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Basic spatial data services dedicated for use in state information systems

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Introduction

Spatial data are used in many areas of human activity and their importance is currently growing rapidly, particularly driven by the ease with which they can be obtained and processed. This largely results from the general development of information technologies, in particular, the development and popularisation of mobile devices (tablets and smartphones) which can, on the one hand, display spatial information from built-in databases or available web services and, on the other hand (against the background of such information), show the current location of the user, determined thanks to a built-in GNSS receiver.

Geographical coordinates, which were previously perceived more from a theoretical perspective, have become very important in practical use thanks to the ease of positioning by commonly available measuring devices (GNSS). The combination of measuring (positioning) devices with a computer, which ensures data processing capacity, resulted in the development and popularisation of various navigation devices which make it possible to continuously monitor the user's position and show the route to the destination (satellite navigation).

What is important for the enhancement of the role of spatial data is also an awareness of the practical benefits of presenting reality through the appropriate data sets and using them to manage the surrounding reality. In all these activities it is essential to build the most faithful model of reality (in the form of databases of spatial data systems), which is necessary in order to efficiently affect the underlying space in various design and decision-making processes. It should be remembered that the model will only be faithful, irrespective of its initial structure, if it is up to date, i.e. if processes for updating the collected data are provided and, above all, implemented.

The document presents a description of the basic tools for presentation and processing of spatial data offered by the Head Office of Geodesy and Cartography (GUGiK) dedicated to the use in state information systems. All the described services are available to the public free of charge. They can be used both in public and commercial systems, as well as for research. The document also describes basic functionalities of the platform www.geoportal.gov.pl, which can be used for the visualisation of spatial data stored in different registers.

Waldemar Izdebski
14 September 2020

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1. Geoportal on-line service

The main task of the **www.geoportal.gov.pl** portal is to provide citizens, entrepreneurs and public administration with spatial information from official registers guaranteeing its quality, timeliness and reliability.

The www.geoportal.gov.pl website is the central point of access to the national spatial data infrastructure. Fig. 1 shows an image of the current home page of **www.geoportal.gov.pl**.

For a typical user, the most important element of the interface is the link to ***National Geoportal***, redirecting to the geoportal's main map website www.mapy.geoportal.gov.pl which, due to its significance, is sometimes referred to as the geoportal.

Figure 1 Home page of www.geoportal.gov.pl

For frequent users of the website, the ***News*** section is also important. It contains information about new data and functions that are added to the service. The interface also offers the option to open other map websites or map compilations under the name:

- Geoportal 3D,
- INSPIRE Geoportal.

In addition, at www.geoportal.gov.pl there is a link to the Centre for Spatial Analysis of Public Administration (CAPAP) and the system of the State Geodetic and Cartographic Resource, which is used for making data available.

However, this is not important at this stage. We will leave this function without any further comment and we will come back to it on another occasion. Similarly, we will not discuss the functionalities available in the website's ***Main Menu***, whose image is shown in Fig. 2, as this may be addressed independently by the user.

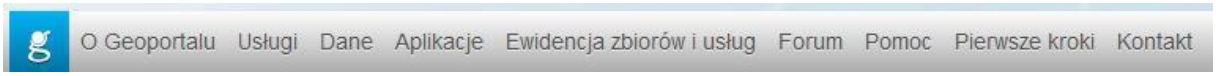

Figure 2 Main menu of the geoportal.gov.pl website

1.1 Geoportal's main map website

Immediately after launching the main map website of the Geoportal, an image similar to the one shown in Fig. 3 is displayed on the screen.

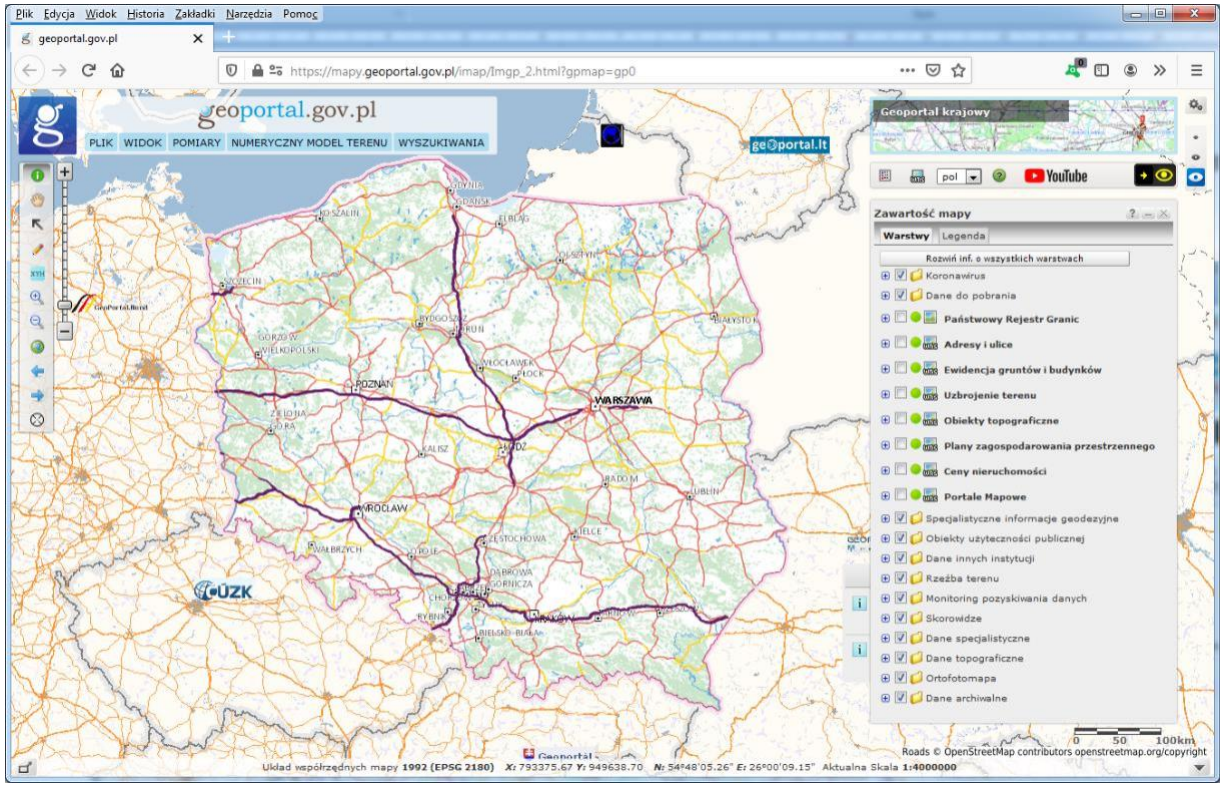

Figure 3 Home page of the main map website (mapy.geoportal.gov.pl)

In particular, the layout of the image seen by the user may be slightly different depending on the resolution of the monitor used. The most important features of the first screen include a map with an outline of the whole of Poland showing the largest cities, forest areas and the road and river network. On the right side we see a tree of data layers, where we can freely control what content available on the website is displayed.

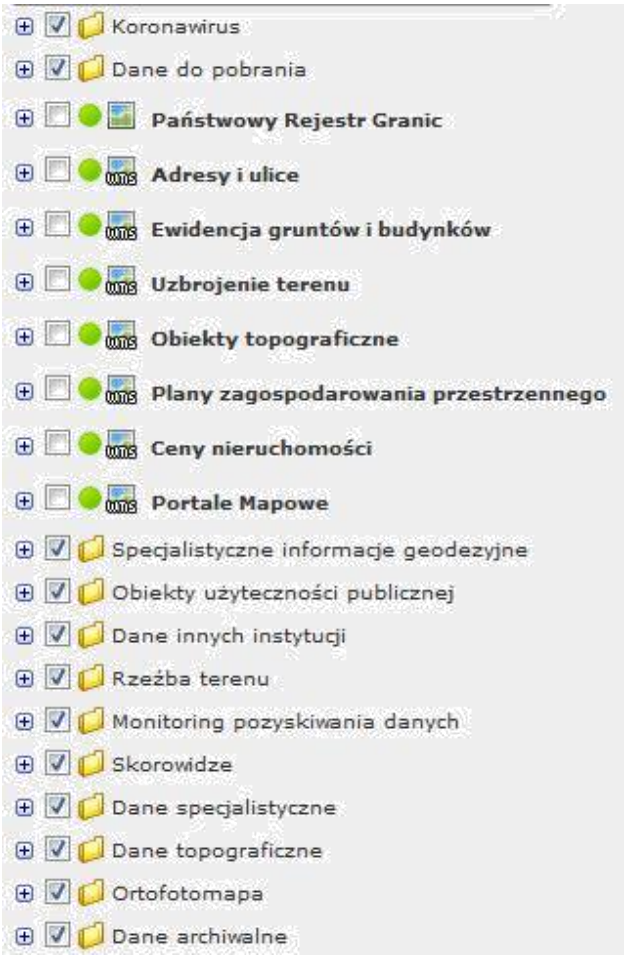

Figure 4 Map content in the form of a tree with a list of layers

In the upper left corner of the screen there is a menu offering basic functions related to views, measurements and searching for information.

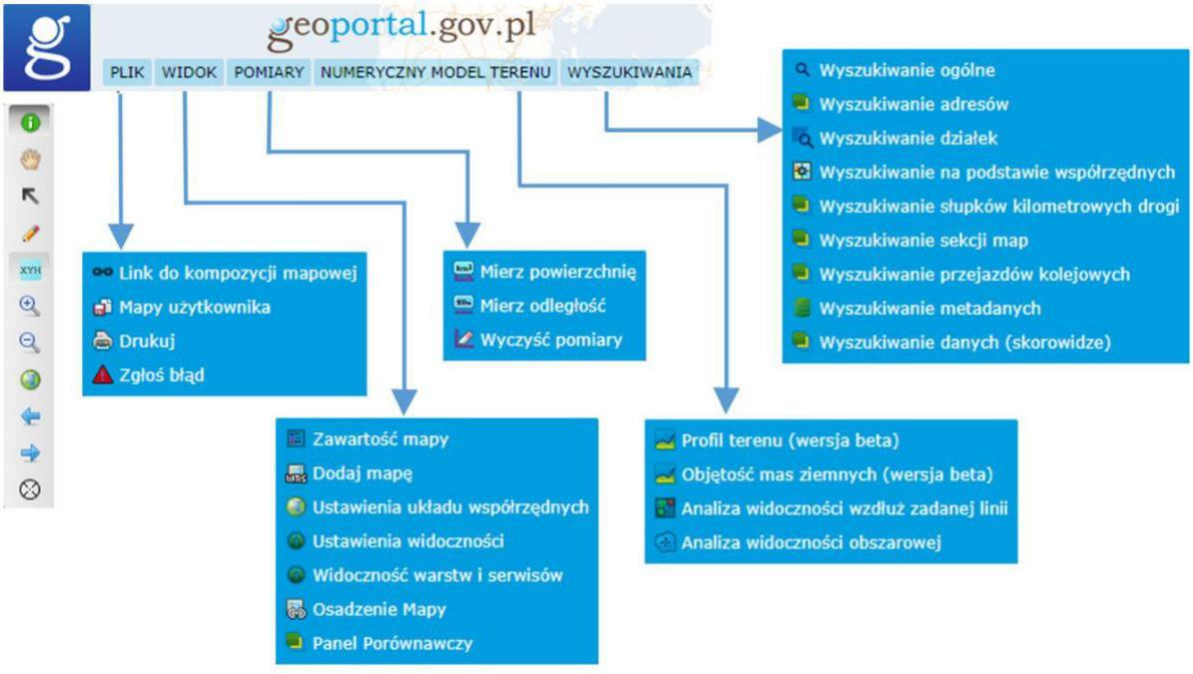

Figure 5 Main menu and toolbar of the map website (mapy.geoportal.gov.pl)

Below the menu there is a toolbar which is useful for navigating the map, i.e. zooming in, out, or panning.

The main map website can also be launched directly (withoutopening the geoportal's home page), by using the following address: http://mapy.geoportal.gov.pl. After launching using this method, we also see an image similar to the one shown in Fig. 3.

The map service provides users with a number of functions, from the possibility of manipulating the map view (zooming in, out and moving) through adjusting the visibility of individual layers (switching on, switching off, adding layers from WMS and WMTS services, changing the display order, changing the degree of transparency) and performing measurements on the map (length, distance, surface area), analyzes using the numerical terrain model, ending with search capabilities (geographical objects, addresses, plots, geodetic matrix points).

For users who prefer to watch a video with a user instruction, the service offers instructional videos, which can be accessed both from the landing page shown in Fig. 1 and from the opened map portal seen in Fig. 3.

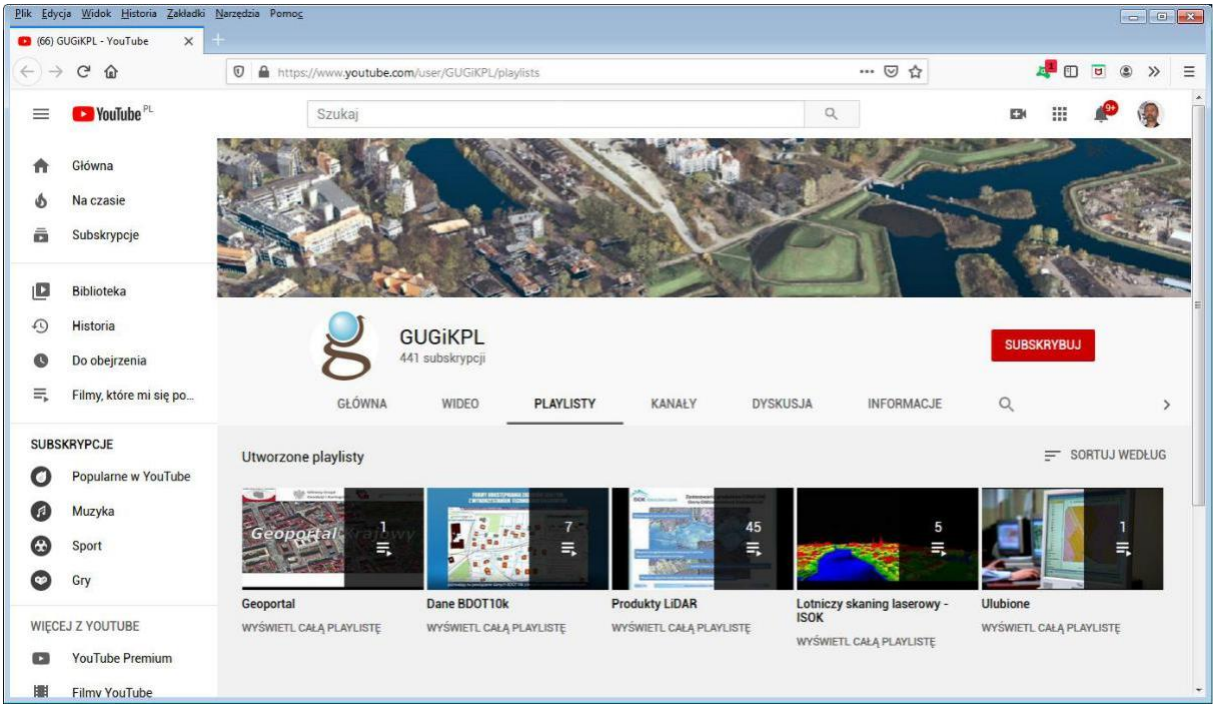

Figure 6 Instructional videos for the Geoportal

1.2 Dedicated Geoportal call

A special request can be submitted in the main map service, so that the following area is displayed to the user immediately after launch:

1. the area indicated with **coordinates,**
2. the indicated **parcel of land,**
3. the indicated **address point.**

In such a case, the request should take one of the following forms:

1. http://mapy.geoportal.gov.pl/?bbox=187692,683333,187892,683533
2. http://mapy.geoportal.gov.pl/?**identifyParcel**=141201_1.0001.1867/1
3. http://mapy.geoportal.gov.pl/?**identifyAddress**=Mińsk Mazowiecki, Kościuszki 3

Thanks to this function at www.geoportal.gov.pl, in many cases the user can open the website with a view of the selected area; thus, he or she will not see the general view as shown in Fig. 3, but upon launch the image will be related to the area specified in the request, e.g. a parcel of land (Fig. 7) or address (Fig. 8).

