

# TerraMapper

## User manual

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2021

## Introduction

TerraMapper is a free mobile GIS application that allows the user to collect geospatial data in the field using a mobile device. It is developed for the Android operating system. The application supports the creation of new vector data layers and the editing of attributes for existing data layers. The application supports the display of raster data layers, which serve as basemaps. In addition to predefined layers, it is also possible to add new raster layers as a basemap. The mobile application is based on the projects that are standardly used in GIS software. Each project must have a defined name and coordinate system, and the geometry type (point, line, polygon) of the data layer is required as well. The mobile application is connected to a database that can be edited in any GIS software. Testing of database preparation was performed in QGIS and ArcGIS software. The database uses the PostGIS database system. The mobile application was developed mainly as a support for field mapping. The mobile application is linked to a database. This allows data preparation for mapping in the desktop version of the GIS software, and after logging in to an external database accessible via the Internet, it is possible to migrate data to a mobile application and perform measurement or editing of attributes in the field. The mobile application allows you to work in two modes - online and offline. An internet connection is only required to log in to the application and database. The data collection itself can take place in online / offline mode. When switching to offline mode, the data layers are stored in the storage of the mobile device. When reconnecting to the Internet, it is possible to migrate all data layers or the entire project from the mobile device to the database. Subsequently, it is possible to reconnect to the database via the desktop interface of the GIS software.

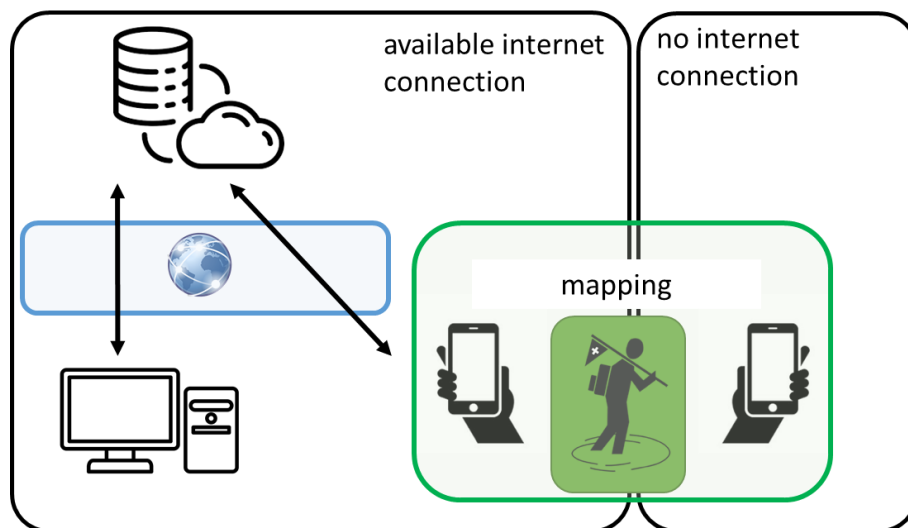


FIG. 1 Scheme of mobile application operation in online and offline mode.

The mutual connection of GIS software and database system enables efficient migration of data layers, as well as data sharing between multiple users. The basic component of this architecture for the mobile application is a database system that allows the transfer of data layers between the desktop GIS software and the TerraMapper mobile application.

## 1. User authentication and creation of a new project in a mobile application

Access to the TerraMapper application is secured by user authentication via login details. Currently, several user credentials are created and distributed among users. This is to ensure the security of access to the database. After turning on the application, the start page will be displayed, where you need to enter the login name and password, as well as select the language of the application.

*Note: When authenticating a user in the Terra mapper application, it is necessary to work in online mode.*

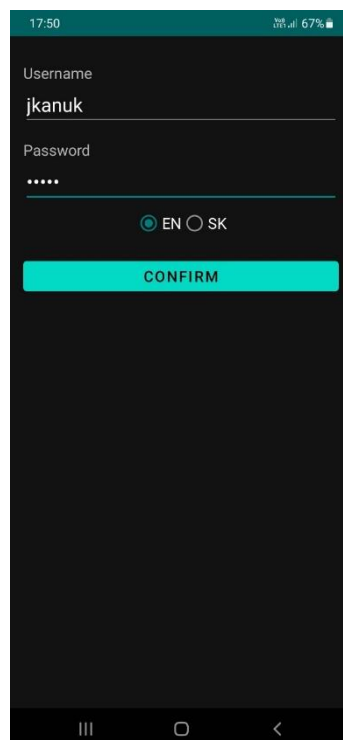


FIG. 2 TerraMapper home page for user authentication.

After successful authentication, the user creates a new project or opens an existing project. The creation of a new project is realized via the NEW PROJECT button. It is necessary to define the name and coordinate system for the new project, or an additional description and then save it (SAVE).

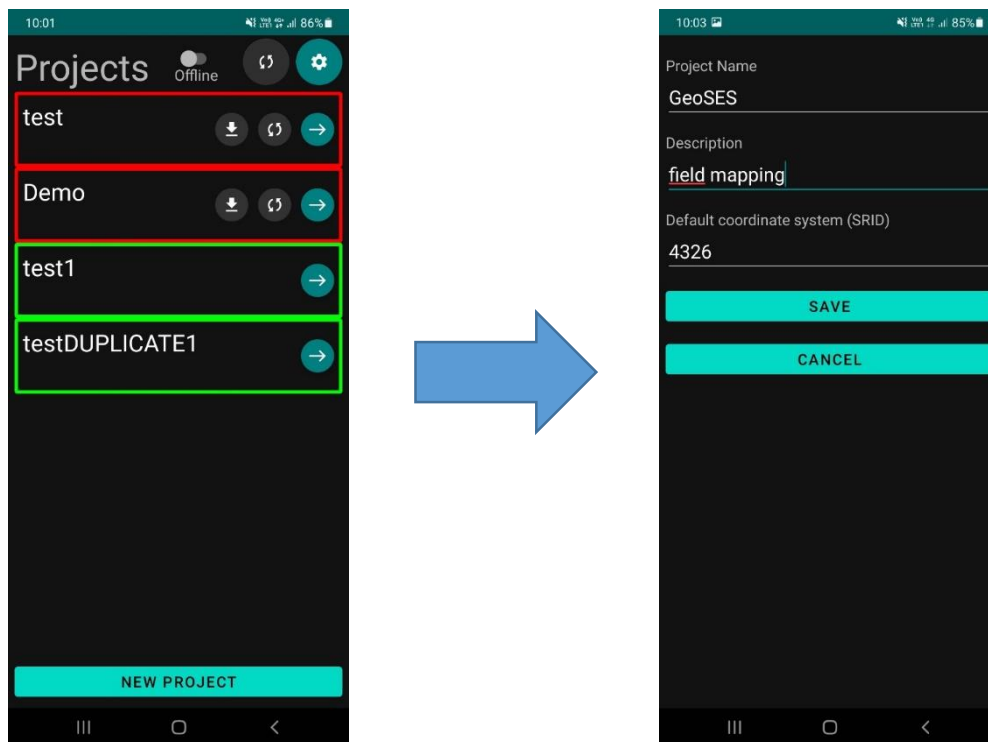


FIG. 3 Creating a new project and defining its basic parameters.

