

MBL617 Theory and Methods in Digital Heritage

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Chapter 1

Syllabus

1.1 Content

The course is an introduction to **Digital Heritage** and has a two-fold purpose. In addition to giving an overview of theories and principles in digital heritage, both in Turkey and internationally, the course gives an introduction to research methods in three areas related to cultural heritage: **collection/management**, **visualization/communication**, and **analysis/ interpretation**.

1.2 Aims

To help students understand the link between cultural heritage and computing; to introduce key issues in digital heritage; to provide students with the basic theoretical and practical knowledge of digital methods such as GIS, AR/VR, AI.

1.3 Learning outcomes

Students who take this course gain will knowledge, ability and proficiency in the following subjects:

- Knowledge of historical, contemporary and specialized issues in the area of visual computation through original research,
- Understanding of the interdisciplinarity of computation in cultural heritage,
- Ability to assess methods and applications of digital heritage through systematic approaches,

- Ability to assess and apply research methodology,
- Competence in creative and critical thinking, problem-solving and decision making.

1.4 Conduct

The course will be conducted as seminars with weekly readings and assignments. During the course of the semester, students are required to submit written and practical assignments as requested by the instructors during class, and one final paper, based on either literature research or an original argument, and an in-class presentation of the final paper at the semester end. The essays submitted throughout the semester are to constitute the basis for the final paper; these should take into account class discussions, as well as students' own reflections. The final paper should be around 3000 words and structured with an introduction, development, and conclusion. The grading for the course is as follows: attendance and in-class participation in discussions and weekly response papers, 30%; hands-on practices, 30%; one end-of-semester paper, 20%; final project presentation by individual/group 20%.

1.5 Project

The collective efforts of the course participants will be part of a digital heritage project on Caravanserais of Anatolia. **All works will be uploaded to the website.**

1.6 Weekly Schedule

Chapter 2

Quick Start to QGIS

2.1 Installing QGIS

There are two options for installation:

- * OSGeo4
- * Standalone Installer

2.2 Familiarizing yourself with QGIS Desktop

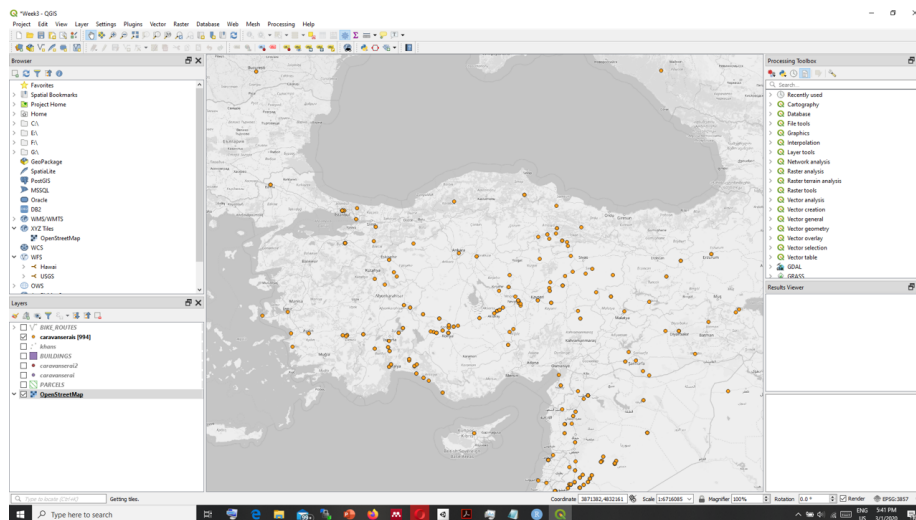


Figure 2.1: QGIS GUI

1. Menu Bar
2. Toolbars
3. Panel
4. Map Canvas
5. Status Bar

Chapter 3

Vector Data

3.1 Types of vector data in QGIS

- Points
- Lines
- Polygons

layer > add layer > add vector layer

- File
- Folder
- Database
- Protocol

Files that can be loaded as vector files:

- Geopackage
- ESRI Shapefile
- Geography Markup Language
- CSV
- ...

WFS data example: [https://mrdata.usgs.gov/services/wfs/ofr20051294?
request=GetCapabilities&service=WFS&version=1.1.0](https://mrdata.usgs.gov/services/wfs/ofr20051294?request=GetCapabilities&service=WFS&version=1.1.0)

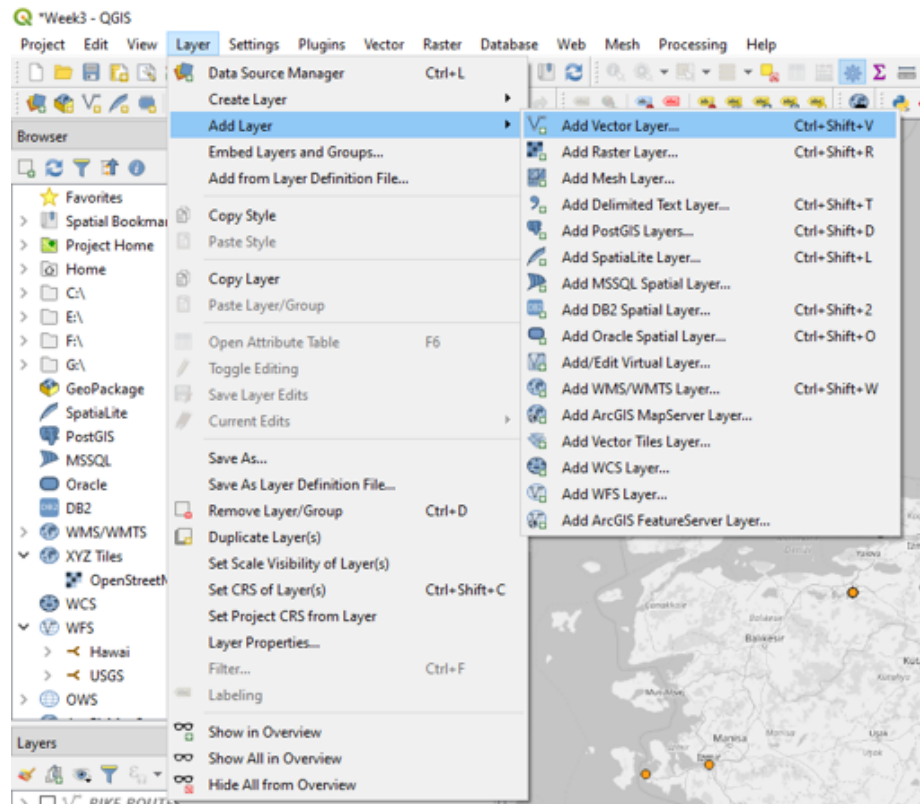


Figure 3.1: Adding Vector Layer

Chapter 4

Raster Data

- Image based
- Georeferencing
- TIFF

layer > add layer > add Raster layer

4.1 CRS - Coordinate Reference Systems

- 4326 – Google Earth
 - Degrees – lat long
 - globe
- 3857 – Google Maps
 - Meters
 - map
- Many others

4.2 Raster File types

4.2.1 WMS

WMS - Web map services: <https://mrdata.usgs.gov/services/ofr20051294?request=GetCapabilities&service=WMS&version=1.3.0>

4.2.2 DEM - Digital Elevation Model

DEM is special satellite image that represents elevation of the terrain in a raster graphic. Every pixel value represents elevation on the terrain.

