

Karatau 100 MW Wind Project Republic of Uzbekistan

ESIA: Volume 4 –
Appendices



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5Cs PROJECT DIRECTOR	Ken Wade

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A – E&S SCOPING REPORT

Nukus 100 MW Wind Farm

Uzbekistan

Environmental & Social Impact Assessment (ESIA): **Scoping Report**

Prepared for:



January 2022

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PROJECT NAME	Nukus 100 MW Wind Farm
5Cs PROJECT NUMBER	1305/001/118
DOCUMENT TITLE	Environmental & Social Impact Assessment: Scoping Report
CLIENT	ACWA Power
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LIST OF ABBREVIATIONS

ABBREVIATION	MEANING
5 Capitals	5 Capitals Environmental & Management Consultancy
AZE	Alliance for Zero Extinction
BOP	Balance of Plant
COVID-19	Coronavirus Disease 2019
COO	Countries of Operation
E&S	Environmental and Social
EAAA	Ecologically Appropriate Area of Analysis
EBRD	European Bank for Reconstruction and Development
EI	Evacuation Infrastructure
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement and Construction
EPFIs	Equator Principles Financial Institutions
ESA	Environmental and Social Assessment
ESIA	Environmental & Social Impact Assessment
GBVH	Gender Based Violence and Harassment
GHG	Greenhouse Gas
GIP	Good Industry Practice
GOU	Government of Uzbekistan
HGV	Heavy Goods Vehicles
IBA	Important Bird Area
IFC	International Finance Corporation
ILO	International Labour Organisation
KBA	Key Biodiversity Area
LLA	Land Lease Agreement
MOE	Ministry of Energy
NEGU	National Electric Grid of Uzbekistan
OHTL	Overhead Transmission Line
OVOS	National Uzbekistan acronym for EIA assessment process
PEF	Purchase Electrical Facilities
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PR	Performance Requirement
SAC	Special Areas of Conversation
ToR	Terms of Reference
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
WDA	Wind Development Area
WTG	Wind Turbine Generator

1 INTRODUCTION

1.1 National Context

The Uzbekistan 2030 Energy Strategy defines the mid-term and long-term objectives and direction for development in the power sector to ensure electricity supply in Uzbekistan between 2020 – 2030. One of the objectives of the Energy Strategy includes the development and expansion of renewables use and their integration into the unified power system. To fulfil this objective, the government of Uzbekistan intends to:

- Ensure diversification in power and heat energy sectors through increased share of renewable energy sources and creation of renewable energy investment project mechanism utilising PPP approaches, enhancement of government policies related to development of renewable energy sources, demonstration of renewable projects.

In regard to the development of wind farms the Energy Strategy states the following as priority:

“Creation of large-scale wind farms with single site capacities ranging from 100 MW to 500 MW mostly concentrated in North-Western region (Republic of Karakalpakstan and Navoi region) shall be the main priority of wind power development”

It is understood that the Project (ref. below) is part of a key facility contributing to this priority.

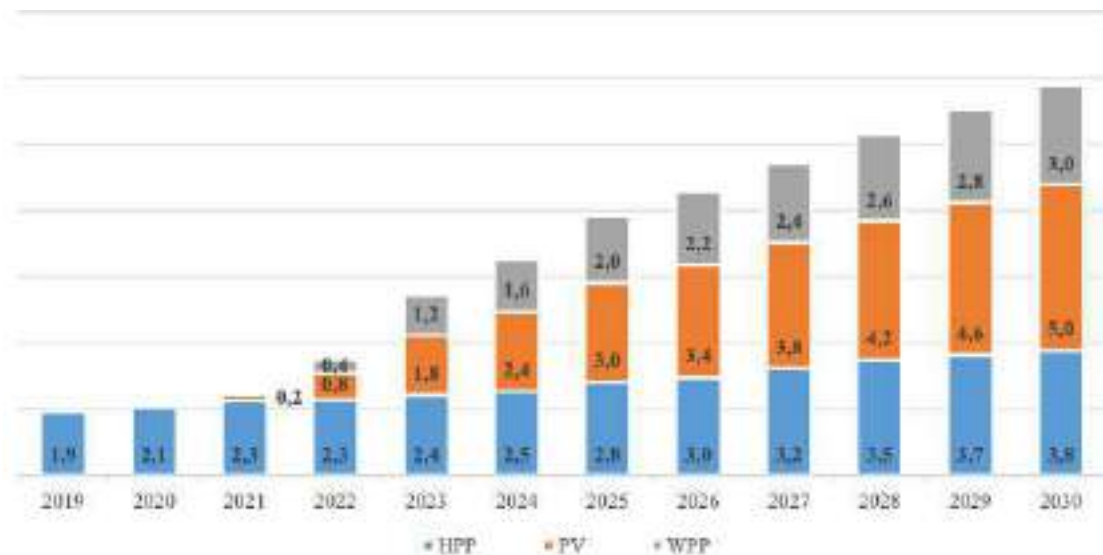


Figure 1-1 Uzbekistan renewables-based generation targets by 2030 (Ministry of Energy of Uzbekistan, 2020)

1.2 The Project

The Government of the Republic of Uzbekistan (GOU) has launched a program for the development of large-scale wind power projects in Uzbekistan. The GOU has signed a memorandum of understanding with the European Bank for Reconstruction and Development (EBRD) with a view to cooperate on the development of large-scale wind power projects up to a total capacity of 1,000 MW.