If the user wants to work on an already created project, he opens the project using the OPEN button (arrow).

## 2. Preparation of data layers in QGIS and their import into the PostGIS database

This user manual is designed for QGIS software, which is freely available. Data layers can also be prepared in other alternative GIS software. Vector data layers need to be created via GeoPackage data format. It is also possible to prepare vector data in ESRI shapefile format. However, to use data layers in TerraMapper, it is important to choose the correct geometry type. The application does not support types of data layers such as multipoint, multiline, multipolygon, etc. When creating new data layers, it is therefore necessary to set a simple type of geometry - point, line, polygon. The correct vector data layers can then be imported into the mobile application. However, a project must be created in the application into which the data layers will be imported via the PostGIS database system. Data layers are imported via PostGIS, which is located in the Browse window in the QGIS software.

Note: Right-click on the PostGIS button to select the New Connection option ...

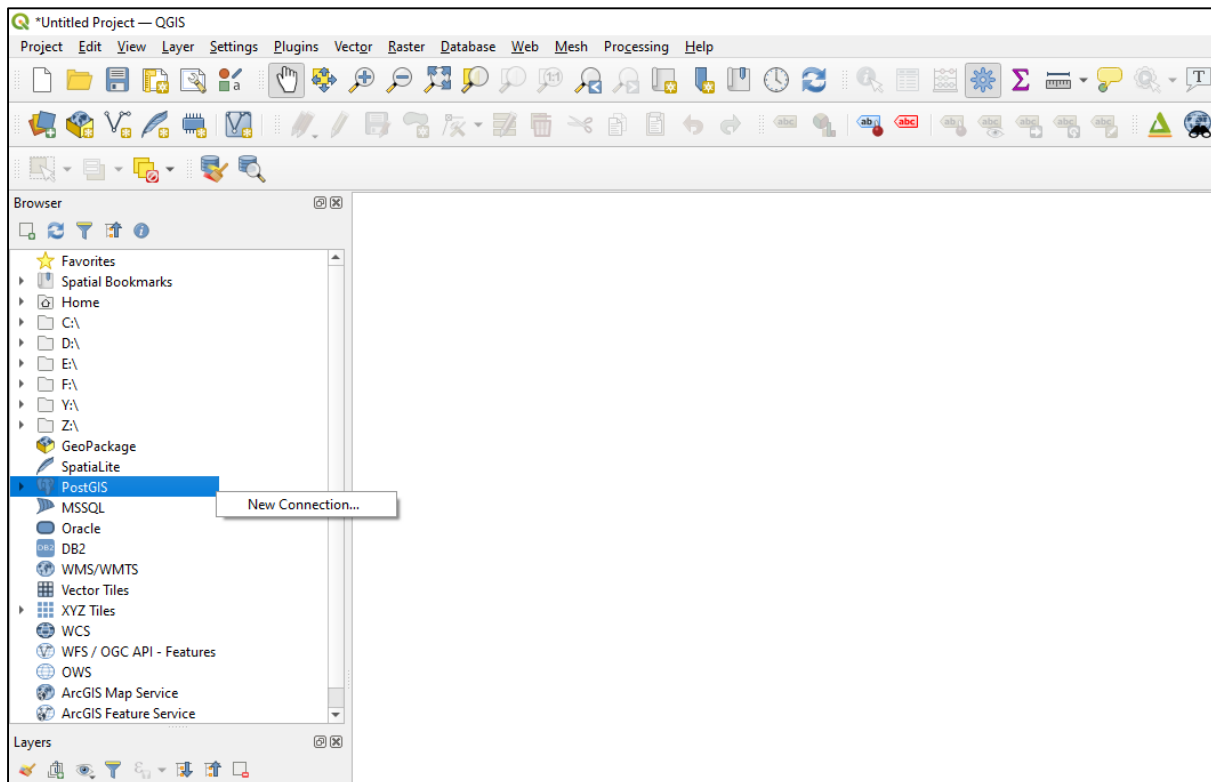


FIG. 4 Creating a new connection to the PostGIS database.

In the Create a New PostGIS Connection window it is necessary to set the parameters of the new connection. The connection name (Name) can be defined by the user as desired. However, the other parameters must correspond to the parameters of the project in the mobile application with which the connection will be established and into which the data layers will be imported. The project parameters are available via the Settings button after its start.