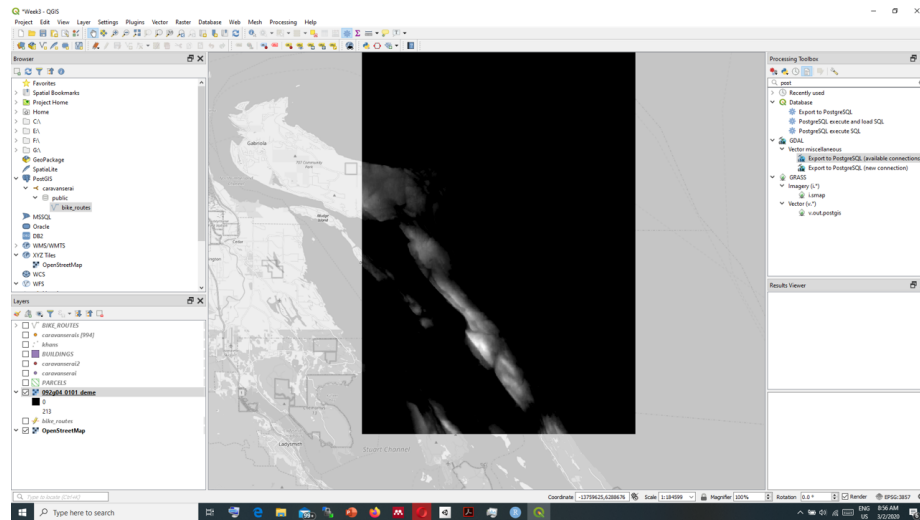


Figure 4.1: DEM

We can add DEM images similar to other raster files.

We can convert raster DEM files to vector contour lines.

GDAL>Raster extraction>Contour

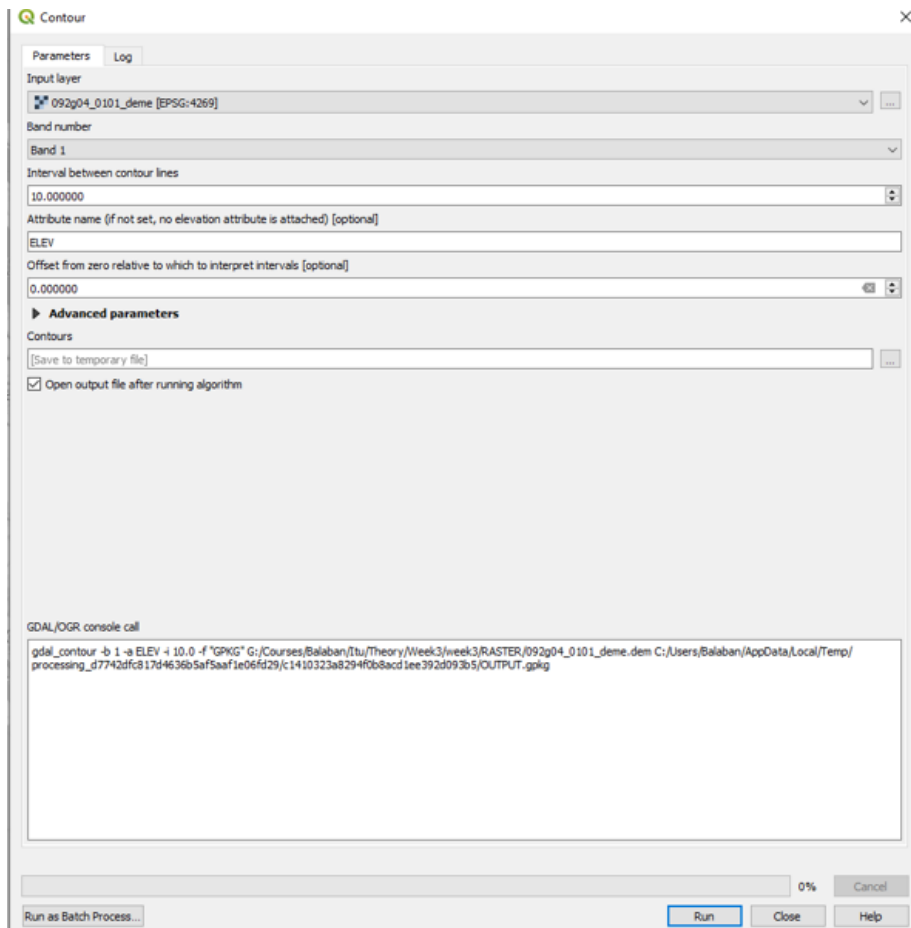


Figure 4.2: Contour

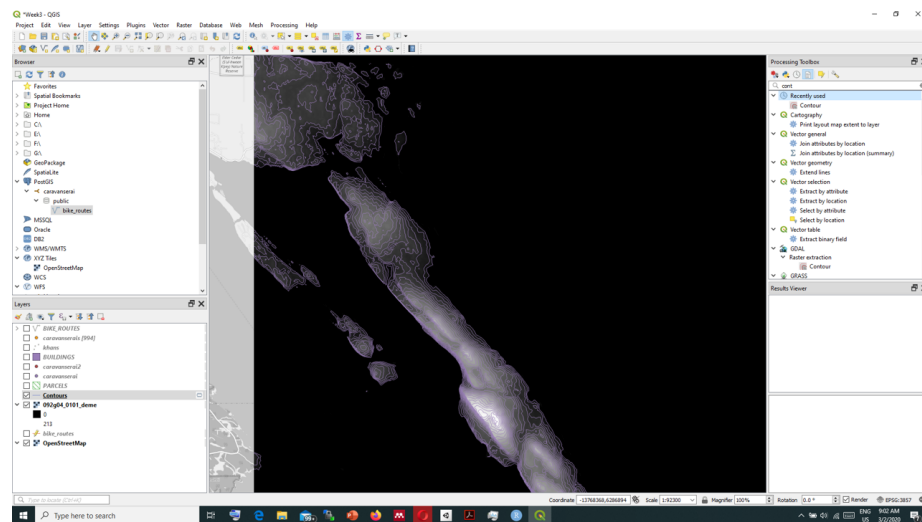


Figure 4.3: After extracting the contours

Chapter 5

3D Maps

We can create 3D maps to visualize the map in 3D. To do this

View >New 3D Map

That opens up a new window with 3D view. You can adjust, pan, zoom to the map.

