Exercise 9 – More about raster data and format conversion

In this exercise you will use some more features enabled in QGIS. You will learn how to convert from raster to vector data, handling plugins and adding a base map.

Assignment: Produce a map with all the essential map elements. The map should view the flooded areas with 10 and 30 meters of water level rise (displayed on the same map) and have Brattefors gård marked as a point. Use a nice map from the ***OpenLayers plugin*** as a base map. The map should cover an A4-paper and should be handed in on Canvas as a **PDF document**.

1. Preparations

As in previous exercise start by creating a new project. You will need the shapefiles **tx_14.shp** which is a point layer used to enabling text in the overview map and **ms_14.shp** which is a polygon layer showing all the lakes and streams in the area. You will also use a DEM covering the area around Billingen conveniently named **Billingen**. The data is from Lantmäteriet and has a resolution of 50 m2 per pixel. Raster data can be stored in a number of different formats and the dataset Billingen is stored in ADF format. The dataset consist several different files stored in the folder **billingen** plus a file in **Billingen.aux** and **billingen.rrd** stored outside the folder. ADF is a type of GRID format which can be stored in several different folders (in this case two) and files. In the folder **billingen** the following files should be present;

- dblbnd.asf which contain limits for the raster
- hdr.adf containing information of the number and size of pixels and squares
- sta.adf containing statistics of the raster
- vat.adf containing the attribute information
- prj.adf containing information concerning the reference system
- tic.adf containing coordination information
- w001001.adf containing the raster data itself
- w001001.adf which is an index file

2. Simulate a rised water level

Start by adding **Billingen** in the same way you add a shapefile but with the raster function. Choose **w001001.adf** among all the adf files since this is the file with the actual raster data (file size tells you about the content). Add **tx_14.shp** and **ms_14** too your project as well.

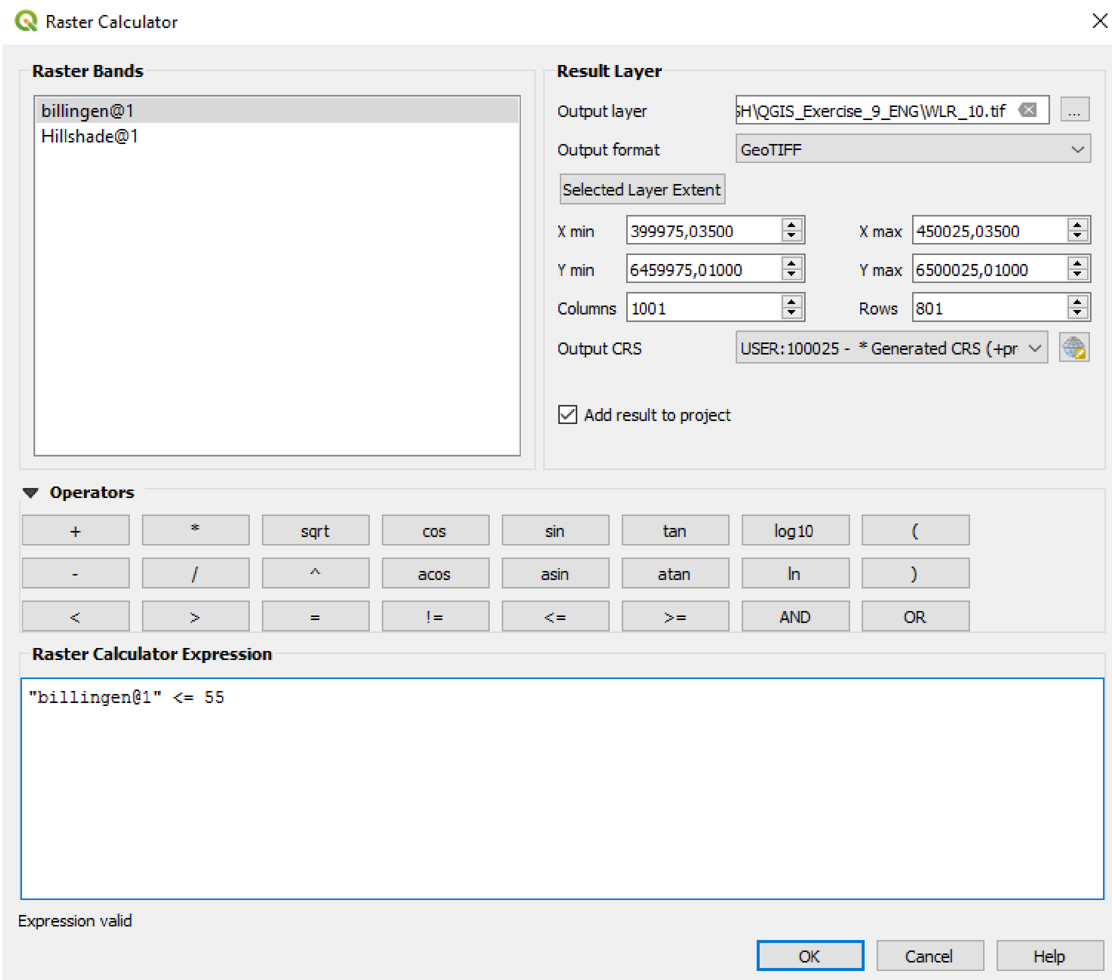
Scenario: The Andersson family lives at Brattefors gård located on the eastern side of the mountain Kinnekulle. They have an interest to know what areas would be affected if the water level of lake Vänern rose.

