Teaching & Learning

Step by-Step Guide

Urbanity Level Analysis with QGIS

Amila Jayasinghe

Amaya Abeywickrama

Samith Madusanka

Teaching & Learning Step by -Step Guide:

Urbanity Level Analysis with QGIS

Authors

Amila Jayasinghe

Amaya Abeywickrama

Samith Madusanka

Publisher

University of Moratuwa

Author contribution

1. Amila Jayasinghe (Supervision, Conceptualisation, Methodology, Validation), Department of Town & Country Planning, University of Moratuwa, Sri Lanka.
2. Amaya Abeywickrama (Formal Analysis, Writing—original draft preparation), Department of Town & Country Planning, University of Moratuwa, Sri Lanka.
3. Samith Madusanka (Project Administration, Review and Editing), Department of Town & Country Planning, University of Moratuwa, Sri Lanka.

All authors have read and agreed to the published version of the book.

Contact authors amilabj@uom.lk

This book was produced with the valuable support of the Erasmus+ Capacity Building in Higher Education (CBHE) project 'Curricula Enrichment for Sri Lankan Universities delivered through the application of Location-Based Services to Intelligent Transport Systems' (LBS2ITS https://lbs2its.net/)

Project Number: 618657-EPP-1-2020-1-AT-EPPKA2-CBHE-JP
Programme: Erasmus+
Key Action: Cooperation for innovation and the exchange of good practices
Action Type: Capacity Building in Higher Education
Co-funding: Erasmus+ Programme of the European Union

This book was reviewed as an Open Education Resource for University students by Prof Retscher Günther (Vienna University of Technology, Austria)under the LBS2ITS project.

LBS2ITS

Curricula Enrichment delivered through the Application of Location-based Services to Intelligent Transport Systems

lbs2its.net

Co-funded by the Erasmus+ Programme of the European Union

Edition

First Edition - May 2025

Copyright

ISBN 978-955-9027-96-6 (ebook)

Citation

Jayasinghe, A., Abeywickrama, A., & Madusanka, S. (2025). *Teaching & learning step-by-step guide—Urbanity level analysis with QGIS* (1st ed.). University of Moratuwa.

Disclaimer

This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. The contents and views in this publication do not necessarily reflect the views of the publisher.

Publisher

University of Moratuwa

PREFACE

This book serves as open educational resource for both undergraduate and postgraduate degree programs, offering a detailed, step-by-step guide to analyzing urbanity levels with the use of a Geographic Information System. Designed to bridge the gap between theoretical knowledge and practical application, this guide is meticulously crafted to meet the needs of students, educators, and practitioners alike.

Within the book, readers will find comprehensive instructions on employing GIS software to analyze spatial information and interpret this data to understand urbanity level and degree of balance in socio-economic and spatial attributes in a particular area. The book not only enhances learning in academic settings by providing real-world applications and case studies but also equips industry professionals with the skills necessary to conduct advanced spatial analysis and contribute meaningful insights in their fields.

Whether you are a student aiming to master analytical skills using geographic information systems, a teacher looking for robust educational tools, or a practitioner in need of refining your technical expertise, this manual offers invaluable guidance and support. It ensures that users at all levels gain proficiency in leveraging modern technologies to monitor, explore, and solve current situations in urban contexts and geographic challenges effectively.

TABLE OF CONTENTS

LIST OF FIGURES

1. WHAT IS URBANITY LEVEL ANALYSIS?

The urbanity level map for a selected area can be obtained by overlaying the Accessibility (space syntax) map, Density (space matrix) map, and Diversity (land use mix) map of that selected area.

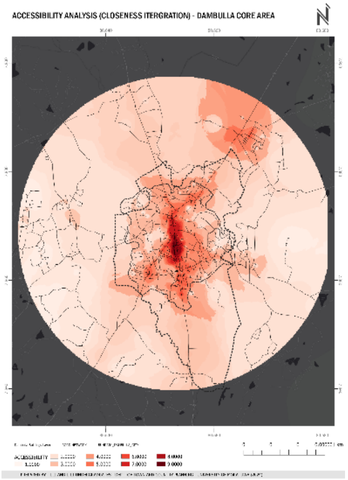


Figure 1- Accessibility Map

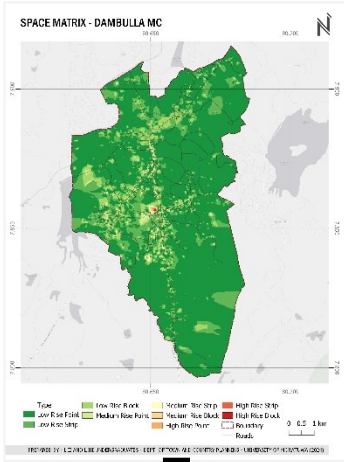


Figure 4 - Density map

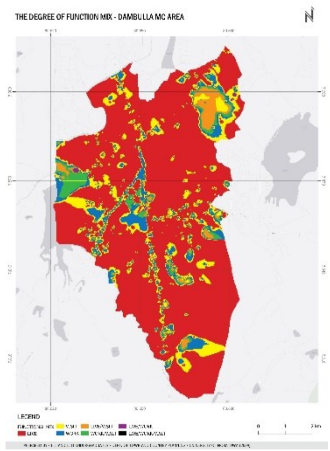


Figure 3 -Diversity Map

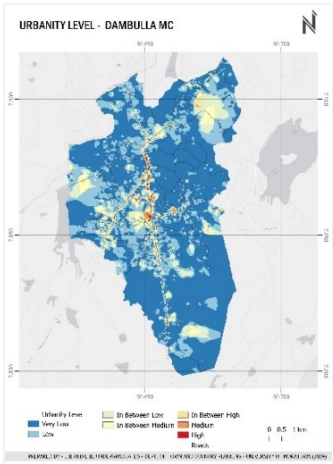
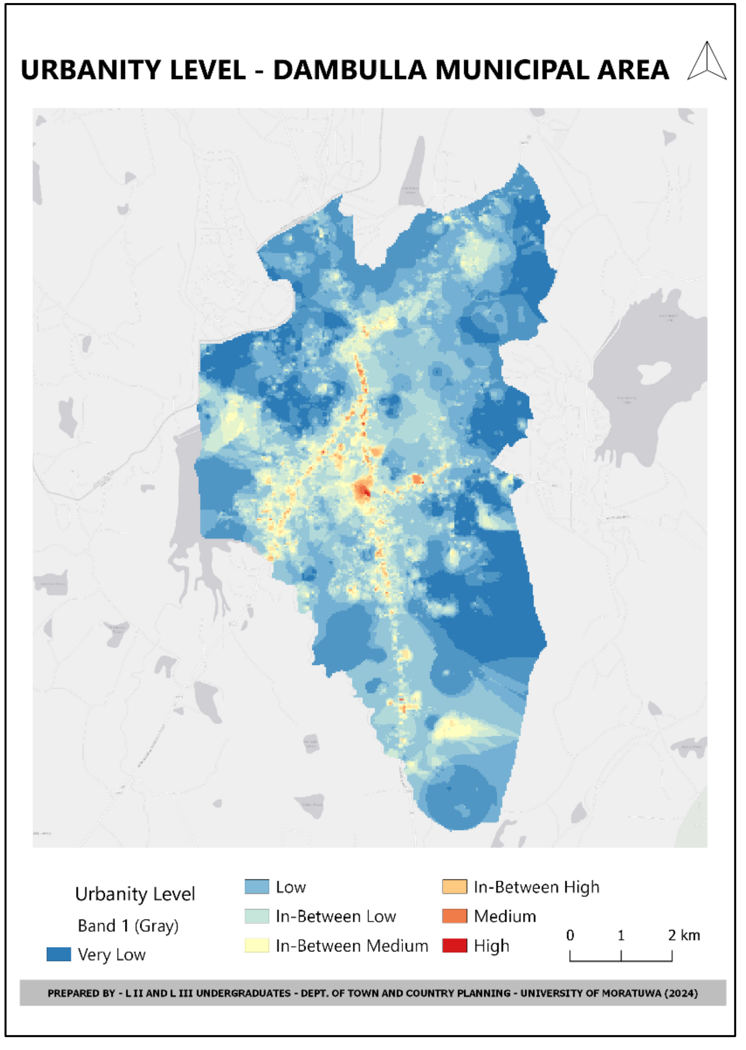


Figure 2 - Urbanity Level Map

1.1 Urbanity Level

The level of urbanity in a specific place is the extent to which certain urban attributes and traits are prevalent. It encompasses various aspects of urban life, including density, diversity, accessibility and also infrastructure, culture, and social dynamics. A more thriving, dynamic, and well-developed urban environment is usually indicated by a higher level of urbanity, which is defined by a variety of land uses, busy streets, cultural amenities, and diverse neighborhoods. The Urbanity Level of a particular place can be categorized into various classes like low level, medium level, high level or low urban, suburban and high urban areas. Especially those categorization standards can be varied according to the certain characteristics of urban areas. By integrating all the quantitative information from the Land use mix, space syntax, and space matrix investigations, a new approach for classifying different kinds of urban environments can be proposed according to the urban morphology. Three categories are used here to categorize the built environment: "balanced with low values," "unbalanced with mixed values," and "balanced with high values." "Balanced" denotes comparable values that are, similarly, high or similarly low in the space syntax, space matrix, and land use mix measurements, whereas "unbalanced" denotes the presence of notable discrepancies between the values of the three metrics. Urbanity level, taken as a whole, provides a comprehensive indicator of the standard and vibrancy of urban environments. It directs efforts towards sustainable, inclusive, and pleasurable urban development for residents as well as visitors.

1.2 Final Outputs



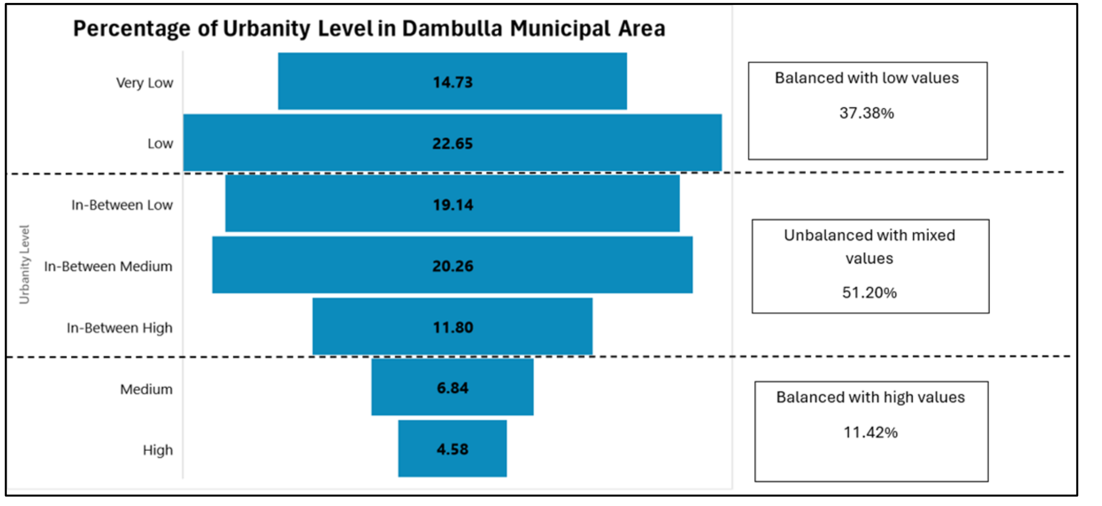


Figure 5 -Urbanity Level Map & Percentage

2. FULL PROCESS

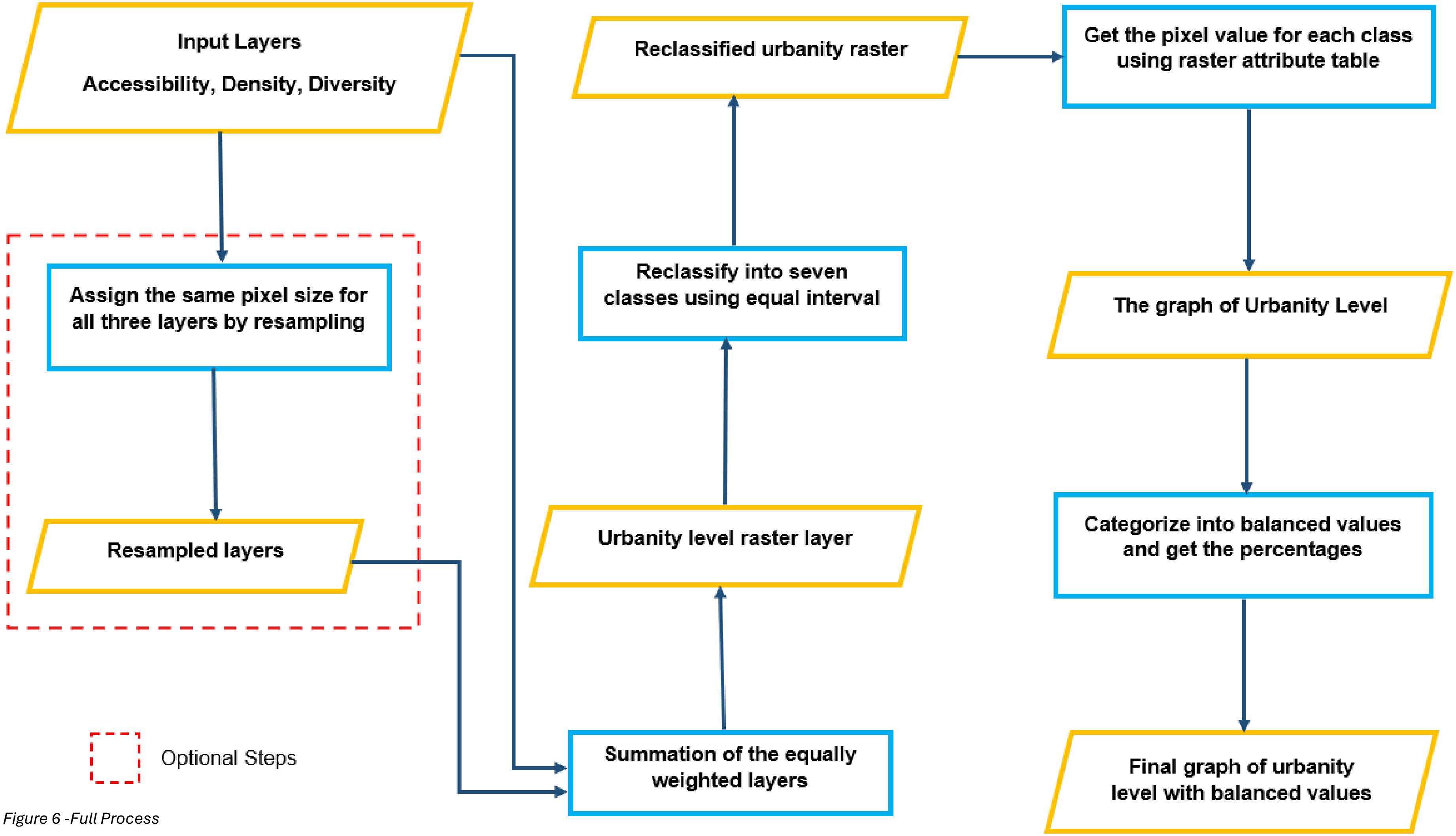


Figure 6 -Full Process

3. REQUIRED APPLICATIONS

- QGIS

QGIS is an open-source Geographic Information System (GIS) software. Users can generate, modify, view, examine, and share geographic data with it. Due to its extensive plugin support and user-friendly interface, QGIS is widely used in a variety of sectors, including environmental research, urban planning, and agriculture. It is used for a variety of activities, including data management, mapping, and spatial analysis.

Figure 7 QGIS Software

- Microsoft Excel

One of the most effective spreadsheet programs for organizing, analyzing, and visualizing data is Microsoft Excel. Its features, which span from advanced data modeling to budgeting, include formulas, functions, charts, and pivot tables. Excel is a vital tool for not only managing personal finances, business, and education but also various utilities.

Figure 8 Microsoft Excel

4. INTRODUCTION TO INPUTS

Accessibility - The ease with which people may access services and destinations in an urban environment is referred to as accessibility. It considers elements such as the city's connectedness, travel times, and transportation infrastructure. The degree of connectedness and mobility that residents have access to is determined by accessibility, which is a critical factor in urbanity-level study. To promote connectedness and raise urbanity levels throughout the city, accessibility analysis aids in the identification of places with poor access and directs the planning of land use patterns, pedestrian infrastructure, and transit networks.

Density - The concentration of people, buildings, and activities in a given area is measured by density. Density in a study of urbanity levels indicates the level of human interaction and urban growth. Taller buildings, more compact land use patterns, and increased pedestrian activity are characteristics of higher-density places. Greater densities are frequently connected to busy urban areas, whereas lower densities are connected to suburban or rural settings. In order to preserve livability and sustainability while promoting urban vitality, the right density balance must be achieved.

Diversity - Diversity in urbanity level analysis refers to the range of elements found in an urban region. This covers a range of land uses, including commercial, industrial, residential, and recreational areas. Increased diversity contributes to a lively and dynamic urban environment by indicating a wider mix of people, activities, and amenities within the urban fabric. Diversity analysis ensures that neighborhoods provide residents with a balanced mix of opportunities and services by assessing the richness and complexity of urban life.

So, accessibility, density, and diversity are the major three inputs for getting the urbanity level of a particular area.

> **Note** – It is a requirement that all three raster layers have the same coordinate system, pixel size and area extent. If one of these factors changes, the result will be different and lacking in accuracy, so, ensuring that is essential before overlaying the three raster layers. For this manual, I have selected WGS 84 as the coordinate system for all three layers and 30m as pixel size. The selected area is the Dambulla Municipal region in Sri Lanka for all three layers. The processing of the above input data is mentioned in accessibility, density, and diversity manuals respectively. You can refer to those manuals to process the above data.

5. STEPS

a. Input Data (Open the QGIS and add accessibility, density, and diversity raster layers into the interface)

The processing of the above input data is mentioned in accessibility, density, and diversity manuals respectively. You can refer to those manuals to process the above data.

i. Launch QGIS on your desktop and double-click on the new empty project to open a new project in QGIS.

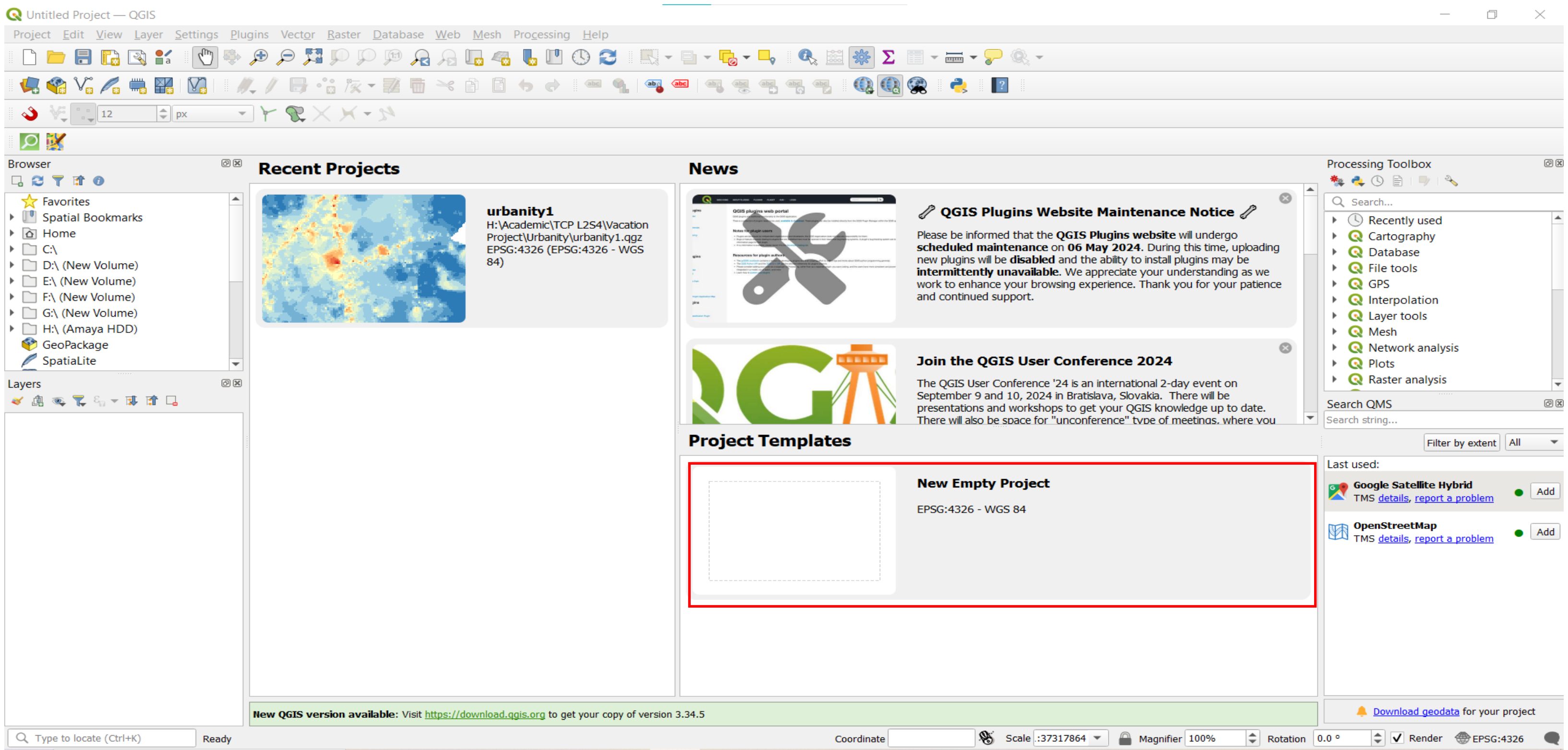


Figure 9 Interface of QGIS

ii. Go to the Layer Tab in the Menu Tool Bar.

