5th International Symposium

MINING AND ENVIRONMENTAL PROTECTION

10 - 13 June 2015., Vrdnik, Serbia

MINING AND ENVIRONMENTAL PROTECTION

PROCEEDINGS

Vrdnik

10 - 13. June 2015.

PROCEEDINGS

5th International Symposium **MINING AND ENVIRONMENTAL PROTECTION**

Editor: prof. dr Ivica Ristovic, Faculty of Mining and Geology, Belgrade

Publisher: Faculty of Mining and Geology, Belgrade

For publisher: Prof. dr Ivan Obradovic, Dean

Technical desing: SaTCIP, Vrnjacka Banja

Printed by: SaTCIP, Vrnjacka Banja

Copies: 150

ISBN 978-86-7352-287-6

The publication of this Proceedings approved by the Council of Faculty of Mining and Geology, University of Belgrade

All Papers in Proceedings are reviewed

This Proceedings was published with the financial assistance of the Ministry of Education, Science and Technological Development of Republic of Serbia

ORGANIZER

UNIVERSITY OF BELGRADE, FACULTY OF MINING AND GEOLOGY, Belgrade
CENTER FOR ENVIRONMENTAL ENGINEERING, Mining Department
www.rgf.bg.ac.rs

COORGANIZERS

BERG FACULTY TU KOSICE, SLOVAKIA
www.fberg.tuke.sk

UNIVERSITY OF LJUBLJANA, FACULTY OF NATURAL SCIENCES AND ENGINEERING, SLOVENIA
www.ntf.uni-lj.si

GOCE DELCEV UNIVERSITY IN STIP, MACEDONIA
www.ugd.edu.mk

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY "MISIS", MOSCOW, RUSSIA
www.en.misis.ru

INTERNATIONAL ACADEMY OF SCIENCES OF ECOLOGY AND PROTECTION MANEB,
SANKT-PETERBURG, RUSSIA

SCIENTIFIC COMMITTEE

dr Michal Cehlar, BERG Faculty, TU Košice, Slovakia, dr Gabriel Fedorko, BERG Faculty, TU Košice, Slovakia, dr Vieroslav Molnar, BERG Faculty, TU Košice, Slovakia, dr Daniela Marasova, BERG Faculty, TU Košice, Slovakia, dr Milivoj Vulic, Faculty of Natural Sciences and Engineering, Ljubljana, Slovenia, dr Zeljko Vukelic, Faculty of Natural Sciences and Engineering, Ljubljana, Slovenia, dr Goran Vizintin, Faculty of Natural Sciences and Engineering, Ljubljana, Slovenia, dr Evgen Dervaric, Faculty of Natural Sciences and Engineering, Ljubljana, Slovenia, dr Milan Medved, University of Maribor, Slovenia, dr Vladimir I. Galkin, MISIS Moscow, Russia, dr Evgenia. E Sheshko, MISIS Moscow, Russia, dr Nikolaj M. Kachurin, TulGU, Tula, Russia, dr Oleg N. Rusak, Sankt-Peterburg, Russia, dr Zoran Panov, Goce Delcev University Stip, Macedonia, dr Zoran Despodov, Goce Delcev University Stip, Macedonia, dr Dejan Mirakovski, Goce Delcev University Stip, Macedonia, dr Viktor Kovalov, Donbas State Engineering Academy, Ukraine, dr Valentin Nedeff, University of Bacau, Romania, dr Alexandru-Viorel Pele, University of Oradea, Romania, dr Raycho Ilarionov, TU Gabrovo, Bulgaria, dr Malgorzata Malec, KOMAG, Gliwice, Poland, dr Monika Hardygora, Wrocław University of Technology, Poland, dr Horst Gondek, VŠB Ostrava, Czech Republic, dr Jiri Fries, VŠB Ostrava, Czech Republic, dr Neven Duic, University of Zagreb, Croatia, dr Nediljka Gaurina-Medjimurec, University of Zagreb, Croatia, dr Vlatko Marusic, University of Osijek, Croatia, dr Vladimir Malbasic, University of Banja Luka, Republic of Srpska, Bosnia and Hercegovina, dr Kemal Gutic, Faculty of Minig, Geology and Civil Engineering,Bosnia and Hercegovina, dr Gordana Stefanovic, University of Nis, Serbia, dr Srdjan Jovic, University of Pristina, Serbia, dr Blagoje Nedeljkovic, University of Pristina, Serbia, dr Gordana Vojkovic, University of Belgrade, Serbia, dr Zoran Nikic, University of Belgrade, Serbia, dr Ivan Obradovic, University of Belgrade, Serbia, dr Nikola Lilic, University of Belgrade, Serbia, dr Bozo Kolonja, University of Belgrade, Serbia, dr Dinko Knezevic, University of Belgrade, Serbia, dr Milos Grujic, University of Belgrade, Serbia, dr Aleksandar Cvjetic, University of Belgrade, Serbia, dr Ivica Ristovic, University of Belgrade, Serbia.

