QGIS Workshop

Introduction

About

Quantum Geographical Information System (QGIS) is an open source platform to visualize, analyze, model and answer spatial issues. The first version was published in 2002. The actual Version is QGIS 3, which integrates, in contrast to QGIS 2, Python 3 in its processing interface. QGIS integrates many extensions such as SAGA GIS and GRASS GIS. QGIS can run on various systems, like Linux, Mac or Windows. With this QGIS is a very powerful tool to treat various kind of spatial problems.

Download and Install

QGIS is available in different versions (64 bit, 32 bit) and comes with two different installers (Standalone, OSGeo4W). On the download page you can find the actual version as well as older versions to download and install.

Link: https://qgis.org/en/site/forusers/download.html

After you have downloaded the installer from the link above, you have to run it and setup QGIS on your local machine. Through the installation process you are able to choose some test datasets. After the installation, a bunch of desktop icons will be created and you can start the programm.

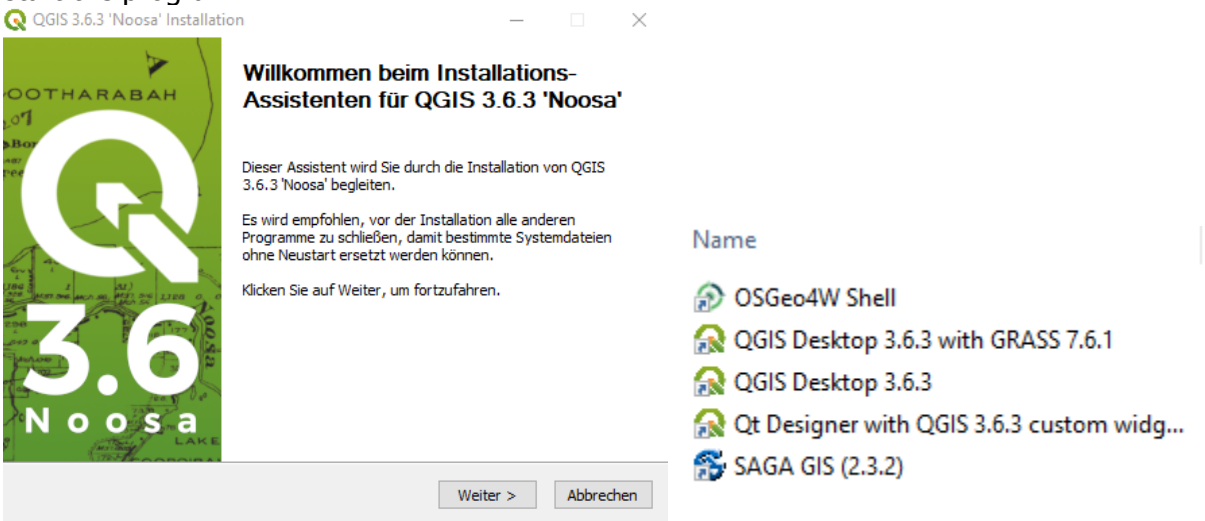


Fig. 1: QGIS installation screen and created desktop icons.

Interface Overview

With QGIS3, the interface was completely reworked from the previous versions. Furthermore, the handling is quite different from other GIS products like MapInfo or Esri ArcGIS. This is the reason for a short overview about the functionality of the new interface (Fig. 2).

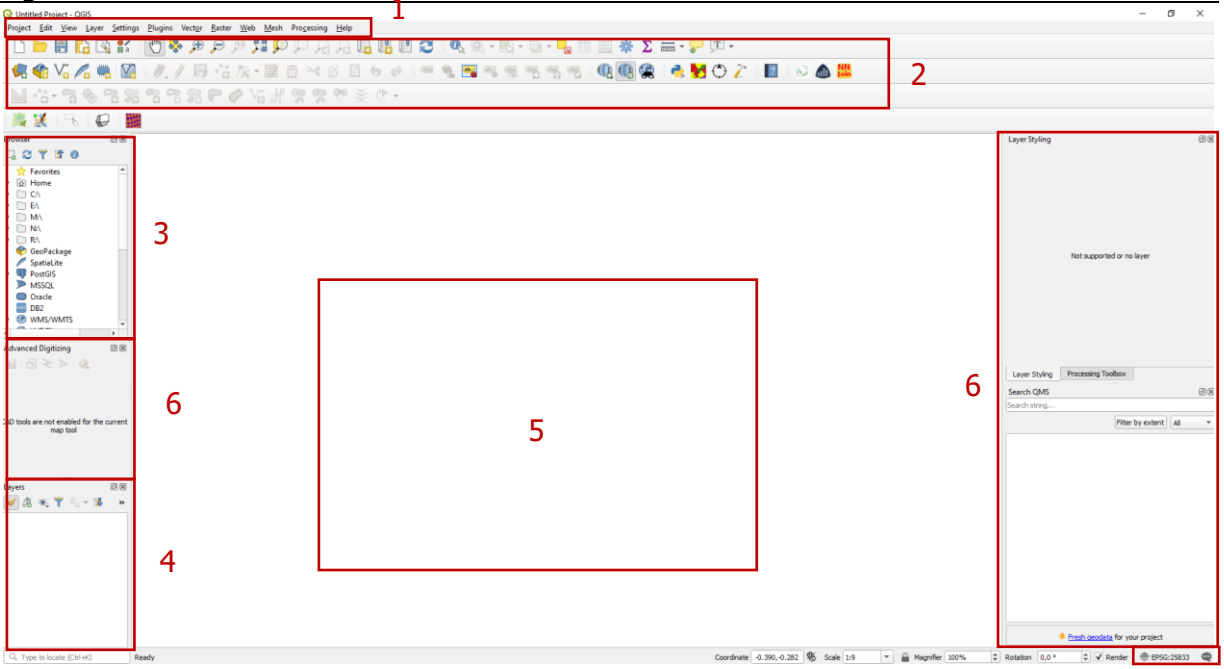


Fig. 2: QGIS 3 Interface.

1 Menu-Bar:

- Create a new project – Menu-Bar – Project – New
- Save Project – Menu-Bar – Project –Save
- Add Layer – Menu-Bar – Layer – Add Layer – Add an arbitary layer (table, shape, raster, …)
- Create Layer – Menu-Bar – Layer – Create Layer – New Shapefile Layer
- Manage and install plugins – Menu-Bar – Plugins – Manage and install plugins
- Vector processing – Menu-Bar – Vector – Vector processing tools
- Raster processing – Menu-Bar – Raster – Raster processing tools
- Open Tools – Menu-Bar – Processing – Toolbox
- Open Graphical Modeller – Menu-Bar – Processing – Graphical Modeller (corresponds to ArcGis Model Builder)
- Open Results Viewer – Menu-Bar – Processing – Results Viewer