1. Click on the layer tab.
2. Select Add Layer.
3. Click on Add raster layer as shown according to the numbers.

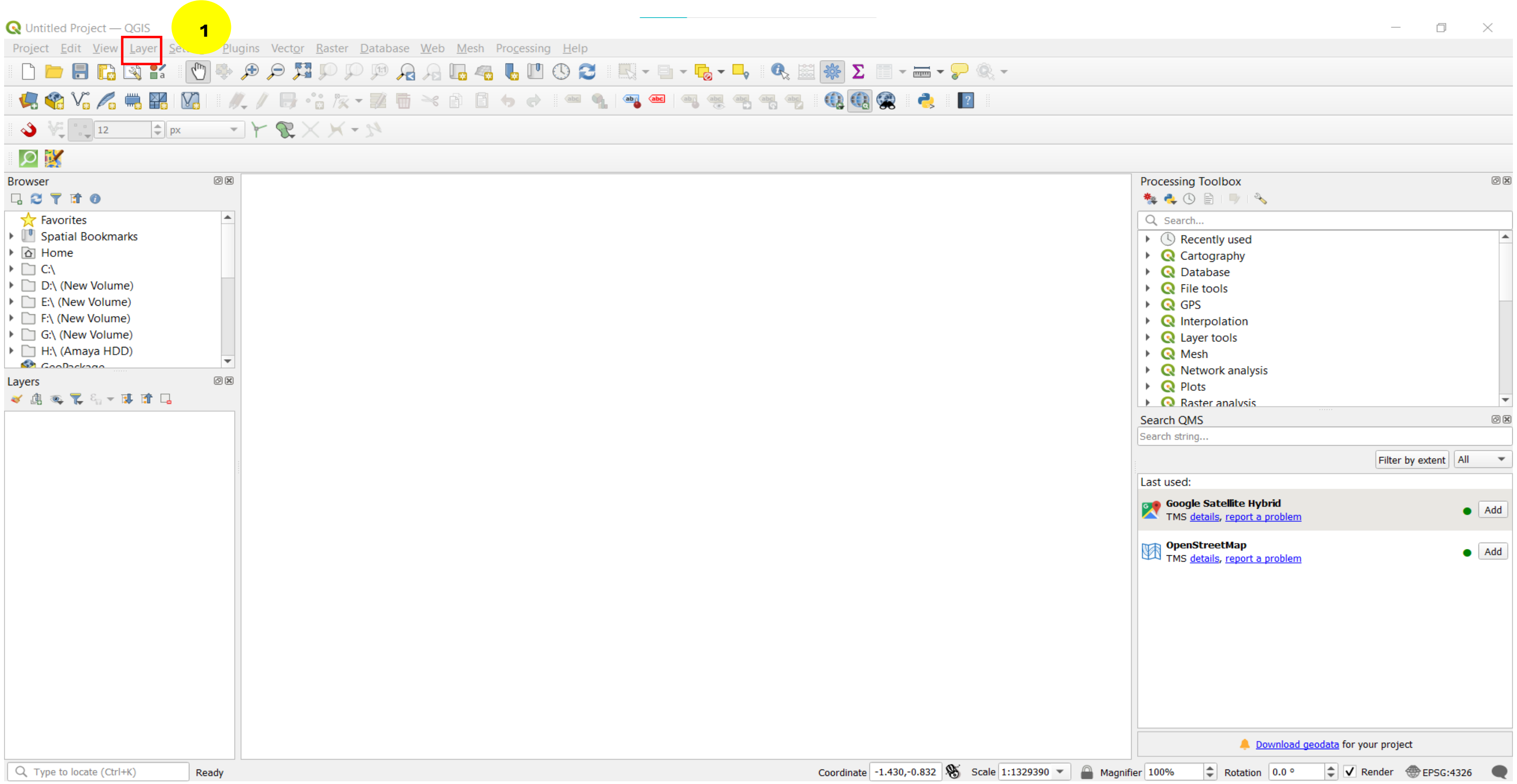


Figure 10 - Menu Tool Bar

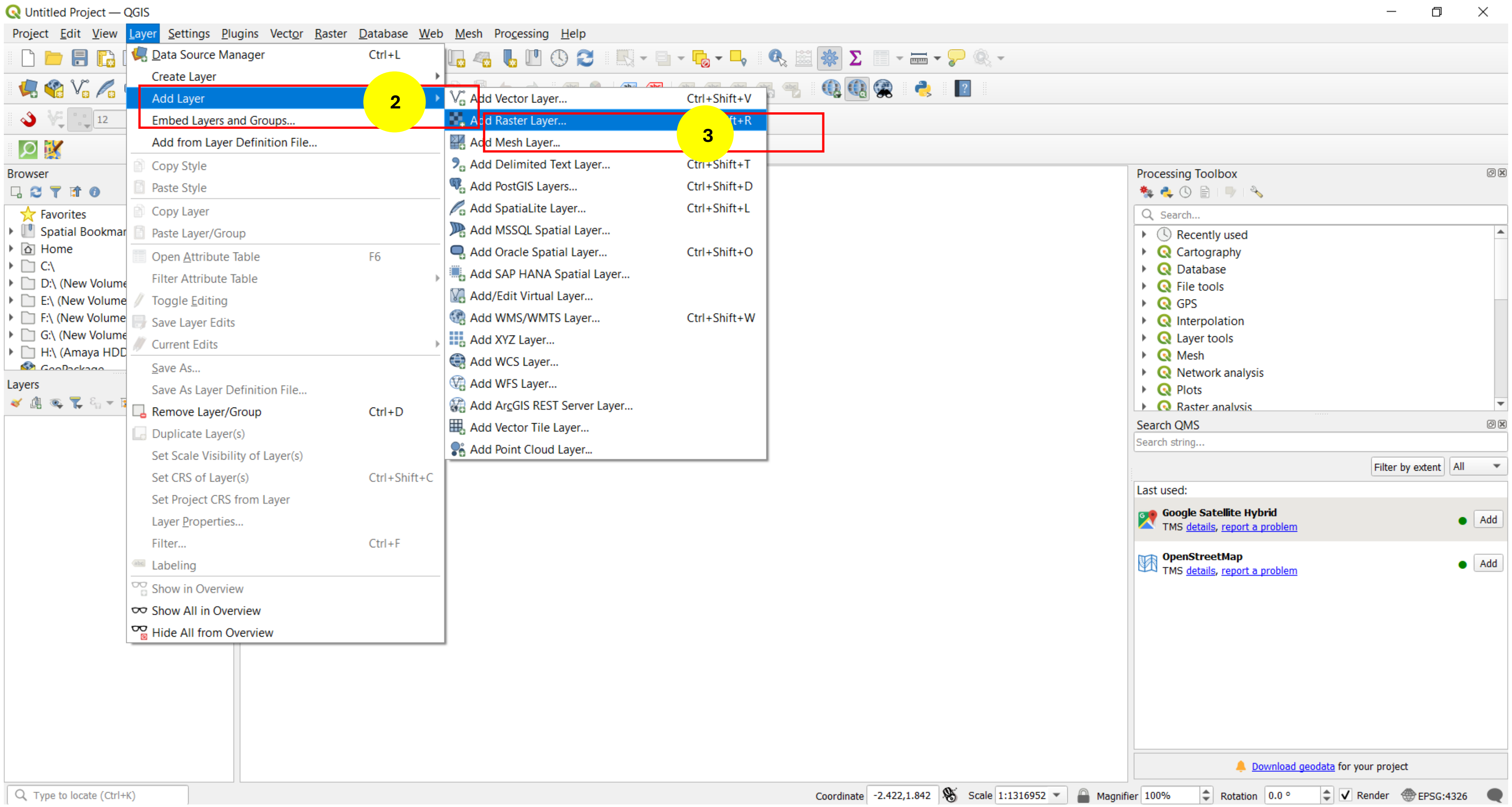


Figure 11 -Add Layer

You can add various types of layers such as vector and raster layers to the project interface from this add layer option.

iii. By clicking Add Raster layer it will open the open data source manager panel.

1. Click on the three-dotted icon to add a raster dataset from your device.
2. Browse to the relevant folder where you have saved your raster datasets and select a dataset. (In this manual first, I have selected the land use mix diversity layer. You can select three layers as your preference hence the selection order of layers will not affect the output.)

Note – It is important to select only the TIF format of your layer when adding a raster layer. Other formats are not applicable.

3. Click on open to add the selected raster layer to the open data source manager panel.
4. Do not change anything under the options in the menu and then click on Add in the open data source manager panel to add that raster layer to the project interface.

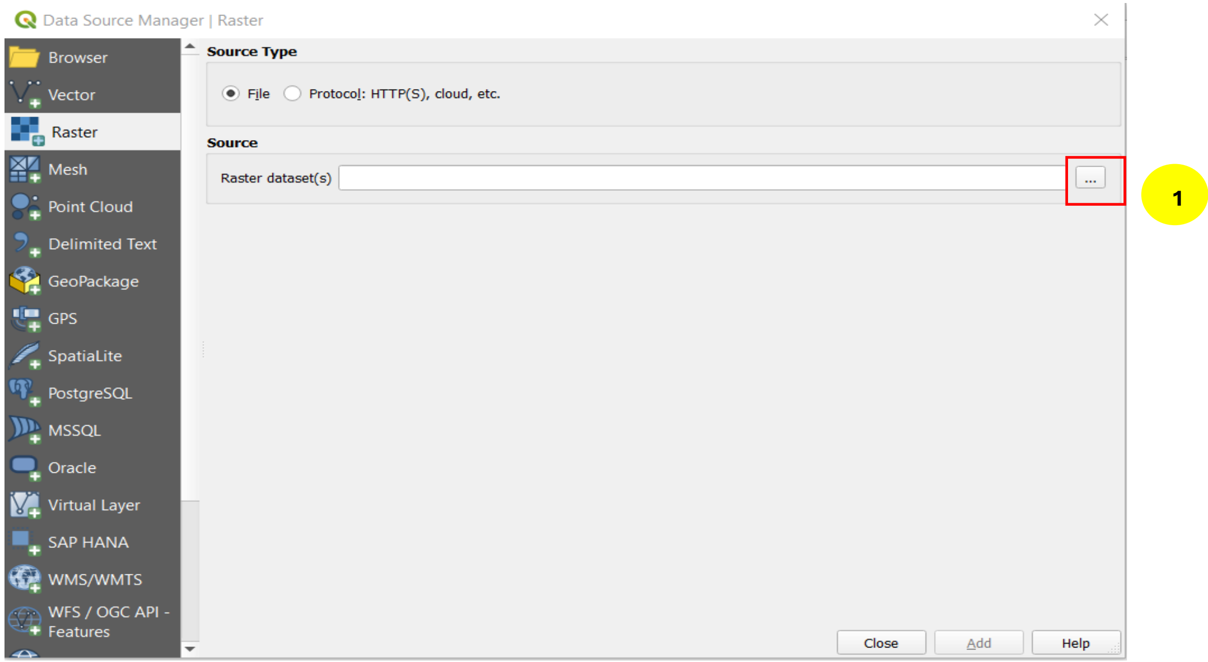


Figure 12 - Data source manager

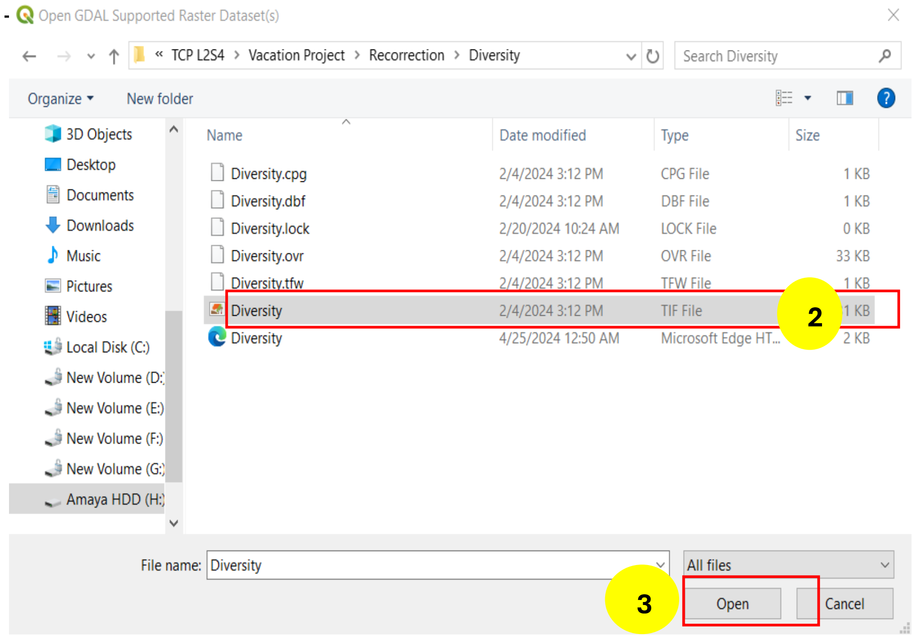


Figure 13 -Add Map

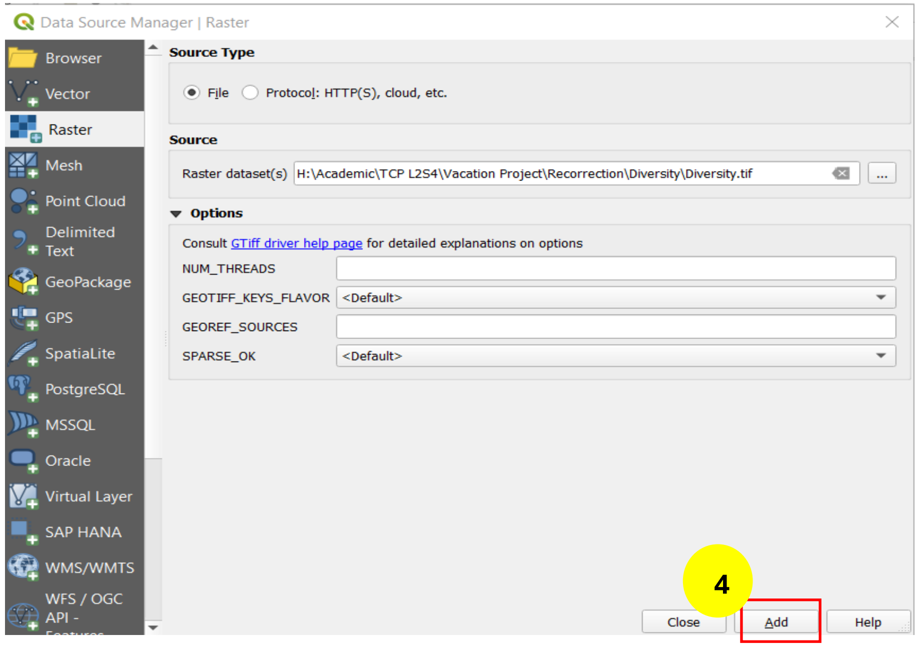


Figure 14 -Add Layer

- Now, the diversity data is added to the interface.

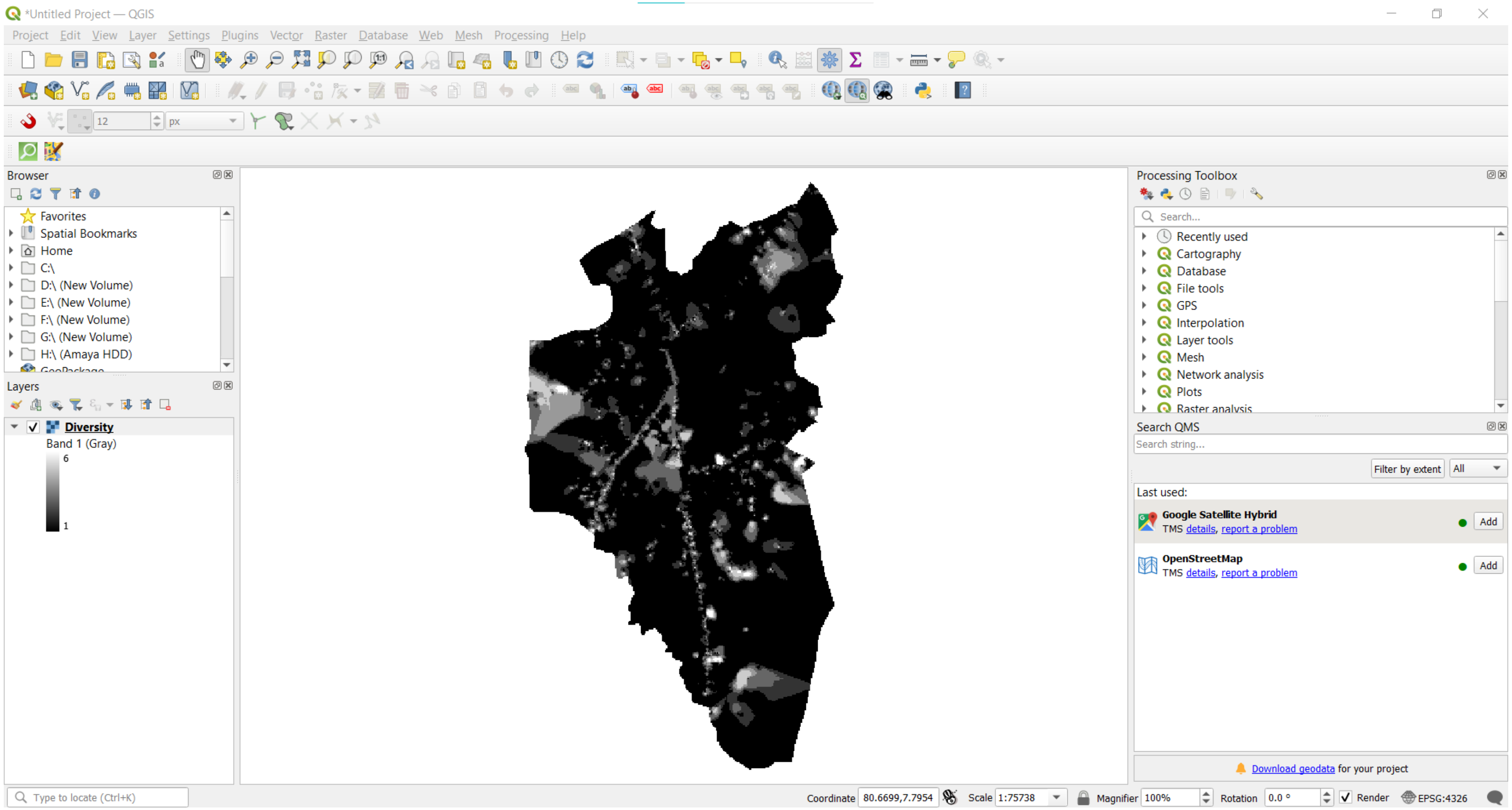


Figure 15 -Diversity Data

iv. **Add the other two datasets according to the process mentioned in steps ii and iii.**

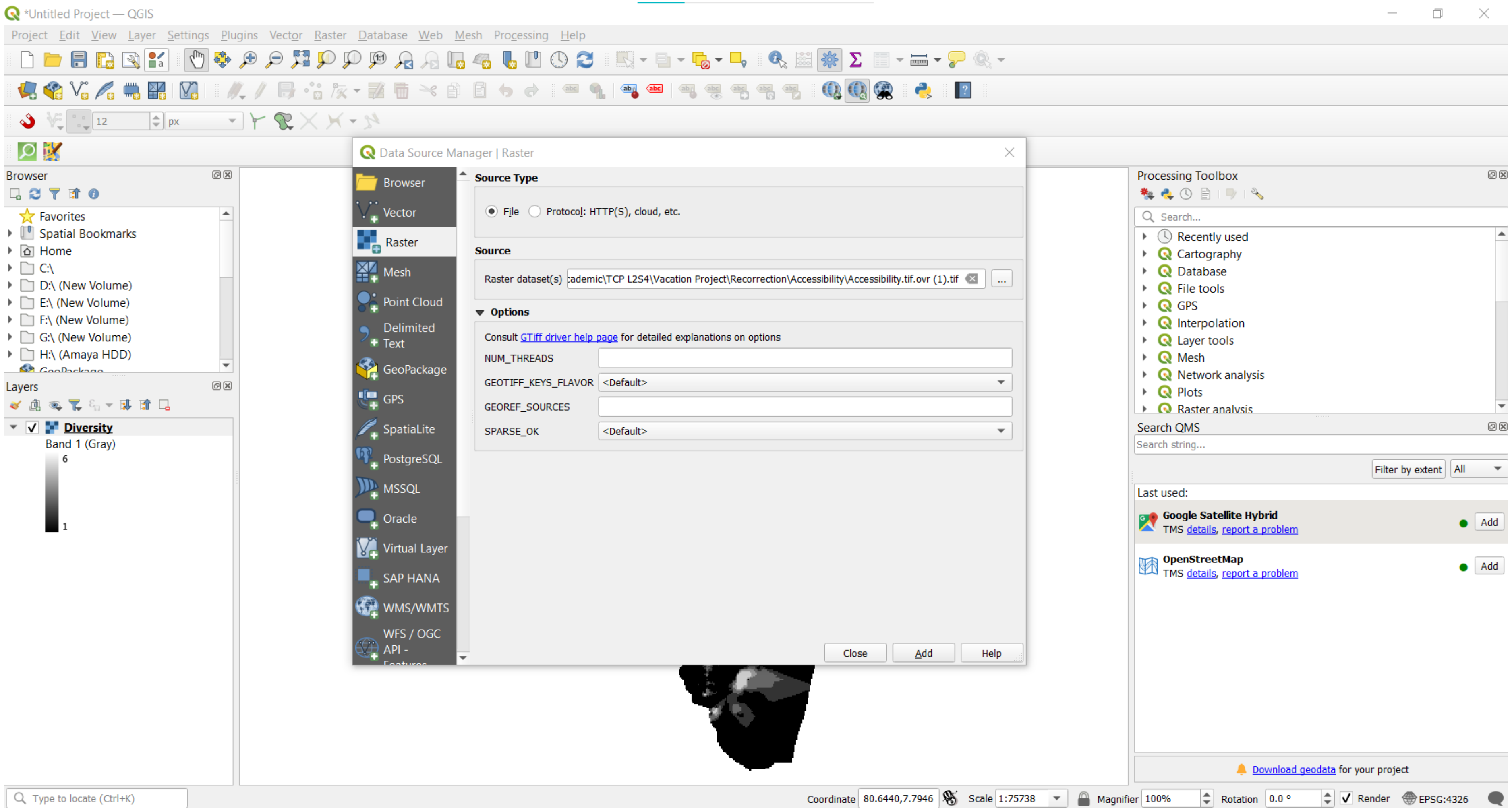


Figure 16 -Add Data

- All three datasets diversity, density and accessibility layers are added to the interface.

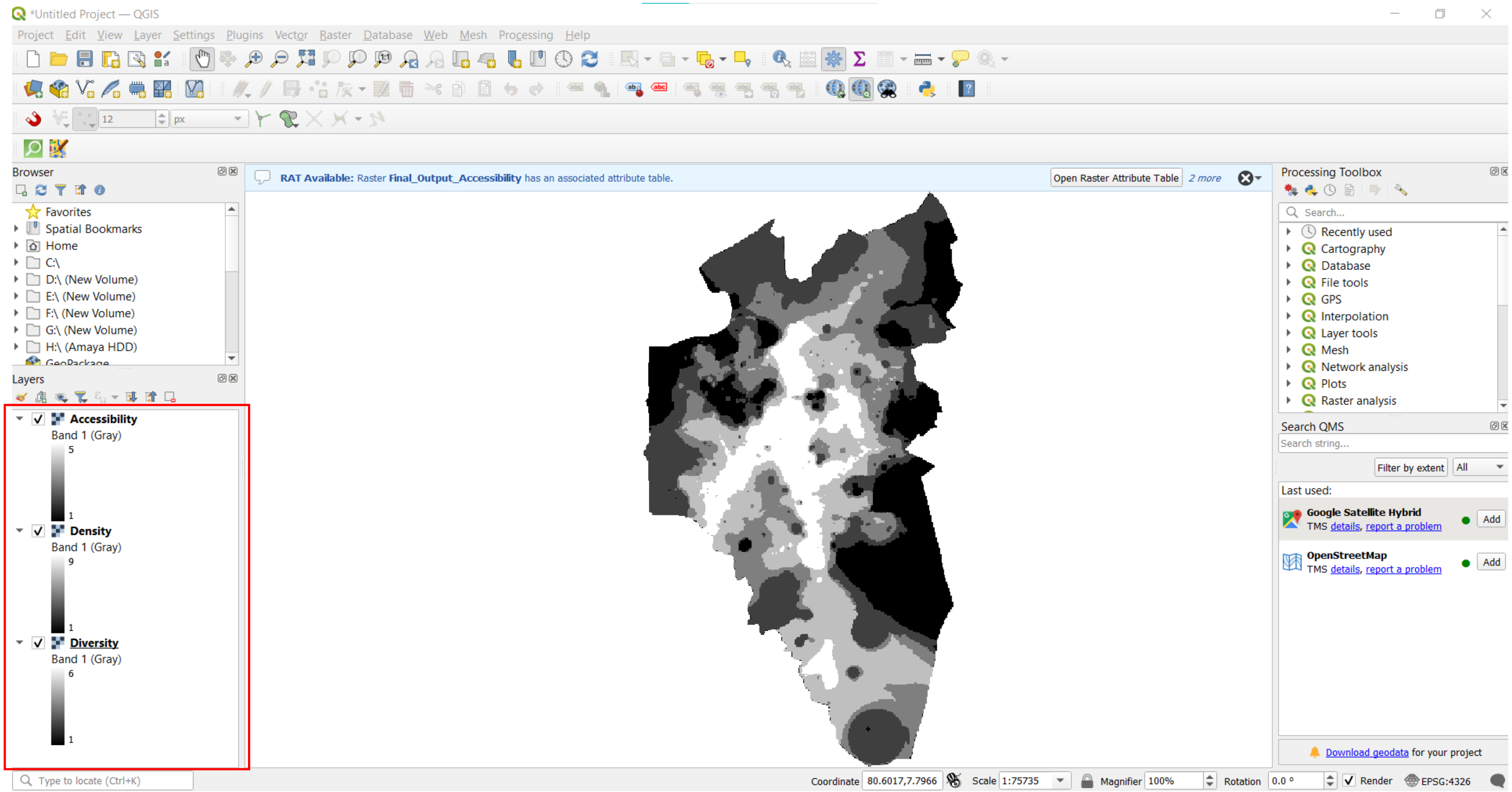


Figure 17 - All three datasets

Optional Steps:

- ❖ As mentioned before, all three raster layers should be in the same coordinate system, cell (pixel) size, and region extent before overlaying. So, space syntax (accessibility) mapping, space matrix (density) mapping, and land use mix (diversity) mapping should be done to the same area extent, and we can check the coordinate system and cell size of a layer by information panel in that raster layer. For that

1. Right-click the relevant layer
2. Go to the properties and click it.

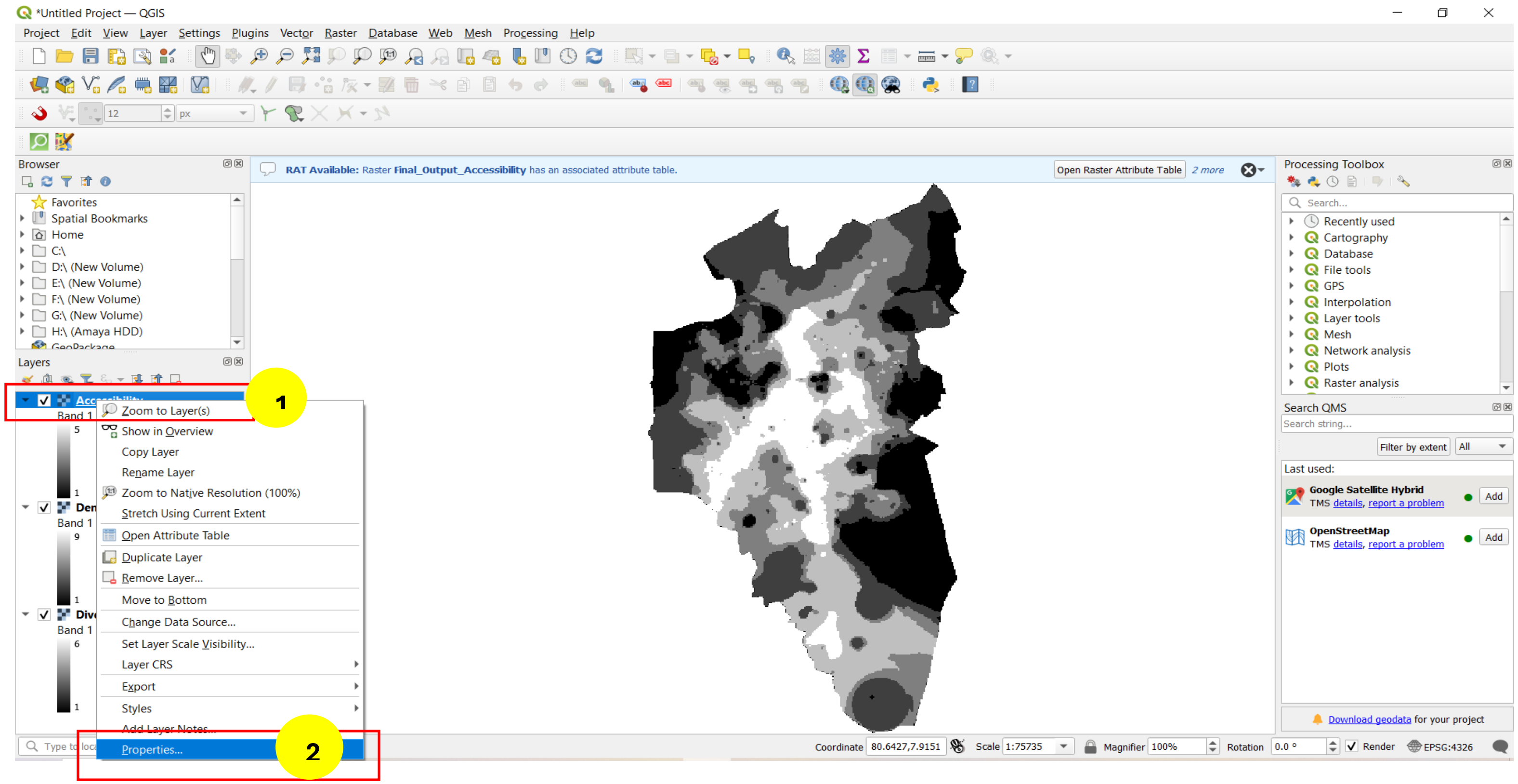


Figure 18 - Check the coordinate system

❖ It will open the layer properties panel and then go to the information section in the layer properties panel and check the coordinate system and cell size of that layer.