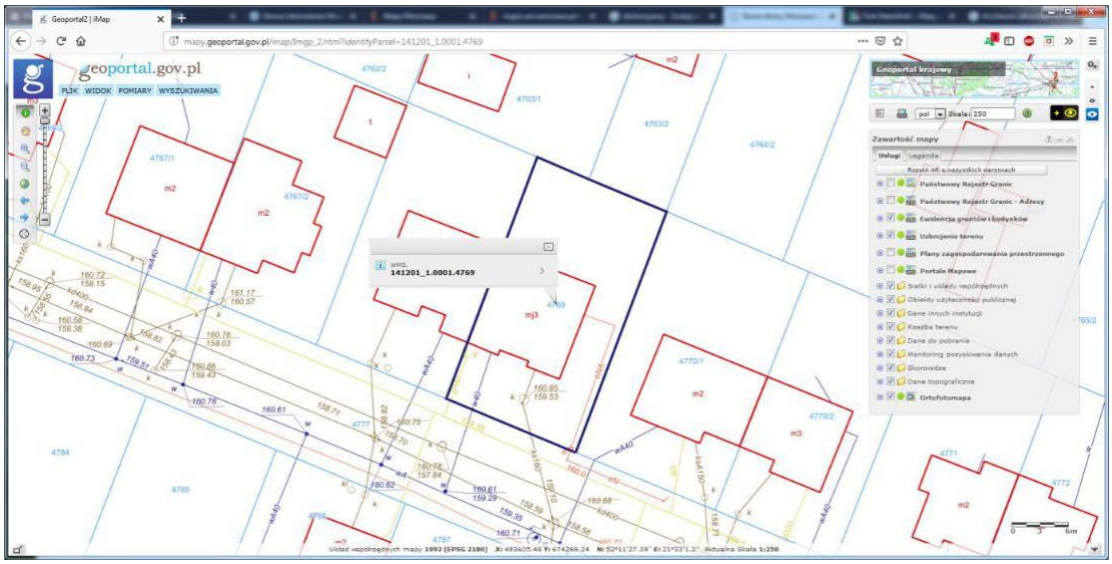

Figure 7 Geoportal map application launched with a land parcel identifier

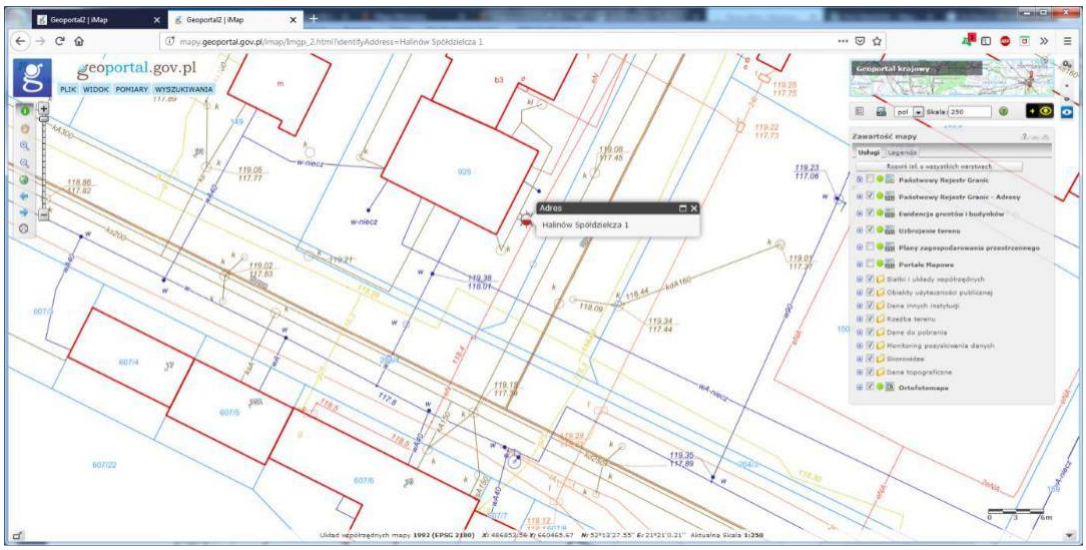

Figure 8 Geoportal map application launched with an address

A practical example of such a request can be seen upon clicking on the land parcel identifier in the Electronic Land and Mortgage Register system, if the parcel of land covered by the property has an identifier entered.

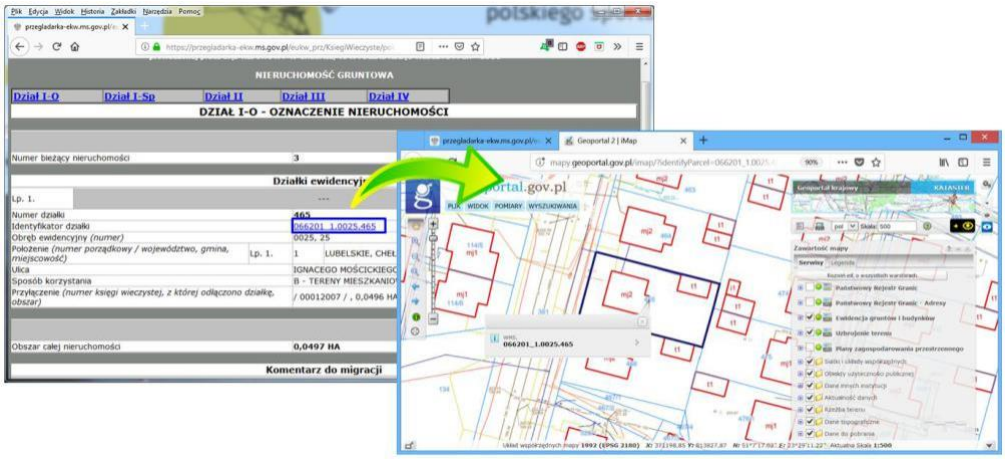

Figure 9 Launching the Geoportal from the Electronic Land and Mortgage Register

Such dedicated requests redirecting to www.geoportal.gov.pl, apart from the Electronic Land and Mortgage Register, are available in many state registers and property advertising websites, as well as in the electoral system used to show the location of election committees (Fig. 10 and Fig. 11).

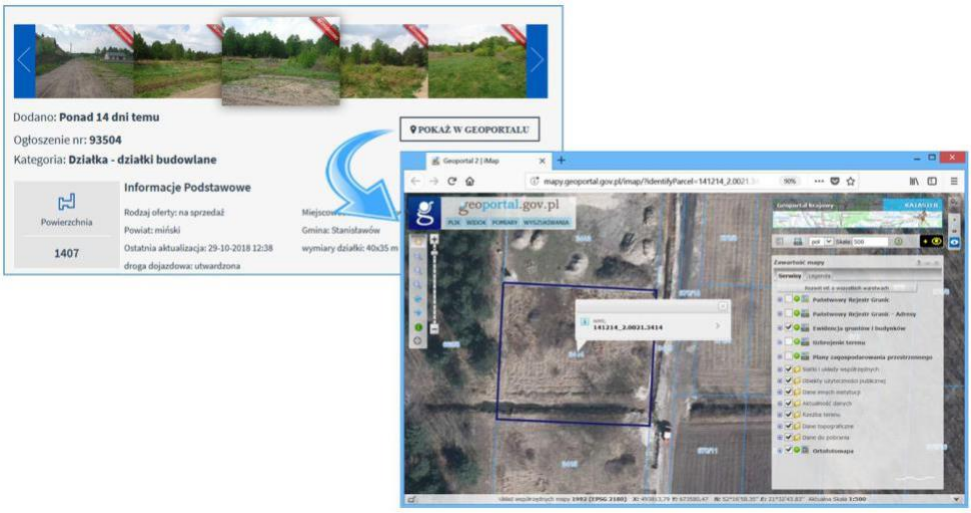

Figure 10. Opening the Geoportal from an advertising website (bezposrednio.net)

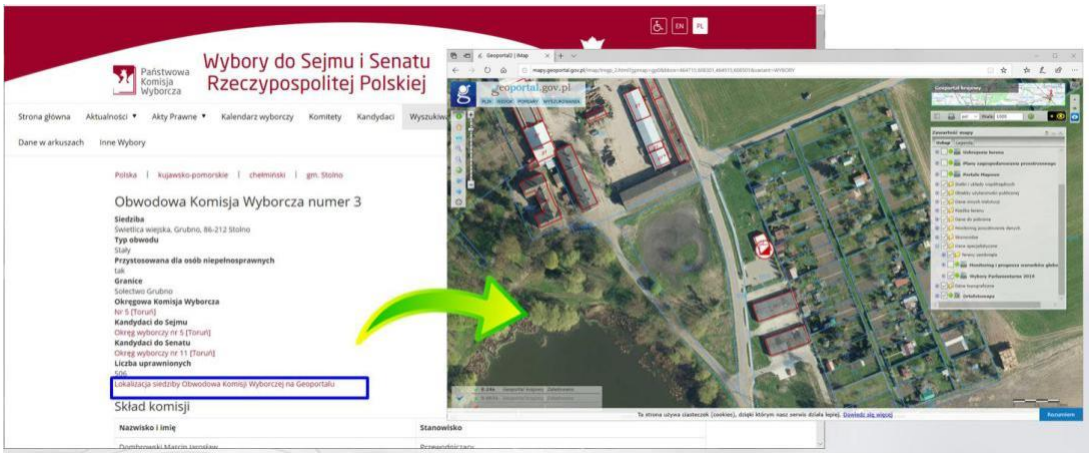

Figure 11. Opening the Geoportal from the electoral system website

The presented mechanism is useful in all places where the record parcels have their identifiers entered, because a reaction can be configured and triggered easily by clicking on the parcel's identifier, which launches www.geoportal.gov.pl with the visualisation of the corresponding record parcel.

1.3 Downloading data

Thanks to the amendment of the Geodetic and Cartographic Law, as of 31 July 2020 extensive resources of geodetic data, which had previously been accessible for a fee, are made available free of charge. The changes refer to geodetic data on a central, provincial and county level, i.e.:

1. Data of the digital terrain model (NMT) – central level
2. Data of the digital terrain coverage model (NMPT) – central level
3. Laser scanning (LIDAR) data – central level
4. Orthophotomaps – central level
5. Geodetic control network point data – county and central level
6. Topographical feature database (BDOT10k) – provincial and central level
7. Geometric data of land parcels and buildings with basic descriptive attributes – county level

The basic form of providing the released data from the central resource is its download to www.geoportal.gov.pl, where in the section "**Data to be downloaded**" the user can download any data required, with no limitations.

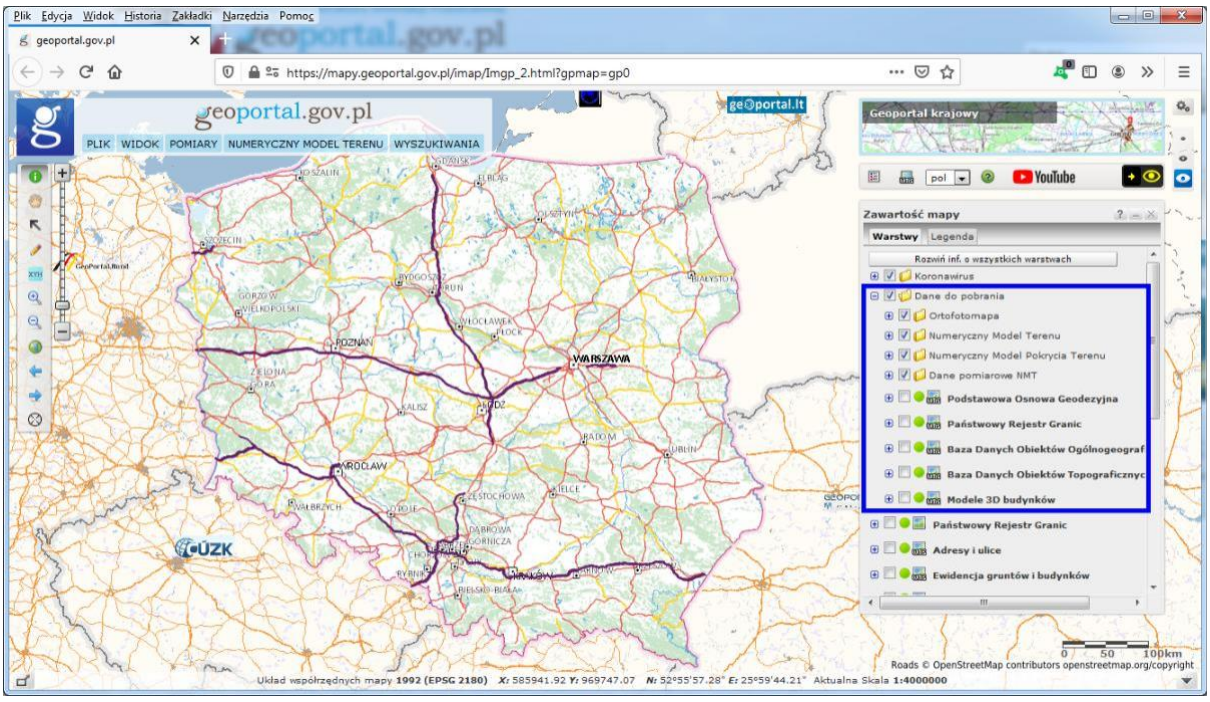

Figure 12. Access to data download using www.geoportal.gov.pl

To download data, the user should activate a relevant information layer and click on the area of interest.

In most cases, data is made available in areas determined with map sections in the 1992 system, but it is also made available for areas within county administrative limits, e.g. BDOT10K, or by geodetic control network.