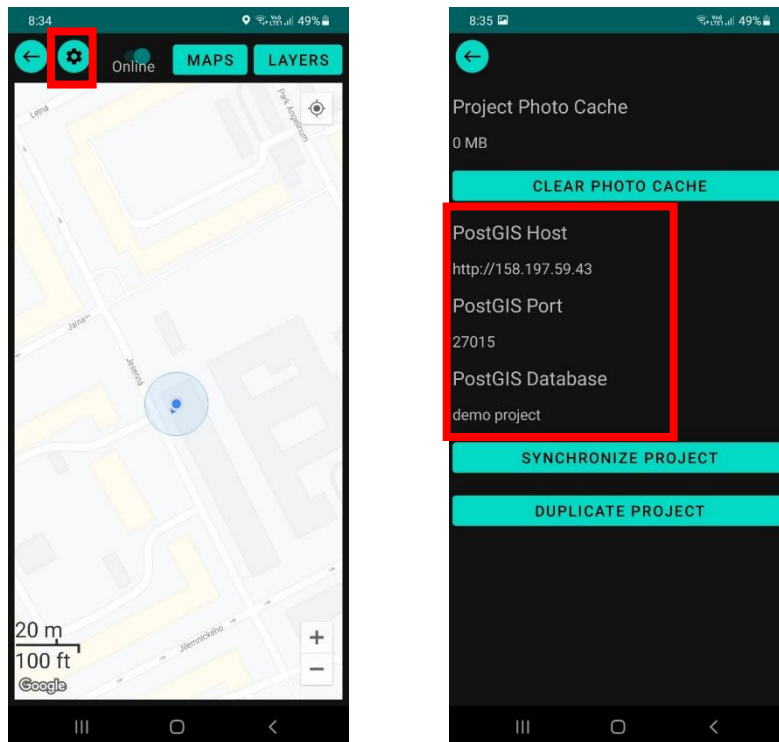
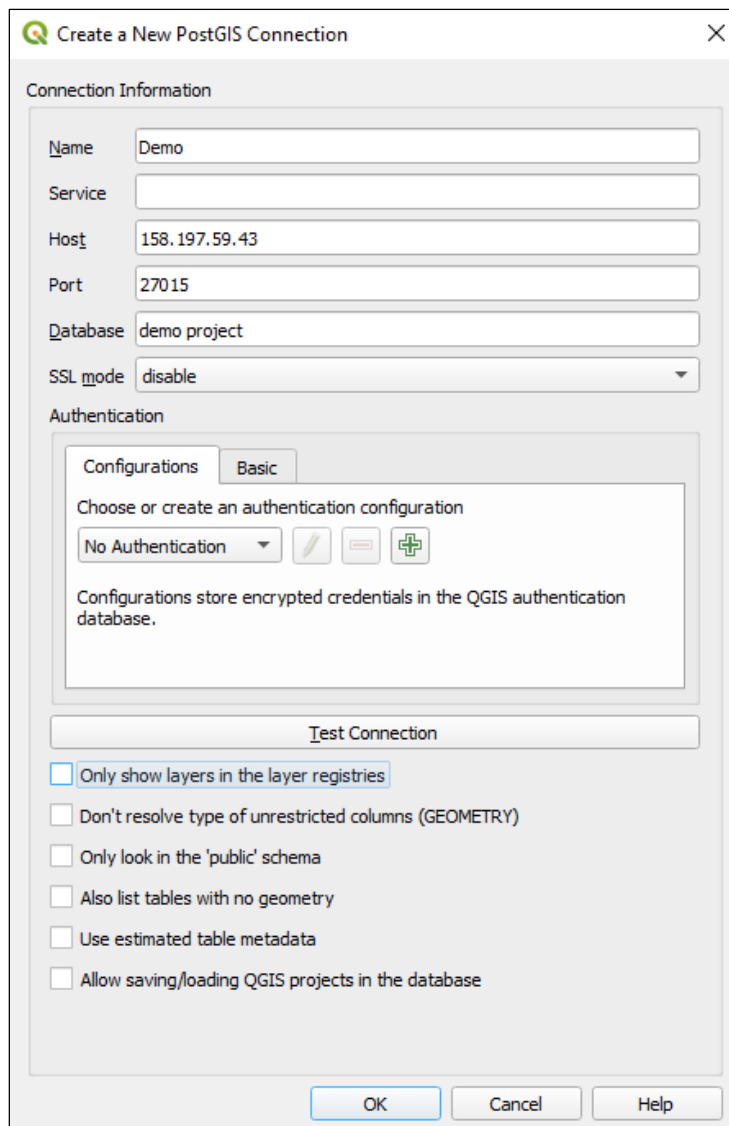


FIG. 5 Project parameters for connection to the PostGIS database.

It is therefore necessary to define the Host, Port and Database parameters in the Create a New PostGIS Connection window in QGIS. The host is marked as PostGIS Host in the mobile application and the IP address must be entered in the Host field in QGIS (data without http: //). The PostGIS Port number is entered in the Port field and the PostGIS Database name in the Database field (Fig. 6). After entering the necessary parameters, click OK to display the Enter Credentials window, where you need to enter the login details under which the user logged in to the TerraMapper mobile application.



The 'Create a New PostGIS Connection' dialog box is shown. It has a title bar with the QGIS logo and a close button. The 'Connection Information' section contains fields for Name (Demo), Service, Host (158.197.59.43), Port (27015), Database (demo project), and SSL mode (disable). The 'Authentication' section has tabs for 'Configurations' and 'Basic'. Under 'Configurations', there is a dropdown menu set to 'No Authentication' and three icons: a pencil, a minus sign, and a plus sign. Below this is a text box stating: 'Choose or create an authentication configuration' and 'Configurations store encrypted credentials in the QGIS authentication database.' A 'Test Connection' button is located below the authentication section. At the bottom, there are several checkboxes: 'Only show layers in the layer registries' (checked), 'Don't resolve type of unrestricted columns (GEOMETRY)', 'Only look in the 'public' schema', 'Also list tables with no geometry', 'Use estimated table metadata', and 'Allow saving/loading QGIS projects in the database'. At the very bottom are 'OK', 'Cancel', and 'Help' buttons.

Create a New PostGIS Connection

Connection Information

Name: Demo

Service:

Host: 158.197.59.43

Port: 27015

Database: demo project

SSL mode: disable

Authentication

Configurations Basic

Choose or create an authentication configuration

No Authentication

Configurations store encrypted credentials in the QGIS authentication database.

Test Connection

☒ Only show layers in the layer registries

☐ Don't resolve type of unrestricted columns (GEOMETRY)

☐ Only look in the 'public' schema

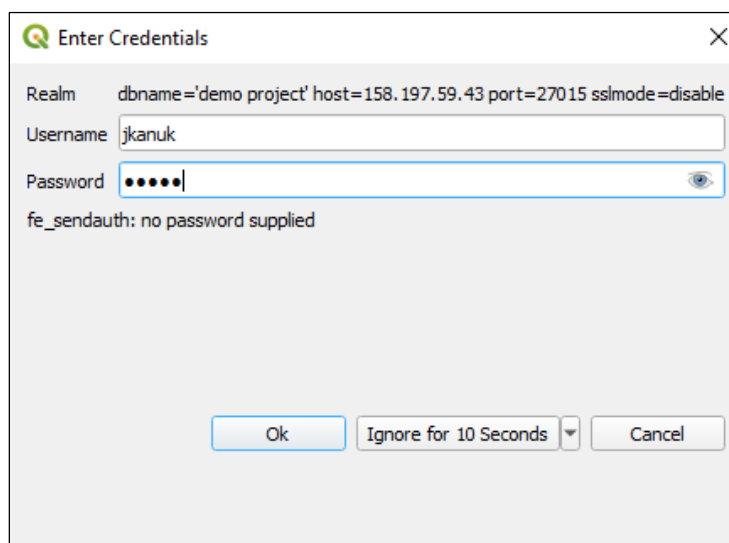
☐ Also list tables with no geometry

☐ Use estimated table metadata

☐ Allow saving/loading QGIS projects in the database

OK Cancel Help

FIG. 6 Setting connection parameters to the PostGIS database in QGIS.



