KAZAKHSTAN

AKTOBE WWTP MODERNISATION PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

July 2023

LIST OF ACRONYMS AND ABBREVIATIONS

AAQD	Ambient Air Quality Directive
amsl	above mean sea level
AD	Anaerobic Digestor
ASEG	Aqtobe Su-Energy Group
BAT	Best Available Technologies
BLS	Bureau of Labour Statistics (USA)
BOD	Biological Oxygen Demand
CESMP	Contractor's Environmental and Social Management Plan
CHP	Combined Heat and Power (facility)
CREM	Committee for Regulation of Natural Monopolies (of the Ministry of National Economy)
E&S	Environmental and Social
EBRD	European Bank for Reconstruction and Development
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
END	Environmental Noise Directive
ESAP	Environmental and Social Action Plan
ESIA	Environmental and Social Impact Assessment
ESP	Environmental and Social Policy
ESMP	Environmental and Social Management Plan
ETS	Emission Trading Scheme
EU	European Union
EUR	Euro
FS	Feasibility Study
FU	Functional unit
GBVH	Gender-Based Violence and Harassment
GET	Green Economy Transition
GHG	Green House Gas
GIP	Good International Practice
GM	Grievance Mechanism
GoK	Government of Kazakhstan
HR	Human Resources
H&S	Health and Safety
IFC	International Finance Corporation
ILO	International Labour Organisation
ISO	International Organization for Standardisation
JSC	Joint Stock Company
KazCenter	JSC Kazakhstani Center for the Modernization of Housing and Utilities Sector
KZT	Kazakhstani Tenge
LCU	Lifecycle assessment
MEGNR	Ministry of Ecology Geology and Natural Resources
MPP	Maximum permitted pollution
OHS	Occupational Health & Safety
PIP	Priority Investment Programme
PPE	Personal Protective Equipment
PR	Performance Requirements (EBRD)
PS	Pumping Station
p.e./P.E.	Population Equivalent
SEE	State Environmental Expertise
SEP	Stakeholder Engagement Plan
SPS	Sewage Pumping Stations
SPZ	Sanitary Protection Zone
ToR	Terms of Reference
URE	Discharge levelling reservoir
WFD	Water Framework Directive
WS	Water Supply
WTP	Water Treatment Plant
WW	Wastewater

WWT	Wastewater Treatment
WWPS	Wastewater Pump Station
WWTP	Wastewater Treatment Plant

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1 EXECUTIVE SUMMARY

The Environmental and Social Impact Assessment (ESIA) has assessed the potential environmental and social (E&S) impacts of the proposed Project to construct a new EU-compliant Wastewater Treatment Plant (WWTP) to replace the existing WWTP in Aktobe City, which is operated by Aqtobe Su-Energy Group (ASEG). The location of the site of the new WWTP, which is immediately adjacent to the existing WWTP, is considered appropriate as it allows for continued use of key inflow and outflow piping infrastructure. Furthermore, the new WWTP will be located two km from the nearest residential area.

The overall impacts of the proposed WWTP Project are assessed to be positive. There are no significant negative impacts expected after successful implementation of proposed mitigation measures included in the Environmental and Social Management Plan (ESMP) for the Project. This applies to both environmental and socio-economic aspects.

1.1 Environmental Aspects

1.1.1 Benefits

The existing WWTP effluents are of very poor quality and raw sludge is dried and treated in sludge ponds without prior stabilization. Both the sludge handling and effluents from the existing WWTP result in substantial odour problems. In particular, the poor effluent quality carries foul odours several kilometres downstream, negatively effecting wellbeing in nearby communities. It also has negative impacts on downstream water quality and aquatic habitats in the discharge levelling reservoir (URE) and the Ilek river.

Hence, the most significant impact of the Project will be improvements in effluent quality to EU and national standards, and the sludge treatment will be much improved with the introduction of anaerobic digestion (AD) to the WW treatment process. Both aspects are expected to significantly reduce or eliminate current odour problems. The improved WWTP sludge handling will also substantially reduce the Green House Gas (GHG) emissions associated with wastewater treatment, compared to the current situation. The outcome of the proposed Project will create an opportunity to reuse both the effluents and sludge for agricultural purposes.

The effluents from the existing WWTP are continuously discharged to the man-made URE reservoir and then released to the Ilek river during spring each year. This arrangement is planned to continue for the treated effluents from the proposed new WWTP. There have been concerns about the integrity of the URE dam wall if the reservoir is filled to its full capacity of 40 million m^3, as water percolates into the dam wall with elevated risk of dam failure. Hence, to ensure safety of the URE dam for continued use by the proposed WWTP, it is required that an independent third-party dam integrity and safety assessment of the URE retention reservoir is performed, prior to its continued use for the new WWTP.

1.1.2 Adverse impacts

Potential negative environmental impacts of the project are mostly typical for construction activities and operation of WWTP of similar size and complexity. These include risks of contamination of soil, surface and groundwater through daily construction and operation activities, air quality and noise. Given the relatively low sensitivity of the affected receptors, and substantial distance to residential areas, such impacts are considered of minor to moderate significance if not adequately managed, but they can be effectively mitigated through the implementation of proposed standard measures. Effective mitigation requires implementation of a robust Environmental and Social (E&S) management system in line with international good practice management system standards. This will bring the negative environmental impacts of the Project to be minor or negligible.

Additionally, construction and operation of the Project is associated with risks for worker health and safety, which are typical to construction and WWTP treatment activities. For this, ASEG and the involved contractors must adopt strict H&S management procedures. Hence, a prerequisite for successful Project implementation is that Environmental & Social (incl. Health and Safety) management is fully adopted, led, and supervised by ASEG, and integrated in all works conducted by contractors involved in the Project. To enable this, training, and capacity building in E&S management amongst ASEG staff and its partners needs to be organised throughout the Project lifecycle.

1.2 Socio Economic Aspects

1.2.1 Benefits

The Project will through improvement of the wastewater treatment have a positive effect on the prevalence of water and sanitation related diseases in the Project area. This will, together with the significant reduction in odour which is mentioned by communities as a significant annoyance, substantially improve the health and wellbeing of the population in the Project area.

The construction of the WWTP will require around 100 workers during the 36-month construction phase which will create temporary employment opportunities for the population in the nearby villages and in Aktobe Region in general. As construction workers are expected to be hired locally there will be no significant influx of workers.

1.2.2 Adverse Impacts

The Project will have few negative socio-economic impacts. Due to the WWTP site's location in an industrial area with no communities in the proximity, the Project impacts on community health and safety due to construction influence on air quality and noise are of moderate significance and will with adequate mitigation and management be reduced to minor significance. Increased traffic and transport are moderate during construction if not adequately managed, but they can be effectively mitigated through the implementation of proposed measures. The risk of communicable diseases and the risk of gender-based violence and harassment are assessed to be minor after mitigation as influx of construction workers is not foreseen.

While some employment opportunities will be created during construction, there will be a reduction of WWTP staff in the operation phase, as the current WWTP staffing is considered excessive for the operation of the new WWTP. Efforts will be made to avoid collective dismissals by redistributing staff to other workplaces within the company. In case this is not possible, the process will be carried out in line with national and EBRD requirements.

The Project may lead to increased wastewater tariffs which could have negative impacts for vulnerable groups in Aktobe City. This needs to be monitored during operations to ensure that such impacts are adequately mitigated and managed by ASEG.

Other social aspects such as impacts on land use and cultural heritage are considered negligible after the implementation of proposed mitigation measures.

2 INTRODUCTION

2.1 Context

The European Bank for Reconstruction and Development (the “EBRD” or the “Bank”) is considering providing finance to JSC Aqtobe Su-Energy Group (“ASEG” or the “Company”), a city-owned company providing water supply, wastewater management, and district heating services in Aktobe City. The finance will be used for construction of a new wastewater treatment plant (WWTP) and associated infrastructure (the “Project”).

Aktobe City is located in the north-western part of Kazakhstan and is the administrative centre of the Aktobe Region.

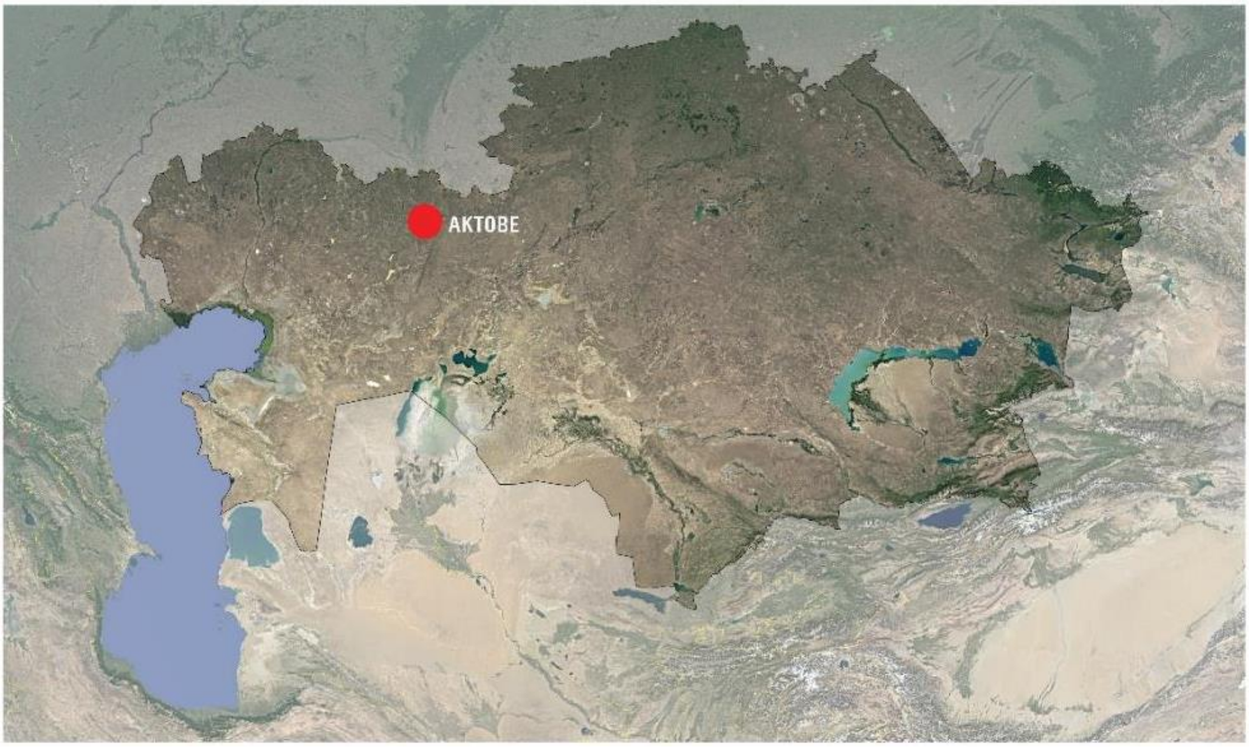

Figure 2.1: Location of Aktobe City in north-western Kazakhstan

A consultancy team from Sweco Danmark and the Kazakhstani company EcoSocio Analysis (the “Consultant”) was engaged by EBRD to conduct a scoping process to identify key environmental and social issues related to the proposed Project and carry out the subsequent Environmental and Social Impact Assessment (ESIA) of the proposed Project.

2.2 Scoping process

The scoping process, which was conducted in February-March 2023, involved initial identification of key environmental and social issues related to the Project. It also scoped out issues that are of lesser or no concern. The scoping process for the Project in Aktobe involved contact to, and consultation with, representatives of several regional and city authorities and individual eco-activists, in addition to several discussions with ASEG.

The outcomes of the scoping process are shown in matrices illustrating interfaces between key Project activities and products and environmental and social receptors. These matrices are presented in the Scoping Report submitted to EBRD and are also included in Annex 3 to this ESIA Report.

2.3 Objectives and key stages of the ESIA process

The ESIA, which builds on the findings during the scoping phase, has the following objectives:

- Assessing any potentially significant future adverse environmental and social impacts associated with the proposed Project.
- Determining measures needed to prevent, minimise, mitigate, and compensate adverse impacts.
- Identifying potential environmental and social opportunities, including those that would improve the environmental and social sustainability of the Project.

The ESIA process is divided into the following key stages:

- Baseline analysis, including analysis of existing data and Consultant's own studies
- Impact assessment
- Management planning

Consultations with stakeholders started during the scoping process and continued during the ESIA. There will be further stakeholder consultations during the public disclosure of this ESIA Report and other documents developed during the ESIA process. The public disclosure process as well as the stakeholder engagement and consultations for the detailed design and construction phases are explained in a separate Stakeholder Engagement Plan.

3 PROJECT DESCRIPTION

3.1 Project overview and location

The **Project** involves the construction of a new Wastewater Treatment Plant (WWTP) for the city of Aktobe in north-western part of Kazakhstan (Figure 3.1). A feasibility study (FS) (April 2023) with a preliminary design of the new WWTP was prepared by the local design agency Aquarem. The proposed new WWTP is to serve a population of nominally 500,000.

The Project comprises the following key infrastructure components:

- Construction of a new WWTP based on activated sludge technology and with design capacity of 100,000 m^3/day average flow and 130,000 m^3/day peak daily flow (500,000 P.E.) compliant with national and EU standards for urban wastewater treatment, including modernisation of a pumping station.
- Anaerobic Digestor (AD) line capacity to treat 195 tons/day of dewatered sludge (at 25% solids) via primary and secondary digestion resulting in on average 22,000 m^3 biogas/day.
- A combined heat and power (CHP) facility to produce heat and electricity from biogas generated by the AD facility, with estimated *approx*. 66,000 kWh/day thermal energy and 50,140 kWh/day electric energy. The power generated by the CHP will be used at the WWTP site.

The project will be implemented in line with the national and EU standards for wastewater treatment, EU requirements for sewage sludge management, EU BAT and EU taxonomy requirements for such facilities. Once implemented, the project will also lead to a reduced level of odour.

Relocation of parts of the existing 110 kV, 35kV and 6kV overhead power lines that are located on the project site will also be required. The overhead lines are planned to be relocated along the perimeter of the new WWTP (further information is included in section 3.3.5 below).This component will be financed from the municipal budget and is considered an 'associated facility' of the proposed Project

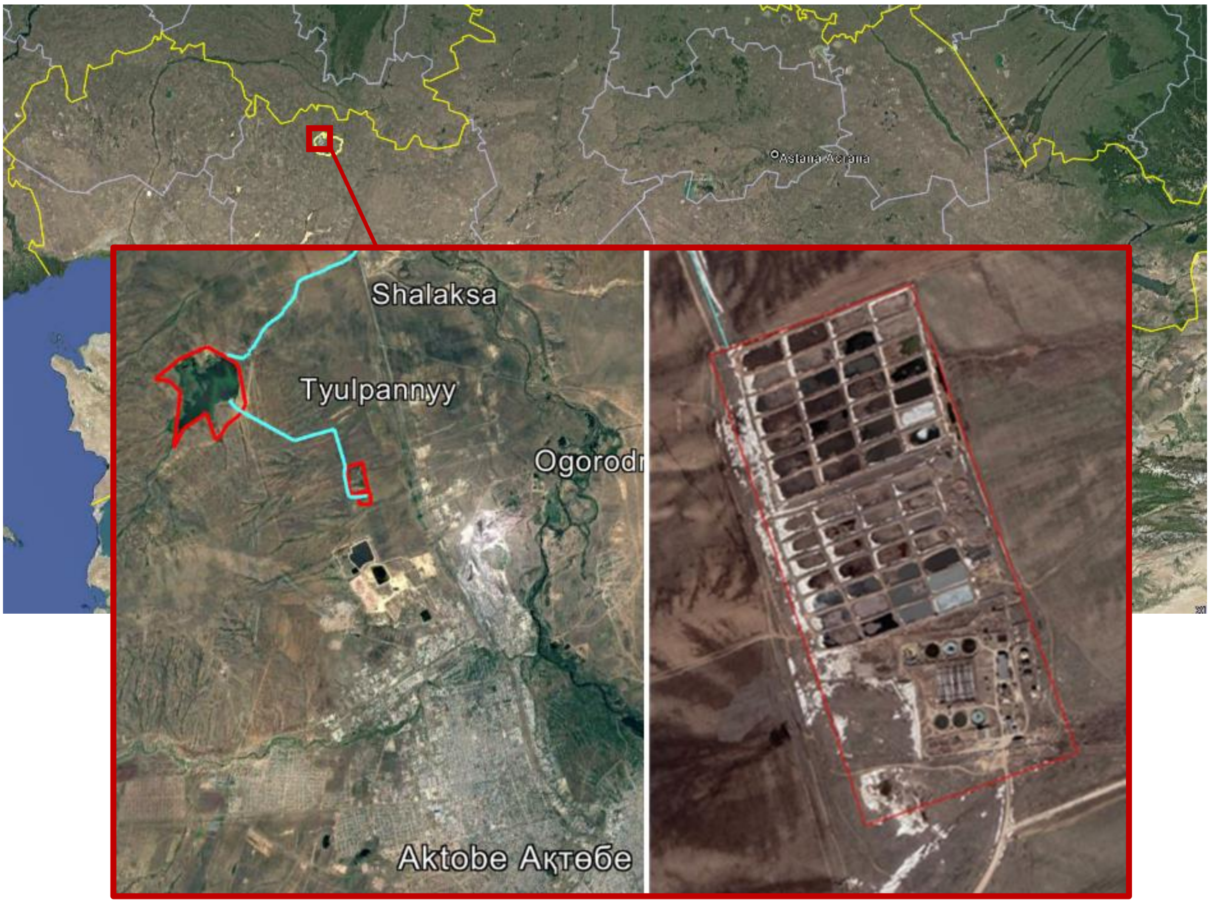

Figure 3.1: Location of the existing Aktobe WWTP and treated effluent (URE) reservoir, north of Aktobe City in north-west Kazakhstan (Source: Google Earth)

The new WWTP will be located on an *approx.* 11 ha plot of land to the east and adjacent to the existing Aktobe WWTP (see Figure 3.2).

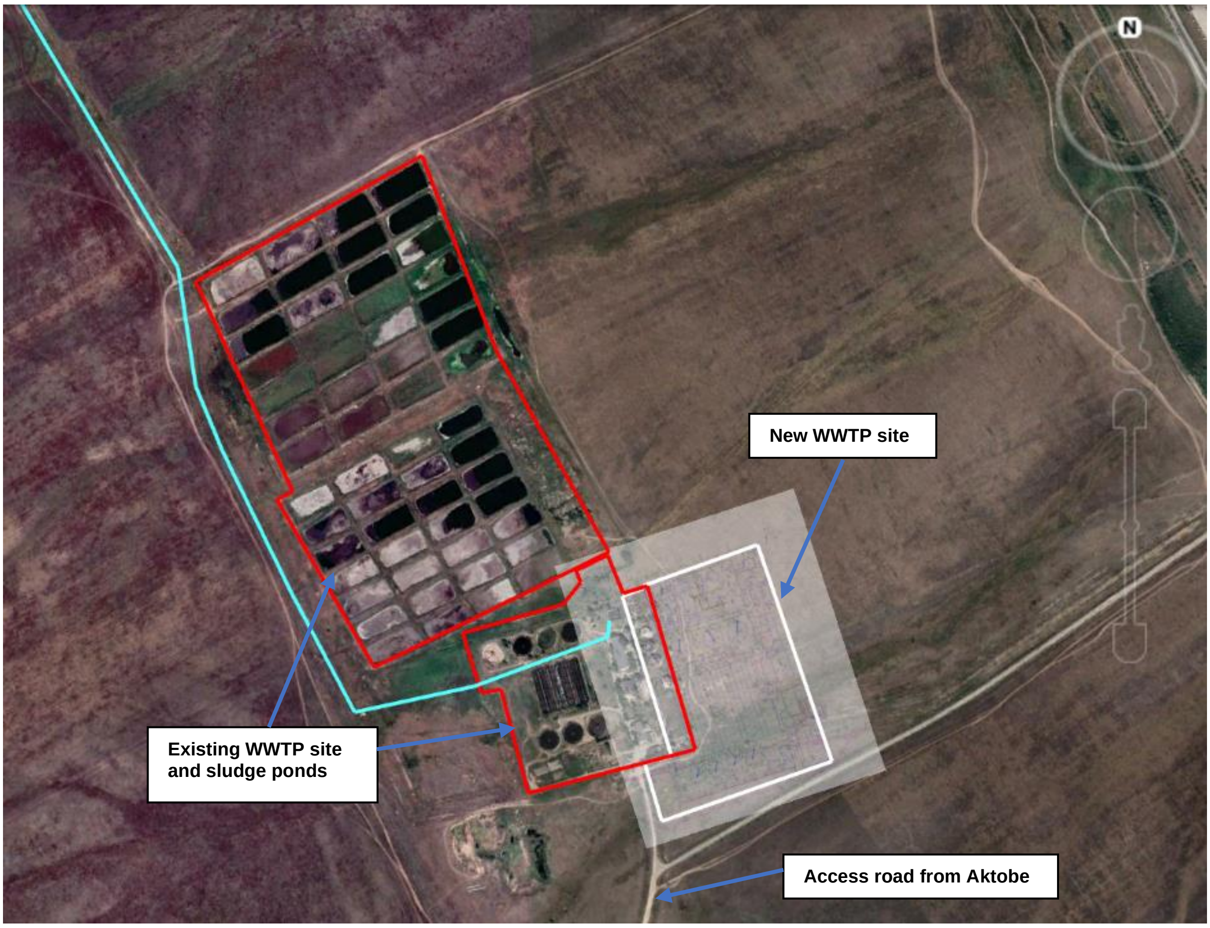

Figure 3.2: The site of the proposed new WWTP to the east of the existing WWTP (Map source: Google Earth)

Selected characteristics of the project in terms of timing and scope are summarised in Table 3.1: below.

Table 3.1: Summary of key project characteristics

Key project characteristics	
Project proponent	Aktobe Su Energy Group (ASEG)
Estimated investment cost (CAPEX)	USD 175.7 million (KZT 78,559,378,638), *incl.* VAT. *Exchange rate as in May 2023: 447 KZT = 1 USD.*
Design capacity for WW treatment	500,000 PE, 100,000 m^3/day average and 130,000 m^3/day peak
Start and duration of construction phase	Planned construction start in June 2024. Duration of construction 36 months.
Estimated commission date of new WWTP	June 2027
Design lifetime of new WWTP	50 years (Civil works) 15 years (Mechanical works)
Number of staff during construction	100
Number of staff during operation	50
Estimated gross power consumption at full operation capacity (MWh/year)	17,000

3.1.1 Project location alternatives

The Feasibility Study (2023) by Aquarem and the Sweco FS (2022) do not consider alternative Project locations. The Project location adjacent to the existing WWTP site is proposed due to different reasons:

- Reuse of existing infrastructure including pipes, the laboratory and also the discharge channel to the URE reservoir and Ilek River.
- Land adjacent to the existing WWTP site available for construction.
- Remote location with 5 km distance to Aktobe City centre, nearest residential area is the Tulpannyy hamlet *approx.* 2 km to the north.

3.2 Existing WWTP and justification of the need for the Project

3.2.1 Description of the existing WWTP

Aktobe has a centralized sewerage system in which domestic wastewater and 16% of all industrial wastewater produced in the city is collected in the sewer collectors and transported by several pump stations to the main pump station (PS) 11, which pumps wastewater into three 8 km long pipelines (2 * ø900 mm, 1 * ø1000 m) to the existing WWTP. The WWTP is a mechanical-biological plant constructed in 1982-1984 with a design capacity of 103,000 m^3/day[1]. The actual wastewater flowrate to the existing Aktobe (WWTP) has been reported as *approx.* 55,000 m^3/day (2018-2020). This is an annual average for the years 2018-2020 based on data from ASEG obtained for the Sweco Feasibility Study (2022), likely based on water consumption as there is no flowmeter. This is understood to be the dry-weather flowrate, and that the inflow may increase to 70,000 m^3/day due to infiltration into the sewage system according to ASEG. ASEG has furthermore informed that tariffs cover only 48,000 m^3/day, the rest being infiltration water.

The existing Aktobe WWTP is located *approx.* 5 km northwest of the city. The existing WW treatment facilities were put into operation in 1981, and reconstruction work was carried out on the site during the period from July 2009 to December 2011. The 70 ha site of the WWTP is located north of the industrial zone, approx. 1 km north of where there are large settling ponds for WW from processing chromite. The nearest residential area is the Tulpannyy hamlet approx. 2 km to the north.

The final recipient of treated effluent from the WWTP is the Ilek river, *approx.* 14 km downstream from the WWTP. The Ilek river flow is very low due to water from the river being used for agriculture and industry upstream. For this reason, the WWTP is not allowed to discharge directly to the river but must collect discharges in a retention reservoir called the discharge levelling reservoir (URE) (See Figure 3.1). Treated effluent from the existing Aktobe WWTP is currently transported via two underground pipes 5.2 km long (ø900 mm) to the reservoir URE (constructed in 1981 with a 25 year' lifetime) which is built in the gulley of a seasonal creek with old clay quarries.

The earth dam of the URE is 2,060m in length and 25m high; dam settlement has resulted in damage to reinforced concrete of the dam top, and risk of dam failure. A study of the URE which is located approx. 4 km northwest of the WWTP, carried out by COWI (2012) showed that the reinforced concrete cover of the headwater of the dam has been damaged as a result of settlement and erosion of the dam body. Hence, there are some concerns about the integrity of the dam if the reservoir is used at its full capacity, due to water percolating into the dam body, with the **associated risk of dam failure**. It is understood that the daily operation of the dam and the retention pond is the responsibility of ASEG.

In the URE, the effluent from the existing WWTP is diluted with the thaw and stormwater and is then discharged along a 9km creek course into the Ilek River near Georgievka village. Discharge from the

[1] Design developed by Lenvodokanalproekt in 1982 and works commissioned in 1984.

URE to the Ilek River is allowed for a period during the year from around 23 March to 5 May when the Ilek River flow is highest to ensure sufficient dilution. The exact timing of discharge is given by the Ilek River flow monitoring point operator Kazgidromet. When the flow of the Ilek River reaches 20m^3/s, the operator informs ASEG and the Water Basin Management Inspection (BVI), which gives a permission to open the 2 reservoir gates of the URE to allow outflow from the URE equivalent to 1/10th of the Ilek River flow (*i.e.,* 2m^3/s).

As with the URE, it is understood that the discharge channel from the URE to the Ilek river will be used as is and in its current form during WWTP operation, and that no construction activities are planned for the channel as part of the WWTP Project. However, in case of future improvements of the channel, e.g., to address erosion of the channel banks, the actual impact from any construction along the channel is considered unlikely to affect the adjacent land plots as their cultivation stops short of the channel due to presence of the old channels (oxbows) and shrubs. Also note that this is not strictly a channel as the URE uses the course of a seasonally drying creek that originally had 3-4m high banks made by thaw water that still flows in the channel bypassing the URE every April. Efforts to secure the channel banks at critical locations can be made, if needed, but any major changes of the channel course are currently found unlikely as these would be costly and complex. Rather, encouraging use of water from the URE for irrigation could effectively reduce flow through the channel and reduce the erosion impact along the channel banks during spring.

The existing Aktobe WWTP utilises a Conventional Activated Sludge treatment process; however, the anaerobic digestion system was discontinued immediately after the WWTP was commissioned. The WWTP has all standard components, *viz.*: screens, grit removal, primary and secondary sedimentation tanks, aeration basins with Activated sludge, sludge beds and sludge storage area.

The existing WWTP includes:
- screens – 3 units;
- circular sand traps – 6 units of $^{\emptyset}$6m;
- primary radial sedimentation tanks – (3 units of $^{\emptyset}$40m);
- mixed sludge pumping station;
- three-corridor biological tanks – 5 units, each of 4 passes;
- secondary radial sedimentation tanks – 4 units of $^{\emptyset}$40 m;
- pumping station and blower station;
- sludge drying ponds - 56 units;
- sand beds;
- regulating reservoir – 40 million m^3;
- administrative and laboratory building;
- sludge thickeners;
- anaerobic digesters (decommissioned);
- reservoirs of surplus activated sludge and domestic wastewater;
- external process pipelines;
- external power supply networks;
- administrative and household services for WWTP.

The existing Aktobe WWTP process was designed with anaerobic sludge digestion and biogas production, but these components were never commissioned. Currently, raw sludge is pumped to a series of sludge ponds for dewatering, which has a number of disadvantages, *incl.:*

i) raw sludge continues to ferment in the sludge ponds, hence producing methane gas (and hence attracting a poor GET calculation);
ii) no biogas is collected which can be combusted for electricity production to reduce electricity costs;
iii) sludge ponds are extensive and space-consuming;
iv) foul odours are produced during the summer months when the dewatered sludge is transferred to long-term storage, which is a public nuisance and breach of the Kazakhstan legislation that allows only 6 months’ siting of waste for entities that do not have a landfill licence.

An existing road provides access from the A-24 main road to the existing Aktobe WWTP site. The access road is shared with the city solid waste landfill. The road is a gravel road in a moderate condition and is considered suitable to support construction and operations for the new Aktobe WWTP.

3.2.2 Need for the new WWTP Project

The city is approximately 62% covered by sewerage networks, however this is expected to increase to up to 80% coverage by the design horizon of 2040, hence increasing the need for WWTP capacity.

Additionally, the mechanical and electrical equipment of the existing Aktobe WWTP is in poor condition and does not treat wastewater to required levels. The existing treatment plant has four treatment lines in parallel, with three lines of biological treatment in a state of disrepair due to the wear of prefabricated reinforced concrete structures of partitions and walls. Currently, only two of the four secondary treatment lines are in operation. The concrete structures are partially damaged, and the reinforcement is exposed. The original design was to utilise anaerobic digestion and biogas production however this has been discontinued. The digested sludge was to be dried in sludge ponds, however the existing treatment plant transports raw sludge to the sludge ponds for drying, where anaerobic digestion occurs and hence sludge removal attracts foul odours. Instead, the existing sludge beds should be replaced with mechanical dewatering devices such as a centrifuge or a belt filter press.

Hence, there is a need for a new modern WWTP that can treat current and future volumes of WW from the city to meet strict effluent quality standards and improve the sanitary and epidemiological well-being of the city's population.

3.3 Proposed New Aktobe WWTP (The Project)

3.3.1 Introduction

A local Feasibility Study (FS) by Aquarem was presented in April 2023, proposing the construction of new WWT works serving a population of nominally 500,000. The object of the local Feasibility Study was the construction of a new wastewater treatment plant with an average influent wastewater capacity of 100,000 m^3/day, and a maximum daily capacity of 130,000 m^3/day for the city of Aktobe.

The FS proposes:

- The use of modern energy-saving technologies and more advanced equipment for wastewater treatment.
- Implementation of the Project would significantly reduce the amount of wastewater pollution and improve the quality of wastewater suitable for irrigation.
- Improvement of the sanitary and epidemiological well-being of the city's population.

The following table summarises the design parameters of the new Aktobe WWTP works, as reflected in the local Feasibility Study (Aquarem, 2023):

Table 3.2: Design parameters for the construction of new WWTP

Design parameters	Unit	Values
Average daily consumption	m^3/day	100,000
Average hourly consumption	m^3/hour	4,167
Average second consumption	m^3/s	1.157
Maximum daily consumption	m^3/day	130,000
Maximum hourly consumption (K=1.47)	m^3/hour	6,120.1
Maximum second consumption	m^3/s	1,700

3.3.2 Inflow characteristics and effluent discharge standards

The influent wastewater parameters have been estimated according to the rate of water consumption and the unit rates of pollution according to SN RK 4.01-03-2011:

Table 3.3: Estimated influent parameters for new Aktobe WWTP

No.	Parameter	Unit pollution rate (g/day*person)	Estimated concentrations Pollution (mg/L)	Actual performance (av./min.)
1	Suspended Solids	65	396.34	421/194
2	BOD ultimate (20 days)	75	457.31	-
3	BOD_5	60	365.85	397.9/163
4	Ammonia Nitrogen, N	8	48.8	44.6/19.8
5	Phosphates, P_2O_5	3.3	20.12	6.6/4.4
6	Detergents	1.6	9.76	-
7	Chlorides, Cl	9	54.88	-
8	Surfactants (surfactants)	2.5	15.24	3.5/04

These estimated parameters are compared to those actually measured by ASEG (2018), as tabled below. The new works for the Aktobe WWTP are to be constructed adjacent to the existing works. The following planned influent wastewater characteristics and effluent discharge standards are proposed:

Table 3.4: Summary of influent wastewater characteristics

The name of indicators	Unit measurements	Estimated values
Estimated values		
Maximum daily	m^3/day	130,000
Maximum hourly	m^3/hour	6,120
Qualitative characteristics of incoming wastewater:		
Suspended solids	mg/L	510
BOD ultimate (20 days)	mgO_2/L	624
BOD_5	mgO_2/L	520
COD	mgO_2/L	845
Nitrogen ammonium salts	mg/L	53.9
Phosphates	mg/L	23.0
Surfactant	mg/L	4.6
Sulphates	mg/L	174
Chlorides	mg/L	288
Iron total	mg/L	0.15
Oil products	mg/L	2.3
Nitrogen nitrite	mg/L	≤0.01
Nitrate nitrogen	mg/L	≤0.11
Characteristics of treated wastewater:		
Suspended solids	mg/L	≤5
BOD_5	mgO_2/L	6.0 (according to BOD ult.)
COD	mgO_2/L	30
Nitrogen of ammonium salts (ammonium ion)	mg/L	2.0
Phosphates	mg/L	3.5
Surfactant	mg/L	0.5
Sulphates	mg/L	350
Chlorides	mg/L	350
Iron total	mg/L	0.3
Oil products	mg/L	0.1
Nitrogen nitrite	mg/L	1.0
Nitrate nitrogen	mg/L	10.1

The discharge standards based on the Maximum Permissible Discharge (MPD) are established for the existing facilities for 2018 - 2027, approved by the Ministry of Environment and Water Resources of the Republic of Kazakhstan, the Committee for Environmental Regulation and Control, the

Department of Ecology of Aktobe Region. The following table summarises the influent characteristics and key discharge parameters for the local discharge standards as specified in the above discharge standards, and compared with the EU discharge standards:

Table 3.5: Comparison of Influent Parameters with Discharge Standards

Qualitative indicators (input/output)				
Indicators	**Units**	**Influent**	**Local Standards Treated Effluent**	**EU Standards**
Suspended Solids	mg/L	510	0.75	35
BOD ultimate (20 days)	mg/L	624	6.0	
BOD_5	mg/L	520	3.0	25
COD	mg/L	844.8	2.0	125
Nitrogen ammonium salts	mg/L	53.9	1.14	*10
Phosphorus total	mg/L	7.5	0.5	**1.0
Surfactant	mg/L	4.6	350	
Sulphates	mg/L	174	350	
Chlorides	mg/L	288	0.3	
Iron total	mg/L	0.15	0.1	
Oil products	mg/L	2.3	1.0	
nitrogen nitrite	mg/L	-	10.2	
nitrogen nitrate	mg/L	-	0.75	

*Total Nitrogen for discharges to sensitive water.
** Total Phosphorus for discharges to sensitive waters.

Note: The local discharge standards are very strict compared to those specified in EU Urban Waste Water Treatment Directive, hence the Project is aligned to the EU's wastewater treatment legislation. The capacity of the new Aktobe WWTP is designed to meet both the local and EU discharge standards for the future influent flowrate.

The discharge standards for the new Aktobe WWTP have been based on water quality standards in the receiving waters specified in accordance with the rules "Sanitary and epidemiological requirements for water sources, places of water intake for domestic and drinking purposes, domestic and drinking water supply and places of cultural and household water use and safety of water bodies" Order of the Minister of National Economy of the Republic of Kazakhstan dated March 16, 2015 No. 209. The following table summarises the water quality standards in the receiving waters.

Table 3.6: Water quality standards for receiving waters

No.	Indicators of the composition and properties of water body	For recreation of the population, as well as reservoirs within the boundaries of populated areas (Category II)
1	Suspended solids	The content of suspended solids should not increase by more than 0.25 milligrams per cubic decimetre[2] (hereinafter mg/dm^3), 0.75 mg/dm^3
2	Floating impurities (substances)	Floating films, stains of mineral oils and accumulations of other impurities should not be detected on the surface of the reservoir.
3	$BOD_{ultimate}$	Should not exceed (at 20 ^OC): 6.0 mgO_2/dm^3; for recreation areas 4.0 mgO_2/dm^3
4	COD	30 mgO_2/dm^3
5	Ammonia (for nitrogen)	2 mg/l
6	Nitrates (according to NO_3)	45 mg/l
7	Nitrites (according to NO_2)	3.3 mg/l
8	Polyphosphates (PO_4)	3.5 mg/l
9	Pathogens	Water should not contain pathogens.
10	Escherichia coli (LCP)	Within the boundaries of populated areas, no more than 5000 in dm^3, for boating and sailing 10000 dm^3, for swimming 1000 dm^3

[2] Note: In the Central Asia region, it is common for discharge standards to be specified in milligrams per cubic decimetre (mg/dm^3), in contrast to Europe where the standards are specified in the SI system as milligrams per litre (mg/L). The measures are the same ($1dm^3$ = 1 Litre).

No.	Indicators of the composition and properties of water body	For recreation of the population, as well as reservoirs within the boundaries of populated areas (Category II)
11	Coliphages	No more than 100 in dm^3
12	Viable helminth eggs	Should not be contained in 1 dm^3
13	Chemical substances	Should not be contained in concentrations exceeding the MPC or MPC

3.3.3 Overall description of the WWTP Process and alternatives considered

The purpose of the new Aktobe wastewater treatment plant is:

I. To produce a treated effluent that is EU-compliant and meeting discharge standards for disposal to the receiving waters.
II. To produce a stabilized sludge suitable for reuse or final disposal.

Due to the sensitivity of the receiving waters (Ilek River) and the strict discharge standards for the WWTP, the treatment process is designed for biological nutrient removal, with EU-compliant treatment of the entire flow of wastewater. The new WWTP should have at least two separate parallel processing lines to facilitate maintenance, and the main elements of the mechanical equipment must have redundant capacities.

Wastewater Treatment technology alternatives

The Feasibility Study (2023) compared a range of wastewater treatment processes for the production of a treated effluent suitable for disposal to the Ilek River. Although the Activated Sludge process is a common industry standard, the secondary treatment process will also be designed for biological nutrient removal. The secondary treatment processes considered included:

- A2O process (Anaerobic-Anoxic-Oxic)
- Johannesburg process
- Modified UCT process

These secondary treatment processes considered are commonly used for the treatment of wastewater and for the biological removal of the nutrients, nitrogen and phosphorus. Based on a qualitative assessment, the optimal process was considered to be the Modified UCT process, due to the advantages of lowest unit costs, high nutrient removal, extensive operating experience, knowledge of the ongoing processes and the proven efficiency of cleaning. For illustrative purposes, a sketch of the Modified UCT process is indicated below[3]:

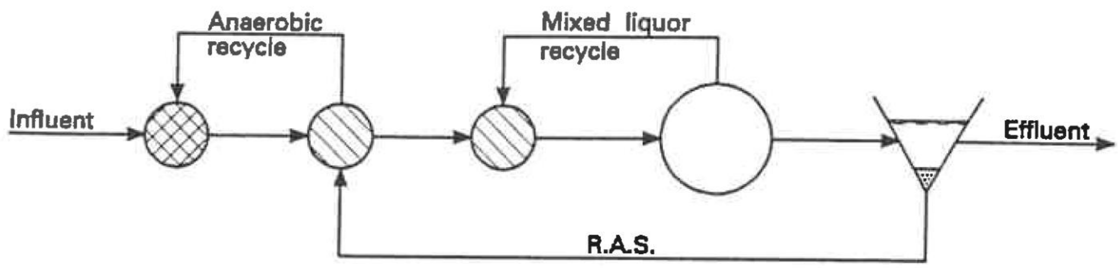

Figure 3.3: Sketch of Modified UCT process.

Note: Whilst the conclusion and choice of treatment process is considered acceptable, Sweco recommends allowing tendering for a range of treatment processes which meet the discharge standards, with the lowest life-cycle cost tender meeting the administrative and technical criteria being suitable for implementation.

[3] In brief: The process includes an anaerobic zone for biological phosphorus removal, first and second anoxic zones (for nitrogen removal) and an aerobic zone (for oxidation of organic pollutants and ammonia), prior to separation of the effluent from the sludge in a sedimentation tanks. The treated effluent is discharged to the receiving waters and the sludge (RAS) is returned to the treatment process.

Sludge Treatment technology alternatives

The Aquarem Feasibility Study (2023) compared two sludge management systems:

I. Anaerobic sludge digestion with production of biogas for combustion in a Combined Heat and Power plant (CHP) for production of electricity.
II. Sludge dewatering, drying and combustion, however no biogas production for electricity generation.

Based on an economic assessment, the Feasibility Study (2023) selected the option of anaerobic digestion of the sludge with biogas production and combustion.

The proposal by Aquarem is to utilise the digested sludge from the WWTP as fertiliser. An area has been proposed for short-term storage of sludge within the WWTP site, prior to collection for land application. However, an actual plan to ensure sufficient offtake of the treated sludge has not been presented. Such a plan needs to be developed, including alternative disposal options in case of insufficient offtake capacity or interest by farms. This pre-construction action has been included in the ESMP for the project.

Sweco notes that for dealing with the digested sludge from the Anaerobic Digestion (AD) process, there are the following options (in order of preference):

1. Sludge re-use for agricultural purposes. This would be consistent with the EU sewage sludge directive and management requirements and exploits the benefit of low-grade fertilizer value. the available land adjacent to the WWTP would be a long-term “sink” for sludge.
2. Sludge storage on-site (at the WWTP site) or at a long-term storage facility. This is feasible due to the excessive land available (especially if the sludge ponds are decommissioned), however provides no economic benefit. There might be opportunity for re-using some of the sludge for horticulture or land rehabilitation uses.
3. Long-term disposal at landfill. This has the disadvantage of reducing the municipal landfill lifetime and provides no economic benefits.

Sludge disposal via incineration is not considered a viable option due to high CAPEX and OPEX involved.

Note: The application of stabilized sludge via anaerobic digestion and heat treatment is consistent with the EU Sewage Sludge Directive, hence the Project is aligned to the EU’s sludge management legislation. The Decommissioning Plan for the sludge ponds (except for a limited number of ponds for emergency requirements) is a requirement of the ESMP.

3.3.4 Technical Description of the proposed new Aktobe WWTP Treatment Process

The new Aktobe WWTP is designed with a Modified UCT process to meet the effluent discharge standards, and with anaerobic digesters for sludge stabilization. The following drawing shows the proposed layout for the new Aktobe WW treatment plant (numbering of the Key Unit Processes in the following figures are based on Aquarem’s detailed drawings):

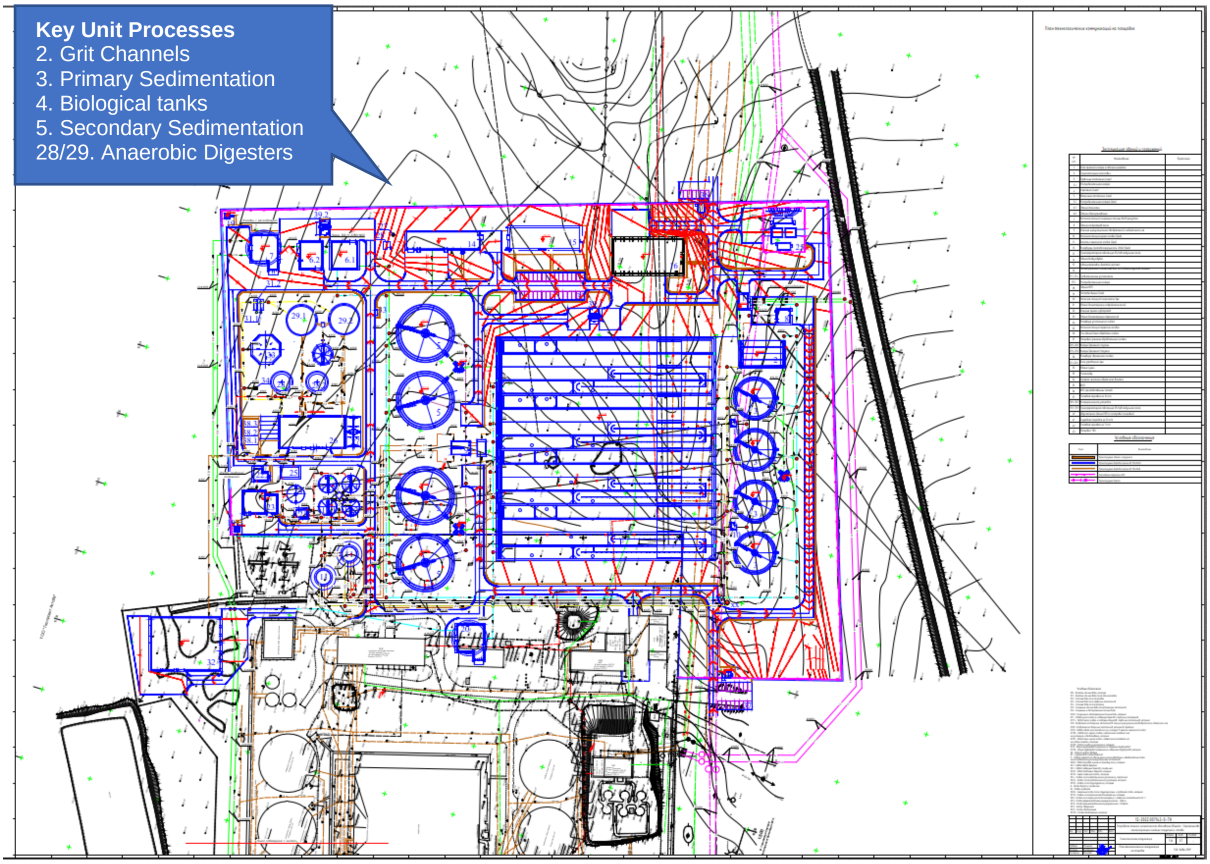

Figure 3.4: Site layout for Aktobe WWTP (blue indicates new works; red indicates earthwork slopes)

Figure 3.5 contains a detailed WWTP process diagram, and a description of the process steps is presented in the below diagram.

Key Unit Processes
2. Grit Channels
3. Primary Sedimentation
4. Biological tanks
5. Secondary Sedimentation
28/29. Anaerobic Digesters

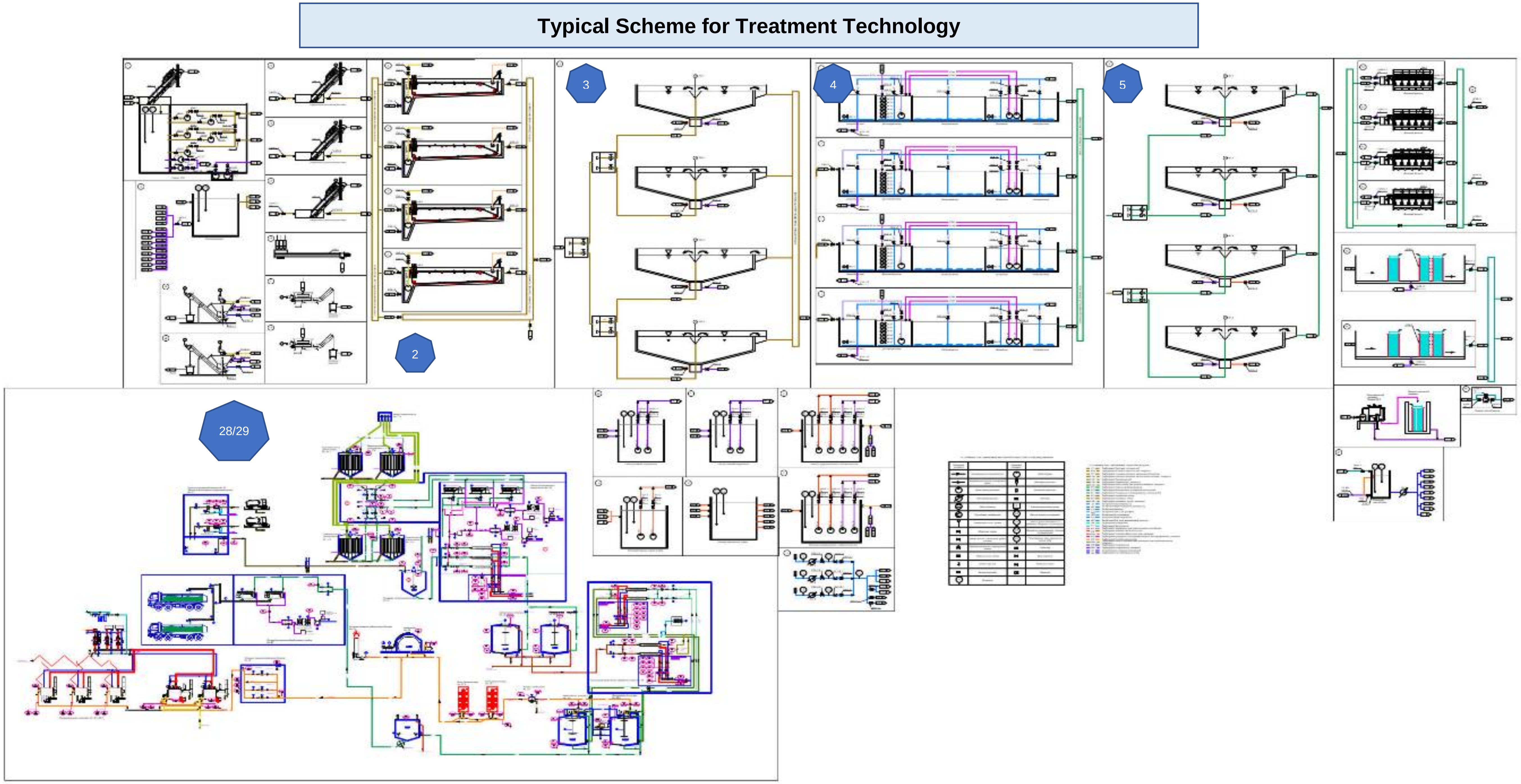

Figure 3.5: Proposed wastewater treatment process layout

The new Aktobe WWTP Process is described below and is based on the site layout in the above figures.

Household wastewater from the city and industrial enterprises enters the main sewage pumping station KNS-11 located 8 km from the existing WWTP, then via two pressure pipelines D1000mm they enter the designed receiving chamber of the building of the Receiving Chamber Block, from which, via gravity pipelines, the wastewater enters mechanical treatment which consists of fine screens, horizontal sand traps, washing and dehydration plant for waste from the screens and sand from the grit traps.

Screenings retained on the screens is transferred via a hydro-chute to a screw washing press, from which they are then automatically dumped into a mobile trailer container-storage, with subsequent removal to landfill agreed with the city's sanitary service.

After the screens, wastewater is fed to horizontal sand traps (Item 2); the sediment from the sand traps is collected by a scraper mechanism and mixed in a pit, from where it is pumped by sand pumps to the building for sand separators and sand washing installation. Washed and dried sand is transported to the municipal solid waste site for disposal.

From the sand traps, wastewater is fed through a gravity pipeline to radial primary settling tanks (refer Item 3), where wastewater is partially treated by removal of settleable solids (primary sludge).

The sludge from the primary settling tanks is fed by gravity to the raw sludge pumping station, from where it is pumped to the sludge mixing tank, where it is combined with excess Activated Sludge from the secondary settling tanks through the circulating and excess sludge pumping station.

From the primary settling tanks, wastewater enters the biological tanks (refer Item 4). Each biological tank includes the following treatment zones separated by reinforced concrete partitions:

- Anaerobic zone (phosphorus removal), which is supplied with wastewater after mechanical treatment facilities and recirculation flow from the anoxic zone, by means of a recirculation pump. Fully anaerobic conditions are maintained in this zone (absence of dissolved oxygen and nitrates). To maintain the sludge mixture in suspension, submersible mechanical mixers are installed in the anaerobic zone.
- Anoxic zone (denitrification), which receives the mixture of the biomass and wastewater from the anaerobic zone, and the "nitrate recycle" sludge mixture from the end of the nitrification zone, and recirculated activated sludge. In this zone, it is necessary to maintain anoxic conditions (absence of dissolved oxygen, presence of nitrates). The concentration of dissolved oxygen in this zone is limited (not more than 0.5 mg/L). Submersible mechanical mixers are installed in the anoxic zone to keep the sludge mixture in suspension. From the end of the anoxic zone, it is planned to recirculate the nitrate-containing sludge mixture to the anaerobic zone (recycle) by mechanical propeller pumps.
- Aerobic zone (nitrification), in which aerobic conditions are maintained at a concentration of dissolved oxygen of 2 mg/L. To do this, the aeration zone is equipped with a fine-bubble diffused air aeration system (disk aerators). The nitrate-containing sludge mixture from the end of the aerobic zone is pumped by propeller pumps to the beginning of the anoxic zone.

After the biological tanks, the Activated Sludge mixture enters the radial secondary settling tanks (refer Item 5), where the Activated Sludge is separated by gravity. The separated sludge from the secondary settling tanks enters the return Activated Sludge pumping station. Circulating activated sludge is returned to the beginning of the biological tanks.

Compressed air is supplied to the aerobic zone from the blower building through two pipelines.

The Return Activated Sludge pumping station serves to separate the flows of circulating (return) and excess sludge.

The Return Activated Sludge is returned to the biological tanks and participates in the biological treatment process; the excess Waste Activated Sludge is pumped into a mixed sludge tank, then sent to the mechanical sludge thickening system for sludge thickening and dewatering.

In the event of an emergency shutdown of the mechanical sludge dewatering shop, a mixture of raw sludge and excess Waste Activated Sludge from the sludge mixing tank is discharged via pumps located in the mechanical sludge dewatering building to the existing emergency sludge ponds. For this reason, a row of 5 sludge ponds should remain as standby units due to emergency.

From the sludge mixing tank, the sludge mixture is pumped to the gravity thickening units through the distribution chamber. Imported substrates from industrial enterprises are collected and then subjected to thermal treatment. The thickened and thermally treated sludge and substrates are collected in the thickened sludge tank, from where they are pumped to the sludge treatment building. After heating in the technical building, the mixed thickened sludge will be pumped to the first stage digesters for pre-digestion. The hydrolysed sludge is returned to the technical building for cooling down to 37°C, and then fed into the second stage digesters for fermentation in the mesophilic mode. The digested sludge is collected in the digested sludge tank, from where it is returned to the technical building for dewatering via centrifuges. Biogas resulting from the sludge fermentation process in the stage II digesters is collected in the upper part of the chambers and discharged to gas holder, with sulphur removal unit. Biogas is supplied to cogeneration units, generating heat and electricity, installed in containers near the technical building. Excess biogas is fed to the flare of combustion system. Generated electricity can be used to power equipment of the plant such as pumps and blowers. Recovered heat is used to maintain the temperature in the digestion tanks, other excess heat can be used for the sludge treatment processes and for heating of various facilities.

Treated wastewater flows to the post-treatment filters. After the filter block, wastewater is fed to the UV disinfection unit. After disinfection, wastewater is transported the URE reservoir from which it is then discharged to the Ilek River. It is understood that the existing pipeline infrastructure for discharge of effluent from the new WWTP to the URE, will continue to be used and hence not affected by the project.

The Aktobe WWTP is designed to dewater the sludge, with the following main characteristics:

Table 3.7: Sludge characteristics

Sludge Characteristics	Quantity
Daily amount of dewatered digested sludge of WWTP (projected)	195 tons/day (dry basis)
Humidity	75%

The installation consists of the following lines:

- Dewatering: two ES1900 drying lines (all in operation) running in parallel and handling the dewatered sludge.

The dewatering process is carried out in a closed circuit in order to ensure a high efficiency of the process. A heat recovery system will also be supplied, using the excess energy of the process gas to produce hot water.

After the drying process the sludge will be stored and covered for two weeks at a designated area on the new proposed WWTP site to stabilise. It is foreseen that the sludge can then be used for agriculture or rehabilitation purposes. A plan for the reuse of sludge and information about the implementation must be provided in the detailed design

The feasibility study by Aquarem (2023) informs that 1,794 tons of reagents (coagulants) will be required annually in the WWT process.

3.3.5 Relocation of overhead power lines

Three different overhead power lines with 110kV, 35kV and 6kV run through the proposed WWTP site and will need to be relocated. This component will be financed from the municipal budget and is considered an ‘associated facility’ of the proposed Project. A separate plan for the relocation of the overhead lines will be prepared at the detailed design stage. This plan will be submitted for approval to the city power network management company. The overhead lines will be relocated by a special contractor following an approved plan.

The substation will remain at the existing location within the existing WWTP site.

The following has been proposed in the Aquarem Feasibility study (2023) in terms of the cable length and the number of towers:

- 6 kV overhead line: 540 m
- 35 kV overhead line: 1,150 m and 11 towers
- 110 kV overhead line: 543 m and 7 towers

Figure 3.6 provides an overview of the existing overhead lines and their planned relocation. The orange lines depict the existing overhead lines while the white lines present their proposed relocation. The area circled in yellow shows the new WWTP site. Regarding the 35 kV overhead line, the Aquarem Feasibility study (2023) considers an alternative relocation which is also presented below (shown as “alt.” in the map).

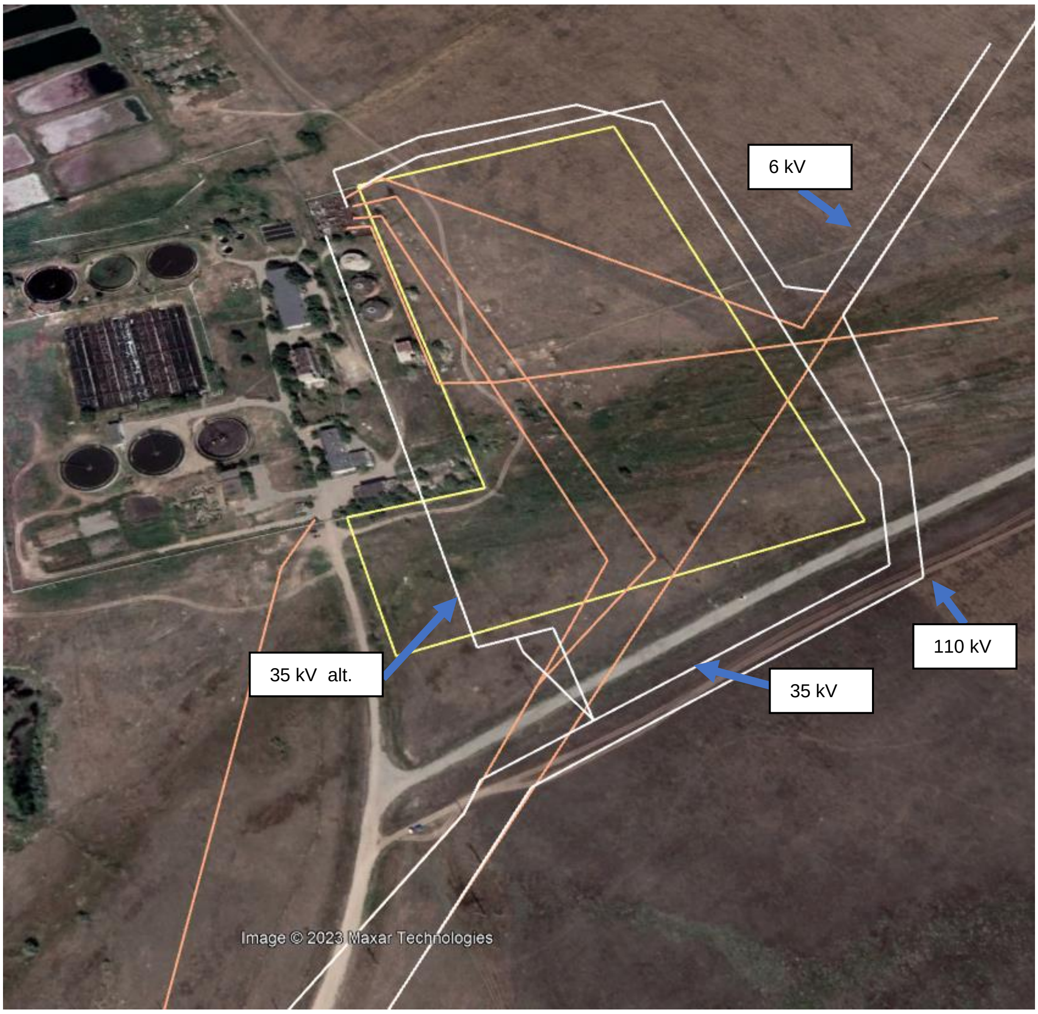

Figure 3.6 Overview of existing (orange) and planned (white) relocation of overhead lines

To illustrate the above, the map below specifically presents the proposed relocation of the 110kV, 35kV and 6 kV overhead lines.

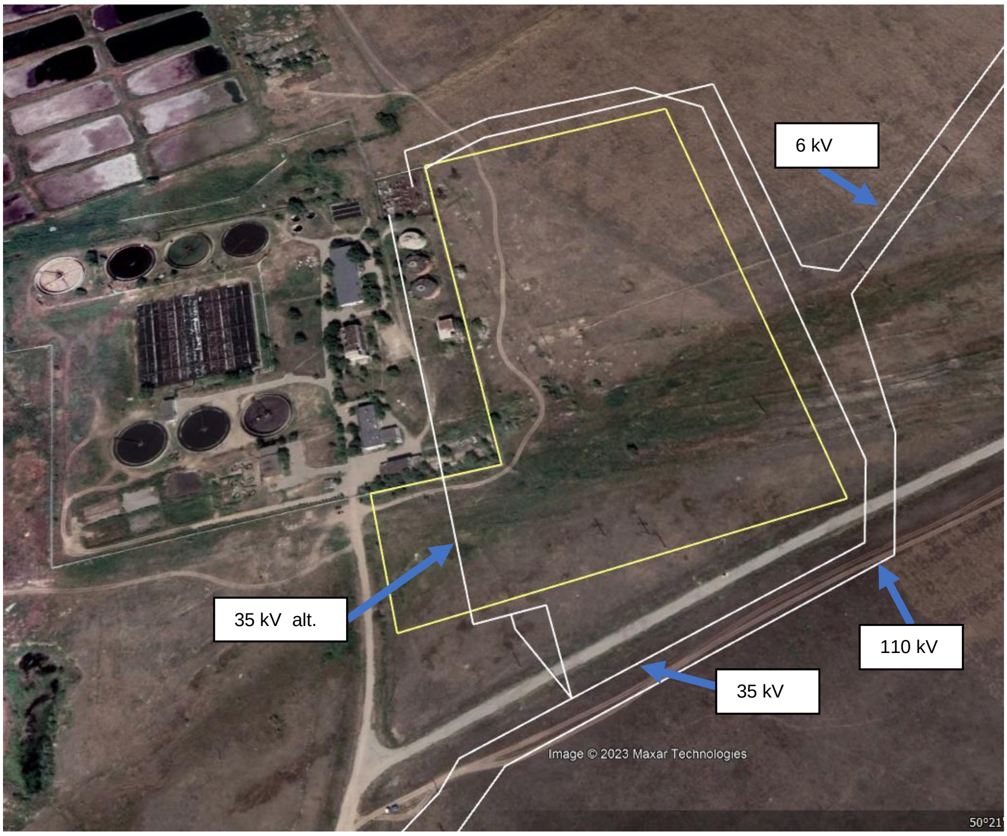

Figure 3.7 Proposed relocation of overhead lines

3.4 Sanitary Protection Zones (SPZ) for the WWTP

The size of the sanitary protection zones around the ASEG facilities is determined in accordance with the sanitary and epidemiological requirements for the establishment of sanitary protective zone of production facilities, as specified below. No residential housing and buildings visited by the general public are allowed to be present in this zone (SanPiN 237 from 20.03.2015). This means that other buildings and structures, e.g., industrial buildings and animal sheds are allowed within the SPZ. There are no restrictions in the use of land within the SPZ for farming, planting of trees or similar.

The local EIA by Aquarem finds that the SPZ for the new WWTP should be 400m. This is to be confirmed by the State Environmental Expertise (SEE) based on legal requirements and the findings of the local EIA. The following table shows the minimum SPZ requirements for different types and sizes of wastewater treatment facilities in Kazakhstan, indicating a likely size of the SPZ of 400 m for the proposed WWTP.

Table 3.8: Minimum SPZ (m) for municipal wastewater facilities (source: SanPiN #237 (2015))

Wastewater treatment facilities	**Design capacity of treatment facilities (thousand m^3/day)**			
	< 0.2	**0.2-5**	**5-50**	**50-280**
Pumping stations and emergency control tanks, local treatment facilities	15	20	20	30
Structures for mechanical and biological treatment with sludge ponds for raw sludge, as well as sludge ponds	150	200	400	500
Facilities for mechanical and biological treatment with thermo-mechanical treatment of sludge in enclosed spaces	100	150	300	**400**

Wastewater treatment facilities	Design capacity of treatment facilities (thousand m^3/day)			
	< 0.2	0.2-5	5-50	50-280
Filtering fields	200	300	500	1000
Irrigation fields	150	200	400	1000
Biological ponds	200	200	300	300

In comparison, the sanitary protection zone (SPZ) for the existing WWTP is 1,000 m. The distance from the existing WWTP and the proposed new WWTP to the nearest housing is 2km.

3.5 Decommissioning of the existing WWTP

Existing Aktobe WWTP

After the new Aktobe WWTP is commissioned, the existing WWTP works becomes redundant. Sweco notes that there are in principle the following options for the decommissioning of the existing WWTP works:

- Option 1: Do Nothing Option: ASEG prefers to retain the existing works for emergency situations. This attracts no capital cost (CAPEX) and limited operating cost (OPEX). It would allow the continued use of the existing WWTP as a standby in emergency situations (which is probably unlikely). It would become a safety hazard for staff unless ASEG secured the existing works and undertook minimal maintenance. In the long-term, ASEG may wish to demolish the works which would attract high CAPEX and rehabilitate the land.
- Option 2: Demolition of Existing Works. ASEG could immediately demolish the existing works upon commissioning of the new WWTP, but this would be a very high CAPEX option (typically 30% of the civil works costs), however would attract no OPEX costs. It would allow the ASEG or the Municipality to re-use the land for other purposes.

The local Feasibility Study (Aquarem, 2023) provides for the demolition of three decommissioned digester tanks of 1600m^3. It is not envisaged to demolish other structures and buildings within the existing WWTP site.

Sludge beds

After the new anaerobic digestion and mechanical sludge dewatering system is commissioned, the existing sludge ponds will become redundant. Consequently, Sweco notes there are a number of options for the existing sludge ponds:

- Option 1: Do Nothing Option. Allow the sludge sitting in the existing ponds to completely dry, and in the long-term removal of the sludge. This attracts no capital cost (CAPEX) and very little operating cost (OPEX). It would allow the continued use of the sludge ponds as a standby in emergency situations (which is probably unlikely and would be an odour nuisance for adjacent households). In the long-term, ASEG or the Municipality may wish to rehabilitate the land.
- Option 2: Decommission ponds and rehabilitate the land for other use. This requires emptying the ponds and land rehabilitation. This attracts capital costs for rehabilitation works (CAPEX) but very little operating costs (OPEX). No continued use of the ponds and no odour nuisance to adjacent households. It allows ASEG or the Municipality to re-use the land.
- Option 3: Maintain a small number of ponds for emergency use. This would require decommissioning most of the ponds (say 90% decommissioning of the ponds) and long-term rehabilitation. This attracts capital costs for rehabilitation works of most of the ponds (CAPEX), and very little operating costs (OPEX). In general, no continued use of most of the ponds (but some would be retained for emergency use), and limited odour nuisance to adjacent households.

For the immediate term, it understood that ASEG prefers to retain the existing sludge ponds for emergency situations, however it is likely that it will gain confidence on the operation of the new WWTP, and eventually fully decommission the majority of the existing sludge ponds. However, no plan for closure of the sludge ponds has been developed/presented, and a requirement to do so is included in the ESMP.

The local Feasibility Study (Aquarem, 2023) envisages to use the existing sludge ponds as a standby in emergency situations. Rehabilitation or other works on the sludge beds are not foreseen or planned yet. The ESMP includes a requirement to prepare a decommissioning and rehabilitation plan for the sludge pond area.

3.6 Overview of key project activities

3.6.1 Construction phase activities and outputs

In the context of this ESIA, the following activities and outputs for the construction phase were identified during the scoping study and are considered in this ESIA.

- Site preparation and excavation
- Transportation of construction material and construction machinery and equipment
- Transportation of workers
- Operation of concrete batch mixer and aggregate crushing
- Installation of pipes
- Installation of biogas plant and CHP
- Construction of WWTP and Operation of construction machinery and equipment
- Wastewater management during construction
- Demolition and construction waste generation
- Electrical installations
- Site drainage installation
- Relocation of power lines
- Landscaping
- Potential decommissioning of existing sludge ponds
- Demolition works of three digesters
- Unplanned events:
  - Spill/overflow of WWTP and climate change related events such as heavy rain
  - Natural disasters (wildfire, earthquake etc.)

3.6.2 Operation phase activities and outputs

The following activities and outputs of the WWTP operation phase were identified during the scoping study and are considered in this ESIA.

- Transportation of material + equipment + waste
- Transportation of workers
- Vehicle fleet management
- WWTP laboratory operation
- WWTP operation and effluents
- Biogas plant operation and maintenance
- Sludge and/or digestate management
- CHP operation and maintenance
- Site drainage and stormwater management

- Landscaping
- Security operations
- Pest control
- Generation of GHG emissions
- Generation of waste
- Generation of sewerage sludge
- Unplanned events:
  - Spill and leak of oil and chemicals
  - Fire, explosion
  - Natural disasters (wildfire, e. quake)

3.7 Analysis of Project Alternatives

3.7.1 Alternatives considered

The above sections describe key project alternatives considered in the process leading up the current proposed WWTP design, which in particular relate to:

- Project location alternatives (3.1.1)
- Wastewater treatment technology alternatives (3.3.3)
- Sludge treatment technology alternatives (3.3.3)

Additionally, the option to renovate parts of the existing WWTP vs. build an entirely new WWTP has been considered. The Sweco Feasibility Study (2022) (which updated a previous Feasibility Study (2019)) proposed the rehabilitation of the existing treatment plant (capacity of an average flowrate of 50,000m^3/d) and new expansion with a parallel treatment line (with an additional capacity of average of 50,000m^3/d). However, this option was not supported by ASEG, which was of the opinion that renovating the existing WWTP facilities was not feasible given the condition of existing structures and uncertainties with regards to cost of renovation and the resulting lifetime extension obtained. Hence, it was decided to pursue a brand new WWTP to service the whole population of Aktobe, with an average capacity of 100,000m^3/d.

3.7.2 No project or zero alternative

In the “no project alternative” the new WWTP will not be constructed, and the existing wastewater treatment practices will remain unchanged, using the largely derelict WWTP. Assuming current level of maintenance, only sub-optimal operation can be sustained, and effluent quality will continue to be of poor quality, exceeding both EU and national standards. Poor quality effluents will continue to be discharged to the URE reservoir and from there to the Ilek river, where they cause odour problems, nuisance, and negative ecosystem impacts. The existing WWTP does not have capacity to deal with expected increase in population connected to the piped WW system and will get increasingly overloaded over time.

Raw sludge from the WWTP would continue to be pumped un-stabilised to the existing sludge ponds for solar drying, resulting in odour problems and substantially higher GHG emissions compared to the proposed Project solution. Dry sludge from the sludge ponds would then be transported to the storage area next to the URE reservoir, which does not have an official permission for long term storage of sludge.

4 ESIA APPROACH

This chapter provides an overview of the overall ESIA approach in terms of key steps and methods applied, which are reflected in subsequent chapters of this report.

4.1 Framework of ESIA

The approach to this ESIA builds on the requirements of the EBRD as reflected in EBRD's Environmental and Social Policy (ESP) and associated Performance Requirements (PR), the EU EIA directive, national legal requirements and other good international ESIA practice.

As part of the Project approval process according to local legislation, a separate national EIA is being developed by the local company Aquarem following the development of a Feasibility Study for the proposed WWTP Project. The EIA is being submitted to the State Environmental Expertise (SEE) for review and processing. To progress to the next stage of the Project design, the preliminary EIA has to be approved by the SEE. The national EIA process is discussed further in chapter 5.2.5 below.

4.2 Stakeholder engagement

Sweco has undertaken engagement with local communities and other stakeholders since the scoping stage and has developed a stakeholder engagement plan (SEP) to inform further stakeholder engagement throughout the lifetime of the Project.

4.3 Project Description and alternatives

The Project as described in chapter 3 defines the focus and scope of this ESIA, based on the Project design outlined in the Feasibility Study conducted by Aquarem in 2023. This reflects the Project design that is being put forward by ASEG (the project proponent) and is seeking environmental approval from the local authorities (SSE) and financing from EBRD. Hence, the ESIA does not as such assess impacts of alternative project designs. However, previously considered design alternatives (in terms of location, technology, size, scale, and/or design), as well as the non-project alternative, and the rationale for pursuing the current design, are also outlined in relevant sections in chapter 3. Additionally, specific options with regards to, e.g. sludge management are discussed in relevant sections of the impact assessment.

4.4 Scoping stage

The purpose of the scoping stage was to identify key issues related to the Project which would be considered in the ESIA process. The scoping process for the Project in Aktobe involved contact to, and consultation with, representatives of several regional and city authorities and individual eco-activists, in addition to several discussions with the Company (ASEG).

A draft Scoping Report was prepared and made available to EBRD in March 2023. The comments provided by EBRD have been incorporated into the further planning of the ESIA process. The Scoping Report was finalised in June 2023 after incorporation of the final Project description based on Aquarem's draft Feasibility Study.

4.5 Project Area and scope of assessment

4.5.1 Temporal boundaries

This ESIA addresses impacts arising throughout the lifetime of the project with primary focus on i) pre-construction (planning) and construction and ii) operation phases. Closure (decommissioning) phase impacts are acknowledged where relevant but not assessed in detail. In general, the closure impacts and required mitigation and management measures are expected to resemble impacts from construction phase activities and should be planned in detail when approaching the WWTP facilities' end-of-life.

4.5.2 Spatial boundaries

Project area

The project area is defined as the area within which new infrastructure will be built and/or where major renovations will take place (actual 'footprint' of the Project), which comprises the site of the new WWTP to the east of the existing WWTP, area for relocation of overhead power line masts on the periphery of the WWTP site, and to some extent the area of the existing WWTP. The planned Project infrastructure and the site boundaries are described in chapter 3. The project area is depicted in Figure 3.2.

The Project area is the area with project activities which are the primary source of impacts during both pre-construction/construction and operation phases. However, the area impacted (influenced) by the project goes beyond the actual project area, and hence the **study area for this ESIA** reaches beyond the actual project area, as discussed below.

Project Area of Influence

The spatial boundaries of the ESIA comprise the geographical area that is potentially affected by the Project, also referred to as the Project Area of Influence (PAI) and reflects the types and geographical scope of potential environmental and social risks and impacts. The key areas that may be directly affected by project activities (**Area of direct influence**), and thus falling within the scope of the ESIA, include:

1) The **WWTP site** (including relocation of overhead power lines) where direct physical impacts can occur (Project footprint) such as removal of vegetation and change in land-use.
2) **Areas used for sludge management and disposal**, including the existing sludge beds and the backfilled borrow pit next to the URE, which is used for long term disposal of dried sludge.
3) **Main roads to and from the WWTP site**, where heavy transport can be a source of impacts.
4) **Villages and other inhabited areas** in the vicinity of the WWTP site, where e.g., odour could be felt.
5) **Waterways** downstream from the WWTP, where treated effluents are discharged and impacts on water quality may be felt, including the **URE retention reservoir**, the 9 km **creek bed leading from the reservoir to the Ilek River**, and the **Ilek River itself** (considered approximately 500 m above and below the discharge point of the creek to the river). There is also a bypass channel which allows for bypassing the URE, if necessary. Management of the URE reservoir is the responsibility of ASEG. The URE discharge channel to the Ilek River and the Ilek River are only directly affected from around March 20th to May 5th when discharge is released from the URE.

The PAI consisting of the above key features are reflected in Figure 4.1 below.