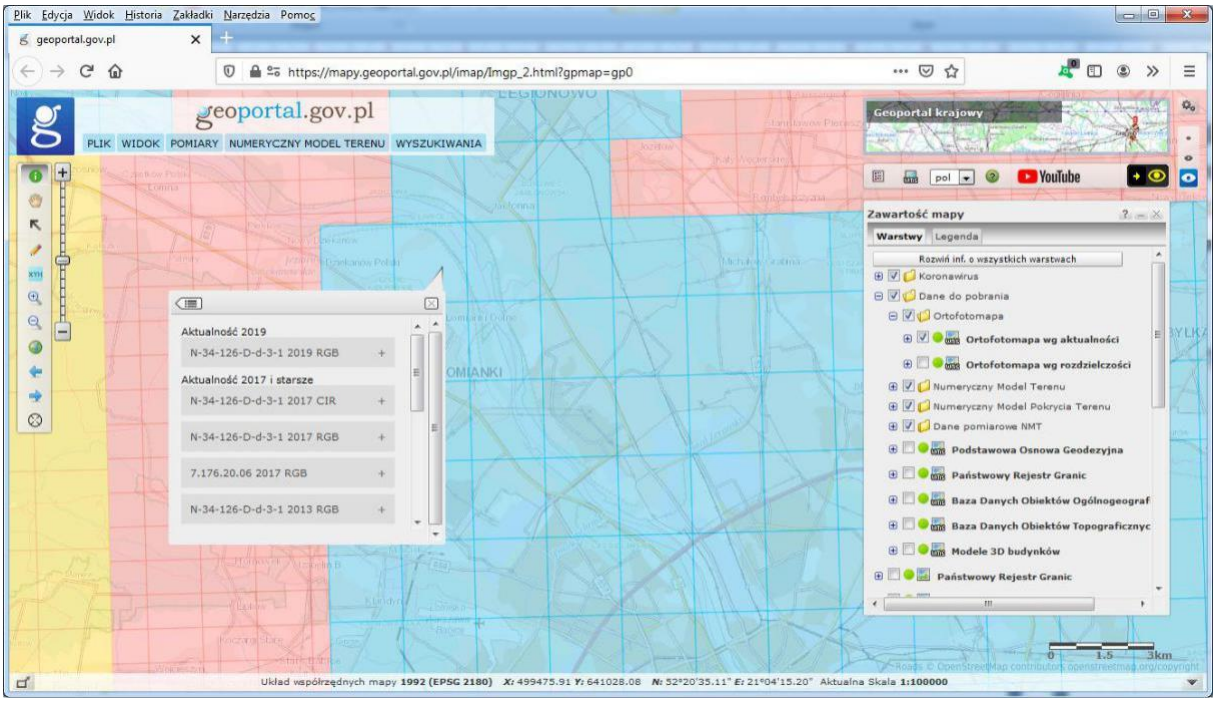

Figure 13. Downloading orthophotomap data by section

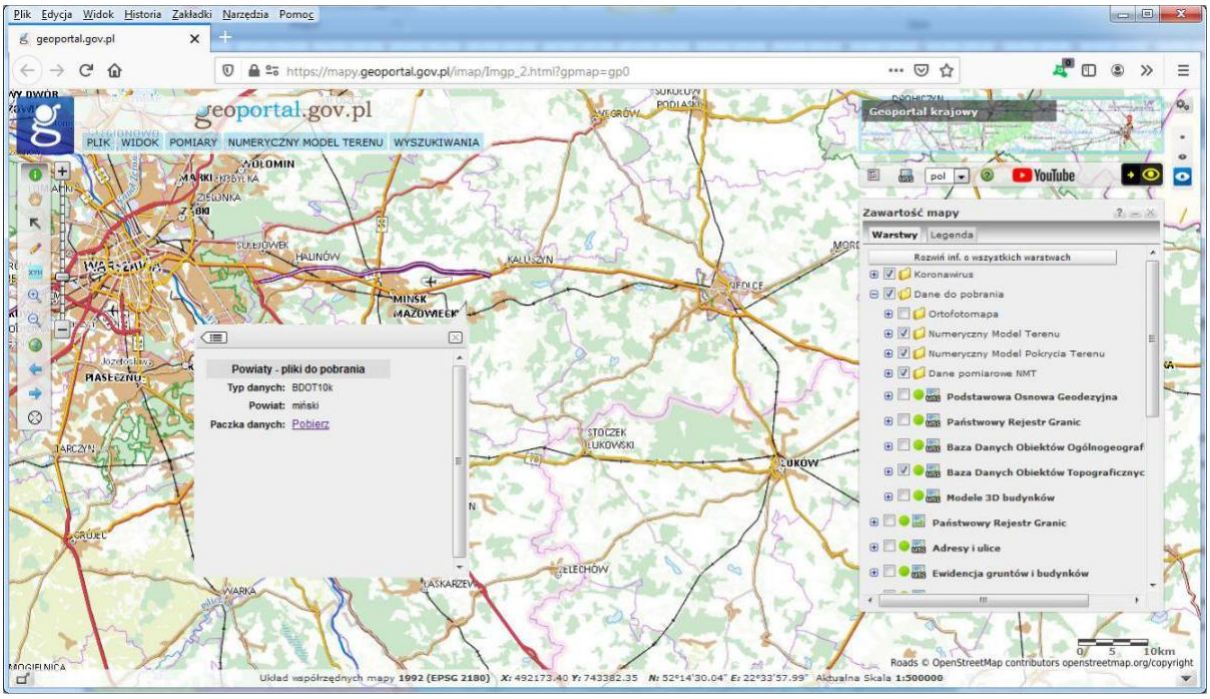

Figure 14. Downloading BDOT10k base in county data packages

The measures taken with regard to making data available free of charge have already greatly facilitated the accessibility of such data and resulted in indirect benefits for the entire economy and public administration. This results from easy access to, and the possibility of mass use of, spatial data, which should translate into technological development and improvement of the society's digital competence. Sale of data generated marginal revenue, which significantly exceeded the costs of handling the sale process and data management. Apart from financial aspects, a particularly important element of the release of data are intangible benefits: increased innovation of private sector companies, meeting the society's expectations regarding the release of data collected for public funds, or the increase of the significance of research work carried out by the education sector using spacial data.

On average, approximately 2.5 TB of data is downloaded on a daily basis, and to date the most data was downloaded on 17 August 2020, i.e. more than 5 TB. All statistics for August 2020 are presented in Fig. 15.

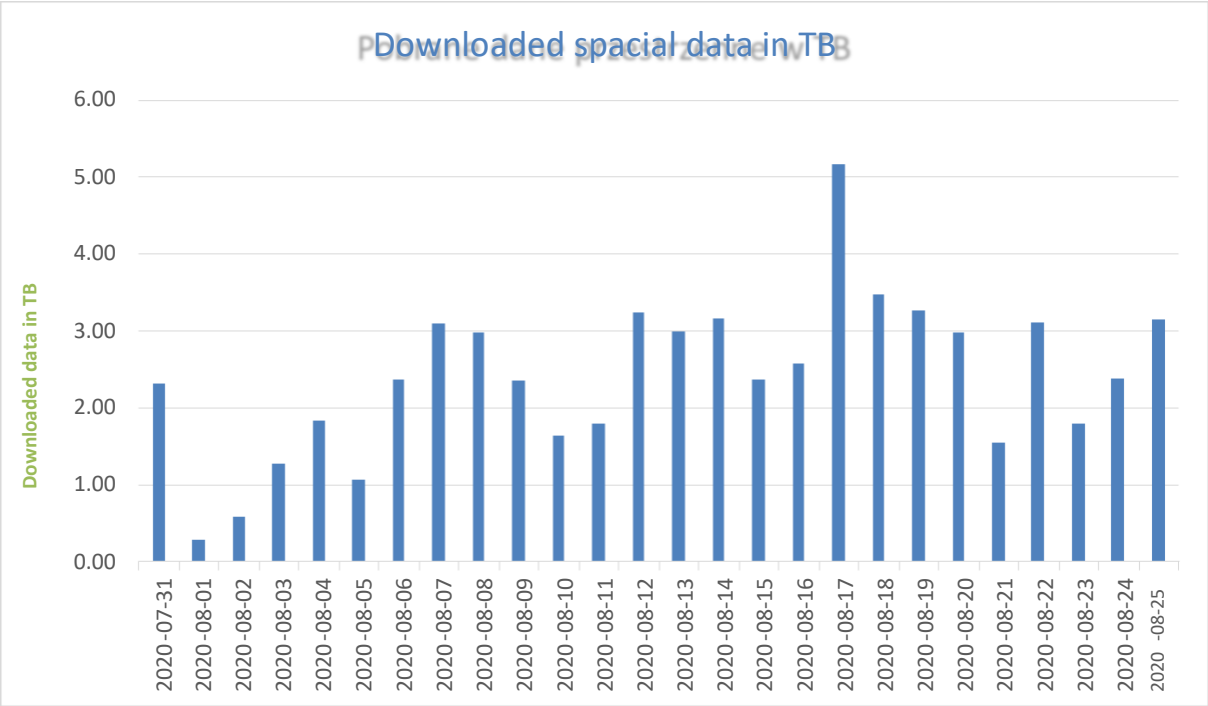

Figure 15. Data download statistics for the last month

1.4 Geoportal 3D

The geoportal3d service enables data collected in the State Geodetic and Cartographic Resource to be viewed as a three-dimensional visualisation. As a background, the digital terrain model in a 1m x 1m grid is used, against which the features from the BDOT10k database and a 3D model of buildings are rendered (Fig. 16).

Figure 16 3D visualisation at www.geoportal.gov.pl

In terms of functions, geoportal3d is similar to the standard map service www.mapy.geoportal.gov.pl, thus the function of searching for a parcel of land or any geographic object is available there. The user can also control the map content and settings.

2. Centre for Spatial Analyses of Public Administration (CAPAP)

The task of the Centre for Spatial Analyses of Public Administration (CAPAP) system is to popularize spatial data and possibilities of their use and to facilitate the publication of spatial data sets by public administration entities.

This task is accomplished by providing by the CAPAP platform a number of intuitive applications and simple services dedicated to people who have no everyday contact with spatial information. With CAPAP tools, users can easily and quickly create their websites based on the technical infrastructure, data and tools provided by the CAPAP platform. The platform is available at http://capap.gugik.gov.pl Below there are examples of websites created with the use of CAPAP tools.

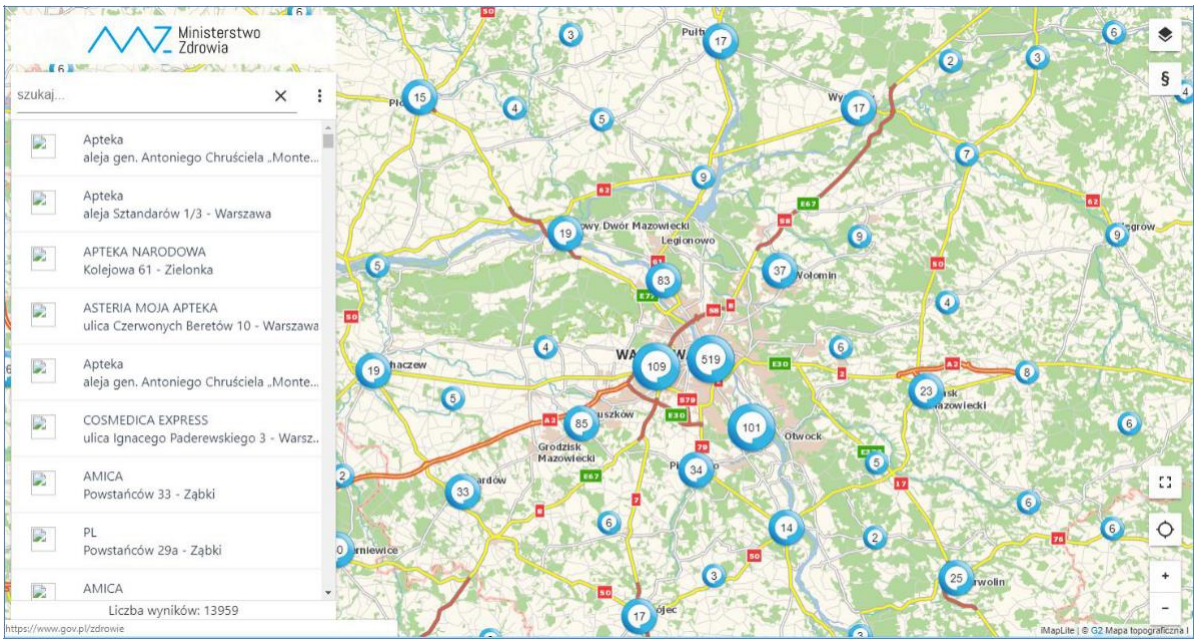

Figure 17 Dedicated CAPAP application showing the implementation of e-Prescription

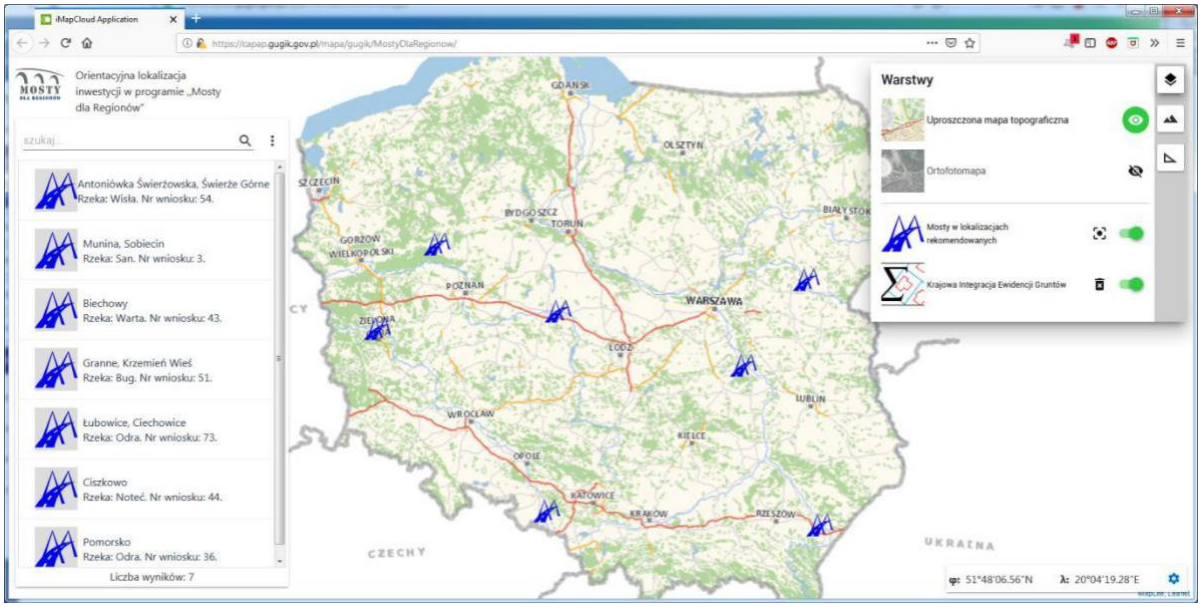

Figure 18 Dedicated CAPAP application showing the location of bridges in the "Bridges for Regions" programme

3. Access services to land and building registry data

In the second half of 2018 GUGiK undertook actions aimed at publishing data on the land and building register directly from the district resources. The aim of the undertaking was to provide widely available network services that would enable the use of land and building register data in the state IT systems and systems created by commercial companies. The services concerned are:

- **KIEG** – (National Land Registry Integration) service providing the ability to generate a map of land and building registry for any area of the country.
- **ULDK** – (Service of Location of Cadastral parcels) service for location of cadastral parcels. It enables spatial location of a given parcel on the basis of its identifier, district name and plot number or on the basis of X,Y coordinates of any point inside it.

All technical details related to the services can be found on the pages of these services, i.e:

- https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaEwidencjiGruntow
- https://uldk.gugik.gov.pl

3.1. KIEG Service

The KIEG Service is a Web Map Service (WMS), compliant with the OGC standard, that can be used in any software that is a WMS client. The service provides the ability to generate a map of land and building inventory for any area of the country, and its essence is the ability to download information from one of the 380 county servers. In the diagram below (Fig. 19) the idea of the KIEG service is presented.

