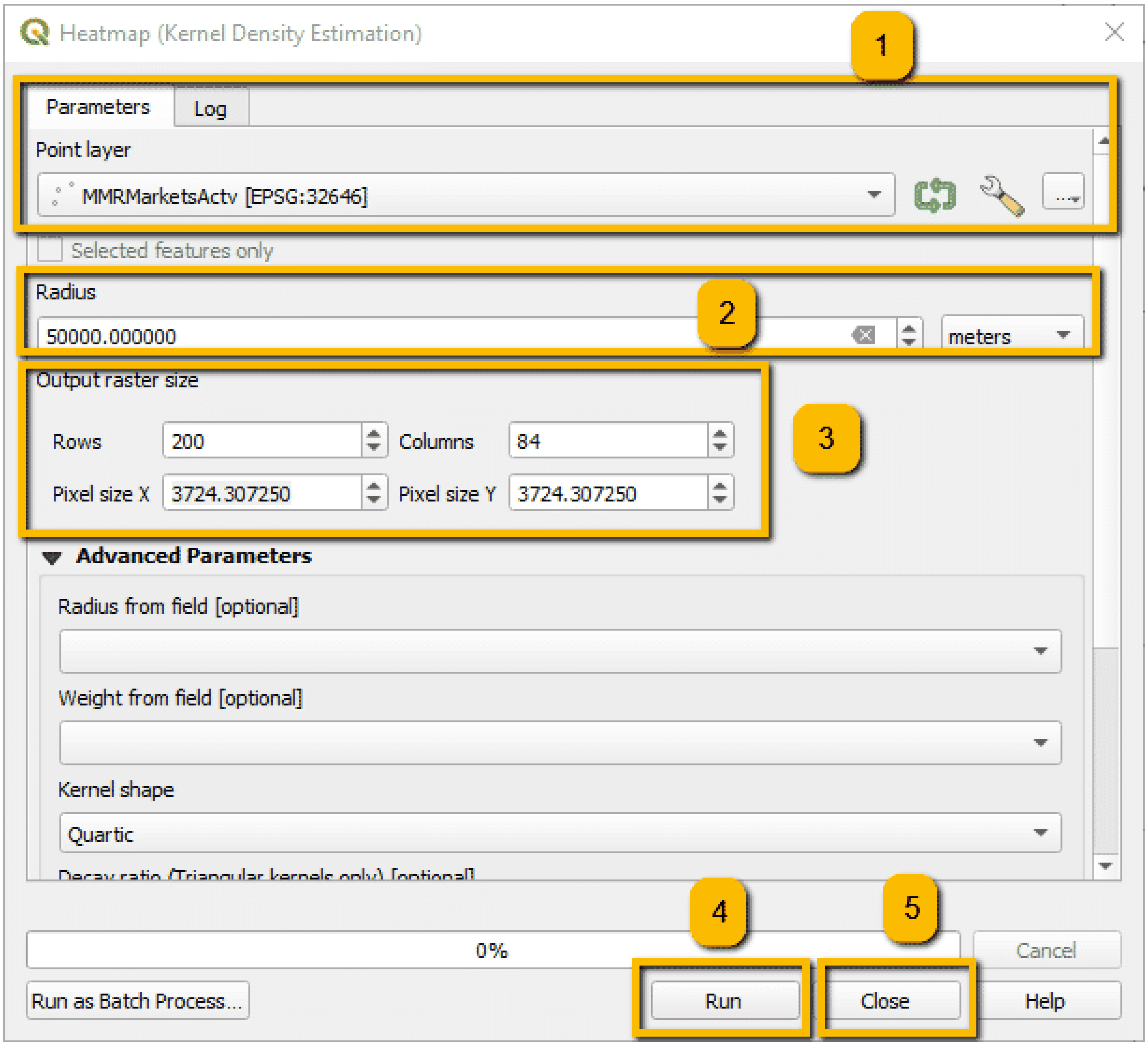

Figure 4.2: Dialog box of settings for heatmap

For further explanation about heatmaps one useful site for information is https://www.qgistutorials.com/en/docs/3/creating_heatmaps.html

and its link to 'QGIS Heatmap Using Kernel Density Estimation Explained' at https://www.geodose.com/2017/11/qgis-heatmap-using-kernel-density.html

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Save image as a raster object and project to Project CRS:

- Right click newly-created "Heatmap" in Layers Pane
- Save Raster Layer as … -> dialog box (Figure 4.3)

1. Format- GeoTIFF (denotes it is a raster file type)
2. File name- "ResData/Geo-Features/MMRMarketsActv_Rast"
3. CRS- Project CRS
4. Extent -> Calculate from Layer -> Select "MMR_0" (the polygon shape file of study area boundary)
5. Click OK