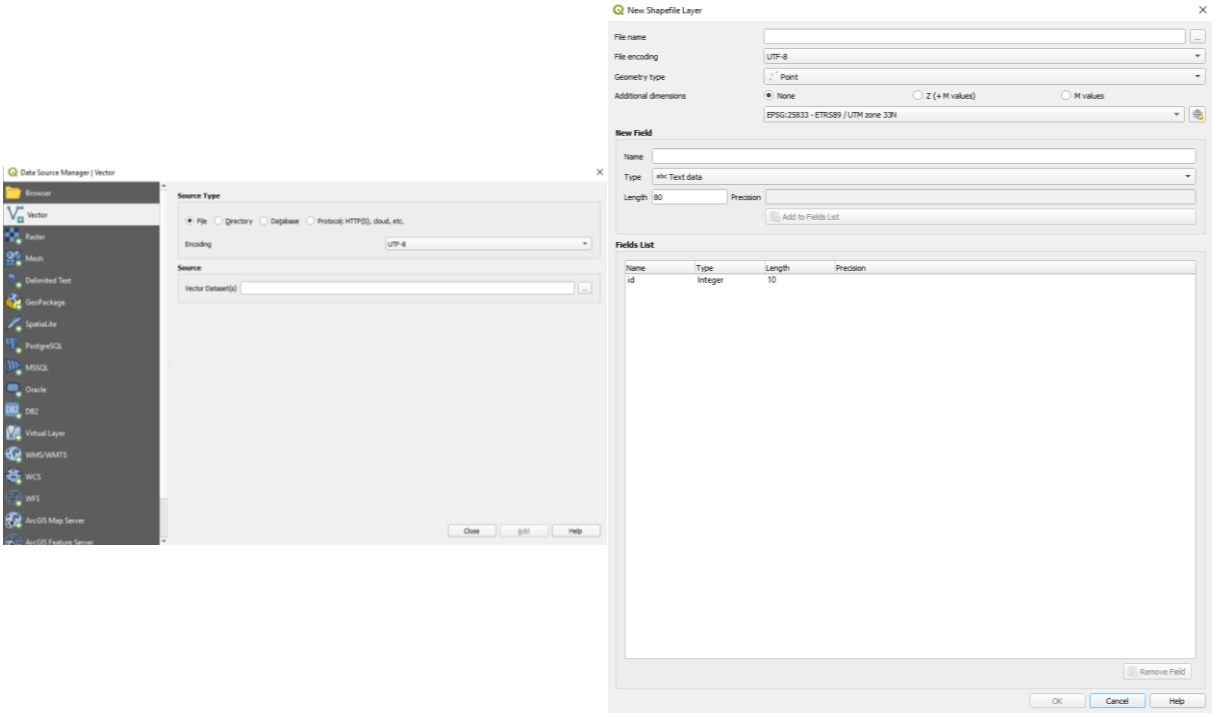


Fig. 3: Add a new vector layer (left) or create a new one (right).

2 Toolbar:

- Query element – Toolbar – Icon with arrow and questionmark – Select – Click on preferred Element in the map
- Select elements – Toolbar – Icon with yellow box and arrow – Select – Span a box on the map to select items
- Select by attributes – Toolbar – Select – Create a query with the help of the attributes
- Reset selection – Toolbar – Icon with yellow box and red symbol

3 File Browser:

- It provides a list of files on your computer. You can drag and drop GIS files into the Layers Panels to view them. We can display it by right click at tool bar and choose the panels you want to use.
- Add new service – File Browser – Select desired datatype with right click – Create New Connection – Set Name and Link to dataset
- Add Open Street Map (OSM) – File Browser – select XYZ Tiles – Add Open Street Map Layer as Basemap

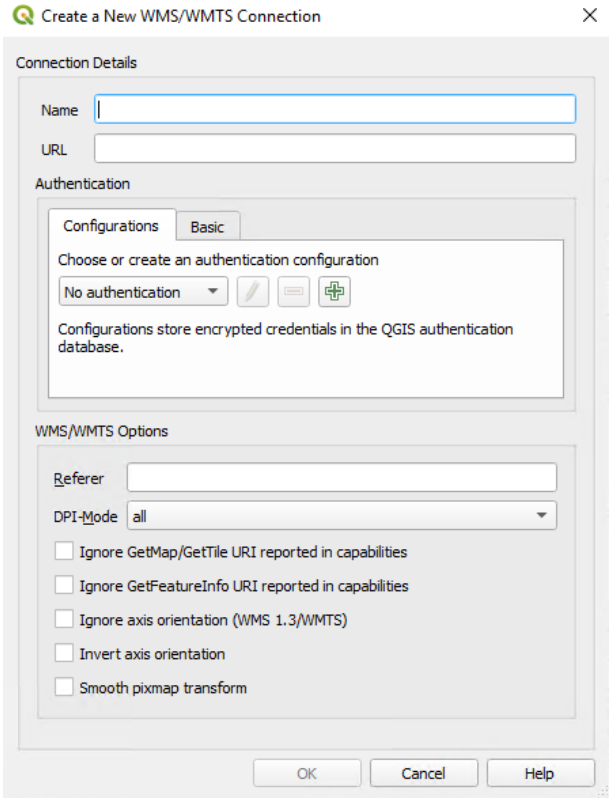


Fig. 4: Add a WMS via URL.

4 Layer Panel:

- This panel shows map layers that are in your current project. Layers can be turned on/off, clubbed , change drawing order, etc.
- Change layer order – File Browser – Drag and drop layer to preferred position
- Change visibility – File Browser – Check or uncheck checkbox next to the layer
- Layer properties – File Browser – Right click – Select Properties

5 Main Map:

It shows geographic display of GIS layer or panel layers. It covers maximum area off course because of its function.

6 Extensions:

These are panels which come with different plugins and extensions. Each of them has a specific function, defined, of course, by the plugin itself.

7 Coordinate Reference System (CRS):

Left click on CRS in the bottom left corner – Select your prefered CRS in the new window – Search for EPSG-Code Suche nach EPSG-Code for example – Possible to select a system from the last chosen ones

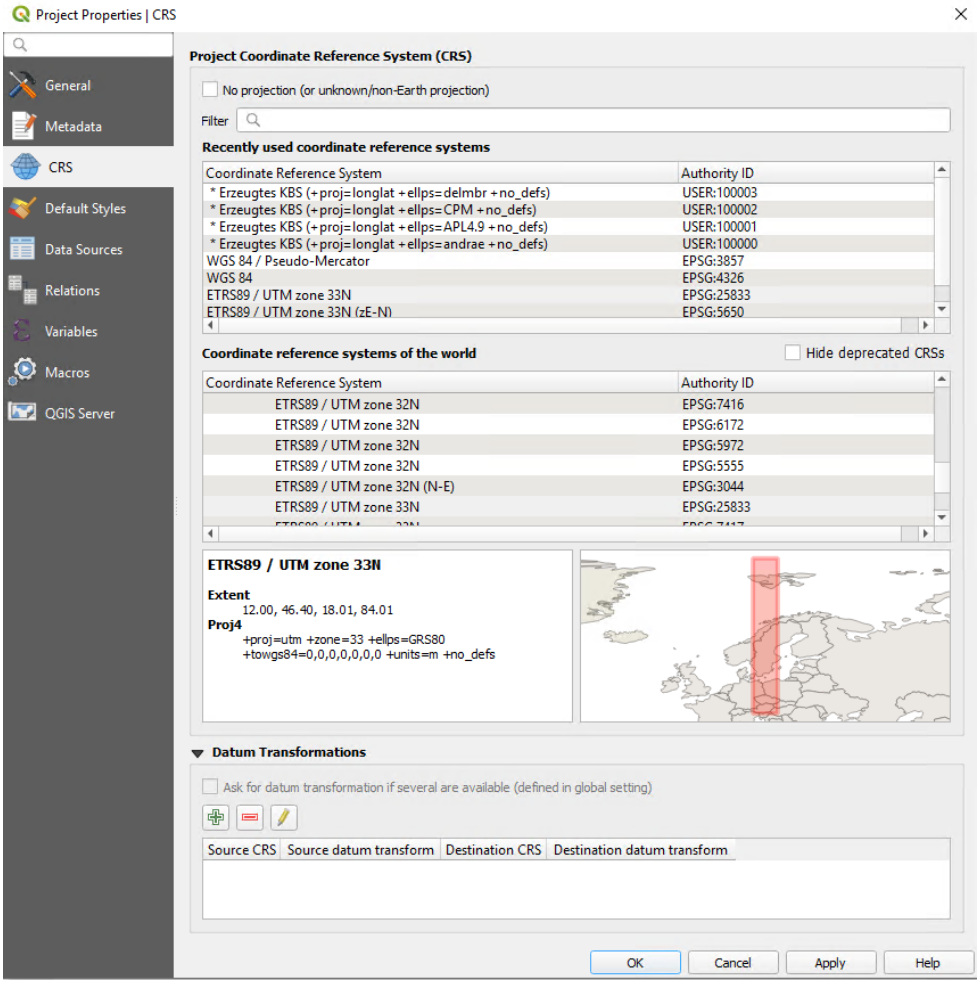


Fig. 5: Choose a CRS for the map.

Exercise

Starting a new Project

The first step to work with QGIS is to create and to setup a new project. QGIS is able to visualize and process a wide range of geodata – from shapefiles over kml to GeoJSON. First we are working with vector data and integrate some basemaps.