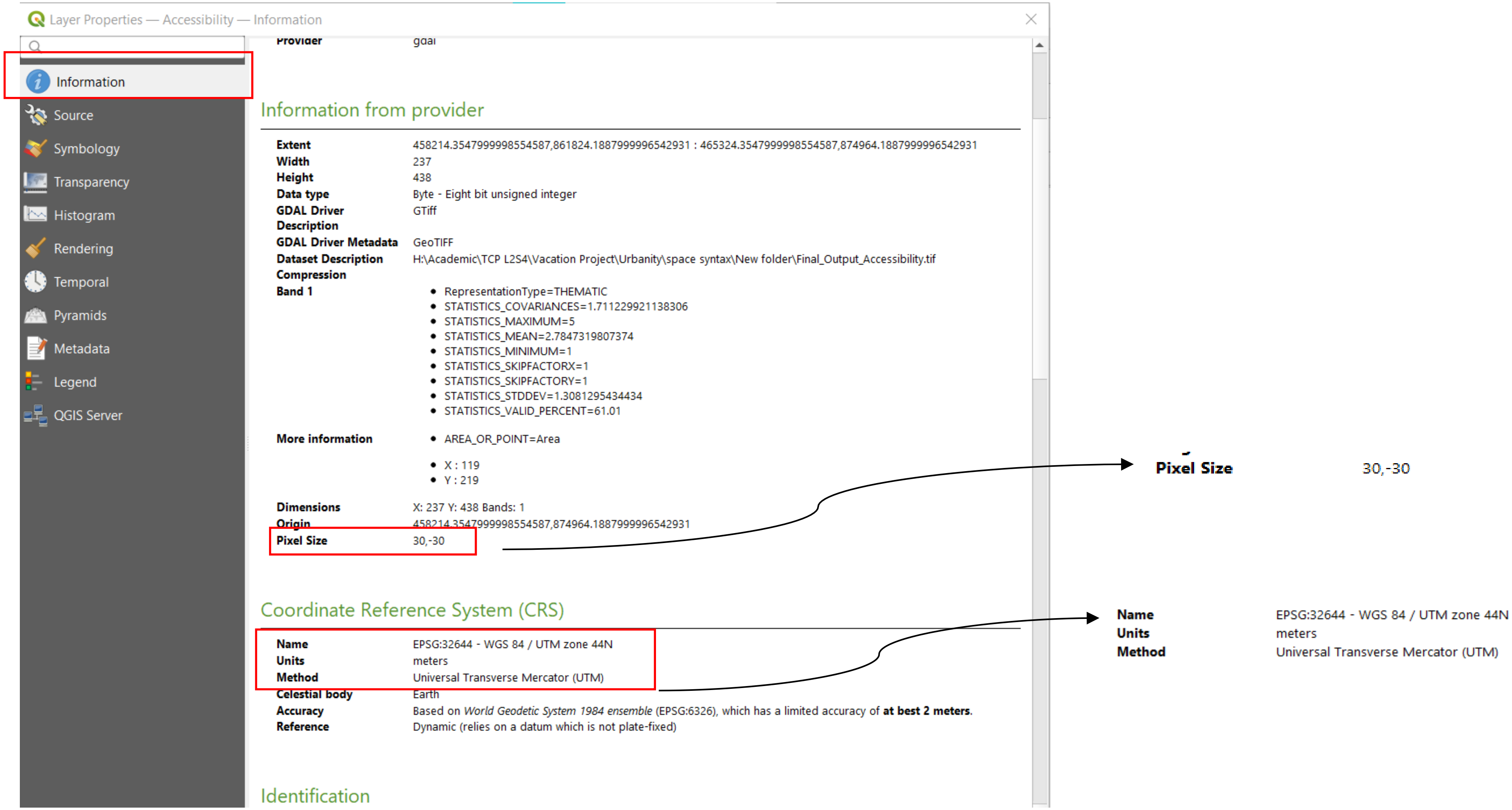


Figure 19 - Layer properties panel

❖ Check whether all three layers have the same coordinate system and cell size following the above process.

❖ If there is a different coordinate system in the layer you must select a relevant coordinate system and apply it to all three layers.

1. Right-click the layer.
2. Go to the layer CRS.
3. Select and click on the set layer CRS option.

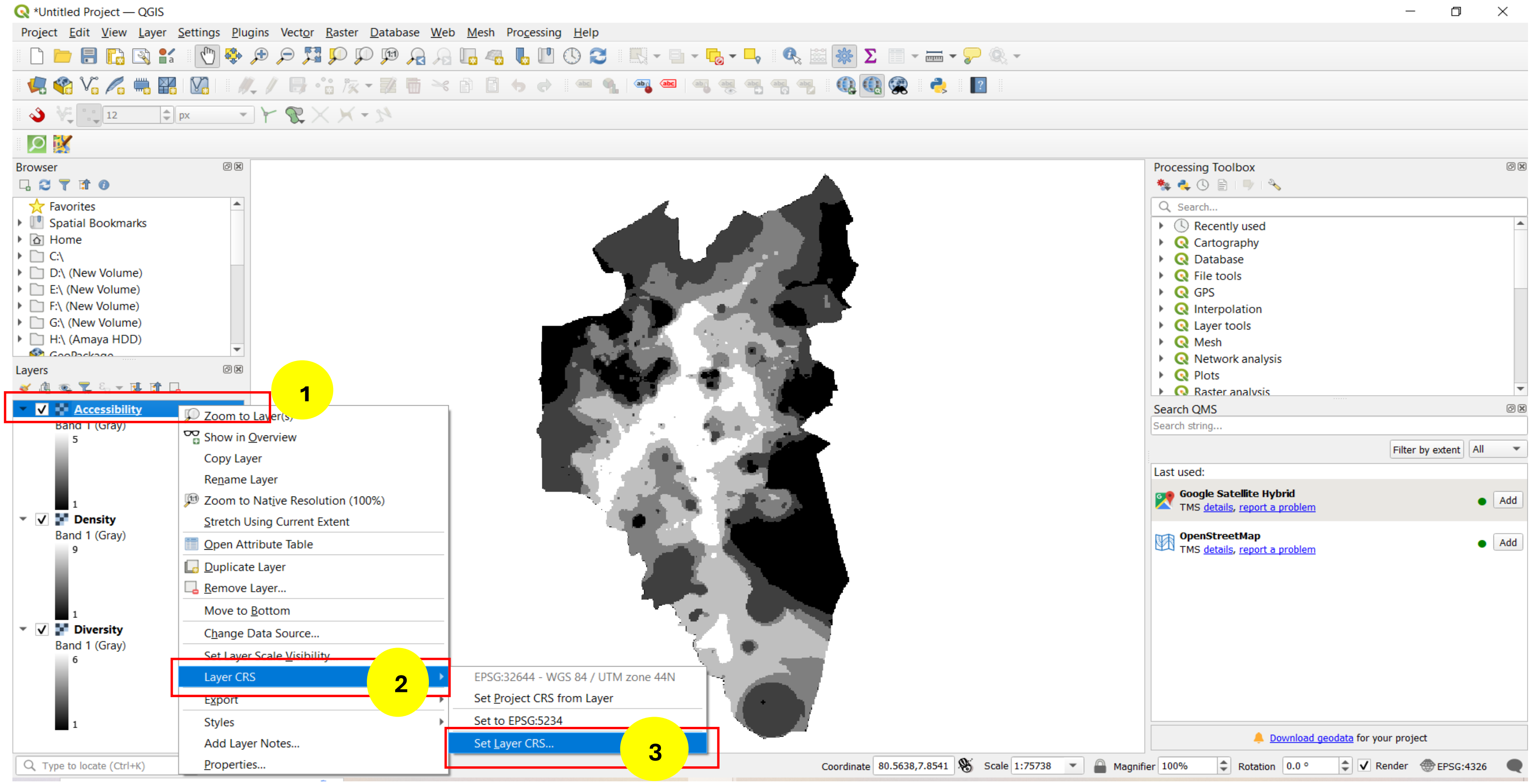


Figure 20 – Set CRS

❖ By clicking set layer CRS, it will open the Coordinate Reference System Selector panel. In there,

1. In the filter search bar, type your relevant coordinate system. (In this manual I have selected the WGS 84 / UTM zone 44N system and it is the most preferred one.)
2. Select that coordinate system that appeared under recently used coordinate systems or predefined coordinate systems.
3. Then click on OK. It will set the selected coordinate system to your layer and especially consider all three layers are assigned to the same coordinate system.

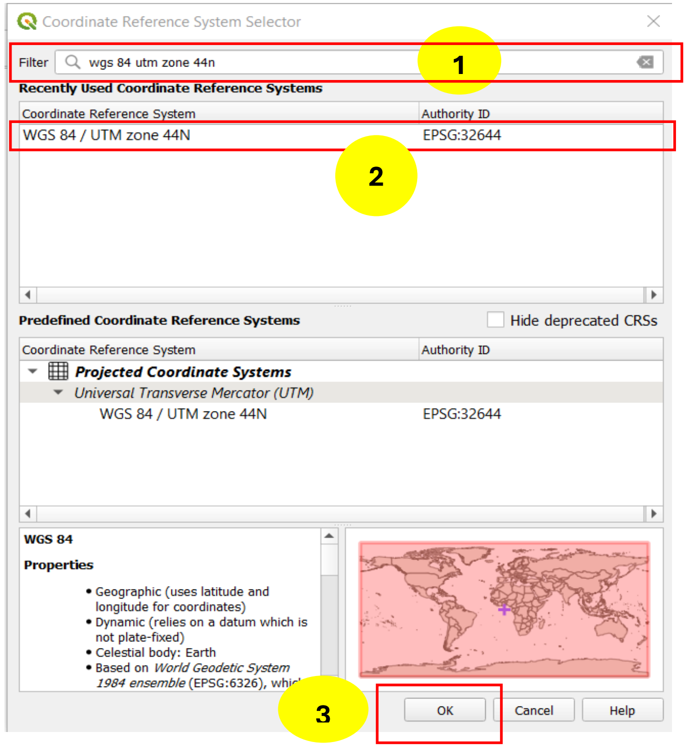


Figure 21 -CRS

Note – When setting a coordinate system, it is most relevant to assign a coordinate system of a layer to other layers except by changing the coordinate system of all layers. If your layer has a geographic coordinate system like SLD99, you can select that one also and it is not mandatory to select a projected coordinate system.

❖ Then if you have different cell sizes you must resample the layers according to a specific cell size like below.

1. Click the processing toolbox in the menu toolbar and it will open the panel of processing toolbox.
2. Type the name ‘resample’ in the search bar of the toolbox and relevant tools will appear under the search bar.
3. Select the r.resample tool from that and double-click it.

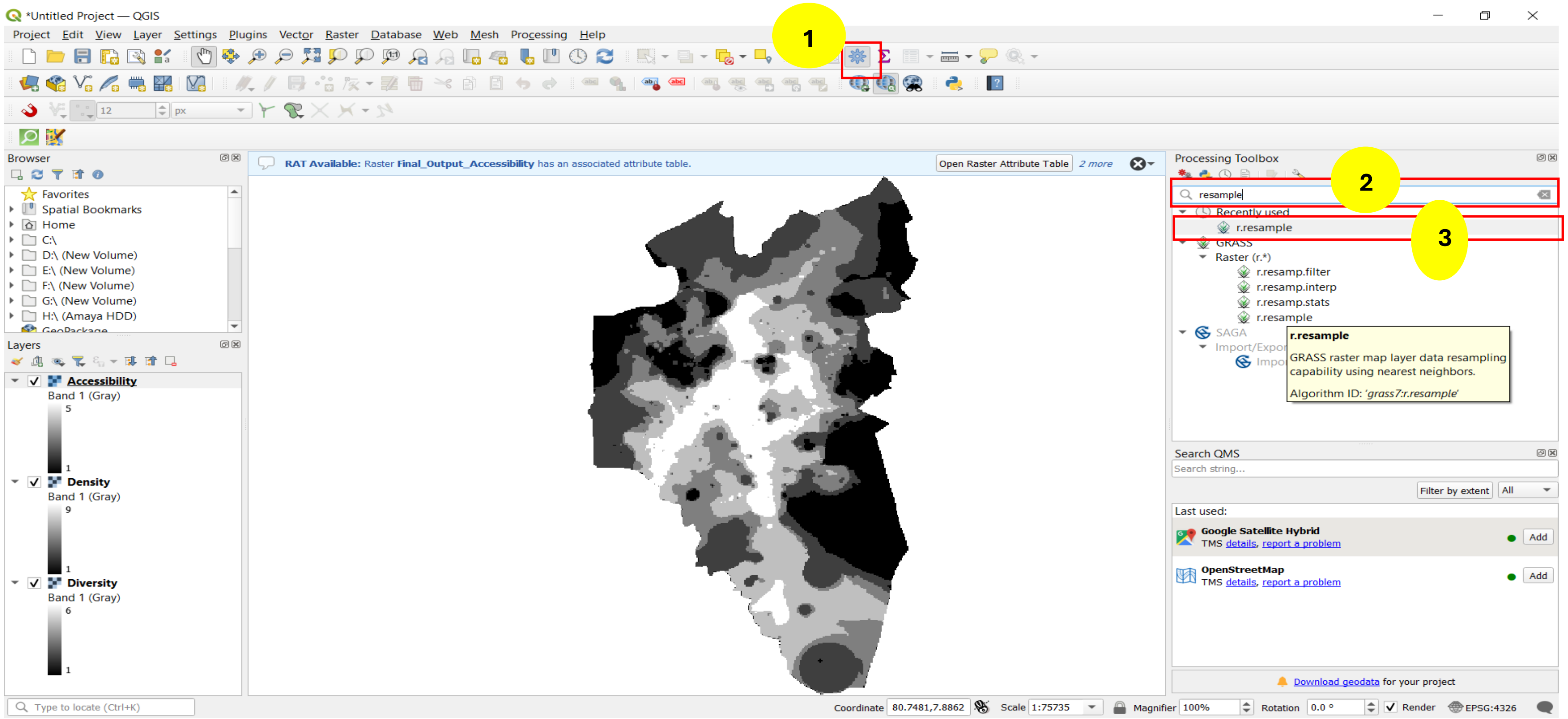


Figure 22 - r.resample

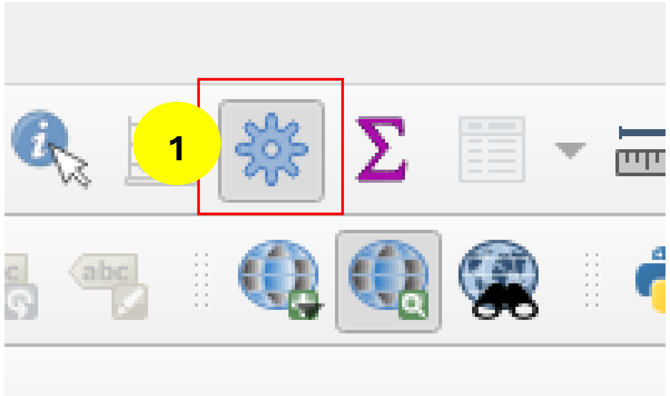


Figure 23 Processing tool

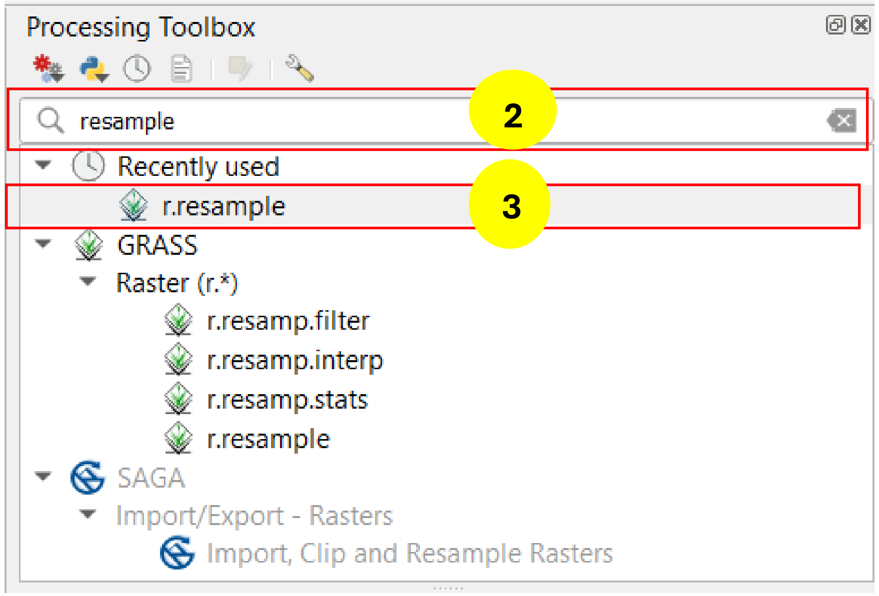
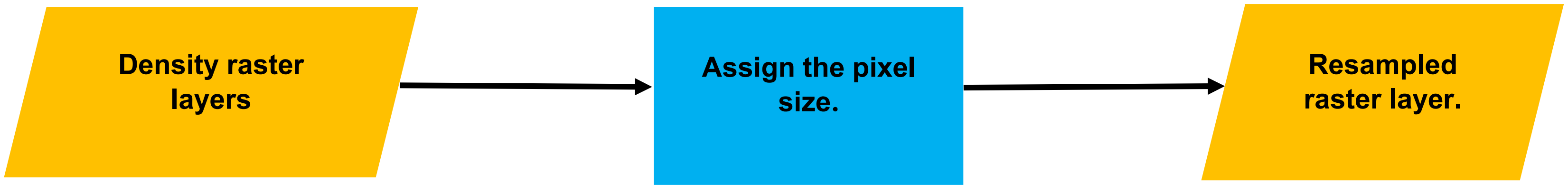


Figure 24 Processing toolbox.

❖ After clicking the resample tool it will open the resampling panel.

1. Select the relevant layer from the drop-down menu.
2. Set the relevant cell size. (In this manual I have set the cell size according to the cell size of the accessibility layer which is 30 and used that for density and diversity layers. So, you can set a new cell size for all three layers or set the cell size of one of the layers to the other two)
3. Click on run to process resampling.



Note – When resampling, it can be done to a layer at one time and all inputs cannot be resampled same time. So, you must resample other layers one by one following the same process.

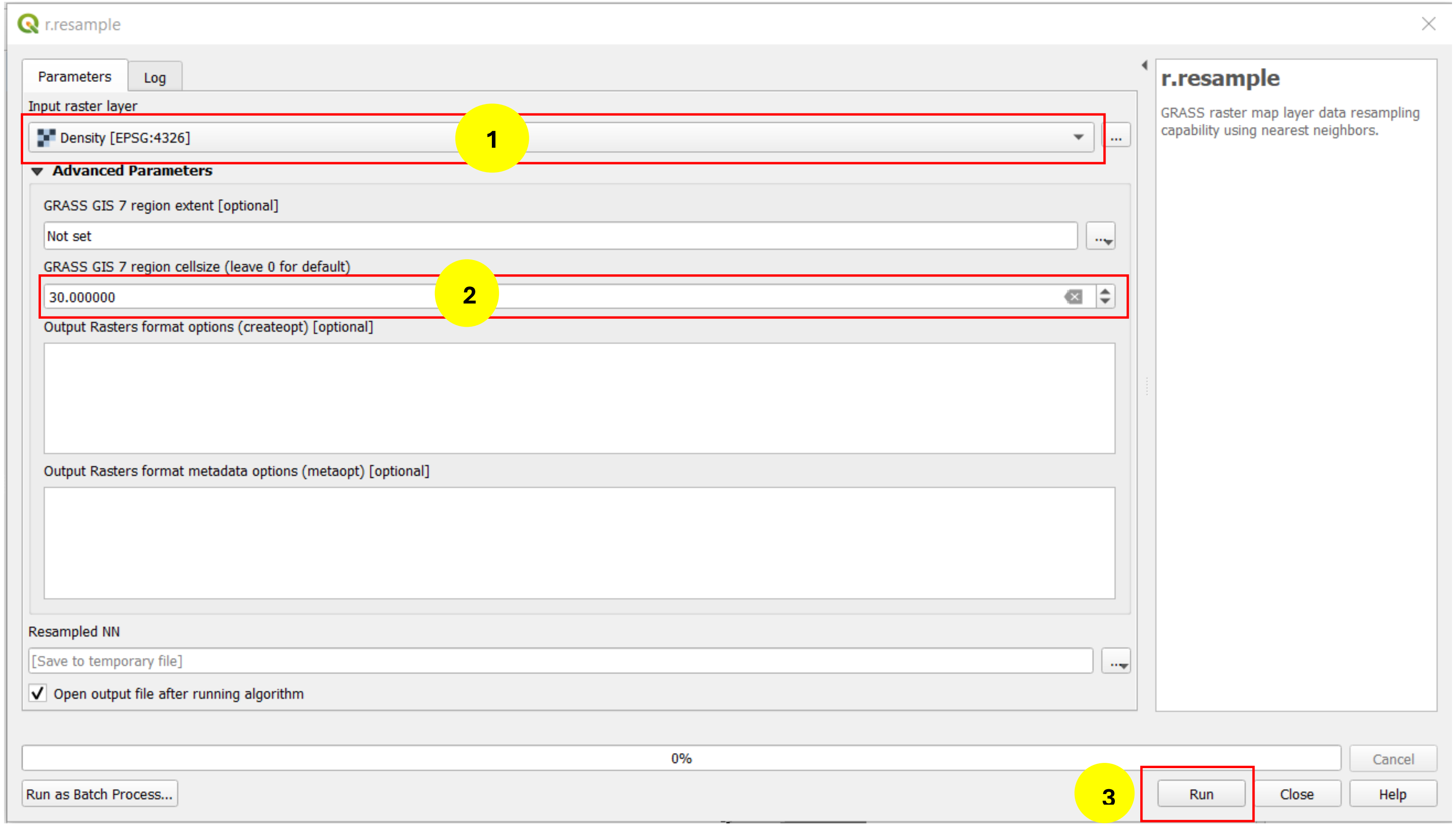
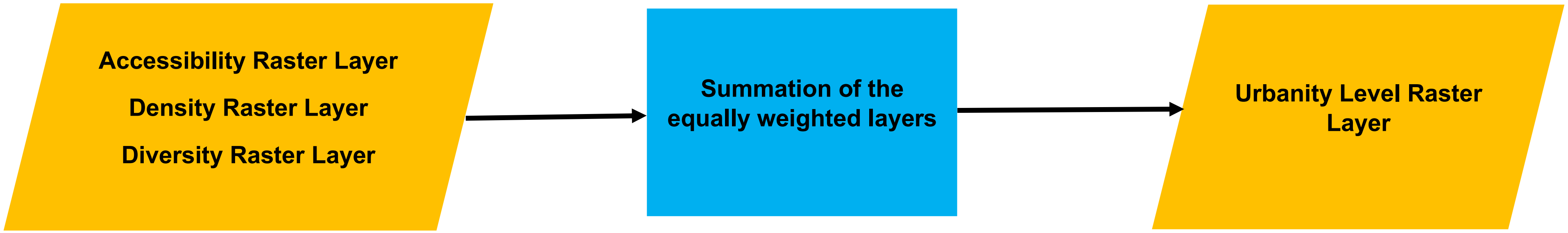


Figure 25 -r,resample

After the process, you will receive the resampled layer. It is important to resample all three layers to the same cell size. With the same coordinate system and cell size for all three layers, now you are ready to overlay the raster layers.

Note – If you are ready with the layers which have same cell size and coordinate system, you can skip these optional steps and can directly enter to step 5.2.1 from step 5.1.4.

b. Overlaying the three raster layers (In this step, accessibility, density and diversity raster layers are summed to get the urbanity level)



i. Open the raster calculator.