The 'Enter Credentials' dialog box is shown. It has a title bar with the QGIS logo and a close button. The 'Realm' field contains the text: 'dbname='demo project' host=158.197.59.43 port=27015 sslmode=disable'. The 'Username' field contains 'jkanuk'. The 'Password' field contains six dots and has a visibility icon (an eye) to its right. Below the password field is the text 'fe\_sendauth: no password supplied'. At the bottom are 'Ok', 'Ignore for 10 Seconds', and 'Cancel' buttons.

Enter Credentials

Realm: dbname='demo project' host=158.197.59.43 port=27015 sslmode=disable

Username: jkanuk

Password: ●●●●●●

fe\_sendauth: no password supplied

Ok Ignore for 10 Seconds Cancel

FIG. 7 Login to the PostGIS database via TerraMapper login.

After a successful access to the PostGIS database, it is necessary to import the required vector data layers. This activity in the QGIS software is provided by the DB Manager plug-in, which is located under the Database tab on the main bar of the QGIS software window.

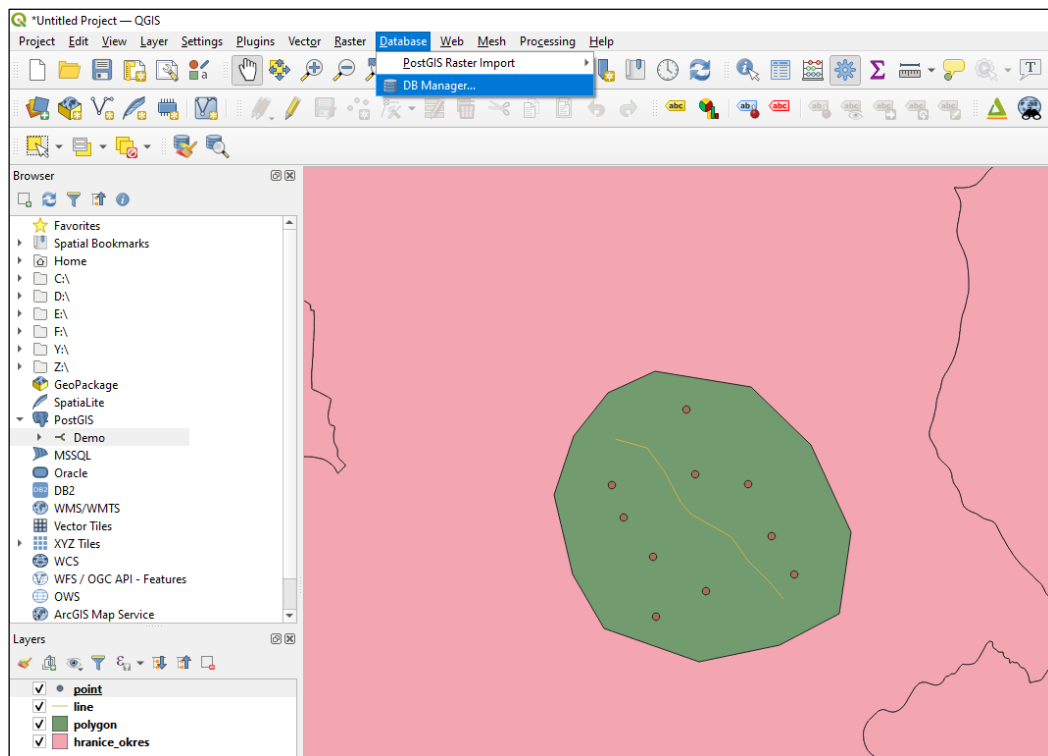
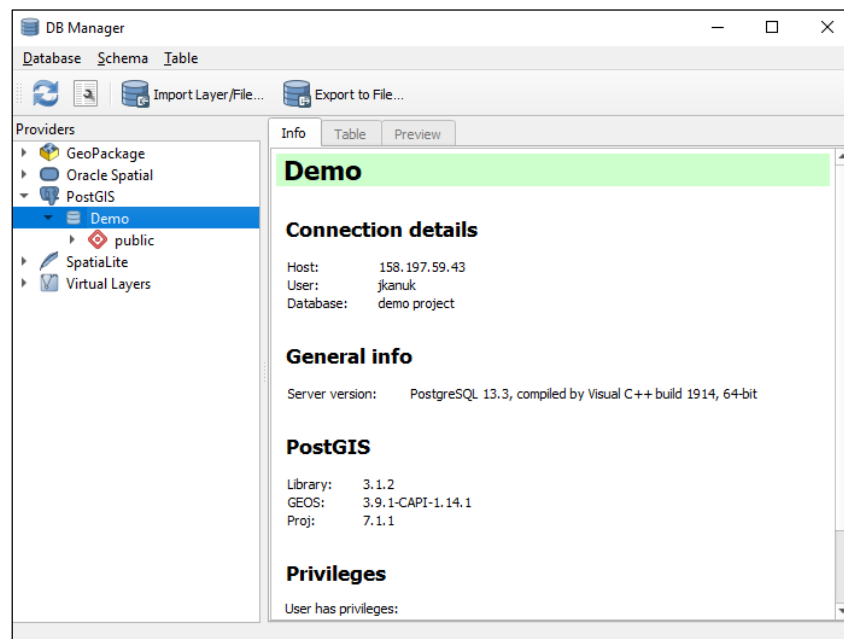


FIG. 8 Location of the DB Manager plug-in within the QGIS software window.

In the DB Manager window, the user opens the PostGIS tab and the Demo database link. Data layers are imported via the Import Layer / File button on the top bar of the DB Manager window.





In the Import vector layer window, the user selects the required data layer (Input) from the list of layers and confirms with OK. If the Internet connection fails, the Enter Credentials window will reappear after confirming the import. Then you need to enter your login details again and the import will be done.