- Create a new project – Menu-Bar – Project – New
- Save the project – Menu-Bar – Project – Save – Name: *„qgis_workshop*"

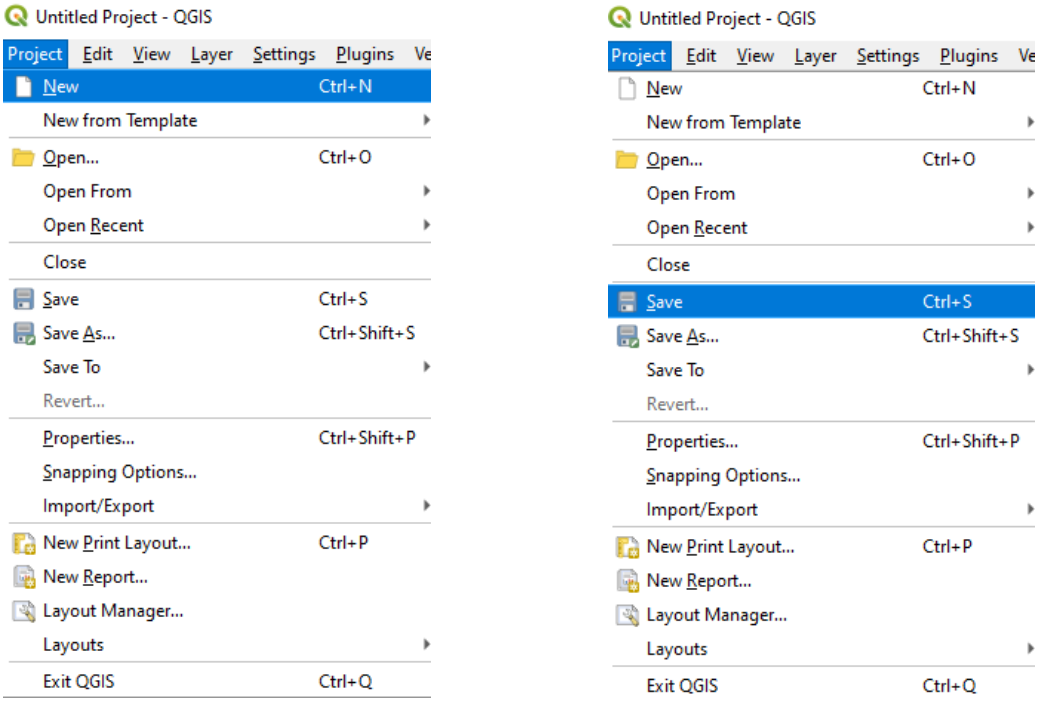


Fig. 6: Create a new project (left) and save it (right).

The next step is to identify your local coordinate system. For Mecklenburg Western Pomerania it is ETRS89 / UTM zone 33N; EPSG 25833. It is important to set the right CRS for the whole project as well as for the single layers. QGIS is able to reproject layers which have other CRS on the fly.

- Set map projection – Left click on CRS in the bottom left corner – Search *„EPSG 25833"* – Select *„EPSG 25833"*
- Set layer projection – Layer Panel – Right click on layer – *„Properties"* – *„Source"* – *„Set source coordinate reference system"*

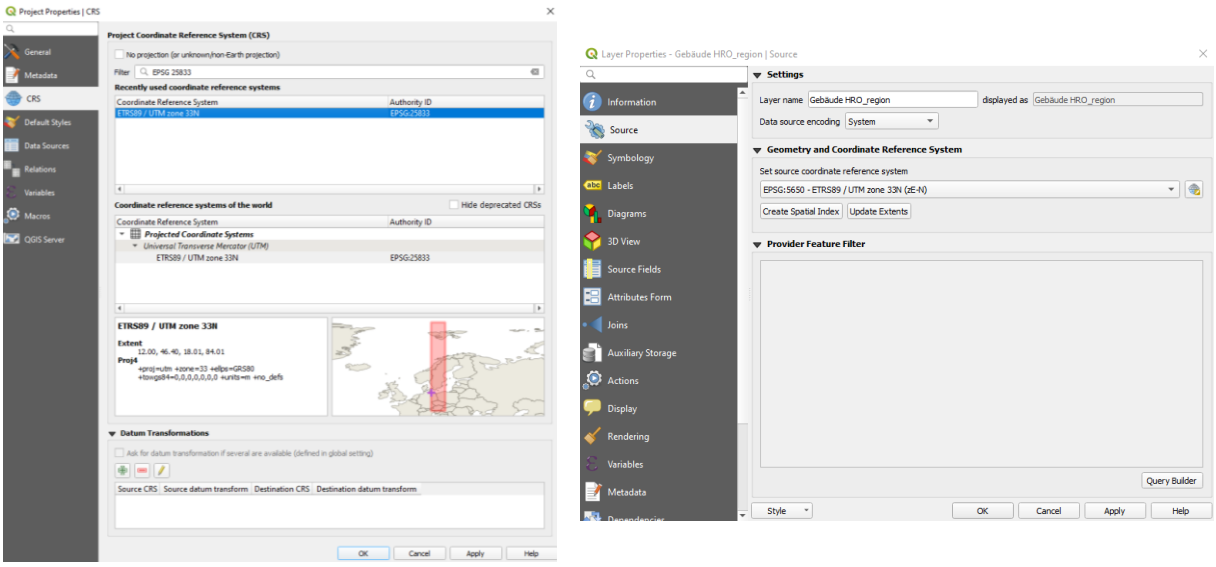


Fig. 7: Set the CRS of the project (left) and for the layer (right).

Basemaps

A very important issue is to get a feeling where your data are located. This can be realized with different kind of basemaps. One of the most popular ones is Open Street Map (OSM). But QGIS gives the possibilities to add basemaps from many other resources. There are three ways to add a basemap in QGIS. To learn how to use basemaps, add one with each variant below. If you need only OSM for your work, the first variant is the way to go, because it is very fast and easy.

1 Via XYZ-Tile service

- Add OSM as XYZ-Tile service – File Browser – „*XYZ-Tiles*" – Select OpenStreetMap with double click

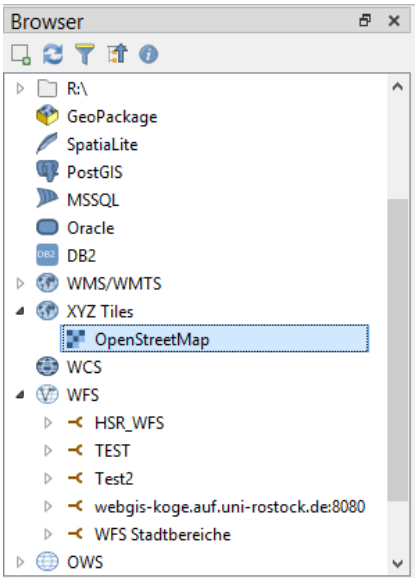


Fig. 8: Add OSM as XYZ-Tile service.

2 Via Link

Search for a preferred version of OSM at https://wiki.openstreetmap.org/wiki/WMS and copy the link to your clipboard.

- Add OSM via link – File Browser – WMS/WMST – Right click – „*New Connection*" – Insert Url and Description – Apply with „*OK*"

Furthermore, you have to give the service a name and set the authentication if needed. There are also some more options, but to insert a simple basemap, there is no need to change one of them from the default state.