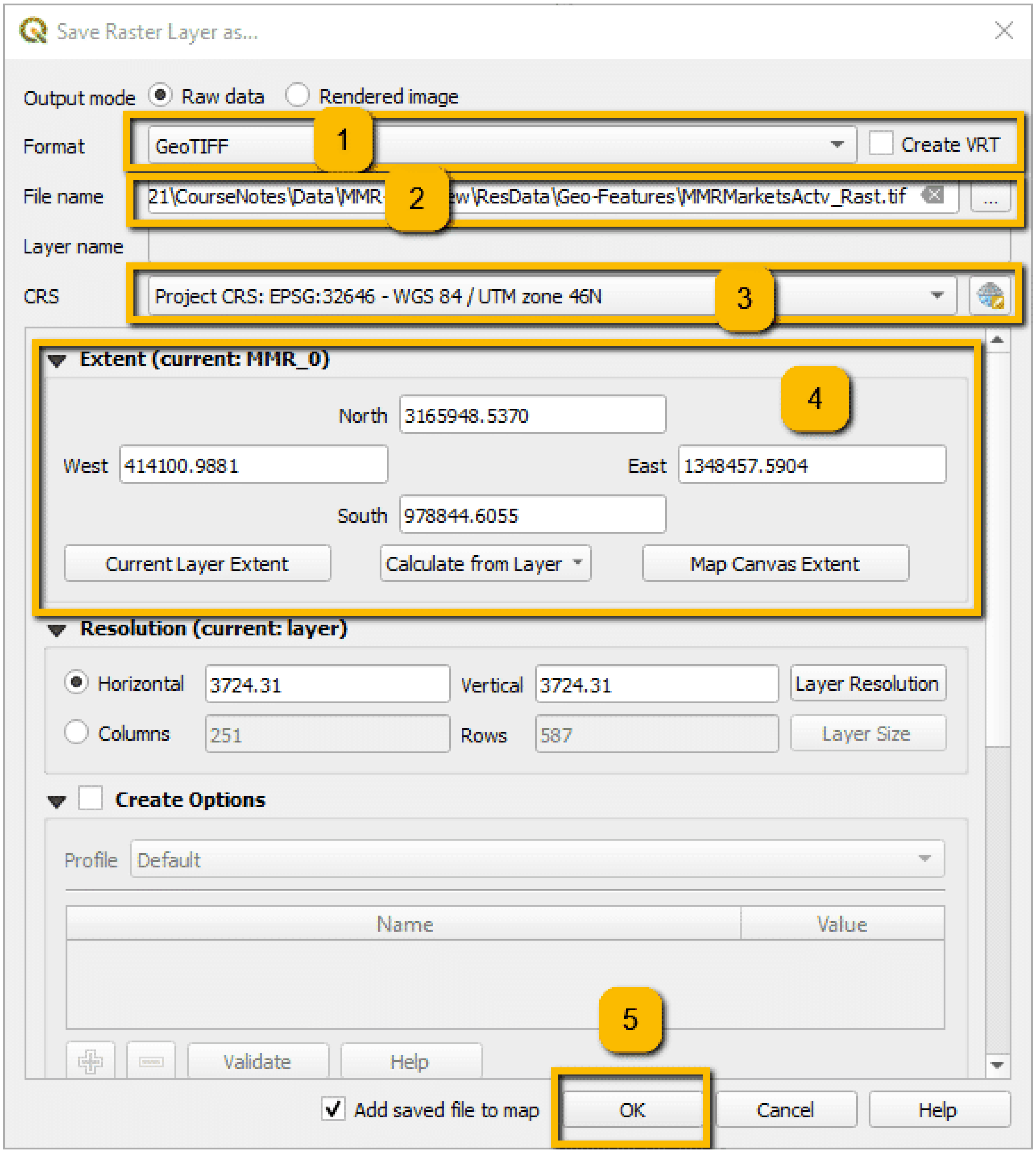


Figure 4.3: Dialog box of settings to save heatmap as a raster file

CONTINUE

Optional- Enhance the appearance of the raster layer (note that changing the symbols does not change the underlying data):

- Layers Pane- Right click on “MMRMarketsActv_Rast
- Properties -> Symbology -> Dialog box (Figure 4.4)

1. Render type- Singleband pseudocolor
2. Color ramp -> All color ramps -> OrRd
3. Click OK

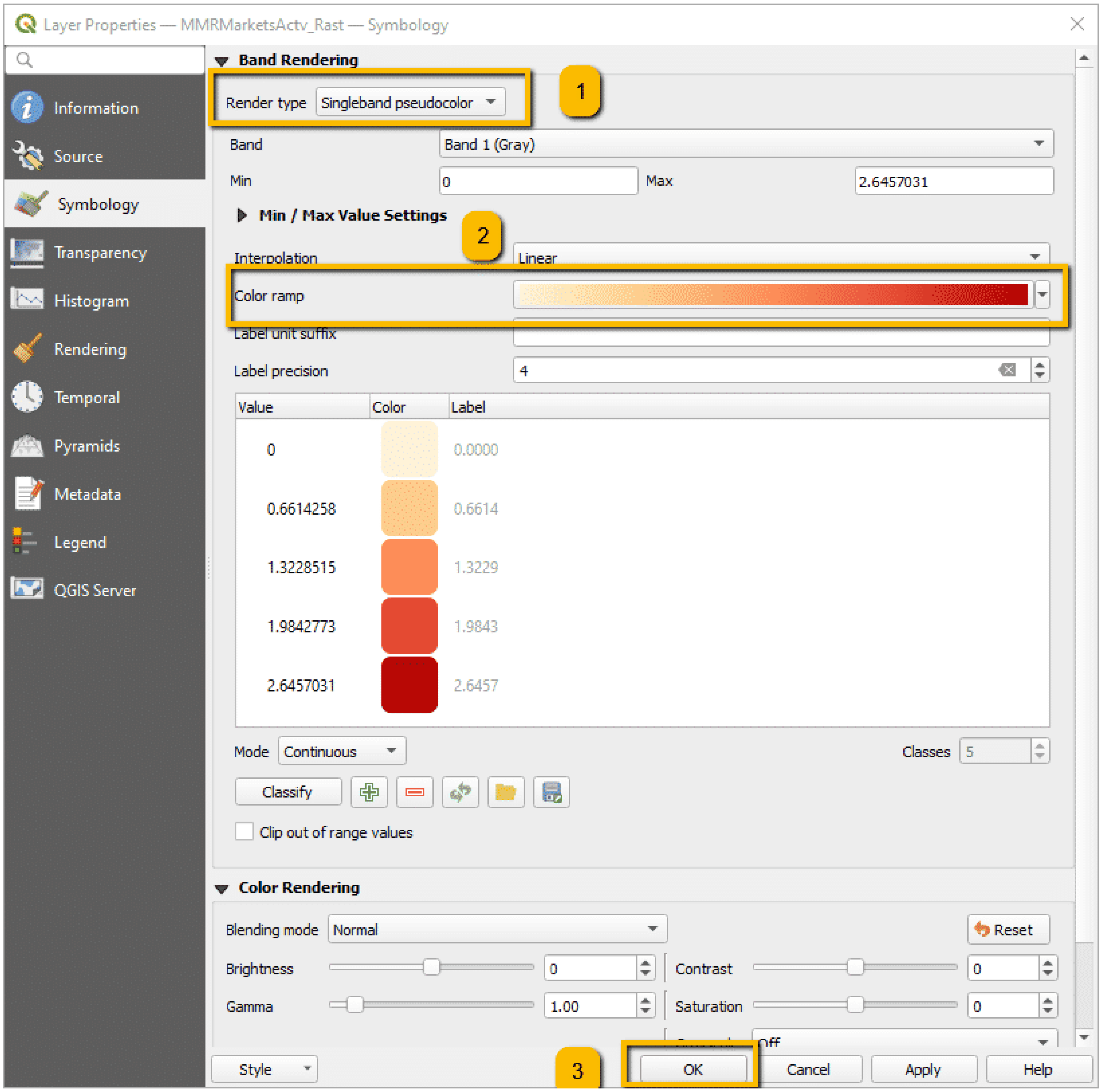
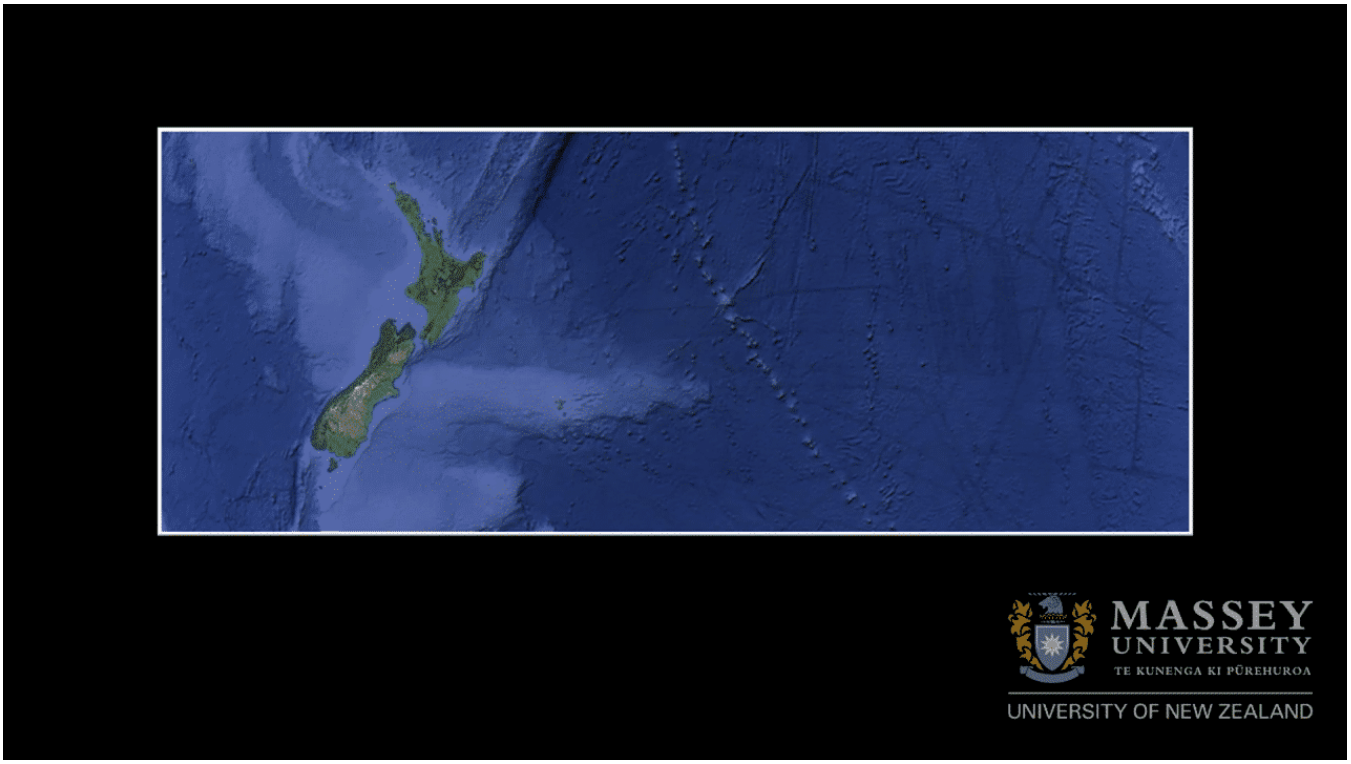


