MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
FACULTY OF ENVIRONMENTAL SAFETY,
ENGINEERING AND TECHNOLOGIES
DEPARTMENT OF ECOLOGY

APPROVED TO DEFENCE
Head of the Graduate Department
_____ V.F. Frolov
«_____» _____ 2020

MASTER THESIS

(EXPLANATORY NOTE)

SPECIALTY 101 "ECOLOGY",
TRAINING PROFESSIONAL PROGRAM
"ECOLOGY AND ENVIRONMENTAL PROTECTION"

Theme: «Environmental impact assessment of the reconstruction of the car M-14 road on the Kherson-Mariupol section»

Done by: student of the EK- 202 group, Maryna O. Neshcheret
(student, group, surname, name, patronymic)

Supervisor: Candidate of Geological Sciences, Associate Professor, Tamara V. Dudar
(academic degree, academic rank, surname, name, patronymic)

Consultant of the chapter "Labor Precaution": _____ Olena V.Konovalova
(signature) (S.N.P.)

Standards Inspector: _____ Andrian A. Iavniuk
(signature) (S.N.P.)

KYIV 2020

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
ФАКУЛЬТЕТ ЕКОЛОГІЧНОЇ БЕЗПЕКИ,
ІНЖЕНЕРІЇ ТА ТЕХНОЛОГІЙ
КАФЕДРА ЕКОЛОГІЇ

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувач випускової кафедри
_____ В.Ф. Фролов
«_____» _____ 2020 р.

ДИПЛОМНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ МАГІСТРА

ЗА СПЕЦІАЛЬНІСТЮ 101 «ЕКОЛОГІЯ»,
ОСВІТНЬО-ПРОФЕСІЙНОЮ ПРОГРАМОЮ
«ЕКОЛОГІЯ ТА ОХОРОНА НАВКОЛИШНЬОГО СЕРЕДОВИЩА»

Тема: «Оцінка впливу на довкілля при реконструкції автомобільної дороги М-14 на ділянці Херсон-Маріуполь»

Виконавець: студентка групи 202 Нещерет Марина Олександрівна
(студент, група, прізвище, ім'я, по батькові)

Керівник: канд.геол.-мін.наук, доцент Дудар Тамара Вікторівна
(науковий ступінь, вчене звання, прізвище, ім'я, по батькові)

Консультант розділу «Охорона праці»: _____ Коновалова О. В.
(підпис) (П.І.Б.)

Нормоконтролер: _____ Явнюк А.А.
(підпис) (П.І.Б.)

КИЇВ 2020

NATIONAL AVIATION UNIVERSITY

Faculty of Environmental Safety, Engineering and Technologies

Department of Ecology

Specialty, training professional program: specialty 101 "Ecology", Training Professional Program "Ecology and Environmental Protection"

(code, name)

APPROVED
Head of the Department
_____ Frolov V.F.
«____» _____ 2020

MASTER THESIS ASSIGNMENT

Maryna O. Neshcheret

1. Theme: «Environmental impact assessment of the reconstruction of the car M-14 road on the Kherson-Mariupol section» approved by the Rector on October 10, 2020, № 1937/ст

2. Duration of work: from 06.09.2020 to 21.12.2020

3. Input data: corresponding legislation (Law on Environment Impact Assessment, Law on Air Protection), air pollutants, Google Earth's images, data on pollutants of the environment components.

4. Content of explanatory note: (list of issues): Analytical review of the literature on the topic of the diploma. The assessment of impacts of the road reconstruction on all components of the environment on the Kherson-Mariupol section. Detail review of the negative impacts on the air environment.

5. The list of mandatory graphic (illustrated materials): tables, figures.

6. Schedule of thesis fulfillment

№	Task	Term	Advisor's signature
1	Formulation of the diploma's theme	06.09.2020	
2	Review of literature and legislation	07.09.2020-16.09.2020	
3	Preparing the main part (Chapter 1)	17.09.2020-01.10.2020	
4	Preparing the main part (Chapter 2)	01.10.2020-14.10.2020	
5	Work with EOL software, performing of emission calculations	15.10.2020-25.10.2020	
6	Preparing the main part (Chapter 3)	25.10.2020-04.11.2020	
7	Consultation on Chapter 4 (Occupational Safety)	05.11.2020	
8	Preparing the main part (Chapter 4)	06.11.2020-18.11.2020	
9	Formulation of conclusions of the thesis	18.11.2020-22.11.2020	
10	Making an explanatory note to the previous presentation, consultation with the norms controller	23.11.2020-27.11.2020	
11	Presentation of the work at the department	01.12.2020	
12	Thesis defense at the department	21.12.2020	

7. Consultant(s) of certain chapter(s):

Chapter	Consultant (academic rank, S.N.P)	Date, signature	
		Given by	Accepted by
Labor Precaution	Olena V. Konovalova, Associate Professor Chair of Civil and Industrial Safety		

8. Date of task issue: «06» September 2020

Diploma (project) advisor: _____ Tamara V. Dudar
(advisor's signature) (S.N.P.)

Task is taken to perform: _____ Maryna O. Neshcheret
(graduate's signature) (S.N.P.)

НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
Факультет екологічної безпеки, інженерії та технологій
Кафедра екології
Спеціальність, освітньо-професійна програма: спеціальність 101 «Екологія», ОПП «Екологія та охорона навколишнього середовища»
(шифр, найменування)

ЗАТВЕРДЖУЮ
Завідувач кафедри
_____Фролов В.Ф.
«____» _____ 2020 р.

ЗАВДАННЯ
на виконання дипломної роботи
Нещерет Марини Олександрівни

1. Тема роботи «Оцінка впливу на довкілля при реконструкції автомобільної дороги М-14 на ділянці Херсон-Маріуполь» затверджена наказом ректора від «10» жовтня 2020 р. №1937/ст

2. Термін виконання роботи: з 06.09.2020 р. по 21.12.2020 р.

3. Вихідні дані роботи: чинне законодавство (Закон про оцінку впливу на довкілля, Закон про охорону атмосферного повітря), знімки Google Earth, забрудники компонентів довкілля.

4. Зміст пояснювальної записки: Аналітичний огляд літератури щодо теми дипломної роботи. Оцінка впливів при реконструкції автомобільної дорого на всі компоненти навколишнього середовища на ділянці Херсон-Маріуполь. Детальний огляд негативного впливу на повітряне середовище.

5. Перелік обов’язкового графічного (ілюстративного) матеріалу: таблиці, малюнки.

6. Календарний план-графік

№ з/п	Завдання	Термін виконання	Підпис керівника
1	Формулювання теми дипломної роботи	06.09.2020	
2	Огляд літератури та чинного законодавства	07.09.2020-16.09.2020	
3	Підготовка основної частини (Розділ 1)	17.09.2020-01.10.2020	
4	Підготовка основної частини (Розділ 2)	02.10.2020-14.10.2020	
5	Робота з програмою ЕОЛ, виконання розрахунків викидів	15.10.2020-25.10.2020	
6	Підготовка основної частини (Розділ 3)	26.10.2020-04.11.2020	
7	Консультація щодо Розділу 4 (Охорона праці)	05.11.2020	
8	Підготовка основної частини (Розділ 4)	06.11.2020-18.11.2020	
9	Формулювання висновків до диплому	19.11.2020-23.11.2020	
10	Написання пояснювальної записки до попередньої презентації, консультація з нормо-контролером	24.11.2020-27.11.2020	
11	Попередній захист дипломної роботи	01.12.2020	
12	Захист дипломної роботи	21.12.2020	

7. Консультація з окремого(мих) розділу(ів):

Розділ	Консультант (посада, П.І.Б.)	Дата, підпис	
		Завдання видав	Завдання прийняв
Охорона праці	Коновалова Олена Вікторівна, доцент, Кафедра цивільної та промислової безпеки		

8. Дата видачі завдання: «06» вересня 2020 р.

Керівник дипломної роботи (проекту): _____ Дудар Т. В.
(підпис керівника) (П.І.Б.)

Завдання прийняв до виконання: _____ Нещерет М. О.
(підпис випускника) (П.І.Б.)

ABSTRACT

Explanatory note to thesis «Environmental impact assessment of the reconstruction of the car M-14 road on the Kherson-Mariupol section»: 101 pages, 13 figures, 30 tables, 41 references.

Object of research – M-14 Road reconstruction on the Kherson-Mariupol section.

Aim of work – to analyze possible effects of the M-14 road reconstruction on all components of the environment on the Kherson-Mariupol section; to assess the negative impacts on the air environment.

Methods of research: mathematical calculations, analysis and synthesis of information, computer software processing, geospatial analysis (Google Earth's maps).

ENVIRONMENT IMPACT ASSESSMENT, COMPONENTS OF THE ENVIRONMENT AIR POLLUTION, ROAD RECONSTRUCTION, EOL SOFTWARE, WATER ENVIRONMENT

CONTENT

LIST OF SYMBOLIC NOTATIONS, ABBREVIATIONS AND NOTIONS

EIA – Environmental Impact Assessment;

NRF – Nature Reserved Fund;

TLV - Threshold Limit Value;

MPC – Maximum permissible Concentration;

ARE system – Automobile-Road-Environment system;

DBN – State Construction Standards.

INTRODUCTION

Relevance of the work. Nowadays, among the anthropogenic sources of pollution in urban areas, transport has had the second place in cities of Ukraine, as it supplies the natural environment with huge masses of dust, soot, exhaust gases, lubricants, heavy metals and hundreds of other substances. In addition, ecosystems are significantly affected by physical factors such as noise, vibration, electromagnetic fields. They are not always available for direct perception and are therefore often ignored in practical environmental studies.

Aim and tasks of the diploma work.

Aim of the work – to analyze possible effects of the M-14 road reconstruction on all components of the environment on the Kherson-Mariupol section; to assess the negative impacts on air environment.

Tasks of the work:

1. To analyze the existing environment conditions near the M-14 Road on the Kherson-Mariupol section.
2. To research possible negative impacts on main components of the environment.
3. To assess the impact on air environment due to the M-14 road reconstruction.
4. To analyze consequences of air pollution.

Object of research – is M-14 Road reconstruction on the Kherson-Mariupol section.

Subject of research is Environment Impact Assessment of the M-14 Road reconstruction on the Kherson-Mariupol section.

Methods of research **–** mathematical calculations, analysis and synthesis of information, computer software, geospatial method (Google Earth's maps).

Scientific novelty of the obtained results **-** is a complex approach to define environmental problems, application of different new technologies and making any process of activity (building, reconstruction) more environmentally-friendly.

Practical importance of the obtained results. This research can be applied to obtain a permission for providing of planned activity, defining negative effects of planned activity on the environment, giving the ways to mitigate them**.**

Personal contribution of the graduate: analysis of environmental conditions in the Steppe part of Ukraine, assessment of impacts during the reconstruction of automobile M-14 road of international significance.

Approbation of results.

1. Scientific and practical conference of young scientists and students «Environmental Safety of the State», National Aviation University.
2. Scientific and technical conference «Innovative technologies-2020», National Aviation University.

Publications*:*

1. «Вплив реконструкції автомобільної дороги М-14 на поверхневі водотоки в межах Запорізької області», Environmental Safety of the State: abstracts of XIV Pan-Ukrainian Scientific and Practical Conference of Young Scientists and Students, Kyiv, April 23rd, 2020.
2. «Pecularities of road reconsruction impact on the environment», Innovative technologies: Materials of scientific and technical conference for students, graduate students, doctoral students and young scientists, Kyiv, October 25-26, 2020.

CHAPTER 1
FORMULATION OF THE PROBLEM, GENERAL DISCRIPTION OF THE ENVIRONMENT NEAR THE M-14 ROAD AND METHODS OF WORK PERFORMING

1.1. Formulation of the problem

Among the anthropogenic sources of pollution in urban areas, transport has had the second place in cities of Ukraine, as it supplies the natural environment with huge masses of dust, soot, exhaust gases, lubricants, heavy metals and hundreds of other substances. In addition, ecosystems are significantly affected by physical factors such as noise, vibration, electromagnetic fields, etc. They are not always available for direct perception and are therefore often ignored in practical environmental studies.

In Ukraine, environmental problem of motor vehicles and roads is associated primarily with improving their environmental safety, the quality and length of transport communications, the need to create a network of roads that meet international quality standards and safety requirements [1].

The existing scale of direct removal of roadside areas in Ukraine and the need to implement environmental measures in transport sector require taking into account the set of characteristics of the system "highway - road transport - environment". The ultimate goal is to find ways to develop motor transport systems that ensure their maximum possible environmental safety and at the same time economic ability.

The issue of environmental road safety was considered by such scientists as V.V. Ambartsumyan, V.M. Lukanin, H. Lenz. Problems of interaction of the highway in ecological systems were considered in the works of D.N. Kavtaradze, L.F. Nikolaeva, O.V. Takhtadjiana and others [2].

The «Automobile-road-environment» complex is a system that includes a motor vehicle, a road used for external and internal transport, and the environment that they directly or indirectly affect.

Specific features of the traffic problem are due primarily to the presence of the automobile-road-environment (ARE) system. The design parameters of vehicles affect the characteristics of traffic. So, the overall dimensions of cars, their traction and brake qualities, convenience of a workplace of the driver and ease of management are important. The road determines the nature of the functioning of the ARE system with its geometric dimensions, profile, equality, visibility conditions for driver. Therefore, the ARE complex is a system. So, in order to achieve efficient traffic, it is necessary to improve the characteristics of vehicles, road conditions and ensure their mutual compliance.

Public roads are divided into highways:

1) Road of state importance, which are divided into:
   a) international, which include roads that connect with international transport corridors and / or are part of the European network of main, intermediate, connecting roads and branches, have the appropriate international indexation and provide international road transport;
   b) national - these include highways combined with national transport corridors and not belonging to international highways, and highways connecting the capital of Ukraine - the city of Kyiv, the administrative center of the Autonomous Republic of Crimea, the administrative centers of the regions, the city of Sevastopol between itself, large industrial and cultural centers with international roads;
   c) regional - these include highways connecting two or more areas, highways connecting major international highways crossing the state border, sea and air ports of international importance, the most important objects of national cultural heritage, resort areas with international and national highways;
2) Roads of local significance are divided into:
   a) territorial, which include highways connecting the administrative centers of the Autonomous Republic of Crimea and regions with the administrative centers of districts, cities of regional significance, cities of regional significance among themselves, as well as highways connecting with state roads major airports, sea and river ports, railway junctions, objects of national and cultural heritage and

resort and nature reserve fund, automobile checkpoints of international and interstate significance across the state border;

b) regional highways, which include highways connecting the administrative centers of districts with the administrative centers of rural settlements, railway stations, airports, river ports, border crossing points and recreation areas;

c) district, which include highways connecting the administrative centers of rural settlements with other settlements within the district, other settlements among themselves, connection with enterprises, cultural facilities, other public roads.

The components of the public road within the right-of-way are: ground, carriageway, road surface, lane, drainage structures, man-made structures, engineering equipment: special structures and means designed to ensure safe and comfortable traffic conditions [3].

The highway affects the environment at all stages of its "life cycle". Namely:

1. Construction:

a) supply of materials:

- asphalt plant - dust, smoke, bitumen evaporation, negative impact on the ecosystem, safety and health of workers. Measures to mitigate the negative impact include the use of existing asphalt plants and the establishment of requirements for the presence of an official permit or a valid license to perform work;
- crushed stone quarry - dust, negative impact on the ecosystem. Measures to mitigate the negative impact include the use of existing gravel quarries and the establishment of requirements for the presence of an official permit or a valid license to perform work;
- sand and gravel quarries - negative impact on the riverbed, water quality and ecosystem. Mitigation measures include the use of existing sand and gravel quarries or the purchase of materials from licensed concentrators, the establishment of requirements for an official permit or a valid work license.

2. Transportation of materials:

a) asphalt - dust, smoke. Measures to mitigate the negative impact are to cover the load in the car body;

- rubble, sand, gravel - dust. Measures to mitigate the negative impact are to moisten or cover the load in the body;
- traffic control - noise, exhaust fumes, traffic jams. Measures to mitigate the negative impact are to transport materials not at peak hours, the use of alternative routes bypassing areas with heavy traffic.

3. Construction site:

a) negative impact of noise on the surrounding population and fauna, as well as workers. Measures to reduce the negative impact are to limit the time of work during working hours, equipping the equipment with silencers;

- dust, measures to mitigate the negative impact are watering if necessary on the construction site and storage of materials;
- vibrations resulting from the operation of the equipment. Measures to mitigate the negative impact are to limit the time of work during working hours;
- creating obstacles for traffic during construction works. Measures to mitigate the negative impact are to create a road traffic control plan that provides for appropriate traffic management measures that are easy to see;
- contamination of water and soil due to improper storage, distribution and use of materials. Measures to mitigate the negative impact are the arrangement and covered storage of materials, insulation of concrete, asphalt and other works from watercourses by using airtight formwork, insulation of places for washing vehicles for transporting concrete and asphalt concrete and other equipment from watercourses by selection of places for washing in such a way as to prevent natural (direct and indirect) runoff of polluted water to watercourses, treatment of wastewater to remove solids;
- pollution of water and soil due to improper waste management. Measures to mitigate the negative impact are to store waste materials in appropriate places, protected from flushing waste into water bodies;
- potential contamination of soil and water due to improper maintenance and refueling of equipment. Measures to mitigate the negative impact include

proper handling of fuels and lubricants and solvents, organization of their safe storage, proper refueling and maintenance of equipment, collection of all types of waste and their removal to the authorized point for processing and recovery of waste;

- negative impact on crops, trees, meadows, etc. Measures to mitigate the negative impact are to ensure control over the work area and the acquisition of land, compensation for damage.

4. Operation:

a) maintenance and repair:

- the negative impact of noise on the surrounding population and wildlife, as well as on workers. Measures to mitigate the negative impact are to limit the time of work during working hours during the day, equipping the equipment with silencers;
- possible pollution of air, water and soil - dust, exhaust gases, fuel spills and lubricants. Measures to mitigate the negative impact are to organize the proper storage of lubricants, fuels and solvents in a safe place; ensuring proper refueling and maintenance of equipment, collection of all waste and their removal to the permitted points of processing and disposal of waste, restriction of speed of work of the equipment, proper organization and covering of places of storage of materials, isolation of places of carrying out concrete, asphalt and other works from watercourses by use of a tight timbering, isolation of places for washing of vehicles for transportation of concrete and asphalt and other equipment from watercourses by choice places for washing in such a way as to prevent the natural (direct and indirect) runoff of polluted water into watercourses, storage of waste materials in appropriate places, safe from washing away waste into water bodies;
- vibrations. Measures to mitigate the negative impact are to limit the time of work during working hours during the day.

5. Operation:

a) increase in intensity and speed of road traffic - noise, dust, exhaust gases, spills of fuel and lubricants. Measures to mitigate the negative impact are the introduction of protective measures (noise barriers, greenery along the roadsides, etc.), limiting the speed of traffic.

b) road safety:

- increased traffic speed. Measures to mitigate the negative impact are to establish appropriate speed limit road signs;
- erosion, falling stones, dangerous conditions. Measures to mitigate the negative impact include the installation of appropriate road signs (falling stones, landslides, wet or slippery surfaces, dangerous turns, overtaking cattle or pedestrian crossings, schools, vehicles with limited speed, merging lanes), the installation of reflective signs in places of rapid precipices or convex mirrors, which allow to see oncoming vehicles at "blind" turns, installation of warning signs in points that comply with the principles of good engineering practice or in agreement with local authorities [4].
- The current state of Ukraine's roads does not yet correspond to the European level, because the necessary speed regimes that are safe for the environment are not provided. Cars have to move in the mode of acceleration-braking at which the greatest emission of harmful substances in environment is observed.

1.2. General environmental conditions in the area near M-14 road

The M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section runs across Kherson, Zaporizhzhia and Donetsk oblasts [6].

The relative share of emergencies of all types in these oblasts is in the range of 1 – 6%, which is higher than the average indicator in Ukraine. The overall number of natural disasters represents the smallest share of all types of emergencies.

Environmental risk according to the Lord Ashby Criteria near the site location is moderate, its numerical value lies in the range of from $1 \cdot 10^{-3}$ to $4 \cdot 10^{-2}$; the ecological

potential of the area is moderate (integral indicators interval ranges from +1.60 to -2.60).

The anthropoecological risk probability estimate in terms of the total radiation contamination density of the site provides a value of around $5.1 \cdot 10^{-5} – 1 \cdot 10^{-4}$, which is the minimal one.

The Caesium-137 (Cs-137) contamination density is generally estimated as a medium one: the pollution value is around 37-185 kBq/km^2.

As for the level of Strontium-90 (St-90) contamination level, almost the whole studied area is subject to medium contamination density of up to 6 kBq/m^2.

The density of contamination of the area by plutonium isotopes (Pu isotopes) is low (0.2 kBq/km^2).

The biogenic activity of radionuclides (Cs-137, Sr-90, Pu isotopes) is in the range of from less than 0.2 to 0.4 (low biogenic activity).