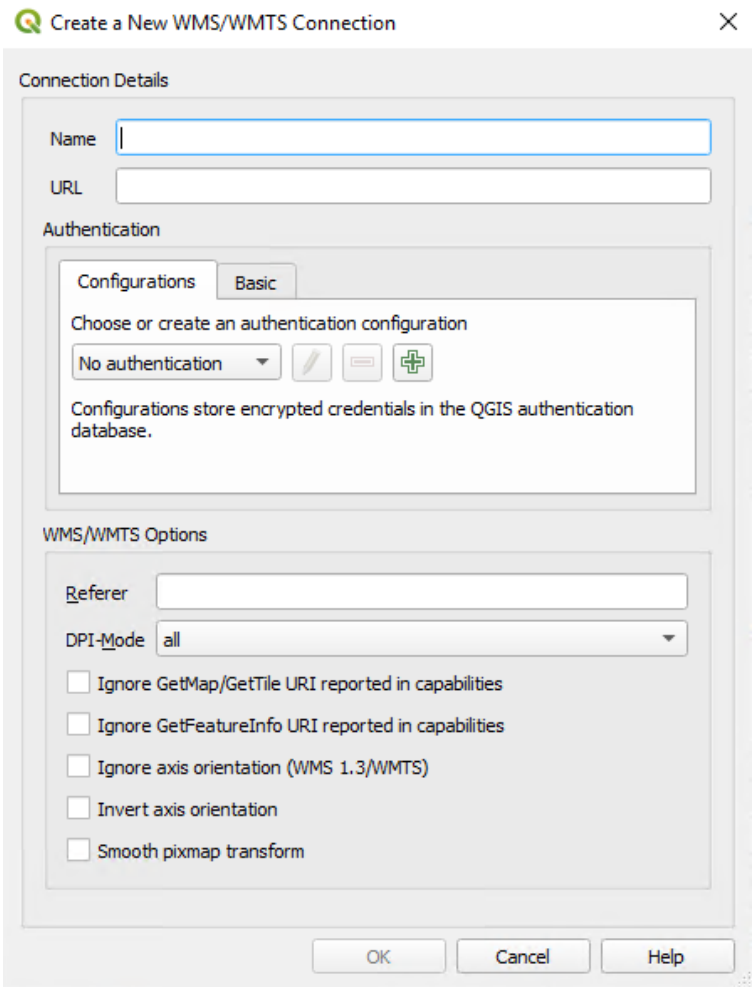


Fig. 9: Add WMS via URL.

3 Via Plugin

You are also able to add different services with the plugin QuickMapServices. First you have to install the plugin. After that, you are able to search for various basemaps. There is also an extra window where indicators are visible which show you if the service is still available or closed for some reason (green or red dot).

- Install Plugin – Menu-Bar – Plugins – Manage and Install Plugins – Search for „*QuickMapServices*“ – Install Plugin
- Add OSM to map – Menu-Bar – Web – QuickMapServices – OSM – Standard

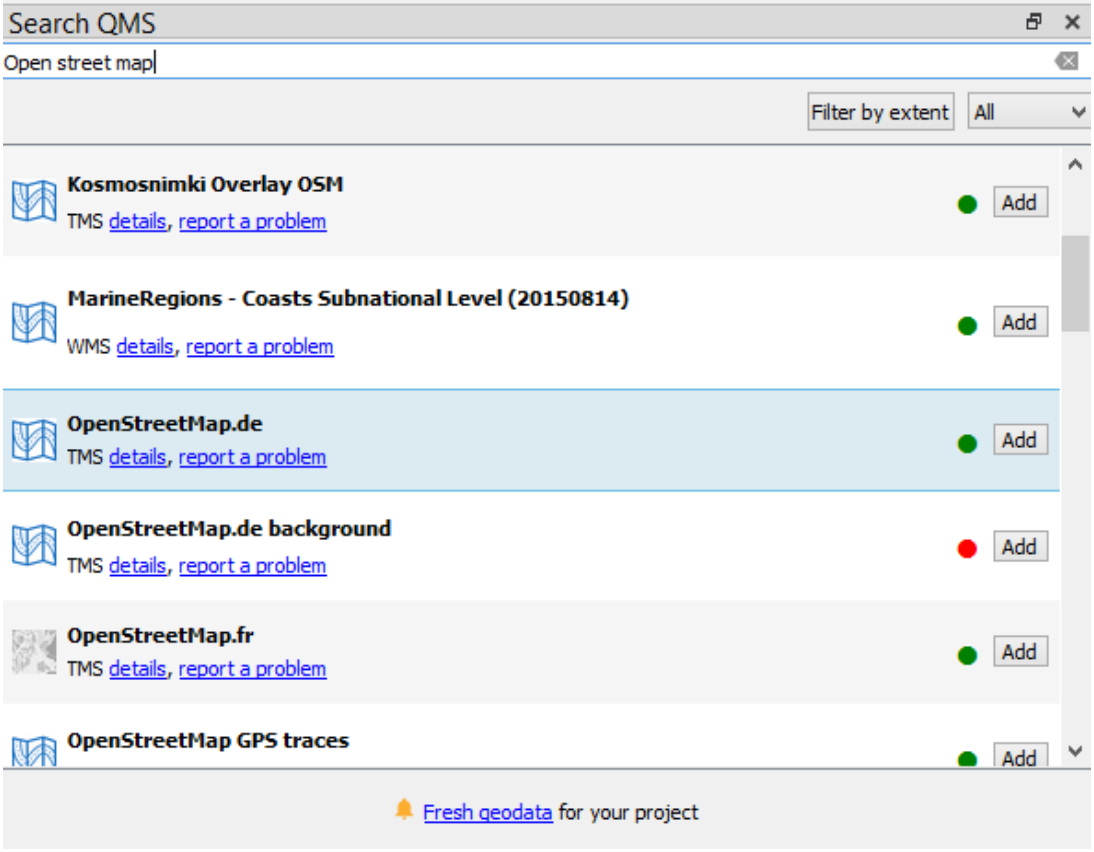


Fig. 10: Searching for Open Street Map in QuickMapServices.

Adding your data

Add the two layers „*recycling_center*" and „*buildings HRO_region*". After that, you have to reproject the buildings layer to match the projection of the map.

- Add the layers – Menu-Bar – Layer – Add Layer – Add Vector Layer – Select layer as source – Click „*Add*"
- Check projection – Layer Panel – Right click on layer – „*Properties*" – „*Source*" – „*Set source coordinate reference system*"

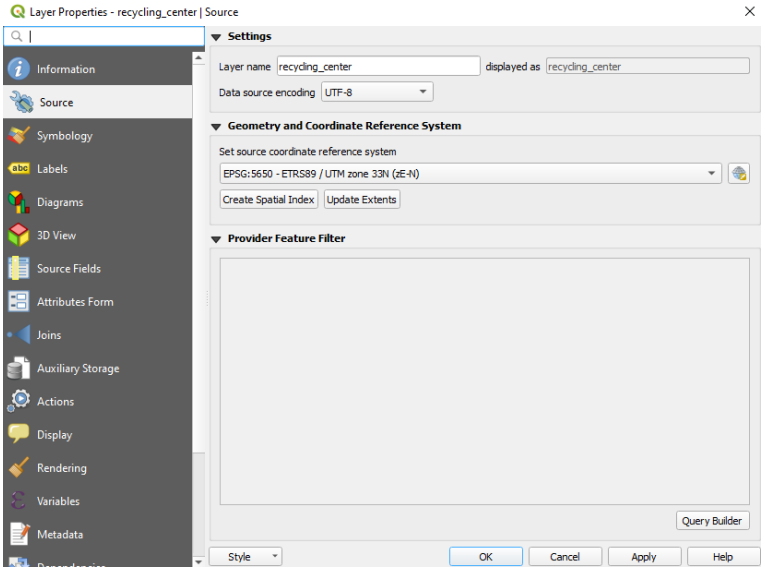


Fig. 11: Check the CRS of the layer.

If the layer is not projected in the right way use the tool „*Reproject layer*" from the toolbox to bring it in the correct spatial relation.

- Activate toolbox – Menu-bar – Processing – Left click on „*Toolbox*"
- Run reproject – Processing Toolbox (right side of the window) – Search for „*project*" – Run „*Reproject layer*" – Set target CRS of the „*recycling_center*"-layer to the CRS of the project (EPSG 25833)

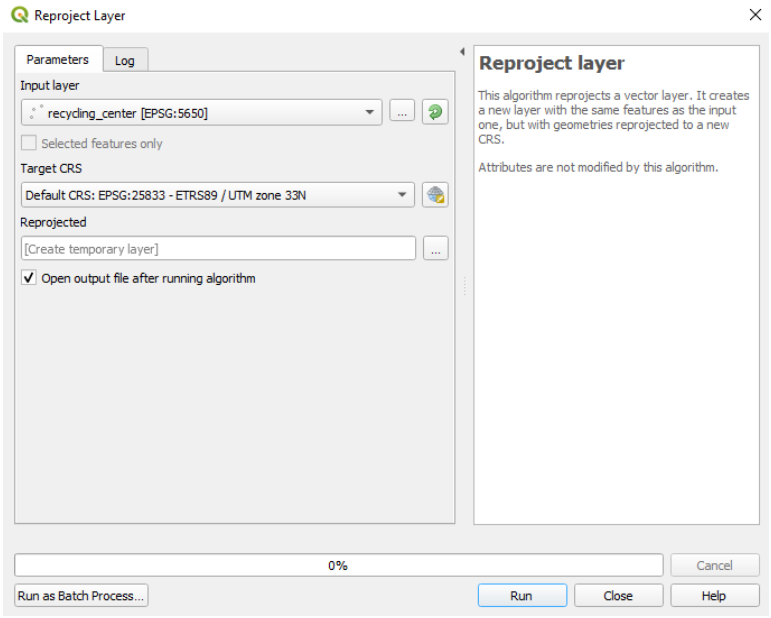


Fig. 12: Reproject the layer of the recycling centers.