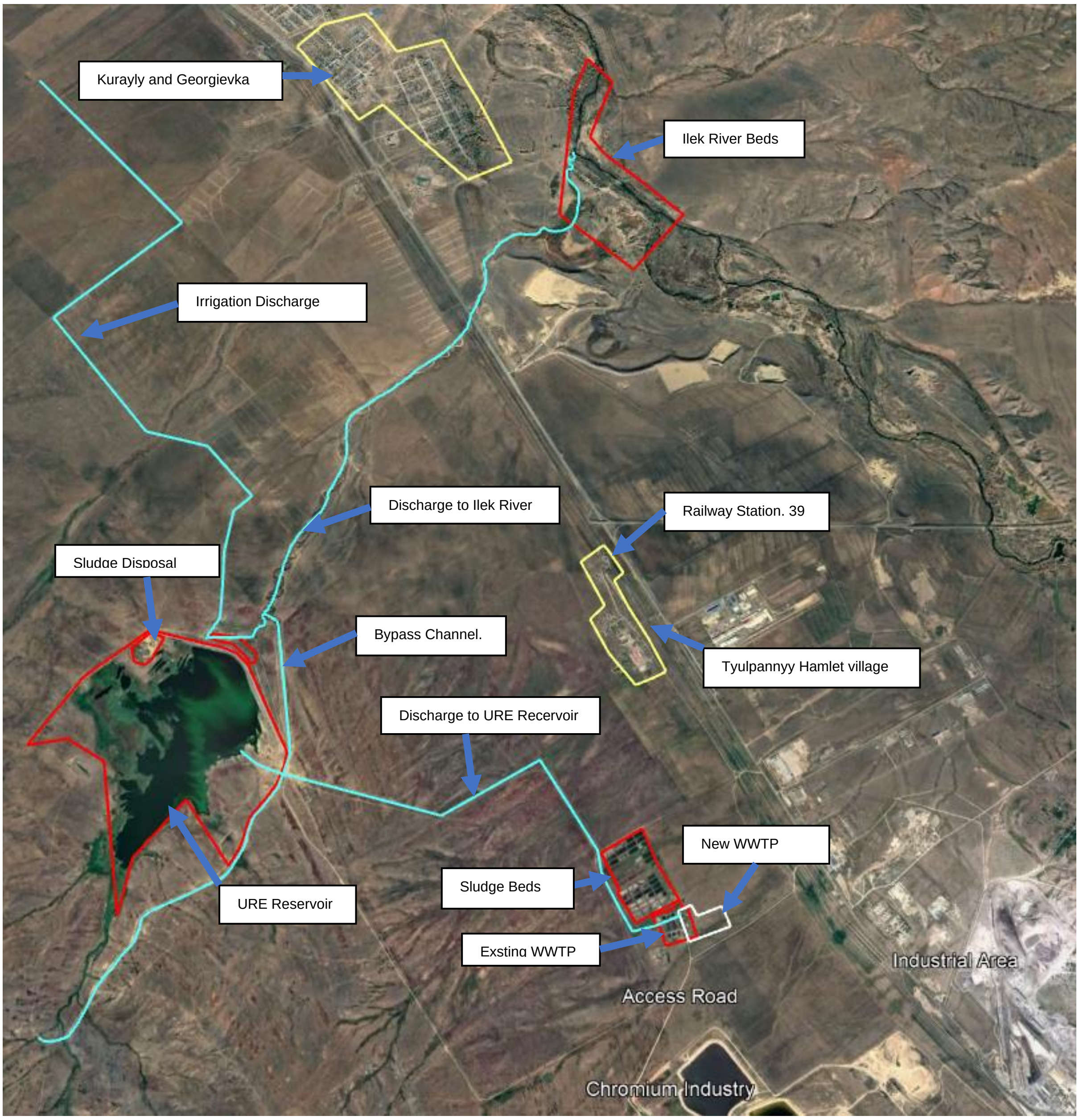

Figure 4.1: The study area of the proposed WWTP project, consisting primarily of the existing and new WWTP sites, sludge management sites, the discharge pipe from the WWTP to the URE retention reservoir, the URE retention reservoir and the open discharge channel from the reservoir to the Ilek river, the Ilek river 500 m above and below the discharge point, farms and villages in the vicinity of the Project (nearest villages at a distance of 2km from the existing WWTP marked with yellow lines). (Map source: Google Earth)

The social setting of the Project in terms of residential areas, population, and distance to WWTP operations is set out in Table 4.1 below.

Table 4.1: Residential areas in the study area

Settlement	Type	Population	Distance to existing WWTP
Railway Junction 39 and Tulpannyy hamlet	Settlements	158	2 km north of the existing WWTP
Georgievka	Village	1,828	10 km north of the WWTP
Kurayly	Village	1,859	10-11 km north of the WWTP
Temir Tulpar Batys LLP	Farm		Fields are 0-9 km from the WWTP
Aterra LLP	Farm		Fields are 0-27 km from the WWTP
Nan	Farm		Fields are 0-39 km from the WWTP
ANDI LLP	Farm		Fields are 2-10 km from the WWTP

Furthermore, the JSC Aktobe Chromium Compounds Plant is located 1 km south of the new WWTP area, while several other industries are located 3-6 km from the WWTP.

A wider area of project influence (**Area of wider influence**) is considered in relation to non-physical impacts such as social and cross-cutting impacts which may extend far beyond the direct PAI. This wider PAI includes as a minimum all Aktobe City, where the benefits of the WWTP will be felt, such as economic opportunities associated with employment and improved wastewater treatment. These may in principle also include cumulative and supply chain impacts extending even further away. The wider PAI is roughly indicated in Figure 4.2.

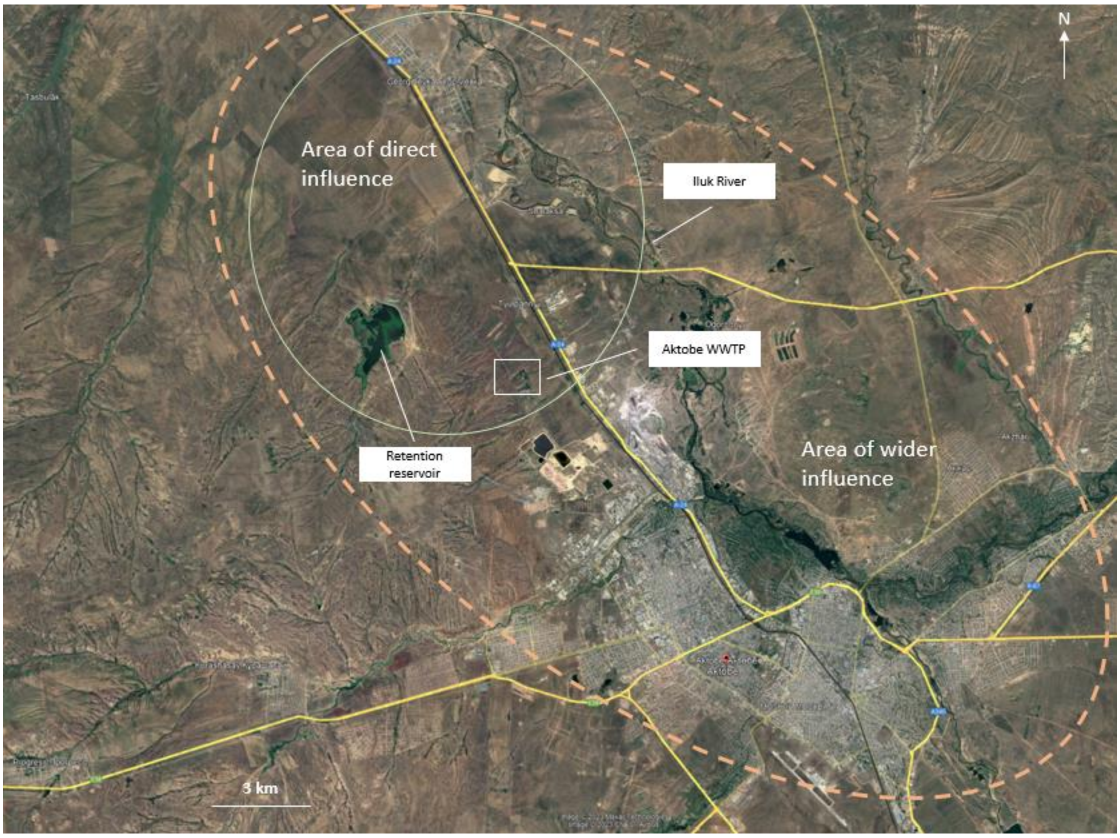

Figure 4.2: Wider project area of influence of the Aktobe WWTP Project

The distance from the effluent discharge point to the Ilek river to the Russian border is approx. 80 km. Due to the distance, dilution, and the likely multiple other anthropogenic impacts on the river over this distance, the Project is **not seen as a source of transboundary impacts**.

4.6 Impact Assessment Approach

The approach for assessing the significance of Project impacts largely follows the EC Guidance on Preparing Environmental Impact Assessment Reports (2017)[4] which applies a multi-criteria analysis and considers the sensitivity of the receiving environment and the magnitude of the predicted effects.

- **Sensitivity** is understood as the sensitivity of the environmental receptor to change, including its capacity to accommodate the changes the Projects may bring about.
- **Magnitude** considers the characteristics of the various changes (timing, scale, size, and duration of the impact) which would occur and affect the receiving environment as a result of the Project.

The term 'receptor' is used to describe environmental features such as air, water, soil, terrain, vegetation, wildlife, (both terrestrial and aquatic), and land use which are valued by society, either for their intrinsic worth and/or their social or economic contribution, and social groups including communities and individuals that may be affected by the Project.

In the context of this ESIA, the following receptors with potential to be affected by the Project were identified during the scoping study and are assessed in this ESIA.

Physical environment components:
- Topography and landscape
- Geology, geomorphology, and soil
- Climate conditions (past and future climate predictions)
- Surface and groundwater (quality and quantitative aspects)
- Ambient air quality
- Ambient noise
- Flora and fauna
    - Terrestrial
    - Aquatic
- Public infrastructure or services supplying:
    - Solid waste management
    - Water supply
    - Energy supply (heat and electricity)

Socio-economic and land use components:
- Employment
- Labour and working conditions
- Worker's health and safety
- Land acquisition and land use
- Community health and safety
- Traffic
- Gender based violence and harassment
- Cultural heritage
- Social infrastructure: schools, health clinics and other social infrastructure in the vicinity of the WWTP

The baseline (pre-Project) conditions and sensitivity of the identified receptors are described in chapter 6 of this ESIA.

The sensitivity of impact receptors and the magnitude of the impact / potential change are assessed using criteria shown in the following tables.

[4] Environmental impact assessment of projects - Publications Office of the EU (europa.eu)

Table 4.2: Sensitivity of the receiving environment

Sensitivity of the receiving environment	
High	High importance and rarity, national scale, limited potential for substitution and low capacity to accommodate proposed form of change.
Medium	Medium importance & rarity, national scale and limited potential for substitution. The receiving environment has some tolerance of the proposed change subject to design & mitigation.
Low	Low or medium importance and rarity, local scale. The receiving environment is tolerant of the proposed change subject to design & mitigation.

Table 4.3: Scale of impact magnitude

Scale of impact magnitude	
High	Loss of resource and/or quality and integrity of resource over a significant area. Severe change/damage to key characteristics, features or elements for more than 2 years or irreversible.
Medium	Loss of resource, but not adversely affecting the integrity over a significant area. Partial loss of/damage to key characteristics: the impact is felt continuously during the entire construction period of the Project (estimated to be 36 months).
Low	Some measurable change in attributes, quality or vulnerability. Minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.

Table 4.4: Criteria for assessing impact significance

Criteria	Components of criteria	Description
Sensitivity of the receiving environment	Existing regulations and guidance (law, programmes, guidelines, zoning)	There are specific receptors in the impact area which have some level of protection, either by law or other regulations (e.g. prohibition against polluting groundwater & Natura 2000 areas) or whose conservation value is increased by programs or recommendations (e.g. landscapes designated as nationally valuable).
	Value of the receptor to society (recreational values, natural values, number of affected people)	Depending on the type of impact, it may be related to economic values (e.g. water supply), social values (e.g. landscape or recreation) or environmental values (e.g. natural habitat).
	Vulnerability to the changes (ability to tolerate changes, number of sensitive targets)	Vulnerability to the change describes how liable the receptor is to be influenced or harmed by pollution or other changes to its environment. For instance, an area that is quiet is more vulnerable to increasing noise than an area with industrial background noise.
Impact magnitude (potential change)	Intensity and direction	Intensity describes the physical dimension of a development and direction specifies whether the impact is negative (”–”) or positive (”+”). Depending on the type of impact, intensity can often be measured with various physical units and compared to reference values, such as the decibel (dB) for sound.
	Spatial extent (geographical area)	The extent of an impact refers to the geographic area over which the impact can express itself. The geographic extent is described as limited, local, or regional based on the following definitions: • Limited: the impact is restricted to direct project site; • Local: the impact will extend beyond the direct project site, thus affecting the vicinity and neighbouring areas. • Regional: the impact will be felt within a greater area
	Duration	The duration of the impact refers to the period during which the impact will be felt and whether the impact will occur intermittently. The duration of an impact is described as long-term, medium-term, or short-term based on the following definitions: • Long-term: the impact is considered permanent or irreversible; • Medium-term: the impact is felt continuously during the entire construction period of the Project (estimated to 36 months) and/or for the full or partial duration of operation; • Short term: the impact is felt temporarily or intermittently for a limited period corresponding to one or a few construction activities/phases.

The assessment of impact significance is made by combining sensitivity and magnitude as presented in Table 4.5. Positive impacts are assessed using the same logic.

Table 4.5: Assessment of negative impact significance

Impact magnitude	Environmental (receptor) sensitivity		
	High	***Medium***	***Low***
High	Major	Major	Moderate
Medium	Major	Moderate	Minor
Low	Moderate	Minor	Negligible

Source: Scottish Natural Heritage. A Handbook on EIA. In: Environmental Impact Assessment of Projects. Guidance on Scoping. EU, 2017

Similar logic is applied with regards to positive impacts, as reflected in the below table.

Table 4.6 Assessment of positive impact significance

Impact magnitude	Environmental (receptor) sensitivity		
	High	***Medium***	***Low***
High	Major	Major	Moderate
Medium	Major	Moderate	Minor
Low	Moderate	Minor	Negligible

4.6.1 Mitigation measures and use of mitigation hierarchy

A series of mitigation measures are identified to address significant adverse impacts, applying a hierarchy of options (the mitigation hierarchy) as outlined below:

- **Avoid** - making changes to the Project's design or location to avoid adverse effects on an environmental feature. This is considered to be the most acceptable form of mitigation.
- **Minimise** - where avoidance is not possible, adverse effects can be reduced through sensitive environmental treatments/design.
- **Restore** - measures taken during or after construction to repair / reinstate and return a site to the situation prior to occurrence of impacts.
- **Compensate/offset** - where avoidance or reduction measures are not available, it may be appropriate to provide compensatory/offsetting measures. It should be noted that compensatory measures do not eliminate the original adverse effect; they merely seek to offset it with a comparable positive one.
- **Improvement measures** - projects can have positive effects as well as negative ones, and the project preparation stage presents an opportunity to enhance these positive features through innovative design

4.6.2 Residual impacts

By default, the impact assessment considers Project impacts without taking into account mitigation measures.

Residual impacts are those that remain following the implementation of the proposed mitigation. These are identified for each of the topics by reviewing the predicted impacts against the mitigation measures proposed and then identifying any residual impact. Residual impacts will be defined based on the same process applied to the evaluation of impacts.

The outcome of the impact assessment for each impact and/or receptor is summarised using the structure shown in Table 4.7, reflecting the assessed pre-mitigation and residual impacts, during construction and operation phases, respectively.

Table 4.7: Table structure for summarising pre-mitigation and residual impacts

Impact characterisation	**Pre-mitigation**	**Residual impact**
Receptor sensitivity:	**Based on baseline section (Very high, high, medium, low)**	
Pre-construction and construction		
Spatial extent	*Limited, local, regional*	*Limited, local, regional*
Duration	*Long, medium or short term*	*Long, medium or short term*
Magnitude of impact	*High, medium, low*	*High, medium, low*
Overall impact significance	Major, moderate, minor, negligible (Negative or Positive)	Major, moderate, minor, negligible (Negative or Positive)
Operation phase		
Spatial extent	*Limited, local, regional*	*Limited, local, regional*
Duration	*Long, medium or short term*	*Long, medium or short term*
Magnitude of impact	*High, medium, low*	*High, medium, low*
Overall impact significance	Major, moderate, minor, negligible (Negative or Positive)	Major, moderate, minor, negligible (Negative or Positive)

4.6.3 Assessment of cumulative impacts

An assessment of cumulative impacts considers the effects of other past, present, and reasonably foreseeable developments in the vicinity of the Project. It also considers unplanned but predictable activities enabled by the Project that may occur later or at a different location, which when combined with the effects of the Project may have an incremental effect on overall impacts.

4.7 Impact mitigation and ESMP development

Proposed mitigation measures and the overall monitoring plan are compiled in the Environmental and Social Management Plan (ESMP), which forms the framework management plan for the Project. The ESMP also outlines which additional, topic-specific management plans are required as the basis for implementing and monitoring the various mitigation measures during construction and operation of the Project, respectively.

5 LEGAL AND REGULATORY FRAMEWORK

5.1 EBRD requirements

The EBRD has classified the project to modernise the Aktobe wastewater treatment plant as “Category A” because it is over 150,000 PE. For this reason, an Environmental and Social Impact Assessment (ESIA) is required according to the EBRD’s Environmental and Social Policy (ESP, 2019).

The ESP underpins all EBRD financed projects, and all projects shall be structured to meet its requirements. EBRD commits to ensuring that projects are structured to meet the EU environmental principles, practices, and substantive standards where these can be applied at the project level, regardless of geographical location. When host country regulations differ from EU substantive environmental standards, projects will be expected to meet whichever is more stringent.

The ESP recognises the Bank’s commitments to respect human rights, gender equality, the needs of vulnerable people or groups, the importance of addressing the causes and consequences of climate change, a precautionary approach to managing living natural resources, and stakeholder engagement.

The Bank has adopted 10 Performance Requirements (PRs) for key areas of environmental and social sustainability that are embedded within the ESP, and which projects are required to meet (Figure 5.1).

As can be seen, PR1 is cross-cutting, whereas the other 9 are aspect specific:

PR 1 Assessment and Management of Environmental and Social Risks and Impacts			
PR 2	Labour and Working Conditions	PR 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources
PR 3	Resource Efficiency and Pollution Prevention and Control	PR 7	Indigenous Peoples
PR 4	Health, Safety and Security	PR 8	Cultural Heritage
PR 5	Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	PR 9	Financial Intermediaries
		PR 10	Information Disclosure and Stakeholder Engagement

Figure 5.1: EBRD Performance Requirements

The EBRD expects its clients to manage the environmental and social (E&S) issues associated with the projects to meet the PRs over a reasonable period of time. This ESIA for the proposed new WWTP will assess whether there is compliance with PR1-8 and PR10, while PR7 on Indigenous Peoples and PR9 on Financial Intermediaries are not relevant for the ESIA.

The following EU Directives are of key relevance to an EBRD ESIA process for a WWTP modernisation project:

- Environmental Impact Assessment Directive 2011/92/EU, as amended by Directive 2014/52/EU
- Water Framework Directive (2000/60/EC)
- Groundwater Directive (2006/118/EC)
- Drinking Water Directive (98/83/EC)
- Urban Wastewater Treatment Directive (97/271/EEC)
- Ambient Air Quality Directive (2008/50/EC)
- Sewage Sludge Directive (86/278/EEC)
- Minimum Requirements for Water Re-use (2020/741/EC)
- Habitats Directive (92/43/EEC) and Birds Directive (2009/147/EC)
- Directive on minimum safety and health requirements for the workplace (89/654/EEC)

- ATEX Directive 2014/34/EU and 1999/92/EC to protect employees from explosion risk in areas associated with an explosive atmosphere

5.2 National, regional, and international legislation and regulations

5.2.1 Environment

National

Table 5.1: Overview of relevant national environmental regulations

Environment	The Environmental Code is in effect in Kazakhstan since 2007, but has been modified a number of times, usually as part of the “package laws” introducing amendments to various legal acts at the same time. Codes in Kazakhstan have a higher legal value than laws. There is a new Environmental Code, entered into force on January 2, 2021, and the last amendments were in 2022. The new Environmental Code is based on 7 main principles, where the main one is “the polluter pays and fixes”. According to the new draft, the fines will be gradually increased, the public will be able to participate in all four stages of the EIA, industrial enterprises will undergo a technological audit to be offered the best available technologies to produce fewer emissions. Also, the code will oblige local executive bodies to entirely redirect the revenue from the environmental fines to measures that should reduce emissions, large companies will be required to launch automated emission monitoring systems, strengthen environmental control and the final principle seeks to improve waste management production and consumption by introducing the circular economy principles used in OECD countries.
Water	The Water Code was adopted on July 9, 2003, and the last amendments were in 2022. The objectives of the water legislation of the Republic of Kazakhstan are to achieve and maintain an ecologically safe and economically optimal level of water use and protection of water resources, water supply and sanitation to preserve and improve the living conditions of the population and the environment. The number of regulated indicators of drinking water quality in Kazakhstan is 74 indicators (all factory, microbiological, parasitological, aggregated data, non-organic and organic substances, indicators related to water treatment technology, radiological)in accordance with the Sanitary Rules "Sanitary and Epidemiological Requirements for Water Sources, Water Intake Points for Domestic and Drinking Purposes, Domestic and Drinking Water Supply and Cultural and Domestic Water Use and Safety of Water Bodies", approved by the Order of the Minister of National economy of the Republic of Kazakhstan dated March 16, 2015 No. 209. Additionally, the water preparation process indicators are taken once per shift except of residual chlorine or ozone (if used which are taken once in an hour)
Strategic Environmental Impact Assessment	New Environmental Code includes Strategic Ecological Assessment. It initiates in the early stage, identifies and examines potential negative environmental impact, considers all necessary measures to avoid or minimizes it. This process is carried out by government body. From January 2024 all strategic planning documents will have strategic ecological assessment mandatory. It covers the scope and procedural steps of the SEA mechanism as envisaged by the 2003 Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context (Protocol on SEA). Mandatory SEA will be envisaged for planned programs in such sectors as: agriculture, forestry, fishing, energy, industry, transport, waste management, water management, telecommunications, tourism, regional development, planning and land use.
Environmental Impact Assessment	The obligation to go through the EIA procedure when intending to carry out production activities is regulated by the Environmental Code of the Republic of Kazakhstan. In the new Environmental code project, all stages of the EIA, starting from the submission of the application and the completion of the procedure, will be covered on the websites of the authorized ministry, as well as local executive bodies, to which the territory of the planned activity belongs, and the media. The public will be able to follow all stages of the EIA: express their opinion, defend it at the legal level, and also see whether it was taken into account. Each stage of the EIA will be covered on the above websites, and public hearings will be covered in the mass media. Moreover, the Rule for Conducting Public Hearings No 286 determines the procedure for holding public hearings.

	The Republic of Kazakhstan has special Instruction on Ecological Assessment № 2804 (SEA, EIA, Transboundary Impact Assessment and simplified EA are types of Ecological Assessment) which defines the general provisions for conducting an EIA in the preparation and decision-making on the conduct of planned economic and other activities at all stages of its organization, in accordance with the project documentation.
Wastewater	The Rules for the admission of wastewater to the drainage systems of settlements No. 546 prescribes that the received wastewater before discharge should be treated in accordance with the treatment technology used on them. The following items shall not be admitted to drainage system: • waters containing soil, sand, construction and household waste, fat; • waters containing sediments from local treatment facilities, solid production wastes; • waters to be used in recycling and re-supply systems (water from pools and fountains, steam condensate, drainage and conditionally clean wastewater); • surface run-off from the territory of industrial sites; • chipped ice and snow; • waters containing radionuclides of various decay periods.
Noise	Order of the Minister of Health of the GoK dated February 16, 2022 No. GoK MoH -15. On the approval of Hygienic standards for physical factors that affect a person determines the permissible values of infrasound and ultrasound levels.
Air quality	Kazakhstan has some air quality policy regulations that are based on other strategic documents, such as air protection requirements integrated into the new draft of the 2020 Environmental Code. The new Environmental Code proposes solutions to the air pollution problems, such as modernization of technological processes, introduction of the Best Available Technologies (BAT) and strengthening Emission Trading Scheme (ETS), as well as fines for environmental pollution will be increased. However, one of the significant drawbacks relates to emissions from industrial sector, where large companies will have 10 years lead time for BAT compliance. Since BAT standards will be developed by 2023, which is a rather long time and implies that the industrial sector will be BAT compliant not earlier than 2033. According to the 2022 environmental air quality monitoring, out of 45 settlements, 10 cities belong to a high level of air pollution. For each of these cities, a roadmap will be developed with measures to reduce air pollution.
Nature	Law on protection, reproduction and use of the fauna No 593 was adopted in 2004 with amendments as of January 2023. It consists of 11 chapters that regulates protection, reproduction and use of the fauna and is aimed at ensuring conditions for the conservation of the fauna and its biological diversity, as well as sustainable use of wildlife objects in order to meet the ecological, economic, aesthetic and other human needs, taking into account the interests of the present and future generations. After coming to force in 1997 the Convention on Biological Diversity, the Kazakhstan obligations include setting up the targets and reporting on their achievement. The country has already issued 6 national reports, the last one being in 2018.
National parks	The Law on Specially protected natural areas regulates creation, expansion, protection, restoration, sustainable use and management of nature conservation areas and objects of the national natural reserves, which have ecological, scientific, historical, cultural and recreational value, as well as being a component of national, regional and global ecological networks. The Law pays special attention to flora and fauna preservation in protected areas. The Forest Code regulates the ownership, use and management of the areas assigned to the Forest Fund, and establishes the legal framework for the protection, protection, reproduction, improvement of the ecological and resource potential of the Forest Fund areas and their economic value, and its rational use. At the same time, the regulation of forest legal relations should be carried out on the basis that the forest is one of the most important components of the biosphere, which has global ecological, social and economic importance.
Sanitary Protection Zones (SPZ)	Size of the sanitary protection zones around ASEG's facilities is determined by relevant authorities in accordance with the sanitary and epidemiological requirements for the establishment of sanitary protective zone of production facilities, as specified in SanPiN 237 from 20.03.2015. This entails that other buildings and structures, e.g., industrial buildings and animal sheds are allowed within the SPZ. There are no restrictions in the use of land within the SPZ for farming, planting of trees or similar.

Requirements of EU environmental regulations

Relevant EU Directives in the field of environment include the EIA Directive, Drinking Water Directive, Urban Wastewater Treatment Directive, Water Framework Directive, Groundwater Directive, Sewage Sludge Directive, the Nature Directives and the Workplace Health and Safety Directives.

Table 5.2: Overview of relevant EU environmental regulations

Environmental impacts	The EIA Directive (2014/52/EU of 16 April 2014 amending 2011/92/EU) states that all projects that potentially have significant effects on the environment shall undergo a systematic process to identify, predict and evaluate the environmental effects of the project. Particular attention should be given to preventing, mitigating, and offsetting the significant adverse effects of the project. The objectives of an EIA are: - to influence the design of the project to optimize its environmental performance; - to identify appropriate measures for mitigating the negative impacts of the proposal; - to facilitate informed decision making, including setting the environmental terms and conditions for implementing the proposal. The EIA process shall be open and transparent, and provide opportunities for public involvement, in particular to those people who are most directly affected by, and interested in the proposal, in an appropriate manner that suits their needs. The screening determination and information from the environmental studies must be made available to the public. The decision-maker is obliged to take account of the opinions and concerns raised by the public, which may be relevant to those decisions.
Surface water	Protection of surface water bodies within the EU is regulated by the Water Framework Directive (WFD) (2000/60/EC), which is based on a system of management by river basin. The Directive requires Member States to prepare River Basin Management Plans including Programmes of Measures for each River Basin District, including for international river basins. Following the WFD, water bodies are classified in five status classes: high, good, moderate, poor and bad. ‘High status’ is defined as the biological, chemical and morphological conditions associated with no or very low human pressure. This is also called the ‘reference condition’ and is the best status achievable. Assessment of quality is based on the extent of deviation from the reference condition. The aim of the Directive is to achieve at least 'good status' for all ground and surface waters in the EU. The Floods Directive (2007/60/EC) is related to the WFD. This obliges EU Member States to carry out a preliminary assessment of flood risk to identify areas of potential flood risk, to establish and publish flood hazard and risk maps and to develop and implement Flood Risk Management Plans to reduce flood risk.
Groundwater	The Groundwater Directive (2006/118/EC) compliments the WFD and establishes a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. The directive establishes quality criteria that takes account of local characteristics and allows for further improvements to be made based on monitoring data and new scientific knowledge. It relates to assessments on chemical status of groundwater and the identification and reversal of significant and sustained upward trends in pollutant concentrations. Annex II of the Directive was amended by Commission Directive 2014/80/EC of 20 June 2014.
Drinking water	The Drinking Water Directive (2020/2184) is the EU’s main law on drinking water. It concerns the access to, and the quality of, water intended for human consumption to protect human health. The EU adopted the recast Drinking Water Directive in December 2020 and the Directive entered into force in January 2021. The recast Drinking Water Directive will further protect human health thanks to updated water quality standards, tackling pollutants of concern, such as endocrine disruptors and microplastics, and leading to even cleaner water from the tap for all. The Directive applies to all water, either in its original state or after treatment, intended for drinking, cooking, food preparation or other domestic purposes in both public and private premises, regardless of its origin and whether it is supplied from a distribution network, supplied

	from a tanker or put into bottles or containers, including spring waters; all water used in any food business for manufacturing, processing, preserving or marketing of products or substances intended for human consumption.
Wastewater	The Urban Wastewater Treatment Directive (91/271/EEC, amended by Directive 98/15/EC) regulates the collection, treatment and discharge of urban wastewater. The Directive requires collection and treatment of wastewater in all agglomerations of >2000 population equivalents (p.e.), secondary treatment of all discharges from agglomerations of >2000 p.e., and more advanced treatment for agglomerations >10 000 p.e. in designated sensitive areas and their catchments, and monitoring of the performance of treatment plants and receiving waters; and controls of sewage sludge disposal and re-use, and treated wastewater re-use whenever it is appropriate. The Directive is currently undergoing a revision process after a recent evaluation identified certain shortcomings and new societal needs that must be addressed. Commission adoption of the revised text is scheduled for first quarter of 2022. The revision addresses: • *Remaining sources of pollution* not tackled in the existing Directive, e.g. storm water overflows, urban runoff, small agglomerations and IAS; • *Emerging challenges* such as contaminants of emerging concern, and wastewater surveillance in the context of pandemics; and • *Aligning the sector with new EU ambitions* such as nutrients recovery, energy efficiency and production.
Water Reuse	Regulation (2020/741) on minimum requirements for water reuse for agricultural irrigation entered into force in 2020. The aim is to stimulate and facilitate water reuse in the EU. The Regulation sets out: • Harmonised minimum water quality requirements for the safe reuse of treated urban wastewaters in agricultural irrigation; • Harmonised minimum monitoring requirements, notably the frequency of monitoring for each quality parameter, and validation monitoring requirements; • Risk management provisions to assess and address potential additional health risks and possible environmental risks; • Permitting requirements; • Provisions on transparency, whereby key information about any water reuse project is made available to the public. The new rules are to be situated in the context of the new Circular Economy Action Plan adopted in 2020, which includes the implementation of the new Regulation amongst Europe's priorities for the circular economy.
Solid waste management	The Waste Framework Directive (2008/98/EC) sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling, and recovery. The Directive lays down some basic waste management principles: it requires that waste be managed without endangering human health and harming the environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest. Waste legislation and policy of the EU Member States shall apply the waste management hierarchy from reuse as a priority through to disposal. The Directive introduces the polluter pays principle and the principle of extended producer responsibility.
Sludge	The Sewage Sludge Directive (86/278/EEC) sets rules on how farmers can use sewage sludge as a fertilizer, to prevent it harming the environment and human health, by compromising the quality of the soil or surface and ground water. To this end, it sets limits on the concentrations allowed in soil of 7 heavy metals that may be toxic to plants and humans. The Directive specifies rules for the sampling and analysis of sludges and soils. It sets out requirements for the keeping of detailed records of the quantities of sludge produced, the quantities used in agriculture, the composition and properties of the sludge, the type of treatment and the sites where the sludge is used.

Nature and biodiversity	The Habitats Directive (92/43/EEC) aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. The Habitats Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species. Some 200 rare and characteristic habitat types are also targeted for conservation in their own right. Together with the Birds Directive (2009/147/EC), it forms the cornerstone of Europe's nature conservation policy and establishes the EU-wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments.
Noise	Directive 2002/49/EC relating to the assessment and management of environmental noise (the Environmental Noise Directive – END) is the main EU instrument to identify noise pollution levels and to trigger the necessary action both at Member State and at EU level. To pursue its stated aims, the Environmental Noise Directive focuses on three action areas: the determination of exposure to environmental noise ensuring that information on environmental noise and its effects is made available to the public preventing and reducing environmental noise where necessary and preserving environmental noise quality where it is good
Air quality	The Ambient Air Quality Directive (AAQD, Directive 2008/50/EC) sets thresholds and objectives for the permissible concentrations of air pollutants. Generally, this directive protects human health. It sets limit values for lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM10 and PM2.5), sulphur dioxide (SO_2), benzene, carbon monoxide (CO), certain toxic heavy metals (arsenic, cadmium, nickel and benzo(a)pyrene) and polycyclic aromatic hydrocarbons (PaH) and ozone (O_3). There is a target value and a long-term objective for ozone is intended to provide protection for vegetation.

5.2.2 Occupational health and safety

National

Table 5.3: Overview of relevant national OHS regulations

Safety and health at work	The Labour Code regulates the rights and obligations of employees in the field of occupational safety and health. The fire safety rules No 55 determine the procedure for ensuring fire safety in order to protect people, property, society and the state from fires. The law No 351 regulates public relations arising in the field of compulsory employee insurance against accidents, and establishes the legal, economic and organizational framework for its implementation.
Workplace	The Labour Code defines safety requirements for workplace, such as the buildings compliance with safety and labour protection requirements, emergency routes/exits and hazardous areas with appropriate signage, etc. Moreover, during working hours, the temperature, lighting, and ventilation in the room where the workplaces are located must comply with sanitary and epidemiological requirements as well as work equipment must comply with the safety standards established for this type of equipment, have appropriate technical passports (certificate), warning signs and be provided with fences or protective devices to ensure the safety of workers in the workplace.
Construction	The Republic of Kazakhstan has special Construction norms and rules (SNiPs) that represents a set of technical, economic and legal normative acts adopted by the executive authorities governing the implementation of urban planning activities, as well as engineering surveys, architectural and construction design and construction. The Republic of Kazakhstan has its own 119 building codes, 8 guiding documents, 188 codes of rules, 69 regulatory and technical manuals, and 10 methodical documents in the construction sector This technical regulation on requirements for the safety of buildings and structures, construction materials and products establishes the minimum requirements for the safety of construction objects and construction products at all stages of their life cycle in order to protect life, health of people and animals, property and environmental protection, as well as to prevent actions that mislead consumers (users) regarding the purpose and safety of construction sites and construction products, elimination of technical barriers to trade.

Requirements of EU H&S regulations

Relevant EU Directives in the field of occupational health and safety (OHS) include the Safety and Health at Work Directive, the Directive on minimum safety and health requirements for the workplace, and the directive on minimum safety and health requirements for temporary or mobile construction sites.

Table 5.4: Overview of relevant EU OHS regulations

Safety and health at work	The Framework Directive on Safety and Health at Work (OSH Directive 89/391 EEC) introduces measures to encourage improvements in the safety and health of workers at work. The Framework Directive contains principles concerning the prevention of risks, the protection of safety and health, the assessment of risks, the elimination of risks and accident factors, and the involvement and training of workers and their representatives. The general principles of prevention listed in the directive include (i) avoiding risks, (ii) evaluating the risks and (iii) combating the risks at source. The Framework Directive also contains basic obligations for employers to ensure the safety and health of workers in every aspect related to work, and the financial costs of so doing may not be imposed on the workers. On the basis of this "Framework Directive" a series of individual directives were adopted (see further below) containing more stringent and/or specific provisions.
Workplace	The Directive on Minimum Safety and Health Requirements for the Workplace (89/654/EEC) states that workplaces must satisfy minimum safety and health requirements in areas such as electrical installations, emergency routes and exits, fire detection and firefighting, room temperature and room lighting. Directive 2000/54/EC covers protection of workers from risks related to exposure to biological agents at work and includes work in sewage purification installations in the indicative list of activities.
Construction	The Directive on Minimum Safety and Health Requirements for Temporary or Mobile Construction Sites (92/57/EEC) lays down minimum safety and health requirements for temporary or mobile construction sites i.e. any construction site at which building or civil engineering works are carried out. It establishes a chain of responsibility linking all the parties involved to prevent risks. The client or project supervisor nominates person(s) responsible for the coordination of health and safety at sites where several firms are present. Where a person responsible for coordination is appointed, the project supervisor or client remains responsible for safety and health. The client or project supervisor also ensures that, before work starts at the site, a health and safety plan is drawn up. The person(s) responsible for coordination on the site shall ensure that employers and self-employed persons apply the general prevention principles, particularly in respect of the situations described, and that the health and safety plan is considered when necessary. They shall also organise cooperation between employers in matters of health and safety and check that the working procedures are being implemented correctly as well as ensure that no unauthorised persons enter the site.
Explosion risks	The ATEX Directive 2014/34/EU governs the manufacturing, placing on the market, and use of equipment intended for use in potentially explosive atmospheres. That is, environments where flammable gases, vapours, mists, or dusts are present or likely to be present in sufficient quantities to cause an explosion, such as for biogas facilities. It sets out essential health and safety requirements for equipment to be used in such context and defines the obligations of manufacturers. The ATEX Directive 1999/92/EC complements the ATEX 2014/34/EU directive and focuses on the protection of workers who are potentially at risk from explosive atmospheres. The Directive establishes minimum requirements for improving the safety and health protection of workers in areas where explosive atmospheres may occur, and places obligations on employers to conduct risk assessments, implement appropriate control measures, provide suitable training to employees, and maintain safe working conditions. It also outlines the responsibilities of workers to comply with safety measures and report any potential hazards.

5.2.3 Labour and human resources

National

Human resources (HR) management and other labour practices in Kazakhstan are regulated based on the following main legislative acts:

Table 5.5: Overview of national labour and human resources legislation

The Constitution of the Republic of Kazakhstan	The Constitution was adopted on August 30, 1995, and the last amendments were in 2022. The Constitution prohibits discrimination on various grounds, including gender. The Constitution also provides for freedom of labour, free choice of occupation, the right to working conditions that meet safety and hygiene requirements, and the right to remuneration without discrimination.
The Labour Law	The Law was adopted in 2015, and the last amendments were made in 2022. The purpose of the labour legislation of the Republic of Kazakhstan is the legal regulation of labour relations and other relations directly related to labour relations, aimed at protecting the rights and interests of the parties to labour relations, establishing minimum guarantees of rights and freedoms in the labour sphere. The principles of the labour legislation of the Republic of Kazakhstan are: the inadmissibility of restricting human and civil rights in the field of labour; freedom of labour; prohibition of discrimination in the field of labour, forced labour and the worst forms of child labour; ensuring the right to working conditions that meet the requirements of safety and hygiene; priority of the employee's life and health; ensuring the right to remuneration for work not lower than the minimum wage; ensuring the right to rest; equality of rights and opportunities for employees; ensuring the right of workers and employers to associate to protect their rights and interests; assistance of the state in strengthening and developing social partnership; state regulation of occupational safety and health issues. In addition, the Law prohibits discrimination against women in employment and provides for equal pay for work of equal value. The Law allows for flexible working arrangements and off-site employment, as well as providing for a range of benefits for working parents such as maternity leave, adoption leave, and parental leave. The Labour Law is supplemented by a list of occupations for which the use of female labour is prohibited or restricted (see further explanation at the end of this section).
The Law on State Guarantees of Equal Rights and Opportunities for Men and Women (2009)	The Law prohibits sex-based discrimination and stipulates equal employment opportunities for women and men (including in relation to recruitment, working conditions, promotion, and training).
Concept of Family and Gender Policy in the Republic of Kazakhstan to 2030 (implemented through a national Action Plan)	The Concept was adopted on December 6, 2016. The Concept sets out the Government's key gender policy aims. The Concept includes specific objectives to increase women's participation in vocational training within high-value and technical sectors, combat discrimination against women in non-traditional occupations, and reduce legal prohibitions against women's employment in certain types of work and occupations. The Concept sets an ambitious target for women's participation in decision-making roles, aiming to increase the share of women at decision-making level in the executive, representative, and judicial branches of government as well as in the state, quasi-state, and corporate sectors to 22% by 2020, 25% by 2023, and 30% by 2030. The Concept also sets targets to reduce the gender wage gap at the national level to 30% by 2020, 27% by 2023, and 25% by 2030.
The Law about trade unions	The Law was adopted in 2014, and the last amendments were made in 2021. This Law regulates public relations arising from the exercise by citizens of the constitutional right to freedom of association, creation, activity, reorganization and liquidation of trade unions. The Law also states the prohibition of discrimination of citizens on the basis of membership in trade unions.
Law "On Amendments and Additions to Certain	As a result of this law, the Labour Law of the Republic of Kazakhstan no longer mentions "prohibited professions,", which means - the abolition of the list of prohibited professions for women

Legislative Acts of the Republic of Kazakhstan on the Issues of Social Protection of Certain Categories of Citizens"	- the abolition of the ban on entering into labour contracts and employment of women in professions that were previously inaccessible to women

Fundamental instruments of the International Labour Organisation (ILO)

ILO has eleven fundamental instruments, which include 10 conventions and the 2014 Protocol for Convention No. 29 on Forced Labour. The instruments are summarised below.

Kazakhstan has ratified ILO's ten fundamental conventions, but not the Protocol from 2014 related to Forced Labour[5].

Table 5.6: Overview of ILO fundamental conventions

C29 Convention concerning Forced or Compulsory Labour, 1930 **P29 Protocol of 2014 to the Forced Labour Convention, 1930**	The Convention prohibits the imposition, or permitting the imposition, of forced or compulsory labour for the benefit of private individuals, companies or associations. Article 2 of the Convention defines forced or compulsory labour as *all work or service which is exacted from any person under the menace of any penalty and for which the said person has not offered himself voluntarily.* A few exceptions are mentioned such as compulsory military service laws for work of a purely military character. The 2014 Protocol, Article 1, stipulates that *In giving effect to its obligations under the Convention to suppress forced or compulsory labour, each Member shall take effective measures to prevent and eliminate its use, to provide to victims protection and access to appropriate and effective remedies, such as compensation, and to sanction the perpetrators of forced or compulsory labour.* Article 2 stipulates that *Each Member shall develop a national policy and plan of action for the effective and sustained suppression of forced or compulsory labour in consultation with employers' and workers' organisations…*
C87 Convention concerning Freedom of Association and Protection of the Right to Organise, 1948	Article 2 of the Convention stipulates that workers and employers shall have the right to establish and, subject only to the rules of the organisation concerned, to join organisations of their own choosing without previous authorisation. Articles 3 mentions that workers' and employers' organisations shall have the right to draw up their constitutions and rules, to elect their representatives in full freedom, to organise their administration and activities and to formulate their programmes. The public authorities shall refrain from any interference which would restrict this right or impede the lawful exercise thereof.
C98 Convention concerning the Application of the Principles of the Right to Organise and to Bargain Collectively, 1949	Article 1 of the Convention stipulates that workers shall enjoy adequate protection against acts of anti-union discrimination in respect of their employment, while Article 2 mentions that workers' and employers' organisations shall enjoy adequate protection against any acts of interference by each other or each other's agents or members in their establishment, functioning or administration. In accordance with Article 4, measures should be taken to encourage and promote the full development and utilisation of a mechanism for voluntary negotiation between employers, or employers' organisations, and workers' organisations on terms and conditions of employment by means of collective agreements.

[5] https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:10011:::NO:10011:P10011_DISPLAY_BY,P10011_CONVENTION_TYPE_CODE:1,F

C100 Convention concerning Equal Remuneration for Men and Women Workers for Work of Equal Value, 1951	Article 2 of the Convention stipulates that the application to all workers of the principle of equal remuneration for men and women workers for work of equal value should be ensured through the methods used to determine rates of remuneration. This may be achieved through national laws or regulations; legally established or recognised machinery for wage determination; collective agreements between employers and workers; or a combination of the mentioned means.
C105 Convention concerning the Abolition of Forced Labour, 1957	Article 1 stipulates a commitment to suppress and not to make use of any form of forced or compulsory labour: a) as a means of political coercion or education or as a punishment for holding or expressing political views or views ideologically opposed to the established political, social or economic system; b) as a method of mobilising or using labour for purposes of economic development; c) as a means of labour discipline; d) as a punishment for having participated in strikes; e) as a means of racial, social, national or religious discrimination.
C111 Convention concerning Discrimination in Respect of Employment and Occupation, 1958	Article 1 defines discrimination as a) any distinction, exclusion or preference made on the basis of race, colour, sex, religion, political opinion, national extraction or social origin; b) such other distinction, exclusion or preference which has the effect of nullifying or impairing equality of opportunity or treatment in employment or occupation as determined after consultation with representative organisations.
C138 Convention concerning Minimum Age for Admission to Employment, 1973	Article 2 stipulates that the minimum age shall not be less than the age of completion of compulsory schooling, and, in any case, shall not be less than 15 years. However, countries whose economy and educational facilities are insufficiently developed may, after consultation with the organisations of employers and workers concerned, where such exist, initially specify a minimum age of 14 years. Article 3 highlights that the minimum age for admission to any type of employment or work which is likely to jeopardise the health, safety or morals of young persons shall not be less than 18 years. However, employment or work may be authorised from the age of 16 years on condition that the health, safety or morals of the young persons are fully protected and that they have received adequate specific instruction or vocational training. Article 7 mentions that light work may be permitted from the age of 13 years.
C182 Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour, 1999	Article 2 stipulates that for the purposes of this Convention the term *child* shall apply to all persons under the age of 18. Article 3 defines *the worst forms of child labour* as a) all forms of slavery or practices similar to slavery, such as the sale and trafficking of children; b) the use, procuring or offering of a child for prostitution or pornography; c) the use, procuring or offering of a child for illicit activities, in particular for the production and trafficking of drugs as defined in the relevant international treaties; d) work which is likely to harm the health, safety or morals of children. Article 6 stipulates that member countries shall design and implement programmes of action to eliminate as a priority the worst forms of child labour.
C155 Occupational Safety and Health Convention, 1981	Article 5 stipulates that for the purpose of this Convention the following main spheres of action should be taken account, as they affect occupational safety and health and the working environment: a) design, testing, choice, substitution, installation, arrangement, use and maintenance of the material elements of work; b) relationships between the material elements of work and the person who carry out or supervise the work, and adaptation of machinery, equipment, working time, organisation of work and work processes to the physical and mental capacities of the workers; c) training, including necessary further training, qualifications and motivations of persons involved, in one capacity or another, in the achievement of adequate levels of safety and health; d) communication and co-operation at the levels of the working group and the undertaking and at all other appropriate levels up to and including the national level; e) the protection of workers and their representatives from disciplinary measures as a result of actions properly taken by them in conformity with the policy referred to in Article 4 of this Convention.

C187 Promotional Framework for Occupational Safety and Health Convention, 2006	Article 1 refers the term *national system for occupational safety and health or national system* to the infrastructure which provides the main framework for implementing the national policy and national programmes on occupational safety and health, the term *national programme on occupational safety and health or national programme* refers to any national programme that includes objectives to be achieved in a predetermined time frame, priorities and means of action formulated to improve occupational safety and health, and means to assess progress;

5.2.4 Social aspects

Consideration of social issues, land acquisition in Kazakhstan, access to information and procedures for public consultations are regulated based on the following national legislation:

Table 5.7: Overview of national legislation on social performance practices and management

Land acquisition	The main applicable law regulating land allocation process is the Land Code No. 59-VII amended on 30.06.2021. It establishes conditions and limits for modifying or terminating ownership of land and land-use rights, outlines the rights and responsibilities of landowners and land users, and regulates land relations. Article 101 of Land Code stipulates that the user right to land plots is provided to Kazakhstan citizens in two ways: i) temporary paid land use (lease) for farming for a period of 10-49 years; and ii) temporary free land use for cattle rearing in distant pastures (seasonal pastures). Procedures for determining the lease cost are described by the Republic of Kazakhstan Government Resolution on Establishment of Base Payment Rates for Land Plots, No. 890, 2003 and the Tax Code 2008. According to these laws, the Central Land Management set the lease rates for the land categories made by the land utilitarian value like arable irrigated or non-irrigated, pastures or wasteland. According to the Land Code Article 165, losses caused to land owners or land users are subject to full compensation in the following cases: compulsory land acquisition for state needs, entailing the termination of the right of ownership or land use; restrictions on the right of ownership or land use with a special land use regime establishment; violation of the land owners or land users rights; land quality deterioration as a result of construction and operation of facilities leading to disturbance of soil fertility, worsening water regime, emitting substances harmful to crops and plantations; land acquisition in emergency situations. Article 166.2 defines the compensation constituents: i) the cost of land or land-use rights; ii) the market cost of the assets located on the plot, including fruit trees and perennial plantings; iii) cost of the expenditures associated with development of the land, its operation, implementation of protective measures, improvement of soil fertility taking into consideration their inflation; iv) all losses inflicted on the owner or land user as a result of land acquisition at the time of termination of ownership or land-use right, including losses they incur due to early termination of their obligations to third parties; and v) loss of revenue.
Access to Information	The Law on Access to Information of November 16, 2015, regulates public relations arising from the realization of the constitutional right of everyone to freely receive and disseminate information in any way not prohibited by law. Access to information is based on the following principles: legality; openness and transparency of the activities of information owners; reliability and completeness; relevance and timeliness; equal access to information; non-disclosure of state secrets and other secrets protected by law; inviolability of private life, personal and family secrets; observance of the rights and legitimate interests of individuals and legal entities.

Grievances	The Law on Grievances Handling procedures № 221-III of January 12, 2007, is no longer in force. On June 29, 2020, in the Republic of Kazakhstan a new Administrative Procedural Code № 350-VI was adopted according to which the term of consideration of an appeal is 15 working days from the date of its receipt, unless otherwise is stipulated by the laws of the Republic of Kazakhstan. Herewith, the term of consideration of an appeal may be extended by a reasoned decision of the head of an administrative body or its deputy for a reasonable period, but not more than two months.
Ratification of the Aarhus Convention on Access to Information etc.	Kazakhstan ratified the Convention on the Access to Information, the Public Participation in Decision Making and the Access to Justice in Environmental Matters (the Aarhus Convention) on 23 October 2000.

5.3 National and international impact assessment and approval processes

5.3.1 National environmental approval process for new WWTP

Environmental Impact Assessment (EIA)

In accordance with national law, an EIA must be carried out for the proposed WWTP by a company licensed to perform such assessments in Kazakhstan[6]. An EIA is “compulsory for all types of activities that are listed in Appendix 1 of the Environmental Code. According to this, an EIA is mandatory for a wastewater treatment facility with a capacity of 30,000 m^3 per day or more, which applies to the Aktobe Project. The recent instruction on EIA[7] notes that all stages of the project design must include an assessment of environmental impact to the details responding to the design stage and as knowledge of the technical specifications of the project allows. The correlation between project design stages and corresponding EIA stages is summarized in the table below.

In line with the above, in parallel with the feasibility study, Aquarem has worked on a Preliminary Environmental Impact Assessment (EIA) which is being submitted to the State Environmental Expertise (SEE). The FS with preliminary design by Aquarem has been approved by ASEG and delivered to the SEE for review.

In order to progress to the next stage of the project design, the Preliminary EIA has to be approved by the SEE. The SEE can release the developer from conducting the next stage, if the Preliminary EIA proves that the negative effects are absent, small, short-term, and benign. The SEE may be satisfied with an Preliminary EIA which is performed with the feasibility study (pre-design documentation) and focuses on environmental impact scoping and alternatives. If the positive SEE conclusion on the Preliminary EIA does not recommend further environmental work, such approval is considered to be final. However, if the results of a Preliminary EIA or analogies show that impacts from the projected development are likely to be considerable or uncertain, then the SEE recommends performing a full EIA.

Hence, no official project approval has been obtained from the SSE to date. These are expected in about a month from delivering the EIA, if approved by SEE.

Table 5.8: Correlation between the environmental and engineering stages during design

EIA stage	Engineering stage
Preliminary EIA	Feasibility Study (pre-design documentation)
Full national EIA	Technical/detailed design documentation

[6] The RoK Law on Permissions and Notifications No. 202-V, dd 16 May 2014
[7] Instruction for performance of environmental impact assessment No. 204-п, dd 28 June 2007

At the EIA stage, construction pollution will be calculated using the proposed personnel, machinery and material specifications. Composition of EIA reports can differ between large complex and small benign developments. For example, calculation of the maximum permitted pollution volumes (MPPs) is not required in EIAs for small and benign developments and is set according to the real discharges at the first year of the operation. For the Aktobe WWTP Project all MPP calculations are to be presented in the SEE approved EIA. These calculations are required in order to obtain an Emissions Permit. The positive conclusion on EIA by SEE acts as a permit for the calculated pollution. The **sanitary protection zone** will be established according to Sanitary-Epidemiological requirements of the Republic of Kazakhstan (RoK) on establishment of sanitary protection zones (SanPiN #237 dated March 20, 2015) on the basis of the calculation of emissions, discharges and waste volumes.

The developer must inform the authorities about any changes in the project approved by the SEE that may affect the environment. The project will not require a second review as long as re-calculated volumes of the used resources, pollution and waste disposal do not exceed the earlier permitted amounts and the level of negative impacts do not increase.

Other Project approval requirements

Power production from biogas is considered, and therefore compliance with the regulations of the Electric Power Law #588-II from July 9, 2004, is required.

At the construction stage, Emissions Permit must also be obtained by the construction contractors for the emissions of the machinery used in construction. The actual emissions are not measured but are reported proportionally to the passed period of construction. Any on-site concrete plant contractors will also have to obtain an Emission Permit for their plant. A special Water Use Permit will not be required, as there will be no need for additional water abstraction.

Transportation of oversize and excessively heavy parts shall be conducted according to the Procedures for Transportation of Oversize and Heavy Freight on the Republic of Kazakhstan Territory #206, 2015 with amendments. The procedures restrict the speed to 60 km/h, and to 10 km/h when passing dams and bridges and oblige to conduct transportation in the hours of the least road occupancy and during daylight when close to settlements. Furthermore, they specify the conditions when a ‘cover’ car and an escort car with the blinking beacon lights are needed. The Procedures prohibit overtaking of all vehicles that move at speed above 30 km/h. Restrictions may also be applied to some local hard surface roads along the transportation route as being maximum 10 tonnes for a wheel pair load. This limit is lowered further to 8 tonnes during daytime and for the ambient temperature at or above +25°C.

An oversize equipment transportation plan and traffic management plan prepared by the construction contractor are to be approved by:

- Regional branches of the enterprise KazAvtoZhol PLC of the Committee for the Automobile Roads of the Ministry of the Industry and Development;
- Transport Control Inspection;
- Traffic Police;
- Railway operator Kaztemirzholy PLC if railway is used;
- Municipal electric power, district heating and gas distribution companies.

After commissioning the WWTP, the environmental protection plan and the environmental operational control plan will have to be updated. Based on the ASEG Maximum Permitted Discharge Project (MPD) environmental expertise conclusion that was issued by the Department of Natural Resources and Regulation of Natural Use of the Region for wastewater discharge, the current WWTP belongs to the third category of hazard. The same category is expected to be given to the new WWTP. An enterprise in this category shall develop an industrial environmental control program and environmental protection plan. The monitoring shall include:

- Quarterly - CO, NO, NO_2, SO_2, soot, benzo(a)pyrene, formaldehyde, $C_{12\text{-}19}$ at the air pollution sources identified by the Maximum Permitted Emission Report.
- Quarterly - CO, NO_2, SO_2 and soot at the edge of the operational sites sanitary protection zones (SPZ) upwind and downwind.
- Annually – gamma radiation, pH, humus, chlorides, sulphates, nitrates, total petroleum hydrocarbons in the soil at 4 corners of ASEG's 11 operational sites.
- Annually – noise and vibration at the SPZs of ASEG's 11 operational site.

The Ilek River water quality is monitored by the authorities 500m upstream and downstream of the effluent discharge point. The groundwater is monitored quarterly in two wells (#124 and 1270) downstream of the southern part of the WWTP by the Basin Inspection contractor Akpan LLP.

In addition to payments for pollution and resource use, ASEG shall obtain the State Environmental Insurance[8] from a licensed insurer.

The operation is controlled by the Natural Resource Management Department of the Regional Council that involves in the decision making the regional departments of the Emergency Situation Committee, the Regional Committee for Consumer Protection Rights (former Sanitary Epidemiological Service) and the Ministry of Labour and Social Security. These bodies will be entitled to review all current and historic relevant documentation that has to be retained for 5 years.

Sanitary Protection Zone (SPZ) requirements for new WWTP

Please refer to section 3.4.

5.3.2 International ESIA process

The ESIA should follow a report format consistent with the EU EIA Directive, and should address the concerns of all EBRD's PRs, e.g. projects involving involuntary resettlement (PR5), risks to biodiversity (PR6), impacts on cultural heritage (PR8) will require an assessment in accordance with the respective PR. The ESIA shall include an analysis of reasonable alternatives, in terms of project location, technology, size, scale and design.

Category A projects, like the WWTP Project in Aktobe, require EBRD's Client – in this case ASEG – to carry out a formalised, participatory disclosure and consultation process which will be built into each stage of the ESIA process, considering the stage of project development. This process involves organised and iterative consultation leading to the client's incorporating, into their decision-making process, the views of the affected parties on matters that affect them directly.

The Client is to engage in a scoping process with identified stakeholders at an early stage of the ESIA process to ensure identification of key risks and impacts to be assessed as part of the ESIA. The Client will disclose the draft ESIA Report, the Environmental and Social Management Plan (ESMP), the Environmental and Social Action Plan (ESAP), the Stakeholder Engagement Plan (SEP), and a Non-Technical Summary (NTS) of the ESIA. Stakeholders will be able to provide comments on the mentioned draft documents. The EBRD Access to Information Directive provides that the Bank disclose ESIAs for Category A projects 120 calendar days prior to Board consideration for public sector projects.

5.3.3 Comparison of national and international approaches

As can be seen from Figure 5.2, the process steps used in the EBRD ESIA and in the national EIA are relatively similar. The main difference is that while the national EIA is submitted to the SEE for approval and for the development of permit conditions, the ESIA is submitted to the EBRD Board for their consideration. Thus, the national process is legally required in accordance with national law, whereas the EBRD ESIA is required in accordance with EBRD's environmental and social safeguards.

[8] Law on the obligatory environmental insurance No 93-III, dd 13 December 2005

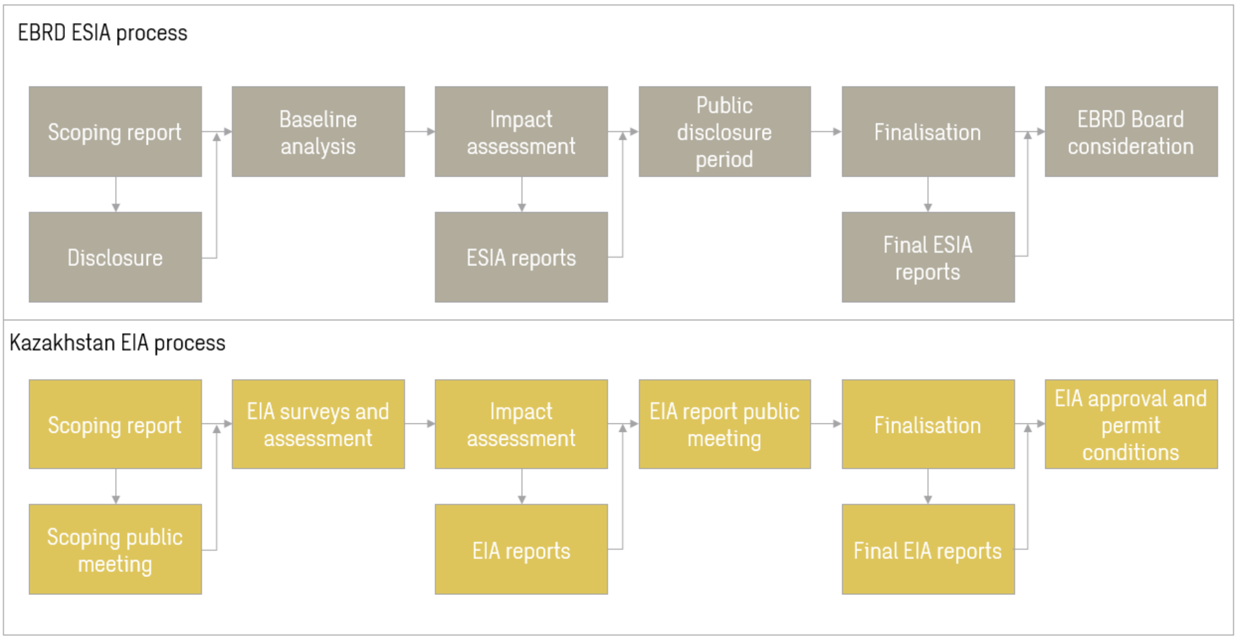

Figure 5.2: Comparison of national EIA process and EBRD ESIA process

Table 5.9 provides a brief overview of the differences between the national and EBRD impact assessments in terms of content covered. A key difference is that social and health and safety aspects are included in the EBRD ESIA process, whereas they are not included in the national process. Topics such as health and safety are managed separately at the national level and are not included in the EIA. Other additional items in the ESIA process include an assessment of Green Economy Transition (GET) indicators to determine if the project makes a substantial contribution to climate change adaptation or mitigation, or if it has other environmental benefits as outlined in EBRD's GET framework.

Table 5.9: Assessment of differences in subject matter between national and EBRD impact assessments

Subject matter	EBRD ESIA	National
Aspects		
Pollution prevention and control	Yes	Yes
Biodiversity	Yes	Yes
Occupational health and safety	Yes	No
Community health and safety	Yes	No
Labour and working conditions	Yes	No
Resettlement and land acquisition	Yes	No
Cultural heritage	Yes	No
Vulnerable groups	Yes	No
Indigenous people	Yes	No
Climate risk and vulnerability	Yes	No
Assessment of Green Economy Transition (GET) indicators	Yes	No
Outputs		
Impact assessment report	Yes	Yes
Non-technical summary	Yes	No
Stakeholder Engagement Plan	Yes	No
Resettlement Framework, if needed (not needed for this Project)	Yes	No
Environmental and Social Management Plans for construction and operation phases	Yes	No

6 BASELINE CONDITIONS

6.1 Physical and Natural Environment

This section describes the current baseline conditions related to the physical and natural environment within the anticipated PAI (see section 4.5.2).

6.1.1 Topography and landscape

The **topography of the existing WWTP site** is characterized by a relatively flat terrain that is slightly inclined towards the north, with elevations ranging from approx. 235m above mean sea level (amsl.) at its south border to 230m at the north border. The lowest point of the site is towards the north of the sludge bed area, with an elevation of 227m amsl. (Figure 6.1).

As can be seen on the same figure, there is a watershed boundary between the first 12 (to the south) sludge beds and the remaining sludge beds to the north.

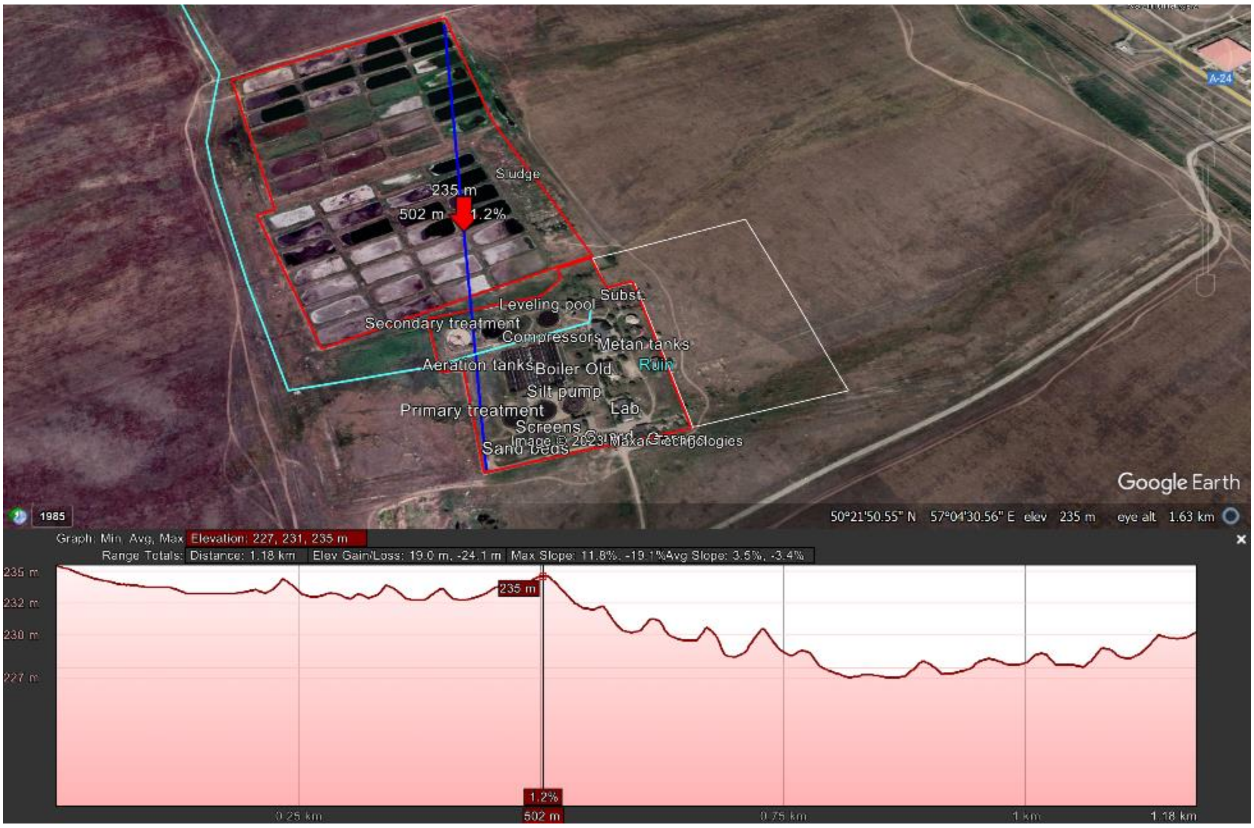

Figure 6.1 Topography North-South transect (blue line) of the existing Aktobe WWTP site (Source: Google Earth)

The proposed **new WWTP site** is located immediately to the east of the current WWTP and has a general inclination towards the north from 230m amsl. at the south border to 225m amsl. at the north border. During site surveys it was noted that there is a small depression close to the southern border which is often filled with snow melt water during spring (Figure 6.2). From west to east the new site is relatively flat with a drop of about 2-3 meters to the east (Figure 6.3Figure 6.3).

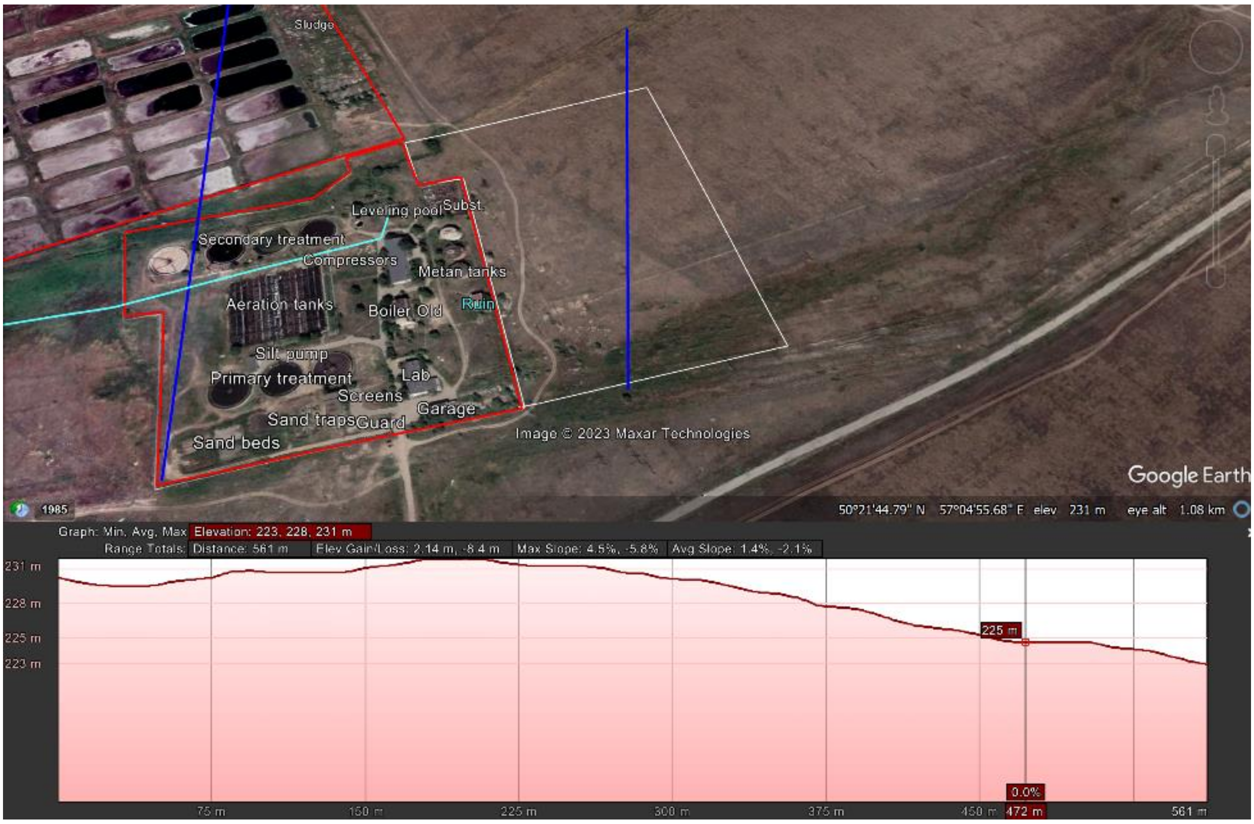

Figure 6.2: Topography North-South transect (right blue line) of the new Aktobe WWTP site (Source: Google Earth)

Figure 6.3: Topography West-East transect (blue line) of the new Aktobe WWTP site (Source: Google Earth)

Approximately 5 km to the NW from the WWTP is the URE effluent retention reservoir which is receiving treated effluent water from the existing WWTP via a discharge pipe. The URE reservoir is at an elevation of 231 m amsl, which is similar to the WWTP site. However, the highest point between the two locations is about 245 m (Figure 6.4).

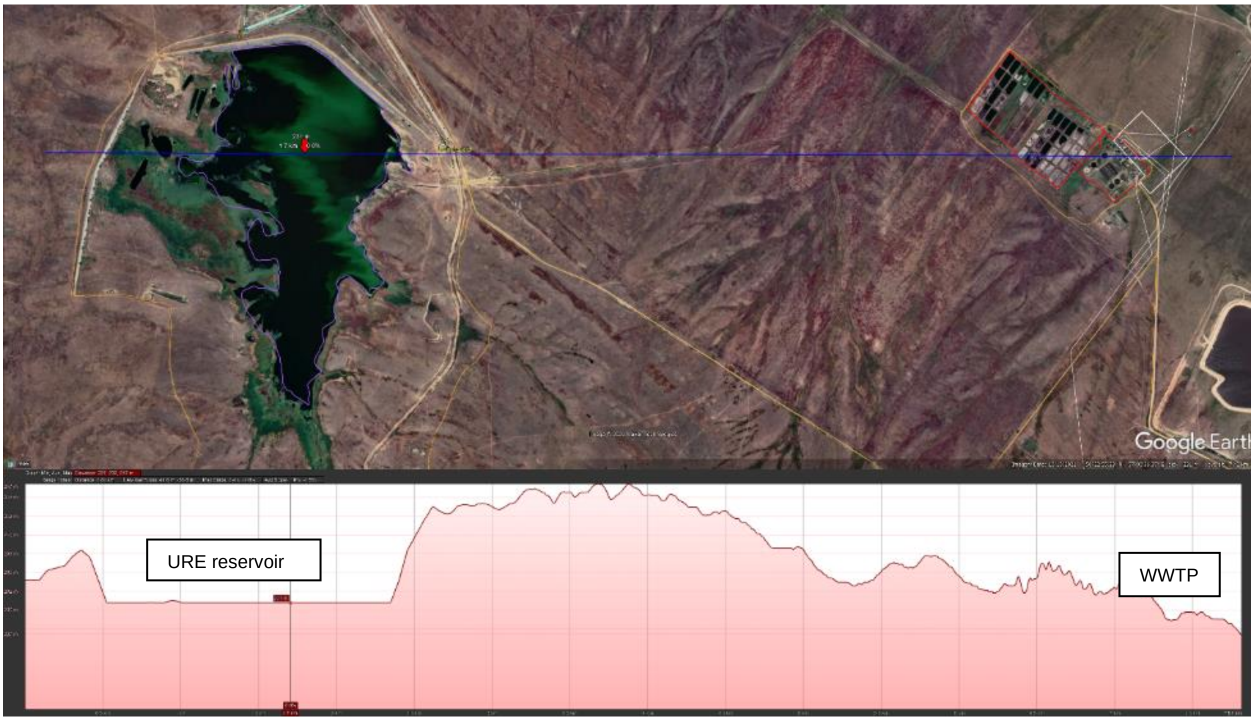

Figure 6.4 Topography and SE-NW transect (blue line) between the WWTP site and the URE reservoir (Source: Google Earth)

A transect showing the topography along the route of the discharge pipe is presented in Figure 6.5. Due to the rise in elevation between the WWTP and the reservoir, the effluents need to be mechanically pumped.

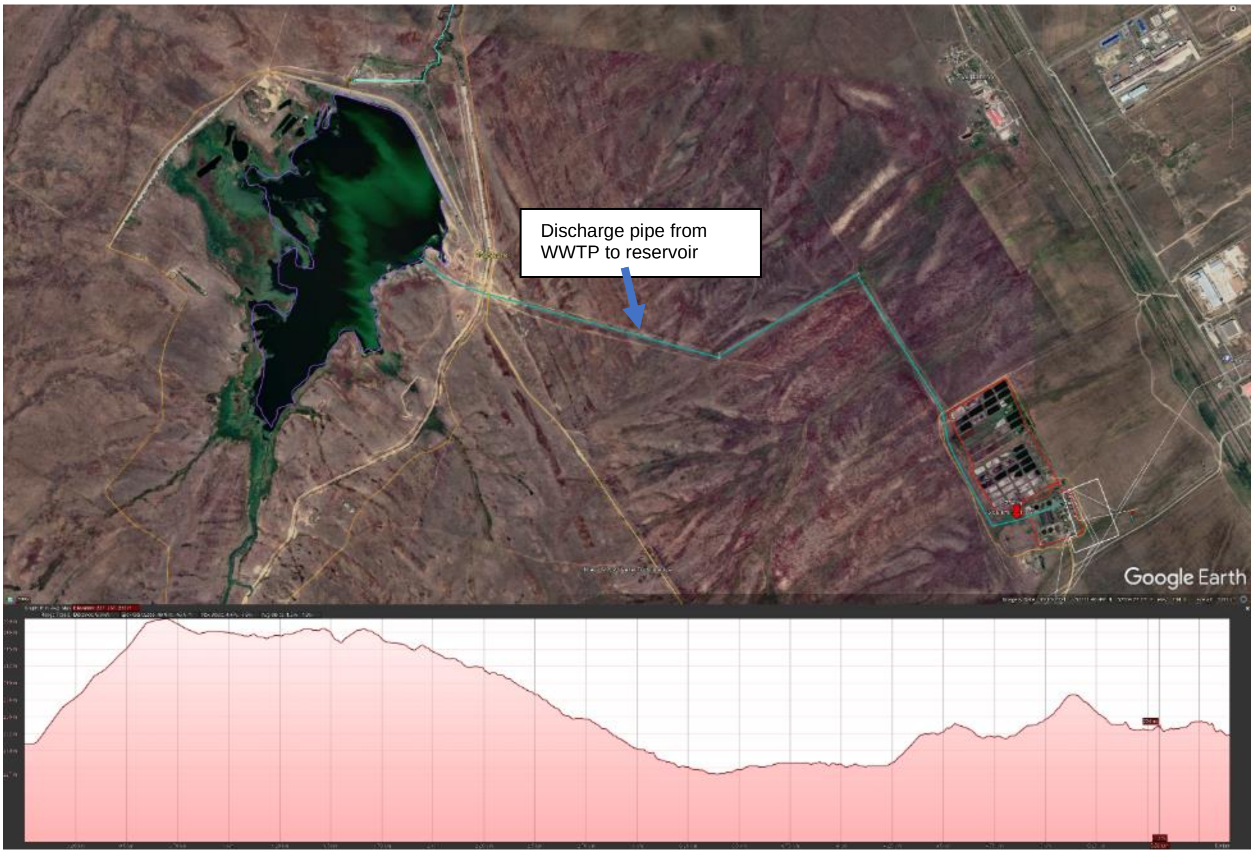

Figure 6.5: Transect of the discharge pipe between the WWTP and the URE reservoir (Source: Google Earth)

The **land-use and landscape** around the WWTP site area is characterized by the WWTP itself on an area of *approx.* 11 ha. and the sludge beds to the north on an area of 35 ha. Towards the east are fields which extend *approx.* 1.2 km towards the main truck railway line and the A-24 road to Russia, on the other side of which there is an industrial area.

To the south there are fields and meadows and approx. 1 km to the south there are settlement ponds associated with the Aktobe Chromium plant, which produces chromium compounds such as chromium oxide, chromic anhydride, tannins, sodium dichromate (source: Wikipedia). To the south is also the access road to the WWTP site (Figure 6.6).

The access road to the WWTP is also the access road to, and passes, the city solid waste landfill and the area north of it is designated for dumping snow scraped from the city streets during the winter. The road is in a poor condition and both domestic and construction waste is scattered around the road (Figure 6.6).

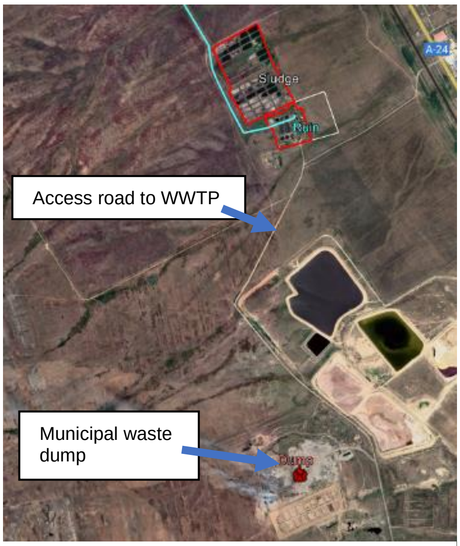

Figure 6.6 Location of access road to the WWTP passing the municipal waste dump and chromium production facility (Map source: Google Earth).