Figure 4.4: Dialog box of settings to edit settings for symbols of heatmap raster file

CONTINUE

Click ▶ to play the video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4.3 Spatial lines risk factors

"Examples of spatial lines risk factors are the road network as proxy variables for legal (primary roads) or illegal animal/animal product movements (secondary roads). The aim of this section is to create a continuous representation of the proximity of locations in the study area to the different road types.

The first task is to convert the polylines spatial vector file of roads to a raster file. This is necessary because the following steps need to work with raster and not vector spatial file types:"

- Layers Pane: Select and highlight polylines spatial object for analysis (ResData/Geo-Features/MMRRoadsPrim)
- Menu bar: Raster -> Conversion -> Rasterize (Vector to Raster) -> Dialog box … (Figure 4.5)

1. Input shape file ("ResData/Geo-Features/MMRRoadsPrim")
2. A fixed value to burn [optional]: Set to 1
3. Output raster size units: Select "Georeferenced units"
4. Width/Horizontal resolution = 1000

5. Height/vertical resolution = 1000

6. Output extent Click button on right -> Calculate from layer -> “MMR_0” (with polygon icon) and the extent should read as displayed

7. Assign a specified nodata value to output bands [optional]: Toggle to “Not set”

8. Click Run, and when finished click Close

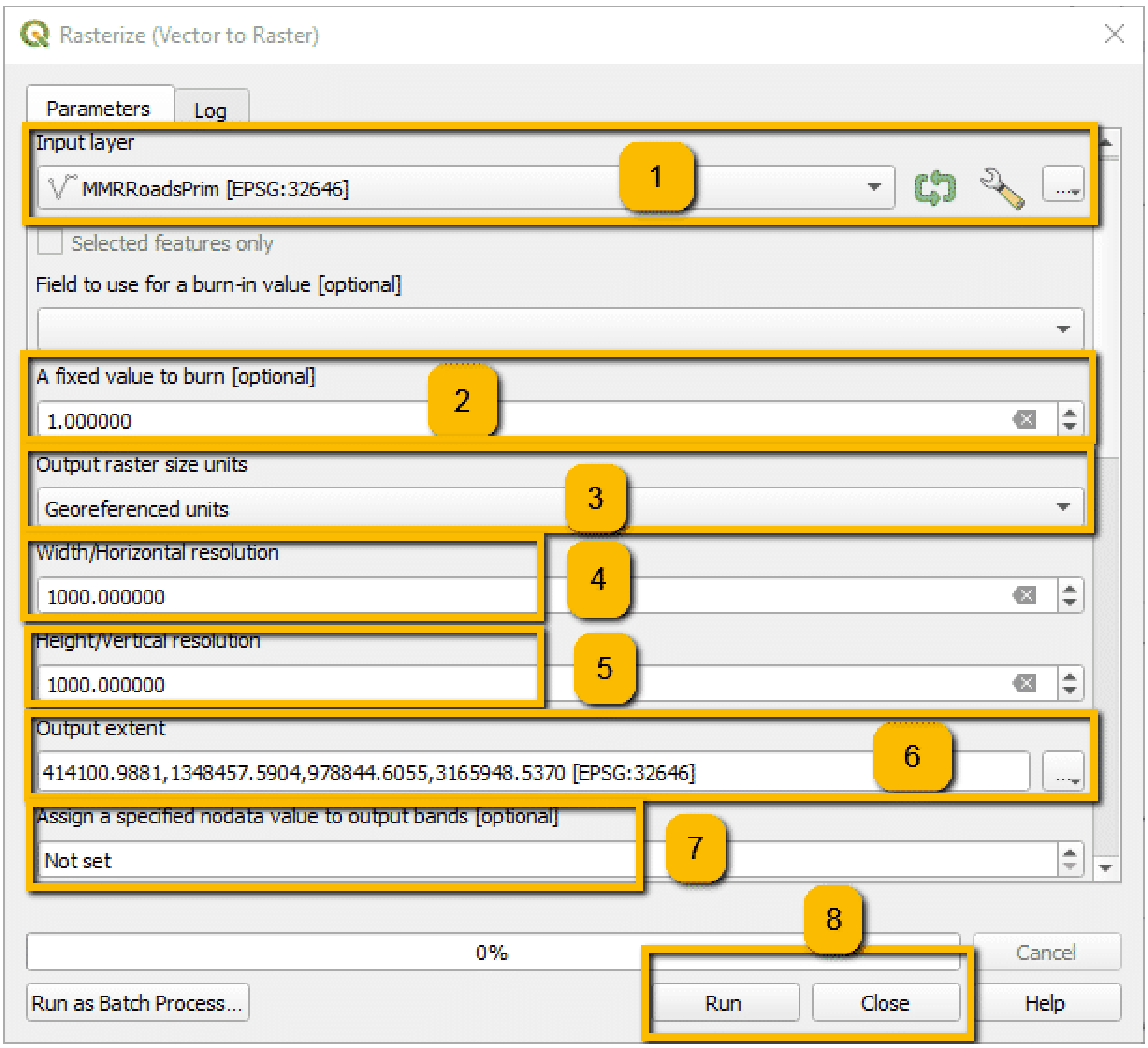

Figure 4.5: Dialog box of settings to create a raster file of primary roads

CONTINUE

- Right-click the newly-created layer “Rasterized” -> Export -> Save As -> Dialog box:(Figure 4.6)