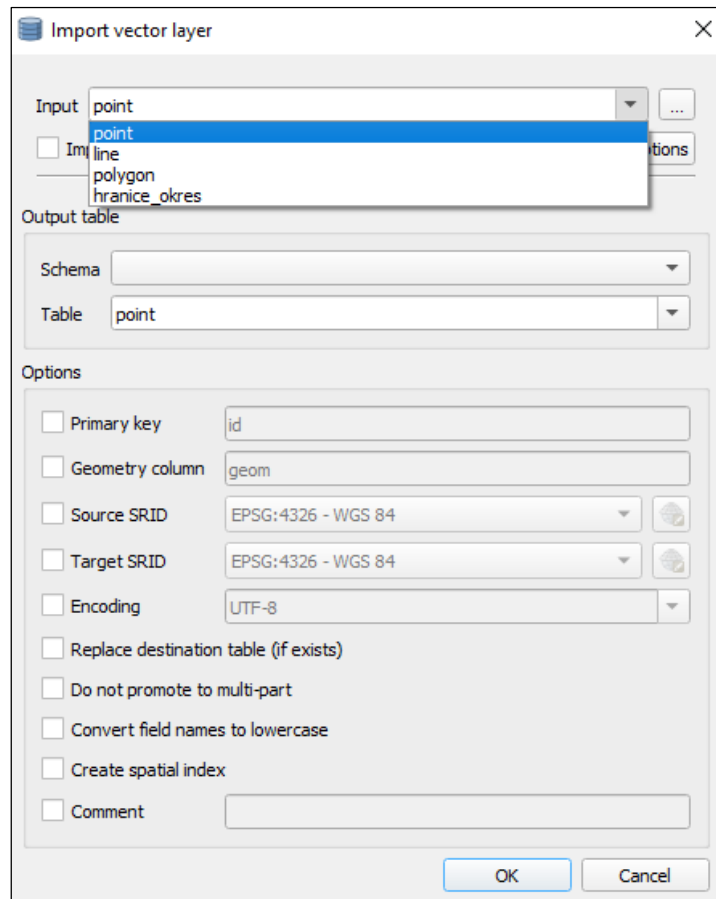


FIG. 9 Import of vector data layers into the PostGIS database via DB Manager.

### 3. Setting and import of raster base layers

TerraMapper contains several predefined base map layers that the user can use. In addition, it is possible to import your own raster base layers into the mobile application. The list of predefined base map layers as well as their selection and import of new ones is available via the MAPS button, which is located at the top of the screen. When activated, a list of available predefined base map layers is displayed.

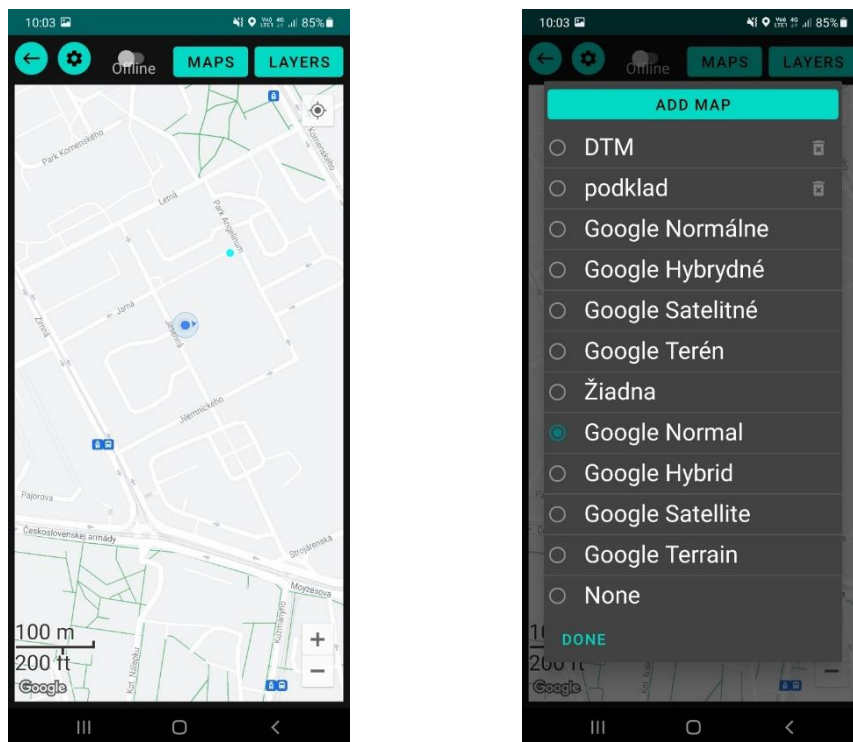


FIG. 10 List of available predefined base map layers

Using the ADD MAP button, the user can add their own base layers to the application. The user interface of the application allows you to add WMS layers or your own raster data layers (Fig. 11).

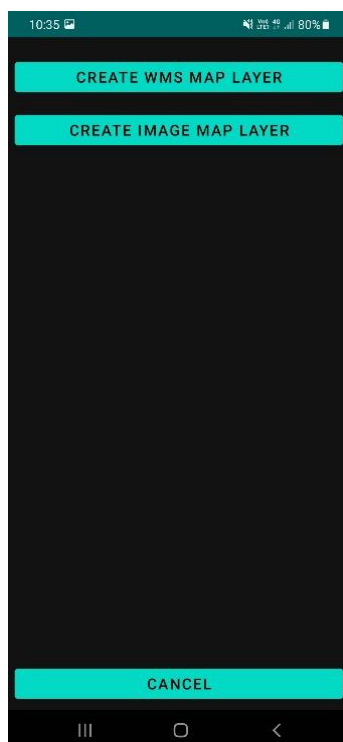


FIG. 11 Adding user own raster data layer

Import of WMS layers is performed via the CREATE WMS MAP LAYER button, where the user defines the name of the new layer and its URL address. After importing a layer, the user selects the desired base map layer.

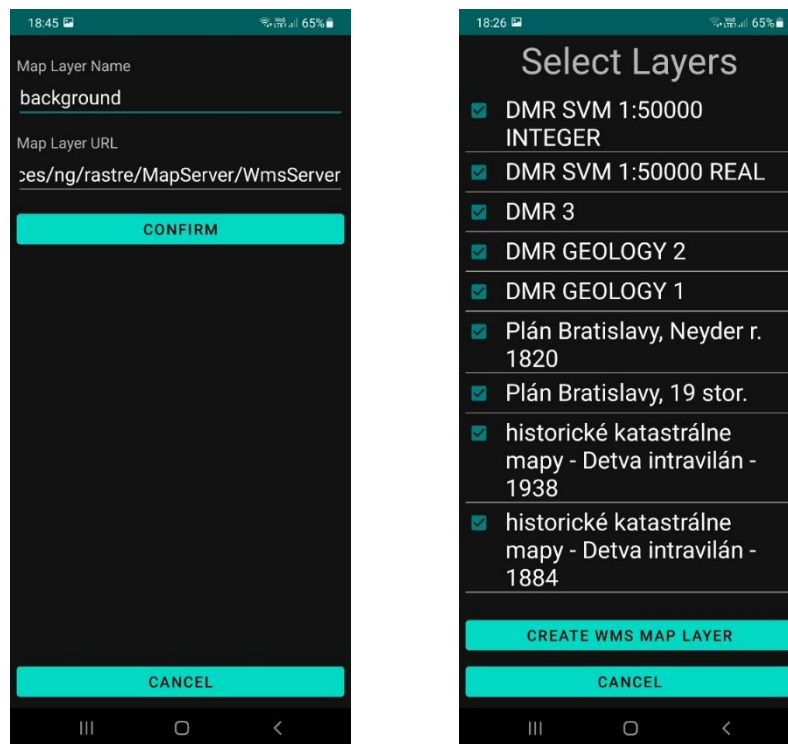


FIG. 12 Import the WMS layer and then select the required base map layer.