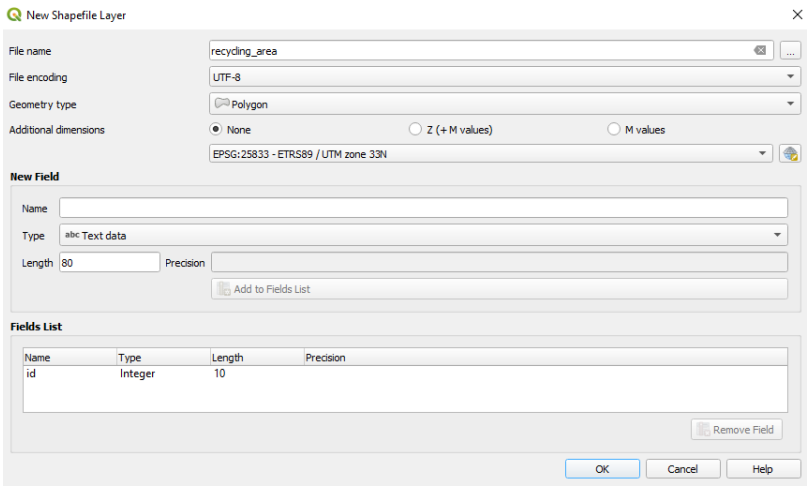
Digitizing

The provided information comes only as points. To gather further spatial information about the recycling centers, we want to digitize them from the basemap. To do so, you have to create a new polygon layer. After that, you are able to create new polygons with an unique ID. Each polygon should describe the area of the corresponding recycling center. Furthermore, the id of the polygon have to be the ID from the corresponding recycling center.
You are also able to create other types of vector data. There are four types of different vector data:

a) Points
b) Multipoints
c) Lines
d) Polygones

For simple point objects, for example a single place such as a disposal site, you can use points. Sometimes you have elements which are distributed over an area. For example if you want to visualize a collection of disposal sites, you can use multipoints, where each point dataset stands for one site.
Lines are commonly used for all kind of roads or traffic elements. And polygones are able to symbolise spatial areas.

- Create a new polygon layer – Menu-bar – Layer – Create Layer – New Shapefile Layer – Name „*recycling_area*“ – Geometry type: „*Polygon*“ – Click „*Ok*“ to complete creation



- Start digitalization – Layer panel – Right click on layer „*recylcing area*“ – Click „*Toggle Editing*“

After that, with a click on this symbol () you are able to start digitizing the recycling centers. A good basemap to do so is the ESRI Satellite (ArcGIS/World_Imagery) WMS. Add it with the QMS plugin.

- Add Basemap for digitizing – Menu-Bar – Web – QuickMapServices – Search QMS – Search for „*ESRI Satellite*“ in the new window (bottom right)

Now you can digitize each recycling center by clicking with the activated tool on the map. If you are ready save the area with a right click and add the id of the corresponding recycling

center in the new window. Close it with „*OK*“ and move on to the next one. When you are ready toggle the edit mode of and save your edits.

- Finalize digitalization – Layer panel – Right click on layer „*recycling area*“ – Click „*Toggle Editing*“ – Save Edits

You are also able to toggle of the editing mode by clicking on the pen-symbol ( ) in the toolbar.

Fig. 13: Digitizing a recycling center.

Join information

You are also able to incooperate tables (attribute collections) into QGIS. Therefore, we provide a table with the count of visits from costumers for each recyling center. To connect this information with the location we have to join this data to the points. This is the reason why the correct id is very important.

- Add the table – Menu-Bar – Layer – Add Layer – Add Delimited Text Layer – Select the csv-table as source – Click „*Add*“
- Join the table onto your polygons – Layers panel – right click on your „recycling_areas“-layer – Select „*Properties*“ – Select „*Joins*“ – Add a join via the +-symbol – Join layer ist he „*recycling_costumers*“-table – Join field is the „*ID*“ – Target field is also the „*ID*“ – Click „*OK*“ – Click „*Apply*“

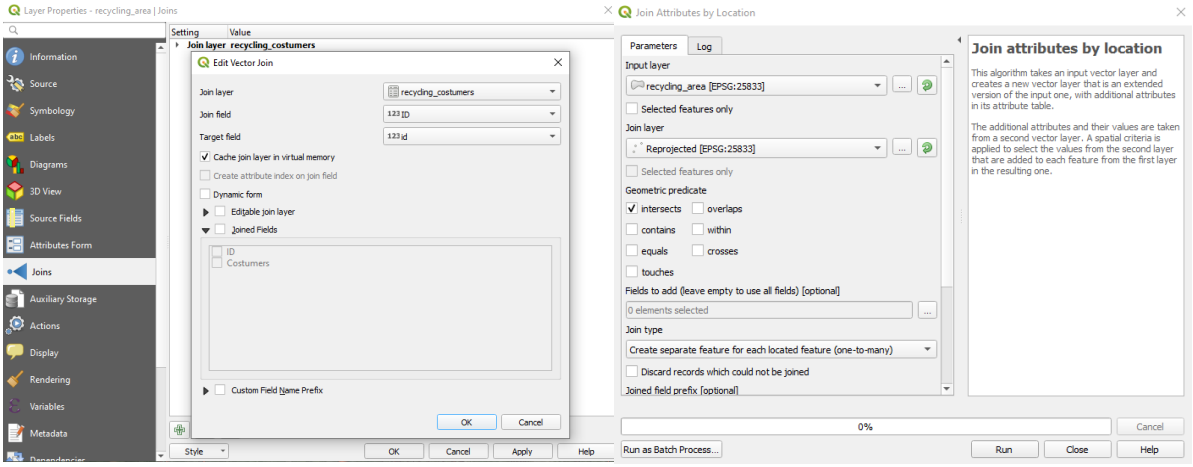


Fig. 14: Adding a join by attributes (left) and by location (right).

Now your areas incooperate the costumers as well as the id of the recycling center. To connect them with the given points you are also able to use a join, especially a spatial join. With that, you get the name of the recycling center.

- Run spatial join – Processing Toolbox (right side of the window) – Search for „*spatial join*" – Run „*Join attributes by location*" – Input layer are your „recylcing_areas" – Join layer are the reprojected points – Click „*Run*"

To look at the data you can open the attribute table of the layer. This table contains all layer-information.

- Open attribute table – Layer panel – Right click on „*Joined layer*" – Click „*Open Attribute Table*"

	id	recycling_costumers_Costumers	id_2	name	Kreis
1	2	41251	2	Recyclinghof Sudstadt	HRO
2	0	59608	0	Werstoffhof Dierkow	HRO
3	1	37540	1	Werstoffhof Reutershagen	HRO

Fig. 15: Attribute table of the final layer.

Calculating information

The polygon has the advantage, that you can calculate the areas for each of them. This information can be combined with customers to check for a correlation with the size of the recycling centers. To calculate with the numbers behind the layer you have to open the attribute table.
An important note is, that you have to add new fields. These can have several data types. Some of them are:

a) Integer
b) Real
c) Text
d) Date
e) Time
f) Double

g) Bool
h) Binary Large Object (BLOB)

Mostly you will use integer for whole numbers, double for double-precision floating-point numbers and text for character based information.

