KAPITEL 6 / *CHAPTER 6* [6]
ACOUSTIC ZONING OF NOISE DISTRIBUTION ON THE TERRITORY OF A MODERN CITY (ON THE EXAMPLE OF THE CENTRAL PART OF THE CITY OF KHARKIV)

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Introduction

Noise map is a graphic representation of the noise distribution in the territory. Points with the same sound level values (or sound pressure levels in certain frequency bands) are connected to each other by contours. Areas of space with the same levels are usually filled with the same color. The noise map gives a visual representation of the noise regime of the area under study [1 – 4].

A noise map gives an idea of the location of noise sources and the spread of noise in the city. The map can be used to judge the state of the noise regime of streets, microdistricts, and the entire city [5 – 7]. Forecast noise maps are of great importance, especially in the planned development of the national economy of our country and mass housing construction. The city noise map makes it possible to regulate the noise level in the residential area of the city [8], and also serves as the basis for the development of comprehensive urban planning measures to protect residential development from noise. When compiling a noise map, cities take into account traffic conditions on main streets, the intensity and speed of traffic, the number of freight and public transport units in the flow, the presence of powerful diesel cars and trams. To compile the map, it is necessary to have information about the main streets (transverse and longitudinal profiles, length of hauls, types of transport hubs with intersections at different levels, types of intersections and squares, road surface, tram track design). Large open-type parking lots and transformer substations should be plotted on the noise map of the city; The map should contain information about the location of industry, external transport (intensity and speed of traffic, the design of the rail track, the presence of bridges and overpasses, the class and location of the airport, bus and railway stations, etc.), about the density of the housing stock by districts and individual highways. The map should

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contain information on the types of buildings being erected, on the location of medical and preventive institutions, research institutes, parks, etc. Design noise levels are taken into account. On the map, it is possible to judge the state of the noise regime on the highways and the territory of residential development directly adjacent to them, to identify the most dangerous areas in terms of acoustism. Maps of different years allow us to judge the effectiveness of measures aimed at reducing noise. As an example, let's consider the noise map of the city of Karaganda. The map is based on field studies: traffic intensity and noise levels of traffic flows 7.5 m from the first lane on city highways, noise levels in residential areas directly adjacent to highways, and inside it. The analysis of the noise map shows that the constant growth of the car fleet in the presence of a large number of narrow streets and sidewalks, insufficient landscaping of the area between residential buildings and the roadway, the lack of the necessary landscaping and isolation of microdistricts and quarters from penetrating traffic noise have created the prerequisites for an increased noise background of the city. To ensure acoustic comfort for the population in such heavy traffic, the width of the highway should be at least 100-120 m. From the city center, it is necessary to bring through and traffic flows and freight transport to bypass sections of highways, create expressways, improve road surfaces, and build underground (or overground) crossings. On highways adjacent to residential areas, special road signs should be used to limit the time of movement of noisy types of urban transport – diesel trucks, motorcycles and mopeds. Thus, the map makes it possible to identify a set of factors affecting the acoustic regime, to recommend the rational placement of the functional zones of the city, which makes it possible to weaken or completely eliminate the influence of the main sources of noise [9].

6.1. Mapping of data on the levels of influence of physical environmental factors in residential areas

6.1.1. Measuring instruments used

A portable (pocket) sound level meter made in China was used as measuring equipment. It has many functions, of which the following were used:

– measurement of sound level, dBA, corrected according to the standardized A scale, taking into account the different perception of sounds of different frequencies by a human auditory analyzer;
– the possibility of spectral analysis of sound: the octave spectrum for all measurements without exception was represented graphically as for normalized bands of 31.5; 63; 125; 250; 1000; 2000; 4000; 8000 Hz; and in the non-normalized bands of 16 and 16000 Hz;
– indication of the highest peak values of level fluctuations in each octave band (upper line of type - above the columnar indication of instantaneous values in each octave band);
– maximum radiation (peak dB at peak frequency, Hz), which is not normalized, but quite interesting from a scientific point of view.

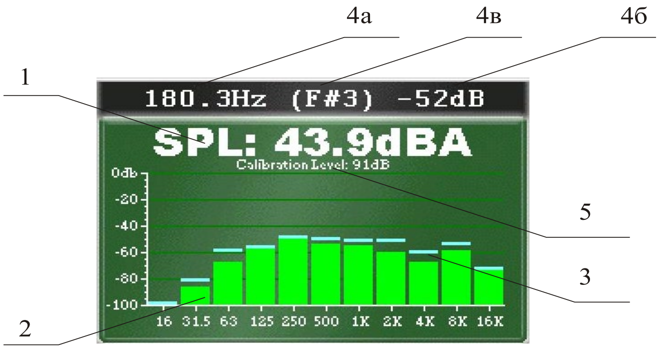


Figure 1 – Screenshot from the screen of the pocket sound level meter (with the indication of the graphical display of the performance of the above functions during measurement)

1. Sound level indicator; SPL – (Sound Pressure Level) – sound level, corrected according to the A correction scale (peculiarities of perception of sound of different

frequencies), shows the measured level in dBA. The main indicator to be monitored.

2. Spectrum Analyzer: It has coordinate axes that are graduated in Hz (here is the abscissa) and in dB (here is the ordinate). Along the axis of the abscissa, the geometric mean frequencies of the octave frequency bands are plotted (they are standardized for each of the octaves). Ukrainian regulations regulate bands ranging from 31.5 Hz to 8000 Hz; the instrument used has a wider measurement range and also operates in octaves of 16 Hz and 16000 Hz. Along the ordinate axis are the sound pressure levels in dB: for some reason, they are deposited on the hundred-point scale and additionally in reverse order. "-100 db" at the beginning of the countdown corresponds in reality to "our" 0 dB; "0 db" corresponds to a real 100 dB. This is not very convenient and, probably, should somehow switch to normal form, but due to the insufficient amount of information in the documentation of the device, it was not possible to switch the reverse indication to direct. When the device is in operation, the measured sound pressure level in it, expressed in dB, is displayed in each octave band in the form of a luminous green column. Spectrum analysis in the form of bars shows the instantaneous values of the levels.

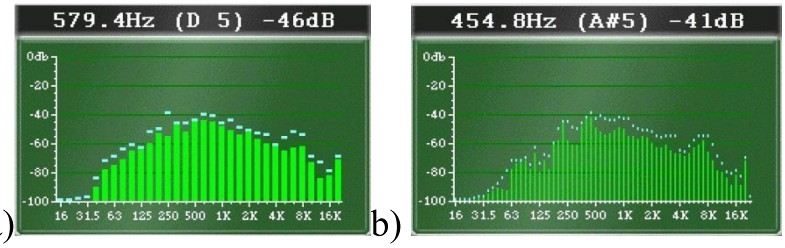
3. An indicator of the highest peak values of level fluctuations in each octave band achieved during measurements earlier. Spectrum analysis in the form of upper dashes of type « - shows the maximum values. Thus, in the same coordinate plane, two graphs are visualized at the same time – the noise spectrum built from instantaneous values; and a noise spectrum plotted from maximum values.

4.) Displays Maximum Radiation: L_{Max} – maximum sound pressure level, dB during measurement at a certain frequency f, Hz (Fig. 0.1. Poses. 4a). This parameter is not normalized, but is of particular interest from the point of view of studying sound. Due to the technical features of the appliance L_{Max} (Fig. 0.1. Poses. 4b) is displayed on the hundred-point scale in reverse order, i.e. "-52dB" with (Fig. 0.1) is actually 100 – 52 = 48 dB. Thus, the strip of the upper banner with (Fig. 0.2) should actually read as follows: "The maximum sound emission is recorded at 180.3 Hz and is 48 dB." Probably, somehow it is possible to switch the indication (Fig. 0.1. Poses. 4b) from a hundred-point countdown to a direct report: (i.e., to immediately show "+48dB" instead of "-52dB" in Fig. 0.2), however, there is no indication of this in the technical documentation of the instrument. (Fig. 0.1. Poses. 4c) – indicates the name of the octave and the serial number of the third octave band in it. These data (Fig. 0.1. Poses. 4c) were not used in experiments in any way; In the description of the device, there is no information about the information on pos. There is simply no 4B.

5. The signature "Calibration level: 91 dB" (in small letters) is purely service information intended to indicate the setting mode: (calibration of the device) and is not used in direct measurements in any way. Perhaps it can be turned off somehow, but there were no instructions from the manufacturer on how to do this.

In addition, the sound meter used has many other functions, of which the following can be distinguished:

– The possibility of not only octave, but also three-octave (Figure 2.a) and even 1/6-octave (Figure 2.b) spectrum analysis.



(a) b)

Figure 2 – Switching the display to indicate three-octave (a) and 1/6-octave (b) spectrum analysis

Poses. 1 from the previous Figure 1 At the same time, for some reason, all other elements and scales from Figure 1 fully coincide with similar elements of Figure 2.

Ability to display readings in the form of a logarithmic scale (with simultaneous maximum expansion of measurement limits to the maximum).

This is not the end of the extremely wide range of possibilities of the device. Coverage of other functions is not part of the task of the research carried out.

At the same time, the abscissa (frequencies) is graded, starting at 0 Hz (infrasound) and ending at 32 kHz (ultrasound). Poses. 1 from the previous Fig. 1 is not visualized, all other elements and scales from Fig. 1 fully coincide with similar elements of Fig. 3.

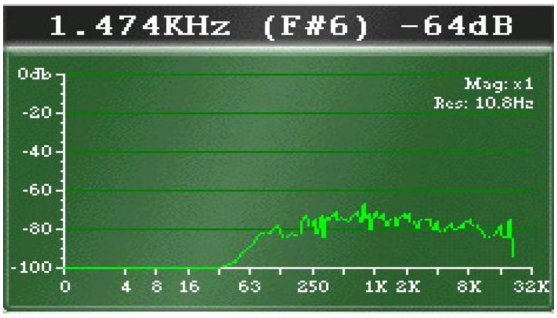


Figure 3 – The same spectrum, but deferred on a logarithmic scale

What is "Mag: x1" is unknown (there is no information in the documentation on this matter). "Res: 10.8 Hz" probably determines the bandwidth resolution: ("Res" translates to "Resolution": "Resolution: starting at 10.8 Hz"?) In any case, it does not matter, the specified parameters do not appear as conditions or the final results of the noise level measurement.

6.1.2. Optimisation of research objects

The place of our research was a section of the territory located in the Nagorny district of the city of Kharkov, in its most central part [10-13]. Here we carried out full-scale noise measurements, modeling, their comparison and addition, and mapping of the noise regime.

The cartographic basis of our research was a digital plan of the area, entered into the licensed ArcGIS software. The initial data for monitoring noise pollution in computer form were divided into so-called "thematic layers": created layers "Buildings"; "Streets"; "Quarters" with attribute tables for them.

After the initial office preparation and planning of the experiment, field measurements were started.

The number of measured noise values is 1200, of which 450 are evening and 750 are daytime.

The very first measurements showed a significant contribution of noise pollution from the tram to the overall noise background of the city. Therefore, it was decided to divide the obtained values into two groups: 1 – noise from the tram; 2– Car noise. The physical meaning of this division is that the noise spectra from rail and road transport differ significantly from each other.