Conclusion on receptor sensitivity – topography and landscape

Based on the current baseline conditions, the proposed WWTP site is located on a relatively flat and remote area adjacent to the existing WWTP. The nearest residential area is the Tulpannyy hamlet approx. 2 km to the north. The WWTP is not visible from the settlement. Other nearby built areas are industrial areas >1 km to the south and east. Hence, the site sensitivity in terms of topography and landscape is considered **low.**

6.1.2 Geology, geomorphology, and soil

As reflected in Figure 6.7, the geology of the WWTP area is characterised by thin Middle Quaternary (Q_2) sandy silt which is partly sedimented over Neogene clays. The retention reservoir (purple colour) for treated effluent, however, is built in Triassic base rock.

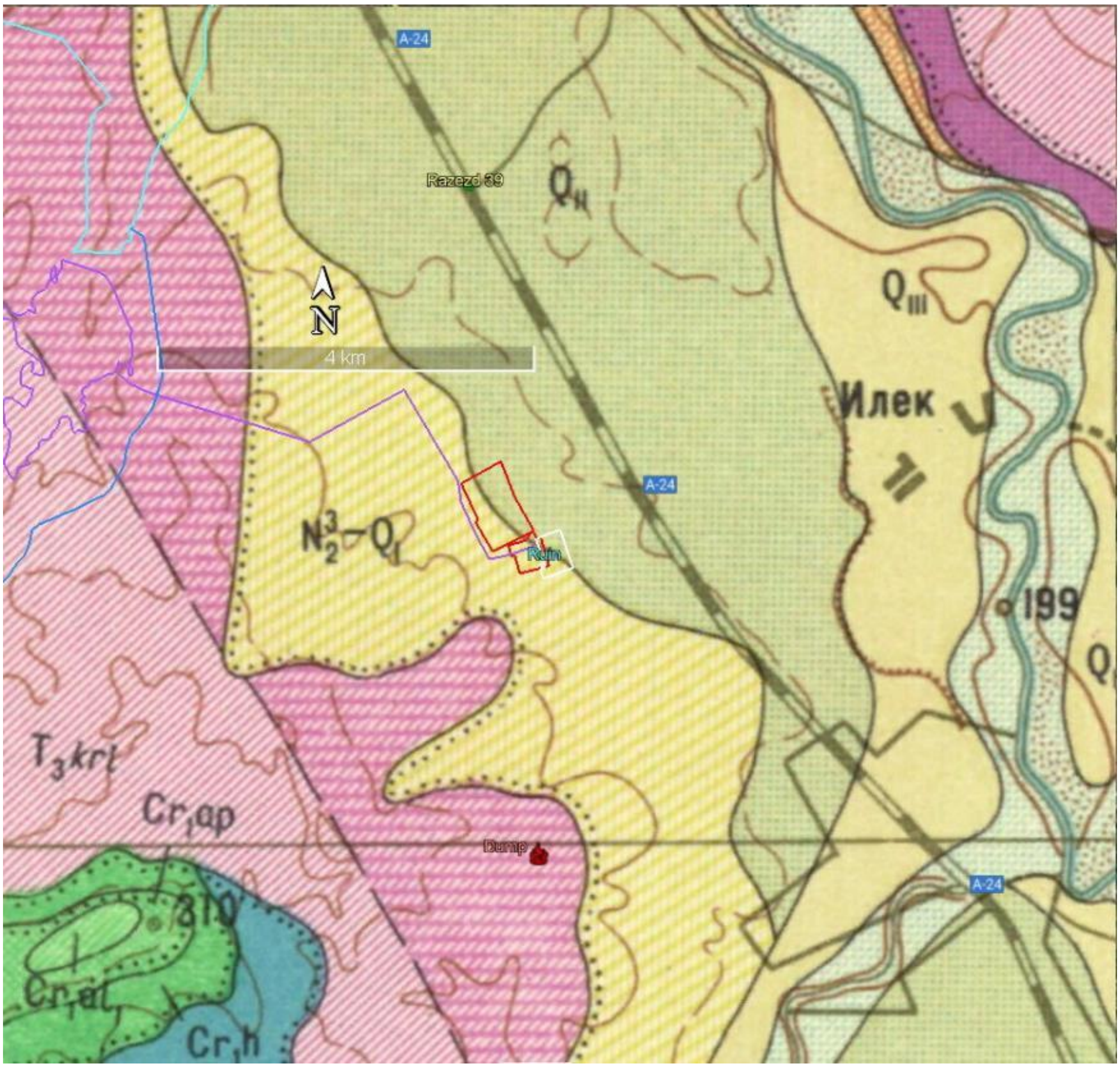

Figure 6.7 Geological map of the WWTP area and surroundings, showing the existing plant and the sludge beds (red square) and the area allocated for the new plant (white square) partially covered with thin Quaternary sandy silt sedimented over Neogene clays and the treated water retention reservoir (purple colour) built in the Triassic base rock.

A geotechnical assessment made by Geoproekt Aktobe in 2016 involved drilling of 21 boreholes down to a depth of 6-8m: 13 boreholes at the WWTP site, 4 at the area proposed for the new plant and 4 along the access road (see Figure 6.8) The results of the analysis showed that Paleogene light sandy semidense to soft-plastic light-brown clay was abundant. This clay was also observed on the surface at the URE reservoir area despite its absence on the geological map (Figure 6.7). Another contractor that was hired by the WWTP to build a compost pad, drilled a borehole at the URE dam to unknown depth and found no groundwater. This suggests that the Paleogene clay extends to some depth there too.

The sampling of sludge bed sediments undertaken for this present ESIA study (2023) also observed this Paleogene clay at the beds' bottom. The clay becomes denser with depth. According to the geological map (Figure 6.7), the clay is overlaid by Lower Quaternary (Q_1) clay, silty clay and silty sand with no indistinct boundary between these two layers. The geotechnical assessment found that the ground salinity is only 1.5% but sulphate prevalence (2.65g/kg) makes it aggressive to normal Portland cements. Aggressiveness to the steelwork however is medium due to lower concentration of chlorides (Cl=1.9g/kg).

The geological map also shows that half of the sludge beds and the WWTP is overlaid by Middle Quaternary (Q_2) sandy silt, but the geotechnical assessment recognises it as brought-in, light (1.2g/cm^3) porous (1.2-1.6m) clay, silty clay and silty sand that cannot serve as a base for foundations. At the WWTP, this layer is 2-6m deep but the geotechnical study suggests that its depth may increase towards the east.

Figure 6.8 Boreholes drilled as part of a geotechnical assessment made by Geoproekt Aktobe in 2016. It shows 17 boreholes drilled in the existing WWTP and the area planned for the new plant east of it (Source: Geoproekt Aktobe geotechnical report 2016)

The geotechnical assessment drilling did not reach the unconformably (i.e. with discontinuity in the geological record, and typically not having the same direction of stratification) underlying Triassic conglomerates, sandstones, siltstones and claystones of Karashilinskaya Formation (T_3krs) visible on the geological map in Figure 6.7. These bed rocks dip to southeast but the angle of the dip and physical condition of this layer is not known. The map also shows that Lower Cretaceous sediments of three formations (Cr_1al, Cr_1ap, Cr_1h) lie under it unconformably. The map also identifies Palaeogene as having later Neogene origin (N_2^3) which may be the case considering absence of unconformable clear contact with the Quaternary sediments.

Soil and soil quality

In terms of **soil,** normal light chestnut soil of loam composition prevails through the new WWTP area and around the existing WWTP and sludge beds. It is formed from the underlying Quaternary eluvial-diluvial silty clay and is rich in humus for the first 23-30cm depending on the elevation. In the lower parts of the WWTP area solonetzic soil formed with tough, impermeable hardpan 2-7 to 30cm below the surface that retains most of the plant's roots and thus humic layer above it.

ASEG conducts soil analysis on an annual basis as required in its permits.

Microbiological tests of soil were made at the URE site, below the dam next to the discharge gate from the reservoir, on 27 September 2022 by a bacteriological laboratory of the National Centre of accreditation on behalf of ASEG. The results are shown in Table 6.1. The same soil samples were also **tested for lead** at the same time and found no lead in the soil.

Table 6.1: Results of microbiological soil tests (mg/kg) at the URE site in Sept. 2022.

Sampling location	Coli titre	Clostridium (Cl.) Perfringes	Thermophiles
Soil at URE sludge storage site	>1.0	>0.1	0.01

As part of this ESIA process, soil samples were collected at the proposed WWTP site and analysed for Persistent Organic Pesticides (POP) concentrations, as an indication of potential historic contamination from past agricultural activities. Samples were taken at five (5) locations within the proposed WWTP site, as reflected in Figure 6.9. Persistent organic pesticide concentrations were determined by gas chromatography with electron capture detector by the National Analytical Centre Laboratory (accreditation KZT02E141 from 12.04.2021) for chlor-organic pesticides and polychlorinated biphenyls (report #COM-2196-P dated 15.05.2023).

In the absence of national and EU criteria, a Danish (DK) soil quality criterion for DDD, DDT and DDE combined has also been included in the table for reference. These compounds exhibit strong binding properties to the soil and are persisting for extended periods.

The overall findings indicate that the POP values are very low and well within the reference values, hence indicating a low level of POP contamination. It is advisable that topsoil removed as part of excavations should be used for landscaping within the site.

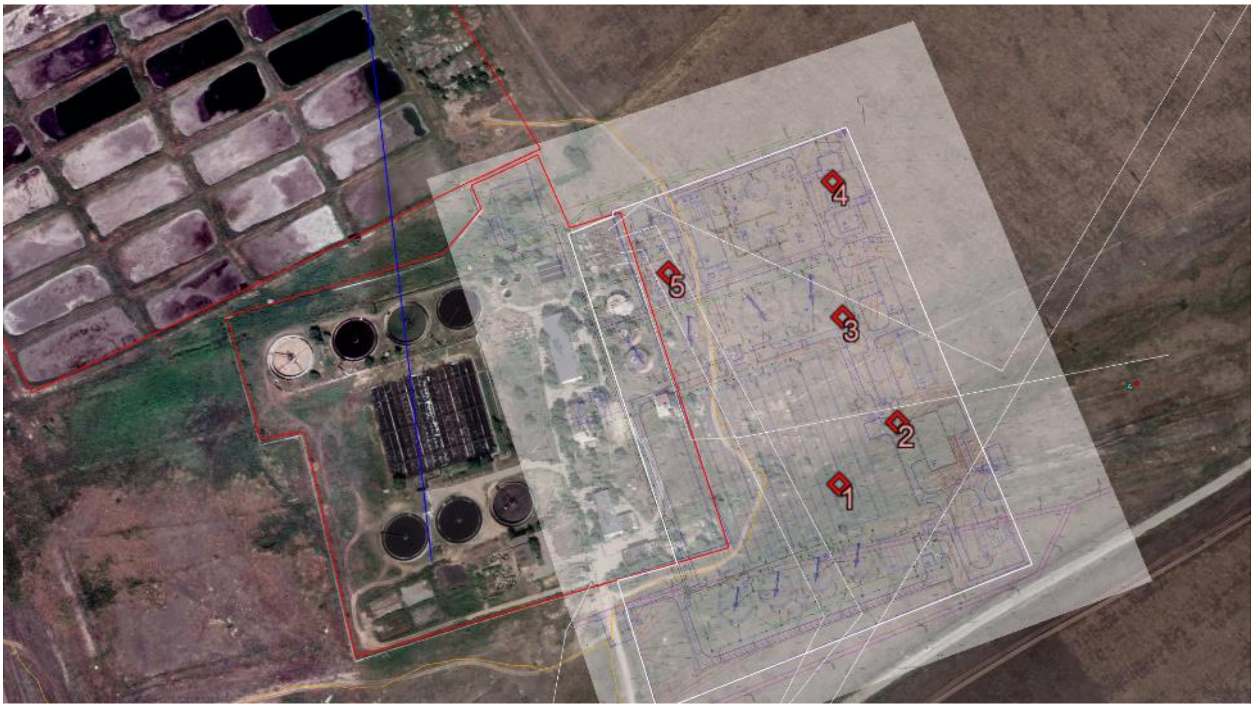

Figure 6.9: Locations of soil samples taken within the proposed WWTP site. Sampling points: 1 – lowland under planned biological tanks; 2 – lowland near the planned workshop-garage foundation; 3 – Drainage channel at the hay field edge under the planned secondary sedimentation tanks; 4 - hay field under the planned disinfection shop and 5 – a wasteland pit under the planned anaerobic digesters.

Table 6.2 Persistent organic pesticides concentration (µg/kg) in soil of the plot allocated for the new WWTP compared with the available MPC and RSC values.

	Sampling point and measured values in µg/kg						**Reference** (µg/kg)
Persistent organic pesticides	**1**	**2**	**3**	**4**	**5**	**MPC or RSC***	**DK soil quality criterion**
alpha-hexachlorocyclohexane	<0.0001	0.0264	0.0089	0.0127	0.108		
beta-hexachlorocyclohexane	0.0117	0.0513	0.049	0.0235	0.285		
gamma-hexachlorocyclohexane	<0.0001	0.0159	0.0348	0.0093	0.755		
delta-hexachlorocyclohexane	<0.0001	<0.0001	<0.0001	0.024	0.427		
4,4-DDD	<0.0001	<0.0001	<0.0001	<0.0001	1.241		500 (combined soil quality criterion)
4,4 DDT	<0.0001	0.1157	0.2167	0.0642	0.436		
4,4-DDE	<0.0001	0.0773	0.0185	0.0323	0.668		
2,4-DDD	<0.0001	0.0174	<0.0001	<0.0001	0.083		
Heptachlor	<0.0001	0.4667	0.0592	0.0316	2.049		
Heptachlor epoxide isomer B	0.0443	<0.0001	0.0096	0.0156	0.098		

	Sampling point and measured values in µg/kg						Reference (µg/kg)
Persistent organic pesticides	**1**	**2**	**3**	**4**	**5**	**MPC or RSC***	**DK soil quality criterion**
Aldrin	0.0235	<0.0001	<0.0001	<0.0001	0.096		
Chlordan	<0.0001	<0.0001	<0.0001	<0.0001	0.075		
Dieldrin	<0.0001	<0.0001	<0.0001	<0.0001	0.084		
Endrin	<0.0001	0.0305	<0.0001	<0.0001	1.158		
Endrin aldehyde	<0.0001	0.0396	<0.0001	<0.0001	8.879		
Keltan (dicophol)	<0.0001	0.0387	0.0511	0.022	0.327	1000	
Chlorbenzilat	<0.0001	0.0307	0.0371	<0.0001	0.452		
Dibutilendan	<0.0001	<0.0001	<0.0001	<0.0001	1.296		
Metoxichlor	<0.0001	<0.0001	<0.0001	0.0501	0.557	*1600	
Endosylphan I (alpha)	<0.0001	0.1382	<0.0001	0.0561	3.156	*100	
Endosulphan II (beta)	<0.0001	<0.0001	<0.0001	<0.0001	0.390	*100	
Endosulphan sulfate	<0.0001	<0.0001	<0.0001	<0.0001	1.145		
Hexachlorbenzol	0.0135	0.0284	0.0565	0.0555	0.426	30	
Hexabrombensol	<0.0001	<0.0001	<0.0001	0.2449	1.844		

Conclusion on receptor sensitivity – geology and soil

The proposed WWTP site is located on a relatively flat and remote area characterised by thin Middle Quaternary (Q_2) sandy silt which is partly sedimented over Neogene clays, and normal light chestnut soil which is rich in humus for the first 23-30cm depending on the elevation. Both the geology and soil are typical for the larger surrounding area, the rarity of the site in this regard is considered low. Hence, site sensitivity in terms of geology and soil is considered **low.**

6.1.3 Seismicity

Most areas of Kazakhstan are located in a stable zone with little or no seismicity. In such a zone lies Aktobe. Seismicity in the country is concentrated along the southern border with People's Republic of China, Kyrgyz Republic, and Uzbekistan. Events of magnitudes 8.3 and 7.4 were recorded in the vicinity of Almaty in 1887 and 1889, respectively[9].

Both figures below show that the region with the highest peak ground acceleration (PGA) with a 10% or 2% probability of exceedance in 50 years on reference site conditions is around Almaty. Overall, the south and south-eastern regions depict a higher seismic hazard, whereas the earthquake risk in Aktobe is low.

[9] https://www.carecprogram.org/uploads/CAREC-Risk-Profiles_Kazakhstan.pdf

Figure 6.10: Seismic hazard map for PGA with a 2% probability of exceedance in 50 years. Source: [CAREC]

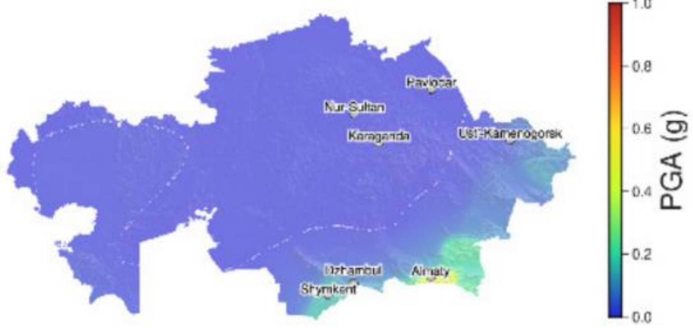

Figure 6.11: Seismic hazard map for PGA with a 10% probability of exceedance in 50 years: Source: [CAREC]

Conclusion on receptor sensitivity – seismicity

The site is not prone to earthquake risk; hence the sensitivity of the site with regards to earthquake risks is considered to be **low**.

6.1.4 Climate (past conditions)

The distance from the ocean and the vast territory sharply determines the continental climate of Kazakhstan, with hot summers and cold winters. Kazakhstan is one of the largest countries in the world and therefore the climate varies significantly throughout the country. The terrain in Kazakhstan belongs to four natural climate zones – forest-steppe, steppe, semi-arid and desert. For the whole country, the annual average temperature is 5.8 ºC and the average annual precipitation is 250 mm. The city of Aktobe is in an area dominated by grassland and cropland.

The climate in Aktobe is highly continental and arid, with cold and windy winters and a fast transition to a hot summer. The climate varies substantially from year to year. The below sub-sections describe the local climate situation based on available data related to **temperature**, **precipitation** and **wind**. The temperature and precipitation data is obtained from the local meteorological station in the city. The data is found through the National Oceanic and Atmospheric Administration[10] and the meteorological site Pogodaiklimat[11]. The station itself is situated in Aktobe city.

Temperature

The variation in average annual temperature in Aktobe from 1922 to 2020 is shown in Figure 6.12. The data has a few gaps in the first half of the measuring period. Data indicates an annual average temperature around 4.6 ˚C. The national average temperature is a bit higher with 5.6 ˚C across the country. There is some variation in the data, but the trend is an increase in average temperature within

[10] https://www.noaa.gov/
[11] [Climate of Aktobe - Weather and climate (pogodaiklimat.ru)]

the last 100 years. **The trend indicates an average rise of 1.5 ˚C in the region over the last 100 years.**

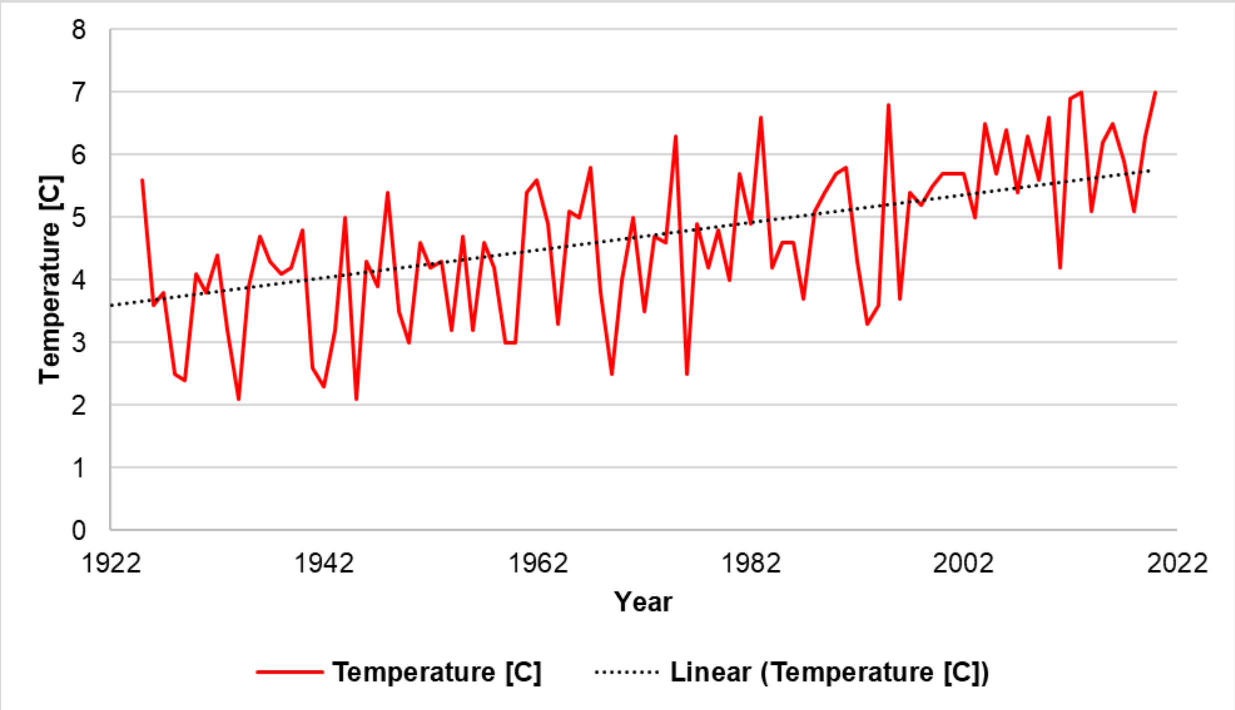

Figure 6.12: Annual mean temperature in Aktobe based on records from 1922 to 2020 from a meteorological station in Aktobe (Source: Pogodaiklimat)

Figure 6.13 illustrates the records of seasonal average temperature which also shows an increase in all seasons. The largest increases in temperature are seen in the winter and spring, also with substantial variation from year to year. The average temperatures are highest during the summer season, reaching just above 20˚C but with maximum temperatures having reached up to 43˚C (in month of July), and below the freezing point during the winter season, ranging from -15 ˚C to -3 ˚C, November through March, with absolute minimum measured as -48˚C (during January).

Based on the Aquarem FS, only 140 days in the year are without frost and 230 days without snow. The fastest change in the temperature is in April immediately after snow melting. Melted water evaporates and roads dry out very rapidly. The long-term average annual evaporation from small water bodies surface reaches 808mm/m^2. Summer precipitation practically fully evaporates and the relative humidity in summer comes close to 50%.

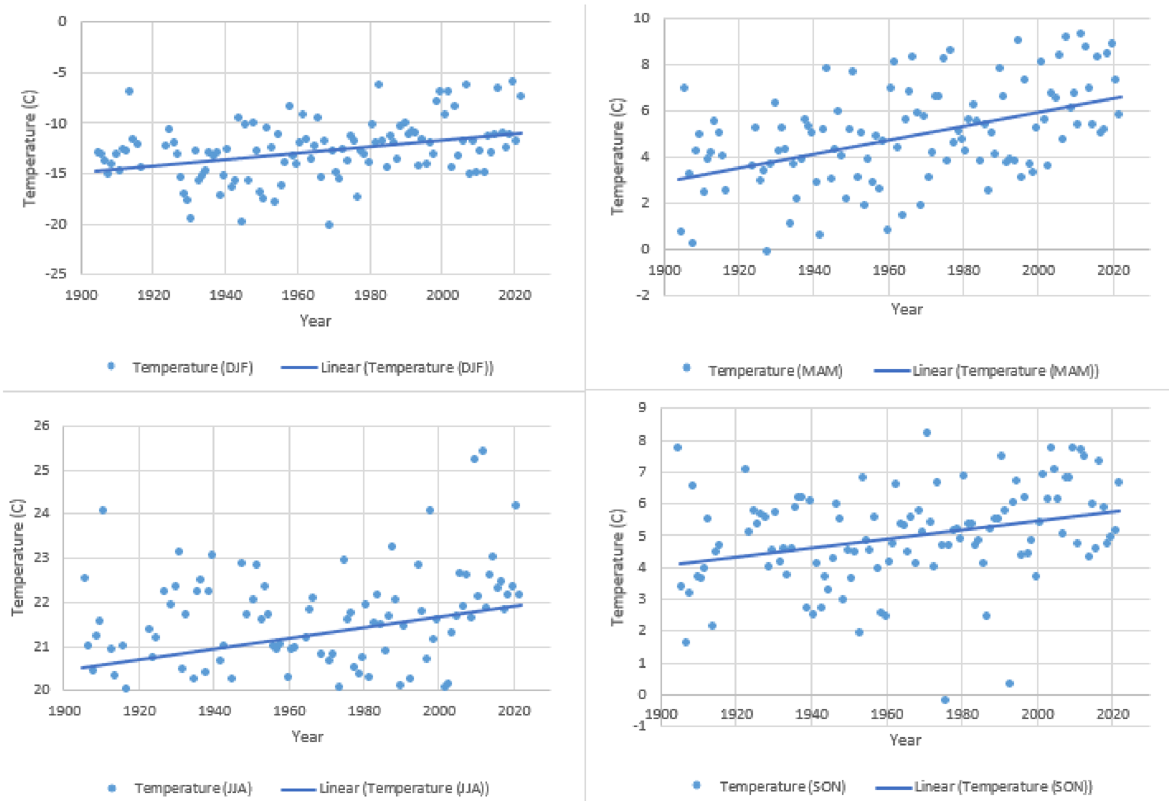

Figure 6.13: Change in seasonal average temperature for: December, January, and February (DJF); March, April, and May (MAM); June, July, and August (JJA); and September, October, and November (SON)

Precipitation

The average **monthly precipitation and temperature** are shown in Figure 6.14. Data ranges from 1905 to 2020 for (with some gaps in early recording years).

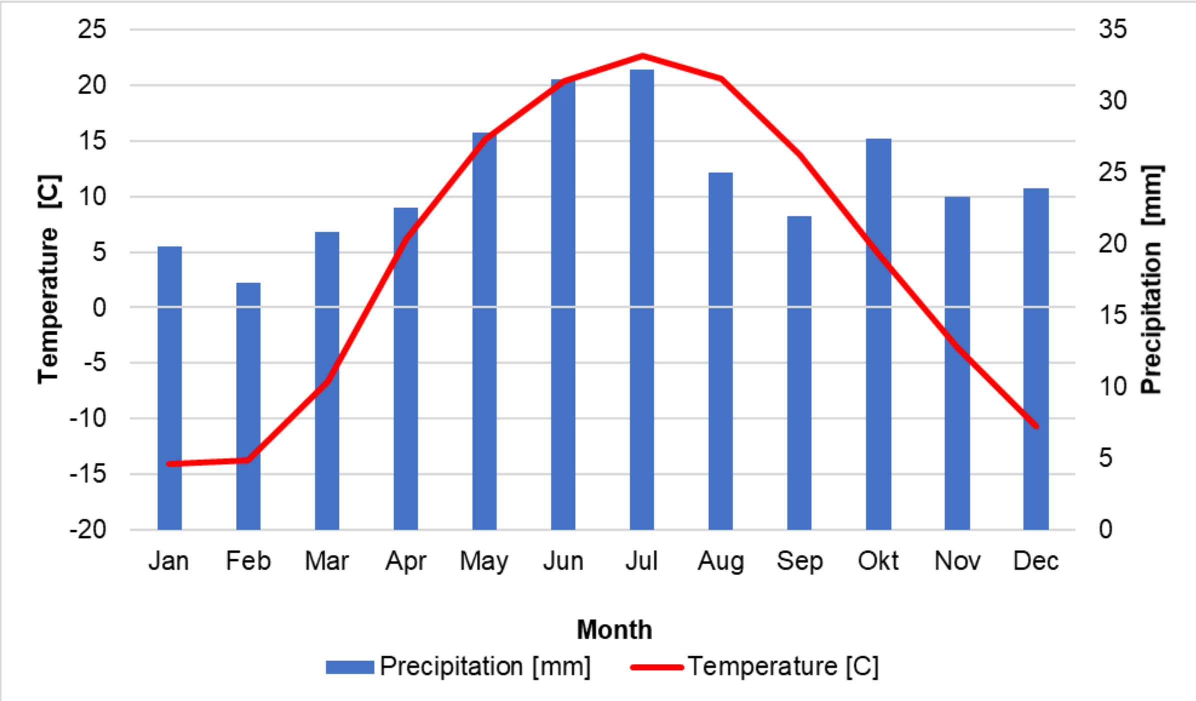

Figure 6.14: Monthly averages for temperature and precipitation for Aktobe, based on long term monitoring data from 1905 to 2020 (Source: Pogodaiklimat)

The annual precipitation for Aktobe is 300 mm, which is slightly more than the national annual precipitation of 250 mm. The monthly precipitation varies from 17 mm in the end of the winter season to 32 mm in the beginning of the summer season. There is not a lot of difference in precipitation between the seasons. The maximum monthly rainfall is registered during the late spring month May and the summer months, with June being the highest. The lowest monthly precipitation is during the winter months from December through March, February being the lowest.

Figure 6.15 shows the annual precipitation for Aktobe covering a period from 1905-2020, with a gap from 1917-1924. As for the temperature, there is an indication that annual precipitation gradually increased over the past 70 years. However, there is a relatively large variation from year to year.

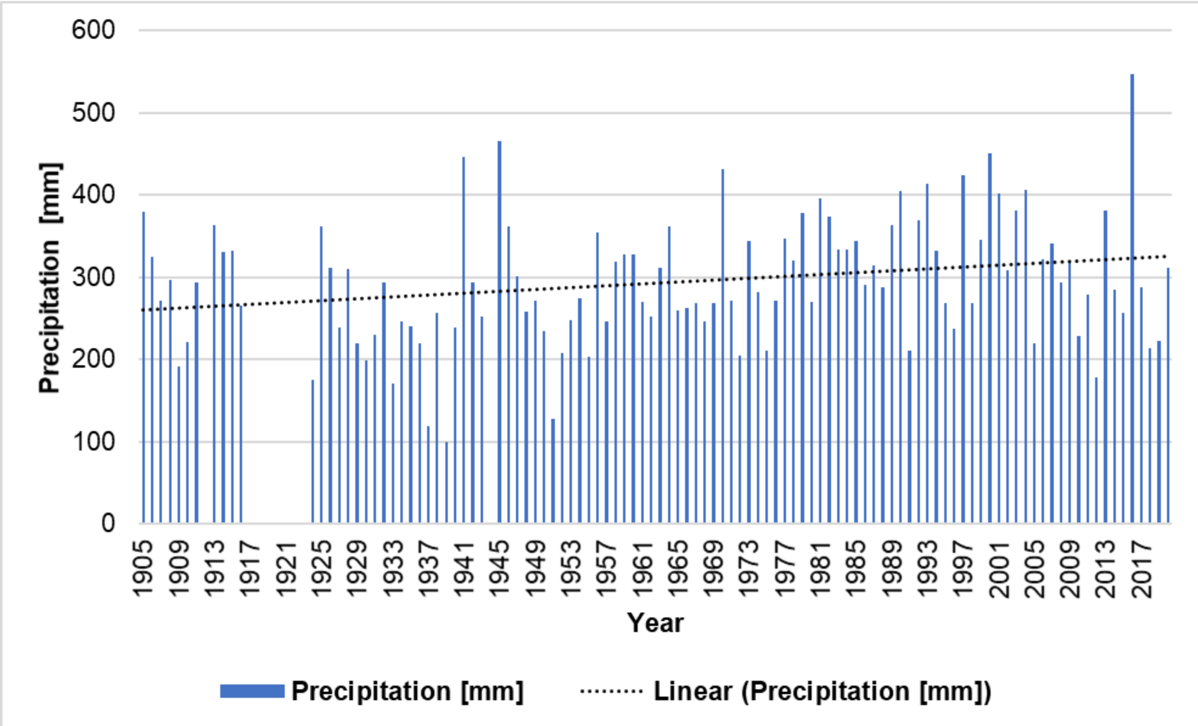

Figure 6.15 Annual rainfall in Aktobe based on records from 1905 to 2020 from a meteorological station in Aktobe, with a gap from 1917 to 1924

Figure 6.16 shows the seasonal precipitation. The figure shows that there is a clear tendency that the precipitation, on average, has increased over the last 100 years. Throughout all seasons, there is a variation from year to year, however a clear tendency of an increase. The seasons with the largest change are winter (December through February) as well as spring (March through May), while the fall (September through November) only shows a small increase. For the summer months (June through August) a slight, almost insignificant, decrease is observed. There is significant variation from year to year, so there is small indication of an increase, or maybe a steady state for the summer season.

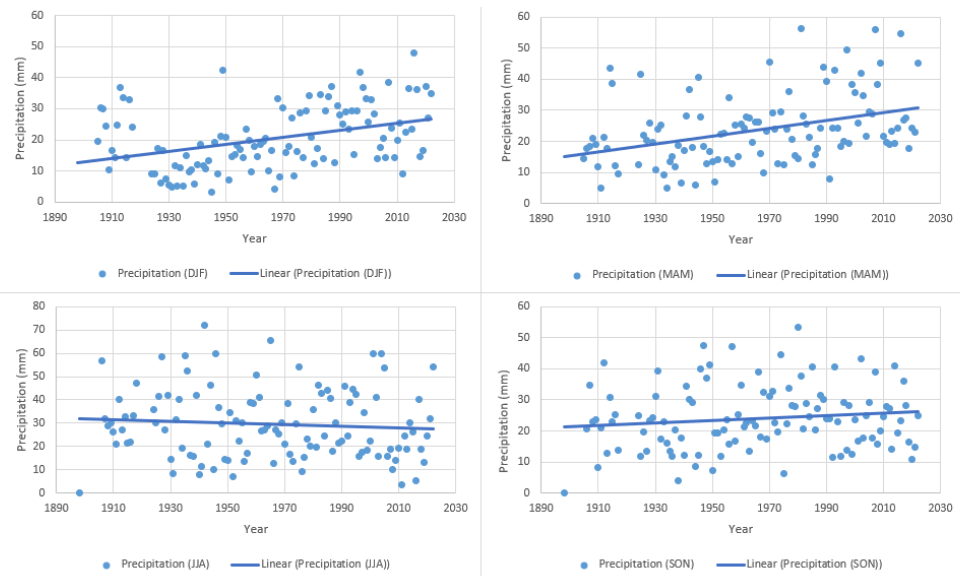

Figure 6.16: Variation in seasonal average precipitation for: December, January, and February (DJF); March, April, and May (MAM); June, July, and August (JJA); and September, October, and November (SON)

For comparison with the local climate conditions presented above, Figure 6.17 shows the average monthly temperature and precipitation for the entire country from 1901-2016. The tendency for the temperature for Aktobe (Figure 6.14) is the same countrywide with warm summer months and cold winter months. The average temperatures for all the country aligns with the average temperature for Aktobe, however, Aktobe has a lower average temperature than nationally. The national patterns for the precipitation are a bit different than for Aktobe. On average, it rains slightly more in Aktobe than nationally and the city receives slightly more rain as compared to the national average, within all seasons.

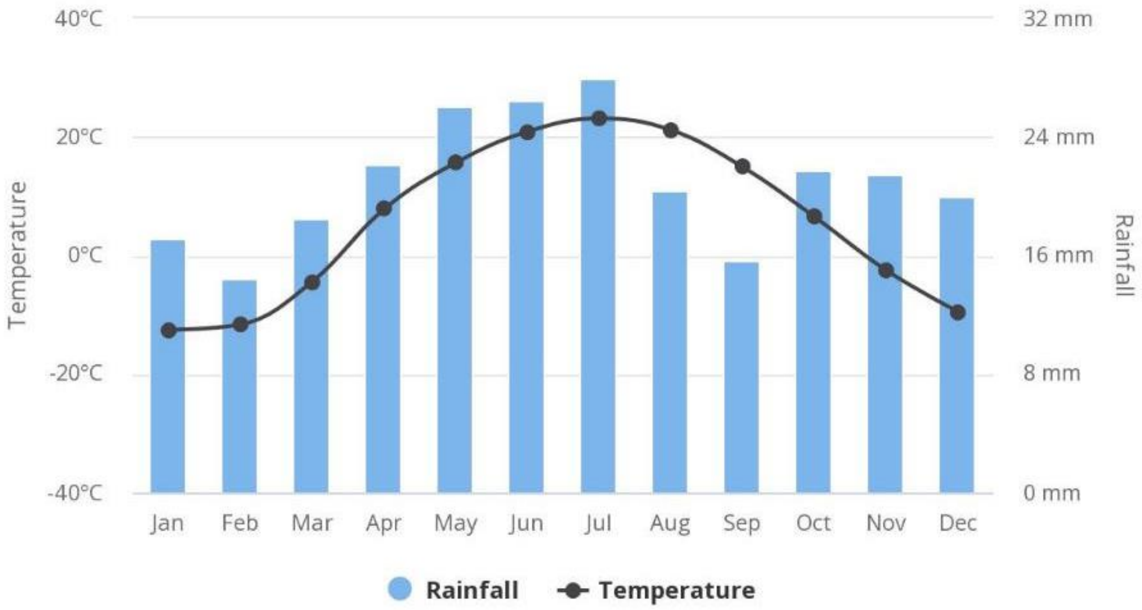

Figure 6.17: Average monthly temperature and rainfall for Kazakhstan from 1901-2016. (Source: World Bank Climate Change Knowledge Portal)

The following Table 6.3 shows the average number of days with solid, liquid and mixed precipitation, indicating more than 70 days with snow. That said, based on the Aquarem FS, there is large variation between years, winters with large volume of snow (56-60 cm on average with 78 cm maximum recorded) may change to almost snowless winters (2-10cm). A 26 cm snow fall experienced during the winter 2023 was blown off almost completely in 10 days from the open spaces. Physical obstacles like a road or house can accumulate considerable volume of snow around it during a snowstorm (occurring on 23 days a year on average). Such snowstorms usually last for 8-9 hours.

Table 6.3: Average number of days per year in Aktobe with solid, liquid and mixed precipitation (Source: http://www.pogodaiklimat.ru/, data period and source not provided)

Type of precipitation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Solid	18	15	10	2	0	0	0	0	0.1	2	9	16	72
Mixed	2	2	2	2	0.1	0	0	0	0	2	4	3	17
Liquid	0.4	0.3	2	8	13	12	11	10	10	8	5	1	81

Wind

Dominant wind directions and speed are relevant in terms of dispersion of odours from WWTP operations. On average, wind speeds in Aktobe are relatively low throughout the year (Table 6.4). However, thunder- and snowstorms are experienced regularly throughout the year. Extreme winds of 32m/sec are recorded on average once in 20 years, but a wind of 28m/sec may occur every 5 years.

Table 6.4: Average wind speeds in Aktobe throughout the year (m/s) (Source: http://www.pogodaiklimat.ru/, data period and source not provided)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2.7	2.8	2.6	2.7	2.5	2.3	1.9	1.9	2.1	2.3	2.4	2.4	**2.4**

The following table shows the proportion of time with different wind directions in Aktobe per month over the year.

Table 6.5: Proportion of occurrences with different wind directions (%) per month in Aktobe (data source:

Wind direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual average
N	3	4	5	6	9	11	15	14	8	8	4	3	7
NE	10	15	16	17	14	15	18	14	10	9	11	10	13
E	12	15	19	19	13	14	14	11	10	8	15	13	14
SE	14	14	14	13	10	10	7	9	11	13	13	15	12
S	24	17	15	12	11	10	6	9	12	15	16	20	14
SW	18	16	13	12	14	11	7	11	17	16	15	18	14
W	14	14	13	13	17	16	16	16	20	19	18	14	16
NW	5	5	5	8	12	13	17	16	12	12	8	7	10
Calm	20	18	18	17	19	20	23	26	26	22	17	21	21

The above data is depicted below, with averages within each quarter of the year.

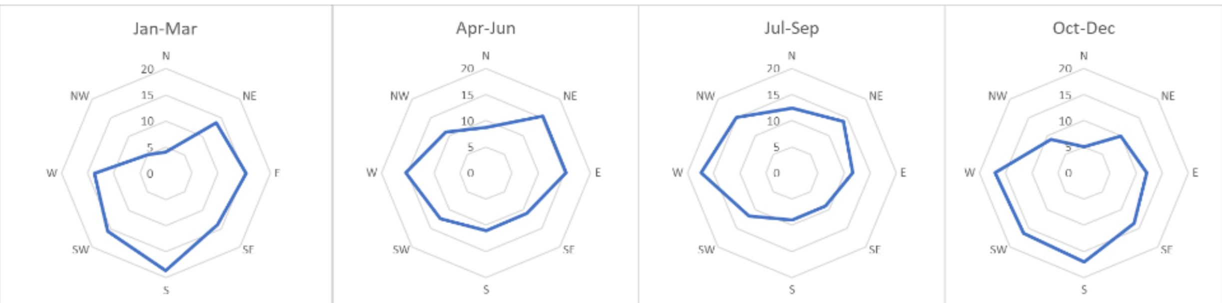

Figure 6.18: Wind directions in Aktobe within the four seasons (average % of time) based on data in Table 6.5.

Based on the above data, southerly winds appear to be dominant during the period from October to March, whereas westerly, easterly, and northerly wind seem somewhat more frequent during summer, yet without a clear trend.
The data does not point in one clear direction as to which neighbours might experience odours from the existing or future WWTP.

Extreme weather events

The climate in Kazakhstan varies considerably throughout the country and extreme weather events will vary from the northern to the southern regions of the country. At the national level, projections show an increase in the number and intensity of weather events with the capacity to cause emergencies and natural disasters. A progressive increase in the number of extreme weather events in Kazakhstan is expected until the end of the century. From 2012 to 2017 the number of hydro-meteorological emergencies increased from 39 to 74, according to the Committee on Emergency Situations[12].

In the warm period of the year, heavy showers, accompanied by thunderstorms, hail, and intense dust storms may occur. On average, Aktobe experiences 21 days with thunderstorms, 28 days with snowstorms and 11 days with dust storm every year, according to data on pogodaiklimat.ru/ (Table 6.6).

Table 6.6: Number of days with different weather phenomena in Aktobe throughout the year (Source: http://www.pogodaiklimat.ru/)

Phenomenon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
rain	3	2	4	10	13	12	11	10	10	10	8	4	97
snow	21	18	13	3	0.2	0.03	0	0	0.1	4	13	20	92
fog	2	2	4	2	0.2	0.1	0.03	0.2	0.2	1	2	2	16
haze	0.1	0	0.03	0.03	0.03	0.1	0.03	0	0.03	0.03	0	0	0.4
thunderstorm	**0**	**0**	**0.03**	**1**	**3**	**6**	**6**	**4**	**1**	**0.03**	**0**	**0**	**21**
snowstorm	**9**	**8**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0.2**	**2**	**5**	**28**
dust storm	**0**	**0.04**	**0**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**0.03**	**0**	**11**
glaze	1	1	1	0.3	0	0	0	0	0	0.1	1	2	6
rime	1	1	2	0.1	0	0	0.03	0	0.03	0	1	1	6

At the national level, the average temperatures increased over the past 20 years and are projected to rise further in the future. The number of days with heatwaves has also increased. In the northern regions of Kazakhstan, the absolute maximum of air temperature typically ranges from 40 to 41 ºC at present. Projections suggest that temperatures may reach up to 44 to 45 ºC by 2085. However, this is considered a distinctive feature of the northern regions of Kazakhstan. In extreme situations the absolute maximum air temperatures are predicted to raise to 50 to 55 ºC by 2085.
According to the CAREC Risk profile of Kazakhstan, there is an average of 393 fatalities in the country due to floods, 24 of these being in the Aktobe region. An important distinction is to be made between pluvial flooding (precipitation runoff flooding) and fluvial flooding (river flooding) - where the later plays a large role across the country.

The most extreme rain events are to be expected in the summer. According to historical data the largest daily amounts of precipitation have occurred in June (59 mm in 1984) and July (59 mm in 2021).
To optimally design according to extreme rain, precipitation data with a small temporal resolution should be used (i.e., 1-minute timesteps). Since this is not available at the moment, the 59 mm in one day will be used in subsequent chapters as a suggested design requirement for flood proving of the infrastructure, making some assumptions about how much of the precipitation falls within a short amount of time.

Climate related implications for WWTP operations

Climate conditions can have implications for the operation of a WWTP. In Aktobe for example, the current WWTP and poorly treated effluent is a source of odour which can be dispersed by wind. In Aktobe, low precipitation and humidity as well as high sun eradiation with few cloudy days result in convection which disturbs horizontal wind propagation during the day, hence reducing the dispersion of odour originating from sludge beds to nearby communities during the day. However, smell from the WWTP site (sludge beds) is commonly sensed 2.5km north of the site in the evenings, when the horizontal wind flow increases.

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[12] Environmental Performance Reviews; Kazakhstan (UNECE; https://unece.org/DAM/env/epr/epr_studies/ECE_CEP_185_Eng.pdf

Also, due to the temperatures and low precipitation, summer precipitation practically fully evaporates and the relative humidity in summer comes close to 50%, from average 80% in winter (January). This greatly helps drying out water in the sludge beds.

Conclusion on climate

The climate in Aktobe is highly continental and arid, with cold and windy winters and hot summers, and substantial variation from year to year. The average temperature has risen on average 1.5˚C over the last 100 years. Also, precipitation has on average increased over the past 100 years, from approximately 270 mm/year to approx. 300 mm/year. However, there is a relatively large variation from year to year. On average wind speeds in Aktobe are relatively low throughout the year, however, thunder- and snowstorms are experienced regularly throughout the year. Southerly winds appear dominant during winter (Oct-Mar), whereas westerly, easterly and northerly winds seem somewhat more frequent during summer, yet with substantial variability. See discussion below on climate change and associated receptor sensitivity.

6.1.5 Climate change projections

This section describes an assessment of future climate conditions in Kazakhstan and Aktobe as caused by climate change, based on available data. It forms the **basis for a climate risk and resilience assessment** for the planned WWTP Project included in the Impact Assessment section further below.

Future Climate Conditions and vulnerability

Future climate projections are generally derived from Global Climate Models (GCMs) or Regional Climate Models (RCMs), which are driven by the global models. The global models provide an overall projection of future climate trends, but cannot show on a very local level the exact developments that should be expected. Nonetheless, global models are useful to show the overall trends to be expected, which is sufficient for planning and design purposes such as for the proposed WWTP, as they indicate what factors may be problematic and hence should be considered in the detailed infrastructure design.

The development of climate scenarios entails “forcing” a change in the climate system. This is done by means of a series of emission scenarios (SRES) or representative concentration pathways (RCPs), both of which provide projections of atmospheric concentrations of greenhouse gases. These scenarios are the main input in the GCMs. There are three main sets of scenarios: SRES, non-SRES and RCP scenarios. The most used until now are the 40 SRES scenarios, which are grouped into four categories (A1, B1, A2 and B2), based on a series of factors, *i.e*. socio-economic and technological development. More detailed information can be found in the IPCC Assessment reports (AR) (AR3, AR4 and AR5).

Hence, the future climate trends analysed in this report are based on a combination of different already-compiled sources showing climate projections, based on different RCMs, with a focus on the climate for the 2050s. Specifically, the following sources have been used for establishing the direction of climate change in Aktobe:

- Kazakhstan’s Sixth National Communication to the United Nations Framework Convention on Climate Change (SNC)
- World Health Organisation
- CAREC Risk Profile for Kazakhstan
- www.climatewizard.org
- World Bank’s Climate Change Knowledge Portal

<u>AR5 and WB Climate Change Knowledge Portal</u>

The projections of future climate change for temperature and precipitation in Kazakhstan for the 2050s, according to simulations based on the AR5, can be seen in the following figures, Figure 6.19 and Figure 6.20.

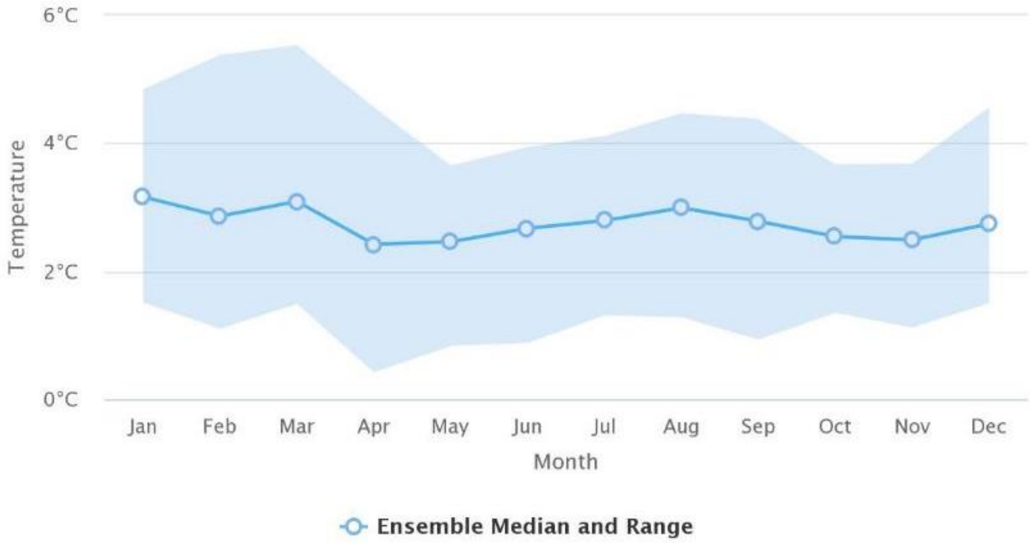

Figure 6.19: Projected change in Monthly Temperature for Kazakhstan in the period 2040-2059, based on the CMIP5 (Source: World Bank Climate Change Knowledge Portal)

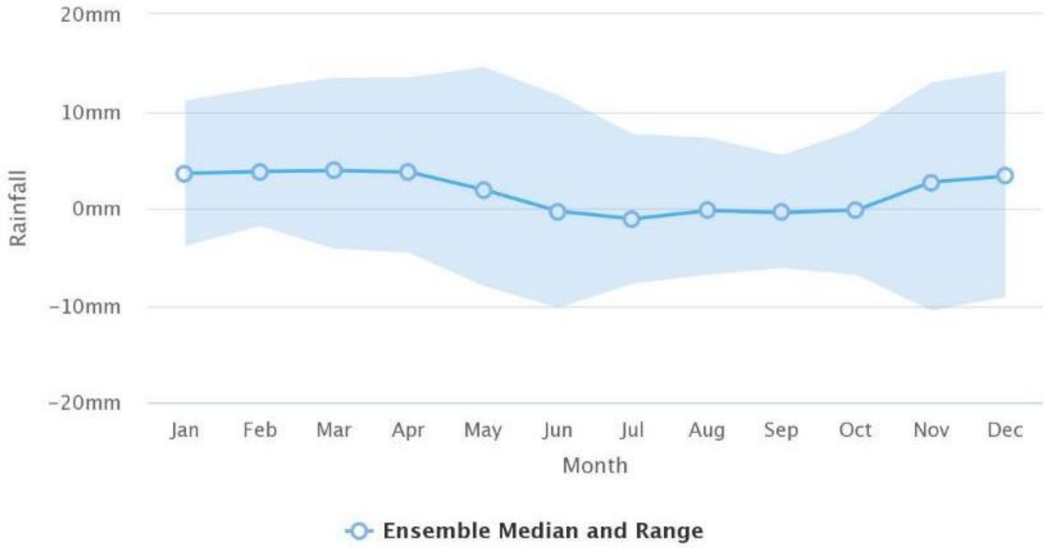

Figure 6.20: Projected change in Monthly Precipitation for Kazakhstan in the period 2040-2059, based on the CMIP5[13]

According to Figure 6.19, the projected change in monthly temperature for Kazakhstan will be an increase of around 2.75 °C in the period 2040-2059, with slight seasonal variations. Especially during December to February and June to August, the temperature will be warmer. It is expected that the number of cold days will decrease in the future. The temperature will have an impact on the water resources in terms of both snow-melting and evapotranspiration – and can have a direct impact on the WWTP in terms of sludge drying and biological processes.

The projected change in precipitation is shown in Figure 6.20. Annual precipitation is projected to rise by an average of 20 mm. Across the country the precipitation during December through May is projected to decrease by 2-5%, and from June through November the precipitation is projected to increase by 1-4%.

13 World Bank Climate Change Knowledge Portal

Climate Wizard

As Kazakhstan is a large country, it is important to look at the projections of the specific region. They establish a clearer direction of climate change in the region; data from the website *www.climatewizard.org* has been included in this report. Climate Wizard provides global and regional ensemble averages from 9 Global Circulation Models (GCM), using three scenarios: namely, medium A1B, high A2 and low B1 (from AR4), with a grid cell resolution of *approx.* 50 km. The projections for the area around Aktobe as expected by mid-century (2050s), on precipitation and temperature, are shown in Table 6.7 and Table 6.8.

Table 6.7: Ensemble average seasonal temperature changes (°C) in Aktobe region, by mid-century (2050s), for three scenarios, over 9 GCMs (Source: www.climatewizard.org)

Season	Months	Low B1			Medium A1B			High A2		
		Average	Min	Max	Average	Min	Max	Average	Min	Max
Winter	DJF	2.1	1.0	4.1	3.1	2.2	4.0	2.8	1.4	4.5
Spring	MAM	2.1	-0.1	3.3	3.0	1.3	4.7	2.8	1.3	4.2
Summer	JJA	2.3	1.1	3.4	3.3	1.8	5.2	2.9	1.5	4.9
Fall	SON	2.2	1.1	3.7	2.9	1.7	3.9	2.4	1.6	3.3
Annual		2.2	0.8	3.4	3.1	1.8	3.8	2.7	1.8	3.8

Table 6.8: Ensemble average seasonal precipitation changes (%) in Aktobe region by mid-century (2050s) for three scenarios over 9 GCMs (Source: www.climatewizard.org)

Season	Months	Low B1			Medium A1B			High A2		
		Average	Min	Max	Average	Min	Max	Average	Min	Max
Winter	DJF	19.2	6.0	28.6	32.1	10.1	55.9	29.7	6.2	56.3
Spring	MAM	17.2	-1.9	45.0	18.9	-10.0	45.9	16.7	-0.4	36.9
Summer	JJA	7.9	-27.5	36.4	-2.8	-49.0	31.7	-4.3	-54.1	46.9
Fall	SON	8.8	-5.5	35.3	4.7	-13.1	23.8	12.3	0.9	39.5
Annual		13.3	-1.0	28.3	13.2	-5.1	27.9	13.6	1.4	32.1

It is important to mention that the data shown in the tables above corresponds to ensemble averages, which means that half of the models project higher changes, while the remaining half project less change.

The climate wizard predictions for temperature suggest increasing temperature throughout all seasons. The greatest increase will occur during the summer season, followed by the winter, or spring seasons, depending on which scenario is modelled. The lowest increase will occur during the fall season. However, overall, all seasons can expect an increase in temperature between 2.1-3.3 °C, across all models and seasons.

When looking at the precipitation projections, the picture is different. The change in the precipitation varies greatly, both from season to season and from model to model. Projections indicate a clear increase of precipitation in both winter and during spring, and fall. The largest increase is projected during the winter season followed by the spring months. The prediction for the summer varies from model to model. Two model predicted a decrease in precipitation during the summer and one predicts an increase. Based on historical data, it appears that the summer predictions are consistent with previous patterns, even small changes in the season have been observed during this time of year.'

Climate related implications for WWTP operations

There is an important differentiation to be made between precipitation in general and extreme events. The above sections indicate the general future trends for precipitation. In terms of extreme events, “Kazakhstan’s Sixth National Communication to the United Nations Framework Convention on Climate Change (SNC)” states that “In view of precipitation insignificance and its big mobility in space and time it was approved in Kazakhstan that change of precipitation amount can be neglected in future, wherefore its current climate rated values can be applied in calculations”.

This conclusion is backed up on a local level. Looking at the World Bank Climate Change Knowledge Portal the future return period of a current 5-year precipitation event is a 5-6 year event in the Aktyubinskaya region – meaning that extreme rainfall might even be less frequent in the region.
This means that in terms of flood risk, it should be sufficient to consider historical events and data when designing future infrastructure.

The tables above show a trend of higher temperatures in all seasons and an increase in precipitation in all seasons except summer. This could lead to hotter and drier summer seasons in the city. Higher precipitation during the colder months could lead to higher risk of fluvial flooding in the area during e.g. spring melt and/or if rain falls on frozen ground. Flooding is only expected to increase in low lying areas that are near rivers. Extreme precipitation events are not expected to be more frequent, why pluvial flooding should not be more frequent. Snow melt could, on the other hand happen faster than previously, meaning that rivers will flood nearby areas. Since the WWTP is not located near any rivers or streams, fluvial flooding does not pose a risk to the project, while pluvial flooding is not expected to be worsended by climate change.

Summary regarding expected future climate conditions and vulnerability

As Kazakhstan is such a large country with different climate zones, the effect of the climate change vary throughout the country. Overall, the projections show a clear trend towards higher temperatures across the entire country. At the national level, temperature increase is greater for the summer and the winter seasons. The local data relevant for Aktobe shows that the winter season on average has the most significant increase of temperatures. However, both in the projection and in the measured data there is a trend of increasing temperatures within all seasons. The projections for precipitation show a different pattern as there is an increase in precipitation within all seasons, except for the summer season. During the summers, the region can therefore expect a hotter and drier climate. In the other seasons, there will be an increase in both temperature and precipitation.

The surface runoff in river basins can be affected by climate change. Aktobe is located on the banks of the Ilek river and a change in surface runoff can affect the flow in the river and thereby have a significant impact on the city. A decrease in surface runoff patterns can result in a reduction of the water level leading to shortage of water.

Some projections indicate a risk of increased runoff and a risk of flooding leading to impact on buildings and underground infrastructure, *e.g.,* pumping stations. The river is suggested to have a declining water level, which have been reduced by 80% over the past decades, due to irrigation and low precipitation. Taken this in to account a decrease in river level poses a bigger threat of the river, opposed to risk of flooding. This said, and as reflected in section 6.1.6, the Ilek river flow had an upward trend from 2020-2022, hence drawing conclusions on short to medium term trends is difficult.

At the country level, there has been an increase in temperature extremes on average. This trend is expected to be representative for Aktobe as well, due to the observed increase in average temperature. Modelling extreme events is still one of the main challenges of climate science, however the consensus is that these events will be more frequent and become more extreme due to climate change.

It is noted that the climate change assessment reflects future scenarios which are subject to various uncertainties. These are further outlined in Annex 2.

Conclusion on the location's sensitivity to climate and climate change

At the global scale, climate is threatened by climate change caused by greenhouse gas (GHG) emissions and has limited capacity to tolerate increased GHG concentrations. However, the level to which different locations around the world will experience this change differs.

Overall, Aktobe experiences harsh and cold winters and warm summers, with large variability between years. Although seasonal and annual variations make it difficult to conclude on climate change trends for Aktobe, the available data indicates that the region is considered likely to experience increasing temperatures within all seasons, as well as increase in precipitation within all seasons, except for the summer season. It should be considered, that given uncertainty in these predictions, and considering that Aktobe is a large region, the effect of climate change will be felt differently based on the specific local context.

The location of the WWTP is considered of mild sensitivity in regards of flood risk, since it is seen that extreme events should not be expected to be more frequent – and since many of the floods experienced in the country are fluvial flooding, and the WWTP is nowhere near a river.

In terms of water stress and drought, the Aktobe region may experience seasonal issues and could be estimated to be of medium sensitivity, *e.g.* reduced flow of the Ilek river would further affect its ability to dilute treated wastewater effluents. This is already an issue due to the poor quality of the effluent treatment. The proposed WWTP project will significantly improve WW treatment and effluent quality, hence alleviate the need for dilution in the Ilek river. The surface and groundwater situation is further discussed in the following chapter, including potential climate change related impacts on water resources.

6.1.6 Surface and groundwater

Overall river basin and water resource context

There are seven main river basins in Kazakhstan as shown in Figure 6.21. Aktobe is in the Ural-Caspian river basin, marked with purple on the figure, in the Western part of the country. The basin is dominated by the Ural River, from the Russian border to the Caspian Sea. The Ural-Caspian river basin is the largest of the seven river basins in Kazakhstan. The Ural-Caspian basin extends over 415,000 km^2 of Kazakhstan and includes part of the Russian Federation. In Kazakhstan it includes West Kazakhstan and Atyrau provinces and part of Aktobe Region. The main river is the Ural river, which originates in Russia[14]. The river Ilek, which flows through Aktobe, empties out in the Ural river.

[14] United Nation Development Programme in Kazakhstan

Figure 6.21: Map of main river basins in Kazakhstan (Source Water resource Committee of the Republic of Kazakhstan)

Surface water resources are extremely unevenly distributed within the country and are marked by significant perennial and seasonal dynamics. Central Kazakhstan, for instance, has only 3 percent of total water resources in the country. The current volume of river runoff in Kazakhstan seems to differ significantly from previous estimations and long-term averages. Reduced surface runoff could provide evidence of significant climatic and anthropogenic effects on water resources and reflects the strong tendency towards possible reduction of surface water resources in the country. The western and southwestern regions (Atyrau, Kyzylorda and Mangystau regions) have a significant water deficit and there is hardly any fresh water available. Most of the runoff occurs in the spring due to snowmelt, especially from the mountains. There are no mountains around Aktobe, so the Ilek river is recharged through surface runoff following rainfall and by surface snowmelt during spring. A change in precipitation patterns and temperature can therefore have a large influence on the river flow patterns.

WWTP area and immediate surroundings

There are no natural **surface water bodies** within the WWTP site or in the immediate WWTP area. A small abandoned 3m deep sand quarry located just south of the WWTP holds temporary water pools of water in it in spring. Three depressions that cross the WWTP site join up half the way to the Ilek river and disappear in the multiple oxbows. The depressions carry thaw water in spring and groundwater for the rest of the year - see Figure 6.22.

Sludge from the WWTP is pumped to the 56 sludge ponds north of the WWTP. The sludge thickness in the sludge beds is 1m at the inflow pipe to each sludge pond to 0.2m further away from it. The northern 28 beds are shallower than the 28 southern beds, so they are filled to a maximum of 0.8m. The beds have been lined with plastic membrane according to ASEG (not verified visually during site visit), have clay lock below and above it and, according to the site manager of the WWTP, do not show any signs of leaking currently.

The sludge beds and secondary sedimentation tanks obstruct the natural flow of groundwater to the east forming small, waterlogged areas upstream to the west of the sludge pond area (Figure 6.23). In 2018, a

1.1 km drainage channel was dug through the field to drain the swamp upstream of the secondary sedimentation tanks.

Examination of satellite images from 2011 suggests that water in the first 12 sludge beds closest to the WWTP seems to be well separated from the groundwater (Figure 6.24). In other words, presence of water in the sludge ponds does not appear to affect the water level in the depression downstream (to the east of the sludge ponds). The remaining 44 sludge beds further to the north are in the northern depression catchment. Here, based on aerial photos from 2011 and 2016, a small stream of sludge water has developed and run through the hay field eastwards towards the railway. The satellite images show that in 2016 this formed a 360m long gulley through the field and affected harvesting.

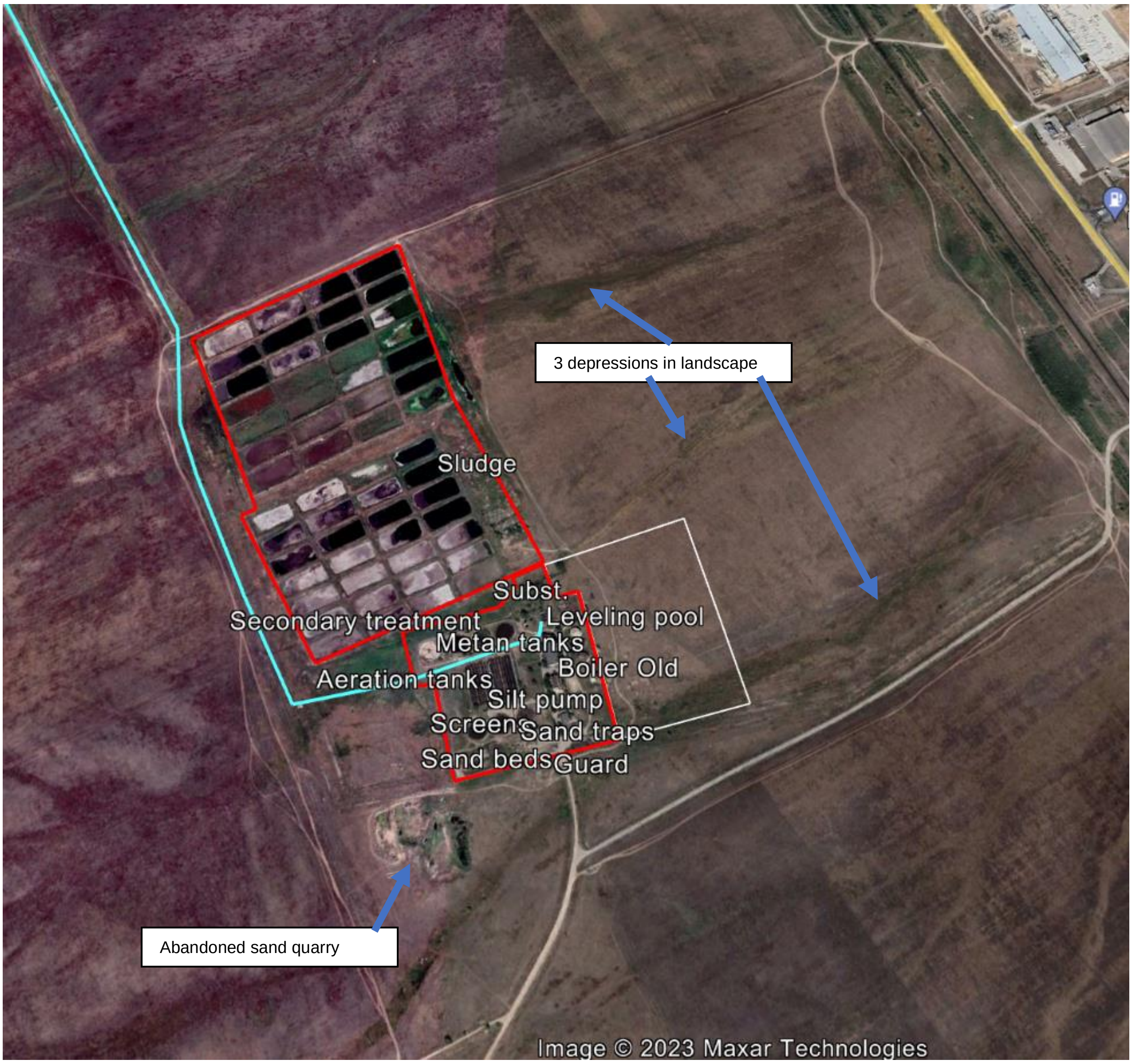

Figure 6.22: Showing the lack natural surface bodies in the immediate vicinity of the WWTP site (Source: Google Earth, aerial photo from 8/2022)

Figure 6.23 Aerial photo from 2016 showing waterlogged areas upstream from the secondary sedimentation tanks. A drainage channel was dug in 2018 to drain the resulting swamp (Map source: Google Earth, aerial photo from 8/2016)

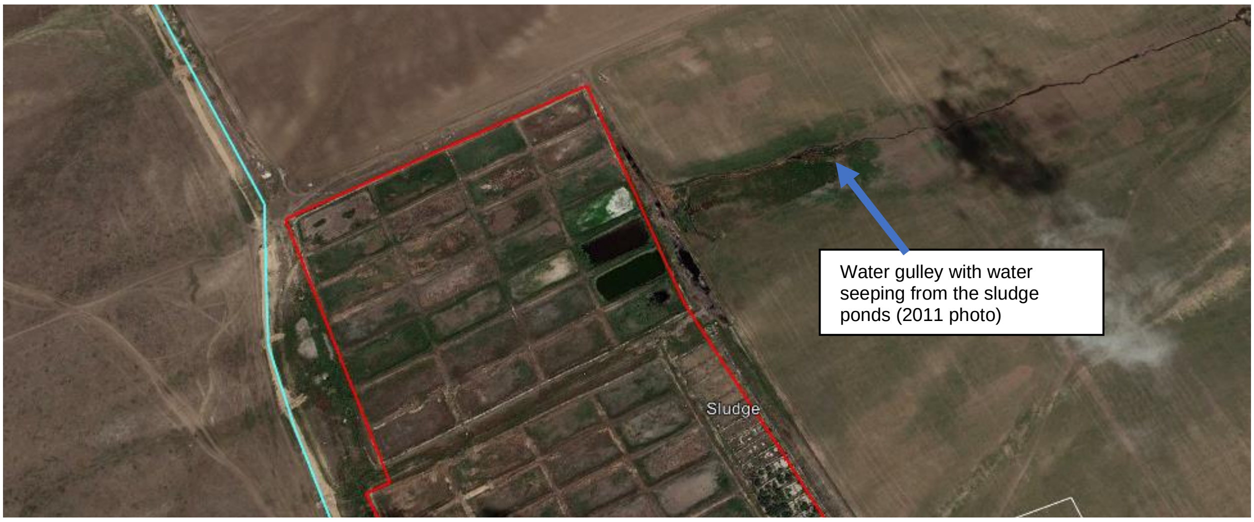

Figure 6.24 An aerial photo from 2011 showing the formation of a water gulley with sludge pond water seeping into the nearby fields and towards the east.

Groundwater in the WWTP area is confined to alluvial Quaternary sediments and was found by the aforementioned 2016 Geoproekt Aktobe geotechnical assessment to be at a depth of 4m and only in the swampy area between the secondary sedimentation tanks and the sludge beds. There, the hydrocarbonate-sulphate-sodium mineralised saline (2-2.5g/L) water most likely originated from the first 12 sludge beds and seasonally from the snow melt as recharge from precipitation in a catchment area that is expected to be very small. This groundwater water flows to the east towards the Ilek River and does not affect the proposed area for the new WWTP.

According to the Aquarem FS, engineering and geological surveys conducted in preparation for the Project indicated that the aquifer was not penetrated by wells to a depth of 8.0 m, indicating that height of the groundwater level is not likely to be an issue.

There are not known to be any direct uses of groundwater at or in the vicinity fo the site. Water supply to the site is via the city water mains network.

Effluent quality from the existing WWTP

Treated effluents from the existing WWTP are continuously discharged to the URE retention reservoir and from there to the Ilek river in the period of peak flow between March 20th and May 5th.

The following table summarises the influent and effluent characteristics for the existing Aktobe WWTP (average values for 2022). The quality of the effluent discharge does not comply with permit limits and EU Standards, except Nitrogen Nitrates, Chlorides, Sulphates, Copper, Zinc, Iron and Chrome.

Hence, the current WWTP's impact on downstream water receptors is negative, as reflected in the below sections.

Table 6.9: Aktobe WWTP Influent and Effluent Characteristics (annual averages, mg/L) and the maximum permitted concentrations at the exit from the secondary sedimentation tanks and the treated wastewater retention reservoir (URE), respectively. Values in red indicate non-compliance with influent and effluent requirements, respectively. Source: ASEG

Parameter	Influent 2022	WWTP influent requirements	Effluent 2022	Effluent Permit Limits 2018-2027		EU effluent Standards
Parameter	**Influent 2022**		**Effluent 2022**	**WWTP**	**URE**	
BOD	581.6	506.8	224.3	4.55	3	25
COD	976.9	767.3	395,3	27.38	24.41	125
Suspended Solids	566.3	425	267.1	20,7	20.65	35
Ammonium Nitrogen	56.4	41.9	48.9	2.0	0.5	
Nitrogen Nitrite	0.016	-	0.085	0.044	0.072	*10
Nitrogen Nitrates	0.05	0.1	0.24	24.91	36.02	
Phosphorus	6.68	6.3	5	2.96	3.5	*1
Dissolved Solids	1110.75	-	1008.3	-	0.05	
Chlorides	280	287.6	292.71	306,6	281.9	
Sulphates	158.5	183.1	178.22	303.3	94.22	
Petroleum products	3.01	1.34	1,7	0.183	0.05	
Anionic surfactants	5.07	1.78	4,21	0.46	0.489	
Copper	0.007	0.01	0.003	0.004	0.0045	
Zinc (II)	0.006	0.006	0.004	2.75	0.0091	
Iron	0.41	0.55	0.23	0.183	0.049	
Chrome (VI)	0	-	0	0.011	0.018	

*EU standards for Total Nitrogen and Total Phosphorus are applicable to sensitive rivers only (>100,000PE).

Effluent samples were taken for the purpose of the present ESIA study over a period of one week in May 2023. As can be seen from the following table the values for both BOD5 and COD were all high and above the relevant EU standards for the discharge of treated effluents.

Table 6.10 Effluent quality from the existing WWTP taken in April-May 2023 (mg/L)

Date	**28.04**	**2.05**	**3.05**	**4.05**	**5.05**	**10.05**	**11.05**	**EU effluent standards**
T°C	24	23	23	23	22	22	22	
H%	74	74	74	74	73	73	73	
pH	7.5	7.6	7.5	7.7	7.6	7.4	7.3	
BOD5	**249.7**	**243.1**	**223.4**	**216.0**	**259.9**	**141.5**	**89.2**	**25**
COD	**353.3**	**368.5**	**386.1**	**346.5**	**372.4**	**271.6**	**213.4**	**125**
Cd	-	0.0041	0.0055	0.0069	0.0006	0.0035	0.0014	
Ni	-	0.0429	0.0320	0.0221	0.0173	0.1256	0.3195	
Cr^3	-	0.0370	0.0385	0.0472	0.0515	0.0325	0.0347	
Pb	-	<0,002	0.0129	0.0057	0.1084	<0,002	0.0223	
Hg	-	-	-	-	-	-	-	
Legionella	0	-	-	-	-	-	-	
Pathogens	0	0	0	0	0	0	0	

The URE reservoir and downstream channel

The final recipient of treated effluent from the WWTP is the Ilek river, *approx.* 14 km downstream from the WWTP. The Ilek river flow is very low as the river water is being used for agriculture and industry upstream. For this reason, the WWTP is not allowed to discharge directly to the river but has to collect discharges in a retention reservoir called the discharge levelling reservoir (URE). Effluent water from the Aktobe WWTP is discharged approx. 5 km distance to the URE reservoir via a discharge pipe (Figure 6.25).