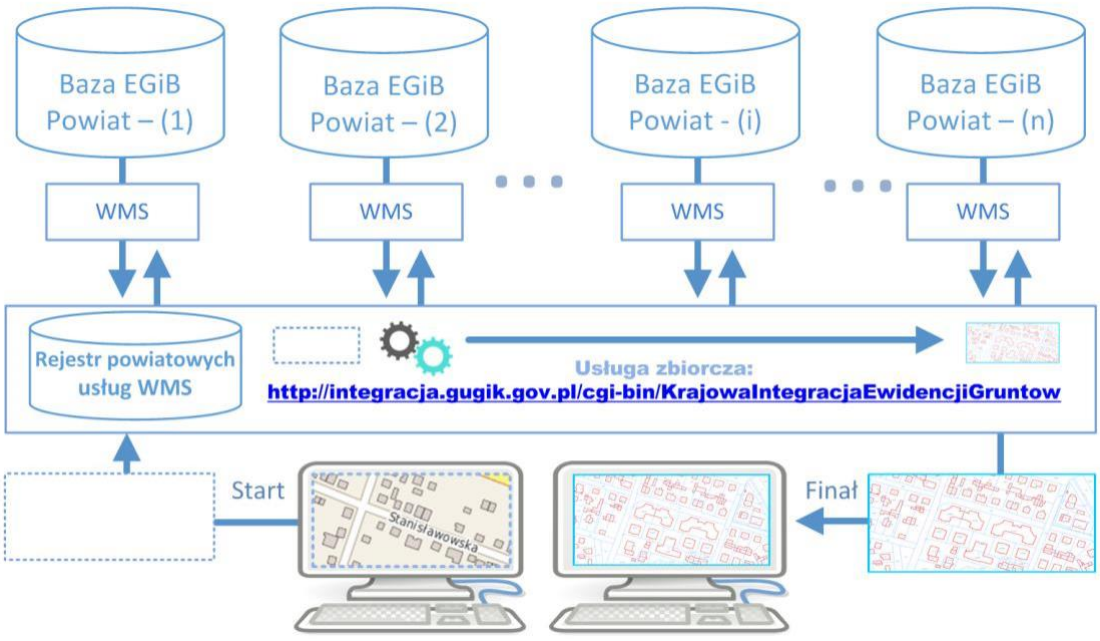

Figure 19 Diagram showing the mechanism of the KIEG service

The actions shown in the diagram above can be described in the following sequence of actions that are performed when using the KIEG service:

- user operates only one WMS (collective) service address, i.e: https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaEwidencjiGruntow) and does not have to remember the addresses of particular district services,
- the user of the collective service sends a request to the collective service to generate a map in the browsed area,
- the collective service on the basis of its register, addresses inquiries to relevant district services of interest to the user, which generate an image of data (maps) from individual districts,
- after receiving a response from districts (one or more) a total data image is generated for the query (map), which is returned to the user.

Figure 20 An example of a map fragment provided by KIEG service

An example of a query with which the image shown in Fig. 20 was generated has the form:

https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaEwidencjiGruntow?REQUEST=GetMap&TRANSPARENT=TRUE&FORMAT=image/png&VERSION=1.3.0&LAYERS=obreby,dzialki,numery_dzialek,budynki&STYLES=,,,,,,&BBOX=483561.42,674195.48,483614.86,674312.56&CRS=EPSG:2180&EXCEPTIONS=xml&WIDTH=1770&HEIGHT=808

Appropriate control of the parameters of calling the collective service gives the possibility to obtain an image of the cadastral map from any area of Poland.

3.2. ULDK service

ULDK service is a service for localization of record parcels. It enables spatial location of a given parcel on the basis of its identifier, district and plot number or on the basis of X,Y coordinates of any point inside it. Diagrams of ULDK service operation in case of localization by identifier and by coordinates are shown in Fig. 21 and 22.

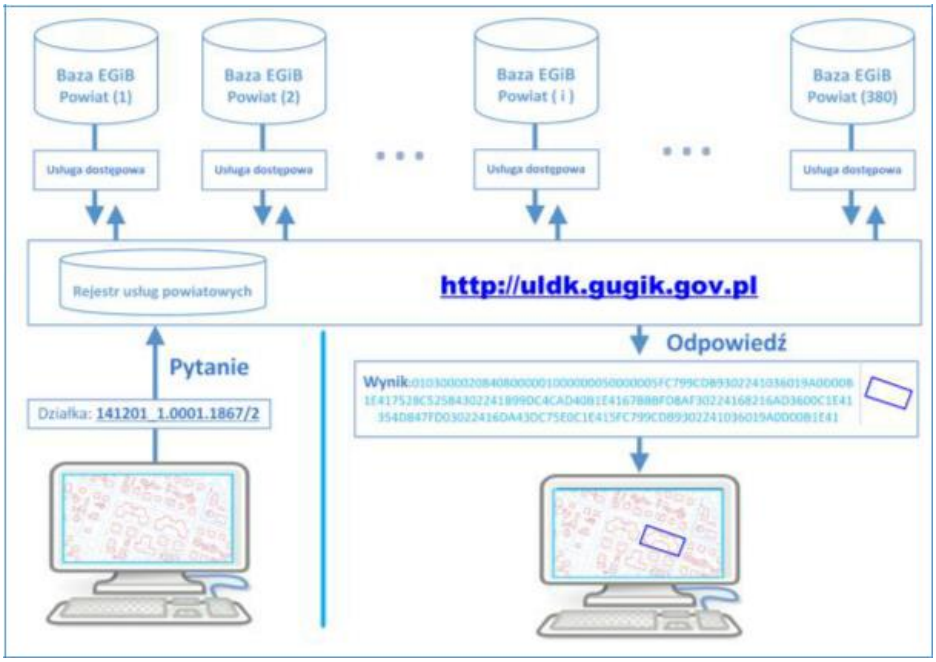

Figure 21 Diagram of locating a parcel of land in ULDK using land parcel identifier (request=GetParcelById)

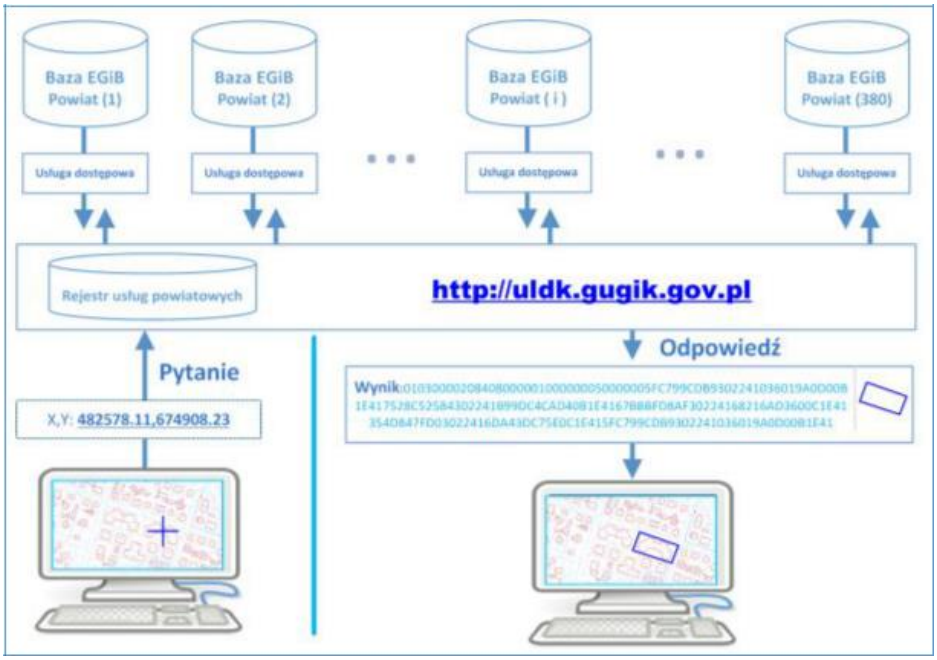

Figure 22 Diagram of locating a parcel of land in ULDK using coordinates (request=GetParcelByXY)

ULDK service offers the possibility of locating a plot of land from any part of Poland. The individual calls have a form:

- https://uldk.gugik.gov.pl/?request=GetParcelById&id=141201_1.0001.1867/2

- https://uldk.gugik.gov.pl/?request=GetParcelByXY&xy=630889.87,497178.59

You can specify the identifier of the coordinate system in a service call, where the coordinates of a point are given (by default it is a system marked as EPSG:2180, i.e. PUWG1992). By default, the parcel geometry is returned in WKB format, which is implemented in most systems dedicated to handling spatial data.

As a standard, as a result of calling the plot location service, without additional parameters, we obtain a result file containing 2 lines.

```
0
0103000020840800000100000000E0000007B14AEC74699244152B81E851B741D410AD7A3F0
4299244100000000002741D41713D0A571A992441333333331E741D419A9999990F99244100
000000E0731D4100000080CF98244152B81E850B741D419A999919CB9824411F85EB51ED73
1D413D0AD723CA982441713D0AD7ED731D415C8FC2F5C49824411F85EB51CE731D410AD7A3
F0B798244152B81E85D7731D4166666666AD982441C3F5285C97731D41E17A142E85982441
66666666B2731D419A999999A3982441EC51B81E84741D415C8FC2F5F1982441B81E85EB51
741D417B14AEC74699244152B81E851B741D41
```

Figure 23 Typical form of response from ULDK

In the first line the response status is entered. In the second line the plot geometry is saved in WKB format. The geometry of the parcel is given only if the parcel is found, i.e. the response status is zero, otherwise the file contains only one line with the query status entered.

The results may look different for a search based on the **geodetic precinct name** and **land parcel number**, which is not always unambiguous, and sometimes more than one parcel of land can be retrieved as a result of repeating geodetic precinct names, e.g. a request concerning land parcel No. 756 in the Stara Wieś geodetic precinct: https://uldk.gugik.gov.pl/?request=GetParcelByIdOrNr&id=Stara_Wieś_756, will generate a file with information on six parcels of land from different counties:

Lp.	Identyfikator działki	Powiat	Gmina	Pokaż w
1	060205_5.0012.756	biłgorajski	Frampol	
2	060405_2.0223.756	Hrubieszowski	Mircze	
3	061502_2.0010.756	Radzyński	Borki	
4	120707_2.0018.756	Limanowski	Limanowa	
5	140905_2.0027.AR_1.756	Lipski	Sienno	
6	180201_5.0005.756	Brzozowski	Brzozów	

Figure 24 Search results for the land parcel Stara Wieś 756

In the case of requests specifying a geodetic precinct name, apart from a result containing more than one item, it should be expected that the response time may be longer, because the request must be processed by all counties where a geodetic precinct with the given name exists. For example, when searching for the land parcel "Dąbrowa 12" we receive as many as 57 land parcels that match the search criteria.

3.2.1 Additional functions of the ULDK service

In addition to the basic location-based ULDK functions, the service has additional features. One of these functions enables the so-called "snapping" to the nearest point of the record parcel. A call example is given below, and the operation illustrations are shown in Figure 25.

https://uldk.gugik.gov.pl/?request=SnapToPoint&xy=482206.91,673473.54&radius=3

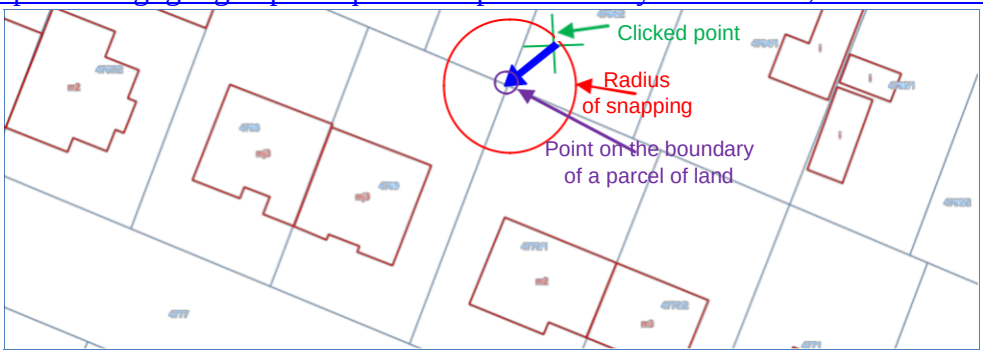

Figure 25 Illustration of the snapping to the point of the record parcel

The result is a file containing 3 lines.

```
0
0101000020840800000 8D85346776E1D41B8E67E71828D2441
1.13679998954068
```

The first one is the response status, the second one is the coordinates of a point in the WKB format, and the third one is the actual distance of the point returned from the point whose coordinates were given in the service call.

The next function is to aggregate several record objects (parcels, districts or communes) into one geometry. An example of a call is shown below, and the operation is illustrated in Figure 26.

- https://uldk.gugik.gov.pl/?request=GetAggregateArea&id=141201_1.0001.4767,141201_1.0001.4768

Figure 26 Illustration of aggregation of objects within one geometry

All technical details related to the service together with the description of all call parameters can be found at https://uldk.gugik.gov.pl

Figure 27 Website of the ULDK service

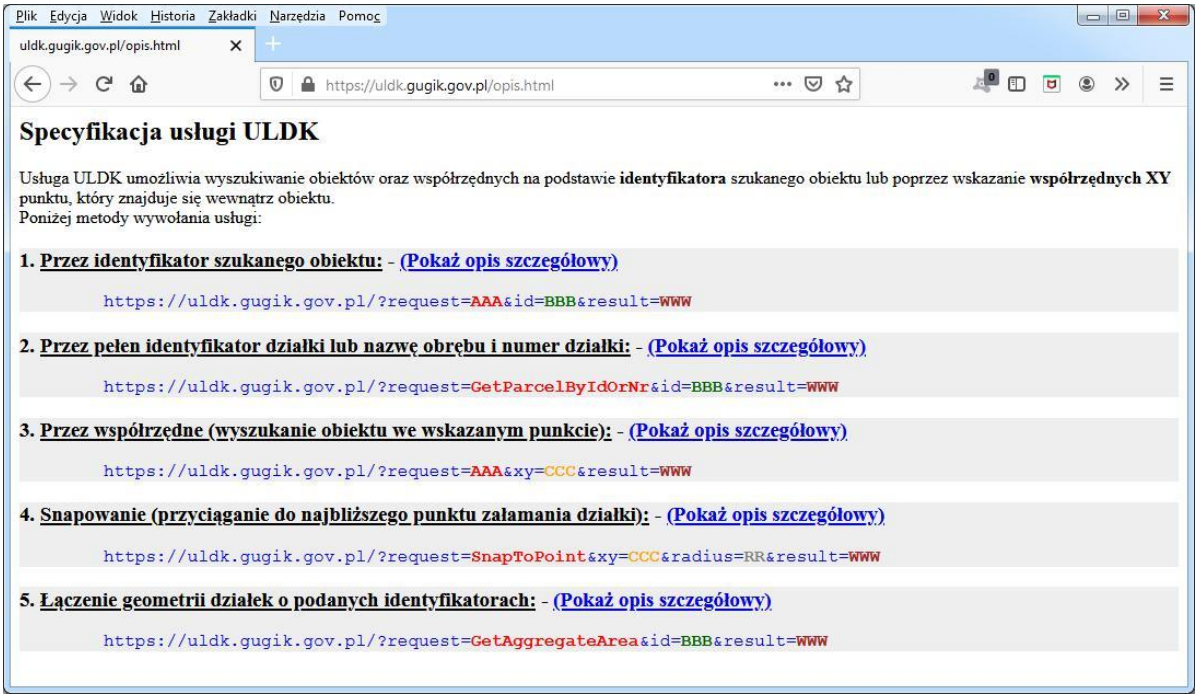

Figure 28 Website with a description of detailed parameters of the ULDK service

3.3. Use of KIEG and ULDK services

Given the importance of the KIEG and ULDK services for users, they are constantly monitored and actions are taken to improve their performance and reliability. As a result of development and popularization activities undertaken by GUGiK, KIEG and ULDK services have become key services in terms of convenient access to up-to-date data on land and building registry maintained by county level units. The use of services is steadily increasing, which is clearly visible in the graph for the nine months of 2019 presented in the figure below.

