

# **GIS TUTORIAL 3: Simple Geospatial Analysis with QGIS**

In this tutorial we will be learning some simple geospatial analyses related to elevation and hydrology with QGIS. This will help us to learn more about our sites. We will be using data from the database as well as data that we download from the internet.

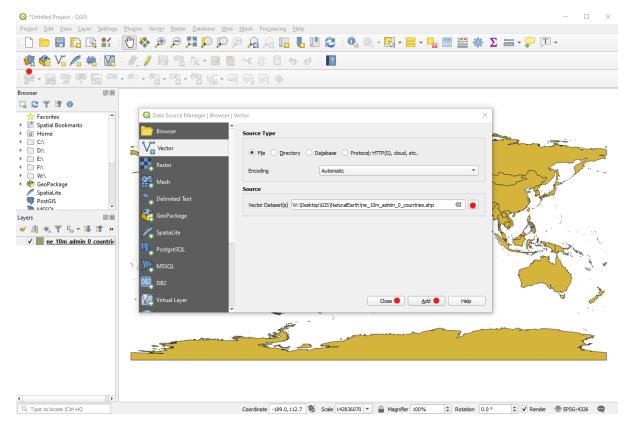
# **1** Sourcing Elevation and Hydrological Data (video tutorial playlist)

We are going to find and download elevation and hydrological data and display it alongside data from the database in QGIS.

### **1.1** Preparing EAMENA data for analysis in QGIS (video tutorial)

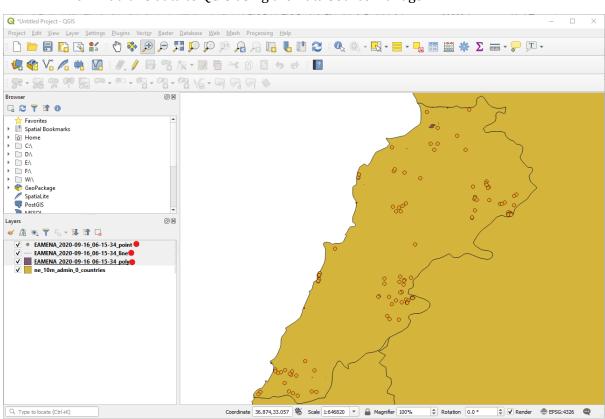
Before we download any other data, we first need to open and prepare some EAMENA data for analysis in QGIS. Before that, we are going to add the NaturalEarth country shapefile that we have already downloaded into QGIS.

• Use the Open Data Source Manager button on the Toolbar to add the NaturalEarth country data to your map.



- Export some data as a shapefile from the EAMENA website for your area of interest.
  - Refer to **Tutorial 19: Exporting from the Database** for detailed instructions how to do this.
  - $\circ$  For this tutorial we will use an export of all the Roman period sites in Lebanon.



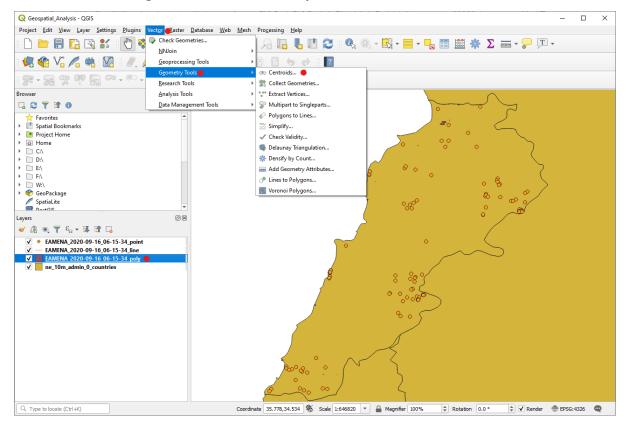


• Add this data to QGIS using the Data Source Manager



You are likely to have a combination of polygon, line and point data when exporting from the EAMENA database. We need to convert all our data into point data so that we can easily work with it in a single file.

- Click on the polygon file in the Layers Panel
- On the Menu go to "Vector" > "Geometry Tools" > "Centroids..."

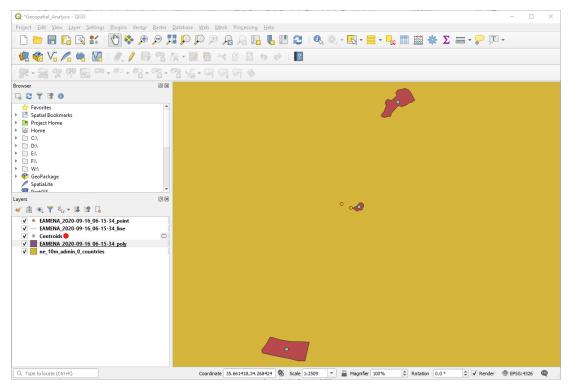


• Make sure that the polygon layer is selected and click "Run"

| Q Centroids                              |   | ×   | ζ |
|--|---|---|---|
| Parameters       Log         Input layer | • | Centroids<br>This algorithm creates a new point layer, with<br>points representing the centroid of the geometries<br>in an input layer.<br>The attributes associated to each point in the<br>output layer are the same ones associated to the<br>original features. |   |
| 0%                                       |   | Cancel  |   |
| Run as Batch Process                     |   | Run 🔴 Close Help  | J |



A new "Centroids" point layer will be created above the polygon layer, appearing as a point in the centre of each polygon.

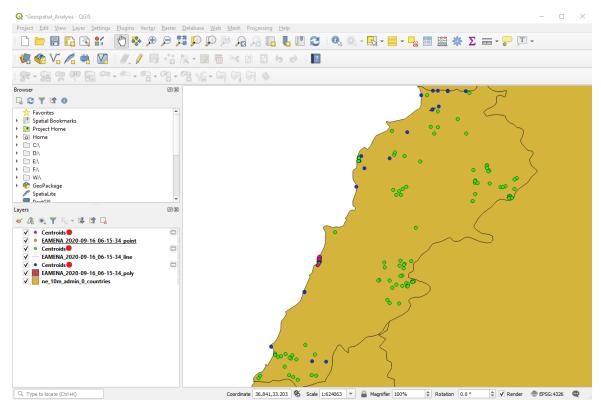


• Repeat this process for your line and point shapefile data

Although it may seem strange, we do need to do this for the points layer too, this is in case one site has more than one point in the shapefile.

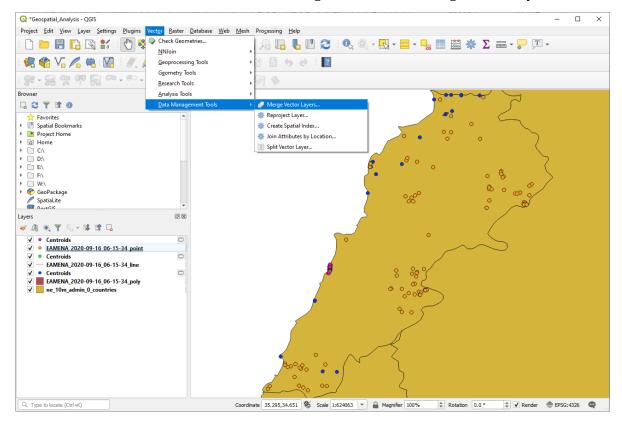


You will end up with three "Centroids" point layers above each of your original EAMENA shapefiles.



These now need to be combined into a single point shapefile.

• On the Menu click "Vector" > "Data Management Tools" > "Merge Vector Layers..."





• Click the "Browse" [...] button next to "Input layers" and tick the three "Centroids" layers and click "OK".

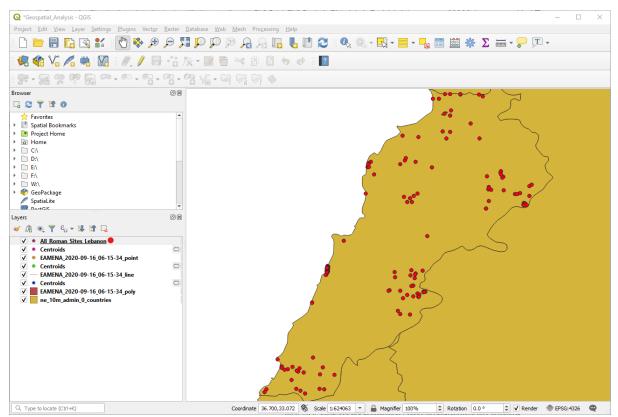
| 🔇 Merge Vecto                                      | r Layers  |  | $\times$ |
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| Parameters   | Log   | <sup>4</sup> Merge vector layers   | -        |
| Input layers                                       | tted  | This algorithm combines multiple vector layers of the same geometry type into a single one.                      |          |
| Destination CR                                     | Q Multiple selection  | × ite  |          |
| Merged [Create tempo ] Open output Run as Batch Pr | <ul> <li>✓ Centroids [EPSG:4326]</li> <li>✓ Centroids [EPSG:4326]</li> <li>✓ Centroids [EPSG:4326]</li> <li>EAMENA_2020-09-16_06-15-34_line [EPSG:4326]</li> <li>EAMENA_2020-09-16_06-15-34_point [EPSG:4326]</li> <li>EAMENA_2020-09-16_06-15-34_poly [EPSG:4326]</li> <li>ne_10m_admin_0_countries [EPSG:4326]</li> </ul> | Select All<br>Clear Selection<br>Toggle Selection<br>Add File(s)<br>Add Directory<br>OK •<br>Cancel<br>Icel<br>P | ▼        |

- Click the "Browse" [...] button next to "Merged" and "Save to File..." and give the merged file a name in your suitable folder within your GIS folder.
- Click "Run" and then "Close" when it has finished.

| Parameters Log  | Merge vector la   | yers   |
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| Input layers 3 elements selected Destination CRS [optional]  Merged W:/Desktop/GIS/Geospatial/All_Roman_Sites_Lebanon.shp  V Open output file after running algorithm | This algorithm combines mu<br>the same geometry type in<br>If attributes tables are diffi-<br>table of the resulting layer<br>attributes from all input lay<br>will be added for the origina<br>source.<br>Create Temporary Layer<br>Save to File | ltiple vector layers of<br>to a single one.<br>erent, the attribute<br>will contain the<br>ers. New attributes |
|   | Save to GeoPackage<br>Save to PostGIS Table<br>Change File Encoding (Sys  | erence :<br>e.set.   |
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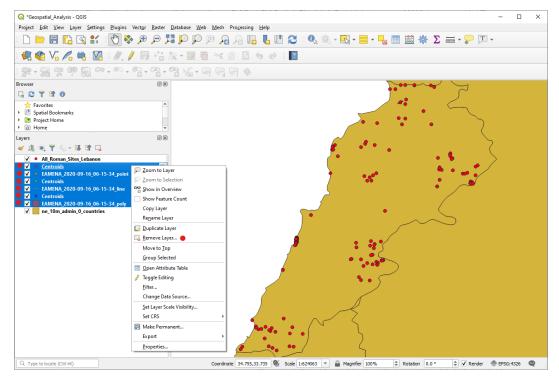


You will now see your new merged layer in the Layers Panel and, when you move it to the top, covering every site in the Map View Window.



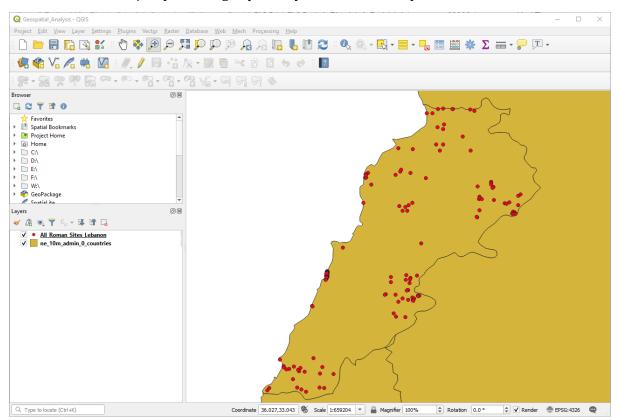
We can now remove all of the old layers that we do not need.

- Press and hold the [Ctrl] key on your keyboard (or [cmd] if you are using a Mac) and click all the old shapefile and centroid layers.
- Right-click one of these layers while holding [Ctrl] and click "Remove layer".





You will be left with just your merged point layer and the country data.

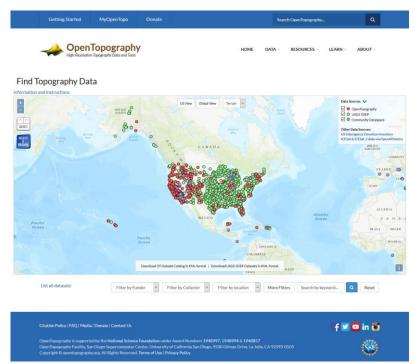




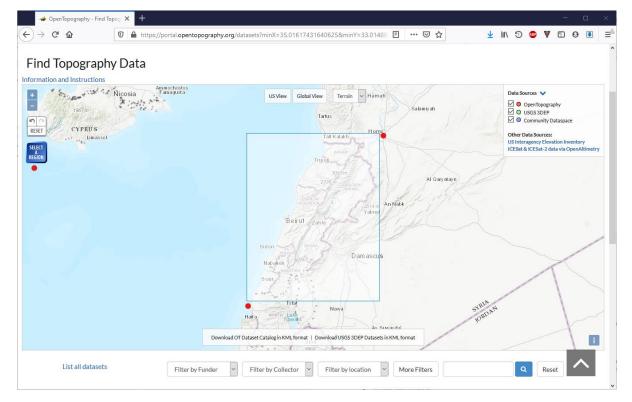
### 1.2 Downloading and adding elevation data (video tutorial)

Now that we have our EAMENA site data ready to analyse, we are ready to download and add some elevation data to our map.