1. Click the processing toolbox in the menu toolbar.
2. Type the raster calculator in the search bar of the processing toolbox.
3. Double-click the raster calculator under raster analysis and it will open the raster calculator.

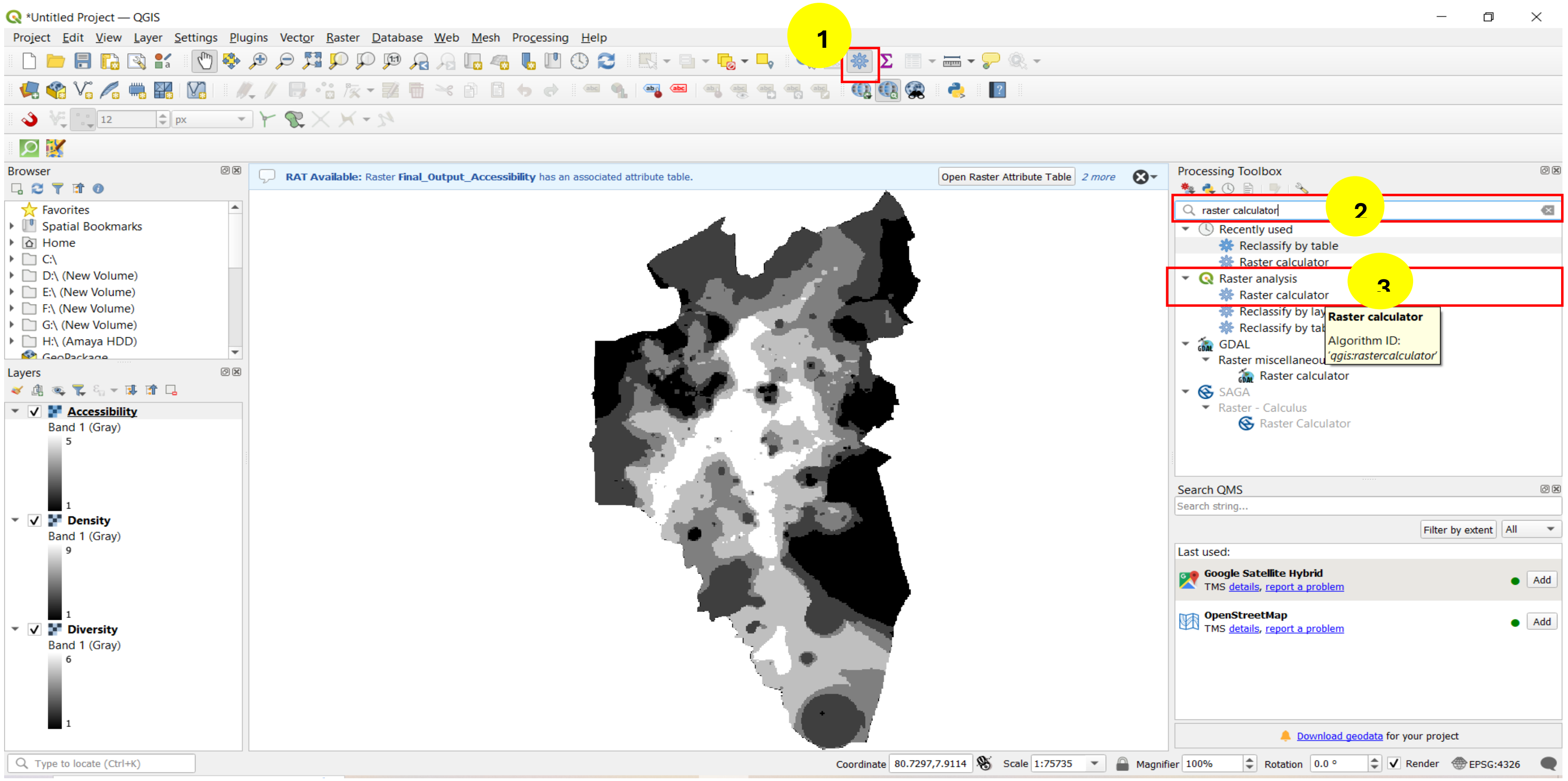


Figure 26 - Raster calculator

1. After opening the raster calculator, it will automatically consist of the layers you have added to the project interface.
2. Double-click on those layers and using operators get the expression for summing the accessibility, density and diversity layers in the expression

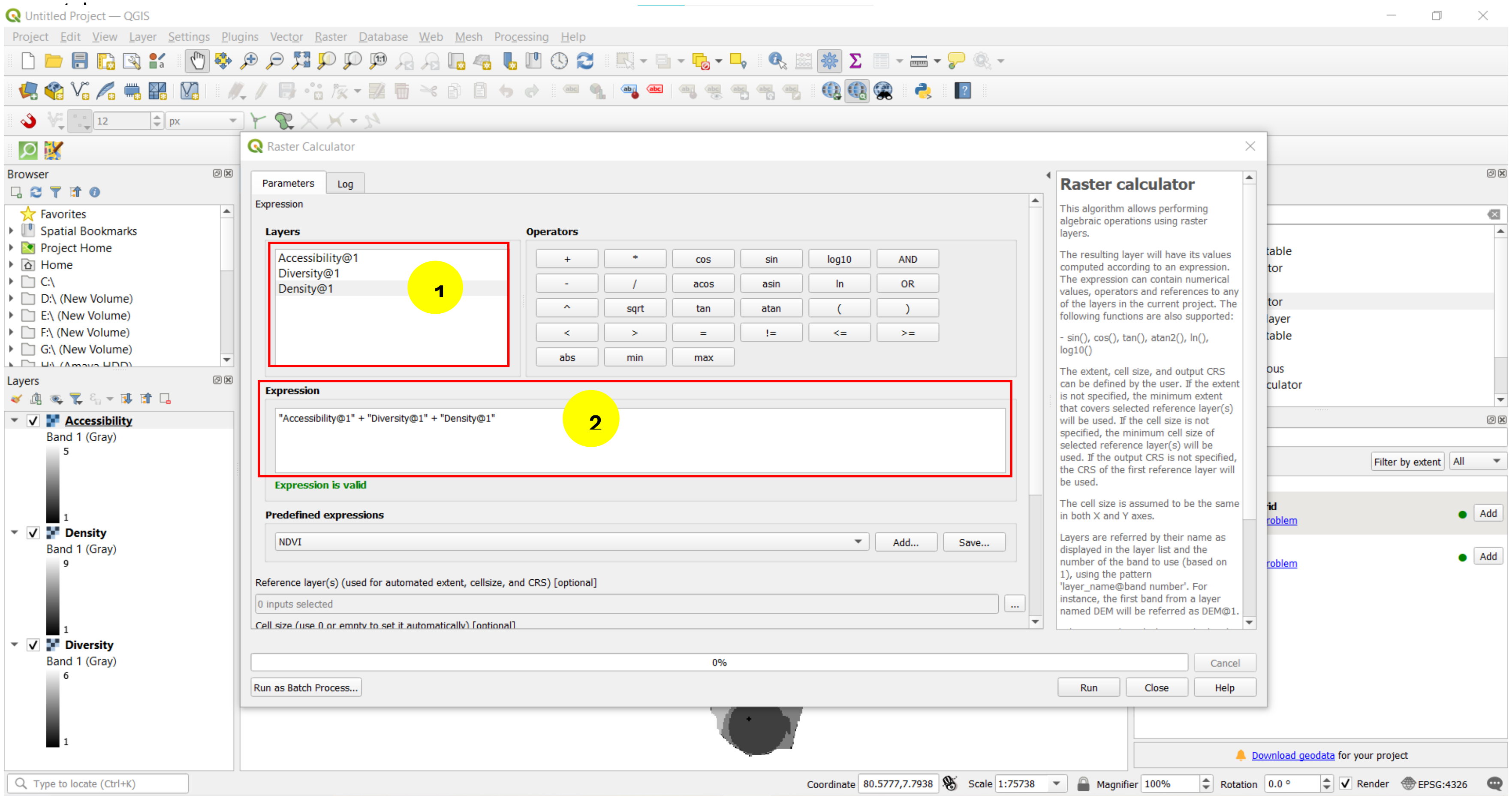


Figure 27 - Set the equation for getting the urbanity level

3. Accessibility, Density, and Diversity equally contribute to and influence the urbanity level. By dividing 100% influence equally to three we can consider 0.33 as the weight factor for these three layers as they equally contribute to the urbanity level. So, we have to multiply each layer from 0.33 to get the urbanity level. (Source - Yu Ye, Akkelies van Nes. (2014). Quantitative tools in urban morphology: combining space syntax, 23.)

Note - **Urbanity Level = (0.33*Accessibility) + (0.33*Density) + (0.33*Diversity)**

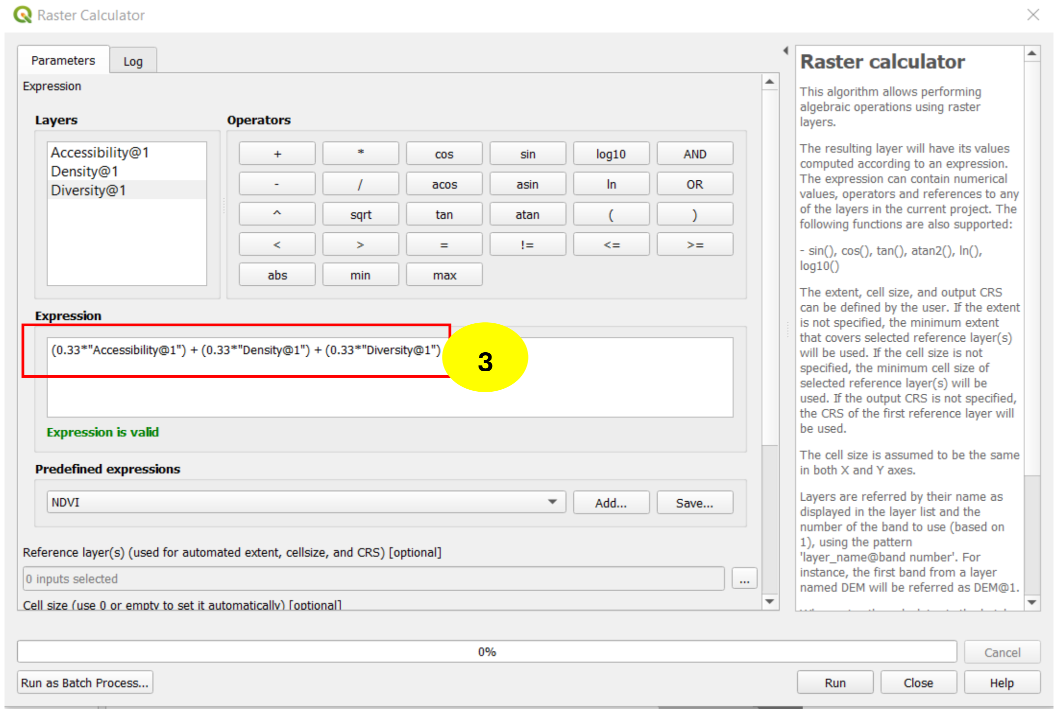


Figure 28 -Equation

iii. **Set the parameters in the raster calculator. (To reach those parameters, you have to scroll down the raster calculator interface and then you can find the parameters mentioned in 1 to 8 sub-steps).**

1. To select a reference layer, click on the three-dotted icon in the reference layer of the raster calculator.
2. Then it will direct you to a window and select a layer of your preference in there. (From this selection it will automatically assign the coordinate system, cell size, and output extent of the selected layer to the output layer)
3. Then click ok to select that reference layer.

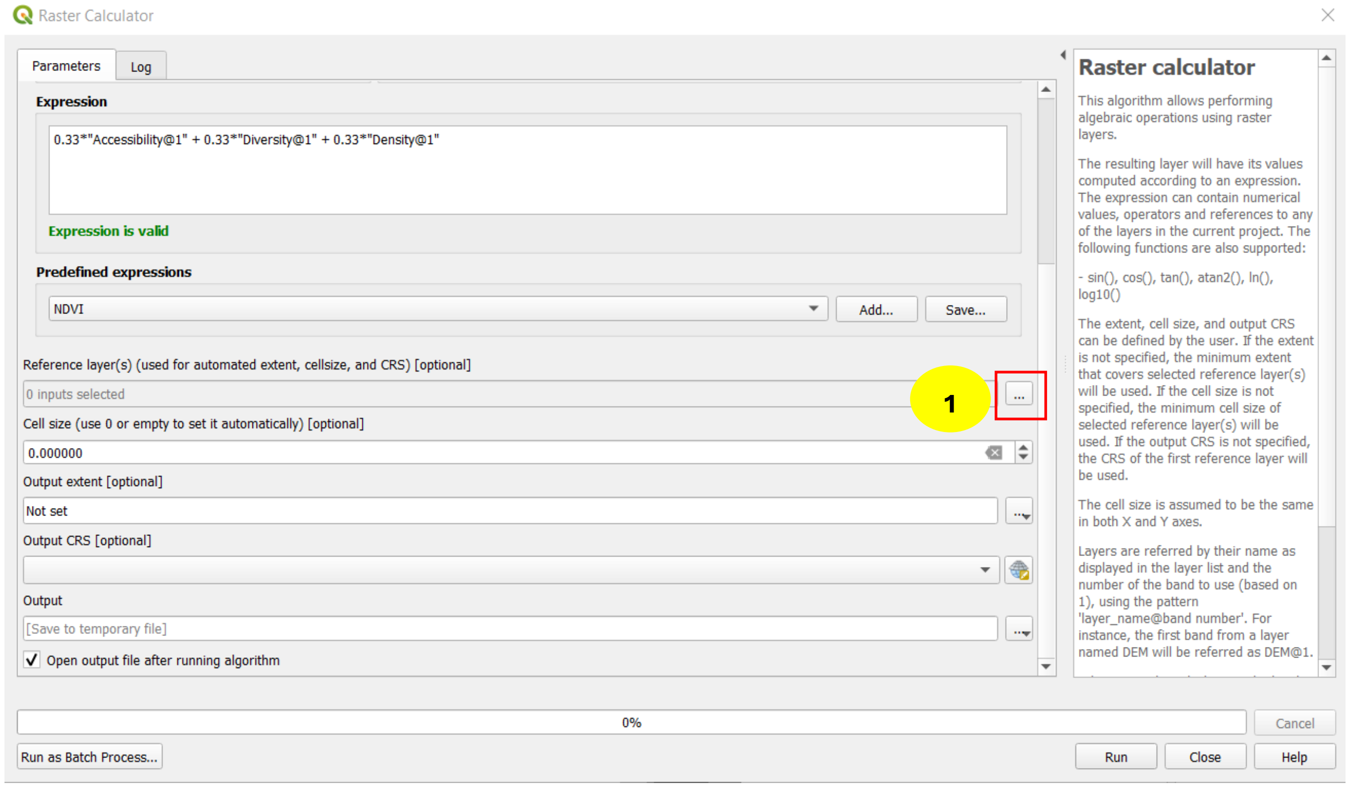


Figure 29 -Raster Calculator

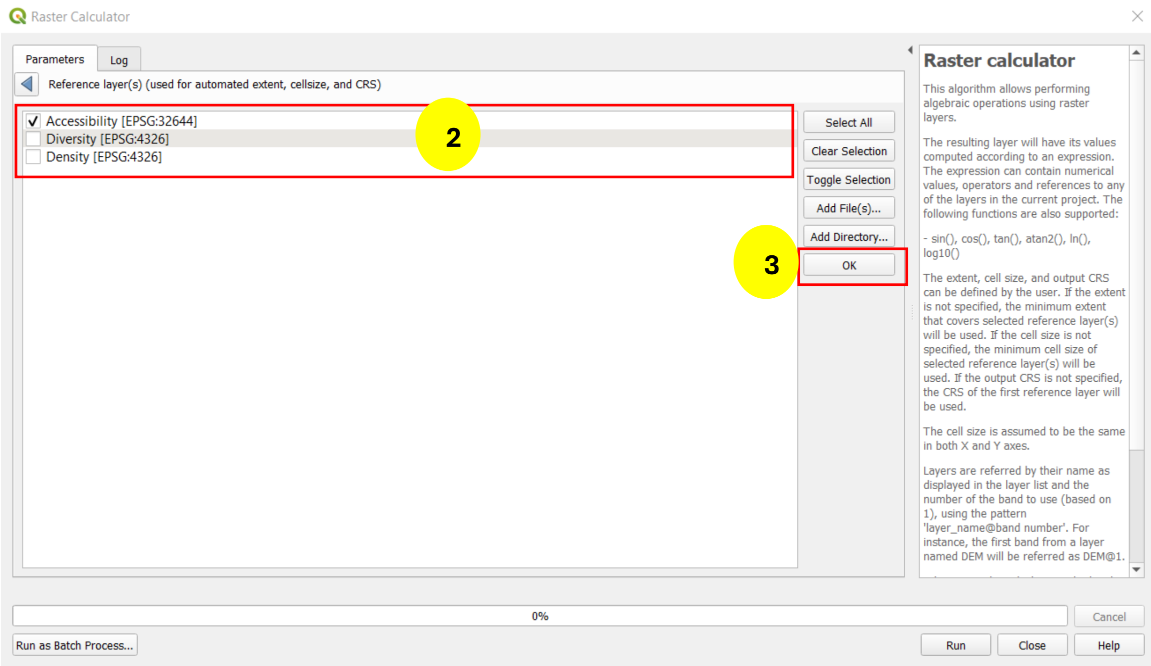


Figure 30 - Raster Calculator

Generally, after selecting the reference layer it will automatically add the extent, coordinate system and cell size of the reference layer to the output and automatically fill out the cell size, output extent and output CRS parameters in the raster calculator. But sometimes it does not occur, and we have to manually add those parameters.

4. Type relevant cell size. (I have typed 30 because this cell size is used for all input raster layers, and it is important to add the same cell size for output as well. You can use the cell size which is used for the resampling process as well)
5. Click on the three-dotted icon in output extent and select a relevant layer from input layers under the calculate from layer option. (This is the most required option since the output and input layers should have the same region extent and it is most relevant to select the same layer as the output extent that you selected as the reference layer)

6. Then select the relevant coordinate system under output CRS. (It is important to select a same coordinate system which also input layers have)

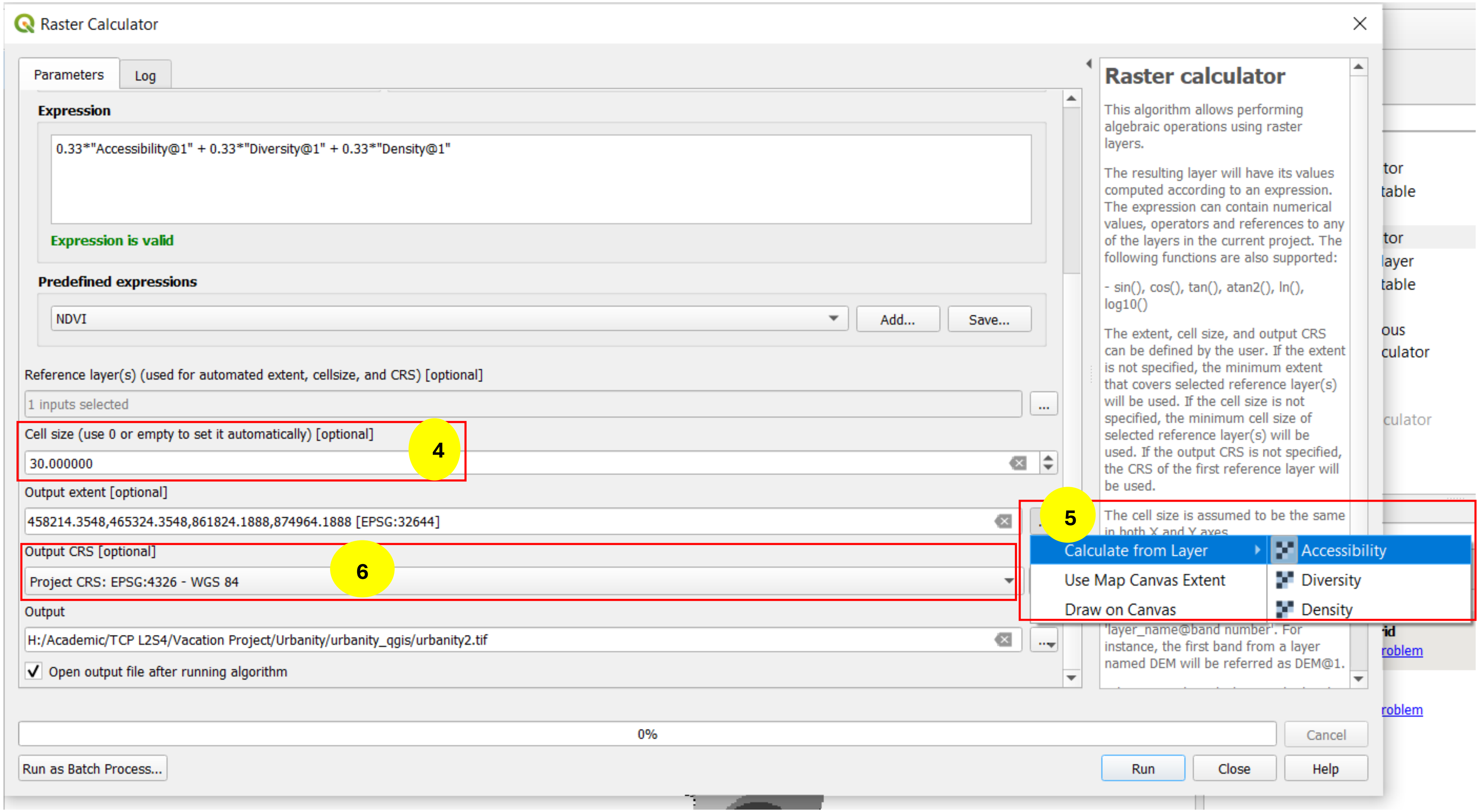


Figure 31 - Raster Calculator

7. Click the icon under output. When saving the output, you can select save to a temporary file or save to a file. If you select to save to a temporary file option, the output will be saved temporarily in the project, and it will only be available until you work on the interface. So, it is important to select save to a file option.

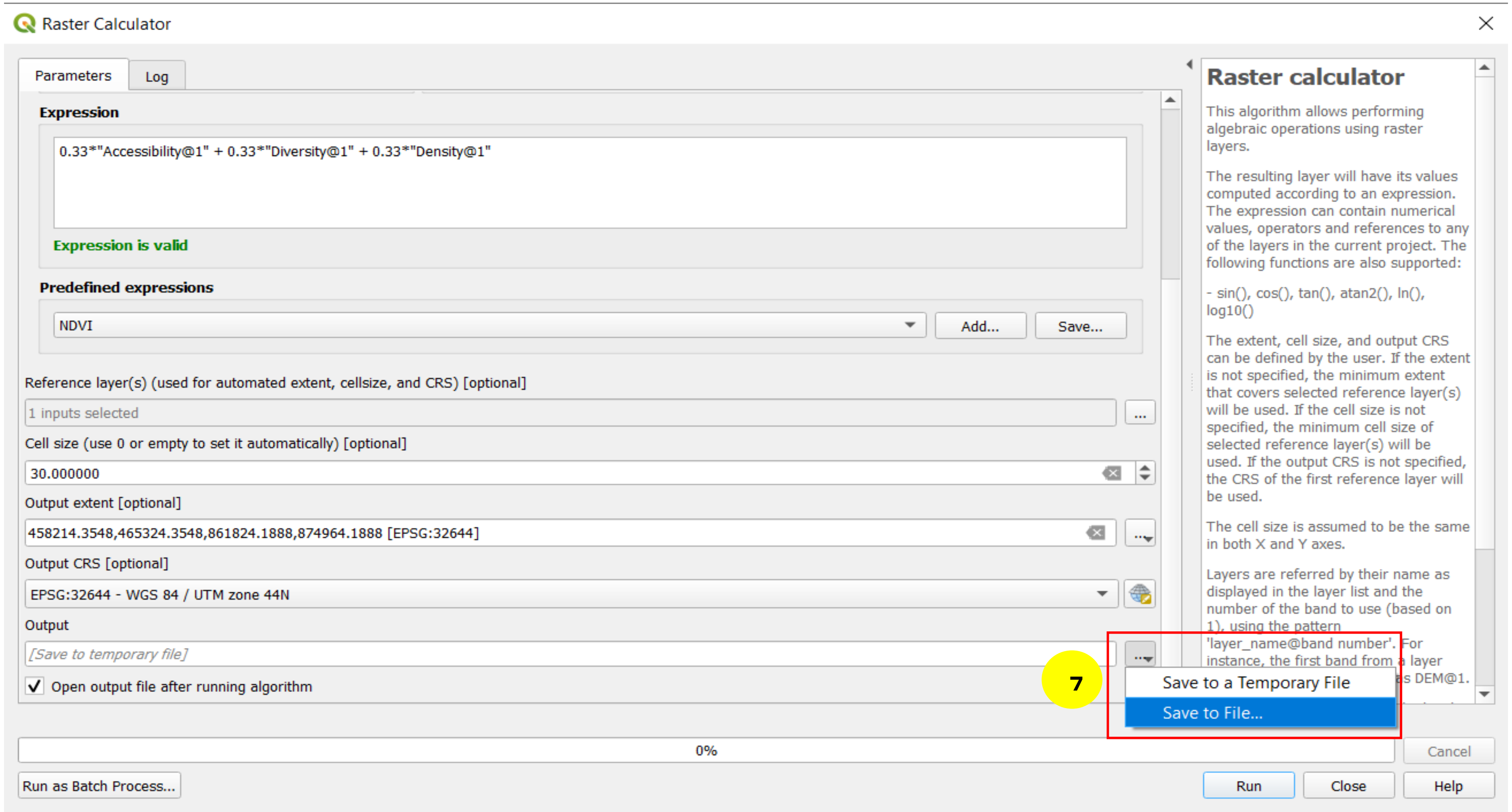


Figure 32 - Raster Calculator

8. After clicking save to file option, browse to a relevant folder in your device and save under a name like urbanity_level. It is important to save output under TIF format and click on save.
9. Then click on run in the raster calculator to run the process.