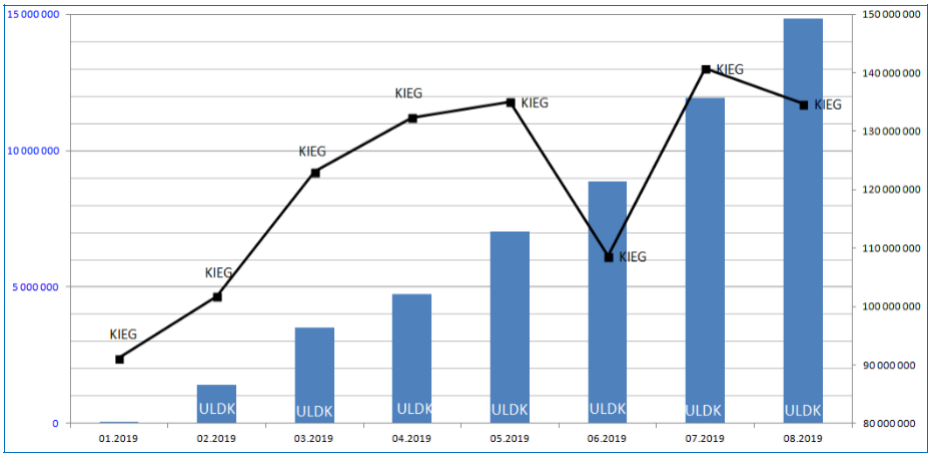

Figure 29 Statistics on the use of KIEG and ULDK services

According to the statistics, the monthly number of calls to the KIEG service already exceeds 140,000,000 and the monthly number of calls to the ULDK service significantly exceeds 15,000,000. The services have a simple interface and are widely available for official as well as commercial use. The majority of service calls are the result of their use on www.geoportal.gov.pl, but other state and commercial systems are also increasingly using these services intensively. One of the last examples is the ISOK system (Computer System for Protecting the Country against Emergency Hazards), in which services are used, for example, to automate the creation of applications in various matters related to water management.

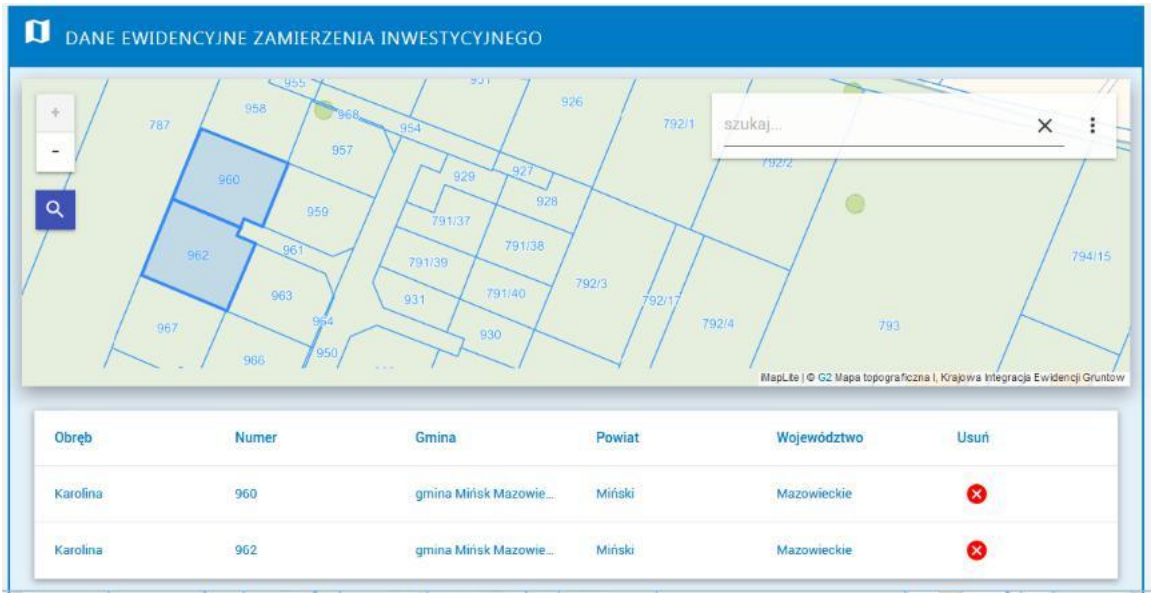

Figure 30 Example of use of KIEG and ULDK services in ISOK system

4. Access services to land development data

Currently, a collective WMS service called National Integration of Utility Network **(KIUT)** has been launched in relation to the area's infrastructure. The service is available at the address (https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaUzbrojeniaTerenu) and already presents utilities from the area of all districts.

An example of the effects obtained from the service is shown in the Fig. 31.

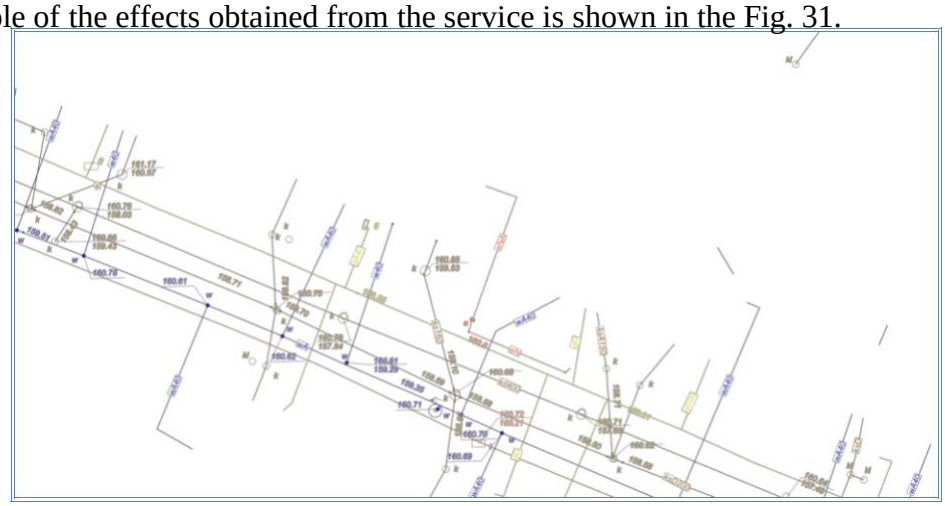

Figure 31 An example of a map fragment provided by the KIUT service

An example of a query with which the image shown in Fig. 31 was generated has the form:

https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaUzbrojeniaTerenu?REQUEST=GetMap&TRANSPARENT=TRUE&FORMAT=image/png&VERSION=1.3.0&LAYERS=gesut,kgesut,przewod_elektroenergetyczny,przewod_telekomunikacyjny,przewod_wodociagowy,przewod_kanalizacyjny,przewod_gazowy,przewod_cieplowniczy,przewod_specjalny,przewod_inny&STYLES=,,,,,,,,,&BBOX=483554.01,674206.79,483603.49,674305.08&CRS=EPSG:2180&EXCEPTIONS=xml&WIDTH=1486&HEIGHT=748

Currently, the service has about 30 million calls per month, and linking the image received from the KIUT service with the image from the KIEG service gives the most complete picture of the terrain information.

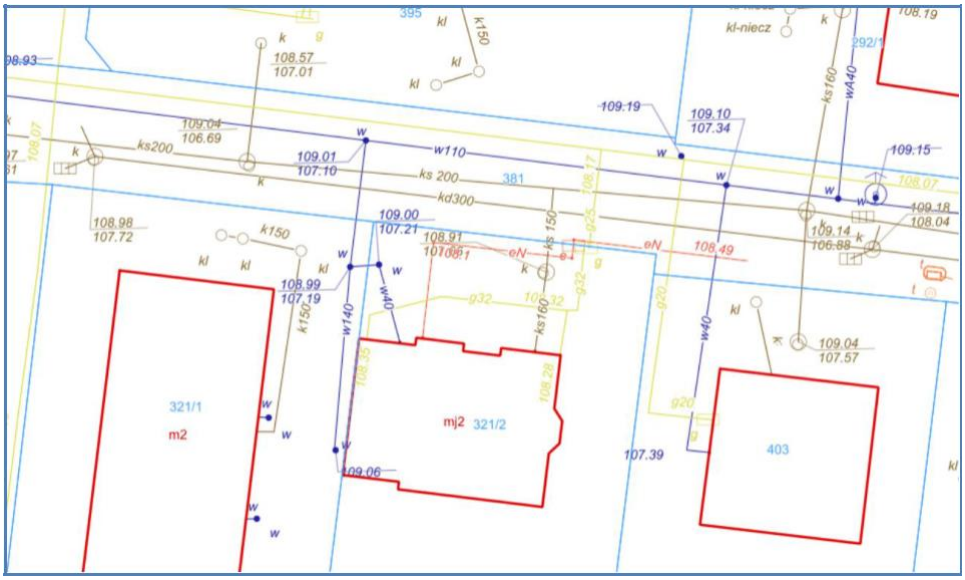

Figure 32 Linking the KIEG image to the KIUT image

5. Access services to data from local spatial plans

As regards local spatial development plans, a collective WMS service called National Integration of Local Spatial Development Plans (**KIMPZP**) is launched. The service is available at the Internet address (https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaMiejscowychPlanowZagospodarowaniaPrzestrzennego) and includes local development plans from 1287 local government units (communes). Currently, in 208 units these are vector plans, and in the remaining 1079 units they are in the form of raster with georeference. The KIMZP service currently records about 5 million queries per month.

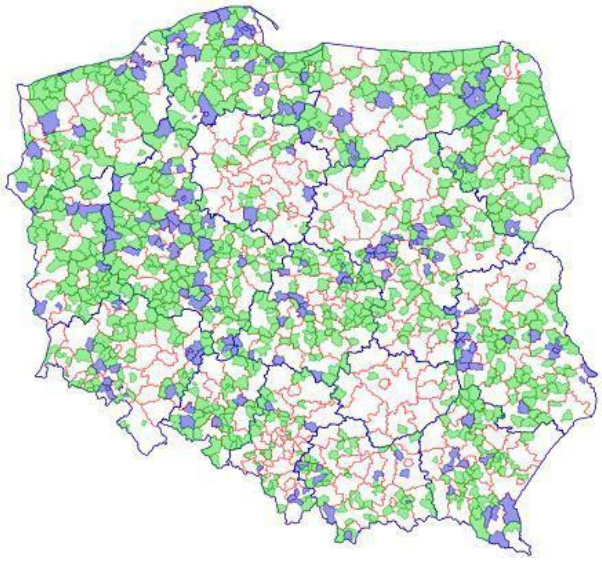

Figure 33 Scope of the KIMPZP service

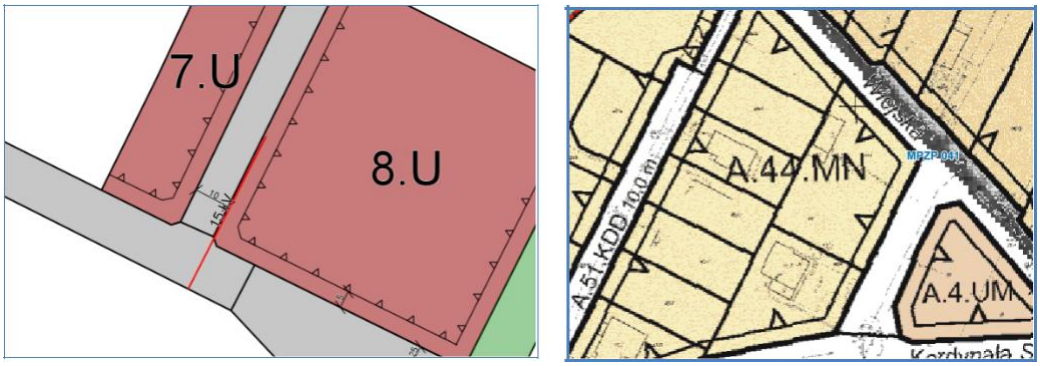

Figure 34 Example of a fragment of the map returned by the KIMPZP service, on the left a fragment of the plan published in vector form, and on the right a fragment of the plan published in raster form.

An example of a query with which the left part of the image shown in Fig. 34 was generated has a form:

https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaMiejscowychPlanowZagospodarowaniaPrzestrzennego?&REQUEST=GetMap&TRANSPARENT=TRUE&FORMAT=image/png&VERSION=1.3.0&LAYERS=plany,raster,wektor-str,wektor-lzb,wektor-pow,wektor-lin,wektor-pkt,granice&STYLES=,,,,,,&BBOX=486786.02,660350.90,486884.97,660547.49&CRS=EPSG:2180&EXCEPTIONS=xml&WIDTH=1486&HEIGHT=748

6. Address data access services

The address numbering in Poland is carried out in self-government units of the commune level. At present, an integrated address database is being created at the national level from the 2477 municipal collections (as part of National Register of Boundaries - PRG), which is the source for the address data services described below.

6.1. Presentation of address data

Up-to-date address data from all across the country can now be viewed using the WMS service available at: https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaNumeracjiAdresowej, which returns a result similar to that visible in Fig. 35.

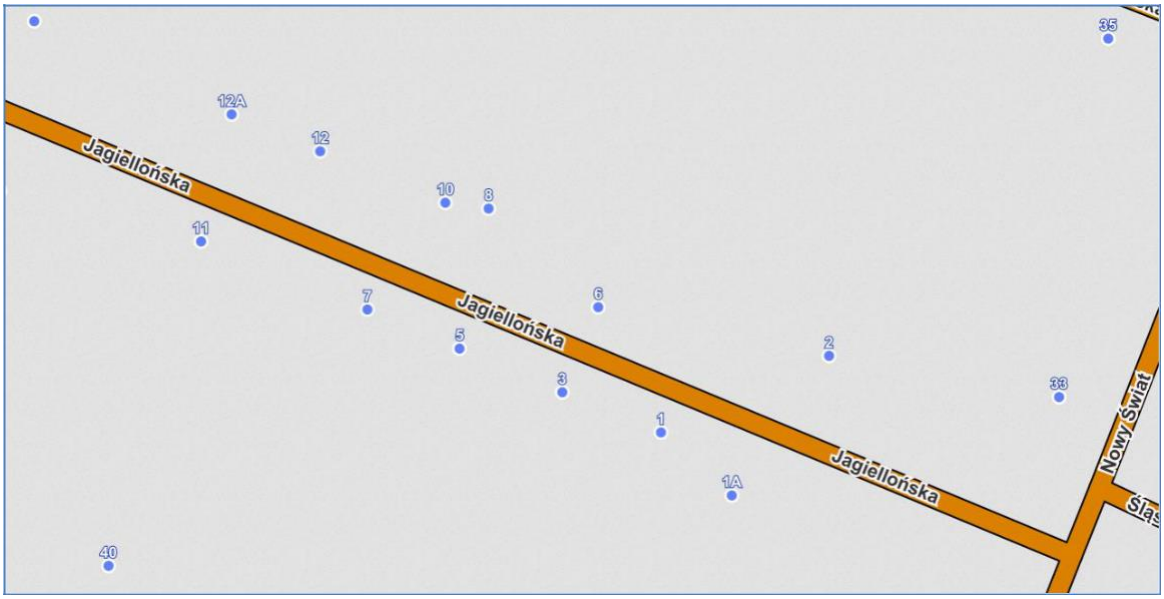

Figure 35 An example of a map fragment provided by the service presenting address data

The example request used to generate the image seen in Fig. 35 is as follows:
https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaNumeracjiAdresowej?REQUEST=GetMap&TRANSPARENT=TRUE&FORMAT=image/png&VERSION=1.3.0&LAYERS=prg-adresy,prg-ulice,prg-place&STYLES=,,&BBOX=483504.86896294885,674231.7036074,483591.25559405546,674401.9633229193&CRS=EPSG:2180&EXCEPTIONS=xml&WIDTH=1287&HEIGHT=653

6.2. Searching for address data

The Universal Geocoding Service (**UUG**), available at https://services.gugik.gov.pl/uug, is used to locate (search) address points, streets and towns. If the service is called without any parameters, then the website with its description and implemented simple search interface will be launched.

Figure 36 Information page of the UUG service

An example of a query about the address location is in the form of:

https://services.gugik.gov.pl/uug?request=GetAddress&address=Marki, Andersa 1

and the standard response in Json format [1]is in form:

Figure 37 Example of an UUG response

The **GetAdress** query always returns the coordinates of one point that locates the object to be searched for (address point, street centre or town centre), and the **address** parameter in the query can take values:

Town, Street Number -> services.gugik.gov.pl/uug?request=GetAddress&address=Marki, Andersa 1
Town, Number -> services.gugik.gov.pl/uug?request=GetAddress&address=Królewskie Brzeziny 13
Town, Street -> services.gugik.gov.pl/uug?request=GetAddress&address=Marki, Andersa
Town -> services.gugik.gov.pl/uug?request=GetAddress&address=Marki

[1] JSON, JavaScript Object Notation - lightweight computer data exchange format. JSON is a text format based on a subset of JavaScript.