• In your internet browser go to <a href="https://portal.opentopography.org/datasets">https://portal.opentopography.org/datasets</a>



- On the map zoom into your area of interest
- Click "SELECT A REGION" and click and drag on the map to create an area of interest





• Scroll down on the page and click "Global Data", and then "SRTM GL1"

| List all datasets                 |  |   |                                   |                    |
|-----------------------------------|--|---|-----------------------------------|--------------------|
|                                   | Filter by Funder Y Filter by Colle               | lector V Filter by location V More                  | e Filters                         | Q Reset            |
| RESULTS:                          |  |   |                                   |                    |
| Total 3 datasets found for all da | ta sources.                                      |   |                                   |                    |
|                                   |  |   |                                   |                    |
| OT High Resolution Topogr         | aphy: [0] OUSGS 3DEP: [0]                        | OT Community Contributed: [1]                       | 🛛 Global Data: [2] 🌘              |                    |
|                                   | re hosted by OpenTopography and are available    |   |                                   |                    |
| data products such as r           | aster and Google Earth Image overlays are also a | available. Click the button to the right of the dat | aset name to access the available | data products.     |
|                                   |  |   |                                   |                    |
| 1 ALOS World 3D - 30m             |  |   |                                   | AW3D30 Ellipsoidal |

- Scroll down and under "3. Visualisation" untick "Generate hillshade images..."
- Scroll down and give the task a name e.g. "Lebanon\_SRTM"
- Type your email address and click "Submit"

| <ul> <li>Generate hillshade images from DEMs</li> <li>Generate additional color-relief and col</li> <li>Generate additional Google Earth KMZ</li> </ul> | lored hillshades   |                                |                               |                            |
|---|--|--------------------------------|-------------------------------|----------------------------|
| 4. Hydrologic Terrain Analysis Product  | s (tauDEM): 🕕  |                                |                               |                            |
| This tauDEM is an advanced processing se<br>In order to access or enable this service, pl   | ervice. It is available for registered users, who<br>lease log in or request an account. | ounderstand these resource in  | ensive algorithms and its pro | oducts.                    |
| 5. Global Solar Irradiation 0   |  |                                |                               |                            |
| This Global Solar Irradiation is an advance<br>In order to access or enable this service, pl  | d processing service. It is available for registe<br>lease log in or request an account. | ered users, who understand the | se resource intensive algorit | thms and its products.     |
| Job Description   |  |                                |                               |                            |
| These options allow users to describe and accessed via myOpenTopo (available only   | keep track of their jobs. Information entered to registered OpenTopography users).       | below is recorded along with c | ther job parameters in your   | personal lidar job archive |
| Job title (up to 100 characters)  | Lebanon_SRTM ●   |                                |                               |                            |
| Job description (up to 500 characters)  | Job description  |                                |                               |                            |
| Enter your e-mail address<br>for notification upon completion of<br>processing  | william.deadman@durham.ac.uk ●   |                                |                               |                            |



You will see a screen informing you that your data is being processed.

• When the task completes click on the "rasters\_srtm.tar.gz" file to download it.

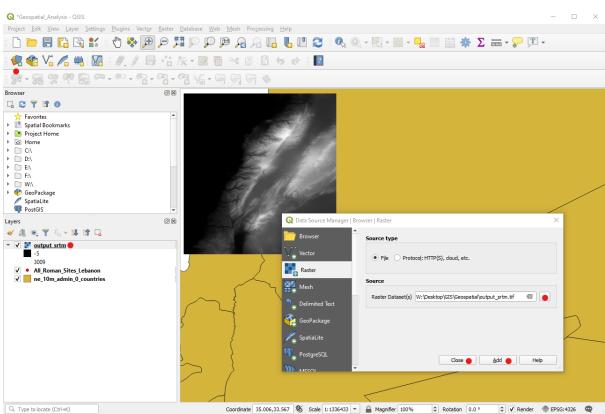
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|---|--------------------------------------|--------------|---------------------|---------------------|---------------|------------------------|
| Raster Job Re<br>Modify and resubmit this |                                      |              |                     |                     | ſ             | Download job metadata  |
| Full job metadata                         | -                                    |              |                     |                     | Vie           | ew job configuration Q |
| Job Id                                    | Dataset                              | Title        | Submission          | Completion          | Duration      | Final Status           |
|   |                                      |              |                     |                     |               |                        |
| rt1601910363153                           | SRTM_GL1                             | Lebanon_SRTM | 2020-10-05 08:06:03 | 2020-10-05 08:06:16 | 13 secs       | Done 🗸                 |

- When the download completes move this file into a suitable folder within your GIS folder
- Right-click the file and select "7-Zip" > "Extract Here", creating a new "rasters\_srtm.tar" file.

| <mark>-   🔄 📑</mark> =   | Extract   | Geospatial —  | ×          |
|--|---|---|------------|
| File Home Share  | View Compressed Folder Tools  |   | ^ <b>?</b> |
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| Geospatial_Analysis.qgz  | 05/10/2020 15:26  | QGIS Project 14 KB  |            |
|  | Open<br>Share with Skype<br>7-Zip<br>Édit with Notepad++  | > Open archive<br>Extract files   |            |
|  | Scan with Microsoft Defender  | Extract Here  Extract to "rasters_srtm.tar\" Test archive   |            |
| •  | Create Smart Backup for selected file(s)  | Add to archive  |            |
|  | Restore previous versions   | Compress and email<br>Add to "rasters_srtm.tar.gz.7z"   |            |
|  | Send to   | Compress to "rasters_srtm.tar.gz.7z" and email  |            |
|  | Cut<br>Copy   | Add to "rasters_srtm.tar.gz.zip"<br>Compress to "rasters_srtm.tar.gz.zip" and email   |            |
|  | Create shortcut<br>Delete<br>Rename   |   |            |
| 6 items 1 item select  | Properties  |   |            |

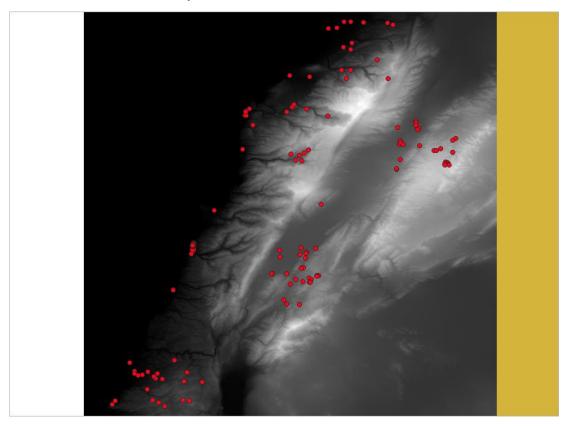
• Use 7-Zip to extract this file too (it is double-zipped), creating a new "output\_srtm" file





• In QGIS use the Open Date Source Manager to add this to your map

You now have elevation data for your area of interest.





# 1.3 Visualising elevation data (video tutorial)

Now that we have added the elevation data to our map, we can now make it easier to read and more attractive.

First, we need to change the coordinate reference system (CRS) of the elevation data and our site data.

• Press the CRS button at the bottom right of the screen

#### EPSG:4326

- Type in the UTM zone for your area of interest (e.g. 36N).
  - If you do not know it, you can find it here
  - https://mangomap.com/robertyoung/maps/69585/what-utm-zone-am-i-in-#
- Scroll down until you see the option with "WGS 84 / UTM zone [your zone e.g. 36N]", click on this and Apply and OK.

| <b>Q</b> Project Properties   CRS |  | ×   |
|-----------------------------------|--|---|
| Q                                 | Project Coordinate Reference System (CRS)  |   |
| 🔀 General                         | No projection (or unknown/non-Earth projection   | 1)  |
| 📝 Metadata                        | Filter 🔍 36N 🔴   | <   |
|                                   | Recently Used Coordinate Reference System  | ns  |
| CRS                               | Coordinate Reference System  | Authority ID  |
|                                   | WGS 84 / UTM zone 36N  | EPSG:32636  |
| Data Sources                      |  |   |
| Relations                         | 4  |   |
| 8 Variables                       | Predefined Coordinate Reference Systems  | Hide deprecated CRSs                                    |
| ~                                 | Coordinate Reference System  | Authority ID  |
| 💱 Macros                          | Sudan / UTM zone 36N   | EPSG:29636  |
|                                   | WGS 72 / UTM zone 36N  | EPSG:32236  |
| QGIS Server                       | WGS 72BE / UTM zone 36N  | EPSG:32436  |
|                                   | WGS 84 / TMzn36N   | EPSG:4038   |
|                                   | WGS 84 / UTM zone 36N  | EPSG:32636 🔴 👻  |
|                                   |  |   |
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|                                   | Source CRS Destination CRS   | <u> </u>  |
|                                   | EPSG:32637 EPSG:22770 +proj=pipeline +step   | p +inv +proj=utm +zone=37 +ellps=WGS84 +step +proj=push |
|                                   | ОК   | Cancel Apply Help                                       |



• In the Layers Panel, right-click the SRTM raster and select "Export" > "Save As".

| Layers  | 0 ×   |   |                               |
|---|---|---|-------------------------------|
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| ✓ • All_Roman_Sites   | Lebanon   |   |                               |
| <ul> <li>✓ ✓ <u>output srtm</u></li> <li>-5<br/>3009</li> <li>✓ ne_10m_admin_0</li> </ul> | <ul> <li>Zoom to Layer</li> <li>Show in Overview</li> <li>Copy Layer</li> <li>Rename Layer</li> <li>Zoom to Native Resolution (100%)</li> <li>Stretch Using Current Extent</li> <li>Duplicate Layer</li> <li>Remove Layer</li> <li>Move to Top</li> <li>Change Data Source</li> <li>Set Layer Scale Visibility</li> </ul> |   |                               |
|   | Set CRS   | • |                               |
|   | Export  | • | Save As                       |
|   | Styles  | • | Save as Layer Definition File |
|   | <u>P</u> roperties  |   | Save as QGIS Layer Style File |
|   |   |   |                               |
|   |   |   |                               |

• Click the Browse button [...] next to "File name" and save your new file in your "Geospatial" folder with a new name e.g. "SRTM\_Lebanon\_UTM".

| 🔇 Save Layer As |                          |   |   |                |        | $\times$ |
|-----------------|--------------------------|---|---|----------------|--------|----------|
| ← → • ↑         | ≪ GIS → Geospatial       | ~ | Ō | ,○ Search Geos | patial |          |
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| Save as type    | : GeoTIFF (*.tif *.tiff) |   |   |                |        | ~        |
| ∧ Hide Folders  |                          |   |   | Save           | Cancel |          |



• Change "CRS" to "Project CRS" and make sure that this matches the UTM Zone you have just chosen for the entire map.

| utput mode 🛈  |  |                |                       |          |           |                       | Create VF      |
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| yer name  |  |                |                       |          |           |                       |                |
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| West 684  |  | South 365473   | 39.9268               |          | st 841796 | 5.9732                |                |
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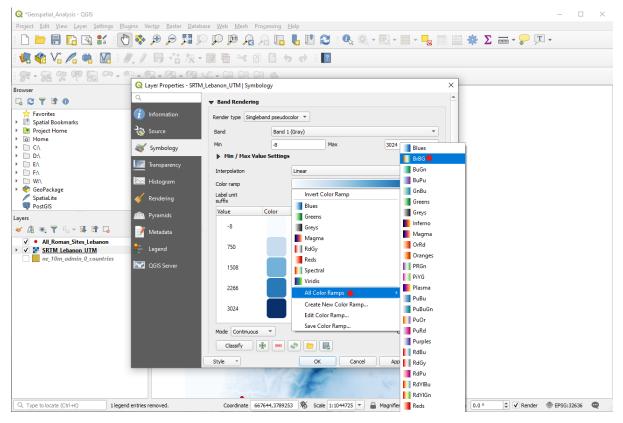
You should now have your new SRTM raster in the Layers Panel.

• Remove the old one by right-clicking "output\_srtm" and selecting "Remove layer"

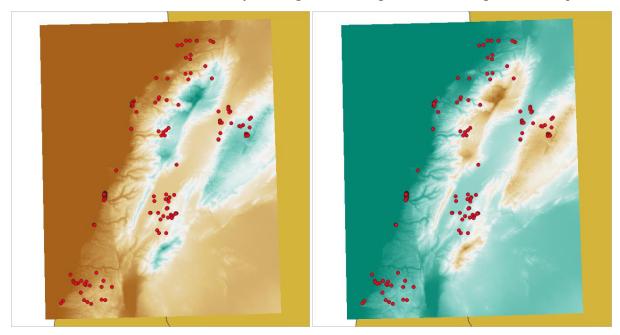


Now we are going to change the symbology of our new SRTM raster.

- Right-click your new raster in the Layers Panel and select "Properties".
- Click on the symbology tab.
- Change "Render type" from "Singleband gray" to "Singleband pseudocolour".
- Click the black arrow next to "Color ramp".
- Click "All Color Ramps" to see more options and click to select the one you want.

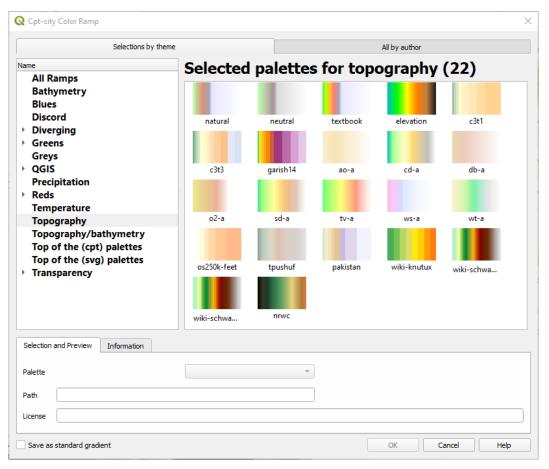


• You can reverse the colours by clicking the arrow again and selecting "Invert ramp"





• You can also find more options (including ones specifically designed for topography) by clicking "Create new ramp" > "Catalog: cpt-city".





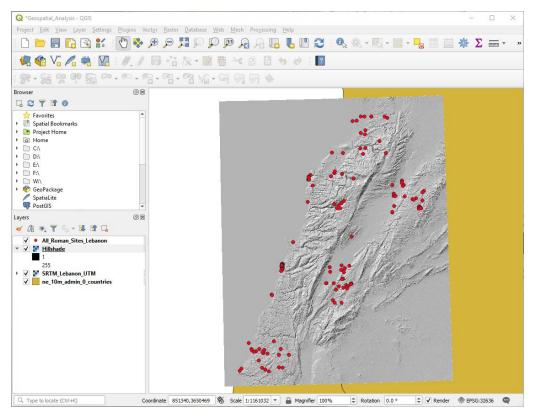
Once we are happy with the colours, we are going to create a second layer that provides some added detail.