In addition to WMS layers, the application also allows the import of custom base map layers in raster format, which is implemented via the CREATE IMAGE MAP LAYER button. This process consists of several steps.

First, the user creates an image (raster) data layer that he wants to import into the application. Second, however, it must record the spatial coordinates of the center of the image in the coordinate system in which the project is also created. It must also record the actual width and length of the area shown in the image. The user then writes all this data in the selected fields and finally adds the image itself (base map layer).

18:54 65%

Map Layer Name  
DSM

Latitude  
48.8368

Longitude  
20.8571

Width in meters  
4800

Height in meters  
3600

SELECT IMAGE

CANCEL

FIG. 13 Setting raster data layer parameters

#### 4. Creation of vector data layers

One of the main functionality of the TerraMapper mobile application is to create new data layers and edit the attributes of individual objects of existing vector data layer in the field. The application does not allow you to change the geometry of layers imported through the PostGIS database, but allows you to add a new one. The creation of data layers is performed in the mobile application via the LAYERS button and then ADD LAYER.

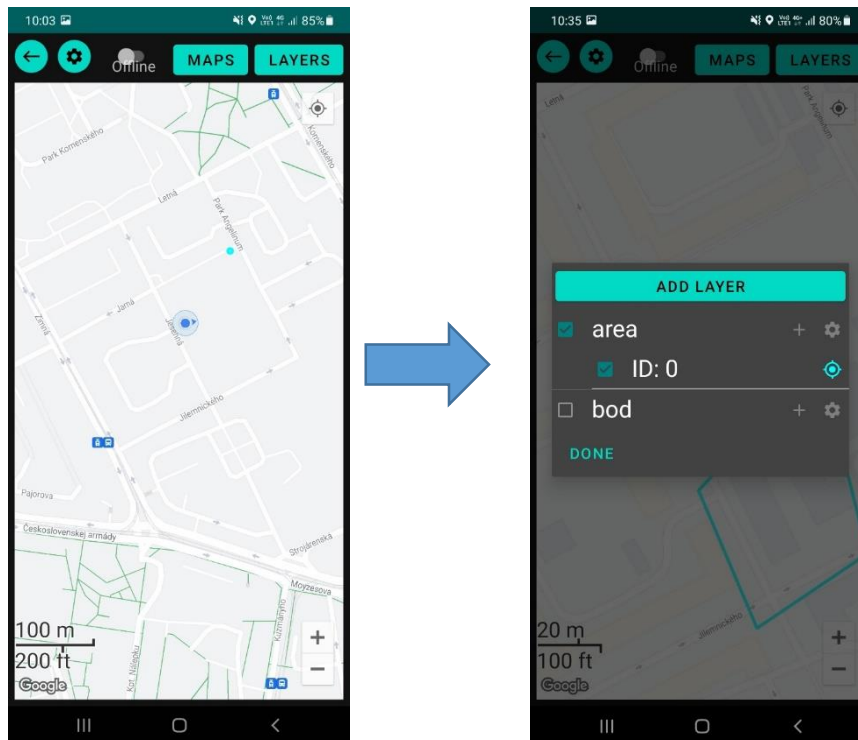


FIG. 14 Creating new vector data layers.

When creating a new layer, it is necessary to define its name and type of geometry, i.e. whether it is a point, line or polygon layer. The layer coordinate system is defined based on the coordinate system of the entire project in which the layer is created. It is also possible to define various attributes for the layer, either numeric or text, via the ADD ATTRIBUTE button and then confirm with the CONFIRM button.

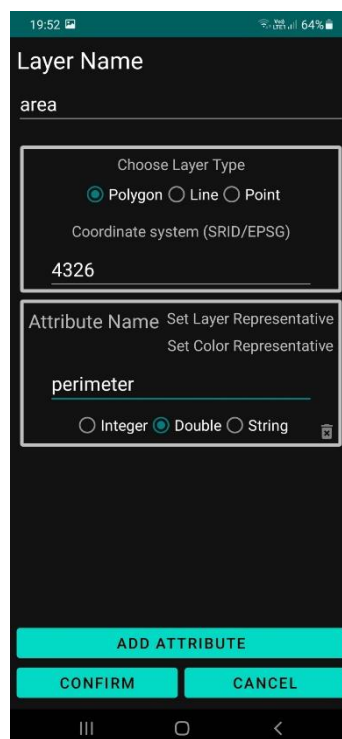


FIG. 15 Defining new layer parameters and attributes.

The geometry of the layer itself is created by selecting the layer via the LAYERS button and then pressing the + button next to the selected layer. After these operations, a message is displayed with the option to select the method of creating the layer geometry - AUTAMTICALLY or MANUAL (Fig. 16).

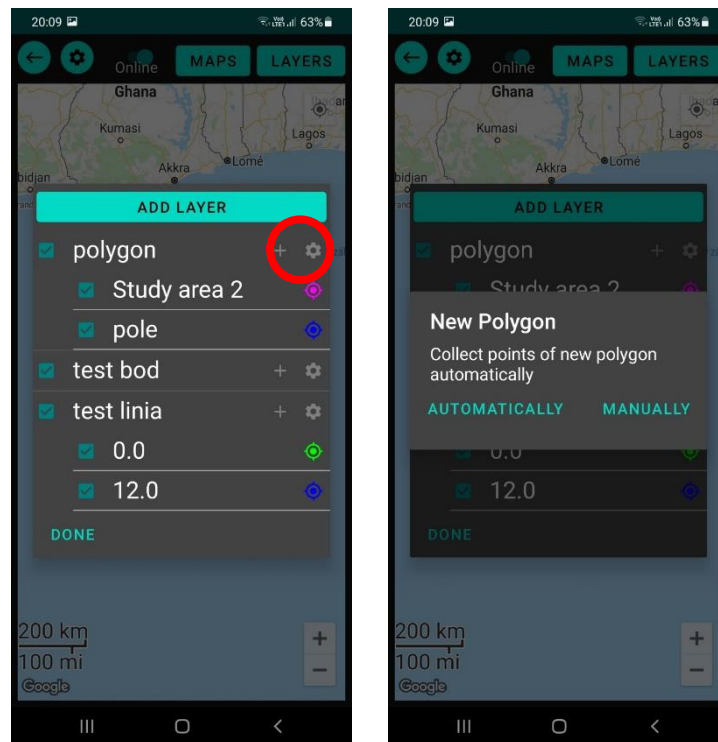


FIG. 16 Creating data layer geometry

When selecting creation of automatic layer geometry, it is necessary to set the step (in meters) or time interval (in seconds) in which the points or vertices of lines and polygons will be recorded (Fig. 16). Creating the geometry of the data layers in manual mode is finally done by adding points / vertices via the blue + button.