- Open attribute table – Layer panel – Right click on „*Joined layer*“ – Click „*Open Attribute Table*“
- Calculate the areas for each recycling center – Click in the toolbar of the attribute table at the calculator symbol ( ) – Toggle „*Create a new field*“ – Output field name „*area*“ – Output field type „*Decimal Number (double)*“ – Expression „*$area*“ – Click „*OK*“
- Calculate the customers per m² – Click in the toolbar of the attribute table at the calculator symbol ( ) – Toggle „*Create a new field*“ – Output field name „costumers_*area*“ – Output field type „*Decimal Number (double)*“ – Expression „*$area*“ – Click „*OK*“

Buffer objects

The main advantage to use GIS-software compared to normal table calculation software is the ability to visualize and calculate spatial relations. In this tutorial we want to buffer our recycling center to get the information, how many buildings are in a specific range.

- Run buffer – Processing Toolbox (right side of the window) – Search for „*buffer*“ – Run „*Buffer*“ – Input layer „*recycling_area*“ – Set distance to „*200 m*“ – Set output to „*buffer_200*“ – Click „*Run*“

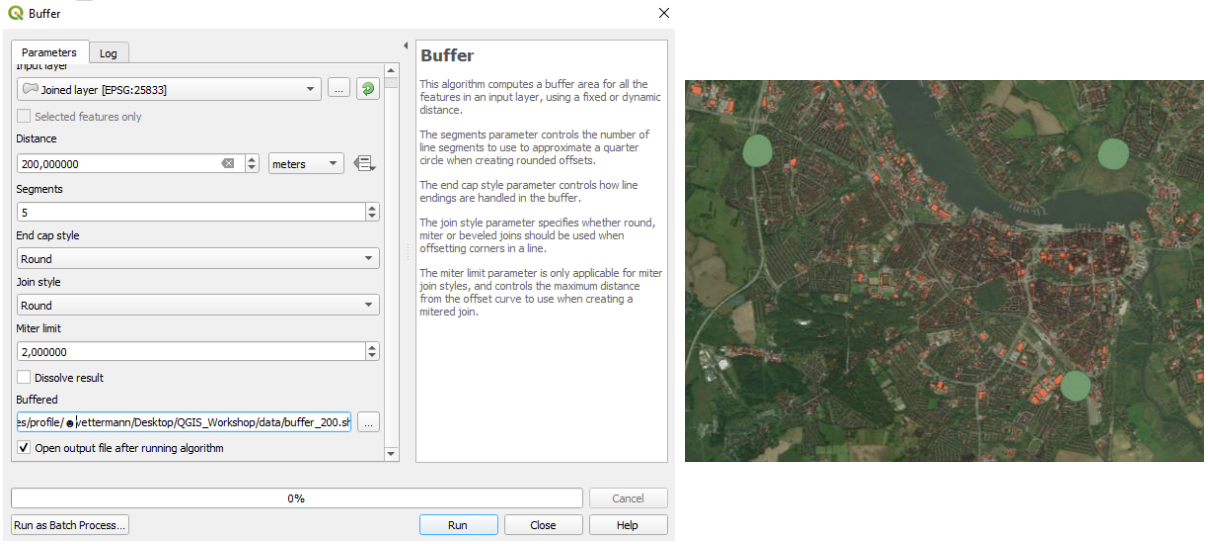


Fig. 16: Creating a buffer for the recyling centers.

Make selections

One of the most common operations is to select specific elements from a layer. In this case, we want to select all buildings inside the buffer region. Furthermore, these have to be residential buildings.

- Select all buildings inside the buffered area – Processing Toolbox (right side of the window) – Search for „*Select by*“ – Run „*Select by location*“ – Select features from „*build-*

ings_hro_region" – For Where toggle „*intersect*" – By comparing the features from select „*buffered*" – Click „*Run*"

- Open attribute table – Layer panel – Right click on „*buildings_hro_region*"
- Subselection of residential buildings – Click on the „*Select attributes by expression*"-symbol ( ) – Select in the middle area „*Fields and Values*" – Doubleclick „*art*" – Add an equalize-sign in the left window – Click in the right side of the window on „*All unique*" – Select „Wohn-/Geschäftsgebäude" – Click on the arrow next to „*Select Features*" – Select „*Filter Current Selection*" – Close the window

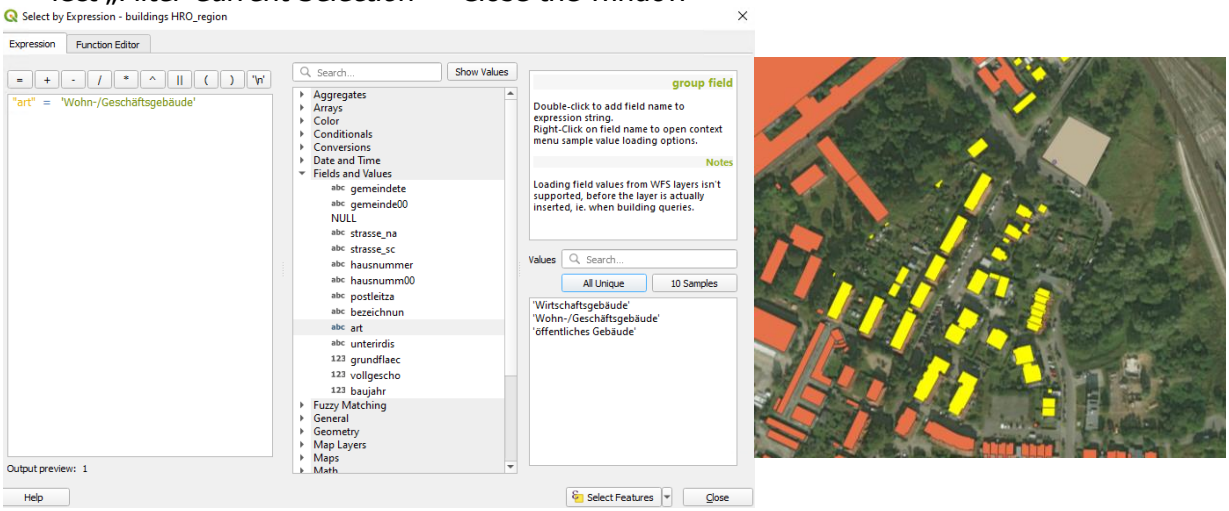


Fig. 17: Select by attributes (left) and the resulting map view (right).

Polygons to Points

For our last operation it is necessary to convert the buildings to points. With that we are able to count the number of buildings inside the buffer and get an idea how many of them are inflicted by emissions from the recycling centers.

- Create centroids – Processing Toolbox (right side of the window) – Search for „*centroids*" – Run „*Centroids*" – Input layer „*buildings_hro_region*" – Toggle selected features only – Click „*Run*"

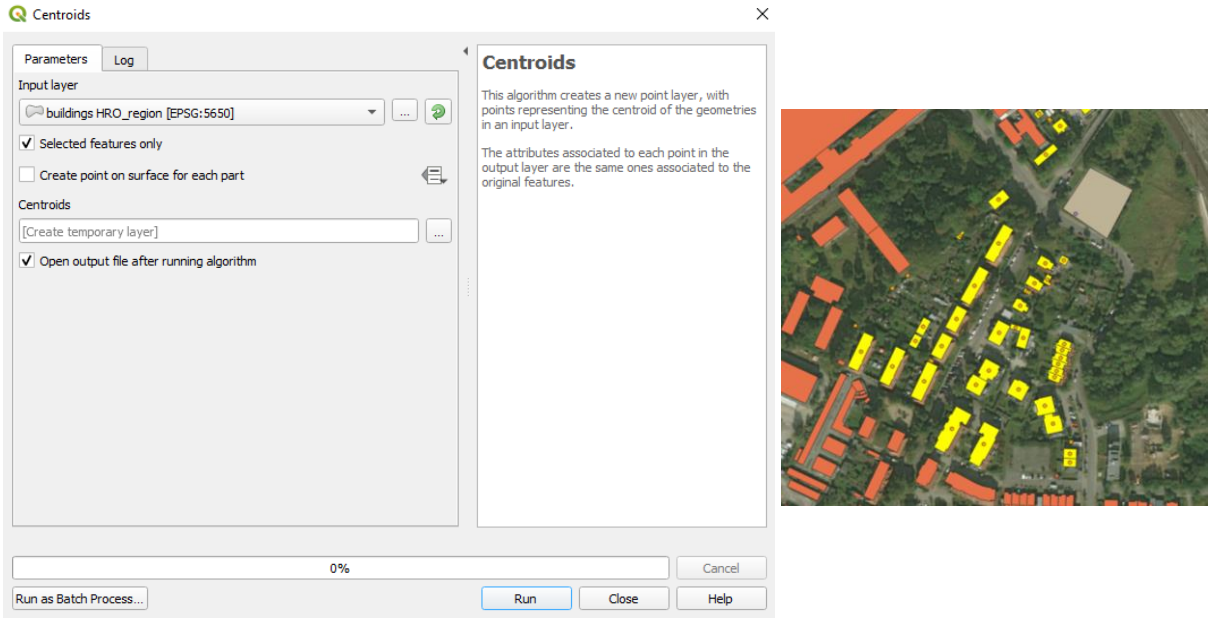


Fig. 18: Create centroids from the buildings (left) and the resulting map view (right).

