11776

(registration number of the case on environment impact assessment of the planned activity)

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

"RECONSTRUCTION OF THE WATER TREATMENT PLANT (WTP) IN MYKOLAIV"

TECHNICAL ASSISTANCE FOR UKRAINE MUNICIPAL INFRASTRUCTURE PROGRAMME PREPARATION AND IMPLEMENTATION (FUNDED BY NIP)

AA-010067-001

5 May 2025

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This technical assistance operation is financed by the EU Neighbourhood Investment Platform (NIP), a mechanism aimed at mobilizing additional funding to finance capital-intensive infrastructure projects in EU partner countries covered by the European Neighbourhood Policy (ENP) in sectors such as transport, energy, environment and social development. The NIP is an integral part of the European Fund for Sustainable Development (EFSD) which is the first pillar of the EU's External Investment Plan.

Project:	Preliminary tender documentation "Mykolaiv water supply sub-project–2_MYK_211 (version 03 dated 18.02.2025)"
Document name:	**Environmental impact assessment report for reconstruction of the water treatment plant (WTP) in Mykolaiv**
Registration number of the case on environmental impact assessment of the planned activity	**11776**
Date:	May 2025
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CONTENT

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ANNEXES

List of Acronyms and Abbreviations

AMC	Adverse Meteorological Conditions
ASIL	Approximate Safe Impact Level
BMF	Building of Main Facilities
CMP	Construction Management Plan
CMU	Cabinet of Ministers of Ukraine
COD	Chemical Oxygen Demand
CP	Calculation Point
CWR	Clean Water Reservoir
DBN	Ukrainian State Construction Standard
DSP	State Sanitary Rules
EFSD	European Fund for Sustainable Development
EIA	Environmental Impact Assessment
EIB or Bank	European Investment Bank
EL	Exposure Limit
ENP	European Neighbourhood Policy
ESAP	Environmental and Social Action Plan
ESMP	Environmental and Social Management Plan
EU	European Union
FS	Feasibility Study
GAC	Granular Activated Carbon
LU	Law of Ukraine
MPA	Meteorological Potential of the Atmosphere
MPD	Maximum Permissible Discharge
MSW	Municipal Solid Waste
MUC	Municipal Utility Company "MYKOLAIVVODOKANAL"
NIP	Neighbourhood Investment Platform
NMVOCs	Non-Methane Volatile Organic Compounds
NRF	Nature Reserve Fund
pH	Hydrogen Index
PS	Pumping Station
RO	Reverse Osmosis
SE	Source of Emission
SPL	Sound Pressure Level
STEL	Short-Term Exposure Limit for Pollutants
TA SP	Technical Assistance Service Provider
TWA	Time-Weighted Average for the Exposure to Pollutants
UMIP	Program for the Development of Municipal Infrastructure of Ukraine
USRIEP	Ukrainian Scientific Research Institute of Ecological Problems
WEL	Exposure Limit for Harmful Substances in Workplace Air
WMP	Waste Management Plan
WTP	Water Treatment Plant

General Information about the Authors of the Environmental Impact Assessment Report

EIA Report for the reconstruction of the water treatment plant (WTP) in Mykolaiv has been prepared by EGIS UKRAINA, Limited Liability Company, in 2025 (see the Table below).

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EIA Report was prepared for the Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)", prepared as part of the Program for the Development of Municipal Infrastructure of Ukraine, which is financed by the European Investment Bank.

Materials and surveys used and considered while preparing this EIA Report are listed in the Table below.

TABLE 2 – MATERIALS AND SURVEYS USED WHILE PREPARING THIS EIA REPORT

Completed Works	Completed By	Contact Details	Year of Completion
Materials of inspection of the BMF, the second stage and the BMF, the third stage of the water treatment plant in Mykolaiv	Khmelnytske obl. zem. ahentstvo, LLC (*Khmelnytskyi Regional Land Agency*)	Starokostiantynivske highway, bldg. 26, office 405, Khmelnytskyi, 29000, Ukraine Phone:+380673917615	2017
Technical Report "On Technical Inspection and Determination of the Technical Condition of Building Structures of the Building of Main Facilities (BMF) of the Stage III of the Water Treatment	BOGARD, LLC	Ozerna street, bldg. 25, office 47, Mykolaiv, Ukraine Phone: 8(063) 993 84 60 8(097) 704 70 44	2022

Completed Works	Completed By	Contact Details	Year of Completion
Plant of the MUC "Mykolaivvodokanal"			
Technical Report "On Technical Inspection and Determination of the Technical Condition of Building Structures of the Building of Main Facilities (BMF) of the Stage II of the Water Treatment Plant of the MUC "Mykolaivvodokanal"	BOGARD, LLC	Ozerna street, bldg. 25, office 47, Mykolaiv, 54058, Ukraine Phone: 8(063) 993 84 60 8(097) 704 70 44	2022
Technical Report "Comparison of Options for the Reconstruction of the Existing WTP for Drinkable Water Supply in Mykolaiv"	RESEARCH AND DESIGN INSTITUTE OF HEATING AND WATER SUPPLY SYSTEMS, LLC (R&DI H&WSS, LLC)	Lypkivskoho Vasylia Mytropolyta street, bldg. 33a, office 139, Kyiv, 03035, Ukraine Phone: 8(050) 382 31 97	2023
Technical Report "Analysis of Surface Water Characteristics of Alternative Water Supply Sources and Recommendations of Treatment Methods for the Existing WTP for Drinkable Water Supply in Mykolaiv"	R&DI H&WSS, LLC	Lypkivskoho Vasylia Mytropolyta street, bldg. 33a, office 139, Kyiv, 03035, Ukraine Phone: 8(050) 382 31 97	2023
Feasibility Study for Mykolaiv Water Supply. Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP)	EGIS UKRAINA, LLC	Antonovycha street, bldg. 29, Kyiv, 01033, Ukraine Phone: 8(044) 359 00 95	2024
Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)"	EGIS UKRAINA, LLC	Antonovycha street, bldg. 29, Kyiv, 01033, Ukraine Phone: 8(044) 359 00 95	18.02.2025
Materials of the geological survey No. 427/1-22	PC CF "KSENA"	21 Sichnia street, bldg. 37, office 503, Kherson, 73000, Ukraine Phone: 8(050) 391 27 13	2024
Consultative Analysis Report on Wastewater Discharge Location for the Water Supply Project in Mykolaiv	EGIS UKRAINA, LLC	Antonovycha street, bldg. 29, Kyiv, 01033, Ukraine Phone: 8(044) 359 00 95	2024
Climate Risk and Vulnerability Assessment Report for the Water Supply Project in Mykolaiv	EGIS UKRAINA, LLC	Antonovycha street, bldg. 29, Kyiv, 01033, Ukraine Phone: 8(044) 359 00 95	2025
Scientific and Technical Report on the Structure of Biodiversity and the Distribution of Its Key Elements (the survey and development of relevant maps of natural and modified habitats, identification of locations of rare species or those of high conservation value in this context, determination of suitable habitats for endangered/critically endangered and endemic species within the territory, development of species valorisation tables, and	Ukrainian Scientific Research Institute of Ecological Problems (USRIEP)	Bakulina street, bldg. 6, Kharkiv, 61166, Ukraine Phone: 8(057) 702 15 92	2025

Completed Works	Completed By	Contact Details	Year of Completion
a section on landscape and visual aesthetic aspects)			
Scientific and Technical Report on the Current State of the Environment (analysis of environmental components: ambient air, soil, surface water, and noise characteristics) Certificate of Compliance of the Measurement System with the Requirements of DSTU ISO 10012:2005 No. 01-0047/2024 of 15 July 2024	Ukrainian Scientific Research Institute of Ecological Problems (USRIEP)	Bakulina street, bldg. 6, Kharkiv, 61166, Ukraine Phone: 8(057) 702 15 92	2025

1 - DESCRIPTION OF THE PLANNED ACTIVITY

The European Investment Bank (EIB, the Bank) is assisting the MUC "Mykolaivvodokanal" under the Ukraine Municipal Infrastructure Programme (UMIP) to develop sustainable solutions for reliable and safe water supply to the City of Mykolaiv following the damage due to the Russian invasion.

The Ukraine Municipal Infrastructure Programme (UMIP) is a multi-sector investment programme aimed at improvement of energy efficiency of renovated municipal infrastructure facilities, reduction of energy and water losses, improvement of solid waste management services, district heating, urban lighting, water supply (including hot and cold water supply, as well as drinkable and other water supply) and sanitation, and overall improvement of security and quality of services provided.

Russian military shelling in 2022 of the city's critical water supply infrastructure including the water pumping station, and transmission mains (pipelines) from the Dnipro Water Intake resulted in significant damage, leaving the City of Mykolaiv without safe or sufficient drinkable water supply. With a prompt support of the International Financing Institutes and donor organisations, certain emergency water supply measures have been implemented, preventing the spread of water-borne diseases and epidemics.

The water supply system deteriorated further in 2023 with the Russian destruction of the Kakhovka Dam and subsequent downstream damage along the Dnipro River. This negatively impacted water intake facilities in the wider Kherson area and left the City of Mykolaiv without access to a reliable source of drinkable water. As of the end of 2023, the city was still being supplied with non-standard quality water through an irrigation canal (Snihurivka) on the Inhulets River, a tributary of the Dnipro River. In the spring of 2024, water quality deteriorated due to seasonal discharges from mining and industrial enterprises into the Inhulets River.

This temporary solution does not meet the city's drinkable water supply needs. Therefore, a more sustainable long-term solution should be implemented regarding water supply sources, as well as the volume, reliability, and safety of water supply services.

As part of the UMIP Project, a Feasibility Study was carried out in 2024 to identify an alternative water source, define the most feasible solution for the water intake from the Southern Buh River, as well as the rehabilitation and commissioning of the Zhovtneve Reservoir as the main future source and reserve for the city water supply.

In the end of 2024, the city was still being supplied with non-standard quality water through an irrigation canal (Snihuriv) on the Inhulets River, a tributary of the Dnipro River.

The overall water supply objective of the city is to ensure sustainable and safe water supply, in necessary quantity and quality, through the use of the following sources:

- the Snihuriv Irrigation Canal (Inhulets River);
- the Dnipro River;
- the Southern Buh River in the area of Nova Odesa;
- the Vitovske, formerly called Zhovtneve, Reservoir;
- the Buh Estuary (for emergency short-term use).

To this end, the existing WTP will be reconstructed and a new treatment chain will be installed to enable water from any of the above-mentioned sources to be treated to drinkable water quality standards.

The facility belongs to Group II in terms of its impact on the ambient air pollution and is classified as a municipally owned enterprise.

Name of the economic activity of the business entity according to KVED (*the Ukrainian Classification of Economic Activities*):

36.00 – Water collection, treatment and supply;

37.00 – Sewerage, wastewater collection and treatment;

41.20 – Construction of residential and non-residential buildings;

42.21 – Construction of pipelines;

71.11 – Architectural activities;

71.20 – Technical testing and research.

There are no other business entities operating on the facility's site.

1.1 - Description of the Planned Activity Implementation Site

The WTP facility site is located in Mykolaiv oblast, Korabelnyi district, which is the south-eastern part of Mykolaiv.

The WTP facility is located at the following address: Yantarna street, bldg. 324-є, Korabelnyi district, Mykolaiv, Mykolaiv oblast.

It is assumed that the planned activity will be implemented within the existing site of Mykolaiv's water treatment plant.

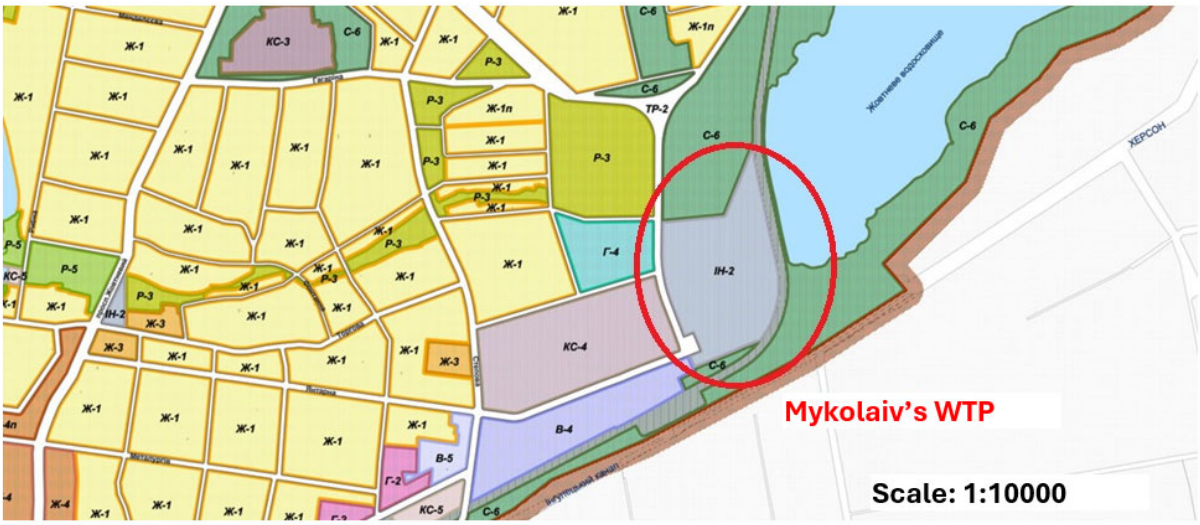
The location of the WTP site is shown in the Figures 1 and 2 below.

The site of the existing WTP, where the planned activity is assumed to be implemented, is surrounded by the following areas:

- to the north – the green planting area within the sanitary protection zone;
- to the west – the industrial enterprise UPTK "Mykolaivprombud", a zone designated for Class IV sanitary classification facilities, and a cultural and sports zone;
- to the south – the railway track and the green planting area within the sanitary protection zone;
- to the east – the railway track and Vitovske (Zhovtneve) Reservoir; and
- the nearest residential area is 890 m away.

The zoning scheme of the area designated for the planned activity, in accordance with the Mykolaiv Zoning Plan, is presented below.

FIGURE 1 – ZONING SCHEME OF THE AREA DESIGNATED FOR MYKOLAIV'S WATER TREATMENT PLANT



Legend:

Zones of the engineering infrastructure

ИН-2	Zone of the engineering infrastructure (Mykolaiv's WTP site)

Public zones

Г-2	Business zone of district-level centres
Г-4	Cultural and sports zone

Residential zones

Ж-1	Single-family housing zone
Ж-1п	Prospective single-family housing zone
Ж-3	Mixed low-rise 2 to 4 storey residential and public development zone
Ж-4	Zone of mixed medium-rise residential buildings and public use buildings
Ж-4п	Zone of prospective mixed medium-rise residential buildings and public use buildings

Recreational zones

Р-3	Public green recreational area
Р-5	Zone designated for recreation and entertainment

Transport infrastructure zone

ТР-1з	Railway zone
ТР-2	Street right-of-way

Service and warehouse zones

КС-3	Zone designated for Class III sanitary classification facilities
КС-4	Zone designated for Class IV sanitary classification facilities
КС-5	Zone designated for Class V sanitary classification facilities

Industrial zones

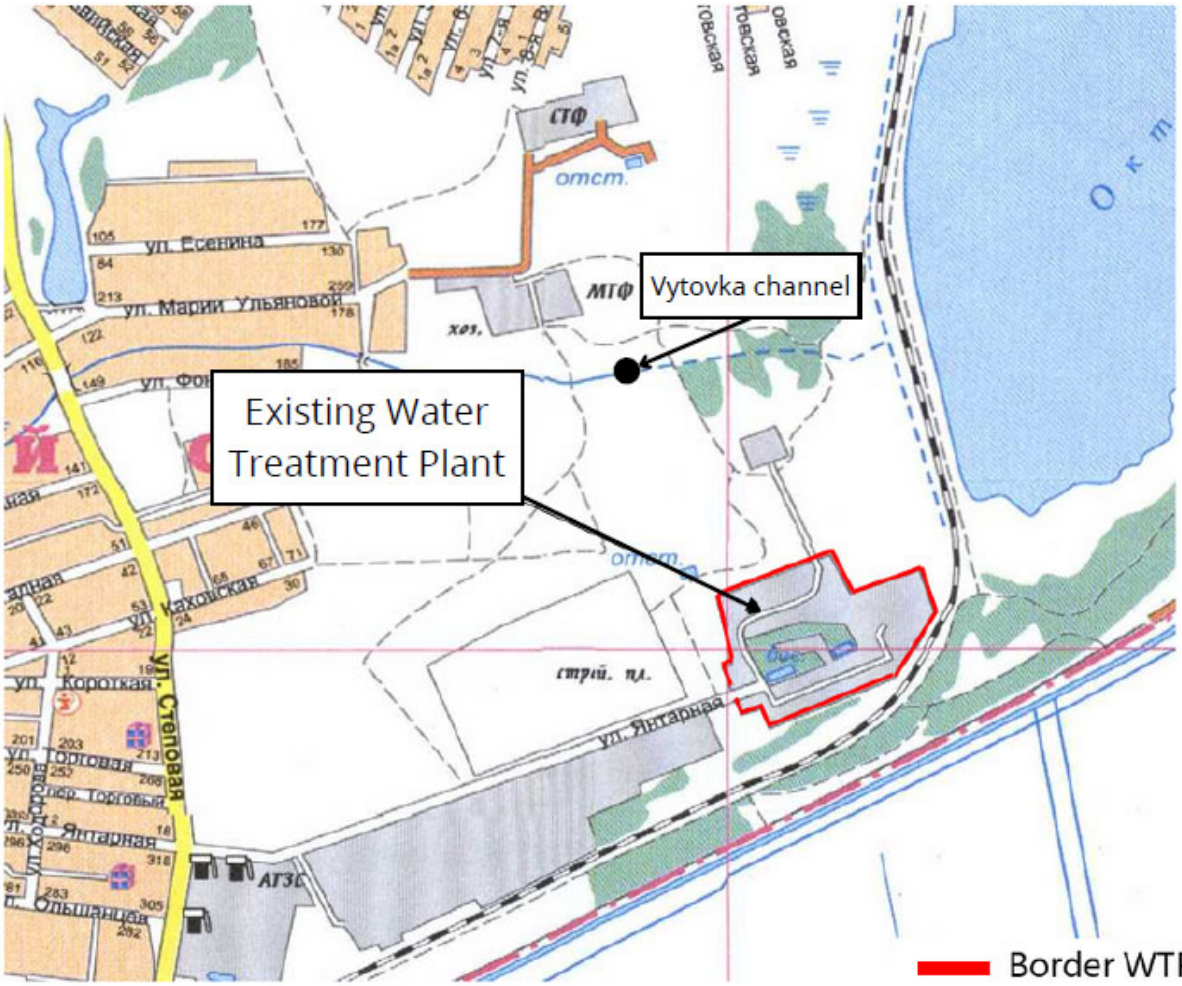
В-4	Zone designated for enterprises of Hazard Class IV
В-5	Zone designated for enterprises of Hazard Class V

Special zones

C-6 Green planting area within the sanitary protection zone

Source: The Mykolaiv Zoning Plan in accordance with the approved Master Plan of the City.

FIGURE 2 – SCHEMATIC PLAN OF THE EXISTING WATER TREATMENT PLANT SITE

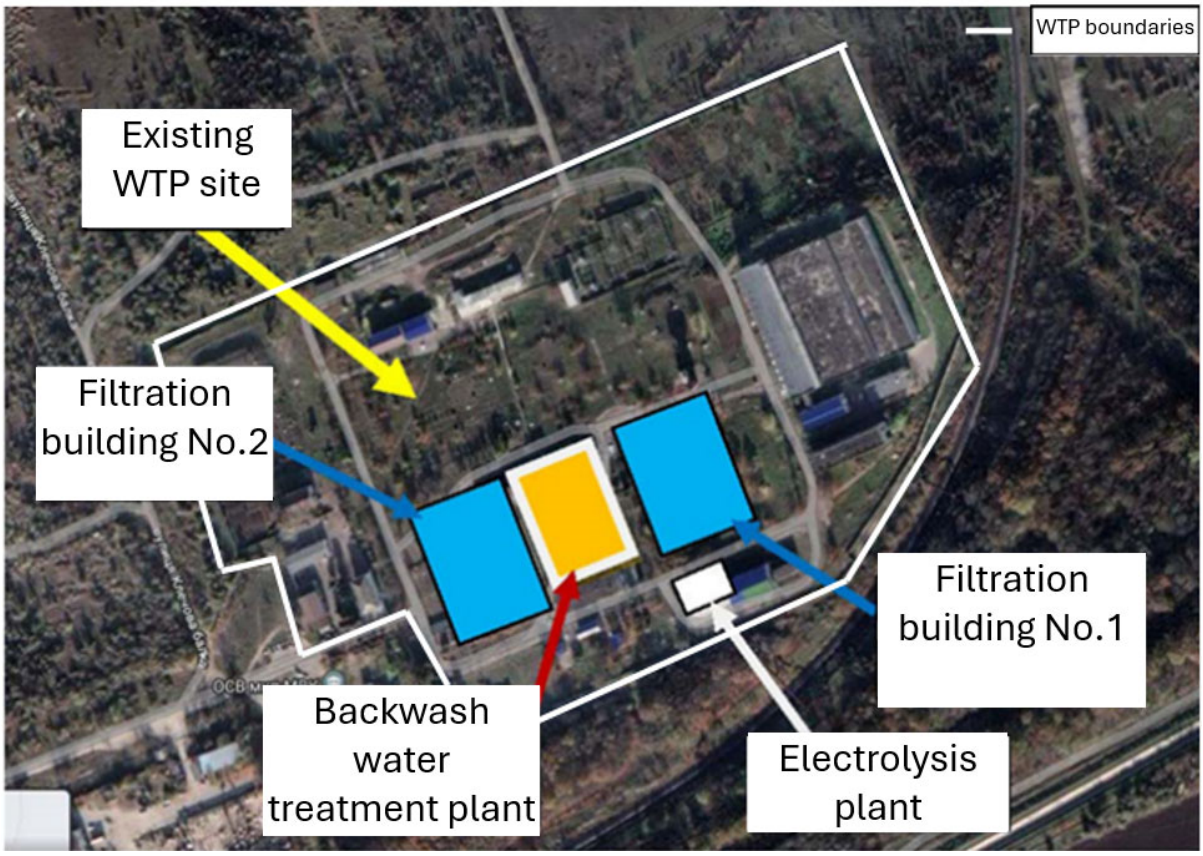


Source: Open street map (http://openstreetmap.org)

The site land is owned by the City of Mykolaiv (municipal property) and has the cadastral number 4810136600:06:042:0051.

The layout of the designed facilities within the existing water treatment plant (WTP) site is shown in the Figure below.

FIGURE 3 – LAYOUT OF THE DESIGNED FACILITIES WITHIN THE EXISTING WTP SITE



Source: Google maps, TA-SP Consultant

The reconstruction of the water treatment plant (WTP) in Mykolaiv is assumed to include construction of the discharge collector designed to discharge brine (i.e., the pipeline for brine conveyance). Brine water is generated only when the reverse osmosis installations are in operation in Mode B, which is designed for treatment of water from the Snihurivka irrigation canal (the Inhulets River) and also includes an additional desalination stage to reduce the Total Dissolved Solids content. Mode C allows for emergency short-term treatment of water from the Buh estuary. The discharge collector is assumed to be placed within Mykolaiv district of Mykolaiv oblast.

FIGURE 4 – CONCENTRATE (BRINE) CONVEYANCE

Source: Consultative Analysis Report on Wastewater Discharge Location for the Water Supply Project in Mykolaiv

In this case, the pipeline will be routed to bypass populated areas, crossing the lands of Mykolaiv City Territorial Community and Halytsynove Territorial Community.

Geodetic coordinates of the WTP are shown in the Table below.

TABLE 3 – GEODETIC COORDINATES OF MYKOLAIV'S WTP

Latitude			Longitude		
Degrees	Minutes	seconds	degrees	minutes	seconds
(°)	(')	('')	(°)	(')	('')
46	52	38	32	04	06

Source: Documents justifying emission volumes for obtaining a permit for pollutant emissions into ambient air from stationary sources for the MUC "Mykolaivvodokanal" (industrial site No.2 – WTP)

1.2 - Objectives of the Planned Activity

The overall objective of the Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" is to implement the most justified, sustainable and reliable solution for drinkable water supply in Mykolaiv.

The planned activity subject to environmental impact assessment is to reconstruct the water treatment plant (WTP) in Mykolaiv.

Phases of design: Preliminary design (the concept of the future facility) to obtain financing from the International Financial Institutions. The preliminary design was prepared to provide indicative design solutions and preliminary cost estimates for the proposed infrastructure investment, namely for the reconstruction of the existing water treatment plant through implementing a new process chain.

The preliminary design was prepared under conditions of Martial Law.

The planned activity, in accordance with Clause 10 (construction of dams and installation of other equipment for the long-term retention or accumulation of water) and Clause 13 (economic activity leading to the discharge of pollutants into water bodies) of Part 3, Article 3 of the Law of Ukraine "On Environmental Impact Assessment" No. 2059-VIII of 23 May 2017 [1], falls under the second category of activities and facilities that may have a significant impact on the environment and are subject to environmental impact assessment. The planned activity will be financed with the involvement of foreign loans under state guarantees.

To ensure continuous and reliable water supply in Mykolaiv, the proposed design for WTP reconstruction assumes the treatment of water from five potential sources of surface water:

- Water supply from the Dnipro River (Kherson Intake);
- Water supply from the Southern Buh River in the area of Nova Odesa;
- Water supply from Zhovtneve (Vitovske) Reservoir;
- Water supply from the Snihurivka Irrigation Canal (the Inhulets River); and
- Water supply from the Buh Estuary source (for emergency short-term use).

While the preferred future scenario is to supply the city with water from the Dnipro and/or the Southern Buh Rivers through Zhovtneve (Vitovske) Reservoir – the only currently available water sources are the Inhulets River as the main source and the Buh estuary as an emergency short-term source. Water from both sources requires treatment for microbiological parameters as well as turbidity, colour, organic content, and also requires desalination. While water from the Inhulets has a salinity of up to 3,500 mg/dm^3, the water from Buh estuary has a total dissolved solids content of up to 12,000 mg/dm^3. Therefore, the existing water treatment plant (WTP) is planned to be reconstructed.

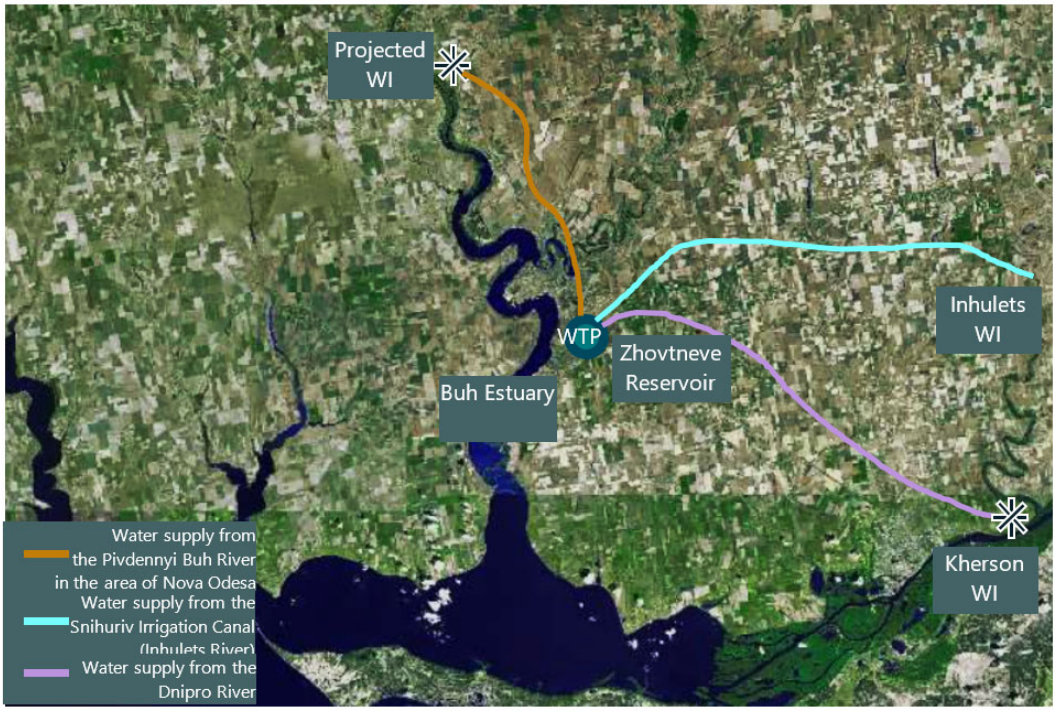
The water treatment plant (WTP) should be designed to achieve drinkable water quality according to the Ukrainian Standard DSanPiN 2.2.4-171-10 "Hygienic Requirements to Drinkable Water Intended for Human consumption" [2], and the EU Drinking Water Directive 2020/2184 [3].

1.2.1 - Water Supply Schemes from Various Sources

Future water supply to Mykolaiv is expected to be provided from various surface water sources. The total water amount will be conveyed to the designed water treatment plant for treatment, storage and supply into the city networks.

The geographical location of the planned surface water sources is provided in the Figure below.

FIGURE 5 – PLANNED SURFACE WATER SOURCES



Source: Google Earth, TA-SP

The overall objective is to create a resilient and sustainable water supply system for the city of Mykolaiv.

In addition to the existing water intakes on the Dnipro and the Inhulets Rivers, a new alternative water intake on the Southern Buh River is currently under implementation by the Government of Ukraine. All existing and new water intakes (except for the Buh Estuary water) are designed to deliver water to Zhovtneve Reservoir, which is planned to be rehabilitated in the near future. From the reservoir, the water will be delivered to the new WTP, subject to implementation of this Preliminary Design.

In the absence of the reservoir and to increase the viability of the system, the raw water from the above sources is designed to be supplied directly to the WTP, by-passing the non-functioning reservoir. Therefore, the design of the WTP should provide sufficient operational flexibility of the treatment process to adapt to the varying quality of water from different sources, as described below.

The Inhulets River:

At present, water to the existing WTP is supplied via the Snihurivka irrigation system from the Inhulets River. In this mode, in addition to the removal of common surface water pollutants, the new WTP should allow to reduce the total mineral content of the treated water using the reverse osmosis system. To reduce treatment costs, its should be allowed for the saline water to be blended with the treated water.

The Dnipro River:

This used to be the single source of water for Mykolaiv until it was destroyed in April 2022. In the case of restoration of the existing water intake in Kherson oblast, the water from the intake will be supplied either to Zhovtneve Reservoir (and further repumped to the WTP), or directly to the new WTP site, and further stored into two raw water tanks. The quality of the surface water from the Dnipro River does not require reverse osmosis to be applied, and this scenario does not assume that the treated water will be subsequently mixed or blended.

The Southern Buh River:

This surface water intake, currently under implementation, is designed to deliver water to the future-rehabilitated Zhovtneve Reservoir. Alternatively, water can be delivered directly to the designed water treatment plant (WTP). The quality of the surface water from the Southern Buh River does not require reverse osmosis to be applied, and this scenario does not assume that the treated water will be subsequently mixed or blended.

Zhovtneve Reservoir:

Zhovtneve Reservoir is planned to create a safe reserve of surface water for Mykolaiv. It is planned to receive raw water from any of the above sources – the Inhulets, the Dnipro and the Southern Buh – with stored water pumped to the water treatment plant.

The Buh Estuary:

It is also assumed to deliver water from the Buh estuary to the water treatment plant in case of emergency. This scenario assumes that saline water will be delivered to the WTP's raw water tanks to further undergo reverse osmosis. Considering significant hydrodynamic load on the membranes, this emergency scenario is expected to be in operation for a period **not exceeding one week**.

Clarification: There are two saline water sources: the Inhulets River and the Buh Estuary. Both are designed to utiliie reverse osmosis (RO) for treatment. However, the operational modes differ significantly. The definitive automation requirements will be determined during the detailed design phase. Such operational modifications are typically implemented by the process engineer, when the primary water source becomes unavailable.

Regardless of water source, all inlet raw water is designed to be delivered to the WTP's head chamber with a minimum inlet pressure of 1 bar.

1.2.2 - Description of the Planned Activity

The reconstruction of the existing water treatment plant (WTP) with implementation of the new process chain is assumed to include an additional desalination stage to reduce the Total Dissolved Solids content.

The WTP is designed to operate in two main operational modes and one emergency operational mode:

- Operational Mode A is designed to be used for treating water from the Dnipro River, the Southern Buh River and Zhovtneve (Vitovske) Reservoir. The water treatment process is carried out without desalination stage.

- Operational Mode B is designed for treating water from the Snihurivka Irrigation Canal (the Inhulets River) and includes an additional desalination stage to reduce the Total Dissolved Solids content.

- Mode C allows for emergency short-term treatment of water from the Buh estuary.

The design capacity of the new plant is correlated with the city's water demand forecast until 2033, which was carried out as part of the Feasibility Study approved by the Final Beneficiary and the Client.

As the city of Mykolaiv has been without drinkable water supply of prescribed quality for the last two years, TA-SP was instructed by the Beneficiary to design the plant in several implementation phases to allow putting into operation of the first part of the Facilities in order to meet the current city's water demand as soon as possible:

- **Implementation Phase 1:** WTP facilities should be designed to satisfy the current city's demand of 90,000 m^3/day of treated water;
- **Implementation Phase 2:** WTP facilities should be complemented with the equipment to satisfy the projected city's demand of 160,000 m^3/day of treated water.

The designed WTP capacities under the various operational modes for each implementation phase are summarised in the Table below:

TABLE 4 – DESIGNED WATER TREATMENT PLANT CAPACITY PER SOURCES OF WATER AND PHASES OF IMPLEMENTATION

RAW WATER SOURCE	TOTAL INLET RAW WATER FLOW, M^3/DAY	TOTAL TREATED WATER FLOW, M^3/DAY	PHASE 1 TREATED WATER FLOW, M^3/DAY	PHASE 2 TREATED WATER FLOW, M^3/DAY	OPERATIONAL MODES
The Dnipro River	160,000	160,000	90,000	70,000	**A1, A2**
The Southern Buh River	160,000	160,000	90,000	70,000	
Zhovtneve Reservoir	160,000	160,000	90,000	70,000	
Main Canal of the Inhulets River	160,000	125,000	70,000	55,000	**B1, B2**
The Buh Estuary	160,000	80,000	45,000	35,000	**C1, C2**

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

1.2.2.1 - Selection of Treatment Process

The general approach to the selection of the treatment process was based on the conclusions and recommendations of the Water Treatment Plant Adaptation Measures Report[1] for the City of Mykolaiv. This Report was made based on laboratory studies of various treatment methods for the water samples taken from various water sources.

In the referenced study, various suitable process chains for the treatment of raw waters from various water sources have been assessed, as summarised in the Table below.

TABLE 5 – LIST OF WATER TREATMENT METHODS FOR TECHNOLOGICAL RESEARCH FOR EACH WATER SAMPLING POINT

NO.	WATER SOURCE	INDICATORS TO BE ADJUSTED					TREATMENT TECHNOLOGIES		
		Turbidity	Colour	Odour	Organic matter	Salinity	Coagulation with filtration	Sorption on activated carbon	Reverse osmosis
1	Water supply from the Dnipro River	+	+		+		+	+	
2	Water supply from the Southern Buh River in the area of Nova Odesa	+	+		+		+	+	
3	Water supply from Zhovtneve Reservoir	+	+	+	+		+	+	
4	Water supply from the Snihurivka Irrigation Canal (Inhulets River)	+	+	+	+	+	+	+	+
5	Water supply from the Buh Estuary (for short-	+			+	+	+	+	+

[1] *TA-SP, Water Treatment Plant Adaptation Measures Report, January 2024, EIB, UMIP*

term use)

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

The following technological methods were recommended in the report to bring the quality of water from the selected potential sources to drinkable quality standards. A summary of those methods is provided below.

Water of the Dnipro River

To correct organoleptic parameters, contact coagulation with the use of coagulants based on aluminium hydroxychloride in doses up to 10 mg/l for Al_2O_3 was recommended. The colour was reduced to the standard at a dose of 25 mg/l for Al_2O_3, but this led to residual aluminium above 0.2 mg/l.

In the case when organic water pollution in terms of permanganate oxidation in the process of coagulation does not reach the standard value (5 mg/l), sorption treatment of water is carried out after its coagulation.

To correct the content of organic substances in water, it is recommended to sorb water either on powdered charcoal in doses of 10 mg/l, or on granular coal - contact time of 20 minutes.

Water of the Southern Buh River, 40 km

To correct organoleptic parameters, contact coagulation with the use of reagents based on aluminium hydroxychloride in doses up to 10 mg/l for Al_2O_3 was recommended. The colour was reduced to the standard at a dose of 25 mg/l for Al_2O_3, but this led to residual aluminium above 0.2 mg/l.

For the correction of organic substances, sorption was recommended either on powdered charcoal in doses of at least 5 mg/l, or on granular carbon - contact time of at least 20 minutes.

In the case when organic water pollution in terms of permanganate oxidation after the processes of coagulation and absorption does not reach the normative indicators, water was proposed to be treated with ozone. After ozonation of water, it is necessary to remove ozonolysis products from water by sorption treatment using activated carbon.

Water from the Inhulets River - at the inlet of the WTP of the Municipal Utility Company "Mykolaivvodokanal"

To correct organoleptic parameters, contact coagulation with the use of coagulants based on aluminium hydroxychloride in doses up to 10 mg/l for Al_2O_3 was recommended. The colour was reduced to the standard dose of 25 mg/L for Al_2O_3, but this led to residual aluminium above 0.2 mg/L and a decrease in water treatment efficiency. The variant of large coagulation dosage was not used in further technology development.

In the case when organic water pollution in terms of permanganate oxidation in the process of coagulation does not reach the standard value (5 mg/l), sorption treatment of water to be carried out after its coagulation.

To adjust the content of organic substances in water, it was recommended to sorb water either on powdered charcoal in doses of 10 mg/l, or on granular coal – contact time of 20 minutes.

To adjust the mineralisation of water, if it is higher than the hygienic standard (1000 mg/l), it was recommended to treat the water by reverse osmosis with preliminary softening of water, which increases the efficiency of demineralisation up to 95%.

The above recommendations were taken as a basis for the definition of the designed treatment process chain.

The following treatment chain has been adopted under this Preliminary:

- Volumetric or contact coagulation;
- Filtration on pressure filters;
- Sorption cleaning on carbon filters.
- Reverse osmosis for saline water

Upon Beneficiary's consent, it was decided not to implement the ozonation method due to significant operating costs.

1.2.2.2 - Designed Treatment Chain

Based on the above conclusions, the following treatment chain has been defined.

The plant is designed to operate in two major operational modes:

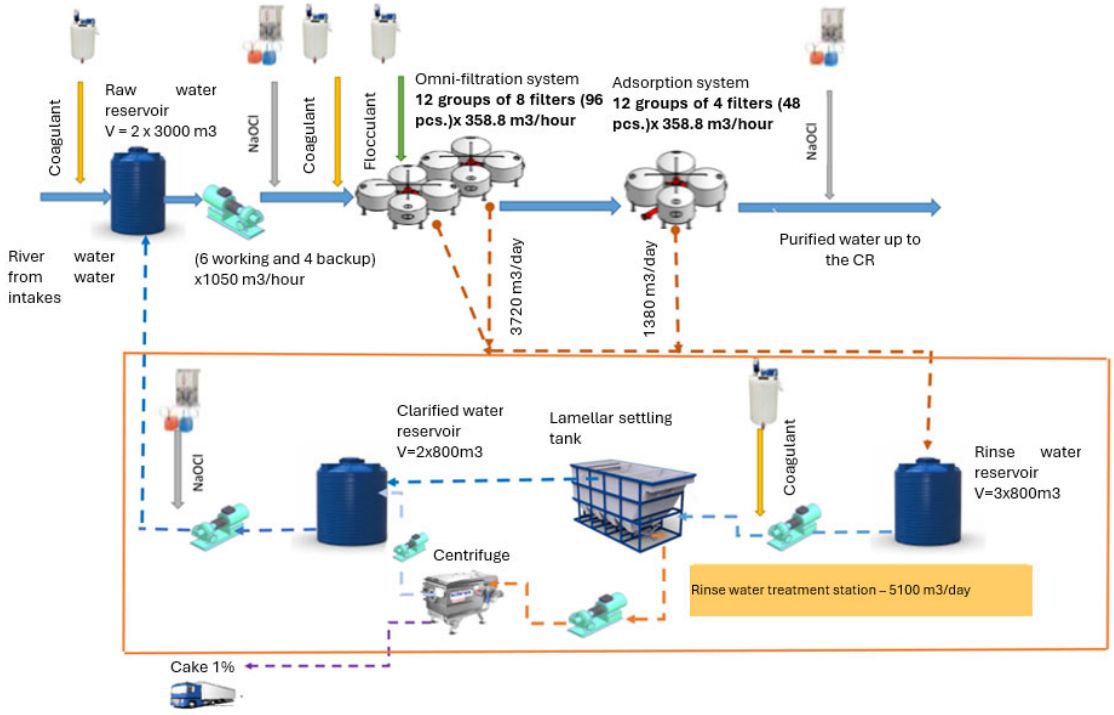
- **Operational Mode A** is designed to be used for treating water from the Dnipro River, the Southern Buh River and Zhovtneve Reservoir. The water treatment process is carried out without desalination (reverse osmosis) stage.
- **Operational Mode B** is designed for treating water from the Snihurivka Irrigation Canal (the Inhulets River) and includes an additional desalination stage to reduce the Total Dissolved Solids content. This mode also allows for an emergency short-term treatment of water from the Buh Estuary (**Mode C**).

Mode A (A1, A2): Without Desalination

- **Raw Water Storage:** Raw water is stored in two inlet reservoirs.
- **Pumping to Filtration:** Water from the reservoirs is fed by Pump Group No. 1 to the filter plant.
- **Coagulant and Disinfectant Dosing:** Coagulants and disinfectant are introduced directly into the feeding pipeline.
- **First-Stage Filtration:** The water enters the upper section of the first-stage multimedia pressure filters.
- **Second-Stage Filtration:** Water from the lower section of the first-stage filters flows with residual pressure to the second stage of multimedia filters.
- **Third-Stage Filtration:** The water proceeds to the third stage of pressure filtration, passing through pressure granular activated carbon (GAC) filters.
- **Treated Water Storage and Disinfection:** Treated water is collected in the existing clean water reservoirs where secondary disinfection with sodium hypochlorite takes place.
- **Filter Backwashing:** Periodic backwashing and direct washing of the pressure filters is performed using raw water from reservoirs.
- **Backwash Water Treatment:** Backwash water is designed to be conveyed to a dedicated treatment plant. After sedimentation in clarifiers equipped with laminar modules, settled water is collected from the upper part of the clarifiers and returned to the head of the treatment works.

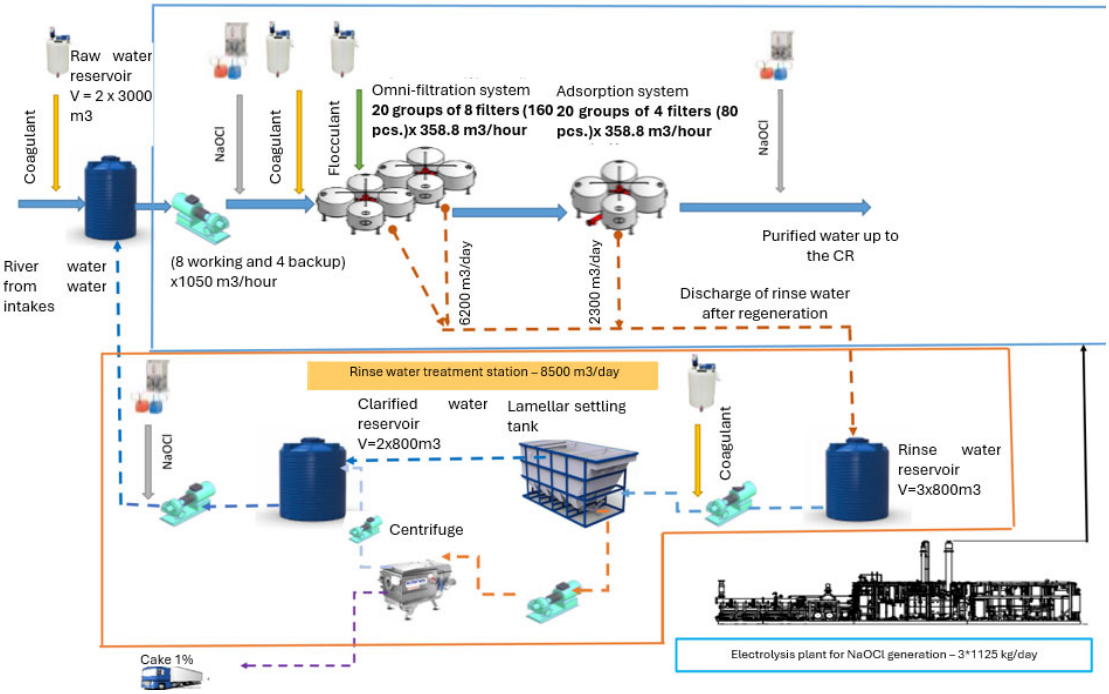
Flow diagrams of the Facilities operating mode A for both implementation phases are provided in the Figures below:

FIGURE 6 – FLOW DIAGRAM OF THE PLANT OPERATION MODE A, IMPLEMENTATION PHASE 1 MODE A1



Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

FIGURE 7 – FLOW DIAGRAM OF THE PLANT OPERATION MODE A, IMPLEMENTATION PHASE 2 MODE A2



Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

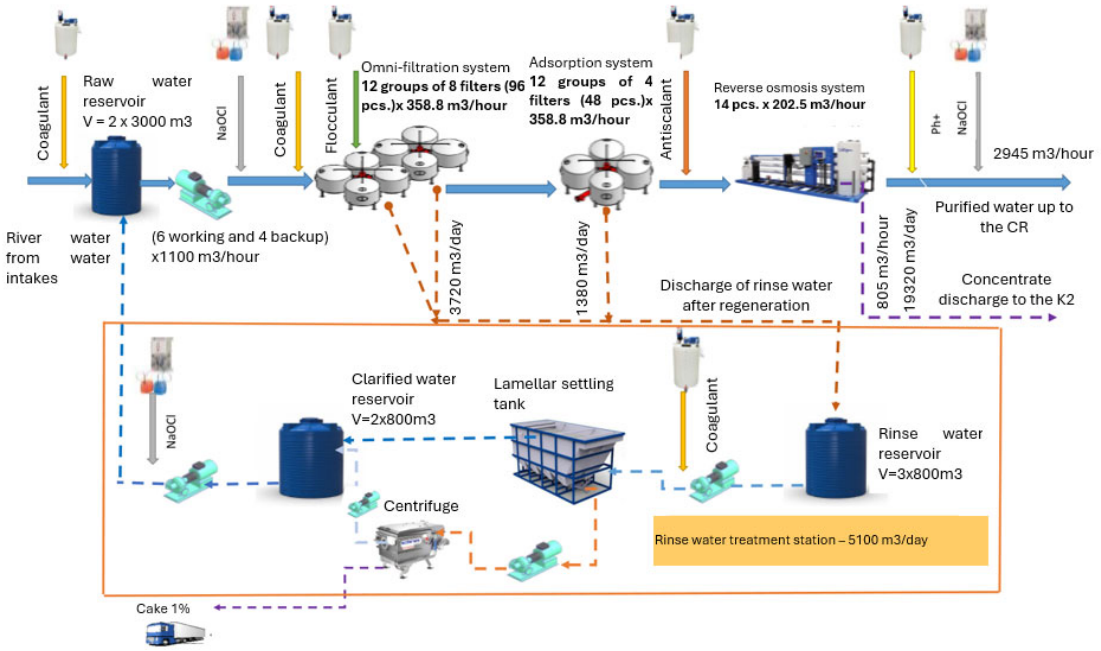
The treatment chain for operational mode A (A1 and A2) includes preliminary disinfection with sodium hypochlorite, two stages of multimedia pressure filters, with coagulant dosing to the first stage, and one stage of granulated active carbon (GAC) pressure filters. To provide the necessary inlet water pressure, a pumping station has been designed. Water after treatment is collected and delivered to the existing clean water reservoirs where it passes secondary disinfection.

Mode B (B1, B2): With Reverse Osmosis

- **Raw Water Storage:** Raw water is stored in two inlet reservoirs.
- **Pumping to Filtration:** Water from the reservoirs is pumped by Pump Group No. 2 to the filter plant.
- **Coagulation and Disinfectant Dosing:** Coagulants and sodium hypochlorite are introduced directly into the feeding pipeline.
- **First-Stage Filtration:** The water enters the upper section of the first-stage multimedia pressure filters.
- **Second-Stage Filtration:** Water from the lower section of the first-stage filters flows with residual pressure to the second stage of multimedia filters.
- **Third-Stage Filtration:** The water proceeds to the third stage of pressure filtration, passing through pressure carbon filters.
- **Reverse Osmosis:** Water under residual pressure is then fed to the Reverse Osmosis (RO) units.
- **Treated Water Storage and Disinfection:** Treated water is collected in the existing clean water reservoirs where secondary disinfection with sodium hypochlorite takes place.
- **Filter Backwashing:** Periodic backwashing of the rapid filters is performed using raw water.
- **Backwash Water Treatment:** Backwash water is designed to be conveyed to a dedicated treatment plant. After sedimentation in clarifiers equipped with laminar modules, settled water is collected from the upper part of the clarifiers and returned to the head of the treatment works.
- **Discharge of Brine:** The RO concentrate is discharged through a newly constructed system to discharge point (see Section 2 for details).
- **Hypochlorite Generation:** Sodium hypochlorite solution is prepared using specialised equipment housed in the electrolysis building.

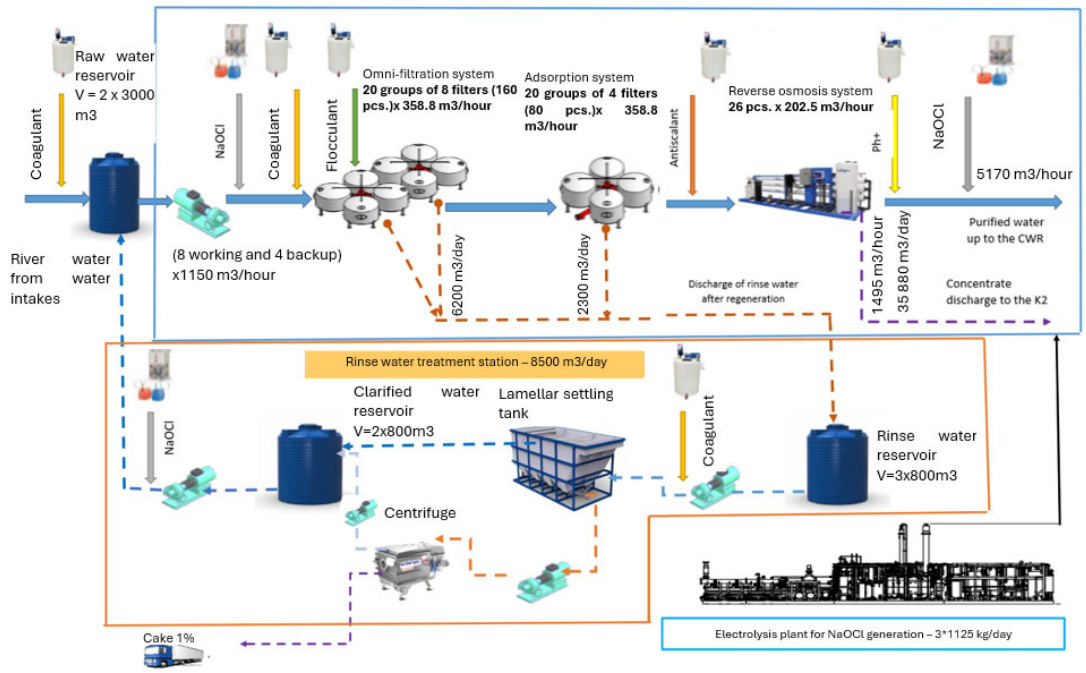
Flow diagrams of the Facilities operating mode B for both implementation phases are provided in the Figures below:

FIGURE 8 – FLOW DIAGRAM OF THE PLANT OPERATION MODE B, IMPLEMENTATION PHASE 1 MODE B1



Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

FIGURE 9 - FLOW DIAGRAM OF THE PLANT OPERATION MODE B, IMPLEMENTATION PHASE 2 MODE B2



Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

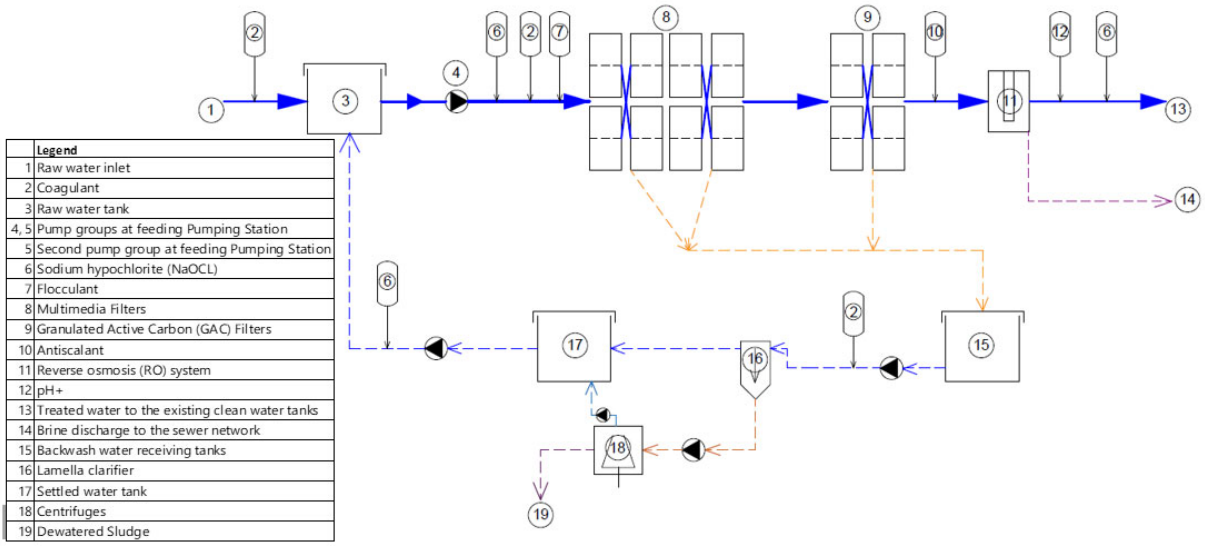
Under the operational mode B (B1 and B2), the above process chain comprises preliminary disinfection with sodium hypochlorite, two stages of multimedia pressure filters and one stage of granulated active carbon (GAC) pressure filters, complemented with a reverse osmosis (RO) stage for water desalination. Treated water is designed to allow partial mixture with by-pass water taken after GAC-filters and storage in the existing clean water reservoirs for secondary disinfection.

Both multimedia and GAC pressure filters are washed with the inlet raw water taken after the first stage disinfection. Backwash and direct flush water from filters are designed to be treated and recycled at a separate Backwash Water Treatment Plant. The treated backwash water returns to the WTP head and only dewatered solids are disposed, ensuring a closed filter wash cycle.

Mode C is basically the Mode B run in an **emergency mode** due to high-mineral content of the Buh estuary water. This is an emergency mode allowed for short-term operation and therefore it is not considered for regular daily operation of the plant.

The proposed treatment chain is provided in the Figure below:

FIGURE 10 – GENERAL TREATMENT PROCESS CHAIN



	Legend
1	Raw water inlet
2	Coagulant
3	Raw water tank
4, 5	Pump groups at feeding Pumping Station
5	Second pump group at feeding Pumping Station
6	Sodium hypochlorite (NaOCL)
7	Flocculant
8	Multimedia Filters
9	Granulated Active Carbon (GAC) Filters
10	Antiscalant
11	Reverse osmosis (RO) system
12	pH+
13	Treated water to the existing clean water tanks
14	Brine discharge to the sewer network
15	Backwash water receiving tanks
16	Lamella clarifier
17	Settled water tank
18	Centrifuges
19	Dewatered Sludge

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

1.2.2.3 - Backwash Water Treatment and Sludge Handling

The construction of the backwash water treatment and sludge handling plant includes the installation of necessary plant and equipment for cleaning the backwash water, which originates from the washing of filters. This treated water then will be returned to the head of the water treatment facilities. The building also foresees auxiliary rooms, and built-in premises for administrative and sanitary purposes.

Periodic backwashing of the pressure filters is carried out using raw water from reservoir. The automated filter control system allows for the disconnection of individual filter groups to ensure adequate flow rates for effective backwashing. Backwashing is performed in reverse flow (upward flow) to dislodge accumulated solids. Then a phase of direct wash is followed to clean the remaining impurities and arrange the filter beds.

Backwash Water Treatment:

The backwash water treatment system operates as follows:

1. **Collection:** Drained backwash water is collected in a regulating reservoir.

2. **Sedimentation:** From the reservoir, the water is fed to the clarifiers and flows by gravity through the lamella modules. To enhance sedimentation, coagulants or flocculants can be added if deemed necessary during the operation.
3. **Recycling:** The settled water is collected from the upper part of the clarifiers and returned to the head of the treatment works for reuse.
4. **Sludge Disposal:** Liquid sludge from the bottom of the clarifiers is conveyed to the centrifuges. Dewatered sludge is dumped to trucks by use of screw conveyors. Further dewatered sludge is transported to solid municipal waste landfill.

Brine Discharge:

Brine water appears only while treatment plant works in B (B1, B2) mode. The generated brine flow in B1 mode is 805 m^3/hour (19,320 m^3/day), and in B2 mode is 1,495 m^3/h, (35,880 m^3/day).

Two options for discharge of the salty brine water from reverse osmosis have been considered:

- Blending of brine water with the treated effluent from the Mykolaiv wastewater treatment plant (near the village of Halytsynove). By mixing the brine water with the treated wastewater effluent, the salt mass balance will be the same as in case of direct supplying of untreated saline water into the centralised water supply system. Therefore, the environmental impact is minimised.
- Brine discharge through newly constructed 700mm diameter pipelines laid along the Vitovska Creek for a distance of 4.5 km. These pipelines terminate in a deep-water outfall for discharge into the Southern Buh River.

To determine and justify an environmentally safe discharge location for the brine from the planned water treatment plant in Mykolaiv, hydrological studies were conducted, resulting in the development of a Consultative Analysis Report on Wastewater Discharge Location for the Water Supply Project in Mykolaiv (provided as a separate document due to its size). According to Letter No. 238/10 dated 14.02.2025 from the Regional Office of Water Resources in Mykolaiv Oblast (Annex 1), the office agrees with the conclusions of the above-mentioned Report. Specifically, the option to transport the brine via a pipeline from the WTP through uninhabited areas near the village of Balabanivka to a location downstream of the Mykolaiv wastewater treatment plant (near the village of Halytsynove) – where it would mix with treated municipal wastewater before being discharged into the existing outfall in the Buh Estuary – is considered both rational and acceptable as this approach results in improved quality indicators of the concentrate (the brine) before its discharge considering that the process of brine mixing with the treated effluent from the Mykolaiv WWTP (in Halytsynove) will reduce the salinity levels of the concentrate. This dilution effect is a significant positive environmental factor in maintaining the quality of surface water of the Buh Estuary.

1.2.3 - Designed Lifetime of WTP Facilities and Project Implementation Programme

The following lifetime is assumed in accordance with the Tender Documentation.

TABLE 6 – DESIGNED LIFETIME OF EQUIPMENT AND FACILITIES

EQUIPMENT AND FACILITIES	YEARS
Suction water conduits (polyethylene, to be specified by the project)	50
Pressure water pipelines (polyethylene, to be specified by the project)	50
Pressure filters (excl. filter media)	25
Reverse osmosis plants (excl. membranes)	25
Concrete structures (buildings and water intake structures)	50
Roads	50
Metal structures	25
Butterfly valves	10
Stamp-welded wedge gate valves	10

Pumping units (Q = 670 l/s; h = 35 m)	10
Electrical	10
Electrical Cables, Accessories	25
Process control equipment and SCADA	10

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

The Procurement Programme, as specified in the Tender Documentation, is provided in the Table below.

TABLE 7 – PRELIMINARY PROCUREMENT SCHEDULE

PROCESS	DATE
Invitation to Prequalification	May 2025
Submission of Applications	June 2025
Prequalification Results	August 2025
Invitation to Tender	September 2025
Submission of Tenders	October 2025
Contract Award and Signing	December 2025

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

Project commencement is scheduled on December 2025.

The Project Implementation Programme, as specified in the Tender Documentation, is provided in the Table below.

TABLE 8 – PROJECT IMPLEMENTATION PROGRAMME

PROCESS	TERM
Development of Feasibility Study and Design Documentation (Design Stage P), Including State Expert Review and Obtaining the Construction Permit	10 months after the Contract signing
Development of Design Documentation (Design Stage R)	12 months after the Contract signing
Commencement of Implementation Phase 1 (reconstruction of the WTP and Equipment to Secure the Design Capacity of 90,000 m^3/day)	10 months after the Contract signing
Completion of Implementation Phase 1	36 months after the Contract signing
Commencement of Implementation Phase 2 (Enhancing the WTP's Capacity to 160 000 m^3/day	36 months after the Contract signing
Completion of Implementation Phase 2	48 months after the Contract signing
Commencement of Construction of the Concentrate (Brine) Conveyance Pipeline	10 months after the Contract signing
Completion of Construction of the Concentrate (Brine) Conveyance Pipeline	36 months after the Contract signing

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

Despite the fact that the Contractor is expected to carry out the works in parallel, implementation and commissioning of Phase 1 is considered an absolute priority. Construction of the collector for concentrate (brin)e discharge is expected to be completed in parallel with Phase 1, and Phase 2 is expected to be commissioned in another year.

The entire construction period is scheduled to be completed within 38 months.

Commissioning of Phase 1 is scheduled in 3 years after the Contract signing, namely in **December 2028**.

Commissioning of Phase 2 is scheduled in 4 years after the Contract signing, namely in **December 2029**.

Decommissioning is not planned. Instead, further activities may include major repairs or reconstruction, depending on the future needs of the City of Mykolaiv.

1.2.4 - Preliminary Number of Workers Involved in Civil Works

The number of workers depends on the Contractor that will be awarded the Contract for Works.

At a minimum, the following specialist teams are expected to be involved:

- Civil works, including demolition and construction of four buildings, and external and internal finishing works, – 10 teams (50 workers);
- Installation of external water supply and sewerage networks – 2 teams;
- Collector for concentrate discharge – 2 teams;
- Installation of external electrical networks – 2 teams;
- Treatment process chain – 4 teams;
- Chemicals facility – 2 teams;
- Automation – 2 teams;
- Internal water supply and sewerage networks – 3 teams;
- Internal electrical networks – 3 teams;
- Ventilation and heating – 3 teams;
- Fire safety, outdoor security system, lighting – 2 teams;
- External roads and landscaping – 2 teams.

1.2.5 - Target Performance Indicators

To meet the water treatment quality standards specified in the requirements below, a variety of design and equipment options are available. However, to ensure the best value for money, certain values have been defined for the components.

The works are divided into two phases in accordance with the construction schedule and the planned water production volumes (Phase 1 and Phase 2). Additionally, to provide the flexibility required for different water intake sources, the operational modes have been defined as specified below (see Table 4 for details).

Each operational mode will be tested prior to commissioning, and if it is confirmed to meet the specified requirements, it may subsequently be accepted by the Client on an individual basis.

1.2.5.1 - WTP Capacity

All the plant components, including raw water transport works shall have a capacity permitting the conveyance and treatment of influent with the quality parameters required so that the constant outflow of the plant will be the flow as defined below at all times.

TABLE 9 – DRINKABLE WATER FLOWS AT THE FACILITIES OUTLET

OPERATIONAL MODE	UNIT, M^3/DAY
Operational mode A1	90,000
Operational mode A2	160,000
Operational mode B1	70,000
Operational mode B2	125,000

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

1.2.5.2 - Quality of the Treated Effluent

The design concept allows that the quality of the treated water whether the plant operates in various modes as illustrated in **Table 9** will comply with the standards defined in **Table 10** and will be entirely compliant with the EU Directive - 2020/2184 on the quality of water intended for human consumption and the Ukrainian regulations concerning the quality of drinkable water DSanPiN 2.2.4-171-10, whatever is stricter.

TABLE 10 – DRINKABLE WATER QUALITY STANDARDS

PARAMETER	EFFLUENT LIMIT VALUE	UNIT
Aluminium	0.2	mg/l
Ammonium	0.5	mg/l
Coliform bacteria	0/100ml	Kl/l
Chloride	250	mg/l
***Clostridium perfringens* (including spores)**	0/100ml	kl/l
Residual free chlorine	0.5	mg/l
Residual total chlorine	1.2	mg/l
Conductivity	2,500	µSm/cm
Colour	20	degree
Total hardness	7.0	mmol/l
Iron	0.2	mg/l
Taste	2	points
Manganese	0.05	mg/l
Odour	2	points
Colony count 22°C	No abnormal changes	CEO
Colony count 37°C	100/ml	CEO
Oxidizability	5	mg/l
Ph	6.5-8.5	Units of pH
Sodium	200	mg/l
Surfactants – Total	0.5	mg/l
Sulphate	250	mg/l
Sulphide and Hydrogen sulphide	0.03	mg/l
Turbidity	1.0 NTU	mg/l
Zinc	1.0	mg/l
TDS	1,000	ppm

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

1.2.5.3 - Sludge

The Design concept for all operational modes has the hydraulic and solids processing capacity as defined below:

TABLE 11 – OUTFLOW QUALITY AND PERFORMANCE LEVELS

PARAMETER	UNIT	VALUE
Solids capacity of sludge dewatering	kg DS/hour	1,910.0
Hydraulic capacity of sludge dewatering	m3/hour	29.5
Maximum dosing of polyelectrolyte	kg / ton DS	1.50
Filtrate from sludge dewatering	TSS mg/l	10.0
Concentration of dewatered sludge	% DS	70.0

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

1.2.5.4 - Operating Costs

The Running Cost Calculation is to cover the main operational expenses of the works for a one-year time period and covers all project components covered for each Operational mode. Base data for the calculation of operating costs have been determined in accordance with flows of each operational mode.