However, a problem occurs when the request concerning an address is not unambiguous, as in Poland there are many towns with the same name, e.g. there are as many as 435 towns named "**Stara Wieś**". One of such cases is presented below, namely a request for o the address "**Słupno, Lipowa 4**",

https://services.gugik.gov.pl/uug/?request=GetAddress&location=Słupno, Lipowa 4,

which returns two items: Słupno in the Wołomin county and a second Słupno in the Płock county, because in each of these towns there is a street with the name **Lipowa** and on both of those streets there is an address number "**4**" (Fig. 38).

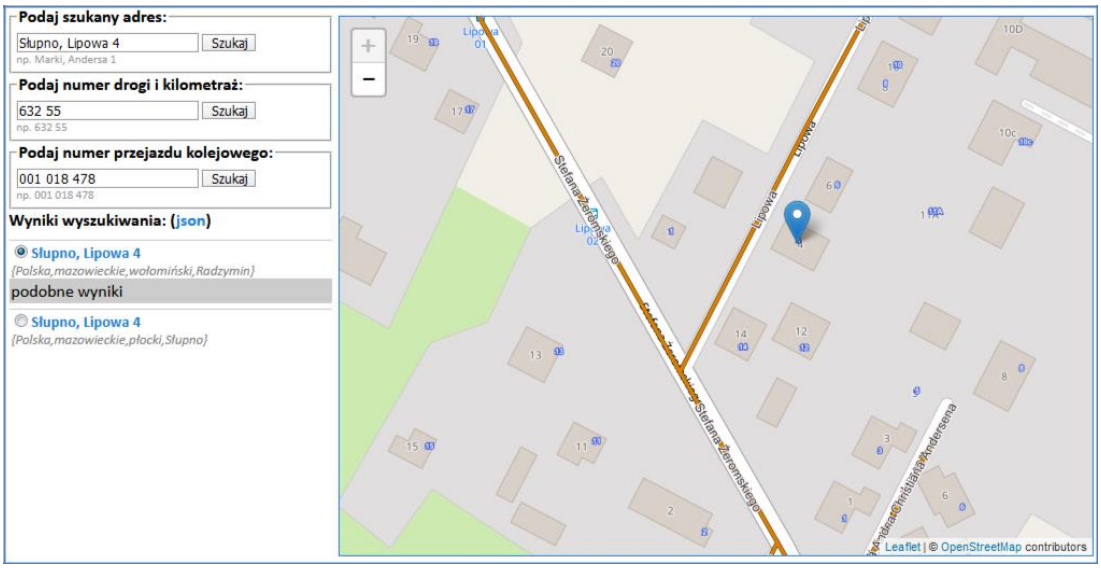

Figure 38 Ambiguous address details

To make an unambiguous search for such addresses, certain parameters should be provided to effectively eliminate the ambiguity. One way to solve this problem is to provide the postal code. In this case, the use of a postal code would return an unambiguous search result.

Figure 39 Ambiguous address details

For addresses, it is also possible to submit a request to generate a list of localities and streets, respectively:

Dictionary of towns for commune
(**request=GetCity**) -> services.gugik.gov.pl/uug?request=GetCity&teryt=141207

Dictionary of streets in town
(**request=GetStreet**) -> services.gugik.gov.pl/uug?request=GetStreet&simc=0668956

Address points are searched for based on the national database of boundaries and territorial subdivisions, which is a compilation of 2,477 municipal and communal address databases.

All request parameters concerning addresses and other data covered by the UUG service can be found at the link -> **Description of the Universal Geocoding Service**.

The UUG service is also used to search for other data, but this will be addressed in Section 10 when discussing access to specialist data.

7. Background data access services (background topographic map)

The topographic background map is based on data on basic topographic objects from the BDOT10k database and is available in the WMTS [2] service at the address: (http://mapy.geoportal.gov.pl/wss/service/WMTS/guest/wmts/G2_MOBILE_500).

The service in an accessible and visually attractive way presents spatial data for the Polish territory originating from PZGiK. As the name suggests, the service is suitable for use as a base map for the presentation of the user's spatial data. The open service interface allows for relatively easy integration with most map applications. The service may be used as a background content, as well as background maps published by companies and organizations such as Google or OpenStreetMap.

Figure 40 An example of a visualisation of a background map

The BDOT10k data is also available in the WMS service at the address:

http://mapy.geoportal.gov.pl/wss/service/pub/guest/kompozycja_BDOT10k_WMS/MapServer/WMSServer

The service is best combined with the WMS service with address data available at the address:

http://mapy.geoportal.gov.pl/wssumm/services/G2_PRGADUMM_WMS/MapServer/WMSServer?

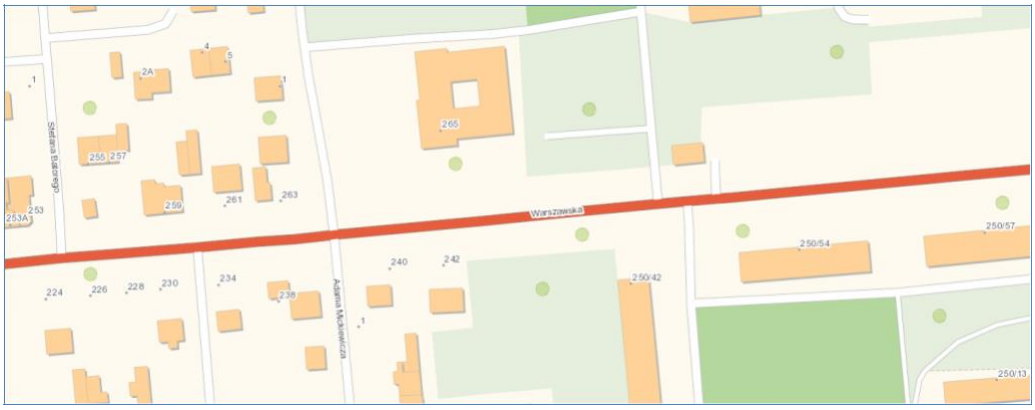

Figure 41 An example of a visualisation of a background map with addresses

[2] WMST - https://en.wikipedia.org/wiki/Web_Map_Tile_Service

8. Orthophotomap data access services

An orthophotomap is a raster image of the land surface resulting from the processing of aerial or satellite photographs. In Poland, the entity responsible for maintaining the database of orthophotomaps under the *Act on Geodetic and Cartographic Law* is the **Surveyor General of Poland**. Currently, the most accurate orthophotomaps are very realistic, because they reproduce in one pixel and terrain with dimensions of 3x3cm (GSD 3cm).

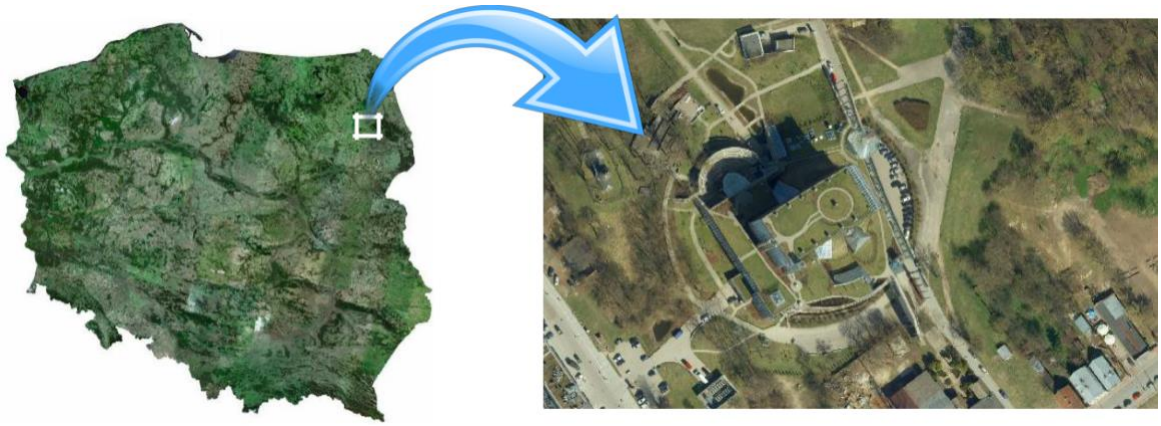

Figure 42 Examples of an orthophotomap

Most of the Polish orthophotomap is made in GSD 25cm standard, and in urban areas there are more and more pixels with dimensions of 7x7cm.

There are plans to complete a 25 cm pixel orthophotomap for the whole of Poland every two years and a 10 cm or smaller pixel orthophotomap for larger cities, but with a delay of one year; the area of each larger city will be updated annually either with a 25 cm pixel orthophotomap or a 10 cm or smaller pixel orthophotomap (Fig. 43).

Figure 43 Orthophotomap update plan for 2020-2022

To use such information effectively and not affect the visibility of the high-resolution orthophotomap with the standard orthophotomap (25 cm pixel), access to the orthophotomap has been separated into the following, depending on the map's resolution:

- **standard orthophotomap** – with a 10 cm and larger pixel,
- **high-resolution orthophotomap** – with a pixel smaller than 10 cm.

8.1. Standard orthophotomap

Digital orthophotomap content is available in Poland in two WMTS and WMS services, which are available at addresses:

- http://mapy.geoportal.gov.pl/wss/service/WMTS/guest/wmts/ORTO
- http://mapy.geoportal.gov.pl/wss/service/img/guest/ORTO/MapServer/WMSServer

Figure 44 Examples of an orthophotomap obtained from the WMS service

An example of a query with which the image shown in Fig. 44 was generated has the form:

http://mapy.geoportal.gov.pl/wss/service/img/guest/ORTO/MapServer/WMSServer?&REQUEST=GetMap&TRANSPARENT=TRUE&FORMAT=image/jpeg&VERSION=1.3.0&LAYERS=Raster&STYLES=&BBOX=483559.2,674197.8,483608.7,674296.1&CRS=EPSG:2180&EXCEPTIONS=xml&WIDTH=1486&HEIGHT=748

8.2. High-resolution orthophotomap

The current availability of the high-resolution orthophotomap is presented in Fig. 45.

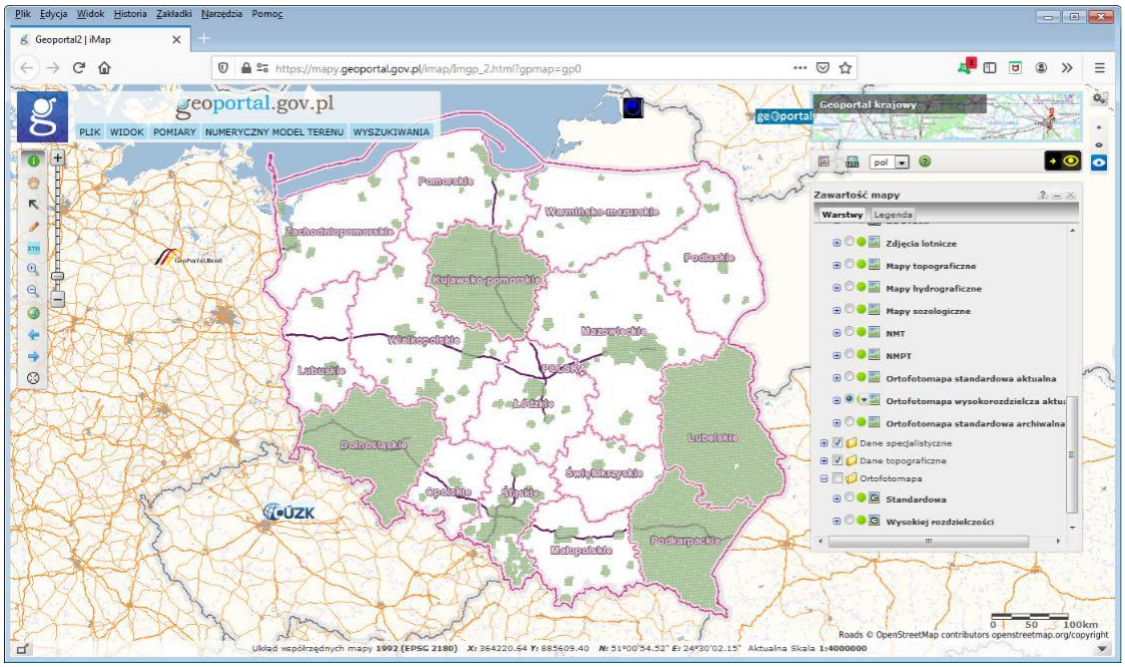

Figure 45 Availability of high-resolution orthophotomap

The content of the high-resolution digital orthophotomap is available in the WMTS and WMS service at:

1. https://mapy.geoportal.gov.pl/wss/service/PZGIK/ORTO/WMS/HighResolution
2. https://mapy.geoportal.gov.pl/wss/service/PZGIK/ORTO/WMTS/HighResolution

Figure 46 Examples of an orthophotomap obtained from the WMS service

The example request used to generate the image seen in Fig. 46 is as follows: https://mapy.geoportal.gov.pl/wss/service/PZGIK/ORTO/WMS/HighResolution?VERSION=1.1.1&SERVICE=WMS&REQUEST=GetMap&LAYERS=3,2,1&SRS=EPSG:2180&BBOX=469724.1,741268.3,469782.9,741300.9&WIDTH=1206&HEIGHT=669&TRANSPARENT=TRUE&FORMAT=image/png&styles=,,

8.3. Orthophotomaps at www.geoportal.gov.pl

Both of the described orthophotomaps are available at www.geoportal.gov.pl and are ready to be used – the user only needs to select the layer to be viewed (Fig. 47).

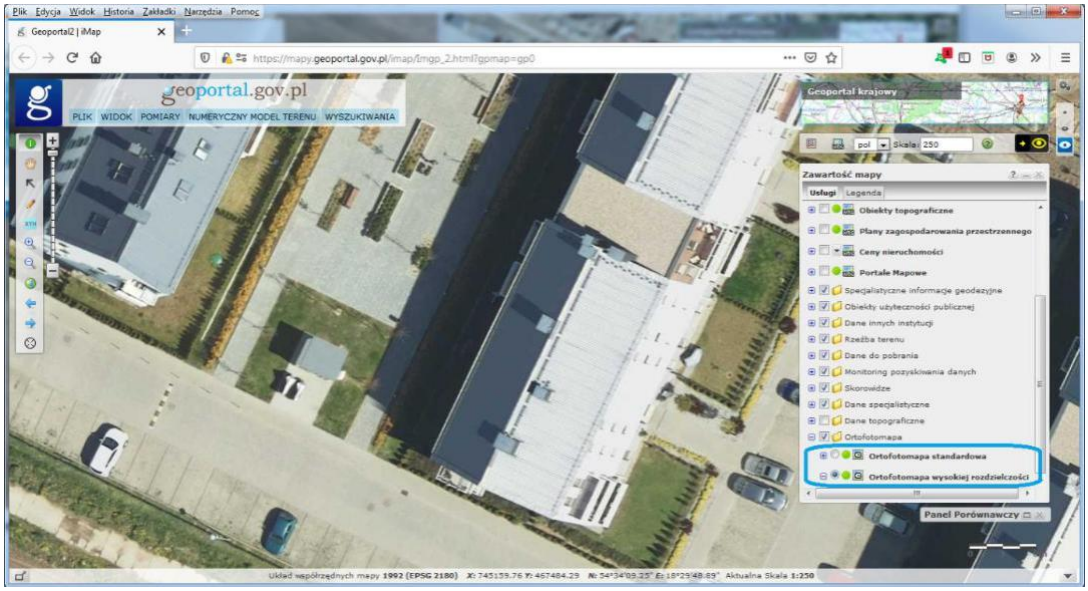

Figure 47 High-resolution orthophotomap viewed at **www.geoportal.gov.pl**

In addition, www.geoportal.gov.pl also offers the possibility to compare both orthophotomaps in the so-called comparison panel. The panel can be activated in the main menu in the "View" tab (Fig. 48).