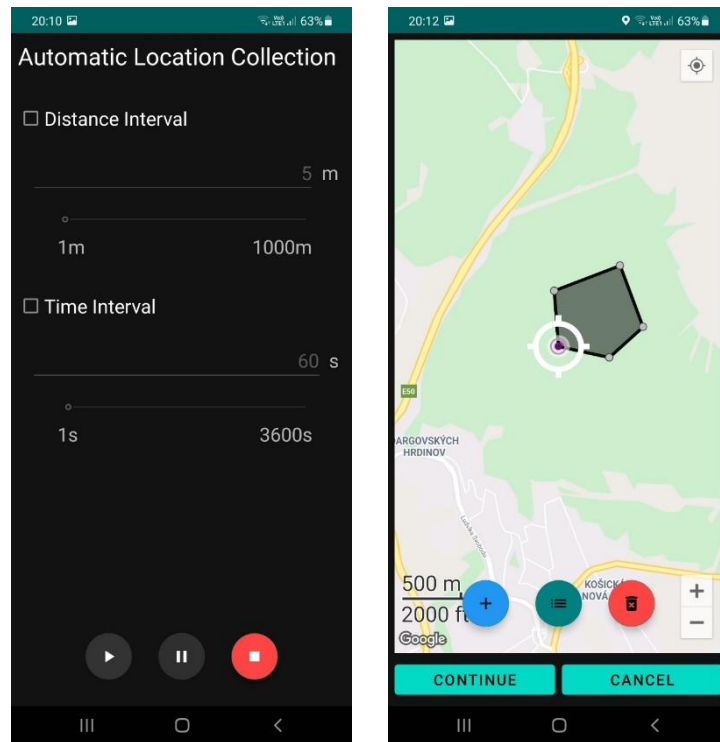


FIG. 17 Automatic and manual creation of data layer geometry

After the creation of the data layer, it is necessary to save its geometry by pressing the CONTINUE button. Then you will be able to write the selected attributes of the layer and save them via the SAVE button.

## 5. Color scale setting

The color scale of vector layers as well as the type of mark (point, line) is set via the LAYERS button by selecting a specific layer and clicking on the mark that represents the given point or vertex of the line or polygon.

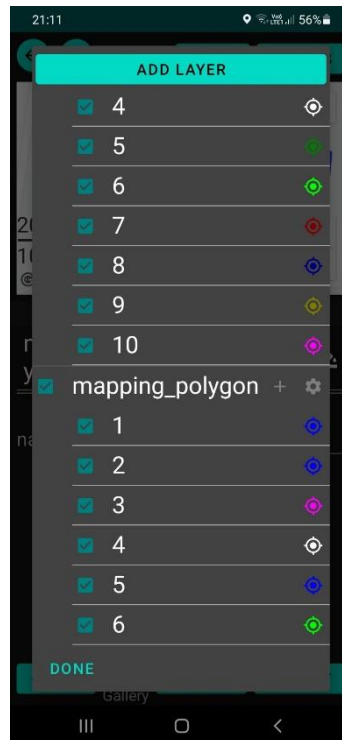


FIG. 18 Editing data layer symbology

The user can use the marker selection button to change the shapes of points and lines, and the color selection button to change the color of the layer.



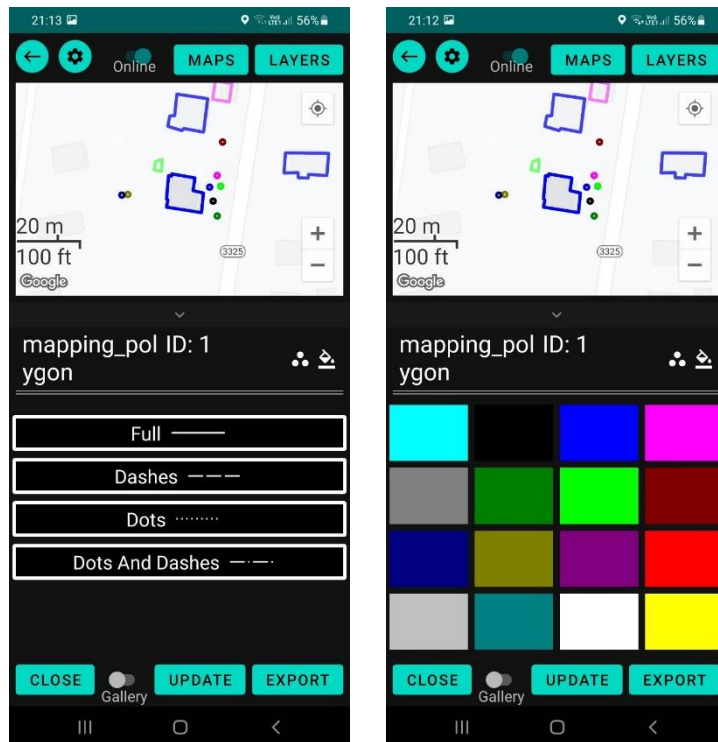


FIG. 19 Setting the geometry and color of data layers

The mobile application also allows creating record geotagged photos for individual object. Using the Gallery and ADD PHOTOS button, the user selects an existing photo or creates a new one in the field.

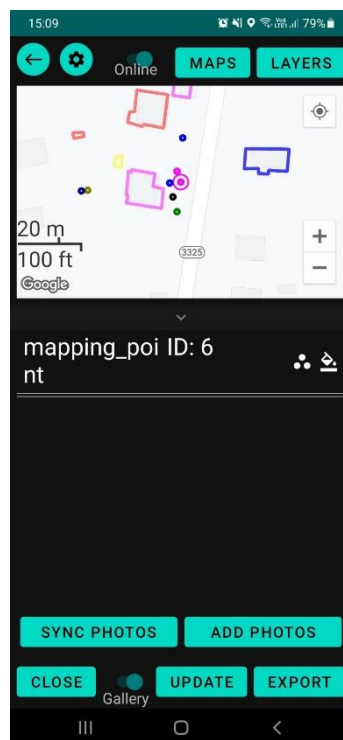


FIG. 20 Add photos to vector layers

## 6. Export of project and vector data layers

Individual points, lines and polygons can be exported from the mobile application to the memory of the mobile device in the ESRI shapefile or KML format.