- On the Menu click Raster > Analysis > Hillshade.
- In the new window make sure that your UTM raster is selected and then scroll down to "Hillshade".
- Click the Browse button [...] and select "Save to File...".
- Navigate to your Geospatial folder and save your new raster as "Hillshade".
- Click Run and then Close when it has finished.

| K Hillshade  |  |   |                                       | ^        |
|--|--|---|---------------------------------------|----------|
| Parameters Log   |  |   |                                       |          |
| Input layer  |  |   |                                       | <b></b>  |
| SRTM_Lebanon_UTM [EPSG: 32636]   | •  |   |                                       | •        |
| Band number  |  |   |                                       |          |
| Band 1 (Gray)  |  |   |                                       | •        |
| Z factor (vertical exaggeration)   |  |   |                                       |          |
| 1.000000   |  |   |                                       | \$       |
| Scale (ratio of vertical units to horizontal)  |  |   |                                       |          |
| 1.000000   |  |   |                                       | \$       |
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| Combined shading   |  |   |                                       |          |
| Multidirectional shading   | A CARLER AND A CARLER  |   |                                       |          |
| ▼ Advanced parameters  |  |   |                                       |          |
| Additional creation options [optional]   | output_srtm.tif SRTM_Lebanon_  |   |                                       |          |
| Profile Default  | UTM.tif  |   |                                       | •        |
|  |  |   |                                       |          |
| Name   | File name: Hillshade 🔴   | Y   |                                       | _        |
|  | Save as type: TIF files (*.tif)  | Y   |                                       |          |
|  |  |   |                                       |          |
| 🖶 📼 Validate H   | ∧ Hide Folders   | Save 🔴 Cancel   |                                       |          |
| Additional command-line parameters [op   | ptional]   |   |                                       |          |
|  |  |   |                                       |          |
| Hillshade  |  |   |                                       |          |
| [Save to temporary file]   |  |   |                                       |          |
|  | _  |   |                                       |          |
| <ul> <li>Open output file after running algorith</li> <li>GDAL/OGR console call</li> </ul> | #11  |   |                                       |          |
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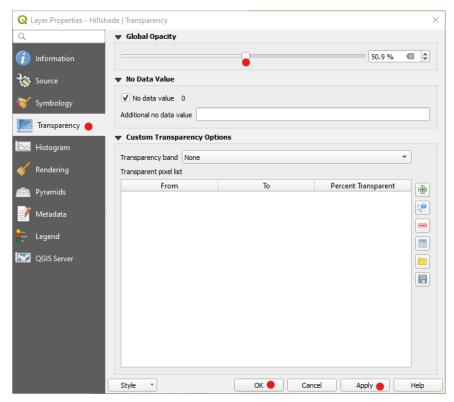


Your new "Hillshade" raster will appear in the Layers Panel and in the Map View



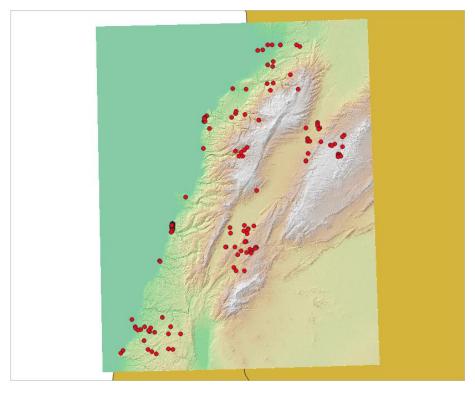
We are going to combine this with the colourful SRTM raster by making it partially transparent.

- Right-click your hillshade raster in the Layers Panel and select "Properties".
- Click on the "Transparency" tab.
- Use the slider to change the Global Opacity to approximately 50%, click Apply and OK.





As long as your Hillshade raster is above your SRTM raster in the Layers Panel, you should now be able to see added relief detail, creating a much more attractive map.



# 1.4 Adding hydrological data (video tutorial)

As well as elevation data, we can also obtain hydrological data from the internet to further improve our map.

• On your internet browser visit the HydroSHEDS website <u>https://hydrosheds.org/page/hydrorivers</u>

This website contains river, lake and basin data that is available to download for free. You can download data by region or for the entire globe.

- For most of the Middle East you need the Europe dataset.
- For North Africa you need the Africa dataset.
- Scroll down to "Shapefiles" and click the "Download" button next to Europe or Africa

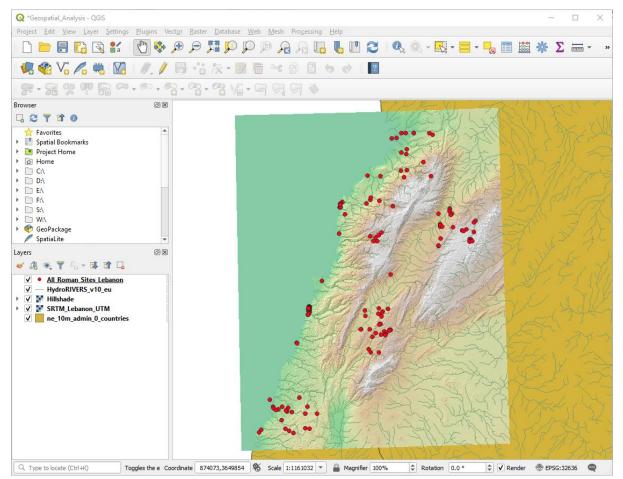
| Shapefiles 🔍  |        |          |                               |
|---------------|--------|----------|-------------------------------|
| Global        | 520 MB | Download |                               |
| Africa        | 103 MB | Download |                               |
| Arctic        | 21 MB  | Download |                               |
| Asia          | 86 MB  | Download |                               |
| Australia     | 47 MB  | Download | Greenland                     |
| Europe        | 65 MB  | Download | Artic Siberia                 |
| Greenland     | 9 MB   | Download | Asio 34                       |
| North America | 63 MB  | Download | Altro                         |
| South America | 91 MB  | Download | South<br>America<br>Australia |
| Siberia       | 45 MB  | Download | C. The second                 |



• Click "Download" again on the new page that opens.



- Allow the zip file to finish downloading. When it is done, move it into your "GIS/Geospatial" folder.
- Right-click the file and select "7-Zip" > "Extract Here" (or another un-archiver program).
- In QGIS use the Open Data Source Manager button to add the new shapefile inside the folder.



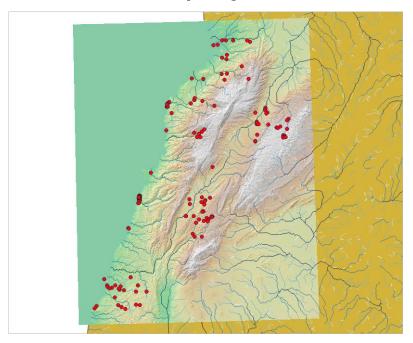


We could make all the rivers look the same, but it would be better to show their relative size.

- Right click the HydroRIVERS shapefile and select "Properties".
- Click on the Symbology tab.
- Change "Single Symbol" to "Graduated".
- Change "Value" to "UPLAND\_SKM".
- Change the Colour ramp to a suitable blue one.
- Click the "Classify" button then Apply and OK.

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| Q                             | 🔄 😑 Graduated   |                                | Ŧ                    |
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| Magrams                       | Classes Histogram   |                                |                      |
| প 3D View                     | Symbol ▼ Values<br>▼ 1.20 - 14.70                         | Legend<br>1 - 15               |                      |
| Fields                        | ✓         14.70 - 27.40           ✓         27.40 - 66.80 | 15 - 27<br>27 - 67             |                      |
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| 🞸 Rendering                   | ✓ Link class boundaries                                   |                                |                      |
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|                               | 👻 Style 👻   |                                | OK Cancel Apply Help |

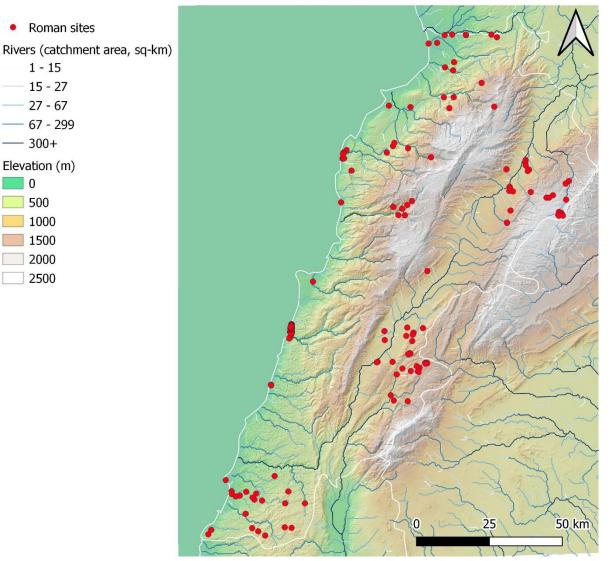
The rivers will now have a different shade depending on the size of their catchment area.





**PRACTICE:** create a topographical map of your area of interest using this data.

•



Roman Sites and Topography in Lebanon



# 2 Elevation and Hydrological Geospatial Analysis (video tutorial playlist)

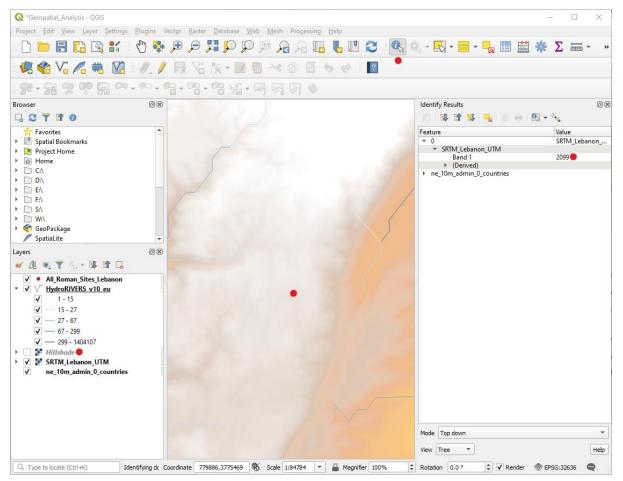
Having downloaded the elevation and hydrological data that we need from the internet, we are now going to use it to carry out some simple geospatial analysis in order to find out more about our sites. We are going to calculate the elevation of all of our sites and how far they are from the nearest watercourse.

### 2.1 Extracting elevation values (video tutorial)

It is possible to read the elevation values of any particular area, including for our sites.

- On the Toolbar click the Identify Features button.
- Turn off the Hillshade layer and then click anywhere on the SRTM raster.

The Identify Results Panel will open and next to "Band 1" you will see the elevation of the pixel that you clicked on.

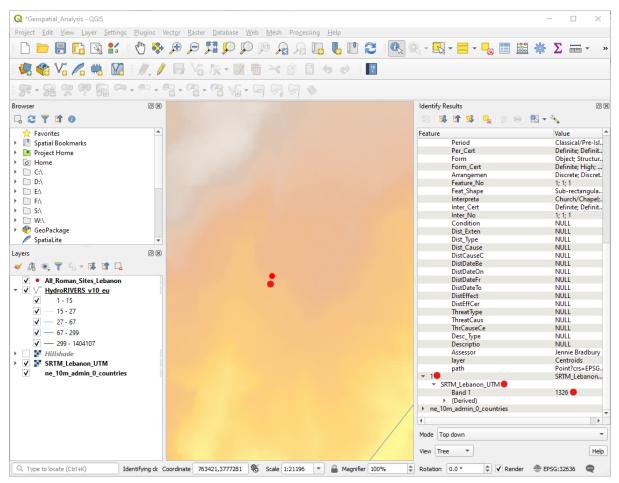


• Find one of your sites and click on it using the "Identify Features" button



You will see lots of information about your site from the database.

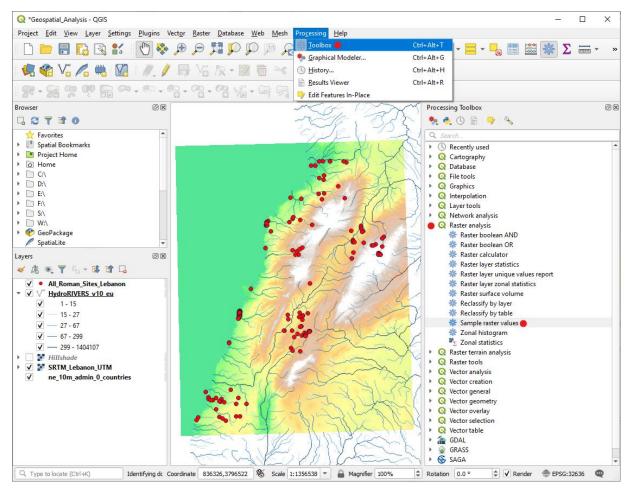
- Scroll down in the results and at the bottom you will see your SRTM raster.
- Expand this twice and you will see the elevation value for the site.





It would take a long time to do this and record the result for every site, so there is also an automatic way of achieving this in QGIS.

- Click "Processing" on the Menu and select "Toolbox".
- Expand "Raster analysis" and double-click on "Sample raster values".





- For "Input point layer" select your sites.
- For "Raster Layer to sample" select the SRTM raster.
- For "Output column prefix" type "Elevation".
- For "Sampled points" click the Browse button [...] and "Save to File".
- Give your new shapefile a name and click "Save".
- Click Run and then Close when it completes.

| Input Point Layer  All_Roman_sites_Lebanon [EPSG:4326]  Selected features only Raster Layer to sample  SRTM_Lebanon_UTM [EPSG:32636]  Advanced parameters  Output column prefix Elevation  Sampled Points  W:/Desktop/GIS/Geospatial/All_Roman_Sites_Lebanon_II.shp  Open output file after running algorithm | Parameters Log   | 4 | Sample raster values  |
|---|--|---|---|
|   | <ul> <li>All_Roman_Sites_Lebanon [EPSG:4326]</li> <li>Selected features only</li> <li>Raster Layer to sample</li> <li>SRTM_Lebanon_UTM [EPSG:32636]</li> <li>Advanced parameters</li> <li>Output column prefix</li> <li>Elevation</li> <li>Sampled Points</li> <li>W:/Desktop/GIS/Geospatial/All_Roman_Sites_Lebanon_II.shp</li> </ul> |   | This algorithm creates a new vector layer with the<br>same attributes of the input layer and the raster<br>values corresponding on the point location.<br>If the raster layer has more than one band, all the |
|   |  |   | Cancel  |

Your new shapefile will be added to your Map View and Layers Panel.