ORGANIZING COMMITTEE:

dr. Ivica Ristovic, Belgrade, Serbia, **president**, dr. Gabriel Fedorko, Košice, Slovakia, **vice president,** dr. Milivoj Vulic, Ljubljana, Slovenia, **vice president,** dr. Vasilii Zotov, Moscow, Russia, **vice president,** dr. Zoran Despodov, Štip, Republic of Macedonia, **vice president,** dr. Vjeroslav Molnar, Košice, Slovakia, dr. Olga O. Sheshko, Moscow, Russia, dr. Jiri Fries, Ostrava, Czech Republic, dr. Dejan Mirakovski, Štip, Republic of Macedonia, dr. Aleksandar Cvjetic, Belgrade, Serbia, Miroslav Ivkovic, TE-KO Kostolac, Kostolac, Serbia, Danko Beatovic, TE-KO Kostolac, Kostolac, Serbia, MSc Ivana Filipovic, Belgrade, Serbia, MSc Milena Lekic, Belgrade, Serbia, MSc Uros Pantelic, Belgrade, Serbia, BSc Bojana Simic, Belgrade, Serbia, BSc Nadežda Petrović, Lazarevac, Serbia

C O N T E N T S:

PLENARY SESSION

Ivica Ristovic:
Mining and Environmental Protection - Experiences and Challenges..... **1**

Daniela Marasová, Michal Cehlár, Nikoleta Husáková, Slovakia:
Procedure of Creation and Design of Simulation Model of Calcined Ore Conveyance..... **9**

Evgen Dervaric, Zeljko Vukelic, Slovenia:
Can Coal Survive..... **15**

Aleksandar Cvjetic, Serbia:
Environmental Noise in Serbian Open Cast Lignite Mines..... **23**

Predrag Dasic, Ivica Ristovic, Jovan Dasic, Serbia:
Analysis of bibliometric indicators for category Mining & Mineral
Processing for 2013 based on JCR and Scopus data..... **30**

WORKS SESSIONS

Gabriel Fedorko, Vieroslav Molnar, Nikoleta Husakova, Slovakia:
Analysis of Variable Pipe Conveyor Belt Motion by the Help of CAX Tools..... **40**

Gabriel Fedorko, Vieroslav Molnár, Dragan Medenica, Slovakia, Serbia:
Modelling of Stress-Deformation States for Conveyor Belts of Classic Belt Conveyors..... **48**

Gabriel Fedorko, Ivana Filipovic, Ivica Ristovic, Slovakia, Serbia:
Utilization of CAD and CAE Technologies by Research of Shifting of Pipe Conveyors..... **55**

Peter Michalik, Vieroslav Molnár, Slovakia:
Scripting – Effective Tool for Acceleration of FEM Analysis in the Program Abaqus..... **64**

Nikoleta Husáková, Slovakia:
Eco-logistics – a Tool for Environmental Protection..... **73**

Evgenia E. Sheshko, Russia:
Substantiation of Efficiency of Application of Sandwich Belt High Angle
Conveyors in the Schemes With Cyclic and Line Technology in Deep Open Pits..... **79**

Vladimir I. Galkin, Russia:
Features of Designs of Belts for Pipe Belt Conveyors..... **86**

Olga E. Sheshko, Russia:
Tendences of Reducing Harmful Emissions Into Atmosphere in Deep Open Pits..... **91**

Svjetlana Sredic, Nada Prerad, Slobodanka Malbasic, Vladimir Malbasic,
Igor Knjeginic, Republic of Srpska, **Bosnia and Hercegovina**:
Possibility of Biomass Production from Fast-Growing Plantations at the
Degraded Areas of Iron Ore Mines Around Prijedor..... **97**

Amor Husic, Rijad Sisic, Zvjezdan Karadzin, Bosnia and Hercegovina:
Possibilities of Utilizing Ventilation Air Methane from FBIH Coal Mines..... **106**

Dragana Jelisavac Erdeljan, Serbia:
Mining Waste Management..... **112**

Milos Grujic, Serbia:
Basic Principles of Quantifying the Criteria for Identifying Priorities
in Solving the Environmental Protection Problems in Mining..... **115**

Bogoljub Vuckovic, Biljana Radovanovic, Nadezda Petrovic, Serbia:
Kolubara Lignites Combustible Sulphur Environmental Impact – Naturall
and Artificial Selected Sources Comparison..... **120**