We can make the vectors from the buildings into 3D objects. For this go to 3D View from layer Properties. Select extrusion and you can set one value for every polygon. Or you can assign a variable by clicking to the icon at the right and setting a variable for extrusion.

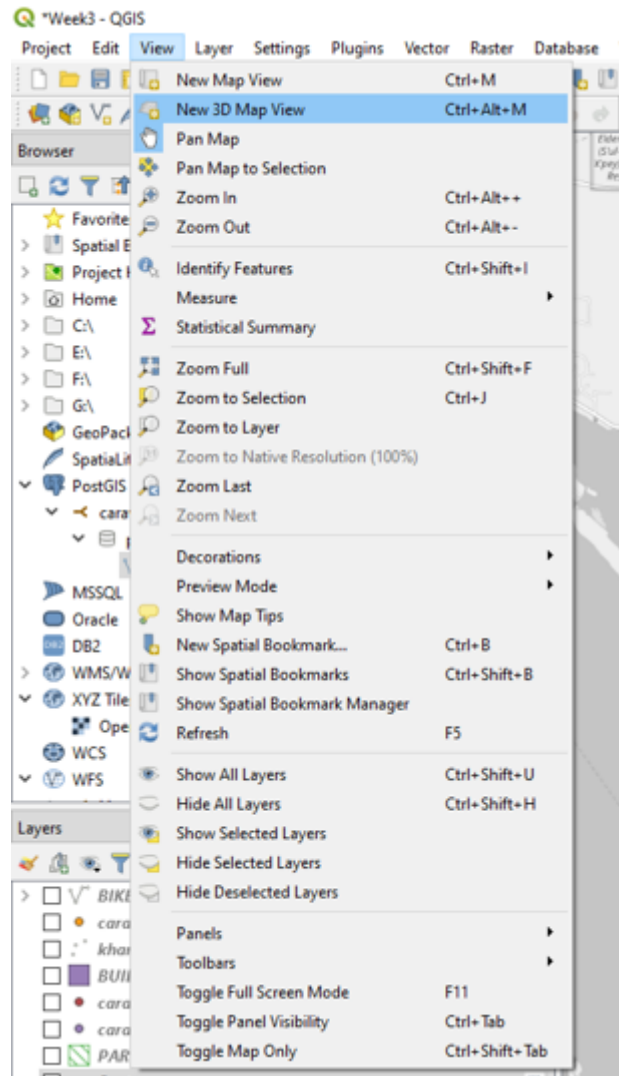


Figure 5.1: Adding 3D Map

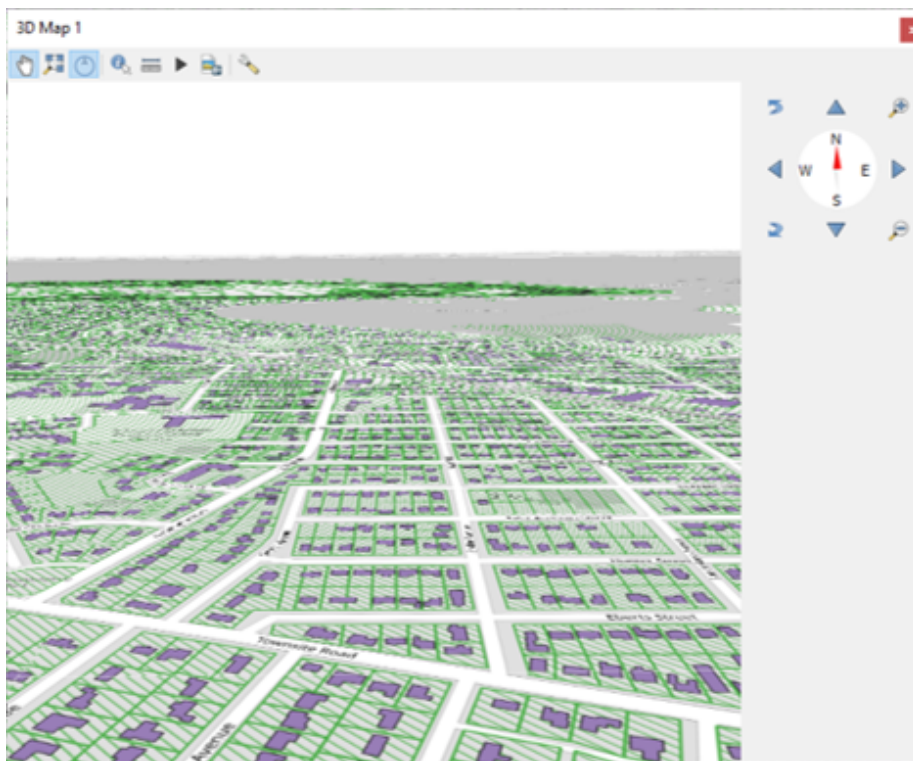


Figure 5.2: 3D Map Example

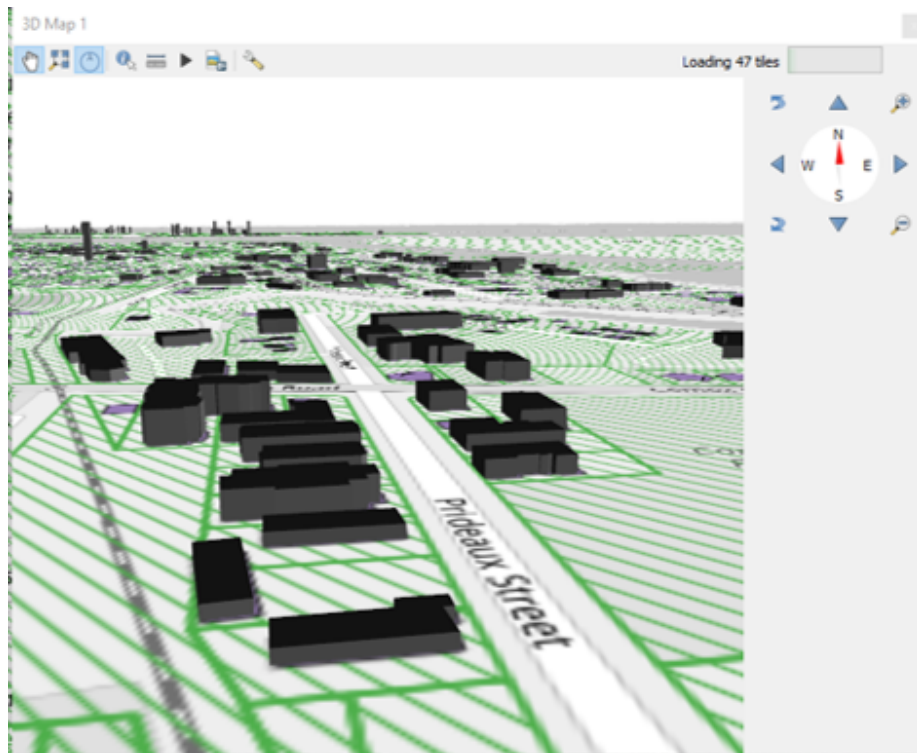


Figure 5.3: 3D Map Example with 3D polygons

Chapter 6

Styling Data

QGIS is very flexible in styling data. We can style our layers to visualize the information better.