- Right-click it and select "Open Attribute Table"
- Scroll to the last column on the right

You will see that a new "Elevation" column has been added and the elevation of each site has been calculated.

|   | DistEffect | DistEffCer | ThreatType      | ThreatCaus      | ThrCauseCe       | Desc_Type | Descriptio       | Assessor         | layer     | path           | Elevation_      |
|---|------------|------------|-----------------|-----------------|------------------|-----------|------------------|------------------|-----------|----------------|-----------------|
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|   | VULL       | NULL       | Agricultural/Pa | Ploughing; Veg  | Planned; Planned | Comments  | Fieldwalking tra | Letty Ten Harke  | Centroids | Point?crs=EPSG | 16.0000000000.  |
|   | VULL       | NULL       | Agricultural/Pa | Ploughing; Veg  | Planned; Planned | Comments  | Fieldwalking tra | Letty Ten Harke  | Centroids | Point?crs=EPSG | 8.00000000000.  |
|   | VULL       | NULL       | Agricultural/Pa | Ploughing; Veg  | Planned; Planned | Comments  | Fieldwalking tra | Letty Ten Harke  | Centroids | Point?crs=EPSG | 5.00000000000.  |
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|   | VULL       | NULL       | NULL            | NULL            | NULL             | NULL      | NULL             | Letty Ten Harkel | Centroids | Point?crs=EPSG | 1447.000000000. |
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|   | VULL       | NULL       | NULL            | NULL            | NULL             | NULL      | NULL             | Pascal Flohr     | Centroids | Point?crs=EPSG | 1152.000000000  |
|   | VULL       | NULL       | NULL            | NULL            | NULL             | NULL      | NULL             | Letty Ten Harkel | Centroids | Point?crs=EPSG | 1411.000000000  |
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| 5 | VULL       | NULL       | Building and D  | Construction    | Possible         | NULL      | NULL             | Letty Ten Harke  | Centroids | Point?crs=EPSG | 55.0000000000   |
| 7 | VULL       | NULL       | NULL            | NULL            | NULL             | NULL      | NULL             | Pascal Flohr     | Centroids | Point?crs=EPSG | 501.000000000   |
| 8 | VULL       | NULL       | NULL            | NULL            | NULL             | NULL      | NULL             | Pascal Flohr     | Centroids | Point?crs=EPSG | 612.0000000000. |

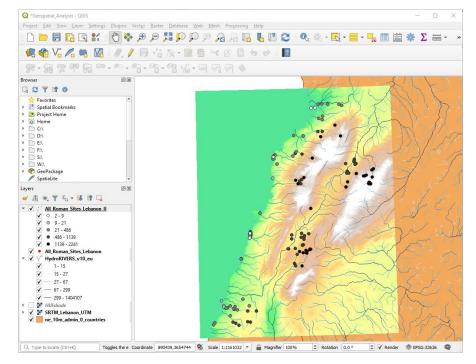


We can show this information on the map in a similar way to how we symbolised the rivers.

- Right-click your new sites shapefile and select "Properties".
- Click on the Symbology tab and change "Single symbol" to "Graduated".
- Change "Value" to "Elevation".
- Pick a colour ramp that you like.
- Click "Classify" and then Apply and OK.

| Q Layer Properties - Al | I_Roman_Sites_Le      | banon_ll   Symbolo  | ду                 |      |        | ×                    |
|-------------------------|-----------------------|---------------------|--------------------|------|--------|----------------------|
| ۹                       | Graduated             | •                   |                    |      |        | -                    |
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Your sites will now be coloured according to their elevation.



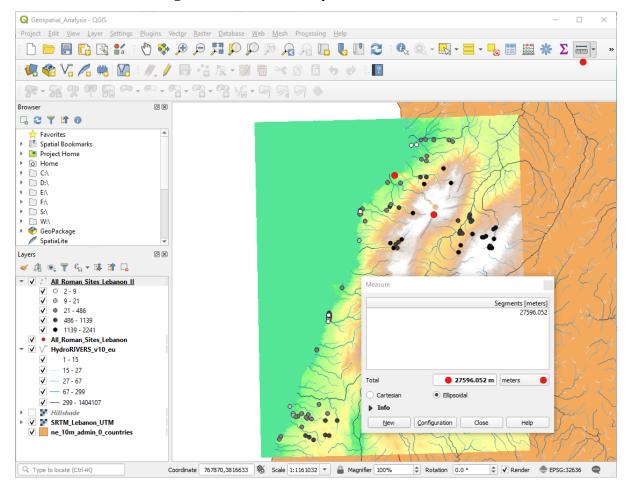
• Remove the old shapefile from the Layers Panel by right-clicking and selecting "Remove layer"



### 2.2 Measuring distance (video tutorial)

In a similar way, it is possible to measure the distance between features in QGIS, for example the distance between our sites and the nearest river.

- On the Toolbar click the Measure Line button.
- Click between any two points on the map to measure the distance between them.
- You can also change the units if this is helpful.





You could use this to measure the distance between two sites, or between a site and the nearest river.

- Zoom into a site and its nearest river.
- Click the Measure Line button and then click on the site and the nearest section of the river.

| 🔇 Geospatial_Analysis - QGIS  | - D ×  |
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This will measure the distance between the site and the river. Just like with the elevation task, there is a way that we can automate this for every site.



First, we must make sure that all our relevant data is in UTM format so that distances are measured in metres rather than decimal degrees.

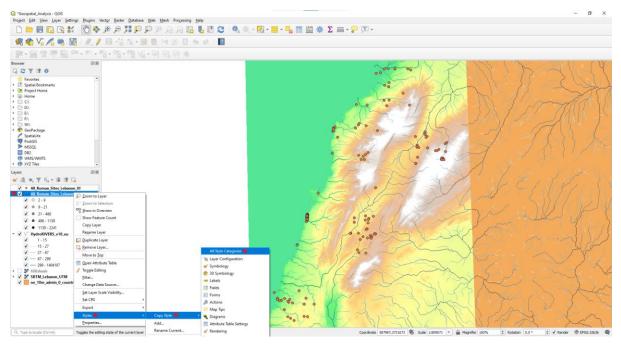
- Right-click your sites shapefile and select "Export" > "Save Sites As".
- Make sure "Format" is "ESRI Shapefile".
- Under "File name" click the Browse button [...] and save a new version of your file.
- For "CRS" select "Project CRS", making sure that this is your UTM zone.
- Everything else can stay the same, so click OK.

| <b>Q</b> Save Vect | or Layer a  | is         |                       |               |          |        |         | $\times$ |
|--------------------|-------------|------------|-----------------------|---------------|----------|--------|---------|----------|
|                    |             |            |                       |               |          |        |         |          |
| Format             | ESRI Sha    | apefile 🔴  |                       |               |          |        |         | · _      |
| File name          | W:\Desk     | top\GIS\Ge | eospatial\All_Roman_S | ites_Lebanon_ | _III.shp |        |         |          |
| Layer name         |             |            |                       |               |          |        |         |          |
| CRS                | Project (   | CRS: EPSG  | :32636 - WGS 84 / UTI | M zone 36N 🛑  | )        |        | -       | 2        |
|                    |             |            |                       |               |          |        |         |          |
| Encoding           |             |            |                       | UTF-8         |          |        | •       |          |
| Save on            | ly selected | l features |                       |               |          |        |         |          |
| ▼ Select           | fields to   | export a   | nd their export opt   | ions          |          |        |         |          |
| Na                 | ime         | Туре       |                       |               |          |        | <b></b> |          |
| ✓ Prim             | n_Name      | String     |                       |               |          |        |         |          |
| ✓ Arch             | hesID       | String     |                       |               |          |        |         |          |
| ✓ Res              | Туре        | String     |                       |               |          |        |         |          |
| ✓ Her              | Туре        | String     |                       |               |          |        |         |          |
| ✓ Herl             | UseType     | String     |                       |               |          |        |         |          |
| ✓ Cert             | ainty       | String     |                       |               |          |        | -       |          |
|                    |             | Select A   | H                     |               | Desele   | ct All |         |          |
| ▼ Geome            | etry        |            |                       |               |          |        |         |          |
| Geometry           | type        |            |                       | Automatic     |          |        | -       |          |
| Force              | multi-type  | 2          |                       |               |          |        |         |          |
|                    | de z-dimen  |            |                       |               |          |        |         |          |
|                    |             |            |                       |               |          |        |         |          |
|                    |             |            | ✓ Add saved file      | to map        | ок 🔴     | Cancel | Help    |          |

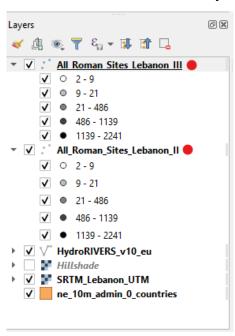


A new version of your file will be added to the Layers Panel and the Map View. However, it will have very basic formatting, so we are going to copy and paste the symbology from the old file before we remove it from the map.

- Right-click your old shapefile and select "Styles" > "Copy Style" > "All Style Categories".
- Right-click your new shapefile and select "Styles" > "Paste Style" > "All Style Categories".



Your new shapefile should now look identical to the old one, so you can now remove the old file.





Now we need to do something similar with the HydroRIVERS shapefile. However, in order to speed up the automatic measuring step, we are also going to just extract part of the file to make it smaller.

- In the Map View, zoom in to the area that you want to trim the rivers shapefile to.
  - The easiest way of doing this for your area of interest is to "Zoom to Layer" on your SRTM raster.
- Open the HydroRIVERS Attribute Table.
- Click the "Show All Features" filter button and select "Show Features Visible on Map".
- Click the row number on the left side next to the first feature at the top of the table.
- Scroll down to the bottom, hold the shift key and click the row number next to the last feature to select all of the visible features.

| <b>Q</b> | HydroRIVERS_v10_e    | eu :: Features Total: 9 | 938544, Filtered: 153 | 5, Selected: 1535 |            |            |           | _          |           |
|----------|----------------------|-------------------------|-----------------------|-------------------|------------|------------|-----------|------------|-----------|
| /        | 🗱 📑 😂 i 🖷            | 1 × 0 0                 | چ 📄 🗧 🧏               | , 🝸 🖺 🏘 🔎         | P 🛯 🐻 🚺 🛔  |            |           |            |           |
|          | HYRIV_ID             | NEXT_DOWN               | MAIN_RIV              | LENGTH_KM         | DIST_DN_KM | DIST_UP_KM | CATCH_SKM | UPLAND_SKM | ENDORHEIC |
| 1518     | 20741220             | 20740742                | 20737602              | 4.73              | 36.9       | 15.3       | 7.38      | 34.6       |           |
| 1519     | 20741223             | 20740283                | 20739158              | 10.23             | 12.5       | 52.3       | 31.88     | 279.9      |           |
| 1520     | 20741292             | 20741620                | 20765143              | 7.13              | 184.3      | 13.5       | 27.36     | 27.4       |           |
| 1521     | 20741293             | 20741620                | 20765143              | 10.69             | 184.3      | 18.5       | 32.58     | 32.6       |           |
| 1522     | 20741294             | 20741490                | 20765143              | 14.65             | 185.1      | 19.6       | 50.41     | 50.4       |           |
| 1523     | 20741295             | 20741490                | 20765143              | 9.45              | 185.1      | 16.4       | 28.63     | 28.6       |           |
| 1524     | 20741296             | 20740470                | 20739158              | 7.31              | 39.4       | 13.0       | 45.03     | 45.0       |           |
| 1525     | 20741425             | 20741757                | 20765143              | 5.66              | 232.9      | 30.3       | 22.15     | 136.8      |           |
| 1526     | 20741426             | 20742504                | 20765143              | 8.38              | 242.9      | 14.9       | 41.59     | 41.6       |           |
| 1527     | 20741550             | 20739932                | 20739158              | 15.89             | 18.1       | 28.3       | 32.23     | 70.8       |           |
| 1528     | 20741621             | 20742332                | 20765143              | 17.03             | 181.4      | 25.6       | 44.64     | 83.1       |           |
| 1529     | 20741691             | 20741915                | 20765143              | 9.76              | 182.9      | 12.9       | 55.64     | 55.6       |           |
| 1530     | 20741760             | 20740742                | 20737602              | 7.80              | 36.9       | 38.6       | 18.19     | 174.9      |           |
| 1531     | 20742204             | 20742502                | 20765143              | 16.77             | 226.9      | 23.1       | 47.54     | 47.5       |           |
| 1532     | 20742206             | 20740401                | 20739158              | 18.77             | 14.1       | 27.4       | 59.27     | 87.8       |           |
| 1533     | 20742331             | 20742939                | 20765143              | 13.08             | 173.2      | 105.9      | 59.27     | 1615.6     |           |
| 1534     | 20742409             | 20740540                | 20735351              | 14.58             | 68.6       | 20.7       | 57.30     | 57.3       |           |
| 1535     | 20743295             | 20743638                | 20765143              | 22.42             | 212.2      | 27.7       | 68.82     | 68.8       |           |
| •        |                      |                         |                       |                   |            |            |           |            | •         |
| 👅 S      | how Features Visible | On Map                  |                       |                   |            |            |           |            | 3         |