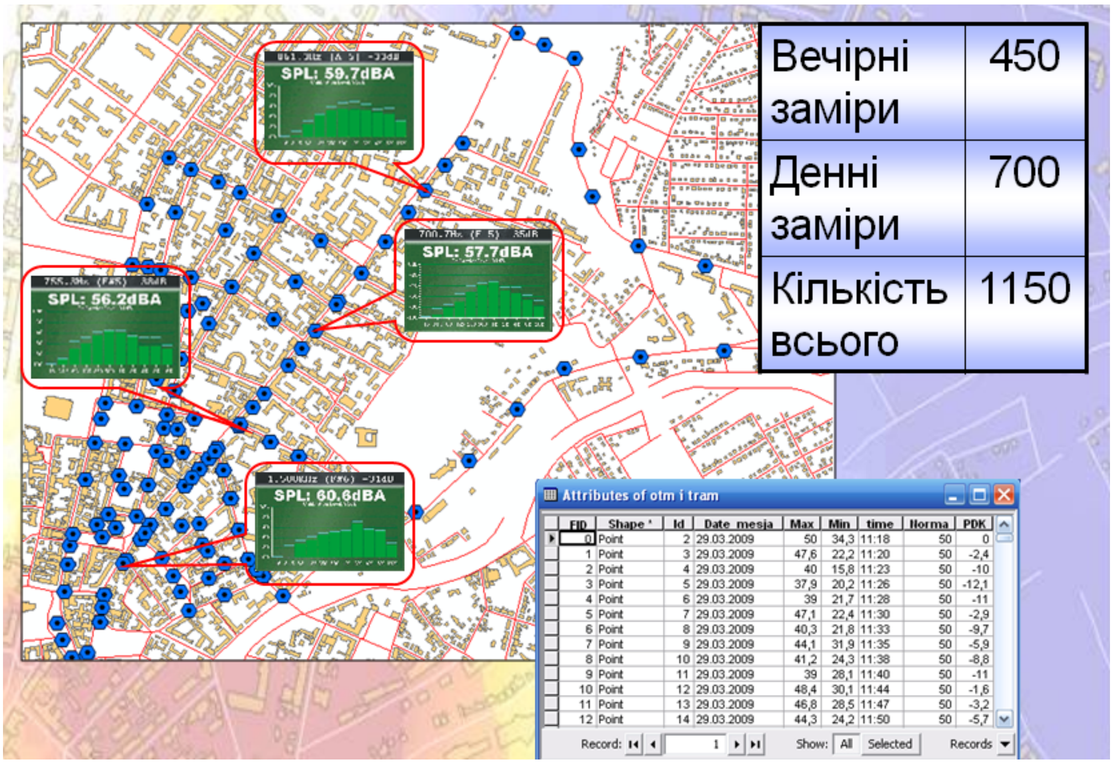


Figure 4 – Thematic layer "Measurements"

It should be noted that the decision on such a distribution was made by the experimenter even before the next objective events in the life of the city [5-12]. Tram traffic in the spring of 2009 on the street. Pushkinsky still existed; Routes No. 5 and No. 7 were still in operation at that time.

From these measurements, it clearly follows that the tram makes the greatest contribution to noise pollution at the intersections of ul. Pushkinskaya and st. Hirshman; st. Pushkinskaya and st. Red Banner, etc.

Noise measurements from trams on the street. Pushkinskaya were held in the last weeks and days of the existence of tram traffic on this street.

Now the tram tracks from the street. Pushkinskaya streets have been dismantled, the street is completely devoted to road transport and it is simply physically impossible to repeat our measurements of noise from trams. So, our noise measurements are the last ever measurements of noise from trams on this street. It is possible to evaluate their contribution and draw a conclusion about the validity / unjustification of the suspension of tram traffic by the noise factor.

Figure 5 provides an idea of the distribution of noise spectra by reference points on the street.

Actual background noise levels range from 43 to 56 dBA, so it should be concluded that even a complete closure of traffic on the street does not always have the effect of reducing noise in accordance with the requirements of current sanitary standards.

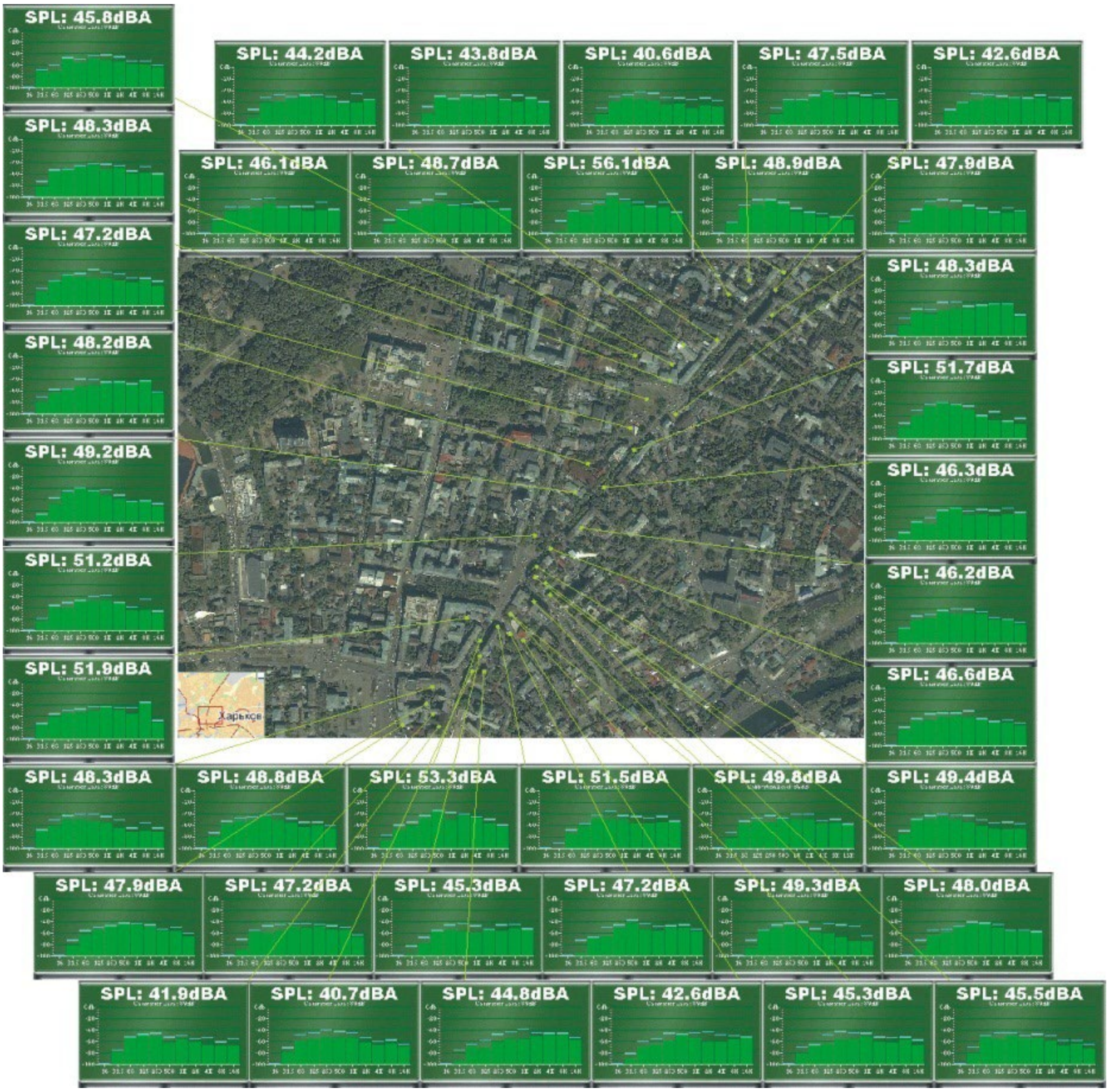


Figure 5 – background noise of Pushkinskaya Street without the contribution of the main sources

Also in Figure 5 a clearly visible decrease in the intensity of sound energy depending on the distance (three rows of measured spectra in the lower part of Figure 5 located one below the other).

To analyze data and solve various spatial problems, the built-in ArcGIS Spatial Analyst module was used, which includes three surface interpolation methods: Kriging, Spline, and IDW.

Figure 6 – Same as the previous Fig. (background noise of Pushkinskaya Street without the contribution of the main sources)

Surface functions are used to provide raster datasets in the form of surface heights, concentrations, or a defined magnitude (in this case, noise pollution).

Analyzing all the above methods of constructing volumetric surfaces, we can conclude that the most convenient for the thematic layer "Measurements" is the Kriging method, namely Ordinary Kriging, which is based on the assumption that the constant

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average value is unknown.

The use of this method makes more sense than others, because it processes data not by direction, but by area.

In order to simulate noise pollution from the tram, two surfaces were constructed using the IDW method [14]. They are built for the "Measurements" layer both with and without the contribution of tram noise.

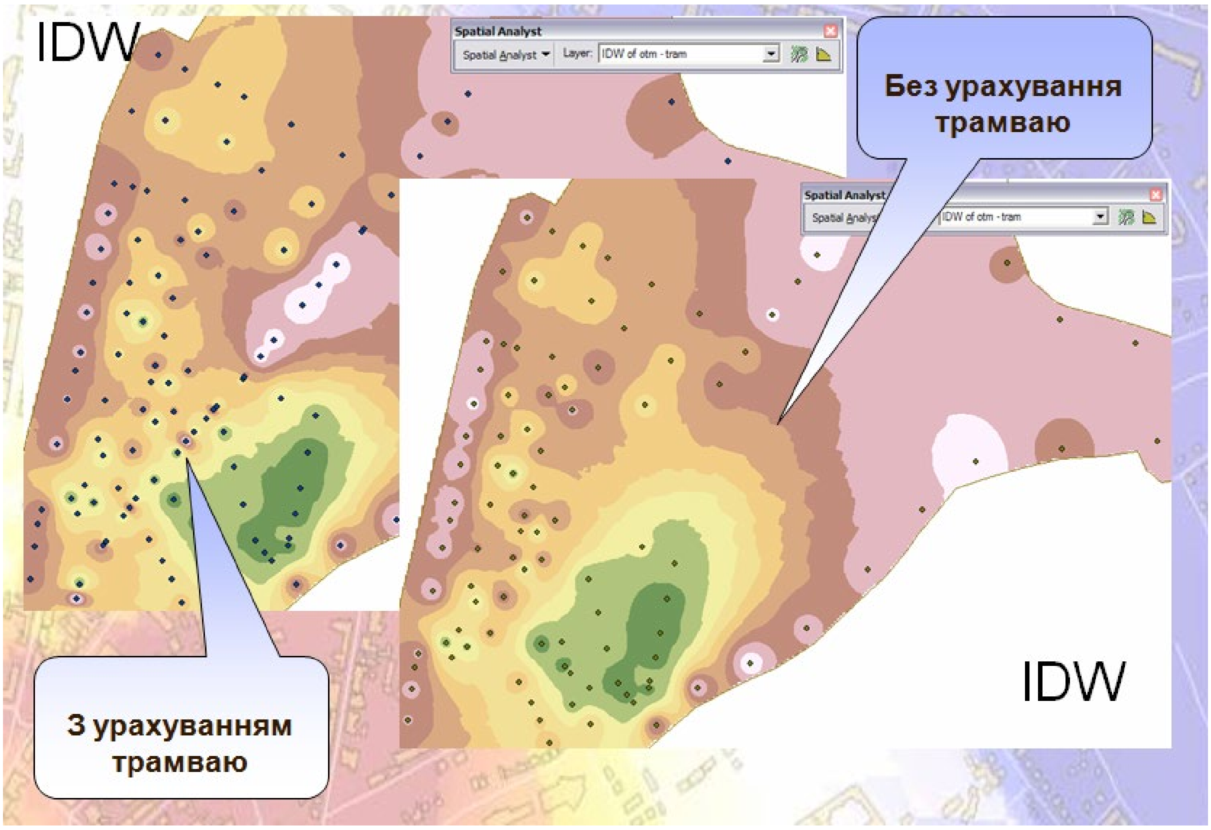

Figure 7 – Surface construction using the IDW method

The IDW method of inversely weighted distances is based on the principle that the closer objects are spaced, the more they resemble each other. This method calculates the value of the cell on the average of the sum of the values of the measurement points. The IDW method is the most optimal for the "Tram" thematic layer, because the influence of the measured variable decreases with increasing distance from the tram noise measurement point.

As a result of the application of cartographic algebra methods, with the help of the function of a raster calculator, a model of the noise impact of a tram on the urban environment was obtained. Areas of acoustic discomfort were identified and visualized on the noise map; They are marked in white. Also, the current situation (i.e. the noise regime of the same territory in the absence of a tram) was adequately studied.

Figure 8 – Creation of a model of noise pollution of the "Tram" layer using GIS tools

For further analysis of noise pollution of the city center using the IDW method, an intra-quarter image of noise pollution was constructed. On it, noise zones where standards are violated were marked in pink, and acoustic comfort zones were marked in green. The acoustic comfort zone exists, it has an almost constant boundary of the territory. Such zones, for example, are the location of O.M.Beketov National University of Urban Economy in Kharkiv, st. Potebni and others. It should be noted that the comparison of interpolation methods showed a stable zone of acoustic comfort in the urban area, which we conventionally called the "quiet center".

Also, on the basis of flat two-dimensional data by the IDW method, a surface of intra-block noise was constructed within the "Quarters" layer. The main indicator in its construction was a deviation from the standard sound level.