6.1 Points

6.2 Polylines

6.3 Polygons

6.4 Raster

Chapter 7

Printing Maps

Chapter 8

Creating Data

Chapter 9

Databases

9.1 Connection to POSTGIS using SSL

QGIS has an ability to connect to various different databases. Geopackage, Oracle Spatial, PostGIS, SpatiaLite.

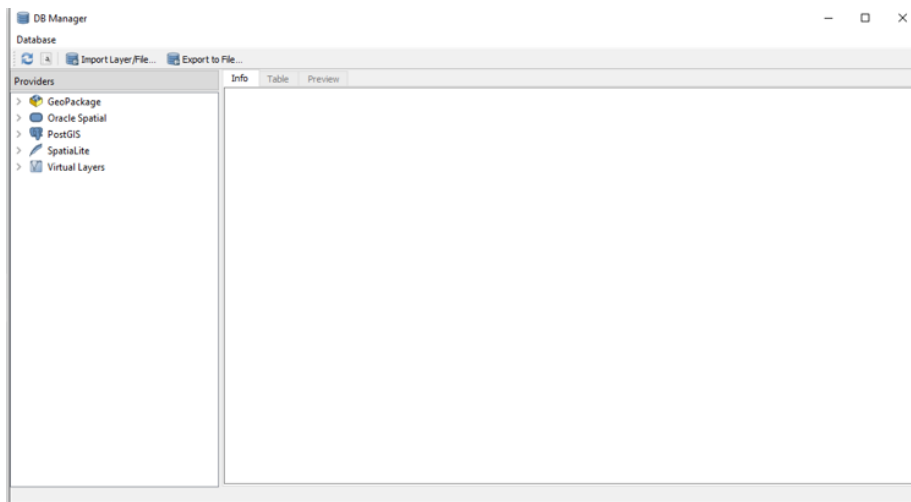


Figure 9.1: Databases that can be connected through QGIS

We are going to use PostGIS in our projects.

PostGIS is the geographic extension of the database management system, PostgreSQL, which allows us to store geographic objects as part of our data tables. A geographic object is a special

type of data that allows us to store a geographic position or a set of them as part of a line or a polygon. Essentially, PostGIS is a powerful tool that enables you to handle complex geographical data and visually explore this data when you use it along with graphical tools, such as QGIS.

We will be hosting our PostGIS database using Google Cloud. To access it we need to connect using SSL. (However, the eduroam connection in the campus prevents us to use the port 5432 which is the usual postgresQL port so we need to use out of the ITU network)

To connect you will need to download 3 certificate files. `server-ca.pem`, `client-cert.pem`, `client-key.pem`. Download these files and place them to a folder that is accesible.

From processing toolbox click the right most icon, **options**.

From the menu select **Authentication**.

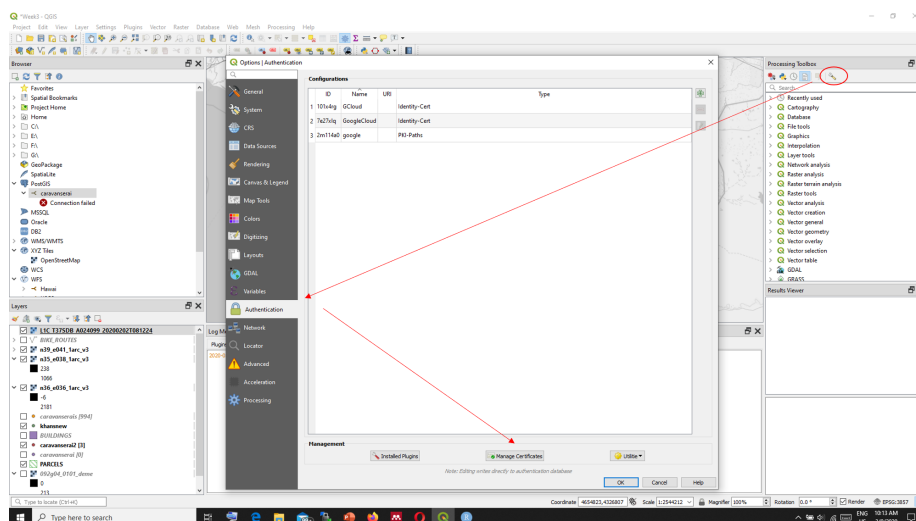


Figure 9.2: Manage Certificates

And next select **manage certificates**.

Here from the authorities tab, click + to add Google Cloud certificate.

Here from the import certificate menu, click ... icon and locate your `server-ca.pem` file.

Back from the certificate manager screen click to the identities tab and click + icon.

From the import identity screen, select PKI PEM/DER Certificate Paths. For cert select `client-cert.pem` and for key select `client-key.pem`.