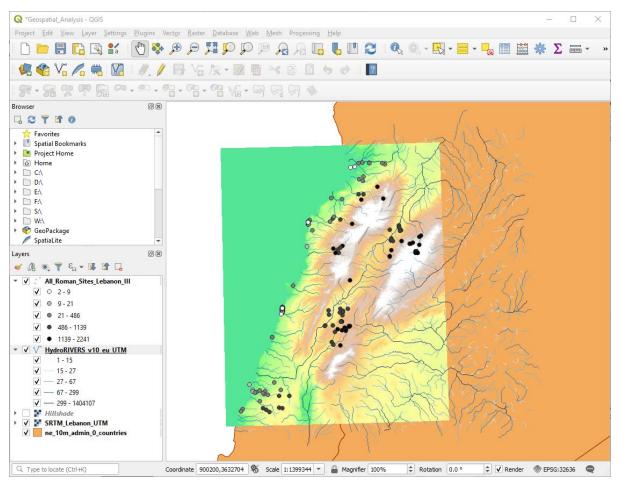
- Close the Attribute Table.
- Right-click the shapefile in the Layers Panel and select "Export" > "Save Selected Features".
- For "Format" select "ESRI Shapefile".
- Click the Browse button [...] and give the new shapefile a name.
- Make sure that for "CRS", you have selected "Project CRS" and that this matches your UTM zone.
- Click OK.

| ormat     | ESRI Shap      | pefile             |                       |               |                            |     |
|-----------|----------------|--------------------|-----------------------|---------------|----------------------------|-----|
| le name   | W:\Deskto      | op \GIS \Geo       | spatial\HydroRIVERS   | _v10_eu_shp\H | lydroRIVERS_v10_eu_UTM.shp |     |
| ayer name |                |                    |                       |               |                            |     |
| RS        | Project C      | RS: EPSG:3         | 2636 - WGS 84 / UTM   | 1 zone 36N 🛑  |                            | - 4 |
| ncoding   |                |                    |                       | UTF-8         |                            | -   |
| Select    |                | export and         | their export opti     |               |                            |     |
|           | ame            | Туре               | Replace with disp     | played values |                            |     |
|           | T_DOWN         | Integer<br>Integer | Use Range             |               |                            |     |
| ✓ MA      | IN_RIV         | Integer            | Use Range             |               |                            |     |
| ✓ LEN     | GTH_KM         | Real               |                       |               |                            |     |
| V DIST    | I_DN_KM        | Real               |                       |               |                            |     |
|           | Г_UР_КМ        | Real               |                       |               |                            | -   |
|           |                | Select All         |                       |               | Deselect All               |     |
| Repla     | ice all select | ed raw field       | d values by displayed | values        |                            |     |
| Geom      | etry           |                    |                       |               |                            |     |
| Geometry  | v type         |                    |                       | Automatic     |                            | -   |
| Force     | multi-type     |                    |                       |               |                            |     |



A new, unformatted shapefile of the rivers in your area of interest will be added to the Layers Panel and Map View.

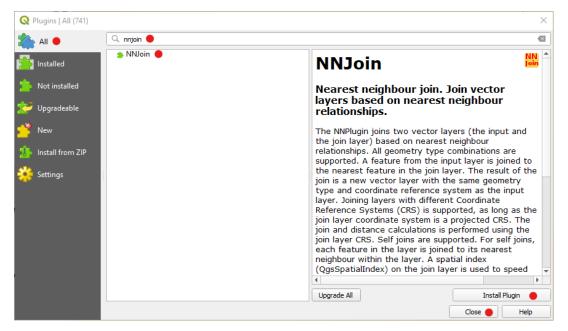
- Copy and paste the symbology from the old shapefile to the new version.
- Remove the old shapefile.



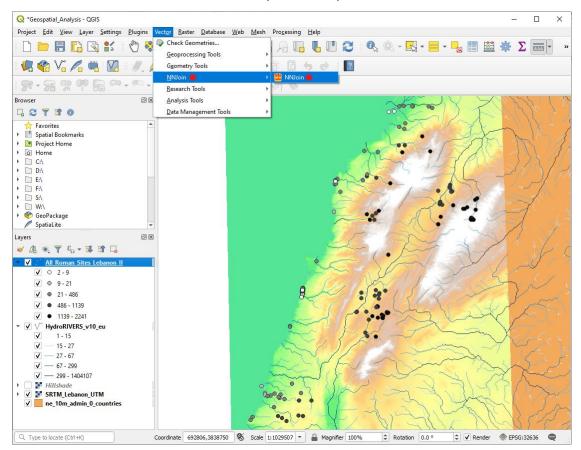


Finally, to automatically measure the distances we need to install a "Plugin" – an extra tool that is not part of the main QGIS software but which runs inside it.

- On the Menu click "Plugins" > "Manage and install plugins".
- Click the All tab.
- Type "nnjoin" into the search box.
- Click "NNJoin" and then Install Plugin and then Close when it completes.



• On the Menu click "Vector" > "NNJoin" > "NNJoin".





- For "Input vector layer" select your sites shapefile.
- For "Join vector layer" select the HydroRIVERS shapefile.
- For "Output layer" give your new file a useful name then click OK and Close when finished.

| <b>Q</b> NNJoin   | ×             |
|---|---------------|
| Input vector layer  |               |
| ● All_Roman_Sites_Lebanon_III ▼ Geometry type: <i>Point</i>                             | Selected only |
| Join vector layer   |               |
| HydroRIVERS_v10_eu_UTM     Geometry type: <i>MultiLineString</i> Approximate geometries | Selected only |
| Join prefix: join_  |               |
| Output layer  |               |
| All_Roman_Sites_Lebanon_IV 🔴  |               |
| Neighbour distance field: distance  |               |
|   |               |
| 0% OK OK Close Cancel   | Help          |

A new layer will be added to QGIS.

• Open the new layer's Attribute Table.

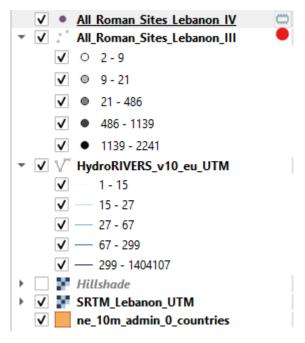
You will notice that as well as elevation, it now also contains all the details of the closest river to each site including, in the last column, the distance between them, in metres.

| - an an m                                      | _  |                              |          |          | 8 6 8    |       |       |      |       |        |      |                                 |             |                 |                 |                           |
|--|----|------------------------------|----------|----------|----------|-------|-------|------|-------|--------|------|---------------------------------|-------------|-----------------|-----------------|---------------------------|
|  |    | •••••                        | 0 · 0 Va |          |          |       |       |      |       |        |      |                                 |             |                 |                 |                           |
| et 0   |    | All_Roman_Sites_Leb          |          |          |          |       |       |      |       |        |      |                                 |             |                 | -               | ×                         |
| ites   | 1  | III 🗟 🔁 📷                    |          |          |          |       |       |      |       |        |      |                                 | 111 000 CLM |                 | 1.1.1.0.046.143 |                           |
| al Bookmarks<br>ct Home                        | 1  | Elevation_<br>940.0000000000 | 20731735 | 20732382 | 20765143 | 9.3   | 259.3 | 19.3 | 49.55 | 85.7   | I I  | IS_AV_CMS join_ORD_STRA<br>0.74 |             | 3 Join_OKD_FLOW |                 | distance 68.3355499816547 |
| e  | 2  | 863.000000000                | 20728648 | 20728572 | 20734976 | 7.11  | 95.7  | 13.8 | 32.32 | 32.3   | 0    |                                 |             | 2 7             |                 | 885.9784127235            |
|  | 2  | 858.0000000000               | 20728111 | 20727904 | 20734976 | 2.57  | 101.3 | 7.3  | 18.21 | 18.2   | 0    |                                 |             | 2 7             |                 | 1291.294474265            |
|  | 4  | 267.0000000000               | 20715882 | 20715365 | 20715307 | 7.26  | 4.5   | 30.4 | 19.1  | 115.9  | 0    |                                 |             | 1 6             |                 | 826.7759452402            |
|  | 5  | 9.000000000000               | 20714747 | 20714284 | 20714284 | 12.13 | 1.7   | 41.3 | 31.1  | 171.6  | 0    |                                 | -           | 1 6             |                 | 1633.574878972            |
| ackage   | 6  | 934.0000000000               | 20730102 | 20729961 | 20734976 | 1.3   | 92.3  | 7.3  | 13.05 | 13.1   | 0    |                                 |             | 3 7             |                 | 125.3612341424            |
| Lite<br>IS                                     | 7  | . 1156.000000000             | 20730184 | 20729961 | 20734976 | 8.1   | 92.1  | 13.2 | 36.64 | 36.6   |      |                                 |             | 2 7             |                 | 1492.018871895            |
| l.   |    | 1021.000000000               | 20729088 | 20728649 | 20734976 | 3.88  | 118.1 | 9.6  | 27.51 | 27.5   | 0    |                                 |             | 3 7             |                 | 161.1185924031            |
| WMTS   |    | . 880.0000000000             | 20728648 | 20728572 | 20734976 | 7.11  | 95.7  | 13.8 | 32.32 | 32.3   | 0    |                                 |             | 2 7             |                 | 1662.557787143            |
|  | 10 | 1113.000000000               | 20720040 | 20729961 | 20734976 | 8.1   | 92.1  | 13.2 | 36.64 | 36.6   | 0    |                                 |             | 2 7             |                 | 1165.802219305            |
| . 🍸 ६ <sub>व</sub> ≠ छि ।<br>I Roman Sites Let |    | 1203.000000000               | 20730184 | 20729961 | 20734976 | 8.1   | 92.1  | 13.2 | 36.64 | 36.6   | 0    |                                 |             | 2 7             |                 | 1443.603674489            |
| I_Roman_Sites_Leb                              |    | . 1058.000000000             | 20728649 | 20727827 | 20734976 | 6.58  | 111.5 | 16.1 | 10.89 | 55.5   | 0    |                                 |             | 3 7             |                 | 811.8952249362            |
| 9-21   | 13 | 941.0000000000               | 20728112 | 20727828 | 20734976 | 2.36  | 113.3 | 8.5  | 16.25 | 16.2   | 0    |                                 |             | 3 7             |                 | 1069.638142482            |
| 21 - 486                                       | 14 |                              | 20729088 | 20728649 | 20734976 | 3.88  | 118.1 | 9,6  | 27.51 | 27.5   | 0    |                                 |             | 3 7             |                 | 2587.423855505            |
| 486 - 1139                                     | 15 | 1023.000000000               | 20729088 | 20728649 | 20734976 | 3.88  | 118.1 | 9.6  | 27.51 | 27.5   | 0    |                                 |             | 3 7             |                 | 848.4051627425            |
| 1139 - 2241<br>ydroRIVER5_v10_e                |    | . 1162.000000000             | 20730649 | 20731735 | 20765143 | 4.86  | 268.6 | 9.9  | 22.35 | 22.3   | 1    |                                 |             | 3 7             |                 | 1013.281652896            |
| 1 - 15   | 17 | 1381.000000000               | 20730649 | 20731735 | 20765143 | 4.86  | 268.6 | 9.9  | 22.35 | 22.3   | 1    |                                 |             | 3 7             |                 | 2118.610469877            |
| - 15 - 27<br>- 27 - 67                         | 18 | 1454.000000000               | 20730574 | 20730259 | 20732024 | 7.9   | 79.8  | 12.6 | 33.79 | 33.8   | 1    |                                 |             | 3 7             |                 | 3314.329634986            |
| - 67 - 299                                     | 19 | 1423.000000000               | 20730574 | 20730259 | 20732024 | 7.9   | 79.8  | 12.6 | 33.79 | 33.8   | 1    |                                 |             | 3 7             |                 | 2633.06266437003          |
| – 299 - 1404107<br>illshade                    | 20 | 874.0000000000               | 20730026 | 20731291 | 20734976 | 5.98  | 81.7  | 94.9 | 43.43 | 1452.6 | 0    |                                 |             | 1 5             |                 | 711.8998902368            |
| TM_Lebanon_UTM<br>10m admin 0 co               | -  | 674.000000000                | 20730020 | 20731291 | 20734970 | 5.90  | 61.7  | 04.0 | 0.0   | 1453.6 |      | 15.00                           |             |                 |                 | 713 7373367467            |
|  |    | Show All Features            |          |          |          |       |       |      |       |        |      |                                 |             |                 |                 |                           |
|  | -  |                              |          |          |          |       | ~     | m    | F. W. | THA    | -42- | V I WIT                         | s           |                 | /               |                           |



The NNJoin plugin works a little bit differently to other tools – it doesn't save the results permanently, so we have to tell it to do this.

• If you look next to your new sites layer you will see a little computer chip icon – this tells us that it is a temporary file.



- Right-click this file and select "Make Permanent".
- Save it as a shapefile in your Geospatial folder with the other files.

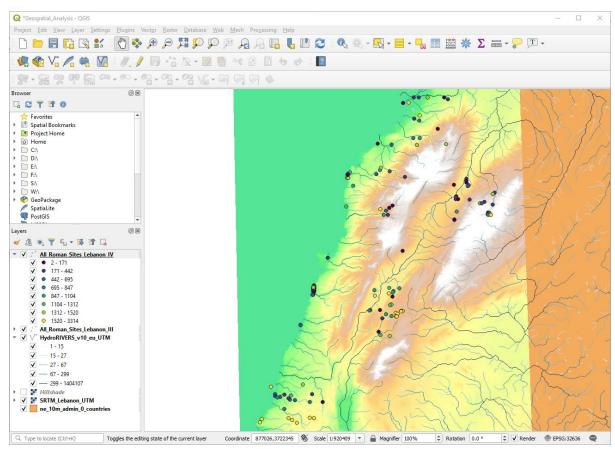


Just as with elevation we can show the distance of each site to its nearest river on our map.