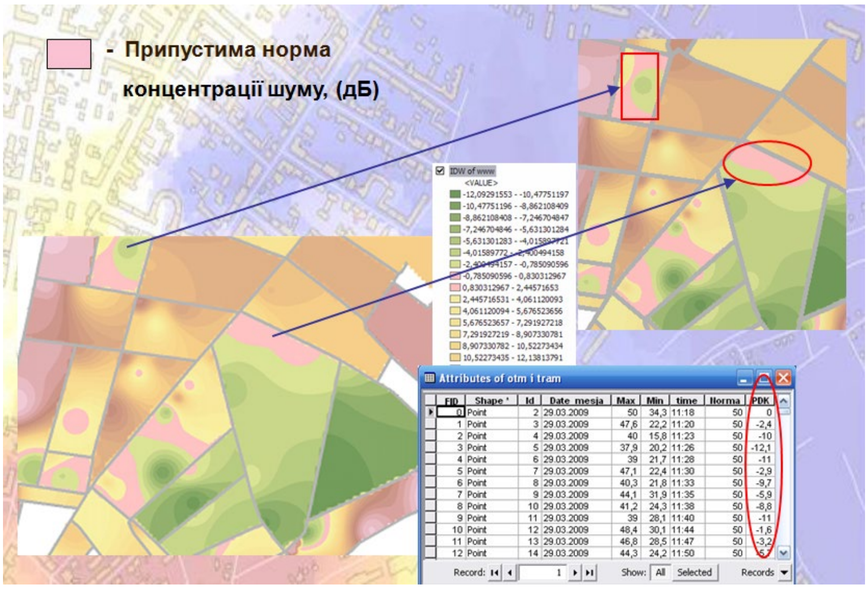

Figure 9 – The so-called "quiet center" of Kharkiv

Areas that meet the standard values are marked in pink, and the most favorable noise comfort zones are shown in green. These zones are the area of KNAMG and the adjacent territory, which is bounded by Revolution and Bazhanov streets, as well as the intra-quarter territory, bounded by vul. Melnikov and Darwin, st. Potebnia, Chubarya, and partially – vul. Chernyshevsky.

The design was multivariate; Various possible options for constructing a noise map were considered, calculated and constructed.

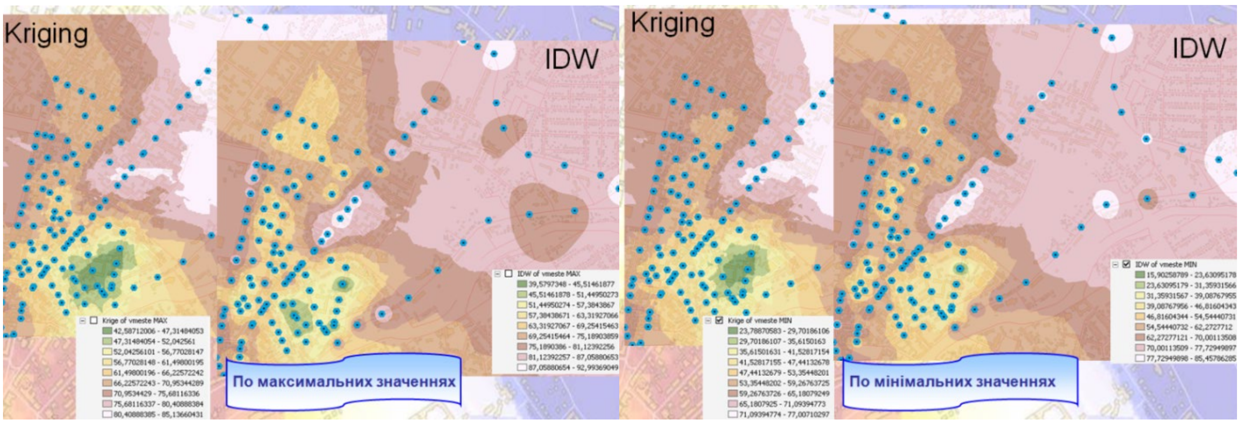

Figure 10 – Comparison of IDW and Kriging methods on the example of the "Measurements" layer

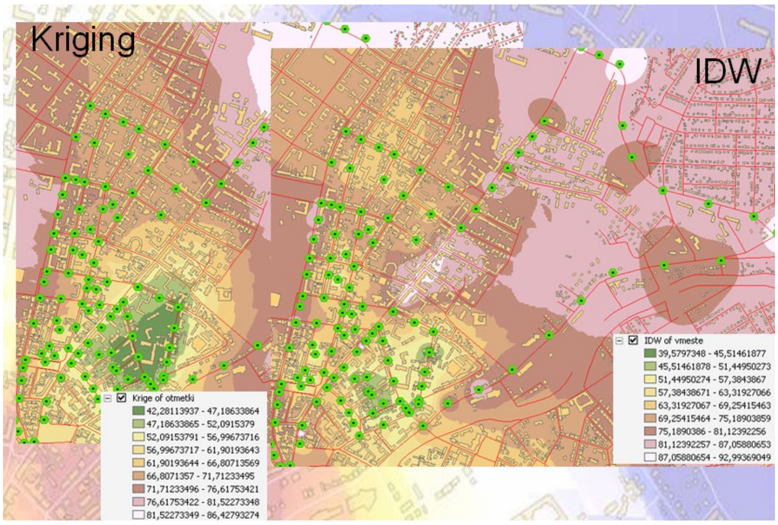

Figure 11 – Comparison of IDW and Kriging methods on the example of the "Elevations" raster without taking into account the tram

6.1.3. Creation of basic datasets of noise pollution in the urban environment

A digital map is a digital model of the earth's surface, formed taking into account the laws of cartographic generalization in the projections, graphics, coordinate system and heights adopted for maps [15-18].

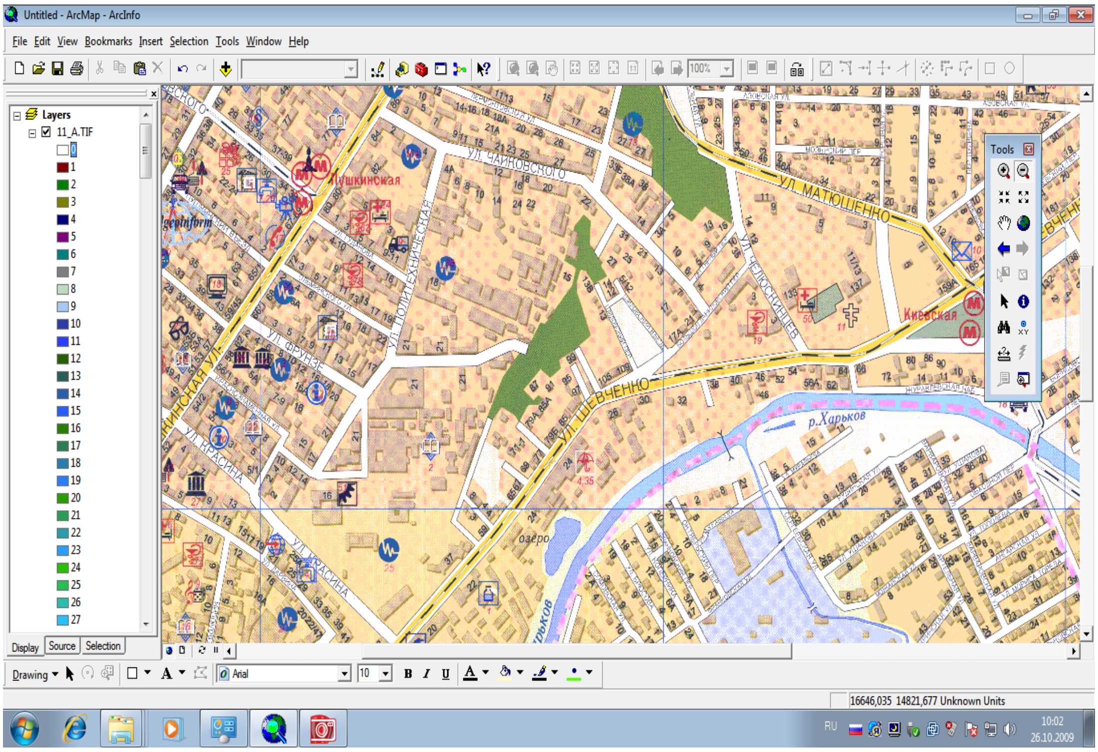

Figure 12 – Study area in ArcMap 9.3

One of the important stages in the creation of digital maps is the digitization of cartographic information.

Digitization is:

– the process of analog-to-digital data conversion, i.e. the translation of analogue data into a digital form available for existence in a digital machine environment;

– in geoinformatics, computer graphics and cartography: conversion of analog graphic and cartographic documents (originals) into the form of digital records corresponding to vector representations of spatial objects.

In this study, by digitization (vectorization), four vector layers were obtained, information about which is contained in Table 1.

Table 1 – Vector layers

Layer name	Alias Layer	Sharu Type	Number of objects
Build	Building	Polygon	48145
Street	Street	Polyline	22567
Tram	Tram	Point	13
Otmetki	Measurements	Point	1115
Otm + tram	Zamiri + tram	Point	1128

The "Buildings" feature layer and its attribute table are presented in Fig. 13 and Table 2:

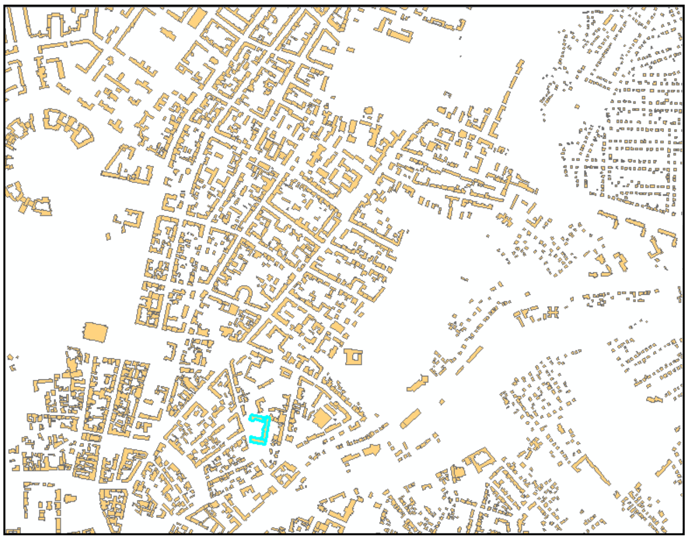

Figure 13 – Buildings layer

Table 2 – Attribute table of the Buildings layer

Attributes of building

FID	Shape	NAME_UKR_1	FULLNAME_N	TYPE_UKR	FLOOR_1	HOMENO_1
1383	Polygon	Революції	ул. Революции	вул.	2	12
1384	Polygon	Революції	ул. Революции	вул.	3	16
1385	Polygon	Революції	ул. Революции	вул.	5	16
1386	Polygon	Революції	ул. Революции	вул.	4	18
1387	Polygon	Революції	ул. Революции	вул.	7	12
1388	Polygon	Революції	ул. Революции	вул.	7	12
1389	Polygon	Революції	ул. Революции	вул.	5	12
1390	Polygon	Революції	ул. Революции	вул.	1	18
1391	Polygon	Мельникова	ул. Мельникова	вул.	2	25
1392	Polygon	Мельникова	ул. Мельникова	вул.	1	27
1393	Polygon	Мельникова	ул. Мельникова	вул.	2	29
1394	Polygon	Мельникова	ул. Мельникова	вул.	1	29
1395	Polygon				4	2

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The "Streets" feature layer and its attribute table are presented in Fig. 14 and Table 3

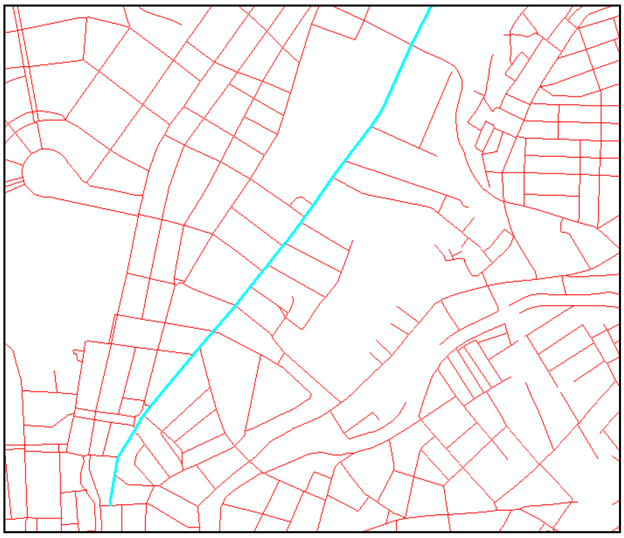

Figure 14 – Streets vector layer

Table 3 – Streets layer attribute table

Attributes of streets

FID	Shape *	ID	NAME_UKR	TYPE_UKR	LENGTH	FULLNAME_U
448	Polyline	0	Пушкінський	в-д	325	Пушкінський в-д
449	Polyline	0	Петровського	вул.	825	Петровського вул.
450	Polyline	0	майдан біля юракадемії	*	149	майдан біля юракадемії *
451	Polyline	0	Каразіна	вул.	478	Каразіна вул.
452	Polyline	0	Пушкінська	вул.	5471	Пушкінська вул.
453	Polyline	0	Студентська	вул.	371	Студентська вул.
454	Polyline	0	Студентський	пров.	407	Студентський пров.
455	Polyline	0	Лермонтовська	вул.	683	Лермонтовська вул.
456	Polyline	0	місцевий проїзд	*	97	місцевий проїзд *
457	Polyline	0	Чайковська	вул.	575	Чайковська вул.
458	Polyline	0	Гуданова	вул.	331	Гуданова вул.
459	Polyline	0	Ольмінського	вул.	322	Ольмінського вул.
460	Polyline	0	Фрунзе	вул.	602	Фрунзе вул.