TABLE 12 – ANNUAL OPERATING COSTS (MODE A1)

DESCRIPTION	VALUE AND UNIT OF MEASUREMENT
Electricity	12,008,584 kWh
Chemicals for water treatment (aluminium hydroxychloride – coagulant)	394,200 kg
Salt for electrolysis	2,032,594 kg
Chemicals for sludge handling (flocculant)	3,258 kg
HCl	99,545 kg
NaOH	219,000 kg
Addition of filter media to multi-layer filters	16,023 bags x 20 kg = 320,460 kg

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

TABLE 13 – ANNUAL OPERATING COSTS (MODE B1)

DESCRIPTION	VALUE AND UNIT OF MEASUREMENT
Electricity	25,498,958 kWh
Chemicals for water treatment (aluminium hydroxychloride – coagulant)	394,239 kg
Salt for electrolysis	2,032,594 kg
Chemicals for sludge handling (flocculant)	3,285 kg
Replacement of membranes for reverse osmosis	2,560 pcs./year
Replacement of cartridges for reverse osmosis	126 pcs./year
HCl	128,312 kg
NaOH	304,189 kg
Addition of filter media to multi-layer filters	16,023 bags x 20 kg = 320,460 kg

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

TABLE 14 – ANNUAL OPERATING COSTS (MODE A2)

DESCRIPTION	VALUE AND UNIT OF MEASUREMENT
Electricity	14,425,384 kWh
Chemicals for water treatment (aluminium hydroxychloride – coagulant)	1,226,400 kg
Salt for electrolysis	2,032,594 kg
Chemicals for sludge handling (flocculant)	11,680 kg
HCl	212,364 kg
NaOH	389,333 kg
Addition of filter media to multi-layer filters	26,705 bags x 20 kg = 534,100 kg

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

TABLE 15 – ANNUAL OPERATING COSTS (MODE B2)

DESCRIPTION	VALUE AND UNIT OF MEASUREMENT
Electricity	39,478,984 kWh
Chemicals for water treatment (aluminium hydroxychloride – coagulant)	1,231,998 kg
Salt for electrolysis	2,032,594 kg
Chemicals for sludge handling (flocculant)	11,733 kg
Replacement of membranes for reverse osmosis	4,680 pcs.
Replacement of cartridges for reverse osmosis	234 pcs.
HCl	288,384 kg
NaOH	619,236 kg
Addition of filter media to multi-layer filters	26,705 bags x 20 kg = 534,100 kg

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

1.3 - Description of Characteristics of the Planned Activity for the Period of Preparatory and Civil Works and Implementation of the Planned Activity, Including (If Necessary) Demolition Works and Needs (Constraints) for the Use of Land Plots

1.3.1 - Results of the Technical Assessment of the Current Technical Condition of WTP in Mykolaiv

In accordance with the Materials of inspection of the Building of Main Facilities (BMF), the second stage and the BMF, the third stage of the water treatment plant in Mykolaiv (2017), Technical Report "On Technical Inspection and Determination of the Technical Condition of Building Structures of the Building of Main Facilities (BMF) of the Stage II of the Water Treatment Plant of the MUC "Mykolaivvodokanal", and Technical Report "On Technical Inspection and Determination of the Technical Condition of Building Structures of the

Building of Main Facilities (BMF) of the Stage III of the Water Treatment Plant of the MUC "Mykolaivvodokanal" (2022), the following conclusions have been made:

Line/Stage 1 of the existing WTP: Taking into account the significant physical wear and tear of the buildings of the first line/stage, it was decided to decommission and demolish the buildings and not carry out their reconstruction due to economical inexpediency.

Line/Stage 2 of the existing WTP: The second line facilities are in obsolete technical condition and not planned to be put back into operation. The land occupied by the parts of the second line can be further used for demolition and construction of the new WTP line.

Line/Stage 3 of the existing WTP: The third line facilities will continue functioning to provide continuous treatment of water. This line will remain operational throughout the construction process of the new treatment facility. After commissioning of the new treatment line, the third line will be decommissioned.

1.3.2 - Civil Works

The existing water treatment plant with auxiliary buildings and structures is located on a land plot owned by the city of Mykolaiv. The relief of the site is flat. Landscaping issues will be resolved when developing the construction project. The indicated territory of the enterprise is protected by a solid fence of reinforced concrete slabs and a barrier.

The general layout of the WTP's current condition is provided in Annex 2 (Main Working Drawings).

Prior to starting the main construction work, it is planned to carry out preparatory work:

- Setting out;
- Establishing a plane surface of the building site;
- Construction site fencing;
- Inspection of the existing structures and definition of the demolition method;
- Demolition of the existing building of the existing WTP of the 1st line and WTP of the 2nd line; and
- Demolition of the existing building of the reagent unit for the arrangement of the electrolysis unit for the production of sodium hypochlorite.

1.3.1 - Demolition and Decommissioning Works

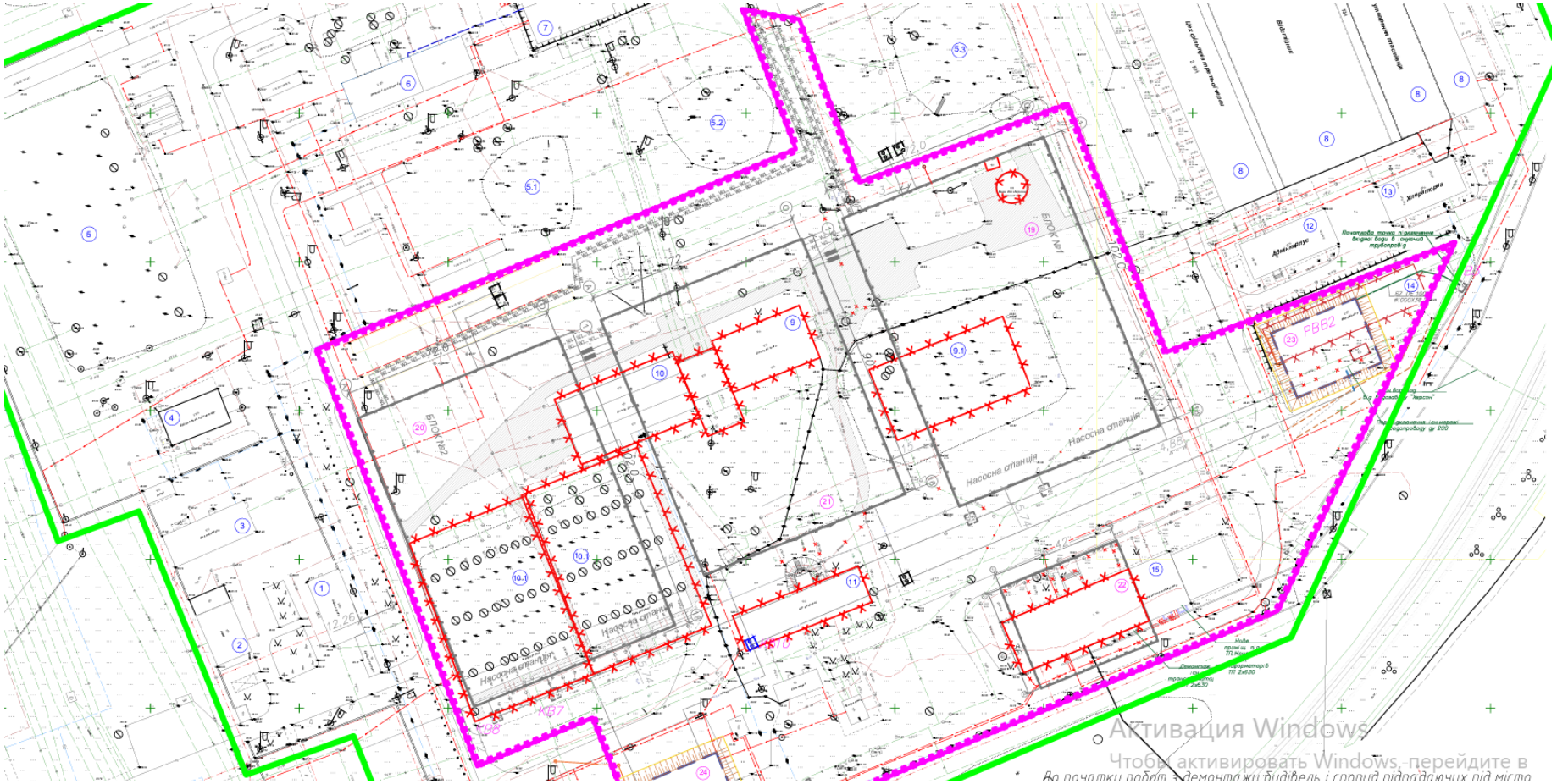
It is planned to demolish the following existing buildings and facilities at the construction site:

- Settling Tank No. 1;
- Settling Tank No. 2;
- Settling Tank No. 3;
- Coagulation Workshop;
- Filter Workshop 1;
- Filter Workshop 2;
- Reagent Facility;
- Microfilter Workshop; and
- Demolishing of technological pipelines, turning platforms, driveways and sidewalks - see sheet ГП.2.

The list can be extended, depending on further site surveys and design solutions adopted at the detailed design stage.

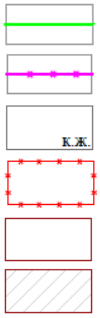
The Demolition Plan – where the facilities (structures and road pavement) to be demolished are specified – is provided in Annex 2 and the Figure below.

FIGURE 11 – DEMOLITION PLAN



Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

Legend:



Boundaries of the existing plant

Boundaries of demolition works

Existing structures

Structures to be demolished

Paved surface (asphalt or concrete pavement)

Road pavement to be demolished

List of buildings and structures			
Plan reference	**Name**	**Number of storeys**	**Note**
1	Administrative facility	1	existing
2	RMM	1	existing
3	Mechanical workshop	1	existing
4	Process water supply building	2	existing
5	Clean water reservoir (CWR), capacity: 2x6,000 m^3	below grade	existing
5.1	Clean water reservoir (CWR), capacity: 2,000 m^3	below grade	existing
5.2	Clean water reservoir (CWR), capacity: 2,000 m^3	below grade	existing
5.3	Clean water reservoir (CWR), capacity: 3,000 m^3	below grade	existing
6	Second-lift pumping station called "Korabel"	2	existing
7	Second-lift pumping station called "Misto"	1	existing
8	Water treatment plant, Line III	1-2	existing
9	Water treatment plant, Line I	1 with a below-grade portion	to be demolished
9.1	WTP settling tank, Line I	below grade	to be demolished
10	Water treatment plant, Line II	1 with a below-grade portion	to be demolished
10.1	WTP settling tanks, Line II	below grade	to be demolished
11	Coagulation workshop	1	to be demolished
12	Administrative facility	2	existing
13	Chlorination plant	2	existing
14	Microfilter building	2	existing
15	Chemicals facility	2	to be demolished (in part)
16	Laboratory	1	existing
17	Boiler house	1	existing
18	Existing open-air power plant (35/6 kV outdoor switchgear)	at-grade	existing
18.1	6 kV switchgear	1	existing
19	Filter station (FS) including a pumping station and the reverse osmosis system. Building 1	1 with a below-grade portion	designed
20	Filter station (FS) including a pumping station and the reverse osmosis system. Building 2	1 with a below-grade portion	designed
21	Backwash water treatment plant	1 with a below-grade	designed

		portion	
22	Sodium hypochlorite generation plant (electrolysis plant)	1	designed
23	Raw water reservoir, capacity of 3,000 m^3	below grade	designed
24	Raw water reservoir, capacity of 3,000 m^3	below grade	designed
25	Storehouse	1	existing

For the proposed scope of facilities, the following structures are designed to be constructed:

- Two raw water reservoirs (inlet tanks) with a capacity of 3,000 m^3 each;
- Two filter buildings, including pumping stations and transformer stations TSS-6/0.4 kV, which are designed for each filter building;
- New building of the backwash water treatment plant;
- New building of the electrolysis plant;
- External engineering networks for the new buildings and access roads;
- The pipeline for brine conveyance.

The Drawings for the location of the designed buildings and structures are provided in Annex 2 and the Figure below.

FIGURE 12 – PRELIMINARY LOCATION OF NEW FACILITIES WITHIN MYKOLAIV'S WTP SITE

Source: The Preliminary Tender Documentation "Mykolaiv Water Supply Sub-Project – 2_MYK_211 (version 03 of 18.02.2025)" as part of Technical Assistance for Ukraine Municipal Infrastructure Programme Projects Preparation and Implementation Support (Funded by NIP) AA-010067-001.

Legend:

Existing facilities

Designed at-grade facilities

Designed below-grade facilities

To allow a proper stormwater run-off at the site, the following measures are planned in accordance with 1.10-1.11 of DBN V.1.1-25-2009 [4]:

- Storm water runoffs (establishing plane inclined surface with drainage);
- Increased ground elevation of filtration station;
- Water collection will be organised based on the layout and the formed topography.

The adjacent access road as well as sidewalks and the adjacent pedestrian zone are planned to be made with asphalt concrete.

The plant layout was designed to meet the requirements of DBN B.2.2-12: 2019 "Planning and Development of Territories" [5] and allow for firebreaks between buildings. The passage of fire trucks is carried out on paved roads on all sides of the building.

1.3.2 - Scope of Works by Implementation Phases

The facilities are designed to be built and commissioned in two implementation phases, as described below.

1.3.2.1 - Implementation Phase 1:

The works under the implementation phase 1 include:

- Relevant Site Surveys and Design Works.

- Preparatory work on the decommissioning and demolition of structures of the first and second lines of existing structures falling into the construction zone (filtration stations and sedimentation tanks), water supply networks, sewerage, electricity supply that fall under the construction site, as provided in the Section above;

- Construction of two (2) x 3,000 m^3 raw water receiving tanks with all necessary pipework, tie-ins, valves and other relevant engineering networks.

- Erecting of two (2) filter plant buildings of sufficient size to fit all necessary operating technological treatment equipment, process lines and auxiliary rooms for a stand-alone independent treatment plant with a throughput capacity of 80,000 m^3/day.

- Inside each filter plant building, installation of all necessary treatment and pumping equipment and pipelines with a treatment capacity of 45,000 m^3/day to ensure plant operating Modes A1 and B1.

- Erecting one (1) Backwash Water Treatment Plant building of sufficient size to fit all necessary operating technological treatment equipment, process lines and auxiliary rooms for treatment and recycling of backwash water with a capacity of 8,500 m^3/day.
    - Receiving and equalizing tanks with pumping station;
    - Lamellar sedimentation tanks and sludge pumps;
    - Clarified water tanks;
    - Pumping station (clarified water pumps);
    - Sludge dewatering unit;
    - Supply of two (2) trucks for sludge transportation.

- Construction of one (1) electrolysis plant building, including installation of process lines to generate sodium hypochlorite by electrolysis, capacity of the plant shall be 1,125 kg/day.

- Construction of all external engineering networks necessary for the operation of the new WTP, as follows:
    - construction of suction pipelines with all necessary automated valves from the raw water tanks to the pumps of the pumping station;
    - laying of treated water pipelines in 2 lines from each filtration station to the existing main network of supply to clean water reservoirs. At the point of tie-in to the existing water supply pipeline to the tanks, new chambers will be arranged (or existing ones will be reconstructed) with the installation of shut-off valves;
    - laying of the drinking water supply pipeline B1 to the buildings of the filtration plant with administrative and amenity premises from the existing water supply networks;
    - laying of domestic sewerage from the designed buildings of the filtration station to the existing wells of the on-site sewerage networks;
    - laying of external on-site industrial sewerage networks,
    - arrangement of brine discharge from reverse osmosis units, installed in the designed filtration plant buildings, to the existing wells of the on-site industrial sewerage networks designed for wash water discharge from the existing filters;
    - construction of a pipeline (collector) for brine discharge from reverse osmosis units;
    - construction of pressurised networks for treated wash water;
    - construction of external power supply networks and transformer stations for all buildings and structures to ensure power supply to the installations at both implementation phases of the project.

- Construction of an access road and landscaping.
- Necessary testing, pre-commissioning and commissioning of Phase 1 Facilities.

1.3.2.2 - Implementation Phase 2:

Phase 2 assumes installation of additional equipment to secure the designed capacity of the plant:

- Installation and connection of additional filtration equipment in the two (2) constructed Filter Buildings:
    - 16 filters of each stage (48 filters in total) in each of the station buildings;
    - installation of reverse osmosis systems – 5 such systems in each building. Each building will be equipped with 13 such systems; the total number of reverse osmosis systems to be installed in two buildings is 26;
    - installation of additional pumps;

- Necessary testing, pre-commissioning and commissioning of Phase 2 Facilities.

As a result of the implementation of the second phase, a full-fledged water treatment facility will be created, which provides reliable water treatment from all major sources of water supply.

Throughout the entire implementation of the Phases 1 and 2 and until Operational Acceptance of the Phase 2, the existing treatment facilities line III should remain fully operational and ensure a reliable and continuous supply of water to the city.

1.3.3 - Raw Water Reservoir/Inlet Tank Construction

Raw water reservoir/ inlet tank

In order to maintain the operating modes of the existing booster pumping station, the pre-design solutions include building two raw water reservoirs/inlet tanks with a total volume of 6000 m3 (each a 3000 m3) for receiving raw water. The raw water is supplied to these reservoirs by means of pumping stations, which are

located on water intake structures (the rivers Southern Buh, Dnipro or reservoir) through two water pipelines DN 1000 mm. Water flows through pipelines to the suction lines of the pumping station and then to the filter station.

Each of the raw water reservoirs with approximate dimensions of 30x24x4.5m has a monolithic reinforced concrete slab of C20/25 class at the bottom, which contains a drainage pit of 400x400x400 (mm). Under the bottom slab, a layer of concrete with class C8/10 with a thickness of 100 mm is prepared. The walls are 300 mm thick and made of monolithic reinforced concrete of class C20/25. The tank has a grid of columns from monolithic reinforced concrete of class C20/25. The size of the columns in the plan is 400x400 mm.

Further, each reservoir is equipped with:

- Connection to supply pipeline D = 1,000 mm;
- Connection to outlet pipeline D = 1,000 mm;
- An overflow Valve with a hydraulic seal and an overflow pipeline D = 700 mm;
- Drainage pipeline system;
- Air vents/ ventilation columns;
- Devices measuring and signalling the water level in the tank;
- Manholes with ladders for periodic maintenance.

1.3.4 - New Construction of Water Treatment Plant Buildings

The architectural solution includes the building façades and volumetric-spatial elements. These were initially defined by the functional requirements of the facility, its location within the existing infrastructure, and the structural design solutions. During the project design stage, parameters related to the layout and positioning of the filters may be adjusted, provided a valid justification is given – for example, to ensure adequate space for equipment installation and maintenance, improve energy efficiency, or allow for proper placement of doors and industrial gates.

Each of the two production buildings is designed as a single-story structure with a footprint of 104.0 × 72.0 meters and a height of up to 9.00 meters. The external walls and roof shall be constructed using factory-made profiled steel sandwich panels with mineral wool insulation. The fire resistance rating of the buildings shall be Class IIIa, and they shall be classified as Category Г production buildings according to fire safety regulations.

The metal frame shall be constructed using a rigid frame system. Transverse frames shall be made of metal beams supported by metal columns. The top chord of the roof beams shall be braced with horizontal ties and struts. The perimeter of the building shall be supported by a metal framing structure reinforced with additional metal structural columns. Roof beams shall be covered with purlins. External walls shall be designed with factory-made sandwich panels consisting of profiled metal sheets and mineral wool insulation sandwiched between them, with a fire resistance rating of E 90 / I 60.

The basement external walls shall be made of brick masonry with external insulation of extruded polystyrene foam. The floor slabs shall be made of cast-in-place reinforced concrete, supported by steel beams and columns protected with fireproof coatings having a fire resistance class of REI 60. The cast-in-place reinforced concrete itself shall have a fire resistance class of at least REI 60.

The roof shall be constructed from factory-made sandwich panels consisting of profiled metal sheets and mineral wool insulation sandwiched between them, with a fire resistance class of REI 60.

The building shall be designed to accommodate process lines with main treatment equipment aimed at bringing surface water quality up to drinking water standards through a complete technological cycle. The building shall also contain auxiliary areas as well as integrated administrative and utility and sanitary-welfare rooms.

The building shall be divided into three sections. The first section of the building shall include facilities for sodium hypochlorite solution production, a transformer room, administrative and utility rooms, and ventilation chambers. The second section of the building shall be designed to accommodate the filtration equipment. The third section shall be designed to accommodate booster pumping units.

The integrated area shall include sanitary-welfare, administrative and utility rooms, along with ventilation chambers, which shall be separated from the production zones. Sanitary-welfare rooms, designed for four people and classified under production process sanitary group 1a, shall be separated from production zones by fire-rated partitions with a fire resistance rating of EI 90. The administrative and utility section shall include an operator's room, supervisors' rooms, an office for the station manager and process engineer, two changing rooms (classified under production process sanitary group 2r) for 14 staff members, a dining area, and utility facilities.

The auxiliary production group shall include a room with electrolysis equipment and a salt storage area, a pneumatic equipment room, an electrical room, and an operator's room. These rooms shall be divided by gypsum board partitions.

Rooms containing Category "B" production processes shall be separated from other areas by fire-resistant partitions with a fire resistance rating of EI 15.

Personnel changing rooms in service facilities shall be equipped with natural lighting through windows with a thermal resistance of not less than 0.75 m^2·K/W.

Rooms housing booster pumps and electrolysis equipment shall be equipped with windows incorporating built-in automatic ventilators. Exhaust ventilation ducts shall be installed in the toilet and shower rooms.

Windows in the building shall be made of metal-plastic with double-glazed insulating glass units. Interior doors shall be made of wood.

The gates shall be insulated with wickets having a thermal resistance of not less than 0.6 m^2 °K/W.

The toilet and shower rooms shall be finished with glazed wall tiles; ceramic tiles shall be provided for the flooring. Walls in the remaining rooms will be painted. The flooring shall be made of cast-in-place reinforced concrete, ceramic tiles, and linoleum.

Fire escape staircases shall be provided to ensure the safety of all building occupants in case of fire.

Smoke removal shall be provided through unprotected wall openings and aeration gaps in the roof structure.

Automatic Heat Supply

The building shall be heated by an installed gas-fired furnace. Thermal expansion shall be compensated by U-shaped expansion loops and pipe bends. The heat carrier shall be water with parameters of 80–60°C, supplied from the designed furnace located in the administrative and utility rooms. The indoor air temperature in the administrative and utility areas shall be calculated in accordance with the standards specified in Table 9 of DBN V.2.2-28:2010 [6], applicable to production facilities.

Heating in the filter room shall be provided by air-heating units, whereas other rooms shall be equipped with electric convectors controlled by electromechanical thermostats.

During the winter months, the booster pump room and the electrical room shall remain unheated, except when excess heat surpasses losses. Heating during maintenance works shall be carried out using air-heating units.

Heating of the 6 kV switchgear building (RP 6 kV) from the 6/0.4 kV transformer substation will be maintained by heat generated from the equipment. In case of failure, heating shall be provided by a portable heat gun.

The heating system shall be designed as a two-pipe, dead-end system with bottom main pipe routing. Heating devices shall be convectors. Heat output regulation of heating devices shall be achieved by installing thermostatic valves near each device. To stabilise the hydraulic regime on the risers, a differential pressure regulator and a shut-off measuring valve shall be installed. Air removal from heating devices shall be performed using "Mayevsky valves" and automatic air vents connected to the network.

Ventilation

Ventilation of the filter plant shall be provided by mechanical and natural induction.

Exhaust ventilation in the filter room and the booster pump room shall be equipped with deflectors and electrically actuated air dampers. In the filter room, the supply air shall be controlled by louvered grilles, while the supply air in the booster pump room shall be controlled by louvered grilles and an air flow regulator. The salt storage for electrolysis shall have natural ventilation with 3 air changes through deflectors. The supply air shall be diffused via louvered grilles. The electrolysis workshop shall be designed for 6 air changes for supply and exhaust ventilation; exhaust fans shall be explosion-proof. Additionally, emergency ventilation with 8 air changes shall be provided and activate upon gas analyser alarm signals to remove harmful substances from gas reservoirs.

Ventilation in the dosing pump rooms and pneumatic equipment rooms shall be natural.

Air exchange in the administrative and utility rooms shall comply with [6]. Separate exhaust ventilation systems shall be provided for dining rooms, toilets, and storerooms.

Ventilation in the 6 kV switchgear building (RP 6 kV) from the 6/0.4 kV transformer substation shall use mechanical and natural induction to remove heat generated by the equipment during operation.

Air shall be supplied to the 0.4 kV transformer rooms of the 0.4 kV switchgear of the filter plant through the grille located in the lower part of the doors. Exhaust shall be performed by axial fans activated by temperature sensor signals.

In the 6 kV switchgear room (RP 6 kV), air shall be supplied through the grille located in the lower part of the doors; exhaust shall be via deflectors.

In case of fire, ventilation systems shall be disconnected from the automatic fire alarm system (AFAS).

Air ducts shall be made of galvanised steel, class "B".

Ventilation in the distribution panels shall be natural and mechanical.

Drainage

Domestic wastewater shall be discharged into the domestic sewage network of the treatment facilities.

1.3.5 - Backwash water treatment building

1.3.5.1 - Purpose and dimensions

The backwash water treatment is carried out in a separate building and includes inlet storage tanks, lamellar settling tanks, and a sludge dewatering system. After treatment, the water is returned to the main part of the treatment plant, and the sludge is sent for dewatering. The dewatered sludge can be transported to special sites for drying and then used in the construction industry.

The building is designed as a single-storey structure with dimensions of 90.0 m x 72.0 m and a height of 9.0 m. The building has a steel frame structure. The exterior walls and roof consist of prefabricated steel profiled sandwich panels with mineral wool insulation. The fire resistance rating of the building is IIIa, and the fire hazard category of the production building is ‘D’.

1.3.6 - New construction of the electrolysis building

Architectural solution (as an option) - building facades, volumetric and spatial solutions were determined mainly by the functional purpose of the electrolysis shop, its location in the existing building, as well as structural solutions.

Production workshop. Designed as a one-storey building along axes 1-7 and A-Z with dimensions of 36.0 x 42.0 m and a height of up to 9.00 m. The building is constructed with a steel frame. The exterior walls and roof are made of factory-produced steel profiled sandwich panels with mineral wool insulation. The fire resistance class of the building is IIIa, and the explosion and fire hazard category of the industrial building is D.

The building is designed to accommodate production lines with the main equipment to produce sodium hypochlorite.

- **The electrolysis unit** consists of the following main components, which are pre-connected to each other:
    - o Electrolysis cell unit
    - o Brine preparation unit
    - o Brine dechlorination unit
    - o Sodium hypochlorite conversion unit
    - o Stabiliser(s)
    - o Control panel

All system equipment and construction materials are fully suitable for chemical environments, mechanical loads during standby, operation and after operation, as well as for ambient temperatures from 4°C to 45°C.

The electrolysis equipment is modular in design, including the electrolyser module(s), brine conditioning module, brine dechlorination module and stabiliser(s), allowing the system to continue to operate while one or more electrolysers are isolated for maintenance and/or replacement.

Each module or unit is a freestanding structure designed with appropriate weight distribution, lifting points and anchoring points to the floor or foundation.

The technological equipment of the electrolysis plant includes the necessary shut-off valves, control and measuring devices (flow, pressure, temperature, sensors, limit switches/pressure switches, etc.) and relevant components with electrical centralisation to ensure the automatic production of sodium hypochlorite solution.

The anodes and cathodes should be oriented vertically to facilitate the escape of hydrogen gas.

The built-in facility includes administrative and utility rooms and ventilation chambers.

Sanitary facilities are designed for four people, with a sanitary group of production processes 1a.

The auxiliary production group includes the pneumatics room, the electrical control room, and the operator's room.

Plasterboard partitions between the rooms are provided.

Premises with category B production processes are separated from other premises by fire-resistant fire partitions.

1.3.7 - External water supply networks

The layout of external water supply and sewerage networks is shown in Annex 2.

Technical solutions include:

- Construction of raw water pipelines with connection to the existing water supply network at the site;
- Ensuring automatic operation of tanks by installing electrically operated valves on the inlet/outlet pipelines;
- Transfer of raw water via D1000 mm pipelines from switching chambers to raw water receiving tanks;
- Dismantling of the existing D700 mm pipeline for supplying surface water to the nodal chambers;
- Laying of raw water pipelines D1000 mm from each inlet water tank (IWT) to the filter buildings;
- Installation of new switching chambers to enable the operation of different pumping groups at the pumping station. The new switching chambers allow each pump group to operate on any water line;
- Laying of treated water pipelines D1,000 mm in 2 lines from the filtration building to the existing main pipeline (leading to the existing tanks).

At the branch from the existing water supply system to the tanks, new chambers will be arranged with shut-off valves. This will allow disconnecting one of the lines and operating the filtering station only at different existing tanks.

- Clean water pipework B9.2 D800 mm;
- Laying of the drinking water supply pipeline B1 to the filtering station building and the filtering station administrative building from the existing network.

Pipeline material:

- Process water pipelines are made of PE 100+ class polyethylene in accordance with DSTU B V.2.7-151:2008 with SDR 17 dimensional ratios (P = 0.63 MPa);
- Drinking water supply pipelines made of PE 100+ polyethylene in accordance with DSTU B V.2.7-151:2008 with SDR 17 dimensional ratios (P = 1.0 MPa);
- Shut-off valves for process pipelines - flanged butterfly valves.

Switching nodes and cameras

The new chambers are designed to be buried in the ground. The cells are rectangular in shape and made of precast concrete.

External sewerage networks

The existing collectors provide the possibility of connecting gravity flow technological networks and receiving and discharging domestic wastewater from the technological lines of the filtering facilities building on the existing site of the water treatment plant.

Technical solutions include:

Stage 1

Laying of industrial sewage from the filter station, which provides the following modes:

- Water from the backwash of the filters and the effluent from the filter building are discharged to the wash water treatment system,

- Water from the direct flushing of the filters is discharged into the designed purified flushing water reservoir and returned to the filter building (which is part of the recycled water system);
- After reverse osmosis, the salt concentrate is discharged into a drainage well;
- In case of failure of elements of the flushing water system, it should be possible to supply water directly to the drainage well;
- Emergency spills in the premises of the pumping station from the drainage pit are discharged into the existing on-site sewerage network of conditionally clean water;
- Relocation of domestic sewer K1 from the existing buildings of the sewage treatment plant No. 4 and chlorination plant to the sewer well on the site;
- Laying of domestic sewer K1 from the planned administrative premises of the filter station building to the existing well;
- Transfer of conditionally clean water sewage (overflows, discharge of water from tanks).

Sewerage network pipelines should be made of two-layer profiled PP SN8 pipes (or equivalent material) for non-pressure sewerage in accordance with DSTU B V.2.5-32:2007 [7].

Round sewer manholes are made of precast concrete elements in accordance with DSTU B V.2.6-106:2010 [8].

Sewerage gravity networks are proposed to be made of polypropylene bell-shaped PP type 'B' SN8 DN 200 - 500 mm according to [7] 'Pressure networks of polyethylene pipes', type PE 100 SDR 17 DN 100 - 500 mm PN 1.0 according to DSTU B EN 12201-2:2018 [9].

If justified, pipelines made of other materials may be used.

The depth of the sewers is 2.0 to 4.3 m, which is determined by the conditions of laying the initial outlets from buildings and connecting wells, terrain slopes, intersections with the road, and existing street engineering networks of the neighbourhood. The total length of the gravity sewers is approximately 4,000 m.

- Construction of a filter wash water treatment plant with receiving tanks, lamellar settling tanks and necessary pumping equipment, which will be designed to treat wash water from the filter station under construction.

- Construction of a clarified water reservoir with the possibility of its supply to the head of the filtering station

- Laying of the wash water discharge pipeline from the pre-treatment filter unit, which allows water to be supplied in the following order:

- Water from the filter backwash (stage 1) and the discharge from the pressure relief system (EPR) is discharged to the rinse water treatment system;

- Water from direct flushing (stage 2) - discharged to the designed recycled water tank and returned to the head of the treatment plant (inlet water tank).

- Pressure networks of flushing water will be made of polyethylene pipes PE 100 SDR 17 PN 0.8 according to [9].

The depth of the burial is approximately 1.3 to 4.0 m, which is determined by the conditions of laying the initial outlets from the existing buildings on the site of the water supply system and connecting wells, terrain slopes and intersections with the road and existing street engineering networks of the neighbourhood.

The total length of gravity sewers is approximately 2,000 m.

Raw water tank / inlet tank

Source water reservoir (2 units) with a useful volume of ~3,000 m^3. Each reservoir is designed to receive source water from the Snihurivska irrigation system, the Zhovtneve reservoir (after reconstruction), the water

intake in Kherson region (after rehabilitation), the new water intake on the Southern Bug River (after construction).

This also includes clarified rinse water and lightly contaminated water from direct filter rinsing.

Surface water is supplied to the reservoirs by pumping stations at the respective water intakes via pipelines located outside the project area. In accordance with the adopted design decisions, water can also be supplied after preliminary treatment.

The flow rate of the source water is measured by an electromagnetic flow meter. The feed water is supplied for treatment by a submersible pumping unit.

The 3,000 m^3 monolithic reinforced concrete tank (dimensions 30x24 m) is equipped with:

- supply pipeline D 1000 mm;
- outlet pipeline D 1000 mm;
- overflow pipeline D 700 mm
- drainage pipework system;
- devices for air outlet and inlet during filling and emptying of the tank - ventilation columns;
- devices for automatic measurement and alarm system of water level in the tank;
- hatches;
- working chambers;
- ladders.

The overflow device protects the tank from overfilling; it is made with a hydraulic seal to prevent the air in the tank from coming into contact with the environment.

Hatches with ladders provide periodic maintenance and repair of the tank.

1.3.8 - Drain manifold

Brine is only produced when the reverse osmosis plants are in operation (mode B). The collector must be constructed during the commissioning phase of Phase 1 to cover a total salt water capacity of 1,495 m^3/h or 35,880 m^3/day. The brine from the reverse osmosis systems is discharged with a residual pressure of about 90 m.

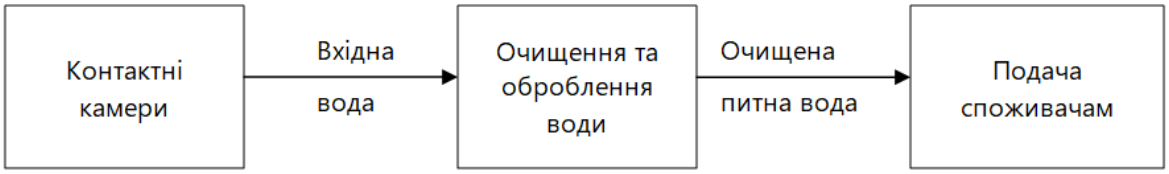
1.4 - Description of the main characteristics of the planned activity (production processes, type and quantity of materials and natural resources to be used)

1.4.1 - Production structure of the facility

Mykolaivvodokanal has the following production structure:

- main production is represented by public utilities;
- auxiliary production is represented by energy and repair facilities, as well as warehousing, chemical laboratory and laundry.

The technological links of the main production are shown in the diagram below.



Mykolaiv WTP specialises in preparing the source water supplied to the water treatment plants to meet the quality indicators that comply with the Sanitary and Epidemiological Norms and Regulations 2.2.4-171-10 'Hygienic Requirements for Drinking Water Intended for Human Consumption' [2] and the EU Drinking Water Directive 2020/2184 [3].

The WTP consists of II lift pumping stations (PS) and 2K pumping station (PS MHZ).

1.4.2 - List of products manufactured at the facility

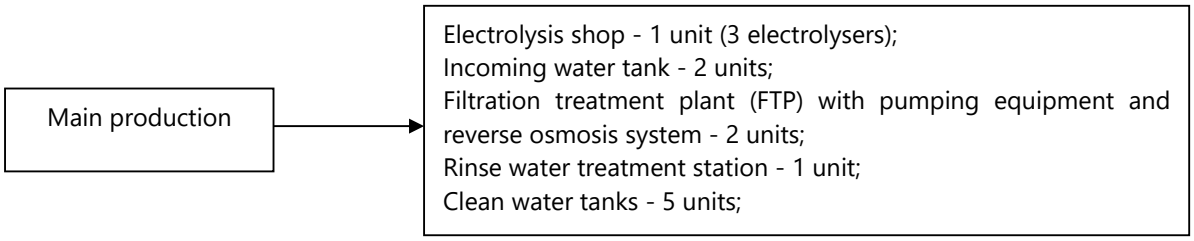
The list of products manufactured at the facility is shown in the table below.

TABLE 16 - LIST OF TYPES OF PRODUCTS MANUFACTURED AT THE FACILITY (MODE "B")

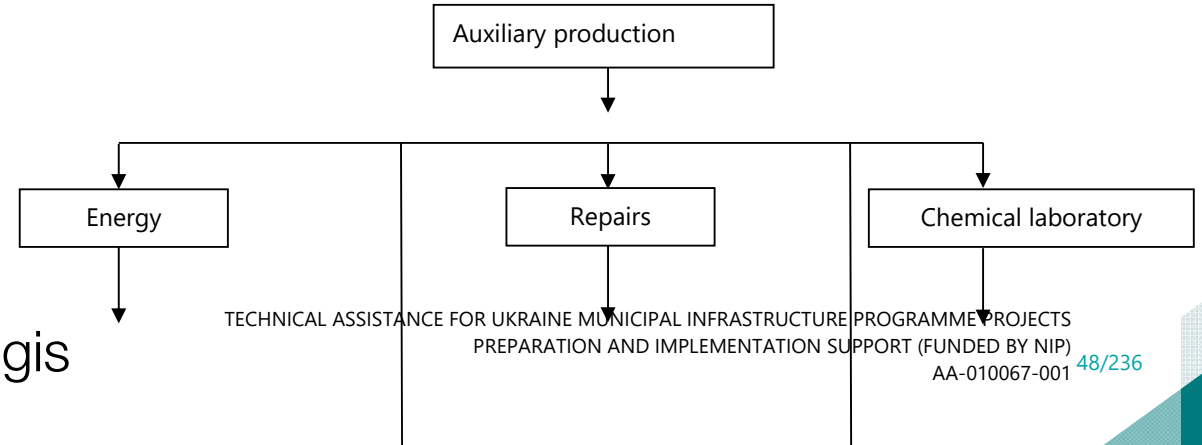
No.	Type of product	Annual issue
1st queue (mode B1)	Drinking water	25,80 million m^3
2nd queue (mode B2)	Drinking water	45,29 million m^3

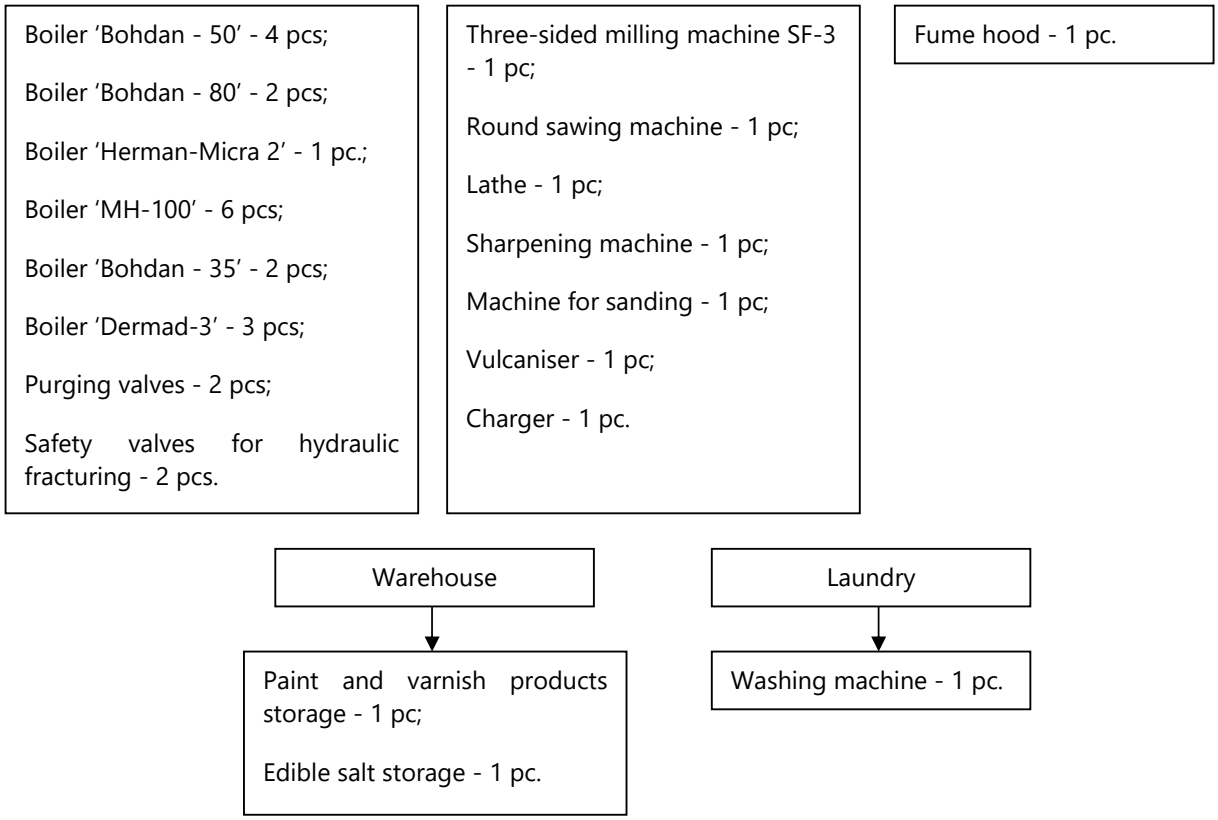
1.4.3 - List and description of production, production processes, technological processes, technological equipment of the facility

Description of the main production facilities, production processes, technological processes, and technological equipment is shown in the diagram below.



Description of auxiliary production is shown in the diagram below.





Main production

All vital facilities affecting the operation of the surface water treatment scheme are divided into two independent parallel lines to increase the system's resilience in martial law conditions.

Thus, raw water is received in two separate raw water tanks and then treated in two parallel filtration plants. The wash water treatment plant is less important and therefore not duplicated.

The purified water from the quick filters flows into a 3,000 m3 clean water tank.

Water from the reservoir is supplied by pumps of the 2nd lift pumping station to the 3rd lift pumping station, and from there to consumers.

The annual consumption of edible salt to produce sodium hypochlorite is 2,032 tonnes. The water treatment plant switches completely from liquid chlorine to sodium hypochlorite for water disinfection, so no chlorine is released into the atmosphere.

During the operation of the WWTP, substances are released into the atmosphere in the form of suspended solid particles of undifferentiated composition in the process of storing edible salt in the warehouse and loading edible salt into the salt dissolution tank in the electrolysis shop.

Auxiliary production

Energy production

Energy production is designed to provide heat to the company's production units in the cold season and is represented by 10 furnace units, which include 15 boilers of various brands and 3 convectors, located in the following units:

- in the administrative building - 1 boiler 'Bohdan-50' with a capacity of 50.0 kW;

- in the material warehouse - 2 boilers 'Bohdan-50' with a capacity of 50.0 kW each;
- in the electrical shop - 1 boiler 'Bohdan-50' with a capacity of 50.0 kW each;
- in the pumping station - 2 boilers 'Bohdan-80' with a capacity of 80.0 kW each;
- in the block of main buildings (administrative building) - 2 boilers 'MH-100' with a capacity of 100.0 kW each;
- in the block of main buildings (filtration shop of the 3rd stage) - 2 boilers 'MH-100' with a capacity of 100.0 kW each;
- in the main building block (contact chamber) - 2 MN-100 boilers with a capacity of 100.0 kW each;
- in the main building block (chlorination plant) - 2 Bohdan-35 boilers with a capacity of 35.0 kW each;
- in the laboratory - 1 Herman-Micra 2 boiler with a capacity of 30.0 kW.

In addition, the ejector room has 3 Demrad-3 convectors with a capacity of 3.0 kW each.

The boilers and convectors operate on natural gas with Q = 33.08 MJ/m^3. The annual consumption of natural gas by boilers and convectors is 105.0 thousand m^3/year.

The combustion of natural gas in boilers and convectors releases carbon monoxide, nitrogen dioxide, mercury compounds, as well as carbon dioxide, nitrogen oxide and methane, which are greenhouse gases, into the atmosphere.

With the commissioning of the above boilers and convectors in 2007, the company's boiler house was decommissioned, where 6 Minsk-1 boilers were installed with an annual natural gas consumption of 500.0 thousand m^3/year.

Warehousing facilities

A warehouse is an enclosed space intended for receiving, storing and distributing edible salt, which is stored in bags and on pallets, as well as paints and varnishes.

During the operation of the warehouse facilities, the following substances are released into the air: xylene, white spirit and substances in the form of suspended solid particles of undifferentiated composition.

Repair facilities

The repair facility is designed to maintain and repair the industrial site's process equipment, as well as to repair tyres (chambers).

When machining parts on a lathe (1 unit), a cooling lubricant (emulsion) is used for cooling).

Sharpening and melting of the tool is carried out on a sharpening machine (1 unit).

The carpentry workshop is intended for the manufacture of wood products that are necessary for the repair of fixed assets of the enterprise.

Wood is processed using woodworking machines: a circular saw (1 unit) and a milling machine (1 unit).

The annual volume of chambers to be repaired is 50 units.

The battery charging post (1 unit) is designed to recharge (charge) the batteries. The annual number of batteries to be charged is 6ST-90 - 4 units.

The following substances are emitted into the air during the repair production: substances in the form of suspended solid particles of undifferentiated composition, non-methane volatile organic compounds (NMVOCs), hydrogen chloride, 1,3-butadiene (divinyl), sulfuric acid.

Laundry

The laundry is designed to wash the overalls of the site employees. The laundry is equipped with a household washing machine (1 unit) with a capacity of 5.0 kg. The annual consumption of Lotus detergent is 0.164 tonnes.

During the operation of the laundry, substances are released into the air in the form of suspended solid particles of undifferentiated composition.

Chemical laboratory

The chemical laboratory is designed to carry out chemical analyses of water supplied to the public for compliance with standards.

The chemical analyses are carried out in a special fume hood (1 unit), and chemicals are stored in special containers with lapped stoppers.

The following substances are released into the air during the laboratory's operation: sulfuric acid, sodium hydroxide, hydrogen chloride.

1.4.4 - Design and existing production capacity of the facility, mode of operation of technological equipment

The Mykolaiv WTP specialises in preparing the source water supplied to the water supply treatment plants to meet the quality indicators that meet the requirements of the Sanitary and Epidemiological Norms and Regulations 2.2.4-171-10 'Hygienic Requirements for Drinking Water Intended for Human Consumption' [2] and the EU Drinking Water Directive 2020/2184 [3].

The existing capacity of the WTP in Mykolaiv is 43.440 million m3/year.

The design capacity of the WTP in Mykolaiv is 58.4 million m3/year.

The WTP in Mykolaiv operates around the clock 365 days a year.

1.4.5 - Raw materials, chemicals, fuels and lubricants and other materials used at the enterprise

Information on the raw materials used and auxiliary materials required for the production of products is presented in the table below.

TABLE 17 – RAW MATERIALS, AUXILIARY MATERIALS REQUIRED FOR PRODUCTION (MAXIMUM DEMAND IN THE "B2" MODE)

Raw materials, auxiliary materials	Purpose	Annual use, t	Availability of documentation regulating the requirements of sanitary legislation
Edible salt	Water disinfection	2 032	DSTU 3583:2015 "Salt. General technical conditions. Amended"
Aluminium hydroxychloride - coagulant	Chemicals for water treatment	1 232	DSTU 3009-95 "Inorganic coagulants. General technical conditions"
Flocculant	Chemicals for sludge treatment	11.7	DSTU 7525:2014 "Drinking water. General requirements for treatment reagents"
HCl	Chemicals for membranes and electrolysis*	288.4	DSTU 2415-94 "Hydrochloric acid technical. Technical specifications"
NaOH	Chemicals for membranes and electrolysis*	619.2	DSTU 2801-94 "Sodium hydroxide (caustic alkali). Technical specifications"

* For periodic regeneration of the ion exchange columns of the brine softening system located on the brine treatment module in the electrolysis shop, 7% HCl and 4% NaOH are required to remove accumulated Ca and Mg.

Information on the use of fuel for technological needs, production of heat, steam and electricity, as well as transport needs on the territory of the enterprise is presented in the table below.

TABLE 18 – USE OF FUEL FOR TECHNOLOGICAL NEEDS, GENERATION OF HEAT, STEAM AND ELECTRICITY, AS WELL AS TRANSPORT NEEDS ON THE TERRITORY OF THE ENTERPRISE

Types of fuel	Annual use	Sulphur content, %.	Ash content, %.	Calorific value, Kcal/kg, Kcal/m3	Directions for use							
					Technological needs	Transport (domestic)	Electricity generation, kWh/year			Steam and heat production, Gcal/year		
							total	for own needs	other	total	for own needs	other
Natural gas (thousand m^3)	105,0	-	-	7901,0	-	-	-	-	-	839,13	839,13	-
Electricity (kWh)	39 478 984	-	-	-	-	-	-	-	-	-	-	-

1.5 - Assessment by type and amount of expected waste, emissions (discharges), water, air, soil and subsoil pollution, noise, vibration, light, heat and radiation pollution, as well as radiation arising from preparatory and construction works and the planned activity

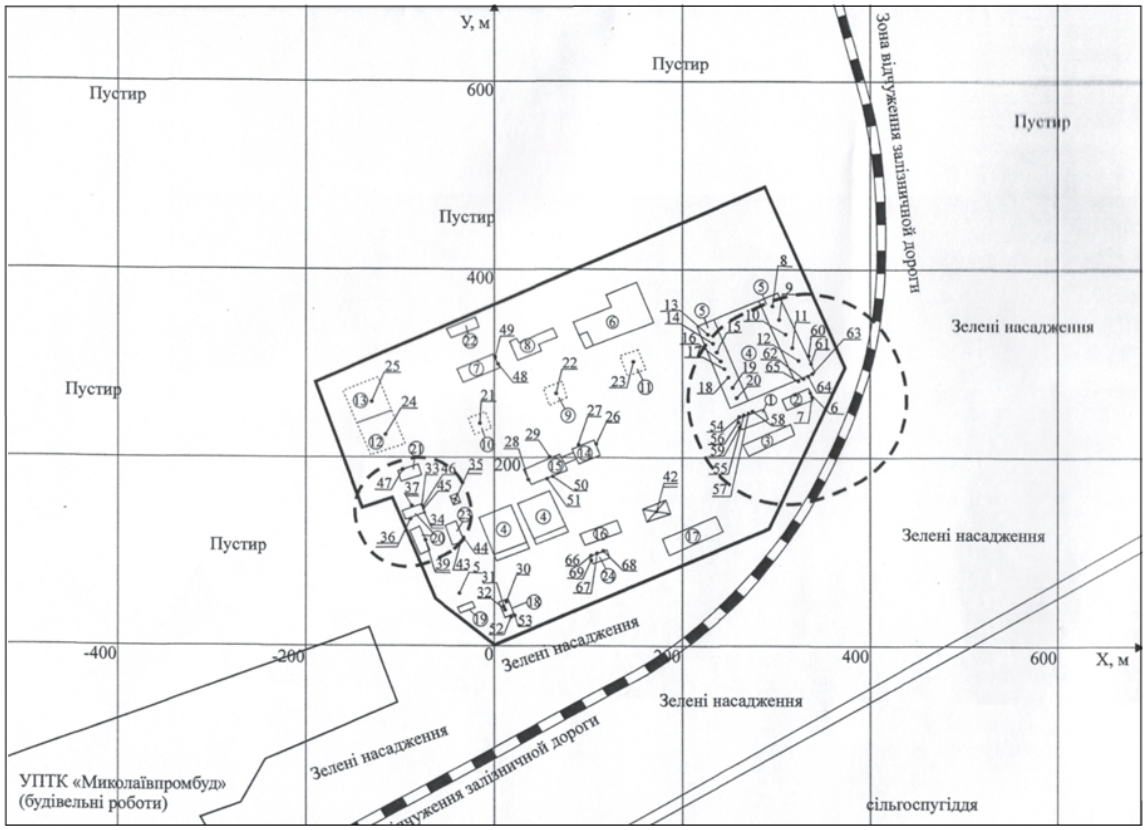
1.5.1 - Sanitary protection zone

According to the 'State Sanitary Rules for Planning and Development of Settlements' approved by the Order of the Ministry of Health of Ukraine of 19.06.96 No. 173 [10], clause 5, the sanitary protection zone should be established from sources of harm to the boundary of residential development, areas of public institutions, buildings and structures, including children's, educational, medical and preventive care institutions, social security institutions, sports facilities, etc, as well as the territories of parks, gardens, squares and other public green building facilities, areas of health and fitness facilities, recreation areas, gardening associations and other similar facilities.

According to [10], the existing sanitary protection zone for the city of Mykolaiv is as follows:

- - for the chlorine warehouse and chlorine dosing room - 100 m (chlorine in containers);
- - for the repair facilities (woodworking, metalworking, sanding and vulcanising machines) - 50 m;
- - for energy production - the sanitary protection zone is not standardised.

FIGURE 13 – EXISTING TERRITORY PLAN OF THE MUNICIPAL ENTERPRISE "NIKOLAIVVODOKANAL" WITH THE SANITARY PROTECTION ZONE (M 1:4500)



Symbols and notation:

- Buildings and structures
- Designation of buildings and structures according to the exposition
- Organised sources of air pollutant emissions
- Unorganised sources of air pollutant emissions
- Open areas
- Boundary of the industrial site of the enterprise
- Boundary of the enterprise's sanitary protection zone, zone of influence
- Boundary of other business entities
- Railway track

TABLE 19 - EXPLICATION OF EXISTING BUILDINGS AND STRUCTURES OF THE MUC "MYKOLAIVVODOKANAL"

No.	Title
1	Administration building of the main building block
2	Chlorinating building
3	Microfilter compartment
4	Sedimentation tank
5	Main building block

No.	Title
6	Electricity substation
7	Ist lift pumping station
8	IInd lift pumping station
9	Clean water tank № 1
10	Clean water tank № 2
11	Clean water tank № 3
12	Clean water tank № 4
13	Clean water tank № 5
14	Filter pumping station № 1
15	Filter pumping station № 2
16	Coagulation workshop
17	Reagent facilities
18	Laboratory
19	Boiler room (not in operation)
20	Workshop
21	Electric shop
22	Material warehouses
23	Administration building
24	Ejector room

TABLE 20 – LIST OF EXISTING EMISSION SOURCES

No.	Title
5	Safety valve for gas distribution system
6	Chlorine dosing station
7	Chlorine storage
8-12	Contact chamber premises
13-20	Filter rooms
21	CWT 1
22	CWT 2
23	CWT 3
24	CWT 4
25	CWT 5
26, 27	Filter workshop No. 1
28, 29	Filter workshop No. 2
30	Fume hood
31,32	Laboratory
33	Paint and varnish storage
34	Woodworking machine
35	Circular sawing machine
36	Coating machine, vulcanisation post, charger

No.	Title
37	Washing machine
39	Lathe, sharpening machine
42	Quartz sand storage
43, 45, 46, 47	Bohdan-50 boiler
44, 53, 56, 59, 62, 65, 69	Purge valve
48-51	Bohdan-80 boiler
52	Herman-Micra 2 boiler
54, 55, 57, 58, 60, 61	MH-100 boiler
63, 64	Bohdan-35 boiler
66-68	Dermad-3 boiler

The sanitary protection zone is located directly from the chlorine warehouse, chlorine dosing station (building No. 2 in the figure above) and repair facility (building No. 20 in the figure above). The sanitary protection zone is maintained.

The nearest residential development is located 890 m to the west of the pollutant emission sources (mechanical workshop, chlorine dosing station and chlorine warehouse).

The existing site meets the requirements for siting a water treatment plant.

FIGURE 14 - DESIGN PLAN OF THE TERRITORY OF THE MUNICIPAL UTILITY COMPANY ''MYKOLAIVVODOKANAL'' WITH THE SANITARY PROTECTION ZONE (M 1:2000))

Symbols and notation:

- Existing buildings and structures
- Above-ground structures under design
- Underground structures under design
- Designation of buildings and structures according to the exposition
- Organised sources of air pollutant emissions
- Unorganised sources of air pollutant emissions
- Boundary of the industrial site of the enterprise
- Boundary of the enterprise's sanitary protection zone, zone of influence

TABLE 21 - EXPLICATION OF DESIGN BUILDINGS AND STRUCTURES OF MYKOLAIVVODOKANAL WTP

Explication of buildings and structures			
Markings on the plan	Title	Number of storeys	Note
1	Administration building	1	existing
2	Repair and mechanical workshop	1	existing
3	Mechanical workshop	1	existing
4	Building of technical water supply	2	existing
5	Clean water tank, vol. 2x6 000 m^3	underground	existing
5.1	Clean water tank, vol. 2 000 m^3	underground	existing
5.2	Clean water tank, vol. 2 000 m^3	underground	existing
5.3	Clean water tank, vol. 3 000 m^3	underground	existing
6	2nd lift pumping station 'Korabel'	2	existing
7	2nd lift pumping station 'Misto'	1	existing
8	Block of treatment facilities of the III stage	1-2	existing
12	Administration building of the main building block	2	existing
13	Chlorinating building	2	existing
14	Microfilter compartment	2	existing
15	Reagent facilities	2	under dismantling (partially)
16	Laboratory	1	existing
17	Boiler room	1	existing
18	Existing open power plant (35/6 kV switchgear)	aboveground	existing
18.1	Distribution system 6 kW	1	existing
19	Filtration treatment plant (FTP) with pumping and reverse osmosis system. Unit 1	1 with an underground part	under design
20	Filtration treatment plant (FTP) with pumping and reverse osmosis system. Unit 1	1 with an underground part	under design
21	Wash water treatment plant	1 with an underground part	under design
22	Sodium hypochlorite production station (electrolysis)	1	under design
23	Inlet water tank 3 000 m^3	underground	under design
24	Inlet water tank 3 000 m^3	underground	under design
25	Material warehouses	1	existing

TABLE 22 - LIST OF EMISSION SOURCES AFTER THE RECONSTRUCTION OF MYKOLAIV WTP

No.	Title
5	Safety valve of the gas distribution unit
30	Fume hood
31,32	Laboratory
33	Paint and varnish warehouse
34	Woodworking machine

No.	Title
35	Round sawing machine
36	Sander, vulcanisation post, charger
37	Washing machine
39	Lathe, sharpening machine
43, 45, 46, 47	Bohdan-50 boiler
44, 53, 56, 59, 62, 65, 69	Purge valve
48, 49	Bohdan-80 boiler
52	Herman-Micra 2 boiler
54, 55, 57, 58, 60, 61	MH-100 boiler
63, 64	Bohdan-35 boiler
66-68	Dermad-3 boiler
70	Ventilation system of the electrolysis department
71	Material warehouse deflector
72,73	Transformer substations

The prospective sanitary protection zone for the WTP of Mykolaiv after reconstruction according to [10] will be as follows:

- for repair facilities (woodworking, metalworking, sanding and vulcanising machines) - 50 m;
- for energy production - the sanitary protection zone is not standardised.

The sanitary protection zone is established directly from the repair facility, i.e. the mechanical workshop (building No. 3 in the figure above).

The SPZ is reduced due to the refusal to use liquid chlorine for water disinfection. At present, under the current conditions, the optimal solution in terms of efficiency and safety is to use electrolytic sodium hypochlorite, which is produced directly at the water treatment plant. The hydrogen generated in the catholyte of the electrolysis cell as a by-product is immediately and safely diluted with atmospheric air to a concentration of 2% or less and safely released into the atmosphere. This is the safest way to do it, as the sodium chloride used as the starting reagent is stored in a warehouse. Salt for electrolysis plants is supplied in 50 or 25 kg bags on pallets. A 15-day supply will be kept in stock. Expected possible emissions from the salt warehouse and electrolysis plant: suspended particles, undifferentiated by composition (sodium chloride (table salt) in small quantities, which does not require the establishment of a sanitary protection zone for either the warehouse or the electrolysis plant.

The design sanitary protection zone has been maintained.

1.5.2 - Land use

The land plot of the WTP site, with an area of 52.8282 hectares, is owned by the city of Mykolaiv (municipal property) and has a cadastral number 4810136600:06:042:0051. An extract from the State Land Cadastre on the land plot is provided in Annex 3.

Land category: land for industry, transport, electronic communications, energy, defence and other purposes.

Type of land plot designation: 11.04 For the placement and operation of main, auxiliary and auxiliary buildings and structures of technical infrastructure (production and distribution of gas, supply of steam and hot water, collection, treatment and distribution of water).

As for the brine pipeline location, it is planned to temporarily allocate land for construction works. The pipeline will be laid bypassing settlements and across land for various purposes, mainly owned by the Mykolaiv City Territorial Community and Halytsynivka Territorial Community. The detailed pipeline layout will be developed at the stage of the feasibility study (FS).

1.5.3 - Estimation by type and quantity of expected pollution from preparatory and construction activities

In the course of reconstruction works, sources of temporary impact will include:

- Operation of vehicles and construction equipment during the delivery of materials and equipment and reconstruction works;
- Dismantling of the existing road surface and structures;
- Laying of utilities and construction of a brine transport pipeline;
- Welding and gas cutting works, pipe brazing;
- Painting of surfaces, structures and facilities;
- Living conditions of the workforce;
- Laying of asphalt concrete pavement;

TABLE 23 - SOURCES OF ENVIRONMENTAL POLLUTION AND NOMENCLATURE OF POLLUTANTS ARISING FROM THE RECONSTRUCTION OF THE MYKOLAIV WATER TREATMENT PLANT

No	Type of activity	Source of impact	Expected negative impact (name of pollutant)	CAS code/S.O. code	Hazard class	MAC (max.single), TSEL, Leq, dBA, MAC (drinking) mg/L	List of components to be affected
Period of work on the reconstruction of the WTP							
1	Operation of vehicles and construction equipment during preparatory and construction works	Motor vehicles and construction equipment	Emissions:	-	-	мг/м^3	Surface layer of atmospheric air
			Nitrogen dioxide	10102-44-0/04001	3	0,2	
			Ammonia	7664-41-7/04003	4	0,2	
			Nitrogen oxide	10024-97-2/04002	3	0,4	
			Soot	1333-86-4/03003	3	0,15	
			Sulphur dioxide	7446-09-5/05001	3	0,5	
			Carbon monoxide	630-08-0/06000	4	5,0	
			Methane	74-82-8/12000	-	TSEL –50 mg/m^3	
			Benz(a)pyrene	50-32-8/13101	1	0.1 µg per 100 m^3	
			NMVOCS	-/11000	4	1,0	
2	Dismantling of the existing road surface and structures and reconstruction works	Construction waste generation	Construction waste	-	3 та 4	-	Land resources

3	Laying of utilities and construction of a brine transport pipeline	Dust generation from earthworks	Inorganic dust containing silica (70 - 20 %)	-/03001	3	0,3	Surface layer of atmospheric air
4	Welding and gas cutting, pipe brazing	Welding electrodes ANO-6 and UONI-13/45	Emissions:	-	-	мг/м^3	Surface layer of atmospheric air
			Iron and its compounds (in terms of iron)	7439-89-6/01003	3	0,4	
			Manganese and its compounds (in terms of manganese)	1313-13-9/1104	2	0,01	
			Amorphous silicon dioxide	7631-86-9/03000	-	0,02	
			Hydrogen fluoride	7664-39-3/16001	2	0,02	
			Fluorides are highly soluble	7681-49-4/16001	2	0,03	
			Poorly soluble inorganic fluorides	-/16001	2	0,2	
		Soldering of pipes	Acetic acid	64-19-7/11028	3	0,2	
			Carbon monoxide	630-08-0/06000	4	5,0	
5	Painting surfaces, structures, buildings	Primer GF-021 (Solvent solvent) and PF-115 paint	Emissions:	-	-	mg/m^3	Surface layer of atmospheric air
			Xylene	1330-20-7/11030	3	0,2	
			Solvent oil	64742-94-5/11000	-	TSEL – 0,2 mg/m^3	
			White spirit	8052-41-31/11000	-	TSEL – 1,0 mg/m^3	
6	Living conditions of working personnel	Labour personnel	Solid waste generation	-	4	-	Land resources
7	Reconstruction process	Dismantling of structures and construction works	Waste generated in the reconstruction process	-	3 та 4	-	Land resources
8	Noise from construction works	Construction equipment operation	Generation of noise load	-		Daytime - 60 dBA Nighttime - 50 dBA	Social environment

As part of the reconstruction works, pipes will be replaced, which will require temporary mechanical disturbance of the ground cover. The soil will be stored next to the trenches and will be backfilled after the pipes are replaced. There is no fertile soil layer on the territory of the WTP. No ground disturbance is expected.

Subject to compliance with safety rules and technological regulations, no impact on water resources is expected during the reconstruction works.