- Right-click your new shapefile and select "Properties".
- Click on the Symbology tab and change "Single symbol" to "Graduated".
- Change "Value" to "distance" (right at the bottom of the list).
- Choose a suitable colour ramp.
- If you increase the number of classes more variation in the colours will become visible.

| <b>Q</b> Layer | Properties - All_F | Roman_Sites_Le       | banon_IV   Symb                       | ology                  |      |        |             | $\times$   |
|----------------|--------------------|----------------------|---------------------------------------|------------------------|------|--------|-------------|------------|
| Q              |                    | 😑 Graduated          | i 🔴                                   |                        |      |        |             | -          |
| 🥡 Info         | ormation           | Value                | 1.2 distance 🔴                        |                        |      |        |             | 3 -        |
| 🗞 Sou          | rce                | Symbol               |                                       |                        | •    |        |             |            |
| 💉 Syn          | nbology            | Legend format        |                                       |                        |      |        | Precision 0 | Trim       |
| (abc Lab       | els                | Method<br>Color ramp | Color                                 |                        |      |        |             |            |
| 🛉 Diag         | grams              |                      | Histogram                             |                        |      |        |             | 0          |
| 🔶 3D V         | View               |                      |                                       | Legend<br>2 - 171      |      |        |             |            |
| i Field        | ds                 | <b>√</b> ● 1         | 171.07 - 441.94                       | 171 - 442<br>442 - 695 |      |        |             |            |
| 🔡 Attri        | ibutes Form        | <b>√</b> ● 6         |                                       | 695 - 847              |      |        |             |            |
| • ┥ Join       | IS                 | <b>√</b> ● 1         | 103.97 - 1311.87<br>1311.87 - 1520.34 |                        |      |        |             |            |
| aux 📑          | iliary Storage     |                      | 1520.34 - 3314.33                     | 1520 - 3314            |      |        |             |            |
| 🧟 Acti         | ions               | Mode HEqu            | al Count (Quantile)                   | ) -                    |      |        | Classes     | 8          |
| 🗭 Disp         | olay               | Classify 🔴           |                                       | Delete All             |      |        |             | Advanced * |
| 🞸 Ren          | dering             | ✓ Link class bo      | oundaries                             |                        |      |        |             |            |
| 8 Varia        | ables              | Layer Rer            | ndering                               |                        |      |        |             |            |
|                | -                  | Style -              | ·                                     |                        | ок 🌒 | Cancel | Apply 🔴     | Help       |





These will now be visible on your map.

## 2.3 Using filtering to analyse different groups of sites (video tutorial)

Now that we have all of this new geospatial information about our sites, we want to be able to use it to better understand them. We are going to do this by asking and answering our own questions about the sites using filtering and statistics in QGIS.

For my example I am going to ask two questions about my data:

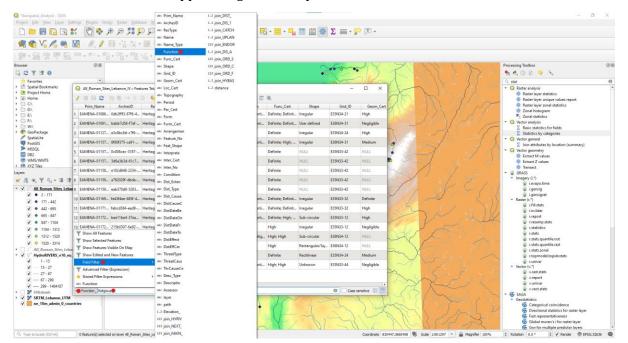
- 1) Are Roman religious sites located in higher positions than other Roman sites?
- 2) Are Roman settlements located closer to rivers and streams than other Roman sites?

You will need to come up with your own questions, but these are two good examples to demonstrate the general method.



We are going to create two new fields in our attribute table, "Religious" and "Settlement", to mark the relevant records.

- Right-click the sites shapefile and select "Open Attribute Table".
- Click the filter "Show All Features" button.
- Select "Field Filter" > "Function".
- In the bottom box type "Religious" and press enter.





You will see that the attribute table now only includes 17 records that contain the word "Religious" in the "Function" field.

|             | ArchesID   | ResType   | Name   | Name_Type   | Function   | Func_Cert  |  |
|-------------|--|---|--|---|--|--|--|
| AMENA-01086 | 0db2fff3-87f6-4  | Heritage Place  | Asmar Jbeil; DA  | Alternative Refe  | Defensive/Fortification; Domestic; Industrial/Productive; Religious,   | Definite; Definit  |  |
| AMENA-01091 | babb7d58-f7af  | Heritage Place  | E36N34-31_000  | Alternative Refe  | Funerary/Memorial; Religious;  | Definite; Definit  |  |
| AMENA-01127 | e3c8bc8d-c7f6  | Heritage Place  | AÃ⁻n Akrine; E3  | Alternative Refe  | Religious  | Definite   |  |
| AMENA-01157 | 6f60f375-ca91  | Heritage Place  | Akk9805; E36N3   | Alternative Refe  | Defensive/Fortification; Domestic; Religious   | Definite; High;  |  |
| AMENA-01157 | 0c008cec-3187  | Heritage Place  | Ayn Labwa; Cro   | Alternative Refe  | Religious  | Definite   |  |
| AMENA-01157 | 3d6a3b3d-61c7  | Heritage Place  | Aaqbe; Crow  | Alternative Refe  | Religious  | Definite   |  |
| AMENA-01158 | e102d648-2234  | Heritage Place  | E35N33-42_000  | Alternative Refe  | Religious  | Definite   |  |
| AMENA-01159 | a782029f-dbde  | Heritage Place  | Aaiha; E35N33  | Alternative Refe  | Religious  | Definite   |  |
| AMENA-01159 | eab370d8-5203  | Heritage Place  | Bonatz_2002_36   | Alternative Refe  | Religious  | Definite   |  |
| AMENA-01169 | fe43f4ee-685f-4  | Heritage Place  | E35N33-32_000  | Alternative Refe  | Defensive/Fortification; Religious   | Definite; Definit  |  |
| AMENA-01171 | febcd384-eed9  | Heritage Place  | Al-Moez Castle;  | Alternative Refe  | Defensive/Fortification; Domestic; Entertainment/Leisure; Military;  | Definite; Definit  |  |
| AMENA-01172 | bee11be4-37ea  | Heritage Place  | Castle of Toron;   | Alternative Refe  | Defensive/Fortification; Domestic; Religious;  | Definite; High;  |  |
| AMENA-01172 | 215b0307-6e92  | Heritage Place  | E35N33-12_000  | Alternative Refe  | Religious 🔴  | High   |  |
| AMENA-01176 | fada9671-0c7c  | Heritage Place  | DaÃ <sup>-</sup> aat el Aati   | Alternative Refe  | Domestic; Religious  | High; High   |  |
| AMENA-01178 | ba89e0b2-0d69  | Heritage Place  | E36N34-12_000  | Alternative Refe  | Religious  | High   |  |
| AMENA-01337 | 2ebadad6-655e  | Heritage Place  | Beit Aziz; Bziza;  | Alternative Refe  | Religious  | Definite   |  |
| AMENA-01339 | 1ae3a71c-8a1e  | Heritage Place  | Bi'qat Mizpa; D  | Alternative Refe  | Defensive/Fortification; Religious   | High; High   |  |
|             | AMENA-01091<br>AMENA-01127<br>AMENA-01157<br>AMENA-01157<br>AMENA-01158<br>AMENA-01159<br>AMENA-01159<br>AMENA-01169<br>AMENA-01172<br>AMENA-01172<br>AMENA-01176<br>AMENA-01178<br>AMENA-011337 | AMENA-01091         babb7d58-f7af           AMENA-01127         e3c8bc8d-c7f6           AMENA-01157         f6f0f375-ca91           AMENA-01157         0c008cec-3187           AMENA-01157         3d6a3b3d-61c7           AMENA-01158         e102d648-2234           AMENA-01158         a782029f-dbde           AMENA-01159         e43f4ee-685f-4           AMENA-01169         febcd384-ced9           AMENA-01171         febcd384-ced9           AMENA-01172         be11be4-37ea           AMENA-01172         fad9671-0c7c           AMENA-01172         fad9601-0c7c           AMENA-01172         ba89e0b2-0d69 | AMENA-01169 fe43f4ee-685f-4 Heritage Place<br>AMENA-01171 febcd384-eed9 Heritage Place<br>AMENA-01172 bee11be4-37ea Heritage Place<br>AMENA-01172 215b0307-6e92 Heritage Place<br>AMENA-01176 fada9671-0c7c Heritage Place | AMENA-01091babb7d58-f7afHeritage PlaceE36N34-31_000AMENA-01127e3c8bc8d-c7f6Heritage PlaceAÄ <sup>-</sup> n Akrine; E3AMENA-011576f60f375-ca91Heritage PlaceAkk9805; E36N3AMENA-011570c008cec-3187Heritage PlaceAyn Labwa; CroAMENA-011570c008cec-3187Heritage PlaceAyn Labwa; CroAMENA-011573d6a3b3d-61c7Heritage PlaceAaqbe; CrowAMENA-01158e102d648-2234Heritage PlaceE35N33-42_000AMENA-01159a782029f-dbdeHeritage PlaceBonatz_2002_36AMENA-01159eab370d8-5203Heritage PlaceBonatz_2002_36AMENA-01169fe43f4ee-685f-4Heritage PlaceAl-Moez Castle;AMENA-01172be11be4-37eaHeritage PlaceCastle of Toron;AMENA-0117215b0307-6e92Heritage PlaceE35N33-12_000AMENA-01172fada9671-0c7cHeritage PlaceDaÄ <sup>-</sup> aat el AatiAMENA-01178ba89e0b2-0d69Heritage PlaceE36N34-12_000AMENA-01178ba89e0b2-0d69Heritage PlaceBeit Aziz; Bziza; | AMENA-01091babb7d58-f7afHeritage PlaceE36N34-31_000Alternative RefeAMENA-01127e3c8bc8d-c7f6Heritage PlaceAÅ <sup>-</sup> n Akrine; E3Alternative RefeAMENA-011576f60f375-ca91Heritage PlaceAkv9805; E36N3Alternative RefeAMENA-011570c008cec-3187Heritage PlaceAyn Labwa; CrowAlternative RefeAMENA-011570c008cec-3187Heritage PlaceAaqbe; CrowAlternative RefeAMENA-011573d6a3b3d-61c7Heritage PlaceAaqbe; CrowAlternative RefeAMENA-01158e102d648-2234Heritage PlaceE35N33-42_000Alternative RefeAMENA-01159a782029f-dbdeHeritage PlaceBonatz_2002_36Alternative RefeAMENA-01159eab370d8-5203Heritage PlaceBonatz_2002_36Alternative RefeAMENA-01169fe43f4ee-685f-4Heritage PlaceAl-Moez Castle;Alternative RefeAMENA-01172be11be4-37eaHeritage PlaceCastle of Toron;Alternative RefeAMENA-01172be11be4-37eaHeritage PlaceE35N33-12_000Alternative RefeAMENA-01172bab960b2-0d69Heritage PlaceDaÄ <sup>-</sup> aat el AatiAlternative RefeAMENA-01178ba99e0b2-0d69Heritage PlaceE36N34-12_000Alternative RefeAMENA-01178ba99e0b2-0d69Heritage PlaceBeit Aziz, Bziza;Alternative RefeAMENA-0 | AMENA-01091babb7d58-f7afHeritage PlaceE36N34-31_000Alternative RefeFunerary/Memorial; Religious; hknownAMENA-01127é3c8bc8d-c7f6Heritage PlaceAÄ <sup>T</sup> n Akrine; E3Alternative RefeReligious;Religious;AMENA-011576f60f375-ca91Heritage PlaceAkk9805; E36N3Alternative RefeDefensive/Fortification; Domestic; Religious;AMENA-011570c008cec-3187Heritage PlaceAyn Labwa; CrowAlternative RefeReligious;AMENA-011573d6a3b3d-61c7Heritage PlaceAaqbe; CrowAlternative RefeReligious;AMENA-01158e102d648-2234Heritage PlaceE35N33-42_000Alternative RefeReligious;AMENA-01159a782029f-dbdeHeritage PlaceBonatz_2002_36Alternative RefeReligious;AMENA-01159eab370d8-5203Heritage PlaceBonatz_2002_36Alternative RefeReligious;AMENA-01171feb384-eed9Heritage PlaceAi-Moez Castle,Alternative RefeDefensive/Fortification; Domestic; Religious;AMENA-01172bee11be4-37eaHeritage PlaceCastle of Toron;Alternative RefeDefensive/Fortification; Domestic; Religious;Ade/CommercialAMENA-01172bee11be4-37eaHeritage PlaceE35N33-12_000Alternative RefeDefensive/Fortification; Domestic; Religious;Ade/CommercialAMENA-01172bee11be4-37eaHeritage PlaceE35N33-12_000Alternative R | AMENA-01091babb7d58-f7afHeritage PlaceE36N34-31_000Alternative RefeFunerary/Memorial; Religious; AnknownDefinite; DefinitAMENA-01127e363b63d-c7f6Heritage PlaceAÄ <sup>T</sup> n Akrine; E3Alternative RefeReligiousReligiousDefinite; DefinitAMENA-011576f607375-ca91Heritage PlaceAkk9805; E36N3Alternative RefeReligiousDefinite; ReligiousDefinite; High;AMENA-011570c008cec-3187Heritage PlaceAyn Labwa; CroAlternative RefeReligiousReligiousDefinite; High;AMENA-011573d6a3b3d-61c7Heritage PlaceAaqbe; CrowAlternative RefeReligiousReligiousDefinite; High;AMENA-01158102d648-2234Heritage PlaceAaqbe; CrowAlternative RefeReligiousReligiousDefinite;AMENA-01159782029f-dbdeHeritage PlaceBonatz_2002_36Alternative RefeReligiousReligiousDefinite; DefinitAMENA-01159febcd384-eed9Heritage PlaceSi5N33-32_000Alternative RefePefensive/Fortification; ReligiousDefinite; DefinitAMENA-01171febcd384-eed9Heritage PlaceSi5N33-32_000Alternative RefeDefensive/Fortification; ReligiousDefinite; DefinitAMENA-01172febcd384-eed9Heritage PlaceSi5N33-32_000Alternative RefeDefensive/Fortification; Domestic; Entertainment/Leisure; MilitaryDefinite; Defini |

We now want to mark these sites so we can easily find them again more easily. We will do this by creating a new field.