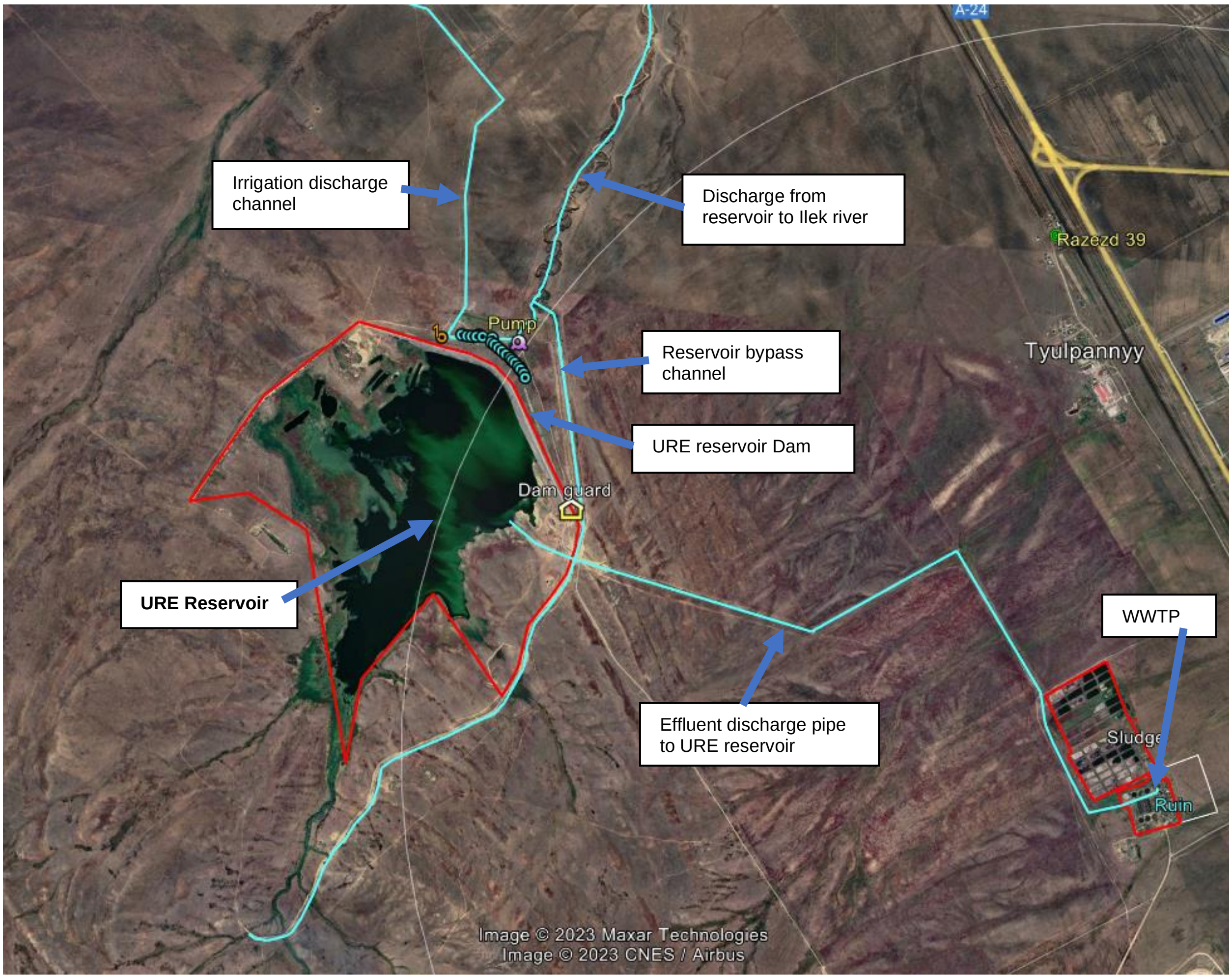

Figure 6.25: Location of the URE reservoir and the various inflow and outflow channels (Map source: Google Earth)

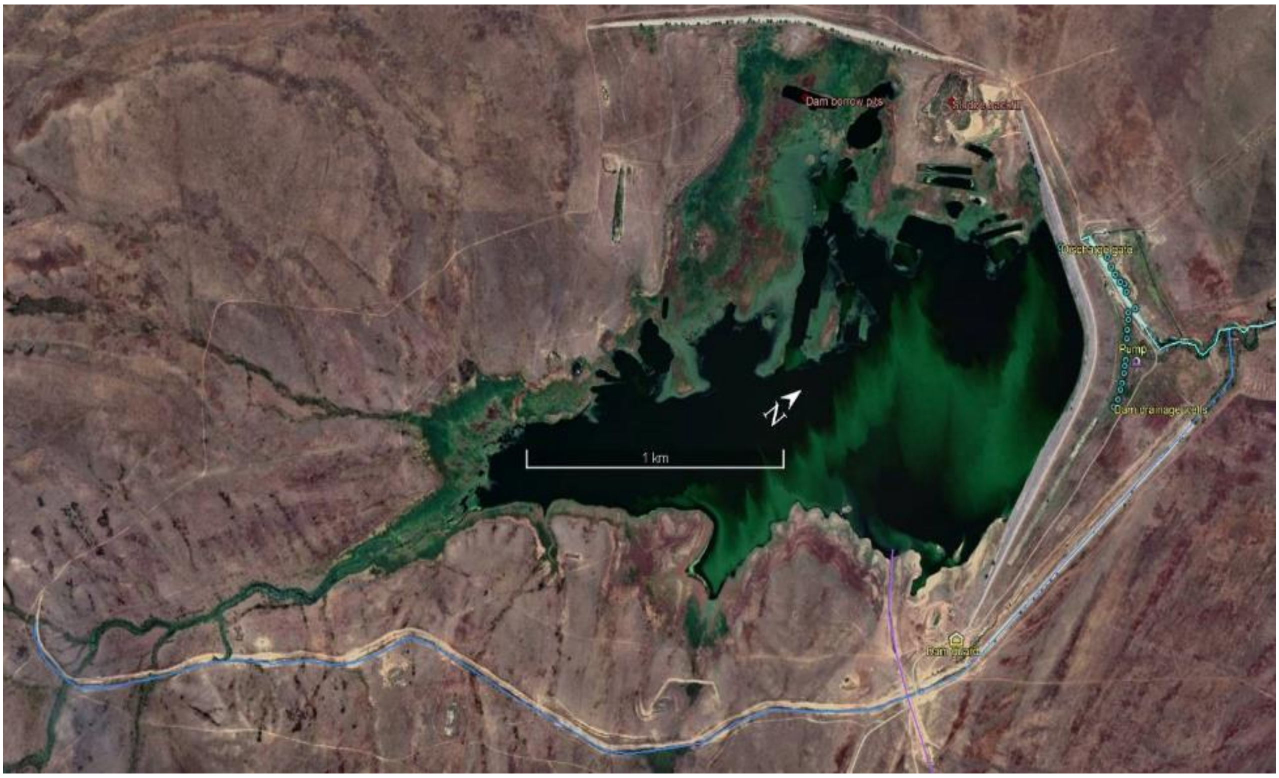

Figure 6.26 A closer view of the discharge levelling reservoir (URE) in October 2021. This shows the pair of underground influent pipes (purple), the creek bypass channel that is not linked with the inflow pipes (dark blue), discharge gate and channel (blue), the dam drainage wells and pump for drainage water return and guard house. The water level is highest in March and lowest in May. Some borrow pits dug to construct the dam are being filled with the active sludge from the WWTP from the sludge beds.

The URE reservoir dam is built from brown clay borrowed from the pits inside the reservoir but due to deterioration of the concrete layer in its inner side, water percolates into the dam body. Perforated PVC pipes under the dam drain this water into 20 manholes at its outer side and then to a pool with the level control pump that returns this water back to the reservoir. The inner side of the dam was consequently reinforced by the large boulders of chromium smelting slag rock, but the risk of the dam failure is still acknowledged by ASEG, which is responsible for the URE and dam operation. For this reason, the URE is not filled to its design capacity of 40,000,000 m^3 and kept to 25,000,000m^3. Discharge from the URE to the Ilek River is allowed via a discharge channel for a period during the year from around 23 March to 5 May when the Ilek river flow is higher to ensure sufficient dilution. As the flow in the Ilek river is dropping, and hence also the possibility to empty the reservoir during the spring window, keeping the water level at max. 25 million m^3 is likely to become more challenging, increasing the risk of dam saturation and failure.

In the URE, the wastewater is diluted with the thaw and stormwater and is then discharged along a 9km creek course into the Ilek River near Georgievka village.

The exact timing of discharge from the URE is given by the Ilek river flow monitoring point operator Kazgidromet. When the flow of the Ilek river reaches 20m^3/sec, the operator informs ASEG and the Water Basin Management Inspection (BVI), which gives a permission to open the 2 reservoir gates of the URE to allow outflow from the URE equivalent to 1/10th of the Ilek river flow (*i.e.* 2m^3/sec). The reservoir operator measures the water level at the outgoing channel section of known area to verify that the gate is opened correctly. Due to unusually high water in the river at the time of this ESIA, site assessment (in March 2023), 4.79m^3/sec of outflow was allowed. In the dry winter years, when the Ilek river flow does not allow to empty the reservoir, water from the reservoir upstream of Aktobe city is released to increase the flow in the Ilek river but this is not always sufficient, as this reservoir water is also used for irrigation and the city's industry, and the reservoir level cannot fall below the intake points. Based on discussion with ASEG employees, the flow in the Ilek river has been falling over the years, and climate change may further increase this trend. Hence, the possibility of using the river flow to dilute poorly treated effluents from the URE is diminishing, and in any case does not represent an optimal solution. That said, the Ilek river flow showed a slightly upward trend from 2020-2022, hence drawing conclusions on short to medium term trends is difficult due to annual climate variations.

The WWTP currently removes *approx.* 50% of the pollution in the influent wastewater, however the URE reservoir also substantially improves the water quality, presumably via gravity settlement (and treatment via bacteria, protozoa, invertebrates and ultraviolet light from the sun). Nonetheless, effluents from the reservoir do not appear to be of sufficient quality, and result in odour and other nuisance *e.g.,* in recreational areas around the Ilek river downstream. The spring discharge contaminates the creek between the URE and the Ilek river, as well as the Ilek riverbanks, and erodes the creek bringing the eroded sediments to the Ilek river flood plain. After releasing effluents from the URE into the Ilek river (after May 5th when the wastewater discharge is stopped), water from an Aktobe reservoir upstream is released for 3 days to clean the riverbanks. However, this is not effective and foul odour emanates from the creek banks for several months after releasing water from the URE, causing nuisance in adjacent areas. The interviewed residents of the Kyrayly village located 1km north of the creek complain about this source of odour and also some residuals at the riverbank.

Continued use of the URE can be seen as an important prerequisite if the treated effluents from the proposed WWTP are to be used for irrigation. The effluent water has not been used for irrigation in the recent past (partly due to poor quality of the water) but should be further encouraged and facilitated to maximise water reuse (as reflected in the ESMP). In the absence of the URE, it is very unlikely that the treated effluent water will be used for irrigation at scale. Currently a local company is reestablishing river water intake few meters downstream from the URE discharge channel entry to the Ilek river, to pipe water back over the motorway for radial irrigation of their fields. Using gravity driven irrigation from the URE directly would be a much more economic option for them.

Currently, the URE contributes to removing pollutants from the poorly treated WWTP effluents before discharge to the Ilek river. With the improved WW treatment to EU and (to most extent) national standards, the absolute necessity of the URE is expected to be much reduced. However, the national effluent standards are extremely (and somewhat unrealistically) strict. Hence, the URE may still be seen as beneficial to meet these strict standards. Also, it allows discharge of treated effluents to the Ilek river during a time window when the river flow is the highest, hence with maximum dilution (as is the current agreement with relevant authorities). Continuous direct discharge to the river would mean discharge during periods of very low flow (including during winter when the flow is negligible and the river is icy), hence with less dilution.

<u>URE water quality</u>

The ASEG laboratory monitors the discharge from the URE reservoir against the applicable MPCs on a monthly basis, except in April while the lagoon is being emptied into the discharge channel and towards the Ilek river. The annual average water quality levels in the URE in 2020-2022 are shown in the table below.

Table 6.11: Annual average water quality in the URE reservoir. Values in red indicate exceedance of MPC levels (Data source: ASEG)

		Annual average (mg/l)		
	MPC (mg/l)	**2020**	**2021**	**2022**
BOD5 - БПК5	4.55	34.2	33.5	36.9
COD - ХПК	27.38	99.9	77.9	99.9
pH		7.5	7.5	7.7
Anionic surfactants - АПАВ	0.46	0.4	0.5	0.6

		Annual average (mg/l)		
	MPC (mg/l)	2020	2021	2022
Sulphates - Сульфаты	303.3	191.0	363.9	194.4
Chlorides – Хлориды	306.6	327.8	317.0	319.3
Iron – Железо	0.183	0.2	0.2	0.3
Petroleum products - Неф.прод	0.183	0.1	0.1	0.2
Suspended Solids - Нераст вещ-ва	20.7	124.5	65.8	91.5
Chromium - Хром (VI)	0.011			
Copper – Медь	0.004	0.0	0.0	0.0
Zinc – Цинк	2.75	0.0	0.0	0.0
Nitrate nitrogen - Азот нитратов	24.91	2.0	0.1	0.3
Nitrite nitrogen - Азот нитритов	0.044	0.8	0.0	0.1
Ammonium nitrogen - Азот аммонийный	2	16.2	27.5	27.8
Dry residue		1,085.7	1,000.0	1,210.0
Boron – Бор	0.017	0.4	0.4	0.3
Phosphorus – Фосфор	2.96	7.0	6.1	5.4

The monthly URE water quality levels measured in 2020-2022 are depicted in the following figures, against the applicable MPCs.

As can be seen, the water quality in the URE does not meet the applicable standards (MPCs), in particular with regards to BOD_5 and COD levels, suspended solids, but also for ammonium nitrogen, boron and phosphorous.

Figure 6.27: Graphs showing the monthly measurements in the URE reservoir against the MPC (red dotted line) for the parameters: BOD_5, Iron, pH, Petroleum products, COD, Suspended solids, Sulphates.

Figure 6.28: Graphs showing the monthly measurements in the URE reservoir against the MPC (red dotted line) for the parameters: Chlorine, Copper, Zink, Nitrate Nitrogen, Nitrite nitrogen, Ammonium nitrogen, Boron, Phosphorus.

URE bottom sediment quality

As part of this ESIA study, bottom sediment samples were taken in the URE at 4 locations in May 2023 and analysed for concentrations of nutrients and total metals through acid extraction, as an indication of accumulation of contaminants in sediments from effluent water.

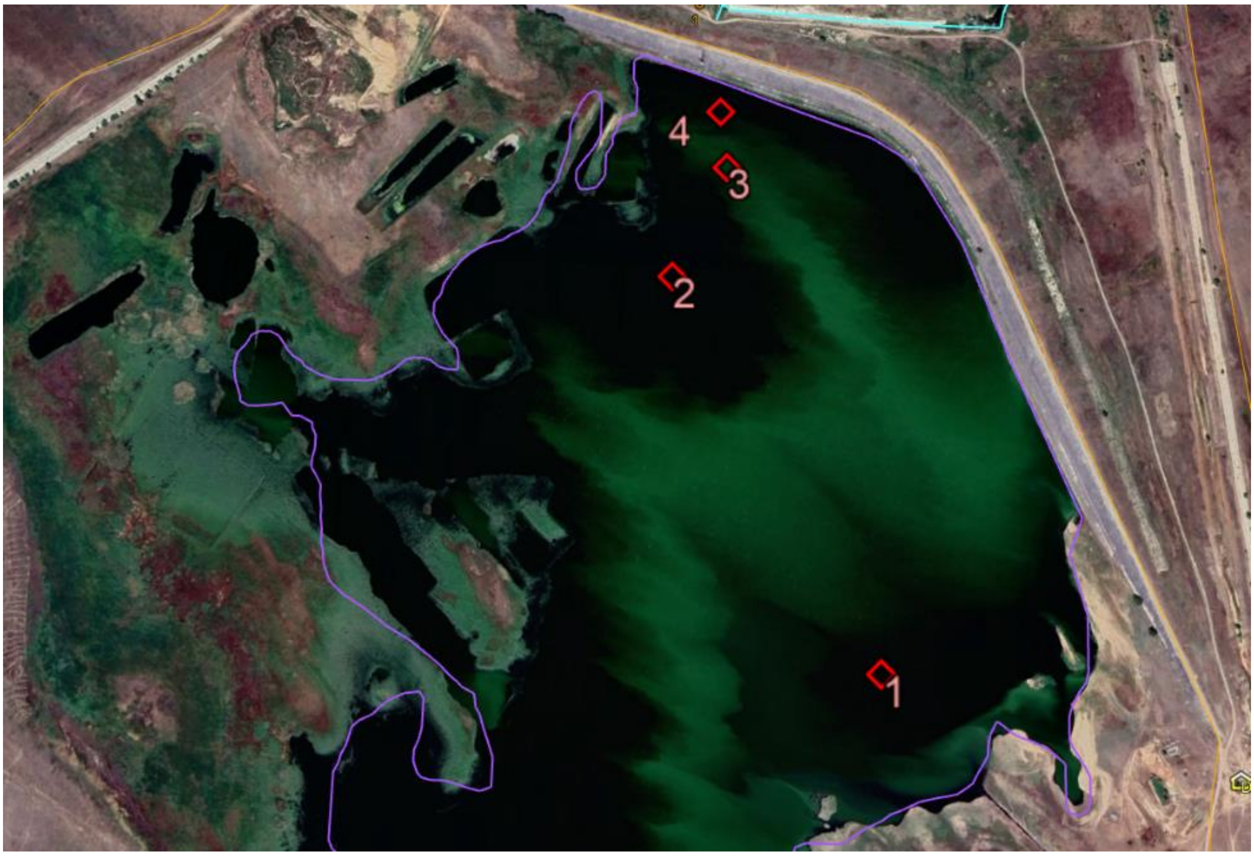

Figure 6.29: Locations of bottom sediment sampling in the URE effluent retention reservoir in May 2023.

The results of the sediment sampling analysis as shown in the following table, indicate that most of the heavy metals concentrations are within the Limit values for concentrations of heavy metals in soil of the EU sludge directive, whereas a few samples exceed the EU benchmark values, in particular for cadmium.

Table 6.12: Results of URE bottom sediment analyses conducted in May 2023, for nutrients and heavy metals, and for reference, the limit values for concentrations of heavy metals in soil according to the EU sludge directive.

Parameter values in mg/kg	**Sample point**				**Limit values for concentrations of heavy metals in soil***
	1	**2**	**3**	**4**	**mg/kg of dry matter**
Depth cm	200	250	150	170	
pH	7.46	7.66	7.45	7.56	
P	0.015	0.008	0.025	0.011	
N	42.6	45.4	48.3	43.7	
Cd	**3.4**	2.3	**6.9**	**3.8**	1 to 3
Cu	65.1	17.8	44.2	51.0	50 to 140
Ni	**92.6**	43.3	51.4	46.4	30 to 75

Parameter values in mg/kg	Sample point				Limit values for concentrations of heavy metals in soil*
	1	2	3	4	mg/kg of dry matter
Pb	3.3	16.7	30.1	3.0	50 to 300
Zn	164.3	28.8	128.3	147.4	150 to 300
Hg	<0,20	<0,20	<0,20	<0,20	1 to 1.5
Cr	3.1	6.0	4.6	4.3	—

* *EU sludge directive summary:* *EUR-Lex - 01986L0278-20090420 - EN - EUR-Lex (europa.eu)*

The Ilek River

Aktobe City is located at an elevation of 220m amsl, at the confluence of the Ilek River and Kargala River. As reflected above, treated water from the WWTP is discharged via the URE reservoir to the Ilek river. According to Berdenov (2016)[15] the Ilek River is the most polluted water body in the Ural-Caspian basin (*esp.* due to Cr^{+6}, BOD and Boron), and is transboundary with Russia. The characteristics of the Ilek river in terms of flow dynamics and water quality are described below.

Water levels and annual flow dynamics

Data on the Ilek river water flow has been obtained from the Republican State Enterprise "Kazhydromet" of Aktobe Region, who monitor and register the water flow on a daily basis. Figure 6.30 shows flow characteristics in the Ilek river based on data for the “Irek hydro station 19195 Aktobe” reflecting a period of 36 months, from January 2020 to December 2022.

The river flow data indicates a typical low flow rate during most months of the year, with monthly average values ranging from as low as 0.8 m^3/s and commonly in the range of 3-5 m^3/s, but with very significant peaks in flow rates in April and into May each year. The average flow rates in April range from 13.3 to 52.2 m^3/s with daily peaks reaching up to around 170 m^3/s in April 2021 and 2022, respectively.

The peaks in the Ilek flow rates are presumably largely due to spring snow melt, as the inflow from the URE is only allowed to be equivalent to 1/10th of the Ilek river flow.

Figure 6.31 shows the daily flowrate in m^3/s in the months March to May, for the years 2020 to 2022, also indicating the period in which water can be released from the URE reservoir. Water can typically be released from the URE reservoir in the period from March 23rd until May 5th or from the day that the river flow reaches at least 20 m^3/s. As mentioned previously, in this period the outflow from the URE is allowed to be equivalent to 1/10th of the Ilek river flow (*i.e.* 2m^3/sec if the river flow is 20 m^3/s). The reservoir operator measures the water level at the outgoing channel section of known area to verify that the URE gate is opened correctly.

[15] Source: *Berdenov, Z.G. et.al. (2016) “Geosystems geological assessment of the basin of rivers for tourists valorization. Case study of Ilek River basin.” GeoJournal of Tourism and Geosites. Year IX, No. 2, Vol. 18, November 2016, pp187-195.*

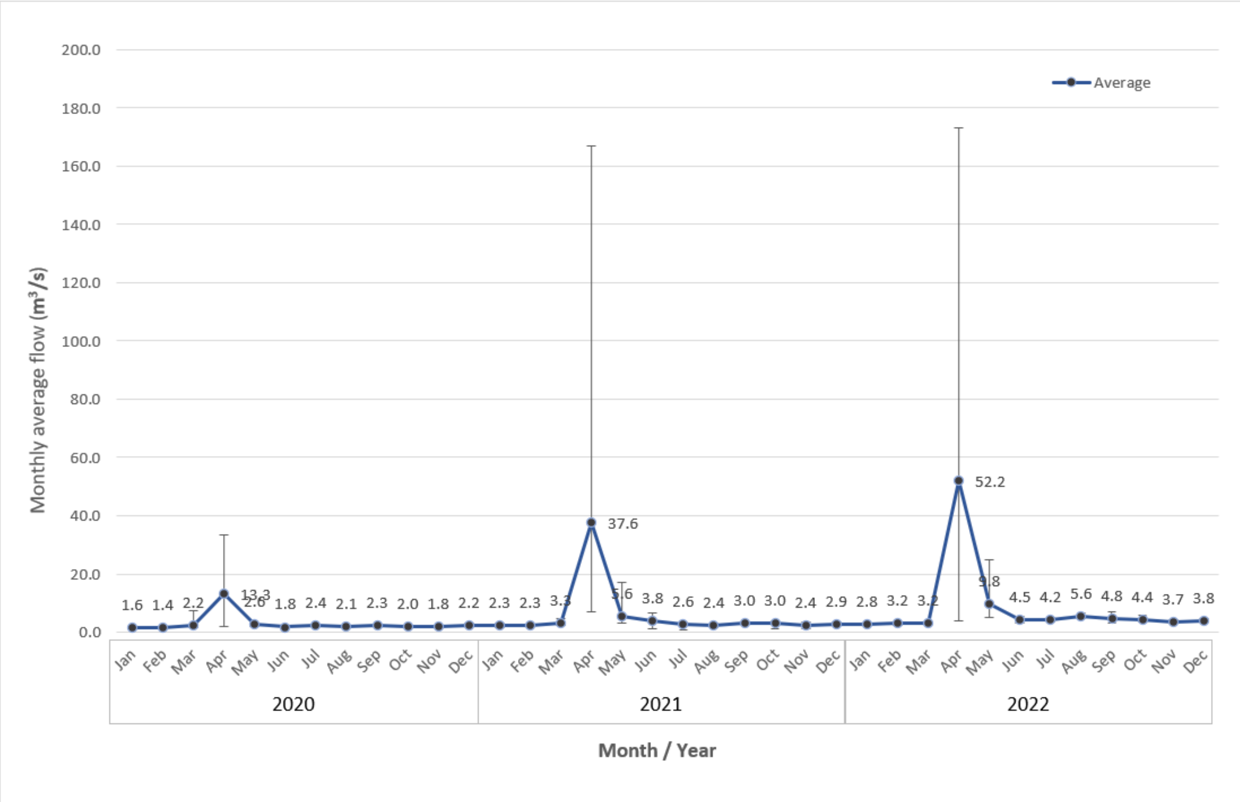

Figure 6.30: The blue line shows the monthly average flow in the Ilek river in m^3/s based on data for daily flow rates. The up-down bars indicate the daily max and min flow values within each month (Data source: Kazhydromet)

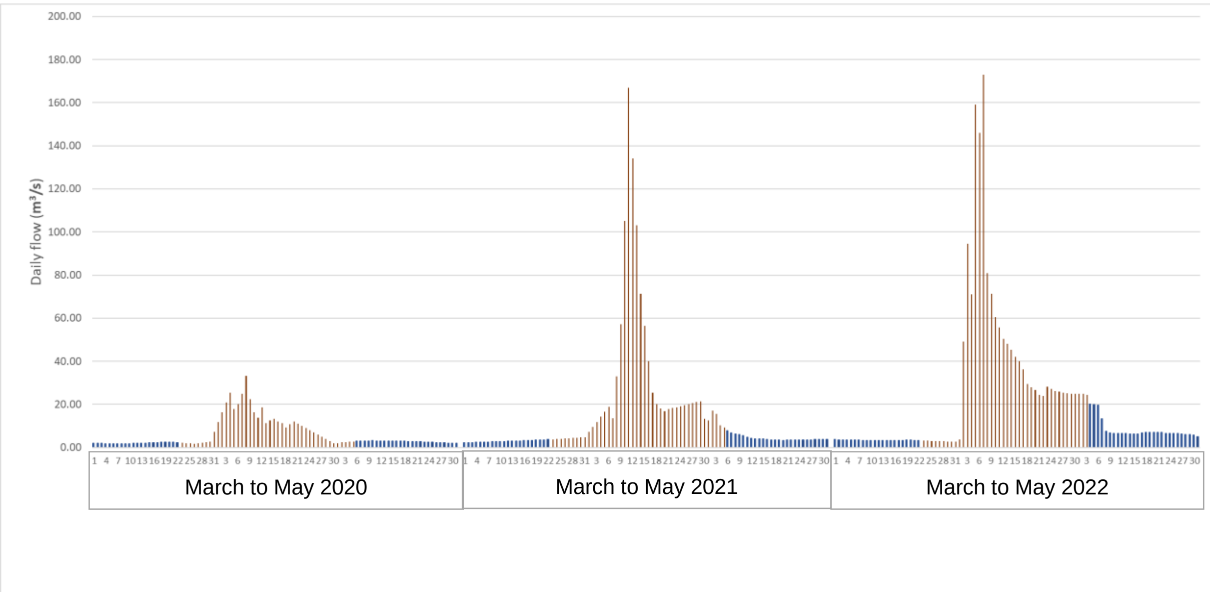

Figure 6.31 Showing variations in the daily flow in the Ilek river (in m^3/s) for the period March to May in the years 2020-2021 respectively. The brown coloured bars indicate the period (23.3-5-5) when water can be discharged from the URE to the Ilek river. Source of data: Kazhydromet

Ilek river water quality

The Ilek river is classified as 1st class according to the Unified system of classification of water quality in the water bodies #151 from 9.11.2016 (*i.e.* the cleanest with the strictest max permitted concentration of pollutants in the discharges).

ASEG monitors water quality in the Ilek river 5-9 times in a year, from the middle-end of March, every 7 days in April and until the middle of May, during the time water is being released from the URE to the Ilek river. The monitoring is done in collaboration with Sanitary Department and the Department of Ecology.

The first sampling point from the reservoir is 500 m upstream of the discharge point in the Ilek River T-1 and the second point is 500 m downstream in the Ilek River T-3, sampled once a week during the discharge, a one-time sample. The pollutant parameters monitored are the same as for the URE.

ASEG reports no problems observed in the last 3 years, such as incidents of dying fish and that there have been no accidental discharges of untreated wastewater effluent, *e.g.* during storm events, to the Ilek river.

A summary of average results above and below the discharge point to the Ilek river, for the years 2020 to 2022 respectively, are shown in Table 6.13.

Table 6.13: The Ilek River annual average water quality 500m above and below the WWTP discharge and the maximum permitted values for the fish containing water bodies (mg/L) (Data source: ASEG)

	2020		2021		2022		Permitted (MPC)
	above	**below**	**above**	**below**	**above**	**below**	
BOD5 - БПК5	2.052	4.95	2.416	3.06	4.248	5.56	3
COD – ХПК	8.550	14.82	14.016	15.20	19.930	22.04	15
pH	7.300	7.52	7.140	7.20	6.713	6.76	6.5
Anionic surfactants – АПАВ	0.025	0.05	0.016	0.02	0.002	0.02	0.1
Sulphates - Сульфаты	205.817	188.73	155.380	140.38	113.313	102.33	200
Chlorides - Хлориды	98.183	132.23	82.300	84.98	55.563	67.41	300
Iron – Железо	0.117	0.12	0.348	0.36	0.341	0.40	0.2
Petroleum products - Неф.прод	0.025	0.02	0.045	0.04	0.022	0.02	0.05
Suspended Solids - Нераст вещ-ва	13.667	40.20	20.920	24.32	48.400	51.04	Background
Chromium - Хром (VI)	0.036	0.04	0.095	0.10	0.037	0.03	0.02
Copper - Медь	0.001	0.00	0.003	0.00	0.002	0.00	0.05
Zinc - Цинк	0.002	0.00	0.003	0.00	0.003	0.00	0.3
Nitrate nitrogen - Азот нитратов	0.692	0.63	0.916	0.99	0.618	0.54	40
Nitrite nitrogen - Азот нитритов	0.020	0.02	0.019	0.02	0.021	0.02	0.1
Ammonium nitrogen - Азот аммонийный	0.021	2.86	0.003	0.38	0.245	0.95	+0.25
Boron - Бор	0.262	0.20	0.132	0.12	0.081	0.08	0.5
Phosphorus - Фосфор	0.024	0.86	0.067	0.26	0.095	0.42	0.1

The above data is depicted in the following graphs, against the applicable MPCs, comparing the water quality above the discharge point (T-1, blue colour) against the quality below the discharge point (T-3, red colour). Where the red coloured area is higher than the blue, there is a negative impact on water quality due to the WWTP effluent discharge from the URE reservoir.

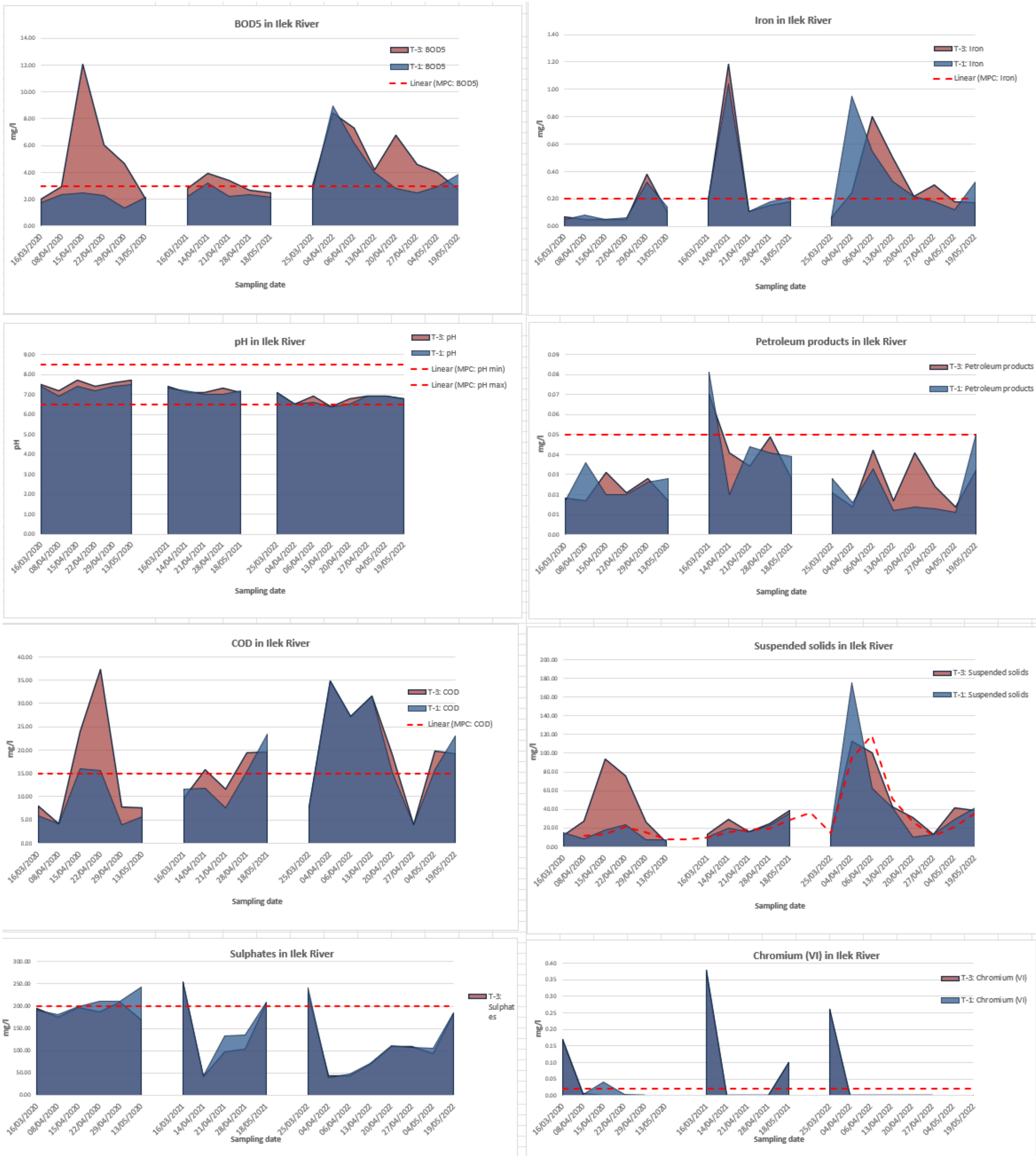

Figure 6.32: Graphs showing the measurements in the URE reservoir against the MPC (red dotted line) in 2020-2022 for the parameters: BOD5, Iron, pH, Petroleum products, COD, Suspended solids, Sulphates, Chromium (VI). The blue area reflects the T-1 (above discharge from URE) and the red T-3 (below discharge from URE).

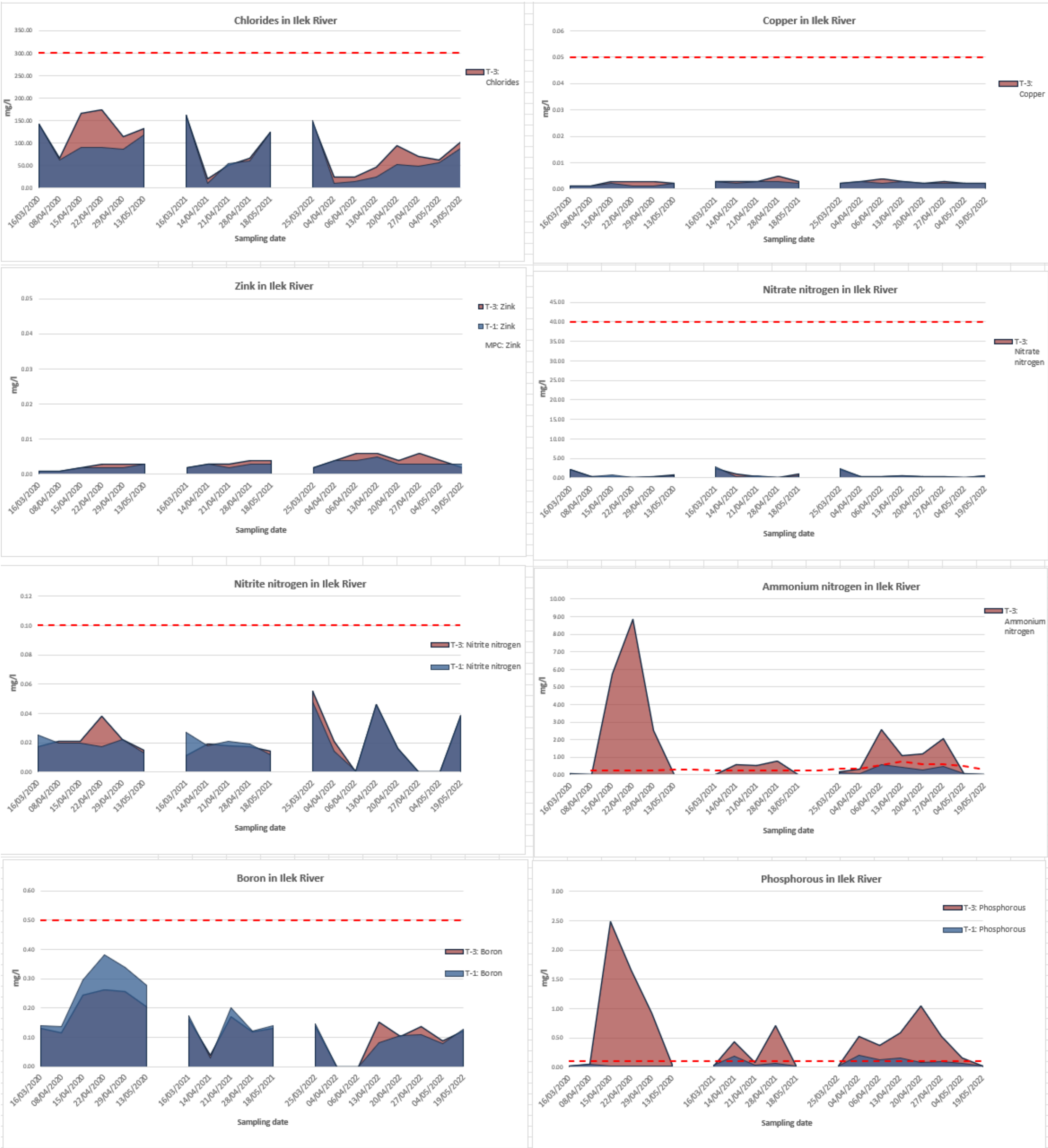

Figure 6.33: Graphs showing the measurements in the URE reservoir against the MPC (red dotted line) in 2020-2022 for the parameters: Chlorine, Copper, Zink, Nitrate Nitrogen, Nitrite nitrogen, Ammonium nitrogen, Boron, Phosphorous. The blue area reflects the T-1 (above discharge from URE) and the red T-3 (below discharge from URE).

In line with the water quality in the URE, the discharge appears to contribute to reduced quality of the river with regards to BOD5, ammonium nitrogen, and phosphorous all years, and COD and suspended solids in 2020 (although SS can also be from erosion of the banks of the discharge channel).

Sludge quality within existing WWTP sludge ponds and URE storage area

Raw sludge from the WWTP is pumped to 56 sludge ponds north of the WWTP where it is sun-dried. During the summer months that dried sludge is then taken to the URE site for long term storage

Sludge samples were collected as part of this ESIA process and analysed for key nutrients as well as heavy metals, as an indication of contaminants in the incoming wastewater and the potential to reuse sludge as fertilizer, *e.g.* in agriculture.

Sludge samples were taken both at the existing sludge ponds (Figure 6.34) and in the area of long-term sludge storage next to the URE effluent reservoir (Figure 6.35).

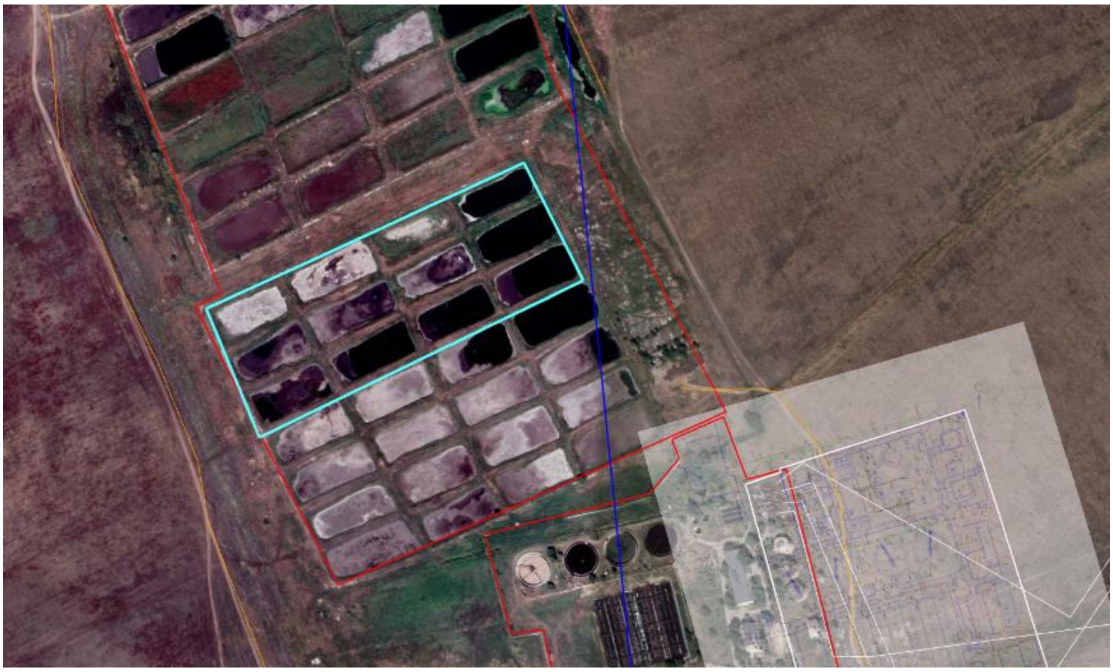

Figure 6.34: Area of the existing sludge ponds where sludge samples were taken (light blue outline)

Figure 6.35: Sludge sampling points (yellow dots) within the long-term sludge storage site to the north of the URE reservoir

The results of the sludge analysis is provided in the following table, and compared against the EU Sewage Sludge Directive “Limit values for heavy metals concentrations in sludge for use in agriculture”. The results indicate that heavy metal values in the sludge are low, and well within the EU limit values. Hence, based on this the sludge is suitable for use in agriculture.

Table 6.14: Results of sludge analysis in the existing sludge beds next to the WWTP and at the URE sludge storage area, compared against the heavy metal limit values for sludge used in agriculture in the EU sludge directive.

Parameter values in mg/kg	Sample point															Limit values for heavy metals concentrations in sludge for use in agriculture
	WWTP Sludge beds			Sludge heaps at URE from 2015-2021										2022		mg/kg of dry matter
Sample	North line	Mid line	South line	1	2	3	4	5	6	7	8	9	10	11	12	
Points	Combined top mid bottom			1-5	2-3	3-5	3	6-8	7,8,10	6-9	7-9	9,10	10	11-12	11-13	
Sample depth cm	0-30	0-31	0-32	30-60	50-80	80-110	110-130	30-50	80-110	50-80	80-110	30-50	50-80	50-80	30-50	
pH	7.1	7.0	7.2	6.2	6.3	6.1	6.9	6.5	6.8	6.7	6.7	6.6	6.9	6.6	6.6	
P	0.01	0.10	0.12	0.13	0.10	0.10	0.08	0.09	0.04	0.07	0.04	0.05	0.03	0.16	0.15	
N	38	37	42	30	32	30	32	35	37	34	34	37	36	34	35	
Cd	1	0	4	4	3	28	3	4	4	3	4	4	8	3	3	20 to 40
Cu	0	0	135	75	66	65	87	92	98	88	119	132	304	87	73	1000 to 1750
Ni	4	9	39	28	25	32	56	52	51	44	90	89	163	33	33	300 to 400
Pb	3	1	54	3	8	18	26	20	22	17	23	30	88	15	12	750 to 1200
Zn	1	1	619	385	357	459	542	615	584	487	783	759	1,416	449	430	2500 to 4000
Hg	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	16 to 25
Cr	6	7	3	3	4	3	3	3	6	4	4	4	5	3	4	—

Impact of climate change on water resources

Climate change is projected to have an influence on Kazakhstan’s water resources, exacerbating existing water shortages and placing greater pressures on agricultural activity.

Basins in some parts of the country already face significant water shortages and much of Kazakhstan’s arable land is subject to drought. The A2 scenario discussed in Chapter 6.1.5 projects that other river volumes in the entire country will decrease by 7-10.3%. Climate change is projected to significantly influence Kazakhstan’s water resources, and the climate in the agricultural regions will become more arid. Agriculture is one of the key elements in Kazakhstan’s economy and, overall, crop yields in central Asia are projected to decrease by up to 30% by 2050[16]. The demand for water will also increase due to the growth from Kazakhstan’s population, which is projected to reach 24 million in 2050, and due to demands of the industry as well as from neighbouring countries.

Increased temperature may lead to more frequent droughts and exacerbate water scarcity. Hence, reusing treated effluent water for agricultural purposes offers an obvious opportunity to increase climate resilience.

A Country Risk Profile for Kazakhstan established by CAREC (March 2022) notes that since 1960, Kazakhstan has experienced significant warming, and that “over the recent period 2000-2016, four near country wide droughts have occurred, leading to widespread agricultural losses” (CAREC, p.33). The report also summarises that in Kazakhstan “flood risk is much more pronounced than earthquake risk.. // .. with heavy rainfall and snow melt causing significant damage” historically (CAREC, p.8).

In terms of **flood risk**, the proposed WWTP site is not located close to rivers or other significant surface water, is located on a relatively flat area with no risk of landslides in the vicinity. ASEG has informed that the existing WWTP has never been flooded. As discussed in Chapter 6.1.5 on climate change projections, the location of the WWTP is considered of mild sensitivity in regards of flood risk, since it is seen that extreme events are not be expected to be more frequent – and since many of the floods

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experienced in the country are fluvial flooding. Hence, the flood risk at the proposed WWTP site is as such considered low. Nonetheless, it is important that the site applies an effective storm water management and landscaping to direct water away from key WWTP infrastructure, although this can be seen as regular flood proofing and dimensioning can be based on historic precipitation data and events Chapter 8.1.3 in the impact assessment section includes a proposed dimensioning of storm water management infrastructure.

Also, in case of more frequent extreme precipitation or snow melting events, there would be an elevated risk of stormwater overloading the sewer system and WWTP, hence requiring effective emergency response measures to handle such events (see Impact Assessment section below and the ESMP).

Current agricultural reuse of WWTP treated effluent and sludge

Treated effluents from the WWTP are currently not used for agricultural irrigation purposes, and the current quality of effluents would not meet minimum requirements of the EU Water Reuse Directive. However, water from the URE reservoir has been used for irrigation in the past, and there are clear opportunities for reusing the effluent water from the new WWTP.

There seems to be an opportunity for local agricultural re-use of effluent approx. 0-9 km to the north-east from the plant. It is recommended that ASEG explore further the potential to reuse effluents for agricultural irrigation (and/or other industrial purposes) in the vicinity of the WWTP, in dialogue with relevant authorities, farmers and industry associations. The water used for crops would, however, require regular testing that pathogen concentration does not exceed the appropriate EU limits.

Similarly, there is currently no reuse of sludge from the Aktobe WWTP for agricultural purposes. However, there appear to be opportunities for local agricultural re-use of sludge between 0 and 5 km to the north-east from the WWTP by two (2) main farms; Temir Tulpar Batys and Andi. As the above discussed testing of heavy metals in historic sludge indicates, the levels are low and in line with the EU Sewage Sludge Directive limit value, and therefore the sludge appears suitable for agricultural use. This also indicates that future sludge streams from the AD process are likely to have low heavy metal concentrations, although monitoring is required prior to any reuse of treated sludge following the EU sludge Directive.

In Kazakhstan, the reuse of sludge for agricultural purposes is accepted, although there is no sludge disposal policy in Kazakhstan. However, waste handling and disposal requirements are given in the Environmental Code. Sludge is categorised as non-hazardous waste and can be used in agriculture or horticulture, providing the maximum permitted concentration of pollutants and pathogens in the soil are met. Composting sludge is also considered to remove pathogens but rarely applied.

Conclusion on receptor sensitivity – surface and groundwater

The key surface and groundwater receptors with potential to be affected by the project, and their sensitivities can be summarised as follows:

- **Surface and groundwater sources at and around the WWTP site**: There are no significant surface bodies around the WWTP site and groundwater appears to be at a depth of at least 4 meters and not affecting the WWTP site. There are not known to be any direct uses of groundwater at or in the vicinity of the site. Hence, sensitivity is considered **low.**
- **The URE effluent retention reservoir**: The reservoir is man-made with a dam and has been used to retain effluent water prior to discharge to the Ilek river and in the past for irrigating agriculture. The current quality of the water in the dam is poor, odorous, and reflecting the poor quality of effluents discharged to it from the WWTP. However, there are some concerns about the integrity of the dam if the reservoir is used at its full capacity, due to water percolating into the dam body, with the risk of dam failure. The proposed Project anticipates continued use of the reservoir, and its importance is likely to grow if effluents will be used for irrigation, which is recommended. Hence, being able to use

the reservoir at full capacity would be ideal. The sensitivity of the reservoir and dam for continued use is considered **medium to high**.

- **The Ilek River**: The river is the final receptor for treated effluents from the WWTP. It has low water flow and hence has limited capacity to dilute large amounts of polluted water, and water from the URE is only discharged to it when the river water flow is at its highest. That said, the river is already a subject of various anthropogenic impacts in the form of both water extraction and discharge upstream and downstream. Yet, it is classified as 1st class according to the Unified system of classification of water quality in the water bodies. Hence, overall, the sensitivity of the river for continued use for effluent discharge is considered **medium to high.**

6.1.7 Ambient air quality

Ambient air quality in Aktobe City - Northern Industrial Area of Aktobe

Aktobe City is a large industrial centre, closely associated with chromite deposits east of the city. It houses factories for ferroalloys, chromium compounds, agricultural machinery, X-ray equipment, and others, including chemical, light and food industries are developed.

The local EIA by Aquarem (2023) also notes that main sources of atmospheric air pollution of the air basin of the region is mainly caused by emissions of large enterprises, including: SNPS Aktobemunaigas JSC, Kazakhoil Aktobe LLP, Aktobe Ferroalloy Plant and DGOK branches of TNK Kazchrome JSC, Intergas Central Asia JSC, UMG Aktobe, Aktobe CHP JSC.

The review of the Aktobe ambient air quality is based on data provided by the National Hydrometeorological Service of Kazakhstan (Kazhydromet). Kazhydromet operates 6 stationary monitoring stations in the city of Aktobe. Area station 2 and 4, which are located in the northern industrial area of Aktobe, have the greatest proximity to the proposed WWTP project area (See Figure 6.36) at a distance of >6 km south from the WWTP site. The ambient air quality in this area is not representative of the WWTP site but can be assumed to be worse than what is experienced at the WWTP Project site for those types of pollutants not originating from the existing WWTP.

Figure 6.36: Location Area Station 2 and 4

Table 6.15 presents the **yearly average** pollution concentrations measured at station 2 and 4 for the years 2018-2022.

Table 6.15: Yearly pollution concentrations measured at station 2 and 4 for the years 2018-2022 (μg/ m³)

Pollutants measured at fixed stations	Average values from stations #2 and #4 (μg/m³)									
	2018		2019		2020		2021		2022	
	#2	#4	#2	#4	#2	#4	#2	#4	#2	#4
Fine Particles (μg/m³)		15.4		20.4		1.5		12.6		4.7
Fine Particles PM-2.5 (μg/m³)										
Fine Particles PM - 10 (μg/m³)	36		25.2		39.8		0		0	
Sulphur dioxide (μg/m³)	14	3.7	19.6	3	17.7	3.6	7.3	3.6	4.6	3.2
Carbon monoxide (mg/m³)	0.316	4.286	0.904	1.433	0.087	0.42	0.21	0.742	0.068	0.413
Nitrogen dioxide (μg/m³)	36	22.7	31	26.7	31.6	37.3	21.8	31.7	22.6	28.1
Nitrogen oxide (μg/m³)	2		2.9		0.6		8.6	36.3	30.2	30.9
Hydrogen sulphide (μg/m³)	1	0.8	1.7	0.8	0.9	0.4	2.4	0.6	1.4	0.1

The pollution concentrations presented for area stations 2 and 4 have been compared with the WHO[17] and EU[18] air quality standards. In addition, the values are also compared with the Maximum Permissible Concentrations (MPC) from the Kazakh Hygienic Standard for Atmospheric Air in Urban and Rural Residential Areas and Areas of Industrial Organisations #29011 from 2.08.2022. The following two tables summarize the respective air quality standards.

Table 6.16: WHO and EU ambient air quality standard levels

Pollutant	Averaging time/period	WHO Standard	EU Standard
Fine particles (PM2.5)	Annual	5 µg/m^3	20 µg/m^3
	24 - hour	15 µg/m^3	-
Fine particles (PM10)	Annual	15 µg/m^3	40 µg/m^3
	24 - hour	45 µg/m^3	50 µg/m^3
Nitrogen dioxide (NO_2)	Annual	10 µg/m^3	40 µg/m^3
	24 - hour	25 µg/m^3	-
Sulphur dioxide (SO_2)	24 - hour	40 µg/m^3	125 µg/m^3
Carbon Monoxide (CO)	24 - hour	4 mg/m^3	10 mg/m^3 (Maximum daily 8 hour mean)

Table 6.17: Kazak Hygienic Standards for Atmospheric Air in Urban and Rural Residential Areas and Areas of Industrial Organisations

Pollutant	Maximum Permissible Concentrations (MPCs)	
	Maximum one-time	Daily average
Fine particles (PM2.5)	160 µg/m^3	35 µg/m^3
Fine particles (PM10)	300 µg/m^3	60 µg/m^3
Nitrogen dioxide (NO_2)	200 µg/m^3	40 µg/m^3
Sulphur dioxide (SO_2)	500 µg/m^3	50 µg/m^3
Carbon Monoxide (CO)	5 mg/m^3	3 mg/m^3

Source: Approval of the Hygienic Standards for Atmospheric Air in Urban and Rural Residential Areas and Areas of Industrial Organisations #29011 from 2.08.2022

It should be noted that the data for stations #2 and #4 are annual averages, whereas some of the EU standard values are only given as 24-hour averages. That limitation aside, the following can be observed for monitoring stations #2 and #4 when comparing with the WHO and EU air quality standards:

- Fine particles (PM10): All annual average values of station 2 and 4 are below the annual WHO and EU limits.
- Nitrogen dioxide (NO_2): All annual average values of station 2 and 4 are above the yearly WHO limits and below the EU limits.
- Carbon monoxide: Only the average value of station 4 in the year 2018 is above the daily WHO limit. All other average values are below the WHO and EU limits.
- Sulphur dioxide (SO_2): All annual average values are below the daily WHO and EU limits.

With regard to the MPCs set in the Hygienic Standards for Atmospheric Air in Urban and Rural Residential Areas and Areas of Industrial Organisations #29011 from 2.08.2022, the only exceedance is at station 4 for the 2018 average carbon monoxide value.

[17] https://www.who.int/publications/i/item/9789240034228
[18] https://environment.ec.europa.eu/topics/air/air-quality/eu-air-quality-standards_en

There does not appear to be a clear trend towards either reduction or increase of pollutants in the period 2018-2022 at station 2 and 4 for most pollutants. However, for Carbon monoxide a decrease at station 4 is noticeable. Similarly, the average Sulphur dioxide value at station 2 is also decreasing

Some average pollution values can vary quite significantly throughout the years, as for instance for Carbon monoxide where at station 4 the yearly average value dropped from 4.2857 mg/m^3 in 2018 to 1.4329 mg/m^3 in 2019.

Overall, it can be said that most of the annual average values at station 2 and 4 for the period 2018-2022 are below the three considered standards.

Ambient air quality at the Aktobe WWTP site

ASEG hires a company to conduct sampling (one-time sampling) of air quality within its sites twice a year. The survey is conducted in accordance with the national standard ST RK 2.302-2014. It is done according to normative documentation GOST 17.2.6.02-85 using GANK-4 gas analyser and Meteometer MES-200A on the border of the conditional sanitary protection zone of its sites.

Recent samples were conducted in March 2022, September 2021, and December 2021 and 2022. The main sites such as the WWTP, the WTP, the production base, Kargalinskoye village, Zarechny, Nokina are measured for carbon monoxide, nitrogen dioxide, sulphur dioxide. The site of the WWTP is measured for hydrogen sulphide and chlorine.

During sampling in 2022, the weather was sunny, atmospheric pressure was 750 mmHg, air temperature dry -12, humid 70, east wind, wind speed 2 m/s. The results are shown in Table 6.18.

Table 6.18: Air quality monitoring results of ASEG for 2022 at the WWTP site (Source: Protocol of atmospheric air sampling and investigation of residential areas #14114 from 28.12.2022)

	Results at WWTP site, boiler house	MPC mg/m^3
Carbon monoxide mg/m^3	0.15	5.0
Nitrogen dioxide mg/m^3	0.020	0.2
Sulphur dioxide mg/m^3	0.025	0.5
Hydrogen sulphide		0.008
Chlorine		0.1

During air quality sampling in 2021, atmospheric pressure was 749 mmHg, Temperature of dry –6, humid 65; direction of wind southeast, speed of wind 5m/s, condition of weather was cloudy. Results are presented below.

Table 6.19: Air quality monitoring results of ASEG for 2021 at the existing WWTP site (Source: Test report #472-526 of atmospheric air of populated areas from 13.12.2021)

	Results at WWTP site	MPC work area mg/m^3
Carbon monoxide mg/m^3	0.21	5.0
Nitrogen dioxide mg/m^3	0.0022	0.2
Sulphur dioxide mg/m^3	Not detected	0.5

One time Hydrogen sulphide sampling was conducted inside the WWTP area in 2020. During the sampling the temperature was -25^{O}C, humidity 70%, pressure 759mmHg. (Table 6.20)

Table 6.20: Results of Hydrogen Sulphide monitoring inside the WWTP site in 2020. (Source: Test report #238 of atmospheric air of populated areas, sanitary area, inhabited territory from 22.12.2020).

Name of indicator, unit of measurement	Work area MPC mg/m³	Actual data received, mg/m³	
		windward	leeward
Hydrogen sulphide (H_2S)	0.008	0.00123	0.00138

The above detected values of 0.00123 and 0.00138 mg/m³ H_2S from 2020 are roughly equal to 0.001 PPM[19]. These are one-time measurements taken during winter (*and* not during summer when sludge ponds are being emptied, for example), and thus not sufficient to draw conclusions about the odour situation. Nonetheless, it can be noted that the human nose has an odour sensitivity (lowest detection) at around 0.0006 ppm for H_2S. It means that the instruments lowest detection is 0.001/0.0006 = 17 times above the sensitivity level. In another way – if the instruments detect H_2S, there will generally be a high odour concentration. The one-time winter measurement of 0.001 PPM would thus indicate a high odour concentration, which is likely to be worse during summer. The odour situation related to current WWTP operations is further discussed below.

Odour situation (qualitative)

The following sources of odour have been identified, both during the ESIA site visit and through the results of the conducted focus groups discussions (FGDs):

- Sludge beds adjacent to the WWTP area and in particular when being emptied / cleaned and transported to the dried sludge storage site next to the URE reservoir.
- The WWTP itself with its biological tanks, primary and secondary tanks.
- URE reservoir.
- Discharge channel from URE reservoir to the Ilek River (used in the period from March 20th to May 5th each year).
- Flooded banks of the discharge channel close to the Ilek river.
- Flooded banks of the Ilek River close to the discharge channel from the URE.

Three focus group discussions (FGDs) were held in April with residents living relatively close to the existing WWTP, *i.e.* in Kurayly and Georgievka villages and at railway junction 39 / Tulpannyy hamlet. Further information about the FGDs and their participants are provided in section 7.3.3.

FGD participants from Kurayly and Georgievka villages complained that they are exposed to a strong odour especially during the summer and in windy weather. In these periods, they did not want to open their windows and their laundry had to be dried at home (meaning inside the house). They mentioned that the smell from the WWTP had a negative impact on residents generally in the villages and particularly on people with respiratory diseases and on children. Furthermore, some residents of the two villages bathe in the Ilek River, including children during the summer holidays and reported odours at the river banks.

Residents in the mentioned villages and settlements identified the discharge creek banks and the banks of the Ilek River as sources of the odour. The spring discharge from the URE contaminates the creek and the riverbanks and erodes the creek bringing the eroded sediments to the Ilek river flood plain. After releasing effluents from the URE into the Ilek river (after May 5th when the wastewater discharge has been stopped), water from the Aktobe reservoir upstream is released for three consecutive days to clean the riverbanks. However, the complaints expressed during the FGDs indicate this is not effective and foul odour continues to emanate from the creek banks for several months afterwards, causing nuisance in the adjacent areas. The same applies to the Ilek riverbanks.

[19] According to: PPM mg/m3 converter for gases | Teesing using molecular weight of M=34.08 g/mol.

Residents near the 39th railway station and of the Tulpannyy Hamlet village also report a constant strong odour throughout the whole settlement. The odour becomes particularly strong during nights and under windy weather conditions. Due to the strong odour, the windows remain closed, and laundry has to be dried inside the house. The residents also feel embarrassed to invite guests to their homes. Children and people with respiratory diseases are particularly affected by the odour. During the noise measurement at the nearest inhabited house to the WWTP conducted on 25th and 26th April 2023, the house inhabitants informed about persistent hydrogen sulphide smell from the WWTP.

During Sweco's site visit, the WWTP site manager also mentioned odour complaints from residents during the cleaning of sludge beds.

The map below shows the different sources of odour circled in red and in contrast the receptors of odour circled in yellow.

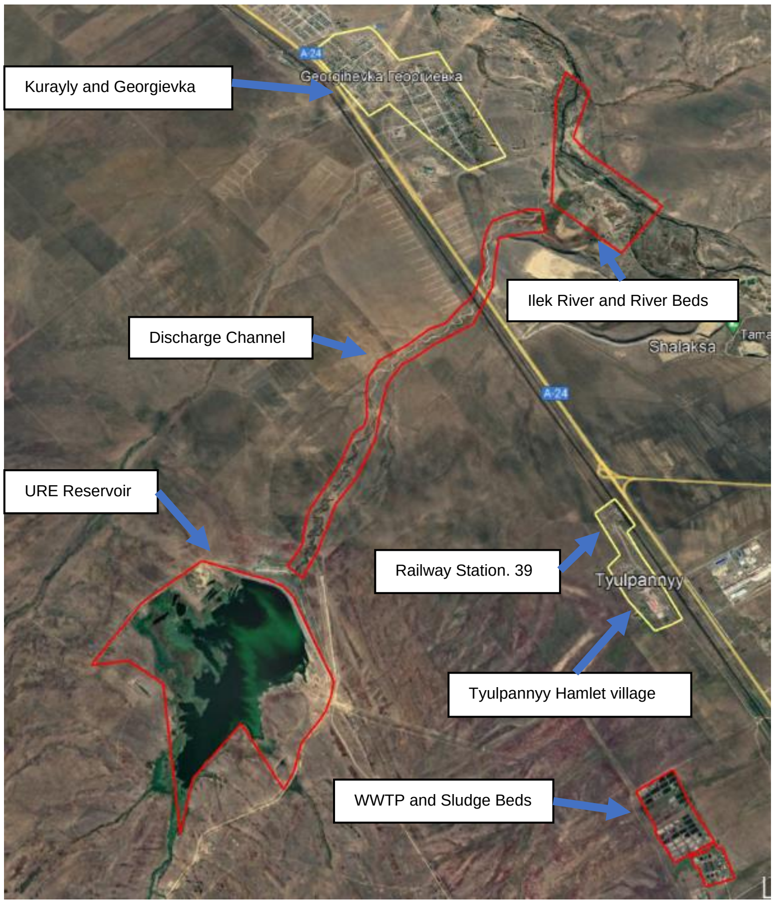

Figure 6.37: Map illustrating the key sources of odour from the WWTP and its products (effluents and sludge) (marked with red) and the receptors, including nearby settlements (circled with yellow line).

Conclusion on receptor sensitivity – ambient air quality

Given its distance from the City and closest industrial areas, the overall ambient air quality at the WWTP is considered relatively good, is open to winds and with capacity to accommodate some impacts, hence of overall low sensitivity, with the exception of odour. The main source of impacts from the current WWTP is odour. This is already a significant issue and an important source of nuisance and reduced wellbeing in inhabited areas closest to the WWTP, the URE, the discharge channel and point of discharge to the Ilek river. Hence, air quality in relation to odour is considered of high sensitivity, with low capacity to accommodate further negative impacts. The **overall air quality sensitivity is therefore considered medium.**

6.1.8 Ambient Noise levels

The WWTP is located in a relatively remote industrial area. The main source of noise emissions related to the operation of the WWTP are WW pumps and the blowers supplying air to the biological tanks, which are all located inside buildings hence have limited impact outside. During a visit to the WWTP, the noise inside the blower building was measured between 75-80 dBA next to the aeration blowers. The nearest potentially significant sources of anthropogenic noise are the railway and A-24 main road which are located > 1 km to the east. The border of the Chromium industrial facility is furthermore located *approx.* 1 km to the south, but the associated factories are *approx.* 3 km away from the WWTP.

The nearest noise receptor to the WWTP site is Tulpannyy hamlet *approx.* 2 km to the north from the WWTP and adjacent to on the western side of the railway line (*approx.* 200 m) and the A-24 road (*approx.* 400 m).

Figure 6.38: Showing Tulpannyy hamlet, which is the nearest residential area, approximately 2 km north from the WWTP site. (Map source: Google Earth)

As part of this ESIA process, ambient noise was measured on 25-26 April (Tue to Wed) 2023 at the nearest residential house nearest to the WWTP, located in Tulpannyy hamlet (the area consists of 7 semi-detached and 2 detached houses and was experienced as quiet without prominent or permanent noise sources). The adjacent dairy farm 400m to the south was closed on the day of noise measurements. The residents informed that they did not experience noise from the main railway track located 450m east from the residential area. The house inhabitants reported no noise propagating from the existing WWTP but on the other hand noted persistent hydrogen sulphide (H_2S) smell from the WWTP. A dirt road passes the village 270m to the east behind several rows of trees, leading 700 m to the north towards Railway Junction 39. No vehicles were seen on this road during the noise metering installation and removal, and the residents reported only occasional local light cars on this road for the entire daytime. Therefore, a traffic survey was not conducted. No other potential sources of noise were noted in the area.

The environmental conditions during the noise measurement consisted of 1-3 m/s SSE wind on 25 April 2023 which increased to 2-6 m/s on 26 April 2023 and during 14:00-17:00 increased further to 10 m/sec. The temperature varied between 22°C during the day to 14.3°C in the early morning. The atmospheric pressure was stable 767.8 falling to 762.5 at the end of the measurement. The relative humidity varied from 20% during the day to 45% at night. High feather clouds did not obstruct sunlight significantly.

For the noise measurement, a 1st grade precision noise meter Shi-01 (Zaschita) was used with the sensitivity range set to 40-110dBA. The meter was placed 1.5m from the house facade. There were no physical barriers between the noise meter microphone and the WWTP. The wind affect was cancelled by pointing the microphone away from it and putting a wind cancelling bowl on top of the microphone. The day measurement was conducted for 18.5 consecutive hours from 14:24 to 22:00 and from 8:00 to 19:00 the next day. The night measurement was taken for 10 consecutive hours from 22:00 to 8:00 the next day.

The measured **day** L_{Aeq} was 50.9dB (maximum 54.0, minimum 40.3) with the impulse setting showing 50.3dB (max 95.8, min 27.5), short averaging 43.7dB (max 90.8, min 27.4) and long averaging 44.8dB (max 80.1, min 27.8).

The **night** L_{Aeq} was 40.5dB (max 48.7, min 40.0) with the impulse setting showing 47.9dB (max 60.8, min 29.0), short averaging 40.2dB (max 59.3, min 24.7) and long averaging 40.5dB (max 50.4, min 28.8).

These measurements indicate ambient baseline noise conditions which are within the national[20] and WHO[21] limits.

Conclusion on receptor sensitivity – noise levels

There are no immediate settlements close to the WWTP, and the nearest settlements do not experience noise from the existing WWTP. Overall, the sensitivity in terms of **noise levels** and noise receptors is considered as **low.**

6.1.9 Biodiversity - Flora (vegetation)

The survey area for vegetation was determined by the area expected to be affected by the proposed Project. This includes first and foremost the approx. 11 ha area planned for the new WWTP. The sludge beds vegetation distribution may change only as a result of reduced water availability, but the noted vegetation contained only few weedy plants. The vegetation around the URE is not expected to be affected by the Project, assuming continued use. All these areas were examined on 21 May 2023 when all plants were in the flowering phase, which allowed their identification to the species level.

The surveyed areas are practically void of shrubs and trees. Some isolated trees and shrubs are found only at the edge of the URE retention reservoir dam, the discharge creek and around the sludge beds and the existing WWTP.

The area of the new WWTP can be divided into three parts: hay field, wasteland and depression where thaw water remains for considerable time during spring. The wasteland is covered by the ephemeras-wormwood-fescue community, while the depression contains mixed grasses-fescue-suaeda communities. The hay field vegetation was identified as mixed grasses community. **None of the above areas contains any protected species**. The sludge bed banks are covered with only 4 weedy plant species thriving due

[20] GOST 12.1.036-81 (ST SEV 2834-80) Safety Standard System. Noise. Permitted levels in houses and public buildings, 1982
[21] Berglund, Lindval, Schvwela. Guidelines for Community Noise. WHO, 1999

to the high nutrients levels. The same plants are present in the elongated depression eastwards along the flow of groundwater that seeps from the beds.

The vegetation around the URE reservoir is considerably more diverse. This may be explained by the larger area covered by the survey but also by presence of different habitat types from the rocky dam to wetland and grassland.

Isolated small weedy aquatic plants were extracted during the URE bottom sediments samples collection at the northern shallower parts. Their species could not be identified. No aquatic or semi-aquatic vegetation like reeds were noted in the sludge beds.

Table 6.21: Identified vegetation diversity within the areas potentially affected by the project. (Species presence is indicated with green shading)

Family	**Species**	**New WWTP site**	**Sludge beds**	**URE**
Rubiaceae	*Galium aparine* L.			
Euphorbiaceae	*Euphorbia virgata* Waldst. ex Kit.			
Cannabaceae	*Cannabis sativa* var. *spotanea* Vavilov			
Boraginaceae	*Asperugo procumbens* L.			
	Nonea pulla DC.			
Rosaceae	*Spiraea hypericifolia* L.			
Scrophulariaceae	*Veronica prostrata* L.			
Asteraceae	*Acroptilon repens (L.) DC.*			
	Cyclachaena xanthiifolia (Nutt.) Fresen.			
	Scorzonera humilis L.			
	Senecio vulgaris L.			
	Tanacetum turlanicum (Pavlov) Tzvelev			
	Carduus hamulosus Ehrh.			
	Acroptilon repens (L.) DC.			
Brassicaceae	*Cardaria repens* (Shrenk) Jarm.			
	Thlaspi arvense L.			
	Descurainia sophia (L.) Web ex Prantl			
Fabaceae	*Astragalus testiculatus* Pall.			
	Medicago falcata L.			
Poaceae	*Agropyron fragile* (Roth) P. Candargy			
Fumariaceae	*Fumaria officinalis* L.			
Euphorbiaceae	*Euphorbia virgata* Waldst. ex Kit.			
Polygonaceae	*Persicaria lapathifolia* (L.) Delarbre			
Chenodipodiaceae	*Atriplex sagittata* Borkh.			
Caryophyllaceae	*Gypsophila perfoliata* L.			

Conclusion on receptor sensitivity - Flora

The main vegetation area directly affected by the Project is the proposed WWTP, comprising an approximately 11 ha of a field that will the transformed to an industrial (WWTP) area and the relocation of power lines on the periphery of the WWTP site. The area is largely divided into a hay field, wasteland and depression where thaw water remains for some time during springs. The area is characterised by low species diversity, and none are rare or protected species. Hence, the flora receptor sensitivity is considered **low.**

6.1.10 Biodiversity – Fauna (wildlife)

Similar to vegetation, the WWTP Project is expected to affect directly only potential habitats within the proposed Project site, including new WWTP site, the sludge ponds if renovated. Potential indirect impacts include downstream aquatic habitats where effluents are discharged, including the URE reservoir and in particular the natural Ilek river. Hence, the fauna baseline studies have focused on:

- Terrestrial and avifauna around the existing and new WWTP sites, including existing sludge beds and around the URE.
- Benthic fauna (hydrobiological) study of the Ilek river around the discharge point from the URE, with focus on invertebrate indicator species.

Terrestrial and avifauna

The Integrated Biodiversity Assessment Tool (https://www.ibat-alliance.org) shows no areas designated for protection within 50km from the WWTP site. The nearest key biodiversity area Kulaksay Lowland (A1b, A1d, D1a) along the Ilek River floodplain is situated beyond the Russian border, about 80km to the northwest of the Project site.

A fauna and habitat survey was conducted by a qualified zoologist, on 21 May 2023, in parallel with the flora survey discussed above. The area surveyed consisted of the existing WWTP components and expected area of potential impact which was defined as 2km from the existing WWTP components, and the URE area.

The municipal landfill, located 3km south of the new WWTP site and 7km from the URE reservoir, was not surveyed (as access was denied). The landfill is considered as a likely food source for birds like the gull (Larus family), Passeriformes and other birds.

No mammals and reptiles, their tracks, borrows, excrements or food remains were noted during the survey. Insects were not surveyed.

Bird migration from Europe, Azerbaijan and India to the West and East Siberia (Tumen, Surgut) cross through Aktobe City. The URE guard reported numbers of waterfowl in March but no significant nesting due to lack of near water vegetation such as reeds. Sludge beds are also visited by ducks, but the visits do not seem to be for feeding.

With regards to birds, 42 species were observed during the survey. Two of them are listed in the Kazakhstan Red Data Book: Little bustard (Tetrax tetrax, NT) and Demoiselle Crane (Crus virgo, LC). Additionally, Ruddy (*Tadorna ferruginea*, LC) and Common shelducks (Tadorna tadorna, LC) were noted nesting nearby and using URE and sludge beds open water for rearing the chicks.

The proposed new WWTP area was inhabited only by a pair of doves. Jackdaws (*Corvus monedula*) were noted on the nesting on the powerline poles. The local crows and 3 swallows visited the site during the time of the observation but nested elsewhere. A flock of 37 migrating white-winged terns (LC) visited the site during the observation.

The following table lists number of birds observed at the WWTP site and the sludge ponds during the survey.

Table 6.22 Table of bird counts from vantage points and routes

Date 21.05.2023	**Start - End: 09:08 - 16:54**
Weather change: temperatures	11-21°C
Humidity	44-42%
Wind	S 2-4m/sec
Cloudiness	0-30% >0.3km high
Precipitation	Dry
AREA FOR THE NEW WWTP	**Start - End: 14:30-15:20**
BIRDS NESTING AND LIVING ON THE SITE	
Eurasian Jackdaw, Corvus monedula *Rock Pigeon, Columba livia*	8 (nest on a concrete power line pole) 2
BIRDS NESTING ONLY IN NEARBY AREAS	
Hooded Crow, Corvus cornix *Barn Swallow, Hirundo rustica*	18 3
MIGRATING BIRDS ON THE SITE	
White-winged Tern, Chlidonias leucopterus	37
SLUDGE BEDS	**Start - End: 15:32-16:54**
BIRDS NESTING AND LIVING BY THE SLUDGE BEDS (MAPS)	
Northern Lapwing , Vanellus vanellus *Common Redshank, Tringa tetanus* *Black-winged Stilt, Himantopus Himantopus* *Kentish Plover, Charadrius alexandrinus* *Marsh Sandpiper, Tringa stagnatilis* *Northern Shoveler, Anas clypeata*	12 2 34 13 4 4
BIRDS NESTING ONLY IN NEARBY AREAS	
Ruddy Shelduck, Tadorna ferruginea *Red-billed Shelduck, Tadorna tadorna* *Little bustard, Tetrax tetrax*	2 2 2 marked in the area adjacent to the Sludge maps.
MIGRATORY BIRDS ON THE SLUDGE BEDS (MAPS)	
Black-capped Avocet, Recurvirostra avosetta *Green Sandpiper, Tringa ochropus* *Temminck's Stint, Calidris temminckii* *Common Oystercatcher, Haematopus ostralegus*	10 2 4 3
MIGRATORY BIRDS IN THE NEARBY AREA	
Black-headed Gull, Larus ridibundus	12
Demoiselle Crane, Anthropoidea virgo	2
URE	Start - End: 09:08-14:12
BIRDS NESTING AND LIVING ON THE URE	
Black-necked Grebe, Podiceps nigricollis *Mallard, Anas platurhunchos* *Northern Shoveler, Anas clypeata* *Northern Pochard, Aythya ferina* *Gadwall, Anas strepera* *Tufted Pochard, Aythya fuligula* *Black-winged Stilt, Himantopus* *Common Coot, Fulica atra*	29 16 54 18 25 28 3 3
BIRDS NESTING ONLY IN NEARBY AREAS	
Red-billed Shelduck, Tadorna tadorna *Ruddy Shelduck, Tadorna ferruginea* *Common Kestrel, Falco tinnunculus* *Black Kite, Milvus migrans* *hen like (Gray Partridge), Galliformes* *Hooded Crow, Corvus cornix* *Black-billed Marpie, Pica pica* *House Sparrow, Passer domesticus* *Northern Starling, Sturnus vulgaris* *Yellow Wagtail, Motacilla flava* *White Wagtail, Motacilla alba*	62 103 3 1 2 8 3 34 8 4 2

Red-headed Bunting, Emberiza bruniceps	2
Chiffchaff, Phylloscopus collybita	8
Sand Martin, Riparia riparia	6
Barn Swallow, Hirundo rustica	12
Eurasian Cuckoo, Cuculus canorus	2
Hoopoe, Upupa epops	2
Rock Pigeon, Columba livia	2
MIGRATING BIRDS ON THE URE	
Wood Sandpiper, Tringa glareola	18
Caspian Gull, Larus cachinnans	47
Red-necked Phalarope, Phalaropus lobatus	36
White-winged Tern, Chlidonias leucopterus	129
Black-headed Gull, Larus ridibundos	36
Demoiselle crane, Grus virgo	4 marked on the fly

The below table lists birds observed by location, including the WWTP area, the sludge ponds area, and the URE reservoir area.

Table 6.23 Summary table of bird counts by habitat (area surveyed)

#	Class	Latin name	Name	WWTP	Sludge maps	URE
1	*Gruiformes*	*Anthropoidea virgo*	Demoiselle Crane		2	4
2		*Fulica atra*	Common Coot			3
3		*Tetrax tetrax*	Little Bustard		2	
4	*Charadriiformes*	*Tringa ochropus*	Green Sandpiper		2	
5		*Tringa totanus*	Common Redshank		2	
6		*Tringa glareola*	Wood Sandpiper´			18
7		*Larus ridibundos*	Black-headed Gull		12	36
8		*Larus cachinnans*	Caspian Gull			47
9		*Chlidonias leucopterus*	White-winged Tern	37		129
10		*Charadrius alexandrinus*	*Kentish Plover*		13	
11		*Tringa stagnatilis*	Marsh Sandpiper		4	
12		*Himantopus Himantopus*	Black-winged Stilt		34	3
13		*Recurvirostra avosetta*	Black-capped Avocet		10	
14		*Vanellus vanellus*	Northern Lapwing		12	
15		*Phalaropus lobatus*	Red-necked Phalarope			36
16		*Haematopus ostralegus*	Common Oystercatcher		3	
17		*Calidris temminckii*	Temminck's Stint		4	
18	*Anseriformes*	*Tadorna tadorna*	Red-billed Shelduck		2	62
19		*Tadorna ferruginea*	Ruddy Shelduck		2	103
20		*Anas platurhunchos*	Mallard			16
21		*Aythya fuligula*	ufted Pochard			28
22		*Anas clypeata*	Northern Shoveler		4	54
23		*Aythya ferina*	Northern Pochard			18
24		*Anas strepera*	Gadwall			25
25	*Podicipediformes*	*Podiceps nigricollis*	Black-necked Grebe			29
26	*Falconiformes*	*Falco tinnunculus*	Common Kestrel			3
27		*Milvus migrans*	Black Kite			1
28	*Passeriformes*	*Corvus cornix*	Hooded Crow		18	8
29		*Pica pica*	Black-Billed Magpie			3

#	Class	Latin name	Name	WWTP	Sludge maps	URE
30		*Corvus monedula*	Eurasian Jackdaw		8	
31		*Passer domesticus*	House Sparrow			34
32		*Sturnus vulgaris*	Northern Starling			8
33		*Motacilla flava*	Yellow Wagtail			4
34		*Motacilla alba*	White Wagtail			2
35		*Emberiza bruniceps*	Red-headed Bunting			2
36		*Phylloscopus collybita*	Common chiffchaff			8
37		*Riparia riparia*	Sand Martin			6
38		*Hirundo rustica*	Barn Swallow			12
39	*Galliformes*	*Perdix perdix*	Gray Partridge			2
40	*Cuculiformes*	*Cuculus canorus*	Eurasian Cuckoo			2
41	*Upupiformes*	*Upupa epops*	Hoopoe			2
42	*Columbiformes*	*Columba livia*	Rock Pigeon	2		2

In summary, no mammals and reptiles, their tracks, borrows, excrements or food remains were noted during the survey. Insects were not surveyed. 42 bird species were recorded during the survey. Of these, two species are listed in the Kazakhstan Red Data Book: Little bustard (Tetrax tetrax, NT (near threatened)) and Demoiselle Crane (Crus virgo, LC (least concern)), both in the sludge pond area. Additionally, two other species classified as of least concern (LC) were observed nesting nearby and using URE and sludge beds open water for the chicks rearing. The proposed new WWTP area was inhabited only by a pair of doves. The highest number of birds were counted around the URE reservoir.