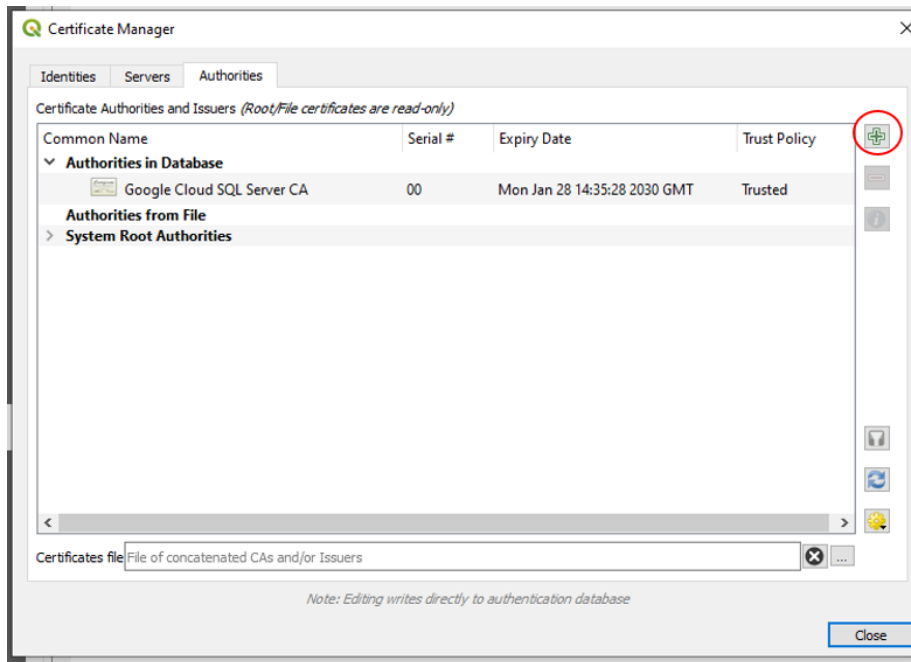


Figure 9.3: Certificate Manager

Next, close the identity screen and from the Authentication screen click + icon.

From the dialogue box, select PKI stored identity certificate, and select the certificate that you have created (editor). write a name (eg. Google Cloud) and save.

Now close the windows and from the browser panel select PostGIS and right click and select new connection.

Here you need to enter information required to setup a connection to our server. Fill out the information as following:

The username and password for our database is **editor** and **123post**. After this step we will be connected to the server.

Server connections work similar to the layers. If you have a geospatial data you can import or export to the database.

For this project, we need to have a database of caravanserais as point geometries and we need topography information as vector layer.

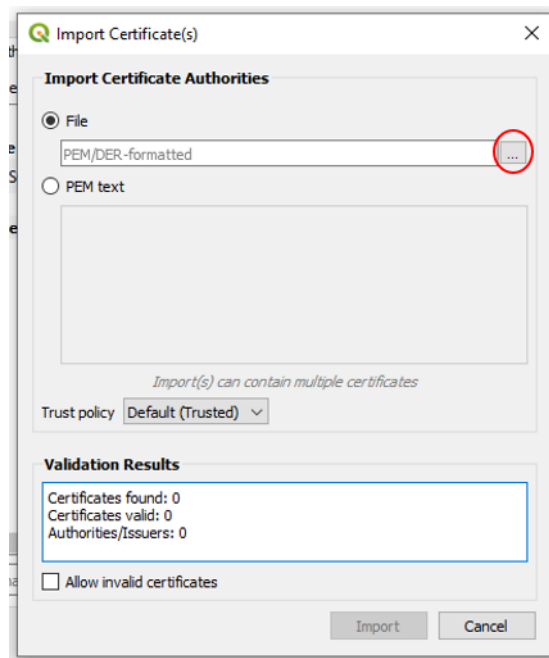


Figure 9.4: Import Certificate

9.2 Introduction to POSTGIS

After connecting to the database, you can see our two tables `iran_han` and `turk_han` on the left side of the screen.

POSTGIS database uses SQL Structured Query Language , to create the table `turk_han` I used the following SQL query (Showing this for you as a reference you dont need to do this, I already created our tables.)

```
CREATE TABLE turk_han ( id serial,
common_names character(30),
alternative_names character(100),
village character(30),
district character(30),
province character(30),
date character(30),
reference varchar,
layer character(10),
the_geom geometry,
CONSTRAINT turk_pkey PRIMARY KEY (id) );
```