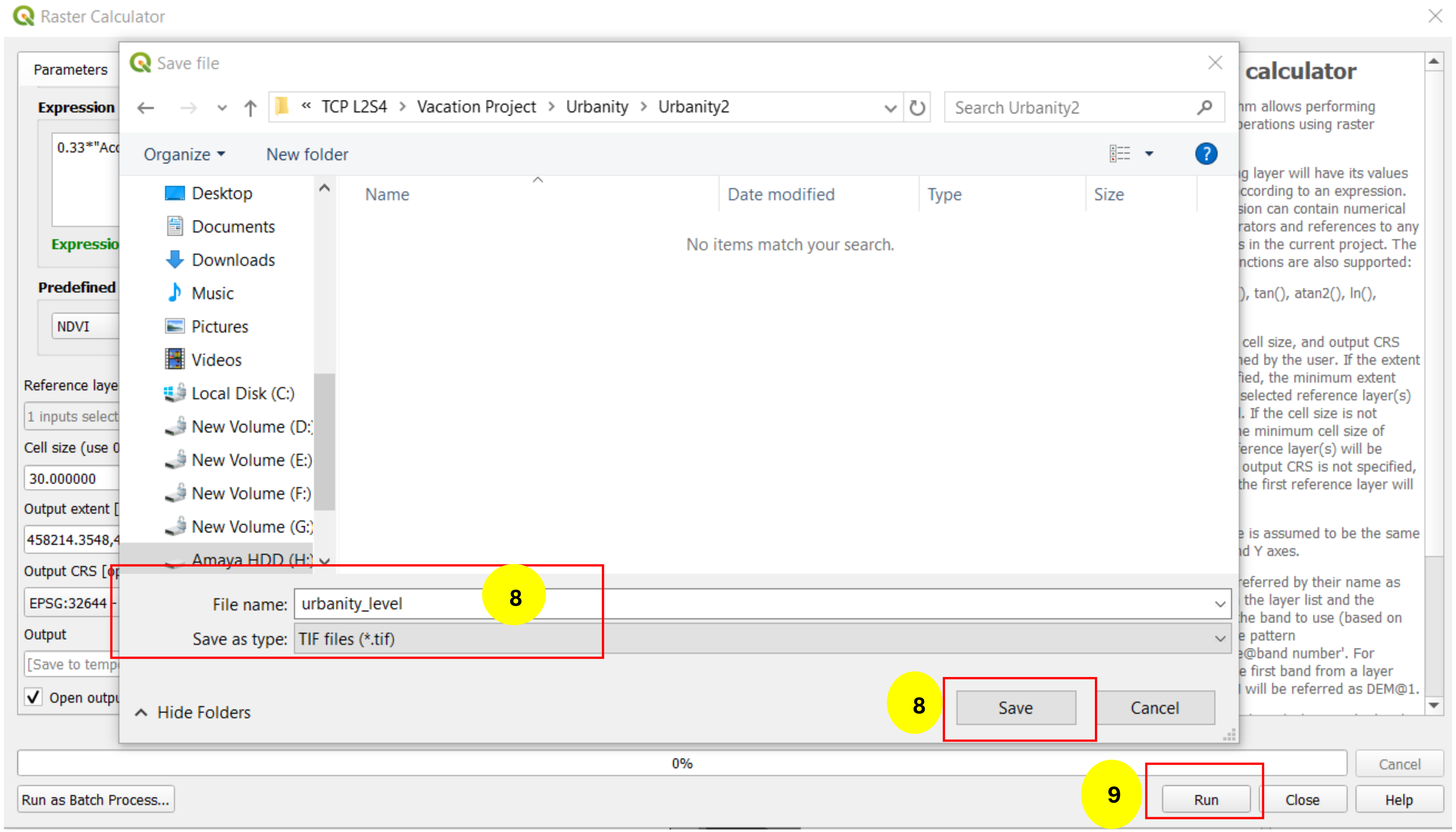


Figure 33 -Save File

iv. Obtain the urbanity raster layer after running the raster calculator process. Now you can get the urbanity level raster which is the equally weighted summation of the accessibility, density, and diversity raster layers.

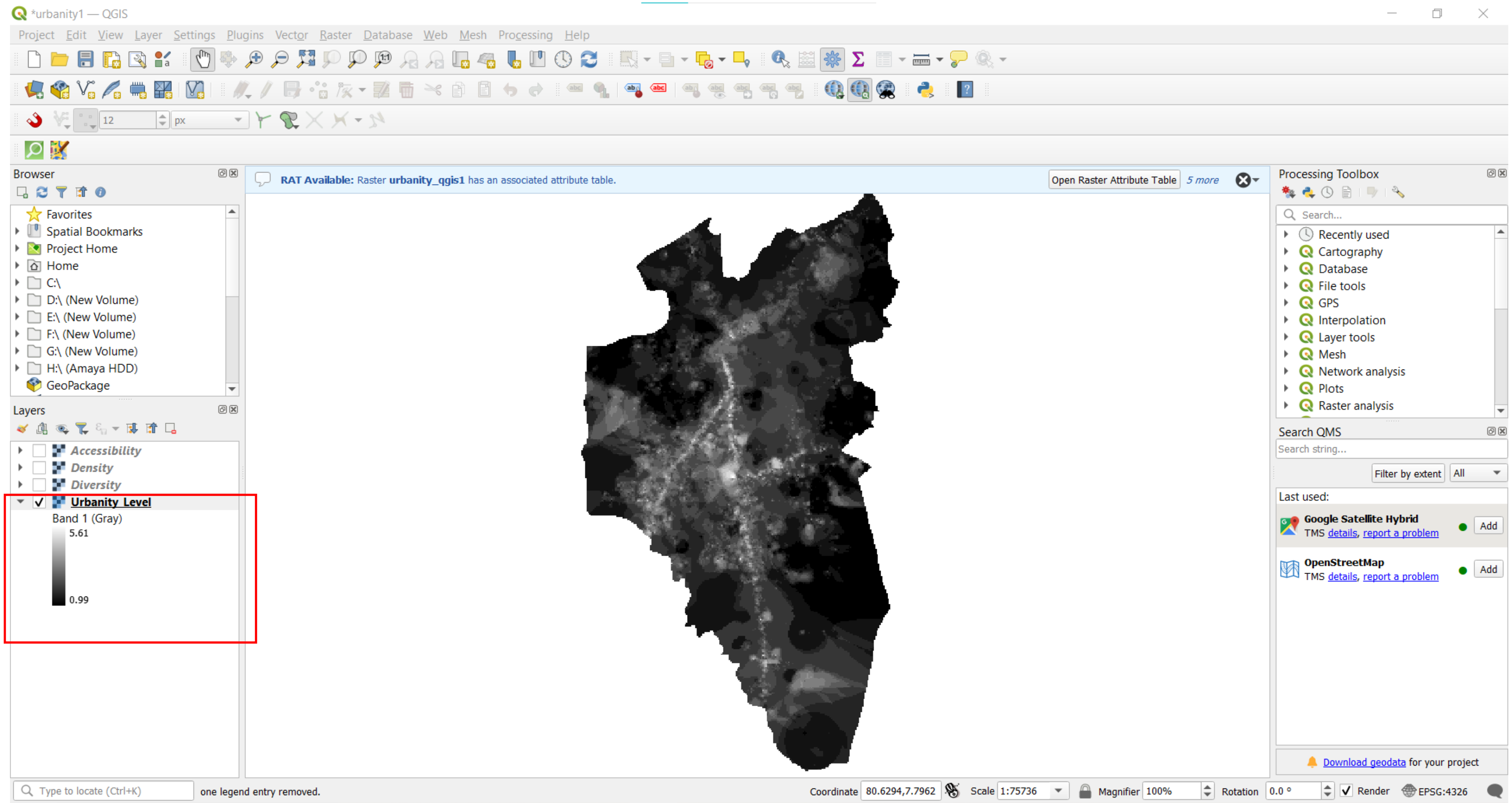


Figure 34 - Obtain the urbanity raster layer

c. **Getting the urbanity level map (In this step relevant color ramp was added to the layer and the urbanity level was categorized into the classes)**

   i. **Set the relevant color ramp.**

1. After getting the urbanity raster layer, right-click it and go to the properties.

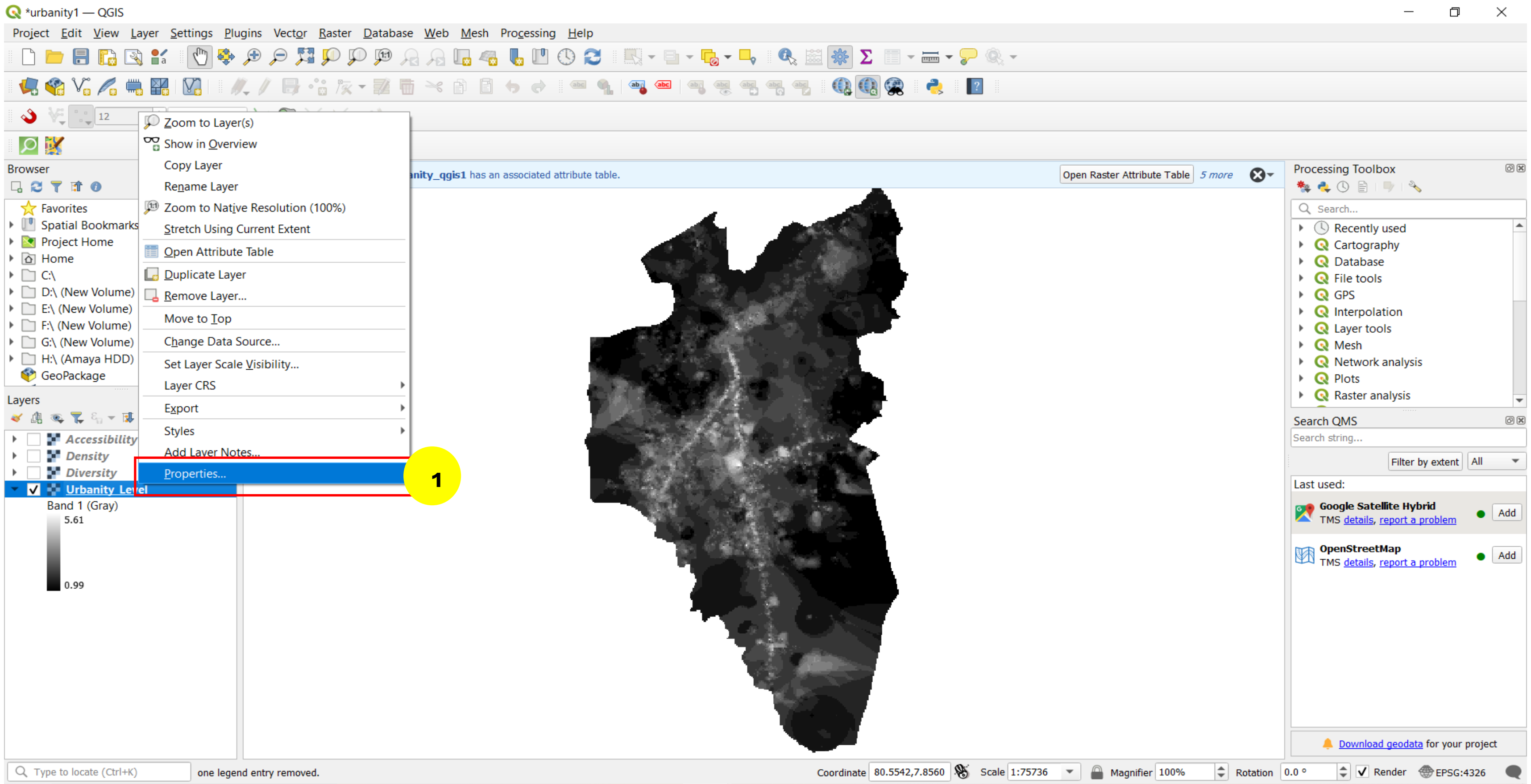


Figure 35 - Set the relevant color ramp

2. Then it will open the layer properties window and go to the symbology panel in there.
3. In symbology, select render type as single band pseudocolor to classify it into classes

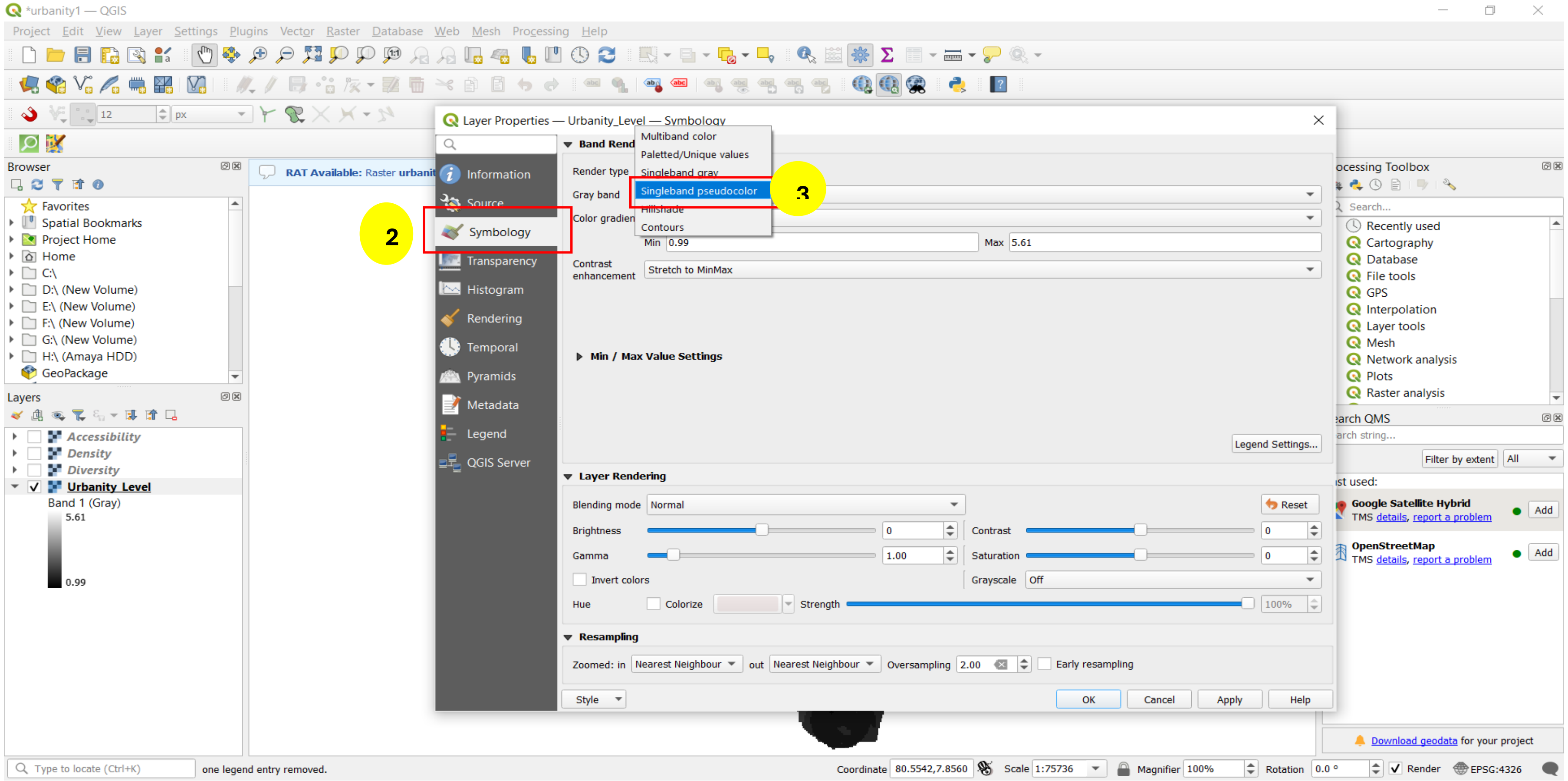


Figure 36 - symbology

4. Select a relevant color ramp from the given range of color ramps. (Also, you can select a variety range of color ramps from all color ramps menu and the selected color ramp can be inverted by clicking invert color ramp)

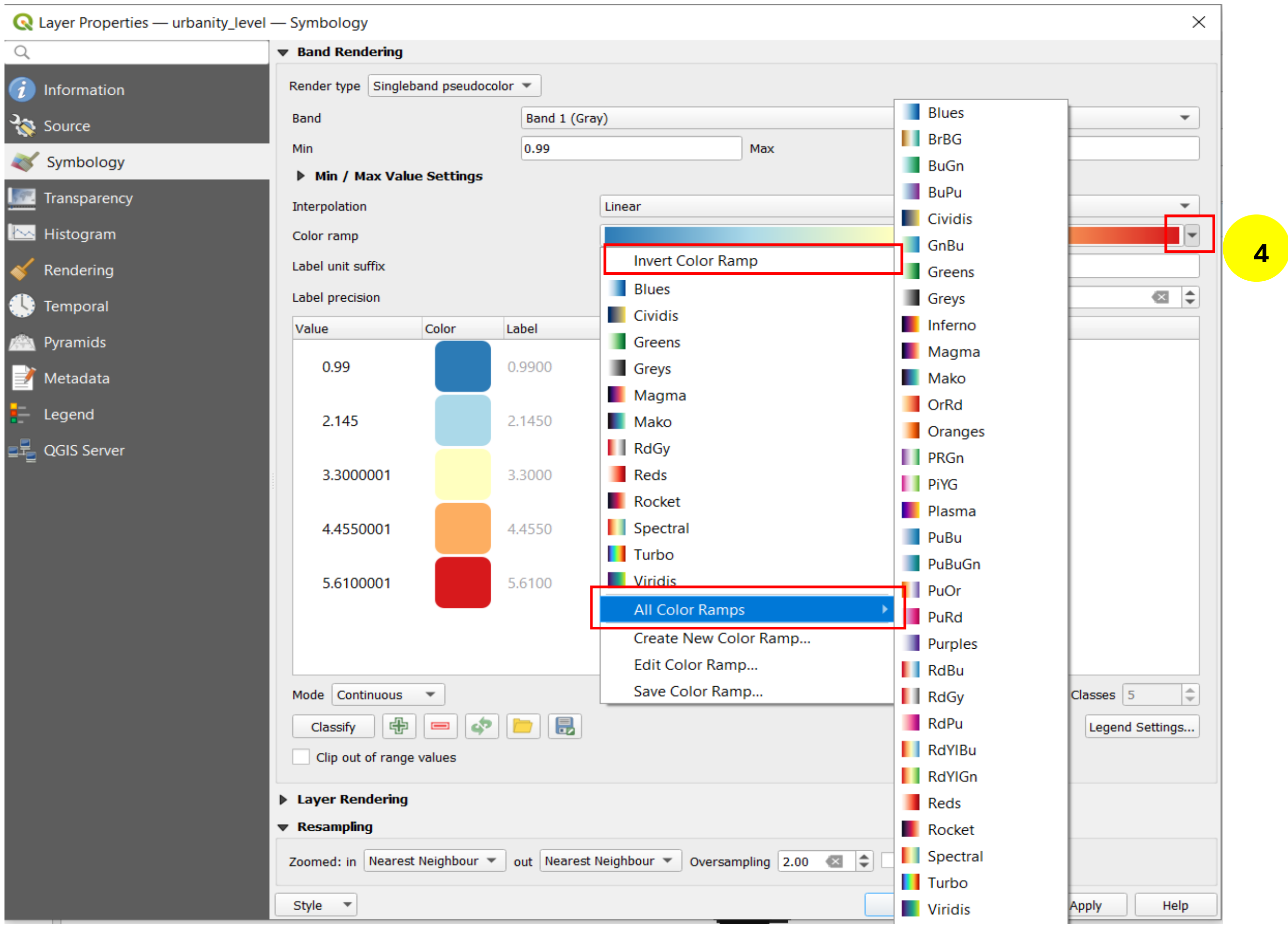


Figure 37 - Select a relevant color ramp

5. Set the classification mode as the equal interval. It will equally assign the values among the urbanity level categories.

6. As we classify urbanity level into the seven categories as Very Low, Low, In-Between Low, In-Between Medium, In-Between High, Medium and High, set the number of classes as seven and it will automatically classify urbanity into seven classes and appear. (Classification of urbanity level can be dependent on the selected study area like it can be less or more than seven classes and different level types. So, you can change the number of classes according to the characteristics of your study area and your preferences)

Source - Yu Ye, Akkelies van Nes. (2014). Quantitative tools in urban morphology: combining space syntax,. 23.

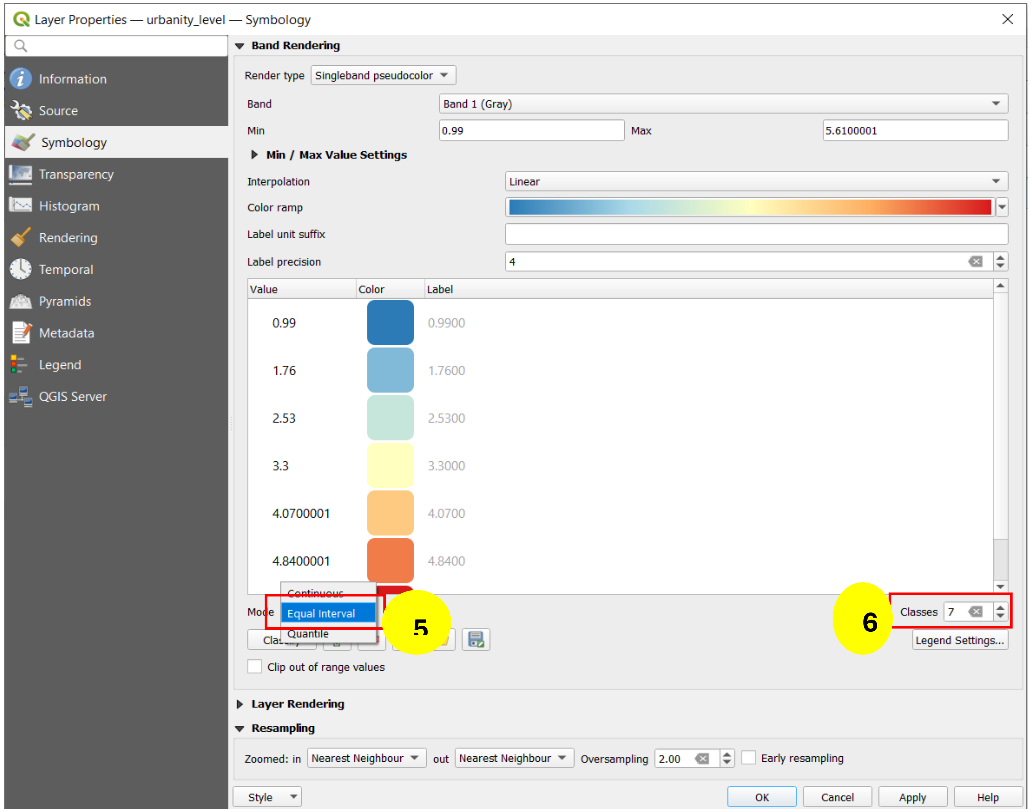


Figure 38 - Classification mode as the equal interval

7. If you want, you can rename the labels using the classification of urbanity. For that, you have to double-click on the existing name that appears under the label column and then type the relevant name for that class on it.
8. Then click on Legend Settings.

