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Satbayev University

ХАБАРЛАРЫ

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

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NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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LOCAL MONITORING OF THE ENVIRONMENTAL SITUATION IN RESIDENTIAL AREAS WITH HIGH LEVELS OF ELECTROMAGNETIC RADIATION

Abstract. The growing energy demand of the city of Shymkent has led to the construction and introduction of new energy hubs, high-voltage power lines, which are being built and conducted around residential areas exposed to environmental and carcinogenic risks. In turn, when constructing new energy facilities, energy companies and designers should present a cartography of residential areas in the project, in addition to the features of the selected territories and the population, which becomes a multi-factor object and subject of research when taking into account environmental and sanitary-epidemiological requirements, as well as when choosing optimal solutions in terms of routing high-voltage power lines. In our case, the residential district of Nursat, Nazarbayev Avenue and Kazygurt were chosen as such objects, which are polluted residential areas from the point of view of the spread of electromagnetic radiation generated by high-voltage power lines with a voltage of 110 and 220 kV.

The introduction of modern information technologies of a new generation made it possible to pinpoint and determine the main zones of electromagnetic radiation contamination, to establish the gradients of the electric and magnetic fields according to the degree of its impact, as well as to determine the number of residential objects that are partly exposed to carcinogenic and environmental risk by using the functional features of the geoinformation program.

Key words: mapping software, satellite monitoring, open access streets maps, coordinates of reference points, geolocal data, polygonal grid

Introduction. In the article [1], the main purpose of the study was to determine the safe distance of residential buildings from the source of electromagnetic fields generated by high-voltage power lines. The article [2] shows the importance of using Arc GIS geoinformation technologies in processing certain results and analyses on the impact of low-frequency energy objects on the environment. ICNIRP standards were used to evaluate this result. The results showed that the electric field strength is below the standard limit. Regulatory bodies such as the Energy Holding Company of Nigeria (PHCN), the Occupational Health and Safety Code (OHSC), and the Lagos State Urban and Regional Planning Regulations (LSURP) have legislated a minimum failure rate for every infrastructure located near power lines. These rules were used to evaluate the infrastructure that violates the rules. 12.5% of the assessed infrastructures complied with the PHCN regulation, 56.85% with the LSURP regulation and 78.12% with the OHSC regulation.

In the studies [3], during the experimental work, the main emphasis was placed on the establishment of their own national standards for the effects of electromagnetic radiation, followed by the presentation of the obtained standards on a regional database.

In turn, the processed database will be publicly available to energy companies and designers in order to ensure the safety of workers and residents of nearby residential areas who are exposed to a carcinogenic risk during the construction and during the implementation of high-voltage power lines.

In [4], a study was conducted in which the reaction of people to new routes of high-voltage power lines was clearly shown experimentally.

The research [5] developed a new open-source approach based on information platforms, which allows for transparent and reproducible route determination, tracking and evaluation, covering the whole of Europe. Each layer represents a criterion that affects the routing of the power line.

Together with the start and end points of the construction project, this allows you to create rasters of accumulated costs for various ratios between the perspective weights that are relevant in the routing process of the linear infrastructure.

The paper [6] presents a new method of automated route selection for the construction of new power lines, based on geographic information systems (GIS). It uses a dynamic programming model to optimize the route. Environmental constraints are taken into account along with all operating,

maintenance and installation costs, including a new approach to the costs associated with the slope of the terrain crossed by power lines. The computational and visual capabilities of GIS are used to select economic corridors, with total costs not exceeding the threshold set by the user. Examples of intensive modeling illustrate the power and flexibility of the proposed methodology.

Materials and methods of research. During the environmental monitoring, objects that are under the influence of electromagnetic radiation generated by high-voltage lines were visually shown on the example of data cartographies. When creating data cartographies, the coordinates of reference points of high-voltage power lines were obtained, which were obtained using Google maps satellite monitoring [7-9]. The coordinates of the location of low-frequency energy facilities in the Kazygurt and Nursat microdistrict are shown in the following table 1.

Table 1 – Coordinates of reference points of high-voltage high-voltage power transmission lines that were carried out in the Kazygrut, Nursat microdistrict and along Nazarbayev Avenue.