To insert a new feature/han we need to run a sql query. Below you can see an

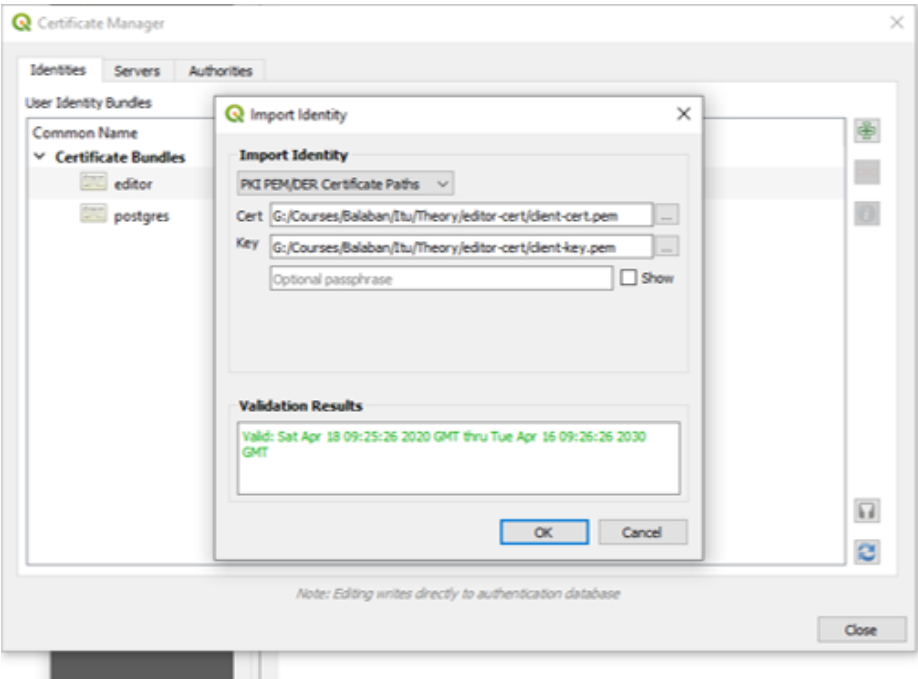


Figure 9.5: Import Identities

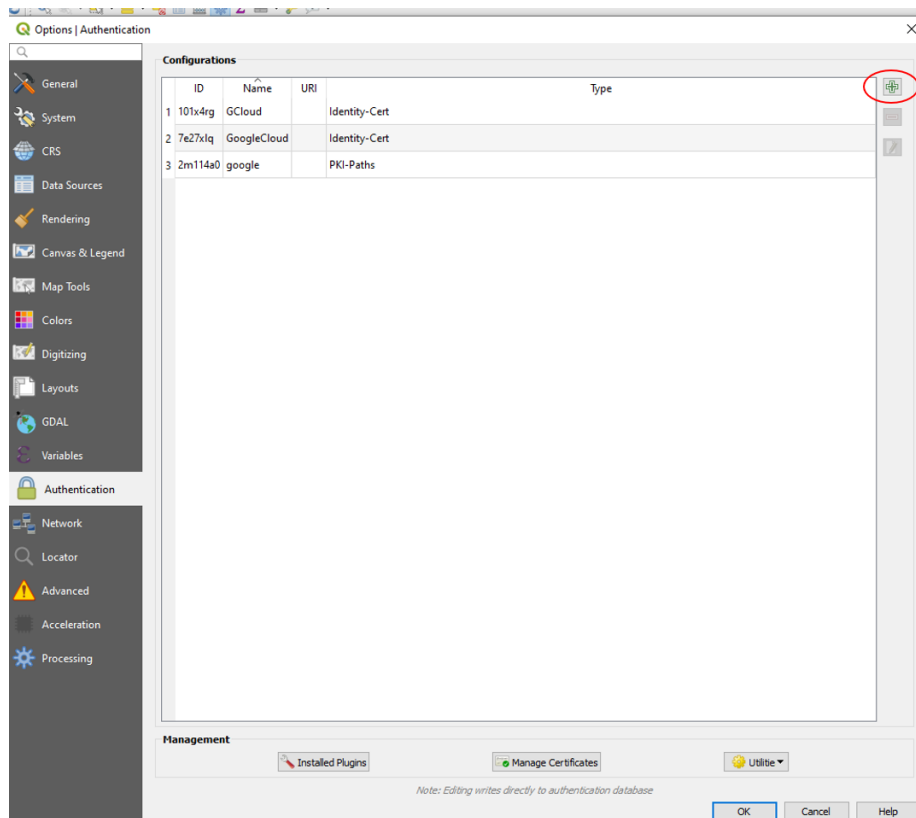


Figure 9.6: Authentication window



Figure 9.7: Authentication Dialogue Box

example feature.

```
INSERT INTO turk_han (common_names,
alternative_names,
village,
district,
province,
date,
reference,
layer,
the_geom)
VALUES ('Alacahan Kervansaray1', NULL, 'Alacahan', 'Kangal', 'Sivas', '1150-1180', NULL, 'VAR', S
```

To update data you need to first find the id of the feature that you want to change. For this you can use SELECT query.

```
SELECT * FROM turk_han
WHERE common_names = 'Alacahan Kervansaray1';
```

For example this query brings all the entries that has common_name as Alacahan Kervansaray1. For example, to update its location you can use the query below.

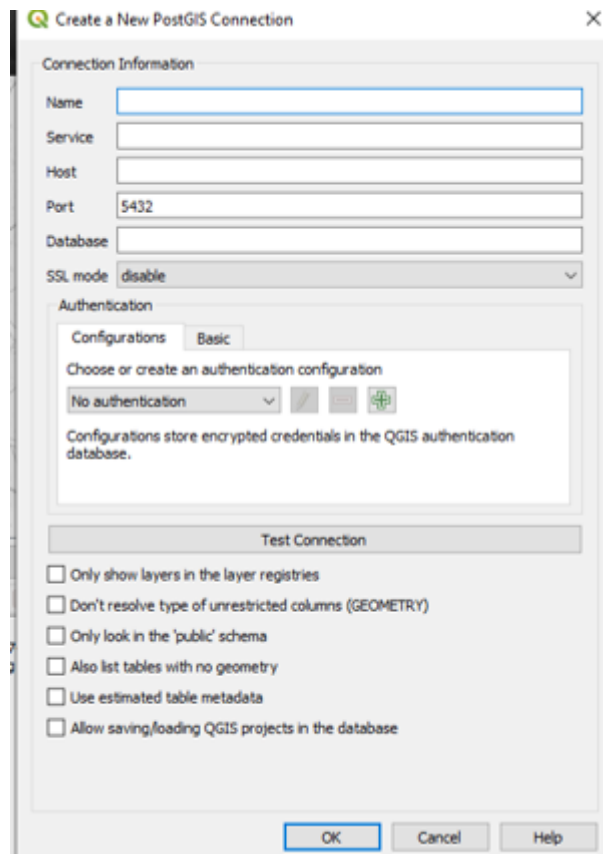


Figure 9.8: PostGIS server settings

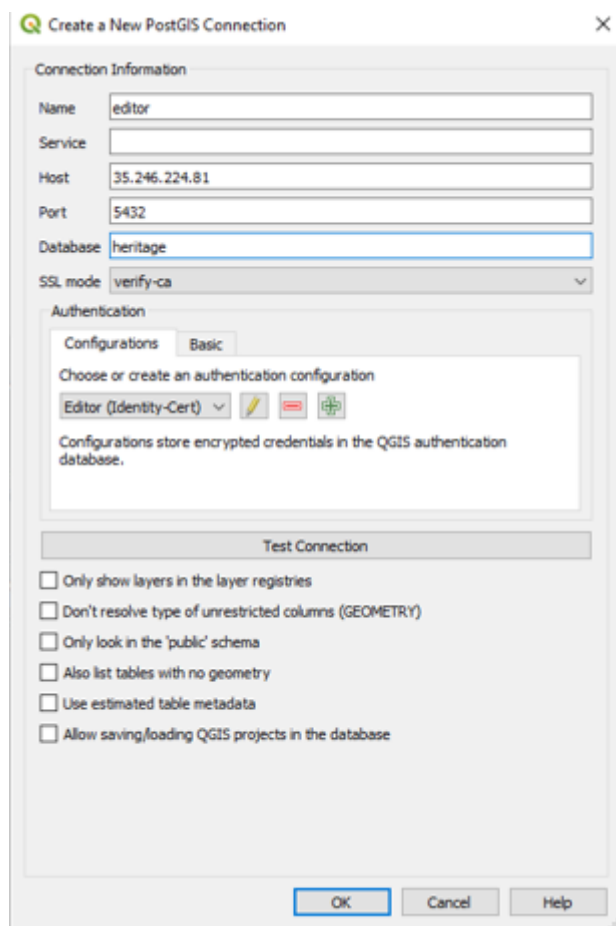


Figure 9.9: PostGIS information

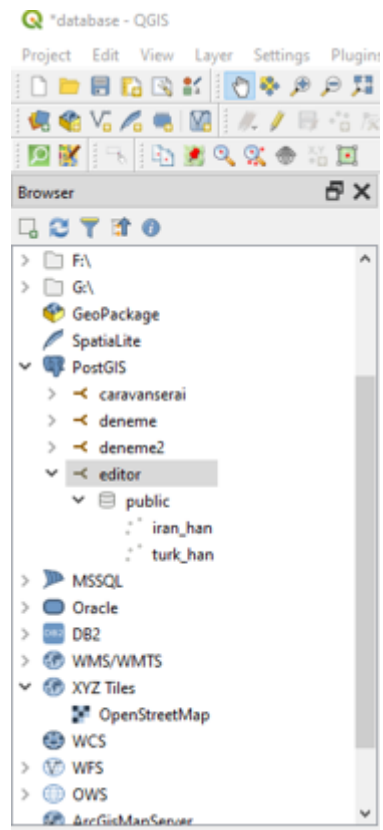


Figure 9.10: PostGIS Connection

```
UPDATE turk_han
SET the_geom = ST_GeomFromEWKT('SRID=4326;POINT(37.5975095 39.10587)')
WHERE
    id = 4;
```

To see longitude we can run another query:

```
SELECT common_names, ST_X(the_geom::geometry) AS longitude FROM turk_han;
```


Chapter 10

Assignment

You have been collecting data from the written resources. The primary resources were:

- International database on caravanserais, OWTRAD
- Academic publications, ACUN, ERDMANN, ILTER, CEKUL, etc..
- Websites by travelers, TURKISHHANS

You have been using QGIS, Google Earth, Gsheet, Gdrive to structure the data. As our approach is rather Geotemporal, for the next step, you will be using the central database of QGIS.