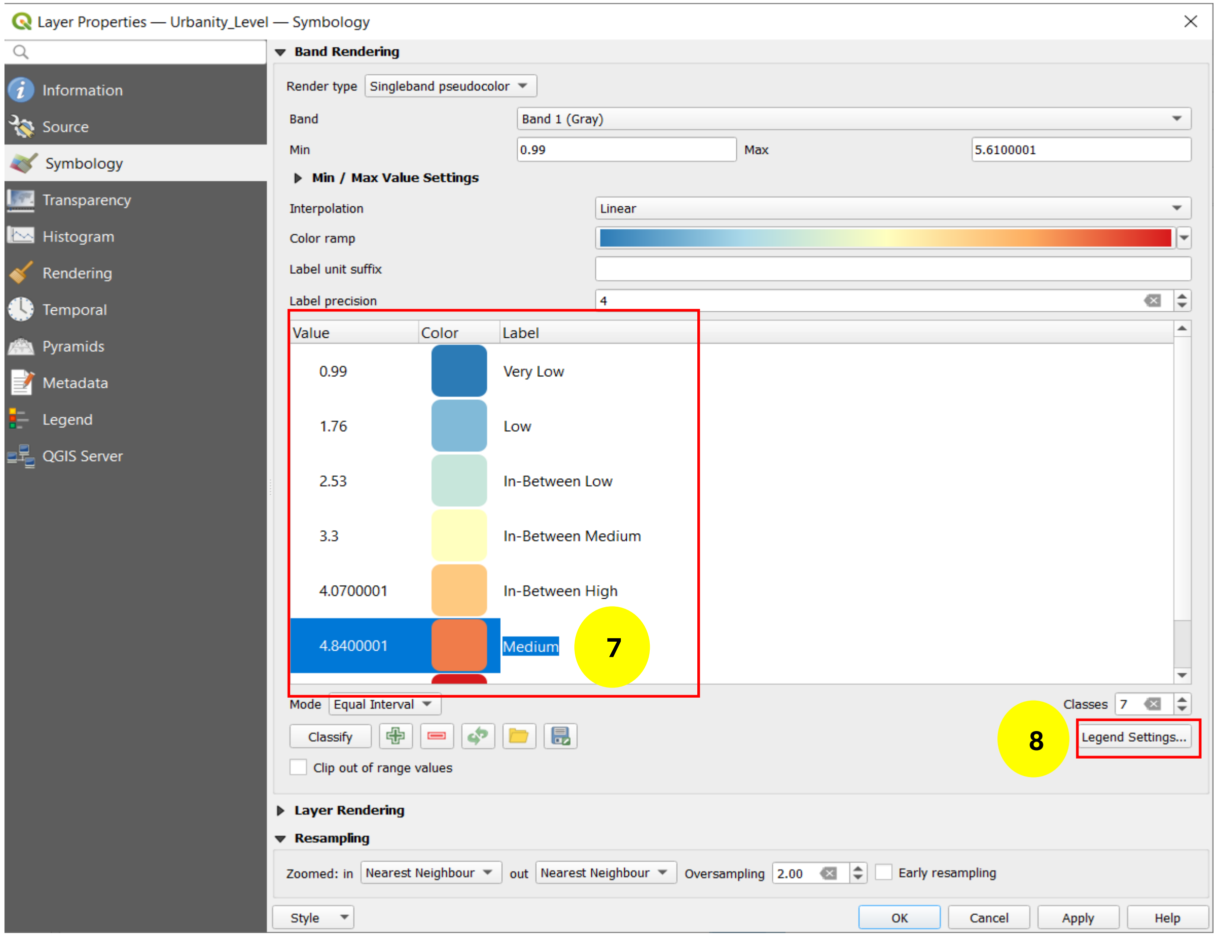


Figure 39 - Rename the labels

9. It will open the Legend Settings window and tick off the use continuous legend and then click ok. From this step, we can see a categorized legend according to the colors and labels we used in step 7 in the layers tab of the QGIS interface instead of appearing as a legend which includes a continuous range of values.

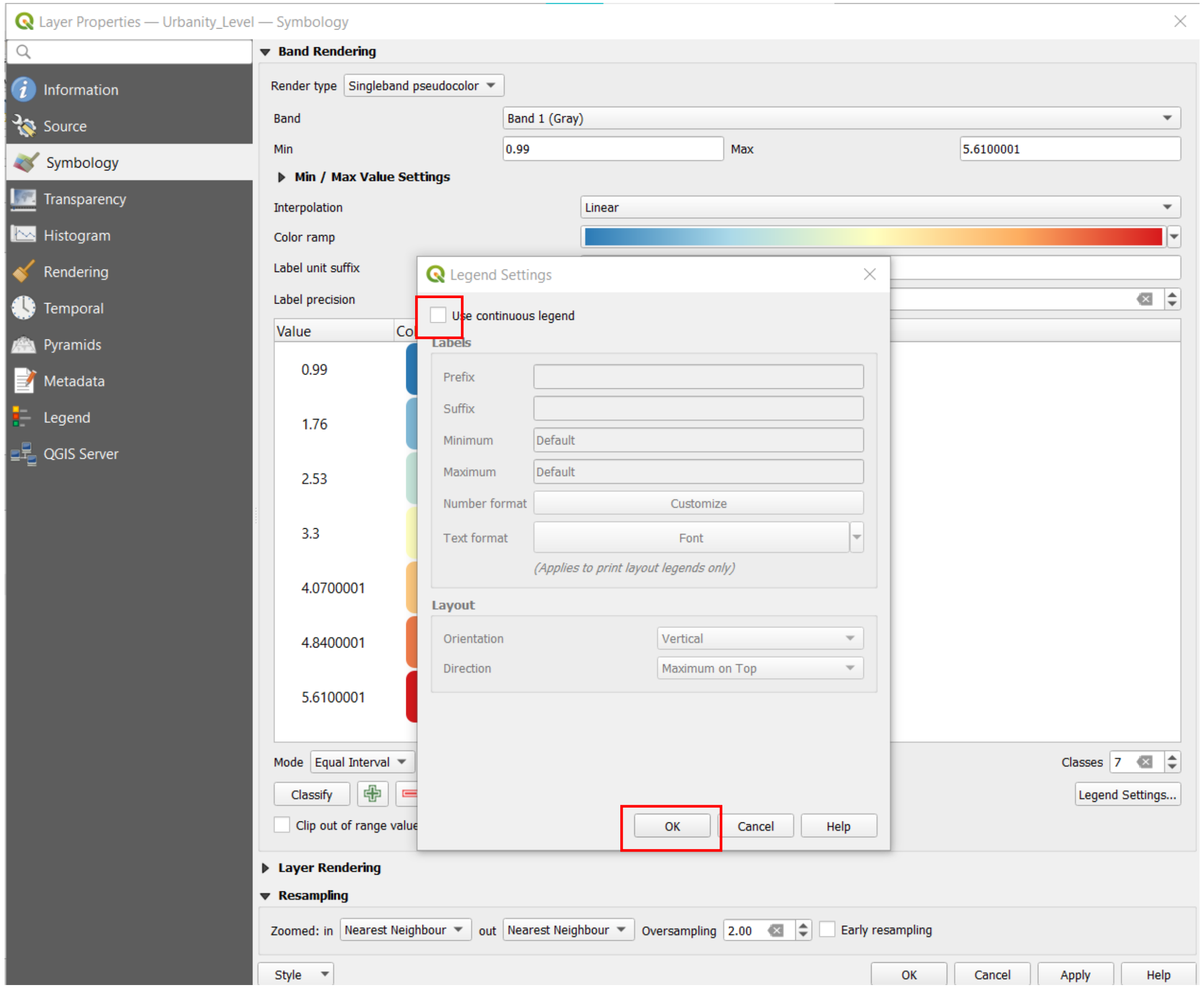


Figure 40 - Categorized legend

10. Then click apply and ok.

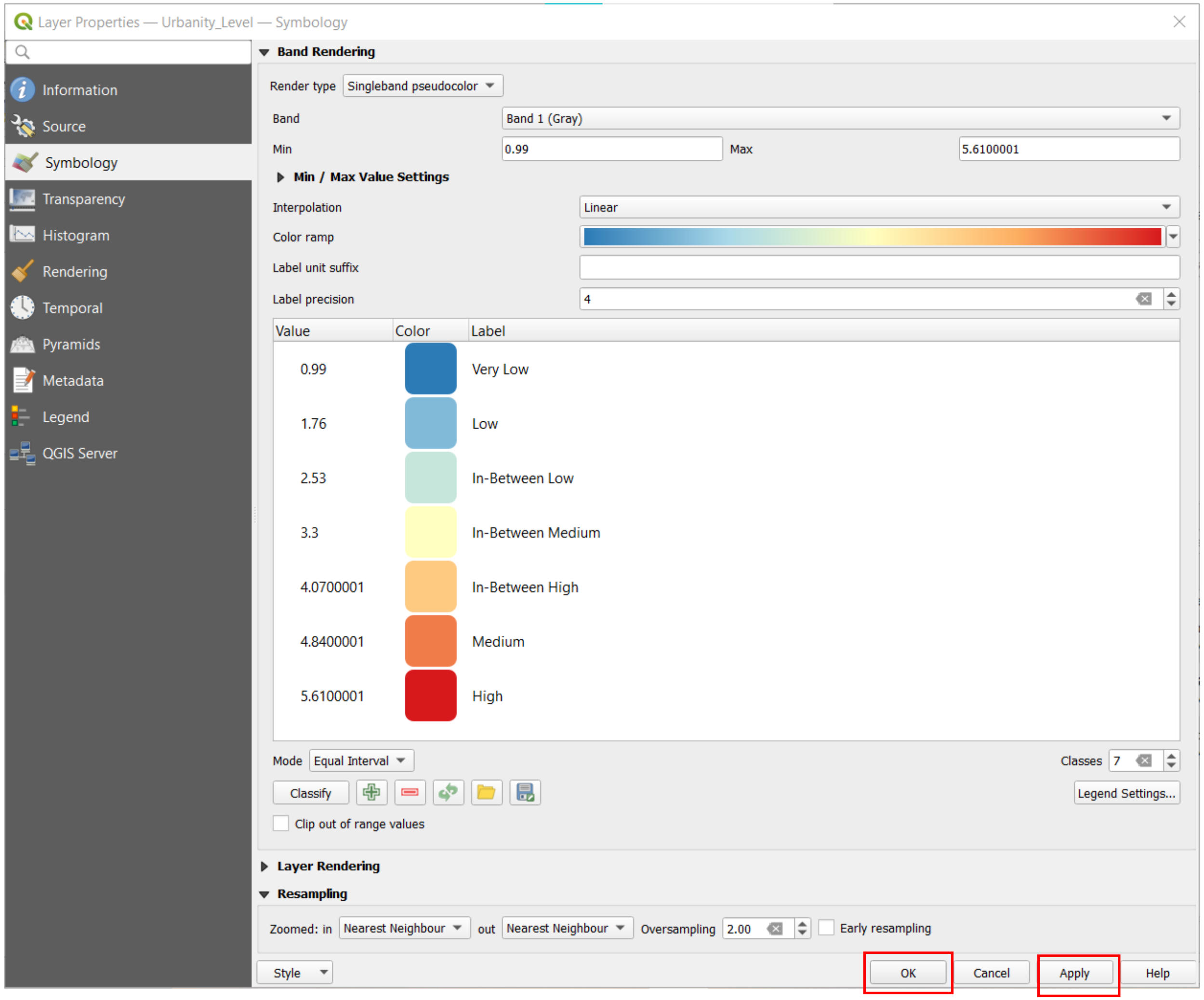


Figure 41 -Symbology

ii. **Now you can get the urbanity map which is categorized into seven classes. According to the map blue color areas show the very low level of urbanity while red color areas show high urbanity levels. Other colors show the urbanity levels which vary from low level to medium level respectively. Also, the legend items can be seen in the layers tab of the interface.**

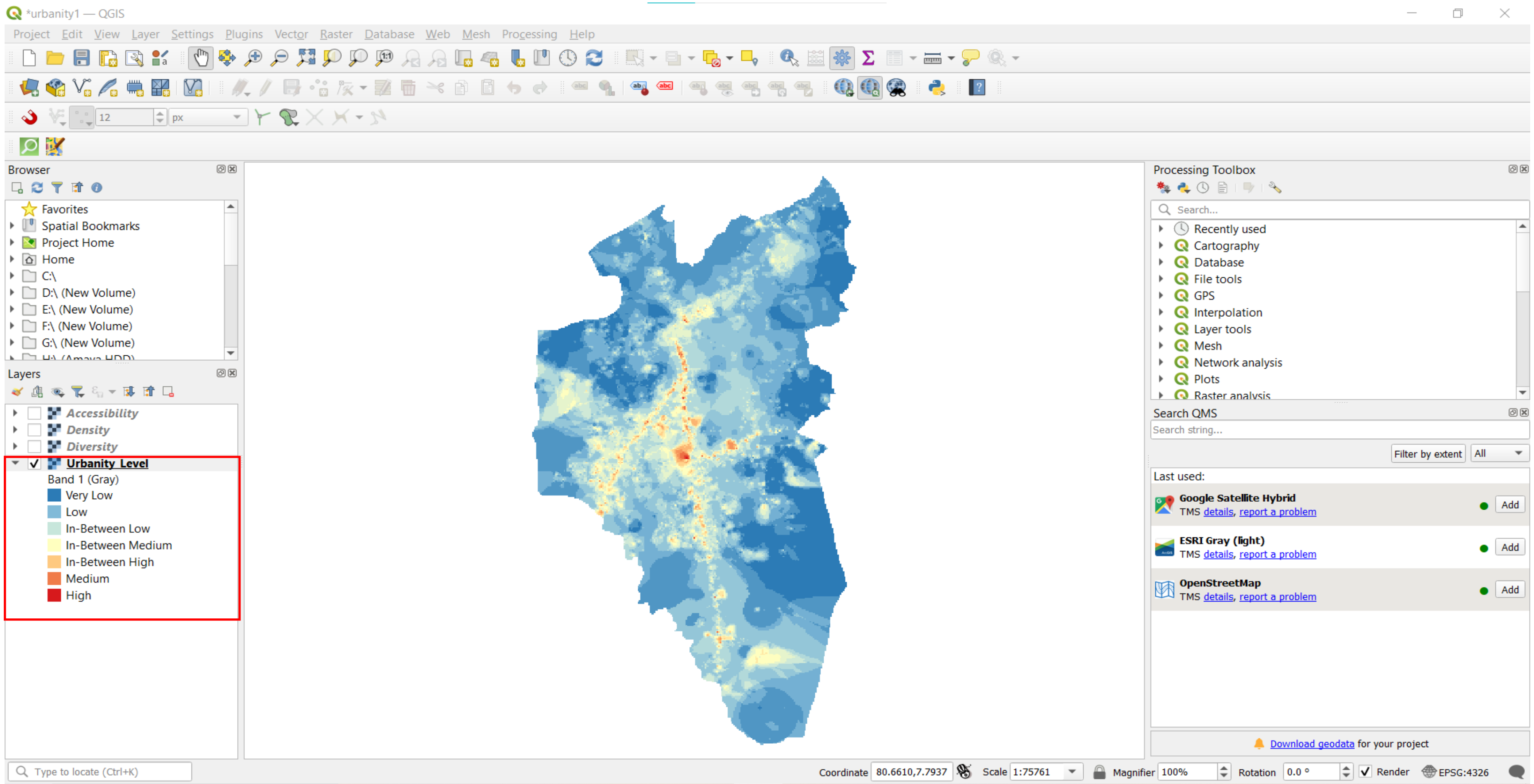


Figure 42 -Categorized Map

d. Getting numerical values and graphs of the urbanity level

Graphs and charts are essential for easily understanding the urbanity level of a particular area. To create those graphs there is a need for numerical values such as the count of pixels in each urbanity category in raster data. But here we cannot get such numerical data directly from an attribute table like vector data. So, we have to install a plugin called “Raster Attribute Table” to open the attribute table for raster data.

i. Install the raster attribute table plugin.

1. Click the plugins icon in the QGIS menu bar.
2. select manage and install plugins.

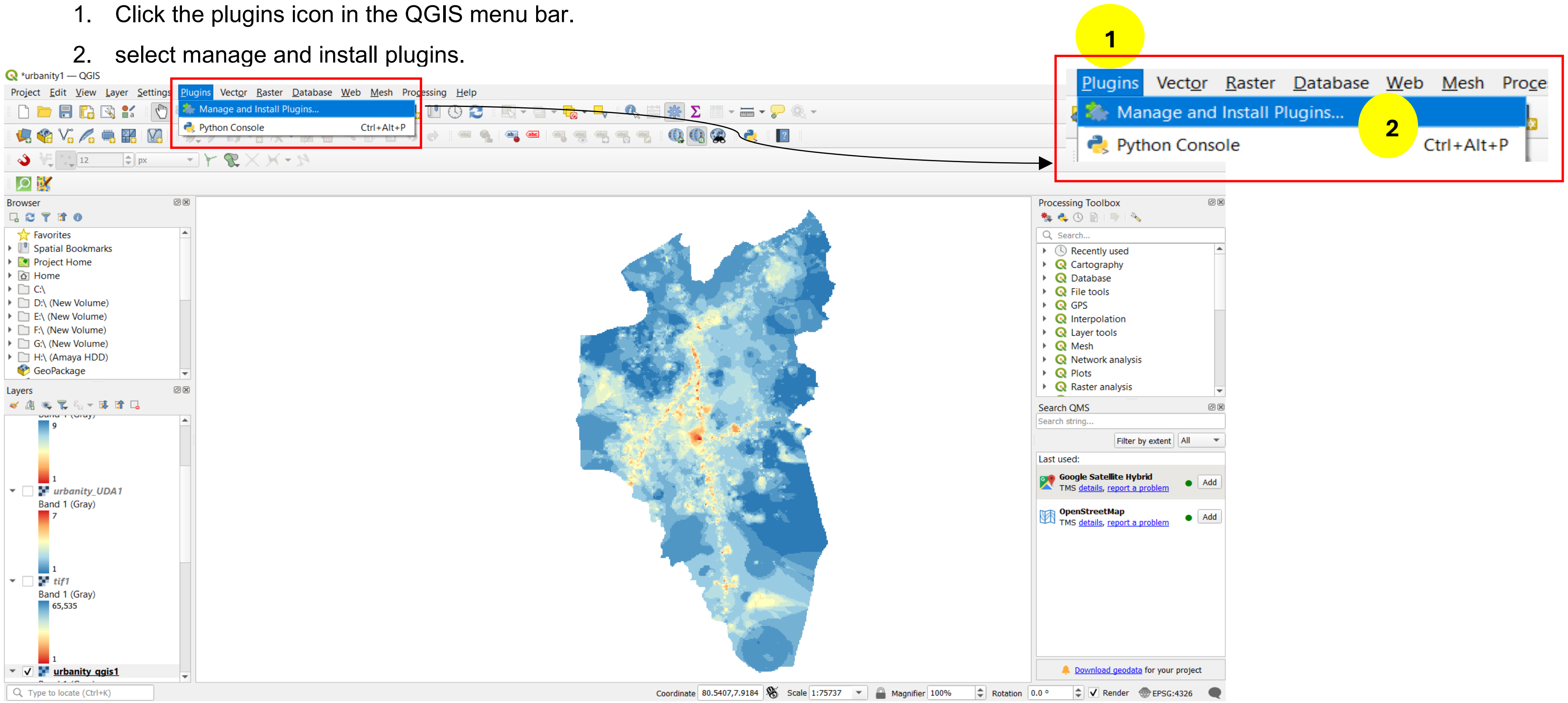


Figure 43 - Install the raster attribute table plugin

3. It will open the plugins window.

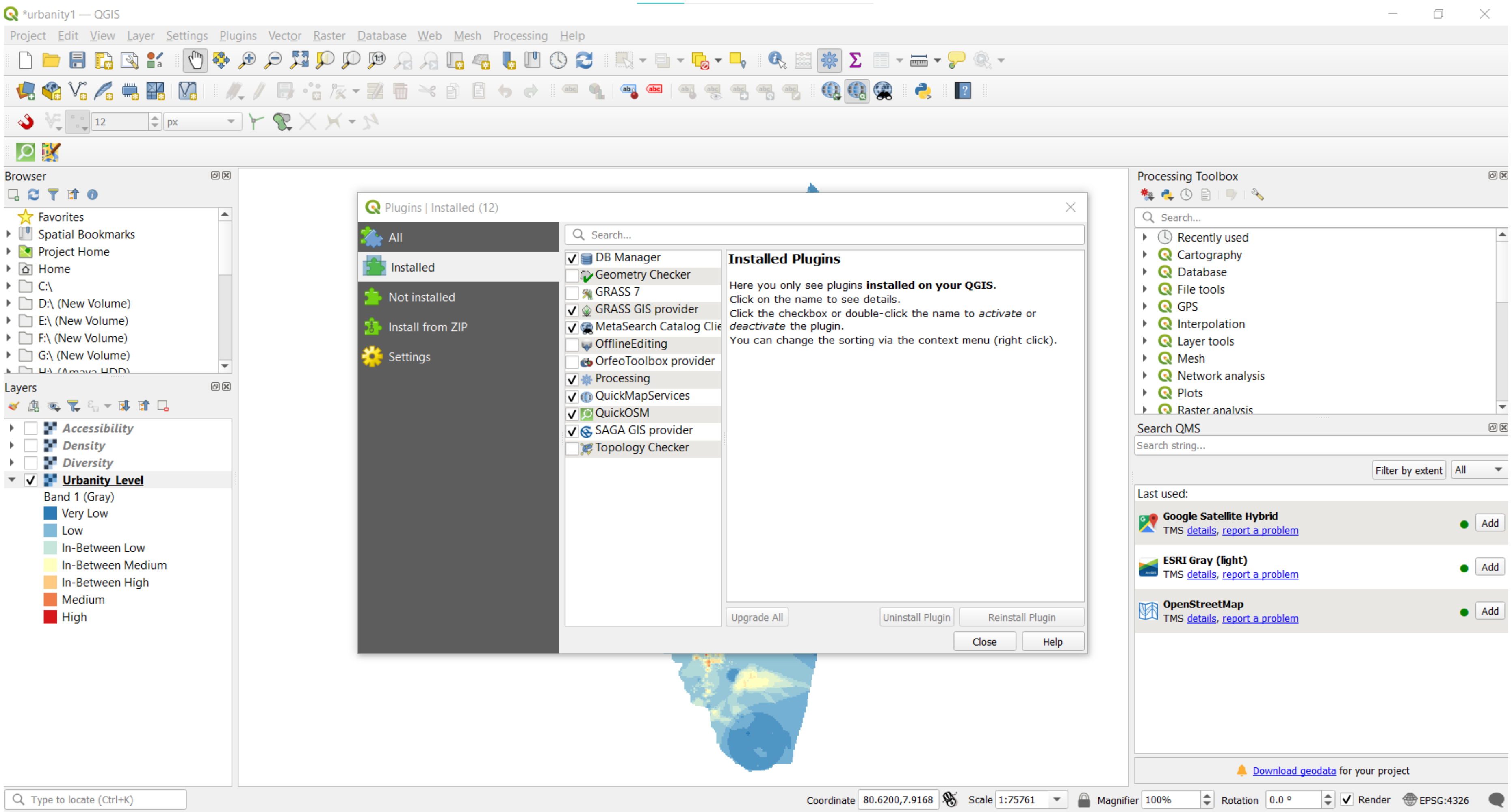


Figure 44 –Plugin Window

4. In there, first go to the settings.
5. Then tick on Show also experimental plugins and Show also deprecated plugins.

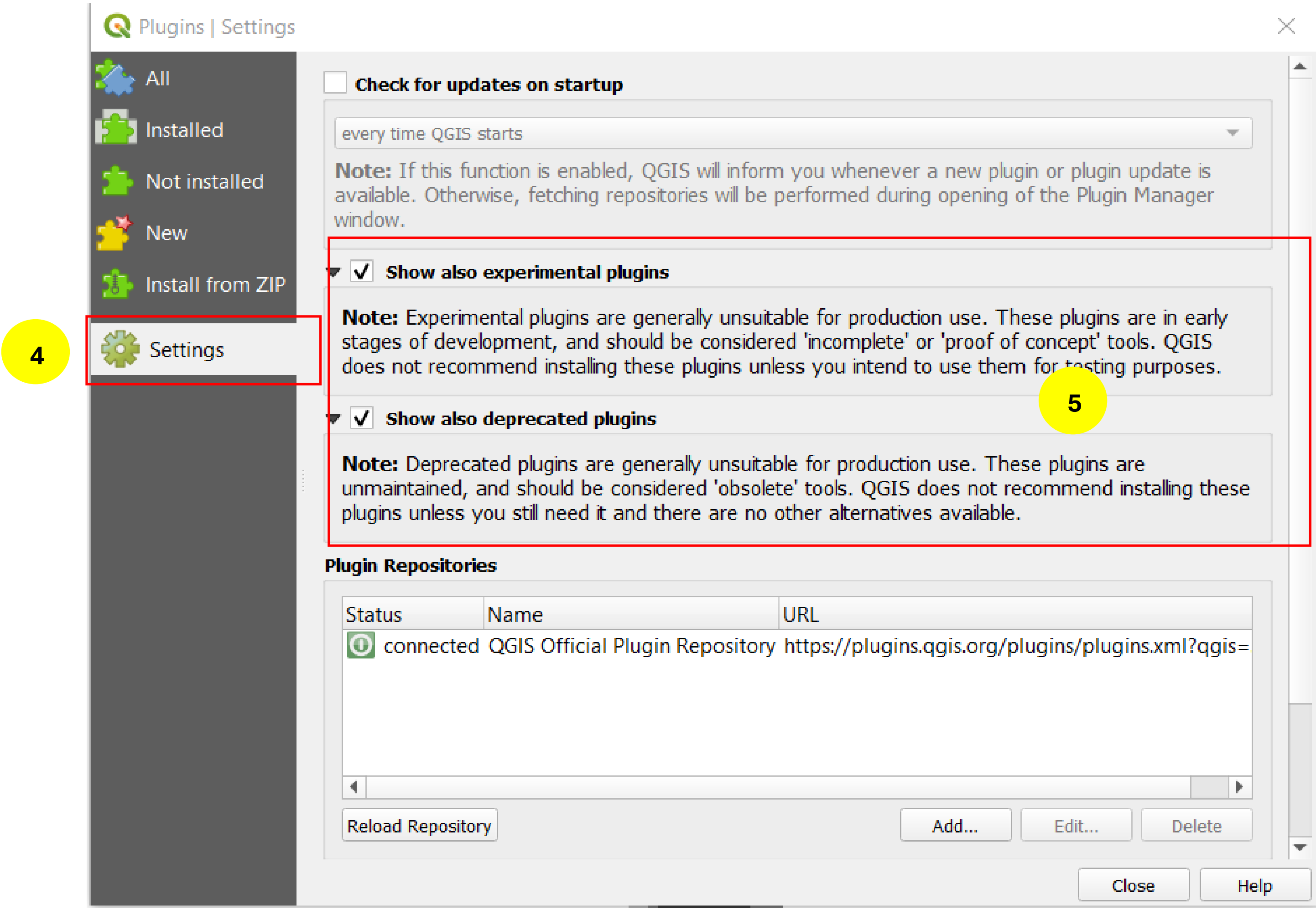


Figure 45 -Setting

6. Then go to all.
7. In the search bar, search for the Rater Attribute Table plugin and select it.
8. Click on the install plugin to install the raster attribute table plugin.