Zeljko Prastalo, Dragan Milosevic, Sasa Mitic, Milinko Radosavljevic,
Nenad Makar, Serbia:
Exploitation Measures Aimed in Preserving the Quality of Humus..... **130**

Nikolai M. Kachurin, Sergei A. Vorobev, Sergei M. Bogdanov, Russia:
Evaluating Polluting Atmosphere by Mining Enterprises and
Optimizing Prophylactic Measures Resources..... **135**

Nikolai M. Kachurin, Sergei A. Vorobev, Dimitryi N. Shkuratckiy,
Sergei M. Bogdanov, Russia:
Environmental Danger of Worked and Liquidated Coal Mines Open Areas..... **141**

Edward M. Socolov, Tatiyna S. Sviridova, Russia:
Polluting Soils by Heavy Metals and Radionuclides..... **150**

Zorica Ivkovic, Dejan Dramlic, Vladica Dragosavljevic, Serbia:
Legislation to preserve and faciliate biological resources in underground coal exploitation..... **154**

Biljana Milutinovic, Gordana Stefanovic, Srdjan Jovic, Hivzo Skrijelj, Serbia:
Development of Mathematical Model for Estimation of Economic
Indicators of Waste Treatment..... **162**

Dragana Savic, Jelena Majstorovic, Dejan Nikolic, Dejan Zivkovic, Serbia:
Geological Investigations of Conceptual Project of Regional Landfill on Kalenic..... **171**

Drago Potocnik, Janez Roser, Milivoj Vulic, Slovenia:
Analysis of Occupational Injuries in the Velenje Coal Mine Using
Modified Sigmoid Function..... **179**

Gregor Novakovic, Simon Kovacic, Milivoj Vulic, Slovenia:
Applicability of 3D Laser Scanning Data in Underground Constructions..... **184**

Janja Vrzel, Nives Ogrinc, Goran Vizintin, Slovenia:
Development of the Conceptual Model – Ljubljansko Polje Aquifer (Slovenia)..... **189**

Zeljko Vukelic, Evgen Dervaric, Goran Vizintin, Slovenia:
Well Optimization in Velenje Coal Mine Using 3D
Finithe Elements Modeling..... **193**

Cvjetko Stojanovic, Biljana Borovic, Republic of Srpska, Bosnia and Hercegovina:
Exploitation of Natural Resources in Function of Sustainable Development..... **199**

Zoran Despodov, Dejan Mirakovski, Nikolinka Doneva,
Stojance Mijalkovski, Zoran Panov, Republic of Macedonia:
Regulation of Saska River with Aim for Environmetal Protection at
N°.4 Flotation Tailing Damp Construction in the Sasa Mine..... **203**

Todor Serafimovski, Goran Tasev, Republic of Macedonia:
Soil Metal Pollution Related to Active Zletovo Pb-Zn Mine..... **209**

Dejan Mirakovski, Marija Hadzi-Nikolova, Zoran Despodov,
Nikolinka Doneva, Stojance Mijalkovski, Republic of Macedonia:
Guidelines for Preparation of Mine Waste Management Plan..... **216**

Marija Hadzi-Nikolova, Dejan Mirakovski, Zoran Despodov,
Nikolinka Doneva, Stojance Mijalkovski Republic of Macedonia:
Verification of the Environmental Noise Dispersion Model in Mining..... **226**

Aleksandar Simic, Radoje Lausevic, Ana Popovic, Mirjana Bartula, Serbia:
Environmental Management and Information System for Surface Lignite Mining..... **232**

Marija Zivkovic, Dejan Ivezic, Aleksandar Madzarevic, Serbia:
The Role of Ecological Indicators in Processes of Strategic
Planning-Case of The City of Nis..... **238**

Vesna Karovic Maricic, Branko Lekovic, Dusan Danilovic,
Miroslav Crnogorac, Serbia*:*
Environmental Benefits of Enhanced Oil Recovery by CO_2 Injection..... **247**

Dusan Danilovic, Vesna Karovic-Maricic, Branko Lekovic,
Miroslav Crnogorac, Serbia*:*
Preventing Harmful Emissions Into the Atmosphere Upon Manipulation Oil Derivatives..... **253**

Snezana Savkovic, Jelena Majstorovic, Predrag Jovancic, Serbia:
Analysis attainable technical-technological results word open pit mines
Elecktrical industry - EPS of Serbia..... **258**

Jelena Malenovic Nikolic, Ana Vukadinovic, Vojin Cokorilo, Serbia*:*
Energy Management and Systems of Environmental Safety in Mining-Energy Complexes..... **262**