Before examining the water level rise you must find the Andersson estate. This is done by using **Select features by using an expression** or manually in the **Attribute table**. Brattefors gård is found in the attribute **TEXT**. If you are uncertain of how to use **Select features using an expression** you can go back to previous exercises 2 or 7 to refresh your memory. When the point that represents Brattefors gård is highlighted press **Zoom map to the selected rows**.

Have a look at the DEM, can you image how the area looks? Generally height models visualizes in a grey scale where white is higher elevation and black is lower. Calculate a **Hillshade** for the area (see exercise 8 if you are uncertain of how). Put the hillshade layer below the DEM. In order to visualize both DEM and hillshade you have two alternatives. 1) Make the DEM layer a bit transparent (20-50%). Disadvantage is "bleeched" colors. 2) Choose layer properties for the DEM layer, then *Style* > *Layer rendering* > *blending mode* > *multiply*. Now it should be easier to interpret the elevation model!

Activate the layer **ms_14** and put it above the height model and hillshade layer. You can now see the areas that are already covered by water. To simulate a water level rise we shall use the **Raster calculator**. The raster calculator is a very useful tool in QGIS. It is used to calculate values from one or several raster. You can find out more about the raster calculator and what it is used for here:
https://docs.qgis.org/3.4/en/docs/user_manual/working_with_raster/raster_analysis.html#raster-calculator
Find it under **Raster → Raster Calculator**

Since the lowest height level is around 44 meters (i.e. Lake Vänerns base level) we have to raise the water level to 54 meters in order to simulate a 10 meter water level rise. Fill out the expression according to the image below. Save the layer in a suitable folder and name it WLR_10. Make sure that the **Add result to project** box is checked.

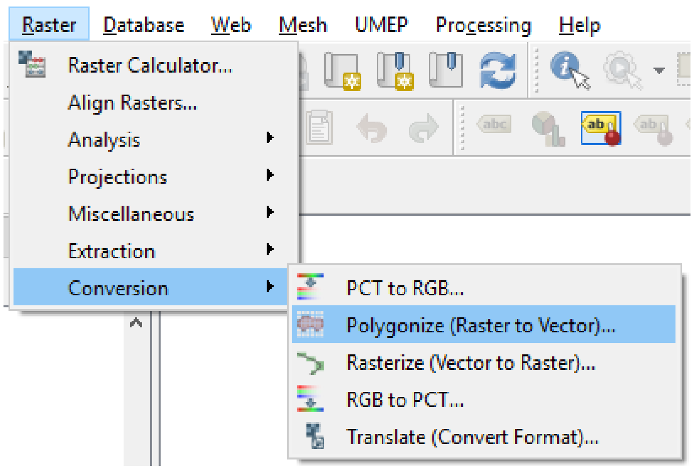


Your new layer should now be added to the project. This layer has two values; 0 which means that the area is more than 10 meters above the present water level meaning that the area will not be flooded, and 0.999 which are areas that are below 10 meters above present water level and thereby will be flooded during the simulated water level rise. As you can see there is only a small part of the whole area that risks being flooded.