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The vector layer "Measurements + tram" and the table of attributes for it are presented in Fig. 15 and Table 4

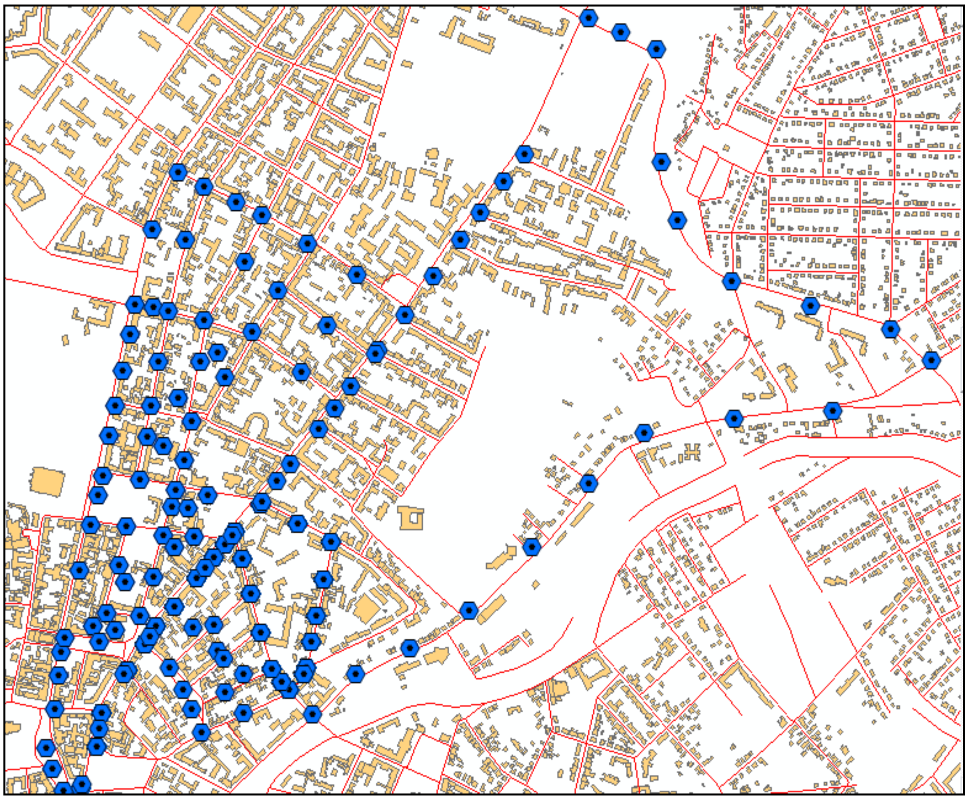

Figure 15 – Vector layer "Measurements + tram"

Table 4 – Attribute table of the "Measurements + Tram" layer

Attributes of otm i tram

FID	Shape *	Id	Date_mesja	Max	Min	time	Norma	PDK
0	Point	2	29.03.2009	50	34,3	11:18	50	0
1	Point	3	29.03.2009	47,6	22,2	11:20	50	-2,4
2	Point	4	29.03.2009	40	15,8	11:23	50	-10
3	Point	5	29.03.2009	37,9	20,2	11:26	50	-12,1
4	Point	6	29.03.2009	39	21,7	11:28	50	-11
5	Point	7	29.03.2009	47,1	22,4	11:30	50	-2,9
6	Point	8	29.03.2009	40,3	21,8	11:33	50	-9,7
7	Point	9	29.03.2009	44,1	31,9	11:35	50	-5,9
8	Point	10	29.03.2009	41,2	24,3	11:38	50	-8,8
9	Point	11	29.03.2009	39	28,1	11:40	50	-11
10	Point	12	29.03.2009	48,4	30,1	11:44	50	-1,6
11	Point	13	29.03.2009	46,8	28,5	11:47	50	-3,2
12	Point	14	29.03.2009	44,3	24,2	11:50	50	-5,7

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The Tram feature layer and its attribute table are shown in Fig. 16 and Table 5

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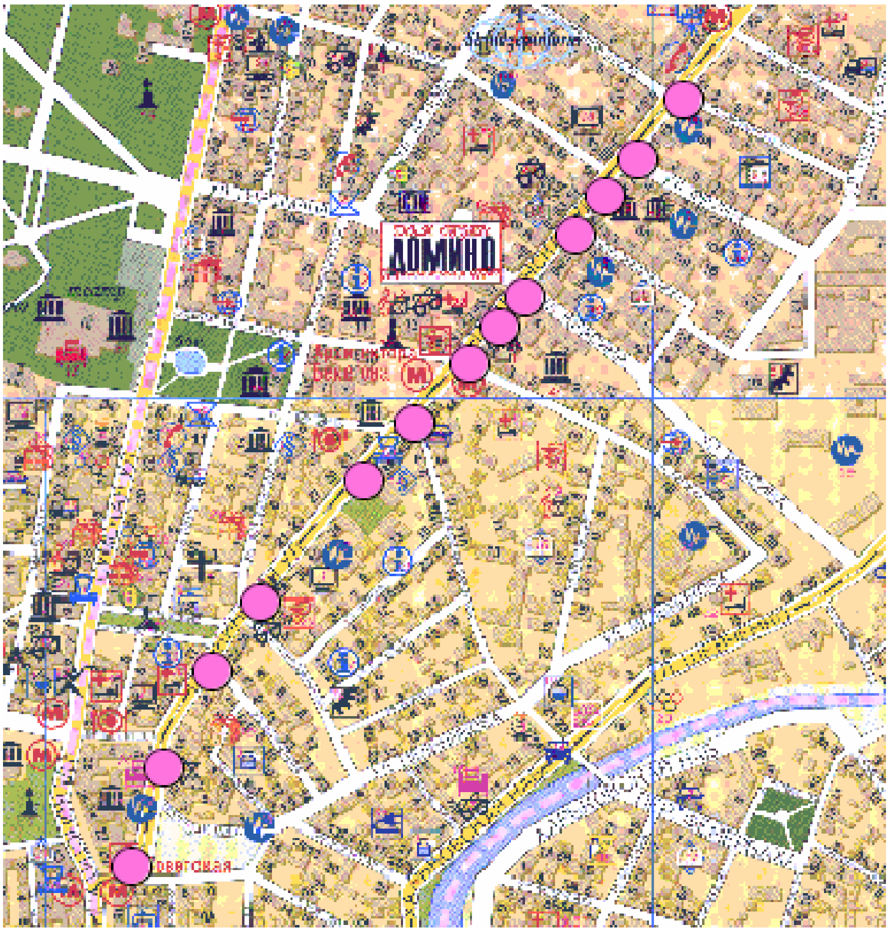

Figure 16 – Streetcar Vector Layer

Table 5 – Streetcar Layer Attribute Table

Attributes of tramvaj

FID	Shape	Id	Date_mesja	Max	Min
0	Point	8	23.04.2009	90	85,4
1	Point	1	23.04.2009	89,5	82,1
2	Point	9	23.04.2009	94,2	78,1
3	Point	10	23.04.2009	84,1	75,5
4	Point	11	23.04.2009	88,9	80
5	Point	12	23.04.2009	93	82,5
6	Point	13	23.04.2009	75,1	67,4
7	Point	2	23.04.2009	90,6	83,5
8	Point	3	23.04.2009	87,9	78,5
9	Point	4	23.04.2009	92,6	85,5
10	Point	5	23.04.2009	89,9	84,5
11	Point	6	23.04.2009	91,1	82
12	Point	7	23.04.2009	84,1	75,6

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6.2. Create a 3D terrain model in ArcGIS 9.3

Load the necessary layers into the project. Activate the 3D Analyst module (Tools – Extentions – 3D Analyst (Fig. 16).

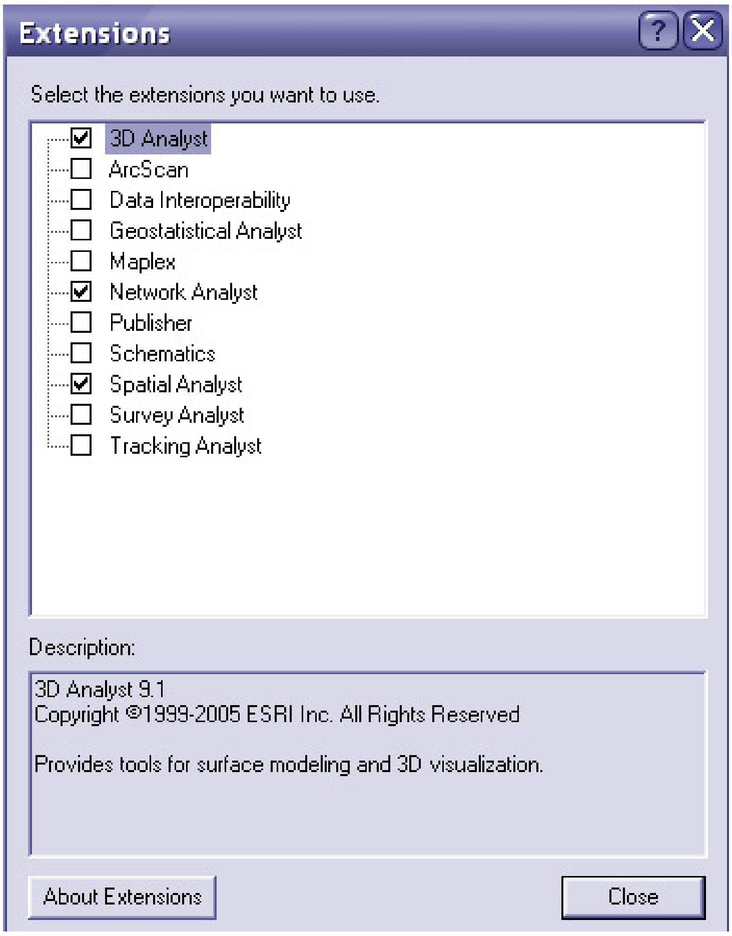

Figure 16 – Activating the 3D Analys module

By calling the context menu by right-clicking on the Arcmap toolbar, turn on the 3D Analyst panel.

To build a 3D model, choose the ArcScene tool.

ArcScene allows you to build multi-layered scenes and define how the objects of each layer in the scene will be represented, how it will be positioned in three-dimensional space, and how it will be displayed. You can also define general properties of a scene, such as lighting. You can select objects in a scene by their attribute values, by their location relative to other objects, or by directly clicking on the objects in the

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scene that you want. You can move around the scene, or specify observer coordinates and targets for the viewer.

You can display vector data, as well as surfaces, in perspective.

Vector data differs from surface data in that it represents discrete objects rather than continuous phenomena. Objects are usually characterized by shape (geometry) and attributes.

To assess noise pollution in this area, a 3D model of the area was built, taking into account the features of the terrain. This model is shown in Fig. (17 – 18).

The 3D model gives us a visual representation of the territory, and you can rotate this area 360° and view the area from different directions [17, 18].