All other pollution, such as subsoil and groundwater pollution, vibration, light, heat and radiation pollution due to the specifics of the planned activities, will not occur as a result of the reconstruction works and during the operation of the checkpoint.

Water from existing networks will be used for drinking and firefighting purposes.

1.5.3.1 - Estimation of air emissions

Air quality impacts during reconstruction and preparation works will be associated with short-term emissions:

- pollutants generated by construction equipment during the laying of asphalt pavement and during the construction of WTP technological facilities;

- inorganic dust during loading and unloading operations, pipe replacement and construction of the brine transport pipeline;

- pollutants generated during welding operations;

- vapours of solvents of paint and varnish materials when performing paint and varnish works.

Sources of pollutant emissions during reconstruction works are fugitive sources of emissions.

Determination of pollutant emissions from road construction equipment and vehicles during the overhaul of the pavement of the WTP territory

During the active phase of reconstruction, there will be a temporary impact on the air by exhaust gases from vehicles and construction equipment during the overhaul of the asphalt pavement of the WTP (approximately 35,000 m^2 or 3.5 ha).

Emissions of pollutants from the operation of internal combustion engines of construction equipment are determined in accordance with DSTU 9030:2020 'Roads. Assessment of environmental impacts' [11] by specific pollutant emissions depending on fuel consumption.

The list of construction equipment and fuel consumption per 1 machine hour of operation is given in the Table below in accordance with the final list of resources and the Order of the Ministry of Communities and Territories Development of Ukraine dated 15.06.2021 No. 156 [12].

TABLE 24 - LIST OF CONSTRUCTION EQUIPMENT USED IN LAYING THE ASPHALT PAVEMENT AND FUEL CONSUMPTION

Name of construction equipment	Time costs, machine hours	Fuel consumption per 1 machine hour of operation, kg	
		Petrol	Diesel fuel
For major repairs of the asphalt pavement on the territory of the WTP			
Dump trucks, carrying capacity 15 tonnes	87,5		4,96
Truck mounted tarriers, capacity 3500 litres	5,6	9,18	
Self-propelled vibrating smooth road rollers, weight 8 tonnes	256,9		4,6
Self-propelled vibrating smooth road rollers, weight 13 tonnes	150,5		5,6
Self-propelled vibrating road rollers on pneumatic wheels, weight 16 tonnes	182		10,5
Watering and washing machines, capacity 6000 litres	34,3	9,18	
Wirtgen road milling cutter W 2100 DC, milling width 2100 mm	98		11,20
Universal asphalt pavers with a capacity of 1000 tonnes per hour	57,4		10,2
Total for the period of overhaul of the asphalt pavement, kg		**366**	**6053**

The calculated pollutant emissions from construction equipment and vehicles are presented in the Table below.

TABLE 25 - RESULTS OF CALCULATIONS OF POLLUTANT EMISSIONS FROM CONSTRUCTION EQUIPMENT DURING THE REPAIR OF ASPHALT PAVEMENT

Type of the vehicle	Name of the pollutant	Code	Emissions of pollutants from internal combustion engines	
			d/s	t/year
Dump trucks, 15 tonne capacity	Nitrogen dioxide	10102-44-0/04001	0,000821	0,013
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000003	0,000
	Sulphur dioxide	1333-86-4/03003	0,000191	0,003
	Sulphur dioxide	7446-09-5/05001	0,000118	0,002
	Carbon monoxide	630-08-0/06000	0,001495	0,024
	Methane	74-82-8/12000	0,000010	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000225	0,004
Truck-mounted tar compactors, capacity 3500 litres	Nitrogen dioxide	10102-44-0/04001	0,000063	0,001
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000000	0,000
	Sulphur dioxide	1333-86-4/03003	0,000000	0,000
	Sulphur dioxide	7446-09-5/05001	0,000003	0,000
	Carbon monoxide	630-08-0/06000	0,001096	0,017
	Methane	74-82-8/12000	0,000004	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000093	0,001
Self-propelled vibratory smooth road rollers, weight 8 t	Nitrogen dioxide	10102-44-0/04001	0,002236	0,035
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000009	0,000
	Sulphur dioxide	1333-86-4/03003	0,000519	0,008
	Sulphur dioxide	7446-09-5/05001	0,000322	0,005
	Carbon monoxide	630-08-0/06000	0,004070	0,064
	Methane	74-82-8/12000	0,000026	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000612	0,010
Self-propelled vibratory smooth roller rollers, weight 13 t	Nitrogen dioxide	10102-44-0/04001	0,001594	0,025
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000006	0,000
	Sulphur dioxide	1333-86-4/03003	0,000370	0,006
	Sulphur dioxide	7446-09-5/05001	0,000230	0,004
	Carbon monoxide	630-08-0/06000	0,002902	0,046
	Methane	74-82-8/12000	0,000019	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000436	0,007
Self-propelled vibratory road rollers on pneumatic wheels, weight 16 t	Nitrogen dioxide	10102-44-0/04001	0,003615	0,057
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000015	0,000
	Sulphur dioxide	1333-86-4/03003	0,000840	0,013
	Sulphur dioxide	7446-09-5/05001	0,000521	0,008

Type of the vehicle	Name of the pollutant	Code	Emissions of pollutants from internal combustion engines	
			d/s	t/year
	Carbon monoxide	630-08-0/06000	0,006581	0,104
	Methane	74-82-8/12000	0,000042	0,001
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000989	0,016
Watering and washing machines, capacity 6000 litres	Nitrogen dioxide	10102-44-0/04001	0,000388	0,006
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000001	0,000
	Sulphur dioxide	1333-86-4/03003	0,000000	0,000
	Sulphur dioxide	7446-09-5/05001	0,000020	0,000
	Carbon monoxide	630-08-0/06000	0,006715	0,106
	Methane	74-82-8/12000	0,000023	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000569	0,009
Wirtgen road milling cutter W 2100 DC, milling width 2100 mm	Nitrogen dioxide	10102-44-0/04001	0,002076	0,033
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000008	0,000
	Sulphur dioxide	1333-86-4/03003	0,000482	0,008
	Sulphur dioxide	7446-09-5/05001	0,000299	0,005
	Carbon monoxide	630-08-0/06000	0,003780	0,060
	Methane	74-82-8/12000	0,000024	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000568	0,009
Universal asphalt pavers with a capacity of 1000 tonnes per hour	Nitrogen dioxide	10102-44-0/04001	0,001108	0,017
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000004	0,000
	Sulphur dioxide	1333-86-4/03003	0,000257	0,004
	Sulphur dioxide	7446-09-5/05001	0,000160	0,003
	Carbon monoxide	630-08-0/06000	0,002016	0,032
	Methane	74-82-8/12000	0,000013	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000303	0,005
		Total:	**0,048893**	**0,771**

Gross emissions of pollutants into the air from the overhaul of the WTP pavement will amount to 0.771 tonnes per year.

All vehicles and special equipment involved in construction works are non-stationary (mobile) sources. Accordingly, it is quite difficult to set clear working conditions, location (coordinates), number of construction equipment involved at the same time and its operation time for the software calculation of dispersion. Therefore, the calculation in EOL 2000 (h) was performed in a conditional area source corresponding to the territory of the FEA and assuming simultaneous operation of all construction equipment.

Determination of NMVOC emissions during asphalt mix paving

As mentioned above, the reconstruction of the WTP will involve the overhaul of the road surface of the 35,000 m^2 area.

In addition to the operation of road equipment, fugitive sources of pollutant emissions include the process of laying asphalt mixtures in two layers:

- the process of paving hot fine-grained asphalt mix with type A surfactants of grade I used in the upper layers of pavements - 4,256 tonnes;

- crushed stone mastic asphalt concrete (SMA-20) - 4,256 tonnes

When paving an asphalt mixture, hydrocarbons of the limit C12-C19 (NMVOCs) are released into the air.

Asphalt mix consumption is 8,512 tonnes (based on the final resource summary of the analogue project). According to the summary of resources, the amount of bituminous road emulsion is 28 tonnes. The amount of NMVOCs was calculated in accordance with the recommendations of the 'Methodology for conducting an inventory of air pollutant emissions for asphalt plants (by the calculation method)' [13]. According to the methodology, the specific emission of a pollutant (NMVOC) can be assumed to be an average of 1 kg per 1 tonne of bitumen.

Gross emissions of NMVOCs will be calculated as follows:

$$M_{gross} = 28\times\ 1/10\text{-}3 = 0{,}028\ t/year.$$

Based on the assumption that the paver will operate for 57.4 man-hours, the maximum single emission of NMVOCs during the laying of asphalt concrete mixture will be 0.136 g/s.

Determination of pollutant emissions from construction machinery and vehicles during the construction of WTP process facilities, namely two filtration stations, a wash water treatment plant, two inlet water tanks and an electrolysis plant

During the reconstruction work, pollutants from construction equipment will be released into the air.

TABLE 26 - LIST OF CONSTRUCTION EQUIPMENT USED IN THE CONSTRUCTION OF TECHNOLOGICAL FACILITIES AND FUEL CONSUMPTION

Construction equipment	Time costs, machine hours	Fuel consumption per 1 machine hour of operation, kg	
		Petrol	Diesel
Single-bucket diesel excavators on pneumatic wheels, bucket capacity 0.5 m3	38,41		6,11
Flatbed trucks, carrying capacity, 5 tonnes	574,85	3,07	
Forklifts, 5 tonne capacity	27,78		5,1
Mobile compressors with an internal combustion engine, pressure up to 686 kPa (7 atm), capacity 2.2 m^3/min	359,33		3,58
Mobile cranes in operation: - installation of process equipment, lifting capacity 32 tonnes	3,87		10,03
Total for the period of construction of technological facilities of the WTP, namely two filtration stations, a wash water treatment station, two inlet water tanks and an electrolysis shop, kg		**1765**	**1702**

The calculated pollutant emissions from construction equipment are presented in the Table below.

TABLE 27 - CALCULATION RESULTS OF POLLUTANT EMISSIONS FROM CONSTRUCTION MACHINERY DURING THE CONSTRUCTION OF THE WTP TECHNOLOGICAL FACILITIES

Type of vehicle	Name of the pollutant	Code	Emissions of pollutants from internal combustion engines	
			g/s	t/year
Single-bucket diesel excavators on pneumatic wheels, bucket capacity 0.5 m3	Nitrogen dioxide	10102-44-0/04001	0,000444	0,007
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000002	0,000
	Carbon black	1333-86-4/03003	0,000103	0,002
	Sulphur dioxide	7446-09-5/05001	0,000064	0,001
	Carbon monoxide	630-08-0/06000	0,000808	0,013
	Methane	74-82-8/12000	0,000005	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000121	0,002
Flatbed trucks, carrying capacity, 5 tonnes	Nitrogen dioxide	10102-44-0/04001	0,002176	0,034
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000004	0,000
	Carbon black	1333-86-4/03003	0,000000	0,000
	Sulphur dioxide	7446-09-5/05001	0,000112	0,002
	Carbon monoxide	630-08-0/06000	0,037635	0,593
	Methane	74-82-8/12000	0,000129	0,002
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,003190	0,050
Forklifts, 5 tonne capacity	Nitrogen dioxide	10102-44-0/04001	0,000268	0,004
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000001	0,000
	Carbon black	1333-86-4/03003	0,000062	0,001
	Sulphur dioxide	7446-09-5/05001	0,000039	0,001
	Carbon monoxide	630-08-0/06000	0,000488	0,008
	Methane	74-82-8/12000	0,000003	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000073	0,001
Mobile compressors with an internal combustion engine, pressure up to 686 kPa (7 atm), capacity 2.2 m^3/min	Nitrogen dioxide	10102-44-0/04001	0,002434	0,038
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000010	0,000
	Carbon black	1333-86-4/03003	0,000565	0,009
	Sulphur dioxide	7446-09-5/05001	0,000351	0,006
	Carbon monoxide	630-08-0/06000	0,004430	0,070
	Methane	74-82-8/12000	0,000029	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000666	0,010
Mobile cranes in operation: - installation of process equipment, lifting capacity 32 tonnes	Nitrogen dioxide	10102-44-0/04001	0,000073	0,001
	Ammonia	7664-41-7/04003	0,000000	0,000
	Nitrogen oxide	10024-97-2/04002	0,000000	0,000
	Carbon black	1333-86-4/03003	0,000017	0,000
	Sulphur dioxide	7446-09-5/05001	0,000011	0,000

Type of vehicle	Name of the pollutant	Code	Emissions of pollutants from internal combustion engines	
			g/s	t/year
	Carbon monoxide	630-08-0/06000	0,000134	0,002
	Methane	74-82-8/12000	0,000001	0,000
	Benz(a)pyrene	50-32-8/13101	0,000000	0,000
	NMVOCS	-/11000	0,000020	0,000
		Total:	**0,054467**	**0,859**

Gross emissions of pollutants into the air from construction activities will amount to 0.859 tonnes per year.

Determination of dust emissions during excavation and loading operations when laying utilities on the territory of the WTP and construction of a brine pipeline

The source of dust generation during the WTP reconstruction works will be the pipe replacement and brine pipeline construction, which will result in excavation and subsequent backfilling of the soil after pipe replacement and pipeline construction. The soil has a bulk density of 1,800 kg/m^3 with a low content of stone inclusions (up to 15%).

The calculation of the volume of inorganic dust generated during excavation and loading operations was carried out in accordance with the 'Collection of methods for calculating the content of pollutants in emissions from unorganised sources of air pollution', UkrNTEK, Donetsk, 1994 [14].

The calculation of the maximum single dust emission during excavation and loading operations is carried out by the formula:

$$q = \frac{k_1 \cdot k_2 \cdot k_3 \cdot k_4 \cdot k_5 \cdot k_7 \cdot G \cdot 10^6 \cdot B`}{3600}$$

Where:

q - dust generation during extraction and loading operations with gunt, g/s.;

k_1 - weight share of the dust fraction in the rock. It is determined by washing and sieving the average sample with the separation of the dust fraction of 0 - 200 μm (k1 Table 4.3.1 [14]);

k_2- fraction of fugitive dust that becomes an aerosol with a particle size of 0-50 μm in relation to all dust in the rock (it is assumed that not all fugitive dust becomes an aerosol) (Table 4.3.1 [14]);

k_3- coefficient that considers the wind speed in the area of construction equipment operation (Table 4.3.2 [14]);

k_4 - coefficient that considers local conditions (Table. 4.3.3 [14]);

k_5- coefficient that considers the moisture content of the material (Table. 4.3.4 [14]);

k_7- coefficient that considers the size of the material (Table. 4.3.5 [14]);

$B`$- coefficient that considers the height of the backfill (Table. 4.3.7 [14]).

G - productivity of the filling unit, t/h;

The annual amount of dust of substances in the form of suspended solid particles, undifferentiated by composition (t/year), is calculated by the formula:

$$M = \frac{q \cdot T \cdot 3600}{10^6}$$

Where:

q – dust emission of substances in the form of suspended solid particles, undifferentiated by composition, g/s.

T – period of operation, h/year.

The calculation of the maximum single and gross emissions of inorganic dust generated during unloading, pouring and moving of inert materials is given in the Table below.

TABLE 28 - RESULTS OF CALCULATIONS OF POLLUTANT EMISSIONS DURING EXCAVATION AND LOADING OPERATIONS

Raw material to be unloaded	Code	k_1	k_2	k_3	k_4	k_5	k_7	G, t/hour	B`	q, g/s	M, t/year
Inorganic dust, containing silicon dioxide in % - 70 - 20	- /03001	0,04	0,02	1,20	1,0	0,20	0,80	16,6	0,50	**0,354133**	**0,612**
Inorganic dust, containing silicon dioxide in % - 70 - 20	- /03001	0,04	0,02	1,20	1,0	0,20	0,80	1,18	0,50	**0,025092**	**0,043**
Inorganic dust, containing silicon dioxide in % - 70 - 20	- /03001	0,04	0,02	1,20	1,0	0,20	0,80	5,72	0,50	**0,122038**	**0,211**
Inorganic dust, containing silicon dioxide in % - 70 - 20	- /03001	0,04	0,02	1,20	1,0	0,20	0,80	3,33	0,50	**0,071014**	**0,123**
Inorganic dust, containing silicon dioxide in % - 70 - 20	- /03001	0,04	0,02	1,20	1,0	0,20	0,80	1,78	0,50	**0,037874**	**0,065**
Inorganic dust, containing silicon dioxide in % - 70 - 20	- /03001	0,04	0,02	1,20	1,0	0,20	0,80	5,59	0,50	**0,119303**	**0,206**
Inorganic dust, containing silicon dioxide in % - 70 - 20	- /03001	0,04	0,02	1,20	1,0	0,20	0,80	6,16	0,50	**0,131507**	**0,227**
									Total:	**0,860961**	**1,488**

The gross emission of pollutants into the air from the reconstruction of the water treatment plant and the construction of a brine pipeline will amount to 1,488 tonnes per year.

Determination of pollutant emissions from welding operations

Emissions of pollutants into the air were calculated in accordance with the methodology of the Marzeev Institute of Hygiene and Medical Ecology 'Emission Indicators (Specific Emissions) of Pollutants from Electric and Gas Welding, Surfacing, Electric and Gas Cutting and Metal Spraying', approved by the Minister of Ecology and Natural Resources of Ukraine on 11 January 2003 [15].

Manual arc welding will be performed using ANO-6 and UONI-13/45 artificial electrodes, with a total electrode consumption of 0.618 tonnes.

The amount of harmful substances emitted into the atmosphere is determined depending on the electrode consumption and specific emissions of the ingredients according to the formula:

$$M_p = q_{уд} * B * 10^{-6}, \text{ т/рік}$$

де:

$q_{уд}$ – specific emissions during electric arc welding, depending on the brand of electrodes (Appendix 1 [15]);

B – annual electrode consumption, kg/year.

The emission rate (g/s) is determined depending on the operating time of the equipment by the formula:

$$M_c = M_p * 10^6 / T * 3600, \text{ r/c}$$

where:

M_p – gross emissions of pollutants, tonnes per year.

T – operating time of welding equipment, hours/year.

Emissions from welding operations during the reconstruction of the WTP are given in Table.

TABLE 29 - INITIAL DATA AND RESULTS OF CALCULATIONS OF EMISSIONS FROM WELDING OPERATIONS

Electrode type	Pollutant	Code	Specific emission rates, g/kg of electrodes	Electrode consumption, kg/year	Operating mode, hours/year	From the welding station	
						g/s	t/year
ANO-6	Iron oxide (in terms of iron)	7439-89-6/01003	14,35	601	300	0,0080	0,00862
	Manganese and its compounds (in terms of manganese dioxide)	1313-13-9/1104	1,95			0,0011	0,00117
UNI - 13/45	Iron and its compounds (in terms of iron)	7439-89-6/01003	10,69	17	9	0,0056	0,00018
	Manganese and its compounds (in terms of manganese)	1313-13-9/1104	0,51			0,0003	0,00001
	Amorphous silicon dioxide	7631-86-9/03000	1,4			0,0007	0,00002
	Fluoride water	7664-39-3/16001	1			0,0005	0,00002
	Highly soluble fluorides	7681-49-4/16001	4,4			0,0023	0,00007
	Poorly dissolved inorganic fluorides	-/16001	2,2			0,0012	0,00004
					Total:	**0,019669**	**0,010**

Gross emissions of pollutants into the air from welding operations will amount to 0.01 tonnes per year.

Determination of pollutant emissions during soldering of polyethylene pipes

In order to calculate the air pollutant emissions, 'Plastics Processing Industry. Collection of indicators of emissions (specific emissions) of pollutants into the atmosphere by different industries', UkrNTEK, Donetsk, 2004, volume II [16] was used.

The capacity of maximum one-time emissions (g/s) of pollutants is determined depending on the operating time of the equipment by the formula:

$$Q_t = \frac{q_{пит} * M * 10^6}{T * 3600}, \text{ г/с}$$

where:

Q_i – maximum single emission in the process of soldering polyethylene pipes, g/s;

q_{num} – specific emissions of pollutants from soldering of polyethylene pipes (according to Table X-56) [16]);

M – amount of material to be soldered, tonnes per year;

T – equipment operating time per year, hours.

In the same notation, the gross emission of pollutants is calculated by the formula:

$$M_i = Q_t * 10^{-6} * T * 3600, \text{ g/s}$$

where:

M_i – gross emissions of pollutants, tonnes per year.

T – equipment operating time per year, hours.

ПIn total, the pollutant emissions from soldering of polyethylene pipes (q_{gross}) are as follows:

- organic acids in terms of acetic acid - 0.5 g/kg;
- carbon monoxide - 0.25 g/kg.

Emissions from soldering polyethylene pipes during pipe replacement are shown in the Table below.

TABLE 30 - INITIAL DATA AND RESULTS OF CALCULATIONS OF EMISSIONS FROM PIPE SOLDERING

Type of works	Pollutant	Code	Specific emission standards, g/kg	Amount of material to be soldered, tonnes per year	Operating mode, hours/year	Amount of pollutant emissions	
						g/s	t/year
Soldering of polyethylene pipe	Acetic acid	64-19-7/11028	0,5	0,5	345	0,0002	0,00025
	Carbon monoxide	630-08-0/06000	0,25			0,00010	0,00013
					Total:	**0,0003**	**0,0004**

Gross emissions of pollutants into the air from pipe soldering will amount to 0.0004 tonnes per year.

Determination of pollutant emissions during paint and varnish works

The amount of pollutants generated is determined based on the specific pollutant emissions per unit of time per unit of equipment, based on the collection 'Production of paint and varnish coatings. Collection of indicators of emission (specific emissions) of pollutants into the air by different industries', UkrNTEK, Donetsk, 2004, volume II [16].

The source of pollutant emissions into the air at an industrial site is the surface of the material being painted.

The amount of harmful substances emitted into the atmosphere during painting is determined depending on the consumption of paint materials and specific indicators according to the formula:

$$M_p = q_c * S_n * 10^{-6}, \text{ t/year}$$

where: M_p – Gross emissions of pollutants, tonnes per year;

q_c – amount of solvent vapours emitted when painting the surface before complete drying, g/m^2 (Table X-31 [16]);

S_n – surface area to be painted, m^2/year.

The emission rate (g/s) is determined depending on the operating time of the equipment by the formula:

$$M_c = M_p * 10^6 / T * 3600, \text{ g/s}$$

where: M_c – maximum single emission of pollutants, g/s;

T – operating time of the painting area, hours/year (2920 hours/year).

The emissions of pollutants released into the atmosphere during the application of paints and varnishes are shown in the Table below.

TABLE 31 - INITIAL DATA AND CALCULATION RESULTS FOR PAINTING

Paints and varnishes	Volatile components present in paint and varnish at working viscosity	Code	Amount of solvent vapours emitted when applying paintwork materials on 1 m² of surface, g		Surface area to be painted, m²/year	Amount of pollutant emissions	
			Painting	Drying		g/s	t/year
Primer EP-057 (solvent RP)	Xylene	1330-20-7/11030	7,57	8,88	700	0,0007	0,0115
Enamel PF-115 (Solvent)	White spirit	8052-41-31/11000	11,52	20,16	9100	0,0183	0,2883
	Solvent	64742-94-5/11000	8,45	8,06		0,0095	0,1502
					Total:	0,0285	0,450

Gross emissions of pollutants into the air from painting will amount to 0.450 tonnes per year.

TABLE 32 - CHARACTERISATION OF SOURCES OF POLLUTANT EMISSIONS INTO THE AIR AND THEIR PARAMETERS DURING RECONSTRUCTION WORKS

Production, process, plant, equipment	No.	Source of emissions	Emission source parameters		Coordinates of emission sources on the map					Parameters of the gas and dust flow at the measurement site			Code	Pollutant	Maximum mass concentration of pollutant mg/m3	Emission power	
			Height m	Diam. of the outlet, m	Model code	X_1, m	Y_1, m	X_2, m	Y_2, m	Volumetric flow rate, m^3/s (at NTP)	Speed, m/s	Temp, degrees.				g/s	t/year
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Municipal Enterprise Mykolayivvodokanal - reconstruction of water treatment plant																	
Works on the reconstruction of the water treatment plant	5001	Non organized	2	-	30	1020	997	520	320	-	-	20	7439-89-6/01003	Iron oxide (in terms of iron)	-	0,013594	0,009
													1313-13-9/1104	Manganese and its compounds (in terms of manganese dioxide)	-	0,001353	0,001
													10102-44-0/04001	Nitrogen dioxide	-	0,017297	0,273
													7664-41-7/04003	Ammonia	-	0,000000	0,000
													10024-97-2/04002	Nitrogen oxide	-	0,000064	0,001
													7631-86-9/03000	Amorphous silicon dioxide	-	0,000735	0,000
													1333-86-4/03003	Carbon black	-	0,003408	0,054
													7446-09-5/05001	Sulfur dioxide	-	0,002250	0,035
													630-08-0/06000	Carbon monoxide	-	0,072250	1,140
													7664-39-3/16001	Hydrogen fluoride	-	0,000525	0,000
													7681-49-4/16001	Well-soluble fluorides	-	0,002309	0,000
													-/16001	Poorly soluble inorganic fluorides	-	0,001154	0,000

Production, process, plant, equipment	No.	Source of emissions	Emission source parameters		Coordinates of emission sources on the map					Parameters of the gas and dust flow at the measurement site			Code	Pollutant	Maximum mass concentration of pollutant mg/m3	Emission power	
			Height m	Diam. of the outlet, m	Model code	X_1, m	Y_1, m	X_2, m	Y_2, m	Volumetric flow rate, m^3/s (at NTP)	Speed, m/s	Temp, degrees.				g/s	t/year
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
													74-82-8/12000	Methane	-	0,000328	0,005
													1330-20-7/11030	Xylene	-	0,000730	0,012
													50-32-8/13101	Benz(a)pyrene	-	0,000000	0,000
													64-19-7/11028	Acetic acid	-	0,000201	0,005
													64742-94-5/11000	Solvent	-	0,009528	0,150
													8052-41-31/11000	White spirit	-	0,018283	0,288
													-/11000	NMVOCS	-	0,035865	0,260
													-/03001	Inorganic dust, with silica content in % - 70 - 20	-	0,354133	0,612
Constructing a pipeline for brine transport	5002	Non organized	2	-	116	5470	6360	477	3	-	-	20	-/03001	Inorganic dust, with silica content in % - 70 - 20	-	0,025092	0,043
Constructing a pipeline for brine transport	5003	Non organized	2	-	35	4617	5502	2320	3	-	-	20	-/03001	Inorganic dust, with silica content in % - 70 - 20	-	0,122038	0,211
Constructing a pipeline for brine transport	5004	Non organized	2	-	86	3620	4200	1350	3	-	-	20	-/03001	Inorganic dust, with silica content in % - 70 - 20	-	0,071014	0,123
Constructing a pipeline for brine transport	5005	Non organized	2	-	17	3240	3420	720	3	-	-	20	-/03001	Inorganic dust, with silica content in % - 70 - 20	-	0,037874	0,065
Constructing a pipeline for brine	5006	Non organized	2	-	89	2890	2180	2268	3	-	-	20	-/03001	Inorganic dust, with silica	-	0,119303	0,206

Production, process, plant, equipment	No.	Source of emissions	Emission source parameters		Coordinates of emission sources on the map					Parameters of the gas and dust flow at the measurement site			Code	Pollutant	Maximum mass concentration of pollutant mg/m3	Emission power	
			Height m	Diam. of the outlet, m	Model code	X_1, m	Y_1, m	X_2, m	Y_2, m	Volumetric flow rate, m^3/s (at NTP)	Speed, m/s	Temp, degrees.				g/s	t/year
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
transport														content in % - 70 - 20			
Constructing a pipeline for brine transport	5007	Non organized	2	-	12	1639	804	2500	3	-	-	20	-/03001	Inorganic dust, with silica content in % - 70 - 20	-	0,131507	0,227
															Total:	1,040834	3,721

TABLE 33 - GROSS EMISSIONS OF POLLUTANTS RELEASED INTO THE ATMOSPHERE DURING THE RECONSTRUCTION PROCESS

Code	Pollutant	MAC (max.single), TSEL, mg/m^3	Hazard class	Pollutant emissions, tonnes per year
7439-89-6/01003	Iron and its compounds (in terms of iron)	0,4	3	0,009
1313-13-9/1104	Manganese and its compounds (in terms of manganese dioxide)	0,01	2	0,001
10102-44-0/04001	Nitrogen dioxide	0,2	3	0,273
7664-41-7/04003	Ammonia	0,2	4	0,000
10024-97-2/04002	Nitrogen oxide	0,4	3	0,001
7631-86-9/03000	Amorphous silicon dioxide	0,02	-	0,000
1333-86-4/03003	Carbon black	0,15	3	0,054
7446-09-5/05001	Sulphurous anhydride	0,5	3	0,035
630-08-0/06000	Carbon monoxide	5	4	1,140
7664-39-3/16001	Hydrogen fluoride	0,02	2	0,000
7681-49-4/16001	Well-soluble fluorides	0,03	2	0,000
-/16001	Poorly-soluble inorganic fluorides	0,2	2	0,000
74-82-8/12000	Methane	50	-	0,005
1330-20-7/11030	Xylene	0.2	3	0,012
50-32-8/13101	Benz(a)pyrene	0.1 µg per 100 m^3	1	0,000
64-19-7/11028	Acetic acid	0,2	3	0,005
64742-94-5/11000	Solvent oil	0,2	-	0,150
8052-41-31/11000	White spirit	1	-	0,288
-/11000	NMVOCS	1	4	0,260
-/03001	Inorganic dust, with silica content in % - 70 - 20	0,3	3	1,488
			Total:	**3,721**

During the reconstruction of the water treatment plant, gross emissions of pollutants into the air will amount to 3,721 tonnes per year.

The expediency of dispersion calculation is carried out in accordance with clause 5.21 of OND-86 [17].

A dispersion calculation for a given pollutant is considered appropriate if the following conditions are met:

$$\frac{M}{\text{ГДК}} \geq \Phi$$

$$\Phi = 0{,}01 * H \text{ at } H > 10 \text{ m}$$

$$\Phi = 0{,}1 \text{ at } H < 10 \text{ m}$$

Де:

M – total value of pollutant emissions from all sources of the enterprise (g/s);

ГДК – maximum allowable concentration of a pollutant (mg/m^3);

H – average height of emission sources across the enterprise (m).

The results are summarised in the table below.

TABLE 34 - EXPEDIENCY OF CALCULATING THE DISPERSION OF POLLUTANTS

Code	Pollutant	MAC (max.single), TSEL, mg/m^3	Total emissions, g/s	Total emissions, fractions of MAC	Average source height, m	Parameter F	Expediency of the calculation
7439-89-6/01003	Iron and its compounds (in terms of iron)	0,4	0,0136	0,034			**NO**
1313-13-9/1104	Manganese and its compounds (in terms of manganese dioxide)	0,01	0,0014	0,135			**YES**
10102-44-0/04001	Nitrogen dioxide	0,2	0,0173	0,086			**NO**
7664-41-7/04003	Ammonia	0,2	0,0000	0,000			**NO**
10024-97-2/04002	Nitrogen oxide	0,4	0,0001	0,000			**NO**
7631-86-9/-	Amorphous silicon dioxide	0,02	0,0007	0,037			**NO**
1333-86-4/03003	Carbon black	0,15	0,0034	0,023			**NO**
7446-09-5/05001	Sulphur dioxide	0,5	0,0022	0,004			**NO**
630-08-0/06000	Carbon monoxide	5	0,0722	0,014			**NO**
7664-39-3/16001	Hydrogen fluoride	0,02	0,0005	0,026	2	0,1	**NO**
7681-49-4/16001	Fluorides well soluble	0,03	0,0023	0,077			**NO**
-/16001	Poorly soluble inorganic fluorides	0,2	0,0012	0,006			**NO**
74-82-8/12000	Methane	50	0,0003	0,000			**NO**
1330-20-7/11030	Xylene	0,2	0,0007	0,004			**NO**
50-32-8/13101	Benz(a)pyrene	0,00001	0,0000	0,001			**NO**
64-19-7/11028	Acetic acid	0,2	0,0002	0,001			**NO**
64742-94-5/11000	White spirit	1	0,0183	0,018			**NO**
8052-41-31/11000	Solvent oil	0,2	0,0095	0,048			**NO**
-/11000	NMVOCS	1	0,0359	0,036			**NO**
-/03001	Inorganic dust, with silica content in % - 70 - 20	0,3	0,8610	2,870			**YES**
31	Nitrogen dioxide and sulphur dioxide			0,09			**NO**
35	Sulphur dioxide and hydrogen fluoride			0,031			**NO**
11002	Hydrogen fluoride and poorly soluble inorganic fluorides			0,032			**NO**

It is advisable to calculate the dispersion for manganese and its compounds and inorganic dust with a silicon dioxide content of 70-20.
Air pollution was calculated using the EOL 2000 (h) software. When determining the size of the calculation area, the need to determine the concentrations of pollutants at the SPZ boundary and the boundary of the nearest residential development was taken into account. A general report on the results of the calculation of pollutant dispersion from the reconstruction of the WTP is provided in Annex 4.

The calculation of dispersion and the summary table of pollutant concentrations in the surface air layer at the boundary of the first line of residential development are presented in Section 5.1.1.

During the construction works, concentrations of any pollutant will not exceed the hygienic regulations for maximum permissible concentrations of chemicals in the air (1 MAC) at the boundary of the first line of residential development.

1.5.3.2 - Assessment of discharges and water pollution

Water supply and sewerage of the construction site is planned to be carried out from the existing WTP networks connected to the general utilities of the enterprise. To meet the technical needs of construction works (moistening of bulk materials and soil, concrete works, concrete watering and washing of vehicle wheels), water supply will be provided from the technical water pipeline B3. Water needs are met in full, up to approximately 10 m^3/day.

The standard of water consumption for drinking needs according to building codes (according to Table 5 of the manual to DBN A 3.1-5:2016 [18]) is 15 l/person per shift. The number of working personnel is determined as 50 people (maximum number).

1. Water demand for drinking purposes:

Q day = 15,0 * 50 = 750 l/day = 0,75 m^3/day.

Q year = 0,75*365 = 273,75 m^3/year.

Drinking water is provided to the workforce through imported bottled water from Mykolaiv, which meets the requirements of Sanitary and Epidemiological Norms 2.2.4-171-10 'Hygienic requirements for drinking water intended for human consumption' [2]. The shelf life and storage conditions of packaged drinking water are established based on the results of the state sanitary and epidemiological examination of this water.

2. Water demand for showers

The water consumption rate for one grid is 500 litres per hour, and the shower is used within 0.75 hours after the end of work:

Q day = 500 * 0.75 / 1000 = 0.375 m^3/day.

Q year = 0.375*365 = 136.875 m^3/year.

3. Water demand for dust reduction:

Dust suppression (hydro-dedusting) will be carried out to minimise the negative impact of excavation. To do this, its moisture content must be brought to 8%. According to preliminary data, about 4,000 m^3 of fertile soil and 35,600 m^3 of soil will be removed due to the construction of a brine pipeline.

Q year = 39 600 * 8/100 = 3 168 m^3/year;

The average daily figure is 8.7 m^3/day of water. Water will be supplied from the technical water pipeline B3.

In accordance with building regulations, domestic wastewater discharge is conditionally assumed to be water consumption.

Water for dedusting is an irrecoverable loss.

The table below shows the water balance for the construction period.

TABLE 35 - WATER BALANCE FOR THE CONSTRUCTION PERIOD

Title	Water consumption		Drainage	
	m^3/day	m^3/year	m^3/day	m^3/year
Domestic and drinking needs	0.75	273.75	0.75	273.75
Shower	0.375	136.875	0.375	136.875
Dust suppression	8.7	3 168	Irrecoverable losses	
Total	**9.8**	**3 578.625**	**1.125**	**410.625**

Domestic wastewater will be discharged into the existing sewerage system.

The water used for sanitary purposes (showers, washbasins, toilets) at the site of preparatory, construction and installation works is supplied from the existing drinking water supply system. No industrial wastewater is generated. No direct impact of construction activities on groundwater is expected.

Rainwater runoff from the territory of the WTP enters the rainwater inlets through the transverse and longitudinal slopes of the territory and is then discharged into the urban rainwater network.

Trucks required for construction, according to the construction plan, stay on the territory of the enterprise for a short time (unloading - loading), there are no queues of vehicles, so the territory is polluted with organic substances, which cannot significantly affect the condition of ground and underground water.

In general, no groundwater or surface water pollution is expected from the reconstruction works.

For the purpose of rational use of water resources and elimination of potential sources of pollution in the vicinity of water resources of the facilities, the project recommends and the following measures should be implemented during construction:

- providing all employees with high quality drinking water;

- mandatory observance of the boundaries of the existing areas allocated for the reconstruction of the WTP and the construction of a brine pipeline;

- equipping workplaces with inventory containers for construction waste;

- prohibiting fires at construction and installation sites;

- strict prohibition of washing machines and mechanisms on the banks of water bodies;

- exclusion of soil, garbage, and construction materials from being dumped into water bodies;

- all wastewater reception facilities should be watertight with a reliable waterproofing device;

- location of parking, maintenance and refuelling areas for road construction vehicles and other temporary structures within the areas allocated for construction;

- cleaning and washing of dump trucks and other construction machines bodies shall be carried out in specially designated areas.

No additional sources of negative impacts on the hydrosphere are expected to arise during preparatory and construction activities.

No wastewater generation and discharge into the environment is expected.

1.5.3.3 - Soil impact assessment

Reconstruction of the WTP is envisaged within the existing land plot (cadastral number 4810136600:06:042:0051) with an area of 52.8282 ha, allocated for the company's economic activities. There is no vegetated soil layer. As for the construction of the brine pipeline, it is planned to temporarily allocate land with an approximate area of 4.5 hectares for its construction. Prior to the start of the pipeline construction, it is planned to remove the fertile soil layer according to the geological survey (approximately 4,000 m3). The surface soil cover (fertile soil layer) will be removed on the basis of a working land management project for the removal and transfer of fertile soil layer developed according to the procedure established by law, which will determine the scope of work on the removal, transfer, storage of fertile soil layer, and in case of earthworks - also the scope of work on the rational use of the fertile soil layer that is removed or accumulated, developed technologies and the order of work, determination of the costs of their implementation.

An estimated 4,000 m^3 of excavated topsoil will be stored in dumps at the boundary of the temporary allotment, and after the brine pipeline is completed, it will be returned to its original location to reinforce the disturbed areas in the same amount of 4,000 m^3. A topsoil balance sheet will be developed at the next stage of the project.

Approximately 35,600 m^3 of soil will be excavated during the construction of the brine pipeline, and 28,620 m^3 will be returned to the trench. The works will result in a surplus of 6,980 m^3 of soil, which will be transferred either to the Infrastructure Restoration and Development Service in Mykolaiv Oblast or as an insulating layer to the landfill (this will be decided at the next design stage).

The impact on the soil is temporary and it can be minimised with proper work execution and compliance with environmental legislation.

In order to prevent negative impact on the soil, the site will be equipped with containers for household and construction waste and transported to a landfill. No unorganised contaminated wastewater is expected to be generated during construction and installation works that could enter the soil. Gas emissions will not affect the geochemical composition of the soil.

Changes made to the topography during vertical planning do not contribute to the activation of undesirable hydrogeological and engineering geological processes (subsidence, flooding, etc.) not only in the planned area but also in the adjacent areas. Thus, no negative impact on the soil during construction and installation works is expected.

No deterioration in the physical and mechanical properties of soils during construction and operation is expected.

1.5.3.4 - Waste assessment

Preparatory and construction works for the implementation of the planned activities include:

- ✓ disassembly/dismantling of old structures. The following existing buildings and facilities are planned to be demolished at the construction site:

- Sump No. 1
- Sump No. 2
- Sump No. 3
- Coagulation shop
- Filter shop, 1 stage
- Filter shop, 2 stage
- Reagent shop
- Microfilters workshop
- Demolition of process pipelines, turning platforms, driveways and sidewalks.

(The list may be expanded depending on further site surveys and design decisions made at the detailed design stage).

- ✓ installation of new foundations, arrangement of appropriate communications and construction of such structures:

- Two raw water tanks (inlet tanks) with a volume of 3,000 m^3 each.
- Two filter station blocks, including pumping stations and TPS-6/0.4 kV transformer substations designed for each filter station block;
- New building of the wash water treatment plant;
- New building of the electrolysis plant.
- External engineering networks to the new buildings and access roads;
- Pipeline for brine transport.

This stage involves the generation of traditional construction waste from disassembly, electrode residues, and ferrous scrap.

The re-equipment will be carried out in stages by specialised companies (under a contract for each type of work).

The household waste generated during the preparatory and construction works will be accounted for and disposed of by Mykolaivvodokanal as part of the company's own household waste in the course of its targeted activities (see calculation below).

The works shall be carried out in accordance with the design and construction plan; the use of advanced technologies, modern machinery and special equipment is envisaged.

Transportation of equipment, components, raw materials for the works will be carried out by the contractor and/or the owner of the equipment, components, raw materials.

Waste arising from the maintenance of such vehicles is accounted for and recovered/disposed of by the companies transporting the relevant goods and equipment.

Waste during construction work.

Preparatory and construction works generate waste, the nomenclature and quantity of which is determined in accordance with the dismantling data and cost estimates of the technical re-equipment project and is shown in the table below. Waste codes are provided in accordance with the National Waste List (NWL) [19][2].

TABLE 36 - AMOUNT OF WASTE DURING CONSTRUCTION AND THE METHOD OF ITS DISPOSAL

No	Waste	Waste codes as in NWL	Hazard class	Waste name as in NWL	Volume of waste, t	Handling
1	Fluorescent lamps	20 01 21*	I	Fluorescent lamps and other mercury-containing waste	0.00108 t	Transferred to specialised companies for disposal under a contract
2	Construction waste[1]	17 09 04	IV	Mixed construction and demolition waste other than that specified in codes 17 09 01, 17 09 02, 17 09	21 900 t	Transferred to a specialised enterprise (landfill) under a contract (as an insulating layer)

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[2] *Постанова Кабінету Міністрів України від 20 жовтня 2023 р. № 1102*

No	Waste	Waste codes as in NWL	Hazard class	Waste name as in NWL	Volume of waste, t	Handling
				03		
3	Remnants of asphalt concrete from dismantling the existing road pavement on the territory of the WTS	05 01 17	III	Bitumen (asphalt)	171.7 t	Transferred to a specialised company for recycling under a contract
4	Paint and solvent containers	15 01 10	III	Packaging containing residues or contaminated with hazardous substances	Upon formation	Transferred to specialised companies for disposal under a contract
5	Oily rags [3]	15 02 02	III	Absorbents, filter media (including oil filters not otherwise specified), wiping cloths and protective clothing contaminated with hazardous substances	0.022 t	Transferred to specialised companies for disposal under a contract
6	Damaged, used or contaminated filter materials (used respirators)	15 02 03	IV	Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths and protective clothing other than those specified in code 15.02.02	Upon formation	Transferred to specialised companies for disposal under a contract
7	Welding waste	12 01 13	IV	Waste from welding processes	0.07 t	Transferred to specialised companies for recycling under a contract
8	Ferrous metal waste[2]	19 10 01	IV	Ferrous metal waste	235.4 t	Transferred to specialised companies for recycling under a contract
9	Glass	15 01 07	IV	Glass containers (packaging)	Upon formation	Transferred to specialised companies for disposal under a contract
10	Packaging materials (mixed)	15 01 06	IV	Mixed packaging	Upon formation	Transferred to specialised companies for recycling under a contract
11	Other substandard plastic products (film, PET tape)	15 01 02	IV	Plastic packaging	Upon formation	Transferred to specialised companies for disposal under a contract

No	Waste	Waste codes as in NWL	Hazard class	Waste name as in NWL	Volume of waste, t	Handling
12	Municipal household waste	20 03 01	IV	Mixed household waste	5.5 t	Transferred to specialised companies for disposal under a contract
				Total:	22 312.7 т	

Notes:

[1] - Construction waste (such as demolition waste, residual construction materials, scaffolding and formwork that cannot be recycled, etc.) may be stored in bulk in designated hard-surfaced areas located on construction sites and will be transported to landfills as it accumulates. The removal of construction waste for further disposal as an insulating layer will be carried out on a contractual basis with companies licensed in the field of waste management.

[2] - Waste properties (ferrous scrap), or physical and chemical characteristics of waste - solid, non-combustible, insoluble.
Waste composition in per cent - 100 % ferrous metal.
Waste is collected centrally with short-term storage in containers.
Waste is removed by a specialised licensed organisation under a contract.

[3] - Composition and properties of the oiled rag: cotton - 73%; hydrocarbons of limit and non-limit - 10%, mechanical impurities - 2%; water - 15%. Physical and chemical characteristics of the waste - solid combustible, insoluble.

Maintenance of construction equipment will be carried out outside the territory of the WTP (construction site), at the Contractor's specialised enterprises.

Municipal and household waste

Construction crews generate household waste.

$$M = \mathrm{N} \times H \times t \times 10^{-3}, m / pi\kappa$$

where:

N - number of builders, people.

H – standard for specific volumes of household waste generation;

t – duration of the construction period, days.

Specific waste generation rate - 0.11 kg/day per employee.

The number of employees involved in the reconstruction process is 50.

The amount of waste for the entire period of the construction works (38 months - approximately 1000 working days) is as follows:

$$M=0,11 \cdot 50 \cdot 1000 \cdot 0,001 = 5,5 \text{ t}$$

Temporary disposal and storage of solid waste will be carried out in containers V=0,75 m^3.

Welding electrode debris

Formed during the technological process of metal welding.

$$M_{зе} = M_{ф} \cdot \alpha, \text{ t/year}$$

where:

$M_{ф}$ – actual electrodes dropped, tonnes per year;

α – standard for waste generation during welding operations.

According to SOU 42.1-37641918-096:2012 "Production norms of natural losses of basic road construction materials" [20], the standard for waste generation during welding operations is 11.1% of the number of used electrodes. According to the estimate, the total amount of ANO-6 and UONI-13/45 electrodes used is 0.618 tonnes. The amount of welding electrode waste is 0.07 tonnes.

Welding electrode scraps are collected at welding sites in metal boxes with a volume of V = 0.5 m3, which are transferred for temporary storage to centralised ferrous metal waste storage facilities at contractors' enterprises as they are filled.

Waste fluorescent lamps

During the reconstruction works, fluorescent lamps will be replaced with LED lamps in all the premises of the substation. This will generate a significant amount of fluorescent lamp waste.

The number of fluorescent lamps to be recycled is 60. The average weight of one fluorescent lamp is 180 g.

Amount of waste:

Mflu. = 0,000018·60 = 0,00108 t/year

Fluorescent lamps will be temporarily stored in a metal sealed container with a lock. Each lamp will be packed separately in corrugated factory packaging and then transferred to specialised companies for further disposal under the contract.

In the future, LED lamps will be used in the operation of the WTG. LED lamps reduce energy consumption by several times and last for a long time without the need for replacement. They are not harmful to human health, LED lamps produce light without IR and UV rays, their light is almost identical to natural light.

Mercury and other heavy chemical compounds are not used in the production of LED lamps. The shelf life of such a lamp can be 10 years.

The lamps do not contain any toxic substances, so they do not need to be demercurised and can be recycled according to the standard recycling scheme. An LED lamp is divided into the following elements:

- polycarbonate and aluminium for the body;

- the plinth is sent to glass waste and will be recycled for the production of building materials or other glass products.

Oiled rag waste

Construction activities generate waste textile materials contaminated with oil products.

$$Q_{об т} = M \cdot 3 \cdot Ф \cdot K \cdot 10^{-6}, \text{ t}$$

where:

M – specific norm of consumption of wiping material for 1 repair unit for 8 years of work (Norms of consumption of materials and tools for repair and operation of passenger cars NIIAT, M., Transport 1977 [21]) M=6 g for 8 years;

3 – number of repair units (2 units);

Ф – annual operating time of machinery and mechanised tools (6,200 hours);

K – coefficient that considers direct operating time of the equipment 0.3.

Amount of waste wiping materials used - 0.022 tonnes.

Waste (oiled rags) is collected centrally and stored in a metal container with a lid for short-term storage. It is removed by a specialised licensed organisation under a contract.

Construction waste

According to DSTU 42.1-37641918-096:2012 "Production norms of natural losses of basic road construction materials" [20], the norms of material losses during construction work are as follows:

for crushed stone, gravel, construction sand in the process of storage and work - 0.4% of the total volume;

asphalt concrete – 2 %; bitumen – 3 %;

Accordingly, the amount of waste generated during asphalt paving will be 171.7 tonnes:

crushed stone and construction sand - with an amount of 230 tonnes, waste will amount to 0.62 tonnes;

asphalt concrete - in the amount of 8,512 tonnes, waste will amount to 170.24 tonnes;

bitumen - in the amount of 28 tonnes, waste will amount to 0.84 tonnes.

In addition, the design envisages the reconstruction of the Waste Water Treatment Plant's technological elements. The estimated total amount of construction waste will be 21,900 tonnes..

The fluorescent lamps are collected centrally and stored in a metal sealed container with a lock. Each lamp is individually packed in corrugated factory packaging and will be transferred to specialised companies for further disposal under a contract.

Waste (oiled rags) is collected centrally and stored in a metal container for short-term storage. It is removed by a specialised licensed organisation under a contract.

Ferrous scrap metal and non-repairable equipment. The contractor that wins the tender for the construction works will transfer the scrap to Mykolaivvodokanal. In turn, Mykolayivvodokanal will transfer the scrap metal to Grand Metal-KR LLC (Kryvyi Rih), which has a valid licence.

All waste (except for fluorescent lamps) classified as non-hazardous will be temporarily stored separately in specially organised collection sites in a manner that is safe for human health and the environment, in compliance with safety regulations, until transferred to waste management entities. Waste will be sorted according to class and reusability. Separate containers will be allocated for glass, waste paper, metal products and polymers. Upon completion of the works, the waste will be transferred for further management to specialised business entities under the relevant contracts. Solid household waste will be regularly transported to the municipal landfill.

To prevent soil contamination with waste during the implementation of the planned activities, the following is provided:

- arangement of a specially prepared site for waste accumulation with subsequent removal via existing paved roads;

- movement of trucks and construction equipment on the territory of the enterprise to the place of work exclusively on established routes, along paved roads.

1.5.3.5 - Noise assessment

The source of noise during the reconstruction of the WTP is the movement of construction equipment, namely the sound effect when the wheels of the equipment come into contact with the road surface and the noise of its engine. Noise will be generated during the following works:

- laying asphalt concrete pavement on the territory of the WTP;
- construction of two filtration treatment plants (FTP);
- construction of a backwash water treatment plant;
- construction of a sodium hypochlorite production plant (electrolysis);
- construction of two inlet water tanks;
- laying of communications and construction of a pipeline for transporting brine to the WWTP in Mykolaiv.

A characteristic feature of noise generated by specialised equipment is sharp fluctuations in its levels, caused

by the uneven nature of the work being carried out, changes in the mode of operation of vehicles, etc. The criteria for assessing non-constant noise are equivalent sound levels L_{Aeq}.

Calculation of noise in the first line of residential development from construction equipment

The noise calculation at the boundary of the first line of residential buildings from construction equipment was performed in accordance with clause 6.2.3 of DSTU-N B V.1.1-35:2013 "Guidelines for the calculation of noise levels in rooms and areas" [22] and Appendix G of DSTU 9030:2020 [11].

In accordance with clause 4.3.7 of DSTU-N B V.1.1-35:2013 [22], the reference points were determined at a height of 1.5 m and at a distance of 2 m from the external enclosing structures of the nearest line of residential buildings in Mykolaiv (see table and figure below).

TABLE 37 - LOCATION OF POTENTIAL OBJECTS OF INFLUENCE OF PLANNED ACTIVITIES

Name of the settlement	Reference point number	Object`s name	Coordinates	Object`s address	Distance from WTP, m
Mykolaiv	PT.1	Residential building	46°52'55"N 32°03'17"E	178, Klechova balka Str.	1030
	PT.2	Residential building	46°52'48"N 32°03'15"E	197, Fontanna Str.	1000
	PT.3	Residential building	46°52'34"N 32°03'10"E	71, Kahovska Str.	890
	PT.4	Industrial area	46°52'07"N 32°03'08"E	318, Yantarna Str.	1100
	PT.5	Residential building	46°51'44"N 32°02'11"E	147, Ostapa Vyshni Str.	480
	PT.6	Residential building	46°50'16"N 32°01'42"E	40, Preobrazhenska Str.	200
	PT.7	Residential building	46°49'57"N 32°01'12"E	85, Vidrodzhennia Str.	480

FIGURE 15 - LOCATION OF RESIDENTIAL BUILDINGS IN RELATION TO THE TERRITORY OF THE WTP AND THE PIPELINE FOR BRINE TRANSPORTATION

The sound pressure level from construction equipment at the reference point is calculated using the formula:

$$L_A = L_{WA} - 20\lg r + 10\lg\Phi - 10\lg\Omega - \Delta L_{Aпов},$$

where:

L_A – sound level for a source with constant noise or equivalent sound level L_{Aeq}, or maximum sound level L_{Amax} for a source with non-constant noise, dBA;

L_{WA} – adjusted sound power level of a source with constant noise or equivalent adjusted sound power level L_{WAeq}, or maximum adjusted sound power level L_{WAmax} of a source with non-constant noise, dBA;

ΔL_{Aair} – sound attenuation in the atmosphere, dBA (according to Table 4 [22]);

r – distance to the reference point, m;

Φ – factor of noise radiation directionality by the source, dimensionless. For noise sources with uniform sound radiation, the following is assumed Φ = 1;

Ω – the spatial angle at which the noise from this source is emitted. If the emission is into the surrounding space, then Ω = 4π.

Measurements of sound pressure levels of construction machinery and mechanisms used in construction work are provided in the Table below.

TABLE 38 - SOUND PRESSURE LEVELS OF CONSTRUCTION MACHINERY AND MECHANISMS

Name	Levels L (dB) for mean-geometric frequencies (Hz) of octave noise bands								L_A eq., dBA	L_A max., dBA
	63	125	250	500	1000	2000	4000	8000		

Self-propelled road roller, weight 13 tonnes, r=3 metres										
SPL at the measurement points	97,7	83,4	88,9	85,4	82,6	81,2	78,5	74,0	98,8	99,2
SPL at 7,5 meters	90,3	76,0	81,5	78,0	75,2	73,8	71,1	63,6	91,0	91,8
Universal asphalt paver, r=3 metres										
SPL at the measurement points	87,9	86,8	72,1	75,8	77,0	72,2	65,3	57,9	93,2	93,8
SPL at 7,5 meters	80,5	79,4	64,7	68,6	69,6	64,7	57,9	50,5	85,8	86,4
Forklift truck, lifting capacity - 5 tonnes, r=3 metres										
SPL at the measurement points	78,0	73,4	70,6	78,7	80,5	77,4	73,8	62,1	87,3	87,3
SPL at 7,5 meters	70,6	66,0	63,2	71,3	73,1	70,0	66,4	54,7	79,9	79,9
Crane on a truck chassis, lifting capacity -32 tonnes, r=3 metres										
SPL at the measurement points	79,6	72,3	70,3	69,8	72,3	66,9	61,1	56,7	75,8	75,8
SPL at 7,5 meters	72,2	64,9	62,9	62,4	64,9	58,5	53,7	49,3	68,4	68,4
Dump trucks with a lifting capacity - 15 tonnes, r=3 metres										
SPL at the measurement points	81,5	77,5	74,5	74,8	74,4	70,1	63,5	55,0	77,8	77,8
SPL at 7,5 meters	74,1	70,1	67,1	67,4	67,0	62,87	56,1	47,6	72,4	72,4
Wirteg road milling machine, r=3 metres										
SPL at the measurement points	98	83,7	89,2	85,7	82,9	81,5	78,8	74,3	99,1	99,5
SPL at 7,5 meters	90,6	76,3	81,8	78,3	75,5	74,1	71,4	63,9	91,7	92,5
Single-bucket crawler excavator – 0.5 m^3, r=3 metres										
SPL at the measurement points	97,7	83,4	88,9	85,4	82,6	81,2	78,5	74,0	98,8	99,2
SPL at 7,5 meters	90,3	76,0	81,5	78,0	75,2	73,8	71,1	63,6	91,0	91,8

SPL – sound pressure level;
RP – reference point.

The equivalent noise level $L_{Aeq,}$ dBA is determined from 7 simultaneously operating construction machines and compared with the daytime standard (no construction work is carried out at night).

TABLE 39 - SOUND LEVELS AT REFERENCE POINTS (DURING DAYTIME HOURS)

RP No.	Name	Distance, m	Levels L (dB) for mean-geometric frequencies (Hz) of octave noise bands								Total noise level in RP, dBA	Standard*, dBA (during daytime hours)
			63	125	250	500	1000	2000	4000	8000		
p.1	Residential buildings	1030	40,2	38,3	22,8	25,0	23,1	12,1	0,0	0,0	42,5	60
p.2	Residential buildings	1000	40,4	38,6	23,1	25,3	23,5	12,7	0,0	0,0	42,7	60
p.3	Residential buildings	890	41,1	39,4	24,0	26,3	24,9	14,7	0,0	0,0	43,6	60
p.4	Industrial area	1100	39,7	37,9	22,3	24,3	22,2	10,8	0,0	0,0	42,1	-
p.5	Residential buildings	480	39,7	38,3	23,2	26,2	25,9	18,2	5,6	0,0	42,3	60
p.6	Residential buildings	200	45,4	44,2	29,3	32,7	33,3	27,3	18,0	5,8	48,2	60
p.7	Residential buildings	480	39,7	38,3	23,2	26,2	25,9	18,2	5,6	0,0	42,3	60
Boundaries of the SPZ	-	50	59,9	58,7	44,0	47,6	48,7	43,6	36,1	27,5	62,8	-

*The standard sound pressure levels are adopted for residential areas affected by noise from

construction and renovation works in accordance with clause 43 of Appendix 1 to DSP No. 463 "State sanitary norms for permissible noise levels in residential and public buildings and in residential areas" [23], i.e. 60 dBA.

The table shows that noise pollution from construction work will not exceed the permissible noise level at the boundary of residential buildings.

1.5.3.6 - Impact assessment of light, heat and radiation pollution during construction works

In accordance with the requirements of the "Radiation Safety Standards of Ukraine" (NRBU-97) [24], technical re-equipment shall include measures to ensure compliance with regulatory levels of ionising radiation. Mandatory radiation monitoring of construction materials, products and structures, both of natural origin (sand, crushed stone and gravel) and industrial origin (bricks, etc.), as well as installed technological equipment, which excludes the entry of radionuclides with building materials and ensures safety both directly on the site and for the life of the population of neighbouring residential buildings is foreseen. Based on the above, ionising radiation levels in the residential area, taking into account the natural background radiation, will not exceed the permissible "Radiation Safety Standards of Ukraine". All materials used during the reconstruction have certificates of conformity and protocols for testing the specific activity of materials in accordance with the requirements of current legislation.

There will be no light or heat pollution during the planned activities.

1.5.4 - Assessment by type and amount of expected pollution resulting from the operation of WTP in Mykolaiv

During operation of the WTP, the following sources of impact will be permanent:

- Operation of boilers and the ventilation system of the electrolysis production facility;
- Activities of the chemical laboratory;
- Mechanical workshop;
- Paint and varnish materials warehouse;
- Laundry;
- Noise pollution from the operation of pumping and ventilation equipment and motor vehicles;
- Discharge of rainwater and meltwater from the WTP territory into the storm water drainage;
- Life activities of personnel, namely the generation of solid waste;
- Formation of dehydrated sludge.

TABLE 40 - SOURCES OF ENVIRONMENTAL POLLUTION AND NOMENCLATURE OF POLLUTANTS ARISING FROM THE OPERATION OF WTP IN MYKOLAIV

No.	Type of activity	Source of impact	Expected negative impact (name and code of pollutant)	Pollutant code	Hazard class	$MAC_{on\ e\text{-}time}$ or PHBV*	List of impacted components
WTP operation in Mykolaiv							
1	WTP operation	Boiler operation	Emissions:	-	-	mg/m³	Surface layer of the atmosphere
			Metallic mercury	7439-97-6/01007	1	0,0003	
			Nitrogen dioxide	10102-44-0/04001	3	0,2	
			Nitrogen oxide	10024-97-2/04002	3	0,4	
			Methane	74-82-8/12000	-	PHBV – 50 mg/m³	
			Carbon oxide	630-08-0/06000	4	5,0	
		Safety valves of GDP	Ethantiol (ethyl mercaptan)	75-08-1/11000	-	PHBV - 0,00003 mg/m³	
			Methane	74-82-8/12000	-	PHBV – 50 mg/m³	
		Transformer substations	NMVOC	-/11000	4	1,0	
			Sulphur hexafluoride	2551-62-4/10190	-	PHBV – 0,001 mg/m3	
		Ventilation system for electrolysis production	Total suspended solids, not differentiated by composition	-/03000	3	0,5	
2	Activities of the Chemical Laboratory	Extraction cabinets	Emissions:	-	-	mg/m³	Surface layer of the atmosphere
			Sodium hydroxide (caustic soda)	1310-73-2/03000	-	PHBV – 0.01 mg/m³	
			Hydrogen chloride	7647-01-0/15003	2	0,2	
			Sulphuric acid	7664-93-9/05004	2	0,3	
3	Mechanical workshop	Lathe, grinding machine	Emissions:	-	-	mg/m³	Surface layer of the atmosphere
			Metal dust	-/03000	-	PHBV – 0,1 mg/m³	
			Emulsol	-/11000	-	PHBV – 0,05 mg/m³	
		Woodworking machine	Emissions:	-	-	mg/m³	Surface layer of the atmosphere
			Wood dust	-/03000	-	PHBV – 0,1 mg/m³	
		Skiving machine, Vulcanisation station, Charging device	Emissions:	-	-	mg/m³	Surface layer of the atmosphere
			Hydrogen chloride	7647-01-0/15003	2	0,2	
			Sulphuric acid	7664-93-9/05004	2	0,3	
			1,3-Butadiene	106-99-	4	3,0	

No.	Type of activity	Source of impact	Expected negative impact (name and code of pollutant)	Pollutant code	Hazard class	$MAC_{one-time}$ or PHBV*	List of impacted components
			(divinyl)	0/11010			
			2-Methylpropene (isobutylene)	115-11-7/11000	-	PHBV – 0,1 mg/m^3	
			Aliphatic aminesC15-C20	-/10000	2	0,003	
			Acrylonitrile	107-13-1/11001	2	0,03	
			Rubber dust	-/03000	-	PHBV – 0,1 mg/m^3	
4	Warehouse of paint and varnish materials	PF-19M enamel	Emissions:	-	-	mg/m^3	Surface layer of the atmosphere
			Xylene	616	3	0,2	
			White spirit	2752	-	PHBV – 1,0 mg/m^3	
		Storage of domestic salt	Suspended solids, not differentiated by composition	-/03000	3	0,5	
5	Laundry	Washing machine	Synthetic detergent	-/03000	-	PHBV – 0,03 mg/m^3	Surface layer of the atmosphere
6	Territory of the WTP	Discharge of rainwater and melt water	Suspended substances	-	-	bkgd + 0,75 mg/d m3	Surface water bodies
			Petroleum products	-	-	0.3 mg/d m3	
7	Living conditions of the working personnel	Operating personnel	Solid waste generation	-	4	-	Land resources
8	Operation of WTP	Disposal of dewatered sludge	Waste generation	-	4	-	Land resources
9	Noise impact	Operation of pumping and ventilation equipment	Noise pollution	-	-	65 - 80 dBA	Workplace
		Operation of motor vehicles	Noise pollution	-	-	60 dBA	Residential buildings

* Vehicles for transporting personnel, consumables, reagents and waste disposal were taken into account in the background concentrations of pollutants.

All other types of pollution, such as contamination of subsoil and groundwater, vibration, light, heat, and radiation pollution, will not occur during the operation of the WTP in Mykolaiv due to the specific nature of the planned activities.

1.5.4.1 - Assessment of emissions

The impact on the air environment is associated with the formation and emissions of pollutants during the operation of WTP technological equipment (metallic mercury, nitrogen dioxide, nitrogen oxide, methane, carbon monoxide, ethyl mercaptan, methane, NMVOCs, sulphur hexafluoride and suspended solids of

undetermined composition) and auxiliary facilities, such as: chemical laboratory (hydrogen chloride, sulphuric acid, sodium hydroxide, chlorine vapours and gaseous compounds), mechanical workshop (substances in the form of suspended solid particles not differentiated by composition, hydrogen chloride, sulphuric acid, 1,3-butadiene, 2-methylpropene, aliphatic amines C_{15}-C_{20}, acrylonitrile) and storage rooms (xylene, white spirit and substances in the form of suspended solid particles not differentiated by composition).

Characteristics of pollutant emission sources

There are 38 sources of pollutant emissions into the atmosphere in the WTP territory, of which 31 are organised emission sources and 7 are unorganised emission sources.

The Figure below shows the locations of emission sources in the WTP territory after reconstruction.