The area is characterized as moderately contaminated in terms of soil radioactive contamination level. It is estimated that there is no potential radiation hazard (the relevant range is more than -0.25).

Natural landscapes have moderate sustainability potential with the integral indicators interval ranging from > -0.49 to +0.80.

Man-induced environmental load has medium magnitude in terms of pollution level (from -0.39 to +0.45).

The natural and ecological potential of the area varies from below medium to medium. The level of ecological and economic equilibrium also corresponds to medium and below medium (from +1.30 to -2.84), production-related environmental restrictions are moderate (selective requirements regarding the production technologies improvement) and partial (expediency of opening of separate production sites).

The average number of days per year with wind speed of 0-1 m/s is 30 days, 2-5 m/s – 55 days.

The total content of major ions (SO_4^{2-}, Ca^{2+}, Na^{+}) in the precipitation is 17-22 mg/l. The acidity of atmospheric precipitation (pH) varies from 6.2 to 6.5.

This area is characterized by high migration of toxic substances in the aquatic environment of landscapes with a high geochemical load.

Soils are resistant to contamination.

Soil self-purification capacity is characterized by soil permeability coefficient (equal to the ratio of precipitation to evaporation multiplied by runoff volume). The soils in the area have high permeability level.

The living conditions (by the ecological conditions of the area) in the oblasts are favourable for the population. In order to assess the living conditions, the following indicators were taken into account: natural conditions of the area for the accommodation (heat and humidity levels, length of the frost-free period, occurrence of dangerous natural phenomena, potable water supply, as well as bogginess of the area or soils salinity, availability of flora and fauna, recreational capacity), environmental pollution (radioactive contamination, pollution of surface water, atmospheric air, soil), anthropogenic load on the area [5].

1.3. Methodology of Environment Impact Assessment Investigation

During the practical activity the following methods were implemented:

- geospatial analysis,
- mathematical calculations,
- related software,
- theoretical processing and generalization of corresponding documentations.

1.3.1. Geospatial analysis

Geospatial analytics gathers, manipulates and displays geographic information system (GIS) data and imagery including GPS and satellite photographs. Geospatial data analytics rely on geographic coordinates and specific identifiers such as street address and zip code. They are used to create geographic models and data visualizations for more accurate modeling and predictions of trends.

Geospatial analytics uses data from all kinds of technology — GPS, location sensors,

social media, mobile devices, satellite imagery — to build data visualizations for understanding phenomena and finding trends in complex relationships between people and places. This geo-referenced data can be applied to nearly any happening on earth. The visualizations can include maps, graphs, statistics and cartograms that show historical changes and current shifts. This can make predictions easier and more accurate.

Geospatial analytics adds timing and location to traditional types of data and this additional context allows for a more complete picture of events. Insights that might have been lost in a massive spreadsheet are revealed in easy-to-recognize visual patterns and images.

Geospatial analytics companies are able to instantly process huge amounts of geographic and geometric data. This gives users the ability to interact with billions of mapped points while looking at real-time geospatial visualizations. Users can explore data across time and space to instantly see how something has changed from days to years.

Geospatial data analytics began in the 1960s when Canada used the first geographic information systems (GIS) to catalog natural resources. Today, geospatial analysis is used for data capture to understand anything from weather modeling, population forecasting to sales trends.

Geospatial big data analytics breaks data out of the endless rows and columns of a traditional spreadsheet and organizes it visually by time and space. It is easier for the human brain to absorb information this way. Geospatial data analytics lets the eye recognize patterns like distance, proximity, contiguity and affiliation that are hidden in massive datasets. The visualization of spatial data also makes it easier to see how things are changing over time and where the change is most pronounced.

Benefits of geospatial analytics include:

- Engaging insights — Seeing data in the context of a visual map makes it easier to understand how events are unfolding and how to react to those events.
- Better foresight — Seeing how spatial conditions are changing in real time can help an organization better prepare for change and determine future action.

- Targeted solutions — Seeing location-based data helps organizations understand why some locations and countries, such as the United States, are more successful for business than others.

For the developing of maps with rivers and the M-14 road section Google Earth software have been used. Google Earth is a computer program that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles. Users can explore the globe by entering addresses and coordinates, or by using a keyboard or mouse. The program can also be downloaded on a smartphone or tablet, using a touch screen or stylus to navigate. Users may use the program to add their own data using Keyhole Markup Language and upload them through various sources, such as forums or blogs. Google Earth is able to show various kinds of images overlaid on the surface of the earth and is also a Web Map Service client. Recently Google has revealed that Google Earth now covers more than 98 percent of the world, and has captured 10 million miles of Street View imagery, a distance that could circle the globe more than 400 times.

In addition to Earth navigation, Google Earth provides a series of other tools through the desktop application. Additional globes for the Moon and Mars are available, as well as a tool for viewing the night sky. A flight simulator game is also included. Other features allow users to view photos from various places uploaded to Panoramio, information provided by Wikipedia on some locations, and Street View imagery. The web-based version of Google Earth also includes Voyager, a feature that periodically adds in-program tours, often presented by scientists and documentarians.

Google Earth has been viewed by some as a threat to privacy and national security, leading to the program being banned in multiple countries. Some countries have requested that certain areas be obscured in Google's satellite images [7].

1.3.2. Mathematical calculations

Mathematical calculations were used to predict and assess possible effects of the road reconstruction on the environment.

The average multiannual meteorological potential of the atmosphere (MPA) allows to identify the predominance of certain processes in the atmosphere (accumulation or dispersion) during a year on a certain territory.

1.3.3. Related software

In order to calculate harmful emissions into the atmosphere EOL 2000 software was used. EOL 2000 is an automated system for calculating the dispersion of harmful emissions in the atmosphere. It is designed to assess the impact of harmful emissions from designed and existing (reconstructed) enterprises on the pollution of the surface layer of the atmosphere (Windows version).

EOL 2000 is useful for enterprises in obtaining a building license (as software for EIA / OVNS - section "Air environment").

The calculated modules of the system implement the "Methodology for calculating the concentrations in the air of harmful substances contained in the emissions of OND-86 enterprises." The system allows calculating pollution fields for a point model of a source of harmful substances with a round and rectangular mouth of a pipe, a linear model, two models of an area source (a model of a settling pond and a model of a source consisting of many single point sources located close to each other with the same values of design and technological characteristics). At the request of the user, when assessing the impact of designed and reconstructed enterprises on air pollution, the calculation is made taking into account background (existing) concentrations.

The program is designed to form a wide range of environmental documents reporting, such as: tables of inventory of sources of emissions of enterprises, documents from section of the EIA of the project documentation, as well as for the calculation scattering of harmful substances.

The program is designed to work on systems running Windows (2000, XP, Vista, 7) and does not impose excessive hardware requirements - it must ensure the proper functioning of OS services.

The program comes as a standard installation package for the MS Windows family.

The installation process on the computer is accompanied by several intuitive questions for the user about the working directory of the program and settings. When the installation program is complete, shortcuts to the program will be created. The first time you run the program, the user will be asked for the password for this version of the software product.

The main elements of the interface are listed below on the figure 1. They are standard behavior of Windows controls and therefore do not require additional qualifications from the user of the program, except for experience in the Windows environment.

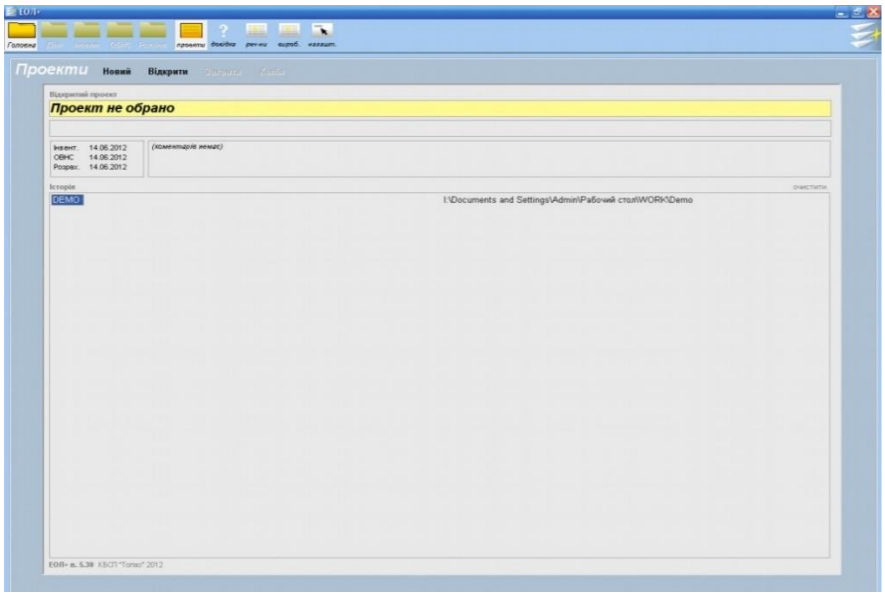

Fig. 1.1. The main elements of the interface in EOL software

The main work window consists of the following components: the navigation bar and the view and edit window for the section selected via the navigation bar. The navigation bar contains the following sections: Home (Concentrates commands to manage the database of substances of the object - opening, closing, saving, backup, etc., User help, Classifiers of substances and production), Data (Editing data, which is the basis for all reporting: sources of emissions and emissions, emissions, etc.), Inventory (View and edit inventory table data), EIA (View and edit EIA form data), Scatter (View and edit scatter-related data).

In many sections, icons of data operations are available under the navigation bar (their composition may change depending on the section): save to database, reboot data from the database, creating an original document for printing, copying, cutting, pasting fragments (including from MS Office documents), adding a line before the current, adding a line after the current, deleting a line, search, etc.

Classifiers of substances and manufactures are available for both viewing and editing (except for sections of consolidated lists). Each classifier has several subsections. A search function for a consolidated list of substances is available [8].

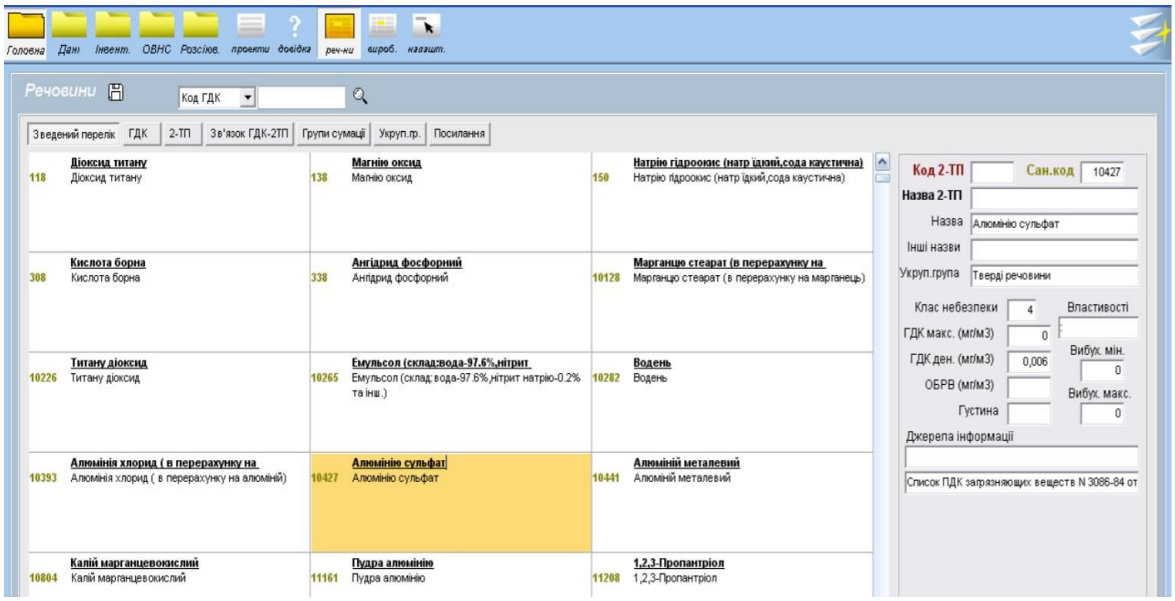

Fig. 1.2. Process of emission calculations

The sequence of work with the object in EOL software involves:

1. Create a new object
2. Filling in the basic data on the object (sources, emissions, etc.)
3. Editing basic data on the object
4. Export of object data in the inventory table, EIA, scattering, Standard 6
5. Editing source tables in the appropriate sections, printing
6. Calculation of scattering
7. Import of data from the workstation, etc.
8. Copy ready-made tables from Word, Excel, etc.

1.4. Legislative background

1.4.1. EIA (OVD) Procedure

The procedure of Environmental Impact Assessment (OVD) is governed by the Law of Ukraine “On Environmental Impact Assessment” No. 2059-VIII dd. 23/05/2017, as well as Resolution of the Cabinet of Ministers of Ukraine No. 1010 dd. 13/12/2017 “On approval

of the criteria used to identify planned activities not subject to Environmental Impact Assessment (OVD), as well as the criteria used to identify expansions and changes of activities and facilities not subject to Environmental Impact Assessment (OVD)", Resolution of the Cabinet of Ministers of Ukraine No. 1026 dd. 13/12/2017 "On approval of the Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)" and Resolution of the Cabinet of Ministers of Ukraine No. 989 dd. 13/12/2017 "On approval of the Procedure of public hearings within the scope of environmental impact assessment (OVD)".

The step-by-step procedure for Environmental Impact Assessment (OVD) is provided below:

- According to para. 2 of Resolution of the Cabinet of Ministers of Ukraine No. 1026 dd. 13/12/2017 "On approval of the Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)" the business entity (the Client) provides the Notification on planned activities subject to environmental impact assessment (OVD) (hereinafter – the Notification) in PDF format using the standard form provided in Annex 2 of the "Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)" via the e-cabinet of the Register.
- According to para. 4 of the "Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)" the business entity (the Client) shall submit the Notification in person or in writing in hard copies to the authorized territorial or central body within three business days after submitting the Notification via the e-cabinet of the Register.
- According to para. 3, Art. 4 of the Law of Ukraine "On Environmental Impact Assessment" the Notification on planned activities subject to environmental impact assessment (OVD) shall be published by the business entity not later than three business days after submitting it to the authorized territorial body by its publishing in printed media (not less than two), selected by the business entity, which cover administrative and territorial

units that may be subject to planned activities, and shall be posted on announcement boards of local self-government bodies or in other public places within the territory where the planned activities are to be performed.

- According to para. 16 of the "Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)" the business entity (the Client) shall provide the payment for public consultations to the account indicated by the authorized central or territorial body before submitting the Environmental Impact Assessment Report.
- According to para. 6 of the "Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)" the business entity (the Client) shall after submitting the Notification and preparing the Environmental Impact Assessment Report in order to receive the conclusion on the environmental impact assessment (OVD) submit the following documents to the authorized body via the e-cabinet of the Register and, in three days after submitting them via the e-cabinet, provide them in writing in hard copies:

1) Announcement on starting public consultations regarding the Environmental Impact Assessment Report (hereinafter – the Announcement) using the standard form provided in Annex 3 of the "Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)";

2) Environmental Impact Assessment Report in accordance with the requirements provided in Annex 4 of the "Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)" and Article 6 of the Law of Ukraine "On Environmental Impact Assessment";

3) Information (documents, materials) confirming the fact and the date of publishing or making otherwise available to the public of the Notification on planned activities and the Announcement on starting public consultations regarding the EIA report, if the relevant Notification has been published, or an agreement concluded with print media

to publish these documents, as well as a document confirming provision of payment for the organization of public consultations.

- According to para. 8 of the "Procedure for the transfer of documents required to provide the conclusion on environmental impact assessment (OVD) and the funds for environmental impact assessment (OVD)" the Environmental Impact Assessment Report and the Announcement on starting public consultations regarding the EIA report shall be submitted and indicate the registration number of the file on environmental impact assessment of planned activities assigned by the Register software during submitting of the Notification on planned activities subject to environmental impact assessment (OVD).
- According to para. 3 of Article 4 of the Law of Ukraine "On Environmental Impact Assessment" the Announcement on starting public consultations regarding the EIA Report shall be made available to the public by the business entity not later than in three business days after submitting it to the authorized territorial body by its publishing in printed media (not less than two), selected by the business entity, which cover administrative and territorial units that may be subject to planned activities, and shall be posted on announcement boards of local self-government bodies or in other public places within the territory where the planned activities are to be performed.
- According to para. 1 of Article 8 of the Law of Ukraine "On Environmental Impact Assessment" the authorized central or territorial body shall publish the Announcement on starting public consultations within three business days after receiving the Environmental Impact Assessment Report.
- According to para. 3 of Article 8 of the Law of Ukraine "On Environmental Impact Assessment" the Announcement on starting public consultations regarding the EIA Report shall remain posted on the official website of the authorized central or territorial body, on announcement boards of local self-government authorities or in other public spaces within the territory, where the planned activities are to be performed, during all the period starting from its official publication until the public consultations are over.
- According to para. 5 of Article 7 of the Law of Ukraine "On Environmental Impact Assessment", after the Environmental Impact Assessment Report is submitted,

public consultations shall be held through public hearings or submitting written comments and proposals.

- According to para. 6 of Article 7 of the Law of Ukraine "On Environmental Impact Assessment" public consultations regarding the planned activities after submitting the Environmental Impact Assessment shall start on the day of official publication of the Announcement on starting public consultations regarding the EIA Report, when the EIA Report is in open access for wide public, and shall last for at least 25 business days, but not more than 35 business days.
- According to para. 9 of Resolution of the Cabinet of Ministers of Ukraine No. 989 dd. 13/12/2017 "On approval of the Procedure of public hearings within the scope of environmental impact assessment" public hearings shall be held not earlier than in ten business days after the Announcement on starting public consultations regarding the EIA Report has been published by the authorized central or territorial body.
- According to para. 11 of the "Procedure of public hearings within the scope of environmental impact assessment (OVD)" repeated public hearing shall be held not earlier than in five business days after official publication of the Announcement on starting repeated public hearings.
- According to para. 18 of the "Procedure of public hearings within the scope of environmental impact assessment (OVD)" the business entity (the Client) shall provide in writing answers to the questions of the public, to which it wasn't able to answer during public hearings, within five working days after the public hearing.
- According to para. 24 of the "Procedure of public hearings within the scope of environmental impact assessment (OVD)" the party organizing public hearings shall provide the authorized central or territorial body with the signed minutes of the public hearing with all the annexes or the relevant act in the case provided for in para. 23 of the Procedure not later than in seven business days after the public hearing.
- According to para. 25 of the "Procedure of public hearings within the scope of environmental impact assessment (OVD)" the authorized central or territorial body shall submit the minutes of the public hearing to the Unified Environmental Impact Assessment Register.

- According to para. 27 of the "Procedure of public hearings within the scope of environmental impact assessment (OVD)" the authorized central or territorial body shall submit the Public Consultation Report to the Unified Environmental Impact Assessment Register together with the Conclusion on the Environmental Impact Assessment.
- According to para. 6 of Article 9 of the Law of Ukraine "On Environmental Impact Assessment" the Conclusion (Decision) on the Environmental Impact Assessment (OVD) shall be provided to the business entity on a free-of-charge basis within 25 business days after the public consultations are finished. The Conclusion shall be accompanied with the Public Consultation Report.
- According to para. 7 of Article 9 of the Law of Ukraine "On Environmental Impact Assessment" the authorized central or territorial body shall make the Conclusion on the Environmental Impact Assessment (OVD) publicly available within three business days after accepting it.
- According to para. 8 of Article 9 of the Law of Ukraine "On Environmental Impact Assessment" the Conclusion on the Environmental Impact Assessment (OVD) shall become invalid in five years, unless there is a decision to start execution of the planned activities.
- According to para. 1 of Article 11 of the Law of Ukraine "On Environmental Impact Assessment" the EIA Report, the Public Consultations Report and the Conclusion on the Environmental Impact Assessment (OVD) shall be submitted by the business entity to receive a Decision of the public authority or the local self-government body regarding performance of planned activities, which constitutes grounds for starting the activities.
- According to para. 4 of Article 11 of the Law of Ukraine "On Environmental Impact Assessment" public authorities and local self-government bodies shall make information on the Decision regarding performance of planned activities publicly available within three days after it is made and provide the public with the possibility to read it.
- According to para. 5 of Article 11 of the Law of Ukraine "On Environmental Impact Assessment" public authorities and local self-government bodies shall, within three days after the Decision regarding performance of planned activities is made, provide information on it to the authorized bodies that took the Decision on the environmental

impact assessment (OVD). The information on the decision regarding performance of planned activities shall be submitted by the authorized bodies to the Unified Environmental Impact Assessment Register within three days after receiving it.