Jelena Malenovic Nikolic, Dejan Vasovic, Serbia:
Improving Systems of Environmental Safety in Mining-Energy Complexes:
Project Management..... **267**

Dejan Vasovic, Jelena Malenovic Nikolic, Stevan Musicki, Serbia:
Water Framework Directive, Industrial Emissions Directive, Seveso Directive:
A Triangle of Equal Sides..... **272**

Radule Tosovic, Serbia:
Expert Economic Evaluation of Mineral Resources in Environmental Protection..... **278**

Tomislav Subaranovic, Vladimir Pavlovic, Ivan Jankovic, Serbia:
Planning and Options of Mine Closure..... **285**

Milorad Stojanovic, Slavica Stojanovic, Serbia:
The Impact of the Construction of Phase II of the Coal Preparation Plant
(Crusher) Tamnava-East Field and Dump Fine Coal on the Environment..... **289**

Gordana Milentijevic, Blagoje Nedeljkovic, Milan Milojevic, Serbia:
Exploration of Pb-Zn ore on Surrounding Areas of the Crnac Mine..... **296**

Gordana Milentijevic, Blagoje Nedeljkovic, Milan Milojevic, Serbia:
The Impact of Flotation Processing of the Pb-Zn ore one the Living Environment
of the MIF Kopaonik in Leposavic..... **301**

Snezana Aleksandrovic, Aleksandar Cvjetic, Serbia*:*
Analysis of Noise Sources in Power Transformers and Rotating Electrical Machine..... **307**

Jovan Zdravkovic, Mladen Vojnic, Serbia:
Deep Well Dewatering on the Open Pit Drmno with Reference to Environmental Protection..... **313**

Radisa Djuric, Dragan Stevic, Filip Todorovic, Serbia:
Impact of Modern Technology Application of New Machines of the Auxiliary
Mechanization for Reduction of Environmental Pollution at the Open-Pit Coal Mine Drmno... **318**

Radisa Djuric, Dragan Milosevic, Zoran Maksimovic, Serbia:
Rational Maintenance of Machinery in the Open Pit Drmno Using
the New Concepts of Vehicles Used for the Collection and Distribution of New Oil..... **323**

Miodrag Denic, Veselin Dragisic, Sasa Stojadinovic, Vladimir Zivanovic, Igor Svrkota, Dragan Jokovic, Serbia:
Isolation of Old Works and the Possibility of a Durable Solution for the
Drainage of the Pit Mine Soko..... **331**

Dusko Djukanovic, Igor Svrkota, Serbia:
Influence of Accidents in Underground Coal Mining to Environment..... **338**

Radoje Pantovic, Nenad Vusovic, Igor Svrkota, MarkoVukovic, Serbia:
Monitoring of Displacements in Support of Kriveljska Reka Collector..... **341**

Novica Momcilovic, Jadranka Vukasinovic, Serbia:
Construction and Exploitation of a Landfill for Ash and Slag Disposal from the
Heating Plant Vreoci for the Purpose of Environmental Protection..... **349**

Dinko Knezevic, Nikola Lilic, Dragana Nisic, Milos Stanic, Vladan Kuzmanovic, Serbia:
Using Previously Polluted Sites for Waste Storage, Prahovo Phosphogypsum
Storage Case Study..... **356**

Nikola Lilic, Vladimir Milisavljevic, Uros Pantelic, Ljiljana Kolonja, Dragan Medenica, Serbia:
Dispersion Modeling of Particulate Matter in Surface Lead and Zinc Mine Suplja Stijena..... **366**

Suzana Lutovac, Cedomir Beljic, Zoran Gligoric, Branko Gluscevic, Serbia:
Parameter Determination of Soil Oscillation Law Using Quotient of the Relative Growth
Increments of Oscillation Velocity and Reduced Distances at Kovilovaca Surface Mine..... **376**

Bozo Kolonja, Dejan Stevanovic, Milica Pesic Georgiadis, Mirjana Bankovic, Ljiljana Kolonja, Serbia:
Uncertainty in Open Pit Optimization..... **385**

Ljiljana Kolonja, Ranka Stankovic, Ivan Obradovic, Olivera Kitanovic, Uros Pantelic, Serbia:
Development of a Business Intelligence Tool For Accident Analysis in Mines..... **393**

Ranka Stankovic, Nikola Vulovic, Nikola Lilic, Ivan Obradovic, Radule Tosovic, Milica Pesic-Georgiadis: **400**
Webgis Cadastre Of Abandoned Mines In Autonomous Province Of Vojvodina.....