Make the same calculation but with a water level rise of 30 meters instead. Remember that the present water level is at 44 meters. Save the layer as WLR_30.

3. Raster to vector conversion

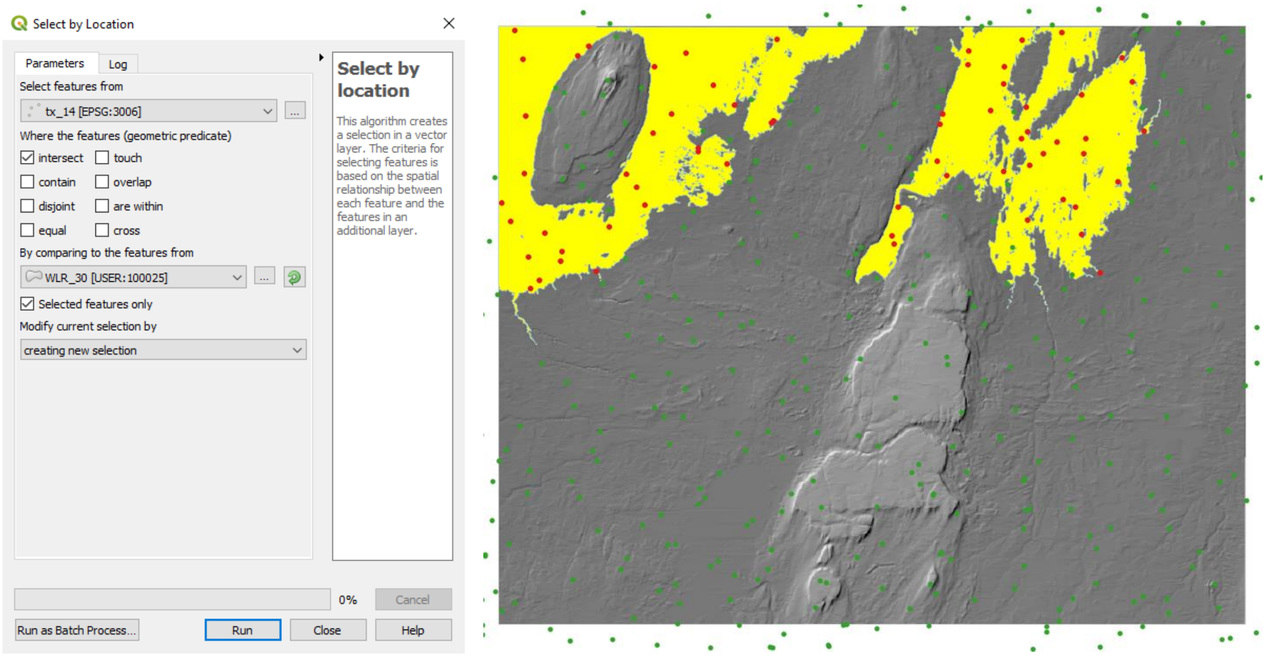
We will now convert WLR_10 and WLR_30 to vector layers. Open the tool **Polygonize** found under **Conversion** as shown below.



Save the layers as shapefiles. The input rasters is the ones you created in the raster calculator. Save the layers under the same name. Press OK. Do this for both WLR_10 and WLR_30. The result is two polygon layers with two values, 1 which represents areas below the water level or 0 representing areas above the water level. Open the attribute table for **WLR_10**. In the column DN you can see that every polygon has the value 1 or 0.

Change the style for the layers so that the unflooded areas (value 0) become transparent and the flooded areas become blue. Make the both layers transparent to 20 %.

Check the tx_14 layer to see if the Andersson family at Brattefors gård is safe from the flooding scenario. It seems like the family can remain calm but many other farms in the area is in the danger zone. Can you see how many buildings that would be affected at a 30 meter water level rise? Go back to exercise 7 if you are unsure how to do it. A tip is first select all the rows with the value 1 in WLR_30, save as a new layer and then use **Clip** tool. But there is also a quicker way which is called **Vector → Research Tools → Select by Location**. You do not need to create a new layer to create a spatial query - you can simply run it for selected features only (see picture below).