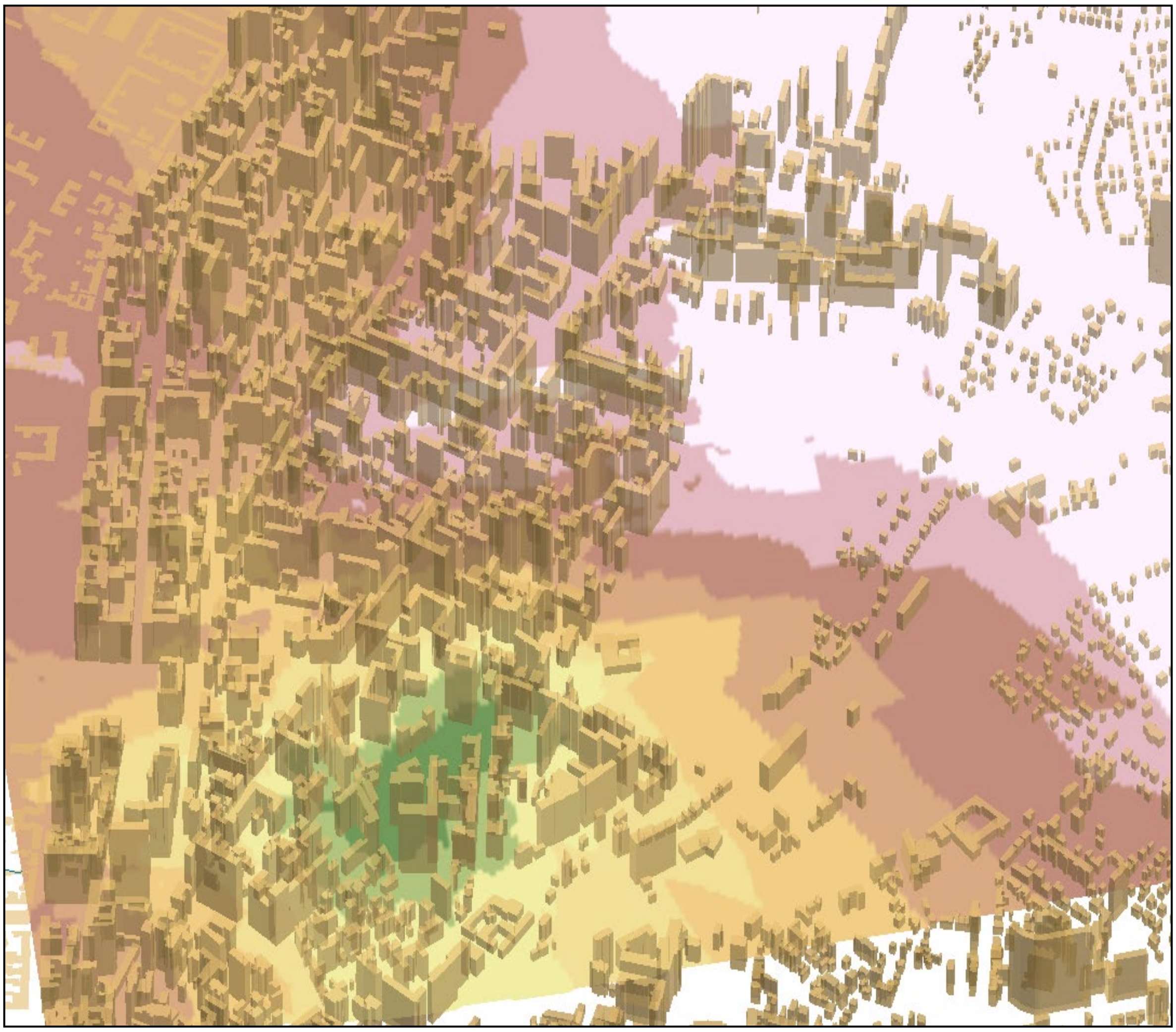

Figure 17 – 3D model of this territory

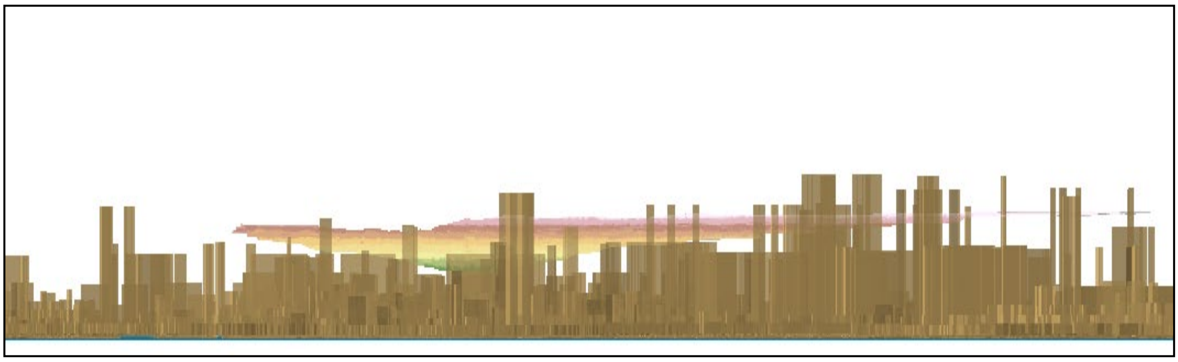

Figure 18 – 3D model of this territory

6.3. Creation of a database on the spatio-temporal distribution of physical pollution in urbanized areas

6.3.1. Creating and designing a spatial database

Geodatabase is a unique technology created by ESRI for storing heterogeneous data, which allows you to increase the efficiency of data storage and use in any complex projects and systems.

The ArcGIS system, like other powerful information systems, has a clear model for working with data, primarily spatial data. This model, the Geodatabase (Geographic Database), is the basis for storing all the information used in the process of working with ArcGIS products. It defines the structure and rules for storing various types of objects: spatial and raster spaces, address spaces, results of geodetic measurements, etc. We can say that a geodatabase is a repository of heterogeneous data, which allows not only to effectively manage information stored locally or on a server, but also to build models of any complexity that meet the requirements of various industries or a specific project, where ArcGIS is used as a system for working with geographic (which has a spatial component) information.

The use of a geodatabase provides not only quick access and efficient work with the data stored with its help. You can also set rules and relationships within the repository and get a number of other useful features that allow you to interact more productively with data and represent information as real-world objects.

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The structure and functionality of the geodatabase are constantly being improved.

Innovations include the concept of an Open Geodatabase. Thanks to the tools built into ArcGIS applications, users can now export the Geodatabase to files where the information is represented as an XML schema. This makes it easier to migrate data between ArcGIS products and between ArcGIS and third-party products. Previously, it was necessary to export to shapefiles and it was not possible to exchange entire geodatabases. Using an XML Schema removes these barriers. In comparison, XML for ArcGIS is essentially the same as shapefiles for ArcView 3.x, but XML has incomparably greater advantages. The main one is that users now have access to an exchange format for the Geodatabase as a whole, rather than its individual parts. You can export the entire Geodatabase or its individual objects (for example, feature classes or tables), and you can also export relationships, domains, topology rules. XML files can store the entire data or just the geodatabase schema.

Support for new data types. Thanks to the numerous improvements being made to optimize the storage and management of raster data, the Geodatabase has significantly improved the performance of loading and reading raster data. Personal geodatabases can now store raster data and raster directories. ArcCatalog introduces a number of tools for efficient management of raster data and raster catalogs. Tools that were previously used only for feature classes can now be used for raster data. For example, you can use the Extract Data tool to prepare raster data or raster catalogs for offline editing. The personal geodatabase management engine automatically stores raster data in IMG format and stores it next to the personal geodatabase in separate folders.

Due to the new ability to build pyramid layers, the performance of working with geodatabases stored using ArcSDE has increased significantly. The advantage over previous versions is that when you load new data into a raster set, the pyramid layer engine in ArcSDE will rebuild only the updated portion, not the entire set. At the same time, the process of constructing image mosaics over large areas is greatly facilitated.

The new ArcCatalog tools allow you to import multiple raster datasets to mosaic them at once on a server or in a local geodatabase, which will save you a lot of time.

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Mechanisms and tools for managing raster catalogs have also been improved. The following features are available here:

–Users can create Raster Catalogs directly from ArcCatalog – it's as easy as creating any other data source. When you create a tablet catalog or a series of aerial photographs, each tablet or image will be represented in the raster catalog as a polygon that stores all the information needed to easily search the catalog and perform other operations, such as selecting individual rasters or viewing their characteristics, using, for example, an identification tool.

–When you create a raster catalog in your personal geodatabase, the catalog metadata—a polygonal coverage that is a set of raster snapshots—will be stored in the geodatabase. In this case, the user can choose one of two modes of working with the raster catalog: Managed and Unmanaged. In the first case, when you add rasters to a directory in a personal geodatabase, they will be stored in IMG files in special folders next to the geodatabase, or directly in the geodatabase itself if you use ArcSDE. Moreover, when deleting a raster record from the directory, the raster itself will be deleted. When using Unmanaged mode, the geodatabase will use the original rasters on disks and will not copy them to IMG files or to the server. This deletes the raster record from the directory, but does not delete the raster data.

You can perform operations such as copying, deleting, exporting, and creating pyramid layers with rasters in raster catalogs.

Raster catalogs support different types of rasters (RGB, black and white, or indexed colors). A raster catalog can consist of several types of rasters. This ability to save and operate different types of rasters is very useful, for example, when creating mosaic images. It should be noted that displaying and managing such a raster catalog requires more system resources, because several processing mechanisms are used for different rasters at once.

Using the ability to store different types of rasters in raster catalogs, you can also display these rasters using different methods for each of them. When adding a raster catalog to ArcMap, the application independently chooses the most appropriate method, and the user can choose the methods available for this type.

In the GRID format, you can store rasters larger than 2.1 GB – there is no limit on the number of cells (pixels). However, it is recommended that larger amounts of raster data be stored using ArcSDE. This will significantly increase the speed of reading and analyzing raster data.

You can now add more than 25 GRID data sources to your ArcMap project. The improvement affected the ArcMap engine, which is responsible for displaying raster data. The new rasters properties window now has a tree-like structure, so all the necessary information is in front of your eyes, making it easier to work in this window.

Added support for new raster formats: JPEG 200 (this is GeoJP2 from MSI), Intergraph CIT/COT, DIGEST ASRP/USRP, MrSID (generation 2 and 3). Export commands and tools allow you to create a 2nd generation MrSID.

In ArcGIS 9.3, it is possible to store raster attributes in a geodatabase. Fields with these types can store any raster supported in ArcGIS – these can be overview images, images of individual objects, diagrams of structures, and other documents. For each feature within the geodatabase, there can be only one field of this type.

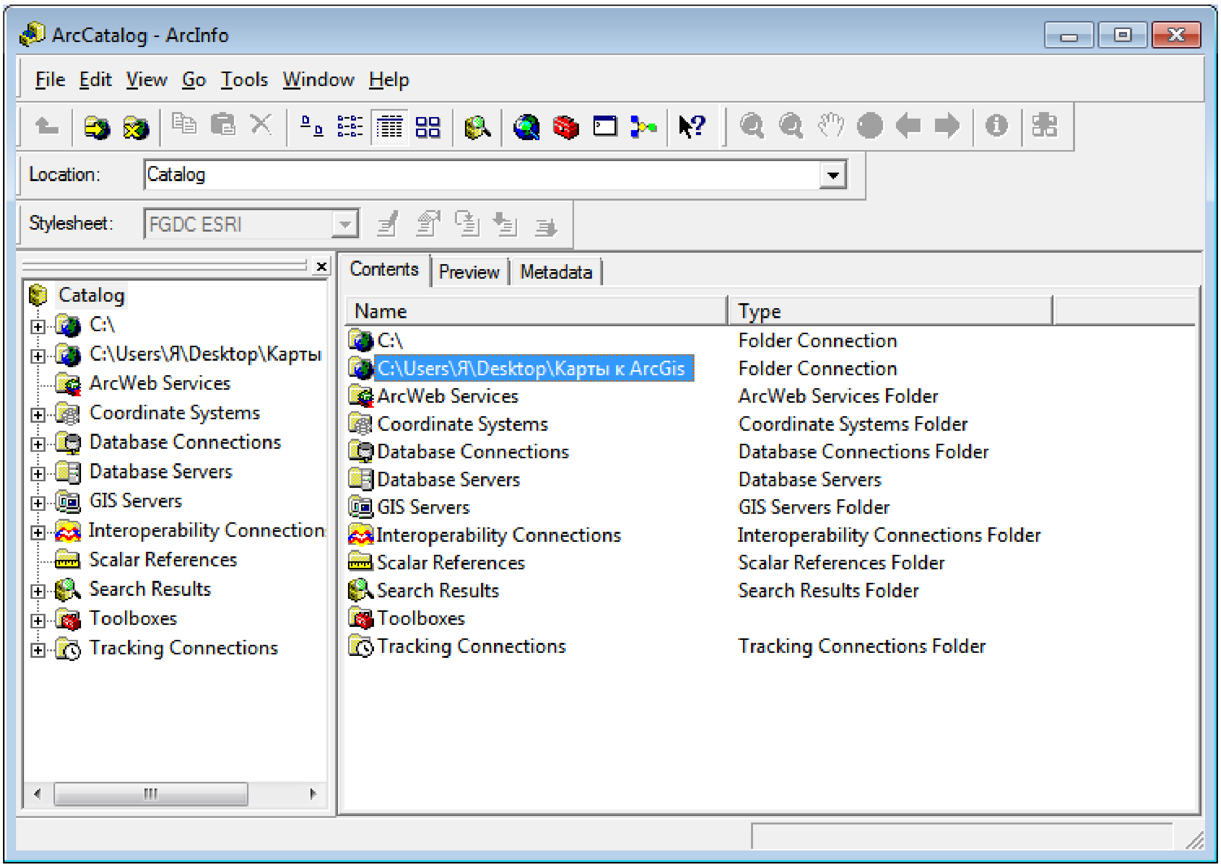

Figure 19 – Geodatabase

When storing rasters using raster attributes, two modes are supported, as in the case of Raster Catalogs: Managed or Unmanaged. With the identification tool, you can view images attached to an object.