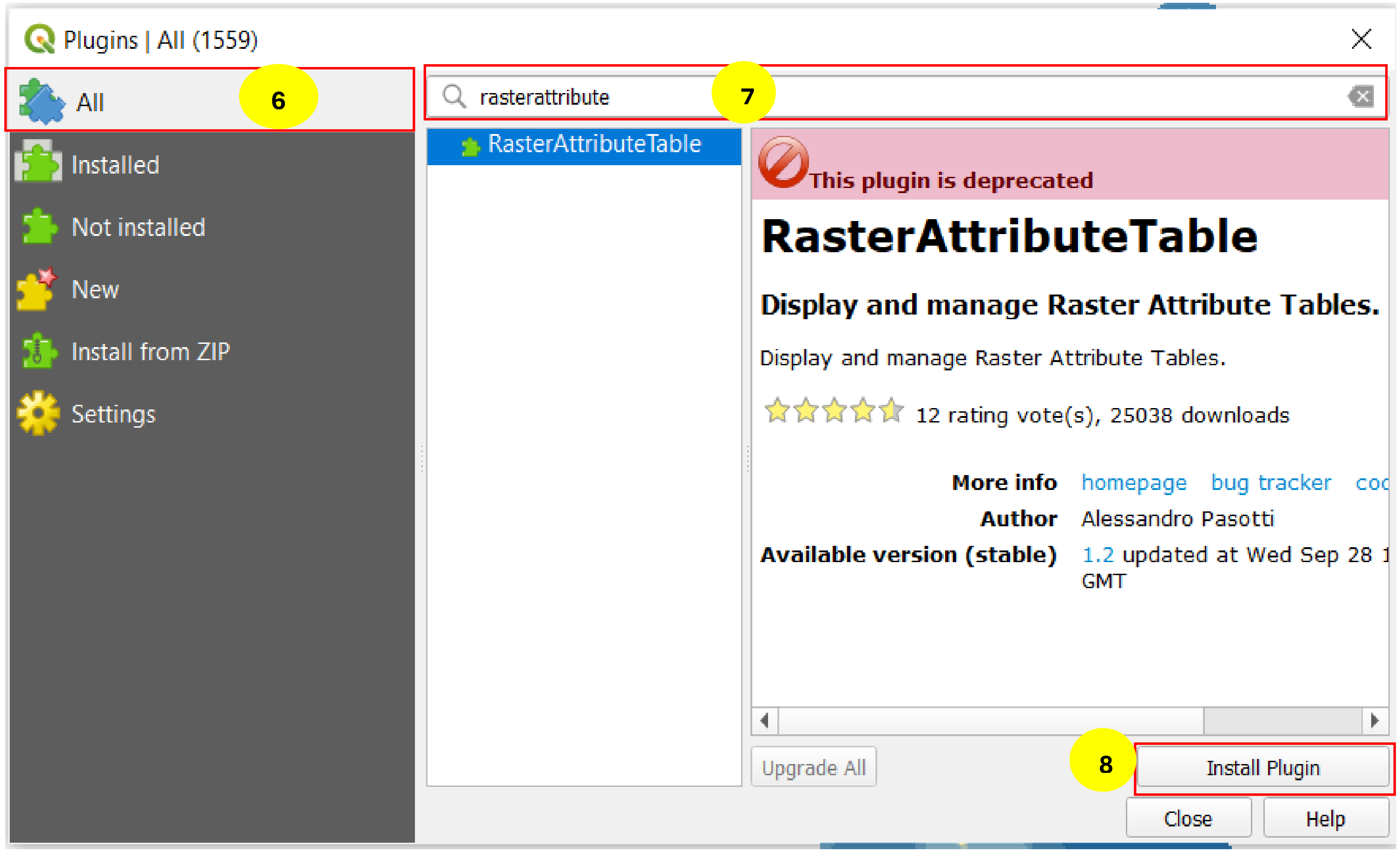


Figure 46 – Install Plugin

Then it will install the plugin.

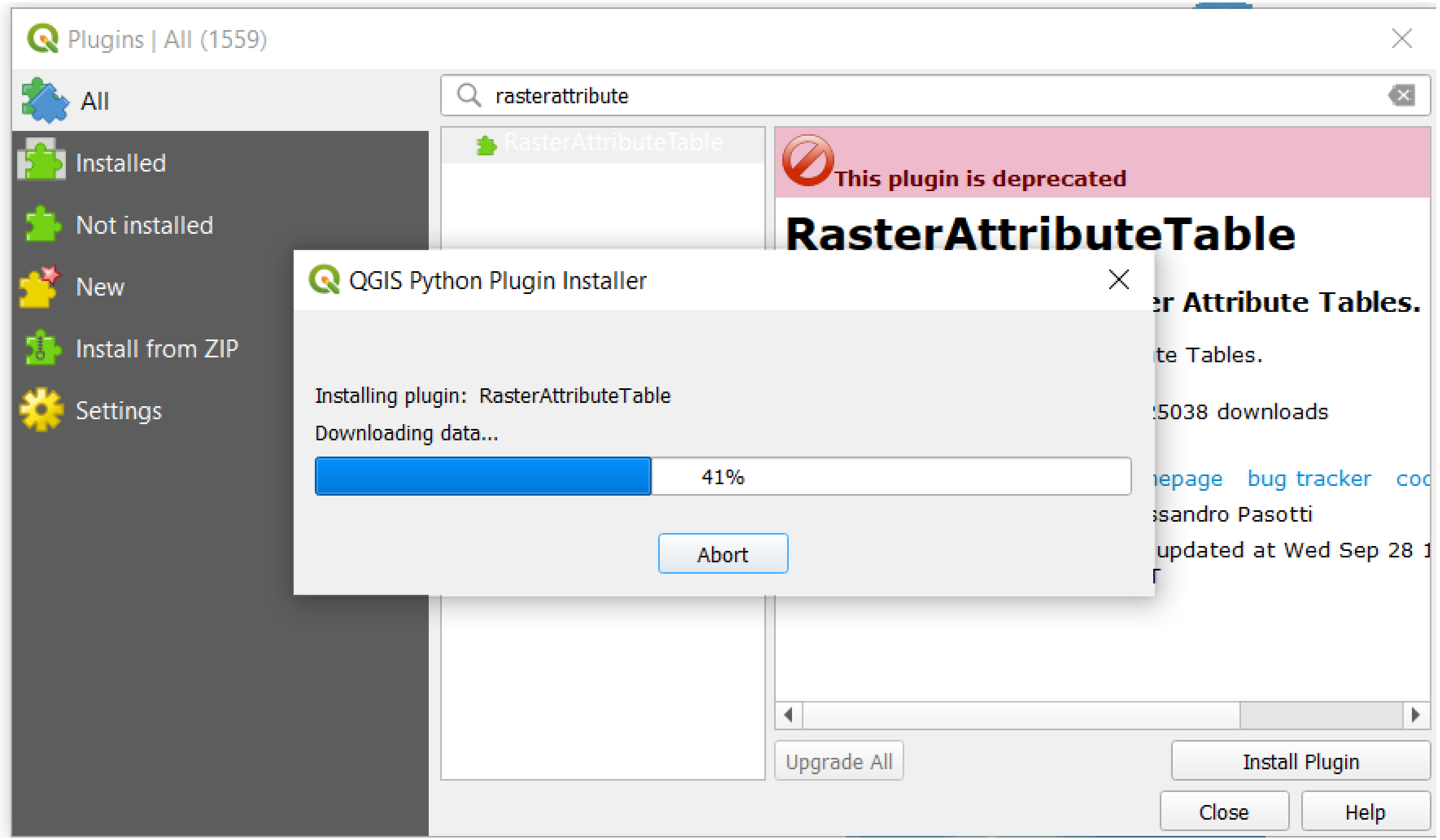


Figure 47 – Plugin Installer

ii. **Getting numerical values for the urbanity categories using the raster attribute table.**

1. After installing the plugin, right-click the urbanity level raster layer.
2. Click on the open attribute table in there and now you can open the attribute table of the urbanity level raster.

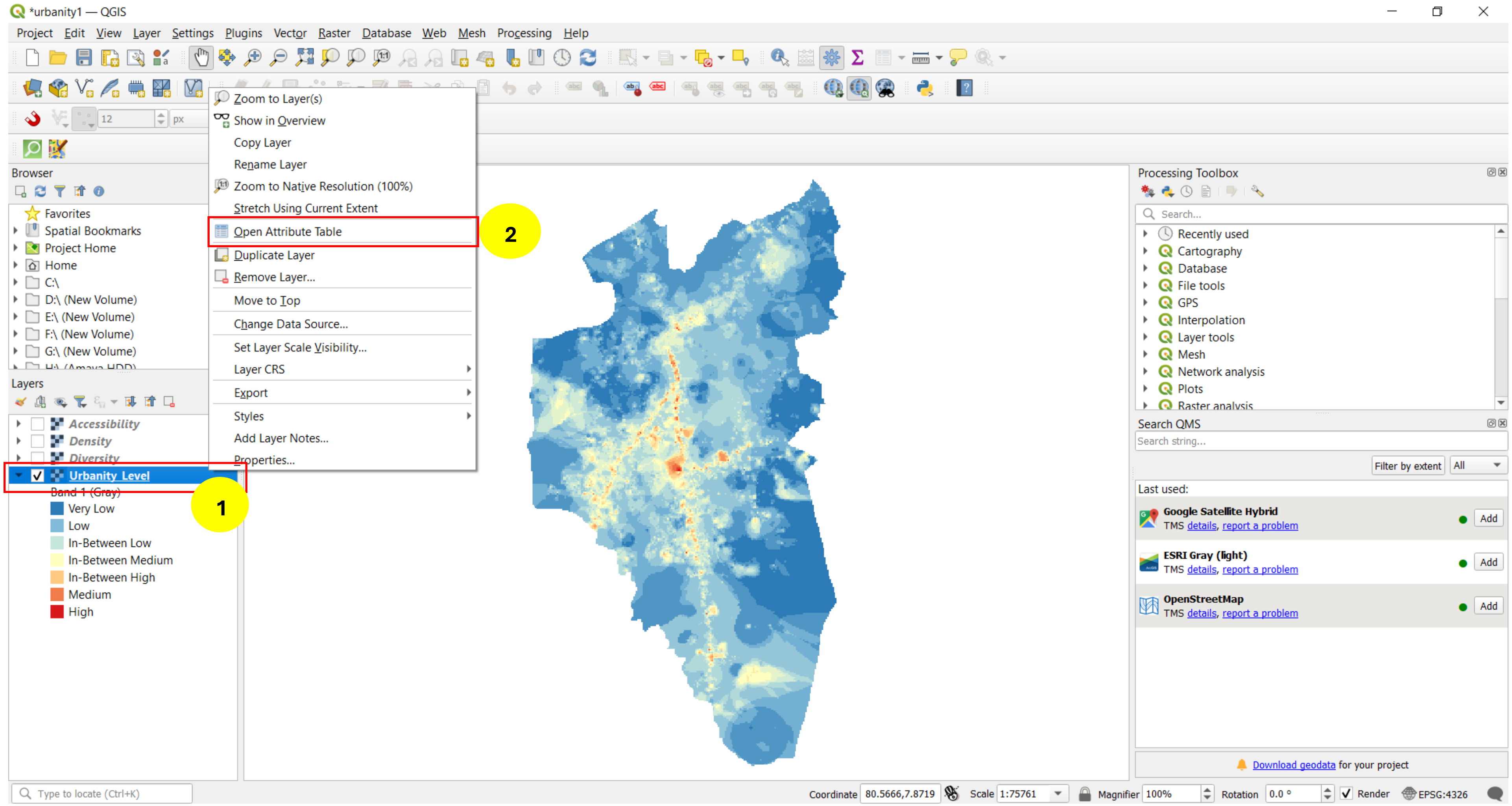
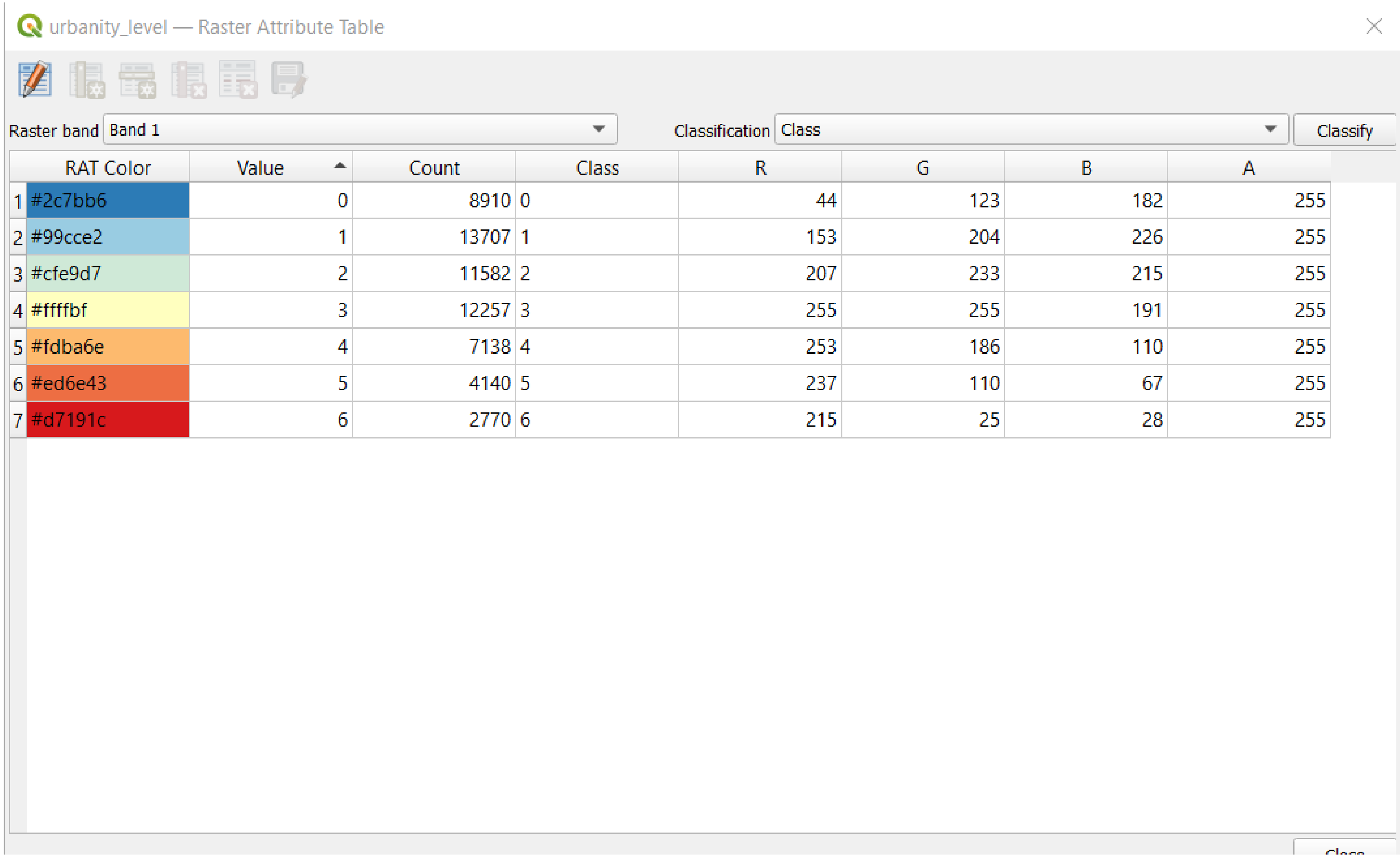


Figure 48 p Getting numerical values for the urbanity categories

This is the raster attribute table of the urbanity level raster layer.



	RAT Color	Value	Count	Class	R	G	B	A
1	#2c7bb6	0	8910	0	44	123	182	255
2	#99cce2	1	13707	1	153	204	226	255
3	#cfe9d7	2	11582	2	207	233	215	255
4	#ffffbf	3	12257	3	255	255	191	255
5	#fdba6e	4	7138	4	253	186	110	255
6	#ed6e43	5	4140	5	237	110	67	255
7	#d7191c	6	2770	6	215	25	28	255

Figure 49 -Raster Layer Attribute

3. In the raster attribute table, there are 7 categories, and we have to get pixel values for those seven categories. So, by looking at the seven classes of urbanity level which we categorized in the symbology panel and the raster attribute table value we can take relevant counts for seven classes.

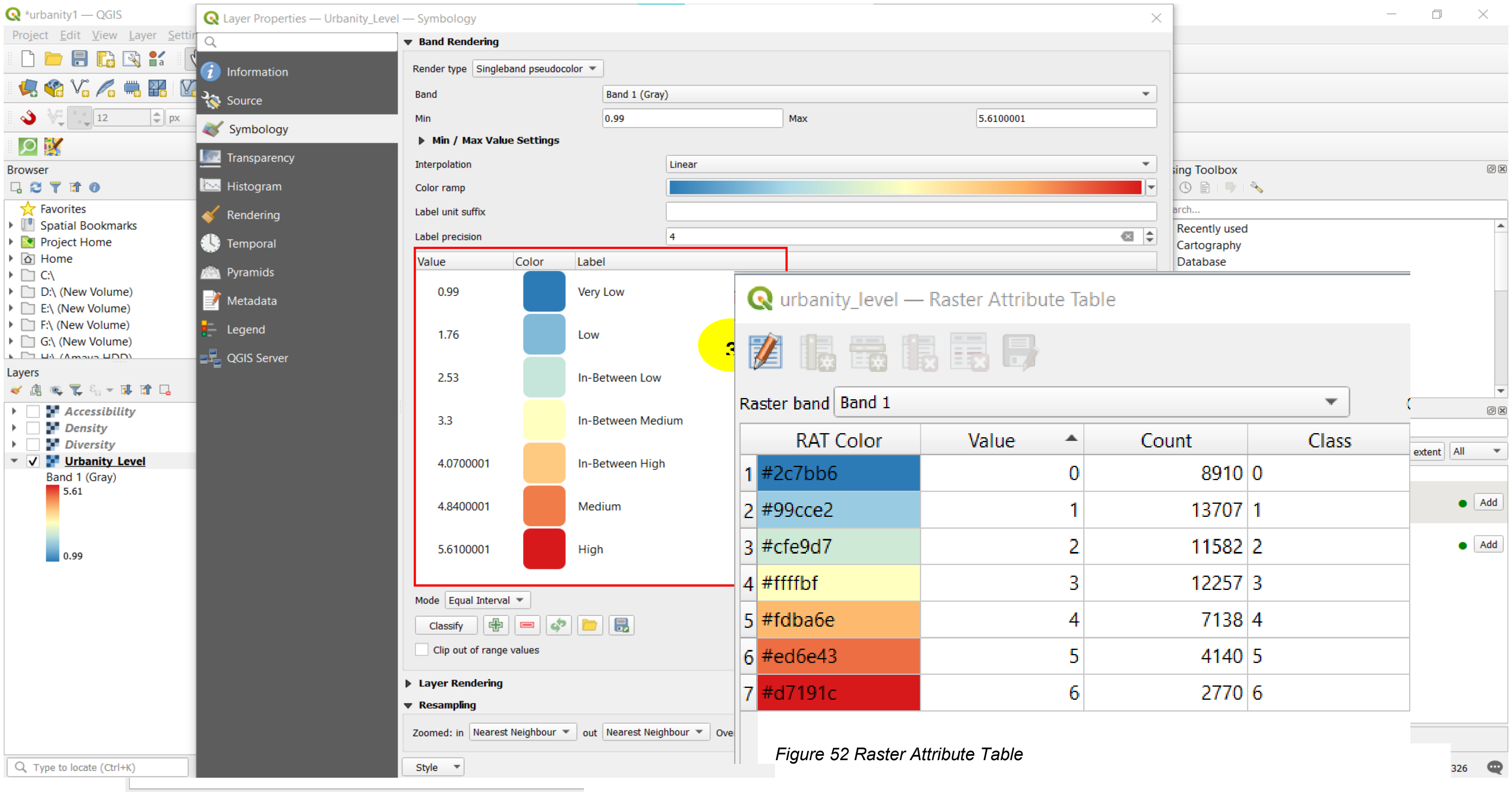


Figure 52 Raster Attribute Table

Figure 51 - raster attribute table

Figure 50 - Raster attribute table

So, Figure A shows the urbanity level categories and Figure B shows the seven classes in the raster attribute table. Now we have to get the relevant count for each urbanity level category by looking at the above two figures. Especially urbanity level categories mentioned in step 6 in 3.1 are also used for categorization here.

As an example, the pixel count which belongs to the very low category is 8910 and the pixel count which belongs to the low category is 13707. So according to that you can open the Microsoft Excel Worksheet and insert those pixel counts in the raster attribute table relevant to the seven classes of urbanity for easy understanding and graph making.

4. Now open the Microsoft Excel worksheet and insert only the urbanity level and pixel count columns into that worksheet.

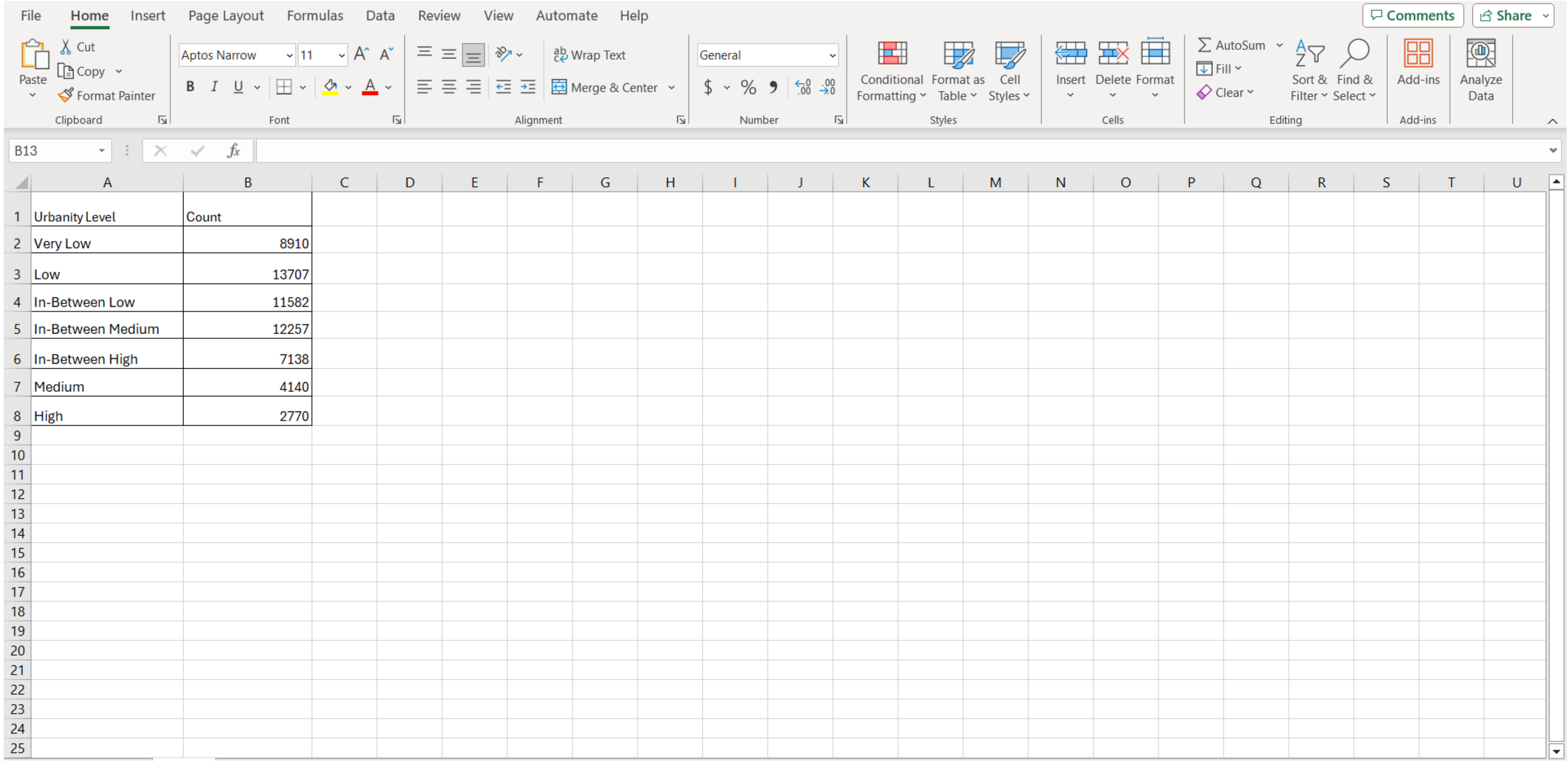


Figure 53 Microsoft Excel Worksheet

5. Then you can get the sum of the total count and put it under the table
6. Get the percentage value of each urbanity level and add it to a new column.