Benthic fauna (hydrobiological Study) for Ilek river – summary

Published information on the macrobenthos of the Ilek River is scarce. In 2012 the macrobenthos zoology was surveyed within the framework of the project on pollution of the main transboundary rivers of Kazakhstan. The Ilek River was surveyed in three locations: at the town of Alga, 80 km upstream of the WWTP/URE discharge, in the tailrace basin of the Aktobe reservoir (36 km upstream) and at the village of Georgievka downstream of the discharge.

With regard to bottom communities, 39 species of bottom animals were found, including nematodes, oligochaetes, leeches, gastropods, mites, amphipods, dragonflies, mayflies, caddisflies, bedbugs, beetles, chironomids, ceratopogonids, typulids and limonids. The average number of species per sample was 19, with an average of 8503 specimens/m² and an average biomass of 7054 mg/m². Chironomids were the most abundant. Insects predominated in terms of numbers and molluscs in terms of biomass. According to the macrozoobenthos indices the water near Alga is classified as clean, downstream of Aktobe reservoir as moderately polluted, and near Georgievka village between clean and moderately polluted.

During the period 2015-2017, macrozoobenthos communities were studied in the Ilek River and its tributaries and in the Aktyubinsk water reservoir. 12 taxa of benthic invertebrates - oligochaetes, chironomids, ceratopogonids, copepods and amphipods - were found in the Ilek River. The maximum mean long-term abundance was 332±56 ind/m², the biomass was 2.7±0.3 g/m². Chironomid larvae were the most diverse. Shannon-Weaver Index value varied from 0.5 to 1.3, Pielu Equality Index - from 0.4 to 0.8.

As part of this ESIA process, eight (8) sediment samples were taken from the Ilek river on 11th May from 15:00 to 18:30, two weeks after the end of treated sewage discharge from the URE retention reservoir, and one week after the end of flushing discharge from the Aktobe reservoir. Laboratory sample processing was performed by utilizing counting and weighing methods and using available manuals to determine the species' taxonomic classification. The Shannon-Weaver (H′) information indices for biomass and Piel (e) were used to assess community structure. The first index indicates the level of biodiversity of the river community. The second index indicates the species parity in terms of individuals in the community. The full hydrobiological report, including survey methodology and other information sources is included Annex 4 herewith.

The key findings of the hydrobiological survey are summarized below.

The macrozoobenthos of the Ilek River based on the survey was represented by insects (13 taxa), oligochaete worms from 2 families and mites (Table 6.24).

Only larvae of chironomid mosquitoes of the subfamily Chironominae were consistently found in the benthos. A high frequency of occurrence was recorded for chironomid mosquitoes of the subfamilies Orthocladiinae and Tanypodinae, while water mites Acariformes and biting midges Ceratopogonidae were found slightly less frequently. Oligochaeta nididae and mosquito-tolkunks of the family Empididae from the order of Diptera were recorded at half of the stations.

The highest number of species was found on station 1 and the lowest on station 8. Accordingly, the highest value of the Shannon-Weaver index was found on station 1 and the lowest on station 8 (Table 6.25).

Figure 6.39: Hydrobiological sampling locations in the Ilek river (red dots). The blue line indicates where the discharge channel/creek from the URE enters the Ilek river.

Table 6.24: Taxonomic composition and frequency of occurrence (%) of macrozoobenthos organisms.

Group	Family	Frequency of occurrence
Insects	Baetidae	25
	Heptageniidae	12.5
	Odonata	12.5
	Ceratopogonidae	62.5
	Empididae	50
	Orthocladiinae	87.5
	Tanypodinae	75
	Chironominae	100
	Hydropsychidae	25

	Hydroptilidae	12.5
	Trichoptera2	12.5
	Trichoptera3	12.5
	Hemiptera	12.5
Worms	Naididae	50
	Tubificidae	12.5
Other	Acariformes	62.5

Table 6.25: Structural indicators of macrozoobenthos at 8 stations of the Ilek River

Indicator	1	2	3	4	5	6	7	8
Number of species	12	10	5	5	6	3	8	1
Number of species, ex/m²	22125	12850	2500	6250	2900	900	11650	150
Biomass, g/m²	7963.75	3026.4	2275.0	2031.9	508.75	508.75	2468.0	75.00
Shannon-Weaver index, H′	1.41	0.91	0.59	0.46	0.92	0.43	1.07	0.00
Pielu index, e	0.57	0.40	0.37	0.28	0.52	0.39	0.51	

At the sampling points further d*ownstream* in the Ilek river, diversity decreased *(Figure 6.40).* The number of species as well as index values decreased almost linearly from station 1 to stations 3 and 4. From station 5 to station 8, there were spikes in diversity indices (*Biomass, g/m²*

).

The number of benthic animals varied from 22125 (St.1) to 150 (St.8) individuals/m² (Table 6.26) and the biomass was from 7964 (St.1) to 75 (St.8) mg/m² (Table 6.27). Insect larvae were the absolute dominants of quantitative development of macrozoobenthos, with the proportion in abundance ranging from 73 to 100% and in biomass from 88 to 100%. Chironomid larvae of the family Chironominae dominated among the insects.

Numbers of benthic invertebrates decreased from station 1 to station 3. On stations 4 and 7, an increase in abundance was observed. Biomass declined further, until station 6, increased at station 7, and the minimum biomass value was recorded at station 8 (Figure 6.41).

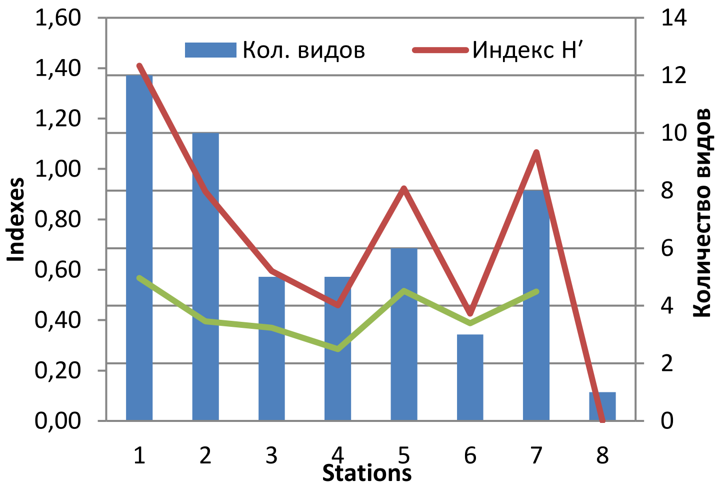

Figure 6.40: Key species indicators for the Ilek river. Blue bars: Shannon-Weaver index, H′. Green line: Pielu index, e. Red line: Number of species.

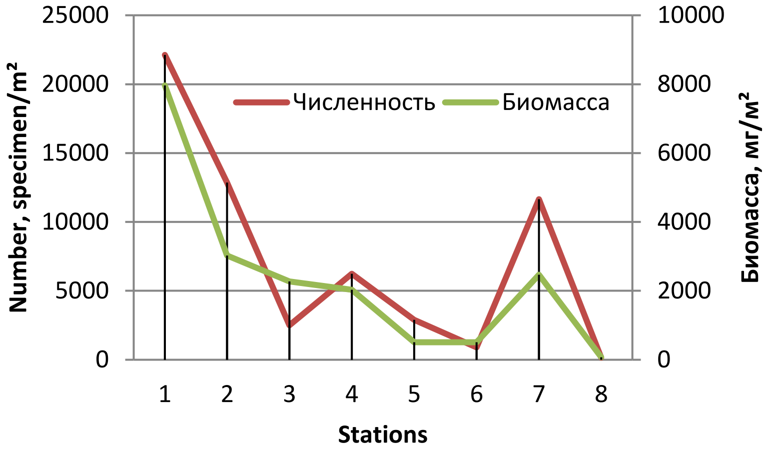

Figure 6.41: Dynamics of Ilek River macrozoobenthos indicators. Red line: Number of species, ex/m². Green line: Biomass, g/m²

Table 6.26: Macrozoobenthos abundance (ex/m²) of Ilek River

Station	Vermes	Insecta	Others	Total
1	750	18750	2625	22125
2	600	12050	200	12850
3	0	2500	0	2500
4	0	6125	125	6250
5	350	2400	150	2900
6	0	900	0	900
7	650	8450	2550	11650
8	0	150	0	150

Table 6.27: Biomass of macrozoobenthos (mg/m²) of the Ilek River

Station	Vermes	Insecta	Others	Total
1	62.50	7713.75	187.50	7963.75
2	5.40	2971.00	50.00	3026.40
3	0.00	2275.00	0.00	2275.00
4	0.00	2021.88	10.00	2031.88
5	30.00	448.75	30.00	508.75
6	0.00	508.75	0.00	508.75
7	5.00	2263.00	200.00	2468.00
8	0.00	75.00	0.00	75.00

Discussion

The development of and trend in the macrozoobenthos in the studied section of the Ilek River depends on both natural and anthropogenic factors. Among the most significant natural factors should be noted the speed of water flow and, as a consequence, the nature of the soil/sediments. As it is known, the richest communities are characteristic for stony soils on the fast current, the poorest - for fine-sandy ones in the zones of slow current.

The depletion of benthic communities is influenced by the substitution of coarse sand with gravel of varying size for fine sand. At stations 5 and 6 the proportion of crushed sand was low and at station 8 the substrate consisted mainly of fine sand.

Nevertheless, the overall downward trend and gradual recovery of the figures to Station 7 does indicate the influence of wastewater discharge.

A secondary factor that can be considered is the cattle watering points (intakes) on the river. Such a waterhole was located 150m upstream of station 8, which, together with the sandy bottom substrate, may partly explain the decline in biological indicators here. Run-off through the groundwater from the various industrial and domestic sewage lagoons can be considered as a source of chronic pollution along the entire length of the river. From the state of the biota at station 1, however, it can be stated that the impact of these pollution sources is negligible, presumably due to the low rate of pollution entering the river from such sources.

At background station 1, which was characterized by coarse sand with a high proportion of crushed stone and no influence from sewage from the URE, the community was characterized by the highest diversity and relatively high quantitative indicators. At station 2, at the wastewater outlet, algae development not observed at other stations was observed. Only at this station oligochaetes of the family Tubificidae tolerant to organic pollution were found, however, the number of these worms was low.

From station 5 there is a gradual recovery of the community - diversity begins to increase, but not quantitative indicators. The decrease in diversity observed at station 6 is more likely due to the nature of the substrate - the predominance of finer-grained sand. At station 7, on substrate similar to the background station, there is an increase in both qualitative and quantitative indices. However, there is no full recovery of the benthocenosis to its initial state.

At station 8 low indicators of diversity and quantitative development are due to the nature of the soil - sand and, probably, watering for cattle. Only a small number of psammophilous chironomids were found here.

<u>Monitoring recommendations</u>

To monitor the recovery of bottom communities after the discharge of treated wastewater it is recommended to take samples from stations with identical coarse sand and gravel bottom sediments:

St.1 – background

St.3 - highest impact of wastewater

St.7 - in the recovery area.

The preliminary analysis of taxonomic composition of macrozoobenthos of the investigated site allows to offer the following indicators of pollution (Table 6.28).

Table 6.28: Suggested pollution indicator species.

Species indicator	Degree of water pollution
Ruptilidae Hydroptilidae	Clean
Mayflies Baetidae	
Dragonflies Odonata	
Copepods Hydropsychidae	Lightly polluted
Oligochaetes Tubificidae	Polluted

Conclusion on receptor sensitivity - Fauna

- **Terrestrial and avifauna around the WWTP site**: The proposed WWTP site is not diverse in fauna and no mammals and reptiles, their tracks, borrows, excrements or food remains were noted during the fauna survey in May 2023. 42 bird species were observed during the survey, around the existing and proposed WWTP site, sludge ponds and URE reservoir, of which two of them are listed in the Kazakhstan Red Data Book, one near threatened (NT) and one of least concern, both in the sludge pond area. Two other species classified as of least concern (LC) were observed nesting nearby and using URE and sludge beds open water for the chicks rearing. The proposed new WWTP area was inhabited only by a pair of doves. Highest number of birds were counted around the URE reservoir. Overall the fauna habitat is considered of low sensitivity, although due to the presence of the two red book listed birds in the area, a more conservative approach is to consider it of **medium sensitivity**.

- **Ilek river aquatic benthic fauna**: The hydrobiological study indicates that the poor-quality effluent discharge from the existing WWTP via the URE has negative impacts on the macrozoobenthos species numbers and diversity. Species indicating polluted water were found closest to the discharge point to the river, whereas the control sampling point showed the highest diversity and relatively high quantitative indicators, and sampling points further downstream from the discharge point indicated gradual recovery (but not full) and improvement in species diversity. Given the river classification as 1st class according to the Unified system of classification of water quality in the water bodies #151 from 9.11.2016 (i.e. the cleanest with the strictest max permitted concentration of pollutants in the discharges), its relatively limited flow and good condition at the control point above the discharge from the URE, but taking into account that the impacts of the effluents appear not to extend over a large part of the river, the sensitivity of the benthic fauna in the river is considered **medium.**

6.1.11 Access road infrastructure

The existing and proposed WWTP site is accessed via an approximately 5 km gravel road connecting the site and the industrial northern industrial area of Aktobe City. The initial 2 km of the access road is also the road to the Aktobe city waste dump / landfill, after which it passes the sedimentation ponds used by the Chromium factory, before arriving at the WWTP site. The WWTP is responsible for maintenance of this road but cannot restrict access along it beyond the landfill because the city needs access to dump snow and cut tree branches near the landfill.

During the ESIA site visit the road appeared in a moderate to poor condition, showing signs of erosion after the winter and snow melt. The WWTP site can also be accessed from the A-24 main road via an approximately 1.5 km gravel road.

The access roads are currently used by heavy transport vehicles on a frequent basis, and are not known to be used by others than the landfill and WWTP on a regular basis.

During normal WWTP operations, the traffic to the WWTP is expected to be a small fraction of the heavy transport to the landfill, however heavy traffic on the road will increase during construction of the proposed WWTP.

Conclusion on receptor sensitivity – access road infrastructure

There is an existing access road to the WWTP site that is also the road to the Aktobe City solid waste landfill, hence frequently used by heavy transport vehicles. Although the road appeared in a moderate to poor condition at the time of the ESIA site visit, showing signs of erosion after the winter and snow melt, it is expected to undergo regular maintenance to sustain current traffic levels, and temporary increase in traffic associated with the WWTP construction. The sensitivity is considered **low.**

6.1.12 Solid and hazardous waste management infrastructure

Waste infrastructure in Aktobe City

Aktobe city does not have solid or hazardous waste processing facilities. Valuable recyclable waste is accumulated and taken via railway elsewhere in the country. Domestic waste is collected by the licensed companies throughout the city and taken to the guarded and fenced landfill located in the Northern Industrial Area of the city, which is located 2.7km south of the WWTP. The landfill and WWTP share the same access road from the city.

The legislation prohibits the landfill to accept construction waste with the intention to encourage its recycling. However, as there are no developed recycling options in the city, this has the unintended effect that this also encourages illegal dumping on the way or around the landfill or in the old quarries around the city.

The landfill has constructed 18 cells for waste disposal, but they are not used, and the waste is dumped and burned at the landfill without processing or sorting.

Solid and hazardous waste generation and management at the existing WWTP

The site visits conducted by Sweco in 2023 as part of the ESIA process for the proposed WWTP indicated that overall levels of housekeeping appeared quite poor. Grit from the grit chamber was dried on the ground open to wind and rain, and pieces of plastic waste were observed around the site.

ASEG holds a waste log and waste passport that contains information on the amount of generated waste, characteristics and management. Amber list (middle hazardous waste (A index)) waste includes used mercury lamps/batteries/oil; oiled rags and waste filters, luminescent bulbs and car batteries. Hazardous waste is accumulated separately and sent to a utilization contractor.

Green list waste includes solid waste, worn-out tires, cinders of welding electrodes, construction waste, office equipment and office waste, ferrous metal scrap, sludge, etc. Scrap metal, welding ends and tires are given to a contractor for utilisation. Office waste is taken by a contractor to the city landfill 5 km south of the site. ASEG has contracts with licensed waste removal contractors based on the type of waste listed above.

The most significant waste stream in terms of quantity is sludge, which is a product of the treatment process. The current WWTP has permit to dispose of 216t sludge annually, but the place for this waste siting is not stipulated in permits and the ratio of calculating weight from volume of sludge is not agreed upon with the regional environmental protection department. Since 2015, the company has excavated on average 40,000 m3 of sludge every winter from the dried sludge beds and placed it in the borrow pit next to the URE dam. The pit was created in 2011 to enforce the outside wall of the URE dam. The bottom of the pit is characterised by a layer of light brown clay which seems to provide good insulation from groundwater, and hence have been seen as a good location for placing sludge for drying. Drilling in the pit made by a compost pit contractor found no groundwater under the area despite the borrow pit being located 60m from the URE which is filled with treated wastewater.

Disposal of WWTP sludge into the old borrow pit at the URE dam is not treated as waste disposal but placement for drying and composting. However, even if it is assumed that the sludge contains 40% of water, the disposed volume greatly exceeds the annual permission of 216t.

Conclusion on receptor sensitivity – waste infrastructure

There is a solid waste landfill 3 km down the access road from the WWTP site, where solid waste fractions are disposed of. Hazardous waste is collected by service providers for treatment. Overall, however, the waste management infrastructure in the city does not appear well developed, and there is risk of illegal dumping of collected waste, including construction waste. Depending on the quantity of waste from the WWTP that needs handling, including during the construction phase, potential dismantling or demolition of buildings, etc., the sensitivity of the solid waste infrastructure to deal with waste from the WWTP is considered **medium to low.**

6.1.13 Water supply infrastructure

The WWTP is connected to the water mains with metered supply. The WWTP is not considered a significant consumer of potable water, which is limited to domestic use and cleaning purposes.

Conclusion on receptor sensitivity – water supply system

The sensitivity of the water supply infrastructure in the context of the project is considered **low.**

6.1.14 Energy supply infrastructure (heat and electricity)

For **electricity supply**, the current WWTP is connected to the regional electricity grid via a substation located on site. The electricity originates from the JSC Aktobe CHPP (Combined Heat and Power Plant).

The Sweco FS (2022) notes that the total electricity consumption of the WWTP in 2021 was *approx.* 9.4 million kWh/year. Data provided by ASEG in 2023 notes lower power consumption by the WWTP in 2022 (Table 6.29).

Table 6.29 Annual power consumption (kWh) for Aktobe wastewater treatment plant (WWTP) (2021-2022) (Source: ASEG)

	2021	2022
WWTP power consumption (kWh/year)	9,291,392	7,301,968

The new WWTP will be using the same substation, although some modifications can be expected.

In terms of **heat supply**, the existing WWTP relies on gas boilers on site to heat the on-site building facilities. The gas is brought to the site via an existing gas pipe.

The proposed WWTP will include anaerobic digestion (AD) of sludge to produce biogas, which will be turned into heat and electricity with an on-site combined heat and power (CHP) plant. This will reduce the dependency on external power sources to operate the proposed WWTP.

Conclusion on receptor sensitivity – energy supply infrastructure

The existing WWTP is connected to the established municipal energy supply system via the electricity grid and gas pipeline network for heating building facilities, which will remain more or less the same, with some local modifications to connect the new WWTP. Hence, the sensitivity of the energy supply system in the context of this Project is considered **low**.

6.2 Socio-economic and Land Use Situation

This section gives an overall description and analysis of the current socio-economic situation in Aktobe City, which is considered the wider area of influence of the Project. This is followed by a presentation of further details about the socio-economic and land use situation in the anticipated PAI, *i.e.* in the areas relatively close to both the existing and planned new WWTP (see section 4.5.2)

6.2.1 Population and development plans for Aktobe City

Population and households

The geographical area of Aktobe City was expanded within the last ten years to include five rural districts with several villages, thereby increasing the population in the city. Aktobe City has a total area of 2,532 sq.km and a population of 523,665 (2022).

Aktobe City is divided into two districts: Astana district and Almaty district, as is depicted in the figure below. Almaty district consists of 18 villages and three residential areas with a total area of 1,752 km^2 and a total population of 323,395 (2022), while Astana district consists of 3 villages and six residential areas with a total area of 780 km^2 and a population of 200,270 (2022). The map below shows the boundary of Aktobe City with its two districts separated by the railway line: Almaty district to the east and Astana district to the west.

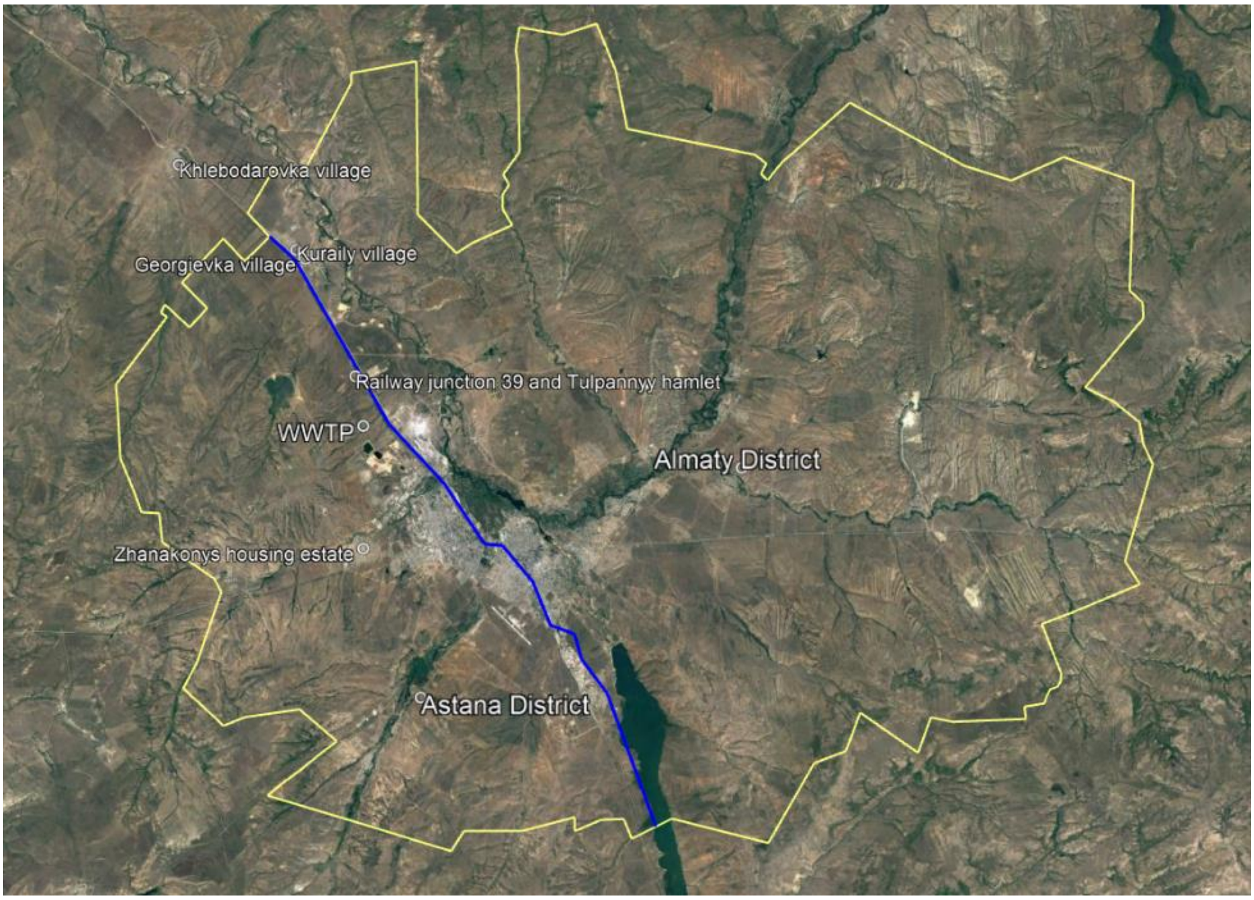

Figure 6.42: Aktobe City with the yellow line indicating its boundaries. The two city districts, Almaty district (west) and Astana district (east) are separated by the railway line (purple line). The map also shows the locations of the WWTP and villages/settlements relatively close to the WWTP.

According to official statistics, the population in Aktobe City was 523,665 by the start of 2022, of which 53% were women and 47% men. This gender difference is similar to the population composition generally in urban areas of Kazakhstan. The higher share of women is due to their prevalence in older age groups.

The population development in Aktobe City has fluctuated somewhat during the period 2013-2022, as shown in the table below, with an average increase of 2.6% per year. The significant population increase from 2015 to 2016 is assumed to be mainly related to the inclusion of five rural districts in Aktobe city. Excluding this period, the average population increase is around 2.1% per year.

Table 6.30: Population development in Aktobe City, 2013-2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Population	415,811	420,606	428,065	455,898	469,424	482,523	494,376	506,881	518,335	523,665
Growth (%)		1.15	1.77	6.50	2.97	2.79	2.46	2.53	2.26	1.03

Source: National Bureau of Statistics, Department of Statistics of Aktobe Region: Socio-economic passport of Aktobe Region and Consultant's calculations

The population development in Aktobe City is closely related to migration levels. The table below shows a positive migration balance for Aktobe City since 2014, while the net migration for Aktobe Region has remained negative from 2013-2022. The levels of both immigration and emigration have increased during the 10-year period for the city as well as the region, indicating a somewhat increased population mobility.

Table 6.31: Registered migration 2013-2022 for Aktobe City and Aktobe Region

	Aktobe City			Aktobe Region		
Year	**Immigration**	**Emigration**	**Net Migration**	**Immigration**	**Emigration**	**Net Migration**
2013	6,050	6,261	-211	14,627	14,702	-75
2014	10,376	7,373	3,003	19,304	19,796	-492
2015	9,182	7,326	1,856	15,578	17,753	-2,175
2016	12,947	10,028	2,919	21,998	25,249	-3,251
2017	20,226	13,579	6,647	36,813	38,463	-1,650
2018	14,915	12,653	2,262	30,615	32,734	-2,119
2019	21,537	17,909	3,628	39,674	42,478	-2,804
2020	22,283	18,720	3,563	33,954	35,601	-1,647
2021	19,951	17,954	1,997	28,544	31,127	-2,583
2022	24,381	23,401	980	30,583	32,834	-2,251

Source: National Bureau of Statistics, Department of Statistics of Aktobe Region: Dynamics of the main socio-economic indicators for Aktobe for 1991-2022

During the period January 2022 – May 2023, Aktobe Region received and processed applications from 33 persons, including six children, for refugee status in Kazakhstan: 32 of them had Ukraine as their country of origin, while one was from Uzbekistan. All were granted refugee status; 10 of them have since left Kazakhstan and have therefore had their refugee status withdrawn (Source: Department for Coordination of Employment and Social Programmes of Aktobe Region).

In Kazakhstan, data on the number of households are normally collected during population censuses, based on which the average household size is calculated for the different regions of Kazakhstan. The Bureau of National Statistics conducted the last census in 2021. Preliminary results of the census show that in 2021 there were 2,321,978 households in Kazakhstan, with an average household size of 3.4 persons, while the preliminary results of the census do not include the average household size of Aktobe and other regions.

Other data from the National Bureau of Statistics indicate an average household size of 3.7 persons for Aktobe Region in 2021. It is assumed that this figure is based on the population analysis prepared in 2019 by the Ministry of the National Economy in collaboration with UNFPA. Aktobe Region covers both urban and rural areas. No relatively recent data appear to be available about the number of households or the household size in Aktobe City.

As shown in the tables below, in 2022 the registered total number of individual houses (34,477) and apartments (159,544) in Aktobe City was 194,021, which is assumed to correspond to the number of households in the city. This indicates an average household size of 2.7 persons in Aktobe City.

According to the National Bureau of Statistics, in 2022 Aktobe City had 34,477 individual houses and 4,546 multi-apartment buildings, as shown in the table below.

Table 6.32: Number of residential buildings in Aktobe City, 2018-2022

	2018	**2019**	**2020**	**2021**	**2022**
Individual houses	29,599	30,363	31,421	33,010	34,477
Multi-story apartment buildings	4,332	4,369	4,410	4,478	4,546

Source: National Bureau of Statistics: Annual records of residential buildings in Aktobe Region

Data about the total number of apartments in the multi-apartment buildings in Aktobe City are included in the table below.

Table 6.33: Number of apartments in the multi-apartment buildings in Aktobe City in 2022

1 bedroom	2 bedrooms	3 bedrooms	4 bedrooms	5 bedrooms	Above 5 bedrooms	Total
32,503	57,472	40,075	17,370	6,066	6,058	159,544

Source: National Bureau of Statistics: Annual records of residential buildings in Aktobe Region

Main economic activities and development plans

As described in the Aktobe Regional Development Plan for 2021-2025 and the Aktobe City Territory Development Programme for 2021-2025, Aktobe Region is one of Kazakhstan's main oil and mining centres. The resource potential of Aktobe Region allows it to be a major industrial centre, closely linked to the chromite deposits to the east of the city, deposits of gypsum, building sand, sand and gravel mixtures, sand, expanded clay, loam, gypsum and building stone, limestone, and mineral waters and salts. There are 374 industrial enterprises and productions in Aktobe City. The Region has also developed industries such as metallurgy, trade, agriculture, construction, and machine building. Mineral reserves are gas and oil as well as oil and gas condensate. There are large deposits of chromite (the highest amount in the Commonwealth of Independent States), nickel-cobalt ore, phosphorite, potassium salt, etc.

The metallurgy industry, which produces more than 30% of the total industrial output of Aktobe City, accounts for the major share of industrial production. Aktobe ferroalloys plant is one of the largest in the Republic of Kazakhstan and produces 22% of the republican volume of ferroalloys. The second largest producer is ARBZ LLP, which specializes in production of rails and related infrastructure. The chemical industry has a share of more than 10% of the total industrial output of Aktobe City.

As mentioned in the Regional Akimat’s website, there was much investment in Aktobe Region in 2022, and much investment is planned for the coming years. Mining and quarrying, the processing industry, wholesale, and retail trade are main areas of investment.

In January 2022, the Government of Kazakhstan approved the Comprehensive Plan for the Socio-Economic Development of the Aktobe Region for 2022-2025. The Plan includes various socio-economic measures to improve the lives of the city population. One measure is the stabilization of the migration process by creating new jobs from 2022 to 2025. More than 39,000 new jobs are planned to be created within 4 years in the Region. The regional development plan also contributes to strengthening the role of the city as a growth centre and a major transport hub in western Kazakhstan. According to information from the Aktobe City Akimat, 13,174 new jobs were created in the city in 2022.

The planning of the city development is carried out in accordance with the Master Plan for the City of Aktobe, approved by the Government of the Republic of Kazakhstan in 2016. The Master plan is, however, outdated – as mentioned in the Aktobe Development Strategy until 2050, prepared by the Ministry of Industry and Infrastructure Development under the national Committee for Construction and Housing and Communal Services – as the city area has increased almost six times and there has been a significant population increase since 2016. A new Master Plan for the city of Aktobe is being developed, which will reflect the city development plans until 2050. A draft version of the Master Plan was discussed at a meeting in the regional Council at the end of 2022. The final version has not yet been published. The new draft Master Plan predicts that Aktobe will become one of the largest cities in Kazakhstan by 2050, with a population of 950,000.

According to the General Plan for the City of Aktobe for 2016-2020, significant territorial growth is envisaged for the city, influenced by the construction of the international transport corridor "Western Europe - Western China".

Tourism in Aktobe City

A relatively limited number of tourists and other visitors stay overnight in Aktobe Region, amounting to in total 186,637 registered visitors in 2022.

Aktobe City had 99 registered accommodation facilities (hotels of various categories of comfort, motels, summer house zones, rest houses and other facilities) in 2022, with 5,503 registered beds. The table below shows the registered development in accommodation facilities and the registered number of overnight stays over the last ten years.

Table 6.34: Accommodation facilities and overnight stays registered in the city of Aktobe, 2013-2022

Year	Number of accommodation facilities, units	Number of rooms, units	Visitors served, persons	One-time capacity, beds	Number of overnight stays
2013	47	1,278	84,258	3,026	224,780
2014	61	1,469	85,017	3,704	220,491
2015	70	1,578	83,589	3,912	209,456
2016	86	1,789	84,744	4,382	260,993
2017	98	1,894	100,450	4,549	257,237
2018	102	1,961	124,401	4,725	296,761
2019	105	2,052	133,417	4,848	311,676
2020	97	2,010	85,050	4,902	125,953
2021	100	2,088	145,023	5,421	244,919
2022	99	2,158	186,637	5,503	353,670

Source: National Bureau of Statistics: Key performance indicators of accommodation facilities (2013-2022)

There is reported to be no peak season for visitors to stay in Aktobe City. This means that on average there was around 970 visitors per day throughout the year of 2022 (353,670 overnight stays spread equally over 365 days). This indicates a bed occupancy rate of less than 20%. The number of visitors and overnight stays was low in 2020 compared to previous and subsequent years due to the COVID-19 restrictions.

The Tourism Department in Aktobe has a vision to develop tourism further, in line with aspirations of the Aktobe Development Strategy until 2050, prepared by the Ministry of Industry and Infrastructure Development under the national Committee for Construction and Housing and Communal Services. One opportunity will be to create a tourist cluster along the historical Great Silk Road, where the international transport corridor Western Europe - Western China is being constructed. There are, however, no specific tourism development plans for the near future. At the same time, the city authorities are trying to develop tourism both in the city and in the region.

Population projections for Aktobe City

The Aktobe Development Strategy until 2050, which was approved in 2019, presents three population projection scenarios for Aktobe City, based on the population in 2018 and assumptions about the demographic development of the city, as shown in the table below (no assumptions are specified in the Strategy document).

Table 6.35: Official population projection scenarios for Aktobe City

Scenario	2018	2025	2030	2050
Expected	487,992	559,599	608,664	848,972
Pessimistic	487,992	531,386	559,007	696,112
Optimistic	487,992	561,675	615,659	1,009,171

Source: Development Strategy for Aktobe until 2050, prepared by the Ministry of Industry and Infrastructure Development under the National Committee for Construction and Housing and Communal Services.

The Feasibility Study conducted by Sweco in 2021-2022 for the Wastewater Treatment Modernisation Programme in Aktobe uses an average annual population growth rate of 2% for its population projections. The growth rate was agreed with the City Akimat based on discussions of the population development over the last 10 years, the development plans for the city as well as the official and other population projection scenarios.

The following three growth scenarios (low, expected, high) were prepared as part of Sweco's Feasibility Study. The assumptions for the three growth scenarios are explained in the table below.

Table 6.36: Population growth rate scenarios and assumptions for Aktobe City

Scenario	**Average Annual Population Growth**	**Assumptions**
Low	1%	Some new job opportunities will be established in the city, which will attract some people to move to and/or remain in Aktobe City.
Expected	2%	New industries will be established in Aktobe City and/or existing industries will expand and create additional jobs. This will attract more people to move to and/or remain in Aktobe City. The city borders may also be expanded to include additional settlements.
High	3%	Additional new industries will be established in Aktobe City and/or existing industries will expand and create additional jobs. This will attract more people to move to Aktobe City. The city borders may also be expanded further.

The three population growth scenarios are shown in the table below.

Table 6.37: Population growth scenarios for Aktobe City for this Feasibility Study

	Option 1 – Low	**Option 2 – Expected**	**Option 3 – High**
Year	**Population when 1% annual increase**	**Population when 2% annual increase**	**Population when 3% annual increase**
2020	512,452	512,452	512,452
2025	538,592	565,788	594,072
2030	566,066	624,676	688,693
2035	594,941	689,693	798,384
2040	625,289	761,477	925,545

Ethnic groups in Aktobe Region

According to the Department of Statistics for Aktobe Region, 84.29% of the population in Aktobe City in 2022 were of Kazakh origin, 10.4% of Russian, 2.14% of Ukrainian, 0.9% of Tatar, and the remaining of other origins.

There are no indigenous people in Aktobe City needing special attention according to the EBRD performance requirement (PR) 7.

6.2.2 Household income and expenditure levels

The National Bureau of Statistics has no statistical data available on household income, expenditure and poverty for individual cities, and Aktobe City Akimat does not have such data either. The National Bureau of Statistics has, however, such data for the regional level, and the data for Aktobe Region will therefore be used in the following with comparison to national-level data. The population in Aktobe City constituted in 2022 approximately 58% of the total population in Aktobe Region.

The table below lists the average income levels per capita for 2018-20221 for Aktobe Region. These are nominal income figures and thus include inflation. Data are not available separately for urban areas of Aktobe Region.

Table 6.38: Average nominal income per capita in Aktobe Region, 2018-2022 (KZT/capita/month)

Area	2018	2019	2020	2021	2022
Aktobe Region	50,983	59,246	61,005	67,305	80,515
Kazakhstan	52,419	57,725	62,035	69,111	80,370

Source: National Bureau of Statistics, based on data reported by enterprises and other organisations

There has been a steady increase in the average income per capita in the last five years, both in Aktobe Region and generally in Kazakhstan. The average income in Aktobe Region in 2022 is slightly higher than in Kazakhstan generally.

The table below shows the average income data per capita for the lowest and highest deciles in Aktobe Region. Income data are not available for other deciles.

Table 6.39: Average income per person in Aktobe Region for deciles 1 and 10, 2018-2021 (KZT/month)

Decile	2018	2019	2020	2021
Decile 1	21,259	23,758	25,231	28,136
Decile 10	96,151	114,417	124,226	150,460

Source: National Bureau of Statistics

The table below lists the average expenditure levels per capita for 2018-2022 for urban areas of Aktobe Region, for Aktobe Region and for Kazakhstan. These data are based on surveys and thus include inflation. Expenditure data include the value of own products used for own consumption. A comparison of the available income and expenditure data for Aktobe Region and for Kazakhstan indicates that the average income per capita in each of the last five years has been higher than the average expenditure, suggesting that the average household has been able to make small savings.

Table 6.40: Average expenditure of Aktobe Region per capita, 2018-2022 (KZT/capita/month)

Area	2018	2019	2020	2021	2022
Urban areas in Aktobe Region	48,345	54,492	59,758	63, 560	82,205
Aktobe Region	44,159	50,123	54,411	60,886	74,804
Kazakhstan	51,198	55,791	59,701	67,440	77,602

Source: National Bureau on Statistics, based on data from surveys

Per capita expenditure data by decile are available for Kazakhstan, as shown in the table below, but not for Aktobe Region or other regions.

Table 6.41: Average expenditure per capita in Kazakhstan by decile, 2018-2021 (KZT/capita/month)

Decile	2018	2019	2020	2021
Decile 1	21,382	23,223	25,246	28,906
Decile 2	27,675	29,973	32,101	36,383
Decile 3	32,253	34,526	36,829	41,227
Decile 4	36,300	39,010	41,477	46,254
Decile 5	40,772	43,958	46,674	51,772
Decile 6	46,267	49,944	53,049	58,756
Decile 7	53,124	57,359	61,159	67,942
Decile 8	62,628	67,426	72,426	80,551
Decile 9	78,071	84,322	89,951	100,923
Decile 10	128,255	139,043	150,018	172,569

Source: National Bureau of Statistics

According to the National Bureau of Statistics, the 10% of the population with the highest expenditure (decile 10) in 2021 had an average per capita expenditure that was six times higher than was the case for the 10% of the population with the lowest income (decile 1). The average monthly expenditure per capita increased with on average 11% per year from 2018-2021 for decile 1, 10% for decile 2 and 9% for decile 3.

6.2.3 Educational levels, including in technical fields

Data on educational level are available for national level (Kazakhstan) and Aktobe Region, but not separately for Aktobe City.

Statistics from the National Bureau of Statistics show that for the period 2012-2021 the net enrolment ratio in primary and secondary education was around 100% both at national level (Kazakhstan) and in Aktobe Region. The table below shows the gross enrolment rate in higher education from 2012-2021 for national level and Aktobe Region. This enrolment rate is defined as the ratio of the number of students, regardless of age, enrolled in technical and vocational education (ISCED-5) and higher education (ISCED 6-8) to the total population aged 18-22. Since 2016, the gross enrolment rate in higher education has been slightly higher in Aktobe Region than at national level.

Table 6.42: Gross enrolment rate in higher education for Kazakhstan and Aktobe Region (%)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Kazakhstan	53.39	50.90	48.37	48.44	51.14	54.29	60.73	66.98	64.07	62.64
Aktobe Region	51.15	49.84	45.63	47.16	51.22	54.87	62.97	70.96	70.47	64.09

Source: National Bureau of Statistics

The following table lists the total number of technical, vocational, and post-secondary students for the last five years for national level and Aktobe Region. In 2022/2023, students in engineering, manufacturing, and construction constitute 21% (national level) and 23% (Aktobe Region), respectively, of the total number of technical, vocational, and post-secondary students. The table indicates a substantially higher number of students in engineering, manufacturing, and construction in 2022/2023 than in previous years. It is assumed that the reason for this is a change in the definition in this category in terms of study programmes included.

In 2022/2023, women constitute 48% of the total technical, vocational, and post-secondary students both at national level and in Aktobe Region, while they constitute 19% (national level) and 18% (Aktobe

Region), respectively, of the students in engineering, manufacturing, and construction. The percentages of female students are relatively similar in the previous four years.

Table 6.43: Number of technical, vocational, and post-secondary students in Kazakhstan and Aktobe Region

	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
Kazakhstan					
Total students (of which female)	489,818 (f: 229,044)	475,443 (f: 222,351)	477,539 (f: 226,110)	494,042 (f: 235,375)	526,909 (f: 251,159)
Students in engineering, manufacturing, and construction (of which female)	27,211 (f: 4,853)	25,742 (f: 4,731)	24,645 (f: 4,576)	15,467 (f: 2,956)	108,935 (f: 20,385)
Aktobe Region					
Total students (of which female)	27,090 (f: 12,657)	24,805 (f: 11,573)	24,638 (f: 11,726)	N/A*	27,787 (f: 13,379)
Students in engineering, manufacturing, and construction (of which female)	1,654 (f.: 382)	1,519 (f.: 339)	1,398 (f.: 363)	N/A*	6,380 (f: 1,156)

** The electronic statistical file for Aktobe Region for 2021/2022 is damaged and data cannot be accessed.*
Source: National Bureau of Statistics

6.2.4 Labour force, employment, and unemployment

Total labour force, employment, and unemployment data

The following table shows that the population in the economically active age (16-59.5 years for women and 16-63 years for men) compared to the total population is similar in Aktobe City, Aktobe Region and at national level, ranging from 68.2% in Aktobe City to 69.9% for Aktobe Region. The level of unemployment is also similar at the three levels, while the youth unemployment rate is higher at national level (3.8%) than in Aktobe City (2.6%) and Aktobe Region (2.8%).

Unemployment figures should, however, be used with caution, as people must register as unemployed and accept the jobs provided by the job centre before they are able to receive unemployment benefits. However, not everyone without a job wants to take the jobs provided by the job centre (for example, as street cleaners and road construction workers) and/or do not want to receive unemployment benefits and therefore do not register as unemployed.

Table 6.44: Key indicators of the labour market: Aktobe City, Aktobe Region, and Kazakhstan, 2022

Population in economically active age of 16-59.5 years (female), 16-63 years (male) (% of total population)	Employed population			Unemployed population	Unemployment rate	Youth unemployment rate (aged 15-28)
	Total	Wage-earners	Self-employed			
Aktobe City						
246,596 (68.2%)	234,794	202,777	32,017	11,802	4.6%	3.3%
Aktobe Region						
446,184 (69.9%)	424,700	360,292	64,408	21,484	4.8%	2.8%
Kazakhstan						
9,429,809 (68.7%)	8,971,539	6,847,300	2,124,239	458,270	4.9%	3.8%

Source: National Bureau of Statistics

As shown in the table below, in 2022 more men than women were registered as being in employment in Aktobe City, both as wage-earners and self-employed. The total unemployment rate was 4.6%, with a higher rate for men (5.5%) than for women (3.6%). The youth unemployment rate was, however, significantly higher for women (4.6%) than for men (2.2%).

Table 6.45: Key indicators of the labour market in Aktobe City, 2022, by gender

Population in economically active age of 16-59.5 years (female), 16-63 years (male) (% of total population)	Employed population			Unemployed population	Unemployment rate	Youth unemployment rate (aged 15-28)
	Total	Wage-earners	Self-employed			
Total						
328,106 (83%)	315,126	274,579	40,547	15,119	4.6%	3.3%
Men						
171,584 (88.6%)	163,370	138,579	24,791	9,421	5.5%	2.2%
Women						
156,522 (77.7%)	151,756	136,000	15,756	5,698	3.6%	4.6%

Source: National Bureau of Statistics

The situation is similar in Aktobe Region and at national level in 2022 as in Aktobe City, with the exception that the national-level unemployment rate is higher for women than men. The two tables below include registered employment and unemployment data for Aktobe Region and national level, respectively.

Table 6.46: Key indicators of the labour market in Aktobe Region, 2022, by gender

Population in economically active age of 16-59.5 years (female), 16-63 years (male) (% of total population)	Employed population			Unemployed population	Unemployment rate	Youth unemployment rate (aged 15-28)
	Total	Wage-earners	Self-employed			
Total						
442,085 (83,3%)	420,601	360,292	64,408	21,484	4.9%	2.8%
Men						
236,214 (88,7%)	223,482	186,459	39,155	12,732	5.4%	1.8%
Women						
205,871 (77,8%)	197,119	173,833	25,253	8,752	4.3%	4.0%

Source: National Bureau of Statistics

Table 6.47: Key indicators of the labour market for Kazakhstan, 2022, by gender

Population in economically active age of 16-59.5 years (female), 16-63 years (male) (% of total population)	Employed population			Unemployed population	Unemployment rate	Youth unemployment rate (aged 15-28)
	Total	Wage-earners	Self-employed			
Total						
9,224,066 (82%)	8,769,597	6 847 300	2,124,239	454,469	4.9%	3.8%
Men						
4,806,879 (85.3%)	4,599,145	3,499,310	1,173,950	207,734	4.3%	2.9%
Women						
4,417,187 (78.7%)	4,170,452	3,347,990	950 289	246,735	5.6%	4.9%

Source: National Bureau of Statistics

The table below indicates that there has not been much change in the key indicators for the labour market in Aktobe Region over the last five years. The unemployment rate thus remained stable at 4.8% from 2018-2021, increasing to 4.9% in 2022. The unemployment rate at national level was also stable during the same period, ranging from 4.9% to 4.8%. Unemployment figures should, however, be used with caution, as explained above.

Table 6.48: Key indicators of the labour market in the Aktobe Region 2018-2022

	2018	2019	2020	2021	2022
Population in economically active age of 16-59.5 years (female), 16-63 years (male) (% of total population)	438,643 (71.1%)	437,292 (70.3%)	437,268 (69.9%)	440, 995 (70.2%)	442.085 (83.3%)
Employed population (% of total economically active population)	417,561 (95.2%)	416,458 (95.2%)	416,411 (95.2%)	419,795 (95.2%)	424.700 (95.2%)
Employees (% of total employed population)	356,404 (85.4%)	356,662 (85.6%)	355,573 (85.4%)	355,486 (84.7%)	360.292 (80.7%)*
Self-employed (% of total employed population)	61,157 (14.6%)	59,796 (14.4%)	60,838 (14.6%)	64,309 (15.3%)	64.408 (14.4%)
Unemployed population (% of total economically active population)	21,082 (4.8%)	20,834 (4.8%)	20,857 (4.8%)	21,200 (4.8%)	21.484 (4.9%)
Economically inactive population/persons not included in the labour force (% of total population)	178,426 (28.9%)	185,171 (29.7%)	188,389 (30.1%)	187,621 (29.8%)	191.709 (30.1%)

** There appears to be a mistake in this calculation. The percentage is rather approximately 85%.*
Source: National Bureau of Statistics

Employment in the construction sector

In 2022, approx. 33,000 persons in Aktobe City were engaged in the construction sector, which constituted 10.3% of the total workforce. This is slightly higher than the percentage of the workforce in Aktobe Region (8.5%) and at national level (7.3%) engaged in the construction sector. Industry (mining and manufacturing) was the economic sector in Aktobe City and Aktobe Region that employed the highest percentage of the workforce (21.2% and 20.1%, respectively), which is significantly higher than the percentage engaged in this sector at national level (12.5%). The table below includes workforce figures for other economic sectors that engaged higher percentages of the workforce in Aktobe City than is the case for the construction sector.

Table 6.49: Workforce engaged in selected economic sectors in Kazakhstan and Aktobe Region, 2022

Economic sector	Workforce in Aktobe City		Workforce in Aktobe Region		Workforce in Kazakhstan	
	Persons	% of total workforce	Persons	% of total workforce	Persons	% of total workforce
Total workforce	315,126	100%	424,700	100%	8,971,500	100%
Selected sectors						
Construction	**32,592**	**10.3%**	**36,100**	**8.5%**	**658,905**	**7.3%**
Industry (mining and manufacturing)	66,956	21.2%	85,400	20.1%	1,121,200	12.5%
Wholesale, retail trade, repairs vehicles	59,545	18.9%	64,900	15.3%	1,497,900	16.7%
Education	33,357	10.6%	54,500	12.8%	1,142,300	12.7%

Source: National Bureau of Statistics and Consultant's calculation of % of total workforce

There are no gender disaggregated workforce data available solely for the construction sector, while such data are available for the industry and construction sectors combined, as shown in the table below. In Aktobe City, 28% of the total workforce in the industry and construction sectors were women in 2022, while it was somewhat lower for Aktobe Region (25%) and national level (27%). The majority of the total workforce were registered as wage earners, with 86% in Aktobe City, 91% in Aktobe Region and 87% at national level.

Table 6.50: Workforce in the industry and construction sectors by gender, Aktobe Region and Aktobe City, 2022

Total workforce			**Wage earners**			**Self-employed**		
Total	**Men**	**Women**	**Total**	**Men**	**Women**	**Total**	**Men**	**Women**
Aktobe City								
73,776	52,760	21,016	**63,703**	44,184	19,519	**10,073**	8,576	1,497
Aktobe Region								
121,420	91,300	30,120	**110,152**	81,799	28,353	**11,268**	9,501	1,767
Kazakhstan								
1,780,060	1,301,837	478,223	**1,541,514**	1,123,337	418,177	**238,546**	178,500	60,046

Source: National Bureau of Statistics

ASEG staffing level

As of February 2023, ASEG employs 2,025 staff, of which 35% are women and 65% men. The management team consists of 10 men.

The following table shows the main units and staff engaged in wastewater services.

Table 6.51: Overview of main ASEG departments/units and staff engaged in wastewater services

Department/Units	Total staff	Men	Women	% of women
Sewer networks	48	48	-	0
Pumping stations for wastewater	211	143	68	32.2
Wastewater treatment plant (WWTP)	79	49	30	38
TOTAL	**338**	**240**	**98**	**30**

Source: ASEG

According to HR staff, ASEG has not dismissed any employees during the last three years. Previous dismissals were reported to be due to disciplinary issues and never to reduce staffing levels. If it were considered necessary or beneficial to reduce the number of staff in a particular working area, then the employees concerned would be offered other jobs within the company, in accordance with the Labour Law.

Employment platform

Kazakhstan has a digital employment platform: www.enbek.kz (often referred to as EBT), which is used by both jobseekers and employers. Information about vacancies can thus be posted on the platform and job seekers can upload applications or CVs to the platform. The platform is updated daily with information from employers, jobseekers, the state database operated by employment centres, private employment agencies, and other online employment platforms (governmental website www.egov.kz).

6.2.5 Poverty and vulnerability levels

4.25% of the population in Aktobe Region lived in 2022 below the official subsistence level, which defines the minimum level of income to buy food and goods but may not include payment for services such as utility bills[22]. The table below shows that the percentage of the population living below the subsistence level is higher generally in Kazakhstan than in Aktobe Region and has been so over the whole period of 2018-2022. 3.3% of the population in Aktobe City lived in 2022 below the official subsistence level, compared to 4.25% for Aktobe Region. It has not been possible to obtain annual statistics for 2018-2021 about the population who lived below the official subsistence level in Aktobe City.

Table 6.52 Percentage of population in Aktobe City, Aktobe Region, Kazakhstan below subsistence level, 2018-2022

Area	2018	2019	2020	2021	2022
Aktobe City	Not obtained	Not obtained	Not obtained	Not obtained	3.3%
Aktobe Region	2.9%	3.0%	3.5%	3.7%	4.25%
Kazakhstan	4.3%	4.3%	5.3%	5.2%	5.0%

Source: National Bureau of Statistics

The table below lists the subsistence and poverty criteria per capita for Aktobe Region (including urban and rural areas). In 2019-2022, the poverty criteria were set as 70% of the subsistence level, while it was 40-50% in previous years.

Table 6.53: Subsistence and poverty criteria per capita for Aktobe Region, 2018-2022 (KZT/capita/month)

Area	2018	2019	2020	2021	2022
Subsistence criteria					
Aktobe Region	25,247	28,724	30,086	34,264	37,389
Poverty criteria (50% of subsistence criteria in 2018, 70% in 2019-2022)					
Aktobe Region	12,624	20,107	21,060	23,985	26,172

Source: National Bureau of Statistics and Consultant's calculations

Housing assistance is also provided to low-income families to cover the costs of housing maintenance, utilities, communication services and rent. The National Bureau of Statistics has data available for national level and Aktobe Region but not for Aktobe City. Data for the latter were obtained from the Aktobe City Akimat. The different sources may be the reason why a higher number of families are registered as recipients of housing assistance in Aktobe City than is the case in Aktobe Region.

Table 6.54: Number of families receiving housing aid in Aktobe City, Aktobe Region, Kazakhstan, 2018-2022

	2018	2019	2020	2021	2022
Aktobe City	2,032	1,263	696	705	458
Aktobe Region	1,934	1,263	693	705	458
Kazakhstan	68,389	54,476	37,368	32,237	28,170

Sources: Aktobe City Akimat and National Bureau of Statistics

Persons living below the poverty line are entitled to targeted social assistance as are other vulnerable groups. The number of persons receiving social assistance varied considerable in the period 2018-2022, as seen in the tables below. The National Bureau of Statistics has data available for national level and Aktobe Region but not for Aktobe City.

[22] https://liter.kz/ne-sootvetstvuet-ekonomicheskim-realiyam-pochemu-prozhitochnyj-minimum-takoj-malenkij/

Table 6.55: Persons receiving social assistance, Aktobe Region and national level, 2018-2022

	2018	2019	2020	2021	2022
Aktobe Region	20,082	92,214	33,871	30,607	29,849
Kazakhstan	571,584	2,177,176	936,189	990,539	775,388

Source: National Bureau of Statistics

Data were obtained from Aktobe City Akimat on the number of families receiving social assistance. The City Akimat informed that social assistance is provided to low-income citizens in the form of cash benefits, measures to encourage employment, social adaptation measures (rehabilitation of persons with disabilities, etc.) and a guaranteed social package for children. It should be noted that the National Bureau of Statistics registers the persons benefitting from social assistance, while the Aktobe City Akimat registers the benefitting families. To enable comparison of these data, an estimate of the number of persons receiving social assistance in Aktobe City is included in the table below. The average household size of 2.7 persons has been used for this calculation.

Table 6.56: Families and estimate of persons receiving social assistance, Aktobe City, 2018-2022

	2018	2019	2020	2021	2022
Aktobe City, families	4,113	19,866	6,695	6,133	5,634
Aktobe City, persons	11,105	53,638	18,077	16,559	15,212

Source: Aktobe City Akimat and Consultant's calculation

After the death of five girls from one family in a fire in Nur-Sultan, in February 2019, protests by mothers with many children swept through several regions of the country. Hundreds of women demanded to increase state benefits, solve the housing issue, and introduce benefits for large families. Due to the protests, the authorities increased the amount of targeted social assistance, developed a programme of preferential mortgages, announced a partial write-off of unsecured consumer loans, and initiated the construction of rental housing for those in need[23]. Thus, the number of families receiving social assistance in Aktobe City increased nearly five times in 2019 compared to 2018. However, in 2020 legislative amendments were introduced, including to the benefits for large families on state targeted social assistance. The new conditions have reduced the number of families/persons who can apply for social assistance.

Veterans and other persons participating in World War II are some of the vulnerable groups receiving social assistance. The table includes data for 2018-2023.

Table 6.57: Veterans and others involved in World War II receiving social assistance in Aktobe City, 2018-2023

Period	Participants and disabled persons of World War II	Indirect participants and disabled persons of World War II	Other categories equated to veterans of World War II	Home front workers assisting the military during World War II
2018	55	979	547	3,351
2019	37	975	464	3,330
2020	24	954	336	3,038
2021	17	1,155	336	2,536
2022	7	1,162	295	1,996
2023	1	1,188	277	1,681

Source: Department for Social Assistance, Aktobe City

[23] Radio Azattyk: Economist Maksat Halyk: "The society really needs social assistance" https://rus.azattyq.org/a/kazakhstan-economy-social-help-interview/30204209.html

6.2.6 Access to water supply and wastewater services

The Aqtobe Su Energy Group (ASEG) provides water supply and wastewater services to households, industrial and other commercial entities as well as budget organisations within Aktobe City. ASEG does not serve any villages or other settlements outside the city boundaries. No fee is charged for the issue of technical specifications, while the customer must pay the costs of materials and actual installations to the nearest connection point.

Access to water supply services

As per December 2022, ASEG had registered 149,821 domestic water supply customers (households), 5,550 corporate customers and 324 budget organisations in Aktobe City. The number of water supply customers can be seen in the table below.

Table 6.58: ASEG's registered water supply customers, December 2022

Customer Category	Customers				
	2018	2019	2020	2021	2022
Domestic customers (households)	128,151	135,232	139,109	141,984	149,821
Corporate customers (industrial and other enterprises)	4,739	5,861	5,600	5,120	5,551
Budget organisations	318	323	321	321	324

Source: ASEG's Customer Department

As explained in section 6.2.1, in 2022 the registered total number of individual houses (34,477) and apartments (159,544) in Aktobe City was 194,021, which is assumed to correspond to the number of households in the city. This indicates an average household size of 2.7 persons. Multiplying the number of domestic customers with this average household size indicates that ASEG supplies piped water to approximately 404,500 persons, which is around 77% of the total population. The Aktobe Development Strategy until 2050 envisages that the total population in Aktobe City has access to piped water supply by 2025. This includes the population in the villages that became part of Aktobe City within the last 10 years (see section 6.2.1 above).

Access to wastewater services

<u>Piped wastewater services</u>

As per December 2022, ASEG had registered in total 118,661 domestic wastewater customers (households), 5,232 corporate customers and 290 budget organisations in Aktobe City. The number of wastewater customers can be seen in the table below.

Table 6.59: ASEG's registered piped wastewater customers, 2018-2022

Customer Category	Customers				
	2018	2019	2020	2021	2022
Domestic customers (households)	101,201	106,032	108,942	112,055	118,661
Corporate customers (industrial and other enterprises)	4,739	5,861	5,600	4,952	5,232
Budget organisations	318	323	300	287	290

Source: ASEG's Customer Department

In addition, some households and some corporate customers (*e.g.* cafés, bathhouses, and other business premises) had their septic tanks emptied by ASEG-operated trucks. In total, 330 customers are thus registered as having an agreement with ASEG in 2022 for emptying of their septic tanks.

Multiplying the number of domestic customers with the average household size (2.7 persons) indicates that ASEG provides wastewater services to approximately 320,400 persons, which is around 61% of the total population.

Households, organisations, and commercial entities using septic tanks or latrines

During the Sweco Feasibility Study in 2021-2022, ASEG provided information about the number of households, budget organisations and commercial entities in Aktobe city which use septic tanks or latrines, as shown in the table below.

Table 6.60: Registered septic tanks and latrines in Aktobe, 2018-2020

<table>
<tr><th rowspan="2"></th><th colspan="3">Septic tanks</th><th colspan="3">Pit latrines</th></tr>
<tr><th>2018</th><th>2019</th><th>2020</th><th>2018</th><th>2019</th><th>2020</th></tr>
<tr><td>Households</td><td>1,935</td><td>1,880</td><td>1,807</td><td>26,053</td><td>27,325</td><td>28,285</td></tr>
<tr><td rowspan="3">Corporate customers (industrial and other enterprises) and budget organisations</td><th colspan="6">Septic tanks and latrines</th></tr>
<tr><th colspan="2">2018</th><th colspan="2">2019</th><th colspan="2">2020</th></tr>
<tr><td colspan="2">190</td><td colspan="2">311</td><td colspan="2">374</td></tr>
</table>

Source: ASEG's Customer Department

According to ASEG, 1,807 households used septic tanks in 2020, while in comparison 28,285 households used pit latrines. The total number of registered household wastewater connections, septic tanks, and pit latrines in 2020 was 139,034, while there was assumed to be in total 179,254 households in the city. The number of households using pit latrines or septic tanks was therefore expected to be considerably higher (Sweco Feasibility Study, 2022).

ASEG does not have information on septic tanks and pit latrines for the last two years.

6.2.7 Water and sanitation related diseases

Statistics on water and sanitation related diseases in Aktobe City were obtained from the Department of Sanitary and Epidemiological Control of Aktobe City, Aktobe Region, and the Republic of Kazakhstan (national level). The Departments provided information on infectious and parasitic diseases over the past 5 years as shown in the three tables below for Aktobe City, Aktobe Region, and Kazakhstan, respectively.

Table 6.61: Registered incidences of water and sanitation related diseases, Aktobe City, 2018-2022

Disease	Incidences per 100,000 persons				
	2018	2019	2020	2021	2022
Salmonellosis	10.8	5.5	3.6	6.4	3.6
Shigellosis (Sh. Flexneri, Sh. Sonei)	6.2	7.3	3.0	0.2	5.0
Rotaviral enteritis	19.7	21.1	2.2	26.6	38.6
Ascariasis	23.0	18.1	13.6	11.2	17.8
Enterobiasis	138.9	84.1	49.5	18.5	27.7
Hymenolepiasis	0.2	-	-	-	0.4
Opistarchosis	1.7	0.6	-	1.5	0.6
Hepatitis A	15.1	4.3	0.2	0.6	1.9

Source: Department of Sanitary and Epidemiological Control of Aktobe Region, Department of Sanitary and Epidemiological Control of Aktobe City and Consultant's calculation of incidences per 100,000.

Table 6.62: Registered incidences of infectious diseases in Aktobe Region, 2018-2022

Disease	Incidences per 100,000 persons				
	2018	2019	2020	2021	2022
Salmonellosis	6.11	3.24	2.06	4.59	2.30
Rotavirus infection	11.15	12.39	1.26	17.25	25.13
Ascariasis	13.03	10.66	7.88	8.29	13.39
Enterobiasis	78.67	49.46	28.68	27.90	31.16
Hymenolepidosis	0.12	0.00	0.00	0.22	0.22
Opisthorchiasis	0.94	0.35	0.00	0.00	0.33
Acute viral hepatitis	8.57	2.55	1.49	0.45	1.32
Dysentery Zonne	1.41	3.01	0.46	0.22	3.51
Dysentery Flexner	2.11	0.81	1.14	0.11	0.33

Source: Aktobe Regional Department of Sanitary and Epidemiological Control and Consultant's calculation of incidences per 100,000.

Table 6.63: Registered incidences of infectious diseases in Kazakhstan Republic, 2018-2022

Disease	Incidences per 100,000 persons				
	2018	2019	2020	2021	2022
Salmonellosis	7.13	5.99	2.70	2.63	5.04
Shigellosis	3.39	3.51	0.98	1.06	4.98
Ascariasis	7.13	6.67	4.78	4.92	6.74
Enterobiasis	54.77	41.96	20.17	20.36	26.15
Hymenolepiasis	0.12	0.07	0.03	0.05	0.12
Opisthorchiasis	3.96	3.11	1.98	1.78	2.64
Hepatitis A	4.85	3.23	2.68	0.77	1.65
Dysentery	3.44	3.56	0.98	1.09	5.02
Oxytosis	54.95	50.82	37.28	39.04	52.44
Trichocephaliasis	-	0.01	0.01	0.04	0.01

Source: Kazakhstan Republic Department of Sanitary and Epidemiological Control and Consultant's calculation of incidences per 100,000.

The incidence rates per 100,000 persons for all diseases mentioned above have fluctuated over the last five years at city, regional, and national levels, with most having decreased between 2018 and 2022. The incidence rate for rotavirus enteritis increased, however, both at city and regional level during the same period. For most diseases, the incidence rates were higher at national and regional than at city level. The incidence rate for ascariasis was, however, considerably lower at national than at the other two levels.

It should be noted that the mentioned diseases are as likely to be caused by poor hygiene, e.g., not washing hands before handling food or storing water in dirty containers, and/or by infected food, as to be caused by poor water quality, and/or poor sanitary situations.

6.2.8 Traffic accident levels

Attempts were made to obtain statistics on traffic accidents for Aktobe City and separately for the area relatively close to the WWTP. According to the Police Department for Aktobe City, such statistics are not available. The Police Department did, however, forward some information about the most dangerous areas traffic-wise in Aktobe City. They include several intersections and crossroads of the city. None of these are in the vicinity of the existing WWTP and the adjacent site of the new WWTP, which are both located approx. 5 km northwest of the city.

6.2.9 Gender-based violence and harassment

There do not appear to be any specific policies or legislation in relation to gender-based violence and harassment in the workplace in Kazakhstan. In December 2022, the Ministry of Labour and Social Protection (MLSP) published an article on their website about gender-based violence and harassment in the workplace[24]. This mentions that as part of the consideration of Kazakhstan's ratification of the International Labour Organization's Convention No. 190, the MLSP together with the UN Entity for Gender Equality and the Empowerment of Women "UN Women" conducted a study to examine the level and root causes of violence and sexual harassment in the workplace in Kazakhstan. A sociological survey was conducted with the participation of 1,340 women and 208 heads of organisations.

Around 13% of women surveyed reported experiencing violence and harassment in the workplace and 10% of employers had received letters from abused women. No cases of physical violence were reported in the survey. The most frequent types of harassment/violence mentioned by survey participants were unpleasant touching, flirting, courtship, attempts to kiss (17%), inappropriate jokes about sexual topics (16%), comments and gestures of a sexual nature (16%).

According to two-thirds of the women surveyed, it is mainly supervisors who behave in this way. The remaining participants mentioned their colleagues and clients as offenders, which was confirmed by their employers. According to the latter, colleagues and clients are more likely to harass women, especially in small and medium-sized businesses, mainly in the service, catering, and trade sectors.

More than 80% of respondents suggested that the legislative prohibition of gender-based violence and harassment in the workplace and strengthening of legal protection for survivors would be useful.

According to its website, MLSP has – based on the above-mentioned survey – prepared proposals for additions and amendments to several legislative and regulatory acts aimed at eliminating violence and harassment in the workplace, including the Labour Law of Kazakhstan. However, according to the Women, Business and Law Index 2023, Kazakhstan has no legislation on sexual harassment in employment and there are no criminal penalties or civil remedies for sexual harassment in employment.

The prevalence of domestic violence is indicative for the Project risk related to gender-based violence and harassment. According to the Interior Ministry, the police annually receive more than 100,000 domestic violence complaints. The latest available data from 2017[25], shows a prevalence of lifetime physical and/or sexual intimate partner violence in Kazakhstan at 16.5%[26], physical and/or sexual intimate partner violence in the last 12 months at 4.7%[27], and lifetime non-partner sexual violence at 1.5%[28]. Under Kazakhstan's current laws, including the 2009 law on Prevention of Domestic Violence, domestic violence is not a stand-alone criminal offense. In September 2020, a draft law on Combating Domestic Violence, which would have strengthened protections for women survivors of family abuse,

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[24] The website of Ministry of Labour and Social Protection: "MLSP prepared proposals to eradicate violence and harassment in the workplace", https://www.gov.kz/memleket/entities/enbek/press/news/details/483686?lang=ru

[25] UN Women Global Database on Violence against Women, based on data from the Statistics Committee of the Ministry of National Economy. 2017. Sample Survey on Violence Against Women in Kazakhstan. Astana, Kazakhstan: Statistics Committee of the Ministry of National Economy of Republic of Kazakhstan.

[26] Proportion of ever-partnered women aged 18-75 years experiencing intimate partner physical and/or sexual violence at least once in their lifetime.

[27] Proportion of ever-partnered women aged 18-75 years experiencing intimate partner physical and/or sexual violence in the last 12 months.

[28] Proportion of women aged 18–75 years experiencing sexual violence perpetrated by someone other than an intimate partner since age 15.

passed its first reading in parliament. However, in January 2021, it was withdrawn[29]. Intimate partner violence is generally prevalent across the region in part because of regressive gender norms, with many men and women finding that domestic violence is acceptable under certain circumstances, as indicated in Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) conducted in Central Asia countries, including Kazakhstan[30].

6.2.10 Residential areas and economic activities in vicinity of existing WWTP

The following are the closest residential areas to the WWTP.

Railway Junction 39 and Tulpannyy hamlet

According to Aktobe City Akimat, this settlement includes 30 houses, inhabited by 158 persons. The houses are built along two main streets. The settlement has 15 hectares of land, including a dairy farm.

Distances taken from Google Earth indicate that the residential houses closest to the existing WWTP are 2 km north of the existing WWTP, 3.8 km east of the wastewater retention reservoir and 3.2 km from the reservoir water discharge creek.

Further information about the settlement is included in the information from the focus group discussions (FGDs) in section 7.4 below.

Georgievka and Kurayly villages

According to Aktobe City Akimat, Georgievka village is located approximately 10 km north of the existing WWTP and has recently become part of Aktobe City. It occupies 2,530 hectares of land and has 1,828 inhabitants. Out of 532 land plots given for house construction, 75 plots are not yet developed. The village has three main streets, seven smaller streets, a public hall, and a library.

Kurayly village is located just north of Georgievka village. According to Aktobe City Akimat, Kurayly village has also recently become part of Aktobe City. It occupies 31,015 hectares of land and has 1,859 inhabitants. The houses (14 of which are blocks of flats) are aligned along 2 main and 10 smaller streets. The village has a school for 546 pupils, a kindergarten, an ambulance clinic, a public hall with 119 seats, a library, a post office, and a police station. It has a bus connection to the city center of Aktobe.

Distances taken from Google Earth indicate that there is approx. 8.3 km from the southern part of Georgievka village to the northern part of the sludge ponds and approx. 6.5 km from the village to the wastewater retention reservoir. Both Georgievka and Kurayly are relatively far from the creek that is used to discharge the retention reservoir water, with the nearest house being approx. 1 km north of the creek. However, Georgievka residents approach the creek at its entry to the Ilek river when they go swimming.

Further information about the two villages is included in the information from the FGDs in section 7.4 below.

Zhanakonys housing estate

Distances taken from Google Earth indicate that Zhanakonys housing estate is 6 km south of the existing WWTP behind the chromium plant tailings, city landfill and Zhenishke River. This area is not considered to be subject to impacts from the existing or the new WWTP mainly because of the distance but also due

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[29] Human Rights Watch, 2023. Revise draft laws to better protect women.
[30] World Bank, 2022. Reducing the prevalence of gender-based violence in Europe and Central Asia requires changing the norms that support it.

to the presence of the city landfill and the chromium smelting tailing ponds between the WWTP and the housing estate. The ponds raise 20 meter above the WWTP and 30 meter above the estate.

Khlebodarovka village

Khlebodarovka village is 13 km north of the existing WWTP and far from the Ilek river. This area is not considered to be subject to impacts from the existing or the proposed new WWTP due to the considerable distance from the plant. There are also two 10-meter and 15-meter hills in between them.

Farms close to the WWTP

Most of the following information about the farms adjacent to the existing WWTP is received from Aktobe City Akimat. Additional information was received during a telephone call to the owner/director of the farm Temir Tulpar Batys LLP. Attempts were also made to contact other farm owners/directors, without success.

<u>Temir Tulpar Batys LLP</u>

The fields of this farm are located within a range of 0-9 km from the existing WWTP. The farm has 309 horses. In 2022, the farm had 400 hectares of land with grain crops, 400 hectares of land with winter crops, and 500 ha hectares of land with forage crops. In 2023, it is planned to have 320 hectares of land with grain crops, 450 hectares of land with oilseeds, and 870 hectares of land of forage crops. Organic fertilisers are used for the crops.

During a telephone call, the owner/director indicated that he is interested in using treated wastewater and fertiliser from the planned new WWTP.

<u>Aterra LLP</u>

The fields of this farm are located within a range of 0-27 km from the existing WWTP. The farm has 237 cattle and 373 small ruminants. In 2022, the farm had 530 hectares of land with grain crops and 660 hectares of perennial plants from previous years. In 2023, it is planned to have 700 hectares of land with grain crops, 200 hectares of land with forage crops and 660 hectares of land with perennial plants from previous years.

<u>Nan peasant farm</u>

The fields of this farm are located within a range of 0-39 km from the existing WWTP. The farm has 472 cattle and 926 small ruminants. In 2022, the farm had 424 hectares of land with perennial plants from previous years. The plan for 2023 is similar.

<u>*ANDI LLP*</u>

The fields of this farm are located within a range of 2-10 km from the existing WWTP. The City Akimat did not provide further information about this farm.

Industries close to the WWTP

There are several industries located in a radius of 1-6 km from the existing and the proposed new WWTP. The table below lists these industries, their main production, and their distance to the site of the new WWTP.

Table 6.64: Industries located within a radius of 1-6 km from the new WWTP

Name of industry	Main production	Distance to new WWTP area
JSC Aktobe Chromium Compounds Plant	Production of monochromate, sodium bichromate, chrome anhydride, chrome tannins and others from chromium ore (Source: Kazakhstan National Encyclopedia (ru) - Vol 1 of 5 (2004).	1 km south of the new WWTP area
Aktobe Ferroalloy Plant JSC Transnational Company KAZCHROM	Large ferroalloys plant (Source: kazchrome.com).	4.5 km south-east of the new WWTP area
PolyWest LLP	Producer of various polyethylene products (Source: http://polywest.kz/o_kompanii_polywest.html).	3.5 km north-east of the new WWTP area.
Aktobe Rail Mill LLP	Production of rails (Source: https://arbz.kz/o-kompanii/o-nas/).	2.7 km north-east of the new WWTP area
JSC Aktobe Oil Equipment Plant	Production of oil pump rods, gas-sand anchors (Source: https://azno.kz/products/).	5.6 km south-east of the new WWTP area
Sapaly BETON LLP	Production of reinforced concrete products and different concrete mixes (Source: http://sapalybeton.kz/).	4.4 km south-east of the new WWTP area

6.2.11 Land use

The new WWTP is planned to be constructed on a 10.8 ha land plot, which is state-owned land. The Aktobe City Akimat issued Resolution No. 235 on 14 March 2023 to grant the Department of Housing and Communal Services, Passenger Transport and Highways of Aktobe City the right to use a land plot of 10.8 ha for a period of five year for the construction of a WWTP in Aktobe City. According to the city Land Management Department, another resolution will be issued after construction of the WWTP to lease this plot for 49 years.

The 10.8 ha land plot is indicated on the map below with white contour.