- According to para. 5 of Article 3 of the Law of Ukraine "On Environmental Impact Assessment" planned activities of first category indicated in part two of this Article shall be subject to compulsory review regarding the grounds to perform transboundary environmental impact assessment in accordance with the international obligations of Ukraine. If the planned activities may have a major transboundary environmental impact, it shall be subject to a transboundary impact assessment according to the procedure established by Article 14 of the Law of Ukraine "On Environmental Impact Assessment".
- According to para. 10 of Article 14 of the Law of Ukraine "On Environmental Impact Assessment" the Decision on taking into account the results of a transboundary environmental impact assessment after being approved by the Interdepartmental Council on Coordination of the Implementation of the Convention on Environmental Impact Assessment in a Transboundary Context in Ukraine shall be approved by the authorized central body and be an integral part of the Conclusion on the Environmental Impact Assessment (OVD) [9].

1.4.2. EIA (OVNS) Procedure

The performance of the Environmental Impact Assessment (OVNS) is regulated by DBN A.2.2-1-2003 "List and content of documents within the scope of Environmental Impact Assessment (OVNS) for design and construction of enterprises, buildings and structures".

The step-by-step procedure for Environmental Impact Assessment (OVNS) is provided below:

- According to DBN A.2.2-1-2003 the business entity and the Contractor prepare the Declaration of Intent (providing an outline of the expected impacts of the planned activities based on the available documents on the state of the environment) and publish in the media. The Declaration of Intent shall include information on the addresses, telephone

numbers, time and date of review of the project documents and OVNS, submitting of proposals;

- The business entity (the Client) and the Contractor shall prepare Terms of Reference for the preparation of EIA (OVNS) documents, indicating the scope and the deadlines for the preparation of EIA (OVNS);

There is no exact time period set between the Declaration of Intent and the Terms of Reference for the preparation of EIA (OVNS) documents.

The date of signing of the Declaration of Intent shall precede or be the same as the date of signing of the Terms of Reference for the preparation of EIA (OVNS) documents.

- Public consultations regarding the Declaration of Intent shall last for 30 calendar days, the comments and the proposals from the public shall be sent to the address of the business entity and taken into account when preparing the EIA (OVNS) documents.
- The Contractor shall carry out works related to the preparation of the EIA (OVNS) documents in accordance with the Terms of Reference for the preparation of EIA (OVNS) documents (there is no set deadline for the EIA (OVNS) preparation, the required period depends on the complexity of the site) and, based on the results of the works performed, prepare the Statement on the environmental impact of activities (Environmental Impact Statement).

The business entity (the Client) or, upon its assignment, the Contractor shall publish the Environmental Impact Statement in the media.

The final EIA (OVNS), taking into account public interests, as part of design documents is provided by the business entity for agreement and passing of the comprehensive state expertise in accordance with the legislation in force [10].

1.4.3. Directive 2011/92/EU

Known as the EIA Directive, the directive aims to ensure: a high level of environmental protection and environmental considerations are integrated into the preparation and authorization of projects.

This objective is achieved by ensuring that environmental assessment of certain public and private projects listed in the directive's Annexes I and II (airports, nuclear installations, railways, roads, waste disposal installations, waste water treatment plants, etc.) is carried out.

The EIA Directive applies to a wide range of public and private projects.

Directive 2011/92/EU defines the *environmental impact assessment (EIA)* process which ensures that projects likely to have significant effects on the environment are made subject to an assessment, prior to their authorisation.

Amending legislation was adopted in 2014. In line with the drive for smarter regulation, it:

- helps reduce administrative burden;
- improves the level of environmental protection to permit sounder, more predictable and sustainable business decisions on public and private investments;
- takes into account threats and challenges that have emerged since the original rules came into force 30 years ago. This means paying more attention to aspects like resource efficiency, climate change and disaster prevention, which are now better reflected in the assessment process.

The main amendments are:

- EU countries can simplify their different environmental assessment procedures.
- Timeframes are introduced for the different stages of environmental assessments.
- The screening procedure, determining whether an EIA is required, is simplified.
- Decisions must be duly motivated in the light of the updated screening criteria.
- EIA reports are to be made more understandable for the public, especially as regards assessments of the current state of the environment and alternatives to the project in question.
- The quality and the content of the reports is improved. Competent authorities also need to prove their objectivity to avoid conflicts of interest.

- The grounds for development consent decisions must be clear and more transparent for the public.
- If projects do entail significant adverse effects on the environment, developers are obliged to avoid, prevent or reduce those effects. These projects must be monitored.

The EIA process operates as follows:

- the project developer may request the competent authority to specify what should be covered by the EIA information to be provided (scoping stage);
- the developer must provide information on the environmental impact (in the form of an EIA report drafted in accordance with Annex IV of the directive);
- the environmental authorities and the public, as well as local and regional authorities (as well as any EU countries that are affected) must be informed and consulted;
- the competent authority decides taking into consideration the results of consultations; this decision also includes a reasoned conclusion on the significant effects of the project;
- the authority informs the public of its decision;
- the public can challenge the decision before the courts.

Consultation with the public is a key feature of EIA process. To ensure effective public participation, the EIA report and other information must be provided as early as possible. This can be done electronically, by public notices or bill posting, or via local newspapers.

Authorities have to decide within a reasonable time whether to approve the project or not. They must make available to the public, as well as to environmental, local and regional bodies, the content of a positive decision, including the main reasons for their approval and any environmental or other conditions they attach. If they refuse development consent, they should explain why.

EU countries may lay down more stringent conditions and fix penalties for any infringements [11].

1.5. Conclusions to Chapter 1

It was analyzed Ukrainian legislation in the sphere of Environment Impact Assessment. This procedure includes: Preparation of an EIA report by the business entity; conducting a public discussion; analysis by the authorized body of the information provided in the EIA report; providing by authorized body with a reasoned conclusion on the EIA, taking into account the results of the analysis; taking into account the conclusion on the EIA in the decision to carry out the planned activity.

It was described methods of research performing, that include mathematical calculations, analysis and synthesis of information, geospatial analysis and computer software.

CHAPTER 2
EXISTING ENVIRONMENTAL CONDITIONS OF THE AREA CROSSED BY THE ROAD

2.1. Physical and geographical zoning of the area crossed by the road

The M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section passes through the territory of 3 regions (oblasts): Donetsk oblast (31.6 km), Zaporizhzhia oblast (194.1 km) and Kherson oblast (180 km).

The M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section is located on the East European Plain, the steppe zone, and crosses several subzones.

Within the southern steppe subzone, km 207+170 – 458+009 section of the road runs through the Black Sea – Sea of Azov territory and belongs to Lower Buh – Dnipro (Dnieper) lowland region (Posad-Pokrovske – Bilozerka district), Lower Dnipro terrace – delta lowland region (Hola Prystan – Dnipriany and Skadovsk – Nova Kakhovka districts), Syvash – Azov lowland region (Askaniia – Podivskyi, Atmanai – Utliuk, Nyzhnomolochanskyi districts).

Within the mid-steppe subzone, km 458+009 – 567+235 section of the road runs through the Black Sea mid-steppe territory and belongs to Western Azov slope and highland region (Prymorsk – Berdiansk district).

Within the northern steppe subzone, km 567+235 – 635+067 section of the road runs through Left Bank – Dnipro – Azov territory and belongs to Azov lowland region (Mariupol – Novoazovsk district).

Structural and geomorphological zoning scheme:

Territory – East European Polygenic Plain;

Region – Black Sea region of bedding-depositional and bedding-denuded lowlands;

Subregion – Black Sea bedding-depositional lowland on Neogene sediments.

The geomorphological structure of the area is represented by loess denuded and

depositional plains, alluvial sediments and river valleys (see Figure 1). The common land forms of relief are pods (flat-bottom depressions) [12].

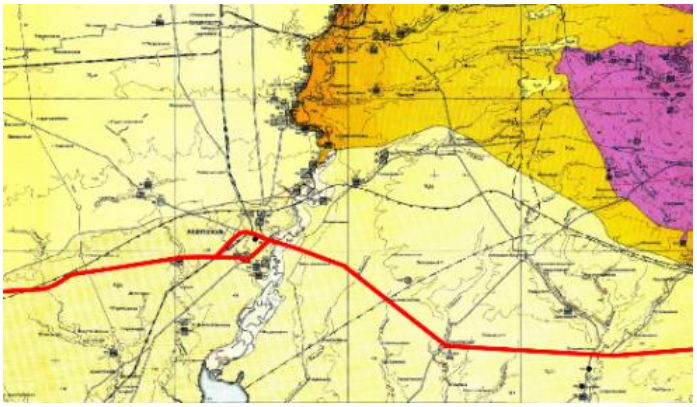

Fig. 2.3. Geomorphological map of M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section

The landscapes of the area crossed by Kherson – Mariupol section of M-14 Odesa – Melitopol – Novoazovsk road belong to steppe and southern steppe landscapes, namely to loess poorly broken (dissected) plains with common low-humic deep-laid mycelial chernozem and poorly drained loess plains with chestnut medium- and strongly solonetzic soils in combination with meadow solonchaks.

The rivers in the area belong to the plain type.

The steppe zone has a temperate continental climate. The continental features of the climate are increasing towards the south and the east.

There are 16 nature reserve fund sites of local and national importance in the area (2 km radius) impacted by M-14 Odesa – Melitopol – Novoazovsk on its Kherson – Mariupol section [13].

2.2 Climate

According to the road building climatic zoning of Ukraine Kherson – Mariupol section of M-14 Odesa – Melitopol – Novoazovsk road is located in the southern road building climatic zone “U-III” in the meaning of DBN B.2.3-4-2015 “Roads”.

M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section is

located in 3 regions (oblasts): Kherson, Zaporizhzhia and Donetsk oblasts in the steppe zone of Ukraine.

The steppe zone has a temperate continental climate. The continental features of the climate are increasing towards the south and the east. The steppe zone is also characterized by the highest long-term radiation balance level. The average temperature in July is +20...+ 24°C, in January – -2...- 9°C. The growing season lasts for 210-245 days.

This zone is significantly affected (especially in winter) by the Siberian anticyclone. The cyclones mostly come from the south and southwest moving to north and northeast.

The average annual precipitation level in the steppe zone is 300-450 mm; it decreases from the north to south. Droughts often occur in the area. Dry winds, dust storms, especially in spring and early summer vegetation periods, cause significant damage to the agriculture. In general, the climate and agro-climatic resources of the zone are favourable for agriculture, particularly when irrigating the arid lands.

Below is a brief meteorological overview of the local climate by oblasts. The meteorological overview is based on the climatic characteristics provided by Kherson Regional Hydrometeorological Centre, Zaporizhzhia Regional Hydrometeorological Centre and Mariupol Hydrometeorological Observatory.

2.2.1. Climate in Kherson oblast

Kherson oblast has a temperate continental climate characterized by relatively mild winters (the average temperature is -1, -3 °C) and hot long summers (the average temperature is +23, +25 °C, while the maximum one is above + 40 °C). The average annual temperature ranges from +9.3 to + 9.8 °C. The average precipitation is around 450 mm per year. The climate is characterized by summer dry winds – strong winds (speed of more than 5 m/s) with low humidity and high temperature. The average number of sunny days is 240 per year. The climatic characteristics of Kherson oblast were established based on the data provided by Kherson Regional Hydrometeorological Centre [14].

Table 2.1

Average monthly and annual temperature in Kherson oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
-1.6	-0.9	3.1	10.2	15.9	20.1	23.1	22.2	16.5	10.4	3.8	-0.6	10.2

Table 2.2

Highest recorded temperature in Kherson oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
16.3	20.6	23.9	28.1	34.4	37.7	40.1	40.3	36.6	33.5	25.4	16.1	40.3

Table 2.3

Lowest recorded temperature in Kherson oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
-30.3	-32.5	-22.5	-8.7	-2.6	0.9	7.4	3.8	-4.8	-11.2	-22.4	-24.3	-32.5

Table 2.4

Average daily sunshine duration in Kherson oblast (hours)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
9.7	10.9	12.5	14.1	15.6	16.4	16	14.7	13	11.4	10	9.2	12.8

Table 2.5

Precipitation in Kherson oblast (mm)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
29	29	29	32	41	53	43	37	48	32	36	38	453

Table 2.6

Average monthly and annual wind speed in Kherson oblast (m/s)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
4.8	5.0	5.0	4.4	4.1	3.6	3.4	3.4	3.0	3.7	4.4	4.7	4.1

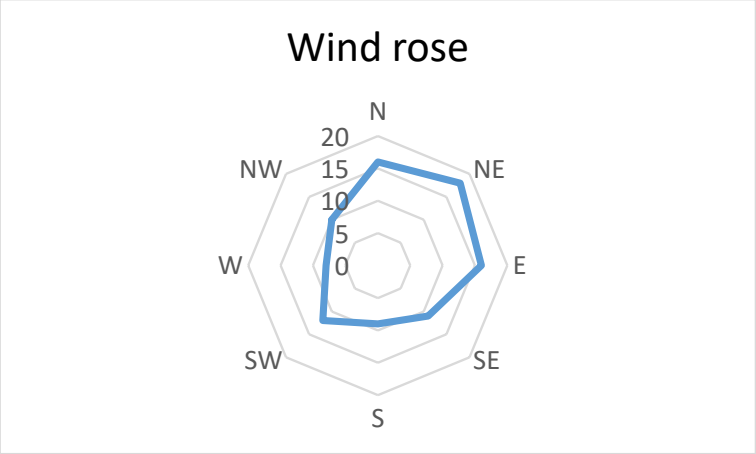

Fig. 2.4. Average annual wind rose for the city of Kherson

2.2.2. Climate in Zaporizhzhia oblast

Zaporizhzhia oblast has a steppe Atlantic-continental climate. The nature of atmospheric circulation is determined by frequent changes of cyclones and anticyclones. The cyclones come throughout the year from the west, northwest, southwest and south. They bring maritime air masses from the Atlantic and the Arctic. The invasion of continental air masses from Asia (anticyclones) causes severe cold weather in winter and droughts in summer.

Winter begins in late November – early December. It is moderately cold, with little snow. The weather is mostly unstable with numerous thaws, after which cold waves may occur. Spring usually comes in the first decade of March. A characteristic feature of the local spring is the intense increase of heat, due to which the spring processes develop quickly and the spring is usually short. Summers are mostly hot and dry. During some periods the movement of colder air masses may be accompanied by active thunderstorm activity, dangerous meteorological phenomena may occur: heavy rainfalls, squalls, hails. Autumn usually comes in the third decade of September. Autumn is characterized by a return of heat against the general background of the temperature dropping and the beginning of ground frosts. The climatic characteristics of Zaporizhzhia oblast were established based on the data provided by Zaporizhzhia Regional Hydrometeorological Centre [15].

Table 2.7

Average monthly and annual temperature in Zaporizhzhia oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
-3.4	-2.2	2.3	10.2	16.4	20.5	22.7	21.7	16.5	9.7	4.3	-0.1	9.9

Table 2.8

Highest recorded temperature in Zaporizhzhia oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
15.0	20.1	26.4	32.3	35.2	37.0	39.5	41.0	37.7	33.6	24.9	17.2	41.0

Table 2.1

Lowest recorded temperature in Zaporizhzhia oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
-33.1	-30	-20.6	-10.6	-1.9	1.6	8.4	3.6	-2.7	-11.3	-21.3	-24.7	-33.1

Table 2.10

Average daily sunshine duration in Zaporizhzhia oblast, (hours)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
9.5	10.8	12.5	14.2	15.8	16.6	16.2	14.8	13.1	11.3	9.8	9.1	12.8

Table 2.11

Precipitation in Zaporizhzhia oblast, (mm)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
42	35	33	32	48	53	50	38	33	23	39	49	475

Table 2.12

Average monthly and annual wind speed in Zaporizhzhia oblast (m/s)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
3.9	3.2	2.9	2.6	2.4	2.1	2.0	2.1	2.1	2.2	2.4	2.5	2.5

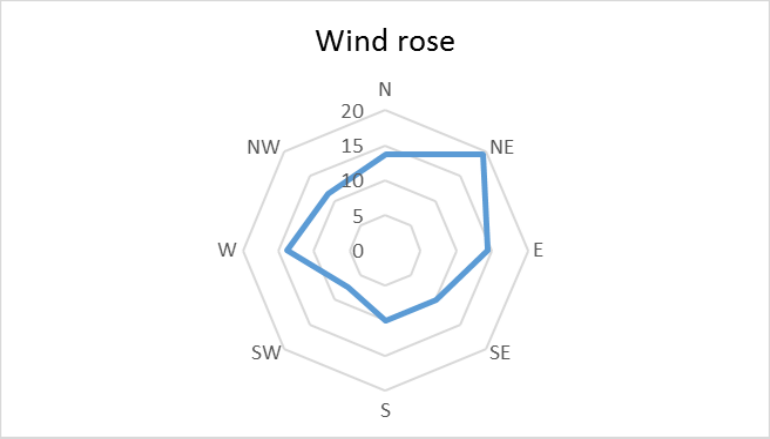

Fig. 2.5. Average annual wind rose for Zaporizhzhia oblast

2.2.3. Climate in Donetsk oblast

As for the climate, Donetsk oblast belongs to the steppe Atlantic-continental region of the temperate zone. The main features of the local climate are: continentality, high daily and annual amplitudes of air temperature, low rainfall, thaws, frequent fogs, droughts and dry winds. All this is caused by a significant distance from the Atlantic Ocean, the proximity of the Asian continent, the local relief, the slight influence of the Black and Azov seas. There is a relative climatic homogeneity in the area. Only the central part of the Donetsk Ridge (Debaltseve), where it is cooler (due to the relief), and Mariupol, where the temperature is higher (due to the influence of the Sea of Azov), stand out of the general picture. The climatic characteristics of Donetsk oblast were established based on the data provided by Mariupol Hydrometeorological Observatory.

Table 2.13

Average monthly and annual temperature in Donetsk oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
-2.8	-3.3	1.7	8.9	15.6	19.4	22.2	21.7	16.1	9.4	2.8	-1.1	9.2

Table 2.14

Highest recorded temperature in Donetsk oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
12.2	16	21.3	31	34.6	38	37.8	39.1	33.9	32.7	20.5	15	39.1

Table 2.15

Lowest recorded temperature in Donetsk oblast, (°C)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
-32.2	-31.1	-21	-10.6	-2.4	2.1	6	2.2	-6	-10	-22.2	-28.5	-32.2

Table 2.2

Average daily sunshine duration in Donetsk oblast, (hours)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
9.6	10.9	12.5	14.2	15.7	16.5	16.1	14.7	13	11.4	9.9	9.2	12.8

Table 2.3

Average precipitation in Donetsk oblast, (mm)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
60	40	30	40	40	60	60	40	40	20	40	50	520

Table 2.4

Average monthly and annual wind speed in Donetsk oblast, (m/s)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
2.5	2.9	2.7	2.5	2.2	1.9	1.7	1.7	1.8	2.1	2.4	2.6	2.2

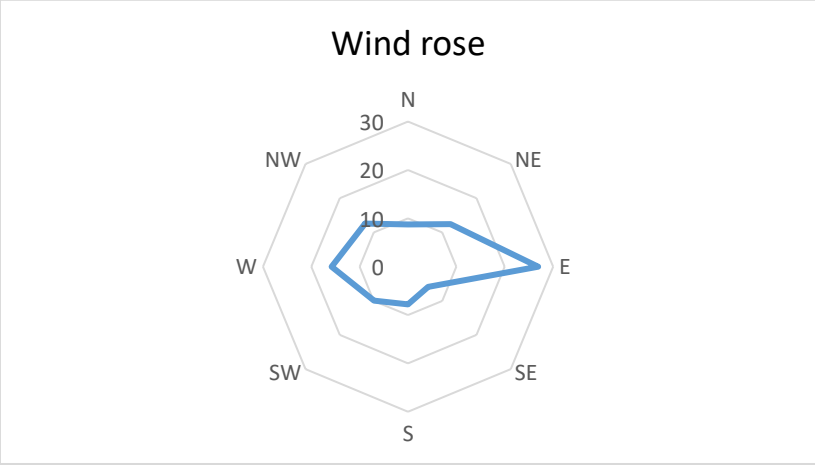

Fig. 2.6. Average annual wind rose for the city of Mariupol

Based on the above, it can be concluded that performance of road development works will have no impact on the local climatic conditions.

The city in general will have a minor impact on the microclimatic conditions only within the reserve technological strip.

2.2.4. Assessment of the impact on the climate

The average multiannual meteorological potential of the atmosphere (MPA) allows to identify the predominance of certain processes in the atmosphere (accumulation or dispersion) during a year on a certain territory and depends on the integral index K_m, which is determined using the following formula:

$$K_m = \frac{(P_{v1}+P_f)}{(P_p+P_{v5})}, \quad (2.1)$$

where P_{v1} means recurrence of days with wind speed of 0-1 m/s – 7 %; P_{v5} means recurrence of days with wind speed of 5 m/s and more – 48 %; P_f means recurrence of days with foggy weather – 52 %; P_p means recurrence of days with precipitation of 0.5 mm or more – 46%.

$$K_m = \frac{(7+52)}{(46+48)} = 0.63$$

The integral index K_m is <1, thus the dispersion processes are prevalent in the local atmosphere.

Based on the above, it can be concluded that performance of road development works will have no impact on the local climatic conditions.