OBJECTID	x, м	y, м	z, м	name
1	69,56505792	42,29352498	25	Kazugurt
2	69,56671752	42,29604867	25	Kazugurt
3	69,5635874	42,29121334	25	Kazugurt
4	69,55852767	42,2918258	25	Kazugurt
5	69,5534706	42,2923942	25	Kazugurt
6	69,5494745	42,29284474	25	Kazugurt
7	69,54513641	42,29406788	25	Kazugurt
8	69,54062849	42,29531494	25	Kazugurt
9	69,53608063	42,29658172	25	Kazugurt
10	69,53194278	42,2977167	25	Kazugurt
11	69,52682585	42,29920416	25	Kazugurt
12	69,52120685	42,30071241	25	Kazugurt
13	69,5674	42,29711387	25	Kazugurt
14	69,517873	42,30164907	25	Kazugurt
15	69,66111903	42,35435369	20	Nursat
16	69,65849679	42,35520754	20	Nursat
17	69,65630018	42,35590878	20	Nursat
18	69,65389224	42,35668267	20	Nursat
19	69,65166657	42,35737922	20	Nursat
20	69,64943143	42,35809723	20	Nursat
21	69,64718974	42,35880808	20	Nursat
22	69,64661969	42,35898763	20	Nursat
23	69,63772058	42,36182363	20	Nazarbayev avenue
24	69,63609364	42,36234736	20	Nazarbayev avenue
25	69,63354906	42,36332174	20	Nazarbayev avenue
26	69,63105546	42,36426242	20	Nazarbayev avenue
27	69,62903561	42,36502889	20	Nazarbayev avenue
28	69,62708935	42,3657687	20	Nazarbayev avenue
29	69,62594653	42,36620148	20	Nazarbayev avenue

After establishing the reference points of high-voltage power lines, which were carried out in the Kazygurt, Nursat microdistrict and along Nazarbayev Avenue, data on high-voltage power lines were entered in the Open Street Maps application.

The cartographic data for the Kazygurt and Nurset microdistricts are shown in Figures 1 and 2.

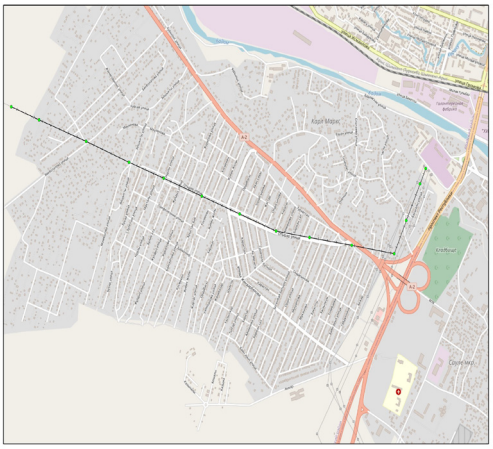


Figure 1. GIS Map of Kazygurt microdistrict based on Open Street Maps applications

Рисунок 2. GIS Map data of the Nursat microdistrict based on Open Street Maps applications

Figure 1 and 2 show the main parts of the neighborhood (streets) that are exposed to electromagnetic radiation.

The geographic information application program Arc GIS allows you to obtain the necessary information about geolocal data, process, and analyze the environmental situation at selected sites. In turn, by introducing the necessary information into the program, you can get specific results and conclusions when conducting environmental monitoring. First, the task is set by introducing the main gradients in the degree of danger of electric and magnetic fields, to determine the quantity of residential objects that are in the danger zone of the electromagnetic field generated by a high-voltage power line, 110 kV and 220 kV voltages [10-11].

Figure 3 shows a sample of geolocal data based on the ESRI ArcGIS program. As a necessary parameter, the distance ranges from the initial wire of the power lines to the point of interest were entered. This range was taken by the hazard gradient of the electric and magnetic fields.