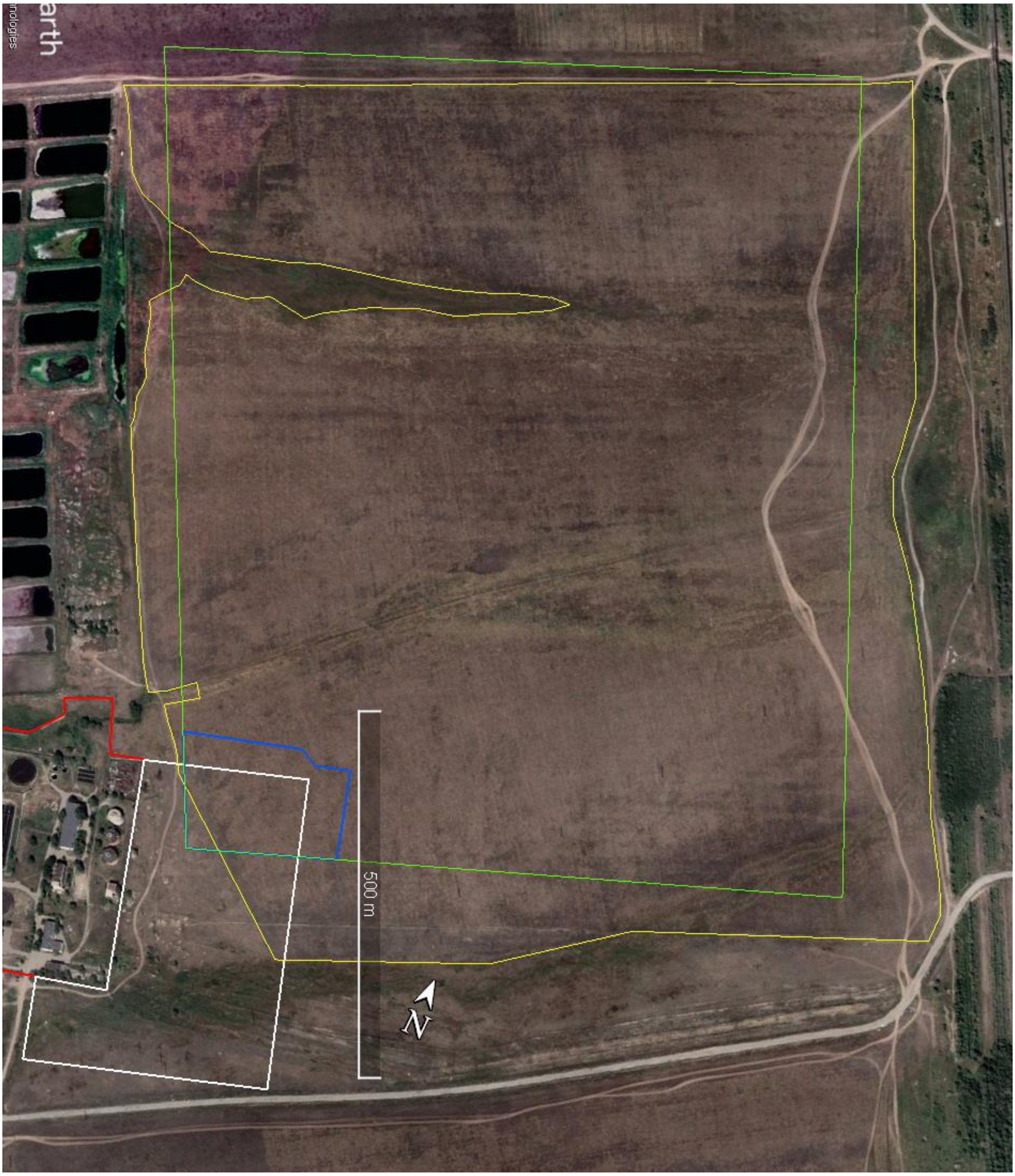

Figure 6.43: The 100 ha plot under lease no. 02-036-164-435 (green outline), the119 ha land actually used by the leaseholder of Temir Tulpar Batys LLP (yellow outline). The land acquisition includes 2.1 ha for the WWTP (white outline) and 1 ha for the overhead power lines (blue outline), in total 3.1 ha. (Source: Department of Land Cadastre and Automated Information System of the State Land Cadastre, https://aisgzk.kz/aisgzk/ru/content/maps/)

The owner of the farm Temir Tulpar Batys LLC has the user right of 2.1 ha of the site for the proposed new WWTP, as indicated in the above map. In addition, the existing overhead power lines passing through the proposed new WWTP site are planned to be relocated to outside the proposed new WWTP site along the northern boundaries of the site. The relocation of the overhead lines affects 1 ha of land to which the owner of the farm Temir Tulpar Batys LLC has the user right. This means that a total of 3.1 ha will need to be withdrawn from the lease agreement with Temir Tulpar Batys LLC.

The farmer was granted the user right for 49 years for the state-owned agricultural plot 02-036-164-435, which is 100 ha, on 8 May 2019, in accordance with Aktobe City Akimat Resolution 1707 from 22 April 2019. According to the lease agreement the farmer is allowed to use the land for agricultural production and has in recent years used the land for hay harvesting. The withdrawn land only forms a small part of the land in the possession of the farm, which in 2023 constitute more than 1,600 ha in total. Further information about the farm is presented in section 6.2.10, under farms close to the WWTP.

A copy of the lease agreement with the farmer for plot 02-036-164-435 was obtained. The lease agreement details the rights and obligations of the parties, payment of fee for the lease, and terms of termination, including the lessor obligation in case of compulsory seizure of the land plot for state needs. These obligations include reimbursing the lessee for losses including reimbursing expenses incurred by the lessee for the development and improvement of agricultural land under the contract. The lessee is also entitled to provision of replacement land and must be informed of all encumbrances and restriction of the rights to the land plot or easement for the right of way.

ASEG in cooperation with Aktobe City Land Management Department has consulted the farmer, and the three parties have made an agreement dated 2 July 2023 on a change of the boundaries of plot 02-036-164-435 on the condition that ASEG will bear all expenses associated with the change. The Aktobe Akimat's Land Management Department will review the prepared land management plan and legalise the change of plot boundaries with the preparation of all necessary documents.

The agreement means that the 3.1 ha land to be used for the WWTP and the relocation of the overhead power lines will be withdrawn from the lease agreement and replaced with at least the same amount of land of equal quality adjacent to the existing land under lease. Conditions of the agreement is adherent to the existing lease agreement for plot 02-036-164-435.

The overhead power lines to be relocated along the eastern and southern boundaries of the new WWTP site will be on state reserve land and will follow in the southern part the right of way of the road. Further information about the relocation of the overhead power lines is included in section 3.3.5.

The land along the URE discharge channel (from the URE reservoir to the Ilek river) is leased agricultural land plots. Except for one, all adjacent plots have easements allowing access to the channel for its potential future improvement. There is no information about the date of the plot lease agreement where easement is not mentioned. However, usually lack of easement in an odd plot indicates that it was given for lease some years ago at a time when the easement concept was not well developed.

6.2.12 Cultural heritage

The Regional Centre for Research, Restoration and Protection of Historical and Cultural Heritage confirmed in February 2023 in a letter to Aquarem the absence of historical and cultural heritage of significance at the proposed location of a new WWTP (350 m east of the existing WWTP between land plots 02-036-164-435 and 02-036-164-222). In May 2023, the Department of Culture, Archives, and Documentation of Aktobe Region provided a list of all registered cultural heritage sites in Aktobe City, including coordinates of their locations. According to this list, the cultural heritage closest to the proposed new WWTP site is the Monument to the Smelters of Ferrous Metallurgy, located 4.65 km from the new WWTP site. The location of this monument is shown in the map below. Other registered cultural heritage sites are located in the city centre and in the eastern part of Aktobe City, i.e., further away from the proposed new WWTP.

Figure 6.44: Location of the Monument to the Smelters of Ferrous Metallurgy and the existing WWTP site. The red line indicates the distance between the monument and the new WWTP site, while yellow lines indicate roads. (Sources: Department of Culture, Archives, and Documentation of Aktobe Region and Google Earth).

6.2.13 Schools, health clinics, and other social facilities in vicinity of the WWTP

There are no schools, health clinics, or other social facilities located close to the existing and the proposed new WWTP.

The closest school and doctor's dispensary north of the WWTP are in Kurayly village. The school is approx. 10.7 km from the WWTP, while the doctor's dispensary is approx. 11.3 km. from the WWTP.

The closest school south-east of the WWTP (towards the city centre) is approx. 6.4 km from the WWTP, while the Eurasia medical centre is approx. 6 km from the WWTP.

The above distances are taken from Google Earth.

The Aktobe City Akimat has informed that the city has 32 ambulatory-policlinic organisations, including 7 polyclinics, 10 hospitals, 3 centres of primary medical-sanitary aid, 12 medical ambulatories. There are 2,373 doctors and 3,891 paramedical workers working in medical entities in the city.

7 STAKEHOLDERS AND CONSULTATION DURING THE ESIA

7.1 Local governance structure and key institutions

Aktobe City is part of Aktobe Region, and some of the departments under the Akimat of Aktobe Region play an important role in relation to this Project as explained further below.

Several departments under the Akimat of Aktobe City are key stakeholder for this Project. ASEG, which is the proponent of this Project, is a 100% state-owned enterprise and reports to the Aktobe City Akimat through the Department of Housing and Communal Services, Passenger Transport and Highways.

Important state, regional and city departments for this Project include:

Table 7.1: Important regional and city departments and their roles in relation to this Project

State, Regional and City Departments	Role in relation to Project
State Departments	
Zhaik-Caspian Basin Inspection	Compliance with legislation, e.g., on approvals related to the Ilek river.
Bureau of National statistics	Collecting and compiling statistics on, among others, population and socio-economic aspects.
KazHydromet	Statistical information about air quality, data from Hydropost.
Aktobe City Police Department	Collecting information about, among others, traffic safety and accidents.
Akimat for Aktobe Region	
Energy and Communal Department of Aktobe Region	Compliance with legislation, e.g. on approvals.
Department of Natural Resources and Regulation of the Use of Natural Resources	Compliance with legislation, e.g. on approvals for MPC for atmosphere air.
Regional Centre for Research, Restoration and Protection of Historical and Cultural Heritage	Registering and listing cultural heritage, approval to build new WWTP.
Department of Agriculture and Land Relations	Compliance with legislation, e.g. on approvals.
Department of Statistics of Aktobe Region	Collecting and compiling statistics on, among others, population and socio-economic aspects.
Department of Sanitary and Epidemiological Control	Registering and monitoring water and sanitation related diseases.
Akimat for Aktobe City	
Department of Housing and Communal Services, Passenger Transport and Highways	ASEG, a 100% state-owned enterprise, reports to the Aktobe City Akimat through this department. Compliance with legislation, e.g. on approvals.
Land Management Department	Compliance with legislation, e.g. on approvals.
Department of Sanitary and Epidemiological Control	Registering and monitoring water and sanitation related diseases.
Department of Agriculture and Land Relations	Compliance with legislation, e.g. on approvals.
Department of Land Management	Discussions and agreement with one farmer about relinquishing his user right to 2.2 ha of land, which is to form part of the proposed new WWTP site.

Aktobe City is divided into two districts: Almaty District and Astana District. The Akimats of the two districts, which are the lowest administrative level in Aktobe City, report to the Akimat of Aktobe City. The responsibilities of the district Akimats include, among others, implementation of the state employment policy, assessment of the need for social assistance in accordance with local regulations and provision of support to low-income and large families, door-to-door public awareness raising in relation to health and social support. The two district Akimat supported the arrangement of focus group discussions during the ESIA (see below) and are expected to support ASEG with organisation of public meeting(s) during the public disclosure of the ESIA package.

7.2 Community-level stakeholders

The table below lists community-level stakeholders, particularly those that live relatively close to the WWTP. Residents in Aktobe City more generally are also key stakeholders, as they will benefit from the improved wastewater treatment resulting from the Project.

Table 7.2: Community-level stakeholders in residential areas relatively close to the site of the proposed WWTP

Community-level stakeholders	Population	Distance to WWTP
Residents in the settlements of Railway Junction 39 and Tulpannyy hamlet	158	2 km north of the WWTP
Residents in Georgievka village	1,828	10 km north of the WWTP
Residents in Kurayly village	1,859	10-11 km north of the WWTP
Temir Tulpar Batys LLP farm		Fields are 0-9 km from the WWTP
Aterra LLP farm		Fields are 0-27 km from the WWTP
Nan farm		Fields are 0-39 km from the WWTP
ANDI LLP farm		Fields are 2-10 km from the WWTP
JSC Aktobe Chromium Compounds Plant		Located 1 km south of the new WWTP area
Residents in Aktobe City		Other residents in Aktobe City than those mentioned above are located relatively far away from the WWTP.

7.3 Stakeholder meetings

7.3.1 Stakeholder meeting in February 2023 during the scoping phase

During the scoping phase of the ESIA, a meeting was conducted with the following stakeholders on 24 February 2023: Energy and Communal Department of Aktobe Region, Deputy Akim of Aktobe City, Zhaik-Caspian Basin Inspection, Department of Natural Resources and Regulation of Use of Natural Resources, Sanitary and Epidemiological Control Department, three individual eco-activists, and ASEG.

Sludge management for the existing WWTP and the planned new WWTP as well as complaints about odours from the existing WWTP were the main topics discussed during the meeting. The complaints of odours were reported to come from settlements located relatively close to the existing WWTP.

7.3.2 Stakeholder meeting in Kurayly village in March 2023

A meeting was held on 27 March 2023 with participation of residents of Kurayly village (4), Almaty District Akimat of Aktobe City (1), ASEG (3), and the Consultant (7).

The ASEG Deputy Chief Engineer explained the plans for the new WWTP. The four residents participating in the meeting supported the plans, hoping that the foul odour that appears at the end of March (when wastewater is started to be discharged into the river) and remains along the discharge creek well into summer, would disappear. One of the residents pointed out that the village bathing place is only 100m downstream from the discharge point and although no one uses river during the discharge period, smell of the discharge can be sensed on the riverbanks for several months after it stops. Foul odour was also mentioned as a problem for the residents at the railway junction 39 and the Tulpannyy hamlet.

7.3.3 Focus group discussions in April 2023

Three focus group discussions (FGDs) were held in April with residents living relatively close to the existing WWTP, i.e., in Kurayly and Georgievka villages and at railway junction 39 / Tulpannyy hamlet. The table below characteristics of the participants in the three FGDs.

Maps were used during the FGDs. They showed the location of, among others, the existing WWTP, the proposed new WWTP, the Ilek river, and the villages/settlements close to the WWTP.

The table below describes the participants in the FGDs.

Table 7.3: Overview of FGDs

№	FGD participants	Description
1	FGD with 7 women from Kurayly and Georgievka villages.	Participants were from both low-income and middle-income households and included young women with children and elderly women. Participants lived relatively close to the creek / Ilek river.
2	FGD with 8 men from Kurayly and Georgievka villages.	Participants were from both low-income and middle-income households and included young men with children and elderly men. Participants lived relatively close to the creek / Ilek river.
3	FGD with 11 women and 1 man from the railway junction 39 / Tulpannyy hamlet.	Participants were from both low-income and middle-income households and included both young participants with children and elderly participants.

Focus groups discussions for Kurayly and Georgivka villages

Two separate FGDs were held at the Public House in Kurayly village, one with 8 men and one with 7 women. Staff from the Almaty District Akimat of Aktobe City as well as ASEG staff provided support in arranging the two FGDs, including with the invitation of participants.

Participants in the two FGDs explained that residents of the two villages grow vegetables (potatoes, carrots, onions, cucumbers, tomatoes, aubergine, pepper, etc.) on their garden plots for their own use and keep cattle, horses, sheep, goats, pigs, breed chicken, and geese. The villagers do not use the river water for irrigation and do not use the land in or around the village for recreational purposes. According to FGD participants, there are no recreational areas near the river. Some residents of the two villages bathe in the Ilek River, including children during the summer holidays. The land near the WWTP is mainly used for cattle grazing by peasant and farming households. Many villagers work in other parts of Aktobe City. There were reported to be no poor families in the two villages, but there are people with disabilities of different categories. There are different ethnic groups in the villages.

The unpleasant smell from the existing WWTP was highlighted both by women and men in the two FGDs. They experience a strong smell especially during the summer and in windy weather. In these periods, they did not want to open their windows and their laundry had to be dried at home (meaning inside the house). They mentioned that the smell from the WWTP had a negative impact on residents generally in the villages and particularly on people with respiratory diseases and on children. Sick family members are mainly cared for by women.

FGD participants expressed the hope that the construction and subsequent operation of the new WWTP would have the following main benefits for them:

- The unpleasant smell from the WWTP would disappear (most important)
- Residents in the two villages can bathe freely in the river in the future.
- It would be possible to use water from the river for irrigation in the future.
- Residents in the villages can get jobs during the construction of the new WWTP.

FGD participants emphasized that several people in their villages would be interested in employment during the construction period. There are unemployed men and women in the villages, who want to get jobs as drivers, handymen, mechanics, security guards, technicians, fitters etc. There are shops including mini markets in the villages, which may be able to provide some supplies for the construction teams.

There was much interest in being consulted after the detailed design had been developed and more information was available about the equipment that would be installed and what methods would be used during construction and operation of the new WWTP. Participants mentioned that it would be easier for them to assess what impact the new WWTP may have on them after information was available from the detailed design. They were also keen to hear more about the construction timelines. They requested to be informed about future consultations via telephone through the staff of the Almaty District Akimat of Aktobe City.

Residents in the two villages mentioned that they have received some information about the existing and the WWTP through the Almaty District Akimat. Other channels of communication in the villages are through a community "WhatsApp" chat group, community activists, a community council (Zhanat Batyrkhanov, Bolatbek Zhanpeys) and a veteran council (Zhambyl Veteran). The FGD participants hoped to receive more information in the future via WhatsApp and via social media (Instagram, Facebook).

Focus group discussion for railway junction 39 / Tulpannyy hamlet

One FGD was conducted with 11 women and 1 man in the house of a female resident of the 39 Railway Junction and Tulpannyy hamlet. Staff from the Astana District Akimat of Aktobe City as well as ASEG staff provided support in arranging the FGD, including with the invitation of participants.

FGD participants explained that mostly retired people live in the settlement. There are also some younger housewives, and some younger men who work in other parts of Aktobe City. Residents grow vegetables (potatoes, carrots, onions, cucumbers, tomatoes, aubergines, peppers, etc.) for their own use. The villagers do not use river water for irrigation and do not use the land in or around the settlement for recreational purposes. The land near the WWTP is mainly used for cattle grazing. There were reported to be no poor families in the settlement and no people with disabilities. Villagers buy their goods in other parts of Aktobe City.

Participants complained that due to the constant, strong and unpleasant smell in the whole settlement, especially at night and in windy weather, it is impossible to open windows, and laundry must be dried inside the house. Furthermore, it is embarrassing for them to invite guests to their houses. It is very difficult for people with respiratory diseases, it is difficult for them to walk outside. One woman from the village thus constantly walks around with a breathing machine. One FGD participant, who is asthmatic, said that she finds the smell particularly difficult to bear. The smell was also reported to have a negative impact on children. Sick family members are mainly cared for by women.

FGD participants hoped that the construction and subsequent operation of the new WWTP would be beneficial for them, including most importantly that the strong and unpleasant smell would disappear.

Some residents in the small settlement were reported to be interested in employment during the construction of the new WWTP. There are thus in total 8 unemployed men and women, who want to work as handymen and technicians.

Information about the operation of the existing WWTP and about the new WWTP is obtained through the Astana District Akimat of Aktobe City. Other communication channels are a general "WhatsApp" chat group in the settlement. There is also an individual/community activist who is contacted by residents (called "Nurgul"). Any meetings and other gatherings of residents are informed through her by phone. The FGD participants hoped to receive more information about the plans for the new WWTP through "WhatsApp" and through social networks.

Participants were interested in participating in consultations concerning the detailed design and the construction of the new WWTP and asked to be informed via Nurgul by phone or through the Aktobe Astana District Akimat staff. As there is no Public House, school, and other administrative buildings in the settlement, they requested that they should be invited to participate in a consultation meeting in Kurayly village and that transport should be arranged for them.

8 PROJECT IMPACTS AND OPPORTUNITIES FOR ENHANCEMENT

8.1 Physical and Natural Environment impacts

This section describes the positive and negative impacts that the proposed WWTP Project is assessed to have on the physical and natural environmental receptors described in the baseline section of this ESIA report, as well as key impacts related to energy consumption, supply chains and communal infrastructure.

The following table provides an overview of the receptors described in the baseline chapter and their assessed level of sensitivity in the context of the Project.

Table 8.1: Sensitivity of assessed receptors related to physical and natural environment

Receptor	Assessed sensitivity
Physical and natural environment	
Topography and landscape	Low
Geology, geomorphology and soil	Low
Climate in Aktobe – sensitivity to climate change	Medium
Surface and Groundwater	
Around the WWTP site	Low
The URE retention reservoir	Medium to high
The Ilek river	Medium to high
Ambient air quality	Medium
Ambient noise levels	Low
Biodiversity - Flora	Low
Biodiversity – Fauna	
Terrestrial and avifauna	Medium
Ilek river benthic fauna	Medium
Access road infrastructure	Low
Waste management infrastructure	Low to medium
Water supply infrastructure	Low
Energy supply infrastructure	Low

8.1.1 Impacts on landscape and topography (incl. visual impacts)

Pre-construction and Construction Phase activities

The construction phase of the proposed new WWTP will involve the following key site preparation activities affecting landscape and topography within the Project site:

- Excavations
- Trenching and backfilling
- Removing vegetation and topsoil to make space for buildings and other WWTP infrastructure
- Construction of WWTP infrastructure and associated administrative buildings
- Relocation of a small section of the overhead transmission lines currently passing through the land plot for the new WWTP site and connection with the substation of the existing WWTP
- Decommissioning of the existing WWTP and sludge ponds.

The activities will change the appearance of the new WWTP site from current greenfield to an industrial use site. With regards to relocation of overhead transmission lines (se chapter 3.3.5), this is considered to constitute a minor change in terms of visual impacts as existing masts and lines crossing the proposed WWTP will be relocated to the periphery of the site, rather than comprising new lines as such. Hence, the impact on topography and site appearance is **direct, negative** and **long-term** but is **limited** to the WWTP site which is an area of approx. 11 ha directly adjacent to the current WWTP site, in addition to transmission line masts located on the periphery of the WWTP site and/or via alternative corridors within the site.

Visual impacts are restricted to the surroundings from where the WWTP can be seen, which contains no inhabited areas. The **magnitude of the impact is considered medium,** with limited change in topography and loss of greenfield site characteristics that do not adversely affect the integrity of a significant area. The overall impact significance is a combination of sensitivity of the receptor and the impact magnitude (see chapter 4.6). Given the **low sensitivity** of the receptor, the **overall impact on landscape and topography is considered as being of minor negative significance**.

In terms of **decommissioning of the existing WWTP**, the plan is to leave it largely unaffected and keep the existing structures in place. Aquarem has informed that there are plans to dismantle the three (3) old digester tanks of 1600m^3 which are located within the current WWTP site. Dismantling of other deteriorated buildings and structures is not envisaged. Hence, the existing WWTP site will remain largely the same.

In terms of the existing sludge pond area, which is almost 40ha, no plans have been presented relating to how these will be closed or rehabilitated. Hence, in parallel with detailed design of the WWTP**, it is required that a plan will be developed for the closing and rehabilitating the part of the existing sludge pond area** that is not needed for emergency purposes. This should reflect plans to, as a minimum, clean the area of existing sludge, and measures to rehabilitate the area to its original natural condition, as further outlined in the mitigations table below and as also included in the separate ESMP. Rehabilitation of the sludge pond area provides an opportunity to eliminate odour impacts from the existing site and to offset the negative landscape and land use impact of converting from the greenfield to an industrial use area for the new WWTP.

Operation and maintenance activities

The main Project impacts affecting landscape and topography occur during the construction phase and then remain unchanged during the operational phase, with exception of ongoing landscaping and maintenance of the site and surroundings, which are considered to have insignificant impacts.

Closure and Decommissioning

The impacts of future decommissioning of the proposed WWTP would have potential negative impacts like those identified for the construction activities in general, e.g., related to potential contamination of soil, surface water, groundwater, air, and noise impacts. Waste materials, in particular aggregates and scrap metal, should be managed to ensure maximal reuse or recycling at end of life in accordance with the waste hierarchy. All planned closure of facilities and infrastructure should be carried out appropriately to prevent the closed site from constituting a risk for humans and animals.

Proposed mitigation measures

The following mitigation measures are proposed to avoid and minimise the identified impacts on landscape, topography, including visual impacts.

Table 8.2: Proposed mitigation measures related to landscape and topography.

Activity	**Impact or risk**	**Proposed mitigation measures**
Pre-construction and Construction phase		
Excavation and levelling of the site	• Change in topography. • Change of site appearance from greenfield to industrial use. • Removal of topsoil and vegetation.	• Detail design and site layout and grading plan in a way that minimises earthwork and limits change to topography (pre-construction) • Separate excavated topsoil from other excavated material and store in a designated

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Construction of WWTP infrastructure	• Change of site appearance from greenfield to industrial use.	area for use in site rehabilitation of e.g., sludge pond area. • Create a buffer zone of native vegetation, trees, and shrubs around the WWTP. • Integrate landscaping and green spaces within the WWTP site, using native vegetation. • Implement thoughtful lighting design to reduce the visibility of the WWTP during night-time hours.
Decommissioning of existing WWTP and sludge ponds	• Rehabilitation of parts of existing WWTP area and sludge ponds.	• Demolish and remove unsafe structures and dispose of demolition waste in a responsible manner. Clean the site of lose debris and solid waste / litter. • In collaboration with relevant authorities, develop a **plan for closing and rehabilitating the part of the existing sludge pond area** that is not required for emergency purposes. Plan activities in terms of cleaning, landscaping and replanting native vegetation, and potential restoring of natural drainage patterns within the sludge pond area. This plan should also reflect (but not be limited to): o Community safety arrangements; o Monitoring of surface water quality, geological and ground water conditions in the area affected by the sludge facilities; o A system for drainage water disposal to treatment as long as needed, up to the time of the facilities conservation or remediation; o Develop conservation and remediation measures. o Provide regular progress reporting on the plan implementation to lenders and other key stakeholders.
Operation phase		
Ongoing site maintenance and landscaping	• Visual appearance of the WWTP site	• Maintain a buffer zone of native vegetation, trees, and shrubs around the WWTP as well as landscaping and green spaces within the WWTP site, using native vegetation.

Summary of residual impacts

The following table summarises the assessed pre-mitigation impacts, and residual impacts considering successful implementation of the above proposed mitigation measures.

The overall impact significance of the **WWTP construction** related to landscape and topography following mitigation measures is considered **Negative – Negligible**. The impact of demolishing parts of the derelict structures of the existing WWTP and rehabilitating **the existing sludge pond area** is considered to have a **neutral to minor positive** landscape impact. Additional operation phase impacts are considered negligible.

Table 8.3: Summary of impacts on landscape and topography, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Low**	
Pre-construction and construction		
Spatial extent	*Limited*	*Limited*
Duration	*Long-term*	*Long-term*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Minor - Negative (Sludge pond rehabilitation: Minor – Positive)	Negligible - Negative (Sludge pond rehabilitation: minor – Positive)
Operation phase		
Spatial extent	*Limited*	*Limited*
Duration	*Long-term*	*Long-term*
Magnitude of impact	*Low*	*Low*
Overall impact significance	Negligible – Negative	Negligible - Negative

Summary of positive impacts and opportunities for environmental enhancement

Despite changes in the site appearance from greenfield to industrial in nature, the Project also comes with an opportunity to improve the appearance of the existing WWTP site by removing highly derelict infrastructure and rehabilitating parts of the existing sludge pond area, which would constitute a positive landscape impact and support biodiversity habitats. It also comes with the opportunity to build staff capacity in good housekeeping and environmental protection, keeping a clean site without litter, with the aim to improve overall site appearance and wellbeing of workers.

8.1.2 Impacts on geology and soil

Pre-construction and Construction Phase activities

The excavation and land preparation activities affecting topography and landscape (discussed above) impact geology and soil in a similar manner. Also, removing vegetation exposes soil to potential erosion from both wind and rain. The excavation activities and land clearance for WWTP structures will change the appearance of the site adjacent to the current WWTP site from current greenfield to an industrial use.

The impacts on the local geomorphology and soils are direct and **long-term** although the geographic extent of the necessary pre-construction and construction activities is **limited** and restricted to the WWTP site itself and the periphery of the site where the overhead transmission line masts will be relocated.

Additionally, the following construction **activities** involve risks related to **contamination and/or disturbance of soil** and groundwater if not adequately managed:

- Excavations and ground disturbance
- Trenching and backfilling, such as for pipeline installations
- Removing vegetation and topsoil to make space for buildings and other WWTP infrastructure.
- Operation of vehicles and machinery
- Haulage activities
- Material handling
- On-site fuel and chemical storage
- Construction equipment maintenance within the construction site
- Generation of solid waste (construction waste, worker household waste and hazardous waste)
- Decommissioning of existing WWTP and rehabilitation of sludge ponds

- Risk of unplanned events and natural disasters, which in turn can increase the risk of spillages of oils, chemicals, sludge, etc.

These construction activities involve the on-site storage and use of diesel fuelled heavy vehicles, associated use of oils and lubricants as well as various building materials and chemicals, paints etc. If accidentally released into the environment these chemicals can affect soil quality and biology, and potential groundwater quality (impacts discussed in a separate section below) if released in sufficiently large quantities. Such accidental impacts would be **direct** and the likelihood of them occurring is **possible to likely.** In terms of **magnitude**, the impact can be low to high depending on the scope of accidental chemical release. That said, it is considered unlikely that large quantities of fuel or chemicals will be stored on site, given the proximity to Aktobe city where majority of vehicles can be fuelled and serviced. The duration of the risk is **medium-term**, during the full construction phase, and the geographic extent of potential soil contamination would be **limited** to the point of release within the WWTP site itself or local if occurring during transport activities to and from the site.

Additionally, removing vegetation exposes soil to erosion from wind and rain, hence calling for **careful soil erosion and sediment runoff planning and control** throughout the construction phase.

Overall, the **impact magnitude** of the listed activities on geology and soil is determined as **medium and negative**. Given the low sensitivity of the receptor, the un-mitigated **overall impact is considered of minor significance**.

In terms of **decommissioning of the existing WWTP**, as discussed in the previous section, the plan is to leave it largely unaffected and keep the existing structures in place, although some demolition activities will take place. Building **demolition activities** are associated with risk of contamination of nearby soil if chemicals and other contaminants from debris and other demolished parts are released into the environment, hence requiring careful demolition management (see mitigation measures below).

No plans have been provided for rehabilitation of the sludge pond area. As also reflected the previous section, **a plan must be developed for cleaning, closing, and rehabilitating the area** to avoid the risk of future contamination of soil and water resources in the area. **Sludge bed closure and rehabilitation** may in the short term involve ground disturbance and alteration of the current topography but is considered **positive in the medium and long term** as land will be brought to its original state.

Operation and maintenance activities

In particular the following WWTP operation and maintenance activities can result in contamination of soil and the underlying geological substructures.

- Haulage activities (transport to and from the site)
- Ongoing landscaping and ground disturbance
- Pipeline installation and maintenance
- Chemical storage and handling
- Stormwater management
- Effluent Discharge
- Sludge management

The Plant operation will involve some ongoing **heavy transport activities** to and from the site, including the transport of chemicals used in the WWTP process and transport of treated sludge for application on nearby fields and/or for long term storage, entailing the risk of accidental spillages from vehicles.

While **ongoing landscaping and site maintenance** may result in ground disturbance, the scope of this activity is considered minimal and the **impact negligible**. Similarly, pipeline maintenance may require excavations within the WWTP site and around incoming pipelines, although the extent of this impact will be limited to the pipeline trench within the WWTP site, which is an area that has already been impacted.

Chemical storage and handling is an aspect that requires careful consideration and management to avoid accidental spillages into soils within or during transport to the WWTP site. Main chemicals may include coagulants used in the WWTP process, oils and lubricants used for machinery, and paints and other chemicals used for maintenance of facilities with the site.

Sludge management is a key aspect of WWTP operations and a potentially important cause of soil, surface and groundwater contamination if not properly managed. The new WWTP will include anaerobic digestion to stabilise the raw sludge coming from the WWTP and abolish the use of the current sludge ponds to stabilise and dry the sludge. This will have a **positive impact in terms of reduced risk of soil and water contamination** compared to the current situation and will furthermore reduce the release of GHGs from the WWTP. The proposed sludge management and associated impacts related to sludge management are discussed in more detail in the section on surface and groundwater below, and in the section on climate impacts.

Application of poorly treated **WW effluents** and/or sludge on land, e.g., for irrigation and fertilizer, can negatively impact soil quality and its fertility, for example through accumulation of salts or pollutants in the soil. The current WWTP effluent quality is not suitable for use for irrigation due to its poor quality, whereas the new WWTP will treat effluents to highest standards, making it suitable for irrigation purposes. This issue of effluent and sludge quality is discussed in more detail in the section on surface and groundwater impacts below, and in a dedicated section on opportunities related to sludge and effluent reuse.

Additionally, **adequate stormwater management** within the WWTP site is important to prevent soil erosion and to avoid the uncontrolled release of potentially contaminated stormwater into the environment, soil or water courses.

Overall, the routine operation phase activities and accidental incidents can lead to impacts on soil and geology that are **direct** and the likelihood of them occurring is **high** in the absence of robust mitigation and management measures. In terms of magnitude, the **impact is medium to high** depending on the quantity of accidental chemical release. The duration of the risk is **long-term**, during the full operation phase although impacts (if they materialise) may be short-term, and the spatial extent of potential soil contamination could be either **limited**, with regards to spillages within the WWTP site, but could be **local to regional** in cases where contaminated sludge and/or effluents were applied to land outside the WWTP area. As reflected in the baseline section, historic sludge does not contain heavy metals exceeding EU sludge directive standards, hence the risk of soil contamination from sludge application is limited. Nonetheless, this would need ongoing monitoring. In an un-mitigated scenario, the overall magnitude of soil impacts is considered medium, resulting in an **overall impact of moderate negative significance,** i.e., if left unmitigated or poorly managed.

Closure and Decommissioning activities

The negative impacts that may occur during decommissioning of the new WWTP are similar to those identified for the construction activities in general, e.g., relating to the potential contamination of soil, surface water, groundwater resources, ambient air, and noise impacts. Waste materials, in particular aggregates and scrap metal, should be managed to ensure maximal reuse or recycling at end of life in accordance with the waste hierarchy. Any planned closure of facilities and infrastructure should be carried out appropriately to prevent the closed site constituting a risk for humans and animals.

Proposed mitigation measures

The following mitigation measures are proposed to avoid and minimise the identified impacts on soil and geology with focus on reducing soil contamination.

Table 8.4: Proposed mitigation measures related to soil and geology.

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Excavations, trenching and backfilling. Stormwater management	• Ground and soil disturbance. • Vegetation removal and associated risk of soil erosion.	• Implement controlled excavation practices to minimise soil disturbance. • Separate excavated topsoil from other excavated material and store in a designated area for reuse. • Careful management of excavated materials to reduce wash out. • Develop and implement an **erosion and sediment control plan** with measures to prevent soil erosion and sediment runoff during construction and operation. This can involve techniques such as installing silt fences, sediment basins, or sediment traps, as well as implementing proper stormwater management practices.
Operation of vehicles and machinery, incl. haulage activities	• Risk of spillages of contaminants from vehicles, oils, etc. affecting soil quality.	• Implement spill prevention and control measures. • Include spillage reaction and clean-up procedures in **emergency plans** and train relevant staff in their use.
Material handling and on-site fuel and chemical storage	• Risk of spillages of contaminants from chemical handling and storage on site.	• Minimise the on-site storage of fuel on site. Above ground storage tanks to be located on impermeable and bunded surface with appropriate oil traps installed. • Only store chemicals in dedicated storage areas with adequate bunding to prevent release to external environment. • Staff handling chemicals should receive appropriate training to avoid and react to potential spillages. • Include spillage reaction and clean-up procedures in emergency plans and train relevant staff in their use.
Construction equipment maintenance and cleaning within the construction site	• Risk of spillages of contaminants from construction vehicles and other machinery.	• Endeavour to service equipment off-site at dedicated service points. When servicing needs to take place on site, only do this on impermeable and bunded surface with appropriate oil traps installed.
Generation of solid waste (construction waste, worker household waste and hazardous waste)	• Potential release of solid and hazardous waste streams into the environment, negatively affecting soils and ecosystems.	• Solid and hazardous waste generated shall be collected at dedicated collection points within the construction site and stored in closed containers. • Waste sorting to prioritise reuse and recycling in line with what options are available locally. • Provide staff training (including to contractors) focusing on eliminating littering and to follow waste sorting and collection procedures. • Conduct regular cleaning of litter within the site in line with good housekeeping.

Activity	Impact or risk	Proposed mitigation measures
Decommissioning of existing WWTP and sludge ponds, and rehabilitation of sludge ponds	• Potential release of contaminants from demolition activities and/or from rehabilitation of sludge ponds.	• Conduct pre-demolition audits prior to commencing any demolition activities to identify any potential contaminants such as asbestos, PCBs, lead based paints, fuels, solvents, cleaning agents, heavy metals, etc. Remove these contaminants prior to further demolition. • Construction debris which cannot be safely reused or recycled on-site is to be removed immediately from the site and disposed of in an appropriate manner according to local regulations. Temporary storage only on impermeable areas without to avoid the risk of leaching into nearby soils. • ASEG to develop a **plan for decommissioning and rehabilitation of the sludge pond area**, including amongst other: • Sludge ponds to be emptied of sludge and cleaned prior to being filled and covered with top-soil and revegetated. • Any potential plastic lining in the sludge ponds to be removed prior to rehabilitation of the land.
Operation phase		
Transport activities	• Risk of spillages of contaminants from vehicles, oils, etc. affecting soil quality.	• Implement spill prevention and control measures. • Include spillage reaction and clean-up procedures in emergency plans and train relevant staff in their use. • Minimise vehicle maintenance and refuelling on site.
Ongoing landscaping Pipeline installation and maintenance involving excavations	• Ground and soil disturbance	• Implement controlled excavation practices to minimise soil disturbance. • Separate excavated topsoil from other excavated material and store in a designated area for reuse.
Chemical storage and handling	• Risk of accidental spills into soils	• Minimise the on-site storage of fuel on site. Above ground storage tanks to be located on impermeable and bunded surface with appropriate oil traps installed. • Only store chemicals in dedicated storage areas with adequate bunding to prevent release to external environment. • Staff handling chemicals should receive appropriate training to avoid and react to potential spillages. • Include spillage reaction and clean-up procedures in emergency plans and train relevant staff in their use.
Stormwater management	• Inappropriate stormwater management can result in contaminants from the WWTP site entering nearby soil.	• Develop and implement an **erosion and sediment control plan** with measures to prevent soil erosion and sediment runoff during construction and operation. This can involve techniques such as installing silt fences, sediment basins, or sediment traps, as well as implementing proper stormwater management practices.

Activity	Impact or risk	Proposed mitigation measures
Effluent Discharge	• Effluents of poor quality can negatively affect soil quality if applied on fields etc.	• **Monitor effluent quality** to ensure that strict standards are met applicable for effluent reuse (see section below on surface and groundwater impacts)
Treated sludge management (storage and application on fields)	• Sludge containing contaminants can negatively affect soil quality where it is stored, and/or where it is applied on land as fertilizer.	• **Monitor sludge quality** to ensure that strict standards (incl. EU standards) are met with regards to potential reuse of AD digested and dried sludge for agricultural purposes (see further discussion in section below on surface and groundwater impacts)

As a general measure, ASEG and its contractors should maintain a registry of all environmental incidents and accidents, their causes and how they were dealt with, to inform continuous improvement efforts.

Summary of residual impacts

The overall impacts related to soil and geology mainly relate to risk of soil contamination from construction and operation phase activities. The risk of such impacts materialising can be effectively minimised with proper mitigation, management, and monitoring measures as outlined above.

The following table summarises the assessed pre-mitigation impacts, and residual impacts considering successful implementation of the above proposed mitigation measures.

Table 8.5: Summary of impacts on soil and geology, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Low**	
Pre-construction and construction		
Spatial extent	*Limited to local*	*Limited to local*
Duration	*Medium term risk (short-term impacts)*	*Medium term risk (short-term impacts)*
Magnitude of impact	*Medium – negative*	*Low - negative*
Overall impact significance	Minor – Negative	Negligible – Negative
Operation phase		
Spatial extent	*Limited to local*	*Limited to local*
Duration	*Long term risk (short to long term impacts if materialised)*	*Long term risk (short term impacts if materialised)*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Moderate - negative	Negligible - negative

8.1.3 Impacts on **climate and climate change aspects**

The impacts related to climate and climate change are assessed from two perspectives:

- The **impact the project will have on climate and climate change**, in the form of GHG emissions
- The potential climate related **impacts on the Project and its resilience** to climate change risks.

GHG impacts the project will have on climate and climate change

During the **construction phase**, the use of construction machinery and heavy vehicles will result in direct CO_2 emissions. These have not been quantified but are expected to be relatively insignificant in the context of the overall Project. However, the construction of the WWTP also requires substantial amounts of building materials, including concrete and steel, which come with embodied GHG emissions associated with the production of the materials and components needed. The embodied carbon in building materials has not been assessed for this Project. However, a lifecycle assessment (LCA) study for Wastewater systems presented in the journal Nature[31] gives an indication of the order of magnitude carbon footprint at the different lifecycle stages of a central wastewater treatment plant, including the construction vs. the operational stages, as reflected in the following figure. Although not specific to this Project, the study indicates that the lifecycle GHG footprint of a central wastewater treatment plant is roughly half of the use stage footprint, which can be seen as significant. Hence, efforts should be made to explore options to reduce the embodied carbon footprint through green design measures. This also underlines the general value of extending lifetime of built WWTP structures, when possible, rather than building entirely new ones. The option of renovating parts of the existing WWTP has been suggested, but has not been considered in detail or pursued further as discussed in chapter 3.7 on project alternatives

From: Model of Carbon Footprint Assessment for the Life Cycle of the System of Wastewater Collection, Transport and Treatment

Element of system	Unit	Construction stage	Use stage	End-of-life stage	All stages, Total
Septic tanks	kg CO_2 eq/FU	440.97	156.32	−21.68	575.61
Household wastewater treatment plants	kg CO_2 eq/FU	292.77	251.05	−3.36	540.46
Sewerage system	kg CO_2 eq/FU	306.91	162.64	−24.85	444.70
Central wastewater treatment plant	kg CO_2 eq/FU	752.22	1373.61	−395.78	1 730.05
				Total	3 290.82

Figure 8.1 Results of comparative analysis LCA of the system of wastewater collection, transport and treatment. The results for a central wastewater treatment plant are highlighted) Carbon footprint is provided per functional unit (FU) which is 1 PE. (Source: Table 9 Results of comparative analysis LCA of the system of wastewater collection, transport and treatment. (nature.com))

The construction related carbon impact is considered of medium – negative magnitude, and overall significance moderate – negative.

In line with good practice and green building principles, it is recommended that a project specific carbon footprint assessment should be conducted based on the treatment plant's detailed design, including an assessment of the carbon embodied in the building materials and remaining lifecycle stages. The outcome can be used to inform design initiatives to further bring down the GHG footprint of the overall project.

The main GHG impacts of the WWTP Project relate to the **operation phase** and are related to the following activities:

- GHG emissions from the **WWTP process** and associated sludge handling.
- **Electricity consumption** for operating the WWTP
- **On-site generation of electricity (and heat**) that compensates for external energy demand, e.g. related to the anaerobic digestion and biogas generation.

The proposed WWTP will include anaerobic digestion of the sludge. The intention is to utilise the digested sludge for agriculture, although a detailed plan for that process is yet to be finalised.

[31] Model of Carbon Footprint Assessment for the Life Cycle of the System of Wastewater Collection, Transport and Treatment | Scientific Reports (nature.com)

Aquarem has provided the following estimate based on its feasibility study (2023):

- Total electricity consumption of the WWTP of approx. **17 million kWh/year, of which:**
  - **Electricity consumption of the WWT lines is**: 38460 kWh/day, equivalent to 14 million kWh/year (assuming operation for 365 days)
  - **Electricity consumption of the AD / biogas plant**: 7990 kWh/day, equivalent to 2.9 million kWh/year.
- **Electric energy output from the biogas powered CHP**: 50140 kWh/day or **18.3 million kWh/year.**

Based on the abovementioned, the WWTP would cover all its electricity demand by on-site generation from biogas, and in fact be a net exporter of energy, rendering it carbon neutral in terms of scope 2 emissions.

Furthermore, Aquarem provided the following breakdown of the energy output from the CHP generation from biogas:

- Quantity of produced biogas: 21991 m^3/day.
- Quantity of energy emitted by combustion in co-generators, including 131 949,52 kWh/day
  - thermal energy: 65974.76 kW/day
  - electric energy: 50140.82 kW/day

The above power consumption estimate of 17 million kWh/year for the proposed plant is higher than the electricity consumption of the existing WWTP, which has been reported as 9.3 million kWh and 7.3 million kWh/year for 2021 and 2022 respectively (Table 8.6). One likely reason is that the estimate is assuming full capacity of the plant of 100,000 m3/day servicing 500,000 people, whereas the population estimated to be serviced by the WWTP in 2021 was around 316,000. Also, the current WWTP is not working optimally and at full capacity. For example, during the ESIA site visit only two air blowers were working and several of the radial primary and secondary sedimentation tank scrapers were only said to be in operation a couple of hours a day, but not continuously as would be expected.

Table 8.6: Annual power consumption (kWh) for the existing Aktobe wastewater treatment plant (WWTP) (2021-2022)

	2021	2022
WWTP power consumption (kWh/year)	9,291,392	7,301,968
Heat	No data provided	No data provided

Source: ASEG

It has not been possible for Sweco to verify the above estimations from Aquarem and the underlying assumptions are not known.

Hence, to estimate the potential GHG emissions associated with the project, and the impact compared to the current situation, the below assessment reflects the assumptions from Sweco's previous feasibility study for the project (2021). It reflects the estimated electricity consumption for the WWTP and the on-site generation from biogas, as well as the direct (scope 1) GHG emissions from the WWTP and sludge handling process.

The key assumptions related to energy consumption and AD/CHP power generation associated with the project in 2027 (PIP+2 years) and in 2040 respectively, are reflected in Table 8.7. The net energy consumption (after subtracting AD generated power) was assumed to be 15 kWh/capita.year based on typical power consumption of similar activated sludge WWTPs in Eastern Europe).

Table 8.7: On-site energy generation and consumption associated with the WWTP only based on Sweco's estimation (Feasibility study, 2022)

Parameter	2027 (PIP+2y)	2040 (LTIS)
Population serviced by WWTP	315,900 persons	500,000 persons
WWTP influent (m^3/day)	60,700	100,000
Sludge flowrate to AD (m^3/day)	342	562
Biogas generated (m^3/day)	4620	7678
AD CHP electricity generated (kWh/year)	3,850,000	6,400,000
Net WWTP grid energy consumption (kWh/year) taking into account biogas/CPH generation	4,740,000	7,500,000
Gross electricity consumption (kWh/year) (before subtracting power from biogas)	8,590,000	13,900,000

'* Roughly estimated as approx. 10% of consumption without PIP improvements

The GHG estimation by Sweco is reflecting the point in time after the completion of the investment project (assumed in 2027), assuming hence before the WWTP is working at its full capacity.

With regards to the scope 1 emissions from the WWTP process, the GHG comparison uses emission factors for carbon footprint of wastewater processes, based on EIB's carbon footprint methodologies[32] assuming:

- **Current WW process**: Secondary treatment without anaerobic digestion of sludge. Sludge disposal: Land use without further treatment
- **Proposed WW process**: Tertiary treatment (nitrogen, phosphorus removal) with anaerobic digestion. Sludge disposal: Land use without further treatment.

The GHG estimation is provided in the following table. It reflects the WWTP only, and excludes improvements in WW pumping stations, which are included in Sweco's Feasibility study (2021).

CO2 emissions reduced		Baseline (2020)	Projected after implementation completion*	Units
Scope 1 emissions from wastewater processes				
	Population	315,900	315,900	Estimated number of people served (2027)
	PE	455,250	455,250	average flowrate per day * BOD concentration /60g per capita.day
	Emission factor for Carbon footprint wastewater treatment (CFWW)**	0.014[a]	0.01[b]	a. Secondary treatment without anaerobic digestion of sludge b. Tertiary treatment (nitrogen, phosphorus removal) with anaerobic digestion
	Emission factor for Carbon footprint sludge disposal (CFSD)**	0.075[a]	0.034[b]	a. Sludge disposal: Land use without further treatment b. Sludge disposal: Land use without further treatment
	Scope 1 emissions from WW processes	40,517	20,031	tons CO2e/yr
Scope 2 emissions from power generation for project components				
	WWTP power consumption	9,405	8,550	MWh/yr
	WW collection power consumption	0	0	MWh/yr
	AD Biogas CHP electricity generated	-	3,850	MWh/yr
	Combined net consumption for WW services	9,405	4,700	MWh/yr
	Electricity grid emission factor***	0.532	0.532	tons CO2/MWh
	Scope 2 emissions from power generation	5,003	2,500	tons CO2e/yr
Total CO2e				
	Scope 1 + Scope 2	45,521	22,531	tons CO2e/yr
Difference in CO2e due to PIP			**22,989**	**tons CO2e/yr**

* Two years after full disbursement of loan (2027)
** EIB Project Carbon Footprint Methodologies. Methodologies for the assessment of project greenhouse gas emissions and emission variations. V.11.3. January 2023 (Annex 6)
*** Grid emission factors for economies in the EBRD regions (Grid+emission+factors_2022 1.pdf)

Figure 8.2: Estimated GHG emissions from the WWTP and improvements compared to the current situation, based on assumptions from Sweco's previous feasibility study (2021).

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[32] EIB Project Carbon Footprint Methodologies. Methodologies for the assessment of project greenhouse gas emissions and emission variations. V.11.3. January 2023 (Annex 6)

The above estimations and assumptions (for 2027 WW piped service level), indicate that the GHG emissions associated with the project will be **approximately 22,500 tons CO_2e/year in 2027, a reduction of approx. 23,000 tons CO_2e/year** compared to the current emissions.

The above calculations are assuming no leakages of biogas from the AD facility. However, it is noted that leakages of biogas (which is a potent GHG gas) from AD facilities can significantly undermine and remove the GHG benefits of the AD process, and in worst case turn them into net-emitters of GHGs. Therefore, it is essential that ASEG adopts and implements strict procedures to control and mitigate potential gas leakages from the facility.

The impact is considered of medium - positive magnitude, and overall significance moderate – positive.

In line with good practice and green building principles, and to get a comprehensive view of the overall GHG emission of the project over its lifecycle, it is recommended that a project specific carbon footprint assessment will be conducted based on the treatment plant's detailed design, including an assessment of the carbon embodied in the building materials and the use stage. The outcome should be used to inform design initiatives to further bring down the GHG footprint of the overall project.

Proposed mitigation measures related to GHG emissions

The following mitigation measures are proposed to minimise GHG emissions **related to detailed design (pre-construction) and operation** of the proposed WWTP project.

Table 8.8: Proposed mitigation measures related to GHG emissions

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Detailed design of WWTP process (pre-construction)	• Energy consumption and associated GHG emissions	• Incorporate energy-efficient design principles into the treatment plant layout and infrastructure • Optimize the plant's footprint to reduce energy requirements for pumping, aeration, and other processes • Conduct a comprehensive carbon footprint assessment of the treatment plant's detailed design and operation, including emission embodied in building materials. The outcome can be used to inform design initiatives to further bring down the GHG footprint of the overall project.
Detailed design of AD and biogas facilities (pre-construction)	• Leakage of methane biogas from AD system, pipes and storage tanks.	• Install an advanced gas monitoring and detection system to continuously monitor methane levels and potential leakages. • Install a flare or combustion system to burn off excess or unused biogas, ensuring complete combustion and preventing uncontrolled methane emissions.
Operation phase		
Operation of WWTP	• Energy consumption and associated GHG emissions.	• Adopt and implement energy management systems to monitor and optimize energy usage throughout the plant. • Provide training and awareness programs for plant staff on energy conservation, GHG reduction, and sustainable operational practices.

Activity	Impact or risk	Proposed mitigation measures
Operation of AD and biogas facilities	• Leakage of methane biogas from AD facilities, pipes and storage tanks.	• Conduct regular inspections and audits of the biogas infrastructure and systems, incl. covers, pipelines, valves, and other equipment to identify potential leaks and implement corrective measures. • Provide training to plant staff on proper biogas handling procedures, including leak detection, emergency response, and maintenance protocols.

In terms of monitoring, ASEG should regularly monitor and report GHG emissions to identify areas for improvement and track progress towards emissions reduction targets. This includes monitoring of biogas system and registration of the level of potential leakages.

Summary of residual impacts related to GHG emissions

Table 8.9: Summary of climate impacts related to GHG emissions, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Medium**	
Pre-construction and construction		
Spatial extent	*Regional*	*Regional*
Duration	*Long term*	*Long term*
Magnitude of impact	*Medium - negative*	*Low – negative*
Overall impact significance	***Moderate - Negative***	***Minor – Negative***
Operation phase		
Spatial extent	*Regional*	*Regional*
Duration	*Long term*	*Long term*
Magnitude of impact	*Medium - positive*	*Medium - positive*
Overall impact significance	Moderate - positive	Moderate - positive

Potential climate related impacts on the project infrastructure and its resilience to climate change (climate resilience)

Extreme weather events and unforeseen climate changes have the potential to affect projects and business continuity during both construction and operation phases. Hence, it is important to understand these risks and adopt appropriate or adaptation measures to increase project resilience.

In general, climate change driven weather events have the potential to undermine investments already built, or planned, in a given water supply and sanitation project. This can span from the risk of flooding of wastewater treatment plants, pumps, and similar infrastructure, to affecting migration patterns of people, which could increase the demand of an area for a greater and better water supply. Hence, it is necessary to identify the specific climate change risks and outline the corresponding adaptation measures if needed, to reduce the negative impacts on water supply and wastewater systems.

As outlined in the baseline section, Aktobe already experiences harsh climate conditions in the form of cold winters and warm summers, regular thunder and snowstorms, with large variability between years. Although seasonal and annual variations make it difficult to conclude on climate change trends for Aktobe, the available data indicates that the region is considered likely to experience increasing temperatures within all seasons, as well as increase in precipitation within all seasons, except for the summer season.

As reflected in the climate change baseline sections, there is no evidence pointing to an increase in extreme precipitation events, meaning the risk of flooding should not be expected to be larger in the future than it is today.

Table 8.10 and Table 8.11 and reflect generic climate change scenarios and their adverse effects and impacts on water resources and water and wastewater systems. Against the listed generic scenarios, the relevance for the proposed Aktobe WWTP site and potential adaptation measures have been assessed, for the pre-construction and construction, and operation phases, respectively.

<u>Climate risks – pre-construction and construction phase activities</u>

*Table 8.10: Generic impacts on water resources and water/wastewater systems based on climate change scenarios and their adverse effects, and their relevance for the proposed Aktobe WWTP **construction phase activities**.*

Climate Change Scenario		**Adverse effect**		**Impact on Water Resources**	**Impact on Water and wastewater systems**	**Potential impact relevance for Aktobe <u>WWTP construction</u> and adaptation measures**
1	Increasing temperatures	1.a.	Glacial/snow melt in river basins	Low water availability in summer months	River flow and flooding increases in spring. Potential damage to water and wastewater facilities	• There is no significant surface water at or adjacent to the construction site, but snow melt water can collect locally. There is **need for regular site drainage and storm water management at the site (guidance provided further below) but no uplift in measures due to climate change.**
		1.b.	More precipitation falling as rain instead of snow	Low water availability in summer months	River flow and flooding increases in spring. Potential damage to water and wastewater facilities	
		1.c.	Algae and pathogen pollution of water source	Deterioration of water quality	Additional requirements for water treatment	N/A
2	Decreasing precipitation	2.a.	Reduction in surface water flow	Low water availability. Higher pollution in rivers, as sewage discharge is less diluted (higher pollution loads).	Additional requirements for water treatment	N/A for construction
		2.b.	Falling groundwater levels	Loss of water storage	Soil subsidence resulting in damages to structures (buildings, wells and pipes)	• Studies indicated groundwater depth at the site to be >8m, hence not considered a significant risk.
3	Increasing precipitation	3.a.	Increased frequency of flooding	Pollution of surface water from damaged wastewater systems	Potential flooding of water and wastewater facilities	• The site topography is not prone to flooding and no increase in flood risk is projected • Regular **site drainage and storm water management** shall be planned at the site in line with common good practice, but no uplift required due to climate change.

Climate Change Scenario		Adverse effect		Impact on Water Resources	Impact on Water and wastewater systems	Potential impact relevance for Aktobe WWTP construction and adaptation measures
		3.b.	Increased groundwater recharge and rise in groundwater table	Increased transport of contamination in soil and groundwater	Potential flooding of sub-surface structures	• Studies indicated groundwater depth at the site to be >8m, hence unlikely to be a risk. • Nonetheless, need for effective site drainage and storm water management at the site, but no uplift required due to climate change.
4	More extreme temperature events	4.a.	Droughts	Increased water use (*e.g.* irrigation). Higher pollution in rivers, as sewage discharge is less diluted (higher pollution loads).	Low water availability causes problems for hygiene and cleaning at waterworks	N/A for construction
		4.b.	Rapid snow melt	Loss of water storage and low water availability in summer months	Potential flooding of water and wastewater facilities	• Regular site drainage and storm water management should be planned at the site, but no uplift required due to climate change.
5	More intense rainfall events	5.a.	Fluvial erosion and turbulent river flow	Greater transport of contaminants to surface waters	Additional requirements at the waterworks (sedimentation and filtration) Damage to water and wastewater facilities	• The site topography is not prone to flooding and no increase in flood risk is projected • Regular site drainage and storm water management should be planned at the site in line with good practice, but no uplift is required due to climate change.
		5.b.	Flash flooding	Pollution of surface water from damaged wastewater systems	Potential flooding of water and wastewater facilities	

Source: Adapted and integrated from Howard and Bartram (2010)[33], Elliot et. Al. (2011)[34] and Bates et. Al. (2008)[35].

Climate risks – operation phase activities

Table 8.11: Generic impacts on water resources and water/wastewater systems based on climate change scenarios and their adverse effects, and their relevance for the proposed Aktobe WWTP ***operation phase activities****.*

Climate Change Scenario		Adverse effect		Impact on Water Resources	Impact on Water and wastewater systems	Potential impact relevance for Aktobe WWTP operation and adaptation measures
1	Increasing temperatures	1.a.	Glacial/snow melt in river basins	Low water availability in summer months	River flow and flooding increases in spring. Potential damage to water and wastewater facilities	• Could affect Ilek river. Increased flow would increase dilution of effluents. No risk to WWTP site.
		1.b.	More precipitation falling as rain instead of snow	Low water availability in summer months	River flow and flooding increases in spring. Potential damage to water and wastewater facilities	

33 Howard, Guy, and Jamie Bartram (2010): "Vision 2030 - The resilience of water supply and sanitation in the face of climate change Technical report." WHO Technical Report.

34 Elliot, M., Armstrong, A., Lobuglio, J. and Bartram, J. (2011): Technologies for Climate Change Adaptation – The Water Sector. T. De Lopez (Ed.). Roskilde: UNEP Risoe Centre.

35 Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., (2008): Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp

Climate Change Scenario		Adverse effect		Impact on Water Resources	Impact on Water and wastewater systems	Potential impact relevance for Aktobe WWTP operation and adaptation measures
		1.c.	Algae and pathogen pollution of water source	Deterioration of water quality	Additional requirements for water treatment	• WWTP will be equipped with water purification using drum microfilters and a UV disinfection of effluents.
2	Decreasing precipitation	2.a.	Reduction in surface water flow	Low water availability. Higher pollution in rivers, as sewage discharge is less diluted (higher pollution loads).	Additional requirements for water treatment	• Could affect Ilek river and reduce effluent dilution. However, WWTP is designed for highest effluent quality.
		2.b.	Falling groundwater levels	Loss of water storage	Soil subsidence resulting in damages to structures (buildings, wells and pipes)	• Studies indicated groundwater depth at the site to be >8m, hence not considered a significant risk.
3	Increasing precipitation	3.a.	Increased frequency of flooding	Pollution of surface water from damaged wastewater systems	Potential flooding of water and wastewater facilities	• The site topography is not prone to flooding and no increase in flood risk is projected • **Regular site drainage and storm water management** shall be planned at the site in line with common good practice, **but no uplift required due to climate change.**
		3.b.	Increased groundwater recharge and rise in groundwater table	Increased transport of contamination in soil and groundwater	Potential flooding of sub-surface structures	• Studies indicated groundwater depth at the site to be >8m, hence not considered significant risk. • Need for regular site drainage and storm water management at the site, but no uplift due to climate change.
4	More extreme temperature events	4.a.	Droughts	Increased water use (*e.g.* irrigation). Higher pollution in rivers, as sewage discharge is less diluted (higher pollution loads).	Low water availability causes problems for hygiene and cleaning at waterworks	N/A However, improved effluent quality offers opportunities for reuse for irrigation, hence increasing drought resilience.
		4.b.	Rapid snow melt	Loss of water storage and low water availability in summer months	Potential flooding of water and wastewater facilities	• City stormwater in inflow water could overload the WWTP. Emergency plan needs to include appropriate measures, including direct bypass to the URE reservoir, although not considered an uplift due to climate change. • Regular site drainage and storm water management should be planned at the site (see outline below the table), although not considered an uplift due to climate change.
5	More intense rainfall events	5.a.	Fluvial erosion and turbulent river flow	Greater transport of contaminants to surface waters	Additional requirements at the waterworks (sedimentation and filtration) Damage to water and wastewater facilities	• The site topography is not prone to flooding and no increase in flood risk is projected. No rivers nearby to cause fluvial flooding.

Climate Change Scenario		Adverse effect		Impact on Water Resources	Impact on Water and wastewater systems	Potential impact relevance for Aktobe WWTP operation and adaptation measures
		5.b.	Flash flooding	Pollution of surface water from damaged wastewater systems	Potential flooding of water and wastewater facilities	• Regular site drainage and storm water management must be planned at the site, but not considered an uplift due to climate change. • City stormwater in inflow water could overload the WWTP. Emergency plan to include appropriate measures, including direct bypass to the URE reservoir, although not considered an uplift due to climate change.

Source: Same as Table 8.10.

Proposed adaptation measures – Climate resilience

Overall, climate change is not assessed to increase the risk of flooding at the WWTP site, hence regular site drainage and stormwater solutions, as well as emergency planning, dimensioned based on historical precipitation data and local surface water conditions is considered sufficient (see further discussion below).

Table 8.12: Proposed measures related to Climate resilience

Activity	Climate impact or risk	Proposed project adaptation measures
Pre-construction and Construction phase		
Detailed design of WWTP site and infrastructure (pre-construction)	• Flooding risk due to rapid snowmelt or extreme rain events at the site with potential impact on WWTP infrastructure	• Regular **site drainage and storm water management** infrastructure shall be designed at the site to protect infrastructure from flooding, to be effective during both construction and operation phases. A specific uplift in required measures due to climate change, as compared to regular good practice considering local conditions and historic trends, is not found necessary. • Construction phase emergency planning to consider response measures in case of unforeseen climate related events (e.g. storms and heavy precipitation).
Operation phase		
Operation of WWTP	• Risk of rapid snowmelt or extreme rain events in Aktobe City, resulting in potential overload and flooding of the WWTP.	• Maintain regular **site drainage and storm water management** infrastructure at the site (see above). • **Detailed design and Emergency planning** to include appropriate measures in case of flood events, including for example direct bypass of the WWTP to the URE reservoir. • Conduct training of staff in emergency measures including how to deal with flood events.

Basic design of site drainage and stormwater management

In the following, a very rough design suggestion for an effective ‘storm water management’ system is proposed to illustrate the magnitude of infrastructure that is necessary to ensure complete drainage. This is provided for guidance related to dimensioning and must be further considered and analysed as part of detailed design of the site and proposed infrastructure.

Figure 8.3 shows the expected flow paths for runoff, based on elevation data and simple rainfall runoff routing. The ‘thickness’ of the blue lines indicates the size of the upstream catchment. It can be seen that the proposed location for the new treatment plans has a very small ‘catchment’ for runoff (17 ha), while the existing plant has a larger catchment (340 ha) when ignoring hydraulic barriers such as roads and local depressions. The catchments are marked with green in Figure 8.4 below.

Figure 8.3: Flow paths (blue lines) that indicate where surface runoff would pass in the area of the old and the proposed new WWTP.

Figure 8.4: Hydrological catchment area for existing WWTP to the left and new proposed site to the right marked with green. Red marks the downstream flow path.

It has previously been stated that more extreme precipitation events are not expected. Hence, drainage of the site should not be considered adaptation to climate change, but just regular flood proofing. Based on the limited data available and through rough assumptions, an approximation of necessary ditch sizes to handle the stormwater is made for both the current and the future WWTP locations.
If assuming 20% runoff from the catchment – a conservative guess in a grassy area, and assuming that the extreme event of 59 mm in one day (recorded twice since 1905) occurs with 80% of the precipitation within hour – also a conservative guess, the necessary ditches, based on the natural terrain elevations would look as outlined in the following table.

Table 8.13: Estimate of necessary drainage infrastructure around existing and future WWTP locations to manage extreme rain events.

Parameter	Existing WWTP location	New WWTP location
Catchment area (ha)	340	17
Reduced area (ha)	68	3
Maximum intensity of rain (um/s)	13	13
Natural slope of terrain (‰)	7,5	15
Material of ditch	Earth	Earth
Channel depth (m)	1	0,5
Channel bottom width / top width (m)	2/4 (trapez shaped)	0,5 / 1,5 (trapez shaped)

The above table shows a rough indication of the necessary dimensions of a ditch around the plant, if planning for the worst rain event recorded in 100 years. This is a worst-case scenario, and since no flooding has been recorded at the plant, it could be considered to build smaller ditches. Draining of the site is to be considered during detailed site and infrastructure design.

Summary of sensitivity of the project to climate change impacts

The proposed WWTP site is located in an area without close proximity to surface waters and groundwater is present mostly at substantial depth. However, snow melt water accumulates at parts of site during spring. Based on a review of existing climate change projection data and the overall site context, the Project site is not considered at risk of fluvial flooding, and climate change is not expected to result in higher risk of pluvial flooding at or around the site. Hence, regular and effective site drainage and stormwater management based on historic precipitation and trends is considered sufficient. Also, addressing climate related events in emergency response planning is important, as suggested above. This includes making provisions for e.g., direct bypass of the WWTP to the URE effluent retention reservoir in case of stormwater floods from Aktobe City overloading the sewers and the WWTP.

8.1.4 Impacts on surface and groundwater resources

Pre-construction and construction phase activities

The construction phase activities with potential to affect surface and groundwater are typical for large construction projects and largely the same as the activities affecting geology and soil. These activities involve **risks and potential impacts related to contamination of surface and groundwater** if not adequately managed, and include:

- Excavations and ground disturbance (incl. planning thereof)
- Trenching and backfilling, such as for pipeline installations (incl. planning thereof)
- Site levelling and drainage
- Operation of vehicles and machinery
- Transport / haulage activities
- Material handling
- On-site fuel and chemical storage
- Construction equipment maintenance within the construction site
- Generation of solid waste (construction waste, worker household waste and hazardous waste)
- Water supply and wastewater from temporary on-site construction worker facilities
- Decommissioning of existing WWTP and rehabilitation of sludge ponds
- Risk of unplanned events and natural disasters, which in turn can increase the risk of spillages of oils, chemicals, sludge, etc.

Construction phase activities are limited to the WWTP site and transport to and from that site and the periphery of the site to which transmission line masts will be relocated

As reflected in the baseline section, there are no surface waters within or immediately adjacent to the proposed WWTP site, but depressions in the landscape carry thaw water in spring and groundwater for the rest of the year. Before excavating and levelling the site, **appropriate site drainage needs to be planned as part of the detailed design in line with good practice considering site conditions and historic climate conditions and trends** (not considered an uplift due to climate change, see previous chapter).

Water for drinking and sanitary use is sourced through the municipal water supply system. Wastewater from potential temporary construction worker facilities on site can be connected to septic tanks or to the sewer of existing buildings on site, and is not considered a significant issue.

It is understood that concrete will be sourced from concrete plants located in Aktobe City, and hence there will not be a dedicated concrete batching plant on-site. In case a concrete batching plan will be located on site, general spill prevention, waste and dust mitigation measures shall apply.

Other potential impacts that relate to risk of accidental release of fuels, oils, chemicals etc. to the environment are similar to those already identified for geology and soil (section 8.1.2) and require same types of mitigation measures.

Similar to geology and soil, the overall unmitigated **impact magnitude** of the listed construction phase activities on surface and groundwater resources is determined as **medium and negative**. Given the low sensitivity of the receptor, the **overall impact is considered of minor to moderate negative significance** if unmitigated.

Operation and maintenance activities

As for geology and soil, the following WWTP operation and maintenance activities can result in impacts on surface and groundwater:

- Haulage activities (transport to and from the site)
- Ongoing landscaping and ground disturbance
- Pipeline installation and maintenance
- Chemical storage and handling
- Stormwater management
- Effluent discharge
- Sludge management

The impact of the WWTP operations can be considered in the context of the following key receptors and their sensitivity, as described in the baseline section:

- **Surface and groundwater sources at and around the WWTP site (**Low sensitivity)
- **The URE effluent retention reservoir (**Medium to high sensitivity)
- **The Ilek River** (Medium to high sensitivity).

At and around the WWTP site, daily operation and maintenance activities of the WWTP come with **risks of accidental release of fuels, oils, chemicals etc.** to the environment that are the same as what has been outlined above for the construction phase and require same types of mitigation measures. Unmitigated, these impacts are considered of minor significance, and negligible subject to implementation of mitigation measures.

Primary impacts during the operation phase relate to both effluent discharge quality and sludge management, as discussed below.

<u>Effluent discharge and quality</u>

In relation to the URE retention reservoir and the Ilek river, the principal impacts of a WWTP operation on surface and groundwater are related to the **quality of treated effluents** and related impacts on the surface water receptors.

In the case of Aktobe, the existing WWTP discharges effluents to the URE retention reservoir, and from there to the Ilek river. For the new WWTP, the effluent receptors will be unchanged. Currently, the effluents from the existing WWTP are of poor quality and not meeting effluent standards, and negatively impacting the water receptors.

The primary objective of the proposed Project is to improve effluent quality and sludge management related to the WW treatment, and to meet national and EU effluent standards, **hence the overall impact of the Project on surface and groundwater sources will be positive**.

The proposed WWTP is designed to treat on average 100,000 m^3/day of wastewater, which is also roughly the amount of effluent that will be discharged from the plant. This amounts to 36.5 million m^3/year of effluent water.

The following Table 8.14 illustrates the anticipated improvements in effluent quality as a consequence of the Project. The proposed WWTP is designed to meet both national and EU effluent standards.

Table 8.14: Existing effluent quality vs. anticipated effluent quality from the new WWTP based on proposed design standards (values are in mg/L)

	Existing WWTP	**New WWTP**				
Parameter	**Effluent 2022**	**Anticipated quality levels***		**Aktobe Effluent Permit Limits 2018-2027**		**EU effluent Standards**
				From **WWTP**	From **URE**	
BOD5	224.3	<5		4.55	3	25
COD	395,3	<30		27.38	24.41	125
Suspended Solids	267.1	<5		20,7	20.65	35
Ammonium Nitrogen	48.9	<2.0		2.0	0.5	*10
Nitrogen Nitrite	0.085	<1		0.044	0.072	
Nitrogen Nitrates	0.24	<10		24.91	36.02	
Phosphorus	5	<1		2.96	3.5	**1
Dissolved Solids	1008.3			-	0.05	
Chlorides	292.71	Similar to influent		306,6	281.9	
Sulphates	178.22	Similar to influent		303.3	94.22	
Petroleum products	1,7	<0.1		0.183	0.05	
Anionic surfactants	4,21	<0.5		0.46	0.489	
Copper	0.003			0.004	0.0045	
Zinc (II)	0.004			2.75	0.0091	
Iron	0.23	<0.3		0.183	0.049	
Chrome (VI)	0			0.011	0.018	

*Total Nitrogen for discharges to sensitive water.
** Total Phosphorus for discharges to sensitive waters.

The improved effluent quality will benefit the URE retention reservoir water quality as well as the water quality in the Ilek river. The water quality and benthic ecosystem in the Ilek river have been negatively affected during the period in spring when water is discharged from the URE.

The URE effluent reservoir has contributed to improved quality of the effluents from the existing WWTP prior to discharge into the downstream creek and Ilek river and ASEG plans to continue using the URE due to the strict water quality standards pertaining to the Ilek river. Continued use of the URE comes with the additional benefit of enabling the potential use of treated effluents for irrigation purposes, given that there is interest from the farms north of the URE. The potential disadvantage of using the URE for effluent retention is that there are concerns about the integrity of the dam structure due to percolation of water into the dam wall, hence the reservoir cannot be filled to its full design capacity of 40 million m^3, which is close to what would be required to retain the annual outflow from the WWTP (36.5 million m^3/year). Hence, continued use of the URE should be subject to an assessment of the dam integrity, as further outlined in the ESMP.

That said, with the new WWTP and improved effluent quality, discharging to the URE is less critical in terms of meeting water quality standards in the Ilek river, hence parts of the effluents could be discharged via the bypass channel directly to the Ilek river without jeopardizing the quality of the Ilek river, in periods where capacity of the URE may be insufficient. This would be subject to agreements with the relevant water authorities.

In terms of potential **reuse of treated effluents for irrigation purposes**, the effluent from the new WWTP will, based on the design parameters, also comply with the EU minimum requirements for water reuse as specified in the EU's water re-use guideline[36], with regards to BOD and TSS corresponding to crop category A, which it the highest water quality level. However, reuse of the water for agriculture must be subject to evidenced compliance with the remaining pathogen (E.Coli, Legionella, etc.) requirement of the EU regulation (Table 8.15) and strict monitoring requirements as outlined in the EU's water re-use guideline.

Table 8.15: EU Water Reuse Directive minimum requirements

Minimum reclaimed water quality class	Crop category	Indicative technology target	Quality requirements				
			E. coli (number/100 ml)	BOD_5 (mg/L)	TSS (mg/L)	Turbidity (NTU)	Other
A	All food crops consumed raw where the edible part is in direct contact with reclaimed water and root crops consumed raw	Secondary treatment, filtration, and disinfection	≤10	≤10	≤10	≤5	Legionella spp.: < 1 000 cfu/l where there is a risk of aerosolisation. Intestinal nematodes (helminth eggs): ≤ 1 egg/l for irrigation of pastures or forage
B	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	Secondary treatment, and disinfection	≤100	In accordance with Directive 91/271/EEC (Annex I, Table 1)	In accordance with Directive 91/271/EEC (Annex I, Table 1)		
C	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	Secondary treatment, and disinfection	≤1000				
D	Industrial, energy and seeded crops	Secondary treatment, and disinfection	≤10000				

Continuous **monitoring of effluent quality** against national and EU effluent standards will be required, to ensure that effluent standards are met and that the WWTP is operating optimally. In case of reuse of effluents from the WWTP/URE for irrigation purposes, the water quality prior to irrigation also needs to be monitored against the EU water reuse regulation requirements.

The potential to reuse effluents for irrigation purposes is further discussed in relevant sections below.

Overall, the impact magnitude on surface and groundwater at the URE and Ilek river **related to the effluents** from the WWTP are assessed to be **medium and positive**, without the reuse of effluents. With reuse of effluent water and compliance with relevant EU requirements, the impact magnitude is assessed as high positive. Hence, the **overall significance of the impacts is considered moderate to major positive.**

<u>Sludge amounts, quality and management</u>

Uncontrolled or inappropriate **storage of sludge**, which is a key product of the WWTP process, can result in seepage of nutrients and/or pollutants to nearby surface and groundwater receptors.

[36] Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020R0741

At the existing WWTP, raw sludge is pumped to 56 sludge ponds for sun-drying, without prior stabilization or dewatering. Although the sludge pond membrane appears to avoid infiltration into groundwater, there have been years when water has seeped from the 44 ponds further to the north into the adjacent hay fields and affected harvesting (as discussed in the baseline chapter).

The proposed WWTP includes anaerobic digestion (AD) of dewatered sludge, and mechanical drying of the digested sludge, hence largely **eliminating the need for the sludge ponds**, with the exception of a few ponds which should be maintained for emergency purposes.

Related to WWTP operation, there is a general risk of situations requiring emergency shutdown of the mechanical sludge dewatering shop. In such an event, a mixture of raw sludge and excess Waste Activated Sludge from the sludge mixing tank will be discharged via pumps located in the mechanical sludge dewatering building to emergency sludge ponds in the existing sludge pond area. For this reason, a row of 5 sludge ponds should remain as standby units due to emergency". These emergency sludge ponds are already accounted for in the preliminary design by Aquarem and **need to be included in the detailed design.**

Compared to the current situation, AD of the sludge comes with numerous benefits, including energy generation, odour control, sludge volume reduction, nutrient recovery and greenhouse gas emissions reduction. Additionally, it results in pathogen reduction. AD operates at higher temperatures and provides a more controlled environment compared to open sludge ponds. This process effectively kills or significantly reduces pathogens present in the sewage sludge, making it safer for handling and potential reuse, and reducing the risk of contamination of surrounding water receptors.

The proposed WWTP is projected to generate 195 tons/day of dewatered digested sludge (Table 3.7) which amounts to roughly 70,000 tons/year.

The Project proposal, based on the Aquarem Feasibility Study (2023) assumes reuse of the digested and dried sludge. A covered sludge storage area on a hard surface is planned within the WWTP area, where treated and dewatered sludge can be stored for two weeks, after which it can be collected and used as fertilizer for agricultural purposes and for rehabilitation of green areas.

It appears, however, that the final details of the sludge disposal are yet to be determined. It is necessary to establish contracts with off-takers (e.g., farmers) regarding the sludge reuse to determine the amounts that can be used in that way and coordinate the timing of application on fields with the need for temporary storage within the WWTP site. Additionally, in case there is insufficient offtake capacity, alternative treated sludge storage solutions need to be determined. Hence, in parallel with the detailed design of the WWTP, a plan for reusing sludge needs to be developed, including alternative sludge storage options if reuse is not possible.

Opportunities to reuse sludge are discussed further in a dedicated section below.

Overall, the improved sludge management of the proposed WWTP, with AD and elimination of the use of existing sludge ponds, is considered to have positive impacts and reduces the risk of water and groundwater contamination at or around the WWTP site, compared to the current situation. This impact is long-term and considered **high positive**. Given the low sensitivity of the receptor, the **overall impact significance is moderate – positive** as compared to the current situation. Note however that in terms of future application of sludge on fields, the impact would be subject to a sensitivity analysis in each particular context to determine the appropriate use for sludge and quantities given the respective soil conditions in each case. As the off-takers of sludge are not known at this time, it is not possible to assess this impact.