FIGURE 16 - PROJECT PLAN FOR THE TERRITORY OF THE WTP MUC "MYKOLAIVVODOKANAL" WITH MARKED SOURCES OF POLLUTANT EMISSIONS

Symbols:

- Existing buildings and structures
- Planned above-ground structures
- Planned underground structures
- ① - Designation of buildings and structures in accordance with the legend
- Organised sources of pollutant emissions into the atmosphere

- Unorganised sources of pollutant emissions into the atmosphere

- Boundary of the enterprise`s industrial site

- Boundary of the sanitary protection zone of the enterprise, impact zone

TABLE 41 – LEGEND OF DESIGN BUILDINGS AND STRUCTURES OF THE WTP MUC "MYKOLAIVVODOKANAL"

Legend of the buildings and structures			
Designation on the plan	**Name**	**Number of floors**	**Notes**
1	Administrative building	1	existing
2	Repair and mechanical workshop	1	existing
3	Mechanical workshop	1	existing
4	Technical water supply building	2	existing
5	Clear-water reservoir CWR capacity 2x6 000 m^3	underground	existing
5.1	Clear-water reservoir CWR capacity 2 000 m^3	underground	existing
5.2	Clear-water reservoir CWR capacity 2 000 m^3	underground	existing
5.3	Clear-water reservoir CWR capacity 3 000 m^3	underground	existing
6	Pumping station, 2nd lift "Korabel"	2	existing
7	Pumping station, 2nd lift "Misto"	1	existing
8	Treatment facilities block, stage III	1-2	existing
12	Administrative building	2	existing
13	Chlorination plant	2	existing
14	Microfilter building	2	existing
15	Reagent storage	2	to be dismantled (partially)
16	Laboratory	1	existing
17	Boiler room	1	existing
18	Existing open power station (ORU 35/6 kV)	ground-level	existing
18.1	Distribution device 6 kV	1	existing
19	Filtration treatment plant (FTP) with pump and reverse osmosis system. Unit 1	1 with underground section	to be designed
20	Filtration treatment plant (FTP) with pump and reverse osmosis system. Unit 1	1 with underground section	to be designed
21	Backwash water treatment plant	1 with underground section	to be designed
22	Sodium hypochlorite production station (electrolysis)	1	to be designed
23	Inlet water tank 3 000 m^3	underground	to be designed
24	Inlet water tank 3 000 m^3	underground	to be designed
25	Material warehouses	1	existing

TABLE 42 - LIST OF EMISSION SOURCES AFTER RECONSTRUCTION OF THE WTP IN MYKOLAIV

No.	Name
5	GDP safety valve
30	Extraction cabinet
31,32	Laboratory
33	Warehouse of paint and varnish materials
34	Woodworking machine
35	Circular saw
36	Sawing machine, vulcanisation station, charging device
37	Washing machine
39	Lathe machine, grinding machine
43, 45, 46, 47	Boiler Bogdan-50

No.	Name
44, 53, 56, 59, 62, 65, 69	Purge valve
48, 49	Boiler Bogdan-80
52	Boiler Herman-Micra 2
54, 55, 57, 58, 60, 61	Boiler MH-100
63, 64	Boiler Bogdan-35
66-68	Boiler Dermad-3
70	Ventilation system for the electrolysis department
71	Material composition deflector
72,73	Transformer substations

Quantitative calculation of pollutant emissions from boilers

The calculation was performed in accordance with the "Collection of emissions` indicators (specific emissions) of pollutants into the atmosphere by various industries. Volume 1, Donetsk, 2004" [25] and the Methodology for determining "Emissions of pollutants into the atmosphere from boilers in the municipal sector with a capacity of less than 50 MW" [26].

The source of the emission is organised.

The gross emission of j pollutant Ej, t, entering the atmosphere with flue gases from a thermal power plant during a period of time P, was determined as the sum of gross emissions of this substance during the combustion of different types of fuel, including during their simultaneous joint combustion:

$$E_j = \sum_i E_{ji} = 10^{-6} \sum_i k_{ji} B_i \left(Q_i^r\right)_i ,$$

Eji – gross emission of j pollutant during the combustion of i fuel during the period of time, t;

kji – emission factor of pollutant j for fuel i, g/GJ;

Bi – consumption of fuel i during the period of time P, t;

(Qri)i – lower working heat of combustion of the i fuel, MJ/kg.

The total consumption of natural gas during the period under review was determined as follows:

B = Bv Pn, (g/s, kg/h, t/year), where

Bv – volume consumption of natural gas (l/s, m^3/h, thousand nm^3/year);

Pn = 0,73 gm/m^3 – density of natural gas under normal conditions.

Mass heat of combustion of natural gas:

Qрн = Qрнv/Pn , MJ/kg, where

Qрнv = 33,08 MJ/m^3 – lower volumetric heat of combustion of natural gas;

Pn = 0,73 kg/m3 – density of natural gas under normal conditions.

Qрн = 33,08/0,73 = 45,32 MJ/kg

Quantitative calculation of pollutant emissions from the purge valve of the internal gas pipeline and gas metering unit piping

The calculation was performed in accordance with "RD 51-100-85 Methodological recommendations for the regulation of air pollutants in gas storage facilities: VNI-Gas, 1985" [27] and in accordance with the "Collection of emission indicators (specific emissions) of pollutants into the atmosphere by various industries" Ukrainian Scientific Centre for Technical Ecology, Volumes I-III, Donetsk, 2004 [28].

The source of the emission is organised.

The type of fuel is natural gas.

The maximum single emission of methane was determined using the formula:

$$Mms = Va \cdot p/3,6, \text{ (g/s), where}$$

Va – actual natural gas consumption through shut-off valves (m^3/hour);

p = 0,73 kg/m^3 – gas density at air temperature.

$$Vд = 1,56 \cdot d \cdot F \cdot B \cdot [\Delta P \cdot p_{out} / p_{in}]0,5, \text{ (m^3/hour), where}$$

d – rated flow coefficient of the valve;

F – valve seat cross-sectional area, (mm^2);

B – coefficient determined according to Table 4.7;

ΔP – pressure difference across valve, (kgs/cm^2);

p_{out} – absolute outlet gas pressure, (kgs/cm^2);

p_{in} – absolute inlet gas pressure, (kgs/cm^2).

The following formula is used to determine annual methane emissions:

$$Myear = Mms \cdot T \cdot N \cdot 10^{-6}, \text{ (t/year), where}$$

T – time of one blowdown, (b);

N – annual number of gas blowdown.

Quantitative calculation of pollutant emissions from transformer substations

Calculation of emissions of saturated hydrocarbons C_{12}-C_{19} (NMVOC) from the operation of a transformer substation

The calculation of pollutant emissions is performed in accordance with the methodology of the Collection of indicators of pollutant emissions into the atmosphere by various industries [28], namely, cl. 4, calculation of hydrocarbon emissions during the storage of petroleum products.

When pouring transformer oil into a tank, the amount of pollutant emissions into the atmosphere, namely saturated hydrocarbons C_{12}-C_{19} (NMVOC), is calculated using the formula:

$$П_р = 4,46 \cdot V_ж^р \cdot P_{s(38)} \cdot M_n \cdot (K_{5x} + K_{5T}) \cdot [K_8 \cdot (1 - \eta)] \cdot 10^{-9}, \text{ kg/hour.}$$

The amount of pollutants emitted into the atmosphere from tanks due to operational evaporation is calculated using the formula:

$$П_р = 4,46 \cdot V_ж^р \cdot P_{s(38)} \cdot M_n \cdot (K_{5x} + K_{5T}) \cdot [K_6 \cdot K_7 \cdot (1 - \eta)] \cdot 10^{-9}, \text{ kg/hour,}$$

When draining oil from tanks, the amount of pollutants emitted into the atmosphere is calculated using the formula:

$П = 0,44 \cdot V_{ж}^{цн} \cdot P_{s(38)} \cdot M_n \cdot (K_{5x} + K_{5T}) \cdot 10^{-9}$, kg/hour.

where $V_{ж}^{р}$ – volume of liquid poured into the tank during the year (m^3/year);

$V_{ж}^{цн}$ – annual volume of liquid drained from tanks (m^3/year);

M_n – molecular mass of vapour liquid;

η – gas tank control device efficiency coefficient (unit shares);

K_{5x} , K_{5T} – correction factors depending on saturated vapour pressure;

K_6 – correction factor, which depends on the saturated vapour pressure and the annual turnover of the tanks;

K_7 – correction factor, which depends on technical equipment and operating mode;

K_8 – coefficient depending on saturated vapour pressure and climate zone;

$P_{s(38)}$ – pressure of saturated liquid vapour at a temperature of 38 ºC (gPa);

M_n – molecular mass of liquid vapour (molecular mass of liquid vapour Mn is determined according to Table 5.2 of the Methodology depending on the initial boiling point of the liquid).

Calculation of elegas emissions (sulphur hexafluoride – SF6) from the operation of a transformer substation

In order to isolate the transformer equipment within the specified safe technical and operational characteristics, a simulation of the situation using gas-insulated equipment and substances was carried out. Emissions of substances resulting from the operation of transformers were calculated in accordance with the EBRD Methodology for the Assessment of Greenhouse Gas Emissions [29].

As a rule, elegas can be stored in cylinders with a volume of 40 litres. The potential annual consumption of elegas is estimated at 100-120 litres, equal to 0.12 m^3. The density of elegas is 6.17 kg/m^3.

Therefore, the total amount of substances that will be used per year is:

$M (SF_6) = 6,17 \cdot 0,12 = 0,7404$ kg = 0,00074 t/year.

According to the methodology, 1% of the used elegas enters the atmospheric air:

$П_{year} (SF_6) = 0,00074 \cdot 0,01 = 0,0000074$ t/year.

$П_{sec} (SF_6) = 0,0000074 \cdot 1000000/(365 \cdot 24 \cdot 3600) = 0,0000002$ g/s.

Ventilation system for electrolysis production

Salt for electrolysis units is supplied in 50 or 25 kg bags on pallets and stored in a warehouse equipped with a crane beam with a lifting capacity of 2.0 tonnes.

Salt is delivered to the loading area above the salt dissolving tanks using a manual hydraulic stacker. The annual salt requirement will be 2,032 tonnes/year.

The salt storage facility for electrolysis has natural ventilation with 3 air exchanges through deflectors. The air flow is dispersed by louvered grilles. The electrolysis shop is equipped with 6 air exchanges for supply and exhaust ventilation, and the exhaust fans are explosion-proof. Additionally, emergency ventilation with 8 air

exchanges is provided, which is activated when the gas analyser alarm is triggered to remove harmful substances from the gas tanks.

Pollutants are emitted through the ventilation system B1 of the electrolysis workshop, height 10.48 m, diameter 0.4 m.

Expected emissions of pollutants: suspended particles, undifferentiated by composition (sodium chloride (table salt)).

Calculation of pollutant emissions from reagent storage and transfer sites.

The calculation of the volume of inorganic dust generated during extraction and loading operations was carried out in accordance with the "Collection of methods for calculating the content of pollutants in emissions from unorganised sources of atmospheric pollution", UkrNTEC, Donetsk 1994 [14].

The maximum single dust emission during extraction and loading operations is calculated using the following formula:

$$q = A + B = \frac{k_1 \cdot k_2 \cdot k_3 \cdot k_4 \cdot k_5 \cdot k_7 \cdot G \cdot 10^6 \cdot B`}{3600} + k_3 \cdot k_4 \cdot k_5 \cdot k_6 \cdot k_7 \cdot q` \cdot F$$

Where:

A – emissions during processing (transfer) of material (table salt), g/s;

B – emissions during static storage of material, g/s;

q – quantity of dust generated during extraction and loading operations, g/s.;

k_1 - weight fraction of dust in rock. Determined by washing and sieving an average sample with separation of dust fractions of size 0 – 200 μm (k_1 Table 4.3.1 [14]);

k_2- the proportion of airborne dust that becomes an aerosol with particle sizes of 0–50 μm relative to the total dust in the rock (it is assumed that not all airborne dust becomes an aerosol) (Table 4.3.1 [14]);

k_3- coefficient that takes into account the wind speed in the area where construction equipment is operating (Table 4.3.2 [16]);

k_4 - coefficient that takes into account local conditions (Table 4.3.3 [14]);

k_5- coefficient that takes into account the moisture content of the material (Table 4.3.4 [14]);

k_6- coefficient that takes into account the surface profile of the stored material and is defined as the ratio of Fϕ/F = 1,3 (Table 4.3.4 [14]);

k_7- coefficient that takes into account the material coarseness (Table 4.3.5 [14]);

Fϕ – actual surface area taking into account the relief of its cross-section;

F – dusting area in the plan, m^2;

$q`$ - dust removal from one square metre of actual surface area;

$B`$- coefficient that takes into account the height of the aggregate handling (Table 4.3.7 [14]).

G - aggregate handling conveyor capacity, t;

TABLE 43 – VALUE OF COEFFICIENTS k_1, k_2 $q`$ *FOR DETERMINING DUST EMISSIONS*

Material name	Material density, g/cm^3	Weight fraction of dust fraction in the material, k_1	Proportion of dust convertible to aerosol, k_2	Dust removal, q', g/m^{2}xs
Salt	2,16	0,03	0,02	0,002

The annual amount of dust substances in the form of suspended solid particles, undifferentiated by composition (t/year), is calculated using the formula:

$$M = \frac{q \cdot T \cdot 3600}{10^6}$$

where:

q – emission of dust substances in the form of suspended solid particles, undifferentiated by composition, g/s.

T – operating period, hours/year.

The calculation of the maximum single and gross emissions of inorganic dust (table salt) generated during unloading, transfer and movement of inert materials is given in the Table below.

TABLE 44 - RESULTS OF CALCULATIONS OF POLLUTANT EMISSIONS INTO THE ATMOSPHERE FROM REAGENT STORAGE AND TRANSFER SITES

Material name	Operation stage	Material consumption, t/year	G, Material consumption, t/hour	Warehouse area, m^2	Operating hours, hours/year	Coarseness of material, mm	Material humidity, %	height of the aggregate handling, m	Wind speed m/s	Material density, t/m3	Coefficients									Emission power	
											K1	K2	K3	K4	K5	K6	K7	q	b	g/s	t/year
Salt	static storage	2032	-	54	8760	1	10	-	2	2,16	-	-	1	0,005	0,1	1,3	0,8	0,002	-	0,000056	0,0018
Salt	loading into the hopper feeder	2032	27,84	-	73	1	10	2	2	2,16	0,03	0,02	1,2	0,005	0,1	-	1	-	0,7	0,001948	0,0005
Total		Suspended substances, not differentiated by composition																		0,002005	0,0023

Gross emissions of pollutants into the atmosphere from storage and transfer sites will amount to 0.0023 tonnes per year.

Chemical laboratory

To determine emissions of pollutants into the atmosphere, the "Collection of indicators of emissions (specific emissions) of pollutants into the atmosphere by various industries" (UkrNTEC, Donetsk, 2004, vol. II) is used [16].

The source of emissions (ES) in the chemical laboratory is the fume hoods "ShV" No. 1 and "ShV" No. 2.

The composition and quantity of pollutants are determined based on the chemical reagents used in the laboratory and the specific indicators of ingredient emissions per unit of time of exhaust equipment operation in accordance with the methodology. The quantity of substances emitted was determined using instrumental measurements (g/s) by Eco-Mykolaiv, LLC.

Mechanical workshop

When lathes are running, suspended substances are formed. The amount of pollutants formed is determined based on the specific indicators of pollutants per unit of time per unit of equipment, based on Table X-14 of the collection "Collection of indicators of emissions (specific emissions) of pollutants into the atmosphere by various industries", UkrNTEC, Donetsk, 2004, Volume II [16].

The amount of dust emissions (t/year) is determined according to specific indicators and the operating time of the lathes using the formula:

$$M_p = q_{y\partial} \times T \times 3600 \times (1 \quad \eta)/10^6, \text{ t/year}$$

where:

$q_{y\partial}$ – specific emissions (g/s), depending on the lathe type (Appendix 1 [17], Table X-14)

T – equipment operating time, hours/year;

η – dust collection equipment efficiency coefficient, %; $\eta = 0$

Painting area

The amount of pollutants generated is determined based on the specific indicators of pollutants per unit of time per unit of equipment, based on the collection "Production of paint and varnish coatings. Collection of indicators of emissions (specific emissions) of pollutants into the atmosphere by various industries", UkrNTEC, Donetsk, 2004, vol. II [16].

The source of pollutants released into the atmosphere at the industrial site is the surface of the material being painted.

Painting is carried out using a brush. The duration of painting works is 250 hours/year.

The amount of harmful substances emitted into the atmosphere during painting is determined depending on the consumption of painting materials and specific indicators according to the formula:

$$M_p = q_c * S_n * 10^{-6}, \text{ t/year}$$

where:

M_p – gross emissions of pollutants, tonnes/year;

q_c – the amount of solvent vapours emitted during surface painting until complete drying, g/m^2 (Table X-31 [16]);

S_n – surface area to be painted, m^2/year.

The emission capacity (g/s) is determined depending on the operating time of the equipment according to the formula:

$$M_c = M_p * 10^6/T * 3600, \text{ g/s}$$

where:

M_c – maximum single emission of pollutants, g/s;

T – painting section operating time, hours/year.

Laundry

The source of emissions (ES) of pollutants is the process of loading washing powder into the washing machine. It is assumed that 150 g of washing powder is used per wash. A total of 3 loads are washed per day. The annual consumption of washing powder is 162 kg.

The source of emissions is unorganised.

Calculation of pollutant emissions from loading washing powder into a washing machine.

The calculation of the volume of inorganic dust formed during the transfer of the reagent was carried out in accordance with the "Collection of methods for calculating the content of pollutants in emissions from unorganised sources of atmospheric pollution", UkrNTEC, Donetsk 1994 [14].

The calculation of the maximum single dust emission during extraction and loading operations is carried out using the formula:

$$q = \frac{k_1 \cdot k_2 \cdot k_3 \cdot k_4 \cdot k_5 \cdot k_7 \cdot G \cdot 10^6 \cdot B'}{3600}$$

Where:

q - dust formation during loading of washing powder, g/s.;

k_1 - the weight fraction of dust in rock. It is determined by washing and sieving an average sample to separate dust fractions ranging from 0 to 200 μm in size (k_1 = *0,07* Table 4.3.1 [14]);

k_2- the proportion of airborne dust that becomes an aerosol with particle sizes of 0–50 μm relative to the total dust in the rock (it is assumed that not all airborne dust becomes an aerosol) (k_2 = *0,05* Table 4.3.1 [14]);

k_3- coefficient that takes into account the wind speed in the area where construction equipment is operating (k_3 = *1* Table 4.3.2 [14]);

k_4 - coefficient that takes into account local conditions (k_4 = *0,05* Table 4.3.3 [14]);

k_5- coefficient that takes into account the moisture content of the material (k_5 = *1* Table 4.3.4 [14]);

k_7- coefficient that takes into account the material coarseness (k_7 = *1* Table 4.3.5 [14]);

B`- coefficient that takes into account the height of the aggregate handling (B' = 0,4 Table 4.3.7 [14]).

G - aggregate handling conveyor capacity, t;

The annual amount of dust substances in the form of suspended solid particles, undifferentiated by composition (t/year), is calculated using the formula:

$$M = \frac{q \cdot T \cdot 3600}{10^6}$$

where:

q – emission of dust substances in the form of suspended solid particles, undifferentiated by composition, g/s.

T – operating period, hours/year.

TABLE 45 – THE AMOUNT OF POLLUTANTS EMITTED FROM LOADING WASHING POWDER INTO A WASHING MACHINE

Material name	Operation stage	Material consumption, t/year	G, Material consumption, t/hour	Operating hours, hours/year	Coefficients							Emission power	
					K1	K2	K3	K4	K5	K7	b	g/s	t/year
Washing powder	loading into a washing machine	0,162	0,034	4,7	0,07	0,05	1	0,005	0,1	1	0,4	0,000067	0,000001

The characteristics of sources of pollutant emissions into the atmosphere and their parameters are given in the Table below.

TABLE 46 - THE CHARACTERISTICS OF SOURCES OF POLLUTANT EMISSIONS INTO THE ATMOSPHERE AND THEIR PARAMETERS

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
MUC “Mykolaivvodokanal” water treatment plant																		
Energy	5	GDP safety valve	6	0,02	956	896	-	-		0,8	-	20	75-08-1/11000	Ethantiol (ethyl mercaptan)	-	0,000300	0,00108	0,000
													74-82-8/12000	Methane	-	15,649000	56,3364	0,073
Chemical laboratory	30	Exhaust cabinet	6	0,20x 0,20	987	915	-	-	At the source outlet	0,52	13	19	1310-73-2/03000	Sodium hydroxide	0,21	0,000100	0,00036	0,001
													7664-93-9/05004	Sulphuric acid	0,23	0,000100	0,00036	0,001
													7647-01-0/15003	Hydrogen chloride	0,14	0,000100	0,00036	0,001
Chemical laboratory	31	Exhaust cabinet	6	0,22x 0,22	980	911	-	-	At the source outlet	1,21	25	19	1310-73-2/03000	Sodium hydroxide	0,04	0,000048	0,00017	0,000
													7782-50-5/15000	Chlorine	0,98	0,000500	0,0018	0,004
													7664-93-9/05004	Sulphuric acid	0,05	0,000100	0,00036	0,001
Warehouse	33	Warehouse of paint and varnish materials	2	0,20x 0,20	943	955	-	-	At the source outlet	0,28	7	16	8052-41-3/11000	White spirit	12,1	0,003400	0,01224	0,025
													1330-20-7/11030	Xylene	15,3	0,004300	0,01548	0,031
Repair	34	Woodworking machine	2	-	944	950	3	3	-	-	-	20	-/03000	Wood dust	-	0,038167	0,1374	0,014
Repair	35	Circular saw	2	-	953	957	3	3	-	-	-	20	-/03000	Wood dust	-	0,025500	0,0918	0,046
Repair	36	Sawing machine, vulcanisation station, charging device	2	-	938	948	3	3	-	-	-	20	-/03000	Rubber dust	-	0,011200	0,0403	0,000
													7664-93-9/05004	Sulphuric acid	-	0,000022	0,00008	0,000
													-/10000	Aliphatic amines C15-C20	-	0,000024	0,00009	0,000

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
													115-11-7/11000	2-Methylpropene (isobutylene)	-	0,001232	0,00444	0,000
													107-13-1/11001	Acrylonitrile	-	0,000003	0,00001	0,000
													106-99-0/11010	1,3- Butadiene (divinyl)	-	0,000002	0,00001	0,000
													7647-01-0/15003	Hydrogen chloride	-	0,000002	0,00001	0,000
Laundry	37	Washing machine	2	-	935	952	1	1	-	-	-	30	-/03000	Synthetic detergent of the 'Lotus' type	-	0,000067	0,00024	0,000
Repair	39	Lathe machine, grinding machine	2	-	941	924	2	2	-	-	-	20	-/03000	Metal dust	-	0,009100	0,03276	0,021
													-/11000	Emulsol	-	0,000003	0,00001	0,000
Energy	43	Boiler Bogdan-50	6	0,18	959	930	-	-	At the source outlet	0,026	1,023	73	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	113,74	0,001690	0,00608	0,018
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	60,31	0,000870	0,00313	0,063
													124-38-9/07000	Carbon dioxide	-	2,894680	10,42085	14,885
													74-82-8/12000	Methane	-	0,000050	0,00018	0,000
Energy	44	Purge valve	6	0,02	964	934	-	-	-	0,00013	0,459	23,1	75-08-1/11000	Ethantiol (ethyl mercaptan)	-	0,000000	0,00000	0,000
													74-82-8/12000	Methane	-	0,092540	0,33314	0,000
Energy	45	Boiler Bogdan-50	6	0,18	943	953	-	-	At the source outlet	0,026	1,023	73	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	118,33	0,001700	0,00612	0,009

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	63,44	0,000900	0,00324	0,032
													124-38-9/07000	Carbon dioxide	-	2,894680	10,42085	7,442
													74-82-8/12000	Methane	-	0,000050	0,00018	0,000
Energy	46	Boiler Bogdan-50	6	0,18	944	951	-	-	At the source outlet	0,026	1,023	74	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	109,39	0,001650	0,00594	0,009
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	56,61	0,000830	0,00299	0,032
													124-38-9/07000	Carbon dioxide	-	2,894680	10,42085	7,442
													74-82-8/12000	Methane	-	0,000050	0,00018	0,000
Energy	47	Boiler Bogdan-50	6	0,18	932	964	-	-	At the source outlet	0,026	1,023	73	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	116,9	0,001680	0,00605	0,018
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	60,2	0,000850	0,00306	0,063
													124-38-9/07000	Carbon dioxide	-	2,894680	10,42085	14,885
													74-82-8/12000	Methane	-	0,000050	0,00018	0,000
Energy	48	Boiler Bogdan-80	6	0,18	975	1022	-	-	At the source outlet	0,04	1,573	78	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	67,65	0,001760	0,00634	0,014
													10024-97-	Nitrogen oxide	-	0,000010	0,00004	0,000

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
													2/04002					
													630-08-0/06000	Carbon monoxide	36,9	0,000950	0,00342	0,050
													124-38-9/07000	Carbon dioxide	-	4,641700	16,71012	11,893
													74-82-8/12000	Methane	-	0,000080	0,00029	0,000
Energy	49	Boiler Bogdan-80	6	0,18	973	1025	-	-	At the source outlet	0,04	1,573	76	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	68,07	0,001690	0,00608	0,014
													10024-97-2/04002	Nitrogen oxide	-	0,000010	0,00004	0,000
													630-08-0/06000	Carbon monoxide	34,96	0,000880	0,00317	0,050
													124-38-9/07000	Carbon dioxide	-	4,641700	16,71012	11,893
													74-82-8/12000	Methane	-	0,000080	0,00029	0,000
Energy	52	Boiler Heman-Micra 2	2	0,06	984	901	-	-	At the source outlet	0,016	5,66	68	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	37,85	0,000440	0,00158	0,011
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	168,15	0,002090	0,00752	0,038
													124-38-9/07000	Carbon dioxide	-	1,736270	6,25057	8,939
													74-82-8/12000	Methane	-	0,000030	0,00011	0,000
Energy	53	Purge valve	3	0,02	990	906	-	-	-	0,00013	0,459	23,1	75-08-1/11000	Ethantiol (ethyl mercaptan)	-	0,000000	0,00000	0,000
													74-82-8/12000	Methane	-	0,092540	0,33314	0,000
Energy	54	Boiler MH-100	6	0,25	1092	100	-	-	At the	0,053	1,08	82	7439-97-	Metallic	-	0,000000	0,00000	0,000

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
						4			source outlet				6/01007	mercury				
													10102-44-0/04001	Nitrogen dioxide	71,31	0,002130	0,00767	0,022
													10024-97-2/04002	Nitrogen oxide	-	0,000010	0,00004	0,000
													630-08-0/06000	Carbon monoxide	215,8	0,006560	0,02362	0,020
													124-38-9/07000	Carbon dioxide	-	5,770550	20,77398	14,826
													74-82-8/12000	Methane	-	0,000000	0,00000	0,000
Energy	55	Boiler MH-100	6	0,25	1095	1005	-	-	At the source outlet	0,053	1,08	80	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	72,48	0,002230	0,00803	0,022
													10024-97-2/04002	Nitrogen oxide	-	0,000010	0,00004	0,000
													630-08-0/06000	Carbon monoxide	217,27	0,006790	0,02444	0,020
													124-38-9/07000	Carbon dioxide	-	5,770550	20,77398	14,826
													74-82-8/12000	Methane	-	0,000100	0,00036	0,000
Energy	56	Purge valve	3	0,02	1087	997	-	-	-	0,00013	0,459	23,1	75-08-1/11000	Ethantiol (ethyl mercaptan)	-	0,000000	0,00000	0,000
													74-82-8/12000	Methane	-	0,092540	0,33314	0,000
Energy	57	Boiler MH-100	6	0,25	1100	1007	-	-	At the source outlet	0,053	1,08	81	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	75,77	0,002270	0,00817	0,022
													10024-97-2/04002	Nitrogen oxide	-	0,000010	0,00004	0,000
													630-08-0/06000	Carbon monoxide	222,1	0,006880	0,02477	0,020

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
													124-38-9/07000	Carbon dioxide	-	5,770550	20,77398	14,826
													74-82-8/12000	Methane	-	0,000100	0,00036	0,000
Energy	58	Boiler MH-100	6	0,25	1105	998	-	-	At the source outlet	0,053	1,08	81	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	71,74	0,002120	0,00763	0,022
													10024-97-2/04002	Nitrogen oxide	-	0,000010	0,00004	0,000
													630-08-0/06000	Carbon monoxide	217,43	0,006680	0,02405	0,020
													124-38-9/07000	Carbon dioxide	-	5,770550	20,77398	14,826
													74-82-8/12000	Methane	-	0,000100	0,00036	0,000
Energy	59	Purge valve	6	0,02	1090	991	-	-	-	0,00013	0,459	23,1	75-08-1/11000	Ethantiol (ethyl mercaptan)	-	0,000000	0,00000	0,000
													74-82-8/12000	Methane	-	0,092540	0,33314	0,000
Energy	60	Boiler MH-100	6	0,25	1127	1050	-	-	At the source outlet	0,053	1,08	82	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	76,56	0,002320	0,00835	0,022
													10024-97-2/04002	Nitrogen oxide	-	0,000010	0,00004	0,000
													630-08-0/06000	Carbon monoxide	216,48	0,006820	0,02455	0,020
													124-38-9/07000	Carbon dioxide	-	5,770550	20,77398	14,826
													74-82-8/12000	Methane	-	0,000100	0,00036	0,000
Energy	61	Boiler MH-100	6	0,25	1131	1043	-	-	At the source outlet	0,053	1,08	80	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	70,76	0,002060	0,00742	0,022

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
													10024-97-2/04002	Nitrogen oxide	-	0,000010	0,00004	0,000
													630-08-0/06000	Carbon monoxide	222,82	0,006730	0,02423	0,020
													124-38-9/07000	Carbon dioxide	-	5,770550	20,77398	14,826
													74-82-8/12000	Methane	-	0,000100	0,00036	0,000
Energy	62	Purge valve	3	0,02	1115	1028	-	-	-	0,00013	0,459	23,1	75-08-1/11000	Ethantiol (ethyl mercaptan)	-	0,000000	0,00000	0,000
													74-82-8/12000	Methane	-	0,092540	0,33314	0,000
Energy	63	Boiler Bogdan-35	6	0,15	1127	1033	-	-	At the source outlet	0,018	1,019	77	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	146,83	0,001590	0,00572	0,006
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	69,07	0,000740	0,00266	0,022
													124-38-9/07000	Carbon dioxide	-	2,029230	7,30523	5,217
													74-82-8/12000	Methane	152,31	0,000030	0,00011	0,000
Energy	64	Boiler Bogdan-35	6	0,15	1120	1029	-	-	At the source outlet	0,018	1,019	76	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	64,62	0,001700	0,00612	0,006
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	69,07	0,000690	0,00248	0,022
													124-38-9/07000	Carbon dioxide	-	2,029230	7,30523	5,217
													74-82-8/12000	Methane	-	0,000030	0,00011	0,000

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Energy	65	Purge valve	6	0,02	1118	1028	-	-	-	0,00013	0,459	23,1	75-08-1/11000	Ethantiol (ethyl mercaptan)	-	0,000000	0,00000	0,000
													74-82-8/12000	Methane	-	0,092540	0,33314	0,000
Energy	66	Boiler Dermad-3	2	0,08	1007	939	-	-	At the source outlet	0,007	1,393	60	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	45,75	0,000240	0,00086	0,001
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	168,63	0,000930	0,00335	0,002
													124-38-9/07000	Carbon dioxide	-	0,215020	0,77407	1,107
													74-82-8/12000	Methane	-	0,000000	0,00000	0,000
Energy	67	Boiler Dermad-3	2	0,08	1012	942	-	-	At the source outlet	0,007	1,393	60	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	45,75	0,000240	0,00086	0,001
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	168,63	0,000930	0,00335	0,002
													124-38-9/07000	Carbon dioxide	-	0,215020	0,77407	1,107
													74-82-8/12000	Methane	-	0,000000	0,00000	0,000
Energy	68	Boiler Dermad-3	2	0,08	1014	944	-	-	At the source outlet	0,007	1,393	60	7439-97-6/01007	Metallic mercury	-	0,000000	0,00000	0,000
													10102-44-0/04001	Nitrogen dioxide	45,75	0,000240	0,00086	0,001
													10024-97-2/04002	Nitrogen oxide	-	0,000000	0,00000	0,000
													630-08-0/06000	Carbon monoxide	168,63	0,000930	0,00335	0,002

Production, process, installation, equipment	No. of emission source	Name of emission source	Emission source parameters		Source coordinates on the map				Sampling location	Gas flow parameters at the measurement point			Pollutant code	Name of pollutant	Maximum concentration of pollutant, mg/m3	Emission power		
			height, m	output opening diameter, m	point or initial centre of symmetry of a plane		the other end of the linear; the width and length of a plane			consumption, m3/s	speed, m/s	temperature				g/s	kg/hour	t/year
					X1, m	Y1, m	X2, m	Y2, m										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
													124-38-9/07000	Carbon dioxide	-	0,215020	0,77407	1,107
													74-82-8/12000	Methane	-	0,000000	0,00000	0,000
Energy	69	Purge valve	6	0,02	1009	936	-	-	-	0,00013	0,459	23,1	75-08-1/11000	Ethantiol (ethyl mercaptan)	-	0,000000	0,00000	0,000
													74-82-8/12000	Methane	-	0,092540	0,33314	0,000
Electrolysis production	70	Ventilation system	10,48	0,4	1064	954	-	-	-	0,00013	0,28	20	-/03000	Suspended substances, not differentiated by composition	-	0,00056	0,0020	0,002
Warehouse	71	Material composition deflector	6	0,02	957	1042	-	-	-	0,00013	7	20	-/03000	Suspended substances, not differentiated by composition	-	0,001948	0,00701	0,001
Energy	72	Transformer substations	2	-	1032	958	1,5	1,5	-	-	-	20	-/11000	NMVOC	-	0,000213	0,00077	0,001
													2551-62-4/10190	Hexafluoride sulphur	-	0,000000	0,00000	0,000
	73	Transformer substations	2	-	1074	974	1,5	1,5	-	-	-	20	-/11000	NMVOC	-	0,000213	0,00077	0,001
													2551-62-4/10190	Hexafluoride sulphur	-	0,000000	0,00000	0,000
															Total:	**78,399520**	**282,23826**	**181,047**

TABLE 47 – CHARACTERISTICS OF SOURCES OF BULK EMISSIONS

Emissions source number	Name of pollutant	Pollutant code	Maximum mass concentration, mg/m3	EMISSION RATE		Frequency, times/day, month, year	Duration of emission, min. hours	Annual value of bulk emissions, tonnes/year
				g/s	kg/hour			

1	2	3	4	5	6	7	8	9
5	Ethantiol (ethyl mercaptan)	75-08-1/11000	Sampling is not possible	0,0003	0,00108	6 times a year	0,3 min.	0,000
	Methane	74-82-8/12000		15,6490	56,3364		0,3 min.	0,000
44	Ethantiol (ethyl mercaptan)	75-08-1/11000	Sampling is not possible	0,00000	0,00000	6 times a year	0,3 min.	0,000
	Methane	74-82-8/12000		0,09254	0,33314		0,3 min.	0,000
53	Ethantiol (ethyl mercaptan)	75-08-1/11000	Sampling is not possible	0,00000	0,00000	6 times a year	0,3 min.	0,000
	Methane	74-82-8/12000		0,09254	0,33314		0,3 min.	0,000
56	Ethantiol (ethyl mercaptan)	75-08-1/11000	Sampling is not possible	0,00000	0,00000	6 times a year	0,3 min.	0,000
	Methane	74-82-8/12000		0,09254	0,33314		0,3 min.	0,000
59	Ethantiol (ethyl mercaptan)	75-08-1/11000	Sampling is not possible	0,00000	0,00000	6 times a year	0,3 min.	0,000
	Methane	74-82-8/12000		0,09254	0,33314		0,3 min.	0,000
62	Ethantiol (ethyl mercaptan)	75-08-1/11000	Sampling is not possible	0,00000	0,00000	6 times a year	0,3 min.	0,000
	Methane	74-82-8/12000		0,09254	0,33314		0,3 min.	0,000
65	Ethantiol (ethyl mercaptan)	75-08-1/11000	Sampling is not possible	0,00000	0,00000	6 times a year	0,3 min.	0,000
	Methane	74-82-8/12000		0,09254	0,33314		0,3 min.	0,000
69	Ethantiol (ethyl mercaptan)	75-08-1/11000	Sampling is not possible	0,00000	0,00000	6 times a year	0,3 min.	0,000
	Methane	74-82-8/12000		0,09254	0,33314		0,3 min.	0,000

Gross emissions of pollutants (tonnes/year) are shown in the Table below.

TABLE 48 - GROSS EMISSIONS OF POLLUTANTS

CAS code	Code	Name of pollutant	$MAC_{one-time}$, TSEL, mg/m³	Hazard class	Emissions of pollutants, tonnes/year
1310-73-2	03000	Sodium hydroxide	0,01	-	0,001
7439-97-6	01007	Metallic mercury	0,003	1	0,000
10102-44-0	04001	Nitrogen dioxide	0,2	3	0,238
10024-97-2	04002	Nitrogen oxide	0,4	3	0,000
7647-01-0	15003	Hydrogen chloride	0,2	2	0,001
7664-93-9	05004	Sulphuric acid	0,3	2	0,001
630-08-0	06000	Carbon monoxide	5	4	0,497
7782-50-5	15000	Chlorine	0,1	2	0,004
74-82-8	12000	Methane	50	-	0,076
106-99-0	11010	1,3-Butadiene (divinyl)	3	4	0,000
115-11-7	11000	2-Methylpropene (isobutylene)	0,1	-	0,000
1330-20-7	11030	Xylene	0,2	3	0,031
75-08-1	11000	Ethyl mercaptan	0,00003	-	0,000
-	10000	Aliphatic amines C15-C20	0,003	2	0,000
107-13-1	11001	Acrylonitrile	0,03	2	0,000
-	03000	Synthetic detergent of the “Lotus” type	0,03	-	0,000
2551-62-4	10190	Hexafluoride sulphur	0,001	-	0,000
8052-41-3	11000	White spirit	1	-	0,025
-	11000	NMVOC	1	4	0,002
-	03000	Suspended solids, not differentiated by composition	0,5	3	0,002
-	11000	Emulsol	0,05	-	0,000
-	03000	Wood dust	0,1	-	0,060
-	03000	Rubber dust	0,1	-	0,000
-	03000	Metal dust	0,1	-	0,021
124-38-9	-	Carbon dioxide	-	-	180,088
				Total:	**181.047**

During operation of the WTP after reconstruction, gross emissions of pollutants, including carbon dioxide, into the atmosphere will amount to 181.047 tonnes per year.

The feasibility of performing dispersion calculations is determined in accordance with cl. 5.21 of OND-86 [17].

Performing dispersion calculations for a given pollutant is considered feasible if the following condition is met:

$$\frac{M}{ГДК} \geq Ф$$

$$\Phi = 0{,}01 * H \text{ at } H \geq 10 \text{ m}$$

$$\Phi = 0{,}1 \text{ at } H < 10 \text{ m}$$

where:

M – total value of pollutant emissions from all sources of the enterprise (g/s);

ГДК (MAC) – maximum allowable concentration of a pollutant (mg/m^3);

H – average emission source height across the enterprise (m).

The results obtained are summarised in the Table below.

TABLE 49 - THE FEASIBILITY OF CALCULATING POLLUTANT DISPERSION

CAS code	Code	Name of pollutant	$MAC_{one-time}$, TSEL, mg/m^3	Total emissions, g/s	Total emissions, % of MAC	Average source height, m	Parameter Φ	Feasibilty of calculation
1310-73-2	03000	Sodium hydroxide	0,01	0,000148	0,015	2	0,1	**NO**
7439-97-6	01007	Metallic mercury	0,003	0,000000	0,000			**NO**
10102-44-0	04001	Nitrogen dioxide	0,2	0,027750	0,139			**YES**
10024-97-2	04002	Nitrogen oxide	0,4	0,000080	0,000			**NO**
7647-01-0	15003	Hydrogen chloride	0,2	0,000102	0,001			**NO**
7664-93-9	05004	Sulphuric acid	0,3	0,000222	0,001			**NO**
630-08-0	06000	Carbon monoxide	5	0,052050	0,010			**YES**
7782-50-5	15000	Chlorine	0,1	0,000500	0,005			**NO**
74-82-8	12000	Methane	50	16,297730	0,326			**YES**
106-99-0	11010	1,3-Butadiene (divinyl)	3	0,000002	0,000			**NO**
115-11-7	11000	2-Methylpropene (isobutylene)	0,1	0,001232	0,012			**NO**
1330-20-7	11030	Xylene	0,2	0,004300	0,022			**NO**
75-08-1	11000	Ethyl mercaptan (ethyl mercaptan)	0,00003	0,000300	10,000			**YES**
-	10000	Aliphatic amines C15-C20	0,003	0,000024	0,008			**NO**
107-13-1	11001	Acrylonitrile	0,03	0,000003	0,000			**NO**
-	03000	Synthetic detergent of the “Lotus” type	0,03	0,000067	0,002			**NO**
2551-62-4	10190	Hexafluoride sulphur	0,001	0,000000	0,000			**NO**
8052-41-3	11000	White spirit	1	0,003400	0,003			**NO**
-	11000	NMVOC	1	0,000426	0,000			**NO**
-	03000	Suspended solids, not differentiated by composition	0,5	0,002004	0,004			**NO**
10265	11000	Emulsol	0,05	0,000003	0,000			**NO**
10293	03000	Wood dust	0,1	0,063667	0,637			**YES**
10400	03000	Rubber dust	0,1	0,011200	0,112			**YES**
10414	03000	Metal dust	0,1	0,009100	0,091			**NO**

It is advisable to calculate dispersion for nitrogen dioxide, carbon monoxide, methane, ethyl mercaptan, wood dust and rubber dust.

The calculation of atmospheric pollution was performed using the EOL 2000 (h) programme. When determining the size of the calculation site, we proceeded from the need to determine the concentrations of pollutants at the boundary of the sanitary protection zone and the boundary of the nearest residential development. A general report on the results of the calculation of pollutant dispersion from the activities of the WTP after reconstruction is given in Appendix 5. A summary table of pollutant concentrations in the atmospheric air at the boundary of the sanitary protection zone and at the boundary of the first line of residential development is given in section 5.2.1.

During operation of the WTP, concentrations of any pollutants will not exceed sanitary standards (1 MAC) at the boundary of the sanitary protection zone and at the boundary of the first line of residential development.

1.5.4.2 - Assessment of discharges and pollution of surface waters

The renewed WTP in Mykolaiv is expected to operate in two main modes:

- **mode A** – designed to treat water from the Dnipro River, the Southern Bug River and the Zhovtneve Reservoir. The water treatment process does not include desalination;
- **mode B** - designed to treat water from the Snigurivka irrigation canal (Inhulets River) and includes an additional desalination stage to reduce the content of dissolved salts. This mode also allows for emergency short-term treatment of water from the Bug Estuary.

In mode "A", no concentrate (brine) formation is expected, and a project is currently being developed to restore the hydrological and sanitary condition of the Zhovtneve Reservoir for drinking water supply to the city of Mykolaiv, and a water pipeline is being built between Nova Odesa and Mykolaiv to supply water from the Southern Bug River (completion in August 2025).

When operating the WTP in Mykolaiv in mode "A", there will be no impact on surface waters.

Although the desired future scenario is to supply the city from the Dnipro and/or Southern Bug rivers via the Zhovtneve (Vitovske) reservoir (mode "A"), currently the only available water sources are the Snigurivka irrigation canal (Inhulets River) as the main source and the Bug Estuary as an emergency short-term source of supply. Water from both sources needs to be treated for microbiological indicators, as well as turbidity, colour, organic matter content, and desalination.

At the end of 2024, the city was still supplied with non-standard quality water with high salt content from the Snigurivka irrigation canal (Inhulets River). Salt water is fed directly into the distribution network, then enters the sewage system and undergoes biological treatment, with no significant change in salt content.

In the case of WTP reconstruction, namely the designed reverse osmosis and brine mixing scheme, water is actually divided into two streams: desalinated water enters the distribution network, then after use in the sewage system and further transported to the WWTP (while the salt content remains unchanged), while the second stream (brine) is fed through a separate pipeline (D 700 mm with a length of approximately 8.9 km, of which 5.665 km are pressure pipes) and mixed with treated wastewater that has undergone complete biological treatment, below the WWTP, and discharged into the Bug Estuary through the existing WWTP discharge system in Mykolaiv. Under these conditions, the mass balance and total content of minerals (chlorides, sulphates) at the discharge point will not differ significantly from the case of the existing supply of salt water to consumers.

The impact of WTP on the aquatic environment consists in the discharge of concentrate (brine) after mixing with treated wastewater from the Mykolaiv (Galytsynove) WWTP into the Bug Estuary. Brine is formed only during the operation of treatment facilities in mode B (B1, B2). The brine consumption in mode B1 is 805 m^3/hour (19,320 m^3/day), and in mode B2 – 1,495 m^3/hour (35,880 m^3/day).

In order to determine and justify an environmentally safe location for the discharge of brine from the planned WTP in Mykolaiv, a Consultative Analysis Report of the Wastewater Discharge Site for the water supply project in Mykolaiv was prepared by conducting hydrological studies (the report is provided as a separate document due to its volume) and a letter was received from the Regional Water Resources Office in the Mykolaiv region No. 238/10 dated 14 February 2025 (Appendix 1), stating that the office agrees with the conclusion of the above-mentioned Report regarding the location and method of brine discharge.

The option of locating the brine discharge point through the WWTP is rational and acceptable in terms of improving the final quality of the concentrate (brine) before discharge, since when brine is mixed with treated wastewater from the WWTP in Mykolaiv (Galytsynove village), the salinity of the concentrate will be reduced, which is a significant positive environmental aspect for the quality of surface waters in the Bug Estuary.

As a result of research conducted in accordance with the current hydrological and physical-chemical situation in the water area of the Bug Estuary, the mineralisation of surface waters in the estuary ranges from 5 to 11 g/l in dry residue. Accordingly, it was concluded that the discharge of concentrate into the Bug Estuary, even without mixing with treated wastewater from the Mykolaiv WWTP (Galytsynove village), does not cause significant changes in the pollution indicators of the surface waters of the Bug Estuary.

1.5.4.3 - Assessment of the impact on the hydrological, geological environment and soil

No impact on the hydrological, geological environment and soil during operation of the WTP is expected.

1.5.4.4 - Waste assessment

During the operation of the checkpoint, waste will be generated, the list of which is provided in the Table below. Waste classification codes are provided in accordance with the National Waste List (NWL).

TABLE 50 - LIST OF WASTE GENERATED DURING THE OPERATION OF WTP

No.	Name of waste	Waste codes in line with the NWL	Hazard class	Annual volume of tonnes generation	Name of waste in the National Waste List	Treatment
1	Mixed municipal waste from employees	20 03 01	IV	3.65 t	Mixed household waste	Collection in rubbish bins and subsequent transfer to a specialised enterprise (to a solid waste landfill) in accordance with the agreement
2	Sweepings from cleaning the WTP territory	20 03 03	IV	30 t	Sweepings from cleaning the streets	Mechanised/manual cleaning and subsequent transfer to a specialised enterprise (to a solid waste landfill) in accordance with the agreement
3	Defective LED lamps	20 01 36	IV	0.012 t	Other electrical and electronic equipment waste not specified under codes 10 01 21, 20 01 23 and 20 01 35	To be disposed as electrical and electronic equipment waste. To be transferred to a specialised enterprise in accordance with the agreement.
4	Dehydrated sediment (suspended solids)	19 09 02	IV	16 731.6 t	Sludge from water treatment (clarification)	The dehydrated sludge is unloaded onto trucks using screw conveyors and can be used in the construction industry or transported to a municipal solid waste landfill as an insulating layer in accordance with the agreement.
5	Reverse osmosis membranes and	19 09 05	III	75.348 t	Saturated or spent ion exchange units	Recycling is currently impossible. There are two

No.	Name of waste	Waste codes in line with the NWL	Hazard class	Annual volume of tonnes generation	Name of waste in the National Waste List	Treatment
	cartridges					methods of disposal: high-temperature incineration or landfill. Transfer to a specialised enterprise (to a solid waste landfill or "Enerhiya" waste incineration plant) in accordance with the agreement.
6	Laboratory chemicals	16 05 06*	III	0.041 t	Laboratory chemicals consisting of or containing hazardous substances, including mixtures of laboratory chemicals	To be transferred to a specialised enterprise in accordance with the agreement.
7	Inorganic chemical waste	16 05 07*	III	0.018 t	Waste inorganic chemical products consisting of or containing hazardous chemicals	To be transferred to a specialised enterprise in accordance with the agreement.
8	Ferrous metal waste	19 10 01	IV	2.143 t	Waste ferrous metals	Grand Metal-KR LLC (or other, as determined by the operating service)
			Total:	**16 842.812 t**		

Sludge disposal: To reduce the volume and moisture content of the sludge prior to disposal, a dewatering unit will be installed. Liquid sludge from the bottom of the settling tanks is fed to centrifuges.

As the sludge accumulates in the lamella clarifiers, depending on the level of filling of its sedimentation section, it is pumped to centrifuges. This equipment operates in a horizontal position and separates the liquid from the sludge by centrifugal force according to the centrifuge principle.

To ensure the necessary dewatering, centrifuges with the following parameters were selected:

- Power 37 kW;
- N 3 300 min -1;
- Hydraulic capacity 25-45 m^3/hour.

The design concept for all operating modes has the hydraulic capacity and solid sludge treatment capacity as specified below:

TABLE 51 - QUALITY AND LEVELS OF WASTE WATER TREATMENT PERFORMANCE

PARAMETER	UNITS OF MEASUREMENT	INDICATOR
Sludge dewatering efficiency based on dry matter	kg dry residue/hour	1 910.0
	t dry residue/year	16 731.6
Hydraulic efficiency of sludge dewatering	m^3/year	29.5
Maximum polyelectrolyte dosage	kg / tonne dry residue	1.50
Filtrate from sludge dewatering	Total suspended solids content mg/l	10.0
Concentration of dewatered sludge	% dry residue	70.0

Source: Preliminary tender documentation "Subproject Water Supply of Mykolaiv – 2_MYK_211 (version 03 dated 18.02.2025)" within the Technical Assistance in the Preparation and Implementation of the Municipal Infrastructure Development Programme of Ukraine (funded under NIP) AA-010067-001.

The dewatered sludge is loaded onto trucks using screw conveyors. Two trucks will be purchased for transportation. The dewatered sludge can be used in the construction industry or transported to a municipal solid waste landfill as an insulating layer.

Replacement of reverse osmosis membranes and cartridges

The weight of one reverse osmosis membrane is 16 kg.

The maximum (in "B2" mode) annual operating costs of reverse osmosis membranes will be 4,680 units (see Table 15), i.e. 74.88 tonnes/year.

The weight of one reverse osmosis cartridge is 2 kg.

The maximum (in "B2" mode) annual operating costs for reverse osmosis cartridges will be 234 units (see Table 15), i.e. 0.468 tonnes/year.

Sweepings from the WTP territory

Waste is generated during the cleaning of the WTP territory. Sweepings consist of sand and small debris (paper, polyethylene, etc.).

The standard for waste generation is calculated in accordance with the methods set out in the following sources:

- Y.A. Shevchenko, T.D. Dmitrienko, "Reference Book on Sanitary Cleaning of Cities and Towns," Kyiv: Budivelnik, 1978, p. 161 [30];

The annual amount of sweepings from cleaning the territory is determined by the following formulas:

$$П_{зм} = \mathrm{N} \times H \times 10^{-3}, \quad t/year$$

where:

H – standard for the formation of waste from areas with improved surface is 3-5 kg/m^2 per year (in accordance with DBN B.2.2-12:2019 [5]);

N - area of hard surface, m^2; Cleaning area is 10 000 m^2.

According to calculations, the annual amount of sweepings from the WTP territory will be 30 tonnes.

Sweeping from the territory is stored in containers and, as it accumulates, is transported by the municipal enterprise "Obriy DKP" in Mykolaiv to a solid waste landfill.

Municipal and household waste

During the operation of the WTP, domestic waste is generated in the course of personnel activities.

$$\mathrm{M_{ТПВ}} = N \times N_p \times k_1,$$

where:

N – number of employees, persons, N = 40 persons;

N_p – number of working days, N_p = 365 days;

k_1 – coefficient characterising the formation of solid waste, kg per person per day, k_1 = 0,25 kg/person.

The amount of waste generated during one year of the WTP operation, resulting from the activities of personnel, is 3.65 tonnes.

Temporary storage and disposal of solid household waste will be carried out in containers V=0.75 m^3 and, as it accumulates, will be transported to a solid waste landfill in accordance with the concluded agreement.

Currently, MUC "Mykolaivvodokanal" has an agreement with CE "Obriy DKP" for the provision of household waste management services.

LED luminaires

The full average service life of the luminaire before reaching its end of life is at least 20 years (in accordance with the luminaire passport PNIM.676190.152 LP). The average operating time of the luminaires during the year is 4,200 hours. Twenty luminaires will be installed to illuminate the territory of the WTP in Mykolaiv. The weight of the luminaire is no more than 6 kg (in accordance with the luminaire passport PNIM.676190.152 LP). The calculation assumed that 10% of the installed luminaires are defective and will be replaced during the year. That is, the annual number of LED luminaires to be replaced during the operation of the municipal lighting system will be 2 units, with a total weight of 2 x 6 = 12 kg.

LED lamps are non-toxic, explosion-proof, fire-resistant, do not emit harmful substances, do not contain sources of ionising radiation and do not have a harmful effect on the human body during direct contact. LED lamps are fully recyclable and must be disposed as electrical and electronic equipment waste. LED lamps are disposed by separating them into parts, which are then sorted according to material (plastic, glass, metal parts) and recycled. This process is completely safe and does not require special protective equipment for those who carry it out (as in the case of fluorescent lamps). LED luminaires will be disposed by the maintenance service by transferring them to the supplier or special recycling points.

The amount of laboratory waste and ferrous metal waste is indicated taking into account the Waste Declaration of the MUC "Mykolaivvodokanal" for 2024 (Appendix 6).

1.5.4.5 - Noise assessment

The WTP does not generate significant noise pollution in the surrounding environment.

Sources of noise on the territory of the WTP are:

- Internal stationary sources of noise - engineering equipment, namely: pumping equipment and ventilation system (constant noise);

- External mobile sources of noise - motor vehicles moving on the territory of the WTP (intermittent noise).

Acoustic calculation involves determining the expected noise levels generated by internal and external noise sources in premises and areas, assessing their compliance with sanitary standards, and determining the required noise reduction levels for sources – initial data for the design of noise protection measures. Acoustic calculations are developed in accordance with the requirements of DBN V.1.1-31:2013 "Protection of territories, buildings and structures from noise" [31] and the requirements of DSTU-N B V.1.1-35:2013 "Guidelines for the calculation of noise levels in premises and areas" [22].

In accordance with the requirements of cl. 7.14 of DBN V.1.1-31:2013 [31], the calculation of noise in premises and areas of industrial facilities from stationary noise sources, the calculation of total noise levels, the selection of reference points and the determination of the required noise reduction were performed in accordance with DSTU-N B V.1.1-35:2013 [22].

In accordance with cl. 7.15 of DBN V.1.1-31:2013 [31], the calculation of noise in residential areas of urban and rural settlements from traffic movement through the territory of the WTP was performed in accordance with DSTU-N B V.1.1-33:2013 "Guidelines for the calculation and design of noise protection for residential areas" [32].

Calculation of noise in WTP premises from stationary noise sources

Noise calculations are performed for rooms with permanent workplaces, namely for the chemical laboratory and for the FTP pumping stations.

In the chemical laboratory, the noise sources are 2 ventilation pipes, and in the pumping station room – the pumping equipment and the ventilation system.

When performing acoustic calculations, the noise characteristics of the equipment are taken from the technical documentation of the manufacturer.

The noise characteristics of the installed equipment are given based on the passport and reference data in the Table below.

TABLE 52 - NOISE CHARACTERISTICS OF EQUIPMENT

Name of the noise source	Frequencies of octave bands, Hz							
	63	125	250	5000	1000	2000	4000	8000
Chemical laboratory								
Exhaust fan V2 (pipe No. 1)	26	34	33	39	32	25	22	18
Exhaust fan V2 (pipe No. 2)	26	34	33	39	32	25	22	18
FTP pumping stations								
Centrifugal pumps	59	66	69	70	65	58	46	38
PV2 supply and exhaust unit	27	31	33	36	35	27	26	20

The following measures are planned to reduce noise levels:

- all areas where noise sources are concentrated - isolated;
- all process and pumping equipment is installed on special foundations;
- equipment is installed on vibration-isolating pads;
- soft inserts are provided at the points where air ducts connect to fans.

Calculations of sound pressure levels from noise sources of technological equipment were performed for premises with permanent workplaces (laboratory and control room).

Industrial noise standards for these rooms are adopted in accordance with Table 2 of DSN 3.3.6.037-99 "Sanitary standards for industrial noise, ultrasound and infrasound" [33].

The calculation of sound pressure levels from noise sources was performed in accordance with cl. 5.1.4 of DSTU-N B V.1.1-35:2013 [22].

There are two noise sources in the chemical laboratory with the same sound power levels L_{w1}, therefore the sound pressure level L at the reference points is determined in octave frequency bands using the formula:

$$L = L_{w1} + 10\lg\left(\sum_{i=1}^{m}\frac{\Phi_i}{S_i} + \frac{4}{B}\right), \text{ dB}$$

where:

L_{Wi} - sound power level of the i-th noise source in octave frequency bands, in dB;

Φ_i – noise radiation directivity coefficient of the i-th noise source in the direction of the reference point in octave frequency bands, dimensionless, $\Phi = 1$;

S_i – area of an imaginary surface of regular geometric shape surrounding the i-th noise source and passing through the reference point, m^2, $S = 2\pi r^2$;

r – distance from the reference point to the acoustic centre of the noise, m;

B – acoustic constant of the room in octave frequency bands;

m – number of noise sources close to the reference point;

n – total number of noise sources in the premises, taking into account the average coefficient of simultaneously operating equipment.

Each premise of the FTP pumping stations has 12 pumps with a capacity of 1,250 m^3/h (6 pumps for each operating mode), of which 3 are standby pumps and a ventilation system with different sound power levels Lw1. Therefore, the sound pressure level L at the reference points is determined in octave frequency bands using the formula:

$$L = 10\lg\left(\sum_{i=1}^{m}\frac{10^{0,1L_{wi}}\Phi_i}{S_i} + \frac{4}{B}\sum_{i=1}^{n}10^{0,1L_{wi}}\right), \text{ dB}$$

where:

L_{Wi} , Φ_i , S_i , B, m and n same as in the previous formula.

The results of calculating sound pressure levels from noise sources of technological equipment in rooms with permanent workplaces and a rest room are given in the Table below.

TABLE 53 - RESULTS OF CALCULATING SOUND PRESSURE LEVELS FROM NOISE SOURCES OF TECHNOLOGICAL EQUIPMENT

Name of the noise source	Frequencies of octave bands, Hz							
	63	**125**	**250**	**5000**	**1000**	**2000**	**4000**	**8000**
Chemical laboratory								
Calculated sound pressure levels from ventilation in the laboratory room	23	31	30	36	29	22	19	15
Permissible sound pressure levels in the laboratory premise	79	70	63	58	55	52	50	49
Premises of FTP pumping stations								
Calculated sound pressure levels from equipment in the control room	43	52	51	49	53	42	40	39
Permissible sound pressure levels in the control room	83	74	68	63	60	57	55	54

Calculation of sound pressure levels from technological equipment in premises with permanent workplaces shows that there are no exceedances of regulatory values.

To eliminate the harmful effects of industrial noise on the health of employees operating pumping equipment, they will be provided with personal protective equipment (earplugs).

No noise impact from equipment outside the premises of the WTP is expected.

Calculation of noise in the first line of residential buildings from mobile noise sources moving through the territory of the WTP

The calculation of noise at the boundary of the first line of residential buildings from traffic moving through the WTP territory was performed in accordance with cl. 6 of DSTU-N B V.1.1-33:2013 "Guidelines for the calculation and design of noise protection for residential areas" [32].

In accordance with sub-clauses 7.1 and 7.2 [32], the reference points were determined at a height of 1.5 m and at a distance of 2 m from the external enclosing structures of the nearest line of residential buildings in the city of Mykolaiv (see Table below).

TABLE 54 - LOCATION OF POTENTIAL OBJECTS OF INFLUENCE OF PLANNED ACTIVITIES

Name of the settlement	Reference point number	Object`s name	Coordinates	Object`s address	Distance from WTP, m
Mykolaiv	PT.1	Residential building	46°52'55"N 32°03'17"E	178, Klechova balka str.	1030
	PT.2	Residential building	46°52'48"N 32°03'15"E	197, Fontanna str.	1000
	PT.3	Residential building	46°52'34"N 32°03'10"E	71, Kahovska str.	890
	PT.4	Industrial area	46°52'07"N 32°03'08"E	318, Yantarna str.	1100

The equivalent noise level L_{Aeq}, dBA from transport is determined in accordance with cl. 6.2.2 [32].

The standard sound pressure levels are adopted for areas directly adjacent to residential buildings in accordance with Appendix 1 of DSP No. 463 "State sanitary norms for permissible noise levels in residential and public buildings and in residential areas" [23] with amendments set out in Appendix 3, i.e. 60 dBA:

1) Operating mode 8.00 -18.00 – 55 dBA;

2) Noise type – broadband – 0 dBA;

3) Existing built-up area – +5 dBA.

In accordance with cl. 7.6 [32], equivalent noise levels at reference points (LA eqla) under existing operating conditions are calculated using the formula:

$$L_{Aeqla} = L_A - \Delta L_{A\ dist} - \Delta L_{A\ air} - \Delta L_{A\ surf} - \Delta L_{A\ scr} - \Delta L_{A\ gr} - \Delta L_{A\ lim} + \Delta L_{A\ ref};$$

where:

where L_{Aeqla} – equivalent sound level at the reference point in the residential area;

L_A – noise characteristic of the noise source in dBA, determined in accordance with section 6 [20] (when calculating the equivalent sound level LA= LAeq);

$\Delta L_{A\ dist}$ – allowance in dBA, which takes into account the reduction in sound level depending on the distance, m, between the noise source and the reference point;

$\Delta L_{A\ air}$ – allowance in dBA that takes into account the reduction in sound level due to sound attenuation in the air;

$\Delta L_{A\ surf}$ - allowance in dBA, which takes into account the reduction in sound level at the reference point of the type of the area surfacing;

$\Delta L_{A\ scr}$ - allowance in dBA, that takes into account the reduction in sound level by screens along the noise propagation path, 0;

$\Delta L_{A\ gr}$ – allowance in dBA, that takes into account the reduction in sound levels by green belts, 0;

$\Delta L_{A\ lim}$ – allowance in dBA, that takes into account the reduction in sound level due to the limitation of the angle of visibility of the noise source from the reference point, 0;

$\Delta L_{A\ ref}$ – allowance in dBA, that takes into account the increase in sound level at the reference point due to the superposition of sound reflected from the walls of the buidling.

Vehicle traffic in the WTP territory is very limited, with an estimated number of vehicles used to service the WTP not exceeding 10 vehicles per day. Vehicles travel at speeds not exceeding 10 km/h. Noise is

intermittent. Noise levels depend on traffic intensity and speed. The equivalent sound level from transport is accepted in accordance with Table 3 [32] and is 72 dBA. In real conditions, the equivalent sound level from transport will be significantly lower.

Equivalent sound levels during daytime hours are shown in the Table below.

TABLE 55 - EQUIVALENT SOUND LEVELS DURING DAYTIME HOURS WHEN OPERATING THE WTP

No.	Reference point	Distance from the object, m	L_{Aeq}, dBA	$\Delta L_{A\ dist}$	$\Delta L_{A\ air}$	$\Delta L_{A\ surf}$	$\Delta L_{A\ ref}$	$L_{A\ area}$*	Norm**
1	Border of the SPZ	50	72	12,5	0,2	0	0	59,3	-
2	PT.1 (res. bldg.)	1030	72	32,9	5,1	0	0	33,9	60
3	PT.2 (res. bldg.)	1000	72	32,7	5,0	0	0	34,3	60
4	PT.3 (res. bldg.)	890	72	31,8	4,4	0	0	35,8	60
	PT.4 (industrial area)	1100	72	33,5	5,5	0	0	33,1	-

Notes:

* $L_{A\ area}$ – sound level at the reference point in the residential area;

** The noise standard is given in accordance with cl. 42 of Appendix 1 to the State Sanitary Standards for Permissible Noise Levels in Residential and Public Buildings and in Residential Areas (namely 55 dBA), taking into account the correction to the permissible levels in accordance with Appendix 3 of these sanitary standards (namely 5 dBA) [23].

The Table shows that noise pollution at the edge of the first line of residential buildings in Mykolaiv does not exceed the permissible noise level.

1.5.4.6 - Impact assessment of light, heat and radiation pollution during the operation of WTP

There will be no ultrasonic and ionising radiation, light and heat pollution during operation of the WTP.

2 - DESCRIPTION OF JUSTIFIED ALTERNATIVES TO THE PLANNED ACTIVITY, MAIN REASONS FOR CHOOSING THE PROPOSED OPTION, TAKING INTO ACCOUNT ENVIRONMENTAL IMPACTS

2.1 - Technical alternatives

The Technical Report "Comparison of Options for the Reconstruction of Existing WTP for Drinking Water Supply in Mykolaiv" considered two technical alternatives, which consisted in the capacity of the WTP.