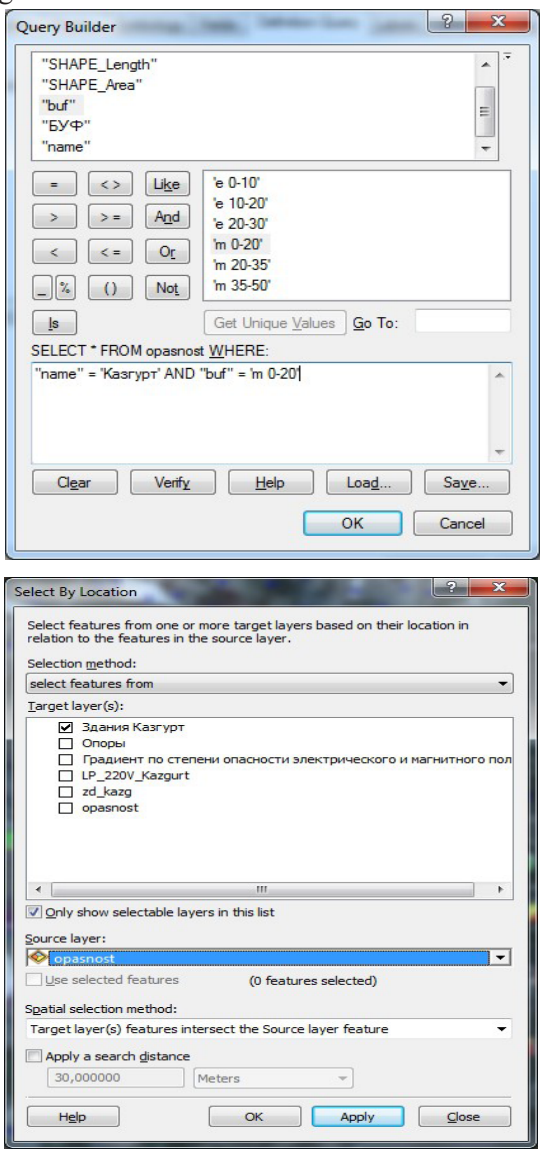


Figure 3. A selection of geolocal data based on the ESRI ArcGIS geoinformation program.

Figure 4 shows a selection of point features that were determined based on the construction of a polygon grid. In the polygonal grid, residential buildings of the Kazygrut microdistrict were calculated, which are located in the danger zone of the electric field in high-voltage power lines with a voltage of 220 kV.

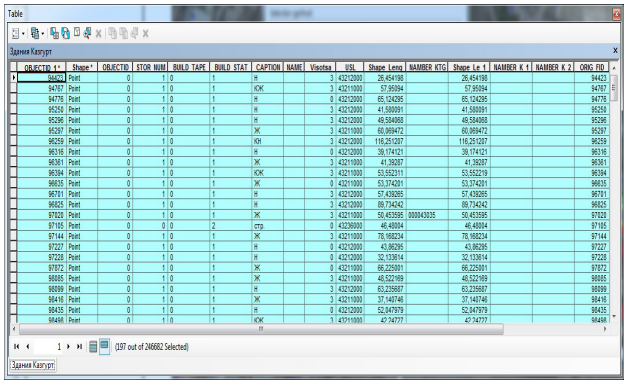


Figure 4. Selection of point objects based on a polygonal grid that are located in the zone of high danger of the electric field in the Kazygurt microdistrict.

Figure 5 shows a selection of point features that were determined based on the construction of a polygon grid. In the polygonal grid, residential buildings of the Kazygrut microdistrict were calculated, which are located in the danger zone of the magnetic field in high-voltage power lines with a voltage of 220 kV.

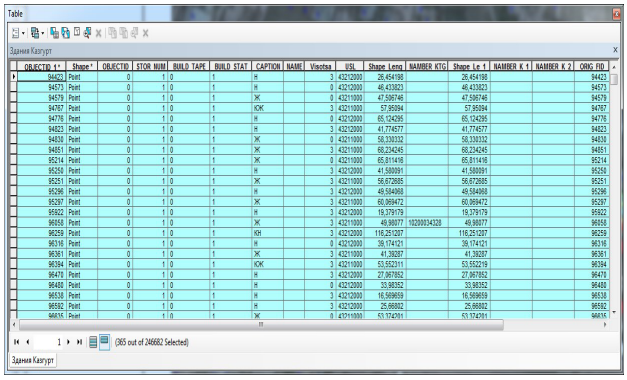


Figure 5. Selection of point objects based on a polygonal grid on the example of residential objects of the Kazygurt microdistrict located in the zone of high magnetic field activity.