- Select all 17 "Religious" sites by selecting the row number next to the first, holding shift, and selecting the row number next to the last site.
- Then click the "Field Calculator" button.

| NA-01127 | 0db2fff3-87f6-4<br>babb7d58-f7af<br>e3c8bc8d-c7f6<br>6f60f375-ca91                                   | Heritage Place<br>Heritage Place<br>Heritage Place   | Asmar Jbeil; DA<br>E36N34-31_000   | Alternative Refe<br>Alternative Refe  | Defensive/Fortification; Domestic; Industrial/Productive; Religious;<br>Funerary/Memorial; Religious; Unknown  | Definite; Definit<br>Definite; Definit  |
|----------|--|--|--|---|--|---|
| NA-01127 | e3c8bc8d-c7f6  |  |  | Alternative Refe  | Funerary/Memorial: Religious: Unknown  | Definite: Definit.  |
| NA-01157 |  | Heritage Place   | A 7 - AL 1 - 52  |   |  |   |
|          | 6f60f375-ca91  |  | AÃ <sup>-</sup> n Akrine; E3   | Alternative Refe  | Religious  | Definite  |
| NA-01157 |  | Heritage Place   | Akk9805; E36N3   | Alternative Refe  | Defensive/Fortification; Domestic; Religious   | Definite; High;   |
|          | 0c008cec-3187  | Heritage Place   | Ayn Labwa; Cro   | Alternative Refe  | Religious  | Definite  |
| NA-01157 | 3d6a3b3d-61c7  | Heritage Place   | Aaqbe; Crow  | Alternative Refe  | Religious  | Definite  |
| NA-01158 | e102d648-2234  | Heritage Place   | E35N33-42_000  | Alternative Refe  | Religious  | Definite  |
| NA-01159 | a782029f-dbde  | Heritage Place   | Aaiha; E35N33  | Alternative Refe  | Religious  | Definite  |
| NA-01159 | eab370d8-5203  | Heritage Place   | Bonatz_2002_36   | Alternative Refe  | Religious  | Definite  |
| NA-01169 | fe43f4ee-685f-4  | Heritage Place   | E35N33-32_000  | Alternative Refe  | Defensive/Fortification; Religious; Trade/Commercial   | Definite; Definit.  |
| NA-01171 | febcd384-eed9  | Heritage Place   | Al-Moez Castle;  | Alternative Refe  | Defensive/Fortification; Domestic; Entertainment/Leisure; Military;  | Definite; Definit.  |
| NA-01172 | bee11be4-37ea  | Heritage Place   | Castle of Toron;   | Alternative Refe  | Defensive/Fortification; Domestic; Religious; Trade/Commercial   | Definite; High;   |
| NA-01172 | 215b0307-6e92  | Heritage Place   | E35N33-12_000  | Alternative Refe  | Religious  | High  |
| NA-01176 | fada9671-0c7c  | Heritage Place   | DaÃ <sup>-</sup> aat el Aati   | Alternative Refe  | Domestic; Religious  | High; High  |
| NA-01178 | ba89e0b2-0d69  | Heritage Place   | E36N34-12_000  | Alternative Refe  | Religious  | High  |
| NA-01337 | 2ebadad6-655e  | Heritage Place   | Beit Aziz; Bziza;  | Alternative Refe  | Religious  | Definite  |
| NA-01339 | 1ae3a71c-8a1e  | Heritage Place   | Bi'gat Mizpa; D  | Alternative Refe  | Defensive/Fortification; Religious   | High; High  |
|          | ENA-01159<br>ENA-01169<br>ENA-01171<br>ENA-01172<br>ENA-01172<br>ENA-01176<br>ENA-01178<br>ENA-01337 | NA-01159.         \$782029f-dbde           NA-01159.         eab370d8-5203           NA-01169.         fed3fde-685f-4           SNA-01171.         febcd384-eed9           SNA-01172.         be11be4-37ea           SNA-01172.         215b0307-6e92           SNA-01172.         15b0307-6e92           SNA-01172.         15b0307-6e92           SNA-01172.         15b0307-6e92           SNA-01176.         16d9671-0C7c           SNA-01178.         be89e0b2-0d69           SNA-01337.         2badad6-655e | NA-01159     782029f-dbde     Heritage Place       NA-01159     eab370d8-5203     Heritage Place       SNA-01159     feb370d8-5203     Heritage Place       SNA-01171     febcd384-eed9     Heritage Place       SNA-01172     bec11be4-37ea     Heritage Place       SNA-01172     bec11be4-37ea     Heritage Place       SNA-01172     bec11be4-37ea     Heritage Place       SNA-01172     be31be4-37ea     Heritage Place       SNA-01172     ba90o7-6e92     Heritage Place       SNA-01176     fab9601-0c7c     Heritage Place       SNA-01176     ba98ob2-0d69     Heritage Place       SNA-01178     ba98ob2-0d69     Heritage Place       SNA-01178     ba98ob2-0d69     Heritage Place | NA-01159         a7820291-dbde         Heritage Place         Aaiha; E35N33           NA-01159         eab370d8-5203         Heritage Place         Bonstz_2002.36           NA-01159         feb370d8-5203         Heritage Place         Bonstz_2002.36           SNA-01169         feb37de8-6854-4         Heritage Place         E35N33-32_000           SNA-01171         febc384-eed9         Heritage Place         Al-Moez Castle,           SNA-01172         bee11be4-37ea         Heritage Place         Castle of Toron,           SNA-01172         bee11be4-37ea         Heritage Place         E35N33-12_000           SNA-01172         15b9037-6622         Heritage Place         E35N33-12_000           SNA-01176         fada9671-0C7c         Heritage Place         DaÃ-at el Aati           SNA-01176         fada9671-0C7c         Heritage Place         E36N34-12_000           SNA-01378         bab9e0b2-0d69         Heritage Place         E36N34-12_000           SNA-01337         2babad6-655e         Heritage Place         Beit Aziz; Brizz; | NA-01159       a782029f-dbde       Heritage Place       Aaiha; £35N33       Alternative Refe         NA-01159       eab370d8-5203       Heritage Place       Bonatz_2002_36       Alternative Refe         NA-01159       eab370d8-5203       Heritage Place       Bonatz_2002_36       Alternative Refe         SNA-01159       feb370d8-5203       Heritage Place       E35N33-32_000       Alternative Refe         SNA-01171       febcd384-eed9       Heritage Place       Castle of Toron;       Alternative Refe         SNA-01172       bee11be4-37ea       Heritage Place       Castle of Toron;       Alternative Refe         SNA-01172       be511be4-37ea       Heritage Place       E35N33-12_000       Alternative Refe         SNA-01172       215b0307-6e92       Heritage Place       E35N33-12_000       Alternative Refe         SNA-01176       fada9671-0c7c       Heritage Place       Ba8 <sup>2</sup> aat el Aati       Alternative Refe         SNA-01177       ba89e0b2-0d69       Heritage Place       Ba84-12_000       Alternative Refe         SNA-01178       ba89e0b2-0d69       Heritage Place       Ba6N34-12_000       Alternative Refe         SNA-01337       2ebadad6-6558       Heritage | NA-01159       a782029f-dbde       Heritage Place       Aalia; E35N33       Alternative Refe       Religious         NA-01159       eab370d8-5203       Heritage Place       Bonatz_2002_36       Alternative Refe       Religious         SNA-01159       feb370d8-5203       Heritage Place       Bonatz_2002_36       Alternative Refe       Religious         SNA-01169       feb37d8-5203       Heritage Place       E35N33-32,000       Alternative Refe       Defensive/Fortification; Religious; Trade/Commercial         SNA-01171       febcd384-ed9       Heritage Place       Castle of Tororv       Alternative Refe       Defensive/Fortification; Domestic; Entertainment/Leisure; Military;         SNA-01172       bes11be4-37ea       Heritage Place       Castle of Tororv       Alternative Refe       Defensive/Fortification; Domestic; Religious; Trade/Commercial         SNA-01172       bes11be4-37ea       Heritage Place       E35N33-12,000       Alternative Refe       Religious         SNA-01175       fada9671-0c7c       Heritage Place       Da <sup>2</sup> aat el Aati       Alternative Refe       Religious         SNA-01176       fada9671-0c7c       Heritage Place       E36N34-12_000       Alternative Refe       Religious         SNA-01178       ba89e0b2- |



- In the Field Calculator type "Religious" for "Output field name"
  Change "Output field type" to "Text (string)".
  Type " 'Religious' " into the "Expression" box (you must include the single quotes).
  Click OK.

| <ul> <li>✓ Only update 17 selected features</li> <li>✓ Create a new field         <ul> <li>Update existing field</li> <li>Output field name Religious</li> <li>Output field length 10</li> <li>Precision 3</li> <li>Output field length 10</li> <li>Precision 3</li> <li>Expression Function Editor</li> </ul> </li> <li>Expression Function Editor</li> <li>() '\n'</li> <li>() Search</li> <li>Show Help</li> <li>Fow_number</li> <li>Aggregates</li> <li>Arrays</li> <li>Color</li> <li>Conditionals</li> <li>Conversions</li> <li>Date and Time</li> <li>Fields and Values</li> <li>Fuzzy Matching</li> <li>General</li> <li>General</li> </ul> | <b>Q</b> Field Calculator   |  | × |
|--|---|--|---|
| Create virtual field<br>Output field name Religious<br>Output field type Text (string)<br>Output field length 10 ‡ Precision 3 ‡<br>Expression Function Editor<br>= + - / * ^    ( ) '\r'<br>'Religious'<br>Conversions<br>Arrays<br>Conditionals<br>Conditionals<br>Conditionals<br>Conditionals<br>Conditionals<br>Fields and Values<br>Fields and Values<br>Fiels and Paths<br>Fuzzy Matching<br>General  |   | Update existing field  |   |
| Show Help          'Religious'       Show Help         'Religious'       row_number         Aggregates       Arrays         Color       Conditionals         Conditionals       Conditionals         Conditionals       Fields and Values         Fields and Values       Files and Paths         Fuzzy Matching       General   | Output field name     Religious       Output field type     Text (string)                             |  | - |
| 'Religious' <ul> <li>Aggregates</li> <li>Arrays</li> <li>Color</li> <li>Conditionals</li> <li>Conversions</li> <li>Date and Time</li> <li>Fields and Values</li> <li>Files and Paths</li> <li>Fuzzy Matching</li> <li>General</li> </ul>   |   | کے Search Show Help  |   |
| You are editing information on this layer but the layer is currently not in edit mode. If you click OK, edit mode will automatically be turned on.   | 'Religious'         Output preview: 'Religious'         You are editing information on this layer but | Aggregates<br>Arrays<br>Color<br>Conditionals<br>Conversions<br>Date and Time<br>Fields and Values<br>Files and Paths<br>Fuzzy Matching<br>General |   |



If you scroll to the last column in the Attribute Table, you will see that it is now the "Religious" column and that all the sites within it have the same label.

| ab | Prim_Name     | 3 =             |                 |            |                |            |            |            | Update Filtered | Update Selected |
|----|---------------|-----------------|-----------------|------------|----------------|------------|------------|------------|-----------------|-----------------|
|    | join_DIS_1    | join_CATCH      | join_UPLAN      | join_ENDOR | join_DIS_A     | join_ORD_S | join_ORD_C | join_ORD_F | join_HYBAS      | Religious 🔴     |
| 1  | .00000000000  | 36.75000000000  | 36.60000000000  | 0          | 0.472          |            |            |            | 2120000840      | Religious 🔴     |
| 2  | .20000000000  | 35.329999999999 | 593.2000000000  | 0          | 8.340000000000 | 3          |            | 6          | 2120746920      | Religious       |
| 3  | 200000000000  | 14.01000000000  | 14.00000000000  | 0          | 0.191          | 1          | 2          | 7          | 2120000860      | Religious       |
| 4  | 500000000000  | 9.190000000000  | 9.1999999999999 | 0          | 0.125          |            | 2          | 7          | 2120746920      | Religious       |
| 5  | .30000000000  | 49.549999999999 | 85.70000000000  | 1          | 0.74           | 2          | 3          | 7          | 2120768140      | Religious       |
| 6  | .10000000000  | 22.55000000000  | 184.8000000000  | 1          | 1.548000000000 |            |            | 6          | 2120768140      | Religious       |
| 7  | .10000000000  | 10.89000000000  | 55.50000000000  | 0          | 0.522          |            |            | 7          | 2120763000      | Religious       |
| в  | 90000000000   | 32.049999999999 | 32.10000000000  | 1          | 0.234          |            |            | 7          | 2120768230      | Religious       |
| 9  | 90000000000   | 22.35000000000  | 22.30000000000  | 1          | 0.193          |            |            | 7          | 2120768140      | Religious       |
| 10 | 400000000000  | 15.74000000000  | 15.40000000000  | 0          | 0.154          |            |            | 7          | 2120000740      | Religious       |
| 11 | 400000000000  | 15.74000000000  | 15.40000000000  | 0          | 0.154          |            |            | 7          | 2120000740      | Religious       |
| 12 | .10000000000  | 65.209999999999 | 65.20000000000  | 0          | 0.53           |            |            | 7          | 2120000630      | Religious       |
| 13 | .6000000000   | 27.48000000000  | 27.5000000000   | 0          | 0.234          |            |            | 7          | 2120000620      | Religious       |
| 14 | 40000000000   | 14.92000000000  | 14.90000000000  | 0          | 0.187          |            |            | 7          | 2120754500      | Religious       |
| 15 | .399999999999 | 21.69000000000  | 85.0000000000   | 0          | 1.095000000000 |            |            | 6          | 2121273270      | Religious       |
| 16 | .5000000000   | 32.119999999999 | 32.10000000000  | 0          | 0.434          |            |            | 7          | 2120000860      | Religious       |
| 17 | .10000000000  | 23.87000000000  | 23.899999999999 | 0          | 0.271          |            |            | 7          | 2120761990      | Religious       |