Closure and Decommissioning activities

The negative impacts that may occur during decommissioning of the new WWTP are similar to those identified for the construction activities in general, e.g., relating to the potential contamination of soil, surface water, groundwater resources, ambient air, and noise impacts. Waste materials, in particular aggregates and scrap metal, should be managed to ensure maximal reuse or recycling at end of life in accordance with the waste hierarchy. Any planned closure of facilities and infrastructure should be carried out appropriately to prevent the closed site constituting a risk for humans and animals and with measures in place to prevent release of contaminants into soil and water bodies.

Proposed mitigation measures

All the mitigation measures outlined for “geology and soil” in chapter 8.1.2 are also applicable for protecting surface and groundwater and should also be implemented with this receptor in mind.

Further measures to be implemented to protect surface and groundwater are outlined below.

Table 8.16: Mitigation measures related to surface and groundwater, in addition to those outlined for ‘geology and soil’.

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Site levelling and drainage	• Snow melt and groundwater in landscape depressions impacting ground stability • Risk of contaminants coming in contact with water on site during excavation and site levelling works.	• Design and plan for appropriate site drainage for the construction site (pre-construction / final design and construction planning).
Potential on-site Concrete batching plant (concrete is likely to be sourced from Aktobe)	• Water consumption • Potential contamination of soil and groundwater from wastewater / cleaning water.	• **If** a concrete batching plant will be located on site, make sure that all spill prevention and control measures also apply to the batching plant and are reflected in contractors’ management plans. • Implement proper water management practices to reduce water consumption and prevent contamination. • Locate the plant on a hard surface to eliminate the risk of spillages to the environment.
Operation phase		

Generation of treated effluent discharge	• Not reusing the effluents for irrigation is a poor use of the resource given that Kazakhstan is a water scarce country
	• **Opportunity** to reuse treated effluent for irrigation on nearby fields.
		• ASEG to develop a **resource management and conservation plan**, that amongst other includes:
		  • **A plan for reusing effluents and sludge** from the WWTP, including measures to consult relevant farmers and other stakeholders with regards to utilisation of these resources.
		  • Explore possibilities to reuse treated effluents from the WWTP via the URE retention for irrigation on nearby fields.
		  • Explore possibilities to reuse digested sludge as fertilizer on nearby fields, to reuse nutrients
		  • Include procedures for monitoring of effluents and sludge in line with relevant EU directives.

Disposal of digested sludge	• Not reusing the digested sludge as fertilizer is a poor use of valuable nutrients. • **Opportunity** to reuse nutrients in sludge as fertiliser on nearby fields.	
Disposal of digested sludge	• The plan is to reuse digested sludge for agriculture. However, there is a risk of insufficient offtake capacity as contracts with off-takers are	• **The plan for reusing effluents and sludge** needs to explore options related to temporary storage of treated sludge if there is insufficient capacity within the WWTP site and/or alternative long term storage solutions if there

Activity	Impact or risk	Proposed mitigation measures
	not in place. Also, plans regarding alternative or temporary storage solutions including locations for digested and dried sludge appear not to have been finalised.	is not sufficient offtake capacity amongst farmers or other users in the area. • Within the plan, **temporary or longer-term storage solutions need to be analysed** and could include the current sludge pond area or the current storage area by the URE, subject to permits from the relevant authorities, and the implementation of appropriate impact mitigations and monitoring of impacts on nearby soil, surface, and groundwater sources.
Ongoing landscaping and maintenance	• Use of pesticides	• Avoid the use of pesticides and herbicides within the site.

As a general measure, ASEG and its contractors should monitor and maintain a registry of all environmental incidents and accidents, their causes and how they were dealt with, to inform continuous improvement efforts.

Summary of residual impacts

The overall key impacts affecting surface and groundwater mainly relate to the following:

- Risk of contamination from construction activities
- Handling and storage of sludge and effluents during operational phase

Risk of contamination affecting surface or groundwater from general construction and operation phase activities **at the WWTP site itself** and related to transport to and from the site. The risk of such impacts materialising can be effectively minimised with proper mitigation, management, and monitoring measures as outlined above, to become of **negligible negative significance**.

The following table summarises the assessed pre-mitigation impacts, and residual impacts considering successful implementation of the above proposed mitigation measures.

*Table 8.17: Summary of impacts on **surface and groundwater at the WWTP site**, pre-mitigation and residual (post-mitigation).*

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Low**	
Pre-construction and construction		
Spatial extent	*Limited to local*	*Limited to local*
Duration	*Medium term risk (short-term impacts)*	*Medium term risk (short-term impacts)*
Magnitude of impact	*Medium - negative*	*Low - negative*
Overall impact significance	***Minor to moderate - Negative***	***Negligible – Negative***
Operation phase		
Spatial extent	*Limited to local*	*Limited to local*
Duration	*Medium term risk (short-term impacts)*	*Medium term risk (short-term impacts)*
Magnitude of impact	*Medium - negative*	*Low - negative*
Overall impact significance	***Minor to moderate - Negative***	***Negligible – Negative***

Operation phase impact from **handling and storage of sludge** from the WWTP process, involving potential leeching and contamination of surrounding water sources from sludge ponds. The proposed Project will abandon the use of the sludge ponds, hence with a positive impact compared to the current practice.

*Table 8.18: Summary of impacts on **surface and groundwater at the WWTP site related to sludge handling and storage**, pre-mitigation and residual (post-mitigation).*

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	Low	
Operation phase		
Spatial extent	*Limited*	*Limited*
Duration	*Long-term*	*Long-term*
Magnitude of impact	*Medium – positive*	*Medium - positive*
Overall impact significance	***Minor – positive***	***Minor - positive***

Operation phase impact related to **effluent discharge** to the **URE** effluent retention reservoir and eventually to the **Ilek river**. The proposed project will significantly improve the quality of effluents, with positive impacts on receiving receptors and with the potential to reuse effluent water for irrigation.

*Table 8.19: Summary of impacts on **surface water of the URE retention reservoir and the Ilek river**, pre-mitigation and residual (post-mitigation).*

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	Medium to high	
Operation phase		
Spatial extent	*Local to regional*	*Local to regional*
Duration	*Long-term*	*Long-term*
Magnitude of impact	*Medium - positive*	*High - positive*
Overall impact significance	***Moderate - positive***	***Major - positive***

Summary of positive impacts and opportunities for environmental improvements

Improved effluent quality as well as sludge treatment resulted from the proposed WWTP enables the reuse of effluents for irrigation in agriculture, and reuse of sludge as fertilizer. It is recommended that ASEG plans and implements initiatives to explore possibilities to exploit the opportunities and enhance the positive outcome of the project, in dialogue with relevant stakeholders.

8.1.5 Impacts on ambient air quality (incl. odour)

Pre-construction and construction phase activities

The typical air quality impacts during construction are related to **dust** generated through excavation activities, removal of vegetation and related soil erosion and transport on gravel roads. The area received limited precipitation, so dust generation can be expected. Also, **emissions from vehicles and construction equipment** result in air pollution containing, e.g., nitrogen oxides (NOx), particulate matter (PM), and carbon monoxide (CO). These impacts are medium-term, limited to the construction phase and spatial extent is limited to the WWTP site itself and access road to the site. There are not immediate residential receptors in the vicinity, so the impacts are likely to affect primarily the health and safety of the workers on site (OHS). These impacts can be effectively mitigated through standard mitigation, management, and good practice measures.

Additionally, emptying the existing sludge ponds as part of potential rehabilitation activities of the area is likely to result in **odour generation** at the site, which can be dispersed to nearby villages. As the use of the sludge ponds will stop with the proposed and improved WWTP process, this impact is also limited to the time it takes to empty the ponds.

Overall, the magnitude of construction phase impacts on air quality is assessed to be medium. The receptor sensitivity is assessed to be low with regards to typical pollutants. The sensitivity is higher for odour, where there are already substantial impacts and limited capacity to accommodate further impact, although this is mostly experienced in residential areas away from the WWTP site but can also affect the wellbeing of workers on site. The overall sensitivity is therefore medium. The un-mitigated significance of **construction phase impacts on air-quality is considered moderate – negative.**

Operation phase activities

During operation phase, the most important impacts relate to odour from the WWTP and associated sludge handling. Additionally, the on-site combined heat and power (CHP) plant will be a source of emissions which may include nitrogen oxides (NOx), particle matter (PM) and in some cases sulphurous compounds, in addition to CO_2. The use of biogas to generate energy at the WWTP site will substitute the need for energy sourced from the Aktobe CHP plant, which uses natural gas (a fossil fuel), hence the overall impact of the CHP in terms of air quality is considered largely neutral at the regional level, and positive in terms of climate impacts (see section above on climate impacts).

As reflected in the relevant baseline chapter, odour from the existing WWTP is already a significant issue and a source of significant impacts on nearby villages. The current odour impacts relate to mainly:

- Cleaning of the sludge ponds during summer
- Odour stemming from poorly treated effluents, which are then discharged to the URE reservoir and the Ilek river and riverbanks, where they cumulate in ponds and smell during summer months.

The proposed WWTP Project is expected to significantly improve the odour situation, through the following design components of the Project:

- The WWTP includes **anaerobic digestion (AD) of the sludge**. This in itself stabilizes the sludge and significantly reduces or eliminates unpleasant odours associated with untreated sludge. The digestion process helps to minimize the release of odorous gases, resulting in a more favourable environment for workers and nearby communities.
- Due to the AD, the **use of the open sludge ponds** for treating and dewatering the raw sludge **will be abandoned**. This removes an important source of odour problems which currently originate from the sludge pond area throughout the summer months.
- The proposed WWTP will **significantly improve the quality of the effluents**, which consequently will not smell. This will eliminate the important source of odour from the URE retention reservoir and the Ilek river and its banks.

For the reasons provided above, Sweco's assessment is that the odour situation will significantly improve and is very unlikely to cause nuisance in nearby villages. This is supported by the general experience that odour from modern WWTPs equipped with AD does not pose a problem beyond a distance in the range of 500 m. from the source. This is further supported by findings of the local EIA, which indicates that no air quality impacts will be felt beyond 800 m from the WWTP site.

The local EIA (2023) conducted by Aquarem includes an assessment of the impact on the ambient air quality via modelling the dispersion of surface concentrations of pollutants, for both construction and operation phases. Calculations of dispersion of pollutants from emission sources of the planned Project were following the "Methodology for calculating the concentration of harmful substances in the atmospheric air from emissions from enterprises" using the software package "ERA" v3.0 of the company NPP "Logos-Plus" and following local EIA requirements.

Based on the dispersion modelling, the local EIA concludes that ambient air quality will comply with maximum permitted concentration (MPC) requirements for all pollutants as applicable to both construction and operation phases of the proposed WWTP, and that the area where influence could be measured was max. 800 m from the proposed site. The EIA dispersion modelling for the operations phase (see extract in Annex 5) included Hydrogen Sulphate (H_2S) which is a key source of odour, as well as ammonia and sulphuric acid, which are also odorous substances. Both H_2S and Ammonia are odorous substances which arises from the WWTP process, including the anaerobic digestion facility. The dispersion modelling also included e.g., nitrogen oxides (NOx) relating to the CHP facility. Hence, the dispersion modelling in the local EIA can be seen as an indication of sufficient dispersion well before reaching the nearest residential areas, which is located >2 km from the WWTP.

The local EIA proposes, based on its overall analysis, a size of a sanitary protection zone (SPZ) for the project of 400 m. In comparison, the current WWTP has a SPZ of 1000 m. The actual size of the SPZ will be determined by the regulator, the State Environmental Expertise (SEE).

Sweco has not conducted a dispersion modelling for odour from the WWTP but notes that the distance from the WWTP site to the nearest residential settlement is >2 km. Without additional availability of significant amounts of reliable and granular data, it is unlikely that such modelling would contribute to more specific findings than those that have already been reflected in the local EIA and discussed above. Obtaining precise outcomes through odour dispersion modelling is difficult, also due to the subjectivity of how odour is experienced.

To further eliminate the risk of odour impacts, the anaerobic digestor (AD) and biogas facility should be designed applying best practice odour controlling technologies, enclosed system design and filters as deemed feasible and applicable, to minimise the release of odorous gases. Operators of the facility should undergo training in process optimisation to help reduce odour generation.

To verify the positive impacts of the Project towards eliminating odour impacts at currently affected receptors, it ASEG must adopt and implement a structured monitoring regime based on approved qualitative methods, with the aim to identify, assess and register odour levels at source, and in the currently affected villages. The monitoring plan should also outline odour thresholds, which if exceeded can trigger additional mitigation measures. A list of potential measures and odour control technologies should be reflected in the monitoring plan. Refer to ESMP for description of required monitoring measures.

Overall, the operation of the proposed WWTP is considered to result in positive impacts on air quality, in the form of significantly reduced odour levels compared to the current situation. The impact is long-term with limited to local spatial extent, and of high magnitude. Given the high sensitivity of the receptor with regards to odour, the **overall significance of the air quality impact is considered major – positive**.

Closure and decommissioning activities

The negative impacts that may occur during future decommissioning of the new WWTP are similar to those identified for the construction activities in general. With regards to air quality, these relate to vehicle emissions and dust generation in particular, including from demolishing activities. Any planned closure of facilities and infrastructure should be carried out appropriately to prevent the closed site constituting a risk for humans and animals and with measures in place to reduce impact on air quality.

Proposed mitigation measures

Table 8.20: Mitigation measures related to ambient air

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Excavations, haulage and transport activities	• Dust generation leading to H&S impacts for workers on site	• Maintain proper road surfaces to minimize dust from vehicle movement. • Use dust collectors or filters on construction equipment to capture airborne particles. • Cover lorries transporting construction and demolition waste • Cover stockpiles of materials to prevent wind erosion and reduce dust emissions. • Apply water to suppress dust generation
	• Emissions from vehicles resulting in air pollution at the WWTP construction site	• Use low-emission or electric-powered construction equipment when possible. • Conduct regular maintenance and tuning of equipment to optimize performance and minimize emissions. • Retrofit older equipment with emission control devices, such as diesel particulate filters. • Encourage eco-driving practices among operators to reduce fuel consumption.
Closure and emptying of sludge ponds	• Odour problems affecting the WWTP site workers and village / residential areas closest to the site.	• Plan sludge pond cleaning activities during periods of favourable weather conditions, such as low wind speeds and atmospheric stability, to minimize odour dispersion. • Consider using vacuum trucks or equipment with enclosed systems to minimize the escape of odorous gases during sludge removal and transport.

In terms of impact monitoring during WWTP operations, ASEG should adopt and implement a structured monitoring regime based on approved qualitative methods, with the aim to identify, assess and register odour levels at source, and in the currently affected villages. Refer to ESMP for proposed monitoring measures.

Summary of residual impacts

The overall key impacts affecting air quality related to dust and machine emissions during the construction phase. Odour from sludge pond closure and/or rehabilitation can also result in odour impacts during the time it takes to empty the ponds. During operations phase, the most important impacts relate to odour from the WWTP and associated sludge handling.

*Table 8.21: Summary of impacts **on air quality** associated with the Project, pre-mitigation and residual (post-mitigation).*

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Medium**	
Pre-construction and construction		
Spatial extent	*Limited to local*	*Limited to local*
Duration	*Medium*	*Medium*
Magnitude of impact	*Medium - negative*	*Low – negative*
Overall impact significance	***Moderate - Negative***	***Minor – Negative***
Operation phase		

Impact characterisation	Pre-mitigation	Residual impact
Spatial extent	*Limited to local*	*Limited to local*
Duration	*Long - term*	*Long - term*
Magnitude of impact	*High – positive*	*High – positive*
Overall impact significance	***Major – positive***	***Major – positive***

8.1.6 Noise and vibration impacts

Pre-construction and construction activities

The typical noise impacts during construction are **related to operations of construction machines and equipment**. These impacts are medium-term, limited in time during day-time and to the length of the construction phase, and the spatial extent is limited to the WWTP site itself and the access road to the site. There are no immediate residential receptors in the vicinity, so the impacts are likely to affect primarily the health and safety of the workers on site (OHS). These impacts can be effectively mitigated through standard mitigation, management, use of personal protective equipment (PPE) and good operational practice measures.

Unmitigated, the noise impacts during construction are considered of medium negative magnitude. The sensitivity of the receptor is low, hence the impact significance is considered minor.

Operation and maintenance activities

During the operations phase of the WWTP, the main sources of noise include pumps and air blowers for the aeration tanks, which will be housed within buildings. These sources of noise are mainly associated with OH&S impacts for workers employeed within these buildings. In outside areas, noise may stem from transport vehicles to and from the site, and various equipment used for maintenance activities but is not considered a concern in surrounding outdoor areas due the distance to inhabited areas (>2 km). Vibrations are not considered a significant issue.

To ensure optimal working environment, detailed design of the WWTP should include measures to limit noise from pumps, air blowers and other noisy equipment, to protect workers.

The local EIA by Aquarem also assesses impacts on noise and notes that occupational noise should not exceed 80 dB(A) at source and 60 dB(A) at a distance of 1 m from working equipment. It also concludes, based on noise dispersion modelling, that noise impacts during operations are limited to the WWTP site itself and will not impact nearby areas. Please refer to Annex 5 for more details on the noise dispersion modelling.

Unmitigated, the noise impacts during operations are considered of low negative magnitude. The sensitivity of the receptor is low, hence the impact significance is considered negligible.

Closure and decommissioning activities

The negative impacts that may occur during decommissioning of the new WWTP are similar to those identified for the construction activities in general, e.g., relating to noise from construction and transport machinery and related to demolition activities. Any planned closure of facilities and infrastructure should be carried out appropriately to prevent the closed site constituting a risk for humans and animals, and plan measures to mitigate construction noise and protect workers from noise impacts, in line with good international practice.

Proposed mitigation measures

The following mitigation measures are proposed to avoid and minimise the identified noise impacts associated with the Project

Table 8.22: Proposed mitigation measures related to noise.

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Detailed design of WWTP facilities (pre-construction)	• Risk of insufficient noise insulation around noisy equipment (pumps, air blowers, etc).	• Detailed design of the WWTP to: • Choose equipment and machinery with low noise emission levels. Look for manufacturers' specifications regarding noise output during the selection process. • Place noisy equipment away from worker areas or implement soundproof enclosures around equipment. • Install vibration isolation mounts or pads for equipment that can cause structural vibrations and noise propagation. • Install physical barriers, such as walls or fencing, to create a sound barrier between noise sources and worker areas. • Include soundproof enclosures or rooms around noisy equipment to contain noise emissions. • Use materials with sound-absorbing properties for barriers and enclosures to reduce noise reflection and transmission in rooms with noisy equipment. • Utilize noise monitoring systems to track noise levels in noisy areas and ensure compliance with applicable regulations and standards.
Operation of vehicles and machinery, incl. haulage activities during construction	• Noise from machinery impacting H&S of construction workers	• Set traffic speed limits and verify drivers' behaviour with regards to driving speed. • Limit construction work to daylight hours. • Raise awareness and educate workers about the potential risks of noise exposure and the importance of using hearing protection. • Provide workers with appropriate personal protective equipment, such as earmuffs or earplugs, to minimize their exposure to high noise levels.
Operation phase		
Operation and maintenance of the WWTP	• Noise from pumps, air blowers and other equipment with impacts on workers	• Implement regular maintenance schedules to keep equipment in optimal condition, minimizing the risk of increased noise levels due to wear or malfunction. • Train operators on proper equipment operation techniques to reduce unnecessary noise emissions. • Raise awareness and educate workers about the potential risks of noise exposure and the importance of using hearing protection. • Provide workers with appropriate personal protective equipment, such as earmuffs or earplugs, to minimize their exposure to high noise levels.

Summary of residual impacts

The noise impacts during construction are **related to operations of construction machines and equipment**. During operations phase the main sources of noise include pumps and aerators for the aearation tanks, which will be housed within buildings but may cause OHS impacts. No significant noise impacts are anticipated outside the WWTP site, due to the distance to nearest receptors.

Table 8.23: Summary of noise impacts, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Low**	
Pre-construction and construction		
Spatial extent	*Limited*	*Limited*
Duration	*Medium term*	*Medium term*
Magnitude of impact	*Medium - negative*	*Low - negative*
Overall impact significance	Minor - Negative	Negligible – Negative
Operation phase		
Spatial extent	*Limited*	*Limited*
Duration	*Long term*	*Long term*
Magnitude of impact	*Low - negative*	*Low - negative*
Overall impact significance	Negligible - negative	Negligible - negative

8.1.7 Impact on biodiversity - Flora

Pre-construction and construction activities

The construction activities will include excavations, trenching and backfilling, removing vegetation cover and transforming a large part of the 11 ha site directly adjacent to the current WWTP site from current greenfield to an industrial use (WWTP) site. The impacts are direct and long term, but limited to the proposed site, which is largely divided into a hay field, wasteland and depression where thaw water remains for some time during springs. The area is characterised by low species diversity. No identified plant species are categorised as rare or protected. Hence, the flora receptor sensitivity is considered **low.**

The magnitude of impact is considered medium negative, and given the low receptor sensitivity, the overall significance of the construction impacts on flora are considered **minor – negative.**

Operation and maintenance activities

The WWTP is not considered to have negative impacts on flora during the operations phase.

It is likely that the inadequately treated effluents from the existing WWTP have resulted in negative impacts on the aquatic vegetation in the man-made URE reservoir, in the form of excessive nutrient loads and risk of eutrophication. Improved effluent quality is likely to contribute to a more hospitable habitat for a larger variety of aquatic plants in the URE. However, no studies have been conducted to verify this. The negative operation impacts related to flora are considered insignificant. However, various measures can be taken to improve the WWTP site by planting vegetation and regenerating habitats, as well as rehabilitating parts of the existing WWTP site, including sludge ponds.

Biodiversity impacts related to the Ilek river are discussed in the below section on Fauna.

Closure and decommissioning activities

The negative impacts that may occur during decommissioning of the new WWTP are similar to those identified for the construction activities in general, e.g., relating to destruction or disturbance of vegetated areas. Any planned closure of facilities and infrastructure should be carried out appropriately to prevent the closed site constituting a risk for humans and animals and follow measures to reduce the impact on existing vegetation related to construction activities, as proposed here below.

Proposed mitigation measures

The following general mitigation measures are proposed to avoid and minimise the identified impacts on flora / vegetation associated with the Project. Some of the proposed mitigation measures related to soil and geology are also applicable in this context, including those related to 'Ground and soil disturbance' and 'Vegetation removal and associated risk of soil erosion', and should be adopted with that in mind.

Table 8.24: Proposed mitigation measures related to flora.

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Detailed design of WWTP facilities (pre-construction)	• Opportunity to identify areas within the proposed WWTP site where existing vegetation can be maintained.	• Plan construction activities to minimize disturbance to flora habitats. • Phase construction activities to allow for the completion of work in one area before moving on to the next, reducing the overall footprint of disturbance. • Develop a **restoration plan** to rehabilitate disturbed areas post-construction, including a **plan to rehabilitate the sludge pond area** to support biodiversity.
Excavations, trenching and backfilling activities	• Removal and/or damage to vegetation	• Implement measures to minimize soil compaction and disturbance in areas with significant vegetation. • Separate excavated topsoil from other excavated material and store in a designated area for reuse. • Utilize appropriate construction techniques, such as temporary access roads or mats, to distribute the weight of construction vehicles and equipment. • Apply mulch or organic materials to exposed soil surfaces to control erosion and promote vegetation growth. • Implement erosion control measures, such as erosion control blankets or sediment barriers, to prevent sediment runoff that could impact nearby flora. • Select native plant species appropriate for the site conditions and recreate habitats that support local flora biodiversity.
Operation phase		
Ongoing landscaping within the WWTP site	• Opportunity to revegetate the site and create new biodiversity habitats.	• Select native plant species appropriate for the site conditions and recreate habitats that support local flora biodiversity. • Consider using treated effluents and treated sludge to support vegetation within and around the site.

Summary of residual impacts

The flora biodiversity impacts related to construction are first and foremost related to excavations, trenching and backfilling and associated removal of vegetation cover. No significant negative impacts on flora are anticipated during construction, although improvement in effluent quality can be expected to benefit aquatic ecosystems in downstream receptors, which are currently negatively affected by poor effluents.

Table 8.25: Summary of flora impacts, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Low**	
Pre-construction and construction		
Spatial extent	*Limited*	*Limited*
Duration	*Long term*	*Long term*
Magnitude of impact	*Medium - negative*	*Low to medium - negative*
Overall impact significance	Minor - Negative	Negligible to minor – Negative
Operation phase		
Spatial extent	*No significant negative impacts anticipated*	
Duration		
Magnitude of impact		
Overall impact significance		

Summary of positive impacts and opportunities for environmental improvements

There are opportunities to regenerate and strengthen habitats for flora and fauna within the proposed WWTP site and to rehabilitate the existing sludge ponds to create more natural biodiversity habitats. This could be seen to offset some of negative vegetation impacts associated with the greenfield WWTP construction.

8.1.8 Impact on biodiversity - Fauna

Pre-construction and construction activities

The construction activities will include excavations, trenching and backfilling, removing vegetation cover and transforming a large part of the 11 ha site directly adjacent to the current WWTP site from current greenfield to an industrial use for the new WWTP. Hence potential habitats of terrestrial and avifauna within the WWTP site can be affected. The impacts are direct and long term but limited to the proposed WWTP site.

The biodiversity baseline surveys conducted indicate that the area is characterised by low species and habitat diversity. No mammals and reptiles, their tracks, borrows, excrements or food remains were noted during the survey. Insects were not surveyed. In terms of bird habitats, the proposed new WWTP area was inhabited only by a pair of doves, and jackdaws were noted on the nesting on the powerline poles. A larger variety of birds were identified around the sludge pond area and around the URE retention reservoir. Two bird species were identified that are listed in the Kazakhstan Red Data Book, both in the sludge pond area. Additionally, two other species classified as of least concern (LC) were observed nesting nearby and using URE and sludge beds open water for the chicks rearing.

Overall, the terrestrial and avifauna habitat within the study area is considered of low sensitivity, although due to the presence of the two red book listed birds in the area, a more conservative approach is to consider it of **medium sensitivity**. The impacts are considered of medium negative magnitude, and the overall significance of impacts is therefore **moderate – negative**, prior to mitigation.

Operation and maintenance activities

In terms of **impacts on terrestrial and avifauna** around the WWTP site, the operation or maintenance of the Project is not considered to have any significant impacts beyond the impacts caused by the construction of the WWTP, and associated removal of habitats within the greenfield area adjacent to the current WWTP site.

However, the project is considered to result in **positive impacts on the aquatic ecosystems** and benthic fauna in the downstream water receptors, in particular **in the Ilek river**, compared to the current situation.

As outlined in the baseline section, the hydrobiological study conducted indicates that the poor-quality effluent discharge from the existing WWTP via the URE has negative impacts on the macrozoobenthos species numbers and diversity in the Ilek river around and downstream from the discharge point from the URE discharge creek. Species indicating polluted water were found closest to the discharge point to the river, whereas the upstream control sampling point showed the highest invertebrate diversity, and sampling points further downstream from the discharge point indicated gradual recovery (but not full) and improvement in species diversity. Given the river classification as 1st class according to the Unified system of classification of water quality, the sensitivity of the river is considered **medium.**

The proposed WWTP is anticipated to significantly improve the quality of the effluents discharged to the Ilek river via the URE retention reservoir. As there is some uncertainty to whether other pollutants will affect the effluents on its way from the WWTP to the Ilek river, the magnitude of impact on the Ilek river receptor is considered medium positive, and the **impact significance therefore moderate positive**.

It is recommended to adopt regular hydrobiology monitoring in the Ilek river to verify the positive impacts from the proposed Project.

Closure and decommissioning activities

The negative impacts that may occur during decommissioning of the new WWTP are similar to those identified for the construction activities in general, e.g., relating to the destruction or disturbance of vegetated areas and potential habitat for animals. Any planned closure of facilities and infrastructure should be carried out appropriately to prevent the closed site constituting a risk for humans and animals, and follow general measures to reduce the impact on existing habitats, as proposed below.

Proposed mitigation measures

The following general mitigation measures are proposed to avoid and minimise the identified impacts on fauna habitats associated with the Project. Some of the above proposed mitigation measures related to flora as well as for soil and geology are also applicable in this context, including those related to 'Ground and soil disturbance' and 'Vegetation removal and associated risk of soil erosion', and should be adopted with that in mind.

A dedicated biodiversity management (action) plan is not considered necessary for the project. Although two bird species were identified that are listed in the Kazakhstan Red Data Book, both were in the sludge pond area and not within the actual proposed WWTP site, and overall importance and sensitivity of the habitat is considered low. Nonetheless, it is important that construction activities are planned with due consideration of fauna with the objective to avoid habitat disturbance during the bird breeding season, as proposed below and in the ESMP.

Table 8.26: Proposed mitigation measures related to fauna.

Activity	**Impact or risk**	**Proposed mitigation measures**
Pre-construction and Construction phase		
Detailed design of WWTP facilities (pre-construction)	• Opportunity to identify areas within the proposed WWTP site where existing habitats can be maintained.	• Plan construction activities to minimize disturbance to fauna habitats, particularly during sensitive breeding or migration seasons. • If needed, implement buffer zones and sediment control measures around wetlands and watercourses to prevent sediment runoff and pollution. • Phase construction activities to allow for the completion of work in one area before moving on to the next, reducing the overall footprint of disturbance. • Develop a **restoration plan** to rehabilitate disturbed areas post-construction, including a **plan to rehabilitate the sludge pond area** to support biodiversity.
Excavations, trenching and backfilling activities	• Removal and/or damage to vegetation and habitats of *e.g.* nesting birds	• Schedule noisy activities during periods when the least impact on fauna is expected, such as avoiding nocturnal species during their active periods. • Create or enhance alternative habitats nearby to compensate for any lost or impacted habitats. • Establish new vegetation areas, nesting sites, or artificial shelters suitable for the affected fauna species, *e.g.* within the sludge pond area. • Provide education and training to construction workers on the importance of fauna protection measures and ensure that workers understand mitigation requirements and their role in minimizing impacts on fauna.
Operation phase		
Ongoing landscaping within the WWTP site	• Opportunity to revegetate the site and create new biodiversity habitats.	• In line with the habitat restoration plan, continue creating or enhance alternative habitats nearby to compensate for any lost or impacted habitats. Establish new vegetation areas, nesting sites, or artificial shelters suitable for the affected fauna species, *e.g.* within the sludge pond area.

Summary of residual impacts

The terrestrial and avifauna biodiversity impacts related to construction are first and foremost related to excavations, trenching and backfilling and associated removal of vegetation and potential habitats of birds or small animals within the affected WWTP area. No additional significant negative impacts on fauna or habitats are anticipated during construction.

Table 8.27: Summary of Terrestrial and Avifauna impacts around the WWTP site, pre-mitigation and residual (post-mitigation).

Impact characterisation	**Pre-mitigation**	**Residual impact**
Receptor sensitivity:	**Medium**	
Pre-construction and construction		
Spatial extent	*Limited*	*Limited*
Duration	*Long term*	*Long term*
Magnitude of impact	*Medium - negative*	*Low - negative*
Overall impact significance	Moderate - Negative	Minor – Negative
Operation phase		
Spatial extent	*No significant impacts anticipated*	
Duration		
Magnitude of impact		
Overall impact significance		

The improved effluent quality from the proposed WWTP is considered to result in **positive impacts on the aquatic ecosystems** and benthic fauna in the downstream water receptors, in particular **in the Ilek river**, compared to the current situation. As no additional enhancement measures are anticipated, the pre-mitigation and residual impacts are the same.

Table 8.28: Summary of aquatic ecosystem impacts in the Ilek river, pre-mitigation and residual (post-mitigation).

Impact characterisation	**Pre-mitigation**	**Residual impact**
Receptor sensitivity:	**Medium**	
Operation phase		
Spatial extent	*Regional*	*Regional*
Duration	*Long term*	*Long term*
Magnitude of impact	*Medium - positive*	*Medium - positive*
Overall impact significance	Moderate - positive	Moderate - positive

It is **recommended to adopt regular hydrobiology monitoring in the Ilek river** to verify the positive impacts from the proposed Project. Recommended frequency is annually for the first 3 years of operation of the new WWTP, and biannually thereafter. Refer to baseline section and/or ESMP for outline of proposed monitoring parameters.

Summary of positive impacts and opportunities for environmental improvements

As for flora, there are opportunities to regenerate and strengthen habitats for fauna within the proposed WWTP site and to rehabilitate the existing sludge ponds to create more natural habitats promoting biodiversity. This could be seen to offset some of the negative vegetation impacts associated with the greenfield WWTP construction on the site directly adjacent to the current WWTP.

8.1.9 Impacts on access roads and communal infrastructure

The proposed WWTP **construction and operation** will rely on various infrastructure or utilities which may not be located on the Project site, and/or not owned and operated by the Project proponent (ASEG) and which may be shared with the remaining community. This includes roads, access to water, energy and waste management or disposal infrastructure. This section discusses the potential impacts associated with the Project on the mentioned key infrastructure.

Pre-construction, construction and operation activities

As outlined in the baseline section, the 5 km **access road** to the site from the city is also the access road to the municipal waste landfill. There do not appear to be other significant users of the road. It is understood that ASEG is responsible for maintaining the road. During normal WWTP operations, the traffic to the WWTP is likely to be limited and only a small fraction of the heavy transport to the landfill. However, heavy traffic on the road will increase during construction (medium term) of the proposed WWTP, to supply the site with the necessary building materials. This can increase the wear and tear of the road, which appeared in a moderate to poor condition at the time of the ESIA site visit, showing signs of erosion after the winter and snow melt.

Nonetheless, provided that the road undergoes regular maintenance to sustain current traffic levels, it is expected that it can sustain temporary increase in traffic associated with the WWTP construction, without significant impact on other users.

In terms of **solid waste generation and disposal**, ASEG relies on external service providers with relevant permits to collect and dispose of solid waste (other than sludge) through appropriate channels based on waste types. That said, recycling infrastructure is not well developed in the city, and most (non-hazardous) waste is brought to the municipal landfill located 3 km down the road from the WWTP. In its current permits, the WWTP is estimated to generate approximately 400 tons of solid waste (excluding sludge) per year, most of which is municipal solid waste (MSW). It is not expected that the proposed WWTP will generate more waste than has been previously, hence no significant impacts are expected during normal operations.

The amounts of construction and demolition waste are however expected to increase during the construction of the WWTP. The quantities are currently unknown and will depend on the degree to which existing WWTP infrastructure will be demolished. There have been examples of illegal dumping of construction and demolition waste in the city, hence it is important to monitor waste contractors to ensure appropriate disposal and compliance.

Like the existing WWTP, the proposed WWTP will be connected to the municipal **water supply** mains with metered supply. The WWTP is not considered a significant consumer of water, which is limited to domestic use and cleaning purposes, hence no significant impacts expected.

For **electricity supply**, the WWTP will be connected to the regional electricity grid via a substation, similar to the current WWTP. The electricity originates from the JSC Aktobe CHPP (Combined Heat and Power Plant) which supplies energy to the city. A few electricity masts currently crossing the proposed WWTP site need to be relocated (see Project description) to bypass the WWTP site and then reconnected to a substation within the existing WWTP site. The Aquarem FS has estimated that the gross electricity consumption of the proposed WWTP will be around 17 million kWh/year, which is an increase from the <10 million kWh consumed currently. As JSC Aktobe CHPP already supplies electricity to the city of Aktobe, including to various industries, this is expected to be a small fraction of the total supply in the city. Additionally, the WWTP will be equipped with a CHP cogeneration facility fuelled by biogas from the anaerobic digestion. Aquarem, based on their FS and EIA work (2023) have informed that the on-site electricity generation may exceed the electricity demand of the WWTP on an annual basis (see project description and chapter 8.1.3 on climate impacts). However, details on the exact demand for off-site vs. on-site electricity are not yet available and should be clarified during detailed design.

For **heat**, the WWTP will be connected to the municipal gas network, which will supply gas to boilers to heat buildings on the site. The proposed WWTP will include anaerobic digestion (AD) of sludge to produce biogas, which will be turned into heat and electricity with an on-site combined heat and power (CHP) plant. This will reduce the dependency on external power and heat sources to operate the proposed WWTP.

With regards to heat from biogas, the local EIA (Aquarem, 2023) states that biogas produced during anaerobic digestion in digesters and purified from impurities is burned in the gas generators of the cogeneration system of the boiler house and generators located in the building, and due to this, electric energy and hot water are generated. The regenerated heat from the generator cooling system will be used for the needs of digester heating systems, heating systems for sewage treatment plants, domestic hot water supply systems, and other purposes. There is also a flare facility for temporary or periodic complete combustion of biogas produced by biogas plants (methane tanks) in the absence of the possibility of its useful use as an energy carrier, as well as for burning elimination of excess biogas, which can be formed during maintenance work during operation and in case of accidents in the system. Sweco notes that there are currently no details available on to what extent on-site heat generation will substitute off-site sources. This should be clarified during detailed design of the facility.

Significant impacts on energy infrastructure are not expected.

Closure and decommissioning activities

N/A

Proposed mitigation measures

Although significant impacts are not expected related to the use of the discussed infrastructure, the following general measures are recommended in line with good practice.

*Table 8.29: Proposed mitigation measures related to potential impacts on **communal infrastructure** and associated resource or waste streams.*

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Use of access road to WWTP site	• Increased wear and tear due to increased heavy traffic during construction phase of the WWTP	• ASEG in collaboration with relevant authorities, ensure that the access road is maintained and in adequate condition for heavy transport, prior to start of construction.
Waste generation and disposal during construction, including construction and demolition waste (CDW)	• Risk of inappropriate handling of CDW by waste contractors and/or contractors' sub-contractors.	• ASEG to adopt and implement auditing of waste contractors to ensure appropriate handling and disposal of waste, and compliance with legal requirements. • Encourage sorting of waste, reuse and recycling to the extent possible, in dialogue with relevant service providers.
Operation phase		
Waste generation and disposal during WWTP operation	• Risk of inappropriate handling of waste by waste contractors and/or contractors sub-contractors.	• Adopt and implement auditing of waste contractors to ensure appropriate handling and disposal of waste, and compliance with legal requirements. • Encourage sorting of waste, reuse and recycling to the extent possible, in dialogue with relevant service providers.
Resource (energy, water, materials) sourcing and consumption	• Risk of higher than necessary resource consumption, driving excessive demand from the distribution network with higher than necessary	• Develop and implement a **resource management and conservation plan** for the Project, outlining procedures and actions to continuously identify opportunities and

Activity	Impact or risk	Proposed mitigation measures
	environmental and climate impacts.	alternatives for resource efficiency in its operations, including related to: - Energy efficiency - Water use efficiency - Material use efficiency - Waste minimisation and strategies for reduction, reuse, and recycling.

Summary of residual impacts

N/A – significant impacts are not expected.

8.1.10 Supply chain risks and impacts (ESG related)

Pre-construction, construction and operation activities

Key construction inputs for civil works, including aggregates, concrete, timber and other building materials are likely to be sourced from local providers, although the initial source of some input materials may be through international supply chains. It is important to ensure that aggregates for construction purposes are sourced from quarries which have the required permits.

Specific mechanical and electrical components for the WWTP itself are likely to be sourced internationally, through international tender processes.

In terms of sourcing of key consumables for the WWTP, the key sources of water, energy and waste services have been described in chapter 8.1.9 above. Additionally, the WWTP will use 1,750 tons of coaculants (reagents) annually, which are likely to be sourced through national suppliers.

Given the nature of the Project, the risks in the supply chain related to Environmental, Social and Governance (ESG) factors, are not considered high. Nonetheless, risk areas include the sourcing of aggregates from local quarries and sourcing of construction materials, including wood products. Minor to moderate impacts may occur in the absence of risk mitigation measures. Nonetheless, it is recommended to adopt basic due diligence procedures to reduce the risk of ESG violations in the supply chain.

Proposed mitigation measures

Although significant ESG supply chain risks are not expected related to construction and operation of the Project, the following general measures are recommended in line with general good practice.

Table 8.30: Proposed mitigation measures related to potential ESG impacts in the supply chain

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Procurement of products and materials for the WWTP construction	• Risk of ESG impacts or violations in the supply chain	• Provide training to procurement teams to raise awareness about supply chain ESG impacts and build capacity to conduct ESG due-diligence to identify and mitigate supply chain risks. • ASEG to integrate supply chain requirements into tendering and contractual documents and processes and reserve the right to monitor supply chain risks in contractors and subcontractors' activities through relevant clauses in contracts.

Activity	Impact or risk	Proposed mitigation measures
Sourcing of aggregates from local quarries	• Risk that material comes from quarries without the necessary permits	• Conduct appropriate due diligence to ensure that aggregates and other locally sourced construction materials come from legitimate sources and hold the necessary permits, including with regards to environmental, health and safety performance.
Sourcing of wood and wood products	• Risk that wood and wood products have been sourced from illegal or unsustainable forest operations	• Endeavor to source wood and wood products with internationally recognised sustainable forestry certifications, such as the FSC label. Conduct appropriate due diligence to verify this.
Operation phase		
Procurement of products and materials for the WWTP operation	• Risk of ESG impacts or violations in the supply chain	• Provide training to procurement teams to raise awareness about supply chain ESG impacts and build capacity to conduct ESG due diligence to identify and mitigate supply chain risks.

Summary of residual impacts

N/A

8.1.11 Opportunities related to reuse of effluents and digested sludge from the WWTP

The proposed WWTP Project will result in significant improvement of effluent quality as well as in treatment of sludge from the WWTP process, compared to the current situation.

This creates opportunities to further enhance the positive impacts of the Project, by striving for the optimal use of water and nutrients, in the spirit of a regenerative circular economy, as shortly outlined below.

It is acknowledged that there is a considerable need to improve resource efficiency in Kazakhstan. This need is clearly reflected in Kazakhstan's Green Economy Strategy, the aim of which is to address the current situation of inefficient use of resources, deteriorating natural resources and dependency on fossil fuels amongst others, and to put the country on a sustainable development path.[37]

Opportunities to reuse treated effluents from the WWTP

The bulk of water consumed in Kazakhstan, *approx.* 70%, is used for agriculture. A state Programme for Water Resources Management in Kazakhstan 2014-2040 is one of several programmes in the country that address water resources and water utilization issues. Amongst the priorities provided by the programme is that average tariffs for water supply to agriculture should be increased ten-fold to 58 tenge (USD 0.18 cent) per m^3 of water.[38] This seems to indicate an increasingly strong incentive for pursuing water efficiency and reuse in agriculture in the near future.

In Aktobe Region, annual rainfall is low, with an average of 330mm per year, consequently there is an opportunity to re-use treated effluent.

Treated effluents from the existing WWTP are not currently used for agricultural irrigation purposes, and the current quality of effluents would not meet EU Water Reuse Directive minimum requirements. However, water from the URE reservoir has been used for irrigation in the past, and there are clear opportunities for reusing the effluent water from the new WWTP.

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37 https://www.oneplanetnetwork.org/sites/default/files/kazakhstan_concept_for_transition_of_the_republic_of_kazakhstan_to_green_economy.pdf

38 https://www.s-ge.com/sites/default/files/article/downloads/industry_report_kazakhstan_water_management_2017.pdf

The proposed new WWTP is designed to treat on average 100,000 m^3/day of wastewater, which is also roughly the amount of effluent that will be discharged from the plant. This amounts to 36.5 million m^3/year of effluent water. While initially designed with 40 million m^3 capacity, the URE is currently only filled to 25 million m^3 due to concerns about the integrity of the dam wall and risk of dam failure when the capacity if fully utilized.

A World Bank Report (2003) indicates that water withdrawals per irrigated hectare in Central Asia may be in the order of 12,000 – 14,000 m^3/ha, which is according to the report “excessively high”[39]. Nonetheless, this gives a rough indication of the irrigation potential of the treated wastewater in terms of how much land could theoretically be supplied with irrigation water in the form of treated effluents, assuming that other conditions such as crop type, soil and effluent conditions are also suitable.

Assuming an annual demand of 10,000 m^3/ha irrigated land, and availability of 25 million m^3 of treated effluent water in the URE, there would be sufficient water to irrigate 2500 ha of land.

As outlined in chapter 8.1.4, the effluent from the new WWTP will, based on the design parameters, also comply with the EU minimum requirements for water reuse as specified in the EU’s water re-use guideline[40], with regards to BOD and TSS corresponding to crop category A, which is the highest water quality level. However, re-use of the water for agriculture must be subject to evidenced compliance with the remaining pathogen (E.Coli, Legionella, etc.) requirement of the EU regulation. (Table 8.15) and strict monitoring requirements as outlined in the EU’s water re-use guideline.

Also, the characteristics of treated wastewater, soil composition and crop type must be considered carefully. Despite the common positive effects of re-using treated effluents for agriculture, studies have shown that increase of electrical conductivity (EC) in soil may negatively affect crop productivity or soil salinization, depending on the treated effluent and soil compositions, and crop type[41]. Hence, careful monitoring of the relevant factors is required prior to use. FAO’s irrigation guidelines provide insights on how to overcome salinity risks associated, guidance on good practice and efficient irrigation methods, *etc*.

Opportunities to reuse treated sludge from the WWTP

At the EU level, the Sewage Sludge Directive 86/278/EEC encourages re-use of sewage sludge in agriculture and regulates its use in such a way as to prevent harmful effects on soil, vegetation, animals and man. The Directive accepts the re-use of sludge on agricultural land if the sludge has undergone treatment involving “biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use”.

The proposed anaerobic digestion (AD) also enables compliance with the EU Sewage Sludge Directive 86/278/EEC.

There is currently no reuse of sludge from the Aktobe WWTP for agricultural purposes. However, there appear to be opportunities for local agricultural re-use of sludge between 0 and 5 km to the north-east from the WWTP by two (2) main farms; Temir Tulpar Batys and Andi. These farms also produced vegetable oil at the plant in the Aktobe south industrial zone (see ESIA for distance and further discussion on opportunities to reuse sludge from the proposed new WWTP).

The proposed WWTP is projected to generate 195 tons/day of dewatered digested sludge (Table 3.7) which amounts to roughly 70,000 tons/year.

39 Irrigation in Central Asia Social, Economic and Environmental Considerations (World Bank, 2003)

40 Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020R0741

41 https://www.researchgate.net/publication/258614930_Salinity_effect_of_irrigation_with_treated_wastewater_in_basal_soil_respiration_in_SE_of_Spain

As reflected in chapter 6.1.6 and Table 6.14, analysis of existing sludge heaps at the Aktobe sludge pond and URE storage sites, indicate a low concentration of heavy metals in the sludge (and hence influent wastewater) which are well within the EU Sludge directive "Limit values for heavy metals concentrations in sludge for use in agriculture", and hence the **opportunity to reuse the treated sludge** as fertilizer in agriculture.

In Kazakhstan, the reuse of sludge for agricultural purposes is accepted. There is no sludge disposal policy in Kazakhstan. However, waste handling and disposal requirements are given in the Environmental Code. Sludge is categorised as non-hazardous waste and can be used in agriculture or horticulture, providing the maximum permitted concentration of pollutants and pathogens in the soil are met. Composting sludge is also considered to remove pathogens but rarely applied.

Spanish studies have shown that long term application of sewage sludge enhances soil properties but indicate maximum dosage of 40 tons per ha (dry solids), applied biannually. Above this level, soil quality did not improve, and may even worsen[42].

Potential land areas for effluent and sludge reuse in the vicinity of the WWTP

In light of the above opportunities, and as reflected in Table 8.16, it is recommended that ASEG develop a **resource management and conservation plan**, that amongst other include **A plan for reusing effluents and sludge** from the WWTP, including measures to consult relevant farmers and other stakeholders with regards to utilisation of these resources.

A tentative identification of nearby farms that could potentially benefit from the use of sludge and/or treated effluent water from the WWTP has been conducted. The identified farms, fields and the distance from the WWTP in km is outlined in Table 8.31.

These options need to be further explored and a **plan for reusing effluents and sludge** will need to be developed by ASEG to continuously explore options to reuse the generated and treated sludge, in dialogue between the operating authority of the WWTP and other relevant stakeholders in the area, municipality, famers, railway operator, Forestry Committee, etc. Any sludge reuse involving land application, must be subject to prior monitoring of contaminants and with account taken of the nutrient requirements of plants, and that the quality of the receiving soil and of the surface and groundwater is not impaired, in line with the EU sludge directive.

The table below shows number of fields owned by nearby farms and the distance to WWTP.

[42] https://ec.europa.eu/environment/integration/research/newsalert/pdf/298na3_en.pdf. Referred to as an example - results not directly transferrable to other countries and regions.

Table 8.31: Kurayly village farmers that can benefit from the use of treated water and sludge. Fields that cannot benefit from gravity distributed water are left blank. Fields that could not be located are in red (Source: From the City Council response № ЮЛМ0006/0 from 27.03.2023).

Farm	Field # 02-036-	Km distance from WWP for application of	
		Sludge	Treated effluent water
Temir Tulpar Batys LLP	164-451	0	
Nurzhigitov Talgat	164-452	0	0
	164-450	5	
	164-435	0	0
	164-436	0	0
	164-437	2	
	164-432	3	3
	164-433	3	3
	164-431	0	0
	164-405	6	
	164-394	9	9
ANDI LLP	164-014		
	164-276	4	
Kabakbaev Madi	164-438	2	2
	164-389	4	
	164-342	4	
	164-341	10	10
	164-334	6	6
	164-042	6	-
	164-289	4,5	-
	164-293	-	-
	164-294	-	-
Aterra LLP	164-429	16	16
	164-423	2	2
Tuleuova Meiramgul	164-251	0	0
	164-345	3	3
	164-346	11	11
	163-1388	8	8
	163-509	8	8
	164-472	27	

Farm	Field # 02-036-	Km distance from WWP for application of	
		Sludge	Treated effluent water
Nan peasant farm Ulyarova Kulyash	163-1731	33	
	163-1732	33	
	163-1733	33	
	163-1734	32	
	163-1735	32	
	163-1736	32	
	163-1737	32	
	163-1738	32	
	163-1739	33	
	163-1740	33	
	163-1730	33	
	164-288	39	39
	164-415	15	
	164-416	12,5	
	164-414	16	16
	164-395		
	163-1383		
	163-1384		
	163-1382		
	163-1101		
	164-387		
	164-222	0	0
	164-385	27	27
	164-386	27	27
	164-384	9	9
	164-383	8	
	164-464	10	10

8.2 Socio-economic impacts

This section describes the positive and negative impacts that the proposed WWTP Project is assessed to have on the human receptors described in the baseline section of this ESIA report. The assessment is made in relation to activities during the pre-construction and construction phase and the operation and maintenance phase, while there are not expected to be any socio-impacts of activities during closure and decommissioning of the proposed WWTP.

The following table provides an overview of the human receptors and their assessed level of sensitivity in the context of the Project.

Table 8.32: Human receptors and level of sensitivity in the context of the Project.

Receptor	Assessed sensitivity
Residents in the settlements of Railway Junction 39 and Tulpannyy hamlet	Medium
Residents in Georgievka village	Low
Residents in Kurayly village	Low
Temir Tulpar Batys LLP farm	Medium – Low
Aterra LLP farm	Low
Nan farm	Low
ANDI LLP farm	Low
Workers at the JSC Aktobe Chromium Compounds Plant	Low
Residents in Aktobe City	Low
Construction workers	High - Medium

8.2.1 Impact on employment

Pre-construction and Construction Phase activities

The construction of the new WWTP will be associated with moderate workforce engagement. The Project is expected to employ around 100 workers during the construction phase of approximately 3 years' duration[43]. The construction workforce will require both unskilled, semi-skilled, and skilled workers.

The baseline demonstrates that in 2022 approx. 33,000 persons in Aktobe City were engaged in the construction sector, which constituted 10.3% of the total workforce. This is slightly higher than the percentage of the workforce in Aktobe Region (8.5%) and at national level (7.3%) engaged in the construction sector.

Due to the Project's location within the borders of Aktobe City and the availability of construction workers in the area, it is expected that the construction workforce will be hired from Aktobe City and villages in the vicinity of the city, enabling local-level job generation.

The construction activities will lead to employment opportunity for a moderate number of unskilled and skilled workers during the construction period. The impact on the employment is **direct** and **medium-term** (estimated 36 month of construction). The spatial extent of the impact is **regional** within Aktobe Region. The impact magnitude is determined as medium and positive. Given the medium sensitivity of the receptor, the **overall impact is considered of moderate - positive** when unmitigated.

Operation and maintenance activities

The ASEG number of staff is relatively high for a utility with a total of 2,025 employees, of which 338 employees work in the departments involved in wastewater related services.

Table 8.33: ASEG number of staff in wastewater related departments

Department	Men	Women	Total
Sewer network	48	-	48
Pumping stations for wastewater	143	68	211
Wastewater treatment plant	49	30	79

The Feasibility Study (FS) prepared by Sweco (2022) considers ASEG as overstaffed and foresees a substantial staff reduction of O&M staff working at the Aktobe WWTP. The FS recommends that efforts are made to transfer the surplus staff to other positions within the company. It is estimated that ASEG will reduce its existing WWTP staff with approximately 50 people.

The collective agreement between the ASEG management and the trade union committee stipulates that in case of staff reductions, ASEG is to terminate employment contracts in the following list of priority:

- Contracts for staff who are in their probationary period.
- Contracts for staff who have least experience from working in public utilities.
- Contracts for staff who do not have an appropriate education or work experience in relation to area of work.

The collective agreement states, furthermore, that priority should be given to retain employees who are sole breadwinners, parents of large families with four or more children, employees who have worked at

[43] As Aquarem's Feasibility Study (2023) does not provide details of the construction workforce, an estimate has been made by Sweco's wastewater specialist.

the company for a long time (men at least for 20 years, women at least for 15 years), pregnant women, and women with children under the age of three years. These stipulations are in line with the national Labour Law, which is referred to in the retirement and other sections of the collective agreement.

According to the national Labour law the notice period in connection with dismissals is one month. It is understood that when reduction of staff is considered necessary in a particular working area, the employees concerned would be offered other jobs within the company, in accordance with the Labour Law.

The impact on employment during operation is **direct** and **long-term**. The spatial extent of the impact is **regional** within Aktobe Region. The impact magnitude is determined as high and negative. Given the medium sensitivity of the receptor, the **overall impact is considered of moderate - negative** when un-mitigated.

Proposed mitigation measures

The following general mitigation and enhancement measures are proposed to minimise the identified negative impacts and enhance the positive ones.

Table 8.34: Proposed mitigation measures related to employment

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Construction of the WWTP	• Risk of influx of workers	• Contractor will develop a local recruitment policy, aiming at employing local workers from the Aktobe City and neighbouring villages where appropriate.
Operation phase		
Operation and maintenance of the WWTP	• Risk of retrenchment	• ASEG shall promptly, but no later than 60 days before any decision is taken in respect of any planned redundancy, inform EBRD if such redundancy affects at least 10% of its total employees over a 30-day period and prepare a Retrenchment Plan in line with PR2 requirements. In the case of any planned redundancy affecting at least 25% of its total employees over a 30-day period of time, ASEG will provide the Retrenchment Plan to EBRD prior to undertaking any of the planned redundancies. ASEG to cooperate with the City Akimat to identify employment opportunities for redundant employees outside of ASEG.

Summary of residual impacts

The employment impacts related to construction are overall positive as the Project will create jobs. During operations a negative impact is foreseen due to reduction of WWTP staff in ASEG.

Table 8.35: Summary of impacts on employment, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Low – medium**	
Pre-construction and construction		
Spatial extent	*Regional*	*Regional*

Impact characterisation	Pre-mitigation	Residual impact
Duration	*Medium term*	*Medium term*
Magnitude of impact	*Medium*	*Medium*
Overall impact significance	Minor - Positive	Moderate - Positive
Operation phase		
Spatial extent	*Regional*	*Regional*
Duration	*Long term*	*Long term*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Major - Negative	Moderate - Negative

8.2.2 Impact on labour and working conditions

Potential risks related to labour and working condition arise in case ASEG and contractors fail to comply with specific requirements of national and international labour standards, leading to:

- Violation of labour conditions, e.g., working hours and overtime, remuneration and delayed payment, provision of rest and holidays, workers' unions, and personal data protection.
- Discriminatory practices and lack of equal opportunity.
- Lack of or restricted access to a workers' grievance mechanism.

Pre-construction and Construction Phase activities

During construction, ASEG is to ensure that provisions for Contractor labour compliance are followed, including but not limited to the following:

- Compliance with national social security, health and safety and labour requirements.
- Adherence to fundamental standards and principles of the International Labour Organization regarding minimum age and child labour, forced labour, freedom of association and non-discrimination.
- Fair and timely remuneration.
- Provision of a workers' grievance mechanism.
- Contractors' personnel management and control.

ASEG is to require the Project contractors and subcontractors to comply with the labour requirements of EBRD PR2 as a special clause in the service and supply contracts. ASEG will monitor contractors and subcontractors for compliance with requirements through regular labour inspections conducted by ASEG staff, establishing compliance on the above.

ASEG shall extend access to their internal grievance mechanism to contractors and subcontractors' workers and ensure that contractors are aware of the need to allow for confidential submission of grievances from their personnel.

It is anticipated that the Project will not require any construction workers' accommodation camp, as workers are expected to be able to commute to and from the WWTP construction site. In 2022, Aktobe City had 99 registered accommodation facilities (hotels of various categories of comfort, motels, summer house zones, rest houses and other facilities), with 5,503 registered beds. A relatively limited number of tourists and other visitors stay overnight in Aktobe Region, leaving an excess accommodation capacity that can be used in case this may be needed during construction. Due to the availability of a construction workforce in Aktobe Region, migrant workers are not foreseen to be hired for Project construction or operation. In case international staff will be used for positions requiring specific expertise, these are expected to be accommodated in Aktobe City.

ASEG will be responsible for managing contractors and subcontractors during the construction phase, ensuring that labour is managed in a manner compliant with EBRD’s Performance Requirement (PR) 2 requirements. It is assessed that ASEG’s approach to and experience in regulating contractor labour conditions is insufficient to ensure proper contractor management on labour and working conditions. The environmental and social requirements and actions set out in the ESMP will apply to all contractors and sub-contractors working on the Project. At the corporate level, ASEG will strengthen its contractor management system to make sure that contractors working on project sites meet these labour requirements.

The impact on labour conditions is **direct** and **medium-term** (estimated 36 month of construction). The spatial extent of the impact is **regional** within Aktobe Region. The impact magnitude is determined as medium and negative. Given the medium sensitivity of the receptor, the **overall impact is considered of moderate – negative** when un-mitigated.

Operation and maintenance activities

Labour and working conditions are regulated by a number of documents including the collective agreement, employee contracts, and internal labour regulations.

In terms of labour management ASEG has many appropriate human resources procedures and has documented and communicated working conditions and terms of employment to their employees. The company does not have a written HR policy, but working conditions are documented in the collective agreement signed between the ASEG management and the ASEG trade union committee. Identified gaps in the Environmental and Social Management System (ESMS) are addressed in the company Environmental and Social Action Plan (ESAP) and will be closed prior to operation.

The impact on labour conditions is **direct** and **long-term**. The spatial extent of the impact is **regional** within Aktobe Region. The impact magnitude is determined as high and negative. Given the medium sensitivity of the receptor, the **overall impact is considered of moderate – negative** when unmitigated.

Proposed mitigation measures

The following general mitigation measures are proposed to avoid and minimise the identified impacts on labour and working conditions associated with the Project.

Table 8.36: Proposed mitigation measures related to labour and working conditions

Activity	Impact or risk	Proposed mitigation measures
Construction phase		
Construction work, operation, and maintenance	• Working conditions and terms of employment	• ASEG to integrate labour requirements in tender documents and in contracts with all contractors involved in the construction. • ASEG to develop and implement auditing and performance monitoring procedures to check contractors’ compliance with labour requirements. • Contractors are required to adopt and implement a Labour Management Plan including human resources policy and procedures, which will set out the approach to labour management consistent with the EBRD requirements and the laws of Kazakhstan. The policy and procedures will cover and ensure

Activity	Impact or risk	Proposed mitigation measures
		compliance with the relevant requirements for the following: i. non-discrimination, equal opportunity, and equal pay. ii. prevention of child labour and forced labour. iii. freedom of association and right of collective bargaining. iv. contractor management. v. terms of employment including recruitment, hours of work, overtime arrangement and overtime remuneration, the right to refuse overtime requests. vi. commitment to apply zero tolerance for gender-based violence, workplace harassment, sexual exploitation, and abuse. vii. formal grievance mechanism. • The human resources policy and procedures including the grievance mechanism will be provided to all workers. These documents will contain information that is clear and understandable regarding workers’ rights under national labour and employment law(s) and any applicable collective agreements.
	• Workers’ grievance mechanism	• The Contractor will provide construction workers with an effective grievance mechanism (GM) and make the GM available for the workforce of sub-contractors and suppliers. • The GM shall include provision for GBVH grievances ensuring confidentiality. • This mechanism shall involve appropriate level of management and address concerns promptly, using an understandable and transparent process that provides timely feedback to those concerned without retribution. The mechanism should allow for anonymous complaints to be raised and addressed. The mechanism should not impede access to other judicial or administrative remedies that might be available under the law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.
	• Workers’ accommodation	• In case workers accommodation will be provided during the construction phase, ensure that facilities are compliant with EBRD/IFC Guidance “Workers’ Accommodation: Processes and Standards”.

Summary of residual impacts

The impacts on labour and working conditions during the construction phase are related to the risk of Contractors and sub-contractors not adhering to national and international labour requirements. Improvements to ASEG human resources practices are addressed in the company Environmental and Social Action Plan (ESAP) and will be closed prior to the operation phase of the Project.

Table 8.37: Summary of impacts on labour and working conditions, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Low - medium**	
Pre-construction and construction		
Spatial extent	*Regional*	*Regional*
Duration	*Medium term*	*Medium term*
Magnitude of impact	*Medium*	*Medium*
Overall impact significance	Moderate - Negative	Minor - Negative
Operation phase		
Spatial extent	*Regional*	*Regional*
Duration	*Long term*	*Medium term*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Moderate - Negative	Minor - Negative

8.2.3 Impact on workers' health and safety

Pre-construction and Construction Phase activities

Basically, all activities during the construction phase of the Project can entail risks related to Occupational Health and Safety (OHS). The types of OHS risks during the construction phase are typical for most large construction and infrastructure projects and include the following activities and associated risks, amongst others:

Table 8.38: Proposed mitigation measures related workers' health and safety

Activity	Risk and Impacts
Construction phase	
Excavation and trenching	• Cave-ins, engulfment, falls, exposure to hazardous substances in soil. • Resulting in worker injuries or fatalities, damage to underground utilities, environmental contamination.
Demolition works	• Structural collapse, falling objects, exposure to hazardous materials (asbestos, lead, etc.), exposure to noise and vibration. • Resulting in worker injuries, release of hazardous substances into the environment.
Working at heights	• Falls from heights, unstable scaffolding, inadequate fall protection measures, falling objects. • Resulting in serious injuries or fatalities, damage to property, disruption of work, potential environmental impact.
Heavy lifting and handling of materials	• Risk of musculoskeletal injuries, strains, falls, struck-by hazards, improper use of lifting equipment. • Resulting in worker injuries, property damage, project delays, increased costs.
Working with hazardous materials.	• Exposure to chemicals, asbestos, lead, silica, solvents, fumes, and dust, inhalation, skin contact, or ingestion hazards. • Resulting in occupational illnesses, long-term health effects, contamination of soil, water, or air.
Electrical work	• Electric shock, burns, arc flash, contact with energized equipment or overhead powerlines. • Resulting in worker injuries or fatalities, electrical fires, damage to equipment, disruption of electrical services.
Welding and cutting	• Risk of burns, eye injuries, inhalation of toxic fumes and gases, fire hazards.

Activity	Risk and Impacts
	• Resulting in worker injuries, fire incidents, damage to structures or equipment, air pollution.
Exposure to Noise and vibration	• Risk of noise-induced hearing loss, communication difficulties, vibration-related disorders. • Resulting in occupational hearing loss, reduced productivity, disturbance to nearby communities.
Work in confined spaces	• Risks of lack of oxygen, toxic gases, engulfment, physical hazards, poor visibility; • Resulting in worker injuries or fatalities, rescue operations, project delays, potential environmental risks
Transport activities	• Risk of vehicle collisions, struck-by incidents, worker exposure to moving traffic; • Resulting in worker injuries or fatalities, traffic congestion, potential disruptions to local traffic flow.

The project will include relocation of sections of 110kV, 35kV and 6kV overhead power lines, as described in further detail in section 3.3.5. A separate plan for the relocation of the overhead lines will be prepared at the detailed design stage and submitted for approval to the city power network management company. The overhead lines will be relocated by a special contractor following the approved plan. It is important that this plan includes specific OHS provisions related to electrical works and safety associated with the OHS relocation process. Also, provisions should be made in this plan related to the access road to the WWTP site and where the lines are passing, in terms of H&S measures, and if any temporary access needs to be prepared during the relocation work. Alignment should be made with relevant sections of the construction traffic management plan.

The sensitivity of workers to H&S risks is high. Given the size and complexity of the construction project, the magnitude of potential impact is considered medium. Hence, the overall significance is **considered major – negative.**

Operation and maintenance activities

The OHS risks related to the operation and maintenance of the WWTP are largely the same as during construction. However, some specific risks are relevant for WWTPs. The IFC EHS guidelines for Water and Sanitation outline the **following risks and impacts** associated with the operational phase of water and sanitation projects:

- **Accidents and injuries**; related to open water and risk of drowning, trenches, slippery walkways, working at heights, energized circuits, and heavy equipment, entry into confined spaces, including manholes, sewers, pipelines, storage tanks, wet wells, digesters, and pump stations. Methane generated from anaerobic biodegradation of sewage can lead to fires and explosions.
- **Chemical exposure and hazardous atmosphere**; including use of potentially hazardous chemicals, ammonia, pollutants accumulating in wastewater and sludge, pumps and piping with mineral scales, lagoons with residual sludge, enclosed facilities, exposure to hydrogen sulphide, methane, carbon monoxide, etc.
- **Exposure to pathogens and vectors**; including pathogens contained in sewage. Bioaerosols which are suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, moulds, and fungi. Vectors for sewage pathogens include insects (e.g. flies), rodents (e.g. rats) and birds (e.g. gulls).
- **Noise**; from pumps, air blowers, traffic, etc.

As for construction, the sensitivity of workers to H&S risks is high. Without proper management of H&S risks, the magnitude or potential H&S impacts at a WWTP site is also medium to high, depending on the type of work and exposure to risks. Hence, the overall significance of impacts if unmitigated is **considered major – negative.**

It should be noted, however, that the existing WWTP is in very poor condition and poses significant safety risks for workers. Hence, in comparison with the existing WWTP, the proposed new WWTP will result in substantial improvements in OHS as it regards infrastructure safety.

Proposed mitigation measures

The risks of health and safety incidents and accidents occurring must be minimised through effective OHS management systems implemented by ASEG and its contractors. The following are proposed high level measures to be taken. Further details are provided in the ESMP.

Table 8.39: Proposed mitigation measures related to Occupational Health and Safety

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Construction work, operation, and maintenance	• Occupational Health and Safety	• ASEG shall develop and adapt an Occupational Health and Safety Policy and procedures for the construction Project, within their overall OHS management system. • ASEG to integrate OHS requirements in tender documents and in contracts with all contractors involved in the construction. OHS requirements to favour companies with OHS management systems in line with international standards (ISO 45001 or similar). • ASEG to develop and implement auditing and performance monitoring procedures to check contractors' compliance with OHS requirements. • OHS Policy and procedures will be developed and adopted by the Contractor and sub-contractors. ASEG will check the adoption and monitor implementation of the Policy provisions. • Prior to commencement of construction works the Contractor shall develop specific health and safety procedures, including procedures for transportation of workers to and from the construction site. • Contractors to provide capacity building to its workers on OHS matters.
		• Ensure provision of sanitary facilities in compliance with sanitary norms.
Organisational capacity and staffing		• ASEG to assign at least one full time employee to the coordination and monitoring of OHS management during the construction phase, including supervision of contractor OHS management. • Each contractor to assign at least one manager to oversee OHS management of their respective work responsibilities.
Medical emergency response plan		• Provide medical emergency response plan • Ensure presence of a well-equipped on-site first aid facility and train staff to act as first aid responders.
Monitoring and reporting		• Construction contractors to report to ASEG on all incidents and accidents and continuous improvement measures on at least a monthly basis. Serious incidents to be reported immediately.
Relocation of overhead power lines	• Specific H&S risks related to electrical safety	• OHS provisions related to electrical works and safety associated with the OHS relocation process to be included in the plan for the

Activity	Impact or risk	Proposed mitigation measures
		relocation of the overhead power lines, to apply for the relevant contractors as contractual obligations. • Provisions should be made in this plan related to the access road to the WWTP site where the lines are passing, in terms of H&S measures, and if any temporary or permanent access needs to be prepared during the relocation work to allow for safe movement of vehicles and heavy equipment to the WWTP site. Alignment should be made with relevant sections of the construction traffic management plan.
Operation phase		
OHS management	• Occupational Health and Safety	• ASEG to adopt and implement an OHS management system based on ISO 45001 or similar for its WWTP operations.

Summary of residual impacts

Table 8.40: Summary of impacts on workers' health and safety, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	High	
Pre-construction and construction		
Spatial extent	*Limited*	*Limited*
Duration	*Medium term*	*Medium term*
Magnitude of impact	*Medium – negative*	*Low – negative*
Overall impact significance	Major – negative	Moderate – negative
Operation phase		
Spatial extent	*Limited*	*Limited*
Duration	*Medium term*	*Medium term*
Magnitude of impact	*Medium – negative*	*Low – negative*
Overall impact significance	Major – negative	Moderate – negative

8.2.4 Impact on migrant influx

While Aktobe Region is experiencing a negative net migration, Aktobe City is seeing a positive net migration, although it has declined over the past years. The Department for Coordination of Employment and Social Programmes in Aktobe Region registered in the period from January 2022 to May 2023 applications from 33 persons for refugee status in Aktobe Region, the vast majority from Ukraine. 10 of these have left Kazakhstan again as per May 26, 2023.

Given the Project's limited use of construction workers, the Project is not expected to prompt additional migrant influx into Aktobe City or Region. No mitigation will be required.

Based on the assessment, the impact on migrant influx is **not significant.**

8.2.5 Impact on community health and safety

The proposed WWTP is located in a relatively remote industrial area with the nearest residential area located two km from the site, while land surrounding the WWTP site is agricultural land.

The main potential receptors considered for the assessment of community health and safety impacts are:

- Residents in Railway Junction 39 and Tulpannyy hamlet located approximately two km north of the WWTP with 30 houses, and 158 inhabitants.
- Residents in Georgievka and Kurayly villages located 10-11 km north of the WWTP. The two villages have 1,828 and 1,859 inhabitants, respectively.
- Farmers at the Temir Tulpar Batys LLP with fields of the farm are located 0-9 km from the WWTP.
- Farmers at the Aterra LLP with fields of the farm located 0-27 km from the WWTP.
- Farmers at the Nan peasant farm with fields of the farm located 0-39 km from the WWTP.
- Farmers at the ANDI LLP with fields of the farm located 2-10 km from the WWTP.
- Workers at the JSC Aktobe Chromium Compounds Plant 1km south-west of the new WWTP.

There are no schools, health clinics, or other social facilities located close to the WWTP. The closest school and doctor's dispensary north of the WWTP are in Kurayly village. The school is approx. 10.7 km from the WWTP, while the closest doctor's dispensary is approx. 11.3 km. from the WWTP. The closest school south-east of the WWTP (towards the city centre) is approx. 6.4 km from the WWTP, while the Eurasia medical centre is approx. 6 km from the WWTP.

Pre-construction and Construction Phase activities

The following potential risks to community health and safety in connection with pre-construction and construction activities are considered in the assessment:

- Non-communicable diseases due to air quality, including odour and dust, and noise from Project construction activities.
- Communicable diseases spread though contact between Project construction personnel and local communities.
- Risk of gender-based violence and harassment (addressed in section 8.2.6).
- Potential for disputes and conflicts.
- Risk of injuries due to traffic and transport to the site during construction.

<u>Air quality</u>

Analysis and assessment of Project impacts related to air quality is presented in section 8.1.5.

Air quality impacts during construction are related to **dust** generated through excavation activities, removal of vegetation and related soil erosion and transport on gravel roads, while **emissions from vehicles and construction equipment** result in air pollution. The analysis of air quality concludes that while dust and emissions are expected there are no immediate residential receptors. Although the site is surrounded by farmland the land is mainly used for forage crops which is not labour intensive, hence the presence of agricultural workers and farmers on the land is limited mainly to period of harvest. Impacts related to air quality are likely to affect primarily the OHS of construction workers on site, which is assessed in a separate section of this report.

Emptying the existing sludge ponds as part of potential rehabilitation activities of the area is likely to result in **odour generation** at the site, which can be dispersed to nearby villages. Focus group discussions with neighbouring communities confirmed that the existing WWTP cause significant odour annoyances to the residents. As the use of the sludge ponds will stop with the proposed and improved WWTP process, this impact is also limited to the time it takes to empty the ponds.

The un-mitigated significance of **air quality impacts during construction** is considered **moderate - negative.**

Noise

Analysis and assessment of Project impacts related to noise in section 8.1.6.

Noise impacts during construction are **related to operations of construction machines and equipment**. These impacts are medium-term, limited in time during day time and to the length of the construction phase, and spatial extent is limited to the WWTP site itself and the access road to the site. There are no immediate residential receptors in the vicinity, so the impacts are likely to affect primarily the OHS of construction workers on site, which is assessed in a separate section of this report.

The un-mitigated significance of **noise impacts during construction** are considered of **moderate - negative**.

Communicable diseases, and risk of conflict

The assessment is based on high-level baseline data on the epidemiological situation in Aktobe City and Aktobe Region. No detailed data on the health profiles of the neighbouring villages are available. Overall, the health-related impacts associated with the Project implementation are two-fold with negative impacts occurring during the construction phase and positive impacts during operation.

The risk of communicable diseases, including sexually transmitted diseases (STDs), such as HIV/AIDS are primarily related to contact between the Project workforce and local residents in the Project area.

The construction workforce is foreseen to mainly be recruited from within Aktobe Region, and no influx of construction workers is expected. Given the distance of the WWTP site to the nearest residential areas the interaction between the Project construction workforce and the local communities will be low. For these reasons, impacts on community health and safety caused by influx, such as spread of communicable diseases, including STDs and COVID, and risk of conflict is assessed to be low.

The un-mitigated significance of **impacts on communicable diseases, and risk of conflict** during construction is considered **minor - negative.**

Traffic and transport

Transport of equipment, construction materials and workforce will be needed during the construction period. The existing and proposed WWTP site is accessed via an approximately 5 km gravel road connecting the site and the northern industrial area of Aktobe City. The initial 2 km of the access road is also the road to the Aktobe city waste dump / landfill, after which it passes the sedimentation ponds used by the Chromium factory, before arriving at the WWTP site. The WWTP site can also be accessed from the A-24 main road via an approximately 1.5 km gravel road. The access roads are currently used by heavy transport vehicles on a frequent basis and are not known to be used by others than the landfill and WWTP and does not pass any residential areas.

Attempts were made to obtain statistics on traffic accidents for Aktobe City and separately for the area relatively close to the WWTP. According to the Police Department for Aktobe City, such statistics are not available. The Police Department did, however, share information about the most dangerous traffic areas in Aktobe City. They include several intersections and crossroads of the city. None of these are in the vicinity of the existing WWTP and the adjacent site of the new WWTP, which are both located approx. 5 km northwest of the city centre.

The un-mitigated significance of **risk of injuries due to traffic and transport** during construction is considered **moderate - negative.**

The impact on community health and safety during construction is **direct** and **medium-term**. The spatial extent of the impact is **local**. The overall impact magnitude is determined as medium and negative. Given the medium - low sensitivity of the receptors, the **overall impact is considered of moderate - negative** when un-mitigated.

Operation and maintenance activities

The potential risks to community health and safety assessed for operation activities considered in the assessment:

- Air quality including odour from the WWTP and the effluent discharge.
- Safe use of effluent and sludge for agricultural purposes.
- Water and sanitation related diseases
- Traffic and transport to the site during operation.
- Risk of URE retention reservoir dam failure in relation to continued use.

The Project will provide significant benefits for the residents in Aktobe, through improved wastewater services. The Project is anticipated to generate a range of positive environmental and health and safety impacts during its operation phase, by treating wastewater to the required standards, and by removing the old and potentially dangerous structures. This is expected to lead to reduced pollution and accident levels, improved sludge management, and should also help improve the biological condition of the environmental recipients, in particular the downstream reservoir and the river to where effluents are discharged, which will improve the community health and safety. The other environmental, health and safety impacts are anticipated to be the same as those for the construction phase of the WWTP.

<u>Air quality including odour</u>

During the operation phase, the most important impacts relate to odour from the WWTP and associated sludge handling. The proposed WWTP Project is expected to significantly improve the odour situation, through the use of anaerobic digestion of the sludge, abandoning the use of open sludge ponds, and improving the quality of effluents.

The un-mitigated significance of **impacts on communicable diseases, and risk of conflict** during construction is considered **major - positive.**

<u>Use of effluent and sludge</u>

There is currently no reuse of effluent and sludge from the Aktobe WWTP for agricultural purposes. However, there appear to be opportunities for local agricultural re-use of effluent and sludge between 0 and 5 km to the north-east from the WWTP by two (2) main farms; Temir Tulpar Batys and Andi. The proposed WWTP project will result in significant improvement of effluent quality as well as in treatment of sludge from the WWTP process, compared to the current situation. This creates opportunities to further enhance the positive impacts of the project.