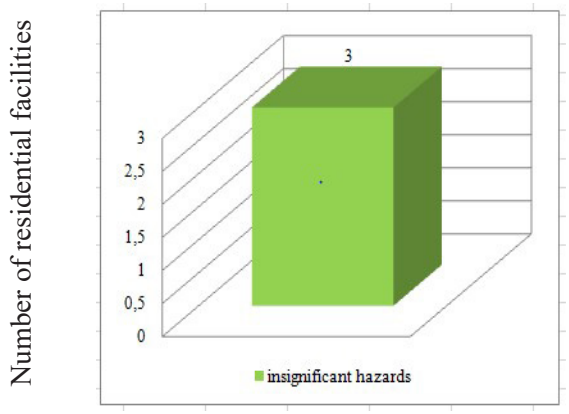
Similarly, for the residential districts of Nursat and for N. Nazarbayev Avenue, residential objects located in the zone of high, medium and insignificant danger of electric and magnetic fields were identified.

When ranking the electric and magnetic fields according to the degree of their impact on the environment, the maximum permissible levels of the electromagnetic field intensity were used.

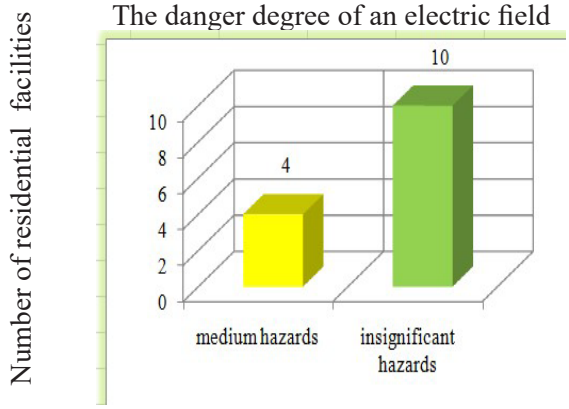
Results and discussion. ESRI ArcGIS geoinformation program allow us define the number of residential objects that are located in the zone of high, medium and insignificant danger of electric and magnetic fields generated by high-voltage power

lines with a voltage of 110 and 220 kV in the Nursat microdistrict, Nazarbayev Avenue and Kazygurt microdistrict was calculated.

Figure 6 shows the number of residential facilities that are in the dangerous zone of electric and magnetic fields in the Nursat microdistrict.



The danger degree of an electric field

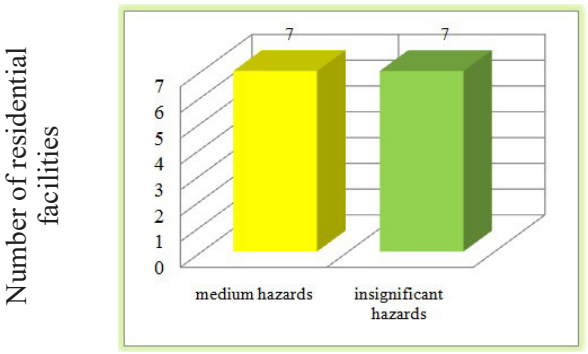


The danger degree of the magnetic field

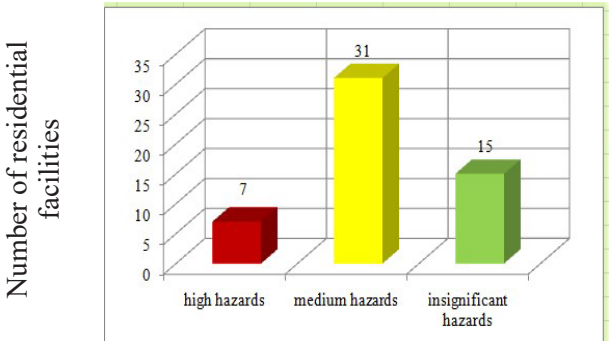
Figure 6. The number of residential facilities within the danger zone of electric and magnetic fields in the Nursat microdistrict.