The city in general will have a minor impact on the microclimatic conditions only within the reserve technological strip.

2.3. Geological environment

The territory crossed by M-14 road on its Kherson – Mariupol section is located in the area of the Black Sea Lowland. In terms of structure it is a relatively young superimposed structure. The lowland basement is represented by a Precambrian sedimentary metamorphic complex, a depressed continuation of the Ukrainian Crystalline Shield. The crystalline rocks layer lies at a depth of 1,600 m. The sedimentary deposits filling the lowland are located in structural elements of different types and ages: Precambrian and epi-Hercynian blocks of the East European Platform separated by a line of graben-type depressions with a folded

basement up to 10,000 m deep [17].

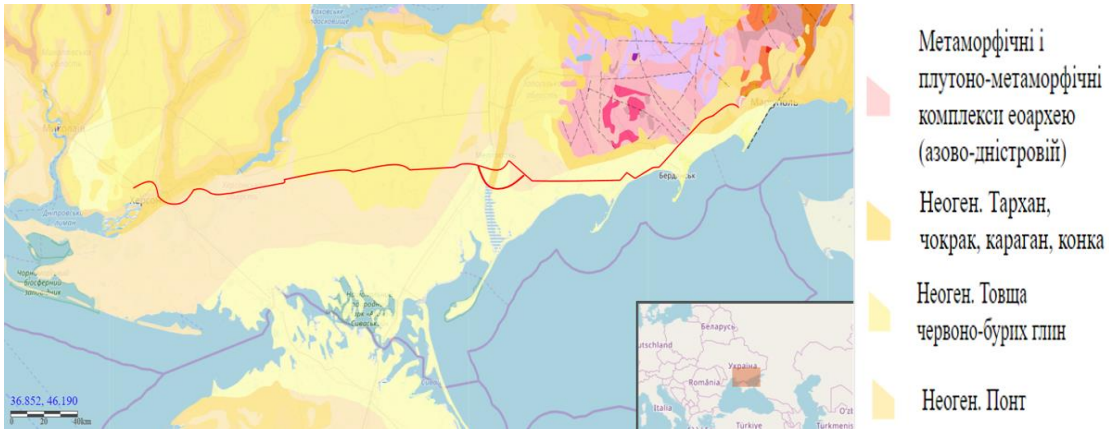

Fig. 2.7. Geologic map of Kherson – Mariupol section of M-14 road

The most interesting elements of the bedrock are Neogene sediments, as the older formations (the ones belonging to the Cimmerian and Alpine structural level) lie at a depth of more than 100 m, thus they are unsuitable for engineering and geological exploration.

The Neogene deposits are represented by a Miocene – Early Pliocene terrigenous and carbonate formation. In terms of lithological classification these are clays, sands and sandstones with intermediate marl and limestone layers. Carbonate rocks, such as limestone and marl, dominate in the upper part of the geological cross-section (Meotian and Pontian levels). The formation deposits are 2,000 – 2,500 m thick, their thickness increasing in the south-eastern part.

Superficial deposits are represented by sandshale, calciferous formations of Cimmerian and Kuyalnik levels, dominated by clays, as well as iron sands and sandstones changing into oolitic brown ironstones (up to 120 m thick at the Kerch Peninsula). Late Pliocene – Early Pleistocene red-brown (Scythian) clay deposits from 5-10 up to 60 m (in the Alma valley) thick are widespread in the interfluves.

The valleys of the Dnipro and other river running in the area are filled in with alluvial deposits, forming Pliocene terraces, represented by sand, loam, sometimes pebbles, up to 20 m thick. These alluvial deposits are everywhere covered by red-brown clays and loess loams (starting from the second upland fringe (terrace above floodplain)).

The quaternary deposits forming upland fringes are mostly represented by inequigranular sand with intermediate layers of sandy loam and loam, while the floodplain

terraces are represented by loam, sandy loam, clay, fine-grained and loamy sand:

adP $_{III}$ – H – alluvial-deluvial deposits. Dark-grey silty loam, in the lower part of the cross-section – with admixtures of these rocks, intermediate layers of sandy loams and sands (up to 5 m). *The deposits include separate crystals of the minerals indicating availability of diamonds and industrial diamonds.* The undivided alluvial-deluvial deposits, which lie in the Mid-Pleistocene deposits and Precambrian formations, belong to the bottoms of dry creeks. They are represented by dark-grey silty loams, in the lower part of the cross-section with intermediate layers of loamy sand and sand with badly-rolled gravel grains, as well as grus and rubble crystalline rocks. The deposit layer is 200-300 m wide. The alluvial-deluvial deposits are not more than 5 m thick.

edP$_{III}$ – eluvial-deluvial deposits of Upper Neopleistocene, undivided. Light and medium-textured brown loams with carbonate inclusions and small Fe-Mn inclusions. The undivided eluvial-deluvial deposits are located on the slopes of rivers and creeks. They are represented by light to medium-texture loams, mostly brown ones, with carbonate inclusions and small Fe-Mn inclusions. The deposits thickness is around 3.2-8 m.

pdP$_{III}$ – proluvial-deluvial deposits. Brown, light-brown light and medium-texture loams in the bottom parts of re-deposited carbonate concretions (1.2-18.2 m) (southern part). The Upper Pleistocene deposits of proluvial-deluvial origin are widespread at the coast of the Sea of Azov. These deposits fill in the old (buried) creeks and can be traced in the sea dereliction areas. They are represented by brown, light and medium-texture light-brown loams, in the bottom part they are mixed with sand and added redeposited carbonate concretions, 1.2-18.2 m thick in the southern part.

aH – alluvial deposits. The alluvial deposits have two layers: in the upper layer they are represented by various loams in terms of their granulometric composition with intermediate layers of clay, silt, grey, dark-grey and greenish-grey loamy sand intermediate layers (1.5-2.5 m), while in the lower layer – by grey, dark-grey quartz-feldspar clayey sand with intermediate layers of clay, silt, loamy sand (2-12.5 m). These deposits are related to the occurrence of gold deposits. Holocene alluvial deposits are relatively wide spread at the bottoms of the Lozuvatka, Obitochna, Kiltychchia and Berda rivers, creating floodplain terraces, which are from 200 m (the Lozuvatka river in Novooleksiyivka village) to 4,700

m side in the Berda river mouth. The floodplain deposits lie in the alluvial deposits of the first and tenth alluvial terraces, on Neogene deposits and Precambrian crystalline rocks. The upper part of the alluvium cross-section shows various loams in terms of their granulometric composition with intermediate layers of clay, silt, loamy sand, more rarely sand of grey, dark-grey, greenish-grey colours with yellow, oxide-yellow ferruginization spots. Their thickness varies from the upper part to the depth of 9-15 m [16].

2.4. Noise pollution

Noise from motor vehicles is one of the most significant negative factors.

Road traffic is the source of the noise during the road operation, namely the sound effect of vehicle wheels contacting with the carriageway pavement and the noise of engines of the vehicles.

A characteristic feature of the noise generated by traffic flows is caused by the sharp fluctuations in its levels due to the traffic flow heterogeneity, changes in the mode of transport, etc.

In order to identify the future (for 20 years after the project implementation, i.e., for 2040) state of the acoustic environment in the surrounding settlements, the equivalent noise level (L_{Aref}) was calculated according to DSTU-N B.V.1.1-33:2013 “Guidelines for calculation and design of noise protection in rural areas”. The amount of noise pollution was calculated for the first line of residential development area, which is located the closest to the road [18].

To identify the noise pollution level, the future traffic intensity was used divided into daytime (from 8:00 to 22:00) and nighttime (from 22:00 to 8:00) intensity. 8% of the daily traffic accounts for nighttime. The average hourly traffic intensity during the daytime represents 7% of the average daily traffic intensity. The future traffic intensity is calculated considering the growth of the national economy and the increase of passenger and cargo transport volumes.

The characteristics of the transport flows (equivalent noise level L_{Aeq}, dBA) are

determined in accordance with para. 6.2.2 of DSTU-N B.V.1.1-33:2013.

According to para. 7.6 of DSTU-N B.V.1.1-33:2013 equivalent noise levels in reference points (LA ref) for the existing operational conditions are calculated using the following formula:

$$LA\,ref = LA - \Delta LA\,dist. - \Delta LA\,att. - \Delta LA\,surf. - \Delta LA\,scr. - \Delta LA\,green - \Delta LA\,lim. + \Delta LA\,overl, \quad (2.2)$$

where:

"L_{Aref}" means equivalent noise level at a reference point in a residential development area;

"L_A" means noise performance of the noise source in dBA;

"$\Delta L_{A\ dist}$" means an adjustment in dBAs, which takes into account sound level reduction depending on the distance (m) between the noise source and the reference point;

"$\Delta L_{A\ att.}$" means an adjustment in dBAs, which takes into account sound level reduction due to the sound attenuation in the air;

"$\Delta L_{A\ surf.}$" means an adjustment in dBAs, which takes into account sound level reduction at the reference point due to the surface characteristics;

"$\Delta L_{A\ scr.}$" means an adjustment in dBAs, which takes into account sound level reduction between sound screens located in the noise travel path;

"$\Delta L_{A\ green}$" means an adjustment in dBAs, which takes into account sound level reduction due to the influence of green planted areas;

"$\Delta L_{A\ lim.}$" means an adjustment in dBAs, which takes into account sound level reduction due to the limitation of the angle of visibility of the noise source from the reference point;

"$\Delta L_{A\ overl.}$" means an adjustment in dBAs, which takes into account sound level increase at the reference point due to the overlaying of sound reflected from enclosures of buildings.

The equivalent noise levels within residential development areas for the next 20 years are summarized in Table 2.19.

Table 2.19

Equivalent noise levels within residential development areas for the next 20 years

Name of the settlement	Distance from the road, m	L_{Aeq}, dBA daytime / nighttime	$\Delta L_{A\ dist.}$	$\Delta L_{A\ att.}$	$\Delta L_{A\ surf.}$	$\Delta L_{A\ green}$	$\Delta L_{A\ overl.}$	$L_{A\ ref.}$* daytime / nighttime	Standards exceeded by** daytime / Nighttime
1	2	3	4	5	6	7	8	9	10
Chornobaivka village	16	78.4 / 70.5	3.5	0.1	1	0	1.5	72.4 / 64.4	7.4 / 9.4
Vysuntsi village	130	76.8 / 68.9	12.8	0.6	1	0	1.5	60.9 / 53.0	- / -
Zelenivka village	180	76.8 / 68.9	14.3	0.9	1	0	1.5	59.1 / 51.1	- / -
Molodizhne village	7	76.8 / 68.9	0.3	0.0	1	0	1.5	74.0 / 66.1	9.0 / 11.1
Antonivka urban type settlement	95	79.2 / 71.2	11.3	0.4	1	0	1.5	64.9 / 57.0	- / 2.0
Oleshky	30	79.2 / 71.2	6.2	0.1	1	0	1.5	70.4 / 62.5	5.4 / 7.5
Petropavlivka village	169	67.1 / 59.1	14.0	0.8	1	0	1.5	49.8 / 41.8	- / -
Nyzhni Torhai village	65	67.1 / 59.1	9.6	0.3	1	0	1.5	54.7 / 46.8	- / -
Chornozemne village	56	67.4 / 59.4	8.9	0.3	1	0	1.5	55.7 / 47.8	- / -
Viazivka village	173	67.4 / 59.4	14.1	0.8	1	0	1.5	49.9 / 41.9	- / -
Udachne village	80	67.4 / 59.4	10.5	0.4	1	0	1.5	54.0 / 46.0	- / -
Melitopol	3,250	68.4 / 60.4	33.3	16.2	1	0	1.5	16.3 / 8.4	- / -
Kostiantynivka village	1,900	68.4 / 60.4	29.4	9.5	1	0	1.5	27.0 / 19.0	- / -
Novoivanivka village	30	70.9 / 62.9	7.1	0.1	1	0	1.5	61.1 / 53.2	- / -
Pryazovske urban type settlement	15	63.0 / 55.1	3.9	0.0	1	0	1.5	56.6 / 48.6	- / -
Volodymyrivka village	55	70.9 / 62.9	9.9	0.2	1	0	1.5	58.2 / 50.3	- / -
Prymorsk	100	64.1 / 56.2	12.7	0.5	1	0	1.5	48.4 / 40.5	- / -
Banivka village	80	63.6 / 55.6	11.6	0.4	1	0	1.5	49.1 / 40.1	- / -
Osypenko village	100	63.6 / 55.6	12.7	0.5	1	0	1.5	47.9 / 40.0	- / -

end of the table 2.19

1	2	3	4	5	6	7	8	9	10
Chervone Pole village	30	63.6 55.6	7.1	0.1	1	0	1.5	53.8 45.9	- -
Komyshuvate village	90	63.6	12.2	0.4	1	0	1.5	48.5	-
		55.6						40.5	-
Manhush urban type settlement	80	63.6	11.6	0.4	1	0	1.5	49.1	-
		55.6						41.1	-

The calculations for the next 20 years show that the cases of exceeding the noise permissible exposure limit are expected at the areas adjacent to the road, in low-rise residential development areas of three settlements: Chornobaivka, Molodizhne and Oleshky. The forecasted exceedance of the sanitary standard in nighttime is equal to 9.4 dBA, 11.1 dBA and 7.5 dBA respectively, thus there is a need to provide noise barriers and additional detailed calculations regarding the structure of noise barriers at the next stage of the project design. The required performance of the noise barriers shall be not less than 12 dBA. During the reconstruction works, typical noise will be created by the movement of trucks and the work of cranes, excavators, bulldozers [19].

According to DBN B.1.1-31: 2013, the permissible sound level in the area adjacent to the residential area should not exceed 45/55 dBA.

During the reconstruction period, maximum measures will be taken to prevent intense noise and isolate noise sources:

- all mechanisms will be kept in good state, their noise and vibration characteristics will correspond to technical characteristics;
- workers will be provided with personal protective equipment;
- It is necessary to carry out a complex of treatment and preventive measures, namely, to define the mode of work; to work should persons not younger than 18 years old, who have passed a preliminary medical examination and have the appropriate qualifications.

2.5. Water environment

M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section is located in the steppe area of Ukraine, which is a region with scarce water supply. The water

supply of the population here is by 3-4 times lower than in Polissia (Polesie) or in the Western Forrest Steppe.

12 rivers are located in the area impacted by the road: 3 of which run across Kherson oblast, 8 – across Zaporizhzhia oblast and 1 – across Donetsk oblast.

A brief description of the data on rivers is provided based on the information received from the Ciz-Azov Rivers Water Resources Basin Department.

2.5.1. Surface watercourses in Kherson oblast

Kherson oblast is located in the dry steppes zone on a watershed of the rivers of the lower reach of the Dnipro and the Black Sea. The river network density is only 50-100 m per 1 km^2 of terrain. There are three surface water bodies in Kherson oblast: the Dnipro river, the Konka river and the Virovchyna river.

The location of surface water bodies of Kherson oblast relative to the alignment of M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section is demonstrated on Figure 2.8.

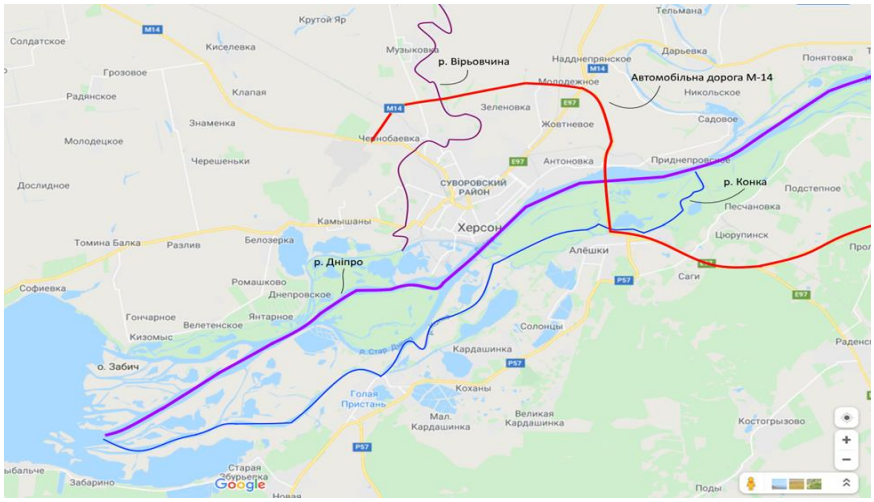

Fig. 2.8. Location of surface watercourses of Kherson oblast relative to the alignment of M-14 road on its Kherson – Mariupol section

The Dnipro is considered a big river; it runs for around 200 km in Kherson oblast. It crosses the steppe and together with the Kakhovka reservoir divides the territory into two parts: right bank and left bank. The right bank is dissected by small river valleys, dry creeks and gullies. The left bank represents almost a horizontal steppe plain with flat bottom

depressions – basins (pods). These unique formations – pods – are large basins accepting snowmelt and precipitation from the surrounding drainage basins. There is an experiment in Kakhovka raion related to the creation of a new vegetable topsoil in pods by performing a full-scale melioration. Almost 100 thousand ha of land have been already put into use as cultivated fields [20].

The Konka is considered a small river, it is 26 km long. It runs in reed beds (plavni) of Oleshky and Hola Prystan raions in Kherson oblast. The Konka flows out of the Dnipro in front of Prydniprovske hamlet of Bilozerka raion. There are Hapskyi and Kruhlyi islands near the inflow of the Konka to the Dnipro Lyman (estuary). The Kruhlyi island divides the river bed into the Old Konka and the New Konka. The river is navigable from the city of Oleshky to its inflow in the Dnipro Lyman. The Konka merges with the Old Dnipro river bed via the strait near Bilohrudove village, thus providing good water connection between Hola Prystan and Kherson (18 km).

The Virovchyna is considered a small river; it runs for 42 km in Kherson oblast, the river bed is 6-20 m wide, the floodplain is 100-800 m wide. The Virovchyna runs in Bilozerka raion of Kherson oblast, as well as in Dniprovskyi, Suvorovskyi and Korablenyi districts of the city of Kherson. It falls into the Koshova river. The marsh vegetation of the Virovchyna occupies most of the river banks and is mostly represented by common reed (*Phragmites australis*), which is a widespread grass plant. The reed beds have an important environmental role, they clean river water from pollution by performing filtering functions, as well as protect river banks from caving and create favourable conditions for dwelling and nesting of semiaquatic birds. Besides the common reed, there are some areas covered with narrowleaf (*Typha angustifolia*) and broadleaf (*Typha latifolia*) cattail, sedges (*Carex*) or occasional standalone plants, such as hedge bindweed (*Calystegia sepium*), yellow iris (*Iris pseudacorus*), bittersweet nightshade (*Solanum dulcamara*), lakeshore bulrush (*Schoenoplectus lacustris*). The following aquatic invertebrates dwell in the river and on its surface: European medicinal leech (*Hirudo medicinalis*), water strider (*Gerridae*), *Dytiscus latissimus*, crayfish (*Astacus*), molluscs (*Mollusca*), *Planorbis planorbis*, zebra mussel (*Dreissena polymorpha*). Mosquito larvae, which are a valuable natural feed for fish, grow in the local water environment. Perches (*Perca*), northern pikes (*Esox lucius*), crucian carps

(*Carassius*), common breams (*Abramis brama*) inhabit the Virovchyna. Newts, turtles, frogs and grass snakes hide in the river waters. Lizards dwell on the banks of the Virovchyna, preferring the slopes. The birdlife of the river is rather rich. The most common bird species one can find in autumn are common starling (*Sturnus vulgaris*), Eurasian tree sparrow (*Passer montanus*), rook (*Corvus frugilegus*), house sparrow (*Passer domesticus*), European herring gull (*Larus argentatus*).

There are no monitoring points to control surface waters quality on Kherson – Mariupol section of M-14 Odesa – Melitopol – Novoazovsk road within Kherson oblast.

2.5.2. Surface watercourses in Zaporizhzhia oblast

M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section crosses 8 bodies of water, namely: the Lozuvatka river, the Obitochna river, the Berda river, the Kiltychchia river, the Molochna river, the Tashchenak river, the Domuzla river and the Korsak river. All these bodies of water are small rivers, except the Molochna river, which is considered a medium-sized river. The location of these bodies of water relative to the site of planned activities and their main characteristics are provided on Figure 2.9 and Table 2.20 respectively.