Sasa Ilic, Serbia:
Selective Mining and Dumping of Overburden on Opencast Coal Mining..... **407**

Aleksandar Cvjetic, Ljubica Figun, Vladimir Milisavljevic, Uros Pantelic, Aleksandra Tomasevic, Serbia:
Noise Management at the Buvac Open Cast Mine..... **410**

Milena Lekic, Ivana Filipovic, Zoran Nikic, Serbia:
Biological Planning Prospects of Municipal Waste Landfills in Serbia..... **420**

POSTER SESSION

Vrhovnik Petra, Recnik Aleksander, Dolenec Matej, Daneu Nina, Grom Nina, Slovenia:
Magnetite Ore Deposit Mala Kopa..... **427**

Vrhovnik Petra, Serafimovski Todor, Tasev Goran, Rogan Smuc Nastja, Dolenec Matej, Slovenia, Republic of Macedonia:
Metal Contamination in Makedonska Kamenica Region:Relevance to Human Health..... **428**

INDEX OF AUTHORS

5th International Symposium

MINING AND ENVIRONMENTAL PROTECTION

10 - 13. June 2015., Vrdnik, Serbia

VERIFICATION OF THE ENVIRONMENTAL NOISE DISPERSION MODEL IN MINING

Marija Hadzi-Nikolova, Dejan Mirakovski, Zoran Despodov,
Nikolinka Doneva, Stojance Mijalkovski
Faculty of Natural and Technical Sciences, Goce Delcev University Stip, Republic of Macedonia

Abstract: *Environmental Noise Dispersion Model (ENDM) simulates outdoor sound prorogation and predicts noise levels from known noise sources for close and distant locations. The Model calculates attenuation due to noise source enclosures and other noise control measures, for distance from the source to the receiver, for the noise source size, type and directivity, for barriers and natural topographical features and for sound absorption in the air.*

In practice the physical environment will usually not be fixed, but will be characterized by constantly varying conditions. These variations in real world conditions will subsequently cause the actual sound field to vary in time and space. Thus it is important to recognize that the output of an Environmental Noise Model (ENM) will only represent an estimate of the range of actual environmental noise levels that could occur in time and space. Therefore verification of ENDM is essential step in increased model confidentiality. By comparing results calculated and measured on site during the model development and model adjustment, compliance between measurement and calculation results could be obtained. This paper presents steps of ENDM verification in mining sites.

Keywords: *Noise, Model, Verification, Environment*

1. INTRODUCTION

Noise pollution affects quality of life and has been linked to health problems [1]. The EU Environmental Noise Directive (END) aims to manage noise and preserve quiet areas by engaging the public, local authorities and operators.

The European Community Green Paper on Future Noise Policy (1996) recognised that environmental noise is "one of the main local environmental problems in Europe" but that it has had a lower priority than other environmental problems, such as air or water pollution [2]. It also recognised that, despite significant reductions in the noise produced by individual sources, total exposure to environmental noise has not changed significantly. For example, the introduction of quieter vehicles has been offset by an increase in traffic.

Environmental noise in Republic of Macedonia is controlled by Law on Environmental Noise Protection and related regulations that gives guidelines and standards covering planning, transport, the environment and compensation. To provide a common approach to noise management, the European
Union introduced the Environmental Noise Directive (END) in 2002. This was transposed into Environmental Noise Regulations in Republic of Macedonia.

2. OBJECTIVES OF NOISE MAPPING

Noise mapping is the first tool to effectively assess noise exposure, communicating information to citizens, and defining effective action plans for protecting citizens from high noise levels and preserving quiet urban areas [3]. Environmental Noise Dispersion Models and Noise Mapping Procedures shows how to integrate data with geographical information systems, improve accuracy in model and prediction software, and assess different methods and descriptors for evaluating annoyance and noise exposure. ENDM is prepared based on regulations, communication processes, physical aspects, and application of noise mapping. Beginning with fundamental concepts in acoustics and a presentation of legal frameworks for noise mapping, many software packages cover all the main issues about noise mapping. It presents numerical models for roads, railways, airports, harbours, and industrial sites [4].

Noise mapping is a form of environmental modelling and like most risk based environmental models is used on the source-pathway-receiver conceptual model, whereby the source emission is first calculated, and then propagated across a geographical extent to the receiver (at a specified location).

Noise dispersion modeling can be used for calculating the areas, that are affected by noise and for determining the number of sensitive buildings, that are affected by high noise levels. Using noise model the number of citizens who are annoyed can be determined. Noise dispersion models can be helpful in planning and decision making process to reduce the noise pollution.