1. “ResData/Geo-Admin/MMRRoadsPrim_Rast”
2. Click OK

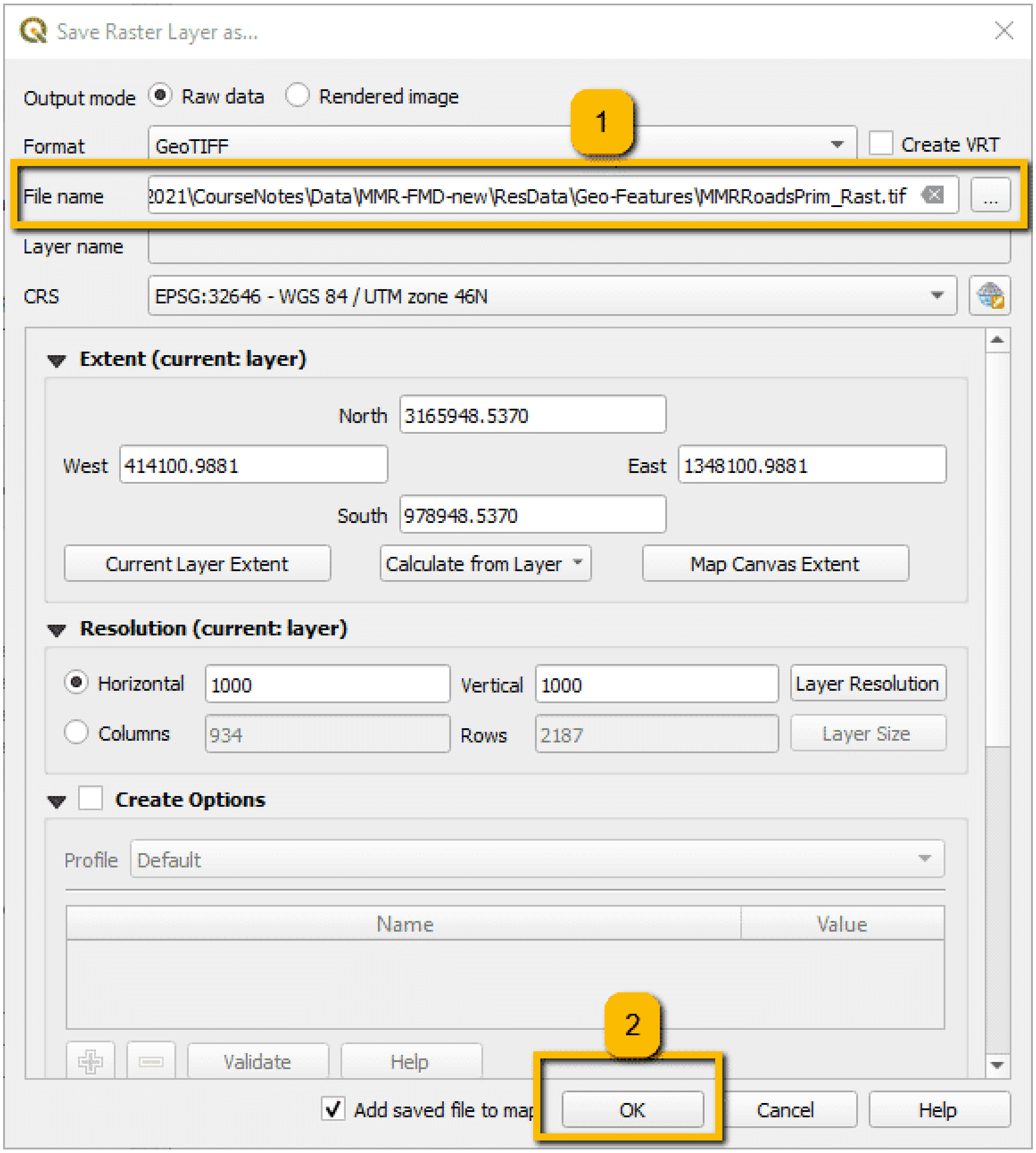

Figure 4.6: Dialog box of settings to save image of proximity to primary roads as a raster file

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Calculate closest distances to raster map of roads:

- Menu bar: Raster > Analysis > Proximity (Raster Distance)-> Dialog box… (Figure 4.7)

1. Input layer- select “ResData/Geo-Admin/MMRRoadsPrim_Rast”)
2. Distance units- select “Georeferenced coordinates”
3. No data value to use for destination proximity raster: Toggle to “Not set”
4. Click “Run” and when finished click “Close”