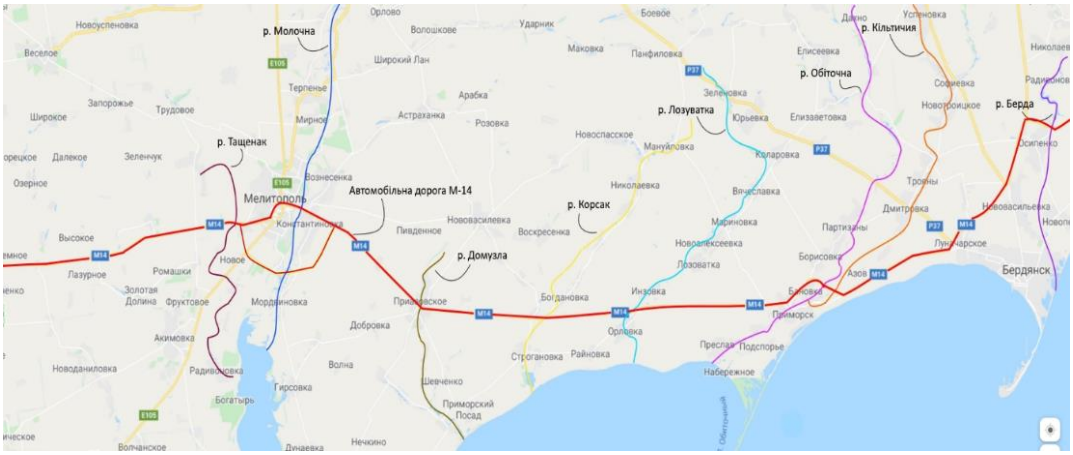

Fig. 2.9. Location of surface watercourses of Zaporizhzhia oblast relative to the alignment of M-14 on Kherson – Mariupol section

Table 2.20

Main characteristics of rivers and their drainage basins in Zaporizhzhia oblast

Name of the river	Where it flows into	Total length, km	Drainage basin area, km^2	Number of tributaries	Total length of tributaries,	Monitoring point/ average water consumption, m^3/s
Molochna	Molochnyi Lyman	197.0	3,450.0	80	178.0	Melitopol (2 points); Tokmak (3 points) / -
Tashchenak	Molochnyi	62.2	467.8	3	36.0	-/ 0.14
Berda	Sea of Azov	120.0	1,743.0	192	271.0	Osypenko village / 2.68
Obitochna	Sea of Azov	96.1	1,437.0	16	175.0	Prymorsk / 1.9
Kiltychchia	Obitochna					- / 0.86
Lozuvatka	Sea of Azov	72.0	566.0	11	65.3	Novooleksiyivka village /
Korsak	Sea of Azov	60.0	703.0	10	27.7	- / 0.703
Domuzla	Sea of Azov	44.4	480.0	1	5.0	-/0.24

The Molochna river is located in Tokmak, Melitopol and (partially) Yakymivka raions of Zaporizhzhia oblast. It falls into the Molochnyi Lyman (basin of the Sea of Azov). It has a mostly trapezoidal valley up to 35 km wide. The Molochna floodplain has a width of from 10-12 m to 2.8 km, it is covered by meadow vegetation and has marshlands on certain sections. The river is 2-4 m wide in its upper course and 20-30 m wide in its middle and lower courses. The Molochna is mostly 0.3-0.4 m deep, while its maximum depth is 3.5 m. The river has a slope of 1.2 m/km. The right bank is high and steep, while the left one is low and plain. In summer the river often dries out, creating stream pools surrounded by reed, cattail and sedge beds. The Molochna is mostly fed by snowmelt (springtime providing for 80% of the annual flow). The water is highly mineralized. The ice coverage on the Molochna is unstable. The course of the river on its significant part is regulated (3 reservoirs and numerous ponds). The water is used for business purposes and irrigation; fish farming.

The Tashchenak river is located in Melitopol and Yakymivka raions of Zaporizhzhia oblast. It falls into the Molochnyi Lyman (basin of the Sea of Azov). The Tashchenak has a slope of 1.2 m/km and a trapezoidal valley of up to 1.5 km wide and up to 20 m deep. The right (western) slopes of the valley are higher and steeper than the left ones. The Tashchenak has a floodplain of up to 200 m wide. The river bed is ill-defined, its typical width in the

middle course is 5 m. In summertime the Tashchenak dries out in its upper course. The water is used for irrigation purposes.

The Berda river is located in Bilmak and Berdiansk raions of Zaporizhzhia oblast. It falls into the Sea of Azov. The Berda has a slope of 2.1 m/km and a mostly trapezoidal valley in its upper and middle courses of up to 3 km wide and up to 50 m deep. The right slopes of the valley are in many places much higher than the left ones, they are dissected by dry creeks and gullies. The Berda has a one-way floodplain of up to 100 m wide and a two-way floodplain in its lower course with many marshes. The river bed is winding, up to 1.5 m deep, 6-10 m wide with certain sections of up to 15-25 m wide. A quarter of the river bed is covered by reed bed. The Berda has a sandy bottom (with rocky bottom on certain sections). It is fed by snowmelt and groundwater. Spring floods often occur on the river. The Berda freezes up in December, the ice on it melts in February (the ice coverage is unstable). The typical annual flow rate is 1.65 l/sec•km^2. The river waters are used for irrigation, water supply, recreation purposes. The Berda watercourse is regulated by reservoirs, ponds. The Berdiansk reservoir near Osypenko village, built in 1954, supplies water to the city of Berdiansk. There are recreational areas on its shores.

The Obitochna river is located in Bilmak (the source of the river), Chernihivka, Berdiansk and Prymorsk raions of Zaporizhzhia oblast. It falls into the Obytichna Gulf of the Sea of Azov. The Obitochna is the third biggest river of the Cis-Azov region. The river has a slope of 1.8 m/km. It starts with a dry creek at the foot of the Azov Upland hills. In its upper course the river banks have hilly relief with deep creeks and crystalline rocks exposure. The Obitochna has a mostly trapezoidal river bed of up to 3 km wide, 30-40 m deep. The floodplain is dry, covered with meadow vegetation and partially waterlogged in the lower course of the river. The river bed is winding with a typical width of 8-10 m. The Obitochna is fed by snowmelt and groundwater. Spring floods often occur on the river. The ice coverage is unstable. The river has a reservoir and around 15 ponds used for water supply, irrigation, fish farming. The Obitochna has riffles with pebble bottom and slough stream pools in its upper course. There are many creeks with brooks along the Obitochna watercourse. It has the following main tributaries: the Kiltychchia (left one), the Sasykulak and the Chokrak (right ones). The city of Prymorsk is located on the Obitochna. The fauna

and flora of the upper course of the river is represented only by roaches (*Rutilus rutilus*), common bleaks (*Alburnus alburnus*), buntings (*Emberiza*), knotweed (*Polygonum*). Common rudd (*Scardinius erythrophthalmus*), common carp (*Cyprinus carpio*) are also widespread in the lower course of the river.

The Kiltychchia river is located in Bilmak, Berdiansk and Prymorsk raions of Zaporizhzhia oblast. It is the left tributary of the Obytichna river (basin of the Sea of Azov). It is 70 km long and has a basin of 554 km^2. The Kiltychchia river has a trapezoidal valley of up to 3 km wide, up to 40 m deep. The Kiltychchia has a moderately winding river bed, it is up to 20 m wide in its medium and lower course. The river has a slope of 2.5 m/km. The Kiltychchia is fed my snowmelt and stormwater. The maximum volumes of the annual flow rate are typical for springtime. The Kiltychchia freezes up in the second half of December, the ice coverage (which is unstable) melts in the middle of February. The watercourse is partially regulated by ponds. The water is used for irrigation and technical water supply. The river bed is very silted; works are carried out on certain sections to clean it from silt. The Kiltychchia has the following main tributaries: the Komyshuvata, the Burtychchia (left ones). Andriivka urban-type settlement and several villages are located on the river.

The Lozuvatka river is located in Prymorsk raion of Zaporizhzhia oblast. It falls into the Sea of Azov. The river has a trapezoidal valley of more than 2 km wide. The floodplain is 200-300 m wide; it is partially swamped in the lower course of the river. The river bed is moderately winding (sometimes very winding). The Lozuvatka has a slope of 1.7 m/km. There are a small reservoir and several ponds on the river.

The Korsak is a river in Ukraine, located in Prymorsk and Pryazovske raions of Zaporizhzhia oblast. It falls into the Sea of Azov. The Korsak is 58 km long, it has a drainage basin of 715 km^2. The Korsak has a valley of up to 3 km wide and up to 30 m deep. The floodplain is 200-300 m wide; it is partially swamped in the lower course of the river. The river bed is slightly winding; in summertime, it dries out on certain sections. The Korsak has a slope of 1.6 m/km. There are several ponds on the river.

The Domuzla is a river in Ukraine, located in Pryazovske raion of Zaporizhzhia oblast. It falls into the Tubalskyi Lyman (basin of the Sea of Azov). The river often dries out in

summertime, creating stream pools which are surrounded by reed, cattail and sedge. The Domuzla is a typical plain river with low summer and winter baseflows, increased water table in autumn and high water level in spring.

The Berdiansk reservoir is used by Communal Enterprise “Berdianskvodokanal” of Berdiansk City Council as a reserve source of water supply for the city of Berdiansk.

The basin monitoring laboratory of the Ciz-Azov Rivers Water Resources Basin Department controls the quality of surface water of the Berdiansk reservoir of the Berda river under the Programme for State Monitoring of Waters Regarding the Surveys of Surface Waters Used by the Population as Potable and Household Water [21].

2.5.3. Donetsk oblast

The hydrographic network of Donetsk oblast is located within the basins of the Dnipro river (28.5% of the oblast), the Don river (the Siverskyi Donets river, 30.2% of the oblast) and the Cis-Azov rivers (41.3%). There are 246 rivers in Donetsk oblast, of which 47 are more than 25 km long. The rivers are plain-type, fed mainly by snowmelt and stormwater. Many rivers dry up in summer and the water supply is provided by 130 reservoirs of Donetsk oblast.

M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section crosses only one body of water in Donetsk oblast, i.e., the Mokra Bilosaraika river (Figure 2.10).

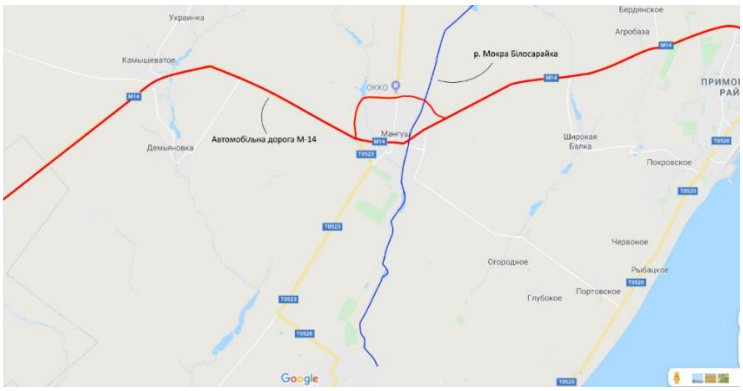

Fig. 2.10. Location of surface watercourses of Donetsk oblast relative to the alignment of M-14 road on Kherson – Mariupol section

The Mokra Bilosaraika river belongs to the Cis-Azov rivers basin. It is 26 km long and has a drainage basin of 360 km^2. Therefore, it belongs to small rivers. The Mokra Bilosaraika has 2 tributaries over 10 km long: the right tributary is called the Buivolova balka (14 km long, drainage basin of 51.2 km^2), and the left tributary is called the Sukha Bilosaraika (27 km long, drainage basin of 164 km^2).

There is Yalta urban-type settlement in the Mokra Bilosaraika mouth, as well as another urban-type settlement on the river called Manhush. The Mokra Bilosaraika causes floods in Yalta. There were floods in 2003, 2006.

According to the State Water Consumption Monitoring System, 15 entities used water from the Mokra Bilosaraika river in 2018. 1.503 mln. m^3 of water were withdrawn, including 1.042 mln. m^3 of surface water and 0.461 mln. m^3 of the underground water.

However, no monitoring of the quality of water in the Mokra Bilosaraika river (the Ciz-Azov rivers basin) was foreseen under the State Water Monitoring Program and no water and soil monitoring was carried out by the basin laboratory.

2.5.4. Assessment of the impact of the Project on surface waters

In total, the following 12 rivers are within the area of influence of M-14 road: the Dnipro river, the Konka river, the Virovchyna river, the Lozuvatka river, the Obitochna river, the Berda river, the Kiltychchia river, the Molochna river, the Tashchenak river, the Domuzla river, the Korsak river and the Mokra Bilosaraika river. In accordance with Article 87 of the Water Code of Ukraine it is forbidden to discharge untreated sewage in the protected shoreline belts and river water protection zones, i.e. sewage from the road within the water protection zones of surface watercourses shall be treated in accordance with the sanitary standards. Table 29 provides the data on the boundaries of protected shoreline belts and water protection zones of surface watercourses.

Table 2.21

Boundaries of protected shoreline belts and water protection zones of surface watercourses

Name of the river	River category*	Protected shoreline belt **, m	Water protection zone ***, m
Dnipro river	big river	100	The outer boundary of the water protection zone is related to the existing boundaries of agricultural lands, paths, forest strips, floodplains, river upland fringes, edges of slopes, beams and gullies and is determined by the furthest flooding line of the water body at the maximum flood water level observed once every ten years.
Konka river	small river	25	
Virovchyna river	small river	25	
Lozuvatka river	small river	25	
Obitochna river	small river	25	
Berda river	small river	25	
Kiltychchia river	small river	25	
Molochna river	medium-size river	50	
Tashchenak river	small river	25	
Domuzla river	small river	25	
Korsak river	small river	25	
Mokra Bilosaraika river	small river	25	

During the next phase of design, it is needed to provide for the installation of 4 water treatment facilities to treat sewage waters received from the road located near each surface watercourse, with a total number of 48 facilities. Particular attention shall be paid to the selection of waste water treatment facilities for the Domuzla river and the Mokra Bilosaraika river, since the road crosses these surface watercourses within settlements. In accordance with clause 8.17 of the State Sanitary Rules (DSP) No. 173 “State sanitary rules of planning and development of settlements”, in case of a discharge of sewage waters within a settlement, the normative requirements established for the composition and properties of water of relevant water bodies shall apply to the sewage waters itself (i.e. excluding their dilution by the water of relevant water bodies). This requires the installation of high-efficiency waste water treatment facilities [22].

2.6. Soils

According to the agropedological zoning of Ukraine, M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section is located within the steppe zone, i.e. southern dry steppe zone, dominated by dark chestnut and chestnut residual solonetz soil and solonetz soils along with solonetzs (soil being located mostly on loess), and within the southern steppe subzone, dominated by southern chernozems on loess.

Southern steppe subzone with southern chernozems coincides with the northern part of the Black Sea Lowland, it stretches from the Danube river in the west to the Sea of Azov in the east and continues in Romania and in the Russian Federation. Due to its significant stretch from west to east, more expressive continental nature of the climate it was divided into two agropedological provinces: Cis-Danube province and Azov – Black Sea province. A big part of the southern steppe subzone is also located in the northern part of the Crimean Peninsula, it covers Tarkhankut Upland, Tavriia Accumulation Plain, Yevpatoria Plain, Kerch Peninsula and directly borders on the south with the Outer Ridge of the Crimean Mountains. According to the agropedological zoning of Ukraine, the Crimean part of the southern steppe subzone is also divided into two subprovinces: Crimean subprovince and Kerch subprovince [23].

The single southern steppe subzone massif is divided by the dry steppe zone with dark chestnut and chestnut soils, covering southern part of the Black Sea Lowland and northern part of the North Crimean Lowland. The northern boundary between the dry steppe zone and southern steppe subzone lies from Kuialnyk Lyman (estuary) (to the east from Odesa) – Berezanka – to the south of Mykolaiv up to the Inhuletz river and along its river bed until its confluence with the Dnipro river – to the north along the Dnipro river to Kakhovka – Ivanivka – Melitopol – Obytichna river – Prymorsk – Sea of Azov.

Southern chernozems have the following specific properties:

- profile differentiation, demonstrated by consolidation of transitional horizons and slight increase of the silt fraction within their range;

- occurrence of druses of gypsum and other highly soluble salts on rather small depths (at the depth of 3-4 m in the northern part of the subzone and 2 m – in the southern part of the subzone);

- new formations of white star-shaped calcium carbonate structures are located in the lower transitional horizon and the rock layer.

The dry steppe zone lies in the shape of a narrow strip (from 5 to 150 km wide) along the coasts of the Black Sea, the Sea of Azov from the Kuialnyk Lyman to Prymorsk and from Rozdolne to the Arabat Spit on the Crimean Peninsula. The zone coincides with the southern part of the Black Sea Lowland and the northern part of the North Crimean Lowland, while the absolute heights of its northern and southern boundaries don't exceed 50 m and gradually decrease towards the Black Sea, the Sea of Azov and the Syvash Gulf (5 m). The dry steppe zone has plain profile becoming more complicated due to numerous pods and rarely shallow steppe creeks. On the left bank, to the south of Kakhovka, there is a quite wide (up to 80 km) terrace valley of the Dnipro, within which there are three terraces: one – sandy one, and the other ones with depths of 2.0-3.0 m with underlying alluvial sands. The dry steppe zone soils develop on loess which, except for the Dnipro terraces, are 20-25 m thick and are divided by soil into three-four different layers (the lower layers are red-brown and very compact (chocolate loess), while the upper ones are fawn-yellow-brown and include light clay. A typical feature of loess is high concentration of highly soluble salts (sodium sulphates and chlorides) and gypsum. In the pods of the northern part of the zone the highly soluble salts and gypsum are washed away from the loess, while the loess in the pods of the Syvash coast and the Black Sea is salty. The subsoil water at the interpod surfaces is mineralized everywhere.

The soils of the zone are formed under fescue-feather grass-wormwood associations, which include many halophytic (Artemisia taurica, Pyrethrum, Kochia, Salicornia, Halocnemum) and ephemeral (Erophila verna, Tulipa) plant species growing in the conditions of insufficient watering (330-360 mm of precipitation per year, Selyaninov Hydrothermal Index equal to 0.3-0.6) and exudational regime (active temperatures sum of 34,000-36,000). During dry years the vegetation is represented by fescue, while in wet years, when the pods, starting from spring, are filled with water, fescue dies out and the area is dominated by Elytrygia pseudocaesia and other plants [24].

Most of the dry steppe area has dark chestnut solonetz soils (70.2%), while the share of chestnut solonetz soils is only 5.8%. Meadow soils and alluvial meadow solonchak or

solonetz soils together with solonetzs represent only 5.8% of the territory of the zone. Small areas are occupied with chernozems on heavy clay and sand, residual carbonate chernozems.

The soil medium has neutral to weak alkaline reaction (pH 5.5 – 7.5).

The current content of heavy metals in the soils in the area of M-14 road reconstruction and capital repair works is as follows:

- copper (Cu) – 30 - 50 mg/kg of soil;
- zinc (Zn) – 30 - 90 mg/kg of soil;
- cobalt (Co) – 10 - 20 mg/kg of soil;
- molybdenum (Mo) – 1.6 - 2.4 mg/kg of soil;
- manganese (Mn) – 900 - 1,600 mg/kg of soil.

The probability estimate of anthropoecological risk in terms of the total radiation contamination density of the site provides a value of around 5.1·10-5 – 1·10-4 (units), which is the minimal one.

The Caesium-137 (Cs-137) contamination density is generally estimated as a low one: the pollution value is in the range of from 10 to 37 kBq/km2.

As for the level of Strontium-90 (St-90) contamination level, almost the whole studied area is subject moderate level of contamination of up to 6 kBq/m2.

The level of the area contamination by plutonium isotopes is low (0.2 kBq/km2).

In terms of the radiation contamination near the road, the area is considered moderately contaminated. There is significant potential radiation danger. In preparation for reconstruction, the vegetative soil is removed from the bottom with a depth of 20-40 cm. Part of the vegetable soil is then used to strengthen the slopes and roadsides, the rest is taken to the dump. Upon completion of the road reconstruction, the areas that were temporarily disturbed for the period of construction works should be rehabilitated.

2.7. Nature Reserve Fund

The area impacted by M-14 Odesa – Melitopol – Novoazovsk road on its Kherson – Mariupol section (2 km radius) includes territories of 16 nature reserve fund sites of local and national significance. The information on all 16 nature reserve fund sites, as well as the relevant preservation orders were received from Departments of Ecology and Natural Resources of Kherson, Zaporizhzhia and Donetsk regional state administrations.

2.7.1. Nature reserve fund of Kherson oblast

M-14 road crosses/borders on five nature reserve fund sites in Kherson oblast. They are shown in Table 2.22.