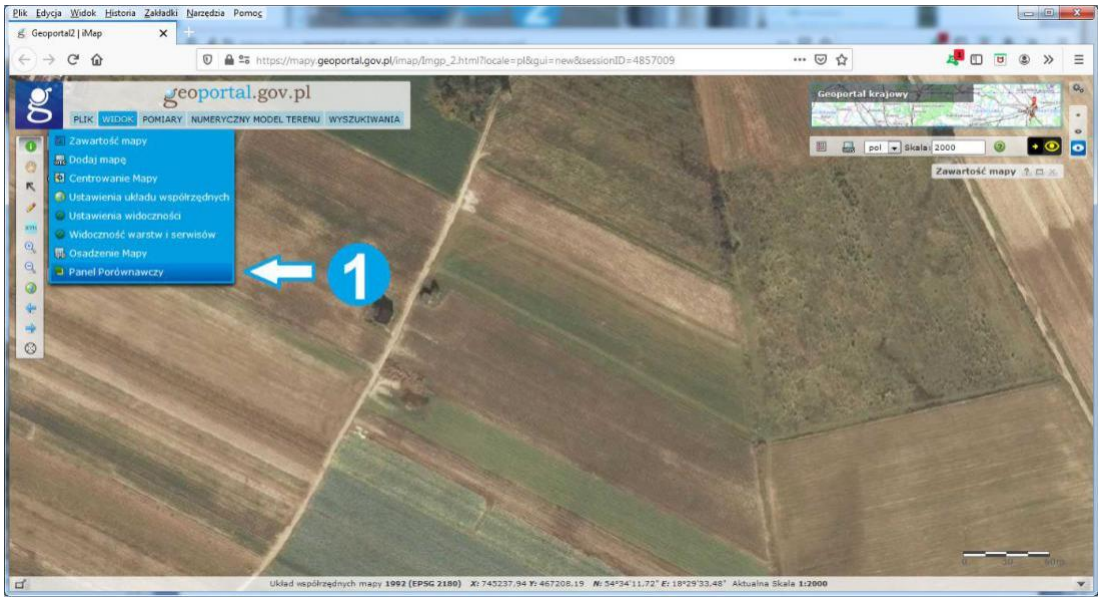

Figure 48 Activation of the comparison panel

After activating the comparison panel, we can control the screen separator slider to view a standard orthophotomap on the left and a high-resolution orthophotomap on the right (Fig. 49).

Figure 49 Comparison panel at www.geoportal.gov.pl

Thanks to this function, aside from the differences resulting from the level of detail of the image, we can see the differences resulting from the date of taking aerial photographs, i.e. the so-called detection of changes.

9. Altitude data access services

The services of access to the numerical terrain model (NMT) are a very important element of the Spatial Information Infrastructure, because thanks to them, in analyses and visualizations related to spatial data it is possible to use the terrain in a simple way. In Poland we have and regularly update the numerical model of the terrain in the grid of 1m x 1m, which is quite a precise reflection of the terrain.

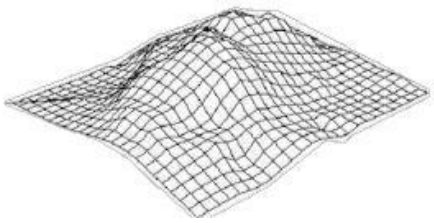

Figure 50 Illustration of the digital terrain model

9.1. Terrain visualisation services

One of the most interesting services related to the presentation of altitude data are WMS and WMTS services presenting them in the form of so-called shading. Currently, services are based on altitude data in the grid (1m x 1m) obtained from airborne laser scanning. The services are available at the following addresses:

WMS	-	http://mapy.geoportal.gov.pl/wss/service/PZGIK/NMT/GRID1/WMS/ShadedRelief
WMTS	-	http://mapy.geoportal.gov.pl/wss/service/PZGIK/NMT/GRID1/WMTS/ShadedRelief

A typical service image is the image shown in Figure 51.

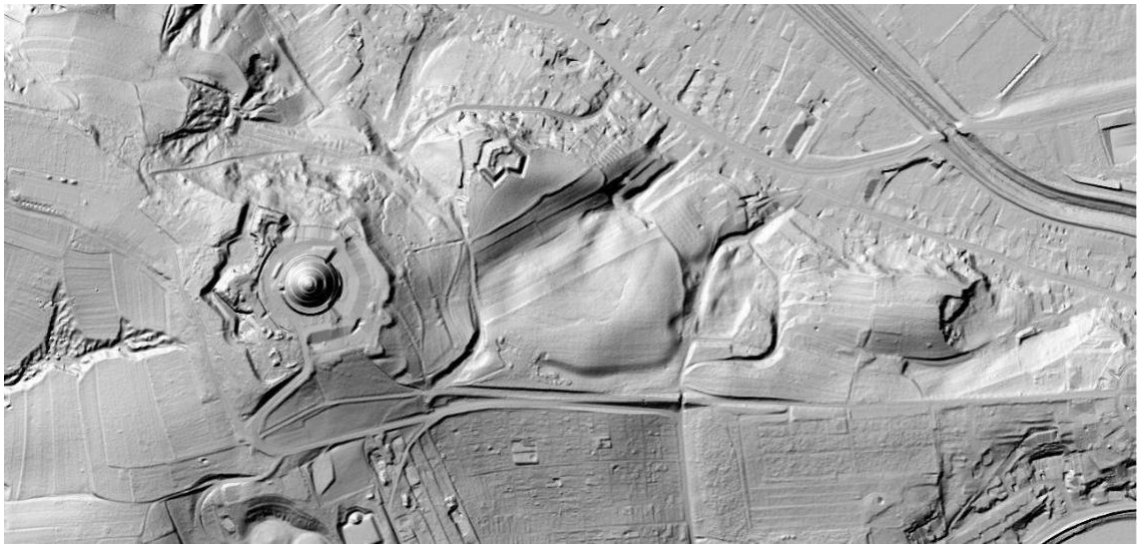

Figure 51 An example of visualisation of the digital terrain model in the form of a shaded relief

The image shown in Fig. 51 was generated with the use of WMS service using the query shown below:

https://mapy.geoportal.gov.pl/wss/service/PZGIK/NMT/GRID1/WMS/ShadedRelief?&REQUEST=GetMap&TRANSPARENT=TRUE&FORMAT=image/jpeg&VERSION=1.3.0&LAYERS=Raster&STYLES=&BBOX=243067.9,563474.0,243873.6,565167.3&CRS=EPSG:2180&EXCEPTIONS=xml&WIDTH=1280&HEIGHT=609

9.2. Access services to point height

The service described below, hereinafter referred to as the "NMT service", is available at https://services.gugik.gov.pl/nmt and supports several basic requests related to the digital terrain model.

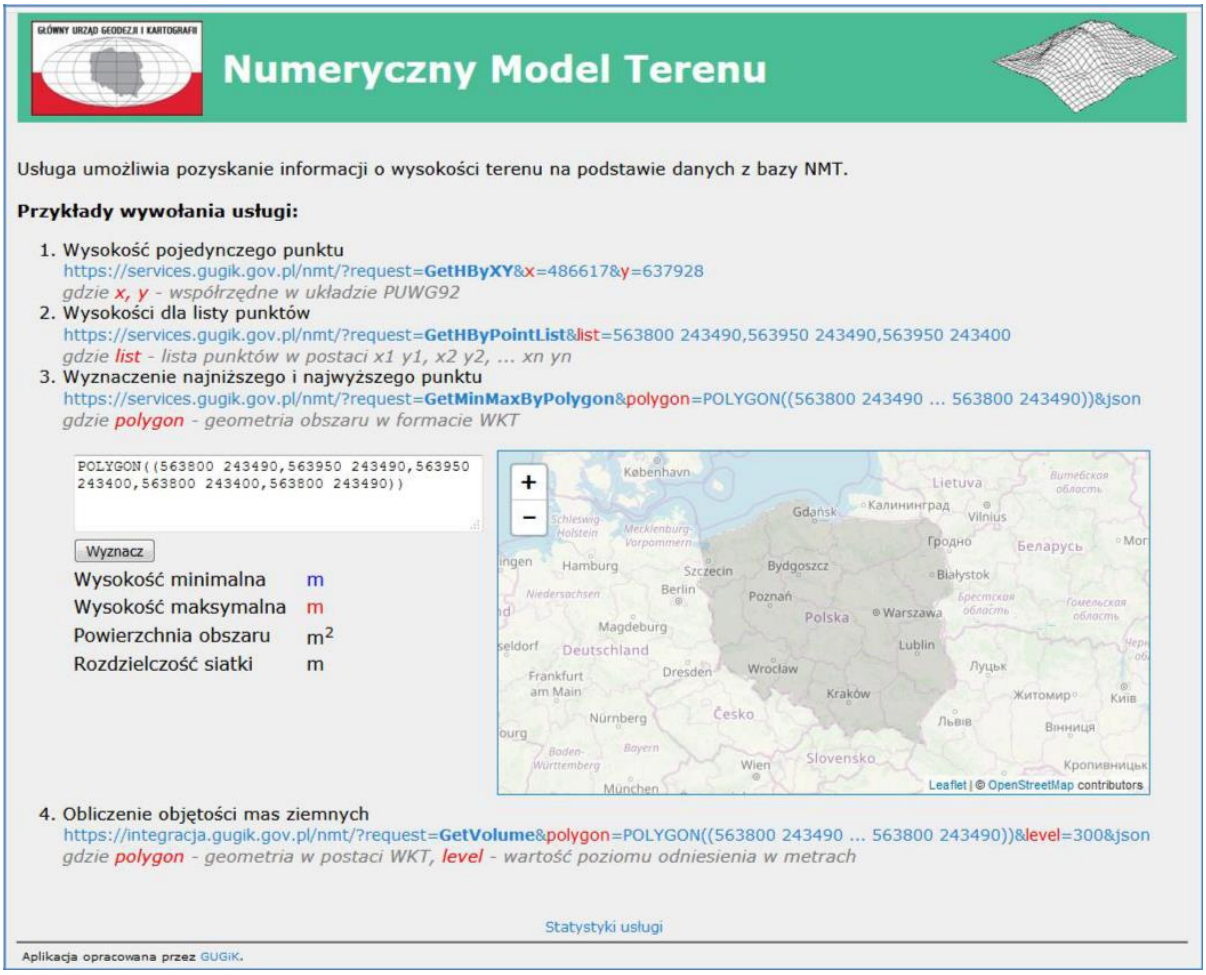

Figure 52 Information page of services at **https://services.gugik.gov.pl/nmt**

The NMT service has been implemented at http://www.geoportal.gov.pl and other websites and desktop applications to perform tasks related to the digital terrain model, such as generation of a terrain profile or calculation of the volume of earth masses. In the following subsections, the basic requests in the NMT service are described in more detail.

9.2.1 Request regarding the height of a single point "GetHByXY"

Using the **GetHByXY** request for any point with X, Y coordinates, we can obtain the height of a point from the digital terrain model with a grid of (1m x 1m). An example of a query that returns 55.8 for the given XY as a result is shown below:

https://services.gugik.gov.pl/nmt/?request=GetHbyXY&x=652222.45&y=252323.45

XY coordinates are entered in the PUWG1992 system and the height is returned in the PL-KRON86-NH height system. The service has still other parameters, which will be successively given for use by the users.

9.2.2 Request regarding the height of multiple points "GetHByPointList"

In many situations related to the digital terrain model, it is necessary to repeatedly use the functionality to determine the height of a number of individual points. In order to speed up the process, an additional functionality has been introduced to enable determination of the height of a list of points with just one request sent to the server, which is a crucial extension of the basic functionality that returns the height of only one point. An example request regarding a given list of points and returning a list of points with their heights assigned is shown below:

https://services.gugik.gov.pl/nmt/?request=GetHByPointList&list=563800 243490,563950 243490,563950 2434000

In response, we receive a list in the following form: 563800 243490 298.2,563950 243490 301.8,563950 243400 294.3

9.2.3 Request regarding extreme heights in an area "GetMinMaxByPolygon"

Another functionality of the NMT service is the ability to determine the minimum and maximum height in an area, as well as the location of points with such extreme heights. An example request related to this functionality is as follows:

https://services.gugik.gov.pl/nmt/?request=GetMinMaxByPolygon&polygon=POLYGON((563800 243490,563950 243490,563950 243400,563800 243400,563800 243490))&json

In the result for the request, we receive the minimum and maximum height in the given area and two lists of points – the first with minimum heights and the second with maximum heights (Fig. 53).

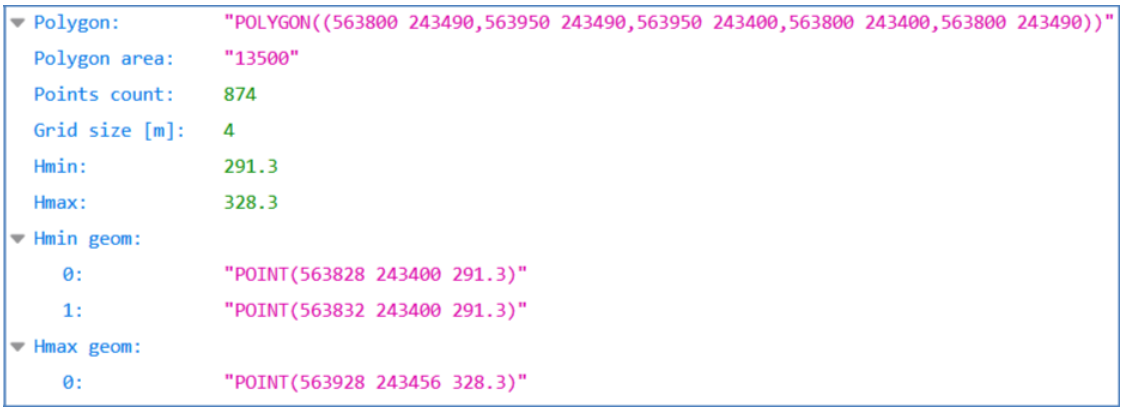

Figure 53 Result for a request in the NMT service regarding the minimum and maximum height in an area

A simple visualisation of the results obtained using the functionality for determining the minimum and maximum height is shown in Fig. 53.

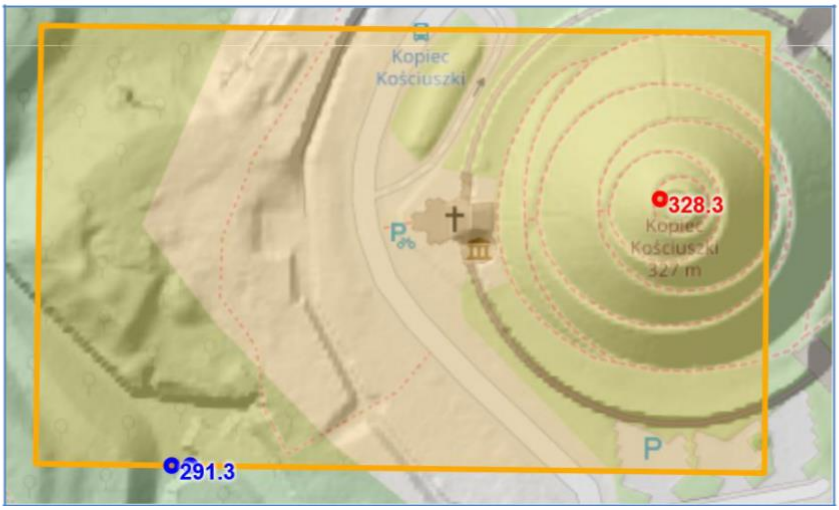

Figure 54 Visualisation of the result for a request regarding determination of the minimum and maximum height in an area

9.2.4 Request regarding the volume of earth masses in an area "GetVolume"

The final functionality in the NMT service is the ability to calculate the volume of earth masses in a designated area, relative to a plane of a given height. The input parameters are: the area defined by XY coordinates and the height of the plane (Fig. 55).