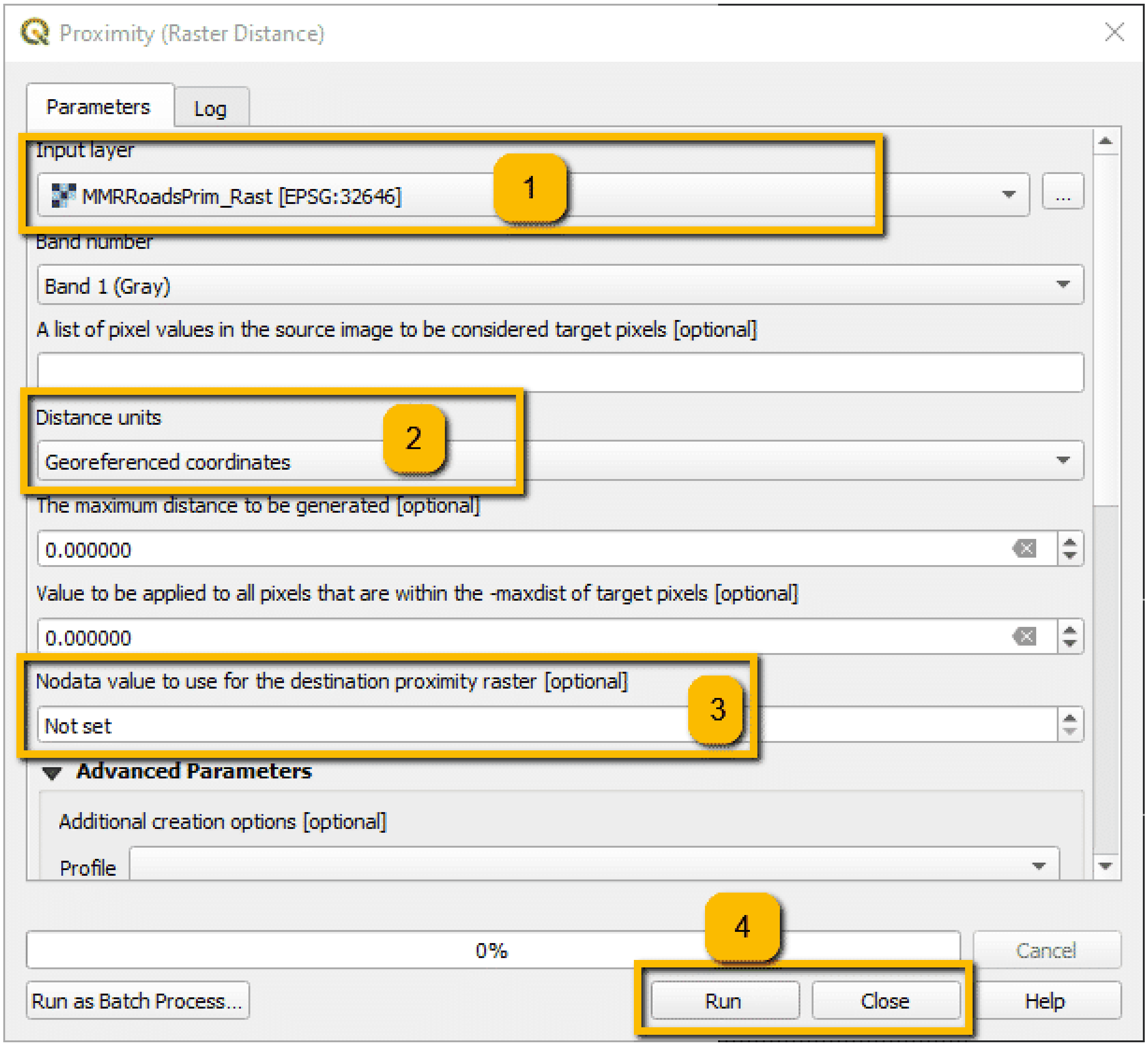

Figure 4.7: Dialog box of settings to create image of proximity to primary roads

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Export and save the newly created “Proximity map” layer:

- Right click “MMRRoadsPrim_Rast_Prox” -> Export -> Save As - Dialog box …(Figure 4.8)

1. Name file in “ResData/Geo-Admin/” folder as “MMRRoadsPrim_Rast_Prox
2. Click “OK”

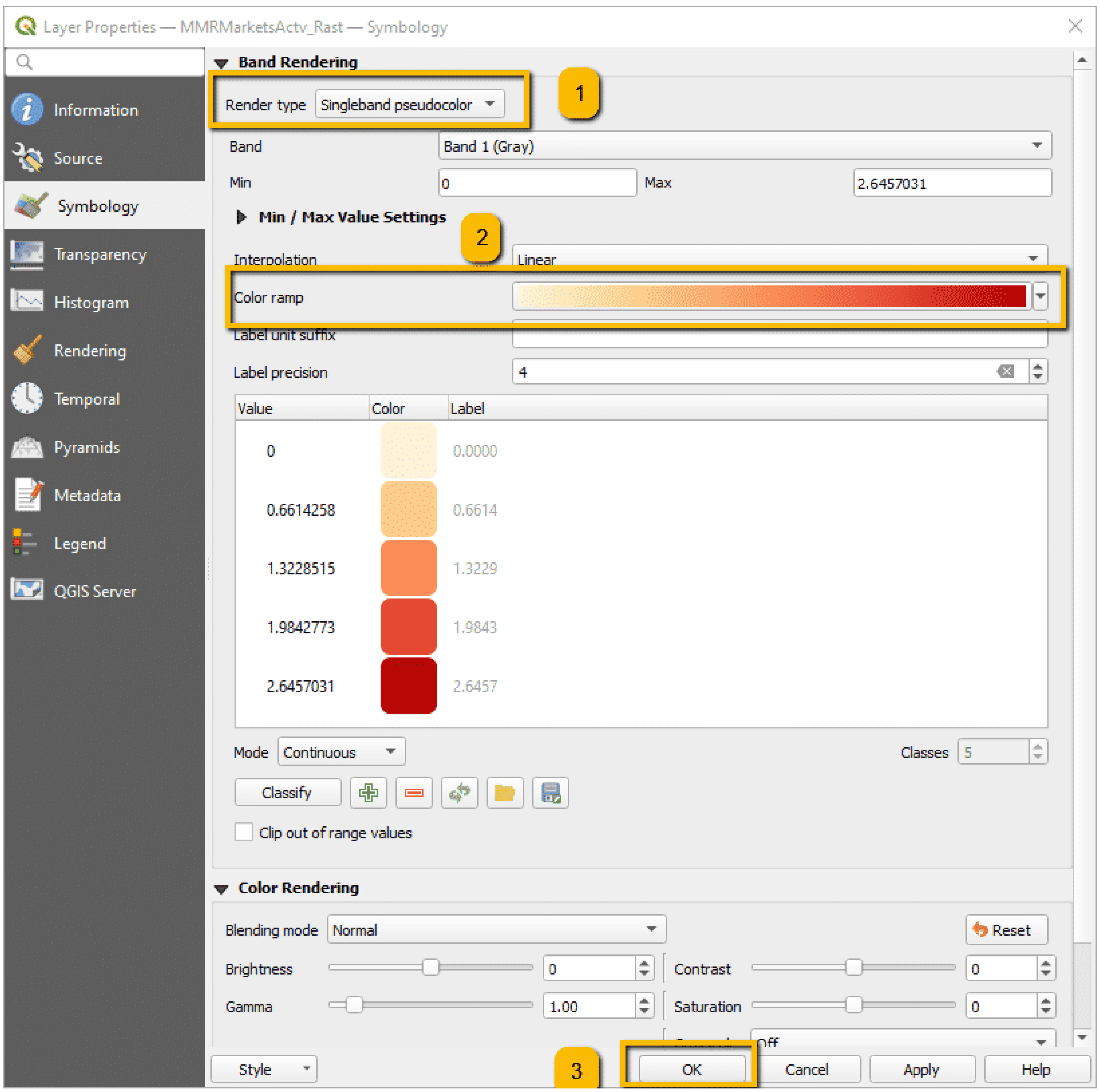

Figure 4.8: Dialog box of settings to save image of proximity to primary roads as a raster file

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"Repeat process for secondary roads but substitute "Sec" for "Prim" in the file name."