2.1 Quality and accuracy of data for noise mapping

The accuracy and quality of noise mapping depend on the scale and details of the input data. Nevertheless redundant data should be avoided reducing the computation time. During noise mapping, if the density of information is high then accurate results can be achieved, specially in the case where the noise levels changes quickly. The observation point (which represents the virtual microphone) should be in high density close to the source and objects, low density parallel to the track and further away.

The densely spacing of observation points is not only scale factor that has to be consider. The scale and the details of the information of area and buildings sensitive to noise are also very important (Stoter, 1999). The quality of the results of noise mapping depends on the quality of input data used. The GIS can control and supervise the quality of the results by considering the quality of input data into account [5].

Noise mapping approach for noise management is effective when there is more reliable, meaningful, transparent and unambiguous information in the noise maps. In order to have an accurate noise maps, the process of noise mapping should be clear and with a proper sequence. The following step illustrates the process of 2D noise mapping:

Step 1: Collection of raw data, preparing, storing and querying of these data.
The GIS provides the central database management environment. The noise data can be imported into GIS where the quality can be checked and stored [6]. The data needed to compute noise levels should be in accordance with the site conditions. The raw data should include the road information, building details, population of area, parks, and other sensitive areas (school, hospitals). The data can be distinguished in two sets; first, the data needed for computing noise in noise calculation model and the second is the geographical data such as location of people, buildings, roads (Kluijver de Henk *et al.*, 2003). Scale and level of detail of the data should be sufficient to reach the proposed accuracy of study.

Step 2: Calculation of noise levels
Computation of noise levels is carried out for the observation points located on map. Computation is carried with standard noise calculation models. The quality of input data required for computation is to be checked for accurate results. The calculation models are integrated with GIS and the result (observation points with noise values) s converted into GIS data.

Step 3: Determining noise contours

Noise contours are computed by interpolation of calculated noise levels of observation points using Noise Modeling Software. Since significant decisions are based on these noise contours, which makes it important that these decision are unbiased (Kluijver de Henk *et al.*, 2003). The accuracy of contour maps of noise situation can be obtained if the density of observation points is significantly high.

Figure 1 shows general review of developing noise dispersion model and content of noise maps [7].

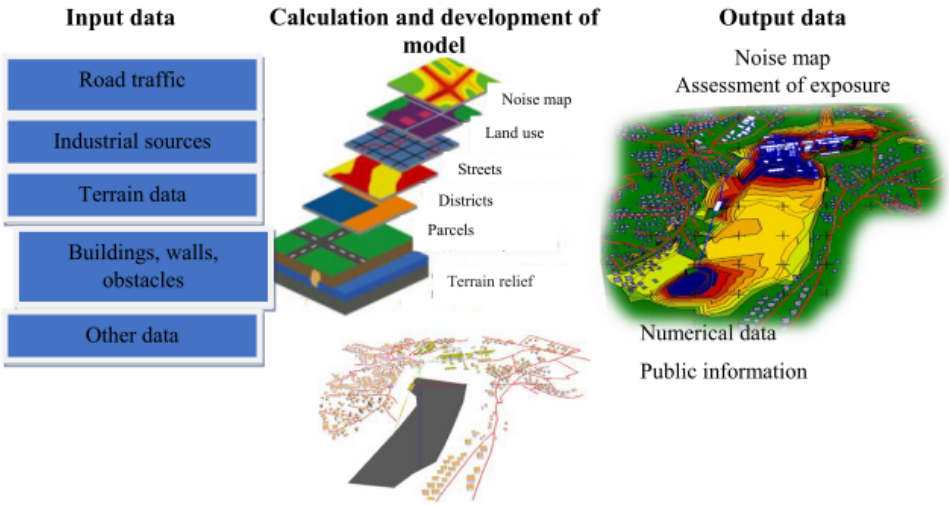

Figure 1 *Review of developing Noise Dispersion Model [7]*

2.2. Input Data Requirements for Assessment of Industrial Noise

The type of information required for each industrial site is determined by the choice of approach being undertaken, and the resolution of the modelling to be carried out. At the most simplistic approach, using area sources to describe operational elements of the industrial site, the following information is typically required [8]:

- Location of industrial area;
- Description of industrial process;
- Sound power emission level(s) for operations on the site; and
- Mean frequency band for assessment of global noise exposure.

If a more detailed assessment is undertaken, more additional information may be required, such as:

- Location, size and height of noise source on site;
- Sound power level(s) for each noise source on site, possibly in octave bands;
- Noise source directivity; and
- Operational periods of each noise source.

2.2.1. Mining noise sources

The sound pressure level generated depends on the type of the noise source, distance from the source to the receiver and the nature of the working environment. For a given machine, the sound pressure levels depend on the part of the total mechanical or electrical energy that is transformed into acoustical energy.