## • Click the Filter "Function" button and select "Show All Features"

| abo    | Prim_Name    |                                       |                  |            | 🗣 🔎 i 🖪 🖩      | , 💋 🧮 i 🚍 i |            |            | ▼ Update   | All Update Select |
|--------|--------------|---------------------------------------|------------------|------------|----------------|-------------|------------|------------|------------|-------------------|
|        | n_DIS_1      | join_CATCH                            | join_UPLAN       | join_ENDOR | join_DIS_A     | join_ORD_S  | join_ORD_C | join_ORD_F | join_HYBAS | Religious 🔵       |
|        | 999999999    | 19.5100000000                         | 202.500000000    | 0          | 2.62000000000  | 3           | 1          | 6          | 2120000850 | NULL 🔴            |
|        | 999999999    | 19.5100000000                         | 202.500000000    | 0          | 2.62000000000  | 3           | 1          | 6          | 2120000850 | NULL              |
|        | 0000000      | 14.3800000000                         | 14.199999999999  | 0          | 0.186          | 1           | 1          | 7          | 2120000840 | NULL              |
|        | 0000000      | 14.3800000000                         | 14.199999999999  | 0          | 0.186          | 1           | 1          | 7          | 2120000840 | NULL              |
|        | 999999999    | 19.5100000000                         | 202.500000000    | 0          | 2.62000000000  | 3           | 1          | 6          | 2120000850 | NULL              |
|        | 999999999    | 19.5100000000                         | 202.500000000    | 0          | 2.62000000000  | 3           | 1          | 6          | 2120000850 | NULL              |
|        | 999999999    | 19.5100000000                         | 202.500000000    | 0          | 2.62000000000  | 3           | 1          | 6          | 2120000850 | NULL              |
|        | 999999999    | 19.5100000000                         | 202.500000000    | 0          | 2.62000000000  | 3           | 1          | 6          | 2120000850 | NULL              |
|        | 00000000     | 14.38000000000                        | 14.199999999999  | 0          | 0.186          | 1           | 1          | 7          | 2120000840 | NULL              |
| )      | 999999999    | 19.51000000000                        | 202.500000000    | 0          | 2.62000000000  | 3           | 1          | 6          | 2120000850 | NULL              |
|        | 00000000     | 36.75000000000                        | 36.6000000000    | 0          | 0.472          | 1           | 1          | 7          | 2120000840 | Religious 🔴       |
| 2      | 999999999    | 2.65000000000                         | 216.9000000000   | 0          | 3.327000000000 | 3           | 1          | 6          | 2120000930 | NULL              |
| 2      |              | 18.02000000000                        | 18.0000000000000 | 0          | 0.24           | 1           | 2          | 7          | 2120746920 | NULL              |
| T      | Show All Fe  | eatures                               | 00               | 0          | 8.340000000000 | 3           | 1          | б          | 2120746920 | Religious         |
| u<br>T |              | ures Visible On Map                   | 99               | 0          | 8.867000000000 | 3           | 1          | 6          | 2120746920 | NULL              |
| T      | Show Edite   | d and New Feature                     | s 00             | 0          | 1.785000000000 | 2           | 1          | 6          | 2120000910 | NULL              |
|        | Field Filter |                                       | 00               | 0          | 14.77200000000 | 4           | 1          | 5          | 2120000950 | NULL              |
| T      |              | Filter (Expression)<br>er Expressions |                  |            | 0.045000000000 |             |            |            | 2120746020 |                   |

You will see that only the fields you selected have the "Religious" label.



We now want to repeat this process for settlement sites.

- Click the Filter "Show All Features" button and select "Field Filter" > "Interpreta[tion]".
- Type "Settlement" in the bottom box and press the Enter key.
- Select all the filtered records using the Shift key.
- Click the "Field Calculator" button.
- Create a "Settlement" text field.
- Type " 'Settlement' " into the "Expression" box and click OK.

| <b>Q</b> Field Calculator   | >  |
|---|--|
| ✓ Only update 196 selected features                                     |  |
| ✓ Create a new field  | Update existing field  |
| Create virtual field  |  |
| Output field name Settlement  |  |
| Output field type Text (string) 💌                                       |  |
| Output field length 10 <  |  |
| Expression Function Editor  |  |
| = + - / * ^    ( ) '\n'<br>'Settlement'<br>Output preview: 'Settlement' | Q Search       Show Help         row_number       •         • Aggregates       •         • Arrays       •         • Color       •         • Conditionals       •         • Conversions       •         • Date and Time       •         • Fields and Values       •         • Files and Paths       •         • Fuzzy Matching       •         • Geometry       • |
|   | OK Cancel Help   |



- Click the Filter "Interpreta[tion]" button and select "Show All Features".Click the "Edit" button to turn editing off.
- Click the "Deselect all" button to clear the selection.

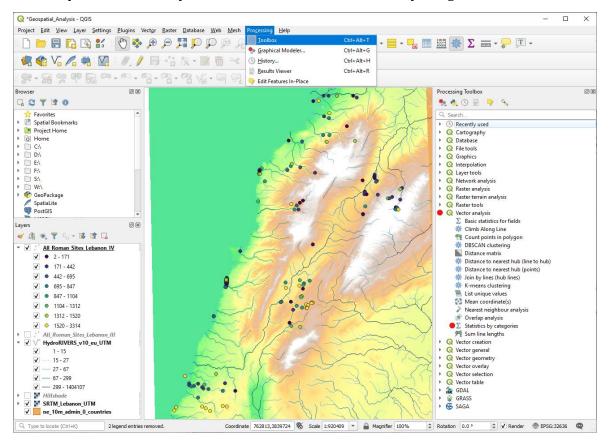
| /  | 72 📑 🔁        | 12 🖬 🔫 🖻        | 🛯   🗞 📒 🖺  | ) 🖳 🝸 🔳 🏘      | • 🗩 i 🔠 🐻 🖇 | 1 🗮 I 🚍 I 🗇 | Q.         |            |             |              |
|----|---------------|-----------------|------------|----------------|-------------|-------------|------------|------------|-------------|--------------|
| •  | join_CATCH    | join_UPLAN      | join_ENDOR | join_DIS_A     | join_ORD_S  | join_ORD_C  | join_ORD_F | join_HYBAS | Religious 🔴 | Settlement 🔴 |
| 1  | .5100000000   | 202.500000000   | 0          | 2.62000000000  | 3           | 1           | 6          | 2120000850 | NULL        | NULL         |
| 2  | .51000000000  | 202.500000000   | 0          | 2.62000000000  | 3           | 1           | 6          | 2120000850 | NULL        | NULL         |
| 3  | 1.38000000000 | 14.199999999999 | 0          | 0.186          | 1           | 1           | 7          | 2120000840 | NULL        | NULL         |
| 4  | 1.38000000000 | 14.199999999999 | 0          | 0.186          | 1           | 1           | 7          | 2120000840 | NULL        | Settlement 🔴 |
| 5  | .51000000000  | 202.500000000   | 0          | 2.62000000000  | 3           | 1           | 6          | 2120000850 | NULL        | NULL         |
| 6  | .5100000000   | 202.500000000   | 0          | 2.62000000000  | 3           | 1           | 6          | 2120000850 | NULL        | NULL         |
| 7  | .51000000000  | 202.500000000   | 0          | 2.62000000000  | 3           | 1           | 6          | 2120000850 | NULL        | NULL         |
| 8  | .51000000000  | 202.500000000   | 0          | 2.62000000000  | 3           | 1           | 6          | 2120000850 | NULL        | NULL         |
| 9  | 1.38000000000 | 14.199999999999 | 0          | 0.186          | 1           | 1           | 7          | 2120000840 | NULL        | NULL         |
| 10 | .51000000000  | 202.500000000   | 0          | 2.62000000000  | 3           | 1           | 6          | 2120000850 | NULL        | NULL         |
| 11 | i.75000000000 | 36.6000000000   | 0          | 0.472          | 1           | 1           | 7          | 2120000840 | Religious 🔴 | NULL         |
| 12 | 65000000000   | 216.900000000   | 0          | 3.327000000000 | 3           | 1           | 6          | 2120000930 | NULL        | Settlement 🔴 |

If you scroll to the right you will see that you now have two new fields with "Religious" and "Settlement" sites marked separately.



We are now going to calculate some statistics based on these two fields to try and answer our questions.

- On the Menu select "Processing" > "Toolbox".
- Expand "Vector analysis" and double-click on "Statistics by categories".



- Select your sites shapefile for "Input vector layer".
- For "Field to calculate statistics on" select "Elevation".
- For "Fields with categories" select "Religious".
- Click Run.

| Q Statistics by Categories   | ×  |
|--|--|
| Parameters       Log         Input vector layer         .* All_Roman_Sites_Lebanon_IV [EPSG:32636]         Selected features only         Field to calculate statistics on (if empty, only count is calculated) [optional]         1.2 Elevation_         Field(s) with categories         1 elements selected         Statistics by category         [Create temporary layer] | Statistics by categories This algorithm calculates statistics of fields depending on a parent class. |
| 0%   | Cancel   |
| Run as Batch Process   | Run 🔴 Close Help   |



A new table will be added to the Layers Panel.

• Right-click this table and select "Open Attribute Table".

|   |                  | tegory :: Features To |         |         | ~ ~ ~ ~       |       | -     |                |        | - □ >           |
|---|------------------|-----------------------|---------|---------|---------------|-------|-------|----------------|--------|-----------------|
| / |                  |                       | 🗈 🙋 🧮 📐 | 👆 🍸 🏋 🏘 | · 🔑   16 16 1 |       | Q.    |                |        |                 |
|   | Religious        | count                 | unique  | min     | max           | range | sum   | mean 🔴         | median | stddev          |
| 1 | Religious 🔴      | 17                    | 17      | 19      | 1370          | 1351  | 12041 | 708.2941176470 | 718    | 454.5632376515. |
| 2 | NULL 🔴           | 179                   | 114     | 2       | 2241          | 2239  | 91175 | 509.3575418994 | 32     | 659.1943411668. |
|   | •                |                       |         |         |               |       |       |                |        |                 |
|   |                  |                       |         |         |               |       |       |                |        |                 |
| 1 |                  |                       |         |         |               |       |       |                |        |                 |
|   | Show All Feature | _                     |         |         |               |       |       |                |        | 8               |

You will see that statistics have been calculated on the elevation of religious sites and non-religious sites.

We are most interested in the mean and median statistics.

- The 'mean' value is the average elevation of the sites in that group.
- The 'median' value is the middle value in the list of the elevations in that group.

In this case, both the mean and the median elevations are considerably higher for religious sites than the non-religious (NULL) sites. This helps us to answer the question of whether or not Roman religious sites are higher than other Roman sites: Roman religious sites are, on average, located at higher elevations than other Roman sites.

Now we are going to use the same method to answer our second question.

- Double-click again on "Statistics by categories" in the Processing Toolbox.
- Select your sites shapefile for "Input vector layer".
- For "Field to calculate statistics on" select "Distance".
- For "Fields with categories" select "Settlement".
- Click Run.
- Right-click the new table and select "Open Attribute Table".

| 6   | Statistics by ca | tegory :: Features To | otal: 2, Filtered: 2, Se | elected: 0       |                |                  |                |                 |                 | - 🗆             | ×  |
|-----|------------------|-----------------------|--------------------------|------------------|----------------|------------------|----------------|-----------------|-----------------|-----------------|----|
| 1   | 7 🛛 🖶 😋          | 11 <b>1</b> × 0       | ै। ६ 블 💟                 | 🔩 🍸 🔳 🏘          | P   🖪 🖪        | / 📰 😑 🗖          | Q.             |                 |                 |                 |    |
|     | Settlement       | count                 | unique                   | min              | max            | range            | sum            | mean 🔴          | median 🔴        | stddev          |    |
| 1 5 | Settlement 🔴     | 67                    | 67                       | 2.419844047987   | 2717.714564904 | 2715.294720856   | 52988.94606780 | 790.8797920567. | 640.6479862135. | 600.3689966436. | 2  |
| 2 / | NULL             | 129                   | 129                      | 5.63082972783527 | 3314.329634986 | 3308.69880525843 | 134604.2765018 | 1043.444003890. | 1013.281652896. | 726.8913982296. | 5. |
| Ĩ   |                  |                       |                          |                  |                |                  |                |                 |                 |                 |    |
|     |                  |                       |                          |                  |                |                  |                |                 |                 |                 |    |
| 4   |                  |                       |                          |                  |                |                  |                |                 |                 |                 | )  |
| 1   | Show All Feature | s 🖕                   |                          |                  |                |                  |                |                 |                 | 8               |    |

Notice that both the mean and median values for Settlement sites are considerably higher than for non-settlement (NULL) sites. Therefore, we can conclude that our Roman settlement sites are closer to river channels on average than non-settlement sites!



If we want to keep our results we need to save them.

- Right-click the newest table and select "Make permanent".
- For file-type select "MS Office Open XML Spreadsheet".
- Click the Browse button [...] and save it in the Geospatial folder and click OK.

| Format                     | MS Office Open XML spreadsheet [XLSX] |                   |                                       |       |  |  |   |   |  |  |
|----------------------------|---------------------------------------|-------------------|---------------------------------------|-------|--|--|---|---|--|--|
| File name W:\Desktop\GIS\@ |                                       | S\Geospatial\Sett | Geospatial\Settlement_Statistics.xlsx |       |  |  |   |   |  |  |
| Layer name                 | Settlement_Statistics                 |                   |                                       |       |  |  |   |   |  |  |
| Encoding                   |                                       |                   | (                                     | UTF-8 |  |  | Ŧ | ) |  |  |
| ▼ Layer                    | Options                               |                   |                                       |       |  |  |   |   |  |  |
| OGR_XLS                    | X_FIELD_TYPES                         | AUTO              |                                       |       |  |  | • |   |  |  |
| OGR_XLS                    | X_HEADERS                             | Αυτο              |                                       |       |  |  | • |   |  |  |
| ▼ Custor                   | n Options                             |                   |                                       |       |  |  |   |   |  |  |
| Data sour                  | ce                                    |                   |                                       |       |  |  |   |   |  |  |
|                            |                                       |                   |                                       |       |  |  |   |   |  |  |

• Repeat for the other table

You can now also open these files in Excel or other spreadsheet software if you want.

**PRACTICE:** use this method to calculate the average upstream catchment area for a site category of your choice.

**ACTIVITY:** set yourself some questions relating to elevation and/or hydrology from your data and answer them using these simple geospatial analyses.