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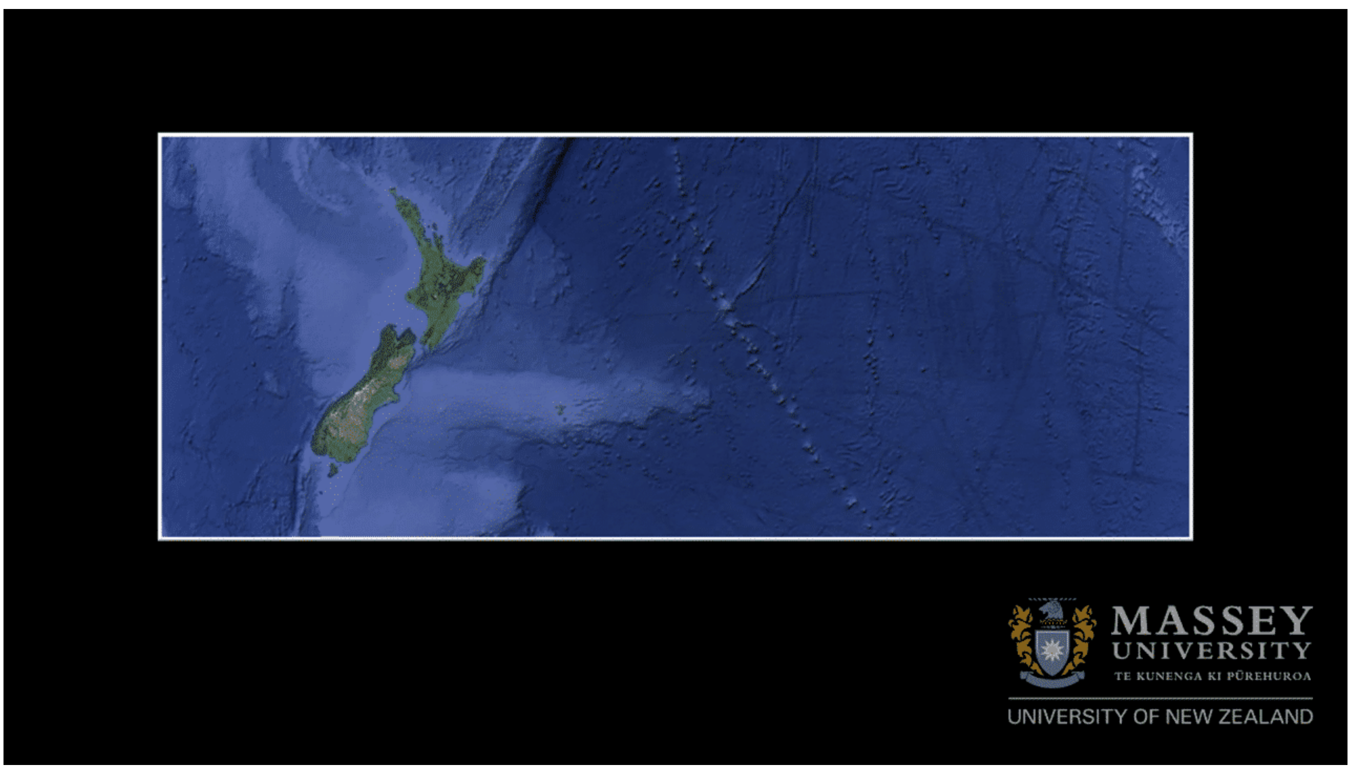

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4.4 Final processing of preliminary raster layers

"**The goal of this processing step is to ensure that the pixel values of the different preliminary raster risk layers are in a suitable form to combine, and that their values make logical sense.**

The first step is to normalise the raster values within each raster cell by dividing its value by the maximum value in the raster file (the maximum score procedure) to create pixel values between 0 and 1. We will use "MMRRoadsPrim_Rast" as an example:"

- Copy maximum raster layer value to use in next calculation (Figure 4.9)

1. Right click on newly-created raster proximity file in Layers Pane -> Properties -> Information ->
2. Locate 'Band 1' - STATISTICS_MAXIMUM' and copy value to computer clipboard (Control + C) and close information box

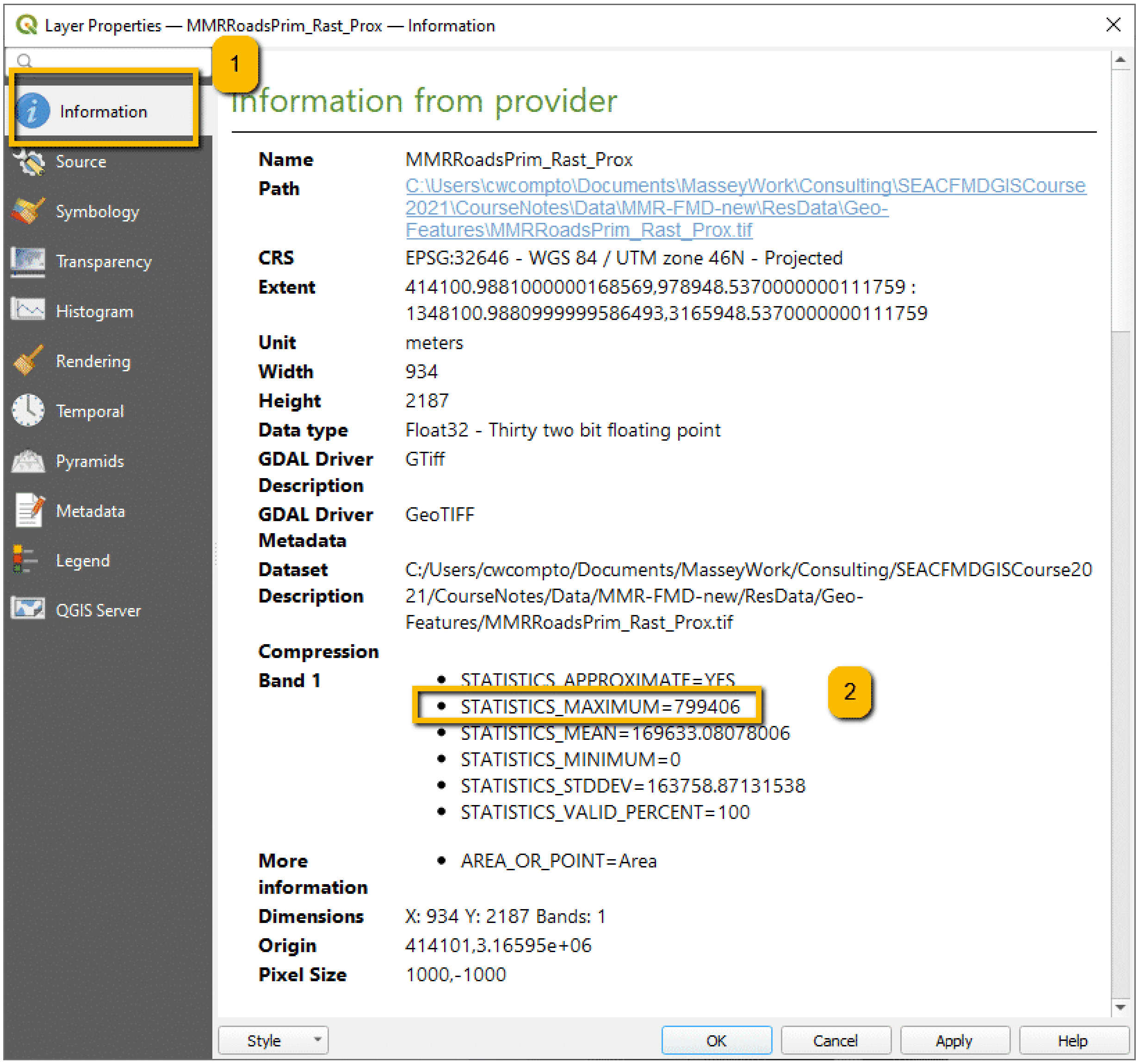

Figure 4.9: Raster file properties pane displaying maximum raster value

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- Menu bar: Raster -> Raster calculator -> Dialog box … (Figure 4.10)

1. In the Raster Bands box double click on the chosen file and raster layer to operate so that it appears in the Raster Calculator Expression box
2. Raster Calculator Expression: Divide the selected raster layer values by the copied maximum value
3. Result layer Output layer: Rename file as "MMRRoadsPrim_Rast_Prox_Norm" in the ResData/Geo-Features folder and click Save
4. Output CRS: Should read as the project CRS EPSG:36246 - WGS 84 /UTM zone 46
5. In dialog box click OK