Sound fields in the workplace are usually complex, due to the participation of many sources: propagation through air (air-borne noise), propagation through solids (structure-borne noise), diffraction at the machinery boundaries, reflection from the floor, wall, ceiling and machinery surface, absorption on the surfaces, etc. Therefore any noise control measure should be carried out after a source ranking study, using identification and quantification techniques.

The mechanism of noise generation on mining site depend on the particularly noisy operations and equipment including drilling, blasting (quarries and mines), crushing, Hand-held pneumatic drills pneumatic equipment (e.g. hammers, etc.), milling machines and grinders, as well as , pumps and compressors, drive units, hand-guided machines, self-propelled working machines, in-plant conveying systems and transport vehicles [9].

With 15 -minute measuring of noise levels in 1/3 octave band nearby heavy mining machinery in mining site, bulldozers, excavators and haul trucks were identified as main noise sources (Figure 2).

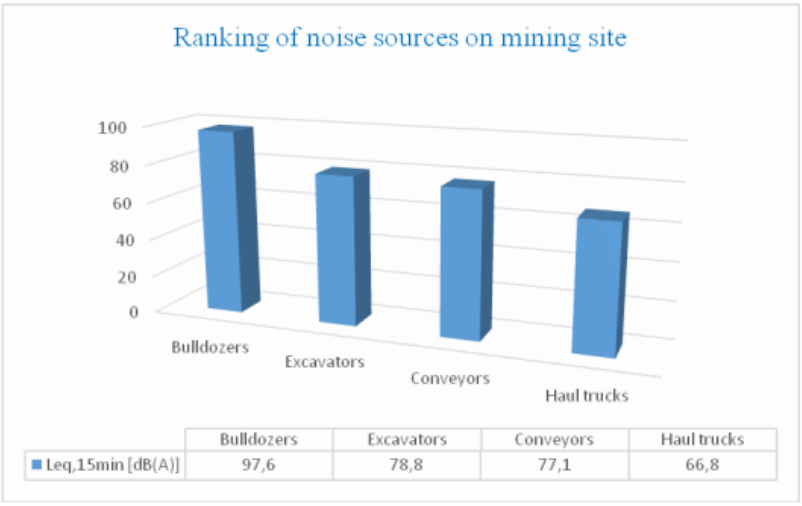

Figure 2 *Main noise sources on mining site*

3. DEVELOPMENT OF NOISE DISPERSION MODEL

Based on measurements of noise level and identification of noise sources in the mining site a Noise Dispersion Model in the vicinity (at recipients) of mining site were performed using most sophisticated Software for Noise and Air Pollution Modeling, SoundPLAN 7.2. production by company Braunstein + Berndt GmbH / SoundPLAN International LLC.

SoundPLAN Software by SoundPLAN International LLC and Braunstein + Berndt GmbH is a software package offering a flexible range of noise and air pollution evaluation modules. It is used by more than 5,000 users, including governments, consultants and researchers in more than 40 countries and is the world's leading environmental prediction software. The speed and accuracy of SoundPLAN has been developed to the point where evaluation of noise and pollution impacts on whole cities can be carried out using computer power available to even the most modest of users. The output can range from noise prediction tables to colour contour maps and 3D animations. SoundPLAN has been a leader in its field for more than 25 years [10].

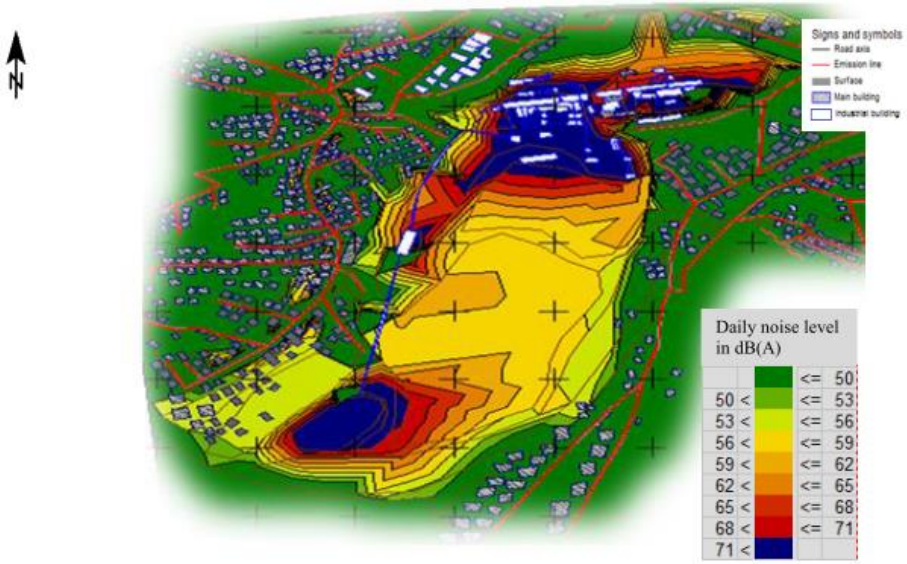

Figure 3 *2D Noise Dispersion Model in vicinity of industrial processing plant on mining site, close to recipients, during the day*