2.1.1 - Technical alternative 1

Commissioning phase 1:

- Relevant research and design work,
- Site preparation and dismantling of equipment and structures that are not suitable for use;
- New construction works.
    - Construction of two raw water receiving tanks (2 x 3,000 m^3) with all necessary pipelines, connections, shut-off valves and other relevant engineering communications.
    - Construction of two (2) filteration plant buildings (FTP) of sufficient size to accommodate all necessary working process treatment equipment, process lines and auxiliary rooms for a separately located independent treatment plant.
    - Inside each building of the filtration plant, all necessary treatment and pumping equipment and pipelines are installed to ensure operating modes A1 and B1 (45,000 m^3).
    - Construction of one (1) backwash water treatment plant of sufficient size to accommodate all necessary working process treatment equipment, process lines and auxiliary rooms for the treatment and reuse of backwash water with a capacity of 8,500 m^3/day.
        - Receiving and equalising tanks with a pumping station;
        - Lamella clarifiers and sludge pumps;
        - Clear water tanks;
        - Pumping station (clear water pumps);
        - Sludge dewatering unit;
        - Purchase of two (2) trucks for sludge transportation.
    - Construction of one (1) electrolysis plant building with installation of process lines for the production of sodium hypochlorite by electrolysis with a capacity of 1,125 kg/day.
    - Construction of all external engineering networks necessary for the operation of the new WTP, including a collector for brine discharge from reverse osmosis systems;
    - Construction of an access road and organisation of a work site.
- Required testing, start-up and commissioning works for Phase 1 Facilities.

Commissioning phase 2

- Installation and connection of additional filtration equipment in two (2) constructed buildings of the filtration plant:
    - 16 filters for each treatment stage (48 filters in total) in each plant building;
    - Installation of additional reverse osmosis units.
    - Installation of an additional pump group;
- Required testing, start-up and commissioning works for Phase 2 Facilities.

According to technical alternative 1, the total installed capacity of electrical equipment in the filter plant units is planned at 1,792.9 kW.

According to technical alternative 1, the total demand for reagents, calculated for 2025, is 3,200 kg/day (for the selected 3 parallel hypochlorite production lines. Each sodium hypochlorite production system produces up to 1,125 kg of chlorine equivalent per day).

2.1.2 - Technical alternative 2

According to technical alternative 2, a water treatment plant with a capacity of 250,000 m^3/day will be built, which will ensure water treatment to drinking water standards when using water from all available sources (listed above), including the Bug Estuary. In this case, the treatment technology will be similar to alternative 1, **but the amount of technological equipment will increase significantly**, and therefore the cost of construction work. In addition, the amount of concentrate solution and the volume of water to be removed will increase significantly.

Increasing productivity requires an increase in the amount of technological equipment, as well as an increase in the area of two buildings of the filtration plant (FTP).

In total, after commissioning according to technical alternative 2, for a total productivity of 250 thousand m^3/day, the amount of technological equipment is as follows:

- Omni-filtration system – 32 groups of 8 filters (256 pcs.) x 358,8 m^3/h;
- Adsorption system – 32 groups of 4 filters (128 pcs.) x 358,8 m^3/h;
- Reverse osmosis system – 42 pcs. x 202,5 m^3/h;
- Pumping unit (Q = 1 100 m^3/h, H= 55m) for osmotic installations (modes B1 and B2) – 20 pcs.;
- Pumping unit (Q = 1 050 m^3/h, H= 30m) without osmosis (modes A1 and A2) – 20 pcs.;

By increasing the number of reverse osmosis units, the number of filter systems, and the number of pumps in the pumping units, the dimensions of the buildings of the 1st and 2nd units of the filtration plant (FTP) according to technical alternative 2 will increase in the plan from 72.0 m x 102.0 m to 102.0 m x 138.0 m.

According to technical alternative 2, the total installed power of electrical equipment in the filteration plant units is planned to be approximately 3,000 kW. According to technical alternative 2, the total demand for reagents is approximately 5,000 kg/day. The number of hypochlorite production lines will increase to five parallel hypochlorite production lines.

2.2 - Territorial alternatives

The planned activities will be carried out on the territory of the existing WTP in the city of Mykolaiv. MUC "MYKOLAIVVODOKANAL" at the address: Mykolaiv region, Mykolaiv, Korabelnyi district, Yantarna Street, 324-e, on a land plot owned by the city of Mykolaiv (communal property) with a specific purpose and established sanitary protection zone.

For operating mode "B", **two potential locations for brine discharge** from reverse osmosis **and five options for brine transportation** were considered as territorial alternatives.

As a result of preliminary geographical analysis, in agreement with the management of the MUC "Mykolaivvodokanal", the following possible options for brine discharge sites have been identified for consideration and justification:

Territorial alternative 1 – Location of existing wastewater treatment plants (WWTPs) in Mykolaiv, located in the village of Galytsynove, for possible mixing of brine with municipal wastewater.

Territorial alternative 2 – The confluence of the Vitovka River and the Bug Estuary.

In order to determine and justify an environmentally safe location for the discharge of brine from the planned water treatment plant in Mykolaiv, a Consulative Analysis Report of the Backwash Water Discharge Site for the water supply project in Mykolaiv was prepared by conducting hydrological studies (the report is provided as a separate document due to its volume).

2.2.1 - Territorial alternative 1

Territorial alternative 1 involves laying a D700 mm pipeline for brine discharge (from reverse osmosis) from the existing WTP site through uninhabited territory near the village of Balabanivka to a location below the wastewater treatment plant in Mykolaiv (village Halytsynove) for mixing with municipal wastewater that has undergone complete biological treatment and subsequent transportation to the wastewater discharge point in the Bug Estuary through the existing WWTP discharge system. The approximate length of the pipeline under this option is 8.9 km.

Currently, the WWTPs in Mykolaiv require significant reconstruction and modernisation.

To prevent the WWTPs from being overloaded with brine from reverse osmosis units, a location for brine discharge has been proposed below the WWTPs near the village Halytsynove. The approximate location for mixing the concentrate and treated wastewater and two options for laying the pipeline:

- the shortest and

- the most rational option.

FIGURE 17 – THE SHORTEST ROUTE FOR LAYING A PIPELINE FOR TRANSPORTING BRINE THROUGH POPULATED AREAS

Source: Consulative Analysis Report of the Backwash Water Discharge Site for the water supply project in Mykolaiv

Theoretically, the pipeline main can be laid in a straight line (the optimal and shortest distance), as shown in the figure above. However, in this case, the pipeline route will pass through populated areas. **The shortest pipeline route is not recommended for implementation.**

It is more rational to lay the pipeline at a safe distance from infrastructure along earth roads (sanitary zone), parallel to the unused Inhulets Canal.

FIGURE 18 – RATIONAL OPTION FOR LAYING A PIPELINE FOR BRINE TRANSPORTATION

Source: Consulative Analysis Report of the Backwash Water Discharge Site for the water supply project in Mykolaiv

In this case, the pipeline will be laid bypassing populated areas on land designated for various purposes.

To implement this option, the concentrate will be collected at a water treatment plant separately from other backwash water, then fed through a D700 mm pipeline for approximately 8.6 km to the wastewater treatment plant in Mykolaiv, located in the village Galytsynove (the final distance will be determined by the relevant project at the next stage of design).

At this location, the concentrate will be mixed with wastewater that has undergone complete biological treatment and will be discharged into the Bug Estuary through the existing WWTP discharge system.

When water with a high salt content (in particular, from the Snigurivka Canal) is used for water supply, highly mineralised water is fed into the network, then enters the wastewater system and undergoes biological treatment, with the salt content remaining virtually unchanged.

When reverse osmosis is used in WTPs, water is actually divided into two streams: one enters the distribution network, the wastewater system and then the WWTP (with the salt content remaining unchanged); the second (concentrate) is fed through a separate pipeline and mixed with treated wastewater downstream of the WWTP. Under these conditions, the total salt content and its components (chlorides, sulphates) will be practically the same as in the version without reverse osmosis.

As a result of studies conducted in accordance with the current hydrological and physical and chemical situation in the water area of the Bug Estuary, the mineralisation of surface waters in the estuary ranges from 5 to 11 g/l in dry residue. Accordingly, it was concluded that the discharge of concentrate into the Bug Estuary, even without mixing with treated wastewater from the WWTP, does not cause significant changes in the pollution indicators of the surface waters of the Bug Estuary.

Geospatial analysis tools (ArcGIS Map Viewer and ESRI Ukraine) were used to preliminarily determine the optimal pipeline route.

2.2.2 - Territorial Alternative 2

Territorial alternative 2 involves the discharge of brine at the confluence of the Vitovka River with the Buh Estuary.

The selected discharge location option is shown in the figure below. The proposed discharge point into the Buh Estuary corresponds to the alignment between the end of P. Orlyka street and Pryozerna street in the Bohoiavlenskyi neighborhood of Mykolaiv (a local wetland area).

There is a boat pier downstream and a yacht club further downstream. The nearest recreational area of this neighbourhood is located 1,500 metres upstream.

FIGURE 19 – BRINE WATER DISCHARGE LOCATION INTO THE BUH ESTUARY (THE DOWNSTREAM END OF THE VITOVKA CREEK) 46.8788510864063, 32.01284106472304

Source: Consultative Analysis Report on Wastewater Discharge Location for the Water Supply Project in Mykolaiv

In accordance with the letter from the Regional Office of Water Resources in Mykolaiv Oblast No. 813/10 of 24.10.2024 (Appendix 7), the **Vitovka River** is classified as a small river of national significance in accordance with the classification of rivers of Ukraine (Articles 5 and 79 of the Water Code of Ukraine [34]). As of now, the Mykolaiv City Council has not adopted any decisions regarding the approval of land management documentation concerning the approval of designs for the establishment of water protection zones and coastal protective strips within the territory of land use in the city of Mykolaiv.

FIGURE 20 – SOURCE OF THE VITOVKA RIVER, DISCHARGE OF BRINE WATER FROM THE FILTRATION PLANT (46.88028266251924, 32.06417872939483)

Source: Consultative Analysis Report on Wastewater Discharge Location for the Water Supply Project in Mykolaiv

The riverbanks are high. The flow velocity varies along different sections of the river. The riverbed is predominantly sandy. The channel is overgrown with trees and shrubs.

FIGURE 21 – LOCATION OF THE CONFLUENCE OF THE VITOVKA RIVER WITH THE BUH ESTUARY (46.87726487224932, 32.01526059983936)

Source: Consultative analysis Report on Wastewater Discharge Location for the Water Supply Project in Mykolaiv

The Vitovka River flows into the Buh Estuary. At the confluence, dense reed vegetation grows along the river channel. Due to frequent flooding, the area is waterlogged and currently not in use.

For this discharge point, three options were considered for transporting brine from the WTP to the discharge location.
Based on the studies carried out regarding the organisation of brine transportation from the WTP to the discharge point at the confluence of the Vitovka River with the Buh Estuary, the Consultant assessed the following proposed alternatives:

1) Transportation via the Vitovka River Channel, Following Pre-Treatment of the Brine Water from Reverse Osmosis to Match the Existing Vitovka River Water Quality Levels.

This option is relatively optimal in terms of eliminating the need for civil works to lay a pipeline. However, the treatment of the brine to meet the established Exposure Limits (EL) requires injection and use of a significant volume of freshwater – approximately 4.5 times the initial volume of the brine. This makes the option economically inefficient. Additionally, the volume of discharged wastewater would increase by 5-6 times the original volume, totalling approximately 200,000 m^3. This level of load would overwhelm the flow capacity of the Vitovka River. There is a risk of altering the river channel and flooding adjacent riverbank areas, which are

quite densely developed. Therefore, this alternative is costly and would have significant negative environmental and social consequences. **Not recommended.**

2) Transportation via the Pipeline Laid from the Point of Discharge from the Filtration Plant along the Vitovka River Channel, with Dredging to be Performed.

This option is possible. However, dredging and other civil works related to pipeline installation along the riverbed would violate the WATER CODE OF UKRAINE. Specifically:

Article 80. Provisions for the Use of Small Rivers.

To secure the water content of small rivers, it is prohibited to:

1) alter the topography of the river basin;

2) damage the channels of intermittent rivers, streams, and watercourses;

3) straighten river channels or deepen their beds below the natural level, or block them without installing culverts, bypasses, or aqueducts;

8) conduct other works that may negatively affect or are affecting the river's water content and quality.

Therefore, implementation of alternative 2 is not possible.

3) Transportation via the Pipeline Laid in a Trench, with Appropriate Thermal Insulation to Prevent Freezing, Running Parallel to the River Channel.

This alternative does not alter or affect the river channel. Civil works would be conducted within the riverbank areas.

Along most of the river's length, the adjacent riverbank areas are accessible for pipeline installation. However, in certain segments, utility structures are located relatively close to the river, which may complicate civil works.

If this alternative is selected for implementation, all details will be finalised in the design. Additionally, with the pipeline installed under this alternative, the water content of the Vitovka River will depend solely on seasonal precipitation and groundwater sources, as no wastewater will be discharged from the WTP. From the discharge point at the filtration plant to the Bohoiavlenskyi Spring – approximately 3.5 km – the riverbed will remain dry, except during periods of rainfall.

Based on the comprehensive assessment conducted in accordance with the project objectives, two final alternative scenarios have been proposed for the brine discharge location:

Territorial alternative 1 *involves the transportation of the brine via the pipeline laid from the existing WTP site through unpopulated areas near the village of Balabanivka to a location downstream of Mykolaiv's wastewater treatment plant (the village of Halytsynove), where it will be mixed with municipal effluents and further transported to the existing effluent discharge location into the Buh Estuary.*

This alternative is rational and acceptable in terms of achieving the better final quality of the concentrate (brine) prior to discharge. The mixing of brine with effluents from Mykolaiv's WWTP (the village of Halytsynove) would result in a reduced salinity level of the concentrate, which is a significant positive environmental factor for maintaining the quality of surface water in the Buh Estuary.

The proposed pipeline route is planned to bypass settlements and remain at a safe distance from the infrastructure and populated areas, thereby avoiding negative social impacts during civil and other works. Construction machinery and transport will not disturb comfort or health of the residents living nearby.

The proposed pipeline will not cross any protected areas or the sites included in the Emerald Network of Ukraine.

An important advantage of this alternative is that, upon completion of the pipeline installation, the MUC "Mykolaivvodokanal" will not be required to obtain a new water use permit, as all necessary permits are already in place for the WWTP operations.

Due to the longer pipeline route, which is approximately 8.6 km, this alternative is less cost-effective in terms of civil works required for pipeline installation.

Territorial alternative 2 *involves the transportation of the brine via the pipeline from the discharge point at the filtration plant (WTP), routed along the Vitovka River channel, to the Buh Estuary.*

Due to the shorter pipeline route, which is approximately 4.5 km, and the presence of the already existing discharge route for the brine water, this alternative is more cost-effective and rational in terms of the cost of civil works required for pipeline installation.

Pipeline installation under this alternative will not violate the Water Code of Ukraine, as the Vitovka River channel will not be altered.

It has been determined that the water quality in the Buh Estuary does not meet the established Exposure Limits (EL) for key physical and chemical parameters. Concentrations of components in the estuarine surface water exceed the established EL multiple times. The mineralisation of the Buh estuary's surface water fluctuates seasonally, influenced by local climate conditions, precipitation, and tidal exchanges within the Dnipro-Buh Estuary. Salinity levels of the surface water range from 4.5 to 11 g/L. Therefore, the potential discharge of brine from the reverse osmosis system will have an insignificant impact on the quality of the Buh estuary's water in terms of its salinity. The discharge outlet will be positioned at an adequate distance from the shoreline and depth. During mixing of the 5 g/L brine with the saline water of the Buh estuary, whose salinity ranges from 4.5 to 10 g/L, salinity levels are expected to equalize within 50–100 meters downstream.

In some areas adjacent to the proposed pipeline route, utility structures are quite densely developed, which may complicate civil works. Therefore, negative social impacts are possible during civil and other works in those areas.

Additionally, at the mouth of the Vitovka River, in the downstream end of the Vitovka Creek, where the brine is proposed to be discharged, the area is swampy, which will significantly complicate civil works related to the installation of the proposed pipeline and may increase overall construction costs.

The proposed pipeline will not cross any protected areas or the sites included in the Emerald Network of Ukraine.

2.3 - Summary of the Selected Alternatives

As far as the selected technical alternative is concerned, the MUC "Mykolaivvodokanal", together with the European Investment Bank (EIB), have selected **the technical alternative 1** for the WTP reconstruction; under this alternative, the capacity of the reconstructed WTP will be 160,000 m^3/day.

This decision was made considering the actual needs of Mykolaiv, as the designed capacity of 160,00 m^3/day is sufficient to ensure the need of the local population for the centralised water supply. Additionally, the above-mentioned capacity will allow to optimize the construction costs without affecting the efficiency and reliability of the water treatment system.

As far as the selected territorial alternative is concerned, the Regional Office of Water Resources in Mykolaiv Oblast, in accordance with their letter No. 238/10 of 14.02.2025 (Annex 1), agrees with the conclusion of the above-mentioned Report that the alternative that suggests the brine should be transported via the pipeline laid from the WTP site through unpopulated areas near the village of Balabanivka to a location downstream of Mykolaiv's wastewater treatment plant (the village of Halytsynove), where it will be mixed with municipal effluents and further transported to the existing effluent discharge location into the Buh Estuary (**territorial alternative 1**) is rational and acceptable in terms of achieving the better final quality of the concentrate (brine) prior to discharge. The mixing of brine with effluents from Mykolaiv's WWTP (the village of Halytsynove) would result in a reduced salinity level of the concentrate, which is a significant positive environmental factor for maintaining the quality of surface water in the Buh Estuary.

3 - DESCRIPTION OF THE CURRENT STATE OF THE ENVIRONMENT (BASELINE SCENARIO) AND ITS POTENTIAL CHANGES WITH THE PLANNED ACTIVITY NOT IMPLEMENTED

The study of the current environmental conditions was carried out by the Ukrainian Scientific Research Institute of Ecological Problems (USRIEP). The Report on the Current State of the Environment, including test protocols, is provided as a separate document due to its volume.

The Report on the Current State of the Environment includes the following information:

- information about the company and its relevant accreditations;
- information about the qualified personnel to be involved in air quality measurements;
- information about the applied methodology for environmental field investigations, sampling methods, analytical procedures, and references to applicable standards and regulations;
- meteorological data recorded during sampling and/or measurements (wind speed, precipitation, temperature);
- information about the results of environmental field investigations;
- photos taken at sampling sites; and
- a summary of findings of field investigations and an assessment of their compliance with applicable national standards.

The study of the current environmental conditions included the following activities:

- one-time sampling of environmental components (ambient air, soil, surface water, and noise levels) within the area of impact of the proposed facility;

- laboratory measurements of the collected samples of environmental components to determine the following parameters of their composition and properties:

- for ambient air: nitrogen dioxide and nitrogen oxide, benzo[a]pyrene, sulphur dioxide, carbon oxide, suspended particulate matter, lead and its compounds, formaldehyde, non-methane volatile organic compounds;
- for soil: copper, zinc, lead, manganese, nickel, cadmium, cobalt, petroleum products;
- for surface water: suspended solids, BOD_5, COD, ammonium nitrogen, nitrites, nitrates, phosphates, petroleum products, surfactants, iron, manganese, zinc, cadmium, chlorides, sulphates;

- *in situ* noise measurements: sound pressure levels in residential areas, measured in dB and dBA during daytime hours;

The obtained measurement results were assessed for compliance with the established standards and applicable regulations.

Samples were collected in accordance with applicable regulatory documents at the points indicated in the table below.

TABLE 56 – SAMPLING POINTS

No.	Coordinates	Address, name	Note
p.1	46°52'24"N 32°03'57"E	Yantarna street, 324-є, WTP in Mykolaiv	ambient air, soil, noise levels
p.2	46°52'15"N 32°04'13"E	Inhul Canal	surface water
p.3	46°52'49"N 32°03'45"E	The Vitovka River	surface water
p.4	46°52'55"N 32°03'17"E	Klechova balka street, 178 (a zone of residential buildings)	ambient air, soil, noise levels
p.5	46°52'48"N 32°03'15"E	Fontanna street, 197 (a zone of residential buildings)	ambient air, soil, noise levels
p.6	46°52'34"N 32°03'10"E	Kakhovska street, 71 (a zone of residential buildings)	ambient air, soil, noise levels
p.7	46°49'57"N 32°01'12"E	Vidrodzhennia street, 85 (a zone of residential buildings)	ambient air, soil, noise levels
p.8	46°49'10"N 31°57'08"E	The Buh Estuary	surface water

Under the baseline scenario (i.e., the non-implementation of the planned activity that involves the reconstruction of the existing WTP in Mykolaiv), environmental quality indicators are expected to deteriorate over time due to the progressive wear and obsolescence of equipment, outdated technological schemes, and water treatment methods currently in use. The existing operational scheme of the WTP does not include a reverse osmosis system, which prevents effective reduction of high concentrations of dissolved minerals in the treated water. As a result, saline effluents continue to be discharged into the Vitovka River and the Buh Estuary from the WTP, causing significant adverse impacts on the aquatic environment of these water sources.

The likelihood of changes in the current environmental conditions with the planned activity not implemented was assessed by analysing trends in the pollution levels of key environmental components over recent years.

The current environmental conditions within the area of the existing WTP in Mykolaiv are presented below.

3.1 - Assessment of the Impact on Ambient Air Quality

3.1.1 - Description of the Current State

In accordance with the letter of Mykolaiv Regional Hydrometeorological Centre No. 9913-1-266/9913 of 21.02.2025 (Annex 8), background concentrations of pollutants were established based on monitoring data for the city of Mykolaiv over the period from January 2022 to December 2024 and are as follows:

TABLE 57 – BACKGROUND CONCENTRATIONS OF POLLUTANTS

Location	Name of pollutant	Concentration, mg/m³				
		Wind speed, m/s				
		0-2	3-11			
		Directions				
		Any	N	E	S	W
Mykolaiv, Korabelnyi district, Yantarna street, 324-є	Dust	0.08010	0.07901	0.08071	0.07783	0.07788
	Sulfur dioxide	0.00538	0.00552	0.00528	0.00518	0.00556
	Nitrogen dioxide	0.03217	0.03071	0.03166	0.03013	0.03282
	Carbon oxide	1.17981	1.18426	1.22552	1.22866	1.21914

In accordance with the Extract from the official EcoSystem registries provided by the Ministry of Environmental Protection and Natural Resources of Ukraine, as presented in Annex 9, the background concentrations of pollutants are as follows:

- 20 mg/m^3 or 0.4 EL for methane;
- 0.000012 mg/m^3 or 0.4 EL for entanethiol;
- 0.04 mg/m^3 or 0.4 EL for wood dust;
- 0.04 mg/m^3 or 0.4 EL for rubber dust;

Climatic characteristics and background concentrations of pollutants were taken into consideration while modelling dispersion of pollutants in the ambient air to assess the impact of the planned activity and its future operation on the residential areas.

The WTP in Mykolaiv hold a valid permit for emissions of pollutants into the ambient air from stationary sources, issued on 07 February 2019, No. 4810136600–261 (Annex 10).

In addition, sanitary and hygienic air quality studies within the area of the planned activity were conducted by the Ukrainian Scientific Research Institute of Ecological Problems (USRIEP), with results presented in the table below.

TABLE 58 – RESULTS OF AMBIENT AIR SAMPLES STUDY

Sampling location (point)	Sampling date	Name of the pollutant	Sample (absorber, filter) code	Relative humidity, %	Wind direction	Wind speed, m/s	Ambient air temperature, °C	Ambient air pressure, mm Hg	Volumetric flow rate of gas, dm^3/min	Sampling time, min	Volume of aspirated air, V_n, dm^3	Concentration of pollutant, mg/m^3	EL, mg/m^3
1	2	3	4	5	6	7	8	9	10	11	12	13	14
P-1	19.03.2025	**Nitrogen oxides (expressed as nitrogen dioxide)**	Д1-1	65	NW	2.0	2	755	Special sampling Gas analyser CM-2-CO-NO2-SO2			**0.047**	0.2
			Д1-2									**0.040**	0.2
			Д1-3									**0.058**	0.2
	19.03.2025	**Sulphur dioxide**	Д1-1	65	NW	2.0	2	755				**0.025**	0.5
			Д1-2									**0.021**	0.5
			Д1-3									**0.023**	0.5
	19.03.2025	**Carbon oxide**	Д1-1	65	NW	2.0	2	755				**0.62**	5.0
			Д1-2									**0.71**	5.0
			Д1-3									**0.64**	5.0
	19.03.2025	**Suspended solids**	Ф1-1	65	NW	2.0	2	755	100	20	2,000	**0.18**	0.5
			Ф1-2						100	20	2,000	**0.26**	0.5
			Ф1-3						100	20	2,000	**0.19**	0.5
	19.03.2025	**Lead and its compounds**	Ф1-1	65	NW	2.0	2	755	100	20	2,000	**0.00060**	0.001
			Ф1-2						100	20	2,000	**0.00072**	0.001
			Ф1-3						100	20	2,000	**0.00066**	0.001
	19.03.2025	**Benzo[a]pyrene**	Ф1-1	65	NW	2.0	2	755	100	60	18,000	**<0.0000001**	*0.1 µg / 100 m^3*
			Ф1-2						100	60			
			Ф1-3						100	60			

Sampling location (point)	Sampling date	Name of the pollutant	Sample (absorber, filter) code	Relative humidity, %	Wind direction	Wind speed, m/s	Ambient air temperature, °C	Ambient air pressure, mm Hg	Volumetric flow rate of gas, dm^3/min	Sampling time, min	Volume of aspirated air, V_n, dm^3	Concentration of pollutant, mg/m^3	EL, mg/m^3
1	2	3	4	5	6	7	8	9	10	11	12	13	14
P-1	19.03.2025	**Formaldehyde**	П1-1	65	NW	2.0	2	755	0.25	20	5	**0.026**	0.035
			П1-2						0.25	20	5	**0.027**	0.035
			П1-3						0.25	20	5	**0.024**	0.035
	19.03.2025	**Non-methane volatile organic compounds**	К1-1	65	NW	2.0	2	755	Special sampling Gas analyser KOLION			**< 1.0**	
			К1-2									**< 1.0**	
			К1-3									**< 1.0**	
P-4	19.03.2025	**Nitrogen oxides (expressed as nitrogen dioxide)**	Д4-1	65	NW	2.0	2	755	Special sampling Gas analyser CM-2-CO-NO2-SO2			**0.032**	0.2
			Д4-2									**0.040**	0.2
			Д4-3									**0.038**	0.2
	19.03.2025	**Sulphur dioxide**	Д4-1	65	NW	2.0	2	755				**0.04**	0.5
			Д4-2									**0.04**	0.5
			Д4-3									**0.05**	0.5
	19.03.2025	**Carbon oxide**	Д4-1	65	NW	2.0	2	755				**0.6**	5.0
			Д4-2									**0.5**	5.0
			Д4-3									**0.6**	5.0
	19.03.2025	**Suspended solids**	Ф4-4	65	NW	2.0	2	755	100	20	2,000	**0.18**	0.5
			Ф4-5						100	20	2,000	**0.21**	0.5
			Ф4-6						100	20	2,000	**0.16**	0.5

Sampling location (point)	Sampling date	Name of the pollutant	Sample (absorber, filter) code	Relative humidity, %	Wind direction	Wind speed, m/s	Ambient air temperature, °C	Ambient air pressure, mm Hg	Volumetric flow rate of gas, dm^3/min	Sampling time, min	Volume of aspirated air, V_n, dm^3	Concentration of pollutant, mg/m^3	EL, mg/m^3
1	2	3	4	5	6	7	8	9	10	11	12	13	14
P-4	19.03.2025	**Lead and its compounds**	Ф4-4	65	NW	2.0	2	755	100	20	2,000	**0.00041**	0.001
			Ф4-5						100	20	2,000	**0.00043**	0.001
			Ф4-6						100	20	2,000	**0.00045**	0.001
	19.03.2025	**Benzo[a]pyrene**	Ф4-4	65	NW	2.0	2	755	100	60	18,000	***<0.0000001***	*0.1 µg / 100 m^3*
			Ф4-5						100	60			
			Ф4-6						100	60			
	19.03.2025	**Formaldehyde**	П4-1	65	NW	2.0	2	755	0.5	20	10	**<0.01**	0.035
			П4-2						0.5	20	10	**0.02**	0.035
			П4-3						0.5	20	10	**0.018**	0.035
	19.03.2025	**Non-methane volatile organic compounds**	К4-1	65	NW	2.0	2	755	Special sampling Gas analyser KOLION			**< 1.0**	
			К4-2									**< 1.0**	
			К4-3									**< 1.0**	
P-5	20.03.2025	**Nitrogen oxides (expressed as nitrogen dioxide)**	Д5-1	65	NW	2.0	2	755	Special sampling Gas analyser CM-2-CO-NO2-SO2			**0.034**	0.2
			Д5-2									**0.031**	0.2
			Д5-3									**0.036**	0.2
	20.03.2025	**Sulphur dioxide**	Д5-1	65	NW	2.0	2	755				**0.02**	0.5
			Д5-2									**0.03**	0.5
			Д5-3									**0.03**	0.5
P-5	20.03.2025	**Carbon oxide**	Д5-1	65	NW	2.0	2	755	Special sampling Gas analyser CM-2-CO-NO2-SO2			**0.3**	5.0
			Д5-2									**0.3**	5.0
			Д5-3									**0.4**	5.0

Sampling location (point)	Sampling date	Name of the pollutant	Sample (absorber, filter) code	Relative humidity, %	Wind direction	Wind speed, m/s	Ambient air temperature, °C	Ambient air pressure, mm Hg	Volumetric flow rate of gas, dm^3/min	Sampling time, min	Volume of aspirated air, V_n, dm^3	Concentration of pollutant, mg/m^3	EL, mg/m^3
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	20.03.2025	**Suspended solids**	Ф5-7	65	NW	2.0	2	755	100	20	2,000	**0.24**	0.5
			Ф5-8						100	20	2,000	**0.26**	0.5
			Ф5-9						100	20	2,000	**0.29**	0.5
	20.03.2025	**Lead and its compounds**	Ф5-7	65	NW	2.0	2	755	100	20	2,000	**0.00032**	0.001
			Ф5-8						100	20	2,000	**0.00035**	0.001
			Ф5-9						100	20	2,000	**0.00038**	0.001
	20.03.2025	**Benzo[a]pyrene**	Ф5-7	65	NW	2.0	2	755	100	60	18,000	***<0.0000001***	*0.1 µg / 100 m^3*
			Ф5-8						100	60			
			Ф5-9						100	60			
	20.03.2025	**Formaldehyde**	П5-1	65	NW	2.0	2	755	2.0	20	40	**<0.01**	0.035
			П5-2						2.0	20	40	**<0.01**	0.035
			П5-3						2.0	20	40	**0.015**	0.035
	20.03.2025	**Non-methane volatile organic compounds**	К5-1	65	NW	2.0	2	755	Special sampling Gas analyser KOLION			**< 1.0**	
			К5-2									**< 1.0**	
			К5-3									**< 1.0**	
Р-6	20.03.2025	**Nitrogen oxides (expressed as nitrogen dioxide)**	Д6-1	65	NW	2.0	2	755	Special sampling Gas analyser CM-2-CO-NO2-SO2			**0.035**	0.2
			Д6-2									**0.038**	0.2
			Д6-3									**0.036**	0.2
	20.03.2025	**Sulphur dioxide**	Д6-1	65	NW	2.0	2	755				**0.04**	0.5
			Д6-2									**0.04**	0.5
			Д6-3									**0.05**	0.5
	20.03.2025	**Carbon oxide**	Д6-1	65	NW	2.0	2	755				**0.2**	5.0

Sampling location (point)	Sampling date	Name of the pollutant	Sample (absorber, filter) code	Relative humidity, %	Wind direction	Wind speed, m/s	Ambient air temperature, °C	Ambient air pressure, mm Hg	Volumetric flow rate of gas, dm^3/min	Sampling time, min	Volume of aspirated air, V_n, dm^3	Concentration of pollutant, mg/m^3	EL, mg/m^3
1	2	3	4	5	6	7	8	9	10	11	12	13	14
			Д6-2									**0.1**	5.0
			Д6-3									**0.2**	5.0
	20.03.2025	**Suspended solids**	Ф6-10	65	NW	2.0	2	755	100	20	2,000	**0.25**	0.5
			Ф6-11						100	20	2,000	**0.21**	0.5
			Ф6-12						100	20	2,000	**0.28**	0.5
	20.03.2025	**Lead and its compounds**	Ф6-10	65	NW	2.0	2	755	100	20	2,000	**0.00031**	0.001
			Ф6-11						100	20	2,000	**0.00035**	0.001
			Ф6-12						100	20	2,000	**0.00037**	0.001
	20.03.2025	**Benzo[a]pyrene**	Ф6-10	65	NW	2.0	2	755	100	60	18,000	***<0.0000001***	*0.1 µg / 100 m^3*
			Ф6-11						100	60			
			Ф6-12						100	60			
P-6	20.03.2025	**Formaldehyde**	П6-1	65	NW	2.0	2	755	2.0	20	40	**<0.01**	0.035
			П6-2						2.0	20	40	**<0.01**	0.035
			П6-3						2.0	20	40	**0.012**	0.035
	20.03.2025	**Non-methane volatile organic compounds**	К6-1	65	NW	2.0	2	755	Special sampling Gas analyser KOLION			**< 1.0**	
			К6-2									**< 1.0**	
			К6-3									**< 1.0**	
P-7	21.03.2025	**Nitrogen oxides (expressed as nitrogen dioxide)**	Д7-1	65	NW	2.0	2	755	Special sampling Gas analyser CM-2-CO-NO2-SO2			**0.033**	0.2
			Д7-2									**0.039**	0.2
			Д7-3									**0.036**	0.2
	21.03.2025	**Sulphur dioxide**	Д7-1	65	NW	2.0	2	755				**0.05**	0.5
			Д7-2									**0.05**	0.5

Sampling location (point)	Sampling date	Name of the pollutant	Sample (absorber, filter) code	Relative humidity, %	Wind direction	Wind speed, m/s	Ambient air temperature, °C	Ambient air pressure, mm Hg	Volumetric flow rate of gas, dm^3/min	Sampling time, min	Volume of aspirated air, V_n, dm^3	Concentration of pollutant, mg/m^3	EL, mg/m^3
1	2	3	4	5	6	7	8	9	10	11	12	13	14
			Д7-3									**0.06**	0.5
	21.03.2025	**Carbon oxide**	Д7-1	65	NW	2.0	2	755				**0.2**	5.0
												0.2	5.0
												0.2	5.0
	21.03.2025	**Suspended solids**	Ф7-13	65	NW	2.0	2	755	100	20	2,000	**0.22**	0.5
			Ф7-14						100	20	2,000	**0.25**	0.5
			Ф7-15						100	20	2,000	**0.19**	0.5
	21.03.2025	**Lead and its compounds**	Ф7-13	65	NW	2.0	2	755	100	20	2,000	**0.00038**	0.001
			Ф7-14						100	20	2,000	**0.00036**	0.001
			Ф7-15						100	20	2,000	**0.00037**	0.001
	21.03.2025	**Benzo[a]pyrene**	Ф7-13	65	NW	2.0	2	755	100	60	18,000	***<0.0000001***	*0.1 µg / 100 m^3*
			Ф7-14						100	60			
			Ф7-15						100	60			
	21.03.2025	**Formaldehyde**	П7-1	65	NW	2.0	2	755	2.0	20	40	**0.021**	0.035
			П7-2						2.0	20	40	**<0.01**	0.035
			П7-3						2.0	20	40	**0.012**	0.035
	21.03.2025	**Non-methane volatile organic compounds**	К7-1	65	NW	2.0	2	755	Special sampling Gas analyser KOLION			**< 1.0**	
			К7-2									**< 1.0**	
			К7-3									**< 1.0**	

Based on the results of pollutant measurements in ambient air (nitrogen oxides, benzo[a]pyrene, sulphur dioxide, carbon oxide, suspended particulate matter, lead and its compounds, formaldehyde, non-methane volatile organic compounds), no exceedances of the Exposure Limits (EL) were detected.

3.1.2 - Summary of the Potential Changes in the State of Ambient Air with the Planned Activity Not Implemented

Refusal to proceed with the reconstruction of the WTP may lead to an increase in pollutant concentrations in workplace air (air of the WTP site). However, no impact on ambient air quality is anticipated in nearby settlements due to the sufficient distance between the facility and the nearest residential zones (890 to 1,000 metres).

3.2 - Assessment of the Impact on Surface Water Quality

3.2.1 - Description of the Current State

The hydrographic network of the city of Mykolaiv is represented by the Southern Buh and Inhul rivers, which flow through the city. The catchment area of the Southern Buh River within Ukraine is 63,700 km².

The total catchment area of the Southern Buh River is 63,700 km².

The overall length of the Southern Buh River is 806 km, all of which lies within Ukrainian territory.

The catchment area of the Inhul River within Ukraine is 9,890 km².

The total catchment area of the Inhul River within Ukraine is 9,890 km².

The overall length of the Inhul River is 354 km, all of which lies within Ukrainian territory.

The drainage density in Mykolaiv ranges from 0.51 to 0.70 km/km².

The maximum specific runoff from rain-induced floods for Mykolaiv is estimated at 0.1 m³/s * km² and less.

Based on the intra-annual distribution of river runoff, Mykolaiv is classified within the Black Sea hydrological region – specifically, the lower reaches of the Danube, Dniester, Southern Buh, Dnipro, and Salhyr rivers.

The mean multiannual evaporation[3] from the water surface in Mykolaiv ranges from 700 to 750 mm.

Water turbidity in the rivers ranges from 100 to 200 g/m³.

Mykolaiv is characterised by a highly regulated river flow regime.

Mykolaiv belongs to the basin of the Southern Buh River. The mean mineralisation of water ranges from 500 to 2,000 mg/dm³, based on 1990–2000 data. The mean water hardness ranges from 0 to 5 mg/dm³, based on 1990–2002 data.

Mykolaiv belongs to the region featuring the high-water period in spring.

The mean multiannual duration of ice cover in Mykolaiv ranges from 70 to 80 days.

The mean multiannual specific runoff for rivers in Mykolaiv ranges from 0.2 to 0.5 L/s*km².

The mean multiannual spring flood runoff depth for Mykolaiv is less than 10 mm.

In accordance with the hydrological zoning, Mykolaiv belongs to the Flatland Part, a zone with limited water content, specifically the Black Sea Region with extremely low water content.

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[3] evaporation was calculated using the following formula: $E = 0.37n(e_0 - e_{200})(1 + 0.14V_{200})$, where E is evaporation for a month, expressed in mm; $e_0 - e_{200}$ is the mean monthly difference between the saturated water vapour pressure, calculated in accordance with the water temperature, and the water vapour pressure in the air at a height of 200 cm; V_{200} is the mean monthly wind speed at a height of 200 cm, expressed in m/s; n is the number of days in a month.

Located 400 metres from the WTP, the Vitovka River runs through the Vitovka Creek before discharging into the Buh Estuary, which belongs to the Southern Buh River basin.

FIGURE 22 – THE VITOVKA RIVER

In the mid-20th century, the riverbed was deepened and connected to the city's wastewater drainage system. Additionally, the river was integrated with the drainage systems of Vitovske Reservoir (formerly known as Zhovtneve) and the Inhulets Irrigation System.

Key general characteristics of the Vitovka River are as follows:

- the catchment area is 26.40 km^2;
- the river length is 13.75 km, the channel width is 4-5 m, the depth is 0.2-0.3 m.
- the specific runoff is estimated at 0.2 L/s per 1 km^2;
- the mean multiannual runoff is 166.53 thousand m^3/year.
- the mean multiannual water discharge is 0.0053 m^3/s.

The Vitovka River is classified as a small river of national significance in accordance with the classification of rivers of Ukraine (Articles 5 and 79 of [34]).

In accordance with the letter from the Regional Office of Water Resources in Mykolaiv Oblast No. 813/10 of 24.10.2024 (Appendix 7), the Vitovka River is currently in economic use, namely as a receiver of return (waste) water, by the economic entities – the MUC "Mykolaivvodokanal" and ABINBEV EFES UKRAINE, PJSC, namely:

- in accordance with the permit for special water use No. 124/ML/49д-24 of 08.07.2024 issued for the MUC "Mykolaivvodokanal", the allowable volume of discharge of return (waste) water (category – industrial) into the Vitovka River amounts to 2,843.240 thousand m^3/year (see Appendix 11);
- in accordance with the permit for special water use No. 80/МЛ/49д-24 of 09.05.2024 issued for the water user ABINBEV EFES UKRAINE, PJSC, the allowable volume of discharge of return (waste) water (category – surface runoff (stormwater and snowmelt)) into the Vitovka River amounts to 36.453 thousand m^3/year (see Appendix 12).

As of now, untreated filter wash water is discharged from the existing WTP in Mykolaiv into the Vitovka River.

The reconstruction of the WTP in Mykolaiv includes the construction of a wash water treatment plant for the reuse of treated wash water that will be recirculated to the WTP head, while the removed and dewatered

sludge will be disposed of (i.e., transported to a municipal solid waste landfill), ensuring a closed-loop cycle of filter washing.

The reconstruction of the WTP in Mykolaiv includes the construction of a pipeline for transporting brine (in the Mode B) along the Inhulets Canal to the WWTP in Mykolaiv, where the brine will be mixed with municipal effluents and further discharged via the existing WWTP outlet into the Buh Estuary.

The Buh Estuary is a bay located in the northern part of the Black Sea. It belongs to the internal maritime waters of Ukraine and is classified as a water body of national significance. Together with the Dnipro Estuary, it forms the Dnipro–Buh Estuary. It receives the inflow from the Inhul and Southern Buh Rivers. Dimensions of the estuary are as follows: width is 11 km, length is 82 km. The average depth ranges from 6 to 7 m, while the maximum depth is 12 m.

FIGURE 23 – THE BUH ESTUARY

The Ukrainian Scientific Research Institute of Ecological Problems (USRIEP) conducted laboratory measurements of surface water quality in the Vitovka River, the Inhulets Canal, and the Buh Estuary.

The results of the measurements of the parameters of composition and properties of three surface water samples (sampling point 2 – the Inhul Canal; sampling point 3 – the Vitovka River; sampling point 8 – the Buh Estuary) are documented in the measurement protocols and summarised in the table below.

The results of the measurements of the parameters of composition and properties of three surface water samples were evaluated by comparison with the applicable

- hygienic standards for water quality in water bodies to be used for drinking, domestic, and other public needs, Exposure Limits $(EL)_{domestic}$, as established by the Order of the Ministry of Health of Ukraine No. 721 of 02.05.2022 "On Approval of Hygienic Standards for Water Quality in Water Bodies to Be Used for Drinking, Domestic, and Other Public Needs" [35], or the Order of the Ministry of Environmental Protection and Natural Resources of Ukraine No. 173 of 05.03.2021 "On Approval of Methodological Recommendations for Developing Standards for the Maximum Permissible Discharge of Pollutants into Water Bodies with Return Waters" [36] (Appendix 3 to the Methodological Recommendations "Reference Data on Surface Water Quality Standards and Efficiency of Return Water Treatment");

- standards for the exposure limits for substances in water of water bodies to be used for fishery, $EL_{fishery}$, as established by the Order of the Ministry of Environmental Protection and Natural Resources of Ukraine No. 173 of 05.03.2021 "On Approval of Methodological Recommendations for Developing Standards for the Maximum Permissible Discharge of Pollutants into Water Bodies with Return Waters" [36] (Appendix 3 to the Methodological Recommendations "Reference Data on Surface Water Quality Standards and Efficiency of Return Water Treatment").

TABLE 59 – THE RESULTS OF THE MEASUREMENTS OF THE PARAMETERS OF COMPOSITION AND PROPERTIES OF THREE SURFACE WATER SAMPLES

Indicators of control	**Measurable physical value, unit of measurement**	**Point 2** (the Inhul Canal)	**Point 3** (the Vitovka River)	**Point 8** (the Buh Estuary)	**EL domestic**	**EL fishery** [2)]
Pн	Potential of hydrogen, pH value	6.96	7.17	7.68	6.5 to 8.5[1)]	6.5 to 8.5[2)]
Chlorides	Mass concentration, mg/dm^3	**643**	**661**	**3,181**	350[1)]	300[2)]
Sulphates	Mass concentration, mg/dm^3	**560**	**541**	**644**	500[1)]	100[2)]
Ammonium nitrogen	Mass concentration, mg/dm^3	0.22	0.424	0.28	2.0[1)]	0.5 to 1.0[2)]
Nitrites	Mass concentration, mg/dm^3	0.058	0.041	<0.03	3.3[1)]	0.08[2)]
Nitrates	Mass concentration, mg/dm^3	<0.5	<0.5	0.95	45[1)]	40[2)]
Phosphates	Mass concentration, mg/dm^3	0.088	0.193	0.115	3.5[2)]	2.14[2)]
COD	Mass concentration, mgO/dm^3	**80**	**106**	**289**	30[2)]	50[2)]
BOD_5	Mass concentration, mgO/dm^3	**7.9**	**22**	**39.5**	3.0[1)]	3.0[2)]
Surfactants	Mass concentration, mg/dm^3	**0.19**	**0.22**	**0.43**	0.5[2)]	0.1[2)]
Suspended solids	Mass concentration, mg/dm^3	**75**	**141**	**209**	75[2)]	25[2)]
Petroleum products	Mass concentration, mg/dm^3	**9.48**	**3.84**	**1.41**	0.3[1)]	0.05[2)]
Total iron	Mass concentration, mg/dm^3	**0.32**	**0.38**	**0.25**	0.3[1)]	0, 1[2)]

Notes 1) Order of the Ministry of Health No. 721 of 02.05.2022 "On Approval of Hygienic Standards for Water Quality in Water Bodies to Be Used for Drinking, Domestic, and Other Public Needs" **2)** Order of the Ministry of Environmental Protection and Natural Resources of Ukraine No. 173 of 05.03.2021 "On Approval of Methodological Recommendations for Developing Standards for the Maximum Permissible Discharge of Pollutants into Water Bodies with Return Waters. Appendix 3 to the Methodological Recommendations "Reference Data on Surface Water Quality Standards and Efficiency of Return Water Treatment".

The comparison results between the measured indicators of the composition and properties of surface water samples and the established $EL_{domestic}$ and $EL_{fishery}$ are presented in the tables below as multiples of exceedance over the respective Exposure Limits.

TABLE 60 – MULTIPLES OF EXCEEDANCE OVER $EL_{DOMESTIC}$

Indicators of control	**Point 2** (Inhul Canal)	**Point 3** (the Vitovka River)	**Point 8** (the Buh Estuary)
Ph	Not exceeded	Not exceeded	Not exceeded
Chlorides	1.84	1.89	9.10
Sulphates	1.12	1.10	1.29
Ammonium nitrogen	0.11	0.21	0.14
Nitrites	0.02	0.01	< 0.01
Nitrates	< 0.01	< 0.01	0.02
Phosphates	0.03	0.06	0.03
COD	2.67	3.53	9.63
BOD_5	2.63	7.33	13.17
Petroleum products	31.6	12.8	4.7
Total iron	1.10	1.27	0.83

Exceedances over $EL_{domestic}$ were observed for the following indicators: sulphates (at all points), chlorides (at all points), COD (at all points), BOD_5 (at all points), petroleum products (at all points), total iron (at points 2 and 3).

TABLE 61 - MULTIPLES OF EXCEEDANCE OVER $EL_{FISHERY}$

Indicators of control	**Point 2** (Inhul Canal)	**Point 3** (the Vitovka River)	**Point 8** (the Buh Estuary)
Ph	Not exceeded	Not exceeded	Not exceeded
Chlorides	2.14	2.20	10.6
Sulphates	5.60	5.41	6.44
Ammonium nitrogen	0.22	0.42	0.28
Nitrites	0.73	0.51	< 0.91
Nitrates	< 0.01	< 0.01	0.02
Phosphates	0.04	0.09	0.05
COD	1.60	2.12	5.78
BOD_5	2.63	7.33	13.17
Petroleum products	189.6	76.8	28.2
Total iron	3.2	3.8	2.5

Exceedances over $EL_{fishery}$ were observed for the following indicators: sulphates (at all points), chlorides (at all points), COD (at all points), BOD_5 (at all points), petroleum products (at all points), total iron (at all points).

3.2.2 - Summary of the Potential Changes in the State of Surface Water with the Planned Activity Not Implemented

As of now, untreated filter wash water is discharged from the existing WTP in Mykolaiv into the Vitovka River.

If the reconstruction of the WTP in Mykolaiv is refused to proceed with, the Vitovka River will continue to be impacted as a receiver of return (wate) water from the WTP, which will contribute to the development of eutrophication processes, a decrease in dissolved oxygen levels, and an increase in water turbidity. If the reconstruction of the WTP is refused to proceed with, the quality of water will be impacted in the Buh estuary and in the Southern Buh River basin area.

3.3 - Assessment of the Impact on the Groundwater

3.3.1 - Description of the Current State

The main aquifers and aquiferous complexes in the deposits within the city of Mykolaiv are classified as Neogene in age.

The lithological composition of the water-bearing formations consists of porous rocks, primarily represented by sands.

The porous rocks in Mykolaiv are characterized as low- to moderately water-bearing.

The age of the water-bearing and aquiclude complexes corresponds to Quaternary alluvial and fluvioglacial formations.

The occurrence zone of mineral waters in Mykolaiv belongs to the Black Sea Artesian Basin – a region characterised by occurrence of low-mineralised chloride-sulphate-bicarbonate (and other three-anion type) sodium, sodium-magnesium, and mixed cation composition waters, as well as bicarbonate-chloride (or chloride-bicarbonate) sodium, chloride sodium waters of varying mineralisation, and highly mineralised and brine-type chloride sodium-calcium mineral waters.

Mykolaiv is recognised as the occurrence zone for iodine- and bromine-rich mineral waters.

The hydrochemistry of the main aquifers, particularly the anion composition of groundwater, is generally two-component in nature.

The natural groundwater resources, particularly the specific discharge of natural groundwater resources in Mykolaiv, is up to 0.5 L/s per 1 km^2.

* the specific discharge of natural groundwater resources refers to the volume of naturally occurring groundwater formed per second per square km of the area.

The projected groundwater resources, particularly the specific discharge of projected groundwater resources in Mykolaiv, is estimated at 35 m^3 per day per 1 km^2.

From the perspective of structural hydrogeological zoning, Mykolaiv is located within the Rus Platform, specifically in the Black Sea Artesian Basin Region, its Odesa District.

From the perspective of functional hydrogeological zoning of groundwater runoff, Mykolaiv belongs to the Black Sea-Azov Hydrogeological Region, specifically to the Southern Buh Province, and is located at the boundary between the southwestern and northeastern Districts.

3.3.2 - Summary of the Potential Changes in the State of Groundwater with the Planned Activity Not Implemented

Refusal to proceed with the reconstruction of the WTP will have no impact on the quality of groundwater.

3.4 - Assessment of the Impact on the Mineral Resources

3.4.1 - Description of the Current State

From the perspective of structural zoning, Mykolaiv is located within the East European ancient (Pre-Riphean) Platform, specifically in the Black Sea Cretaceous-Paleogene Depression.

Metallogenic zoning of the sedimentary cover and the metallogenic epochs relate to the Dniester-Black Sea (Late Proterozoic-Early Paleozoic) Province and the Black Sea (Mesozoic-Cenozoic) Sub-Province.

Due to its geographical location and relief, Mykolaiv oblast is not rich in mineral resources. There are no deposits of combustible minerals in Mykolaiv oblast.

The most valuable mineral resources found in the oblast are construction materials, namely gypsum, clay, quartz sand, manganese, and limestone. There are also deposits of coal and peat. The poor reserves of coal and peat are insufficient to meet even the needs of Mykolaiv itself, let alone the entire oblast. Therefore, these coal and peat deposits are not actively developed.

3.4.2 - Summary of the Potential Changes in the State of Mineral Resources with the Planned Activity Not Implemented

Refusal to proceed with the reconstruction of the WTP will have no impact on mineral resources.

3.5 - Assessment of the Impact on Land and Soils

3.5.1 - Description of the Current State

Engineering and Geological Conditions

Mykolaiv is classified as the territory where the intensity of landslide development is low.

The territory of the city of Mykolaiv is prone to moderate waterlogging.

The groups of rock complexes occurring closest to the surface are composed of sandy sediments with cohesive interlayers – sands interbedded with loams, clays, and silts.

The degree of susceptibility of the territory to exogenous geological processes (EGPs) is very high, with more than 50% of the area affected by EGPs.

From the engineering-geological perspective, the complexity of land development is considered elevated for the city of Mykolaiv. Contributing factors include subsidence of loess soils, waterlogging, and karst processes.

For the purpose of this report, materials of the geological survey No. 427/1-22 conducted by the PC CF "KSENA" have been used.

From the geomorphological perspective, the studied area is located on the second-to-third floodplain terrace of the Southern Buh River, with absolute surface elevations ranging from 10.0 to 55.0 metres.

The design has been developed for the architectural-construction climatic region of civil works (the Southeastern Steppe) featuring the following parameters (in accordance with DSTU-N.B.V.1.1-27-2010 [37], DBN V.1.2-2:2006 [38]):

- designed winter air temperature: - 20°C;
- characteristic snow load: 870 Pa;
- characteristic wind load: 470 Pa;
- characteristic ice layer thickness: 22 mm; and
- characteristic wind load under icing conditions: 270 Pa.

The main climatic indicators used for the geological survey in accordance with [37] are provided in the table below.

TABLE 62 – MAIN CLIMATIC INDICATORS USED FOR THE GEOLOGICAL SURVEY

PARAMETER	VALUE
Heating season duration, days	161[4]
Mean annual air temperature, °C	10.1
Assumed air temperature of the coldest 5-day period, °C	-20[5]
Engineering-geological complexity category of the area	II (Moderate)
Soil freezing depth, m	0.8[6]
Groundwater presence and level	Not detected
Relief of the area	Smooth, flat

Source -DSTU-N B V.1.1-27:2010 "Building Climatology"
Source - the geological survey No. 427/1-22 conducted by the PC CF "KSENA", 2022

From the perspective of the geological structure of the studied area, it is composed of Quaternary aeolian-deluvial and deluvial deposits, overlying Neogene formations; up to a drilling depth of 5.0 m, the subsurface profile is composed of (top to bottom):

- IGE I – topsoil level;
- IGE 2 – deluvial heavy sandy loam, dark gray to black, from semi-solid to soft plastic, non-subsiding;
- IGE 3 – light loam, brown with carbonate inclusions, solid, subsiding;
- IGE 4 – light brown loamy sand with iron staining, solid, subsiding;
- IGE 5 – heavy loam, brown to dark brown, solid, non-subsiding; and
- IGE 6 – gray-white fractured limestone featuring low strength.

When fully saturated to the depth of 5.0 m, the soils of the studied area exhibit settlement, totalling 3.5 cm.

During the survey (April 2022), the stable groundwater level within the studied area was recorded at a depth of 1.5 to 1.9 metres.

In accordance with the map ZSR-2004-A (with 10% probability of exceeding MSK-64 seismic intensity levels over 50 years, recurrence interval 1 in 500 years), the studied area is not seismically active (see DBN V.1.1-12: 2014 [39]). In accordance with the table 5.1 of [39], the seismic soil category of the construction site is Category II (Two). Therefore, the seismicity level of the studied area does not increase based on the selected map.

Soil classification follows DSTU B V.2.1-2-96 [40].

Soils and Soil Resources[7]

Humus content in the arable layer of soils in Mykolaiv (depth up to 30 cm) is 2.6 to 3.0 %.

Average humus reserves in Mykolaiv are 100 to 150 tons/ha.

Humus reserves in Mykolaiv are 101 to 150 tons/ha.

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[4] In accordance with the source DSTU-N B V.1.1-27:2010 "Building Climatology" and the source – the geological survey, the duration of the heating period at the average temperature of 0.4 to 0.6°C ranges from 164 to 168 days.

[5] In accordance with the source DSTU-N B V.1.1-27:2010 "Building Climatology" and the source – the geological survey, the temperature of the coldest 5-day period is between -18°C and -19°C, while the temperature of ventilation in winter ranges from -6.7°C to -6.9°C.

[6] The value of 0.8 m is cited in DBN as the assumed one. However, the historical minimum and maximum observed soil freezing depths are 50 cm and 90 cm, accordingly.

[7] National Atlas of Ukraine, 2007

Soils of Mykolaiv are classified as chestnut soils, specifically dark chestnut residual-solonetzic soils, developed from loess formations.

The soil conditions in Mykolaiv are characterised by nearly neutral to neutral pH, ranging from 5.6 to 7.0.

For Mykolaiv, the level of available mobile forms of phosphorus (P_2O_5) in the arable layer of soil for agricultural crops is transitional to high, with the average content of P_2O_5 ranging from 7.6 to 10.0 mg/100 g of soil.

For Mykolaiv, the level of available mobile forms of potassium (K_2O) in the arable layer of soil for agricultural crops is high, with the average content of K_2O exceeding 12.0 mg/100 g of soil.

Content of microelements in soils:

The gross content of copper in Mykolaiv ranges from 13 to 24 mg/kg of soil.

The gross content of zinc in Mykolaiv ranges from 41 to 60 mg/kg of soil.

The gross content of molybdenum in Mykolaiv ranges from 3.1 to 4.0 mg/kg of soil.

The gross content of cobalt in Mykolaiv ranges from 10.1 to 15.0 mg/kg of soil.

The gross content of chromium in Mykolaiv ranges from 61 to 80 mg/kg of soil.

The gross content of manganese in Mykolaiv ranges from 501 to 900 mg/kg of soil.

The gross content of lead in Mykolaiv ranges from 11.1 to 13.0 mg/kg of soil.

The gross content of nickel in Mykolaiv ranges from 26 to 30 mg/kg of soil.

Soil fertility level[8] in Mykolaiv is moderate, corresponding to 31-40 bonitet points.

In accordance with the agro-soil zoning, Mykolaiv lies in the plain-steppe zone, specifically the Southern Steppe, within the Right-Bank Southern Steppe Agro-Soil Province, with southern chernozems and with meadow-chernozem solonetzic soils in depressions.

The existing WTP is in an area where the topsoil was removed in the 1960s.

Soil samples were taken within the first-line residential development boundary and analysed for toxicological indicators. The obtained results of the measured indicators of composition and properties of the taken soil samples were assessed against the relevant Exposure Limits (EL), as established by the Resolution of the Cabinet of Ministers of Ukraine No. 1325 of 15 December 2021 "On Approval of Exposure Limits for Hazardous Substances in Soils and the List of Those Substances" [41].

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[8] *soil fertility level was determined based on the average bonitet score of agro-productive soil groups across all natural-agricultural regions.*

TABLE 63 – RESULTS OF DETERMINING THE MASS FRACTION OF POLLUTANTS IN SOIL

Indicators of control	Measurable physical value, unit of measurement	Point 1 Yantarna street, 324-є	Point 4 Klechova street, 178	Point 5 Fontanna street, 197	Point 6 Kakhovska street, 71	Point 7 Vidrodzhennia street	EL, mg/kg
Petroleum products	Mass fraction, mg/kg	64.5	64.5	44.6	49.5	29.9	**500**
Copper mob.	Mass fraction, mg/kg	0.1	0.44	0.18	0.24	0.10	**3.0**
Manganese gross	Mass fraction, mg/kg	540	510	470	520	500	**1,500**
Manganese mob.	Mass fraction, mg/kg	36	72	73	62	36	**140**
Nickel mob.	Mass fraction, mg/kg	0.67	0.83	0.50	0.70	0.67	**4.0**
Cobalt mob.	Mass fraction, mg/kg	0.058	0.087	0.067	0.095	0.058	**5.0**
Lead gross	Mass fraction, mg/kg	13	15	15	21	11	**32**
Lead mob.	Mass fraction, mg/kg	0.54	1.8	2.1	3.0	0.54	**6.0**
Cadmium gross	Mass fraction, mg/kg	0.22	0.20	0.20	0.25	0.18	**3.0**
Cadmium mob.	Mass fraction, mg/kg	0.0053	0.018	0.019	0.025	0.0053	**0.7**
Zinc mob.	Mass fraction, mg/kg	0.37	3.1	2.8	3.9	0.37	**23**

No exceedance of the Exposure Limits (EL) for the content of pollutants in soil has been found.

Relief

The integral coefficient of relief dissection[9] in Mykolaiv ranges from 0.25 to 0.5.

The density of horizontal dissection of the relief by permanent watercourses in Mykolaiv ranges from 0.1 to 0.2 km/km^2.

The plains and uplands of ancient and young platforms formed under conditions of neotectonic movements of the Earth's crust, differentiated by intensity and direction, are classified for Mykolaiv as denudation landforms, specifically subhorizontally flat plains developed on Neogene deposits.

From the perspective of geomorphological zoning, Mykolaiv lies in the East European Polygenetic Plain, the Black Sea Region of structural-accumulative and structural-denudation lowlands, specifically the Black Sea structural-accumulative lowland developed on Neogene deposits, and more precisely the Buh-Dnipro accumulative-denudation flat, slightly dissected lowland.

3.5.2 - Summary of the Potential Changes in the State of Soils and Land with the Planned Activity Not Implemented

Refusal to proceed with the reconstruction of the WTP will have no impact on the quality of soils.

3.6 - Impact Assessment on Fauna, Flora and Biodiversity

3.6.1 - Description of the Current State

The biodiversity study was conducted by the Ukrainian Research Institute of Ecological Problems (UKRNDIEP). Due to its volume, the report on the structure of biodiversity and the distribution of its main elements is provided in a separate document.

Based on the results of the biodiversity study, relevant maps were compiled, as well as lists of plant and animal species:

- natural and modified habitats;
- places where rare species or species of high conservation importance in this context are found (in accordance with the requirements of the Law of Ukraine "On the Red Data Book of Ukraine" [42], disclosure of information about the exact location (growth) of objects listed in the Red Data Book of Ukraine is not permitted in order to prevent their destruction by poachers);
- suitable habitats for species that are threatened/critically endangered, as well as endemic species within the territory (if any).

The study focuses on a land plot with cadastral number 4810136600:06:042:0051 (territory of Mykolaiv WTP) and a 100 m wide corridor on both sides of the proposed pipeline for transporting concentrate. This corridor is considered acceptable for operational survey and is wide enough to take into account most of the impacts that will arise during construction work and to meet the operational needs of the WTP site.

TABLE 64 - LOCATIONS OF KEY BIODIVERSITY ELEMENTS

Area	Location/geographical coordinates	Study objectives
p. 1	Vitovka river 46°52'49"N 32°03'45"E	Analysis of habitats and species of flora/fauna along the Vitovka River. Attention to riparian vegetation and characteristics of hydrobiocenoses should be paid.
p. 2	Land plot of existing WTP in Mykolaiv	Anthropogenically transformed land plot. It is necessary to ensure

[9] *The integral (isohypsometric) coefficient of dissection reflects, in an integrated manner, the surface slope, relative elevation of the relief, and horizontal dissection.*

Area	Location/geographical coordinates	Study objectives
	with cadastral number 4810136600:06:042:0051	that there are no rare species of flora/fauna or species of high conservation value.
p. 3	Protective forest belts along the railway and the Ingulets Canal	The pipeline for transporting concentrate (brine) from reverse osmosis is planned to be constructed using the open trench method, which involves cutting down green spaces and disturbing the soil. In this regard, it is necessary to ensure that construction work does not affect rare species of flora and fauna or species of high conservation value.
p. 4	Agricultural land	The pipeline for transporting concentrate (brine) from reverse osmosis is planned to be built across agricultural land that could serve as a food source for rare fauna species.
p. 5	Bug Estuary – at the discharge point of treated WWTP wastewater. 46°49'10"N 31°57'08"E	An analysis of habitats and species should be carried out along the course of the Bug Estuary (at a distance of 500 m upstream and downstream from the point of discharge of brine from reverse osmosis (standby mode) diluted with treated wastewater from the wastewater treatment plant (WWTP) in Mykolaiv. Attention to riparian vegetation should be paid.

FIGURE 24 - LAYOUT OF THE WTP IN MYKOLAIV AND LAYING OF THE PIPELINE FOR TRANSPORTING CONCENTRATE (BRINE) FROM REVERSE OSMOSIS

According to physical and geographical zoning, the study area is located within the Dnieper-Bug lowland region of the Central Steppe and Southern Podillia slope-upland region of the Northern Steppe subzone of the Steppe zone (National Atlas of Ukraine, 2007 [43]). According to zoogeographical zoning, it is located within the Western Steppe (Northern Black Sea) section of the Pontic district of the Azov-Black Sea region.

3.6.1.1 - Point 1 Vitovka River

The Vitovka River flows along the bottom of the Vitovska Balka ravine from east to west through the Korabelnyi district of Mykolaiv, flowing into the Bug Estuary.

The vegetation on the river banks includes woody and shrubby species of willows (Salix sp.), boxelder maple (Acer negundo), russian olive (Elaeagnus angustifolia), common dogwood (Swida sanguinea), black elderberry (Sambucus nigra), common hop (Humulus lupulus), wild cucumber (Echinocystis lobata), common bindweed (Calystegia sepium), common reed (Phragmites australis), sedge species (Carex sp.).

FIGURE 25 - VITOVKA RIVER

The ornithological complex includes: common cuckoo (*Cuculus canorus*), great spotted woodpecker (*Dendrocopos major*), bluethroat (*Luscinia svecica*), great reed warbler (*Acrocephalus arundinaceus*), marsh warbler (*Acr. palustris*), common chiffchaff (*Phylloscopus collybita*), barred warbler (*Sylvia nisoria*), common whitethroat (*S. communis*), Eurasian blue tit (*Parus caeruleus*), great tit (*P. major*), Eurasian penduline tit (*Remiz pendulinus*), Eurasian magpie (*Pica pica*), hooded crow (*Corvus cornix*), common starling (*Sturnus vulgaris*), Eurasian tree sparrow (*Passer montanus*), European greenfinch (*Chloris chloris*), European goldfinch (*Carduelis carduelis*).