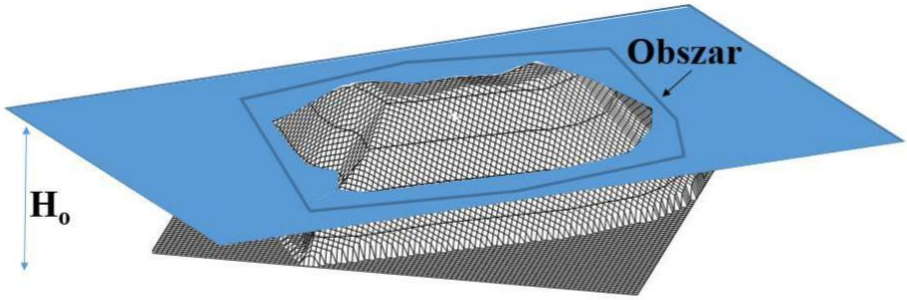

Figure 55 Illustration of the functionality for determining the volume of earth masses

An example request related to the described functionality for calculation of earth mass volume is as follows:

https://integracja.gugik.gov.pl/nmt/?request=GetVolume&polygon=POLYGON((563800 243490,563950 243490,563950 243400,563800 243400,563800 243490))&level=300&json

As a result of the request, we obtain the surface area, the lowest and the highest point within that area and the volume of earth masses above and below the designated plane (Fig. 56).


```
Polygon:        "POLYGON((563800 243490,563950 243490,563950 243400,563800 243400,563800 243490))"
Level:          300
Polygon area:   "13500"
Hmin:           291.3
Hmax:           328.5
Volume below:   25925.07
Volume above:   50789.98
```


Figure 56 Visualisation of the results of a request regarding the functionality for determining the volume of earth masses

10. Access services to specialist data

In this section, we will describe access to several types of specialist data. Although not commonly used, such data are sometimes highly practical for specialist applications.

10.1 Road kilometre markers

The first group of such data covers data on road kilometre markers. The Head Office of Geodesy and Cartography does not have such data, so in this case we use OpenStreetMap data.

10.1.1 Graphic display

The road kilometre markers are graphically displayed in the service available at:

https://mapy.geoportal.gov.pl/wss/ext/OSM/SiecDrogowaOSM

where one of the available layers is "**pikietaz**" ["picketing"]. An example image obtained from the service (with layers showing roads) is presented in Fig. 57.

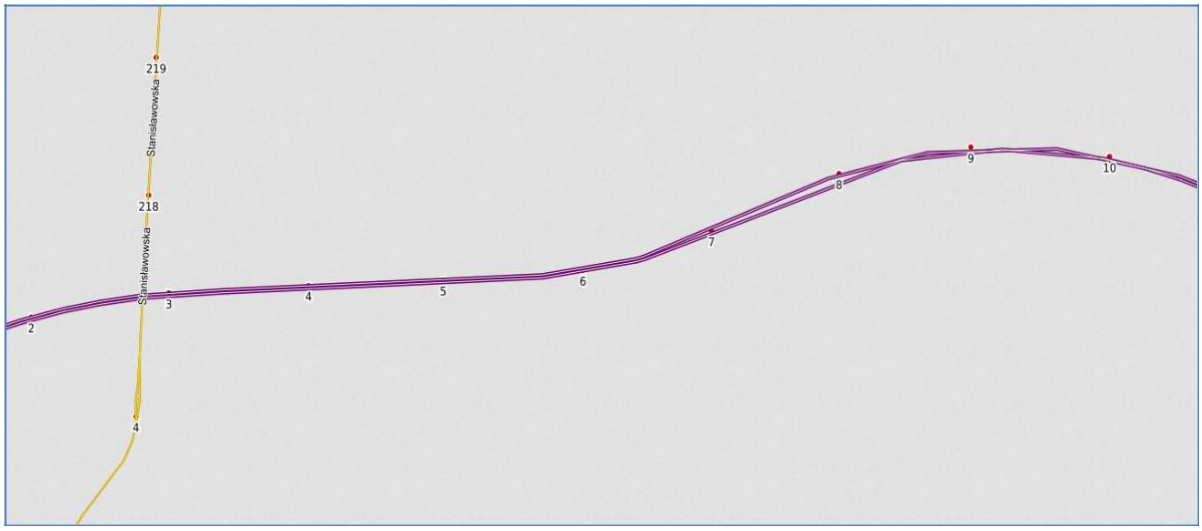

Figure 57 Visualisation of road kilometre markers

The request used for generating the image seen in Fig. 57 is as follows:

https://mapy.geoportal.gov.pl/wss/ext/OSM/SiecDrogowaOSM?&REQUEST=GetMap&TRANSPARENT=TRUE&FORMAT=image/png&VERSION=1.3.0&LAYERS=copyright,pikietaz,drugorzedne,glowne,ekspresowe,autostrady&STYLES=,,,,,&BBOX=483667.0265007198,672306.656887647,487695.31580729835,680991.6221742441&CRS=EPSG:2180&EXCEPTIONS=xml&WIDTH=1313&HEIGHT=609

10.1.2 Searching for (locating) kilometre marker posts

Spatially locating kilometre marker posts along main roads is possible thanks to the UUG (Universal Geocoding Service), referred to above when discussing the location of addresses. The service can be used by submitting a **GetRoadMarker** request, which returns the coordinates of a specific kilometre marker post or a point located at the midpoint of the indicated road. The **location** parameter in the request can take the following form:

Road marker and kilometre marker post -> services.gugik.gov.pl/uug?request=GetRoadMarker&location=71410

Road marker -> services.gugik.gov.pl/uug?request=GetRoadMarker&location=714

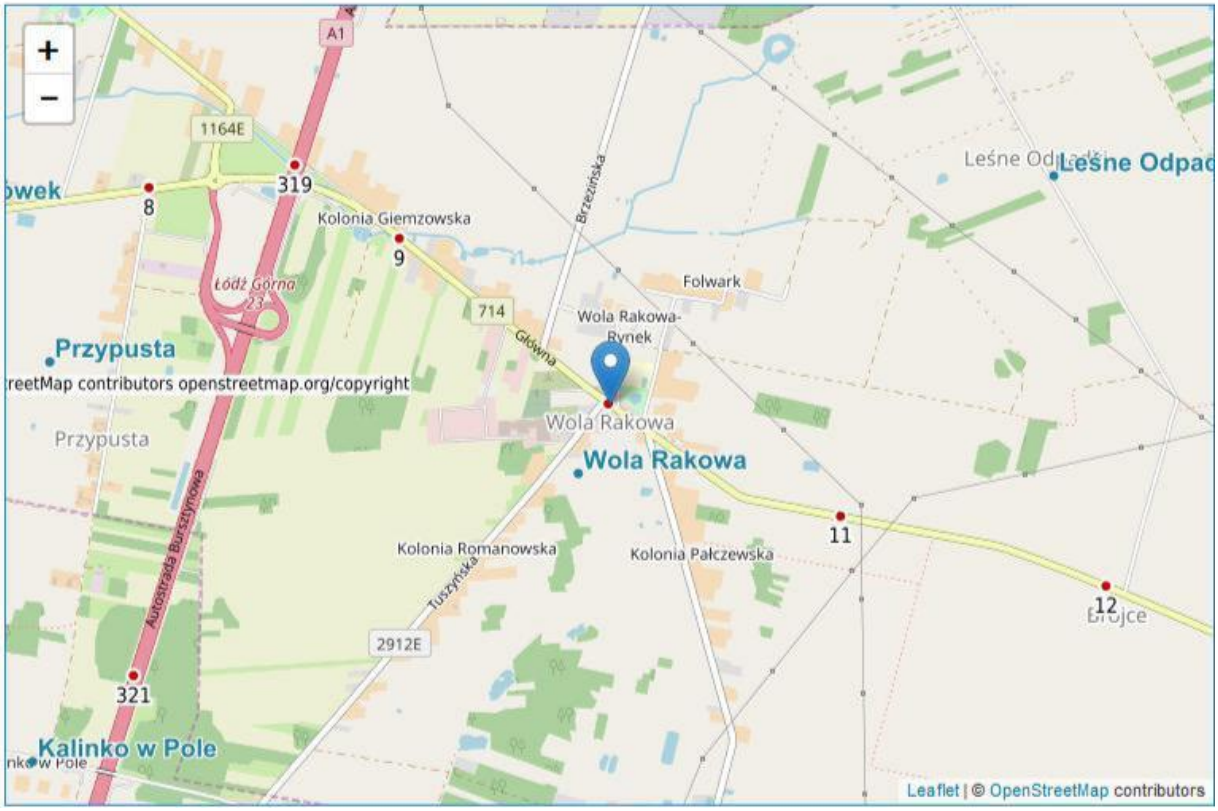

Figure 58 Use of the UUG service to locate kilometre marker post no. 10 on road 714

The **UUG** service also makes it possible to generate a list of roads for which a kilometre marker option is available:

List of main roads

(**request=GetRoads**) -> services.gugik.gov.pl/uug?request=GetRoads

10.2 Level crossings

Data on level crossings are available thanks to the cooperation between the Head Office of Geodesy and Cartography, the Rail Transport Authority (UTK) and the managers of individual level crossings. The data are updated on an ongoing basis, as information is received from individual managers. The list of level crossing managers and the number of level crossings managed is shown in Fig. 59.

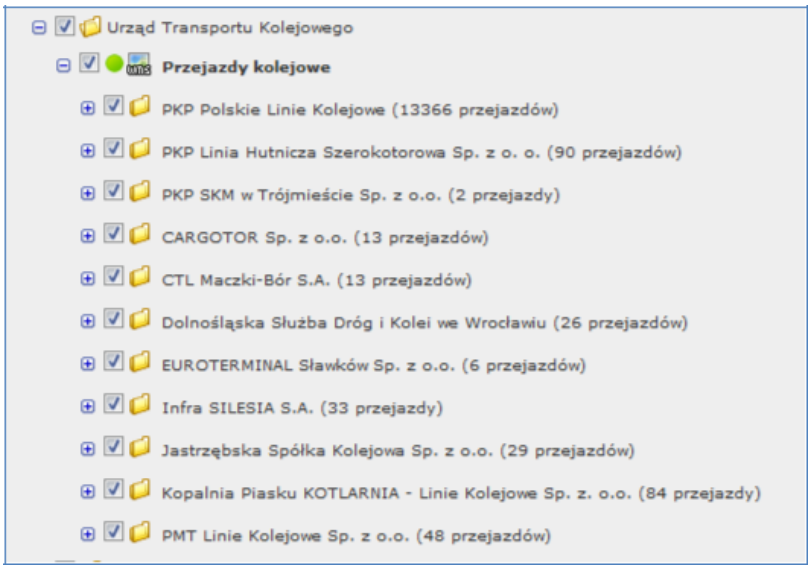

Figure 59 List of level crossing managers

10.2.1 Graphic display

A graphic display of the location of level crossings may be viewed using the WMS service available at:

https://mapy.geoportal.gov.pl/wss/service/sdi/Przejazdy/get

An example image obtained from the service is presented in Fig. 60.

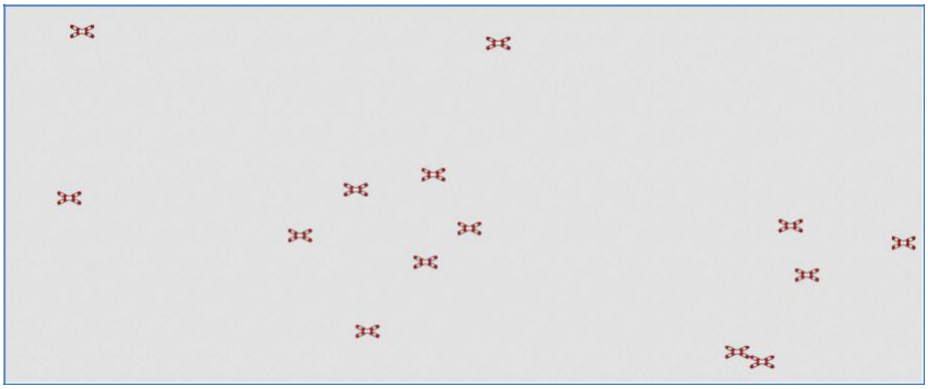

Figure 60 An example of the presentation of level crossing data

The request used for generating the image seen in Fig. 60 is as follows:

https://mapy.geoportal.gov.pl/wss/service/sdi/Przejazdy/get?&REQUEST=GetMap&TRANSPARENT=TRUE&FORMAT=image/png&VERSION=1.3.0&LAYERS=11,10,9,8,7,6,5,4,3,2,1&STYLES=,,,,,,,,,,,&BBOX=488721.90119380254,636778.3358310052,492750.1905003811,645463.3011176024&CRS=EPSG:2180&EXCEPTIONS=xml&WIDTH=1313&HEIGHT=609

10.2.2 Searching for level crossings

Level crossings may be located with a GetLevelCrossing request in the **UUG** service. An example request is as follows:

https://services.gugik.gov.pl/uug/?request=GetLevelCrossing&location=001 018 478

It returns the location of a level crossing with the identifier "001 018 478", as shown in Fig. 61.

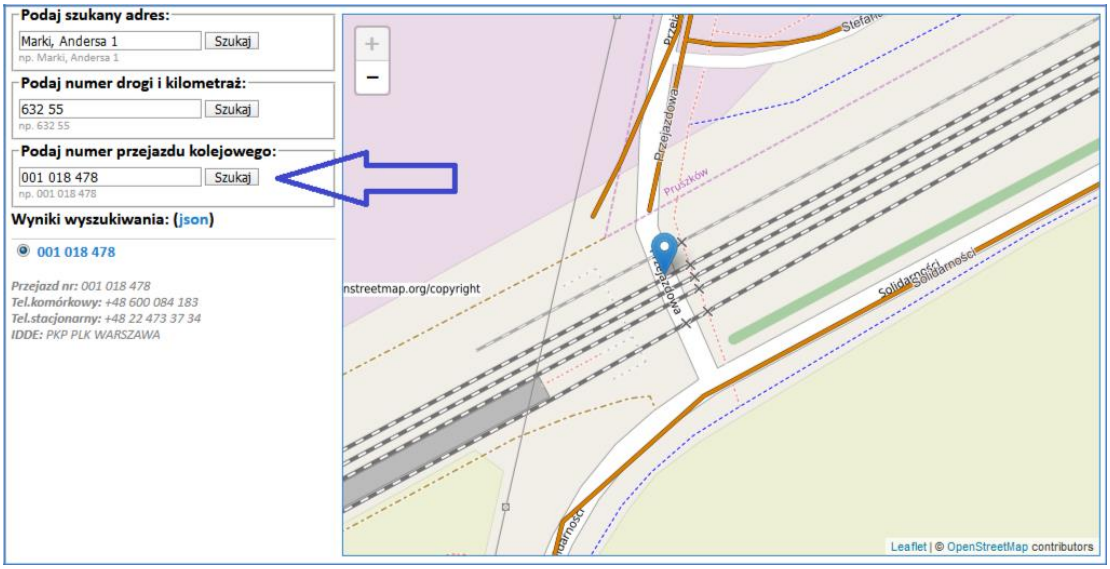

Figure 61 Use of the UUG service for locating the level crossing with the identifier 001 018 478