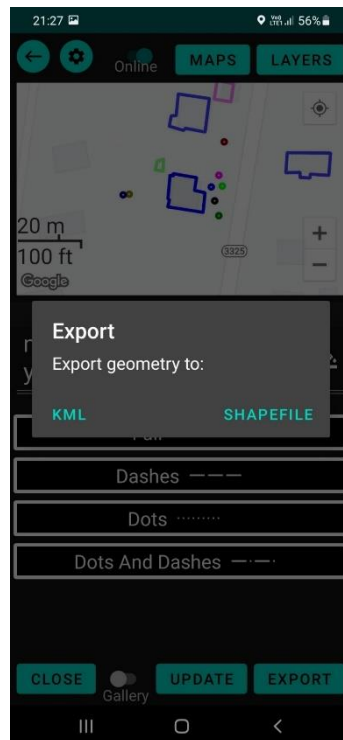


FIG. 21 Exporting data layers

The application also allows the synchronization of the entire project with the PostGIS database, which saves all changes in the layers in the database. Synchronization is performed via the Settings button and then with the SYNCHRONIZE PROJECT button. The data layers can be migrated from the database directly to the QGIS software. Data layers are exported via DB Manager, where it is first necessary to select the required layer from the list of layers and save it in the computer's memory via the Export to File button. QGIS software allows the user to select multiple data formats in which the data layers can be exported.

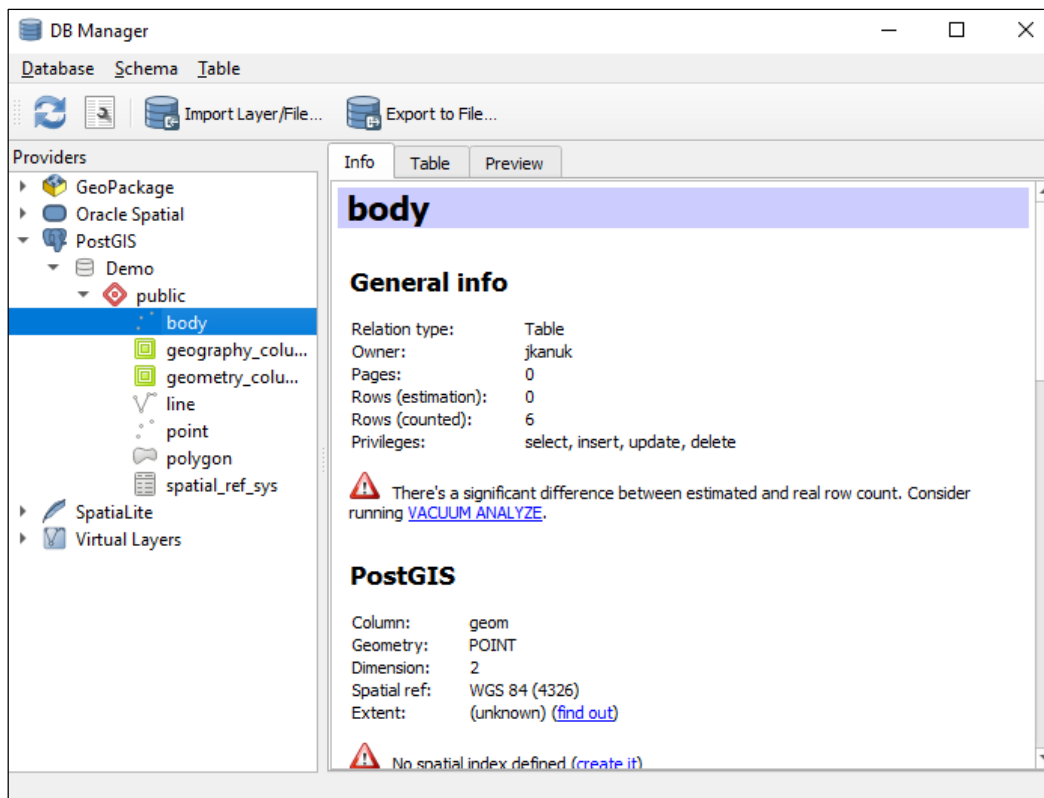


FIG. 22 Selecting a data layer from the list of layers in the PostGIS database.

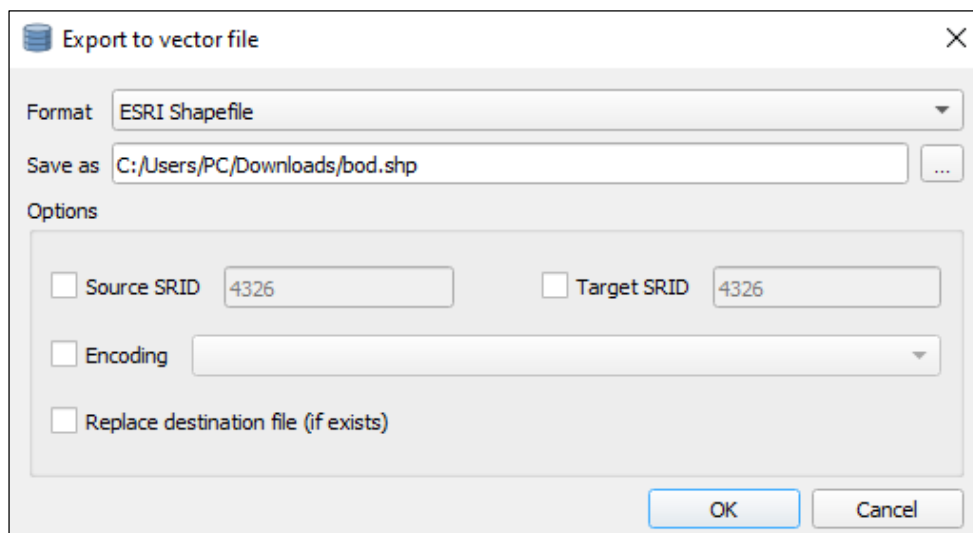


FIG. 23 Exporting the data layer to the computer's memory in the selected data format.