3.6.1.2 - Point 2 Water Treatment Plant (WTP) Territory

The land plot where the reconstruction works are planned has been significantly affected by human activity during the construction of water treatment plant (WTP) in Mykolaiv in the 1960s, therefore there are no rare or valuable plant species within its boundaries.

The following species grow on the territory of the WTP: Bole's poplar (*Populus boleana*), Norway maple (*Acer platanoides*), boxelder maple (*Acer negundo*), black locust (*Robinia pseudoacacia*), honey locust (*Gleditsia triacanthos*), tree of heaven (*Ailanthus altissima*), russian olive (*Elaeagnus angustifolia*), ornamental forms of plum species (*Prunus*), wild rose species (*Rosa* sp.), hoary cress (*Lepidium draba*), wormwood species (*Artemisia* sp.).

FIGURE 26 – WTP TERRITORY

The following species grow on the territory of the WTP: Bole's poplar (Populus boleana), Norway maple (Acer platanoides), boxelder maple (Acer negundo), black locust (Robinia pseudoacacia), honey locust (Gleditsia triacanthos), tree of heaven (Ailanthus altissima), russian olive (Elaeagnus angustifolia), ornamental forms of plum species (Prunus), wild rose species (Rosa sp.), hoary cress **(**Lepidium draba), wormwood species (Artemisia sp.)

The following birds nest in the area: Eurasian collared dove (Streptopelia decaocto), great spotted woodpecker (Dendrocopos. major), house martin (Delichon urbicum), white wagtail (Motacilla alba), black redstart (Phoenicurus ochruros), Eurasian blue tit (Parus caeruleus), great tit (Parus major), Eurasian jay (Garrulus glandarius), Eurasian magpie (Pica pica), hooded crow (Corvus cornix), common starling (Sturnus vulgaris), house sparrow (Passer domesticus), Eurasian tree sparrow (Passer montanus), European greenfinch (Chloris chloris), European goldfinch (Carduelis carduelis).

Among reptiles, the sand lizard (Lacerta agilis) is found.

3.6.1.3 - Point 3 Protective Forest Belt along the Railway and the Ingulets Canal

Protective forest belts along the railway and the Ingulets Canal consist of tree and shrub layers.

FIGURE 27 – FOREST BELT

The tree stand consists of: English oak (Quercus robur), boxelder maple (Acer negundo), European ash (Fraxinus excelsior), black locust (Robinia pseudoacacia), honey locust (Gleditsia triacanthos), apricot (Prunus armeniacais), white mulberry (Morus alba), Siberian elm (Ulmus pumila), russian olive (Elaeagnus angustifolia).

The shrub layer consists of: false indigo-bush (Amorpha fruticosa), Siberian peashrub (Caragana arborescens), sea buckthorn (Hippophae rhamnoides), smoketree (Cotinus coggygria), hawthorn species (Crataegus sp.), blackthorn (Prunus spinosa), wild rose species (Rosa sp.), and bloody dogwood (Swida sanguinea).

The bird fauna of the protective forest belts includes: European turtle dove (Streptopelia turtur), Eurasian wryneck (Jynx torquilla), Syrian woodpecker (Dendrocopos syriacus), great spotted woodpecker (D. major), tree pipit (Anthus trivialis), song thrush (T. philomelos), thrush nightingale (Luscinia luscinia), spotted flycatcher (Muscicapa striata), common chiffchaff (Phylloscopus collybita), Eurasian blackcap (Sylvia atricapilla), barred warbler (S. nisoria), common whitethroat (S. communis), lesser whitethroat (S. curruca), Eurasian blue tit (Parus caeruleus), great tit (P. major), red-backed shrike (Lanius collurio), Eurasian jay (Garrulus glandarius), Eurasian magpie (Pica pica), hooded crow (Corvus cornix), common starling (Sturnus vulgaris), Eurasian tree sparrow (Passer montanus), chaffinch (Fringilla coelebs), European greenfinch (Chloris chloris), European goldfinch (Carduelis carduelis), common linnet (Acanthis cannabina), yellowhammer (Emberiza citrinella).

Among reptiles, the sand lizard (Lacerta agilis) can be found in forest belts.

Mammals found in forest belts include the European hedgehog (Erinaceus europaeus), European mole (Talpa europaea), European wood mouse (Sylvaemus sylvaticus) and yellow-necked mouse (Sylvaemus flavicollis).

3.6.1.4 - Point 4 Agricultural Land

The agricultural land is used as feeding grounds by grain-eating and predatory birds (which feed on mouse-like rodents) nesting in the Balabanivka forest reserve, located near Point 4:

grey partridge (Perdix perdix), common pheasant (Phasianus colchicus), common kestrel (Falco tinnunculus), red-footed falcon (F. vespertinus), common buzzard (Buteo buteo), long-eared owl (Asio otus), rook (Corvus frugilegus), hooded crow (C. cornix), common raven (C. corax), Eurasian jackdaw (Corvus monedula) (these birds nest in the concrete supports of high-voltage power lines near the Balabanivka tract), common starling (Sturnus vulgaris), Eurasian tree sparrow (Passer montanus).

During seasonal migrations and in winter, the winter moth hunts mouse-like rodents (Buteo lagopus).

FIGURE 28 - AGRICULTURAL LAND

Among **mammals**, the European mole (*Talpa europaea*), mound-building mouse (*Mus spicilegus*), common vole (*Microtus arvalis*), greater blind mole-rat (*Spalax microphthalmus*) are widespread in the agrocenosis.

3.6.1.5 - Point 5 Bug Estuary – at the Discharge Point of Treated WWTP Wastewater

The Bug Estuary is a bay located in the northern part of the Black Sea. It belongs to the internal waters of Ukraine and has the status of a water body of national importance. Together with the Dnieper Estuary, it forms the Dnieper-Bug Estuary. The waters of the Inhul and Southern Bug rivers flow into it. The estuary is 11 km wide and 82 km long. Its average depth is 6-7 m, with a maximum depth of 12 m. The city and port of *Mykolaiv* are located in the northern part of the Bug Estuary.

The biodiversity research area Point 5 is a section of the left bank of the Bug Estuary in the Korabelny district of the southern part of Mykolaiv.

A wide strip of common reeds (Phragmites australis) stretches along the shore of the estuary. Among the reeds, sedge species (Carex sp.), yellow loosestrife (Lysimachia vulgaris), purple loosestrife (Lythrum salicaria), bittersweet nightshade (Solanum dulcamara), hedge bindweed (Calystegia sepium) grow.

he bird species that make up the nesting ornithocomplex: Little grebe (Tachybaptus ruficollis), great crested grebe (Podiceps cristatus), great bittern (Botaurus stellaris), little bittern (Ixobrychus minutus), mallard (Anas platyrhynchos), garganey (Spatula querquedula), common pochard (Aythya ferina), western marsh harrier (Circus aeruginosus), water rail (Rallus aquaticus), common moorhen (Gallinula chloropus), Eurasian coot (Fulica atra), Savi's warbler (Locustella luscinioides), paddyfield warbler (Acrocephalus agricola), reed warbler (Acr. scirpaceus), great reed warbler (Acr. arundinaceus), bluethroat (Luscinia svecica), bearded reedling (Panurus biarmicus).

FIGURE 29 - BUG ESTUARY

During seasonal migrations, various species of waterfowl (ducks, martins, terns) are found in the estuary). Reptiles include the European pond turtle (Emys orbicularis), the common grass snake (Natrix natrix), dice snake (Natrix tessellata), while amphibians include the marsh frog (Pelophylax ridibundus).

3.6.1.6 - Main Habitats of Plant and Animal Species Requiring Special Protection

According to the Letter of the Department of Ecology and Natural Resources of the Mykolaiv Regional Military Administration dated 10 March 2025 No. 377/01.1-04/06 (Appendix 13) and according to the results of the survey near the study area, the following was found: 2 objects of the natural reserve fund and the water area of the Emerald Network (see Figure below).

Hydrological reserve of local importance "Vitovske Reservoir"

Located in the southern part of Mykolaiv, in the Korabelnyi district, 230 m from the territory of the Mykolaiv WTP.
Area: 429 ha. Status granted by Decision No. 281 of 11 December 1990.
The status was granted to preserve part of the water area and coastal zone of the Zhovtneve Reservoir.
Since 2007, the reservoir has not been in operation and is almost completely dry, so the Hydrological reserve "Vitovske Reservoir" has lost almost all of its value.
At the time of its creation, the reserve was called the "Zhovtneve Reservoir", but due to decommunisation, it was renamed the "Vitovske Reservoir".
The Vitovske Reservoir is a former reservoir in the Mykolaiv Raion of the Mykolaiv Oblast (Vitovska Balka) and in the Korabelnyi Raion of the city of Mykolaiv. It was created in 1957. The reservoir is offstream.

Balabanivka Forest Reserve of Local Importance

The reserve is located in the southern part of Mykolaiv, in the Balabanivka area (part of the Korabelnyi district), 500 m from the nearest section of the pipeline construction site for transporting brine.
It covers an area of 510 hectares. It was established by Decision No. 675 of the Executive Committee of the Mykolaiv Regional Council on 28 December 1982. It is managed by the Mykolaiv Forestry Branch of the State Specialised Economic Enterprise "Forests of Ukraine". (Mykolaiv Forestry, section 17-26).
The status was granted to preserve an artificially created forest area dominated by pine trees.
The forest was established in 1959 on sandy deposits on the left bank of the Bug Estuary.

Due to its proximity to Mykolaiv and cottage areas, the ecosystem of the reserve is subject to significant anthropogenic impact. Illegal logging, sand extraction, waste disposal and fires often occur in the area.

The territory of the Emerald Network of the Dnieper-Bug Estuary (Dniprovsko-Buzkyi Lyman UA0000109)[10]

The Dnieper-Bug Estuary is located 3,200 metres from the nearest section of the pipeline construction site for transporting brine.
The site supports a high diversity of bird species and is an important area for a significant number of migratory birds. The site is part of the Dnipro Ecological Corridor. This corridor is one of the three main migration routes in Ukraine.
More detailed information can be found in the Report on the Structure of Biodiversity and Distribution of its Main Elements.

[10] https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=UA0000109

FIGURE 30 - SCHEME OF THE MAIN HABITATS OF PLANT AND ANIMAL SPECIES REQUIRING SPECIAL PROTECTION

3.6.1.7 - Conclusions from Biodiversity Research

Having studied the structure of biodiversity and the distribution of its main elements in the territory of the existing WTPs of the MUC "Mykolaivvodokanal", we conclude the following:

1. The study area has no natural habitats; all habitats have been modified as a result of human activity, with the exception of the Dnieper-Bug Estuary, which can be classified as a natural habitat.
2. The Dnieper-Bug Estuary is a bird migration route, but birds do not use its waters near point No. 5 for rest and feeding due to the proximity of urban development.
3. Suitable habitats for species requiring special protection have been identified outside the project area, at a distance that does not create an impact, namely:
   - Vitovske Reservoir, a hydrological reserve of local importance – 230 m;
   - Balabanivka Forest Reserve of Local Importance – 500 m;
   - Territory of the Emerald Network Dniprovsko-Buzkyi Lyman UA0000109 – 3,200 m.
4. A significant number of species with conservation status were found in the study area, but among them only the European pond turtle (*Emys orbicularis*), included in the IUCN Red List and the Red Book of Ukraine, requires special protection. It inhabits the Dnipro-Buzkyi Estuary and the study area at Point No. 5, where there is a wide coastal reed bed and no anthropogenic impact has been observed. No construction work will be carried out at Point No. 5.
5. During the study of points No. 1, No. 2, No. 3, No. 4 and No. 5, no habitats or species of plants and animals requiring special protection were identified.
6. The activities planned for the territory of the existing WTPs in Mykolaiv, MUC "Mykolaivvodokanal", will not lead to a transformation of the biodiversity structure within its boundaries.

3.6.2 - Description and Assessment of Potential Impacts

The decision not to reconstruct the WTP will not affect flora, fauna or biodiversity.

3.7 - Climate Impact Assessment

3.7.1 - Description of the Current State

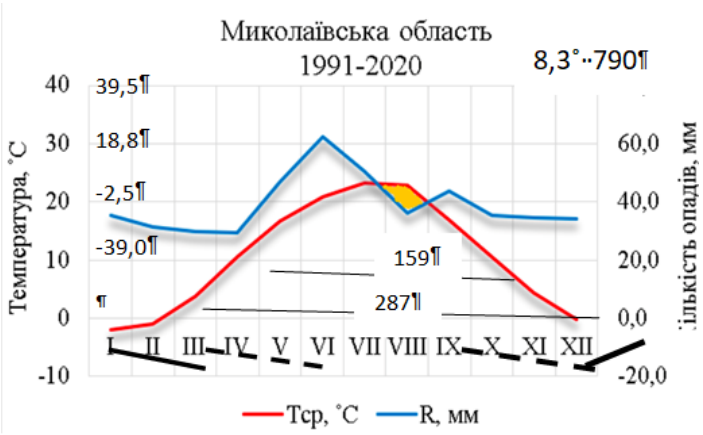
The climate is steppe, temperate continental, with mild, dry winters and long, hot, dry summers with limited precipitation.

The Mykolaiv region is located in the steppe agroclimatic zone of Ukraine, in the lower reaches of the Southern Bug River.

Weather and climate observations in the region, as of 31 December 2022, were carried out by five meteorological stations located in the settlements of Bashtanka, Voznesensk, Mykolaiv, Pervomaisk, and Ochakiv.

According to long-term observations, it has been established that in the current climate period (1991-2020), the region has a temperate continental climate with arid conditions. In terms of precipitation and temperature conditions, the northern part of the region belongs to the zone of insufficient moisture, while the central and southern parts belong to the arid zone (see the Figure below). The average annual air temperature in the region is +10.5°C, and the annual temperature range (the difference between the average temperature of the warmest and coldest months) is +25.4°C.

FIGURE 31 – GOSSEN-WALTER CLIMATE DIAGRAM FOR THE MYKOLAIV REGION. AVERAGE MONTHLY AIR TEMPERATURE AND PRECIPITATION IN THE PERIOD 1991-2020



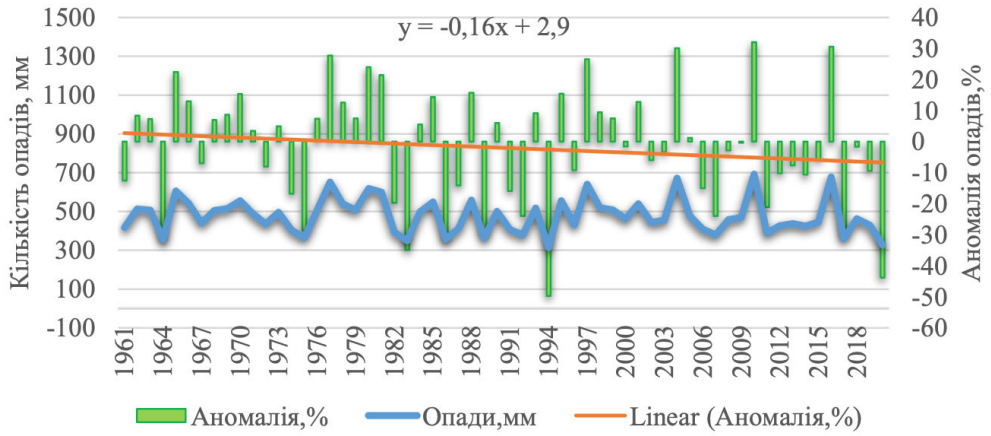
The Mykolaiv region is characterised by an arid steppe climate with long hot summers and moderately cold, dry winters. The average annual precipitation is about **406 mm**, which is half that of the western regions of Ukraine. The lowest precipitation occurs in the southern parts of the region, particularly on the Black Sea coast. During the summer months, there are long periods without rain, accompanied by high air temperatures and significant evaporation.

The region's hydrological network is underdeveloped, with mostly shallow rivers and an unstable water regime. The main water bodies are the **Southern Bug, Inhul, and Inhulets rivers**, as well as a number of irrigation canals and reservoirs. The water balance is vulnerable to climate change, especially due to frequent droughts and the risk of groundwater level decline.
Source: Climate Change Adaptation Strategy for the Mykolaiv Region, 2024

Changes in temperature conditions in the Mykolaiv region
Significant changes in temperature are characteristic of the Mykolaiv region. Throughout the year, there is an increase in air temperature, both average and maximum and minimum. According to data, the rate of change in average and average maximum air temperatures per year in 1981-2010 was 0.60°C/10 p and 0.70°C/10, respectively, and was higher than in Ukraine as a whole (0.58 and 0.60°C/10, respectively), while the average minimum temperature was the same as in Ukraine (0.5°C/10). The air temperature rose most rapidly in summer. The average seasonal air temperature during this period was 0.87°C/10 p, and the average maximum temperature was 1.1°C/10 p, which was almost three times higher than in winter. Significant changes are characteristic of the maximum air temperature in spring – 0.7°C/10 p.

Changes in the moisture regime in the Mykolaiv region
Over the past decades, the Mykolaiv region has seen changes not only in temperature but also in moisture regime. Annual precipitation in the region decreased between 1961 and 2020. However, these changes were insignificant, amounting to 1.6% over 10 years (see Figure below).

FIGURE 32 - INTERANNUAL VARIABILITY OF PRECIPITATION PER YEAR AND ITS ANOMALY (%) RELATIVE TO 1991-2020



The average annual precipitation norm in 1991-2020 did not change significantly compared to 1961-1990. However, there was a redistribution of precipitation throughout the year, which led to changes in the climatic norms of individual months and seasons (Figure 2-13). The most significant changes are characteristic of autumn. The average autumn precipitation in the Mykolaiv region increased by 16%. This increase is due to a significant increase in October (46%) and September (19%), although in November there was a slight decrease (-7%).

A slight increase in precipitation was also observed in May and June – 8% and 5%, respectively. However, such changes are insignificant for precipitation. In other months, there was a decrease in precipitation, which was highest in April (16%), July (16%) and August (19%). A significant decrease in precipitation in July and August, accompanied by a significant increase in air temperature, especially maximum temperatures, led to increased aridity in the region. As a result, the climate of the southern and central regions of Mykolaiv Oblast became more arid.

Source: Climate Change Adaptation Strategy for the Mykolaiv Region, 2024

More detailed information is provided in the Climate Risk Assessment Report (the Report is provided as a separate document due to its size).

The climatic characteristics of the area where the planned activity is to be carried out are provided by the Mykolaiv Regional Centre for Hydrometeorology and are presented in Appendix 14.

TABLE 65 - METEOROLOGICAL CHARACTERISTICS AND COEFFICIENTS DETERMINING THE CONDITIONS FOR THE DISPERSION OF POLLUTANTS IN THE ATMOSPHERIC AIR OF MYKOLAIV

Name of characteristics	Value
Coefficient depending on atmospheric stratification, A	200
Terrain relief coefficient	1
Average air temperature of the warmest month (July) absolute maximum	25,2 °C heat
	41,6 °C heat
Average air temperature of the coldest month (January) absolute minimum	0,6 °C heat
	29,7 °C frost
Average annual wind rose	%
lull	12,8
N	22,9
NE	12,4
E	13,2

Name of characteristics	Value
SE	5,6
S	16,0
SW	8,9
W	9,2
SW	11,8
Average wind speed per year, m/s	3,3
Wind speed exceeding 5% of cases in a given area, m/s	8-9

Source: Letter from Mykolaiv Regional Centre for Hydrometeorology dated 21.02.2025 No. 9913-1-268/9913

TABLE 66 - WIND SPEED RECURRENCE BY GRADATIONS (% OF TOTAL NUMBER OF CASES)

Wind speed, m/s	Recurrence, %
0-1	25,8
2-3	33,1
4-5	22,9
6-7	11,2
8-9	5,3
10-11	1,4
12-13	0,2
14-15	0,1
16-17	0
18-20	0

Source: Letter from Mykolaiv Regional Centre for Hydrometeorology dated 21.02.2025 No. 9913-1-268/9913

TABLE 67 – AMOUNT OF PRECIPITATIONS

Month	1	2	3	4	5	6	7	8	9	10	11	12	Year
Average precipitation, mm	26,5	22,8	19,2	34,5	45,6	68,5	38,2	34,9	22,0	26,2	49,0	38,9	426,2
Long-term average, mm	30	26	25	27	48	52	40	31	34	34	29	30	406

Source: Letter from Mykolaiv Regional Centre for Hydrometeorology dated 21.02.2025 No. 9913-1-268/9913

The above-mentioned area of the WTP location is characterised by aridity, with average annual evaporation from the land surface (400 mm) equal to the total precipitation falling during this period.

The average of the highest ten-day snow cover heights in the protected area is 9 cm, with a maximum of 30 cm. In 65% of recorded winters, there is no permanent snow cover.

The prevailing wind direction throughout the year is north-easterly (20% of days). The average annual number of days with strong winds (15 m/sec. and above) is 13, with a maximum of 36. The maximum wind speed is 21 m/sec. and is possible annually at 24-25 m/sec. once every 5-10 years, 26-27 m/sec once every 15-20 years.

Frequent fog in October-March (14 days out of 17 per year) causes the accumulation of condensation nuclei in the air and stagnation in the surface layer of the atmosphere.

The climatic conditions are not conducive to an increase in the intensity of the planned activities' impact on the environment.

The average long-term meteorological potential of the atmosphere characterises the prevalence of

certain processes (accumulation or dispersion) in the atmosphere over a year in a given territory and depends on the integral indicator Km, which is determined by the formula:

$$K_{м} = \frac{(P_{ш} + P_{т})}{(P_{о} + P_{в})}$$

where:

Рш – frequency of days with wind speed 0-1 m/sec – 25,8%;

Рв – frequency of days with wind speed of 5 m/sec and above – 41,1%;

Рт – frequency of days with fog – 4,7 %;

Ро – frequency of days with precipitation of 0.5 mm and above – 18 %.

Km = (25,8+4,7)/(18+18,2)=0,84

In the area where the WTP is located in Mykolaiv, Km <1, which indicates the predominance of dispersion processes in the atmosphere.

3.7.2 - Description and Assessment of Potential Impacts

The decision not to reconstruct the WTP will not affect the climate.

3.8 - Assessment of the Impact of Waste on the Environment

3.8.1 - Description of the Current State

As one of the largest regional centres in southern Ukraine, the city of Mykolaiv faces a number of environmental challenges related to the management of municipal solid waste (MSW). Currently, the city's waste management system remains underdeveloped and needs to be modernised in line with European standards.

More than 200,000 tonnes of solid waste are generated in Mykolaiv every year. The majority of this waste is organic, plastic, paper, glass and textile waste. Due to the war, there has also been an increase in the volume of construction and hazardous waste, including debris from buildings, household appliances and medical waste.

Collection and transportation system: MSW collection in the city is carried out by municipal enterprises and private operators. The main method of collection is container-based, although in some areas an outdated system of collection in unorganised locations still remains. The existing material and technical base (containers, specialised equipment) is largely worn out, leading to unauthorised accumulation of waste.

Sorting and recycling: The city does not have a developed separate collection system. Pilot projects to install containers for plastic, glass and paper cover only a small proportion of households. Waste recycling is almost non-existent, with a significant proportion of collected waste ending up in landfill.

Municipal solid waste landfill: The main solid waste landfill, located near the city, has been in operation for over 40 years. It is more than 85% full and does not meet modern environmental standards for waterproofing, leachate collection and biogas. There is a risk of groundwater and environmental pollution.

3.8.2 - Description of Possible Changes without Planned Activities

The decision not to reconstruct the WTP will not affect the situation with waste in the city.

3.9 - Assessment of the Impact on the Social Environment

3.9.1 - Description of the Current State

The planned activities will take place within the city of Mykolaiv (reconstruction of the WTP) and on the territory of the Halytsynove amalgamated territorial community (construction of a pipeline for transporting brine).

3.9.1.1 - Social Environment in Mykolaiv

Mykolaiv is the administrative centre of the Mykolaiv region, located in the southern Ukraine. Before the full-scale invasion, it had a population of about 470,000, but due to the war, the number has temporarily dropped to about 350,000–380,000 (according to local authorities' estimates in 2023). The city is of great importance as an industrial, educational, scientific and cultural centre of the region. Its social environment is shaped by historical, demographic, economic and security factors.

Demographic situation

Before the war, the city was predominantly populated by the working-age population, with a slightly higher proportion of women. Mykolaiv had stable birth rates and moderate migration levels.

Before the war, the working-age population accounted for over 60% of the total population.

Women made up approximately 53% of the population.

People of retirement age accounted for about 20%.

As a result of the full-scale aggression of the Russian Federation in 2022, the city underwent significant changes:

- Part of the population was evacuated or left the country, especially families with children and the elderly.
- At the same time, Mykolaiv took in internally displaced persons (IDPs) from Kherson and other frontline regions.

According to official data, as of 2023, there are over 25,000 internally displaced persons (IDPs) registered in the city.

Today, the social structure includes a significant proportion of vulnerable groups: pensioners, IDPs, low-income families, persons with disabilities, and veterans.

Economic conditions and employment

Mykolaiv has traditionally been a city of shipbuilding, machine building and port logistics. After 2022, a significant number of enterprises stopped or limited their activities, which affected employment and income levels.

Until 2022, there were over 150 large and medium-sized industrial enterprises operating in Mykolaiv, particularly in shipbuilding, machine building, food processing and the chemical industry.

In 2023, the official unemployment rate in the region reached 12–15%, with unofficial employment even higher.

Unemployment rates remain high, especially among young people, women and IDPs. At the same time, small business initiatives, volunteer projects and humanitarian support are becoming more active.

A significant proportion of employment is in the public sector, education, healthcare and small businesses.

Education and culture

The city has a network of general education, vocational and higher education institutions. Among the leading ones are Petro Mohyla Black Sea National University, Admiral Makarov National University of Shipbuilding, Mykolaiv College of Transport, etc.

There are over 100 secondary schools, 50 kindergartens and several universities in the city.

Due to the danger of shelling, more than 85% of educational institutions have been operating remotely since 2022.

Mykolaiv is also a centre of cultural life in southern Ukraine, with theatres, museums and galleries. However, many cultural events have been cancelled or postponed due to the martial law.

State of social infrastructure

The network of medical facilities, social protection and service institutions is functioning but operating under increased pressure.

There are more than 20 medical facilities in Mykolaiv (including a regional hospital, an infectious diseases hospital and children's hospitals).

Some medical facilities have been damaged by shelling and need to be repaired.

Over 15,000 households receive assistance as low-income families.

The need for psychological assistance, rehabilitation services and social support is constantly growing.

A significant part of the social infrastructure has been damaged or needs to be restored (including schools, kindergartens, hospitals and social protection facilities).

Social cohesion

More than 60 public organisations are actively working in the city, particularly in the areas of volunteering, assistance to internally displaced persons and veterans.

The volunteer movement has developed significantly since 2022: more than 30,000 residents have been involved in various ways in helping the Armed Forces of Ukraine, displaced persons, hospitals, etc.

3.9.1.2 - Social Environment of the Halytsynove ATC

The Halytsynove ATC was formed by merging 4 village councils, which together comprise six settlements: Halytsynove, Lymany, Lupareve, Prybuzke, Ukrainka, and Stepova Dolyna.

The territory of the amalgamated territorial community stretches south of the city of Mykolaiv, where the Bug River flows into the Dnipro Estuary at the border between the Mykolaiv and Kherson regions. The western border is the coast of the Bug River estuary.

Due to its location in the immediate vicinity of Mykolaiv, the community has quick access to important motorways and railways of international, national and regional importance in virtually all directions. In addition, it has quick access to the airport in Mykolaiv.

The population of the Halytsynove ATC before the full-scale invasion was 9,091 people as of 2020[11].

TABLE 68 - POPULATION

Indicator	2016	2017	2018	2019	2020
Total number of residents in the community	9 021	9 003	9 055	9 080	9 091

[11] https://galycynivska.dosvit.org.ua/economic-profile/general

Indicator	2016	2017	2018	2019	2020
Average age of residents	42	42	42	42	42
Number of persons per 1 sq. km	29	29	29	29	29
Population growth over the previous year	-0.2	+0.58	+0.38	+0.28	+0.12

Demographics

The two largest settlements in the community are Halytsynove (the centre of the ATC) and Lymany, accounting for 28.4% and 25.8% of the total population of the community, respectively. In addition to these two settlements, the community includes 4 villages: Lupareve, Prybuzke, Ukrainka, and Stepova Dolyna.

The community has a low population density (29 people per km^2, which is lower than in the district and region). It has over 9,000 residents, of whom about 18% are under 18 (below working age) and 21% are over working age.

The working-age population is 3,079.

The number of employed people is 2,284.

The population structure of the ATC is dominated by people of working age.

Women aged 18-60 live in 82.4% of households, and men aged 18-65 live in 60.4% of households. This indicates the high potential of the local economy.

The territory of the Halytsynove community covers 311.35 km^2.

There are several large enterprises operating in the community, which form the local labour market (Mykolaiv Alumina Plant – 895 employees, "Metallurg" – 457).

Many companies located in the community are engaged in agricultural production (in particular, "Avangard" and "Rodnichok").

The largest employers also include budgetary institutions, which employ more than 400 people in total.

In total, there are more than 30 companies operating in the agricultural sector in the community, about 8 entities engaged in industrial production, several companies providing services, dominated by bars and restaurants, and about 30 companies engaged in trade, mainly shops.

Together, this represents a solid tax base for the community budget, particularly personal income tax.

The widespread and intensive cultivation of agricultural crops in the community is of particular importance for the economic situation of the ATC.

Despite its location in a suburban area, there is no tradition of greenhouse cultivation of fruit and vegetables for the nearby market in Mykolaiv, which could be a significant source of income for the community.

The economic activity of residents covers many areas: work in nearby Mykolaiv, work at local industrial enterprises, work in the agricultural and budgetary sectors, and work in local small retail and service establishments.

There is no industrial processing of agricultural products in the community, which could create additional jobs and increase revenues for the community budget.

The community lacks a unified centralised water supply system. Water is drawn from wells near homes or through local water supply systems (separate in each settlement), which are managed unsystematically by

residents (technical maintenance, repairs, etc.). In total, water supply is available to about 85% of the community.

The waste management system in the community operates on the basis of collecting municipal solid waste from residents and placing it in a small landfill within the community. At the current volume of waste removed from the community, it should be sufficient for approximately 30 years. The community is responsible for waste collection and provides these services free of charge. There is no waste sorting system or facility for waste recycling.

The Halytsynove community does not have its own internet service – work is underway to set one up. As a result, there is no official website where residents can find information, reports from community council meetings, announcements, including those concerning the budget of the amalgamated community. There are several private, school, library and community websites, including social media pages, where certain information about the community is posted.

3.9.2 - Description of Possible Changes without Planned Activities

In 2022, russian military shelling of critical water supply infrastructure, including a water intake pumping station and main water pipes from the Dnipro River, caused significant damage, leaving the city of Mykolaiv without a safe or sufficient supply of drinking water. In 2022, water with a high mineral content was supplied to the city's network from the Dnieper-Bug Estuary, which led to the destruction of significant sections of steel pipelines.

The state of the water supply system deteriorated significantly in 2023 when russia destroyed the Kakhovka hydroelectric power plant dam, causing further damage downstream along the Dnieper River. This had a negative impact on water intake facilities in the Kherson region and left the city of Mykolaiv without access to a reliable source of drinking water.

The city of Mykolaiv has not been supplied with drinking water of the required quality for the past two years. At the end of 2024, the city was still being supplied with water that did not meet the established standards through an irrigation canal (Snihuriv) on the Inhulets River, a tributary of the Dnipro River.

These changes in the city's water supply system, which took place in 2022-2023 due to russian military aggression, also significantly affected the operation of the wastewater treatment plants (WWTPs) in Mykolaiv (village of Halytsynove). The city's population has a mixed water supply system, which has complicated the operation of municipal WWTPs due to the discharge of salt concentrate with a mineralisation of 2.3-11.0 g/m3 (exceeding the requirements of DSanPiN 2.2.4-171-10 [2] for mineralisation by up to 11 times) into the sewerage network.

Failure to reconstruct the WWTP with the introduction of a reverse osmosis system will significantly affect the health of the population of Mykolaiv and the city's critical infrastructure (water pipelines, WTP, WWTP).

3.10 - Assessment of the impact on cultural heritage objects and other tangible objects

3.10.1 - Description of the current situation

There are no cultural heritage objects within the area of the WTP location. The only historical site located 100 m from the construction site of the pipelines for brine transportation is the Mohyla-Maiachna mound.

The Mohyla-Maiachna mound is a geographical and historical site located nearby Korabelnyi district of the city of Mykolaiv. Information on the official status of the Mohyla-Maiachna mound protection is absent.

Geographical location:
Coordinates: 46°49’55” N. lat., 32°01’37” E. long.
Absolute altitude: 56.1 meters above sea level

Height of the mound itself: about 5 meters
It is one of the highest points of the terrain, which makes it a noticeable dominant landscape.

FIGURE 33 – MOHYLA-MAIACHNA MOUND

At the top of the mound there is a geodetic sign indicating its use as a trigonometric point for topographic and cartographic works.

Although there are no specific archaeological studies of the Mohyla-Maiachna mound recorded in open sources, its name and shape indicate a probable funerary origin.

3.10.2 - Description of possible changes without the planned activities implementation

Refusal to reconstruct the WTP will not affect cultural heritage objects and other tangible objects.

3.11 - Description and assessment of the possible environmental impacts caused by technology and substances used

At present, a liquid chlorine is used to disinfect drinking water at the Water treatment plant of the city of Mykolaiv. Chlorine belongs to particularly hazardous chemicals.

Liquid chlorine is stored in special containers and is supplied to evaporation units, where it is converted into gaseous chlorine, which is then dosed into water for disinfection.

The liquid chlorine reserve is stored in warehouses in containers of up to 1 ton.

The distance from residential, civil and household facilities to warehouses with liquid chlorine in containers is assumed to be 100 m[12].

Chlorine storage is associated with a number of serious hazards, both for workers and for the environment and the surrounding population.

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[12] *Annex 7 to the State Sanitary Rules for Planning and Development of Settlements, approved by thre Order of the Ministry of Health of Ukraine dated June 19, 1996 No. 173*

Chlorine is a highly toxic substance, and even in low concentrations, gaseous chlorine can cause irritation of the mucous membranes, eyes and respiratory system. Chlorine is deadly in high concentrations.

Mechanical damage to containers, corrosion of equipment, improper transportation, or breach of the seal of containers with liquid chlorine can cause chlorine to be released into the atmosphere. Under adverse weather conditions, a toxic chlorine cloud can spread over a large area, posing a danger to city residents.

Hazards for the WTP personnel:

- Intoxication: employees are at risk of inhaling chlorine in case of leaks or emergencies.
- Chemical burns: in case of contact with liquid chlorine, burns to the skin and mucous membranes are possible.
- Psychological stress: working with hazardous substance requires constant concentration and technical discipline.

In modern practice, liquid/gaseous chlorine is increasingly being replaced by sodium hypochlorite. And during the reconstruction of the WTP, it is foreseen to construct an electrolysis workshop to produce sodium hypochlorite, which is an alternative, safer reagent for water disinfection. Since it is planned to obtain hypochlorite directly at the treatment plant, its storage volumes can be equated to a daily supply.

The use of sodium hypochlorite, which is obtained at the place of use by electrolysis of sodium chloride solutions, as a disinfectant reagent is one of the promising methods of disinfection. While retaining all the advantages of chlorination using liquid chlorine, the use of electrolytic sodium hypochlorite allows to avoid the main difficulties connected with transportation and storage of toxic liquid/gas. In addition, the use of this reagent allows to eliminate the user's constant dependence on liquid chlorine suppliers, as it is produced centrally by the chemical industry, as well as to eliminate the use of specialized vehicles.

Water purification with sodium hypochlorite instead of chlorine has the following advantages: safe storage and transportation, ease of dosing, long-term disinfection effect, low probability of the threat of a man-made accident and avoidance of negative impacts on the health of city residents.

3.11.1 - Description of probable changes without implementation of planned activities

Refusal of the WTP reconstruction and preservation of the technology of water disinfection with liquefied chlorine preserves the increased risk of poisoning for the WTP service personnel, and in the event of an accident, for residents of the city of Mykolaiv.

4 - DESCRIPTION OF ENVIRONMENTAL FACTORS LIKELY TO BE AFFECTED BY THE PLANNED ACTIVITIES AND ITS ALTERNATIVES, INCLUDING POPULATION HEALTH, STATE OF FAUNA, FLORA, BIODIVERSITY, LANDS, SOILS, WATER, AIR, CLIMATIC FACTORS, MATERIAL OBJECTS, INCLUDING ARCHITECTURAL, ARCHAEOLOGICAL AND CULTURAL HERITAGE, LANDSCAPE, SOCIO-ECONOMIC CONDITIONS AND INTERRELATIONS BETWEEN THESE FACTORS

During the reconstruction works, the impact on the environment will be insignificant.

Operation of the object after the reconstruction will minimize the impact on the environment and health of the population of the city of Mykolaiv, guarantee sustainable development and prevent environmental disasters connected with possible accidents at the WTP.

Environmental factors that are likely to be affected by the planned activities will be atmospheric air, lands (withdrawal of land plots for temporary use), soils, the state of fauna, flora, archaeological and cultural heritage (not excluded due to excavation works), socio-economic conditions, waste generation.

Other environmental factors, such as the state of surface water and groundwater, biodiversity, objects of the nature reserve fund and the Emerald Network, and architectural heritage, will not be affected, since the planned activities are carried out outside the protection zones of these objects.

Impact on climate and landscape is not expected, as the project does not involve large-scale construction works with high greenhouse gas emissions or large-scale excavation works that could affect the landscape.

The **table** of a summary description and assessment of the possible impact of the planned activities on the environment is given below.

The impact significance assessment "INSIGNIFICANT IMPACT" is used if it is obvious that the project will have a negative impact on the assessed territory, but such impact will be less than the established threshold value.

The impact significance assessment "MODERATE IMPACT" is used if it is obvious that the necessary measures to minimize the negative impact allow reducing the negative impact of the project to the established threshold value.

The impact significance assessment "SIGNIFICANT IMPACT" is used if it is obvious that the negative impact of the project on the assessed territory cannot be reduced to the lower level.

The project will have an insignificant impact on the environment during the reconstruction stage and during its operation.

Decommissioning (project life cycle phase 2) is not envisaged. In the future, major repairs or reconstruction works are envisaged in accordance with the future needs of the city of Mykolaiv.

TABLE 69 - SUMMARY DESCRIPTION AND ASSESSMENT OF THE POSSIBLE IMPACT OF THE PLANNED ACTIVITIES ON THE ENVIRONMENT

Factors	Phases of the project life cycle	Description (characteristics) of the impact																	Assessment of the impact significance		
		negative	positive	transboundary	direct	indirect or collateral	inevitable	reversible	irreversible	short-term	medium-term	long-term	temporary	permanent	local	large-scale	cumulative	probable in normal mode	probable in the event of accidents	insignificant	moderate	significant
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Atmospheric air	0	+	-	-	+	-	+	+	-	+	-	-	+	-	+	-	+	-	-	+	-	-
	1	+	-	-	+	-	+	-	+	-	-	+	-	+	+	-	-	-	-	+	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surface water	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	+	-	+	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Groundwater	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public health	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
	1	-	+	-	+	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fauna	0	+	-	-	+	-	-	+	-	+	-	-	+	-	+	-	-	-	-	+	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flora	0	+	-	-	+	-	+	-	-	+	-	-	+	-	+	-	-	-	-	+	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biodiversity	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lands	0	+	-	-	+	-	+	+	-	+	-	-	+	-	+	-	-	-	-	+	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Factors	Phases of the project life cycle	Description (characteristics) of the impact																	Assessment of the impact significance		
		negative	positive	transboundary	direct	indirect or collateral	inevitable	reversible	irreversible	short-term	medium-term	long-term	temporary	permanent	local	large-scale	cumulative	probable in normal mode	probable in the event of accidents	insignificant	moderate	significant
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Soils	0	+	-	-	+	-	-	+	-	+	-	-	+	-	+	-	-	-	-	+	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Climatic factors	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Material objects (architecture, archaeological and cultural heritage)	0	+	-	-	-	+	-	+	-	+	-	-	+	-	+	-	-	+	-	+	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Landscape	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Socio-economic conditions	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	+	-	+	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste	0	+	-	-	+	-	+	-	+	+	-	-	+	-	+	-	-	-	-	+	-	-
	1	+	-	-	-	+	+	-	+	-	-	+	-	+	+	-	-	-	-	+	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Explanation to the table: environmental factors are listed in the c 1 in accordance with the Law (including, it is recommended to indicate separately protected areas and objects that are likely to be affected), as well as some special factors of impact, such as 1) waste, 2) hazardous technologies and chemicals used. Column 2 - phases of the project life cycle: 0 – preparatory and construction works, 1 – implementation of the planned activities (operational phase), 2 – decommissioning, including dismantling works upon completion of the planned activities.

Decommissioning (project life cycle phase 2) is not envisaged. In the future, major repairs or reconstruction works are envisaged in accordance with the future needs of the city of Mykolaiv

Columns 3-20: they are filled in using the "plus" or "minus" signs; short explanations regarding quantitative or qualitative assessments may be added. Columns 21-23 (assessment of the impact significance) are filled in taking into account the characteristics given in the columns 3-20. To fill in this table, it is recommended to use the following terms with the following meanings:

Direct impact – impact (change, appearance or disappearance) that occurs as a result of direct physical (mechanical, chemical or biological) contact between the source and the object of impact.

Indirect impact – impact that the source of impact has on the object through a series of intermediate, sometimes not fully known links (objects or processes).

Inevitable impact – impact that cannot be avoided using existing technologies, even if preventive measures are taken (measures to prevent, avert or avoid negative impact or consequences).

Reversible impact – impact in which the changes that have occurred in the object or environmental process can develop in the opposite direction, the object or environmental process can return to their original state, and the properties of the environment can be restored.

Irreversible impact – impact in which the changes in the object or environmental process that have occurred as a result of the impact cannot develop in the opposite direction, and the object or process that has been changed cannot return to its original state (the state that existed before the impact began).

Short-term impact – impact, the consequences of which last and have time to fade away in a period of time not exceeding one year. Medium-term impact: from one to three years. Long-term impact: from three years. If the consequences last for more than 10 years, such an impact is very long-term.

Cumulative impact – the total impact on the environment resulting from the totality or combination of impacts of the given planned activities in conjunction with the impacts of other currently existing planned activities and objects, planned activities and objects that were carried out (operated) in the past or are expected in the foreseeable future (for which a decision on implementation has been received).

Temporary impact – impact that is observed during a limited period of time and then may re-occur (return) after some time with a certain regular or random repeatability.

Permanent impact – impact that is observed all the time (without interruptions, but possibly with different intensity) during one or more phases of the project life cycle.

5 - DESCRIPTION AND ASSESSMENT OF POSSIBLE IMPACT OF THE PLANNED ACTIVITIES ON THE ENVIRONMENT, IN PARTICULAR MAGNITUDE AND SCALE OF SUCH IMPACT, NATURE, INTENSITY AND COMPLEXITY, LIKELIHOOD, EXPECTED START, DURATION, FREQUENCY AND INEVITABILITY OF THE IMPACT

5.1 - Description and assessment of possible impact on environment during preparatory and construction works

5.1.1 - Description and assessment of possible impact on the air environment

The impact on the air environment during preparatory and construction works is connected with short-term emissions of:

- pollutants generated during the operation of construction equipment during the laying of asphalt concrete pavement and during the construction of technological structures of the WTP;

- inorganic dust during unloading and loading operations, pipe replacement and construction of the pipeline for brine transportation;

- pollutants generated during welding works;

- vapours of paint and varnish solvents during paint and varnish works.

Sources of pollutant emissions during preparatory and construction works are non-organized sources of emissions.

During the preparatory and construction works, the gross emission of pollutants into the atmospheric air will be 3,721 t/year (see the clause 1.5.1 of this Report).

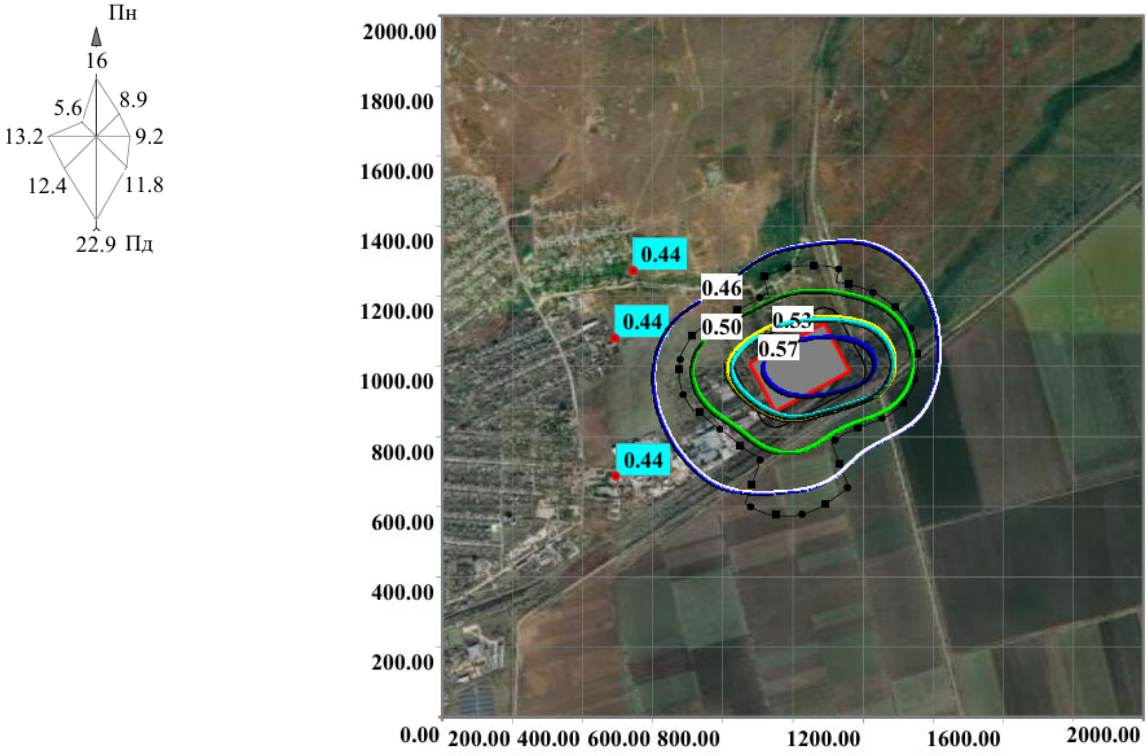
The calculation of the dispersion of pollutants into the atmospheric air from construction works was performed using the EOL 2000 (h) program and is given in the Annex 4. The program is included into the list of programs recommended for use by the Ministry of Environmental Protection and Natural Resources of Ukraine.

The automated system for calculating atmospheric pollution "EOL" is designed to assess the impact of pollutant emissions from designed and operating enterprises on pollution of the surface layer of the atmosphere. The calculation modules of the system implement the "Methodology for calculating concentrations of harmful substances contained in enterprises emissions into atmospheric air. OND-86" [17].

The purpose of the calculation is to determine the highest concentration of pollutants at the reference point. When determining the dimensions of the calculation site, we took into account the need to determine the concentrations of pollutants at the border of the nearest residential area.

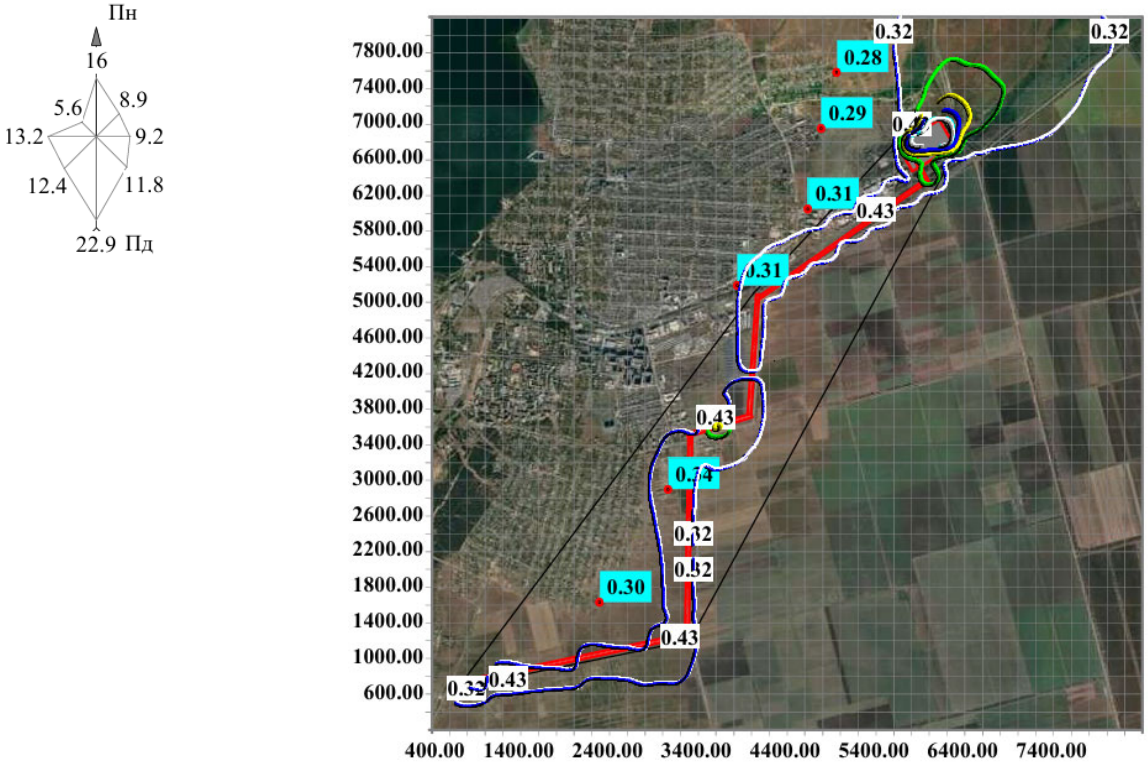
Below there are maps of the pollutants dispersion during the preparatory and construction works, for which it was advisable to carry out the calculation, namely for manganese and its compounds and inorganic dust, with a silicon dioxide content in % - 70 - 20.

FIGURE 34 - CONCENTRATION OF MANGANESE AND ITS COMPOUNDS IN PARTICLES OF THE MPC ON THE TERRITORY OF THE CONSTRUCTION SITE AND AT THE BORDER OF THE FIRST LINE OF THE RESIDENTIAL AREA, TAKING INTO ACCOUNT BACKGROUND CONCENTRATIONS



During the construction of the pipeline for brine transportation, a significant amount of dust will be emitted.

FIGURE 35 - CONCENTRATION OF INORGANIC DUST WITH SILICA DIOXIDE CONTENT IN % - 70 – 20 IN PARTICLES OF THE MPC ON THE TERRITORY OF THE CONSTRUCTION SITE AND AT THE BORDER OF THE FIRST LINE OF THE RESIDENTIAL AREA, TAKING INTO ACCOUNT BACKGROUND CONCENTRATIONS



In accordance with the calculations in the worst case (maximum number of operating equipment, adverse weather conditions, dangerous wind speed, at which the maximum concentration is achieved at the reference points with the flow of possible wind directions, unhindered distribution) the surface concentrations of the pollutants at the border of the first line of the residential area (see Table 38 and Figure 15) and at the construction site will reach the values given in the Table below.

TABLE 70 - POLLUTANTS CONCENTRATIONS IN PARTICLES OF THE MPC AT THE NEAREST BORDER OF THE RESIDENTIAL AREA AS A RESULT OF WORKS ON THE WTP RECONSTRUCTION, INCLUDING THE CONSTRUCTION OF THE PIPELINE FOR BRINE TRANSPORTATION

Pollutants	Pollutants code	Construction site	RP.1 Klechova Balka Str., 178	RP.2 Fontanna Str., 197	RP.3 Kakhovska Str., 71	RP.4 Yantarna Str., 318	RP.5 Ostapa Vyshni Str., 147	RP.6 Preobrazhenska Str., 40	RP.7 Vidrodzhennia Str., 85
		Distance, m							
		-	1,030 m	1,000 m	890 m	1,100 m	480 m	200 m	480 m
		Concentrations of pollutants in the MPC particles							
Manganese and its compounds (calculated as manganese dioxide)	1313-13-9/1104	0.57	0.44	0.44	0.44	0.4	0.4	0.4	0.4
Inorganic dust with silicon dioxide content in % - 70 - 20	-/03001	0.48	0.28	0.28	0.29	0.31	0.31	0.34	0.31

During construction works at the construction site and at the border of the first line of the residential area, the concentrations of any pollutant will not exceed the hygienic standards for the air of populated areas and will comply with the requirements of the current sanitary legislation of Ukraine.

5.1.2 - Description and assessment of possible impact on the aquatic environment

In order to protect the aquatic environment, the following requirements are established within the project on the construction organization:

- wastewater generated at the construction site (territory of the WTP) will be collected and removed using the existing rainwater collection system on the territory of the WTP. The project provides for two mobile reinforced ramps for washing construction equipment wheels, each of which is equipped with a pallet and special side screens. Wastewater after washing will be collected by special vehicles and transferred to a specialized organization in accordance with the concluded contract.
- technical inspection, cleaning and washing of construction equipment bodies, as well as refuelling of equipment on the territory of the construction site of the object are not provided for and will take place in places, specially provided and organized for the possible implementation, from the point of view of the requirements of the legislation of Ukraine (outside the territory of the construction site, at special refuelling complexes);
- arrangement of surface runoff, strengthening of slopes;
- equipping construction sites with special places for collecting and disposing waste and garbage, installing portable toilets and fencing the territory;
- using modern environmentally friendly, energy-efficient construction equipment and technology.

In order to minimize the negative impact of earthwork, dust suppression (hydro-dedusting) will be carried out. For this, its humidity must be brought to 8%. According to preliminary data, about 4,000 m^3 of fertile soil and 35,600 m^3 of soil will be removed, this is connected with the construction of the pipeline for brine transportation. Water for dust suppression is an irreversible loss and will amount to 3,168 m^3/year. Water supply will be carried out from the technical water pipeline.

During construction works, the impact on the aquatic environment is considered acceptable.

5.1.3 - Description and assessment of possible impact on the geological environment and soils

The impact on the geological environment will be in the temporary withdrawal of lands with an approximate area of 4.5 hectares, for the purpose of the construction of the pipeline for brine transportation. The impact on the soil is temporary in nature and consists in the temporary withdrawal of 4,000 m^3 of fertile soil with its subsequent return and recultivation.

In order to prevent negative impact on the soil, it is envisaged to equip the site with containers for household and construction waste and to transport it to a household waste landfill. During construction and installation works, the formation of unorganized contaminated effluents that may enter the soil is not envisaged. Gas emissions will not affect the geochemical composition of the soil.

Changes made to the relief during vertical planning do not contribute to the intensification of undesirable hydrogeological and engineering geological processes (subsidence, flooding, etc.) not only on the planned territory, but also on the adjacent territories. Thus, negative impact on the soil during construction and installation works is not expected.

During the implementation of works, soil contamination may be caused by construction waste, paints, petroleum products. The most likely contamination is soil contamination by construction equipment during the reconstruction period. The soil layer contaminated with fuel and lubricants will be removed and transferred for further disposal to the relevant organizations with which contracts will be concluded.

With proper construction management and compliance with technological regulations for the works implementation, the impact on the geological environment and soils will be minimal.

5.1.4 - Description and assessment of possible impact on the social environment

During construction works at the border of the residential area, the concentration of pollutants in the atmospheric air and the noise level from construction equipment within the residential area will meet sanitary norms. Equivalent sound levels during the daytime will be 48.2 dBA. During the reconstruction works, temporary inconveniences due to the movement of freight vehicles on nearby local roads are possible.

The impact on the social environment is considered acceptable.

5.1.5 - Description and assessment of possible impact on flora and fauna

During the reconstruction of the WTP of the city of Mykolaiv, no trees are expected to be cut down on the territory of the WTP, the territory may be cleared of shrubs, but the cutting down of green spaces is expected during the construction of the pipeline for brine transportation within the protective forest belt along the railway and the Inhulets Canal (vol. 3 in the Report on the structure of biodiversity and the distribution of its main elements on the territory of the operating WTP of the city of Mykolaiv, MUC "Mykolaivvodokanal").

The green spaces of this forest belt include:

- Trees: English oak (Quercus robur), ash-leaved maple (Acer negundo), common ash (Fraxinus excelsior), black locust (Robinia pseudoacacia), thorny locust (Gleditsia triacanthos), apricot (Prunus armeniacais), white mulberry (Morus alba), dwarf elm (Ulmus pumila), wild olive (Elaeagnus angustifolia).
- The shrub layer consists of: false indigo-bush (Amorpha fruticosa), Siberian pea-tree (Caragana arborescens), sea buckthorn (Hippophae rhamnoides), smoke tree (Cotinus coggygria), hawthorn species (Crataegus sp.), blackthorn (Prunus spinosa), ground rose species (Rosa sp.), common dogwood (Swida sanguinea).

At this stage, the list of green plantations to be cut down has not been compiled, but the approximate total number of green plantations to be cut down will be 260 pcs.

At the next stage of design, a list of green plantations to be cut down will be compiled and compensatory measures will be provided.

Construction works may affect the following fauna:

- The avifauna of the protective forest belts includes: European turtle dove (Streptopelia turtur), Eurasian wryneck (Jynx torquilla), Syrian woodpecker (Dendrocopos syriacus), great spotted woodpecker (Dendrocopos major), tree pipit (Anthus trivialis), song thrush (Turdus philomelos), thrush nightingale (Luscinia luscinia), spotted flycatcher (Muscicapa striata), common chiffchaff (Phylloscopus collybita), Eurasian blackcap (Sylvia atricapilla), Barbary dove (Streptopelia risoria), common whitethroat (Curruca communis), lesser whitethroat (Curruca curruca), Eurasian blue tit (Parus caeruleus), great tit (Parus major), red-backed shrike (Lanius collurio), Eurasian jay (Garrulus glandarius), Eurasian magpie (Pica pica), hooded crow (Corvus cornix), common starling (Sturnus vulgaris), Eurasian tree sparrow (Passer montanus), Eurasian chaffinch (Fringilla coelebs), European greenfinch (Chloris chloris), European goldfinch (Carduelis carduelis), common linnet (*Linaria cannabina*), yellowhammer (Emberiza citrinella).
- Of the reptiles, the sand lizard (Lacerta agilis) is found in the forest belts.
- Among mammals, the European hedgehog (Erinaceus europaeus), the European mole (Talpa europaea), the European mouse (Sylvaemus sylvaticus), yellow-necked wood mouse (Sylvaemus flavicollis) can live in forest belts.

During the study of the territory where construction works are planned, no habitats and species of plants and animals that require special protection were identified. The activities planned on the territory of the operating WTP of the city of Mykolaiv of the MUC "Mykolaivvodokanal" will not lead to a transformation of the biodiversity structure within its boundaries.

5.1.6 - Description and assessment of possible impact on cultural heritage objects and other tangible objects

There are no cultural heritage objects within the area of the WTP location. The only historical site located 100 m from the construction site of the pipelines for brine transportation is the Mohyla-Maiachna mound. Information on the official status of the Mohyla-Maiachna mound protection is absent.

Due to the considerable distance from the mound to the territory of the pipelines for brine transportation, the impact is considered insignificant. However, the project provides for more detailed studies at the next stage of design and development of the Action Plan in case an object with signs of an archaeological heritage object or a historical and cultural heritage object is identified.

5.1.7 - Waste management generated during preparatory and construction works

During the preparatory and reconstruction works of the WTP, waste will be generated, the list of which is provided in the clause 1.5.1.3. The projected amount of waste generated during the reconstruction process is 22,312.7 tons. Industrial and domestic waste will be stored in metal containers with lids installed in specially

designated places. Temporary waste storage areas will be provided with a hard coating that will prevent hazardous waste components from entering the soil. Accumulation is carried out to volumes that allow organizing their transfer from the point of view of economic feasibility, subject to compliance with current standards for industrial waste management.

The adopted industrial waste management scheme, which operates at similar enterprises, eliminates the release of waste into the environment during waste storage or movement.

5.1.8 - Description and assessment of the impact on the environment caused by light, heat, radiation pollution, electromagnetic and ionizing radiation

5.1.8.1 - Light pollution

Light pollution is an effect created by lighting installations that, in addition to illuminating the areas for which they are intended, additionally illuminate other, adjacent areas. For example, outdoor lighting fixtures or lighting devices of sports facilities, squares, architectural objects illuminate the facades of adjacent buildings and windows of residential buildings, which disturbs the residents.

The scattered light of the fixtures has a strong impact on the environment, creating both discomfort for the residents and pollution of the night sky due to the emission of the light flux portion into the upper hemisphere.

The implementation of the construction works at night is not envisaged by the project. Light pollution is not envisaged.

5.1.8.2 - Thermal pollution

Thermal pollution may occur during the construction of the asphalt concrete pavement of the WTP territory. Heating of the road pavement is possible at an ambient air temperature of +28°C to 40-42°C. During the construction of the road pavement on the WTP territory, it is envisaged to use a separating layer made of geosynthetic material with a surface density of 400 g/m^2, which has very low thermal conductivity, and thus will not affect the heating of the soil.

5.1.8.3 - Radiation pollution, electromagnetic and ionizing radiation

The use of installations, equipment and materials that emit radiation pollution into the environment, as well as electromagnetic or ionizing radiation at the object is not envisaged.

5.2 - Description and assessment of possible impact on environment caused by the implementation of the planned activities

5.2.1 - Impact on the air environment

The impact on the air environment is connected with the formation and emissions of pollutants during the operation of the WTP technological equipment (metallic mercury, nitrogen dioxin, nitrogen oxide, methane, carbon monoxide, ethyl mercaptan, methane, NMVOC, sulphur hexafluoride and suspended solids not differentiated by composition) and auxiliary facilities, such as: chemical laboratory (hydrogen chloride, sulphuric acid, sodium hydroxide, vapour-like and gaseous chlorine compounds), mechanical workshop (substances in the form of suspended solid particles not differentiated by composition, hydrogen chloride, sulphuric acid, 1,3-butadiene, 2-methylpropene, aliphatic amines C_{15}-C_{20}, acrylonitrile) and warehouses (xylene, white spirit and substances in the form of suspended solid particles not differentiated by composition).

Characteristics of pollutants emission sources

38 sources of pollutants emissions into the atmospheric air are expected on the territory of the WTP, of which 31 are organized emission sources and 7 are unorganized emission sources:

During the operation of the WTP after reconstruction, the gross emission of pollutants into the atmospheric air (including carbon dioxide) will be 181.046 t/year.

It is advisable to calculate the dispersion for nitrogen dioxide, carbon monoxide, methane, ethyl mercaptan, wood dust and rubber dust.

The calculation of atmospheric air pollution was performed using the EOL 2000 (h) program. The general report on the results of the calculation of the dispersion of pollutants from the WTP activities after reconstruction is given in the Annex 5.

When determining the dimensions of the calculation site, we took into account the need to determine the concentrations of pollutants at the border of the SPZ and the border of the nearest residential area.

Below there are maps of the pollutants dispersion during the operation of the WTP, for which it was advisable to carry out calculations.