Next step will to explore the ACCURACY of the data:

- Level 1: REGISTERED HISTORICAL BUILDINGS (TESCILLI BINALAR) by Ministry of Culture and Tourism, State Museums/Sites (Müzeler ve Ören Yerleri), Local Authorities (Belediyeler):
 - <https://www.kulturportali.gov.tr/>
 - <https://muze.gov.tr/muzeler>
- Level 2: Researched Historical Buildings by Local and Academic Authorities. ÇEKÜL: <https://www.cekulvakfi.org.tr/> International Universities Local/National Universities
- Level 3: Travelers, Touristic Informations, Locals
- Level 4: Digital Tools and Methods

Table 10.1: Assigned Areas

n	location	name
1	Bursa - Konya	AYS
2	Denizli- Alanya- Konya	TAN
3	Mersin - Aksaray- Konya	NUR
4	Konya - Aksaray - Nevsehir	BEG
5	Sakarya - Kayseri- Sivas	SUM
6	Sinop - Sivas - Malatya	VAR
7	Urfa - Kayseri	CEM
8	Mardin - Sivas	FEY-GUL
9	Igdir - Sivas	SEN
10		SAT
11		NIM
12		SEP

10.1 Collecting the data & Creating the layer

First step for this assignment is to gather the location info for the caravanserais that you are assigned.

Create a GeoPackage layer.

Layer>Create Layer>New GeoPackage Layer...

After creating an empty geopackage layer, we are going to create our caravanserais as points.

Right click on the created layer and select **Open Attribute Table**.

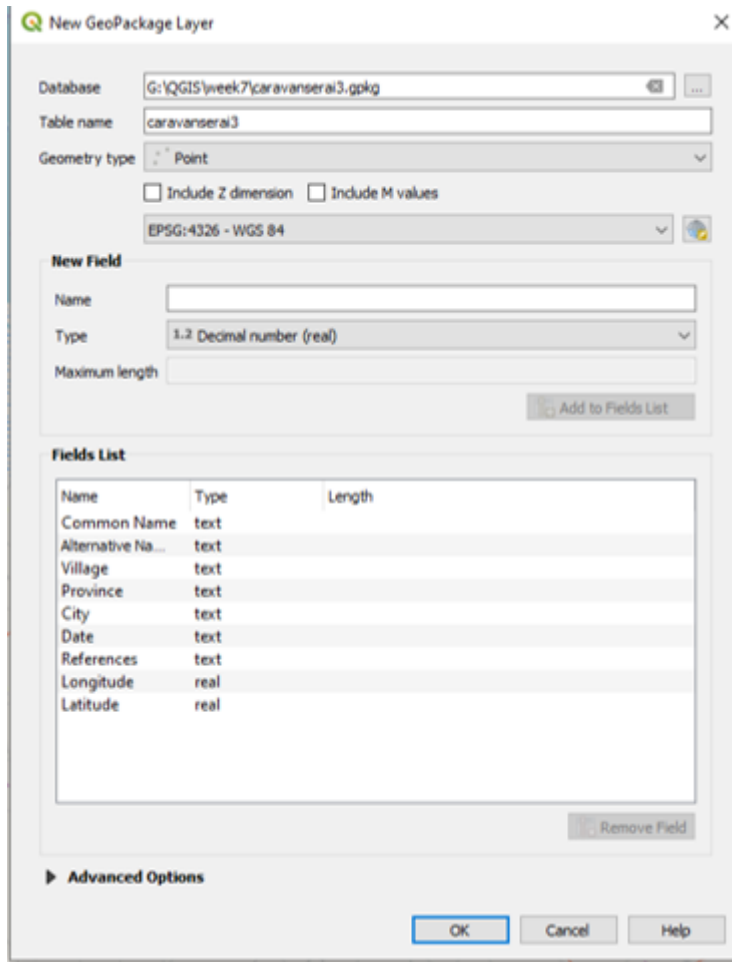
Here you can see our empty table we need to create as many fields as we require. We will at least require Name field as text and Longitude and Latitude as decimal fields. In this table to edit the layer we need to click on the **Toggle Editing mode** icon. Enter the fields with the collected data.

After creating all the features in our table we need to create the point geometries that is on the coordinates that we entered. For this, we are going to use **Create points layer from table** from processing toolbox.

After creating an empty geopackage layer, we are going to create our caravanserais as points.

Right click on the created layer and select **Open Attribute Table**.

Here you can see our empty table we need to create as many fields as we require. We will at least require Name field as text and Longitude and Latitude as decimal fields. In this table to edit the layer we need to click on the **Toggle Editing mode** icon. Enter the fields with the collected data.



New GeoPackage Layer

Database: G:\QGIS\week7\caravanserai3.gpkg

Table name: caravanserai3

Geometry type: Point

☐ Include Z dimension ☐ Include M values

CRS: EPSG:4326 - WGS 84

New Field

Name:

Type: 1.2 Decimal number (real)

Maximum length:

Add to Fields List

Fields List

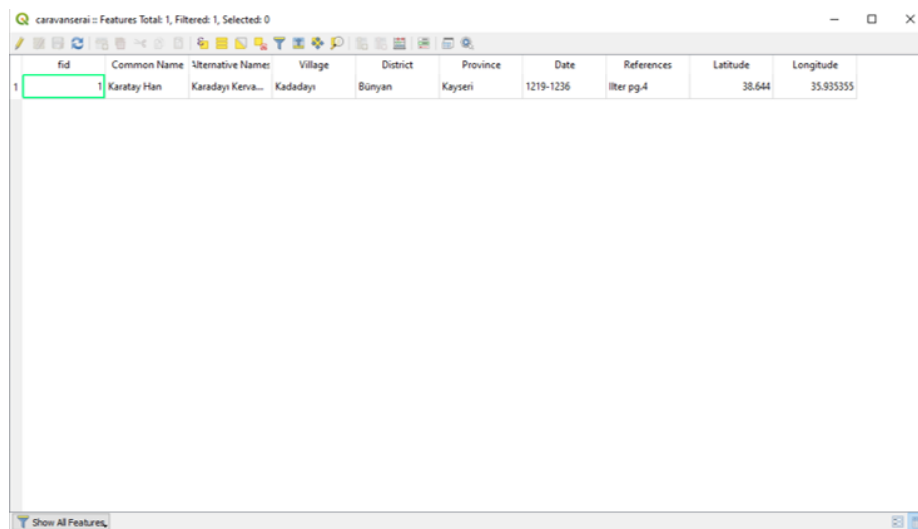
Name	Type	Length
Common Name	text	
Alternative Na...	text	
Village	text	
Province	text	
City	text	
Date	text	
References	text	
Longitude	real	
Latitude	real	