Figure 6 shows that 3 residential facilities in the Nursat microdistrict are in the insignificant danger zone due to the electric field origin, 4, and 10 residential facilities in the medium and insignificant danger zone, respectively, due to the magnetic field origin.

Figure 7 shows the number of residential buildings that are in the dangerous zone of electric and magnetic fields along Nazarbayev Avenue.



The danger degree of an electric field

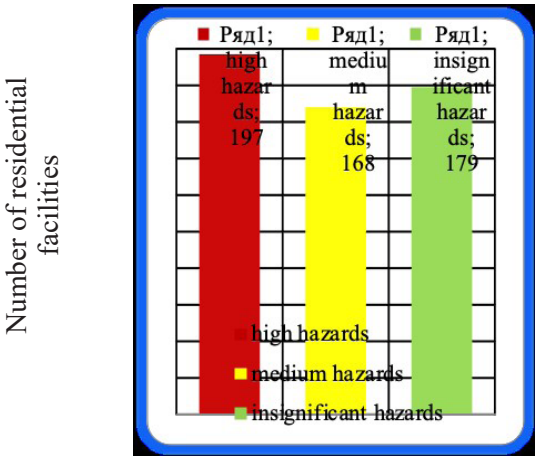


The danger degree of the magnetic field

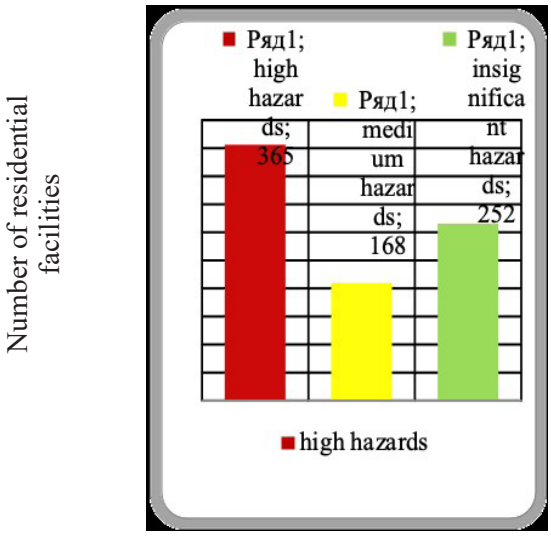
Figure 13. The number of residential facilities that are in the dangerous zone of electric and magnetic fields along Nazarbayev Avenue.

Figure 7 shows that 7 residential facilities are in the area of insignificant risk zone and 7 residential facilities in the medium risk zone of electric field origin, 7.31 and 15 residential facilities, respectively, located in an area of high, average, or insignificant risk for the magnetic field origin in the Nazarbayev prospect.

Figure 8 shows the number of residential facilities located in the dangerous zone of electric and magnetic fields in the Kazygurt microdistrict.



The danger degree of an electric field



The danger degree of the magnetic field

Figure 8 shows that 197,168 and 179 residential facilities, respectively, are in the high, medium, and insignificant dangerous zone due to the electric field origin, and 365,168 and 252 residential facilities, respectively, are in the high, medium, and insignificant dangerous zone due to the magnetic field origin in the Kazygurt microdistrict.

Conclusion. Today, the geoinformation map describing the current situation of the development of electric power networks allows timely and precise determination of the optimality of high-voltage power transmission lines, and increases the level of efficiency and ensures the safety of residential areas that are located around low-frequency energy facilities. In turn, in the last decade, global domestic energy companies have identified and developed new forms of methodology for the use of GIS equipment to justify the laying of high-voltage lines from the point of view of economic efficiency, as well as smoothing the processes of environmental risk and, accordingly, the concern of people who are exposed to carcinogenic risks.

In our case, the necessary maximum permissible levels of electric and magnetic field strength were introduced, which made it possible to visually represent the electromagnetic coverage of certain residential areas in the selected territories. Based on the polygonal grid in the GIS, the number of residential objects that are located around low-frequency energy objects was determined and the residential zones were selectively evaluated according to the degree of influence of the intensity of the electromagnetic field distribution.