- Count Points – Processing Toolbox (right side of the window) – Search for „*counts*" – Run „Count points in polygon" – Input Polygons „Buffer" – Input Points „Centroids" – Click Run

The result of this process is a new polygon layer („*count*") where the corresponding number of points for each polygon is listed in a new column.

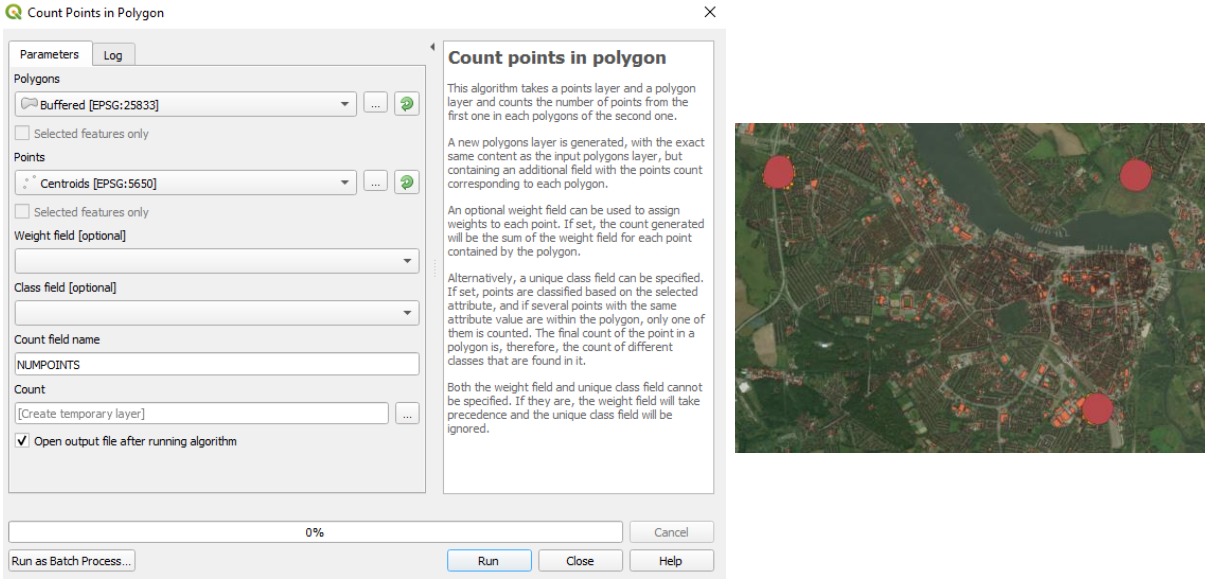


Fig. 19: Count points per polygon (left) and the resulting map view (right).

	id	recycling_	id_2	name	Kreis	area	costumers_	NUMPOINTS
1	1	37540	1	Werstoffhof Re...	HRO	1842,136092435...	0,049071286426...	94
2	2	41251	2	Recyclinghof S...	HRO	1850,841608938...	0,044867799785...	51
3	0	59608	0	Werstoffhof Die...	HRO	2945,277307020...	0,049410772161...	61

Fig. 20: Resulting attribute table.

Layer styling

The next step is to visualize your results. Therefore you can style each layer in the way you want. In our case we want to visualize the number of buildings inside the buffered area by the colour of the buffer. Also, the colour of our digitized recycling centers should be set by the area per costumer. This can be done by the following steps.

- Set colour of the buffered area – Right click on the layer „*counts*“ in the layer panel – Select „*Properties*“ – Select „*Symbology*“ in the new window – Select „*Categorized*“ in the dropdown menu – Select Column „*NUMPOINTS*“ in the second dropdown menu – Click „*Classify*“ – Click on the colour symbols in the legend – Change the colour in your manner – Click „*Apply*“

The next step is to move the layer of the recycling center areas up. Therefore you have to click the layer „*joined layer*“, hold your mouse button and move it via drag and drop to the top in the layers panel. After that we can style the layer.

- Set colour of the buffered area – Right click on the layer „*joined layer*“ in the layer panel – Select „*Properties*“ – Select „*Symbology*“ in the new window – Select „*Graduated*“ in the dropdown menu – Select Column „*costumers_area*“ in the second dropdown menu – Select in the drop down menu colour ramp spectral colour ramp – Click „*Classify*“ – Click on the colour symbols in the legend – change the colour in your manner – Click „*Apply*“

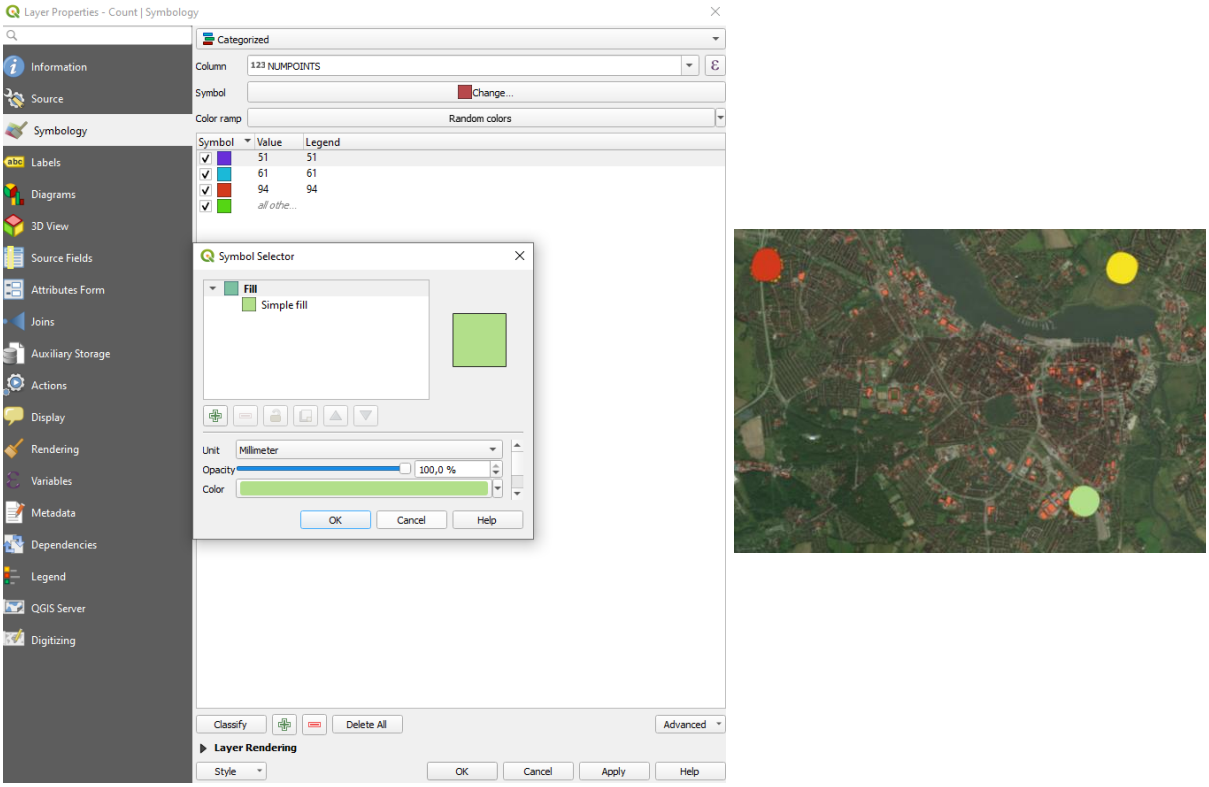


Fig. 21: Styling the buffered areas.