4. VERIFICATION OF THE NOISE DISPERSION MODEL

Verification of noise dispersion model is made on the basis of noise level measurements conducted in the residential areas in the vicinity of the mining site on 5 measurement points close to mining site. Table 1 shows that the measured noise level close to noise sources and the nearest recipients in vicinity of the mining site fully confirm the Noise Dispersion Model in immediate and wider surrounding of the mining site developed using the Software for Noise and Air pollution Modeling, SoundPLAN 7.2, based on the measurements of the noise level at sources in the mining site. Small deviations that occur at individual measurement points resulting of additional noise that comes from parking space and nearby roads, which software takes into account in the Noise Dispersion Model.

A comparison of the measured and calculated values at the points for the verification of the model provided the deviation of the calculated and measured values in the range of ± 4dB (A).

Table 1 *Comparison of measured equivalent noise level and calculated noise levelaccording to model for 5 measurement points close to noise sources on the mining site*

Measurement point	Measured $L_{eq,15min}$ [dB(A)]	L_{eq} [dB(A)] according to model
1	71,6	75-78
2	73,3	72-75
3	61,9	66-69
4	63,6	66-69
5	62,8	63-66

5. CONCLUSION

Noise Dispersion Model and noise maps are used to assessment and monitoring of noise adverse impact effects and can be useful in planning and decision-making on noise reduction measures. SoundPLAN Software is a leader in the field of noise mapping. SoundPLAN as software for noise modeling and mapping is quite flexible in the management and control of multiple scenarios and models of noise and offers fast and reliable transformation of these models into noise maps. SoundPLAN uses advanced algorithms to filter the data so that the model can be reduced to the defined tolerance from the user. SoundPLAN software offers many tools for data preparation, consistent control and preparation of reports and documentation. These tools offered very good solutions for all that can be expected from a acoustic simulation program. Noise maps are considered to be sufficiently accurate near major noise sources to allow the areas of highest exposure to be identified for Noise Action Plans.

Environmental Noise Dispersion Model has proven to be a popular and useful acoustic tool to provide accurate prediction for a wide range of environmental noise sources. Improvements are being made to the algorithms as more information becomes available. Improvements are also being made to interfaces with other programs and software packages. Thus the program has become even simple to use without any decrease in the accuracy of the predictions, and noise level contours can be clearly presented.

REFERENCES

[1] Noise Pollution: *The Problem and Some Solutions Informations Collected from Assorted Websites*, 2010.

[2] European Commission, *Future Noise Policy, Green Paper*, COM (96)540, Brussels, 1996.

[3] European Commission Working Group, *Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure,* 2006.

[4] Nicoll, R., Butten, N., Shilton,S., *Northern Ireland Environmental Noise Directive Mapping Data Study: Data Options, Feasibility, and Pilot Study Report*, 2005

[5] Stoter, J., *Noise Prediction Models and Geographic Information Systems, a sound combination*. SIRC 99-The 11th Annual Colloquium of the SpatialInformation Research Centre University of Otago, Dunedin, New Zealand, 1999.

[6] Burrough, P.A., *Principles of Geographic Information System for Land Resource Assessment*,. Oxford Clarendon Press, London, 1986.

[7] Hadzi-Nikolova, M., *Modern approach in management and noise control in urban areas*, PhD Thesis, June, 2013.

[8] Barron, R.F., *"Industrial Noise Control and Acoustics",* Louisiana Tech University Ruston, Louisiana,U.S.A , 2001.

[9] Mirakovski, D., Hadzi-Nikolova, M., Ristovic, I., Despodov, Z., Panov, Z., *Modeling of Noise Impact Assessment on the Aggregate Surface Mines,* Integrated International Symposium TIORIR`11, Zlatibor, Republic of Serbia, 2011.

[10] *SoundPLAN Manual 7.1*, Braunstein + Berndt GmbH/SoundPLAN International LLC, January, 2012.

[11] Tonin, R. *Validation of Environmental Noise Model,* Renzo Tonin & Pty Ltd, Sidney, Australia, 2000.