The new version of the geodatabase also adds support for Globally Unique Identifiers (GUIDs) and special attributes that preserve presentation styles. These settings are unique to each feature or record in a geodatabase table and allow developers to use them in distributed geodatabases.

With ArcCatalog in ArcGIS 9, you can create Multipatch data that allows you to store complex three-dimensional features within a geodatabase.

6.3.2. Geobase – Saltivsky residential area

The purpose of our research was to build a map of noise distribution in the specified area (Saltivka district in Kharkiv).

In accordance with the requirements of regulatory documents, a significant number of control points were located in the study area, the location of which is shown in Fig. 20. Noise was measured at each of these points.

Figure 20 – Cartographic basis of a fragment of the study area with a scheme of the location of control points (and their numbers), where noise measurements were carried out

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Further in Table 6 the same acoustic measurements from the previous figure are presented in the processed tabular form. The numbers of the control points correspond to their layout in the area from Fig. 20. The type of data is a "point" everywhere, because according to the initial provisions we measured only noise in a certain set of control points, and not "noise in space", not "noise on the plane" or anything else.

Table 6 – Noise measurement data at each of the reference points, dBA

Measurement Location No.	Type of data	Night measurements, dBA	Daytime measurements, dBA	Measurement Location No.	Type of data	Night measurements, dBA	Daytime measurements, dBA
4	Point	46	61	255	Point	48	61
5	Point	44	62	256	Point	52	71
9	Point	50	70	258	Point	42	52
42	Point	47	54	231	Point	45	61
67	Point	46	61	233	Point	47	56
69	Point	49	67	234	Point	43	62
82	Point	51	74	235	Point	51	76
86	Point	36	56	236	Point	50	62
95	Point	49	70	237	Point	47	59
97	Point	48	64	238	Point	53	81
99	Point	44	56	239	Point	46	57
148	Point	48	66	240	Point	47	69
151	Point	47	67	241	Point	51	74
154	Point	49	67	242	Point	45	58
155	Point	47	54	243	Point	43	62
156	Point	48	63	245	Point	48	64
158	Point	47	54	246	Point	46	66
159	Point	49	60	247	Point	49	70

Measurement Location No.	Type of data	Night measurements, dBA	Daytime measurements, dBA	Measurement Location No.	Type of data	Night measurements, dBA	Daytime measurements, dBA
160	Point	47	71	249	Point	47	70
161	Point	46	61	250	Point	48	64
162	Point	47	69	251	Point	47	69
163	Point	51	66	252	Point	50	70
164	Point	47	64	257	Point	40	52
165	Point	49	60	259	Point	45	59
166	Point	44	58	260	Point	42	56
167	Point	47	69	261	Point	44	69
168	Point	49	70	262	Point	47	54
169	Point	50	70	263	Point	49	60
170	Point	49	75	264	Point	44	50
171	Point	50	66	267	Point	46	61
172	Point	47	66	268	Point	44	58
176	Point	54	62	269	Point	46	61
177	Point	53	79	270	Point	44	59
178	Point	49	59	271	Point	47	68
179	Point	48	70	272	Point	45	54
180	Point	53	82	273	Point	44	50
181	Point	45	54	274	Point	46	61
182	Point	46	64	275	Point	44	50
183	Point	48	70	276	Point	47	67
184	Point	52	71	277	Point	46	66
185	Point	45	59	279	Point	51	76
187	Point	53	65	280	Point	46	64
188	Point	47	71	281	Point	50	62

Measurement Location No.	Type of data	Night measurements, dBA	Daytime measurements, dBA	Measurement Location No.	Type of data	Night measurements, dBA	Daytime measurements, dBA
189	Point	46	61	282	Point	47	67
190	Point	45	54	284	Point	43	62
191	Point	51	74	285	Point	49	70
192	Point	50	70	286	Point	44	50
193	Point	47	56	287	Point	43	51
194	Point	51	71	288	Point	48	65
195	Point	56	81	289	Point	52	78
196	Point	54	78	290	Point	43	54
197	Point	53	79	291	Point	42	52
198	Point	48	70	292	Point	45	54
199	Point	45	54	293	Point	44	59
200	Point	46	61	296	Point	44	65
204	Point	52	71	297	Point	47	65
205	Point	43	54	298	Point	43	56
206	Point	46	56	299	Point	53	81
207	Point	45	64	300	Point	52	71
208	Point	46	51	301	Point	54	75
210	Point	55	85	302	Point	53	73
211	Point	44	52	303	Point	46	57
212	Point	43	62	304	Point	45	61
213	Point	46	57	305	Point	44	64
215	Point	48	61	306	Point	46	61
216	Point	50	70	307	Point	44	57
217	Point	49	70	309	Point	49	70
218	Point	47	60	310	Point	47	55

Measurement Location No.	Type of data	Night measurements, dBA	Daytime measurements, dBA	Measurement Location No.	Type of data	Night measurements, dBA	Daytime measurements, dBA
219	Point	53	79	311	Point	48	63
220	Point	49	70	313	Point	46	67
221	Point	50	70	315	Point	44	50
222	Point	41	52	316	Point	45	54
223	Point	48	66	317	Point	48	66
224	Point	44	59	318	Point	47	66
225	Point	43	59	319	Point	52	78
226	Point	50	75	321	Point	46	56
227	Point	47	71				
228	Point	56	81				
229	Point	50	79				
230	Point	53	82				

Numbering of control points from Table 6 and the corresponding diagram from Figure 20 a priori was continuous, i.e. point No. 1; 2; 3, etc. to No. 350. All this gives an idea of the enormous amount of work on measuring acoustic characteristics carried out by us in the course of research! In addition, as can be seen from Table. As shown in Figure 1, each point corresponds to two dimensions: one of which characterizes noise during the daytime, and the other at the same point characterizes noise at night. This was necessary to have an idea of the fluctuation of noise levels in the same place of the territory depending on the time of measurements: (for example, an intersection with extremely busy and heavy traffic during the day is a secluded place at night when 1 car passes through it per hour).

But during the office processing of the results, some shortcomings and errors in the measurements were revealed. This is, first of all, the discrepancy between the location of the same control point when carrying out day and night measurements: (for example, when moving to the control point, the researcher made a mistake and measured day and night the noise in two different places located close, but still at a distance of more than 10 m from each other: what can no longer be taken as the same place of measurement?) One day the measurement was successfully carried out; But, appearing at the same place in the evening, the researcher saw a hefty pit surrounded by a fence at the site of the asphalt solid during the day: the water supply had burst, and the city's utilities are carrying out repair work here! There were other mistakes: for example, it turned out that for one control point there was data from day measurements, but for some reason there was no night measurements; or vice versa, etc. In some cases, non-compliance with the requirements of GOST 20444-85 regarding the conditions of measurements, etc., was recorded. Therefore, unreliable, bad and bad data are removed from the original noise measurement database and only reliable data are provided in Table 1 (as a result of which the numbering of the reference points is not continuous).

But the table 6 is only a database of noise in the study area, but not a noise map. The final result is still very, very far away.

Further office processing of information is required. After making the necessary measurements, we proceed to the office stage of research and transfer the data to a desktop computer.

First of all, it should be pointed out that the original map of the area itself is not suitable for further use. It can only be used as an auxiliary data layer in the early stages of the project, for example, for the layout of the control points of Figure 20. Rasters are used only to visualize continuous layers. There is a need to bring the project to the form that is subject to processing, that is, vectorization.

Vector features (geographic features with vector geometry) are quite versatile. They are often used to display geographic information, and are well suited for depicting objects with well-defined boundaries, such as wells, streets, rivers, administrative divisions, and land plots. A feature is any feature with a specific location that is stored as one of its properties (fields) in an attribute table. Such features are usually represented in geographic space as points, lines, polygons, or as annotations and are

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organized as feature classes. Feature classes are collections of objects of the same type with a common spatial representation and set of attributes.