FIGURE 36 - NITROGEN DIOXIDE CONCENTRATION IN PARTICLES OF THE MPC AT THE BORDER OF THE SPZ OF THE WTP AND AT THE BORDER OF THE FIRST LINE OF THE RESIDENTIAL AREA

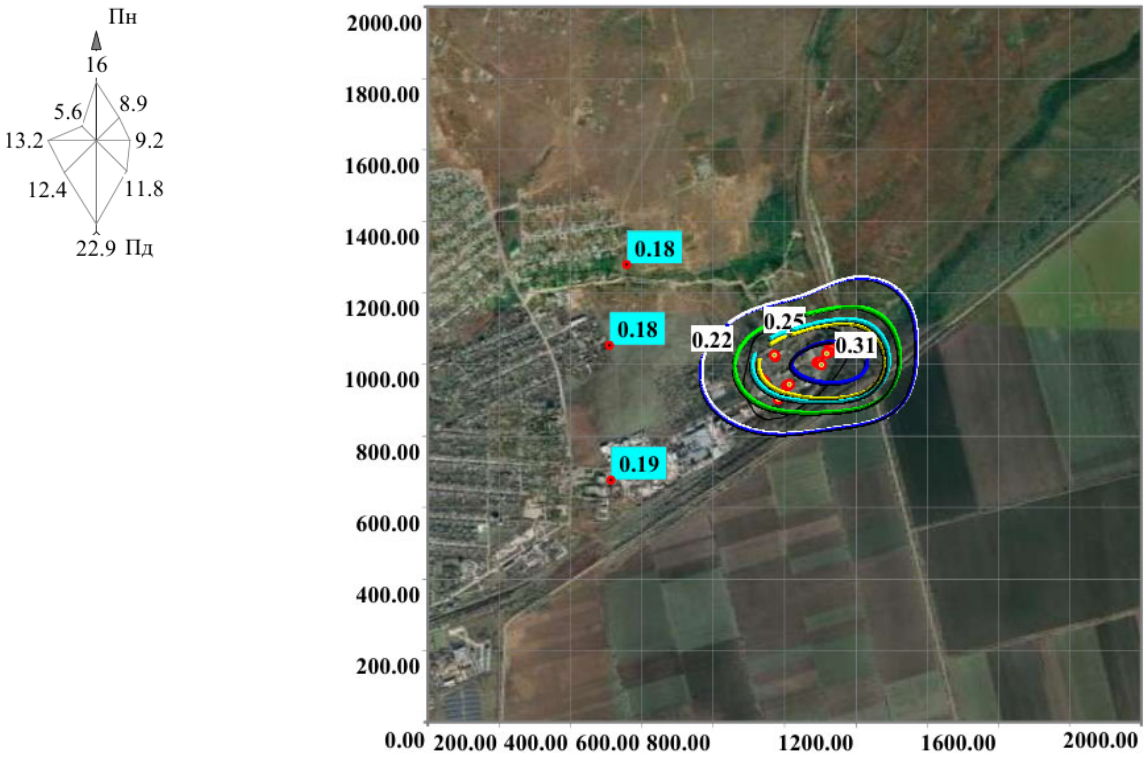


FIGURE 37 - CARBON MONOXIDE CONCENTRATION IN PARTICLES OF THE MPC AT THE BORDER OF THE SPZ OF THE WTP AND AT THE BORDER OF THE FIRST LINE OF THE RESIDENTIAL AREA

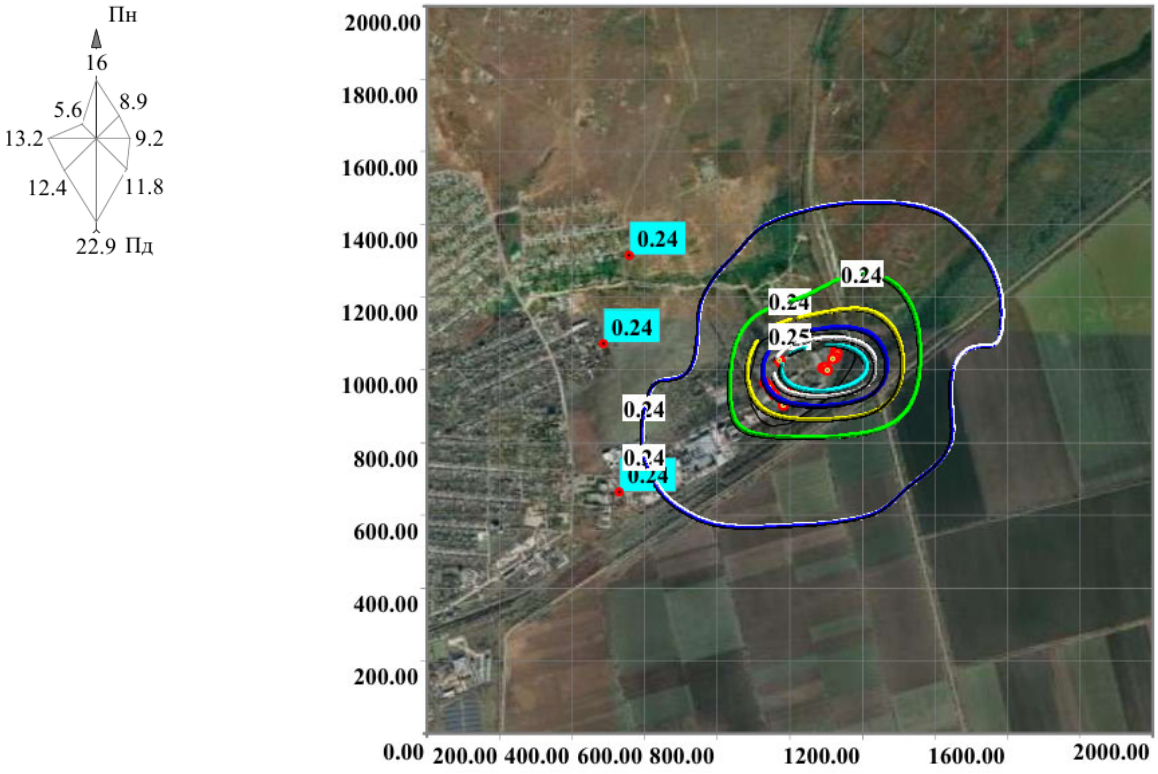


FIGURE 38 - METHANE CONCENTRATION IN PARTICLES OF THE MPC AT THE BORDER OF THE SPZ OF THE WTP AND AT THE BORDER OF THE FIRST LINE OF THE RESIDENTIAL AREA

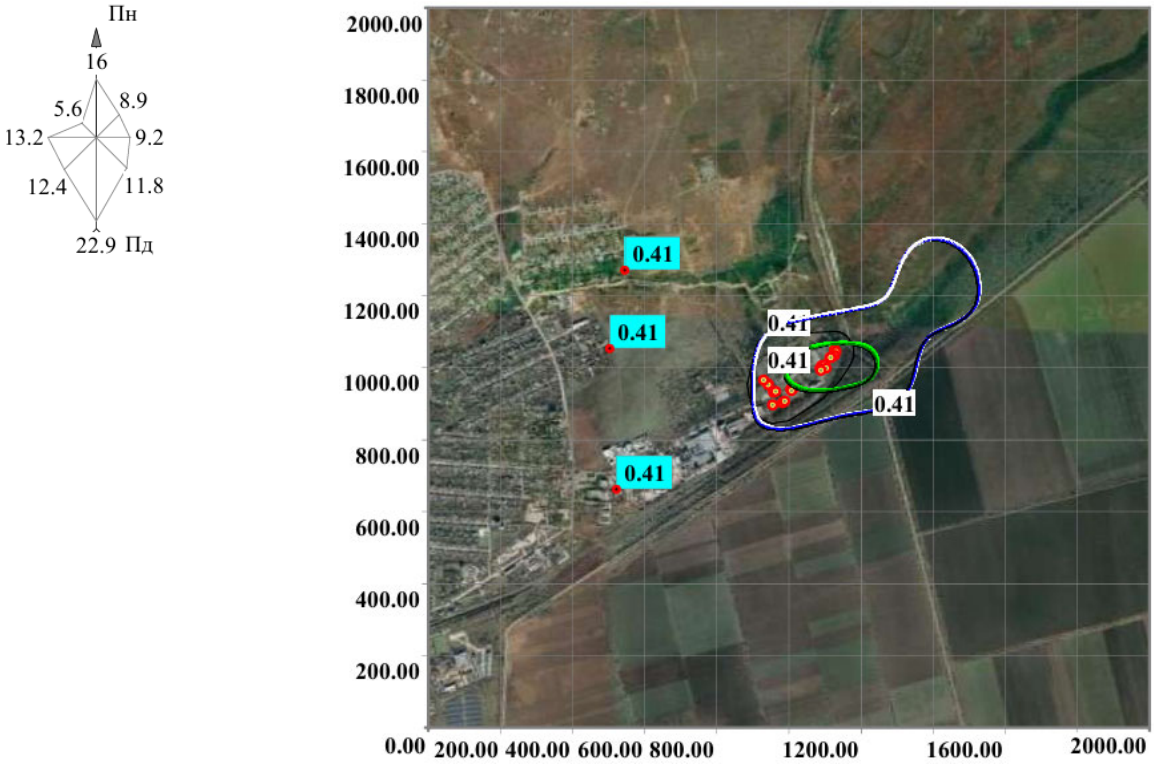


FIGURE 39 - ETHYL MERCAPTAN CONCENTRATION IN PARTICLES OF THE MPC AT THE BORDER OF THE SPZ OF THE WTP AND AT THE BORDER OF THE FIRST LINE OF THE RESIDENTIAL AREA

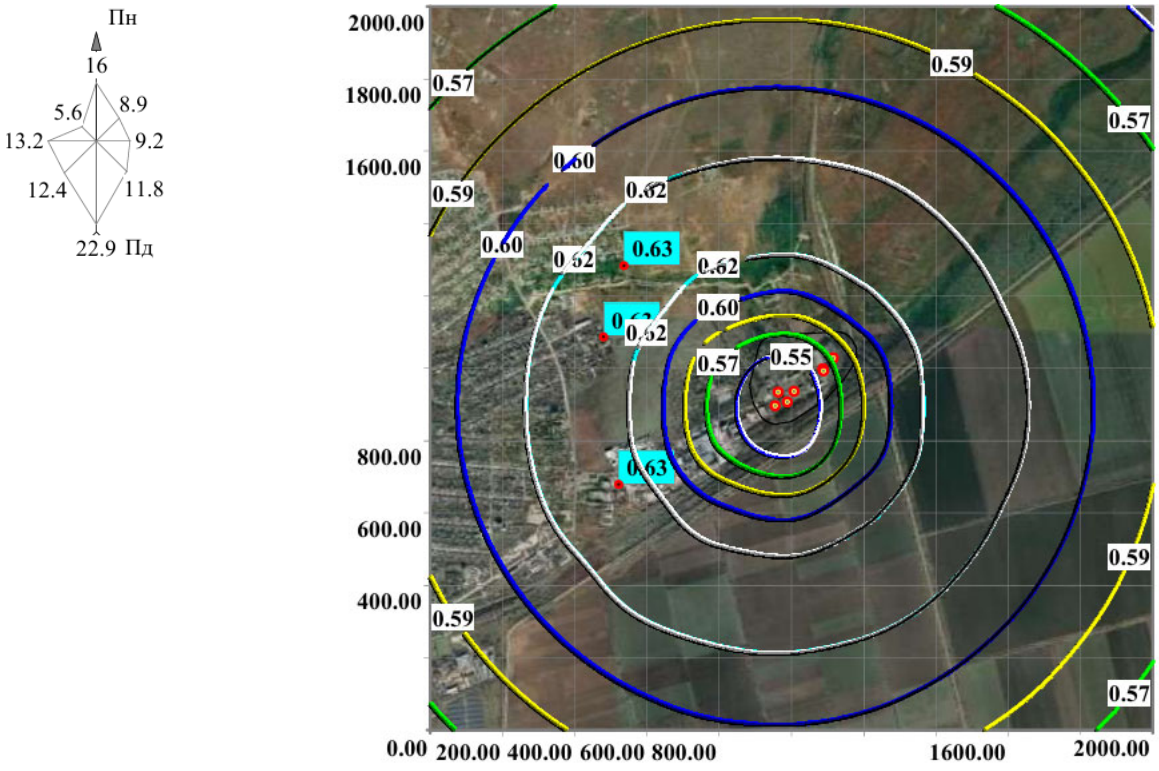


FIGURE 40 - WOOD DUST CONCENTRATION IN PARTICLES OF THE MPC AT THE BORDER OF THE SPZ OF THE WTP AND AT THE BORDER OF THE FIRST LINE OF THE RESIDENTIAL AREA

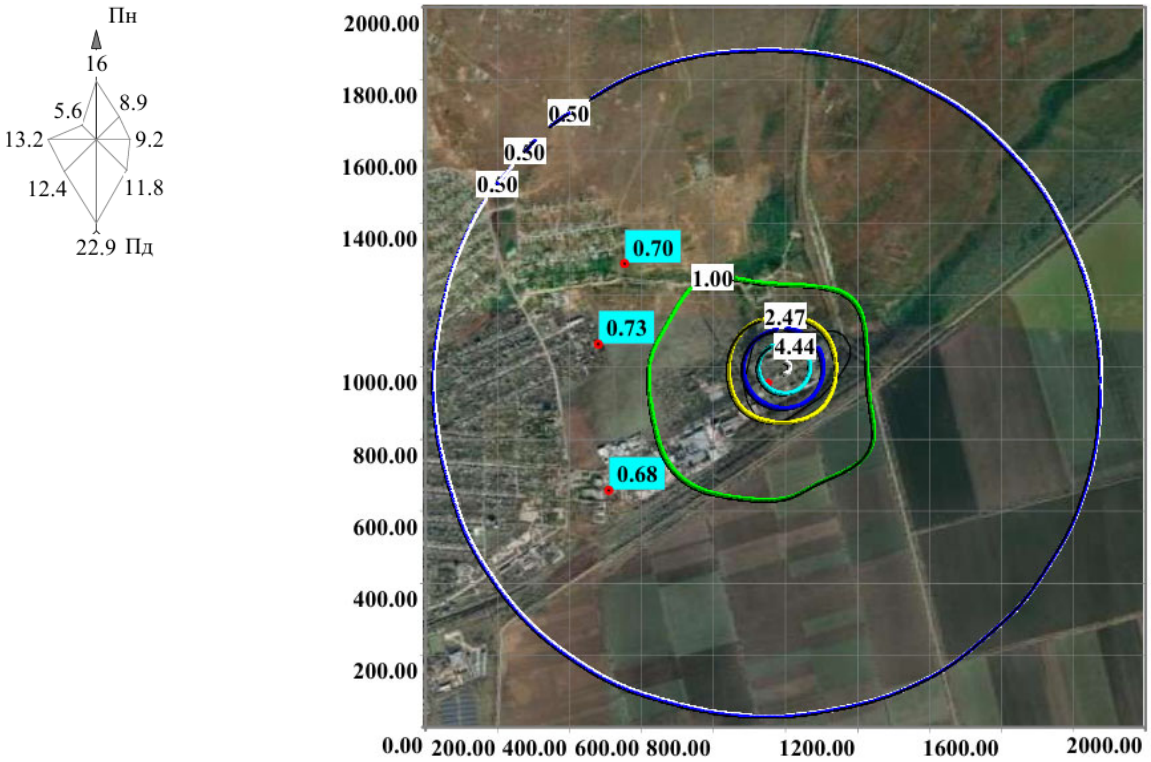
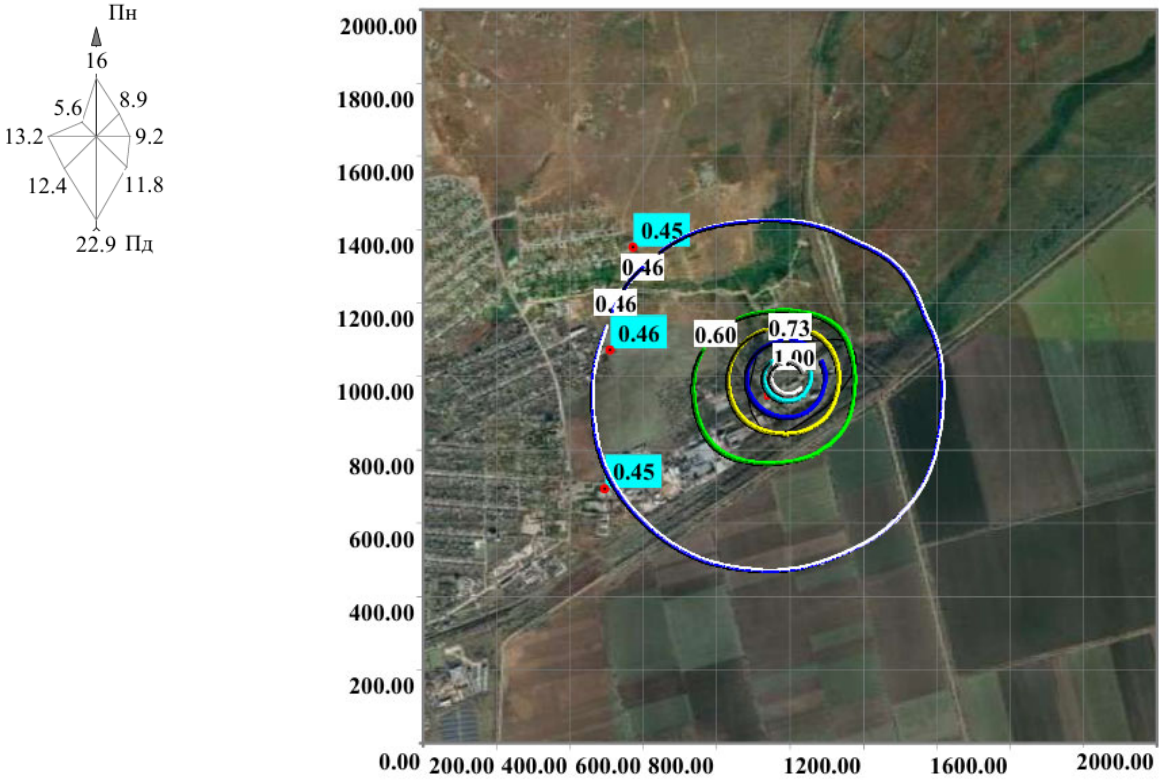


FIGURE 41 - RUBBER DUST CONCENTRATION IN PARTICLES OF THE MPC AT THE BORDER OF THE SPZ OF THE WTP AND AT THE BORDER OF THE FIRST LINE OF THE RESIDENTIAL AREA



In accordance with the calculations in the worst case (adverse weather conditions, dangerous wind speed, at which the maximum concentration is achieved at the reference points with the flow of possible wind directions, unhindered distribution) the surface concentrations of the pollutants at the border of the residential area will reach the values given in the Table below.

TABLE 71 - POLLUTANTS CONCENTRATIONS IN PARTICLES OF THE MPC AT THE NEAREST BORDER OF THE RESIDENTIAL AREA DURING THE OPERATION OF THE WTP

Pollutants	Pollutants code	WTP territory (working area)	RP.1 Klechova Balka Str., 178	RP.2 Fontanna Str., 197	RP.3 Kakhovska Str., 71	RP.4 Yantarna Str., 318
		Distance, m				
		0	1,030 m	1,000 m	890 m	1,100 m
		Concentrations of pollutants in the MPC particles for settlements[13]				
Nitrogen dioxide	10102-44-0/04001	0.31 MPC for settlements	0.18	0.18	0.18	0.19
Carbon monoxide	630-08-0/06000	0.25 MPC for settlements	0.24	0.24	0.24	0.24
Methane	74-82-8/12000	0.41 MPC for settlements	0.41	0.41	0.41	0.41
Ethylmercaptan	75-08-1/11000	0.55 MPC for settlements	0.63	0.63	0.63	0.63
Wood dust	-/03000	4.44 MPC for settlements /or 0.22	0.70	0.70	0.73	0.68

[13] Order of the Ministry of Health of Ukraine dated 10.05.2024 No. 813 "On approval of the state medical and sanitary norms for the permissible content of chemical and biological substances in the atmospheric air of the populated areas"[44]

Pollutants	Pollutants code	WTP territory (working area)	RP.1 Klechova Balka Str., 178	RP.2 Fontanna Str., 197	RP.3 Kakhovska Str., 71	RP.4 Yantarna Str., 318
		Distance, m				
		0	1,030 m	1,000 m	890 m	1,100 m
		Concentrations of pollutants in the MPC particles for settlements[13]				
		MPC for working area[14]				
Rubber dust	-/03000	1.0 MPC for settlements	0.45	0.45	0.46	0.45

During the operation of the WTP at the border of the first line of the residential area, the concentrations of any pollutant will not exceed the hygienic standards for the air of populated areas and will comply with the requirements of the current sanitary legislation of Ukraine.

During the operation of the WTP, when carrying out auxiliary works (namely, wood processing) on the territory of the object, a short-term increase in the concentration of wood dust is possible, but without exceeding the hygienic standards for the air of the working area. During the performance of these works, personnel must be provided with protective glasses and half-face or full-face masks to protect the respiratory system.

5.2.2 - Quality of the treated water and impact on the aquatic environment

The project concept assumes that the quality of treated water, regardless of the operating mode of the plant, will meet the standards specified in the table below and will fully comply with the EU Directive 2020/2184 [3] on the quality of water intended for human consumption and Ukrainian regulations on the drinking water quality DSanPiN 2.2.4-171-10 [2].

The water quality parameters at the inlet and outlet of the WTP are given below.

[14] Order of the Ministry of Health of Ukraine dated 09.07.2024 No. 1192 "State medical and sanitary norms for the permissible content of chemical substances in the air of the working area" [45]

TABLE 72 - WATER QUALITY DESIGN PARAMETERS AT THE INLET AND OUTLET OF THE WTP

INDICATOR	UNIT	RAW WATER – CATEGORY A (FRESHWATER)				RAW WATER – CATEGORY B (SALINE)		TREATED WATER		
		DNIPRO RIVER	PIVDENNYI BUH RIVER (NEW WATER INTAKE)	ZHOVTNEVE RESERVOIR	DESIGN QUALITY – MODE A	INHULETS RIVER MAIN CHANNEL	DESIGN QUALITY – MODE B	DSANPIN 2.2.4-171-10	EU DIRECTIVE 2020	OUTLET DESIGN QUALITY - MODES A AND B
Colour	degree	24	40	22	**40**	120	**120**	≤ 20	acceptable to consumers without abnormal changes	**20**
Odour	degree	3	3	2	**3**	3	**3**	2	acceptable to consumers without abnormal changes	**2**
Turbidity	nephelometric turbidity unit (NTU)	1.5	2.5	1.4	**2.5**	5.0	**5.0**	LCM ≤ 1,0 ≤ 2,6 - for underground water intake sources	0.3 in 95% never exceeds 1 LCM (least common multiple**)**	**1.0**
Dry residue (Total Dissolved Solids)	mg/l	324	523	725	**725**	2,162	**2,162**	≤ 1000	-	**1,000**
Sulphates	mg/l	80	114	178	**178**	220	**220**	≤ 250	250	**250**
Chlorides	mg/l	40	76	160	**160**	680.6	**680.6**	≤ 250	250	**250**
Total hardness	mmol/l	3.7	6.67	6.8	**6.8**	17.2	**17.2**	≤ 7.0	-	**7.0**
Alkalinity	mmol/l	2.76	4.9	-	**4.9**	2.8	**2.8**	not defined	-	not defined
Hydrogen index	pH	8.1	8.4	-	**8.4**	8.1	**8.1**	6.5-8.5	≥ 6.5 та ≤ 9.5	**6.5-8.5**
Ammonium (ammonia)	mg/l	0.14	0.17	-	**0.17**	0.39	**0.39**	≤ 0.5	0.5	**0.5**
Nitrite	mg/l	0.5	0.5	-	**0.03**	0.5	**0.5**	≤3.3	0.5	**0.5**
Nitrate	mg/l	0.17	2.8	-	**0.7**	50.0	**1.5**	≤50	-	**50**
Aluminium	mg/l	0.02	0.02	0.02	**0.02**	0.02	**0.02**			**0.2**
Oxidisability	mg/l	7.9	10.7	5.5	**10.7**	16.3	**16.3**	≤ 5.0	5.0	**5.0**
Total iron	mg/l	0.3	0.3	0.3	**0.3**	0.06	**0.06**	≤ 0.2	0.2	**0.2**

INDICATOR	UNIT	RAW WATER – CATEGORY A (FRESHWATER)				RAW WATER – CATEGORY B (SALINE)		TREATED WATER		
		DNIPRO RIVER	PIVDENNYI BUH RIVER (NEW WATER INTAKE)	ZHOVTNEVE RESERVOIR	DESIGN QUALITY – MODE A	INHULETS RIVER MAIN CHANNEL	DESIGN QUALITY – MODE B	DSANPIN 2.2.4-171-10	EU DIRECTIVE 2020	OUTLET DESIGN QUALITY - MODES A AND B
Manganese	mg/l	0.064	0.079	≤0.05-0.5	**0.079**	0.009	**0.009**	≤ 0.05	0.05	**0.05**
Residual free chlorine	mg/l	-	-	-	**-**	-	**-**	0.5		**0.5**
Residual total chlorine	mg/l	-	-	-	**-**	-	**-**	1.2		**1.2**
Trihalomethanes (THM)	mg/l	<0.1	-	-	**0.1**	-	**-**	≤ 100	-	**100**
Volatile phenols	mg/l	<0.001	-	-	**0.001**	-	**-**	≤ 0.001	-	**0.001**
Total Microbial Number	CFU/cm³	92	-	-	**92**	-	**-**	-		**-**
Escherichia coli (E. coli)	/100 ml	354	-	-	**354**	-	**-**	-	0 / 100ml	**0 / 100ml**
Intestinal enterococci	/100 ml	-	-	-	**-**	-	**-**	-	0/100мл	**0/100ml**
Colony count 22°C	-	-	-	-	**-**	-	**-**	-	-	**without abnormal changes**

The reconstruction of the WTP in the city of Mykolaiv involves the construction of a washing water treatment (purification) station and its reuse (purified washing water is supplied into the head of the WTP), and the removed and dehydrated sediment is disposed of (transported to the landfill for solid household waste), which ensures a closed filter washing cycle. This will have a positive impact on the aquatic environment, because the sediment from washing water, in the amount of 16,731.6 t/year, will not enter the Vitovka River and the Buzkyi Estuary, but will be transported to the landfill for solid household waste.

5.2.3 - Impact on the geological environment and soil

During the operation of the WTP, the impact on the geological environment and soil is absent.

5.2.4 - Impact on the social environment

During the operation of the WTP at the border of residential area, the concentration of pollutants in the atmospheric air and the noise load on the territory of the residential area will meet sanitary requirements. Equivalent sound levels during the day will be 35.8 dBA.

The impact on the social environment is considered positive.

The positive impact on the social environment will consist in providing the city of Mykolaiv with high-quality drinking water. Drinking water will meet the requirements of DSanPiN 2.2.4-171-10 "Hygienic requirements for drinking water intended for human consumption" [2] and the EU Directive 2020/2184 on the quality of water intended for human consumption [3].

Thanks to the reconstruction of the water treatment plant of the city of Mykolaiv and the introduction of modern water treatment technology from five different sources, the reliability and sustainability of the water supply for the city of Mykolaiv is ensured. This approach guarantees uninterrupted supply of drinking water even in case of emergencies, in particular as a result of hostilities, and reduces the city's dependence on individual sources of water intake. The implementation of this project is an important step towards strengthening water security and increasing the resilience of critical infrastructure in times of crisis.

5.2.5 - Waste management generated during the operation of the planned activities object

During the operation of the WTP, waste will be generated, the list of which is provided in the clause 1.5.2.5.

The projected annual amount of waste from the operation of the WTP is 16,842.812 tons, of which 16,731.6 tons/year of dewatered sludge.

A site with separate waste collection containers will be provided for temporary storage of waste. Waste will be sorted according to class, as well as taking into account the possibility of its further use. Separate containers will be allocated for glass, waste paper, metal products, and polymers. Solid household waste will be regularly transported to the municipal landfill for solid household waste.

During the operation of the WTP, solid household waste and industrial waste will be generated:

- Solid household waste is accumulated in a special metal container with a lid on a site with hard pavement.

Industrial waste:

- Dewatered sludge is unloaded onto trucks using screw conveyors. Dewatered sludge can be transported to special sites for drying, and then used in the construction industry, and can also be transported to the municipal landfill for solid household waste.

- Reverse osmosis membranes and cartridges are changed once a year. Currently, there are two methods of their disposal: either high-temperature incineration or landfill. It is planned to transfer them to a specialized enterprise (to the landfill for solid household waste or to the waste incineration plant "Energy") according to the contract;
- Metal shavings are temporarily placed in a metal container on a site with hard pavement;
- Electrode stubs are temporarily placed in a metal container with a lid on a site with hard pavement;
- Ferrous scrap is temporarily placed on a site with hard pavement;
- Rags contaminated with petroleum products are temporarily placed in a sealed container (tank) with a closed top that prevents it from precipitation, on a site with hard pavement;
- Paint and varnish containers (cans) are temporarily placed in a sealed container on a site with hard pavement, which prevents waste from entering the soil;
- Residues of abrasive materials (residues of an abrasive wheel, abrasive dust) are temporarily stored in a special container with a lid on a site with hard pavement. They are used at the enterprise during construction.

Procedure for transferring production waste for disposal:

- Waste is transferred to the appropriate representatives established by order of the MUC "Mykolaivvodokanal" meeting the established requirements.
- Waste is weighed on scales installed in the warehouses of the enterprise.

Waste is transferred upon its generation. The period for placement of production waste is 1 quarter. At the end of the current quarter, all waste must be transferred for further disposal.

Waste management as part of the planned activities is organized in accordance with the current legislation of Ukraine, state norms, rules and standards. The waste declaration will be submitted by the business entity in electronic form through the Unified State Web Portal of Electronic Services by filling in the form (approved by the resolution of the Cabinet of Ministers of Ukraine dated 07.05.2022 [46]) no later than February 20 of the year following the reporting year, on an annual basis.

The contractual documentation for servicing the planned activities in terms of the removal of its waste includes regular (in accordance with the current norms) sanitation of all containers intended for temporary storage of generated waste – at the carriers' own specialized sites.

5.2.6 - Description and assessment of the impact on the environment caused by light, heat, radiation pollution, electromagnetic and ionizing radiation

During the operation of the WTP, there is no impact on the environment caused by light, heat, radiation pollution, electromagnetic and ionizing radiation.

5.3 - Assessment of the impact associated with risks to human health

Determining the risk of atmospheric air pollution allows predicting the probability and medical and social significance of possible violations of public health and establishing the priority of measures to manage risk factors at the individual and population levels.

The main types of impact of the planned activities on the environment are emissions of pollutants into the atmospheric air.

The list of priority pollutants is determined by referring to the lists of common pollutants and those pollutants subject to monitoring in accordance with the Resolution of the Cabinet of Ministers of Ukraine dated 14.08.2019 No. 827.

Risk assessment of the planned activities impact on public health

The risk assessment of the planned activities on the environment was carried out in accordance with Annexes B and C of DBN A.2.2-1:2021 "Composition and content of materials for environmental impact assessment (EIA)" [47]. The risk assessment includes:

- assessment of the risk of the planned activities impact on public health;
- assessment of the social risk of the planned activities impact.

5.3.1 - Assessment of the risk of the planned activities impact of on public health

The assessment of the risk of the planned activities impact on public health from atmospheric air pollution during the operation of the WTP in the city of Mykolaiv is carried out based on calculations of the risk of developing non-carcinogenic and carcinogenic effects (in accordance with the Annex B [47]).

The assessment of the risks of the planned activities on public health by the atmospheric air factor was carried out using the EOL 2000 [h] program, namely the "Risk Indicator" utility. The risk assessment report is provided in the Annex 15.

The "Risk Indicator" utility implements the risk assessment of the planned activities and social risks by the atmospheric air factor in accordance with DBN A.2.2-1:2021 "Composition and content of materials for assessing environmental impacts during the design and construction of enterprises, buildings and structures" [48] (EIA) and the Methodological Recommendations "Assessment of carcinogenic and non-carcinogenic risk to public health from chemical pollution of atmospheric air", Order dated 18.10.2023 No. 1811 [49].

5.3.1.1 - Risk of developing non-carcinogenic effects

The risk of developing non-carcinogenic effects is determined by calculating the hazard index (HI), the assessment of which is carried out in accordance with the Table B.1 (see Table below).

$$HI = \sum HQ_i,$$

where HQ_i – hazard coefficient for separate substances, which is determined by the formula:

$$HQ_i = C/R_fC,$$

where C – estimated average annual concentration of the i-th substance at the border of the residential area, mg/m^3 (according to the calculation of EOL 2000 (h));

R_fC – reference (safe) concentration of the i-th substance, mg/m^3.

HQ = 1 – limit value of the accepted risk.

Risk characteristics	Hazard quotient (HQ)
The risk of adverse effects is extremely low	less than 1
The limit value of the accepted risk	equal to 1
The probability of adverse effects increases in proportion to the increase in HQ	more than 1

During the operation of the WTP in the city of Mykolaiv, the following substances are expected to be emitted into the atmosphere: nitrogen dioxide, carbon monoxide, chlorine, ethyl mercaptan, xylene and acrylonitrile. The concentrations of all other pollutants emitted into the atmospheric air will be zero at the border of the residential area.

The pollutants that have a risk of developing non-carcinogenic effects are listed in the table below.

TABLE 74 – NON-CARCINOGENIC RISKS OF THE PLANNED ACTIVITIES BY SUBSTANCES

CAS code (*group code)	Substance name	Annual average concentration of the *i*-th substance, (mg/m^3)	Background concentrations, (mg/m^3)	Reference (safe) concentration, (mg/m^3) R_fC	Hazard quotient (*hazard index)
*25	Summation Group No. 25 (10102-44-0, 630-08-0)	-	-	-	*1.378
*33	Summation Group No. 33 (10102-44-0, 630-08-0)	-	-	-	*1.378
*100	Impact group on respiratory system (10102-44-0, 107-13-1, 7782-05-5)	-	-	-	*1.142
*101	Impact group on central nervous system (1330-20-7, 630-08-0)	-	-	-	*0.403
*103	Impact group on blood (1330-20-7, 630-08-0)	-	-	-	*0.403
10102-44-0	Nitrogen dioxide	0.039	0.032	0.04	0.981
630-08-0	Carbon monoxide	1.192	1.180	3.000	0.397
7782-05-5	Chlorine	0.000029	0	0.0002	0.148
75-08-1	Ethyl mercaptan	0.000012	0.000012	0.0010	0.012
1330-20-7	Xylene	0.0018	0	0.3	0.006
107-13-1	Acrylonitrile	0.0000014	0	0.0020	0.0007
7439-97-6	Mercury and compounds	0	0	0.0030	-
Overall risk					1.545

According to the calculations, the risk of harmful effects from the planned activities is given in the table below.

TABLE 75 - RISK OF DEVELOPMENT OF NON-CARCINOGENIC EFFECTS FROM OPERATION OF THE WTP IN THE CITY OF MYKOLAIV

№	Risk characteristic	Pollutant (combined action group)	Hazard quotient (*hazard index)
1	The likelihood of developing harmful effects increases in proportion to the increase in HQ	25: Summation Group No. 25	1.378
		33: Summation Group No. 33	1.378
		100: Impact group on respiratory system	1.142
2	The risk of harmful effects is extremely low	10102-44-0: Nitrogen dioxide	0.981
		101: Impact group on central nervous system	0.403
		103: Impact group on blood	0.403
		630-08-0: Carbon monoxide	0.397
		7782-05-5: Chlorine	0.148
		75-08-1: Ethyl mercaptan	0.012
		1330-20-7: Xylene	0.006
		107-13-1: Acrylonitrile	0.0007

There is a slight probability of developing harmful effects on the respiratory system in case of non-compliance with the requirements of the Occupational Safety and Health regarding PPE when carrying out related works on the territory of the WTP.

5.3.1.2 - Risk of developing carcinogenic effects

Carcinogenic risk is the probability of developing neoplasms during a person's life caused by the influence of a potential carcinogen.

Carcinogenic effects are possible with any doses that cause damage to genetic material.

The risk of developing individual carcinogenic effects from substances that have a carcinogenic effect is calculated by the formula:

$$ICR_i = C_i \, UR_i ,$$

where C_i – estimated average annual concentration of the i-th substance at the border of the residential area, mg/m^3;

UR_i – individual carcinogenic risk of the i-th substance, mg/m^3, which is determined by the formula:

$$UR_i = \frac{SF_i(\text{мг}/_{\text{кг}} \cdot \text{добу})^{-1} \cdot 1}{70 \text{ кг} \cdot 20 \text{ м}^3/\text{добу}}$$

Where:

SF_i – factor of the carcinogenic potential of the i-th substance = 0.24 (mg/kg*day)$^{-1}$;

- 70 kg – standard human body weight;
- 20 m^3/day – daily air consumption.

The carcinogenic risk due to the combined action of several carcinogenic substances polluting the atmosphere is determined by the formula:

$$CR_a = \sum ICR_i ,$$

Where:

ICR_i – carcinogenic risk of the i-th substance.

The assessment of the level of carcinogenic risk of the object's activities is carried out in accordance with the levels of carcinogenic risk:

TABLE 76 - LEVELS OF CARCINOGENIC RISK

Risk level	Risk throughout life
Unacceptable for professional contingents and the population	More than 10^{-3}
Acceptable for professional contingents and unacceptable for the population	$10^{-3} – 10^{-4}$
Conditionally acceptable	$10^{-4} – 10^{-6}$
Acceptable	Less than 10^{-6}

TABLE 77 - LIST OF POLLUTANTS THAT HAVE A RISK OF DEVELOPING CARCINOGENIC EFFECTS

CAS code	Substance name	Annual average concentration of the i-th substance, (mg/m^3)	Factor of carcinogenic potential of the i-th substance, (mg/kg*day)$^{-1}$ SF_i	Unit risk (UR) (m^3/mg)	Carcinogenic risk of the i-th substance
107-13-1	Acrylonitrile	0.0000014	0.24	0.0685	$0.1*10^{-6}$
			Σ		**$0.1*10^{-6}$**

According to the calculations, the level of risk of developing carcinogenic effects from the planned activities is acceptable.

5.3.2 - Assessment of the social risk of the planned activities impact

The social risk of the planned activities is defined as the risk for a group of people who may be affected by the implementation of the object of economic activities and the features of the natural and technogenic system.

The estimated value of the social risk (Rs) is determined by the formula:

$$R_s = CR_a \times \frac{N}{T} \times V_u \times N_p$$

Where:

R_s – social risk, person/year;

CR_a – carcinogenic risk of the combined effect of several carcinogenic substances polluting the atmosphere, which is determined in accordance with the clause 5.3.1. of this Report (CRa =0,1 10^{-6}), dimensionless;

V_u – vulnerability of the territory to the atmospheric air pollution, which is determined by the ratio of the area assigned to the object of economic activities to the area of the object with a sanitary protection zone, and is 0.9;

N – population, determined: a) according to the data of the microdistrict where the object is located, if there are any in the settlement; b) according to the data of the entire settlement, if there are no microdistricts, or the object has city-forming significance; c) according to the data of settlements located within the zone of influence of the design facility, if it is located outside their boundaries, people.

The WTP in the city of Mykolaiv is located at a distance of 890 - 1100 m from the first line of the residential area and there are no residential buildings located in the sanitary protection zone, therefore the average number of people working at the WTP was taken into account – 40 people.

T – life expectancy (determined for this region or assumed to be 70 years), people/year;

N_p – coefficient of "social tension", which is equal to 1 for the reconstruction of the object, if the number of workplaces does not change.

The assessment of the level of social risk of the planned activities is carried out according to the Table below.

TABLE 78 - CLASSIFICATION OF THE LEVEL OF SOCIAL RISK КЛАСИФІКАЦІЯ РІВНЯ СОЦІАЛЬНОГО РИЗИКУ

Risk level	Risk throughout life
Unacceptable for professional contingents and the population	more than 10^{-3}
Acceptable for professional contingents and unacceptable for the population	10^{-3}-10^{-4}
Conditionally acceptable	10^{-4}-10^{-6}
Acceptable	less than 10^{-6}

$$R_s = 0.0000001 \cdot 0.9 \cdot (40/70) \cdot 1 = 5.14 \cdot 10^{-8}$$

Thus, the level of social risk of the planned activities is assessed as acceptable.

The results of the risks calculations showed that the operation of the WTP in the city of Mykolaiv will not have a negative impact on the health of the population.

5.4 - Assessment of the impact associated with risks for the cultural heritage objects and the environment, including the possibility of emergencies

The Mohyla-Maiachna mound is located 100 m from the planned route of the pipeline for brine transportation and the impact of construction works on it is not expected, but during the digging of the trench for the pipeline, the likelihood of accidental archaeological finds cannot be ruled out.

5.5 - Cumulative impact of other existing objects, planned activities and objects for which a decision on the implementation of the planned activities has been received

Cumulative impacts mean the totality of impacts from the implementation of the planned activities and other types of human activities, existing or planned in the nearest future, that may lead to significant negative or positive impacts on the environment or socio-economic conditions, and which would not have occurred in the absence of other activities, except for the planned activity itself.

Scattering calculations, performed taking into account background air pollution, i.e. taking into account the contribution of other air pollutants, showed no exceedances of the maximum permissible concentrations.

In addition, it is worth noting that the Environmental Impact Assessment Report "Restoration of the Hydrological and Sanitary Condition of the Zhovtneve Reservoir for Drinking Water Supply in the city of Mykolaiv" is currently being developed, its registration number is 11698.

The Zhovtneve Reservoir is located 230 m from the territory of the WTP.

A possible cumulative effect will be observed in the event of simultaneous construction works on the territory of the WTP and on the territory of the Zhovtneve Reservoir. The scattering calculation during simultaneous construction will be carried out only for inorganic dust, with a silicon dioxide content in % - 70 – 20 and its concentration on the territory of the WTP will increase from 0.48 MPC to 0.67 MPC, i.e. it is acceptable.

During the operation of the Zhovtneve Reservoir, there is no negative impact on the environment.

The cumulative impact of the planned construction object and neighbouring production facilities, which are the sources of the environmental pollution, is permissible and acceptable. Negative cumulative impact on the environment is not expected.

5.6 - Assessment of the impact of the planned activities on the climate, including the nature and scale of greenhouse gas emissions, and the sensitivity of the activities to climate change

The sensitivity of the planned activities to climate change was determined in the Climate Risk Assessment Report. The Report has been provided as a separate document due to its size.

The conclusions of this Report are presented below.

5.6.1 - Identification of potential climate hazards

The overall objectives of water resources risk and vulnerability assessment and the components of the priority investment plan for climate change are to determine the extent of the possible impact of climate change on the quantitative and qualitative indicators of water resources in the assessed area, to determine the available water volumes, and to assess the possibilities of meeting water needs for both drinking purposes and for water use in various sectors of the economy.

For the reconstruction project of the Water Treatment Plant (WTP) in the city of Mykolaiv, such climatic conditions create additional challenges. In particular, the lack of precipitation, high evaporation, frequent

droughts, and the likelihood of infrastructure overheating require careful consideration when choosing materials, designing cooling systems, waterproofing, and protecting equipment from overheating or dehydration. Particular attention should be paid to ensuring uninterrupted water supply and purification in conditions of limited resources and possible extreme weather conditions.

The dangers associated with the climate change were identified during the project implementation[15], in accordance with the IPCC Guidelines, JASPERS "Fundamentals of adaptation, vulnerability and risk assessment"[16] and "Methodological recommendations on the risk and vulnerability of socio-economic sectors and natural components to climate change".[17]

Climate forecasts show rising in average and extreme temperatures, increased precipitation intensity, droughts, and increased flood risk in the region. Based on IPCC AR6[18], as well as on national climate studies, the following key hazards have been identified for the project area:

TABLE 79 - IDENTIFICATION OF CLIMATE HAZARDS FOR MYKOLAIV

Sector	Climatic factor
Critical Infrastructure (Built Environment)	Increase in average temperature
Critical Infrastructure (Built Environment)	Extreme heat
Critical Infrastructure (Built Environment)	Heavy rainfall and flooding
Critical Infrastructure (Built Environment)	Increase in wind speed
Freshwater ecosystems	Decrease in average precipitation
Freshwater ecosystems	Increase in drought periods
Freshwater ecosystems	Extreme heat
Freshwater ecosystems	Increase in average temperature
Freshwater ecosystems	Heavy rainfall and flooding

The main climatic and hydrological factors include:

- Air temperature – change in average annual temperature, increase in duration of extreme heat periods, which affects evaporation and load on technical equipment.
- Precipitation – change in total precipitation, its seasonality and probability of heavy rainfalls, which can cause flooding or overload of treatment systems.
- Climatic water balance – decrease in water content of the Southern Buh due to droughts and increasing evaporation can lead to resource shortages.
- Hydrological regime of the Southern Buh River – decrease in water level, flow instability and deterioration of water quality due to increased temperature and concentration of pollutants.

Changes in these main climatic and hydrological factors can lead to various climatic hazards that can affect the project. The consultants identified and characterized the main climatic and hydrological hazards for the planned Project in the city of Mykolaiv.

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[15] *https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter2.pdf*

[16] *https://jaspers.eib.org/knowledge/publications/the-basics-of-climate-change-adaptation-vulnerability-and-risk-assessment*

[17] *https://zakon.rada.gov.ua/rada/show/v0386926-23#Text*

[18] *https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter12.pdf*

5.6.1.1 - Future climate trends for the city of Mykolaiv

Predicting climate change, including those caused by human activities, is one of the most urgent and complex challenges of the modern science. The most promising approach to solving it is based on the use of mathematical models of the climate system, which have been actively developed by leading research institutions around the world over the past 20-30 years.

Today, the most modern models of the general circulation of the atmosphere and ocean (AOGCMs) include all the most important processes that determine and affect the Earth's climate as a whole and its regional features. In the Sixth Assessment Report of the IPCC (IPCC AR6), climate models are used as the main tool for building projections of climate change scenarios (SRES and RCP). To assess regional climate change, the report presents a climate atlas containing the results of ensemble calculations of AOGCMs for separate regions.

The climate change impact assessment takes into account the main Climatic Impact Drivers (CIDs) for Mykolaiv, including increases in average and extreme temperatures, changes in precipitation, droughts periods, floods, and extreme weather events. These drivers are identified based on their high significance for the water supply infrastructure, which is confirmed by numerous studies and the climate risk profile of Ukraine.

Taking into account the specifics of the project on reconstruction of the Water Treatment Plant in the city of Mykolaiv as an infrastructure project, and based on the climate profile of Ukraine, the main Climatic Impact Drivers (CIDs) that may affect this project include:

- Extreme heat
- Heavy precipitation and pluvial floods
- River floods
- Hydrological droughts

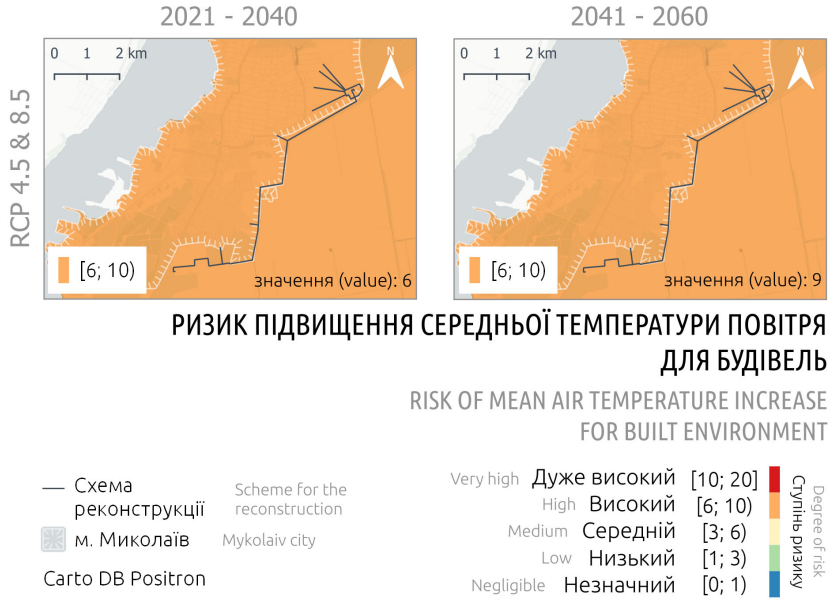
Current climate conditions and projected changes have been taken into account in the planning process, which allows ensuring the resilience of the infrastructure to potential challenges associated with extreme weather events and other climate risks.

5.6.1.2 - Critical Infrastructure (Built Environment)

The Mykolaiv Water Supply Project belongs to the sector "Cities, Settlements, and Key Infrastructure according to the IPCC AR6 WGI classification (see Table 12.2). Water supply is an integral part of the city infrastructure that ensures the vitality of settlements. Water treatment systems are a key component of the city engineering infrastructure that ensures sanitary safety, public health and overall viability of the city. The project involves the reconstruction of the Water Treatment Plant, the introduction of modern purification technologies, as well as the construction of a sodium hypochlorite preparation station and facilities for the disposal of wash water. These physical facilities are part of the Built Environment, which must be resilient to climate change.

Taking into account the increasing risks associated with extreme temperatures, droughts, downpours and other climatic phenomena, increasing the climate resilience of water treatment infrastructure is critically important for ensuring a continuous and high-quality supply of drinking water to the population, in particular in conditions of hostilities and the destruction of logistical chains.

FIGURE 42 - INCREASE IN AVERAGE TEMPERATURE

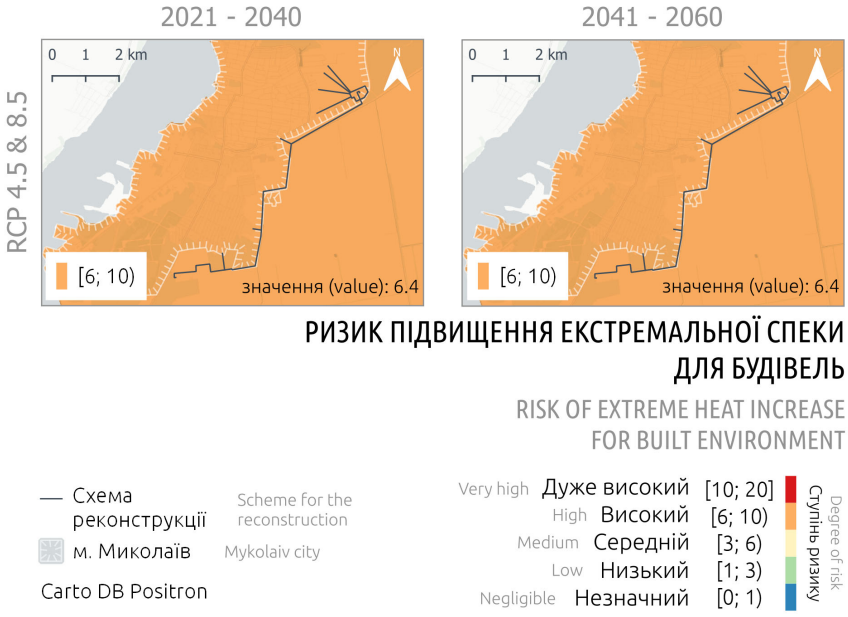


In the nearest future period of 2021-2040, according to the combined RCP 4.5 and RCP 8.5 scenarios for the Built Environment sector in Mykolaivka, a uniformly high risk of an increase in average air temperature has been identified, with a value of 6 points.

By the middle of the century 2041-2060, this risk remains high, but increases to 9 points, which indicates a significant thermal load on engineering infrastructure, in particular Water Treatment Plant, and a possible negative impact on their efficiency, durability and energy consumption.

Taking into account these risks, within the framework of the Water Treatment Plant reconstruction, it is advisable to provide for adaptation measures, including: increasing the resistance of materials and equipment to high temperatures, introducing energy-efficient water treatment technologies, improving ventilation and cooling systems for technical premises, as well as improving automated monitoring for rapid response to thermal fluctuations.

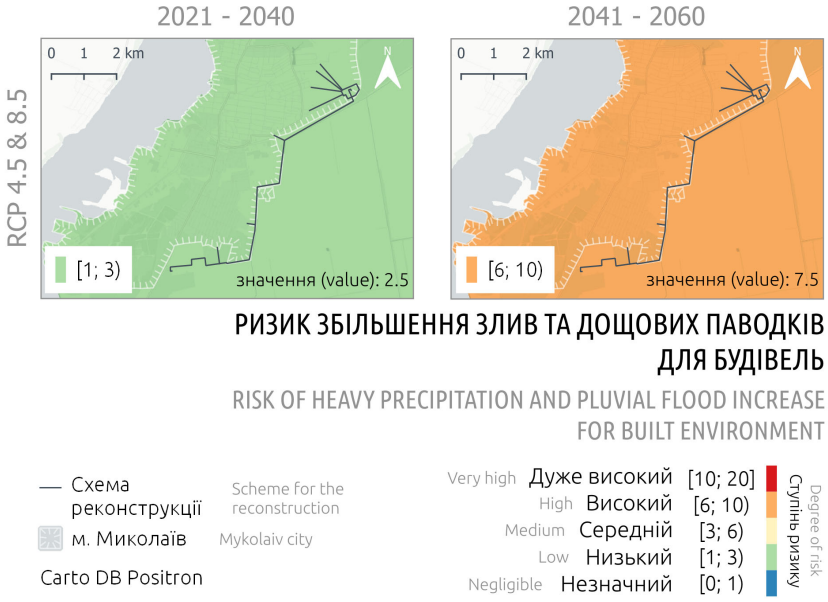
FIGURE 43 - EXTREME HEAT



In the period of 2021-2040 and by the middle of the century 2041-2060, according to the combined RCP 4.5 and RCP 8.5 scenarios for the Built Environment sector in Mykolaiv, a uniformly high risk of increased extreme heat is determined, with a value of 6.4 points.

In order to adapt to the increase in extreme heat, it is advisable to provide for measures to improve the thermal insulation of building structures, to implement passive cooling systems, to ensure proper ventilation of technological premises, as well as to use materials and equipment resistant to high temperatures for the stable operation of the Water Treatment Plant.

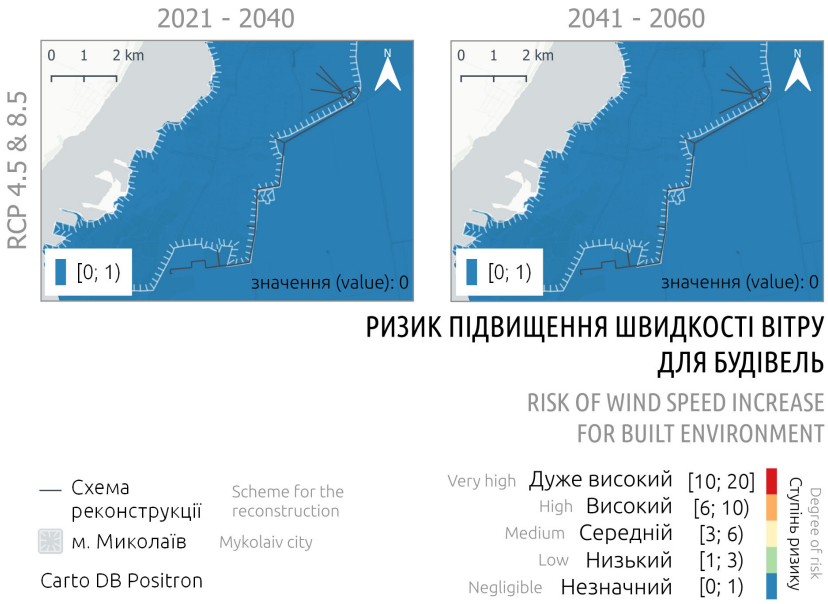
FIGURE 44 - HEAVY PRECIPITATIONS AND FLOODS



For the period of 2021-2040, according to the combined RCP 4.5 and RCP 8.5 scenarios, for the Built Environment sector the a low risk of increased precipitation extremes is identified, with a maximum value of 2.5 points across the entire territory of Mykolaiv.

By the middle of the century 2041-2060, this risk increases significantly and becomes high, with a maximum value of 7.5 points across the project area, indicating a likely increase in the frequency and intensity of short-term showers and rain floods. Such climate change may cause flooding of the Water Treatment Plant infrastructure, increase the load on the drainage system, and disrupt the stable operation of the water treatment equipment. Taking into account these risks, it is advisable to provide for adaptation measures within the framework of the project on the WTP reconstruction, including the arrangement of an effective surface drainage system, waterproofing of structures, modernization or redesign of drainage infrastructure in accordance with expected loads, as well as the creation of buffer green zones to slow down runoff and to increase the area's resistance to excessive moisture.

FIGURE 45 – INCREASE IN WIND SPEED



In the period of 2021-2040 and by the middle of the century 2041-2060, according to the combined RCP 4.5 and RCP 8.5 scenarios for the Built Environment sector, there is no risk of increased wind speed and gusts in the project area.

Taking into account this, it is expected that the increase in wind speed will not have a significant impact on the water treatment facilities infrastructure and can be neglected.

- **Conclusions**

Analysis of climate forecasts for Mykolaiv under the combined **RCP 4.5** and **RCP 8.5** scenarios proves the presence of moderate and high risks for the water supply sector, in particular due to an increase in average air temperature, increased extreme heat, changes in precipitation intensity, and increased pressure on freshwater ecosystems. At the same time, the risk level from wind load is absent. These challenges can be effectively addressed if targeted adaptation measures are implemented.

The project on the reconstruction of the Water Treatment Plant (WTP) in the city of Mykolaiv is aimed not only at solving current problems with the quality and stability of water supply, but also makes a significant contribution to adaptation to the consequences of climate change. By introducing modern treatment technologies, increasing energy efficiency, modernizing engineering infrastructure, and reducing water losses, the project will contribute to:

- Increasing the resilience of the water supply system to extreme weather conditions, including periods of heat and fluctuations in precipitation.
- Reducing the anthropogenic load on freshwater ecosystems by reducing water losses and implementing technologies for the reuse of treated water.
- Optimizing energy consumption and reducing greenhouse gas emissions, which is an important component on the path to climate neutrality.
- Improving the microclimate of the object's territory, in particular through the planned landscaping measures, using heat-resistant materials, and passive cooling.

Thus, the implementation of the project will have not only engineering and technical, but also environmental and climatic significance, contributing to the adaptation of the city infrastructure to climate change and the sustainable development of the Mykolaiv region.

5.6.2 - Nature and extent of greenhouse gas emissions

Climate greenhouse gases include six gases listed in the Kyoto Protocol, namely: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).

The processes/activities that typically generate greenhouse gases are listed below:

CO2 – stationary combustion of fossil fuels, indirect use of electricity, oil/gas production and refining, flue gas desulphurisation (limestone-based), aluminium production, iron and steel production, nitric acid production, ammonia production, adipic acid production, cement production, lime production, glass production, solid household waste incineration, transport (mobile incineration).

CH4 – combustion or decomposition of biomass, oil/gas extraction and processing, coal mining, landfill for solid household waste, municipal wastewater treatment.

N2O – stationary combustion of fossil fuels/biomass, nitric acid production, adipic acid production, solid household waste incineration, municipal wastewater treatment, transport (mobile incineration).

HFCs – refrigeration industry / air conditioning / insulation industry.

PFCs – aluminium production.

SF6 – electricity transmission systems, certain branches of the electronics industry (e.g., LCD production).

For the WTP, the formation of 3 types of gases is relevant: CO_2, CH_4, N_2O and SF_6. Total emissions of these gases are calculated in units of CO_2 equivalent. According to the Sixth Assessment Report of the IPCC (IPCC AR6), N2O has a higher 100-year global warming potential (GWP100) – 273 times higher than the potential of carbon dioxide (CO2) in equivalent mass terms. CH4 – 27 times higher than the potential of carbon dioxide (CO2) in equivalent mass terms. SF6 – 22,800 times higher than the potential of carbon dioxide (CO2) in equivalent mass terms.

As a result of the operation of the WTP in the city of Mykolaiv, greenhouse gases will be released annually into the atmospheric air, the amount of which are given in the Table below.

FIGURE 46 - AMOUNT OF GREENHOUSE GAS EMISSIONS AS A RESULT OF THE OPERATION OF THE WTP IN THE CITY OF MYKOLAIV

Year of operation	Gross emission, t/year	GWP_{100}	CO2 equivalent, t/year
CO2, t/year	180.088	1	180.088
CH4, t/year	0.076	27	2.052
N2O, t/year	0.000	273	0.000
SF6, t/year	0.000	22 800	0.169
		Total, t/year	**182.309**

According to the EIB Environmental and Social Standards (2022), the project is not subject to the preliminary assessment of greenhouse gas impacts if the amount of greenhouse gases does not exceed 25,000 t CO2 per year.

In addition, according to the Resolution of the Cabinet of Ministers of Ukraine dated September 23, 2020 No. 880 [50], the construction and operation of the WTP is not included into the list of activities, greenhouse gas emissions resulting from which are subject to monitoring, reporting and verification.

There is no need to foresee measures to prevent the negative impacts of the planned activities on the climate and microclimate, as well as related adverse changes in the environment.

During the reconstruction of the WTP, the release of the significant amounts of heat, moisture, greenhouse gases and other substances, the emissions of which may affect the climate and microclimate in the surrounding area, are not expected. The occurrence of microclimatic conditions that contribute to the spread of harmful or non-native species of fauna and flora in the area of the WTP location is not expected.

The object will not have an impact on the climate.

The impact of chemical factors of atmospheric pollution is insignificant and permissible. Thermal pollution of the air basin is not expected.

5.7 - Assessment of the possible transboundary impact

There are no grounds for assessing possible transboundary environmental impact. There are no direct or indirect impacts on ecological and social receptors of other countries.

5.8 - Assessment of the impact on environment caused by technology and substances used

The technologies and materials provided for construction works meet modern requirements to ensure minimization of environmental impact.

The project materials and the Environmental Impact Assessment Report adopt technological solutions and measures that will ensure compliance with the requirements of norms and rules, limit the negative impact of the planned activities objects on the ecological environment caused by technology and substances used.

During the operation of the object, engineering protection measures are provided to prevent the occurrence of an emergency of a technogenic and natural nature.

The adopted set of technical solutions with the start of the designed activities ensures compliance with the requirements of environmental and sanitary legislation, and also ensures the operational reliability of the facilities in relation to the surrounding technogenic environment.

The design documentation provides for the use of LED lamps and the application of road markings with cold plastic that does not contain solvents and is environmentally safe, the use of asbestos and paints with toxic ingredients, solvents or lead-based paints is prohibited. The Client's tender requirements will specify the requirements for construction equipment and safety level.

The planned measures allow minimizing the possibility of emergencies and ensuring the prevention of negative environmental impacts or their mitigation to a negligible and acceptable level.

6 - DESCRIPTION OF FORECASTING METHODS USED TO ASSESS ENVIRONMENTAL IMPACTS AND ASSUMPTIONS BASED ON SUCH FORECASTING, AS WELL AS ENVIRONMENTAL DATA USED

In order to determine the extent of the impacts of the planned activities on environmental indicators, an assessment of the possible impact and a forecast calculation of changes in environmental components were performed: atmospheric air, water environment, soils and the social environment.

The assessment of the possible impact of preparatory and construction works and operation of the Valky bypass on the environment and the forecast of changes in environmental indicators were determined by the calculation and analytical method (mathematical modelling) using generally accepted approved methodologies and the method of analogies, which took into account the experience of designing and operating similar facilities.

When analysing the impact of the planned activities on the environment, we compared the expected results of changes in the natural and socio-economic environment without and with the implementation of the project. In particular, the forecast of the impact on the air environment during construction works and during operation is expressed in determining the values of pollutant emissions into the atmospheric air from the planned sources. Calculations were performed based on the data received from the Client, the location of the bypass road in relation to the residential area, its geometric parameters, climatic conditions and background concentrations of pollution. An assessment of the level of atmospheric air pollution from the planned activities was performed according to hygienic standards (MPC, summation groups, complex indicators and hazard criteria) and calculations of surface concentrations. The forecast of the impact on the aquatic environment was performed using a computational and analytical method. When forecasting the physical impact of the planned activities on the environment, calculation methods and regulatory documents valid in Ukraine that establish regulatory levels of impact were used (DBN V.1.1-31:2013 "Protection of territories, buildings and structures from noise" [31], SSN 3.3.6.039-99 "State sanitary norms for general and local industrial vibration" [51]). The forecast of the impact on soils was performed using a calculation and analytical method, taking into account the projected volumes of industrial and household waste generation and the conditions for its reduction and treatment. The forecast of the impact on the social environment is connected with changes in the quality characteristics of atmospheric air at the border of the protective strip of the road and at the border of the nearest residential area, which is performed automatically using the "EOL 2000 (h)" program, which implements the main dependencies and provisions of "OND-86. Methodology for calculating concentrations of harmful substances in the atmospheric air contained in emissions of enterprises" [17]. This program is intended for assessing the impact of emissions of pollutants from designed and operating enterprises on the pollution of the surface layer of the atmosphere.

Analysis of the environmental impact during construction works showed that the main impact of the planned activities is expected on the atmospheric air. Therefore, the assessment of the "zone of influence" of the bypass road, as well as the assessment of the risks of developing non-carcinogenic and carcinogenic effects when the object affects the population, were determined by the factor of atmospheric air pollution.

The "zone of influence" of the planned activities was determined in accordance with the clause 2.19 [17] on the basis of the calculations of the dispersion of pollutants in the atmospheric air.

The list of the foreseen waste that may be generated during the construction of the object was formed after analysing all technological stages of construction, and on the basis of the data obtained on the list of materials and types of works that will be carried out during construction. The final forecast data were derived after a comparative analysis with similar facilities.

The following methods were used to predict the possible impact of the planned activities:

1. Methods of performing works with reference to standards, regulations, normative and methodological literature and reference materials [17], [10]:

- OND-86 "Methodology for calculating concentrations of harmful substances in the atmospheric air contained in emissions of enterprises". – 1987;

- SSN-173-96 "State sanitary rules for planning and development of settlements", Kyiv, 1996;

2. Methods used in determining the values of emissions by the calculation method [14], [15], [16], [25], [26], [13]:

- Collection of methods for calculating the content of pollutants in emissions from unorganized sources of atmospheric air pollution", UkrNTEK;

- Emission indicators (specific emissions) of pollutants from the processes of electric and gas welding, surfacing, electric and gas cutting and metal spraying, approved by the Ministry of Natural Resources and Environment on January 11, 2003;

- Collection of emission indicators (specific emissions) of pollutants into the atmospheric air by various industries, UkrNTEK, Donetsk, 2004 (volume I -III);

- Methodology for determining "Emissions of pollutants into the atmosphere from boilers with a capacity of less than 50 MW in the municipal sector";

- M 218-03449261-628:2007 Industry methodology for determining specific emissions of major pollutants in the production of asphalt concrete mixture.

All methods of environmental forecasting are limited. The information used is always insufficient for a priori judgment about all possible consequences of the implemented measure (especially in the long-term perspective). This is due to the exceptional complexity of natural systems, their individual uniqueness, and the inevitability of natural chain reactions, the direction of which is often difficult to predict.

7 - DESCRIPTION OF THE PLANNED MEASURES TO PREVENT, AVOID, REDUCE, MITIGATE, ELIMINATE SIGNIFICANT NEGATIVE IMPACTS OF THE PLANNED ACTIVITIES ON THE ENVIRONMENT, INCLUDING COMPENSATION MEASURES

The planned activities will be financed by the European Investment Bank (EIB), therefore, the Finance agreement with the Creditor will include an Environmental and Social Action Plan (hereinafter referred to as the ESAP), which will ensure compliance with the EIB requirements for conducting the activities (namely, the "Environmental and Social Standards", 2022 [52]), as well as compliance with national and EU legislation.

MUC "Mykolaivvodokanal" will be responsible for ensuring that the Contractor who will carry out the reconstruction complies with the ESAP requirements, by adopting and implementing an appropriate contractor management system. This will be achieved by including relevant requirements and conditions into the procurement tender documents, as well as through direct monitoring and supervision by the project implementation unit of the MUC "Mykolaivvodokanal".