Table 2.22

List of nature reserve fund sites in Kherson oblast located in the area impacted by M-14 road

№	Name of the site	Type	Category	Status	Area, ha	Location	Distance from M-14 road, m
1	2	3	4	5	6	7	8
1	Nyzhnodniprovskyi	-	National nature park	-	80,177.8	Territory of Beryslav, Bilozerka, Hola Prystan and Tsiurupynsk raions, Kherson and Nova Kakhovka (Kherson oblast)	crossed by the road
2	Urochyshche (landscape unit) Sahy	landscape	Nature reserve (zakaznyk)	National importance	500	Tsiurupynsk raion of Kherson oblast in 2-9 compartments of “Sahy” landscape unit of state forest fund of Research Forestry of State Enterprise «V.M. Vynohradov Steppe Branch of Ukrainian Research Institute of Forestry and Forest Melioration”	borders on the road

end of the table 2.22

1	2	3	4	5	6	7	8
3	Oleshkivski Pisky (Oleshky Sands)	-	National nature park	-	989.69	Tsiurupynsk raion of Kherson oblast, 30 km to the east from Kherson	440
4	Korsunskyi	faunal (zoological)	Nature reserve (zakaznyk)	Local importance	3,357	Territory of Korsunka forestry of Oleshky raion on sections of Kozachi Laheri sandy area, near Korsunka and Krynky villages	crossed by the road
5	Balka (dry creek) Velyki Sirohozy	landscape	Nature reserve (zakaznyk)	Local importance	636	Territory of Nyzhni Torhai, Nyzhni Sirohozy, Verkhni Sirohozy, Novooleksandrivka and Pershopokrovka village councils	crossed by the road

"Nyzhnodniprovskyi" national nature park. The "Nyzhnodniprovskyi" national nature park is a protected area in Kherson oblast, created on 24 November 2015. The park is located within the territory of Beryslav, Bilozerka, Hola Prystan and Tsiurupynsk raions, Kherson and Nova Kakhovka in Kherson oblast.

The territory of the "Nyzhnodniprovskyi" national nature park, approved in accordance with the established procedure, includes 80,177.80 ha of state-owned lands, namely: 14,479.80 ha of state-owned lands provided for permanent use to the national nature park, including the lands alienated from land users in accordance with Annex 1, and 65,698.00 ha of state-owned lands transferred to the national nature park without the right of permanent use.

The territory of the "Nyzhnodniprovskyi" national nature park is one of the most important natural alluvial and littoral complexes in Europe. Only in its lower course, i.e. from Kakhovka Hydroelectric Power plant to Dnipro-Buh estuary (Lyman) the Dnipro preserved its relatively natural state.

The Dnipro delta and adjacent territories still have common and rare groups of alluvial forests, wetlands, meadows, sand steppes, steppe hills of the Dnipro and creeks, rock cleavage areas, including 12 rare plant types listed in the Green Book of Ukraine. The

cenoses include 71 animal species, 32 plant species listed on the IUCN Red List, the European Red List, the Red Data Book of Ukraine (the Red Book of Ukraine), the Red List of Kherson oblast [25].

According to nature conservation legislation the territory of the Park is divided into the following areas: protected area, regulated recreation area, permanent recreation area and area used for economic activities. Each area has its own protection, reproduction and operation regime based on the nature conservation, recreational, scientific, historical and cultural and other roles of natural complexes and sites.

The park was created to preserve, reproduce and ensure efficient use of natural complexes and sites of the Dnipro delta as one of the most important alluvial and littoral complexes in Europe of special nature protection, recreational, historic and cultural, scientific, educational and aesthetic value, to ensure preservation of the Dnipro Delta wetland area which has international importance.

"Sahy" landscape nature reserve of national importance. It is the nature reserve of national importance of 500 ha created in 1977. Of the overall area of the "Sahy" reserve, the forest covers 103.2 ha, sands – 379.8 ha, lakes – 0.4 ha, marshes – 10.5 ha and the remaining territory occupies 6.1 ha.

The "Sahy" national landscape nature reserve was created to preserve and reproduce natural complexes. It is located in Tsiurupynsk raion (Kherson oblast) in 2-9 compartments of the "Sahy" landscape unit of state forest fund of Research Forestry of State Enterprise «V.M. Vynohradov Steppe Branch of Ukrainian Research Institute of Forestry and Forest Melioration" and is part of the nature reserve fund of Ukraine protected as a national heritage site, it is a component of the international system of natural territories and sites under special protection.

Forest cenoses, psammophytes and steppes, flattened sand dunes, wetland cenoses are protected within the territory of the nature reserve. Natural vegetation plays an important role in forested areas, there are rare formations of Dnipro birch (*Betula borysthenica*) and *Stipa borysthenica*, as well as clumps of grey alder (*Alnus incana*). The rare species of animals and plants, which can be encountered here, include common viper (*Vipera berus*), *Anacamptis palustris*, *Cetraria steppae*, *Festuca beckeri*, *Thymus alpestris*, *Dianthus*

arenarius, *Stipa borysthenica*, *Centaurea borysthenica*, *Senecio borysthenicus*, masterwort, etc. Many birds use lakes and wetlands to dwell and nest, small natural alder and birch forests are inhabited by rooks, roe deer, wild boars, pheasants, hares, foxes, raccoon dogs, muskrats and other animals and birds.

"Oleshky Sands" national nature park. The Oleshky Sands is the largest sand massif in Europe, consisting of boundless sand barchans up to 5 m high and covered by scarce vegetation. These sands are located in Tsiurupynsk raion (the former name of Tsiurupynsk was Oleshky) of Kherson oblast in 30 km to the east from Kherson. The Dnipro sands existed for a long time, while the Oleshky Sands, as they are now, appeared quite recently: in the XIXth century large flocks of sheep grazing nearby ate all the grass and freed the sands, which increased in size due to wind erosion.

The sands have semi-desert climate, which is moderate and has certain subtropic continental climate properties. In summer, the sand temperature rises up to 70 °C and hot upstream air flows move the clouds away. Therefore, the rains here are rarer than in Kherson and on the other bank of the Dnipro. Sandstorms happen here from time to time. In winter, it is relatively warm with rare heavy frosts. Winters are characterized by a little to no snow and short duration of snow cover.

There is a fresh water-filled layer at the depth of 30-40 m. However, it isn't allowed to draw water from it on a big scale, as it will entail reduction of the groundwater level and inability of the forests to hold the sands. The vegetation is sparse; the desert is contained by man-made pine forests. Large-scale fires often occur in the area, as the trees easily catch fire in summer due to weather conditions.

One can outline the following main factors influencing the environmental situation in the area: decreasing forested area and decreasing sand layer. The decrease of forested areas is caused by deforestation, fires, natural mortality of pine trees incapable of reproduction, and may result in the expansion of the sand massif. On the other hand, unregulated use of sand for construction works and establishing of agricultural facilities in the area results in a decreased level of groundwater and its pollution. Such measures may deprive local population from high-quality potable water and have negative impact on the forest.

The area of business activities of the park is used for business activities aimed to

perform tasks assigned to the park, there are settlements, park utility facilities, as well as lands of other land owners and anthropogenic landscapes of biosphere reserves (includes traditional land use areas, forest and water use areas, lands used for settlements, recreational purposes and other types of business activities; it is prohibited to hunt there) upon receiving consent from the Park Scientific Technical Council.

"Korsunskyi" faunal reserve of local importance. The "Korsunskyi" reserve is located within the territory of Korsunka forestry of Oleshky raion on sections of Kozachi Laheri sandy area, near Korsunka and Krynky villages. The land is mostly covered with pine forests alternating with grassy meadow cenoses in lower parts of sandy areas and psammophytic steppe areas.

There are a lot of rare species of plants and animals and a certain number of rare plant formations listed in nature conservation documents. The overall number of natural flora species is 96, of which 6 are endemic. The following endemic plant species are indicated in the European Red List: *Astragalus borysthenicus Klokov*, *Senecio borysthenicus*, *Tragopogon borysthenicus*, *Arenaria zozii Kleopow*. The natural fauna of the reserve includes 47 species of animals, of which 2 are endemic species: thick-tailed three-toed jerboa (*Stylodipus telum*) and sandy mole-rat (*Spalax arenarius*).

Several animal species indicated in Appendix 2 to the Bern Convention dwell in the area: sparrowhawk (*Accipiter nisus*), white-tailed eagle (*Haliaeetus albicilla*), European bee-eater (*Merops apiaster Linnaeus*), rosy starling (*Sturnus roseus*), *Vipera renardi*. Some animal species need to be protected from hunting, such as roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), moose (*Alces alces*), etc.

The "Korsunskyi" faunal reserve of local importance, having an area of 3,357.0 ha, was created for the purpose of nature conservation, research and aesthetic education of the coming generation. The reserve facility is located in compartments 23-56 of the Korsunka forestry of State Enterprise "Kakhovka Forestry". It is part of the nature reserve fund of Ukraine protected as a national heritage site, which is a component of the international system of natural territories and facilities under special protection.

"Balka Velyki Sirohozy" landscape reserve of local importance. The area of the nature reserve is 636.0 ha, it is located within the territory of Nyzhni Torhai (94.87 ha),

Nyzhni Sirohozy (184.87 ha), Verkhni Sirohozy (112.13 ha), Novooleksandrivka (87.63) and Pershopokrovka (156.50 ha) village councils [26].

2.7.2. Nature reserve fund of Zaporizhzhia oblast

There are 11 nature reserve fund sites in Zaporizhzhia oblast located in the area impacted by M-14 road (Table 2.23).

Table 2.23

List of nature reserve fund sites in Zaporizhzhia oblast located in the area impacted by M-14 road

№	Name of the site	Type	Category	Status	Area, ha	Location	Distance from M-14 road, m
1	2	3	4	5	6	7	8
1	Horkyi Park	-	Park-monument of garden art	National importance	31.0	Kirova Street, Melitopol, Zaporizhzhia oblast	6,500 (from Melitopol bypass)
2	Lisopytomnyk (forest nursery)	-	Park-monument of garden art	Local importance	80.8876	North-eastern part, Melitopol, Zaporizhzhia oblast	6,200 (from Melitopol bypass)
3	Virgin land area in the Korsak river floodplain	Entomological	Nature reserve (zakaznyk)	Local importance	63.0	Bohdanivka village council, Pryazovske raion, Zaporizhzhia oblast	3,470
4	Virgin land area in the Korsak river floodplain	Entomological	Nature reserve (zakaznyk)	Local importance	57.0	Dmytrivka village council, Pryazovske raion, Zaporizhzhia oblast	4,890
5	Korsak river mouth	Landscape	Nature reserve (zakaznyk)	Local importance	800.0	From Botieve amalgamated territorial community of Pryazovske raion, Zaporizhzhia oblast, to the Sea of Azov	5,100
6	Bank of the Obitochna old river bed	Botanical	Nature reserve (zakaznyk)	Local importance	2.0	Prymorsk city council, Zaporizhzhia oblast	1,500

end of the Table 2.23

1	2	3	4	5	6	7	8
7	Lysiacha balka	Botanical	Nature reserve (zakaznyk)	Local importance	3.0	Dmytrivka village council, Berdiansk raion, Zaporizhzhia oblast	710
8	Part of the coast of the Sea of Azov	Paleontological	Natural monument	Local importance	13.82	Azovske village council, Berdiansk raion, Zaporizhzhia oblast	970
9	Balochka luhova	Botanical	Natural monument	Local importance	1.0	Novovasylivka village council, Berdiansk raion, Zaporizhzhia oblast	25
10	Balka Vovcha	Entomological	Nature reserve (zakaznyk)	Local importance	69.0	Osypenko village council, Berdiansk raion, Zaporizhzhia oblast	400
11	Balka Zasorina	Entomological	Nature reserve (zakaznyk)	Local importance	87.0	Osypenko village council, Berdiansk raion, Zaporizhzhia oblast	borders on the road

"Balka Zasorina" entomological reserve. The "Balka Zasorina" is an entomological reserve of local importance. It is located in Berdiansk raion of Zaporizhzhia oblast, within the territory of Osypenko village council. The area of the reserve is 87 ha, it received its current status in 1982.

The "Balka Zasorina" entomological reserve was created for the purpose of protection of wild bees, rare species of beetles (bugs) and butterflies. The reserve is located on the slopes of the dry creek (balka) and the river bank, covered with meadow steppe, true steppe and petrophytous steppe vegetation. A legend says that the dry creek (balka) is named after kozak (cossack) Zasoryn, who lived at a farmstead near the Berda, one of the largest rivers of the basin of the Sea of Azov, in the end of XVIII century. In 1954, Berdiansk reservoir was built on the Berda river near Osypenko village. It has a sanitary zone status and there are several areas to which there is no free access. The pebble-covered beach of the reserve is a popular impromptu recreation site among tourists. One can access the "Balka Zasorina" via a dirt road from Odesa – Rostov highway.

"Balka Vovcha" entomological reserve of local importance. The reserve is located in Berdiansk raion of Zaporizhzhia oblast within the territory of State Enterprise "Berdiansk Forestry". The area of the "Balka Vovcha" is 69 ha, it received its current status in 1982.

"Horkyi Park" recreation and leisure park. The "Horkyi Park" is an urban park of municipal ownership in Melitopol (Zaporizhzhia oblast), the main park of the city and a monument of garden art. The park is famous for a wide variety of its trees, numerous amusement rides and the "Fairytale Meadow" (children entertainment area). The "Horkyi Park" is a traditional site for recreation and leisure of many local citizens and visitors of the city, it plays an important role in the cultural life of Melitopol.

There are about 50 species of trees and about 30 species of shrubs growing in the park. One can find the following trees: common oak (Quercus robur), false acacia (Robinia pseudoacacia) and its mop-headed form (Robinia pseudoacacia Umbraculifera), Japanese pagoda tree (Styphnolobium japonicum), Ailanthus altissima, honey locust (Gleditsia triacanthos), small-leaved lime (Tilia cordata), European horse-chestnut (Aesculus hippocastanum), different species of maple, birch, poplar, pine; shrubs: Caragana arborescens, wild privet (Ligustrum vulgare), savin juniper (Juniperus Sabina), common lilac (Syringa vulgaris), different forms of lilac. Some of the trees are around 80 years old. Exotic plants are represented by Taxus baccata, Maclura pomifera, Cercis siliquastrum, Forsythia suspensa.

"Lisopytomnyk" park-monument of garden art of local importance. The park is located in Melitopol raion of Zaporizhzhia oblast, in south-eastern part of the city of Melitopol. The area of the park is 37.9 ha; its current status was received in 2001.

"Virgin land area in the Korsak river floodplain-1" entomological reserve of local importance. The reserve is located in Pryazovske raion of Zaporizhzhia oblast, village Dmytrivka. It has an area of 57 ha; the land plots belong to Dmytrivka village council.

"Virgin land area in the Korsak river floodplain-2" entomological reserve of local importance. The overall area of the reserve is 63.0 ha. It was created in order to ensure protection and to contribute to reproduction of a common natural landscape of the steppe area of Southern Ukraine, natural complexes, where one can find rare species of plants (Stipa lessingiana, Stipa maeotica), rare insect species listed in the Red Data Book of Ukraine (Anax imperator, Megachile rotundata, etc.). The land plots belong to Bohdanivka village council.

"Korsak river mouth" landscape reserve of local importance. The reserve is located

in Pryazovske raion of Zaporizhzhia oblast, to the east of Pryazovske urban-type settlement. The reserve was made available for use to "Azovets" kolkhoz (collective farm), "Peremoha" fish farm, Pryazovske forest district [27].

"Bank of the Obitochna old river bed" botanical reserve of local importance. The reserve is located in Prymorsk raion of Zaporizhzhia oblast, on the outskirts of the city of Prymorsk on the territory of Nohaiskyi State Agrotechnical College. The reserve has an area of 2 ha; its current status was received in 1982.

The nature reserve was created to protect natural complex with preserved steppe vegetation, having rare and endangered plant and animal species (Stipa capillata, Stipa ucrainica, Stipa lessingiana, Tulipa quercetorum, Pulsatilla nigricans, lesser kestrel (Falco naumanni), pallid harrier (Circus macrourus), steppe polecat (Mustela eversmanni)). The reserve is part of the nature reserve fund of Ukraine protected as a national heritage site, it is a component of the international system of natural territories and sites under special protection.

The uniqueness of the site and its status as a nature reserve is related to the fact that there are a lot of species of medicinal plants growing on the bank of the old bed of the Obytichna river falling into the Sea of Azov. The 96-km long Obitochna river goes from the north to the south, its last section, 17 km long, runs parallel to the Sea of Azov. Here it is divided from the sea by 30-40 m high ridge of yellowish brown clay. The Obitochna river dried up in its lower course, its flow going aside. The temperate continental climate of the area favours the growth and distribution of a wide variety of plants, the majority of which are medicinal ones.

"Lysiacha balka" botanical natural monument of local importance. The natural monument is located in Berdiansk raion of Zaporizhzhia oblast on the lands of Dmytrivka village council (Dmytrivka village). It has an area of 3 ha and received its current status in 1982. "Lysiacha balka" was created to provide support and protection to the man-made natural complex located in the area of forb-fescue-feather grass (true) steppe, the flora of which is represented by meadow plants.

"Part of the coast of the Sea of Azov" is paleontological natural monument of local importance. The natural monument is located in Berdiansk raion of Zaporizhzhia oblast, to

the south-west of Lunacharske (Azovske) village, at the coast of the Sea of Azov. It has an area of 5 ha and received its current status in 1972.

"Balochka luhova" botanical natural monument of local importance. The natural monument is located in Berdiansk raion of Zaporizhzhia oblast, Shovkove village. It has an area of 1 ha and received its current status in 1982. The "Balochka luhova" was created to provide support and protection to the man-made natural complex located in the area of wild steppe, medicinal and ornamental plants.

2.7.3. Nature reserve fund of Donetsk oblast

M-14 road doesn't cross or border on any nature reserve fund sites in Donetsk oblast.

2.7.4. Assessment of impact on the nature reserve fund

During reconstruction of M-14 road there may be some complications due to the need of additional land allocation, i.e. nature reserve fund lands (in accordance with Article 151 of the Land Code of Ukraine especially valuable lands can be alienated upon approval of the Verkhovna Rada of Ukraine).

Ukrainian legislation protects nature reserve fund as a national heritage site, for which a special regime of protection, reproduction and use is established. It is prohibited to carry out any activities which have or may have negative impact on natural, historical and cultural complexes and sites or prevents their targeted use. In view of the above, performance of works on certain sections of M-14 road will require special precautions [28].

2.8. Flora

Priazovya is a unique region in terms of origin and natural conditions. It is characterized by high diversity at the level of species and ecosystems. Under the influence of human activity in the XIX and especially in the XX century. the landscapes of the Azov

region have been significantly transformed. And only in some areas, in particular in the coastal zone of the sea, at the outcrops of rocks, areas that had special and conservation use (military training grounds, reserves, national parks) or were unusable (beams, ravines, river floodplains) natural vegetation preserved.

It should be noted that the phytodiversity of the Azov region, in particular its rare part, has been studied unevenly and insufficiently until recently. However, this region is quite interesting and unique in botanical terms. This is due to the specificity and uniqueness of natural steppe, littoral, floodplain, halophytic ecosystems, which are mostly in a disturbed state, as well as the presence of a significant number of subendemic taxa, active speciation due to ecotone status and ancient origin [29].

According to geobotanical zoning, the territory of Ukraine, where the road M-14 Odessa-Melitopol-Novoazovsk passes on the section Kherson-Mariupol, belongs to the steppe zone, namely to the Dnieper-Azov district of cereals and wormwood-grass steppes and hearth meadows; and to the Priazovsky district of grass-grass steppes and vegetation of granite outcrops.

The steppes of this sub-province are characterized by the significant role of Stipa ucrainica P. Smirn., And for Prysyvash and the north-western Priazovye - also Artemisia taurica Willd. The flora of the Azov region includes at least 2,200 species of vascular plants. According to our data, only the flora of the coastal zone of the Sea of Azov includes 1913 species of vascular plants from 609 genera, 121 families and 4 divisions.

The spectrum of 10 leading families of this flora is formed by Asteraceae (245 species), Poaceae (182), Fabaceae (136), Brassicaceae (108), Caryophyllaceae (96), Rosaceae (91), Lamiaceae (90), Chenopodiaceae (68), Apia 66), Scrophulariaceae (64). The high position of the families Apiaceae, Brassicaceae, Fabaceae, Lamiaceae, Rosaceae indicates the significant role of the Ancient Mediterranean in the formation of this flora. The peculiarity of the flora of the Azov region is a significant number of Black Sea species (about 350 species), such as Cleisogenes maeotica Klokov et Zoz, Koeleria lobata (M. Bieb.) Roem. et Schult., Allium guttatum Steven, Hyacinthella pallasiana (Steven) Losinsk., Syrenia dolichostylos Klokov, Thumus dimorphus Klokov et Des. -Schost., Verbascum ovalifolium Donn and others. In total, about 120 subendemic taxa have been identified in

the Azov region. Of these, more than 50 species grow on the accumulative shores: Achillea birjuczensis Klokov, Achillea euxina Klokov, Agropyron cimmericum Nevski, Apera maritima Klokov, Arenaria zozii Kleopow, Asparagus levinae Klokov, Asperula maeotica M. Pop. ex Klokov, Centaurea odessana Prodan, Crambe pontica Steven ex Rupr., Medicago kotovii Wissjul., Minuartia birjuczensis Klokov, Odontites salina Kotov, Papaver tumidulum Klokov, Polygonum janatae Klokov, Taraxacum salsum litrsákis et Thëkökisral et Štëloral et Štëlois et. -Schost. etc. About 30 endemic species have been observed on forest shores: Astragalus heningii (Steven) Klokov, Caragana scythica (Kom.) Pojark., Cymbochasma borysthenica (Pall. Ex Schlecht.) Klokov & Zoz, Gagea maeotica Klokov, G. tesquicola A. Krasnova, M. Bieb.) M. Bieb., Ornithogallum melancholicum Klokov ex A. Krasnova, Otites dolichocarpus Klokov, Papaver maeoticum Klokov, Rosa adenodonta Dubovik, Scleranthus syvaschicus Kleopow, etc.