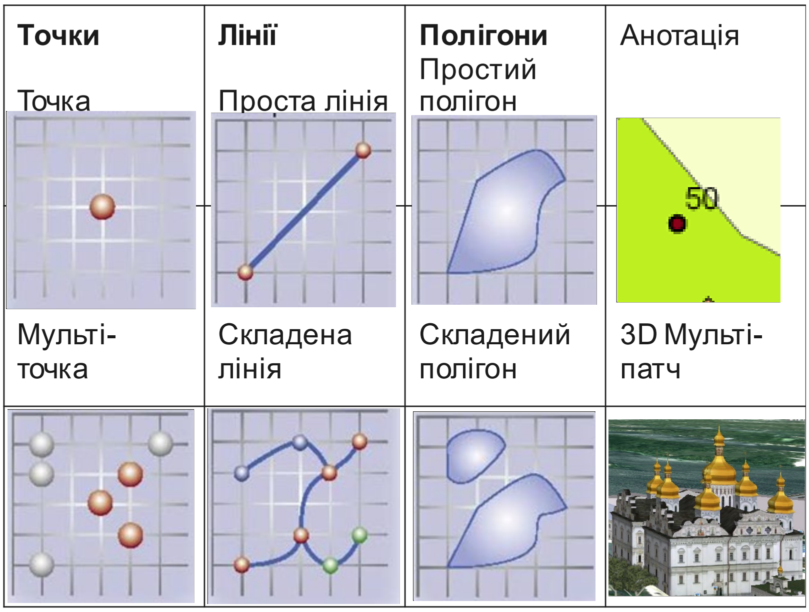

Figure 21 – Variants of vector objects

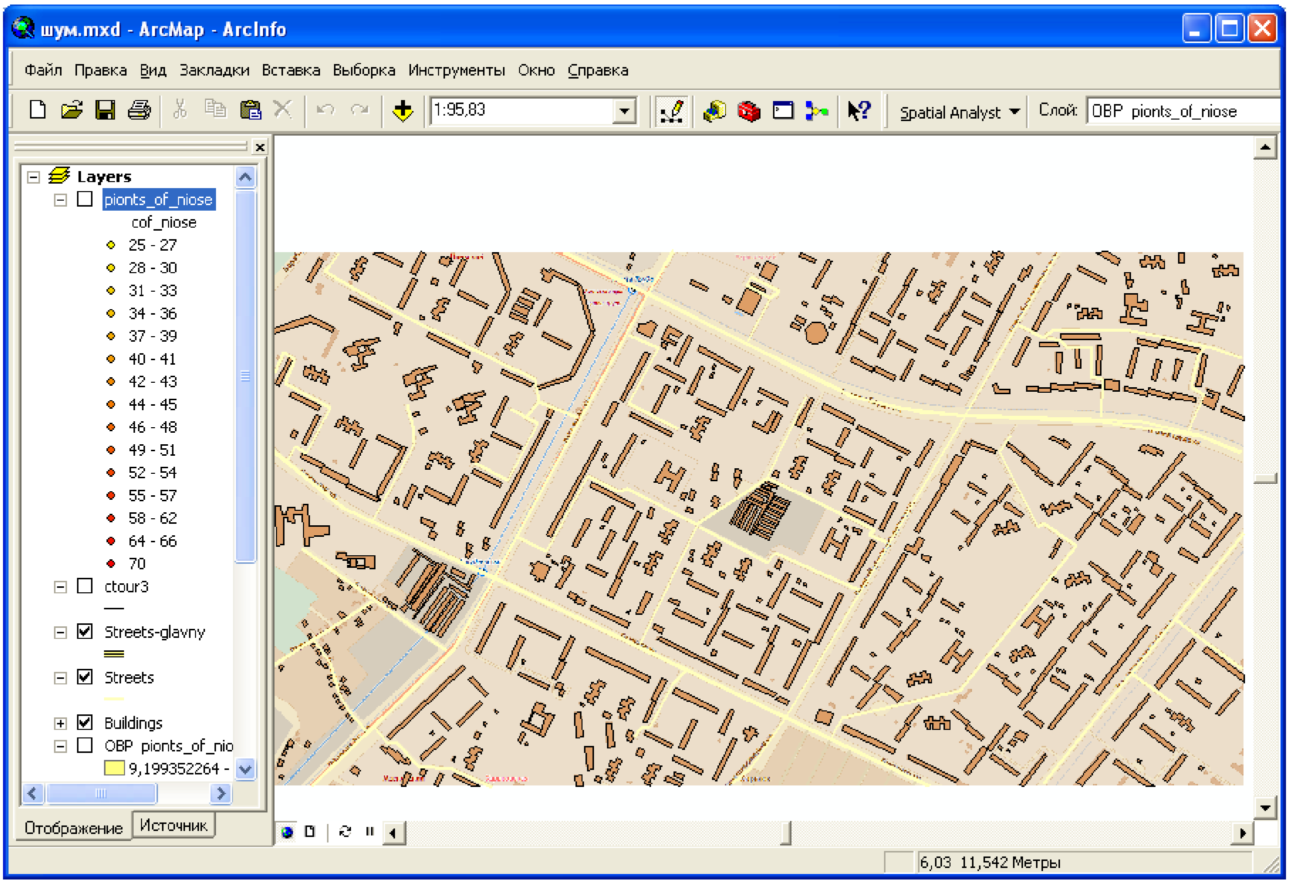

Figure 21 – The intermediate stage of research is preparation for the construction of a noise map (data processing, entering into the calculation block of the program)

Figure 22 It is an image of the area, only processed, rid of unnecessary cartographic information (that is, vectorization has been carried out). Raster elements are replaced here by vector elements, such as the typology of which is shown above in Figure 21.

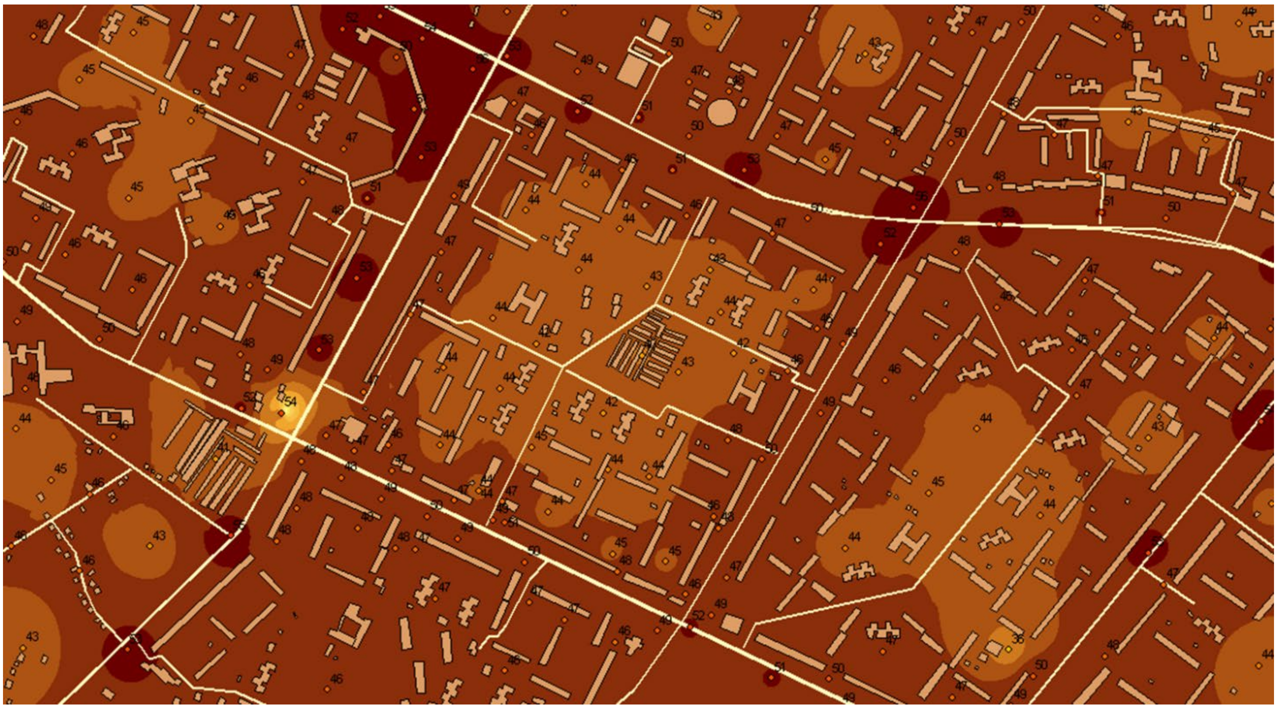

Figure 23 – Noise map based on research results (night time)

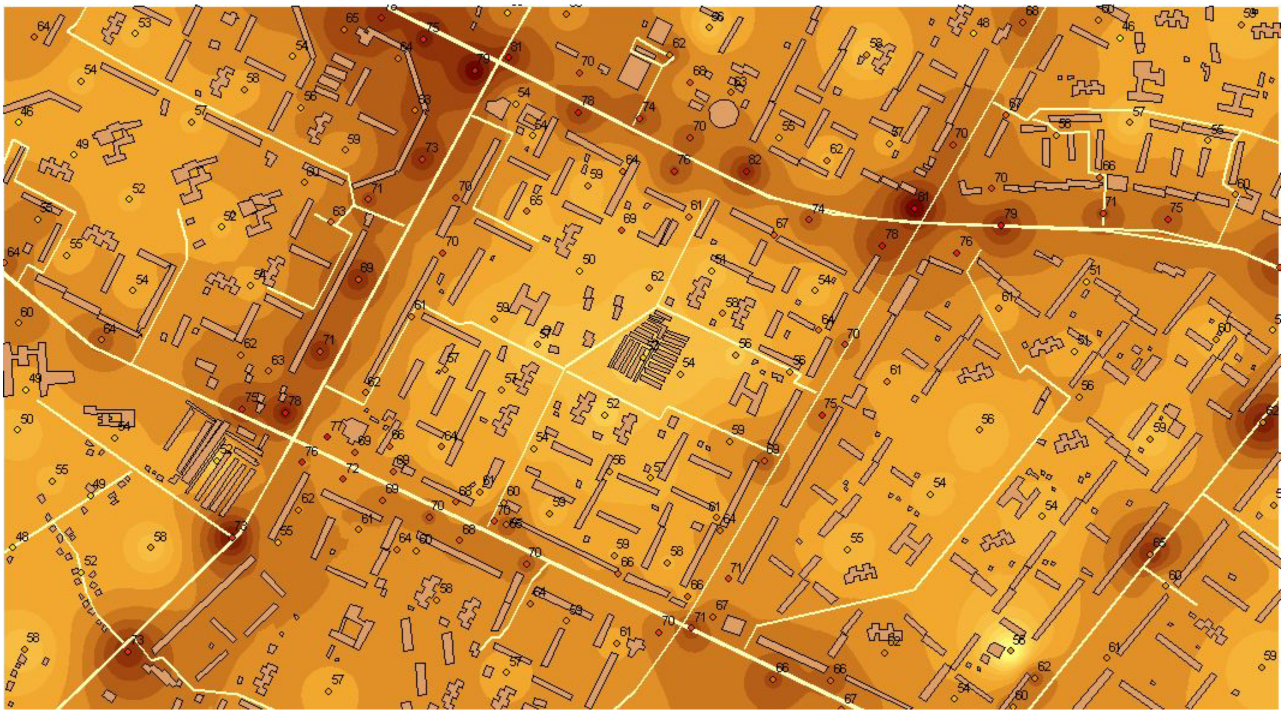

Figure 24 – Noise map based on research results (daytime)

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And, only having a vectorized map of the area, presented in Figure 24, – (the compilation of which is the most time-consuming stage of office processing of results), we proceed to the construction itself.

For this purpose, ArcGIS tools were used.

6.3.3 Noise study in the Saltivsky tram depot

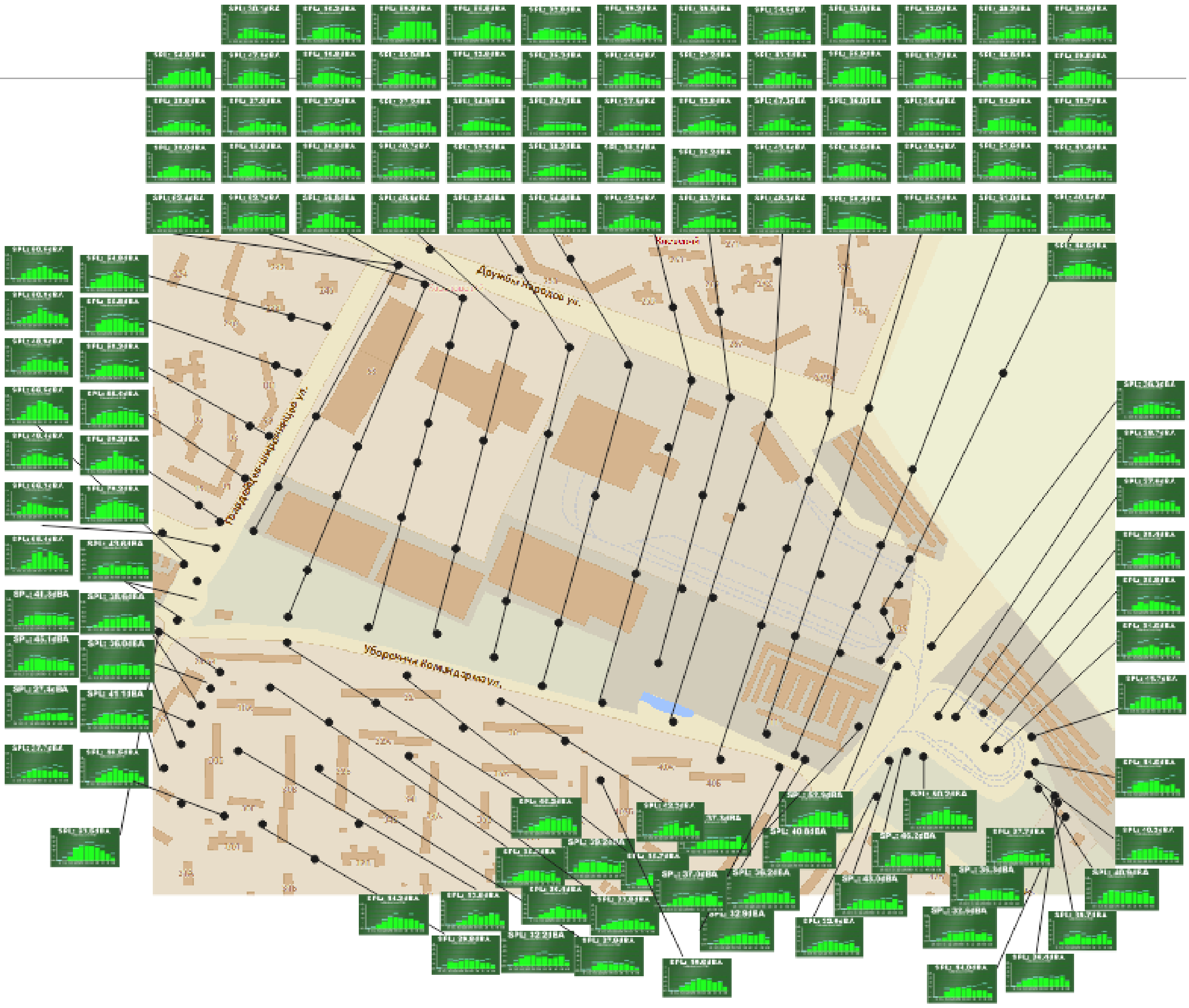

Figure 24 – Cartographic basis of a fragment of the study site with data of full-scale measurements