Remove Field

► Advanced Options

OK Cancel Help

Figure 10.1: Create GeoPackage Layer

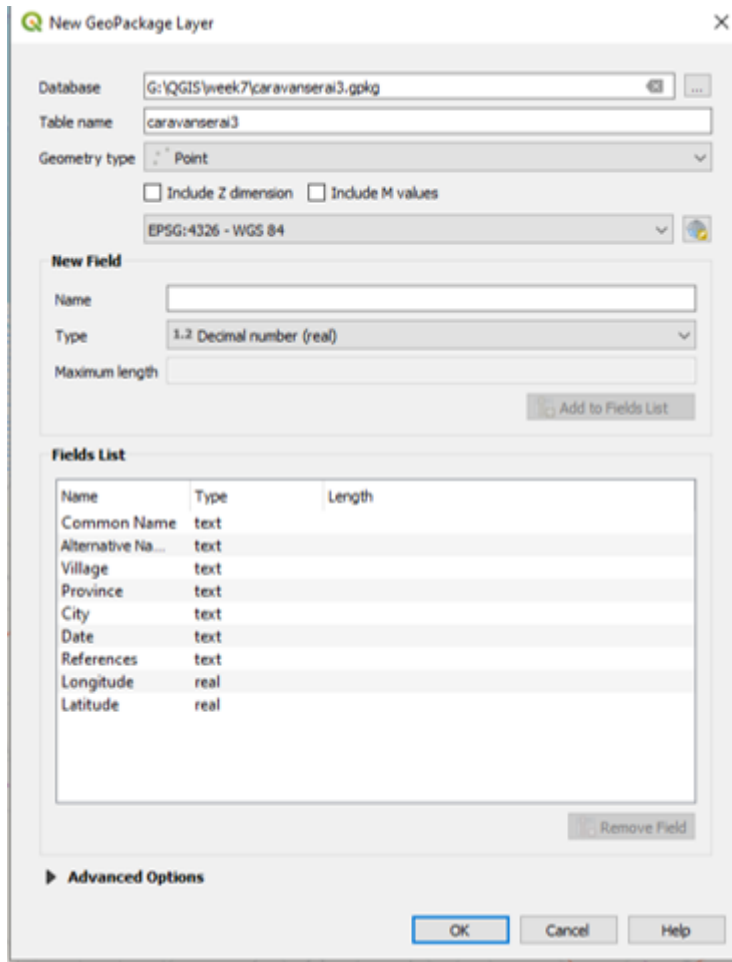


caravanserai : Features Total: 1, Filtered: 1, Selected: 0

fid	Common Name	Alternative Name	Village	District	Province	Date	References	Latitude	Longitude
1	Karatay Han	Karadayı Kervan...	Kadadayı	Bünyan	Kayseri	1219-1236	İlter pg.4	38.644	35.935355

Show All Features

Figure 10.2: Create GeoPackage Layer



New GeoPackage Layer

Database: G:\QGIS\week7\caravanserai3.gpkg

Table name: caravanserai3

Geometry type: Point

☐ Include Z dimension ☐ Include M values

CRS: EPSG:4326 - WGS 84

New Field

Name:

Type: 1.2 Decimal number (real)

Maximum length:

Add to Fields List

Fields List

Name	Type	Length
Common Name	text	
Alternative Na...	text	
Village	text	
Province	text	
City	text	
Date	text	
References	text	
Longitude	real	
Latitude	real	

Remove Field

► Advanced Options

OK Cancel Help

Figure 10.3: Create GeoPackage Layer

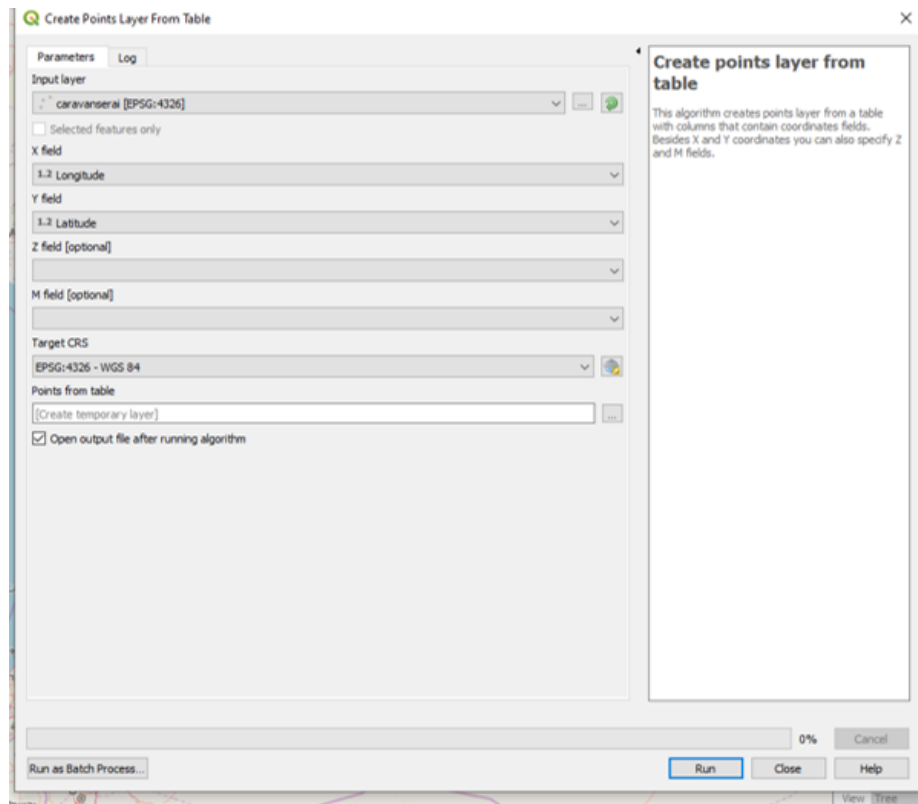


Figure 10.4: Create Points Layer from table