The following endemic species grow on the granite layer of the Azov Upland: *Achillea glaberrima* Klokov, *Centaurea pseudoleucolepis* Klepow, *Erodium beketovii* Schmalh., *Thymus graniticus* Klokov et Des. –Schost. Around 20 endemic taxa were found on the cleavages of the Kerch peninsula limestone: *Asperula cimmerica* V.Krecz. ex Klokov, *A. praepilosa* V. Krecz. ex Klokov, *Crambe mitridatis* Juz., *Galium xeroticum* (Klokov) Soo, *Jurinea sordida* Steven, *Thymus callieri* Bord. Ex Velen., *Ziziphora taurica* M. Bieb., etc.

The Ciz-Azov flora includes more than 70 plane species listed in the Red Book of Ukraine: *Asparagus pallasii* Miscz., *Astragalus borysthenicus* Klokov, *Astrodaucus littoralis* (M.Bieb.) Drude, *Caragana scythica* (Kom.) Pojark., *Glaucium flavum* Crantz., *Stipa borysthenica* Klokov ex Prokudin, *S. capillata* L., *Tamarix gracilis* Willd., *Trachomitum sarmatiense* Woodson, etc. (The Red Data Book of Ukraine, 2009 edition). The Red Data Book taxa of the coast of the Sea of Azov are concentrated on abrasive cliffs and in steppes spread along beach scarps (67 species), in sandy supprolitoral zone (25), water cenoses (12), on meadows (9), marshes (7), salt marshes (solonchaks) (5), forests (4), screes (4).

35 plant species of the Cis-Azov region are on the European Red List: *Astragalus borysthenicus* Klokov, *Arenaria zozii* Kleopow, *Cymbochasma borysthenica* (Pall. ex Schlecht.), *Ornithogalum melancholicum* Klokov ex A. Krasnova, *Otites artemisetorum*

Klokov, etc [30].

Works related to the reconstruction of M-14 road km 207+170 – km 222+383 and km 239+463 – km 293+173 sections, as well as to the further construction of Melitopol bypass and the construction of Prymorsk bypass may have impact on the local flora due to the need to allocate additional lands for the permanent use and cut the vegetation. Factor that will affect the vegetation during reconstruction work will be cutting down trees and shrubs. It's should be provided a compensatory planting of trees in the amount of 1:1. Carrying out of the planned works on reclamation of the territory will create conditions for fast restoration of a vegetative cover. Sowing perennial grasses will ensure the stability of the roadsides and slopes of the ground, as well as protect the surrounding area from weeds.

2.9. Fauna

M-14 Odesa – Melitopol – Novoazovsk road on Kherson – Mariupol section is located in the steppe area of Ukraine.

This area is inhabited by mammals, birds, fish, reptiles, amphibians. Many steppe animals are forced to live in burrows, ungulates develop ability to move rapidly, animals tend to live in groups (herds). The most common mammals in the steppe area are little ground squirrel (*Spermophilus pygmaeus*), great jerboa (*Allactaga major*), vole (*Microtus*), social vole (*Microtus socialis*), grey dwarf hamster (*Cricetulus migratorius*), blind mole rat (*Spalax*), steppe polecat (*Mustela eeversmanii*), Southern birch mouse (*Sicista subtilis*), beech marten (*Martes foina*), European rabbit (*Oryctolagus cuniculus*). The most common birds in the steppes are lark, quail, bunting, grey partridge (*Perdix perdix*). One can see great bustards (*Otis tarda*), demoiselle cranes (*Grus virgo*), steppe eagles (*Aquila nipalensis*), buzzards from time to time in the area [31].

The fauna on the coast of the Sea of Azov, where steppe areas interchange with sand spits, floodplain forests, meadows and marshes, lymans (estuaries), is very rich and diverse. Wetland and aquatic animals live side by side with steppe animals. Common birds include gulls, European herring gulls (*Larus argentatus*), *Podiceps*, ducks, herons, European

bitterns (*Botaurus stellaris*). Greylag geese (*Anser anser*), mute swans (*Cygnus olor*), pelicans nest in the Dnipro delta. Red deer (*Cervus elaphus*) were naturalized in the "Kosa Obitychna".

In order to conserve wild flora and fauna and their natural habitats an Emerald network was created, identifying plant and animal species, as well as territories of special conservation interest. It was initiated and coordinated by the Bern Convention (1979). The network shows known locations in Ukraine of animal and plant species listed in Resolution 6 of the Convention (Figure 2.11, Figure 2.12, and Figure 2.13).

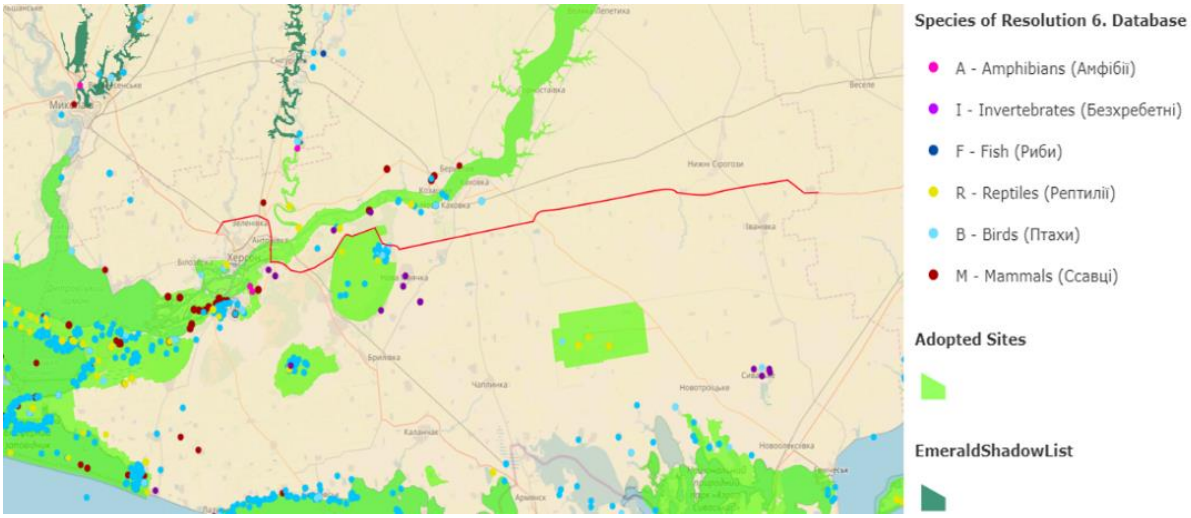

Fig. 2.11. Animal species listed in the Bern Convention impacted by M-14 road in Kherson oblast

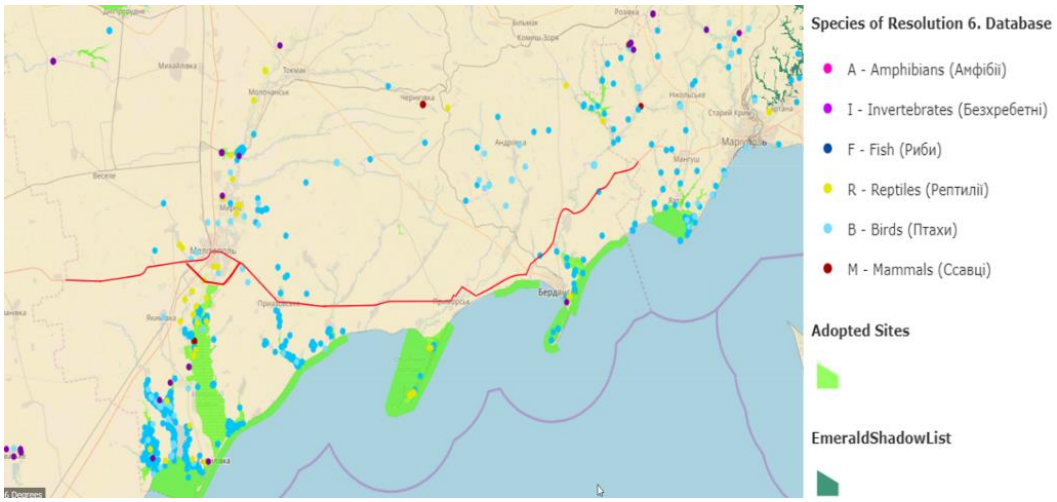

Fig. 2.12. Animal species listed in the Bern Convention impacted by M-14 road in Zaporizhzhia oblast

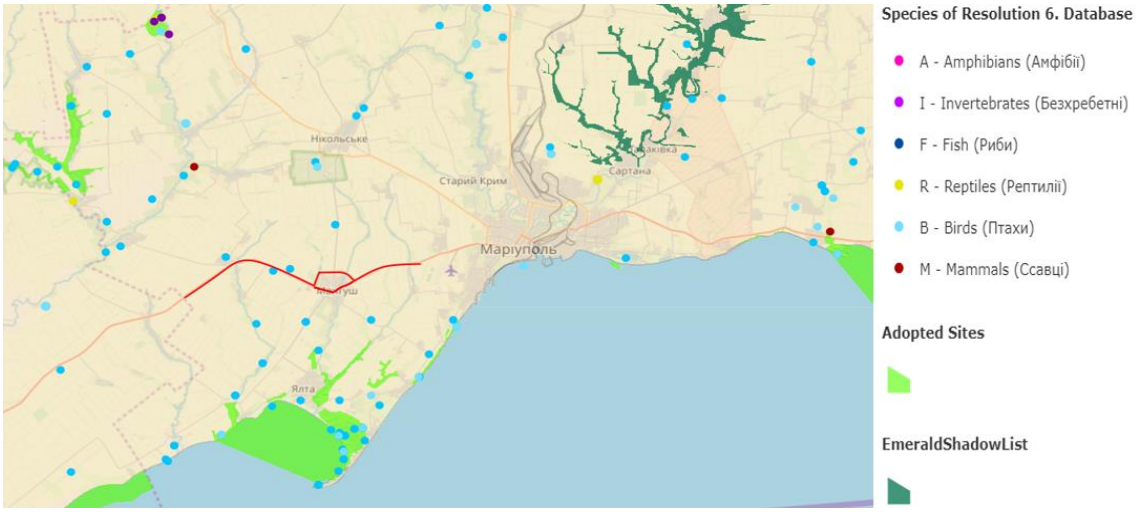

Fig. 2.13. Animal species listed in the Bern Convention impacted by M-14 road in Donetsk oblast

As seen above, it is birds that mostly fall in the area impacted by the road. Works related to the reconstruction of M-14 road km 207+170 – km 222+383 and km 239+463 – km 293+173 sections, as well as to the further construction of Melitopol bypass and the construction of Prymorsk bypass may impact birds nesting sites due to the need to allocate additional lands for the permanent use and cut the vegetation. No impact is forecasted on other sections of the road, as there are no planned operations related to cutting protective forests and additional land allocation. Influence on the representatives of the animal world during the reconstruction works and operation of the object is not expected. As the planned activity does not provide the construction of a road in a new direction, changes in the existing conditions of fauna migration are not expected [32].

2.10. Conclusion to Chapter 2

It was analyzed general environmental conditions in the steppe part of Ukraine in the area near M-14 road. They were taken into account to assess the potential impacts during the road reconstruction. It was conducted impact assessment on all components of the environment. Also, it was proposed measures to mitigate these negative impacts.

CHAPTER 3
IMPACT ASSESSMENT ON AIR ENVIRONMENT

3.1. Contribution of road transport to urban air pollution

Road transport is a major source of air contamination in the urban areas of the Ukraine and much of Europe. As such, it has a significant role to play in solving these problems, and in improving air quality and public health. In order to explore these air pollution issues, the relationships between emissions-generating activities, air pollution concentrations and health impacts need to be understood. There is clear evidence of the impact of traffic-related air pollution on human health. The greatest evidence is in relation to particulate emissions, most importantly the fine particulate matter. Vehicles emit a range of pollutants including nitrogen oxides (NOx) and particulate matter (PM). The EU has set limit values for the maximum amount of air pollution citizens should breathe but urban populations are still exposed to levels of NO2 and PM above these limits, mainly due to passenger cars and vans circulating in these areas.

NOx comprises a mixture of nitric oxide (NO) and nitrogen dioxide (NO2). NO2 is a toxic gas that causes 79,000 premature deaths in Europe per year, including Ukraine. In the air, NO is also converted to NO2 in a process that forms ozone (O3). NOx emissions also form secondary particles in the air and contribute to acidification and eutrophication, causing serious damage to ecosystems. Road transport accounts for a third of NOx emissions and is the dominant source in urban, heavily-trafficked areas.

The European Environment Agency estimates that road transport contributes to excessive concentrations about 70% for nitrogen dioxide (NO2) and about 30% for particulate matter (PM). It is estimated that around 7% of the urban population is exposed to NO2 levels above the limit value and that more than three-quarters of the urban population is exposed to PM levels exceeding the maximum permissible concentration.

Fine particulates are able to penetrate deeply into the human respiratory system. Acute effects of short-term exposure to particulates have been found to include increases in

hospital admissions and premature death of the old and sick due to disease of the respiratory and cardiovascular systems. Incidences of high concentrations of particulate matter have been found to cause additional hospital admissions and deaths [33].

Lung and heart conditions can be exacerbated during short-term episodes of high levels of PM, significantly affecting quality of life and increasing both deaths and hospital admissions. It has been identified that children, the elderly and those with pre-existing respiratory and cardiovascular disease are most likely to be susceptible to the health impacts of air pollution. Intervention studies have shown a marked improvement in health as a result of pollution abatement. It has been recognized that long-term exposure to PM has the biggest impact on health. Long-term PM exposure has led to increased levels of fatal cardiovascular and respiratory diseases, including lung cancer. Both impacts have been revealed through increased death in cities with higher concentrations of airborne particles. Long-term exposure to PM has also been shown to increase age-specific mortality risk, particularly from cardiovascular causes.

Many of the results for the health effects of PM are related to particle mass, rather than the various sources or components of PM – there is currently no 3.2 43 Assessing the Impacts clear understanding of which properties of particles (e.g. size, presence of specific chemical substances) are most responsible for toxic effects. Therefore, improved understanding of the 'behavior' and composition of PM will help to improve our understanding of its impacts. No wholly safe level has been identified, for either acute or long-term effects.

The recent REVIHAAP (Review of evidence on health aspects of air pollution) study reviewed the effects of short-term exposure to PM on mortality and morbidity with reference to a number of multi-city epidemiological studies, and of long-term exposure, again on both mortality and morbidity. The review was based on several studies of long-term exposure conducted on large cohorts in Europe and North America, and concluded that short-term exposure is a cause of both cardiovascular mortality and morbidity.

Epidemiological, clinical and toxicological studies reviewed have provided significantly more insight into the physiological effects and plausible biological mechanisms that link short- and long-term PM exposure with mortality and morbidity.

Long-term exposure to PM has been linked, through additional studies, to several new health outcomes, including atherosclerosis, adverse birth outcomes and childhood respiratory disease (ibid.). The emerging evidence from the review also suggests that there are possible links between long-term PM exposure and neurodevelopment and cognitive function, as well as other chronic disease conditions, such as diabetes.

Exposure to ambient concentrations of air pollutants (including PM) is associated with an increase in exacerbations of asthma in those who already have the condition. It is recognized that air pollutants cause irritation and inflammatory responses of the airways, therefore it is not too surprising that air pollutants can produce this kind of effect, since those suffering from asthma are predisposed to respond to such effects through bronchoconstriction. More recent studies have also produced evidence to suggest that air pollution might play a part in the induction of asthma in some individuals who live near busy roads, particularly those carrying high numbers of HGVs, which produce more emissions than passenger cars.

A report considering the possible effects of outdoor pollution (including PM) on cardiovascular disease concluded that the review of the evidence demonstrated clear associations between both daily and long-term average concentrations of air pollutants and effects on the cardiovascular system, reflected by a variety of outcome measures including risk of death and of hospital admissions. COMEAP concluded that many of these associations were likely to be causal in nature, and therefore a precautionary approach should be taken in future planning because of the public health implications.

3.2. Emission calculations near the M-14 road and impact assessment on the air

One of the negative impacts caused by the road is air pollution due to exhaust gases produced by internal combustion engines (ICE). The operation of road transport on M-14 international road results in transfer of a significant amount of pollutants to the atmospheric environment, while the amount of pollutants directly depends on the traffic and the road parameters.

The Resolution of the Cabinet of Ministers of Ukraine "On approval of the list of the most common and dangerous pollutants, the emissions of which into the air shall be regulated", regulates emissions of the following pollutants: nitrogen oxides, benzo(a)pyrene, sulphur dioxide and other sulphur compounds, carbon oxide, suspended solids, lead and its compounds, formaldehyde, volatile organic compounds. There were carried out analysis of pollutants contained in the exhaust gases of vehicles [34].

In accordance with the "List of threshold limit values of chemical and biological substances in the atmosphere of populated areas" sanitary and hygienic characteristics of the major and most important pollutants are given in Table 3.24.

Table 3.24

Sanitary and hygienic characteristics of the major and most important pollutants

№	Name	Code	TLV-STEL, mg/m^3	TLV-TWA, mg/m^3	Hazard class
1	Nitrogen dioxide	301	0.2	0.04	3
2	Nitrogen oxide	304	0.4	0.06	3
3	Soot	328	0.15	0.05	3
4	Sulphuric anhydride	330	0.5	0.05	3
5	Carbon monoxide	337	5.0	3.0	4
6	Methane	410	SRLI – 50 mg/m^3	-	4
7	Benzo(a)pyrene	703	-	0.1 mcg/100 m^3	1
8	Non-methane volatile organic compounds (NMVOCs)	2754	1.0	-	4

Calculations were made for all settlements that fall into the buffer zone of M-14 road. Based on the results of the calculations, it was concluded that there could be cases of exceeding the threshold limit values (TLV) only in 3 settlements, namely Chornobaivka village, Molodizhne village and Oleshky. [35]

The volume of pollutants and greenhouse gases emitted into the atmosphere due to the use of certain types of fuels by vehicles is calculated using the following formula:

$$B_{ij} = П_{\text{інп}} \times К_{ij} \times К_{ij\text{тс}} \quad (3.2)$$

where:

"B_{ij}" means the volume of emissions of "j" pollutant and greenhouse gas from the use of "i" fuel;

"$П_{iнп}$" means annual consumption of "i" fuel by vehicles;

"K_{ij}" means average specific volume of emissions of "j" pollutant from consumption of "I" fuel;

"$K_{ijтс}$" means the coefficient of influence of the technical state of a motor vehicle on the volume of emissions of "j" pollutant due to the use of "i" fuel.

The indicative distance travelled by a car per cycle is "L", measured in kilometres.

In accordance with "Fuel and lubricant consumption rates for road transport" approved by the Order of the Ministry of Transport of Ukraine the average consumption of petrol by an average car per 1 km of road in tonnes is 0.000074 t/km for vehicles with petrol engines.

"n" means the number of car types.

"D" means the number of working days per year. D = 365.

The future road traffic intensity (2040) within Chornobaivka village is 13,968 vh/day, Molodizhne village – 14,915 vh/day and Oleshky – 25,819 vh/day in passenger car units per day.

The results of the calculations are summarized in Tables 3.25, 3.26 and 3.27.