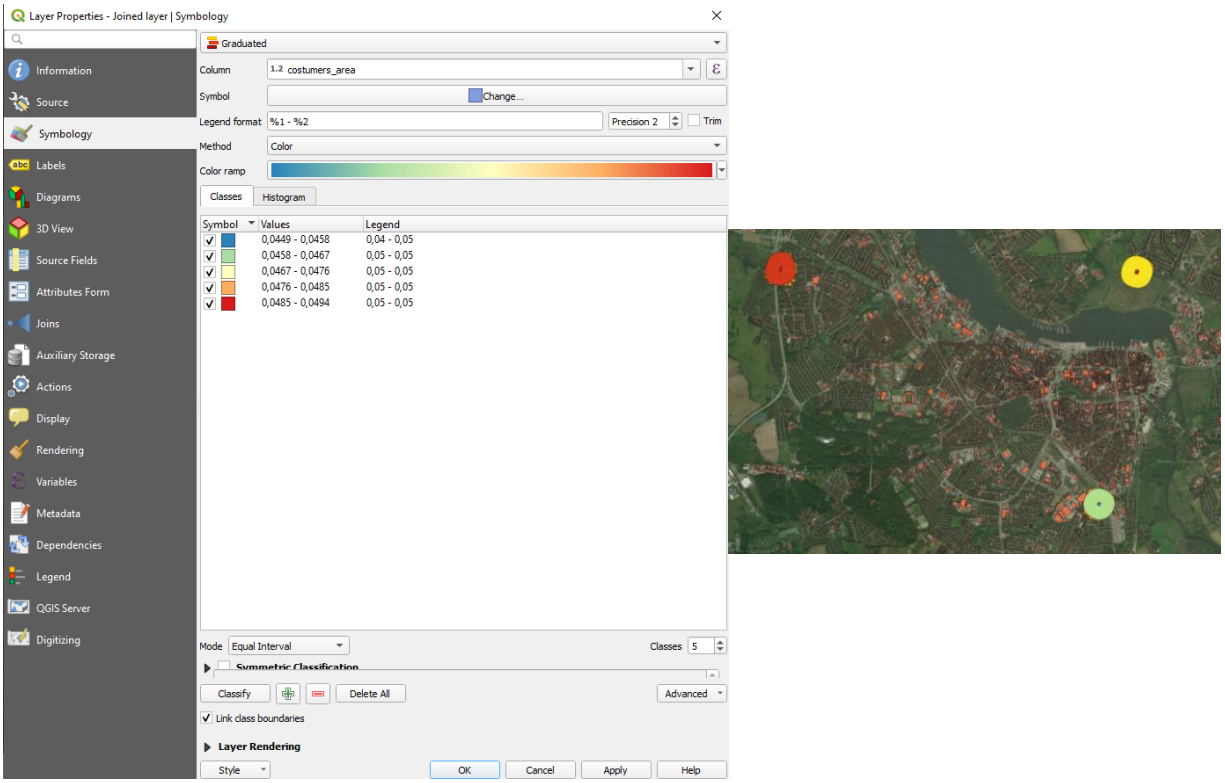


Fig. *22*: Style the recylcing centers.

Create a map

The final step in this workshop is the creation of a map you can export and share with others. This is normally the final product of your QGIS work.

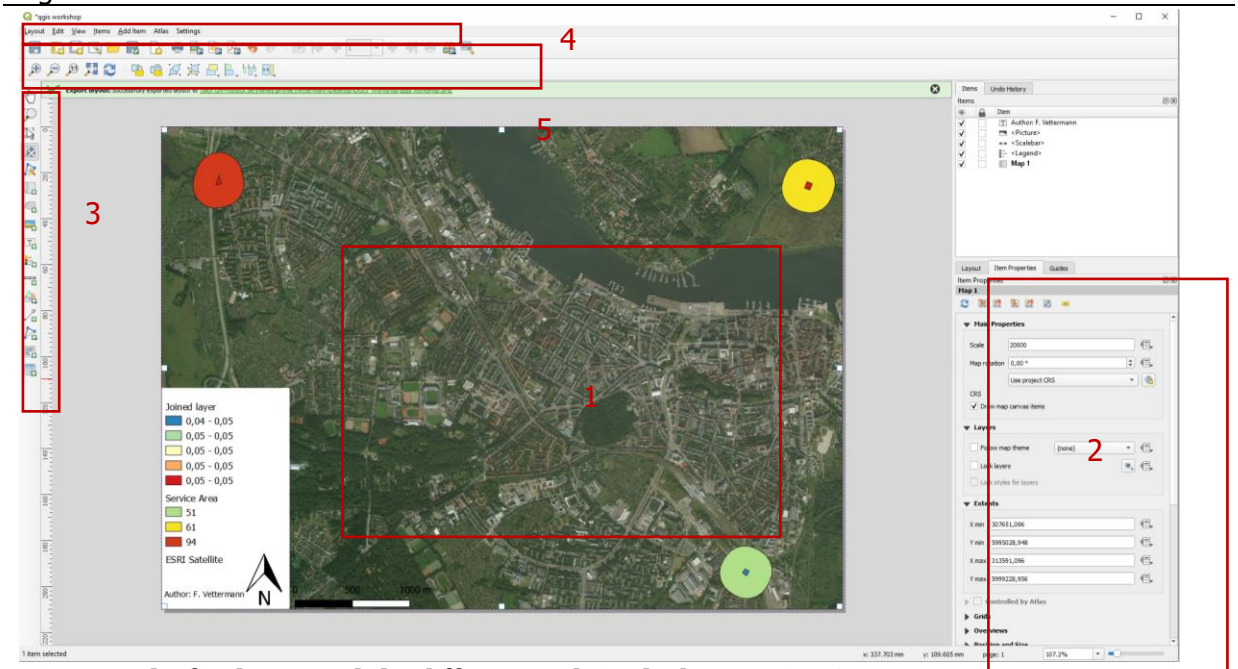


Fig. 23: The final map and the different tools in the layout view (1 - Map Area; 2 - Properties; 3 - Map Tools; 4 - Menu Bar; 5 - Toolbar).

Creating the map

- Create new map layout – Menu Bar – Project – New Print Layout – Set name to „*QGIS Workshop*"
- Add a map area – Menu Bar in the print layout – Add element – Add map – Span a map area
- Set the scale of the map – Click into the new map window – Right side of the window – Set scale to 1:25000
- Move the map into the right position – Click on the Button „*Move Item Content*" - Move the map that you can see all recycling center

Adding a legend

- Add a Legend – Menu Bar in the print layout – Add element – Add Legend – Span a legend area
- Setup the legend – Click into the legend area – Right side oft he window – Toggle „*Auto update*" off – Remove all layers except the „*Joined layer*"; „*count*" and the basemap
- Rename layers – Doubleclick „*joined layer*" – Rename it to „*Recyling Areas*" – Click „*OK*"
- Rename layers – Doubleclick „*Count*" – Rename it to „*Service Area*" – Click „*OK*"
- Rename layers – Doubleclick „*ESRI Satellite (ArcGIS/World_Imagery)*" – Rename it to „*ESRI Satellite*" – Click „*OK*"
- Move legend to desired position and resize it – Click into the legend area – Right side oft he window – Toggle „*Resize fit to contents*" off – Resize and move legend element

Adding various items

- Add a Scale Bar – Menu Bar in the print layout – Add element – Add Scale bar – Span a Scale Bar area

- Add a north arrow – Menu Bar in the print layout – Add element – Add picture – Span an Area – Right side oft he window – Image Source – Select the north arrow image from your data folder
- Add a text field with your name as author – Menu Bar in the print layout – Add element – Add Label – Right side oft he window – Write your name into the main text field

Finalize map

- Save the Project – Menu Bar in the print layout – Layout – Save Project – Name it „*work-shop_project*" – Click „*Save*"
- Export it as Image – Menu Bar in the print layout – Layout – Save Project – „*Export as Image*" – Submit it