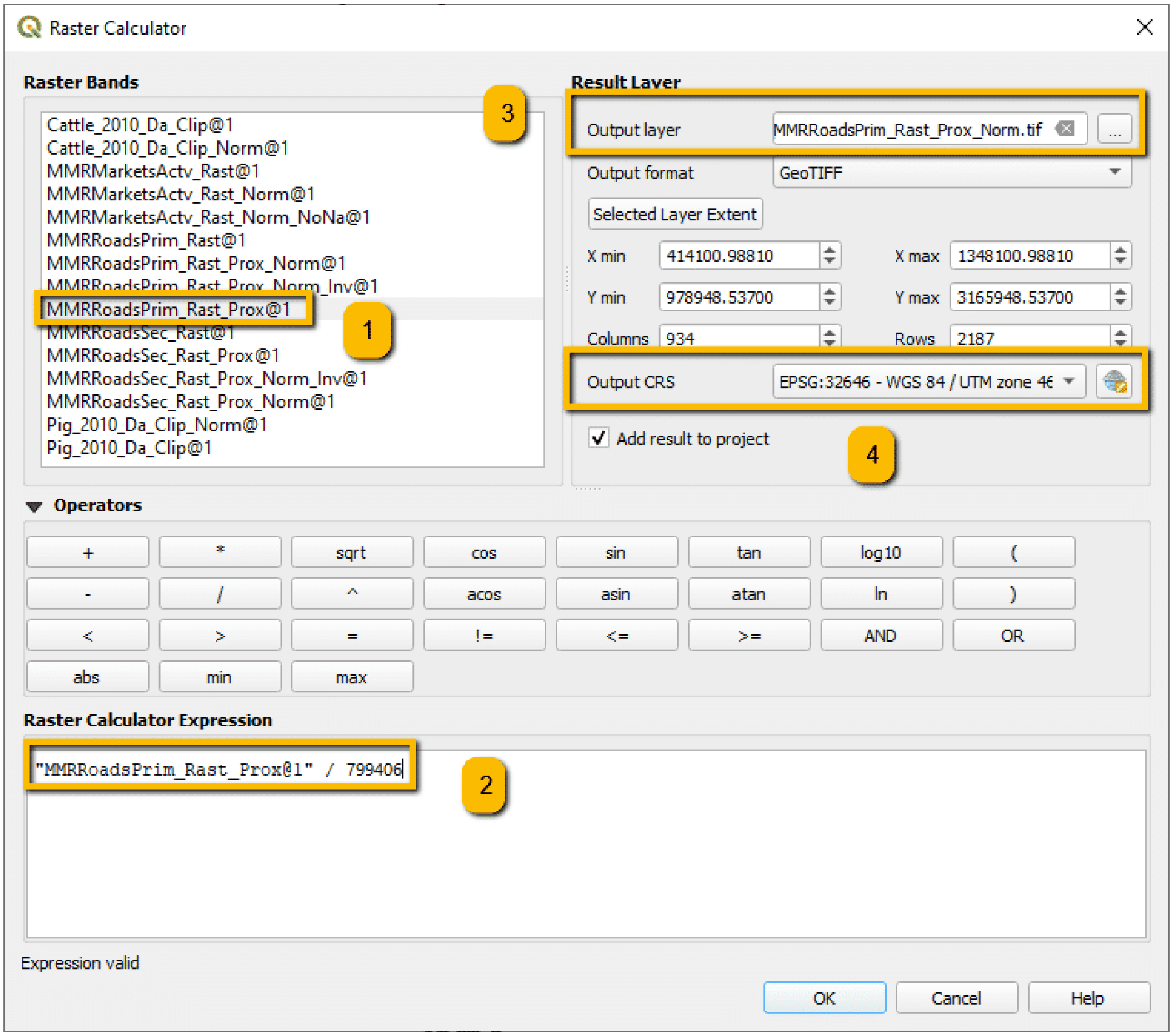

Figure 4.10: Raster calculator settings used to normalise raster layer

Repeat these steps for the other raster risk factor layers from the previous operations, renaming them with the same conventions.

CONTINUE

"The second step is to correct the pixel values for raster layers of distances from spatial lines so that they make logical sense. Currently, the pixel values reflect the real distance to the closest road, that is, increased distance equates to increased values. But we want pixel values with increased distance to equate to reduced risk e.g. distance to primary roads.

To achieve this, we create a new raster layer calculated as <u>1 - normalized value</u>. In this way greater values are nearer the road, denoting increased risk with increased proximity, and lesser values are further from the road, denoting decreased risk with decreased proximity. We achieve this by using the raster calculator again:"

- Menu bar: Raster -> Raster calculator -> Dialog box … (Figure 4.11)

1. Double click on the file and raster layer to operate on ("MMRRoadsPrim_Rast_Prox_Norm@1") so that it appears in the Raster Calculator Expression box
2. Raster Calculator Expression: 1 - selected raster layer values
3. Result file: Rename file as "MMRRoadsPrim_Rast_Prox_Norm_Inv" and click Save
4. In dialog box click OK