Table 3.25

Emissions of pollutants into the atmosphere within Chornobaivka village

Substance	Specific emissions, kg/t	Coefficient of influence of the car technical state, C	Fuel consumption, t/km	Distance L, km	Number of days	Number of cars per day	Emissions	
							t/year	g/s
1	2	3	4	5	6	7	8	9
CO	201.8	1.5	0.000074	1.58	365	13,968	180.44	5.72
NO_2	21	0.9	0.000074	1.58	365	13,968	11.27	0.36
SO_2	1	1	0.000074	1.58	365	13,968	0.60	0.02
NMVOC	53	1	0.000074	1.58	365	13,968	31.59	1.00

end of the table 3.25

1	2	3	4	5	6	7	8	9
Methane	0.94	1.5	0.000074	1.58	365	13,968	0.84	0.03
NO	0.188	1	0.000074	1.58	365	13,968	0.11	0.004
Soot		-	0.000074	1.58	365	13,968	-	-
CO_2	3,138	1	0.000074	1.58	365	13,968	1,870.55	59.31
Benzo(a) pyrene		-	0.000074	1.58	365	13,968	-	-

Table 3.26

Emissions of pollutants into the atmosphere within Molodizhne village

Substance	Specific emissions, kg/t	Coefficient of influence of the car technical state, C	Fuel consumption, t/km	Distance L, km	Number of days	Number of cars per day	Emissions	
							t/year	g/s
CO	201.8	1.5	0.000074	0.838	365	14,915	102.19	3.24
NO_2	21	0.9	0.000074	0.838	365	14,915	6.38	0.20
SO_2	1	1	0.000074	0.838	365	14,915	0.34	0.01
NMVOCs	53	1	0.000074	0.838	365	14,915	17.89	0.57
Methane	0.94	1.5	0.000074	0.838	365	14,915	0.48	0.02
NO	0.188	1	0.000074	0.838	365	14,915	0.06	0.002
Soot	-	-	0.000074	0.838	365	14,915	-	-
CO_2	3,138	1	0.000074	0.838	365	14,915	1,059.36	33.59
Benzo(a) pyrene	-	-	0.000074	0.838	365	14,915	-	-

Table 3.27

Emissions of pollutants into the atmosphere within Oleshky

Substance	Specific emissions, kg/t	Coefficient of influence of the car technical state, C	Fuel consumption, t/km	Distance L, km	Number of days	Number of cars per day	Emissions	
							t/year	g/s
CO	201.8	1.5	0.000074	0.986	365	25,819	208.14	6.60
NO_2	21	0.9	0.000074	0.986	365	25,819	13.00	0.41
SO_2	1	1	0.000074	0.986	365	25,819	0.69	0.02
NMVOCs	53	1	0.000074	0.986	365	25,819	36.44	1.16
Methane	0.94	1.5	0.000074	0.986	365	25,819	0.97	0.03
NO	0.188	1	0.000074	0.986	365	25,819	0.13	0.004
Soot	-	-	0.000074	0.986	365	25,819	-	-
CO_2	3,138	1	0.000074	0.986	365	25,819	2,157.71	68.42
Benzo(a)pyrene	-	-	0.000074	0.986	365	25,819	-	-

But, there is some features, that should be paid attention. The calculations of emissions of pollutants by motor vehicles into the atmosphere include an element of uncertainty due to the following reasons: the ratio of trucks and passenger cars may vary depending on the day of the week, the number of vehicles is not a constant value. During the first years of operation of the road, the number of vehicles will be lower. Moreover, the use of catalytic converters to reduce emissions of carbon monoxide, hydrocarbons, sulphur oxides and nitrogen in combination with the uncertainty regarding their number allows us to state that the calculated emissions of pollutants are somewhat overstated.

In accordance with the OND-86 “Methodology used to calculate atmospheric concentrations of harmful substances contained in the emissions of an enterprise” the ground level concentrations are calculated only for those pollutants, for which:

$$M / TLV - STEL > F \quad (3.3)$$

where:

“M” means the total volume of emissions from all sources of the enterprise referring to the most unfavourable emission in the established conditions, including ventilation facilities and fugitive (mobile) emissions (g/s);

“TLV-STEL” means the threshold limit value/short-term exposure limit (mg/m3). F=0.1 at a height of emission sources of less than H=10.0 m.

Thus, it is required to calculate the volumes of pollutants dispersed in the surface layer of the atmosphere only for carbon monoxide, nitrogen dioxide and non-methane volatile organic compounds.

In order to determine the level of air pollution in the surface layer of the atmosphere at the boundary of residential development area during the operation of the facility, the volume of pollutants dispersed into the atmosphere was calculated using the EOL 2000 (h) automated calculation system, which implements the OND-86 methodology.

The volume of pollutants dispersed in the atmosphere was forecasted for 2040 taking into account the stratification coefficient, the terrain coefficient and background concentrations.

In accordance with the “Procedure for determining the background concentrations of pollutants in the atmosphere” approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine the background concentrations of pollutants in the atmosphere are equal to: nitrogen dioxide – 0.018 mg/m^3, 0.09 TLV; carbon monoxide – 0.4 mg/m^3, 0.08 TLV; non-methane volatile organic compounds – 0.4 mg/m^3, 0.4 TLV.

Maximum concentrations of pollutants in the surface layer of the atmosphere at the boundary of the first line of residential development area of Chornobaivka village, Molodizhne village and Oleshky, taking into account the background indicators, are shown in Table 2.28 [36].

Table 3.28

Maximum concentrations of pollutants in the surface layer of the atmosphere, in shares of TLV

Substance	Chornobaivka village	Molodizhne village	Oleshky	TLV-STEL*, mg/m^3
NO_2	0.55 TLV	0.47 TLV	0.71 TLV	0.2
CO	0.37 TLV	0.32 TLV	0.48 TLV	5
NMVOCs	0.66 TLV	0.62 TLV	0.75 TLV	1

The concentrations of pollutants do not exceed 1 TLV and it can be stated that the influence of the project site on the atmosphere will be within acceptable sanitary standards.

3.3. Conclusion to Chapter 3

It was considered in detail air environment and its impacts due to road reconstruction. The EOL program was studied. The system allows calculating pollution fields for a point model of a source of harmful substances with a round and rectangular mouth of a pipe, a linear model, two models of an area source.

It was calculated the emissions from road transportation on this road and it was defined three points of possible exceeding MPC. But after additional calculations it was received such results: Chornobaivka village (NO_2 – 0.55 TLV, CO – 0.37 TLV, NMVOCs – 0.66 TLV), Molodizhne village (NO_2 – 0.47 TLV, CO – 0.32 TLV, NMVOCs – 0.62 TLV), and Oleshky (NO2 – 0.71 TLV, CO – 0.48 TLV, NMVOCs – 0.75 TLV). The concentrations of pollutants do not exceed 1 TLV and it can therefore be stated that the influence of the project site on the atmosphere will be within acceptable sanitary standards.

CHAPTER 4
LABOUR PRECATION FOR THE ENVIRONMENTAL EXPERT

4.1. Analysis of harmful and dangerous production factors

According to the theme of my diploma project “Environment Impact Assessment of the M-14 Road Reconstruction at the Kherson-Mariupol section”, the research about impact assessment of the road have performed with the help of computer software. So, this operational procedure is chosen to be analyzed.

Analysis, processing of information and performing of mathematical calculations at this stage of technological progress is carried out with the use of computer technology, which is associated with harmful effects on the human body, which is in the immediate vicinity of a computer.

In the process of performing work, the environmental expert may be affected by the following hazardous and harmful production factors:

1. Factors which belong to physical harmful factor:
   - a dangerous voltage level in an electrical circuit, the short circuit of which can occur through the human body;
   - increased level of electromagnetic radiation;
   - an increased level of static electricity);
   - reduced air ionization;
   - increased noise level;
   - irrational organization of the workplace;
   - insufficient illumination of the working area.
2. Factors which belong to psychophysiological harmful factor
   - increased nervous stress;
   - psycho-emotional stress, overwork [37].

4.1.1. Requirements for the area of the workplace

The area of the room where the personal computers are located is determined in accordance with applicable regulations. The following norms are set for one workplace equipped with a personal computer: area - not less than 6 m^2; volume - not less than 20 m^3.

Grounded structures located in the room (heating batteries, water pipes, cables with grounded open screen, etc.) must be reliably protected by accidental shields or nets from accidental contact. These rooms must also have first aid kits, automatic fire alarm systems and portable carbon dioxide fire extinguishers. Access to fire extinguishers must be free.

Workplaces should be positioned relative to the light slots so that natural light falls mainly on the left side.

The design of the personal computer user's workplace should ensure the maintenance of the optimal working posture of the office worker. The design of the desktop must meet modern ergonomic requirements and ensure optimal placement on the work surface of the equipment used (display, keyboard, printer) and documents.

The rules set the height of the work surface of the desktop, the parameters of width and depth for desktops, which should provide the ability to perform operations in the range of the motor field.

The work chair should be lift-swivel, height-adjustable, with the angle of inclination of the seat and back, from the back to the front edge of the seat, the surface of the seat should be flat, the front edge - rounded. Adjustment for each of the parameters must be carried out independently, easily and securely fixed.

The surface of the seat and back of the chair should be semi-soft with a non-slip, airtight coating that is easy to clean and not electrified.

The rooms can be equipped with cabinets for storing documents, magnetic disks, shelves, racks, cabinets, etc., taking into account the requirements for the area of the rooms.

The floor surface should be smooth, non-slip, with antistatic properties. It is forbidden to use polymeric materials that emit harmful chemicals into the air, to decorate the interior of rooms with personal computers [38].

4.1.2. Electrical safety requirements

Personal computers and peripherals must be connected to the mains only with the help of working plugs and factory-made electrical sockets. Plug-in connections and electrical outlets must have special contacts for the connection of the neutral protective conductor. Their design must be such that the connection of the neutral protective conductor occurs earlier than the connection of the phase and neutral working conductors. The disconnection procedure must be reversed. It is necessary to make it impossible to connect the contacts of the phase conductors with the contacts of the neutral protective conductor. It is not allowed to connect computers, peripherals to the usual two-wire mains, including - using transient devices.

4.1.3. Requirements for ventilation, heating, air conditioning, microclimate

Rooms for working with personal computers must be equipped with heating, air conditioning, or supply and exhaust ventilation. Optimal values of microclimate parameters should be provided in workplaces: air temperature should be 22–25 ° C, relative humidity - 40–60%, air velocity - no more than 0.1 m/s.

If the permissible values are exceeded, the working day of employees must be reduced by at least 10%.

To maintain the permissible values of the microclimate and the concentration of positive and negative ions, it is necessary to provide installations or devices for humidification and / or artificial ionization, air conditioning. In Ukraine, there are no legally approved maximum permissible levels of carbon dioxide in the air for residential, office and public buildings. However, given its impact on employees, namely a significant reduction in their ability to work, employers should pay attention to this issue and take preventive measures [39].

Modern technological advances have resulted in an increase in energy consumption each year and an increase in the load on the cables, which in turn leads to an increase in the

voltage of electromagnetic fields, the adverse effects of which can lead to poor health.

4.1.4. Light requirements

It is known that prolonged work on the computer and with documents in low light can lead to significant visual strain, so the lighting requirements are very important. The workplace should be placed so as to avoid direct light in the eyes. To ensure protection and achieve standardized levels of computer radiation, it is necessary to use screen filters, local light filters (personal eye protection) and other means of protection that have been tested in accredited laboratories and have an annual hygienic certificate. Artificial lighting of the room should be carried out by a system of general uniform lighting. In the rooms with the predominant work with documents, the use of a combined lighting system is allowed. Fluorescent lamps should be used as sources of artificial lighting. The general lighting system should be in the form of continuous or intermittent lines of luminaires located on the side of the workplaces (usually on the left) parallel to the line of sight of workers.

To ensure normalized values of illumination in the premises, it is necessary to wash windows and lamps at least 2 times a year, as well as to replace burnt-out lamps in a timely manner.

4.1.5. Requirements for noise and vibration levels

To ensure compliance with the permissible noise levels in the workplace, sound absorption devices are used, the choice of which is justified by special engineering and acoustic calculations. Among the organizational and technical measures to limit the adverse effects of noise and vibration on workers are such as the use of rubber, foam, other noise or vibration-absorbing materials, or other materials for similar purposes, which are allowed to decorate the rooms, allowed by state sanitary and epidemiological surveillance [40].

4.1.6. Mode of work and rest: regulated breaks, lunch break

When organizing work related to the use of personal computers, regulated rest breaks should be provided to preserve the health of employees, prevent occupational diseases and maintain their ability to work. Work and rest regimes should provide additional short breaks in the periods preceding the appearance of objective and subjective signs of fatigue and reduced efficiency. The main work with a personal computer should be considered that it takes at least 50% of the time during the work shift. During the day should be provided: breaks for rest and eating (lunch breaks); breaks for rest and personal needs (according to labor standards). In order to reduce the negative impact of monotony, it is advisable to use alternating operations of word processing and numerical data (change the content of work), alternating data entry and text editing. To reduce nervous and emotional stress, fatigue of the visual analyzer, improve cerebral circulation, overcome the adverse effects of hypo dynamics, prevent fatigue, it is advisable to use some breaks to perform a set of exercises.

4.2 Measures to reduce the impact of harmful and dangerous production factors

Assessment of the level of conditions, severity and intensity of work on a point scale consider the scale on the example of the assessment of factors of the production environment for the research engineer of the office equipped with a PC. Output data is shown in the Table 4.29.

Table 4.29

Output data

Factor (indicator)	Factual data	Duration (hours)
1	2	3
Working conditions:		
Microclimate (t, °C)	27	8
Lightning of the room	320	8

end of the Table 4.29

1	2	3
Category of visual works	A-2	-
Level of Noise, dB	86	5
The intensity of work		
Total energy expenditure of the body, W	300	7
Stereotyped working movements (number per shift)	38000	6
Difficulty of work		
Duration of concentration (in % of time per shift)	76	7
Duration of working day, hours	8	8

We determine the available factors of labour conditions and production environment affecting the employee in the process of labour. Their actual value and duration are introduced to columns 1, 2, 3, of the Table 4.30.

Table 4.30

Scoring results scale

Factor (indicator)	Measured indicators $I_{meas.}$	Action time (min.)	MPC indicators	$X_{deter.}$, scores	Working conditions class	X_i, scores
1	2	3	4	5	6	7
Microclimate (t, °C)	27	8	22,9-25,8	3	3.3	3
Lightning of the room	320	8	400	-	3.1	1
Category of visual works	A-2	-	-	-	-	-
Level of Noise, dB	86	5	50	-	3.1	0,63
Total energy expenditure of the body, W	300	7	290	0,91	3.2	2
Stereotyped working movements (number per shift)	38000	6	40000	0,71		
Duration of concentration (in % of time per shift)	76	7	75	0,89		
Duration of working day, hours	8	8	8	0,15		

By energy consumption, we determine the category of work for the environmental engineer of the office equipped with PC. Working conditions must correspond to light physical work - category Ib.

According to the category of works Ib, the category of visual works A-2 and the identified indicators of working conditions and intensity, we determine the MPC (GDR) of the identified factors. For individual factors and indicators according to the method defined "Hygienic classification of labour", we determine the estimated coefficients Xdeter.

The calculated coefficient X_{deter} for microclimate estimation is determined in points, according to formula 4.4:

$$X_{deter} = \frac{(1 \times t_1 + 2 \times t_2 + 3 \times t_3 + 4 \times t_4)}{T} = \frac{3 \times 8}{8} = 3 \quad (4.4)$$

Total energy expenditure of the body is calculated by the formula 4.5:

$$X_{deter} = \frac{I_{meas} \times T \times 1}{8 \times P_{add}} = \frac{300 \times 7 \times 1}{8 \times 290} = 0{,}91 \quad (4.5)$$

Stereotyped working movements is calculated by the formula 4.6:

$$X_{deter} = \frac{I_{meas} \times T \times 1}{8 \times P_{add}} = \frac{38000 \times 6 \times 1{,}0}{8 \times 40000} = 0{,}71 \quad (4.6)$$

Duration of concentration is calculated by the formula 4.7:

$$X_{deter} = \frac{I_{meas} \times T \times 1}{8 \times P_{add}} = \frac{76 \times 7 \times 1{,}0}{8 \times 75} = 0{,}89 \quad (4.7)$$

Duration of working day is calculated by the formula 4.8:

$$X_{deter} = \frac{I_{meas} \times T \times 0{,}15}{8 \times P_{add}} = \frac{8 \times 8 \times 0{,}15}{8 \times 8} = 0{,}15 \quad (4.8)$$

Next, we determine the class and degree of harmfulness of working conditions for each of the identified factors and indicators. Class and degree of difficulty and intensity of work is defined as the sum of the calculated points of all indicators of X_{deter} according to the formula 4.9:

$$X_{sum} = \sum_{i=1}^{n} X_i = 0{,}91 + 0{,}71 + 0{,}89 + 0{,}15 = 2{,}66 \quad (4.9)$$

By the value of the sum of the calculated scores of indicators X_{sum} = 2,66 - 3rd class, 2nd grade.

4.3. Occupational Safety Instruction

4.3.1. General safety requirements

The environmental engineer informs his immediate supervisor about any situation that threatens the life and health of people, about every accident that occurs at work, about the deterioration of his health, including the manifestation of signs of an acute illness.

While on the territory and in the buildings of the organization, at the work sites and workplaces, the design engineer is obliged to: timely and accurately comply with the internal labor regulations, orders of the immediate supervisor, provided that he is trained in the rules for the safe performance of this work; comply with the requirements of local regulations on labor protection, fire safety, industrial sanitation, regulating the procedure for organizing work at the facility; observe labor discipline, work and rest regime; take good care of the employer's property.

4.3.2. Safety Requirements before starting work

Inspect the workplace and equipment. Remove all unnecessary items. Remove dust from the display screen of a personal computer. Adjust the height and angle of the screen. Adjust the seat height. Check the health of the equipment. Check approaches to the workplace, escape routes for compliance with labor protection requirements. Check by visual inspection:

- absence of cracks and chips on the cases of sockets and switches, as well as the absence of bare contacts;
- reliability of closing all current-carrying devices of the equipment;
- presence and reliability of grounding connections (absence of breaks, strength of contact between metal non-current-carrying parts of the equipment and the grounding wire);
- the integrity of the insulation of electrical wires and power cords of electrical appliances, the serviceability of safety devices;
- sufficiency of lighting of the workplace;

- absence of foreign objects around the equipment;
- condition of floors (absence of potholes, irregularities, etc.).

4.3.3. Safety Requirements during work with computer

With the rapid advancement of information technology, use of computers is already part of many people's daily life. Those engaged in electronic information and computer-related professionals have to use computer s for long periods. Their regular and repetitive actions in operating their computers may cause repetitive strain injuries and visual fatigue if they have not adopted a proper working posture. To avoid any involved health risk, employer s and employees have to consider their conditions and environmental factors such as lighting condition, computer workstation design and working posture in the office.

The monitor should be placed at a level where its topmost line of display is at about or just below the operator's eye level. The viewing distance between the operator's eyes and the screen should be around 350 to 600 millimeters for reading text of normal font size.

A footrest is recommended if an operator cannot rest his feet flatly on the floor even if the chair height has been properly adjusted. Small sized people usually need foot rest support. The footrest should be stable, non-slippery, incline and height adjustable, and should not restrict leg movement.

If intensive keyboard operation has to be performed, a wrist rest may be used if the user finds it more comfortable. The primary function of a wrist rest is to keep the wrist straight during keyboard use and provide padding. When a proper wrist rest is used correctly, it can reduce the risk of repetitive strain injuries. However, while keying, remember to keep the hands above the keyboard and move the whole hand to reach side keys, rather than resting the wrist on the rest and bending the wrist sideways. The wrists should only be resting on the wrist rest during pausing.

Anti-glare screens improve screen visibility by reducing bright spots or washout caused by ambient light on monitor screens. Thus, these screens may be used to reduce screen reflections. Radiation emitted by a computer monitor is well below the limits set by international bodies for limiting health risks. It is therefore not necessary to add any filter to reduce the emission. In any case, the anti-glare screens are not designed for effective

screening of radiation. Currently, there is no scientific evidence that prolonged computer work will cause permanent damage to the eyes or eyesight. However, prolonged use of computer can lead to eye strain. The best preventive measure to reduce eye strain is to view distant objects on a regular basis and do eye exercises.

4.3.4. Safety Requirements after work

Switch off the equipment during a power outage and leaving the workplace after work. Inspect the workplace and equipment. Remove all unnecessary items. Check by visual inspection equipment on lack of defects [41].

4.4. Conclusions to Chapter 4

It was analyzed labor conditions for environmental expert during the performing the research on Environment Impact Assessment. Mainly, most of his work is directed on the work with computer. It was defined possible risks for worker and it was stated measures to prevent emergency situations. There are also requirements and recommendations for safety work.

CONCLUSIONS

1. It was analyzed general environmental conditions in the steppe part of Ukraine in the area near M-14 road. They were taken into account to assess the potential impacts during the road reconstruction.

2. It was analyzed Ukrainian legislation in the sphere of Environment Impact Assessment. This procedure includes: Preparation of an EIA report by the business entity; conducting a public discussion; analysis by the authorized body of the information provided in the EIA report; providing by authorized body with a reasoned conclusion on the EIA, taking into account the results of the analysis; taking into account the conclusion on the EIA in the decision to carry out the planned activity.

3. It was conducted impact assessment an all components of the environment, and it was proposed measures to mitigate these impacts.

4. It was applied different methods and new technologies for this project. Namely, The EOL program was studied. The system allows calculating pollution fields for a point model of a source of harmful substances with a round and rectangular mouth of a pipe, a linear model, two models of an area source.

5. It was considered in detail air environment and its impacts due to road reconstruction. It was calculated the emissions from road transportation on this road and it was defined three points of possible exceeding MPC. But after additional calculations it was received such results: Chornobaivka village (NO_2 – 0.55 TLV, CO – 0.37 TLV, NMVOCs – 0.66 TLV), Molodizhne village (NO_2 – 0.47 TLV, CO – 0.32 TLV, NMVOCs – 0.62 TLV), and Oleshky (NO_2 – 0.71 TLV, CO – 0.48 TLV, NMVOCs – 0.75 TLV). The concentrations of pollutants do not exceed 1 TLV and it can therefore be stated that the influence of the project site on the atmosphere will be within acceptable sanitary standards.

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