The un-mitigated significance of **impacts related to the use of effluent** during operation is considered **moderate - positive.**

<u>Water and sanitation related diseases</u>

Statistics on water and sanitation related diseases in Aktobe City were obtained from the Department of Sanitary and Epidemiological Control of Aktobe Region of the Committee of Sanitary and Epidemiological control of the Ministry of Health. The Department provided information on infectious and parasitic diseases in Aktobe over the past 5 years. The incidence rates per 100,000 persons for all diseases including those related to water and sanitation have fluctuated over the last five years, with most having decreased substantially between 2018 and 2022, except for rotaviral enteritis which has significantly increased. However, these incidences cannot necessarily all be attributed to poor water quality, and/or poor sanitary situations.

Some reduction in water and sanitation related diseases is expected from the improved wastewater treatment as a result of the Project, resulting in reduced mortality and morbidity; this may lead to reduced health costs for the individual family and the society as a whole. The expected positive impacts cannot, however, be quantified.

The un-mitigated significance of **impacts on water and sanitation related diseases** during operation is considered **moderate - positive.**

Traffic and transport

The operation will involve some ongoing heavy transport activities to and from the site. During normal WWTP operations, the traffic to the WWTP is expected to be a small fraction of the heavy transport to the landfill.

The un-mitigated significance of **risk of injuries due to traffic and transport** during operation is considered **minor – negative.**

The overall impact on community health and safety during operation is considered to be positive. The impact is **direct** and **long-term**. The spatial extent of the impact is **local.** The overall impact magnitude is determined as medium and positive. Given the medium - low sensitivity of the receptors, the **overall impact is considered of moderate – positive**.

The overall impact on community health and safety during operation is considered to be positive. The impact is **direct** and **long-term**. The spatial extent of the impact is **local.** The overall impact magnitude is determined as medium and positive. Given the medium - low sensitivity of the receptors, the **overall impact is considered of moderate – positive**.

Safety of the URE reservoir dam

As discussed in the baseline chapter on surface and groundwater, there has been deterioration of the concrete layer in the inner side of the URE. Hence, water percolates into the dam body. Perforated PVC pipes under the dam drain this water into 20 manholes at its outer side and then to a pool with the level control pump that returns this water back to the reservoir. The inner side of the dam was consequently reinforced by the large boulders of chromium smelting slag rock, but the risk of the dam failure is still acknowledged by ASEG, which is responsible for the URE and dam operation. For this reason, the URE is not filled to its design capacity of 40,000,000 m^3 and kept to 25,000,000m^3.

As the flow in the Ilek river is dropping, and hence also the possibility to empty the reservoir during the spring window, keeping the water level at max. 25 million m^3 may become more challenging, increasing the risk of dam saturation and failure. Also, the importance of the reservoir is likely to increase, if the effluents will be used for irrigation water, which will be possible (and is recommendable) with the proposed WWTP.

A detailed assessment of the dam integrity has not been within the scope of the ESIA. However, , it is required that ASEG commission a **third-party dam integrity and safety assessment** of the URE retention reservoir, prior to its continued use of the URE for the new WWTP. This should be conducted by an independent qualified firm with the necessary experiences and ensure that the dam structures of the reservoir are safe, fit and future-proof for receiving effluents from the WWTP. The assessment should be conducted soonest possible, and prior to construction of the WWTP.

Proposed mitigation measures

The following general mitigation measures are proposed to avoid and minimise the identified impacts on community health and safety associated with the Project.

Table 8.41: Proposed mitigation measures related to community health and safety

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Air quality and noise	• Non-communicable diseases	• Described in section 8.1.5 and 8.1.6
Continued use of the URE retention reservoir	• Risk of dam failure with devastating impact on people and infrastructure	• ASEG to commission a third-party dam integrity and safety assessment of the URE retention reservoir, prior to its continued use for the new WWTP. This should be conducted by an independent qualified firm with the necessary experiences and ensure that the dam structures of the reservoir are safe, fit and future-proof for receiving effluents from the WWTP.
Interaction between construction workers and communities	• Communicable diseases	• As part of the safety induction training and regular safety trainings, inform about the risk of STDs and methods for prevention. • Introduce a Code of Conduct to be followed by contractors and subcontractors. • Inform the local communities on functioning of the grievance mechanism. • Dissemination of Project related information among local communities as indicated in the Stakeholder Engagement Plan
Transport of construction materials	• Risk of accidents	• Manage the Project transportation activities in a manner ensuring use of roads at low traffic hours to the extent possible. • Ensure observance of traffic safety rules, including speed limits. • Regular inspections of vehicle fleet to avoid breakdowns during trips and prevent consequential traffic congestion or increased risk of accidents.
Operation phase		
Traffic and transportation	• Risk of accidents	• ASEG to include the new WWTP traffic and transportation into its management plan.

Summary of residual impacts

The community health and safety impacts during construction are related to the risk of injuries related to increased traffic and impacts related to construction nuisance of air quality and noise. This will, however, mainly constitute an OHS risk to construction workers, due to the distance to the site of other human receptors. Residual impacts are considered minor.

For operation, the impacts are considered positive due to improvements in the water and sanitation health conditions.

Table 8.42: Summary of impacts on community health and safety, pre-mitigation and residual (post-mitigation).

Impact characterisation	**Pre-mitigation**	**Residual impact**
Receptor sensitivity:	**Low - medium**	
Pre-construction and construction		
Spatial extent	*Local*	*Local*
Duration	*Medium term*	*Medium term*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Moderate - Negative	Minor - Negative
Operation phase		
Spatial extent	*Local*	*Local*
Duration	*Long term*	*Long term*
Magnitude of impact	*Medium*	*Medium*
Overall impact significance	Moderate - Positive	Moderate - Positive

8.2.6 Risks of gender-based violence and harassment

There do not appear to be any specific policies or legislation in relation to gender-based violence and harassment in Kazakhstan, legislation on sexual harassment in employment is not in place and there are no criminal penalties or civil remedies for sexual harassment in employment.
While there are no official statistics on the prevalence of GBVH, a survey undertaken by UN Women documented that 13% of women reported experiencing violence and harassment in the workplace. Based on this survey, the Ministry of Labour and Social Protection (MLSP) has in December 2022, published an article on their website about gender-based violence in the workplace, proposing amendments to several legal acts, including the Labour Code as well as the integration of ILO Convention No. 190 on the Elimination of Violence and Harassment in the World of Work.

As demonstrated by Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) the prevalence of domestic violence including intimate partner violence is high in Central Asia countries, including Kazakhstan. This is in part because of regressive gender norms, with many men and women finding that domestic violence is acceptable under certain circumstances. Such norms can enhance the risk of GBVH both in relation to the workforce and the interaction with communities.

Pre-construction and Construction Phase activities

Generally, the risk of gender-based violence and harassment is exacerbated with influx of construction workers. As the Project will not lead to any significant influx, there is nothing to suggest that the Project will impact on gender-based violence and harassment resulting from construction workers' interaction with communities.

The risk of GBVH between workers at the construction site is also considered to be low due to the limited number of constructions workers and given that most of these workers are expected to come from Aktobe City and surrounding villages. As a precautionary measure it is recommended, however, that the Contractor puts in place a workers' Code of Conduct and provide inductions and trainings such as i) introduction and training for Contractor's and sub-contractors' staff to include awareness on GBVH definitions, prevention, encouragement to report/submit concerns and grievances related to GBVH etc., and ii) introduction to local communities on the same, ensuring that communities are familiar with the expectations as to how construction workers should behave, the rights of community members and their access to a grievance mechanism.

The risk of gender-based violence and harassment during construction is **direct** and **medium-term**. The spatial extent of the impact is **local**. The overall impact magnitude is determined as medium and negative. Given the medium sensitivity of the receptors, the **overall impact is considered of moderate – negative** when un-mitigated.

Operation and maintenance activities

The risk of GBVH during operation and maintenance relates both the risk of inter-worker misconduct as well as misconduct by workers during stakeholder interaction or vice-versa. ASEG does not have a separate policy or procedures related to gender-based harassment and/or violence, and such a policy and procedures do not appear to be included in the Rule of Conduct and Relationship for ASEG Employees and/or in the Order on Workplace Discipline and Ethics. Identified gaps in the Environmental and Social Management System (ESMS) are addressed in the company Environmental and Social Action Plan (ESAP) and will be closed prior to the operation phase of the Project.

The risk of gender-based violence and harassment during operation is **direct** and **short-term**. The spatial extent of the impact is **local**. The overall impact magnitude is determined as medium and negative. Given the medium sensitivity of the receptors, the **overall impact is considered of moderate - negative** when un-mitigated.

Proposed mitigation measures

The following general mitigation measures are proposed to avoid and minimise the identified impacts related to gender-based violence and harassment during the construction phase of the Project.

Table 8.43: Proposed related to gender-based violence and harassment.

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
General construction	• Risk of GBVH	• Contractor puts in place a workers Code of Conduct including zero tolerance for GBVH, and provide inductions and trainings for Contractor's and sub-contractors' staff to include awareness on GBVH definitions, prevention, encouragement to report/submit concerns and grievances related to GBVH etc.

Summary of residual impacts

The GBVH risks during construction concerns inter-worker and worker-community misconduct, which is considered preventable following good labour practices implemented through the mitigation measures. Identified gaps in the Environmental and Social Management System (ESMS) are addressed in the company Environmental and Social Action Plan (ESAP).

Table 8.44: Summary of impacts on gender-based violence and harassment, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Medium**	
Pre-construction and construction		
Spatial extent	*Limited*	*Limited*
Duration	*Medium*	*Medium*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Moderate - Negative	Minor - Negative

Impact characterisation	Pre-mitigation	Residual impact
Operation phase		
Spatial extent	*No significant impacts anticipated.*	
Duration		
Magnitude of impact		
Overall impact significance		

8.2.7 Impact on land acquisition and land use

Pre-construction and Construction Phase activities

The new WWTP is planned to be constructed on a 10.8 ha land plot which is state-owned land. The Aktobe City Akimat issued Resolution No. 235 on 14 March 2023 to grant the Department of Housing and Communal Services, Passenger Transport and Highways of Aktobe City the right to use a land plot of 10.8 ha for a period of five year for the construction of a WWTP in Aktobe City. According to the city Land Management Department, another resolution will be issued after construction of the WWTP to lease this plot for 49 years.

2.1 ha of the land plot for the WWTP is currently under lease of the owner of the farm Temir Tulpar Batys LLC who has the user right of this land. The relocation of existing overhead power lines passing through the WWTP site, will require additional 1 ha of land under the same lease. The farmer was granted the user right for 49 years for the state-owned agricultural plot 02-036-164-435, which is 100 ha, on 8 May 2019, in accordance with Aktobe City Akimat Resolution 1707 from 22 April 2019. The farmer is allowed to use the land for agricultural production and has in recent years used the land for hay harvesting.

ASEG in cooperation with Aktobe City Land Management Department has consulted the farmer, and the three parties have made an agreement dated 2 July 2023on a change of the boundaries of the plot 02-036-164-435 under lease, on the condition that ASEG will bear all expenses associated with the change. The agreement means that the 3.1 ha land to be used for the WWTP and the relocation of the overhead power lines will be withdrawn from the lease agreement and replaced with at least the same amount of land of equal quality adjacent to the existing land under lease. This agreement adheres to the conditions stipulated in the lease agreement.

The impacts on land acquisition and land use pre-construction are **direct** and **long-term**. The spatial extent of the impact is **limited**. The overall impact magnitude is determined as low and negative. Given the medium - low sensitivity of the receptor, the **overall impact is considered of minor - negative** when un-mitigated.

Operation and maintenance activities

No land acquisition or easement will be needed during the operation phase of the Project.

Proposed mitigation measures

The following general mitigation measures are proposed to minimise the identified impacts on land acquisition and land use associated with the Project.

Table 8.45: Proposed mitigation related to land acquisition and land use.

Activity	Impact or risk	Proposed mitigation measures
Pre-construction and Construction phase		
Allocation of land	• Risk of entitlements not delivered	• ASEG to ensure that the land acquisition be implemented in accordance with the written agreement dated July 2, 2023, between ASEG, the Aktobe Land Management Department and the farmer, withdrawing 3.1 ha of land under the farmer's lease agreement for plot 02-036-164-435. Alternative land will be provided as stipulated in the agreement, affected assets will be compensated at full replacement cost, and all associated legal transaction cost will be covered by ASEG.

Summary of residual impacts

The land acquisition and land use impacts related to the Project is considered minor, and with the implementation of the proposed mitigation, negligible.

Table 8.46: Summary of impacts on land acquisition and land use, pre-mitigation and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Low**	
Pre-construction and construction		
Spatial extent	*Limited*	*Limited*
Duration	*Long term*	*Long term*
Magnitude of impact	*Low*	*Low*
Overall impact significance	Minor - Negative	Negligible
Operation phase		
Spatial extent	*No significant impacts anticipated.*	
Duration		
Magnitude of impact		
Overall impact significance		

8.2.8 Impact on cultural heritage

The site designated for the proposed WWTP does not contain any registered cultural heritage or archaeological objects. The site has been approved by the Aktobe City Department of Housing and Communal Services, Passenger Transport and Highways.

The Regional Centre for Research, Restoration and Protection of Historical and Cultural Heritage confirmed in February 2023 in a letter to Aquarem the absence of historical and cultural heritage of significance in the proposed location of a new WWTP (350 m east of the existing WWTP between land plots 02-036-164-435 and 02-036-164-222). In May 2023, the Department of Culture, Archives, and Documentation of Aktobe Region provided a list of all registered cultural heritage sites in Aktobe City and coordinates of their location. This list indicates that the cultural heritage closest to the proposed new WWTP is the Monument to the Smelters of Ferrous Metallurgy, located 4.65 km from the WWTP. Other registered cultural heritage sites are located in the city centre and in the eastern part of Aktobe City, i.e. further away from the proposed new WWTP.

Pre-construction and Construction Phase activities

Based on the information received from the Regional Centre for Research, Restoration and Protection of Historical and Cultural Heritage and the Department of Culture, Archives, and Documentation of Aktobe Region, there is nothing suggesting that the pre-construction and construction activities will cause any impacts on cultural heritage.

Contract documents should, however, require contractors to develop and implement chance find procedures in case of new cultural heritage discoveries during construction work. Standard conditions of contract provide basic procedures when such articles are found.

The impacts on cultural heritage during construction is **direct** and **medium-term**. The spatial extent of the impact is **limited**. The overall impact magnitude is determined as medium and negative. The **overall impact is considered of minor - negative** when un-mitigated.

Operation and maintenance activities

The risk of impacting cultural heritage during operation and maintenance is considered low.

The impacts on cultural heritage during construction is **direct** and **short-term**. The spatial extent of the impact is **limited**. The overall impact magnitude is determined as medium and negative. The **overall impact is considered of minor - negative** when un-mitigated.

Proposed mitigation measures

The following general mitigation measures are proposed to minimise the identified impacts on cultural heritage associated with the Project.

Table 8.47: Proposed mitigation measures related to cultural heritage.

Activity	Impact or risk	Proposed mitigation measures
Construction and operation phases		
Soil excavation	• Chance Find	• The Contractor will develop and adopt a Chance Find Procedure for the construction work. Covering, at a minimum: the legal framework for cultural heritage; the process to follow in the event of chance finds; roles and responsibilities for implementing the procedure and an induction for all workers, including project staff, contractors, and government agencies. • ASEG will develop and adopt a Chance Find Procedure for the operation and maintenance work

Summary of residual impacts

The impacts on cultural heritage related to the Project is considered minor, and with the implementation of the proposed mitigation, negligible.

Table 8.48: Summary of impacts cultural heritage, pre-mitigation and residual (post-mitigation).

Impact characterisation	**Pre-mitigation**	**Residual impact**
Receptor sensitivity:	**Low**	
Pre-construction and construction		
Spatial extent	*Limited*	*Limited*
Duration	*Medium*	*Medium*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Minor - Negative	Negligible
Operation phase		
Spatial extent	*Limited*	*Limited*
Duration	*Short term*	*Short term*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Minor - Negative	Negligible

8.2.9 Impact on vulnerable groups

4.25% of the population in Aktobe Region and 3.3% of the population in Aktobe City lived in 2022 below the official subsistence level, which defines the minimum level of income for basic needs. Persons living below the poverty line are entitled to targeted social assistance, as are other vulnerable groups. In Aktobe city, 5,634 families and 15,212 persons received such assistance in 2022.

According to information received from FGDs with residents in the villages of Kurayly and Georgivka there are no poor households in the villages, while some people are living with disabilities. The same is the case for residents in the railway junction 39 / Tulpannyy hamlet, where most people are retired but not considered poor or vulnerable.

Pre-construction and Construction Phase activities

The interaction between the Project construction workforce and the neighbouring communities is expected to be limited, and no impacts related to vulnerable groups are foreseen during the construction phase.

Operation and maintenance activities

The Project may lead to an increase in tariffs. 3.3% of the population in Aktobe City received social support in 2022, constituting 5,634 households, and 458 families received housing aid. ASEG's collection ratio of water and wastewater bills was close to 100% in the last years, as noted in Sweco's Feasibility Study (2022). The report also notes that the collection ratio from 2020 was not affected by the COVID-19 situation due to special assistance to help socially vulnerable groups to pay their utility bills. The high collection ratio indicates that most households pay their water and wastewater bills without problems.

Sweco's Feasibility Study Report (2022) includes an affordability analysis using EBRD's affordability methodology, which sets 5% of the total household expenditure as the affordability threshold for water supply and wastewater services. This affordability analysis is based on a total investment of EUR 30.5 million in an improved WWTP and shows that potential future tariff increases to cover this investment as well as operations cost are affordable to households in all deciles. The 10% of the population with the lowest income (decile 1) is thus estimated to spend less than 2% of their household income on water and wastewater services after potential tariff increases. It is uncertain whether this affordability analysis is valid for the current project proposed in the local Feasibility Study (2023), which has significantly higher investment costs.

The impacts on vulnerable groups during operation is **direct** and **long-term**. The spatial extent of the impact is **regional**. The overall impact magnitude is determined as medium and negative. The **overall impact is considered of moderate - negative** when un-mitigated.

Proposed mitigation measures

The following general mitigation measures are proposed to minimise the identified impacts on vulnerable groups associated with the Project.

Table 8.49: Proposed mitigation measures related to vulnerable groups

Activity	Impact or risk	Proposed mitigation measures
Operation phase		
Tariff increase	• Risk of non-affordable services	• ASEG to closely monitor the affordability for low-income households after potential tariff increases due to the Project.

Summary of residual impacts

The Project is not assessed to cause any impacts on vulnerable groups related to construction, while the increase in tariff during operation may have minor residual impacts on vulnerable groups.

Table 8.50: Summary of impacts on vulnerable groups, pre-mitigation, and residual (post-mitigation).

Impact characterisation	Pre-mitigation	Residual impact
Receptor sensitivity:	**Medium**	
Pre-construction and construction		
Spatial extent	*No significant impacts anticipated*	
Duration		
Magnitude of impact		
Overall impact significance		
Operation phase		
Spatial extent	*Local*	*Local*
Duration	*Long term*	*Long term*
Magnitude of impact	*Medium*	*Low*
Overall impact significance	Moderate - Negative	Minor - Negative

8.3 Cumulative Impacts

The ESIA study has considered the potential cumulative impacts in relation to other existing, planned and/or proposed projects within the PAI. With regards to existing activities, the following cumulative impacts may be of relevance:

- **Noise** and **traffic safety** due to increase in heavy traffic during the construction phase of the WWTP which will be in addition to existing traffic load in the city. The main access to the proposed Project site is outside the city centre and through an existing industrial area, hence significant cumulative impacts affecting traffic levels in the city are not anticipated.
- **Water quality in the Ilek river**; the Ilek river is already affected by various anthropogenic activities other than the Aktobe WWTP, both upstream and downstream from the effluent discharge point from

the existing WWTP. Existing impacts would be reflected in the background water quality and benthic fauna characteristics reflected in the respective baseline data.

- **Odour** from the WWTP activities; The existing WWTP is likely the most significant source of odour impacts in the area (based on, among others, focus group discussions). However, it is possible that other activities, e.g. nearby farms, may be sources of odour during periods, for example in relation to application of manure on fields. Such sources of odour impacts may not be felt currently due to the existing WWTP impacts.

Based on the information available during the ESIA process, no planned or proposed activities have been identified that could result in further cumulative impacts in the context of the proposed WWTP Project.

9 OVERALL ESIA CONCLUSION

The ESIA has assessed the potential environmental and social (E&S) impacts of the proposed Project to construct a new wastewater treatment plant (WWTP) for the city of Aktobe in Kazakhstan. The WWTP is designed for treating on average 100,000 m^3/day influent WW to service a population of 500,000. The proposed WWTP will replace an existing WWTP that is located immediately adjacent to the proposed new WWTP site. The location of the site is considered appropriate as it allows for continued use of key inflow and outflow piping infrastructure, and it is remotely located a few km away from nearest residential areas.

The overall impacts of the proposed WWTP project are assessed to be positive.

The existing WWTP effluents are of very poor quality and raw sludge is dried and treated in sludge ponds without prior stabilization. Both the sludge handling and effluents from the existing WWTP result in substantial odour problems, in particular the poor effluent quality carries foul odours several kilometres downstream, negatively effecting wellbeing in nearby communities, and has negative impacts on downstream water quality and aquatic habitats in the URE retention reservoir and the Ilek river.

Hence, the most significant impact of the Project will be improvements in effluent quality to EU and national standards, and the sludge treatment will be much improved with the introduction of anaerobic digestion (AD) to the WW treatment process. Both aspects are expected to significantly reduce or eliminate current odour problems. The improved WWTP sludge handling in line with EU requirements for sewage sludge will also substantially reduce the GHG emissions associated with WW treatment, compared to the current situation.

The outcome of the proposed Project will create an opportunity to reuse both the effluents and sludge for agricultural purposes. However, a detailed plan for how to promote effluent reuse and to ensure offtake of the treated sludge has not yet been presented, nor has a plan for closure of the existing sludge ponds. Hence, a plan for this needs to be prepared by the proponent (ASEG) in parallel with the detailed design of the WWTP, including a plan for alternative long-term storage of treated sludge in case there is not sufficient offtake capacity or interest in the area.

The effluents from the existing WWTP are discharged to the man-made URE retention reservoir prior to release to the Ilek river during spring each year, and this arrangement is planned to continue for the proposed WWTP. There have been concerns about the integrity of the URE dam wall if the reservoir is filled to its full capacity of 40 million m^3, as water percolates into the dam wall with risk of dam failure. Hence, the URE reservoir is only used to a capacity of 25 million m^3. Although using the URE can be seen as less critical to meet water quality standards in the Ilek river with the improved effluents form the proposed WWTP, it is considered likely that the importance of the URE may grow in case effluents will be used for irrigation, which is recommended to make full use of the water resource. Hence, to ensure safety of the URE dam for continued use by the proposed WWTP, it is recommended that an independent third party dam integrity and safety assessment of the URE retention reservoir is performed, prior to its continued use for the new WWTP. This should be conducted by an independent qualified firm with the necessary experiences and ensure that the dam structures of the reservoir are safe, fit and future-proof for receiving effluents from the WWTP.

Potential negative environmental impacts of the project are mostly typical for construction activities and WWTP of similar size and complexity. These include worker health and safety risks and risks of contamination to nearby environment through daily construction and operation activities. These impacts are of minor to moderate significance if not adequately mitigated and managed but can be effectively mitigated through the implementation of proposed measures, and through the implementation of robust

Environmental and Social (E&S) management system design in line with international good practice management system standards. This will bring the negative impacts of the Project to be minor or negligible. Within this, Environmental, Health and Safety (EHS) management needs to be fully adopted, led, and supervised by the project proponent, and also integrated in all works conducted by contractors involved in the project.

In terms of socio-economic impacts, the proposed Project will have few negative impacts. Due to the WWTP site's location in an industrial area with no communities in the proximity, the Project impacts on community health and safety due to construction impacts on air quality and noise is of moderate significance and will with adequate mitigation and management be reduced to minor significance. Increased traffic and transport are moderate during construction if not adequately managed but can be effectively mitigated through the implementation of proposed measures. While some employment opportunities will be created during construction, there will be a reduction of WWTP staff in the operation phase.

Other social aspects such as impacts on land use and cultural heritage are considered to be negligible after the implementation of proposed mitigation measures.

The Project will through improvement of the wastewater treatment have a positive effect on the prevalence of water and sanitation related diseases in the Project area. This will together with the significant reduction in odour substantially improve the health and wellbeing of the population in the Project area. The risk of increased tariffs negatively impacting on vulnerable groups in Aktobe City needs to be monitored during operations to ensure that such impacts are adequately mitigated and managed.

The following table summarises the findings of the ESIA for the identified potential impacts. An environmental and social management plan (ESMP) is proposed in a separate document. The ESMP needs to be fully executed to ensure successful mitigation of potential negative impacts.

Table 9.1: Summary of findings for identified potential impacts

Receptor/Baseline aspect and main impacts / risks	**Construction Impact significance**		**Operation Impact significance**	
	Pre-mitigation	**Post-mitigation**	**Pre-mitigation**	**Post-mitigation**
Impacts on physical and natural environment				
Landscape and topography				
• Change in topography • Change of site appearance from greenfield to industrial • Removal of topsoil and vegetation	Minor - Negative	Negligible - Negative	Negligible - Negative	Negligible - Negative
Soil and geology				
• Ground and soil disturbance • Soil erosion and stormwater managem. • Risk of spillages of contaminants • Sludge handling	Minor - Negative	Negligible – Negative	Moderate - Negative	Negligible - Negative
Climate and climate change aspects				
Climate – GHG impacts • Material embodied GHGs	Moderate - Negative	Minor – Negative	Moderate – Positive	Moderate - Positive

Receptor/Baseline aspect and main impacts / risks	Construction Impact significance		Operation Impact significance	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
• Energy consumption • WWT process				
Climate Resilience • Flood risk	Overall low sensitivity to climate change, Not requiring uplift compared to regular good management and design practices.			
Surface and groundwater resources				
At and around the WWTP site • General site activities resulting risk of contamination • Erosion and stormwater management	Minor to moderate - Negative	Negligible – Negative	Minor to moderate - Negative	Negligible – Negative
Handling and storage of sludge (WWTP site) • Risk of contamination from sludge handling	-	-	Minor - Positive	Minor - Positive
Surface water of the URE retention reservoir and the Ilek river • Level of water pollution rom effluents	-	-	Moderate – Positive	Major - Positive
Ambient air quality				
• Dust generation • Emissions from vehicles resulting • Odour problems	Moderate - Negative	Minor – Negative	Major – Positive	Major – Positive
Noise and vibration				
• Noise from machinery • Noise from pumps, air blowers and other equipment • Impacts on human receptors	Minor - Negative	Negligible – Negative	Negligible - Negative	Negligible - Negative
Flora				
• Removal and/or damage to vegetation • Opportunity to revegetate the site and existing sludge pond area	Minor - Negative	Negligible to minor – Negative	No significant negative impacts anticipated	
Fauna				
Terrestrial and Avifauna • Removal and/or damage to vegetation and habitats • Opportunity to revegetate the site and create new biodiversity habitats	Moderate - Negative	Minor – Negative	No significant negative impacts anticipated	
Aquatic ecosystem Ilek River	Not affected		Moderate – Positive	Moderate - Positive

Receptor/Baseline aspect and main impacts / risks	Construction Impact significance		Operation Impact significance	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
• Benthic fauna diversity in the Ilek river and impacts from effluents				
Communal infrastructure (access roads, solid waste, water and electricity supply)				
Communal infrastructure • Increased wear and tear due to increased heavy traffic • Risk of inappropriate handling of waste • Strain on water and energy infrastructure	Significant impacts are not expected.			
Supply chain (ESG risks)				
Supply chain • General risk of ESG impacts or violations in the supply chain • Risk that material comes from quarries without the necessary permits	High supply chain risks are not expected. However, minor to moderate impacts may occur in the absence of basic risk management / due diligence procedures.			
Opportunity to reuse effluents and digested sludge				
• Opportunity to reuse effluents in the area • Opportunity to reuse sludge in the area	There are opportunities to reuse both effluents and sludge in the area of the proposed WWTP, enabled by the improved quality and effluents and sludge handling with anaerobic digestion.			
Socio-economic impacts				
Employment				
• Risk of influx of workers • Risk of retrenchment	Minor - Positive	Moderate - Positive	Major – Negative	Moderate - Negative
Labour and working conditions				
• Working conditions and terms of employment • Workers' grievance mechanism • Workers' accommodation	Moderate - negative	Minor - Negative	Moderate - negative	Minor - Negative
Worker's health and safety (OHS)				
• Risk of accidents typical to construction activities • H&S risk specific to water and sanitation projects	Major - Negative	Moderate – negative	Major - negative	Moderate – negative
Migrant influx				
• Project is not expected to prompt additional influx of migrants into Aktobe City or Region	Significant impacts are not expected.			
Community health and safety				

Receptor/Baseline aspect and main impacts / risks	Construction Impact significance		Operation Impact significance	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
• Communicable diseases • Non-communicable diseases • Risk of accidents	Moderate – negative	Minor - Negative	Moderate – Positive	Moderate - Positive
Risk of URE dam failure associated with continued use • Concerns about integrity of the URE dam with **risk of dam failure**	The dam is not affected by project construction.		There are **concerns about the integrity of the dam wall**, in particular if the reservoir is used at its full capacity. A 3rd party dam safety assessment should be conducted prior to continued use of the URE for the proposed WWTP effluents.	
Gender based violence and harassment				
• Risk of GBVH	Moderate - Negative	Minor - Negative	Significant impacts are not expected.	
Land acquisition and land use				
• Risk of entitlements not delivered	Minor - Negative	Negligible – Negative	Significant impacts are not expected.	
Cultural heritage				
• Chance Find	Minor - Negative	Negligible – Negative	Minor - Negative	Negligible – Negative
Vulnerable groups				
• Risk of non-affordable services	Significant impacts are not expected.		Moderate - Negative	Minor - Negative
Cumulative impacts				
• Cumulative impacts with other planned or proposed projects.	No planned or proposed activities have been identified that could result in cumulative impacts in the context of the proposed WWTP project.			

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

An Environmental and Social Management Plan (ESMP), which also includes a monitoring plan, has been prepared. The ESMP includes a proposed framework for an Environmental Social Management System (ESMS), a project impact mitigation plan based on the recommendations in the ESIA, and a framework proposal for specific E&S management plans that need to be prepared either by ASEG or by the construction contractor(s).

Please refer to the separate ESMP.

ANNEX 1: RECORDS OF PUBLIC MEETINGS & CONSULTATIONS

The following stakeholder meetings were held during the scoping and the ESIA processes:

1. 24 February 2023: stakeholder meeting during the scoping phase (minutes included below).
2. 27 March 2023: stakeholder meeting in Kurayly village (summary of discussions included in section 7.3 of this ESIA report).
3. April 2023: Two FGDs for Kurayly and Georgivka villages with 8 men and 7 women, respectively (summary of discussions included in section 7.3.3 of this ESIA report)
4. April 2023: One FGD for railway junction 39 and Tulpannyy hamlet with 11 women and 1 man (summary of discussions included in section 7.3.3 of this ESIA report).

MINUTES OF MEETING
Stakeholder consultation to prioritise environmental and social impact assessment (scoping)
24 February 2023, 16:00 (ZOOM Conference)

PARTICIPANTS:

Public authorities:
- Bekeev Nurbergen Bazarbauly - Head of Energy and Communal Department of Energy and Communal Department of Aktobe region
- Khamiev Aidos Tangalievich - Deputy Akim of Aktobe City
- Askar Zhumabekov - representative of the Zhaik-Caspian Basin Inspection
- Kylyshbayev Gabit - Acting Head of Department of Natural Resources and Regulation of Use of Natural Resources
- Roza Makazhanova - Representative of Sanitary and Epidemiological Control Department

Eco-activists
- Ayman Kazi
- Kydyrova Aidana
- Adilbek Nurtazin

Representatives of Aqtobe Su Energy Group

EcoSocio Analysts:
- Vladimir Merkuryev
- Nargiza Ospanova
- Merey Mursal
- Kanat Serdaliev

Presentation was made by Vladimir Merkuryev.

Aqtobe Su Energy Group: What will be done with the treated sludge? How will it be disposed of?

Vladimir: The limitation in sludge disposal will depend on its contents of hazardous substances mostly heavy metals, which are dangerous for humans and animals. We plan to take samples of water and incoming sludge to determine the concentration of hazardous substances. If the concentrations are not significant, then it can be assumed that the sludge stored since 2014 has concentrations below the MPC and can be used as fertilizer.

Aqtobe Su Energy Group: We studied this issue, there are no heavy metals, but there are helminths. If new WWTPs are built, a sludge disposal plant should be built so that sludge does not accumulate at the WWTP. After Biogas and what is accumulated.

Vladimir: Aquarem is considering a sludge dewatering, pelleting and incineration plant. Our engineers have reviewed the proposal given to Aquarem by VOMM and have decided that Biogas is the best option.

Aqtobe Su Energy Group: At one time water was supplied to fields for irrigation, but this project failed. Now discharges from RCU (regulating capacity unit) storage tanks go in spring along the creek to Ilek river 8 km, due to high energy eroding its banks and carrying suspended solids into the river, which worsens the discharge performance. We need to make bank reinforcements. Yes, we are given only 1-1.5 months in spring to discharge 10,000,000 m^3 of water. We discharge 7-8 m^3 per second, so there is erosion. The flow capacity of the creek bed does not allow for the discharge of such volumes.

Vladimir: Scouring occurs due to the large amount of water that needs to be discharged in May, but with good treatment, it can be discharged continuously bypassing the reservoir

Aqtobe Su Energy Group: The RCU itself has been in operation since 1981, there is a lot of sludge accumulated there and this needs to be cleaned. The biggest question for us is what to do with the sludge

Vladimir: It doesn't need to be cleaned as the treated effluent from the WWTP can go directly to the river, and the reservoir can be used for abnormal situations of excessive or accidental discharge. When treated water enters the RCU, it will pick up contamination from the sludge I n it.

Aqtobe Su Energy Group: But here the level of treatment must reach standards for agricultural use.

Nevertheless, the current main impact from the WWTP is the odour, which is always present and reaches Georgievka 9km away from the lagoons when the wind blows in its direction, which is frequent, the odour is there. Within a 2-3km radius the smell is present regardless of the wind.

Vladimir: Then we need to involve residents of Tulpanoye, Razezd 39 and Grigorievka into the consultation. We have tried to find a former Akim, who could help with the consultation, but all these villages have already joined the city, and so far we haven't been able to find them for this meeting. Have we missed anyone else? (In response, no other settlements were mentioned).

Aqtobe Su Energy Group: We could still consider cleaning up the silted up RCU whose design capacity was 40,000,000 m3 initially.

Vladimir: The issue of cleaning it up has not been raised by the Bank, and then where to dispose of this contaminated soil. The increased volume of water in the RCU could exacerbate the existing problem of leaking of the dam and increase the risk of a breach. The result of the seepage can be seen in the satellite images.

Aqtobe Su Energy Group: What is visible is a normal occurrence. There are 19 wells around the perimeter of the dam nose where the water level is monitored and a pumping station that pumps water back to the URE. There is a leakage problem, but at the discharge sluices, which do not hold. And the concrete discharge canal needs repair.

Are there any more questions for us?

Vladimir: The questions were given at the end of the presentation, namely:

- Are there other key activities that need to be considered?
- What impact do you think these activities can have?
- What can be done to manage them?
- Who will mainly experience the impacts mentioned?
- Are any of these people/groups particularly vulnerable?
- Where can we find data and information to support our research on these impacts?
- Which organisations do you think are important for us to talk to?

If there are no answers to these now, you can give them to us later.

To summarise the meeting: the priority is sludge disposal, prevention of streambed erosion for spring discharge, and discharge to a storage tank only if the water accumulated over the winter can be used to irrigate the fields. Biological tanks and settling tanks (primary and secondary) are obligatory to be enclosed. And each plant should have modern and efficient gas filters (just not a charcoal filter).

Thank you for your time. Goodbye.

ANNEX 2: CLIMATE CHANGE SCENARIOS - ANALYSIS OF UNCERTAINTIES

The scenarios outlined in the climate change assessment discussed in chapter 6.1.5 are the result of a series of climate models, which carry an uncertainty. It is important to understand this uncertainty as it has the potential to lead to over- or underestimates of the most relevant climate variables, *e.g*. precipitation and temperature. Furthermore, the results presented from the models are given averages, meaning that half of the models predict higher changes whereas the other half predict lower impacts.

In the context of this report, only little will be done to address these uncertainties. However, it is of utmost importance to delineate from where the uncertainties originate and define the implications for the water infrastructure of Aktobe. In this regard, the main causes of uncertainties in the above-outlined climate change development are:

- Low model resolution (e.g. 5x5 degrees from SNC projections, the equivalent to approx. 500x500 km).
- Lack of observed reliable data.
- Uncertainties in the climate forcing scenarios (SRES and RCP).
- Inaccuracy in simulating large scale patterns, i.e. ENSO (El Niño-Southern Oscillation).
- Difficulty in simulating small-scale processes, such as convection.

Although the amount of data collected at Almaty is significant (+80 years of measurements, however with small gaps) compared to other locations where limited observed data tends to be the case, it has not been possible to perform a deeper analysis of the data to validate it. Hence, potential errors have not been investigated, and this might cause under/overestimates of precipitation and temperature.

Likewise, quantitative estimates of projected changes in precipitation are difficult to obtain, due to lack of observed data, significant inter-model differences in representing monsoon processes, and lack of clarity over changes in ENSO (El Niño-Southern Oscillation) patterns (DHI, 2012).

A way to tackle some of these issues would be to perform a probability analysis on the data, which might lead to more robust results. However, more data would need to be collected. For example, the interaction between snow cover and temperature response is a complex process, and this requires more specific data, *i.e*. evapotranspiration, solar radiation, *etc*.

It should be noted that, for the purposes of this Project, the important issue is to properly identify the direction of change in the climate projections. Tackling the uncertainty attained to these projections is an issue to be dealt with in other projects. The biggest challenge in suggesting adaption measures in Aktobe might be the high uncertainty related to extremes (which lacks a national assessment regarding climate projections), *i.e*. extreme rainfall events and heatwaves. Hence, the assessment of climate change impacts is carried out considering these uncertainties.

ANNEX 3 – SCOPING OF POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

The following sections reflect the outcome of a scoping assessment for the Project, for the pre-construction/construction and operational phases, respectively. The matrices illustrate interfaces between key Project activities and products and environmental and social receptors. Where a potential interface is identified, an assessment of the respective impacts is included in the ESIA (scoped in). Areas, where no interface is anticipated, are scoped out.

Main Potential Environmental and Social Impacts

Pre-construction and Construction Phase Matrix

			Routine activities and products																	Unplanned events	
			Demolition works, if any	Demolition waste generation	Site preparation and excavation	Transportation of construction material, construction machinery and equipment	Transportation of workers	Access road construction and relocation of power lines	Operation of concrete batch mixer and aggregate crushing	Installation of pipes	Installation of biogas plant and CHP	Construction of WWTP and operation of construction machinery and equipment	Wastewater management in construction	Construction and demolition waste generation	Electrical installations	Site drainage installation	Decommissioning of sludge ponds	Landscaping	GHG emission generation	Spill/overflow of WWTP and climate change related events such as heavy rain	Natural disasters (wildfire, earthquake etc.)
Environmental receptor	Physical	Geology and geomorphology			■					■		■				■				■	
		Soils / soil quality	■	■	■			■		■	■	■		■		■	■	■		■	■
		Groundwater resources	■	■	■							■	■	■		■	■			■	
		Surface waters	■	■	■				■	■		■	■	■		■				■	■
		Landscape and visuals	■	■	■			■		■	■	■		■		■	■	■		■	■
		Ambient air quality	■	■	■	■		■	■	■		■	■	■		■	■	■	■	■	
		Climate						■			■	■				■		■	■		
		Noise and vibration	■	■	■	■		■	■	■	■	■		■		■	■	■			
	Resource consumption	Energy	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■		■	
		Materials						■	■	■	■	■			■	■		■		■	
		Water	■	■				■	■			■		■				■		■	
	Biological	Protected areas		■									■	■						■	
		Flora and fauna	■	■	■			■					■	■		■	■	■		■	■
Social receptor	Other services	Social infrastructure: schools, health clinics, utilities	■		■			■												■	■
	Workforce	Local employment and commercial opportunities	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
		Refugee influx due to war in Ukraine	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
		Workers' employment conditions	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
		Workers' accommodation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■

			Routine activities and products																	Unplanned events	
			Demolition works, if any	Demolition waste generation	Site preparation and excavation	Transportation of construction material, construction machinery and equipment	Transportation of workers	Access road construction and relocation of power lines	Operation of concrete batch mixer and aggregate crushing	Installation of pipes	Installation of biogas plant and CHP	Construction of WWTP and operation of construction machinery and equipment	Wastewater management in construction	Construction and demolition waste generation	Electrical installations	Site drainage installation	Decommissioning of sludge ponds	Landscaping	GHG emission generation	Spill/overflow of WWTP and climate change related events such as heavy rain	Natural disasters (wildfire, earthquake etc.)
	Health & safety	Workers' health & safety																			
		Community health & safety																			
		Risks of gender-based violence & harassment																			
		Traffic and traffic safety																			
	Economic and physical displacement	Land use & acquisition																			
		Houses & other structures																			
		Commercial activities																			
		Household economic activities & livelihood																			
	Cultural heritage	Cultural heritage																			
	Disproportionate group impacts	Vulnerable groups																			
	Indigenous people	Indigenous people																			
Cross-Cutting E & S Aspects	Transboundary impacts																				
	Cumulative impacts																				
	Supply chain																				

Operation Phase Matrix

			Routine activities and products																	Unplanned events			
			Transportation of material + equip. + waste	Transportation of workers	Vehicle fleet management	WWTP laboratory operation	WWTP operation and effluent	WWTP maintenance	Biogas plant operation	Biogas plant maintenance	Sludge and/or digestate management	CHP operation	CHP maintenance	Site drainage and stormwater management	Landscaping	Security operations	Pest control	Waste generation	Sewerage sludge generation	GHG emission generation	Spill/overflow of WW or stormwater and climate change related events such as heavy rain	Spill and leak of oil and chemicals	Fire, explosion	Natural disasters (wildfire, e. quake)
Environmental receptor	Physical	Geology and geomorphology																						
		Soils / soil quality																						
		Groundwater resources																						
		Surface waters																						
		Landscape and visuals																						
		Ambient air quality																						
		Climate																						
		Noise and vibration																						
	Resource consumption	Energy																						
		Materials																						
		Water																						
	Biological	Protected areas																						
		Flora and fauna																						
Social receptor	Other services	Social infrastructure: schools, health clinics, utilities																						
	Workforce	Local employment and commercial opportunities																						
		Refugee influx due to war in Ukraine																						
		Workers' employment conditions																						
		Workers' accommodation																						
	Health & safety	Workers' health & safety																						
		Community health & safety			?										?		?							
		Risks of gender-based violence & harassment																						
		Traffic and traffic safety			?																			
		Land use & acquisition																						

			Routine activities and products																		Unplanned events			
			Transportation of material + equip. + waste	Transportation of workers	Vehicle fleet management	WWTP laboratory operation	WWTP operation and effluent	WWTP maintenance	Biogas plant operation	Biogas plant maintenance	Sludge and/or digestate management	CHP operation	CHP maintenance	Site drainage and stormwater management	Landscaping	Security operations	Pest control	Waste generation	Sewerage sludge generation	GHG emission generation	Spill/overflow of WW or stormwater and climate change related events such as heavy rain	Spill and leak of oil and chemicals	Fire, explosion	Natural disasters (wildfire, e. quake)
	Economic and physical displacement	Houses & other structures																						
		Commercial activities																						
		Household economic activities & livelihood																						
	Cultural heritage	Cultural heritage																						
	Disproportionate group impacts	Vulnerable groups																						
	Indigenous people	Indigenous people																						
Cross-cutting E & S aspects	Transboundary impacts																							
	Cumulative impacts																							
	Supply chain																							

Potential interface – scoped IN
No interface – scoped OUT

ANNEX 4 – ILEK RIVER HYDROBIOLOGICAL STUDY

Published information on macrozoobenthos of the Ilek River is scarce. In 2012, the macrozoobenthos was surveyed within the framework of the project on pollution of the main transboundary rivers of Kazakhstan. The Ilek River was surveyed in three locations: at the town of Alga, 80 km upstream of the WWTP discharge, in the tailrace basin of the Aktobe reservoir (36 km upstream) and at the village of Georgievka downstream of the discharge. In bottom communities, 39 species of bottom animals were found, including nematodes, oligochaetes, leeches, gastropods, mites, amphipods, dragonflies, mayflies, caddisflies, bedbugs, beetles, chironomids, ceratopogonids, typulids and limonids. The average number of species per sample was 19, with an average of 8503 specimens/m² and an average biomass of 7054 mg/m². Chironomids were the most abundant. Insects predominated in terms of numbers and molluscs in terms of biomass. According to macrozoobenthos indices the water near Alga is clean, in the downstream of Aktobe reservoir - moderately polluted, and near Georgievka village - between clean and moderately polluted.

In 2015-17, macrozoobenthos communities were studied in the Ilek River and its tributaries and in the Aktyubinsk water reservoir. 12 taxa of benthic invertebrates - oligochaetes, chironomids, ceratopogonids, copepods and amphipods - were found in the Ilek River. The maximum mean long-term abundance was 332±56 ind/m², the biomass was 2.7±0.3 g/m². Chironomid larvae were the most diverse. Shannon-Weaver Index value varied from 0.5 to 1.3, Pielu Equality Index - from 0.4 to 0.8.

Assessment Methodology

Eight soil samples of macrozoobenthos from the Ilek River were taken on 11 May from 15:00 to 18:30 two weeks after the end of treated sewage discharge from the equalisation tank (URE) and one week after the end of flushing discharge from the Aktobe reservoir. The sampling was carried out along the central axis of the discharge, avoiding backwaters, rivers and areas shaded by vegetation. The exception was station 2, which had to be sampled immediately downstream of the URE discharge, where there was an overflow. At this location, due to the presence of stones of 2-3cm, sampling was not possible, and sampling was done from 5 points across the river with a spatula to the sampler depth from approximately the same area directly into the flushing net. Samples were taken at 8 stations, 500m apart (Figure 2 further below), with a 0.004m² rod sampler GR-91 in five sampling rounds (repeats) with an offset of 1-1.5m upstream between the samples. Depth was measured on rod with marked divisions at 10cm intervals. With increasing depth, the riverbed changed from rocky (rolled gravel ∅1-3 cm) at stations 1-3 to sandy. Water transparency was close to 1m at all sites. Bottom vegetation was absent everywhere, except for two stems (probably, fallen from the shore) at station 6. The flow varied from fast on rifts near stations 1, 2 and 8 to almost absent between stations 5-6. Temperature was measured with a spirit thermometer permanently lowered into the water. Due to jamming of stones in the sampler hatch, at two stations: 1 and 4 it was possible to take only two complete samples each. Samples were washed in a 250 µm mesh screen, released into the river water, transferred to a 1 L plastic jar with a tight lid and labelled. Fixation of samples containing water was carried out with 15% formalin 1-3 hours after sampling. The calculated final concentration of formalin in the samples was close to 10%.

Table 1 Sampling stations parameters

Station no	Depth (m)	T°C	Amount of sampling	Sample area м²
1	1.5	11.5	2	0.008
2	0.2	12.5	5*	0.02
3	2	11.6	5	0.02
4	2	11.8	2	0.008
5	3.5	12	5	0.02
6	3.5	12	5	0.02
7	2	12.1	5	0.02
8	1.5	12.1	5	0.02

Laboratory sample processing was carried out by the counting and weighing method. Identification and counting of hydrobionts was carried out using MBS Micros microscopes. Taxonomic belonging was determined according to available manuals [44]. Taxonomic belonging was determined to the maximum

[44] Lepneva S.G. Fauna of the USSR. Copepods. Larvae and pupae of the suborder Annulipalpia. Moscow-Leningrad:1964. -562 pp. Lepneva S.G. Fauna of the USSR. Ruchnikovs. Larvae and pupae of the suborder Integripalpia. Moscow-Leningrad: 1966. - 560 pp.

possible level: to the subfamily in chironomids, to the family in oligochaetes, diptera (except chironomids), mayflies, and some caddisflies. The rest of the animals were identified to the order or even higher level. Further, the number of individuals of each taxonomic unit was counted. The mass was determined by weighing of small animals on torsion scales with a division value of 0.001 g, of larger organisms on electronic scales with a division value of 0.01 g. If weighing of the smallest animals was impossible, nomograms for determination of animal weight according to body size and shape were used [45].

Figure 1: Photo 1 Ilek river above station 1 (top), 130m below it (middle) and 180m below station 2

Narchuk E.P. (Volume Editor). Descriptor of freshwater invertebrates of Russia. Vol.5. Higher insects. - SPb. - 2001. – 825 pp.
Narchuk E.P., Tumanov D.V. (Editors of the volume). Russian freshwater invertebrates. -Volume 4. Two-winged insects. SPb. - 2000. – 998 pp.
Narchuk E.P., Tumanov D.V., Tsalolikhin S.Ya. Identifier of freshwater invertebrates of Russia. - Vol. 3. Spiders, lower insects. SPb. - 1997. – 440 pp.
Pankratova V.Y. Larvae and pupae of mosquitoes of subfamilies Podonominae and Tanypodinae of fauna of the USSR. -L.:1977. – 254 pp.
Pankratova V.Ya. Larvae and pupae of mosquitoes of subfamily Chironominae of fauna of the USSR. L.:1983. – 296 pp.
Pankratova V.Ya. Larvae and pupae of mosquitoes of the subfamily Orthocladiinae of the fauna of the USSR. - L.:1970. – 344 pp.
Chekanovskaya O.V. Aquatic miniparous worms of the fauna of the USSR. - 1962. – 411 pp.
[45] Chislenko L.L. Nomograms for determining the weight of aquatic organisms by body size and shape (marine mesobenthos and plankton). - L, 1968. – 106 pp.

Preparation of data for the analysis was carried out by the program "Biota" [46] and Microsoft Excel spreadsheets. Statistical data processing was performed using Primer v.6 package [47].

The Shannon-Weaver (H′) information indices for biomass and Piel (e) were used to assess community structure. The first index indicates the level of biodiversity of the river community. The second index indicates the species parity in terms of individuals in the community [48].

Results

The macrozoobenthos of the Ilek River in May 2023 was represented by insects (13 taxa), oligochaete worms from 2 families and mites (Table 2).
Only larvae of chironomid mosquitoes of the subfamily Chironominae were consistently found in the benthos. A high frequency of occurrence was recorded for chironomid mosquitoes of the subfamilies Orthocladiinae and Tanypodinae, while water mites Acariformes and biting midges Ceratopogonidae were found slightly less frequently. Oligochaeta nididae and mosquito-tolkunks of the family Empididae from the order of Diptera were recorded at half of the stations. The highest number of species was found on station 1 and the lowest on station 8. Accordingly, the highest value of the Shannon-Weaver index was found on station 1 and the lowest on station 8 (Table 3).

Table 2: Taxonomic composition and frequency of occurrence (%) of macrozoobenthos organisms

Group	Family	Frequency of occurrence
Insects	Baetidae	25
	Heptageniidae	12.5
	Odonata	12.5
	Ceratopogonidae	62.5
	Empididae	50
	Orthocladiinae	87.5
	Tanypodinae	75
	Chironominae	100
	Hydropsychidae	25
	Hydroptilidae	12.5
	Trichoptera2	12.5
	Trichoptera3	12.5
	Hemiptera	12.5
Worms	Naididae	50
	Tubificidae	12.5
Other	Acariformes	62.5

Table 3: Structural indicators of macrozoobenthos at 8 stations of the Ilek River

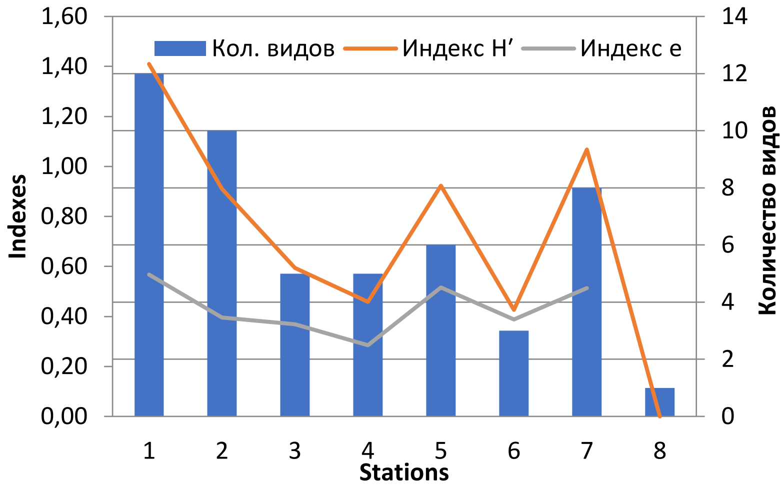
Indicator	1	2	3	4	5	6	7	8
Number of species	12	10	5	5	6	3	8	1
Number of species, ex/m²	22125	12850	2500	6250	2900	900	11650	150
Biomass, g/m²	7963.75	3026.4	2275.0	2031.9	508.75	508.75	2468.0	75.00
Shannon-Weaver index, H′	1.41	0.91	0.59	0.46	0.92	0.43	1.07	0.00
Pielu index, e	0.57	0.40	0.37	0.28	0.52	0.39	0.51	

Downstream, diversity decreased (Figure 3).The number of species as well as index values decreased almost linearly from station 1 to stations 3 and 4. From station 5 to station 8, there were spikes in diversity indices (Figure 3).

The number of benthic animals varied from 22125 (St.1) to 150 (St.8) individuals/m² (Table 2) and the biomass was from 7964 (St.1) to 75 (St.8) mg/m² (Table 3). Insect larvae were the absolute dominants of quantitative development of macrozoobenthos, with the proportion in abundance ranging from 73 to 100% and in biomass from 88 to 100%. Chironomid larvae of the family Chironominae dominated among the insects.

[46] Certificate of state registration of rights to the object of copyright under the name "Biota" (computer program) No. 1715 dated July 11, 2017.
[47] Clarke K.R., Warwick R.M. Changes in marine communities: an approach to statistical analysis and interpretation, 2nd edition, PRIMERV6: Plymouth, 2001 and Clarke K.R., Gorley R.N. PRIMER v6: User Manual/Tutorial. PRIMER-E, Plymouth, 2006.192 pp
[48] Odum Yu. Ecology. - Volume 2. - M., 1986. - 376 p. and Konstantinov A.S. General hydrobiology. - M, 1986. - 472 p.

Numbers of benthic invertebrates decreased from station 1 to station 3 (Figure 3). On stations 4 and 7 an increase in abundance was observed (Figure 3). Biomass declined further, until station 6, increased at station 7, and the minimum biomass value was recorded at station 8.



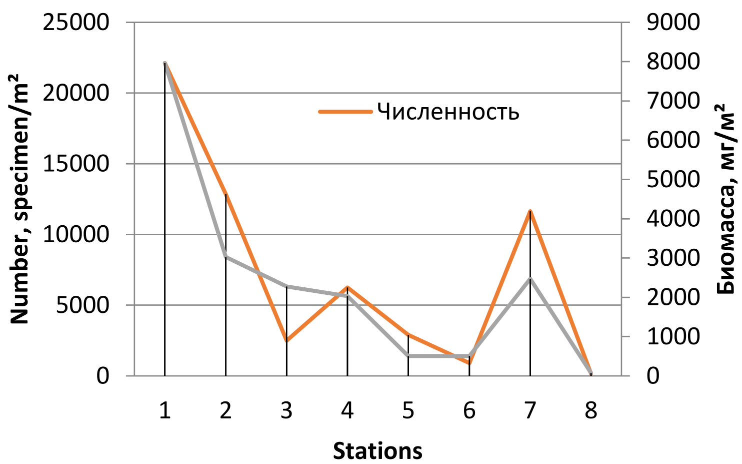


Figure 3 Dynamics of Ilek River macrozoobenthos indicators

Figure 2 Sampling stations

Table 4 Macrozoobenthos abundance (ex/m²) of Ilek River

Station	Vermes	Insecta	Others	Total
1	750	18750	2625	22125
2	600	12050	200	12850
3	0	2500	0	2500
4	0	6125	125	6250
5	350	2400	150	2900
6	0	900	0	900
7	650	8450	2550	11650
8	0	150	0	150

Table 5 Biomass of macrozoobenthos (mg/m²) of the Ilek River

Station	Vermes	Insecta	Others	Total
1	62.50	7713.75	187.50	7963.75
2	5.40	2971.00	50.00	3026.40
3	0.00	2275.00	0.00	2275.00
4	0.00	2021.88	10.00	2031.88
5	30.00	448.75	30.00	508.75
6	0.00	508.75	0.00	508.75
7	5.00	2263.00	200.00	2468.00
8	0.00	75.00	0.00	75.00

Discussion

The development of macrozoobenthos in the studied section of the Ilek River depends on natural and anthropogenic factors. Among the most significant natural factors should be noted the speed of water flow and, as a consequence, the nature of the soil. As it is known, the richest communities are characteristic for stony soils on the fast current, the poorest - for fine-sandy ones in the zones of slow current. The depletion of benthic communities is influenced by the substitution of coarse sand with gravel of varying size for fine sand. At stations 5 and 6, the proportion of crushed sand was low, and at station 8 the substrate consisted mainly of fine sand.

Nevertheless, the overall downward trend and gradual recovery of the figures to Station 7 does indicate the influence of wastewater discharge. A secondary factor can be considered as cattle watering points on the river. Such a waterhole was located 150m upstream of station 8, which, together with the sandy bottom substrate, may partly explain the decline in biological indicators here. Run-off through the groundwater from the various industrial and domestic sewage lagoons can be regarded as a source of chronic pollution along the entire length of the river, but it can be stated from the state of the biota at station 1 that the impact of these pollution sources is negligible, presumably due to the low rate of pollution entering the river from them.

At background station 1, on coarse sand with a high proportion of crushed stone and no influence from sewage, the community was characterised by the highest diversity and relatively high quantitative indicators. At station 2, at the wastewater outlet, algae development not observed at other stations was observed. Only at this station oligochaetes of the family Tubificidae tolerant to organic pollution were found, however, the number of these worms was low.

From station 5 there is a gradual recovery of the community - diversity begins to increase, but not quantitative indicators. The decrease in diversity observed at station 6 is more likely due to the nature of the substrate - the predominance of finer-grained sand. At station 7, on similar substrate to the background station, there is an increase in both qualitative and quantitative indices. However, there is no full recovery of the benthocenosis to its initial state.

At station 8, low indicators of diversity and quantitative development are due to the nature of the soil (sand) and, probably, watering by cattle. Only a small number of psammophilous chironomids were found.

Recommendations

To monitor the recovery of bottom communities after the discharge of treated wastewater, it is recommended to take samples from stations with identical coarse sand and gravel bottom sediments:

- St.1 - background
- St.3 - highest impact of wastewater
- St.7 - in the recovery area.

The preliminary analysis of taxonomic composition of macrozoobenthos of the investigated site allows to offer the following indicators of pollution (Table 6).

Table 6: Suggested pollution indicator species

Species indicator	Degree of water pollution
Ruptilidae Hydroptilidae	Clean
Mayflies Baetidae	
Dragonflies Odonata	
Copepods Hydropsychidae	Lightly polluted
Oligochaetes Tubificidae	Polluted

More detailed surveys will enable the identification of indicator species to species.

ANNEX 5 – SUMMARY OF KEY FINDINGS OF THE LOCAL EIA

The following summarises the key findings of the local EIA (OVOS) report prepared by Aquarem (2023) (summary by Sweco / EcoSocio Analysist)

The preliminary EIA (predOVOS) of this 130 000m^3 maximum daily capacity plant was prepared according to the Order of the Minister of Ecology, Geology and Natural Resources #280 from 30/06/2021 on approval of the Instruction on organisation and performance of environmental assessment.

The predOVOS has 90 pages and 15 appendixes that contain responses on the requests of information on the area sensitivity, calculation of noise, emissions and waste volumes. It is based on the feasibility study information without visiting the site. It identifies no impact from the development and states that no land is to be acquired for the new plant, which is incorrect as around 3ha has to be taken from another land tenant. The chapter 5 Impact assessment contain two lines stating that the project does not intend to use natural or genetic resources.

Overall, the EIA states no impacts from the project.

The purpose of predOVOS is to justify higher pollution volumes to receive the emission permit with the volumes that cannot be exceeded. Despite the calculated annual emission being over 71t (with the current permit of 10t/y), the report predicts considerable improvement in the Ilek river water and ambient air quality and reduction in the generated waste. The increase in the currently permitted 10t/year to the calculated 7 294t/year is explained by the use of a different calculation methodology. It suggests 47 314 t discharges to the river annually mainly sulphates and chlorides but including 7t of hydrocarbons and 35.5 t of surfactants.

The main air pollutants during construction are predicted to be dust (381 t) and dimetilbensol (22t). The total volume of pollutants during construction is equated to 430 t. During the operation this volume is predicted to increase to 968 t mainly because of H_2S (261 t), N_2O (147 t) as well as ammonia (27 t) NO (28 t) and formaldehyde (27 t). H_2S appears not to be included in the dispersion modelling, whereas ammonia is.

Emission dispersion modelling showed no exceedances of the maximum permitted concentrations of 20 air pollutants at the residential areas for construction and operation.

For construction, noise dispersion was calculated for 8 frequencies (63, 125, 250, 500,1000, 2000, 4000, 8000 Hz) for a dozer, dump truck and roller working together. At 97m from the source, the noise was 73, 63, 55, 49, 46, 44, 43 and 42.99 dB respectively, which was from 4.5 to 0.01dB below the maximum permitted level for these frequencies. For the operation, the calculation showed that noise would not propagate beyond the plant fence.

Around 33 tons of waste with 7kg of paint waste is expected to be generated during construction. The main waste during the operation is thought to be the sand traps grit (7 117 t) and dried sludge (130 t). Out of hazardous waste, oil (2.4 t), car batteries (1.2 t) and oil filters (0.6 t) are named.

In the risk assessment section predOVOS describes that if a sewage collector breaks, ESAG reduces water supply to the houses that discharge to the damaged collector. Such restriction can last from 1 to 30 days. If water bodies are affected, the emergency committee restricts.

The nature protection measures are copied from the Law on the protection, reinstatement, and use of the wildlife. Here, it is also stated that the measures will be prescribed by the State Environmental Expertise in its conclusion on the predOVOS and that the developer will comply with those prescriptions.

Copies of the air dispersion modelling tables in the local EIA, for construction and operation phases are included on the following pages, followed by the noise dispersion calculations.

Air dispersion modelling:

Таблица 1. 8 Сводная таблица результатов расчета рассеивания (период строительства)

Код ЗВ	Наименование загрязняющих веществ и состав групп суммаций	Cm	РП	СЗЗ	ЖЗ	ФТ	Граница области возд.	Колич.ИЗА	ПДКмр (ОБУВ) мг/м3	Класс опасн.
0123	Железо (II, III) оксиды (диЖелезо триоксид, Железа оксид) /в пересчете на железо/ (274)	20,6394	0,157431	нет расч.	0,000507	нет расч.	нет расч.	2	0.4*	3
0143	Марганец и его соединения /в пересчете на марганца (IV) оксид/ (327)	19,2333	0,093072	нет расч.	0,000474	нет расч.	нет расч.	2	0,01	2
0184	Свинец и его неорганические соединения /в пересчете на свинец/ (513)	133,937	0,589283	нет расч.	0,003406	нет расч.	нет расч.	1	0,001	1
0301	Азота (IV) диоксид (Азота диоксид) (4)	27,4216	0,687826	нет расч.	0,401924	нет расч.	нет расч.	4	0,2	2
0304	Азот (II) оксид (Азота оксид) (6)	3,5407	0,168981	нет расч.	0,130901	нет расч.	нет расч.	4	0,4	3
0328	Углерод (Сажа, Углерод черный) (583)	47,8529	0,208285	нет расч.	0,001211	нет расч.	нет расч.	3	0,15	3
0330	Сера диоксид (Ангидрид сернистый, Сернистый газ, Сера (IV) оксид) (516)	6,5017	0,396146	нет расч.	0,353693	нет расч.	нет расч.	3	0,5	3
0337	Углерод оксид (Окись углерода, Угарный газ) (584)	12,2815	1,025525	нет расч.	0,883477	нет расч.	нет расч.	4	5	4
0616	Диметилбензол (смесь о-, м-, п- изомеров) (203)	52,0522	1,183911	нет расч.	0,022498	нет расч.	нет расч.	1	0,2	3
0621	Метилбензол (349)	1,599	0,036368	нет расч.	0,000691	нет расч.	нет расч.	1	0,6	3
0703	Бенз/а/пирен (3,4-Бензпирен) (54)	21,6259	0,094362	нет расч.	0,000548	нет расч.	нет расч.	2	0.00001*	1
1119	2-Этоксиэтанол (Этиловый эфир этиленгликоля, Этилцеллозольв) (1497*)	1,0866	0,024714	нет расч.	0,00047	нет расч.	нет расч.	1	0,7	-
1210	Бутилацетат (Уксусной кислоты бутиловый эфир) (110)	1,6072	0,036556	нет расч.	0,000695	нет расч.	нет расч.	1	0,1	4
1325	Формальдегид (Метаналь) (609)	0,133	0,00691	нет расч.	0,000043	нет расч.	нет расч.	1	0,05	2
1401	Пропан-2-он (Ацетон) (470)	1,6338	0,03716	нет расч.	0,000706	нет расч.	нет расч.	1	0,35	4
2752	Уайт-спирит (1294*)	11,2526	0,255937	нет расч.	0,004864	нет расч.	нет расч.	1	1	-
2754	Алканы C12-19 /в пересчете на C/ (Углеводороды предельные C12-C19 (в пересчете на C); Растворитель РПК-265П) (10)	24,5511	0,384858	нет расч.	0,010631	нет расч.	нет расч.	4	1	4
2902	Взвешенные частицы (116)	39,4305	0,2724	нет расч.	0,184585	нет расч.	нет расч.	3	0,5	3
2908	Пыль неорганическая, содержащая двуокись кремния в %: 70-20 (шамот, цемент, пыль цементного производства - глина, глинистый сланец, доменный шлак, песок, клинкер, зола, кремнезем, зола углей казахстанских месторождений) (494)	4258,541	19,87004	нет расч.	0,107597	нет расч.	нет расч.	10	0,3	3
2930	Пыль абразивная (Корунд белый, Монокорунд) (1027*)	7,5005	0,025367	нет расч.	0,000191	нет расч.	нет расч.	1	0,04	-
6007	0301 + 0330	33,9233	1,010654	нет расч.	0,683	нет расч.	нет расч.	4		
6035	0184 + 0330	140,4387	0,765236	нет расч.	0,355728	нет расч.	нет расч.	4		
__ПЛ	2902 + 2908 + 2930	2595,1555	12,03032	нет расч.	0,065546	нет расч.	нет расч.	13		

Таблица 1. 9 Сводная таблица результатов расчета рассеивания (период эксплуатации)

Код ЗВ	Наименование загрязняющего вещества	ЭНК, мг/м3	ПДКм.р, мг/м3	ПДКс.с., мг/м3	ОБУВ, мг/м3	Класс опасности	Выброс вещества с учетом очистки, г/с	Выброс вещества с учетом очистки, т/год, (М)	Значение М/ЭНК
1	2	3	4	5	6	7	8	9	10
0123	Железо (II, III) оксиды (диЖелезо триоксид, Железа оксид) /в пересчете на железо/ (274)			0,04		3	0,035861	0,06455	1,61375
0143	Марганец и его соединения /в пересчете на марганца (IV) оксид/ (327)		0,01	0,001		2	0,000528	0,001	1
0150	Натрий гидроксид (Натр едкий, Сода каустическая) (876*)				0,01		0,000013	0,00009243	0,009243
0301	Азота (IV) диоксид (Азота диоксид) (4)		0,2	0,04		2	0,213315197	5,87610072	146,902518
0302	Азотная кислота (5)		0,4	0,15		2	0,0005	0,003528	0,02352
0303	Аммиак (32)		0,2	0,04		4	0,0335243	1,05481876	26,370469
0304	Азот (II) оксид (Азота оксид) (6)		0,4	0,06		3	0,054451344	1,67301	27,8834999
0316	Гидрохлорид (Соляная кислота, Водород хлорид) (163)		0,2	0,1		2	0,000132	0,00093139	0,0093139
0322	Серная кислота (517)		0,3	0,1		2	0,000027	0,0001884	0,001884
0330	Сера диоксид (Ангидрид сернистый, Сернистый газ, Сера (IV) оксид) (516)		0,5	0,05		3	0,010260941	0,00903375	0,180675
0333	Сероводород (Дигидросульфид) (518)		0,008			2	0,0662583	2,0891869	261,148363
0337	Углерод оксид (Окись углерода, Угарный газ) (584)		5	3		4	1,08663424	22,6044517	7,53481723
0410	Метан (727*)				50		0,8629667	27,1834506	0,54366901
0416	Смесь углеводородов предельных С6-С10 (1503*)				30		0,2693534	8,4846331	0,2828211
0616	Диметилбензол (смесь о-, м-, п- изомеров) (203)		0,2			3	0,247686	0,1173	0,5865
0621	Метилбензол (349)		0,6			3	0,039328	0,018625	0,03104167
0898	Трихлорметан (Хлороформ) (576)		0,1	0,03		2	0,000493	0,00347861	0,11595367
1042	Бутан-1-ол (Бутиловый спирт) (102)		0,1			3	0,048038	0,02275	0,2275
1061	Этанол (Этиловый спирт) (667)		5			4	0,023597	0,011175	0,002235
1071	Гидроксибензол (155)		0,01	0,003		2	0,008236	0,2594367	86,4789
1210	Бутилацетат (Уксусной кислоты бутиловый эфир) (110)		0,1			4	0,039328	0,018625	0,18625
1240	Этилацетат (674)		0,1			4	0,039328	0,018625	0,18625
1325	Формальдегид (Метаналь) (609)		0,05	0,01		2	0,0086978	0,2739804	27,39804
1728	Этантиол (668)		0,00005			3	0,0004307	0,013568	271,36
2752	Уайт-спирит (1294*)				1		0,258455	0,1224	0,1224
2754	Алканы С12-19 /в пересчете на С/ (Углеводороды предельные С12-С19 (в пересчете на С); Растворитель РПК-265П) (10)		1			4	0,100247864	0,74752753	0,74752753
2868	Эмульсол (смесь: вода - 97.6%, нитрит натрия - 0.2%, сода кальцинированная - 0.2%, масло минеральное - 2%) (1435*)				0,05		0,01008	0,009072	0,18144
2908	Пыль неорганическая, содержащая двуокись кремния в %: 70-20 (шамот, цемент, пыль цементного производства - глина, глинистый сланец, доменный шлак, песок, клинкер, зола, кремнезем, зола углей казахстанских месторождений) (494)		0,3	0,1		3	0,5279	0,6871	6,871
	В С Е Г О :						**3,985670786**	**71,368639**	**867,999581**

Примечания: 1. В колонке 9: "M" - выброс ЗВ,т/год; при отсутствии ЭНК используется ПДКс.с. или (при отсутствии ПДКс.с.) ПДКм.р. или (при отсутствии ПДКм.р.) ОБУВ

2. Способ сортировки: по возрастанию кода ЗВ (колонка 1)

Noise dispersion calculations:

Construction period

The main sources of noise during construction are bulldozers, dump tracks, excavators and other construction equipment. To reduce the noise level, the following measures are envisaged:
− applied installations have noise levels that do not exceed admissible values;
− the equipment is covered with thermal insulation, which reduces the noise level;
− use of PPE by personnel , including ear plugs.
In addition to these measures, sound pressure from equipment can be reduced by improving the sound insulation properties of the envelope.

Calculation of the distance at which sound pressure levels are equal to the maximum permissible ones

Calculation of sound pressure levels from the noise source located on the territory of the enterprise is calculated according to MSN 2.04-03-2005 "Protection against noise".

Octave sound pressure levels L in dB at the design points, if the noise source and the design points are located in the residential area or on the site of the enterprise, should be determined by the formula:

$$L = L_p - 15\lg r + 10\lg\Phi - \frac{\beta_a r}{1000} - 10\lg\Omega,$$

Where L_p - octave sound power level in dB of the noise source. According to source:
For equipment - according to the data of the enterprise.
for this type of equipment octave sound power level in dB:

Sound pressure levels L_p (equivalent sound pressure levels L_{eq}) in dB in octave frequency bands with geometric mean frequencies in Hz								**Sound levels L_a and equivalent sound levels $L_{a\ eq}$ in dBA**
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
Bulldozer								
96.30	86.10	78.60	73.20	70.0	68.80	69.00	71.10	70.00
Dumper truck								
110.30	100.10	92.60	87.20	84.0	82.80	83.00	85.10	84.00
Excavator								
96.30	86.10	78.60	73.20	70.0	68.80	69.00	71.10	70.00

Φ - directivity factor of the noise source, dimensionless, determined by experimental data. For noise sources with uniform sound emission (as in our case) it is necessary to take Φ = 1.

Ω - spatial angle of sound emission, taken for noise sources located: in space - Ω = 4π; on the surface of the territory or enclosing structures of buildings and structures - Ω = 2π; n a two-faceted corner formed by enclosing structures of buildings and structures - Ω = π;
n this case the source is located on the surface of the territory Ω = 2π
βα - sound attenuation in the atmosphere in dB/km, taken from the table:

Geometric mean frequencies of octave bands in Hz							
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
0	0.7	1.5	3	6	12	24	48

r – is the distance in m from the noise source to the point where $L_{sum} < L_{spl}$. According to the Sound Pressure Level for areas immediately adjacent to residential buildings, defined in Table 1 of SanPiN RK № 3.01.035-97, taking into account the time factor:

Sound pressure levels L_{spl} (equivalent sound pressure levels L_{eq}) in dB in octave frequency bands with geometric mean frequencies in Hz								**Time**
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
75	66	59	54	50	47	45	43	From 7 till 23 h

The octave sound pressure levels from several noise sources L_{sum} in dB should be determined as the sum of the sound pressure levels L in dB at the selected design point from each noise source (or each barrier through which noise enters the room or the atmosphere) according to the formula:

$$L_{sum} = 10\lg\sum_{i=1}^{n} 10^{0.1L_i},$$

Carrying out calculations we obtain that at a distance r = 97 м,
the sound pressure of the equipment under consideration is less than the MPC:

	Sound pressure levels L (equivalent sound pressure levels L_{eq}) in dB in octave frequency bands with geometric mean frequencies in Hz							
	63	125	250	500	1000	2000	4000	8000
Bulldozer								
L_{calc}	58.52	48.25	40.67	35.13	31.63	29.85	28.89	28.66
Dumper truck								
L_{calc}	72.52	62.25	54.67	49.13	45.63	43.85	42.89	42.66
Excavator								
L_{calc}	58.52	48.25	40.67	35.13	31.63	29.85	28.89	28.66
Octave sound pressure levels from all sources								
L_{calc}	72.85	62.58	55.00	49.46	45.97	44.19	43.22	42.99
Comparison of sound pressure level with total level								

L_{spl} - L_{calc} From 7 till 23 h	-2.15	-3.42	-4.00	-4.54	-4.03	-2.81	-1.78	-0.01

Operation period

Acoustic calculations have been carried out to determine the expected noise levels from the proposed facility at design points within the immediate residential area. Noise impacts of the facility can be considered as energetic pollution of the environment, in particular the atmosphere. The main difference between noise impacts and pollutant emissions is the impact on the environment of sound vibrations transmitted through the air or solid bodies (ground surface). The magnitude of noise impact on humans depends on the sound pressure level, frequency characteristics of noise, its duration, periodicity, etc. Noise reduces labour productivity at enterprises and is the cause of many common industrial diseases. Noises even of low intensity can lead to negative changes in the human body, which, first of all, is manifested in the violation of the functions of the central nervous system. Even weak tonal and impulse noises pose a great danger to humans, having a strong irritating effect and leading to premature fatigue.

The level of sound impact created by noise sources of the projected facility should be lower than the maximum permissible level of sound impact.

#	Type of labour activity, workplace	Time of day	Sound pressure levels, dB, in octave bands with geometric mean frequencies, Hz									Sound levels and equivalent sound levels (in dBA)	Maximum sound levels L_{Amax}, dBA
			31.5	63	125	250	500	1000	2000	4000	8000		
22	Areas immediately adjacent to residential buildings, rest homes, residential homes for the elderly and the disabled	7.00 - 23.00	90	75	66	59	54	50	47	45	44	55	70
		23.00- 7.00	83	67	57	49	44	40	37	35	33	45	60

The sources of noise during facility operation are:

- engineering equipment (pumps, lifting and transport equipment, air purification units for odourous substances);
- moving and parking transport of employees and visitors of the facility.

Noise sources (pumps) are located inside the buildings, the enclosing structures of which are a barrier to the spreading noise. Noise sources are concentrated in interconnected rooms.

Parameters of noise sources are presented in Appendix 6.

The nearest residential area is located at a distance of 4.8km. The technological equipment of the treatment plant will not have a negative acoustic impact on the surrounding area.
The results of the noise dispersion calculation are presented in Annex 6. As the results of the noise dispersion calculation show, the level of noise impact is limited to the territory of the enterprise.
No exceedances of noise levels in the residential area, at fixed points were detected.