	A	B	C
1	Urbanity Level	Count	Percentage
2	Very Low	8910	14.73
3	Low	13707	22.65
4	In-Between Low	11582	19.14
5	In-Between Medium	12257	20.26
6	In-Between High	7138	11.80
7	Medium	4140	6.84
8	High	2770	4.58
9		60504	

Figure 54 - Percentage value of each urbanity level

Sum of the total count = 22559 + 23703 + 11236 + 4119 + 879 + 317 + 18

Percentage = (Count of an urbanity level/Total sum of counts) *100

Very Low Percentage = (22559/62831) *100

iii. After getting pixel counts for each urbanity level, make the graphs for the urbanity level.

1. In the Excel worksheet, hide the count column by right clicking the column and then clicking on hide.

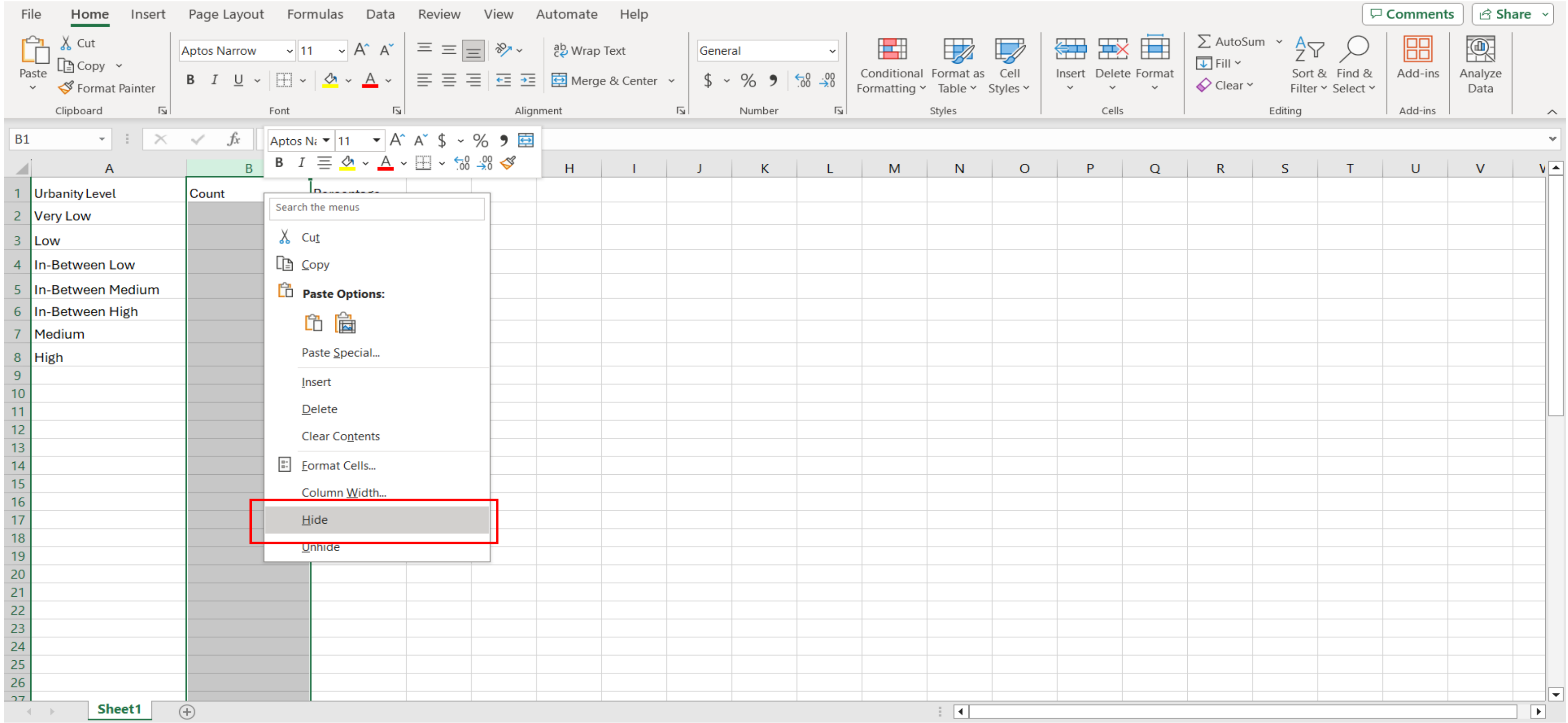


Figure 55 - Hide the count column

2. Go to the insert panel in the Excel worksheet.
3. Then click on Insert Column or bar charts.
4. Now click on more column charts.

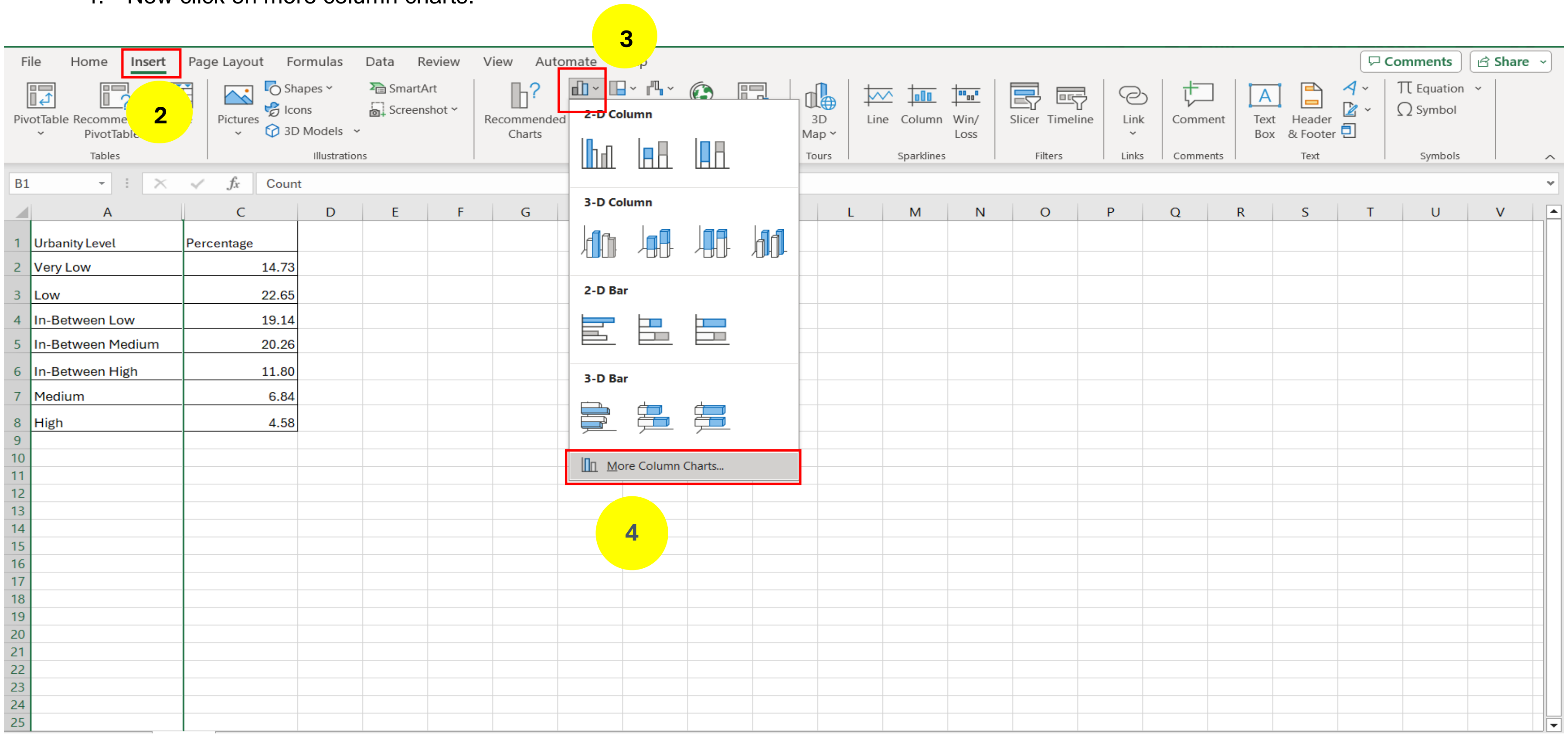


Figure 56 -Add Charts

5. Select the data cells in the Excel worksheet.
6. Then select funnel charts under the more chart options and click ok. Now you can create a funnel chart that shows the percentage of urbanity level in the selected area.

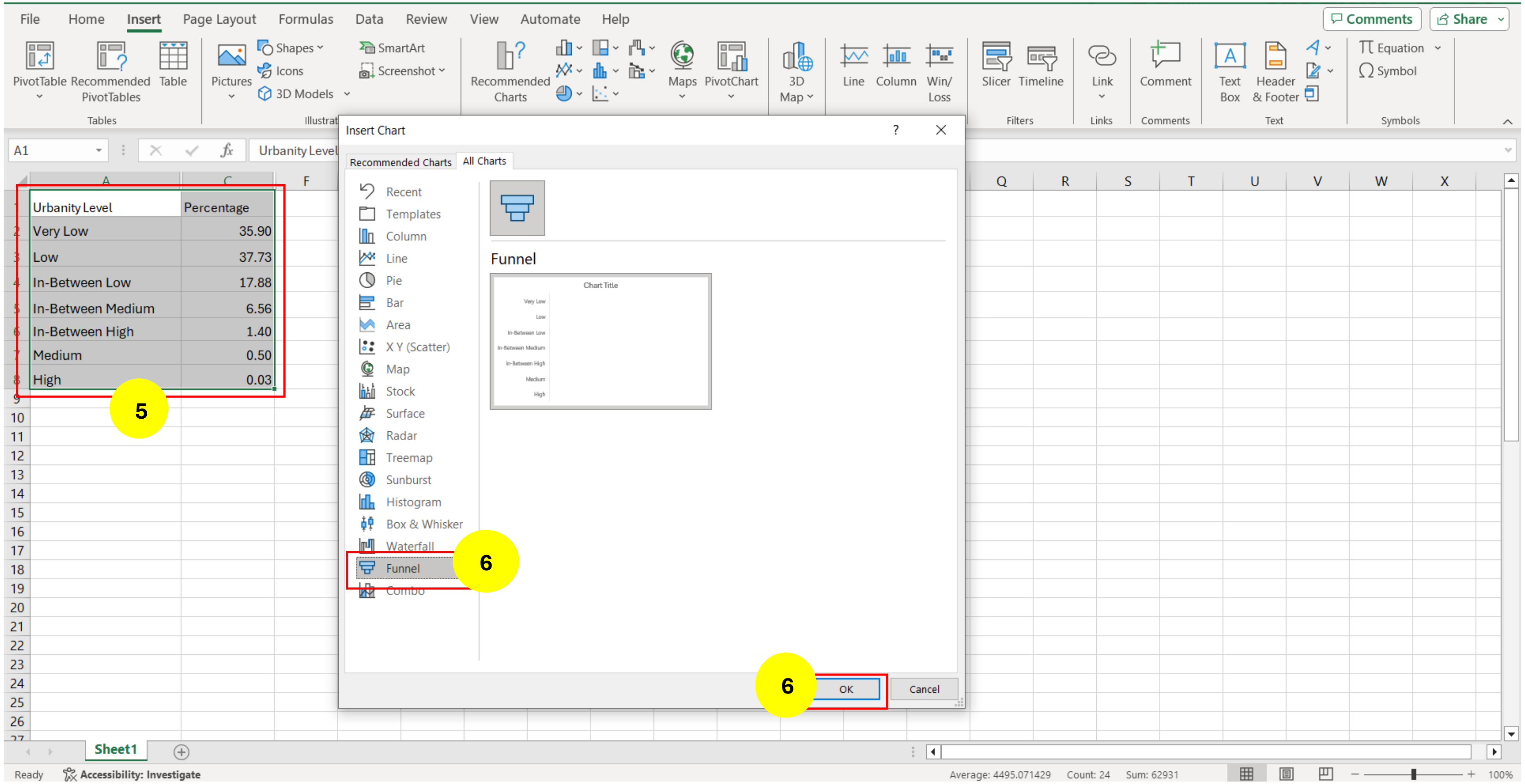


Figure 57 - Add Charts

Now you can get the funnel chart of the urbanity level.

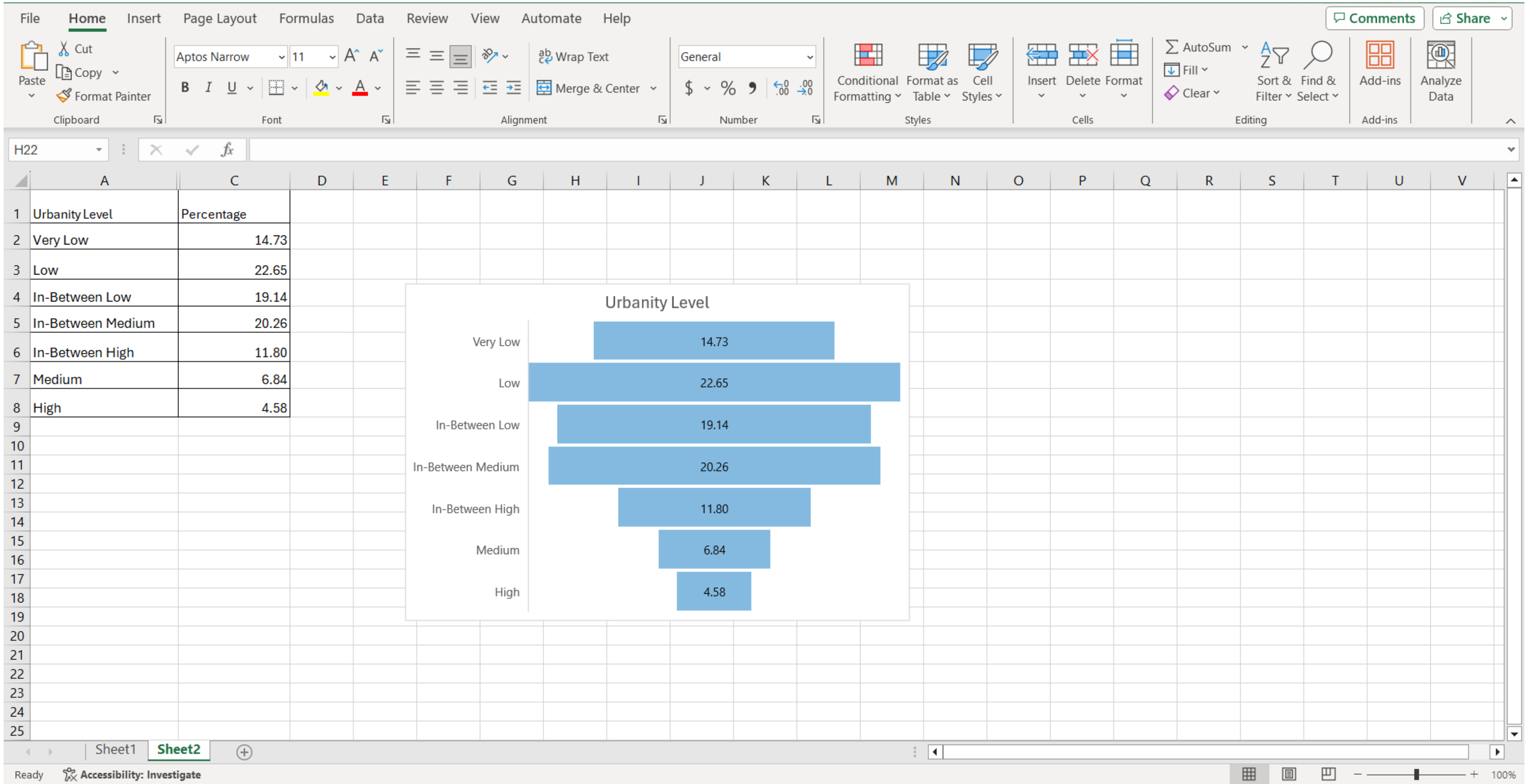


Figure 58 - funnel chart

Source - Yu Ye, Akkelies van Nes. (2014). Quantitative tools in urban morphology: combining space syntax,. 23.

7. To identify the degree of balance in urbanity levels, add a new column to the Excel table named Level of balance. Degree of balance can be categorized into three classes balanced with low values, unbalanced with mixed values, and balanced with high values. According to the degree of balance, very low and low urbanity levels belong to the balanced with low values and in-between low, in-between medium and in-between high urbanity levels belong to the category of unbalanced with mixed values. Following the same process medium and high urbanity levels belong to the category of balanced with high values.

	A	B	C	D
1	Urbanity Level	Count	Percentage	Level of balance
2	Very Low	8910	14.73	Balanced with low values
3	Low	13707	22.65	
4	In-Between Low	11582	19.14	Unbalanced with mixed values
5	In-Between Medium	12257	20.26	
6	In-Between High	7138	11.80	
7	Medium	4140	6.84	Balanced with high values
8	High	2770	4.58	
9		60504		

Figure 59 -Level of Balance

8. Now you can add another column to the table and sum up the relevant percentages of urbanity level to fill the total percentage of the level of balance in three categories.

Total Percentage = sum of the percentage values of same level of balance category

Total percentage of balanced with low values = percentage of very low level + percentage of low level

	A	B	C	D	E
1	Urbanity Level	Count	Percentage	Level of balance	Total Percentage
2	Very Low	8910	14.73	Balanced with low values	37.38
3	Low	13707	22.65		
4	In-Between Low	11582	19.14	Unbalanced with mixed values	51.2
5	In-Between Medium	12257	20.26		
6	In-Between High	7138	11.80		
7	Medium	4140	6.84	Balanced with high values	11.42
8	High	2770	4.58		
9		60504			

Figure 60 -Total Percentage

Then you can modify the funnel chart by adding the degree of balance as well.

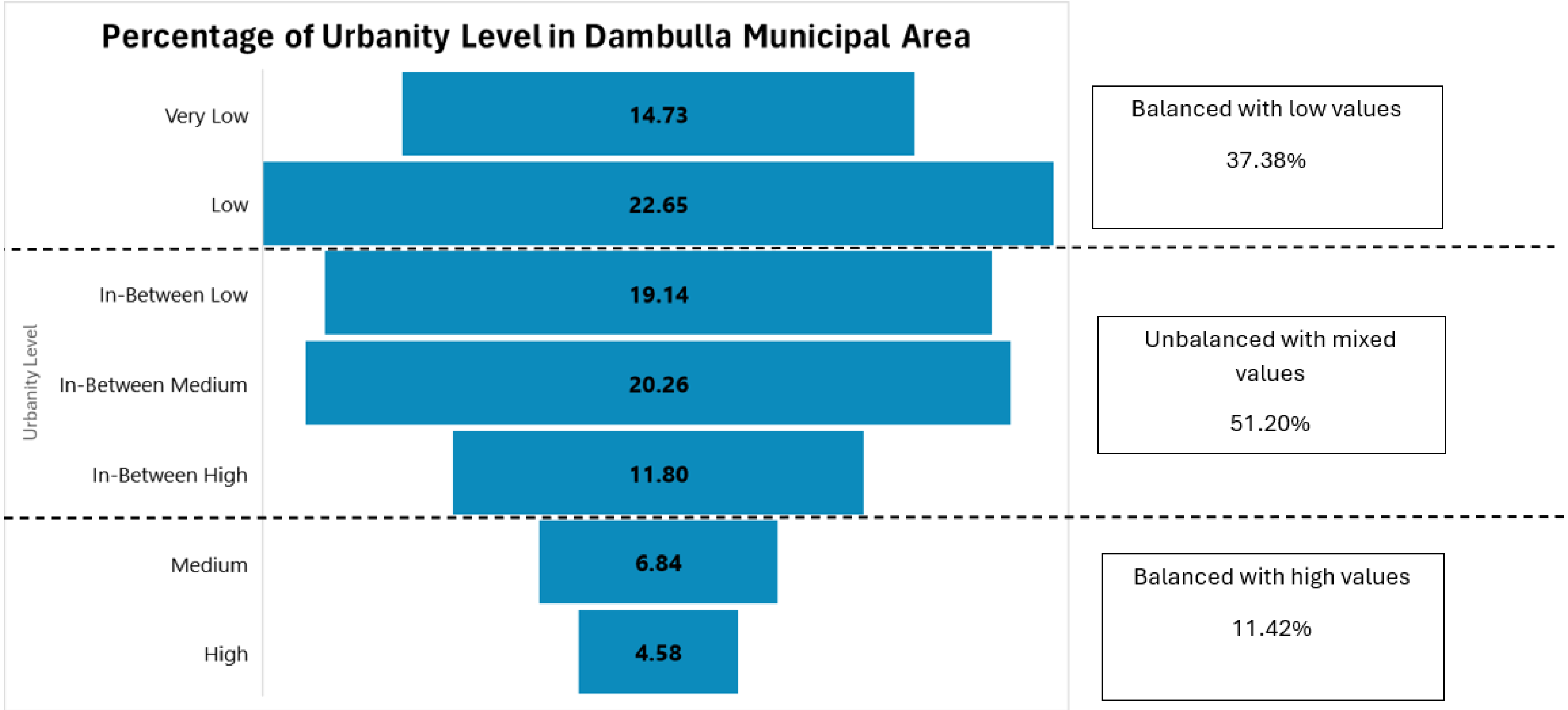


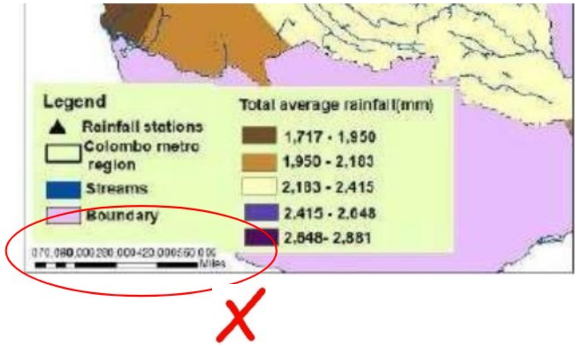
Figure 61 Percentage of Urbanity Level and Balanced Values

6. PREPARATION OF THE MAPS

1. Use Suitable Colors & Symbols
2. Show adjacent administration boundaries.
3. Maximum utilization of map space
4. Show the Graticule Network with appropriate grid size.
5. Show the basic elements in the map.
    a. Transportation Networks
    b. Water Bodies
6. Prepare a descriptive map.
    a. Label notable features.
        i. Major Road Types
        ii. Major Rivers
        iii. GN Boundaries
        iv. If needed, show the location of the area in a different data frame.
7. Check the units of the scale bar.
8. Mention correct units at the legend.
9. Check the text given in the legend.
10. Mention the correct sources.

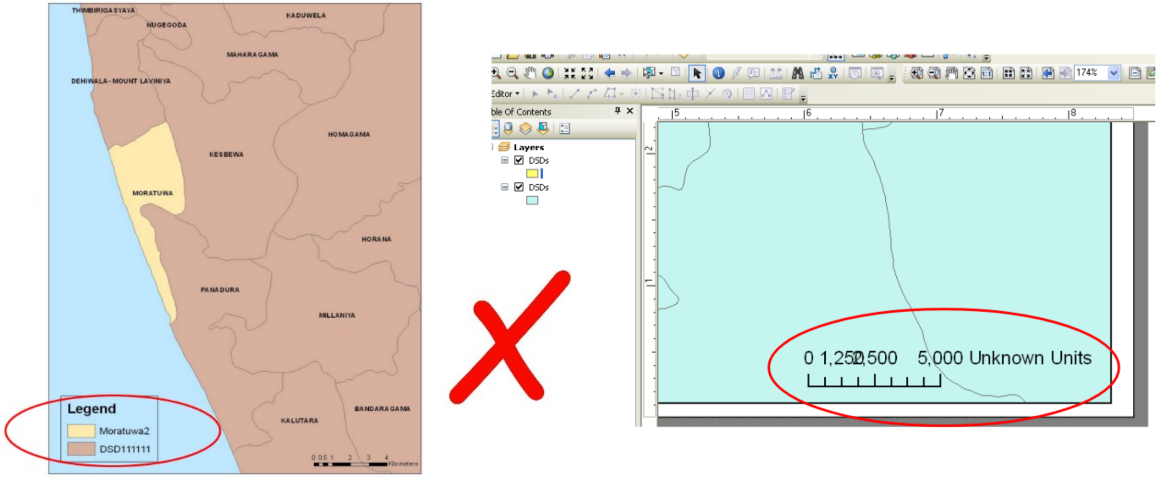
Examples

Maximum utilization of map space



Check the units of the scale bar.

Figure 62 Incorrect formats of maps



Check the text given in the legend.

AFTERWORD

Understanding urbanity levels is a cornerstone of Urban Informatics and Planning, offering valuable insights into how spatial form and socio-economic patterns co-evolve across different settlement scales. This guide provides a practical, GIS based framework for identifying and analyzing urban gradients, equipping users with the skills to interpret urban complexity using quantifiable in dicators.

By bridging theory with datadriven practice, this resource empowers students, educators, and professionals to conduct nuanced urban assess mentscritical for shaping balanced, inclusive, and sustainable cities. Let this guide serve as both a methodological foundation and a catalyst for informed, equity-oriented decision-making in urban analysis.

lbs2its.net

618657-EPP-1-2020-1-AT-EPPKA2-CBHE-JP

ISBN 978-955-9027-96-6