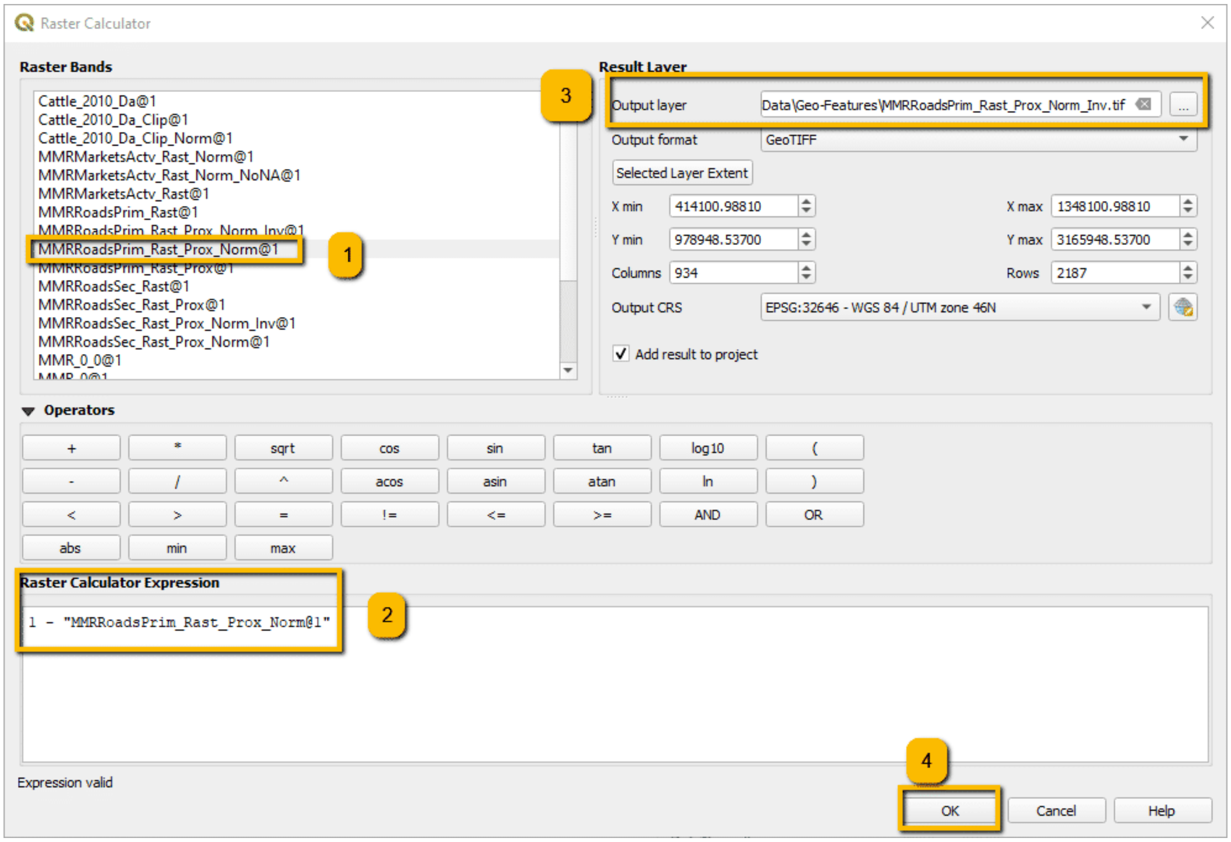

Figure 4.11: Raster calculator settings used to correct proximity values

ⓘ **Repeat this process for the secondary roads, naming the files with the same conventions.**

CONTINUE

"The third step is to deal with missing or "no data" values. The

> **raster calculator can’t function on pixels in the stacked layers if any of the aligned pixels have missing (no data) values. The next step, therefore, is to remove ‘no data’ pixels from any raster image where their pixels do not entirely cover the extent of the study area to allow the raster calculator to work with these pixels in other layers. For our exercise, this step applies to the normalised raster file of livestock markets heat map:**”

- In Toolbox menu click on Toolbox icon -> Processing Toolbox pane
- Search for “No data”
- Raster tools -> Fill NoData cells
- Double click on Fill NoData cells-> Dialog box (Figure 4.12)

1. Select “MMRMarketsActv_Rast_Norm”
2. Fill value: Set to 0
3. Output raster: Click folder button to right “Save to file …” and name new file as “MMRMarketsActv_Rast_Norm_NoNA” in “ResData-Features” folder
4. Click Run and when finished click Close

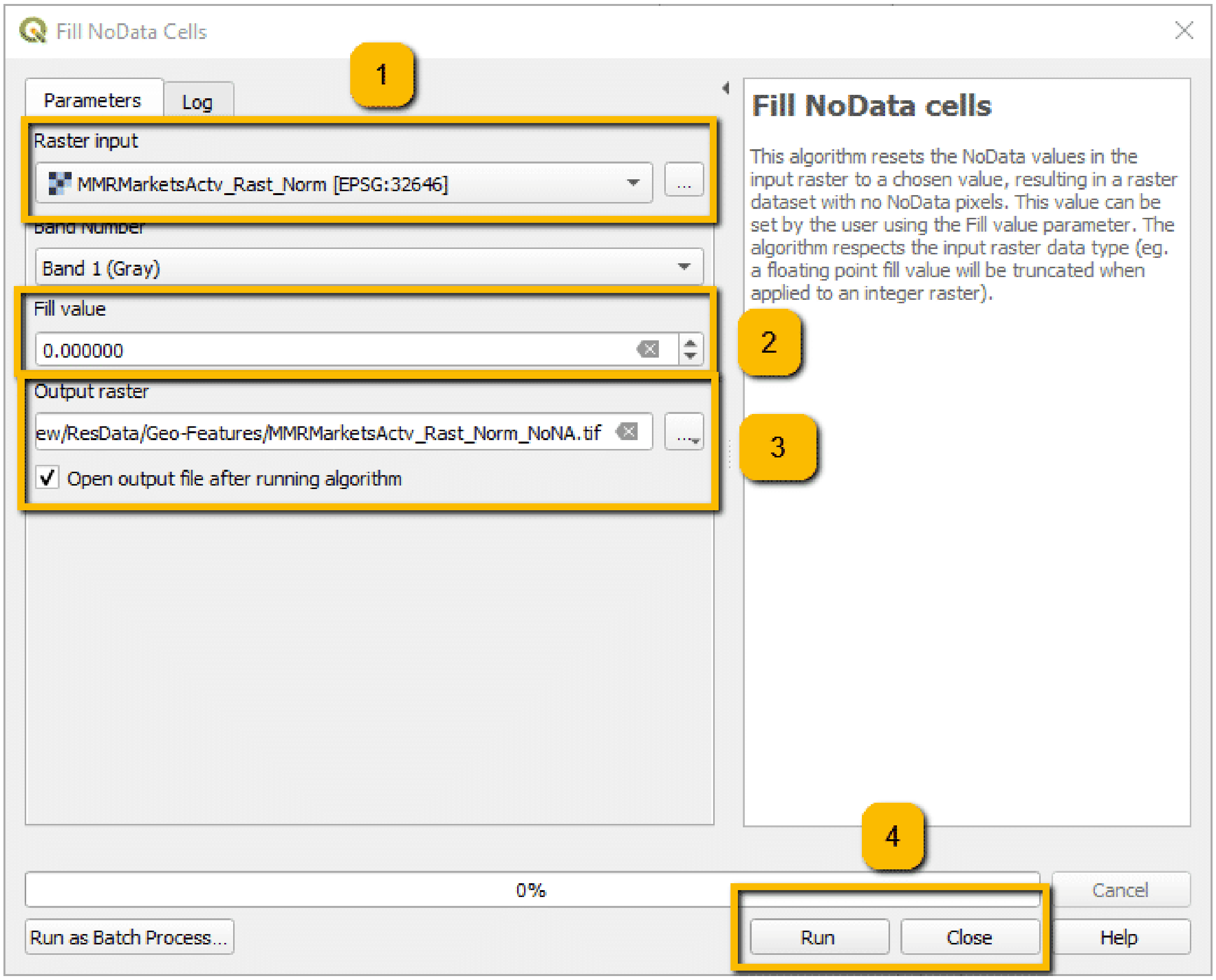

Figure 4.12: Fill NoData cells dialog box used to correct raster layer with no data values

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Exercise 4.1: Considerations when creating spatial risk surfaces

"There are often several choices that need to be made when creating raster spatial risk layers.

Create a table that allows you to answer the following questions:

1. **For each spatial risk layer, identify the optional values that you could have used when creating the raster risk layer**
2. **Describe the likely effects on the risk layer raster values and what that might mean for the final spatial risk map after the layers are combined**

CONTINUE

Have you completed the table as requested?

Yes

No

SUBMIT

CONTINUE

Table 4.1: Possible effects of changing parameters for GIS functions used to create final spatial risk assessment map for occurrence of FMD in Myanmar

Spatial risk factor	Parameters with optional values	Effect of changing parameters on final risk map
Proximity to livestock markets	Heatmap (Kernel Density Estimation)- Radius	Increased radius would increase the area around the markets influenced by the market and likely enclose more actual outbreak locations
	Heatmap (Kernel Density Estimation)- Kernel shape	A view of the possible kernel shapes shows that apart from uniform, they differ little from the default quartic shape, so alternate valid shapes would likely have little effect
Proximity to roads	N/A	
Population	N/A	

density of livestock		

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Congratulations - end of lesson reached

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