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ЭЛЕКТРОМАГНИТТІК СӘУЛЕЛЕНУДІҢ ЖОҒАРЫ ДЕҢГЕЙІ БАР ТҰРҒЫН АУДАНДАРДЫҢ ЭКОЛОГИЯЛЫҚ ЖАҒДАЙЫНЫҢ ЖЕРГІЛІКТІ МОНИТОРИНГІ

Аннотация. Шымкент қаласының өсіп келе жатқан энергетикалық қажеттілігі жаңа энергетикалық тораптардың, жоғары вольтты электр беру желілерінің құрылысына және жүргізілуіне алып келді, олар өз кезегінде тұрғын үй алаптарында канцерогендік қауіп-қатер төндіруі мүмкін факторлардың бірі болып табылады. Өз кезегінде, жаңа энергетикалық нысандарды салу кезінде энергетикалық компаниялар мен жобалаушылар жобада таңдалған аумақтардың ерекшеліктерін және экологиялық және санитарлық - эпидемиологиялық талаптарды ескере отырып, көп факторлы объект пен зерттеу объектісіне айналатын тұрғындар санын, сондай-ақ жоғары кернеулі электр желілерін бағыттау тұрғысынан оңтайлы шешімдерді таңдаған кезде тұрғын үй аймақтарының картасын ұсынуы керек.

Біздің жағдайда осындай объектілер ретінде Нұрсат шағын ауданы, Назарбаев даңғылы және Қазығұрт шағын ауданы таңдалды, олар кернеуі 110 және 220 кВ жоғары вольтты электр беру желілерінен туындайтын электромагниттік сәулеленудің таралуы тұрғысынан ластанған аумақтар болып табылады.

Жаңа буынның заманауи ақпараттық технологияларын енгізу электромагниттік сәулеленумен ластанатын негізгі аймақтарды дәл бағалауға және алдын-ала анықтауға, оның әсер ету дәрежесіне сәйкес электр және магнит өрісінің градиенттерін анықтауға, сондай-ақ геоақпараттық бағдарламаның функционалды ерекшеліктерін қолдануға мүмкіндік беретін құрылымдарды қолдана отырып, ішінара канцерогенді және экологиялық қауіпке ұшырайтын объектілер болып табылатын тұрғын үй объектілерінің саны анықталды.

Түйін сөздер: картографиялық қамтамасыз ету, спутниктік мониторинг, көшелерге ашық ақпараттық қол жеткізу, тірек нүктелерінің координаталары, геолокалдық деректер, полигоналдық тор.

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ЛОКАЛЬНЫЙ МОНИТОРИНГ ЭКОЛОГИЧЕСКОЙ ОБСТАНОВКИ ЖИЛЫХ РАЙОНОВ С ПОВЫШЕННЫМ УРОВНЕМ ЭЛЕКТРОМАГНИТНОГО ИЗЛУЧЕНИЯ

Аннотация. Растущая энергетическая потребность города Шымкент привела к строительству и введению новых энергетических узлов, высоковольтных линий электропередач, которые возводятся и проводятся вокруг жилых районов, подвергающихся экологическому и канцерогенном риску. В свою очередь, при возведении новых энергетических объектов энергетическим компаниям и

проектровщикам следует представить в проекте картографию жилых зон, с дополнением особенностей выбранных территорий и численности населения, которые становятся многофакторным объектом и предметом исследования при учете экологических и санитарно-эпидемиологических требований, а также при выборе оптимальных решений с точки зрения маршрутизаций линий электропередач высокого напряжения. В нашем случае в качестве таких объектов были выбраны микрорайон Нурсат, проспект Назарбаева и микрорайон Казыгурт, которые являются загрязненными жилыми зонами с точки зрения распространения электромагнитного излучения, порождаемые высоковольтными линиями электропередач, напряжением 110 и 220 кВ.

Внедрение современных информационных технологий нового поколения позволило точечно оценить и предопределить основные зоны заражения электромагнитного излучения, установить градиенты электрического и магнитного поля по степени ее воздействия. Также применением функциональных особенностей геоинформационной программы было определено количество жилых объектов, которые отчасти и являются объектами, подвергающиеся канцерогенному и экологическому риску.

Ключевые слова: картографические обеспечение, спутниковый мониторинг, открытый информационный доступ улиц, координаты опорных точек, геолокальные данные, полигональная сетка.

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