The MUC "Mykolaivvodokanal" will implement an Environmental and Social Management System (ESMS) that is appropriate to the nature and scale of the Project and the level of environmental and social (ES) impacts and issues in accordance with international best practice. The MUC "Mykolaivvodokanal" will also need to appoint dedicated personnel, including management representative(s), with clear responsibilities and powers to support and implement the ESMS, and ensure that the personnel is directly responsible for activities related to the Project's implementation in the field of environmental and social (ES) issues and the activities of the MUC "Mykolaivvodokanal", and has appropriate qualifications and training.

The ESMP will be developed taking into account the results of the EIA and it will include measures aimed at preventing, averting, avoiding, reducing, eliminating the likely negative impact of the activities on the environment during the construction period and during the operation period. The ESMP will consist of the following sections:

- environmental and social management plan;
- waste management plan;
- occupational health and safety;
- public disclosure and stakeholder engagement.

In accordance with the terms of the Contract, before the start of the reconstruction works, the Contractor will be obliged to develop and implement:

- Waste Management Plan (WMP) taking into account the relevant national legislation of Ukraine and EU legislation;

- Construction Organization Plan (COP), including the Contractor's Environmental and Social Management Plan (ESMP). At a minimum, the ESMP will cover measures in the following areas: air emissions, noise and vibration management, measures to prevent and control surface water and groundwater pollution during construction, soil contamination management, hazardous materials and waste management, biodiversity protection, spill response management, emergency preparedness and response (including a Fire Action Plan), grievance management mechanism for employees and external stakeholders, requirements for security personnel, disclosure of information and interaction with stakeholders, Action Plan/Procedure in the event of discovery of a find of archaeological value, public health and safety management, traffic management, health and safety of employees.

When carrying out reconstruction works and carrying out planned activities for the operation of the WTP after reconstruction, a number of measures are provided for preventing, averting, avoiding, reducing and eliminating negative impacts on the environment.

According to the assessment, no significant negative impact on the environment from the implementation of preparatory and construction works and the implementation of the planned activities for the reconstruction of the WTP is expected.

If the technological regulations are met, no impact on the aquatic environment, soils, the state of fauna, flora and biodiversity is expected. The planned activities will not affect climatic factors, material objects and landscapes. A positive impact on socio-economic conditions is expected.

During the implementation of preparatory and construction works and the implementation of the planned activities, a minor impact on atmospheric air and a minor impact due to operations in the field of waste management are expected.

The planned activities for the reconstruction of the WTP will be carried out taking into account modern requirements in the field of construction, engineering and other technologies, as well as in the field of environmental protection. The adopted technological process, technological, ventilation and other equipment of leading manufacturers exclude the possibility of emergencies and the creation of high ground concentrations of pollutants in the atmosphere of the residential area, subject to compliance with the rules of operation and safety.

The regulatory state of the environment and environmental safety during the operation of the WTP is ensured by the adopted design solutions, in particular:

- use of progressive low-waste technology;

- use of modern technological equipment;

- sealing of technological equipment and pipelines, shut-off equipment and seals;

- use of the optimal temperature regime of processes;

- monitoring the sealing of technological equipment and pipelines, shut-off equipment and seals;

- organizing full and separate collection of production waste;

- automation and mechanization of the technological process;

- using technical quality water and a circulating water supply system;

- preventing water leaks from all water supply communications and water-containing structures;

- installing ventilation and technological equipment on a vibration base and connecting fans to air ducts through flexible inserts;

- using energy-saving technologies and organizing energy-saving measures, etc.

In order to reduce the impact of the planned activities on the reconstruction of the WTP on the environment, the project provides for the following measures:

- resource-saving measures;

– conservation and rational use of land, water, energy, fuel resources, their reuse;

- protective measures;

– installation of protective structures (drainages, screens), including technological measures (use of environmentally friendly materials, cleaning, safe waste management), planning measures (organization of a sanitary protection zone, landscaping);

- protective measures – monitoring of the territory of the zones of influence of the planned activities;

- compensatory measures (if necessary) – compensation for irreversible damage from the planned activities by carrying out measures to equivalently improve the state of the natural, social and man-made environments, monetary compensation for losses.

7.1 - Resource-saving measures

Introduction of modern energy-saving technologies is one of the priorities during the implementation of this project. The requirements of the regulatory documents have been taken into account, according to which the following is provided:

- Electricity.

Savings are achieved due to:

- automated process control system;

- use of frequency converters for equipment with variable load (fans, pumps, etc.), which provide electricity savings of up to 30%;

- absence of permanent electric lighting in closed pits, due to the absence of service personnel in the premises, since the object operates in automatic mode. Lighting is turned on only during the repair and adjustment period. In this case, LED lamps are used as the most economical;

- accounting of consumed electricity by active and reactive energy meters, which have the ability to connect them to the automated energy accounting system;

- use of cables with cross-sections that ensure minimal voltage losses.

7.2 - Protective measures:

- prohibition of discharge of sewage and stormwater by gravity along the terrain;

- organization of specially designated and appropriately equipped places for temporary storage of each individual type of waste in accordance with their hazard characteristics and in accordance with the requirements of current sanitary and hygienic norms and rules;

- waste management shall be carried out in accordance with the requirements of the Law of Ukraine "On Waste Management" [53], permitting documents and concluded contracts with specialized organizations in the field of waste management, including hazardous waste;

- ensure the implementation of organizational, economic, technical and other measures to ensure compliance with the requirements stipulated by environmental safety standards and regulations in the field of atmospheric air protection and permits for pollutant emissions;

- control over emissions of pollutants from stationary sources of emissions into the atmospheric air, the indicators of which shall not exceed the maximum permissible emissions of pollutants from stationary sources.

7.2.1 - Methods and means of monitoring the state of atmospheric air

Emissions into the atmosphere from the WTP in the city of Mykolaiv shall be carried out in accordance with the permitting documentation provided for by the current legislation of Ukraine, namely the Permit for Emissions of Pollutants into the Atmospheric Air by Stationary Sources.

The maximum permissible emission standards (MPE) of pollutants are established in accordance with the Order of the Ministry of Natural Resources of Ukraine dated 27.06.2006 No. 309 [54]. According to the clause 1.1. of this Order, MPE standards are established for organized emissions of stationary sources of atmospheric pollution.

After the WTP is put into operation after reconstruction, it is necessary to conduct an inventory of emission sources and obtain a new Permit for emissions of pollutants into the atmospheric air. Based on data on actual emissions of pollutants into the atmosphere from all sources, a list of pollutants for which emission control will be required during the operation of Water Treatment Plant will be determined.

Control of atmospheric air pollution at the border of the sanitary protection zone of the enterprise and the border of the residential area will be carried out according to the established plan-schedule, which will be

approved during the registration of the Permit for emissions of pollutants. The report using the form No. 2-TP (air) (annual) "Report on emissions of pollutants into the atmospheric air from stationary sources of emissions", approved by the Order of the State Statistics Service dated April 04, 2024 No. 84 [55] MUC "Mykolaivvodokanal" will submit the document to the territorial body of the State Statistics Service no later than January 20 of the year following the reporting year on an annual basis.

7.2.2 - Measures to regulate emissions during adverse weather conditions (AWC)

Measures to regulate emissions during adverse weather conditions (AWC) are developed in accordance with RD 52.04.52-85 [56]. Warnings about increased air pollution levels due to expected adverse weather conditions are prepared by the departments of the Ministry of Energy and Environmental Protection. The business entity will ensure that the enterprise is shut down or that the object is switched to a mode that ensures reduced emissions during adverse weather conditions.

7.2.3 - Environmental protection measures during the planned activities

7.2.3.1 - Air environment protection measures during the reconstruction works

1) During the excavation works, dust control measures will be applied by watering and moistening the soil.

2) During the removal of old road pavement and dismantling of structures, dust pollution will be reduced by continuous watering place of works.

3) Soil and construction waste will be stored in a specially designated area, which allows minimizing the presence of dust.

4) When transporting construction materials, all trucks are equipped with tarpaulin awnings or other acceptable types of covers to prevent dust pollution and falling of materials from the body during transportation.

5) Burning of construction materials/waste is prohibited on the site.

6) All equipment meets the requirements for emissions into the atmosphere established by Ukrainian regulatory documentation. Equipment and machinery are properly operated and maintained, and all necessary measures are taken to prevent unnecessary idling on the work site.

7) Dust and emissions from vehicles are minimized through effective management and technical supervision of works on the site. Workers are provided with protective masks as necessary.

8) Regular monitoring of the condition of construction machinery engines is carried out.

9) Regular inspections will be carried out to achieve uniform and proper operation of construction machinery, which will help prevent the emission of unacceptable concentrations of pollutants (e.g. aliphatic and aromatic hydrocarbons) on the work site and surrounding areas.

Modern construction methods and energy-saving technologies are used.

The use of asbestos and paints with toxic ingredients, solvents or lead-based paints is prohibited.

In addition to the above measures, the Contractor will monitor air quality in accordance with the Environmental and Social Monitoring Plan.

7.2.3.2 - Air environment protection measures during the operation of the WTP

To the technological process:

- the business entity will ensure effective operation and maintenance of structures, equipment and apparatus in proper condition;

- the business entity will ensure that all emissions into the atmospheric air do not lead to inconvenience outside the object;

- the business entity will carry out works with technological or repair maps;

- the business entity will operate the equipment in accordance with the requirements and environmental restrictions.

To volley emission sources

Volley emissions from emission sources No. 5, 44, 53, 56, 59, 62, 65, 69 must not exceed 3 times the maximum permissible emissions in accordance with the legislation.

To unorganized sources of emissions

- the business entity will ensure the shutdown of the enterprise or the organization of the transition of the object to a mode that ensures the reduction of emissions during adverse weather conditions.

- wood processing (DV No. 34, 35) will be carried out in closed premises to reduce emissions into the atmospheric air of substances in the form of suspended solid particles undifferentiated by composition;

- sharpening and processing of metal parts (DV No. 39) will be carried out in closed premises to reduce emissions into the atmospheric air of substances in the form of suspended solid particles undifferentiated by composition.

Production control.

- The enterprise will ensure constant and safe access to sampling points for monitoring emissions into the atmospheric air, as well as safe access to any other sampling and monitoring points.

In addition, for the disinfection of drinking water, it is planned to abandon the use of chlorine, which is the most dangerous component in accidents, in favour of sodium hypochlorite.

7.2.3.3 - Measures to protect surface, ground, underground water and soil during reconstruction works

1) Wastewater generated on the site will be collected, removed from the site using the existing drainage system and fed into the city's sewerage network.

2) There should be no direct discharge of sanitary or washing water onto the soil.

3) Storage areas for all fuel and chemical materials (if any) should be placed on a water-resistant base, be sealed, securely fixed, marked and separated by a fence.

4) The service area of the construction site should be built on a water-resistant layer with proper drainage to collect spills. No vehicle maintenance operations are allowed on the site.

5) Refuelling of vehicles and construction equipment should be organized outside the construction site in specially equipped places (gas stations and the Contractor's production bases).

6) Construction and work sites must be equipped with sanitary toilets.

7) Temporary storage and handling of construction, household and hazardous waste will be carried out in accordance with the "Construction Waste Management Plan".

8) In the event of spills, accidents or emergencies, the Contractor's personnel must act in accordance with the "Emergency Response Plan".

In addition to the above measures, the Contractor's environmental personnel (environmental engineer) will conduct monitoring in accordance with the Environmental and Social Monitoring Plan.

7.2.3.4 - Measures to protect surface, ground, underground waters and soils during the operation of the WTP

- The reconstruction of the WTP in the city of Mykolaiv involves the construction of a washing water treatment (purification) station and its reuse (purified washing water is supplied into the head of the WTP), and the removed and dehydrated sediment is disposed of (transported to the landfill for solid household waste), which ensures a closed filter washing cycle. This will have a positive impact on the aquatic environment, because the sediment from washing water, in the amount of 16,731.6 t/year, will not enter the Vitovka River and the Buzkyi Estuary, but will be transported to the landfill for solid household waste

- laying of external and internal water-bearing communications in accordance with current building norms and regulations;

- commissioning of water-bearing communications is carried out after checking their tightness;

- waterproofing and shotcrete of the network of capacity structures, use of sealants in the reconstruction of existing structures and technological communications;

- technical service of the enterprise conducts periodic monitoring of water-bearing communications according to the maintenance schedule to prevent water leaks into the soil, ensuring their timely repair;

- monitoring the degree of water purification at the outlet of the WTP;

- monitoring the quality of surface water in control sections from the release of purified water;

- compliance with the requirements of the updated Permit for Special Water Use.

7.2.3.5 - Noise protection measures during the reconstruction process

1) Works are carried out only during working hours on weekdays. Works are not planned to be carried out on weekends and holidays. In the event of a need to carry out works that cause an increased noise level, residents living nearby will be informed about this 10 days in advance.

2) Workers are provided with personal protective equipment for use when carrying out works with a high noise level.

3) During the works, the covers of generators, air compressors and other mechanical equipment remain closed.

4) All vehicles and equipment are properly soundproofed. Modern equipment that meets noise reduction standards or equipment upgraded to meet the required standards is also used.

5) Drivers of vehicles and construction equipment are instructed to prevent the use of sound signals (honks) and unnecessary idling of equipment.

6) Adjustment of the Site activities schedule to prevent unnecessary accumulation of large amounts of heavy equipment.

In addition to the above measures, the Contractor's environmental personnel (environmental engineer) will monitor the noise situation in accordance with the Environmental and Social Monitoring Plan.

No noise protection measures are required during the operation of the WTP.

7.2.3.6 - Waste management

During the reconstruction, the Contractor shall ensure:

1) proper organisation and control of construction works in order to minimise waste generation;

2) localisation and subsequent removal of construction debris and household waste to places of processing, temporary storage and disposal;

3) regular transportation of construction materials as work progresses, no storage of large batches at construction sites;

4) temporary storage of construction waste on construction sites in specially designated areas;

5) availability of mobile containers for metal waste, oily rags, petroleum products at work sites;

6) installation of toilets, living and recreation areas,

7) fencing of areas for the storage of hazardous waste;

8) storage of hazardous waste, namely:

- used fluorescent lamps (undamaged) and devices containing mercury – in factory packaging (if factory packaging is not available, lamps must be wrapped in paper and separated in rows with paper or soft cardboard) in a closed container;

- waste contaminated with petroleum products: oiled rags, sand, paper – in undamaged plastic or metal containers or polymer bags;

- used filters (without oil) – in undamaged plastic or metal containers or polymer bags;

- temporary storage of hazardous waste on construction sites in specially designated areas with a hard surface to prevent penetration into the soil in the event of spillage or damage to the storage container;

- Temporary storage of all hazardous or toxic substances on the site shall be carried out in safe containers with the necessary markings containing information on the composition, properties and instructions for use.

9) Placement of containers for the collection of solid household waste at the work site.

10) Washing of vehicles and machinery and the discharge of fuel and lubricants are prohibited on the construction site.

For the removal and disposal of all waste groups, the Contractor must conclude appropriate agreements with licensed or specialised companies that carry out such activities.

In order to prevent and avoid possible negative impact of waste on the environment, the owners of waste, namely the Contractor (during the reconstruction period) and MUC "Mykolaivvodokanal" (during the operation period) are obliged to:

- take effective measures to reduce the volume of waste generated and to dispose of it.
- monitor changes and innovations in environmental legislation, including on waste management, and organise environmental protection work at the enterprise, taking into account these changes and innovations.
- timely conclude contracts for the transfer of waste to specialised organisations that have the necessary licences in the field of hazardous waste management for the collection, transport and disposal of waste, if it is generated.
- ensure the comprehensive use of material and raw resources.
- ensure the complete collection, proper storage and transfer of waste for disposal/removal.
- carry out constant monitoring of the condition of temporary waste storage sites (prevent waste from being stored in unauthorised places, prevent mixing of different types of waste and ensure a sufficient number of containers for waste collection.

7.3 - Protective measures:

- timely scheduled and preventive maintenance of machinery and equipment, with mandatory post-repair checks of noise and vibration characteristics, as well as parameters of pollutant emissions into the atmosphere;

- conducting laboratory studies of pollutant emissions from stationary sources of pollution on an annual basis;

- conduct quarterly laboratory tests of atmospheric air quality at the boundary of the enterprise's sanitary protection zone.

7.4 - Compensatory measures:

Pay environmental taxes for emissions of pollutants into the atmosphere in a timely manner and in full.

7.5 - Emergency situations:

Emergency situations are characterised by a certain state of a facility caused by a violation of safe operating conditions, in which all possible actions of sources of danger to the working area and the environment are under control and kept within established limits by means of technical measures provided for in the design. The damaging factors that arise during an emergency, if they reach certain values, can cause harm to human health, the environment and material assets. Assessment of emergency situations and their impact on the environment includes analysis of emergency scenarios and their probability of occurrence and is carried out on the basis of a thorough analysis of the facility's activities in accordance with regulatory documents, as well as taking into account accidents and emergency situations that have occurred at similar facilities.

Possible factors leading to emergency situations at the designed facility may include:

- measures to prevent local fires in the event of a breach of fire safety measures (smoking, use of open flames, faulty electrical wiring, etc., the damaging factors of which are smoke, flames, reduced oxygen concentrations, toxic chemicals (products of combustion of fuel, insulation and cable sheathing, paint and varnish materials, oils, dust, etc.) that are released into the environment;

- violation of the operating modes of technological equipment, resulting in significant emissions of pollutants into the atmosphere, etc.;

- damage to the integrity of technological equipment and communications; natural disasters; human error.

In view of the above, a system of safety measures has been established to prevent the occurrence of emergencies, warn of their development, and limit the scale and consequences of accidents, including technical and organisational measures, in particular:

- continuous visual and automatic monitoring of potential sources of danger;

- construction and design measures provided for by standards and regulations;

separation of premises of different fire hazard categories by fire partitions;

- increased requirements for the quality of equipment used;

- protection against direct lightning strikes, secondary effects and high potential transfer through ground and underground communications and structures;

- protective neutralisation and earthing of equipment;

- electrical wiring for equipment and lighting in accordance with the fire hazard category of the premises;

- strict adherence to technological discipline and safety requirements;

- installation of a continuously operating supply and exhaust ventilation system, etc.

All production premises, installations and structures are equipped with primary fire extinguishing equipment that has a certificate of conformity or a statement of conformity, and fire-fighting equipment (fire shields) in accordance with applicable regulations.

The installed technological equipment is fire-safe under normal operating conditions, and protective measures are provided to limit the scale and consequences of fires in the event of dangerous malfunctions and accidents.

All buildings, premises and structures are cleaned of combustible debris and production waste in a timely manner and are kept clean at all times.

Fire alarm and warning systems are in place to ensure fire safety. The premises of the enterprise's departments are equipped with primary fire-fighting equipment in accordance with NAPB A.01.001-2014 Fire Safety Rules in Ukraine [57].

Analysis of the technological process and regulations, qualitative characteristics of technological equipment and raw materials allows us to conclude that all possible potential sources of danger and their impact on the working area and the environment are under control and maintained within established limits through appropriate measures, ensuring accident-free production.

The methods and means of workplace organisation, technological processes and equipment, the use of emergency, construction, fire-fighting and other measures, as well as compliance with safety regulations adopted at the enterprise, exclude the possibility of accidents and the creation of emergency fire situations leading to high ground-level concentrations of harmful impurities in the residential area.

A comprehensive assessment of the residual environmental impact of the planned activities of the WTP after reconstruction showed that, subject to compliance with current requirements for technological, ventilation and other equipment used, environmental protection and fire safety, as well as the rules for operating technological equipment and engineering systems, its operation is environmentally safe.

A comparison of the types and levels of residual effects on the environment of the operation of the WTP allows us to conclude that its economic activity complies with the requirements of environmental legislation:

- the calculated maximum ground-level concentrations in the atmospheric air of the residential area of all pollutants emitted by WTP sources meet the requirements of sanitary standards;

- there is no exceedance of the maximum permissible emissions established by Ukrainian legislation;

- acoustic discomfort in the nearest residential area is excluded;

- the possibility of disruption of the hydrological regime of water bodies, depletion and pollution of groundwater and surface water due to the absence of discharge of untreated industrial and surface effluents is excluded;

- any changes in the geological and structural-tectonic structure that have developed in the area, as well as the occurrence of karst and mudflow phenomena, landslides, changes in the condition and properties of rock masses leading to deformation of the earth's surface, are excluded;

- production, operational and domestic waste is transported for recycling or disposal, depending on its type, in accordance with agreements concluded with organisations that have the appropriate permits to operate;

- a system of safety measures prevents the occurrence of emergency situations, warns of their development, limits the scale and consequences of accidents, and minimises harmful man-made impact on the environment.

There are no violations of the existing environmental situation in the area of the WTP and in the nearest residential buildings, nor is there any threat of negative impact on the living conditions of the population and the social environment as a whole.

No unforeseen consequences in the field of environmental ecology are expected from the implementation of the planned activities. The planned set of measures allows for the almost complete elimination of emergency situations and, consequently, the negative impacts on the environment associated with them.

Provided that the measures envisaged in the project are complied with, there will be no negative impact on groundwater and surface water, air, soil, the geological environment, flora and fauna, protected areas and the social environment during construction and operation.

The project involves the implementation of a set of technical solutions and measures aimed at creating an automated control system for WTP technological processes. The purpose of the designed automated system is to improve the efficiency of drinking water treatment, increase the efficiency of sludge treatment with its subsequent disposal in accordance with the specified conditions and characteristics of technological processes, as well as to achieve the specified quality indicators of technological processes while reducing operating costs associated with maintenance and repair of technological equipment.

8 - DESCRIPTION OF THE EXPECTED SIGNIFICANT IMPACT OF ACTIVITIES ON THE ENVIRONMENT DUE TO THE VULNERABILITY OF THE PROJECT TO EMERGENCY RISKS, MEASURES TO PREVENT AND MITIGATE THE IMPACT OF EMERGENCIES ON THE ENVIRONMENT, AND MEASURES TO RESPOND TO EMERGENCIES.

In accordance with paragraph 1 of the Annex to the Resolution of the Cabinet of Ministers of Ukraine "On approval of the list of objects belonging to business entities, the design of which is carried out taking into account the requirements of civil protection engineering and technical measures" dated 9 January 2014 No. 6 [58], facilities for decontamination, preparation, purification and storage of drinking water are included in the list of facilities that ensure the sustainable functioning of the state in emergency situations and during special periods.

At the next stage, design will be carried out in accordance with the requirements of DSTU 8773:2018 "Composition and content of the section on civil protection engineering measures in the design documentation for the construction of facilities. Basic provisions" [59].

During construction, in order to avoid and prevent negative impacts on employees and the environment from possible emergencies and accidents, the following will be done:

- civil protection measures will be implemented;
- employees will be provided with collective and individual protection equipment in accordance with the law;
- information on safety measures and appropriate behaviour in the event of an accident will be posted;
- evacuation measures for employees and property will be organised and implemented in the event of emergencies;
- employees will be trained in civil protection, including industrial and fire safety rules;
- plans will be developed to localise and eliminate the consequences of accidents at the facility;
- training and education on civil protection issues will be conducted;
- measures to ensure fire safety will be developed.

In accordance with Article 25 of the Law of Ukraine "On Protection of Population and Territories from Technogenic and Natural Emergencies", the following measures shall be taken to protect the population and territories from technogenic and natural emergencies:

- the development of plans for the localisation and elimination of accidents (disasters) with subsequent approval by the central executive bodies responsible for the formation and implementation of state policy in the fields of civil protection, fire and technogenic safety;
- ensuring timely notification of enterprise employees about the threat of or occurrence of an emergency of a man-made or natural origin.

Prior to the reconstruction of the WTP, the most dangerous emergency situation on the territory of the WTP was a chlorine release. The danger posed by the chlorination unit is characterised by the presence of liquid chlorine in containers. At high temperatures and pressures, liquid chlorine is explosive and creates favourable conditions for intense evaporation. If the tightness of containers with liquid chlorine is compromised during the warm season, it can evaporate completely and form a toxic cloud at ground level in a very short time. Currently, in the main building of the filtration station, next to the chlorination room, there is a chlorine storage facility containing one container (1 tonne) of liquid chlorine.

A sudden release of liquid chlorine from the container is possible during destruction (significant damage) due to increased pressure inside it, an explosion inside, mechanical and corrosion damage to the body, external factors (terrorist act), which may lead to the release of the entire mass of liquid chlorine into the storage room and poisoning of people, as well as the possible spread of a chlorine cloud over the entire territory of the filtration station and beyond. Calculations to predict the extent of contamination, in accordance with the methodology[19], are presented in the table below.

TABLE 80 - RESULTS OF FORECASTING THE EXTENT OF CONTAMINATION

Reagent	Contamination depth, km	Area of possible chemical contamination, km^2	Area of predicted chemical contamination, km^2	Population in the area of chemical contamination, persons	Time of arrival of the contaminated cloud to residential areas, min
Chlorine (1 t)	4.8	72.35	3.85	7000	1.2 – 4.2
Sodium hypochlorite (50 kg of chlorine)*	0.2	0.57	0.13	40	-

* In this case, the emergency release of the reagent will not pose a threat to the safety of the population of Mykolaiv.

In modern practice, liquid/gaseous chlorine is increasingly being replaced by sodium hypochlorite as one of the most effective measures for preventing emergencies.

The reconstruction of the water treatment plant includes the construction of an electrolysis plant for the production of sodium hypochlorite, which is an alternative and safer reagent for water disinfection. Since hypochlorite is planned to be produced directly at the treatment plant, its storage volumes can be equated to daily reserves.

The use of sodium hypochlorite, which is produced on site by electrolysis of sodium chloride solutions, as a disinfectant is one of the promising methods of disinfection. Retaining all the advantages of chlorination with liquid chlorine, the use of electrolytic sodium hypochlorite avoids the main difficulties associated with the transport and storage of toxic liquids/gases. In addition, the use of this reagent eliminates the user's constant dependence on factories supplying liquid chlorine, which is produced centrally by the chemical industry, as well as on the use of specialised transport vehicles.

Chlorination stations and converted electrolysis plants for the production of sodium hypochlorite are not subject to control by inspection authorities.

Water treatment with sodium hypochlorite instead of chlorine has the following advantages: safe storage and transportation, ease of dosing, long-lasting disinfecting effect, low probability of industrial accidents and avoidance of negative impact on the health of city residents.

The facility is equipped with emergency (fire alarm) systems, primary fire extinguishing equipment and firefighting equipment. Fire extinguishers are provided for extinguishing internal fires. Sources of ignition on the territory of the WTP may include electrical networks, pump motors, power cabinets and automation equipment.

To extinguish external fires on the territory of the WTP, a fire hydrant is provided, which is illuminated at night and in the evening. In the event of a fire, personnel must follow the "Instructions for WTP personnel in case of fire".

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[19] *Joint order of the Ministry of Emergency Situations, the Ministry of Agrarian Policy of Ukraine, the Ministry of Economy of Ukraine, and the Ministry of Ecology and Natural Resources of Ukraine dated 27 March 2001 No. 73/82/64/122 On approval of the Methodology for forecasting the consequences of spills (releases) of hazardous chemicals in accidents at industrial facilities and in transport.*

The WTP is designed for trouble-free operation, but the possibility of non-standard situations cannot be ruled out in the following cases:

- prolonged power outages;

- failure of any of the units;

To prevent such situations, the WTP is equipped with a controller that provides an emergency alarm. The negative impact on the environment during emergency operation of the WTP is insignificant and quickly eliminated.

Accidents are recorded in a special log.

In the event of an accident at the WTP, the personnel on duty must stop the pump unit in accordance with special emergency instructions without the permission of a higher-level duty manager. He must immediately notify the next higher-level duty manager or dispatcher of his actions.

Each pumping unit is periodically inspected, overhauled, and repaired according to an approved schedule.

The frequency and scope of each type of work is determined based on the manufacturer's instructions, taking into account local conditions.

The start-up and commissioning of the unit after repair shall be carried out under the supervision of the person who oversaw the repair.

The possibility of air pollution in the working area of the water treatment technology is excluded.

The possibility of emergency situations involving soil contamination in the working area and adjacent territories is excluded.

Administrative measures in the event of man-made and natural emergencies:

MUC "Mykolaivvodokanal" shall notify the Department of Ecology and Natural Resources of the Mykolaiv Regional State Administration by telephone and e-mail as soon as possible after any of the following occurs:

- Any discharge that exceeds the requirements set out in the Discharge Permit and the Special Water Use Permit;
- Any malfunction or error in the control or monitoring equipment that could lead to a loss of control over the pollution prevention system;
- Any accident that may pose a threat to the environment or may require expert response measures.

As part of the notification, MUC "Mykolaivvodokanal" shall indicate the date and time of such an accident, provide detailed information about what happened and the measures taken to minimise emissions and prevent similar accidents in the future.

MUC "Mykolaivvodokanal" will document any accidents in a special log and will immediately notify the Department of Ecology and Natural Resources of the Mykolaiv Regional State Administration and Lenders of any incidents or accidents related to MUC "Mykolaivvodokanal" or with the WTP and related facilities that have or may have a significant negative impact, or about any changes in the scope, design or operation of the facility.

9 - IDENTIFICATION OF ALL DIFFICULTIES ENCOUNTERED IN THE PREPARATION OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

The following difficulties were identified during the preparation of this Report:

- Lack of certified software for determining gross and maximum single emissions of pollutants into the atmosphere, waste generation volumes, and software for acoustic calculations in accordance with the methods agreed by the Ministry of Environmental Protection and Natural Resources of Ukraine, which would have significantly reduced the time required to prepare the Report;

- When calculating maximum single emissions of pollutants (g/s) and noise pollution from construction equipment, it is difficult to predict the number of machines operating simultaneously. The Report assumed the maximum number of machines operating simultaneously, which overestimates the calculation results in relation to actual emissions and noise levels;

- Calculations of the dispersion of pollutant emissions into the atmosphere from the operation of construction equipment contain an element of uncertainty for the following reasons: for construction equipment, which is a mobile source and whose speed exceeds the wind speed by tens of times, causing turbulization and dispersion of emissions, the OND-86 [17] method is not entirely acceptable.

10 - COMMENTS AND SUGGESTIONS RECEIVED DURING THE PUBLIC DISCUSSION OF THE PLANNED ACTIVITY

According to the letter from the Ministry of Environmental Protection and Natural Resources of Ukraine dated 28 March 2024 No. 21/21-04/1608-25 (Appendix 16), no comments or suggestions from the public regarding the planned activity were received.

11 - SUMMARY OF ENVIRONMENTAL MONITORING AND CONTROL PROGRAMMES DURING THE IMPLEMENTATION OF PLANNED ACTIVITIES

During the reconstruction of the WTP

MUC "Mykolaivvodokanal" will monitor the implementation of the measures specified in the Environmental and Social Action Plan (ESAP). Based on the monitoring results, MUC "Mykolaivvodokanal" will determine and reflect any necessary corrective and preventive actions in the ESAP (to be updated annually), implement the agreed corrective and preventive actions, and monitor these actions to improve their effectiveness.

MUC "Mykolaivvodokanal" will be required to provide the Lenders with regular (annual) reports on the Project's compliance with environmental and social (ES) indicators and the Stakeholder Engagement Plan. MUC "Mykolaivvodokanal" will prepare and submit to the Lenders (in this case, the EIB) annual environmental and social reports on environmental and social issues, health and safety issues, which will be reviewed or otherwise assessed by the Lenders at all stages of the Project implementation (including an indication of the progress of the ESAP implementation). Lenders will periodically verify monitoring information by conducting inspections of the facility (WTP) by Lenders' specialists and/or independent experts.

During the implementation of the project, monitoring will be carried out during the reconstruction of the WTP in accordance with international best practices and national legislation.

The table below provides a summary of the monitoring plan for the reconstruction period.

ТАБЛИЦЯ 81 - SUMMARY MONITORING PLAN FOR THE PERIOD OF RECONSTRUCTION WORKS

Subject	Parameter	Site	Method	Period	Responsibility
Noise	Noise level	Monitoring points in the working area and on the edge of residential buildings, namely: - 324 Yantarna Street, Mykolaiv, WTP territory (46°52'24'N 32°03'57'E); - 178 Klechova Balka Street, Mykolaiv (46°52'55'N 32°03'17'E); - 197 Fontanna Street, Mykolaiv (46°52'48'N 32°03'15'E); - 71 Kakhovska Street, Mykolaiv (46°52'34'N 32°03'10'E); - 40 Preobrazhenska Street, Mykolaiv (46°50'16'N 32°01'42'E); - 85 Vidrodzhennia Street, Mykolaiv (46°49'57'N 32°01'12'E).	Measurements by a certified laboratory. Visual observations Monitoring of the implementation of the ESAP noise management plan	**Initial** – before the start of reconstruction **Periodic** – every season during reconstruction **Final** – after completion of reconstruction **Irregular** – due to complaints from the population	Performed by: a certified laboratory performs instrumental research. Field observation by the Contractor's environmental and social specialist Supervised by: the Engineer's social and environmental specialist, Project Implementation Unit (PIU) representative.
Surface water quality	Suspended solids Biological oxygen demand (BOD5) Dissolved oxygen (DO) Oil and grease, or total petroleum	Vitovka River (46°52'49'N, 32°03'45'E); Inhulets Canal (46°52'15'N, 32°04'13'E); Buh Estuary (46°49'10'N, 31°57'08'E).	Measurements by a certified laboratory. Methods of determination: gravimetric, photocolorimetric, titrimetric, physical, potentiometric, methods of sanitary and microbiological	**Initial** - before the start of reconstruction **Periodic**: Once a month at outfall No. 1, May – October (6 samples) above the discharge point;	Performed by: a certified laboratory performs instrumental research. Visual observation by the Contractor's environmental and social specialist Supervised by: Environmental and Social specialist of the Engineer,

Subject	Parameter	Site	Method	Period	Responsibility
	hydrocarbons (TPH)		analysis of surface waters, sanitary and helminthological studies of wastewater by centrifugation. Monitoring of the implementation of the 'water quality management' plan of the ESAP	May – October (6 samples) below the discharge point **Final** – after completion of reconstruction **Irregular** – due to complaints from the population	PIU representative
Soil quality	Oil product leaks and spills Availability of spill containment devices and leak-proof bases in hazardous waste storage areas Employee awareness of emergency spill response procedures	Construction site (area of the WTP and area of pipeline construction for brine transportation)	Visual observations Monitoring of the implementation of the ESAP soil quality management plan	Continuous monitoring during construction works, in particular during rainy and snowy seasons	Performed by: visual observation by the Contractor's environmental and social specialist Supervised by: Environmental and Social specialist of the Engineer, PIU representative
Landslides and erosion	Load-bearing structures Rainwater drainage Avoiding unnecessary removal of vegetation	Construction site (area of the WTP and area of pipeline construction for brine transportation)	Visual observation	Before and during reconstruction, particularly during rainy and snowy seasons Continuous monitoring during reconstruction	Performed by: visual observation by the Contractor's environmental and social specialist Supervised by: Environmental and Social specialist of the Engineer, PIU representative
Air quality	Level of concentration of emissions of main pollutants from construction equipment: CO, NO_2, SO_2, dust	Monitoring points in the working area and on the edge of residential buildings, namely: - 324-ye, Yantarna Street, Mykolaiv, WTP territory (46°52'24'N 32°03'57'E); - 178, Klechova Balka Street,	Measurements by a certified laboratory. Visual observation. Monitoring of the implementation of the ESAP air quality management plan	**Initial** - before the start of reconstruction **Periodic** - every season during reconstruction **Final** – after completion of reconstruction **Irregular** – due to complaints from the population	Performed by: A certified laboratory performs instrumental research. Field observation by the Contractor's environmental and social specialist Supervised by: Environmental and Social specialist of the Engineer, PIU representative

Subject	Parameter	Site	Method	Period	Responsibility
		Mykolaiv (46°52'55'N 32°03'17'E); - 197 Fontanna Street, Mykolaiv (46°52'48'N 32°03'15'E); - 71 Kakhovska Street, Mykolaiv (46°52'34'N 32°03'10'E); - 40 Preobrazhenska Street, Mykolaiv (46°50'16'N 32°01'42'E); - 85 Vidrodzhennia Street, Mykolaiv (46°49'57'N 32°01'12'E).			
Waste management	Availability of contracts with specialised companies for the disposal of all types of waste. Compliance with rules for the collection and temporary storage of waste. Separate storage of waste depending on the hazard class.	Site (area of the WTP and area of pipeline construction for brine transportation)	Visual observations Monitoring of the implementation of the ESAP "waste management in construction" programme	Before and during reconstruction, in particular during dry and rainy seasons Continuous monitoring Unplanned inspections during construction	Performed by: visual observation by the Contractor's environmental and social specialist Supervised by: Environmental and Social specialist of the Engineer, PIU representative, local authorities.
Health and safety of workers	Checking the availability and quality of personal protective equipment Conducting training and briefings on occupational safety,	Contractor's construction camp	Visual observation Regular review of documentation and technical specifications for equipment, provision of HIV/AIDS	Continuous monitoring Training sessions – once every four months	Performed by: Environmental and Social Expert of the Contractor Supervised by: Environmental and Social specialist of the Engineer, PIU representative, local authorities.

Subject	Parameter	Site	Method	Period	Responsibility
	fire safety and HIV and other STIs		protection equipment Monitoring of the implementation of the "occupational health and safety management" plan of the ESAP		
Traffic organisation	Traffic organisation schemes, as well as compliance with requirements for the safe transportation of materials and compliance with traffic rules by drivers.	Construction site (area of the WTP and area of pipeline construction for brine transportation) Local roads	Visual observation Regular review of documentation Monitoring of the implementation of the "traffic management" plan of the ESAP	Before and during reconstruction Continuous monitoring	Performed by: Contractor Supervised by: Environmental and social specialist of the Engineer, PIU representative, local authorities
Flora/Fauna	Control over the removal of green spaces	Site (area of the WTP and area of pipeline construction for brine transportation)	Visual observation, Preparation of relevant permits for the removal of green spaces	Before and during reconstruction Continuous monitoring	Performed by: visual observation by the Contractor's environmental and social specialist Supervised by: Environmental and Social specialist of the Engineer, PIU representative, local authorities.
Cultural heritage	Control over the construction of a pipeline for transporting brine	The area of construction of a pipeline for transporting brine in the vicinity of the Mohyla-Maiachna burial mound. 46°49'55" N, 32°01'37" E	Visual observation Regular review of documentation Monitoring the implementation of the "Action Plan in case of discovery of an object with signs of archaeological heritage or historical and cultural heritage" of ESAP	Before and during reconstruction Continuous monitoring	Performed by: visual observation by the Contractor's environmental and social specialist Supervised by: Environmental and social specialist of the Engineer and, if necessary, representative of the cultural heritage department of the city of Mykolaiv. Representative of the PIU, local authorities.
Gender issues	Discrimination based on gender	Contractor's construction camp	Monitoring compliance with EMP requirements	Before and during reconstruction	Performed by: Contractor Supervised by: Environmental and

Subject	Parameter	Site	Method	Period	Responsibility
			Monitoring complaints from staff	Continuous monitoring	Social specialist of the Engineer, PIU representative
Religious issues	Discrimination on religious grounds	Contractor's construction camp	Monitoring compliance with EMP requirements Monitoring complaints from staff	Continuous monitoring	Performed by: Contractor Supervised by: Environmental and Social specialist of the Engineer, PIU representative
Preventing illegal employment	Having complete and accurate registers of employed workers	Contractor's construction camp	Verification of registers Monitoring of complaints from staff	Continuous monitoring	Performed by: Contractor Supervised by: Environmental and Social specialist of the Engineer, PIU representative
Informing local community members	Installing information boards, posting information notices with contact details in public places Responding to complaints	Settlements located in the immediate vicinity of the project site (Korabelny district of Mykolaiv and Halytsynivska territorial community)	Meetings with community representatives Regular updates of information announcements Responding to complaints	Monitoring during reconstruction	Performed by: Contractor Supervised by: Environmental and Social specialist of the Engineer, PIU representative

During operation of the WTP

The WTP is designed with a complete and functional monitoring, control, automation and data collection system, including fibre optic cable communication between the various functional parts and buildings of the water treatment plant. The SCADA system consists of hardware and software components to achieve stable water quality and plant performance.

The SCADA system provides all necessary control and measuring instruments for monitoring and controlling the following operations:

Raw water tanks:

- Level gauges for measuring the water level in the tanks;
- Flow meters for measuring the inlet and outlet flow;
- Remote and manual valve actuators at the inlet and outlet of the tanks.

Pump stations in filter units 1 and 2:

- Suction and discharge pressure sensors for each individual pump;
- Flow meters for measuring water flow at the pump outlet;
- Water temperature sensors for each pump;
- Frequency converters with control boards for all pumps;
- Remote and manual valve actuators on gate valves;
- Level gauges for measuring the water level in the drain pit;
- Drain pump control boards;
- Monitoring of temperature, gases and humidity in the room.

Filter groups in filter units 1 and 2:

- Inlet water quality sampler (automatic checking of turbidity, salinity, pH, colour, UV-254 (organic substances), redox potential, manual sampling for laboratory);
- Pressure sensors at the inlet and outlet;
- Flow meters at the inlet and outlet;
- Automated and manual valve actuators for filtration, reverse and direct flushing modes;
- Air pressure gauges on valve actuators;
- Raw water quality sampler (automatic testing of turbidity, salinity, pH, colour, UV-254 (organic), oxidation-reduction potential, residual aluminium and chlorine, manual sampling for laboratory testing).

Reverse osmosis units:

- Pressure reduction level;
- Inlet water quality sampler (automatic testing of turbidity, salinity, SDI, residual chlorine);
- Membrane condition;
- Sample collector for purified water quality at the outlet (automatic check of turbidity, salinity, pH, colour, UV-254 (organic), oxidation-reduction potential, manual sampling for laboratory);
- Sample collector for raw water quality at the concentrate (automatic mineralisation check).

Chemical reagent preparation and dosing units (coagulants, flocculants, sodium hypochlorite, etc.):

- To be specified in detail during the design development stage.

Wash water treatment facilities:

- Storage tanks: levels, turbidity;
- Feed pumps: volumes, pressure, safety control;
- Lamella clarifiers: turbidity after clarifier, flow rate (rinse if reduced);
- Clarified wash water tanks: levels:
- Clarified wash water pumps: volumes, pressure, safety control;

- Centrifuges.
    - Level gauges for measuring the water level in the drain pit;
    - Control panels for drainage pumps;
    - Monitoring of temperature, gas and humidity in the room.

Electrolysis shop:

- Control of incoming water;
- Energy consumption;
- Inlet water quality sampler (automatic testing of turbidity, salinity, pH, colour, UV-254 (organic), oxidation-reduction potential, manual sampling for laboratory testing).

Acceptance of the facility

- Video monitoring
- Lightning protection

12 - SUMMARY OF NON-TECHNICAL INFORMATION

Name of the document: Environmental Impact Assessment (EIA) Report on the reconstruction of water treatment plant (WTP) in Mykolaiv

Employer: MUC "Mykolaivvodokanal"

Financing: European Investment Bank (EIB)

Project location: The territory of existing WTP in Mykolaiv, located at 324-e, Yantarna Street, Korabelnyi District, Mykolaiv, Mykolaiv Region.

Planned activities, in accordance with paragraph 10 (construction of dams and installation of other equipment for the retention or accumulation of water for long periods of time) and paragraph 13 (economic activities leading to the discharge of pollutants into water bodies) Part 3 of Article 3 of the Law of Ukraine "On Environmental Impact Assessment" dated 23 May 2017 No. 2059-VIII belongs to the second category of activities and objects that may have a significant impact on the environment and are subject to environmental impact assessment. The planned activities will be financed with foreign loans backed by state guarantees.

The shelling by Russian forces in 2022 of critical water supply infrastructure in the city, including the water intake pumping station and main water pipes from the water intake point on the Dnipro River, caused significant damage, leaving the city of Mykolaiv without a safe or sufficient supply of drinking water. In 2022, water with a high mineral content was supplied to the city's network from the Dnipro-Buh Estuary, which led to the destruction of significant sections of steel pipelines.

The state of the water supply system deteriorated significantly in 2023 when Russia destroyed the Kakhovka hydroelectric power plant dam, causing further damage downstream along the Dnipro River. This had a negative impact on water intake facilities in the Kherson region and left the city of Mykolaiv without access to a reliable source of drinking water.

The city of Mykolaiv has not been supplied with drinking water of the required quality in recent years. At the end of 2024, the city was still supplied with water that did not meet established standards through an irrigation canal (Snihuriv) on the Inhulets River, a tributary of the Dnipro River.

These changes in the city's water supply system, which took place in 2022-2023 due to Russian military aggression, also significantly affected the operation of the waste treatment plants (WTPs) in Mykolaiv (village of Halytsynove). The city's population has a mixed water supply system, which has complicated the work of municipal wastewater treatment plants due to the discharge of salt concentrate with a mineralisation of 2.3-11.0 g/m3 (exceeding the requirements of DSanPiN 2.2.4-171-10 for mineralisation by up to 11 times) into the sewerage network.

The overall objective of the city's water supply is to ensure a sustainable and safe water supply in the required quantity and quality through the use of the following sources:

- Snihurivka irrigation canal (Inhulets River);
- Dnipro River;
- Southern Buh River in the area of Nova Odesa;
- Vitovske (formerly Zhovtneve) reservoir;
- Buh Estuary (for emergency short-term use).

To this end, the existing WTP will be reconstructed and a new technological chain will be installed, which will allow water from any of the above-mentioned sources to be purified to drinking water quality standards.

Although the desired future scenario is to supply the city from the Dnipro and/or Southern Buh rivers via the Zhovtneve (Vitovske) reservoir, the only available water sources at present are the Inhulets River as the main source and the Buh Estuary as an emergency short-term source. Water from both sources requires

purification according to microbiological indicators, as well as turbidity, colour, organic matter content, and desalination. While water from the Inhulets has a salinity of up to 3,500 mg/dm3, water from the Bug Estuary has a total soluble solids content of up to 12,000 mg/dm3. To this end, it is planned to reconstruct the existing water treatment facilities of the WTP.

The positive impact on the social environment will be to provide the city of Mykolaiv with high-quality drinking water. Drinking water will comply with the requirements of DSanPiN 2.2.4-171-10 "Hygienic requirements for drinking water intended for human consumption" and the EU Drinking Water Directive 2020/2184.

Thanks to the reconstruction of water treatment facilities in Mykolaiv and the introduction of modern water treatment technology from five different sources, the reliability and sustainability of water supply for the city of Mykolaiv is ensured. This approach guarantees uninterrupted drinking water supply even in emergency situations, including those caused by military actions, and reduces the city's dependence on individual water sources. The implementation of this project is an important step towards strengthening water security and improving the resilience of critical infrastructure in times of crisis.

Impact of planned activities on the air environment

Reconstruction

During the preparatory and construction works, the gross emissions of pollutants into the atmosphere will amount to 3.721 tonnes per year.

During construction work on the construction site and on the boundary of the first line of residential development, the concentration of any pollutant shall not exceed the hygienic standards for air in populated areas and shall comply with the requirements of the current sanitary legislation of Ukraine.

Operation

During operation of the WTP after reconstruction, gross emissions of pollutants into the atmosphere (including carbon dioxide) will amount to 181,046 tonnes per year.

During operation of the WTP at the boundary of the first line of residential development, the concentration of any pollutant will not exceed the hygienic standards for air in populated areas and will comply with the requirements of the current sanitary legislation of Ukraine.

Impact of planned activities on the aquatic environment

Reconstruction

In order to protect the aquatic environment, the Construction Method Statement sets out the following requirements:

- runoff generated on the construction site (the WTP territory) will be collected and removed using the rainwater collection system existing on the WTP territory. The Method Statement provides for two mobile reinforced gantries for washing the wheels of construction equipment, each equipped with a pallet and special side screens. Waste water after washing shall be collected by special vehicles and transferred to a specialised organisation in accordance with the agreement concluded.

- technical inspection, cleaning and washing of construction machine bodies, as well as refuelling of equipment on the construction site of the facility is not provided for and will take place in specially designated and organised locations (outside the construction site at special refuelling stations) in accordance with the requirements of Ukrainian legislation.

- surface drainage, slope reinforcement;

- equipping construction sites with special areas for waste and rubbish collection and disposal, installing bio-toilets and fencing off the territory;

- use of modern environmentally friendly, energy-efficient construction equipment and technology.

To minimise the negative impact of earthworks, dust suppression (hydro-dust removal) will be carried out. To this end, its moisture content must be brought to 8%. According to preliminary data, approximately 4,000 m^3 of fertile soil and 35,600 m^3 of soil will be removed in connection with the construction of a pipeline for transporting brine. Water used for dust suppression is irretrievable and will amount to 3,168 m^3/year. Water will be supplied from a technical water supply system.

During construction, the impact on the aquatic environment is considered acceptable and insignificant.

Operation

The reconstruction of the wastewater treatment plant in Mykolaiv involves the construction of a station for the treatment (purification) of wash water and its reuse (purified wash water is fed into the head of the WTP), while the removed and dewatered sludge is disposed of (transported to a solid waste landfill), ensuring a closed filter washing cycle. This will have a positive impact on the aquatic environment, as 16,731.6 tonnes of sludge from wash water per year will not enter the Vitovka River and the Buh Estuary, but will be transported to a solid waste landfill.

Impact of planned activities on groundwater

Reconstruction: No impact.

Operation: No impact.

Impact of planned activities on public health

Reconstruction

During construction work on the edge of residential buildings, the concentration of pollutants in the air and noise pollution from construction equipment in residential areas will comply with health requirements. Equivalent sound levels during the day will be 48.2 dBA. During the reconstruction work, temporary inconveniences may occur due to the movement of heavy vehicles on adjacent local roads.

The impact on the social environment is considered acceptable.

Operation

During the operation of the WTP at the edge of residential buildings, the concentration of pollutants in the atmospheric air will comply with sanitary requirements.

There is a negligible probability of harmful effects on the respiratory system in case of non-compliance with the requirements of the OHS regarding the use of personal protective equipment during associated works on the territory of the WTP.

According to calculations, the risk of carcinogenic effects from the planned activity is acceptable.

The results of risk calculations showed that the operation of the WTP in Mykolaiv will not have a negative impact on public health.

Impact of planned activities on flora and fauna

Reconstruction

The estimated total number of green spaces to be removed is 260.

At the next stage of design, a list of green spaces to be removed will be drawn up and compensation measures will be planned.

Due to the fact that all the habitats studied have been modified as a result of human activity, no significant impact on fauna is expected. During the study of the area where construction work is planned, no habitats or species of plants and animals requiring special protection were identified. The activities planned within the existing WTP of the city of Mykolaiv, MUC "Mykolaivvodokanal", will not lead to a transformation of the biodiversity structure within its boundaries.

Operation: No impact.

Impact of planned activities on biodiversity

Reconstruction

During the study of the project implementation area, no habitats or plant and animal species requiring special protection were identified.

The activities planned in the existing WTP of Mykolaiv, MUC "Mykolaivvodokanal", will not lead to a transformation of the biodiversity structure within their boundaries.

Operation: There is no impact on biodiversity during the operation of the WTP.

Impact of planned activities on land and soil

Reconstruction

The reconstruction of the WTP is planned within the existing land plot (cadastral number 4810136600:06:042:0051), with an area of 52.8282 hectares, allocated for the economic activities of the enterprise. There is no vegetation layer in the soil. As for the construction of a pipeline for transporting brine, temporary land allocation with an estimated area of 4.5 hectares is planned for its construction. Before the start of pipeline construction, the fertile soil layer is to be removed, according to geological survey data (approximately 4,000 m^3). The surface soil cover (fertile soil layer) will be removed based on a working land management project developed in accordance with the procedure established by law for the removal and transfer of the fertile soil layer, which will specify the scope of work for the removal, transfer and storage of the fertile soil layer and, in the case of earthworks, also the scope of work for the rational use of the fertile soil layer that is removed or accumulated, the technologies developed and the sequence of work, as well as the costs of their implementation.

The estimated volume of fertile soil removed, amounting to 4,000 m3, will be stored in dumps at the edge of the temporary diversion area and, after completion of the brine pipeline construction, will be returned to its original location to reinforce the disturbed areas in the same quantity of 4,000 m^3. A balance sheet for the fertile soil layer will be drawn up at the next stage of the project.

During the construction of the brine pipeline, an estimated 35,600 m^3 of soil will be removed, with 28,620 m^3 of soil being returned to the trench. As a result of the work, there will be an excess of 6,980 m^3 of soil, which will be transferred either to the Infrastructure Restoration and Development Service in the Mykolaiv region or used as an insulating layer at a solid waste landfill (this issue will be resolved at the next stage of design).

The impact on the soil is temporary. With proper execution of the work and compliance with environmental legislation, the impact can be minimised.

Operation: During operation, the WTP has no impact on the geological environment or soil.

Impact of planned activities on climate factors

Reconstruction: No impact.

Operation:

An analysis of climate projections for Mykolaiv based on the RCP 4.5 and RCP 8.5 scenarios indicates moderate to high risks for the water supply sector, in particular due to rising average air temperatures, more extreme heat waves, changes in precipitation intensity and increased pressure on freshwater ecosystems. At the same time, there is no risk from wind loads. These challenges can be effectively addressed through the implementation of targeted adaptation measures.

The project to reconstruct the water treatment plant (WTP) in Mykolaiv is not only aimed at solving pressing problems with the quality and stability of water supply, but also makes a significant contribution to adaptation to the effects of climate change. Thanks to the introduction of modern treatment technologies, improved energy efficiency, modernisation of engineering infrastructure and reduced water losses, the project will contribute to:

- Improving the resilience of the water supply system to extreme weather conditions, including heat waves and precipitation fluctuations.
- Reducing anthropogenic pressure on freshwater ecosystems by reducing water losses and introducing technologies for the reuse of treated water.

- Optimising energy consumption and reducing greenhouse gas emissions, which is an important component on the path to climate neutrality.
- Improving the microclimate of the site, in particular through planned greening measures, heat-resistant materials and passive cooling.

Thus, the implementation of the project will have not only engineering and technical significance, but also environmental and climatic significance, contributing to the adaptation of urban infrastructure to climate change and the sustainable development of the Mykolaiv region.

Impact of planned activities on archaeological and cultural heritage sites

Reconstruction

There are no cultural heritage sites in the vicinity of the WTP. The only historical monument located 100 m from the pipeline construction site for brine transportation is the Mohyla-Mayachna burial mound. . There is no information about the official protection status of the Mohyla-Mayachna burial mound.

Due to the significant distance between the burial mound and the brine pipeline construction site, the impact is considered insignificant. However, the project provides for more detailed research at the next stage of design and the development of an Action Plan in case an object with signs of archaeological heritage or historical and cultural heritage is identified.

Operation: No impact.

Impact on the landscape

Reconstruction No impact.

Operation: During operation, the WTP has no impact on the landscape.

Impact of planned activities on socio-economic conditions

Reconstruction

During construction work on the edge of residential buildings, the concentration of pollutants in the air and noise pollution from construction equipment in residential areas will comply with health requirements. Equivalent sound levels during the day will be 48.2 dBA. During the reconstruction work, temporary inconveniences may occur due to the movement of heavy vehicles on adjacent local roads.

The impact on socio-economic conditions is considered acceptable and insignificant.

Operation

During operation of the WTP at the boundary of the residential area, the concentration of pollutants in the atmospheric air and noise levels in the residential area will comply with sanitary requirements. Equivalent sound levels during the day will be 35.8 dBA.

The impact on the social environment is considered positive.

The positive impact on the social environment will be to provide the city of Mykolaiv with high-quality drinking water. Drinking water will comply with the requirements of DSanPiN 2.2.4-171-10 'Hygienic requirements for drinking water intended for human consumption' and the EU Drinking Water Directive 2020/2184.

Thanks to the reconstruction of water treatment facilities in Mykolaiv and the introduction of modern water treatment technology from five different sources, the reliability and sustainability of water supply for the city of Mykolaiv is ensured. This approach guarantees uninterrupted drinking water supply even in emergency situations, including those caused by military actions, and reduces the city's dependence on individual water sources. The implementation of this project is an important step towards strengthening water security and improving the resilience of critical infrastructure in times of crisis.

Impact on the environment caused by light, heat, radiation pollution, electromagnetic and ionising radiation

Reconstruction

The project does not provide for construction work at night. Light pollution is not expected.

Heat pollution may occur during the construction of the reinforced concrete pavement of the WTP territory. The road surface may heat up when the air temperature reaches +28°C to 40-42°C. When laying the road surface on the WTP territory, a separating layer made of geosynthetic material with a surface density of 400 g/m2 is to be used, which has very low thermal conductivity and will therefore not affect soil heating.

The use of installations, equipment and materials that emit radiation pollution into the environment, as well as electromagnetic or ionising radiation at the facility, is not expected.

Operation

During WTP operation, there is no environmental impact from light, heat, radiation, electromagnetic or ionising radiation.

Waste

Reconstruction

The estimated amount of waste generated during the reconstruction process is 22,312.7 tonnes. Industrial and domestic waste will be stored in metal containers with lids, installed in designated areas. Temporary waste storage areas will be provided with a solid covering to prevent hazardous waste components from entering the soil. Waste will be accumulated to volumes that allow for its transfer in terms of economic feasibility, subject to compliance with applicable industrial waste management regulations.

Operation

The estimated annual amount of waste from the operation of the WTP is 16,842.812 tonnes, of which 16,731.6 tonnes/year is dehydrated sludge.

A site with separate waste collection containers is planned for temporary storage of waste. Waste will be sorted according to class and taking into account the possibility of further use. Separate containers will be allocated for glass, waste paper, metal products and polymers. Solid household waste will be regularly transported to the municipal solid waste landfill.

Conclusions

The proposed project is technically and socially feasible, complies with Ukrainian environmental legislation and EU standards, and will ensure a reliable and safe water supply for the city of Mykolaiv. It will reduce dependence on a single water source and make the water treatment system more resilient to crisis situations.

13 - LIST OF REFERENCES INDICATING THE SOURCES USED FOR DESCRIPTIONS AND ASSESSMENTS

1 Law of Ukraine "On Environmental Impact Assessment" dated 23 May 2017 No. 2059-VIII

2 DSanPiN 2.2.4-171-10 "Hygienic requirements for drinking water intended for human consumption"

3 EU Drinking Water Directive 2020/2184

4 DBN V.1.1-25-2009 "Protection against hazardous geological processes, harmful operational influences, and fire. Engineering protection of territories and structures against flooding and inundation"

5 DBN B.2.2-12: 2019 "Planning and Building Territories"

6 DBN V.2.2-282010 "Buildings and Structures. Buildings for administrative and domestic purposes"

7 DSTU B V.2.5-32:2007 "Engineering equipment of constructions and buildings. External networks and constructions. Free-flow pipes made of polypropilene, polyethylene, unplasticised polyvinylchloride and their shaping parts for outer sewage systems of buildings and constructions and cable sewage. Technical conditions"

8 DSTU B V.2.6-106:2010 "Concrete and reinforced concrete structures for wells of sewerage, water supply and gas pipelines. Technical conditions (GOST 8020-90, MOD)"

9 DSTU B EN 12201-2:2018 "Pipeline systems for water supply, drainage and sewerage under pressure. Polyethylene (PE). Part 2. Pipes (EN 12201-2:2011 + A1:2013, IDT)"

10 DSP 173-96 "State sanitary rules for the planning and construction of settlements. With amendments"

11 DSTU 9030:2020 "Motorways. Assessment of environmental impact"

12 Order of the Ministry of Community and Territorial Development of Ukraine dated 15 June 2021 No. 156 On approval of estimated norms in Ukraine for construction

13 M 218-03449261-628:2007 "Industry-specific methodology for determining specific emissions of major pollutants in the production of asphalt concrete mix"

14 "Collection of methods for calculating the content of pollutants in emissions from unorganised sources of atmospheric pollution", UkrNTEC, Donetsk, 1994.

15 Emission indicators (specific emissions) of pollutants from electric and gas welding, surfacing, electric and gas cutting, and metal spraying processes, approved by the Minister of Ecology and Natural Resources of Ukraine on 11 January 2003

16 Collection of emission indicators (specific emissions) of pollutants into the atmosphere by various industries, UkrNTEC, Donetsk, 2004, vol. II

17 Methodology for calculating concentrations in the atmosphere of harmful substances contained in industrial emissions. OND-86

18 DBN 3.1-5:2016 "Organization of construction production"

19 Resolution of the Cabinet of Ministers of Ukraine dated 20 October 2023 No. 1102 "On approval of the Procedure for classification of waste and the National List of Waste"

20 SOU 42.1-37641918-096:2012 "Production norms for natural losses of basic road construction materials"

21 Standards for the consumption of materials and tools for the repair and maintenance of passenger cars NIIAT, M., Transport 1977

22 DSTU-N B V.1.1-35:2013 "Guidelines for calculating noise levels in rooms and areas"

23 DSP No. 463 "State sanitary norms for permissible noise levels in residential and public buildings and in residential areas"

24 Resolution No. 62 of 01.12.1997 on the introduction of State Hygienic Norms of Radiation Safety of Ukraine (NRBU-97)

25 "Collection of indicators of emissions (specific emissions) of pollutants into the atmosphere by various industries. Volume 1, Donetsk, 2004".

26 Methodology for determining "Emissions of pollutants into the atmosphere from municipal sector boilers with a capacity of less than 50 MW"

27 "RD 51-100-85 Methodological recommendations for the regulation of air pollutants in gas storage facilities: VNII-Gas, 1985"

28 "Collection of indicators of emissions (specific emissions) of pollutants into the atmosphere by various industries" Ukrainian Scientific Centre for Technical Ecology, Volumes I-III, Donetsk, 2004

29 EBRD methodology for assessing greenhouse gas emissions
30 Yu.A. Shevchenko, T.D. Dmitrienko "Reference book on sanitary cleaning of cities and towns", Kyiv: Budivelnyk, 1978, p. 161
31 DBN B.1.1-31:2013 "Protection of territories, buildings and structures from noise"
32 DSTU – H Б.В.1.1-33:2013 "A guide of calculating and designing protection from noise in settlement territory".
33 DSN 3.3.6.03799 "Sanitary norms of industrial noise, infra and ultrasound"
34 Water Code of Ukraine
35 Order of the Ministry of Health of Ukraine dated 02.05.2022 No. 721 "On approval of Hygienic standards for water quality of water bodies for drinking, domestic and other needs of the population"
36 Order of the Ministry of Environmental Protection and Natural Resources of Ukraine dated 05.03.2021 No. 173 "On approval of Methodological recommendations for the development of standards for maximum permissible discharge of pollutants into water bodies with return waters"
37 DBN-N B V.1.1-27:2010 "Protection against hazardous geological processes, harmful operational influences, and fire. Building climatology"
38 DBN V.1.2-2:2006 "System for ensuring the reliability and safety of building structures. Loads and influences. Design standards"
39 DBN V.1.1-12: 2014 "Construction in seismic areas of Ukraine"
40 DBN B V.2.1-2:-96 "Foundations and basements of the buildings and constructions. Soils. Classification (GOST 25100-95)"
41 Resolution of the Cabinet of Ministers of Ukraine dated 15 December 2021 No. 1325 "On approval of standards for maximum permissible concentrations of hazardous substances in soils, as well as a list of such substances"
42 Law of Ukraine "On the Red Book of Ukraine"
43 National Atlas of Ukraine, 2007
44 Order of the Ministry of Health of Ukraine dated 10 May 2024 No. 813 "On approval of state medical and sanitary standards for the permissible content of chemical and biological substances in the atmospheric air of populated areas"
45 Order of the Ministry of Health of Ukraine dated 09.07.2024 No. 1192 "State medical and sanitary standards for permissible levels of chemical substances in the air of the working area"
46 Resolution of the Cabinet of Ministers of Ukraine dated 07.05.2022 "Certain issues of state control over compliance with legislation on food products, feed, animal by-products, animal health and welfare, state veterinary and sanitary control and the import of goods into the customs territory of Ukraine during the period of martial law"
47 DBN A.2.2-1-2021 "Composition and content of environmental impact assessment (EIA) materials"
48 DBN A.2.2-1:2021 "Composition and content of materials for environmental impact assessment (EIA) in the design and construction of enterprises, buildings and structures"
49 Methodological recommendations "Assessment of carcinogenic and non-carcinogenic risks to public health from chemical pollution of atmospheric air", Order No. 1811 dated 18.10.2023
50 Resolution of the Cabinet of Ministers of Ukraine dated 23 September 2020 No. 880 On approval of the list of activities resulting in greenhouse gas emissions subject to monitoring, reporting and verification
51 DSN 3.3.6.039-99 "State sanitary norms of production general and local vibration"
52 Environmental and social standards, 2022
53 Law of Ukraine "On Waste Management"
54 Order of the Ministry of Environmental Protection of Ukraine No. 309 dated 27.06.2006 "On approval of standards for maximum permissible emissions of pollutants from stationary sources"
55 Order of the State Statistics Service dated 4 April 2024 No. 84 On approval of the form of state statistical observation No. 2-TP (air) (annual) "Report on emissions of pollutants and greenhouse gases into the atmosphere from stationary sources of emissions"
56 RD 52.04.52-85 Regulation of emissions under unfavourable meteorological conditions. Methodological guidelines
57 NAPB A.01.001-2014 "Fire safety regulations in Ukraine"
58 Resolution No. 6 dated 09.01.2014 On approval of the list of facilities for which the design documentation for construction must include a section on civil protection engineering measures

59 DSTU 8773:2018 “Composition and content of the section on civil protection engineering measures in the design documentation for the construction of facilities. Basic provisions”.

ANNEXES

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