For a more detailed study (taking into account the contribution of industrial and specific traffic noise), a site of this residential area with the Saltovsky tram depot located in it (surrounded by multi-storey residential buildings with a high population density) was chosen. The traditional approach usually looks at either industrial noise;

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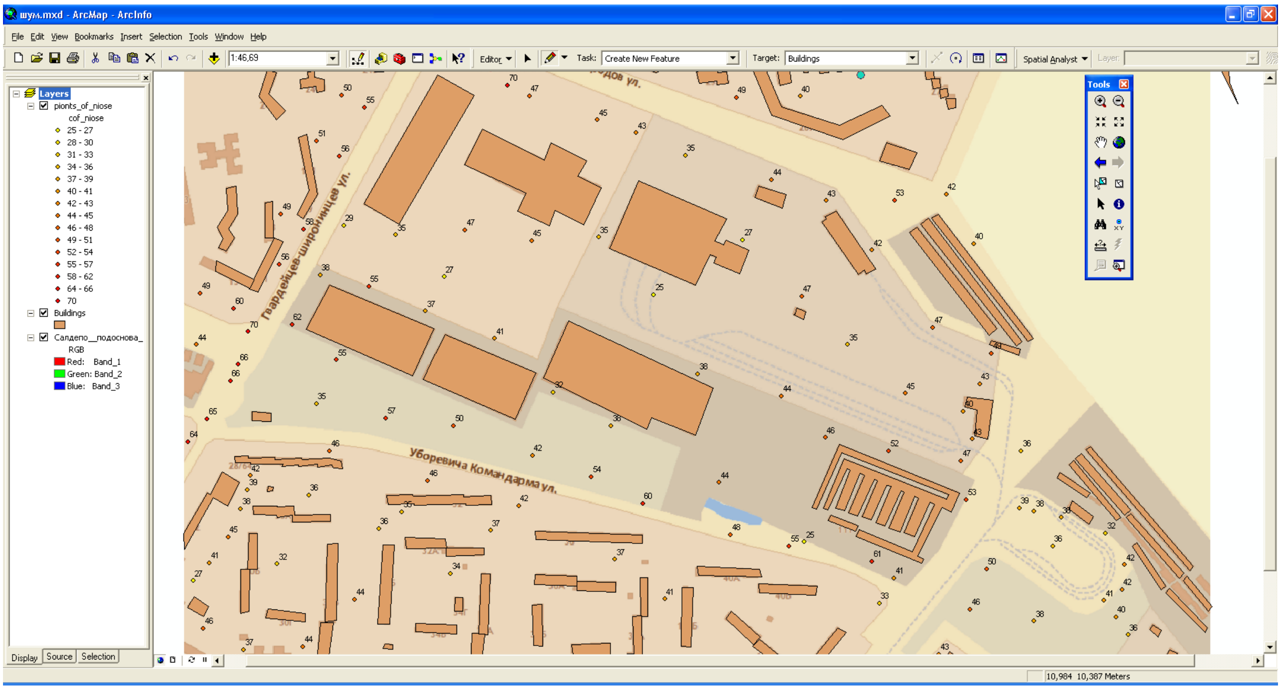
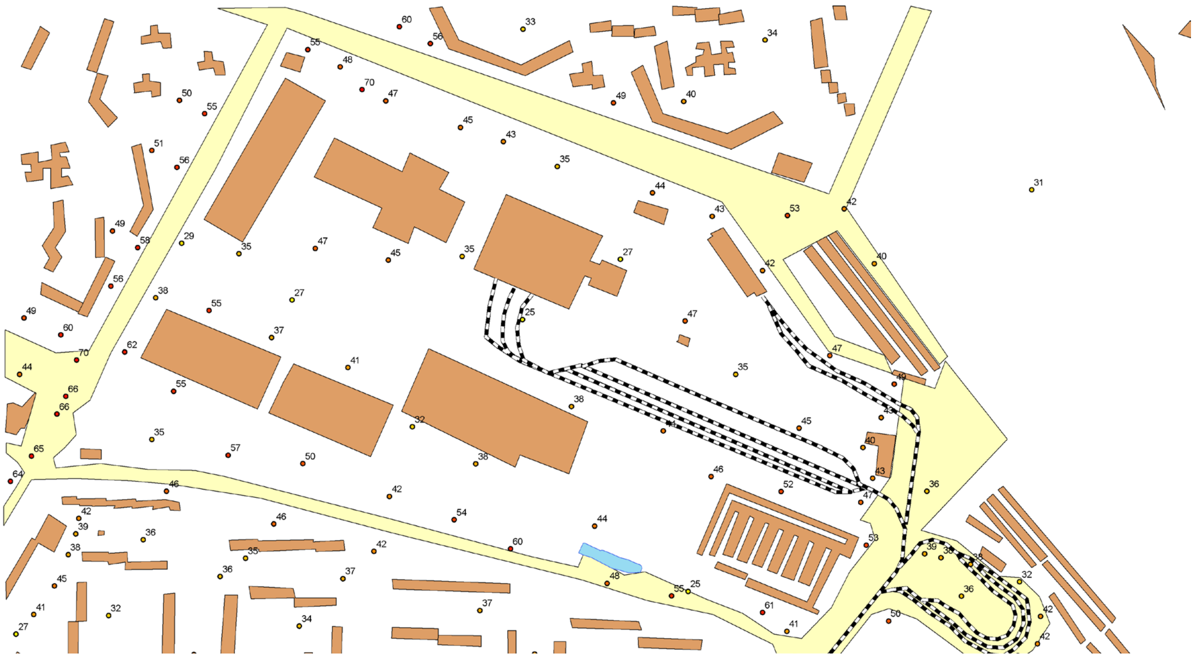
or noises in the residential area; We are studying the impact of the enterprises of the communal warehouse zone on the noise regime of residential development. Classically investigate the noise of motor vehicles; We have taken a motor vehicle and a tram. No one has ever done a study of noise on the territories of tram depots (and even more so – mapping).

a)



b)



c)

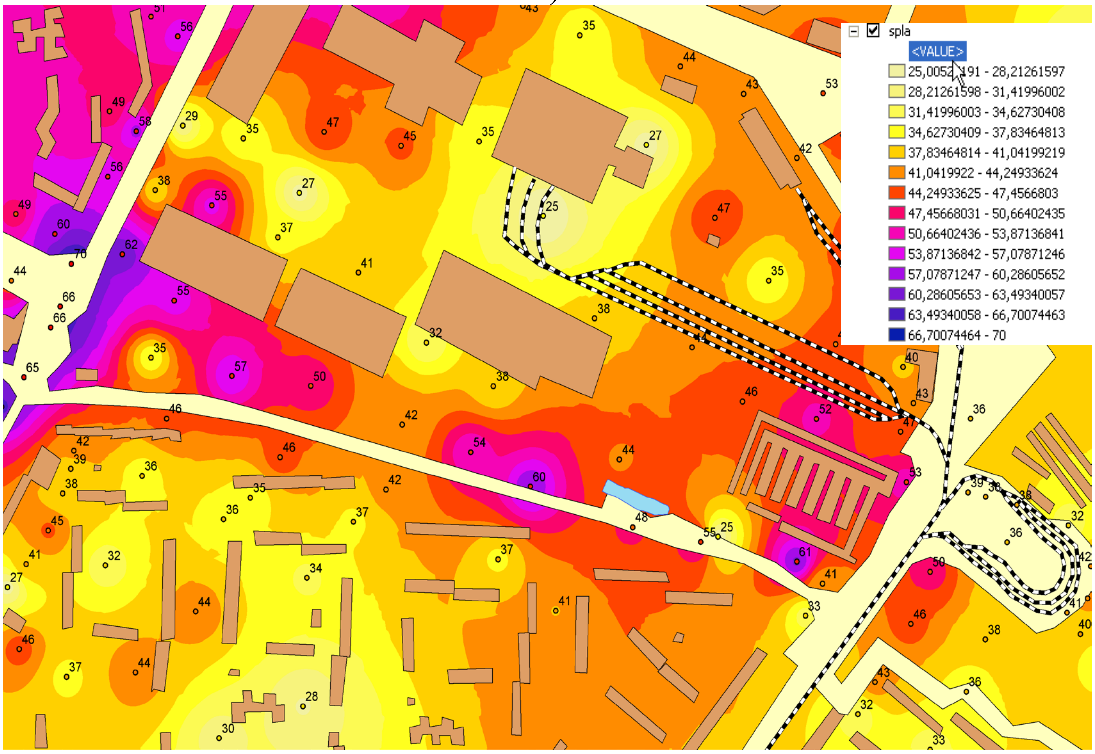


Figure 25 – Intermediate stage of research – preparation for the construction of a noise map (data processing, entering into the calculation block of the program)

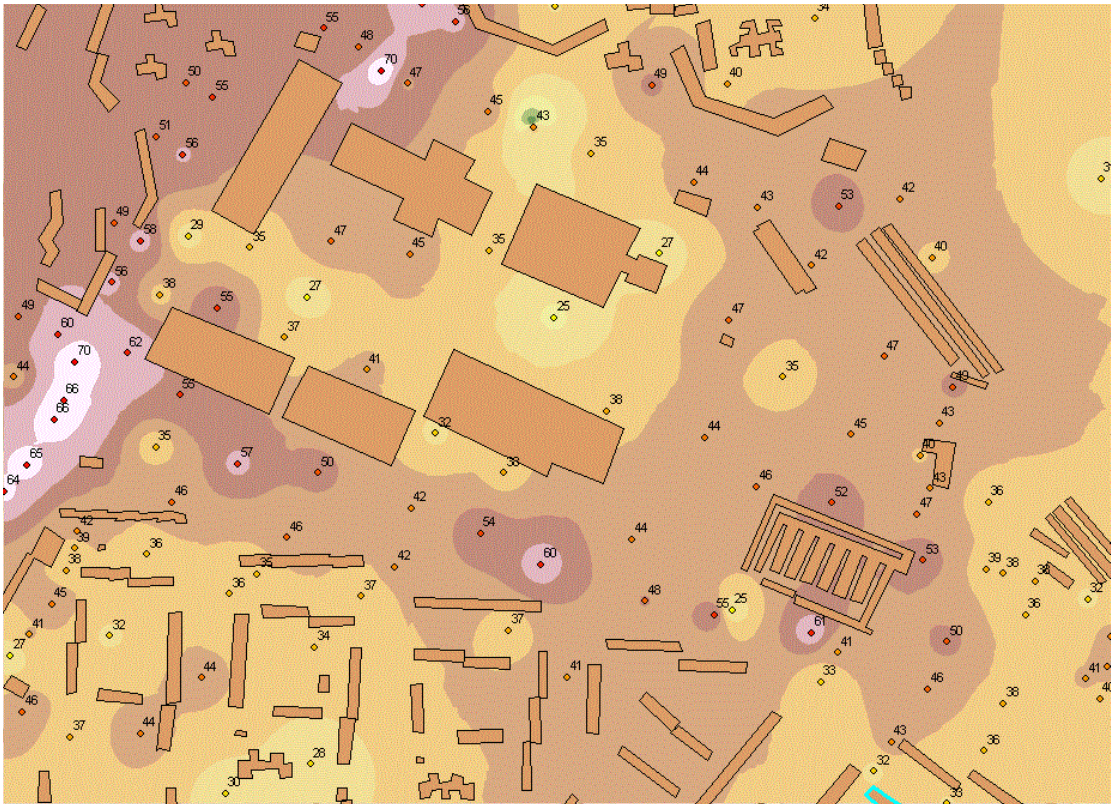


Figure 26 – Noise map based on research results. Numbers – measured sound level, dba, at reference points

A fragment of the study area is presented in Figure *27*. Noise measurements were carried out in the daytime.

As a result of the research, we built a map of noise distribution in the specified area.

Summary and conclusions

The paper considers the methodology of creating maps noise of populated areas using the applied software ensure ArcGis.

In as territory subject study, a densely populated area in the central part of the city of Kharkov. Based on direct in-situ measurements noise maps were created: general, built according to the indicator: level sound, dBA; and noise spectral analysis maps, built according to sound pressure level, dB in octave bands frequencies with geometric mean frequencies 31.5; 63; 125; 250; 500; 1000; 2000; 4000 and 8000 Hz.

Acoustic zones are highlighted in green on noise maps comfort, yellow – acceptable, bordering on exceeding the levels above the normative; Zones with deliberately unacceptable levels.