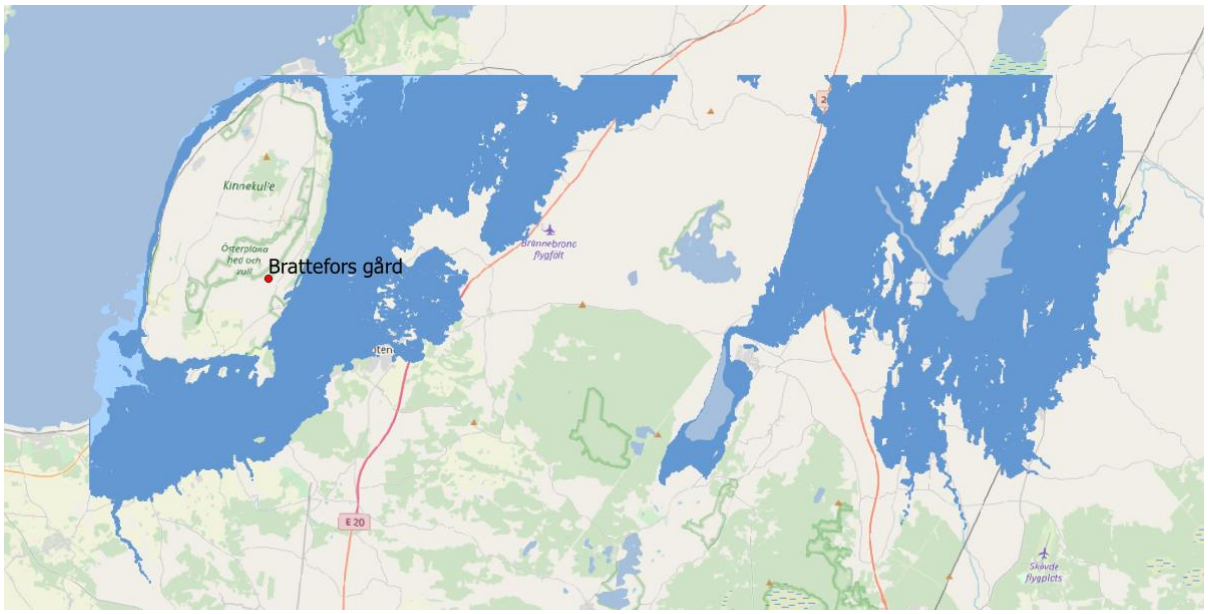
As we can see there are 64 farms/buildings that would be affected if the water level would rise by 30 meters.

4. Handling plugins

Plugins add functionality to QGIS by making the user able to choose among the different programs. With the later versions of QGIS many plugins can be installed as standards. One example of this is Terrain Analysis found under the raster menu. Besides the preinstalled there are plugins you install yourself and there are many to choose from. Open **Plugins → Manage and Install Plugins**. Click the tab installed and look through the plugins. You surely recognize some of them. Click the tab **All** and search for **QuickMapServices**. Click **Install plugin** (if it's not already installed). When the installation is done close the window. **QuickMapServices** make it possible to use maps from different sources.

Before you move forward, make sure to save your project, as sometimes the program crashes when loading data from the Internet. In the menu click **Web → QuickMapServices → OSM → OSM Standard.** The coordinate system does not need to be changes for the base map.

An overview of the area your map covers appear. Make sure the layers WLR_10 and WLR_30 are placed above the layer from QuickMapServices. This is a smooth way to visualize your layers against a base map.



Create a map with all the essential map elements included. The map should show the flooded areas at 10- and 30-meter water level rise scenarios, the current water level and Brattefors gård should be marked as a point. Use a QuickMapServices basemap. **Pay attention to the order of the layers!** The scale should be set so that only the area under investigation is visible. If you have trouble with loading QuickMapServices data from the Internet, use your elevation raster with hillshade as a base map. Hand the map in as a **PDF** on Canvas.

End of Exercise 9!