ACWA Power have been awarded the contract to design, finance, construct, operate, maintain and (at the request of the Government) decommission or transfer, the Nukus 100 MW Wind Project including the Evacuation Infrastructure (EI) (the Project) in the Karatau mountain region of the Republic of Karakalpakstan.

Please refer to more detailed Project information in the following chapter.

1.3 Scope of Document

5 Capitals Environmental and Management Consulting (5 Capitals) has been engaged by ACWA Power to undertake the independent Environmental Impact Assessment (EIA) and Environmental and Social Impact Assessment (ESIA) processes, as well as certain other environmental & social related scope. In order to undertake the EIA/ESIA, it is necessary to delineate the terms of reference (amongst other items), which is part of the basis for this document, the Project's 'Scoping Report'.

ACWA Power is also seeking an amount of project finance from financial Institutions who have their own internal environmental & social investment policies/standards or may be members of voluntary agreements such as the Equator Principles. In addition to the Project requiring alignment with the environmental and social policies and guidelines of those who are providing financing, the Project is required to be delivered in accordance with the EBRD Environmental and Social Policy (ESP) 2019 and supporting performance requirements, the Equator Principles IV 2020 and the technical performance criteria set out in certain World Bank Group Environmental, Health and Safety (EHS) Guidelines. Based on the requirements of these institutions, a process for undertaking Environmental & Social Impact Assessment (ESIA) to assess potential impacts and determine suitable mitigation measures will be necessary as a process to reach financial close.

A key stage in the development of the Project, requires an EIA in compliance with Uzbekistan national EIA requirements (OVOS). 5 Capitals has partnered with a locally based consultant, 'Juru Energy' (Tashkent, Uzbekistan) to undertake certain elements of the scope, including

baseline surveys, consultations and submission of the national EIA to the State Committee of the Republic of Uzbekistan on Environmental Protection.

1.4 Objectives of the ESIA Scoping Report

The main objectives of this report in relation to the Project are as follows:

- To provide an overview of the Project;
- To provide an overview of the regulatory framework requiring ESIA, other obligations and environmental & social standards applicable to the project (such as those required by the lenders);
- To outline preliminary environmental & social baseline conditions and receptors;
- To ensure that proposed assessment techniques (including required baseline surveys) are designed to enable the establishment of representative environmental conditions for the Project and its areas of impacts/influence;
- To identify preliminary environmental & social potential impacts relating to the construction and operational phases of the Project, for the ESIA to assess these issues specifically; and
- To specify the structure and content of the subsequent ESIA.

This Scoping Report has been informed by:

- Analysis of the Project details and proposed works (as advised by ACWA Power);
- Review of the Environmental and Social Assessment (ESA) prepared by Juru Energy and submitted in April 2021 as part of the tender documentation;
- Desk-based study of available mapping and aerial photography;
- Site visit by 5 Capitals in December 2021 and site visits by 5 Capitals' sub-consultant (Juru Energy) from May 2020 onwards;
- The Bird Baseline Survey provided as part of the tender documentation which comprised bird surveys conducted from 25th April 2020 to April 25th 2021 and Collision Risk Modelling (CRM) for the Wind Turbine Generator (WTG) site;
- Review of available secondary information, including but not limited to:
 - BirdLife International <birdlife.org>; World Database of Protected Areas <protectedplanet.net>; Key Biodiversity Areas <keybiodiversityareas.org>; Climate Change Knowledge Portal - World Bank Group <<https://climateknowledgeportal.worldbank.org>> etc.;
- 5 Capitals' experience of conducting ESIAs for similar wind projects in Uzbekistan and the wider region; and
- 5 Capitals' experience of working with lenders to ensure necessary financing requirements are met.

2 PROJECT INFORMATION

2.1 Key Project Information

Table 2-1 Key Project Information

PROJECT TITLE	Nukus 100 MW Wind Farm
PROJECT DEVELOPER	ACWA Power
PROJECT COMPANY	"ACWA POWER WIND KARATAU" FE LLC
OFF TAKER	JSC National Electric Grid of Uzbekistan
EPC CONTRACTOR	To be confirmed
O&M COMPANY	NOMAC
ENVIRONMENTAL CONSULTANT	5 Capitals Environmental and Management Consulting (5 Capitals) PO Box 119899, Dubai, UAE Tel: +971 (0) 4 343 5955, Fax: +971 (0) 4 343 9366 www.5capitals.com
	Juru Energy Consulting LLC Chust Str. 10, 100077, Tashkent, Uzbekistan Tel: +998 71 202 0440, Fax: +998 71 2020440
POINT OF CONTACT	Ken Wade (Director), Ken.wade@5capitals.com

2.2 Project Location

The Project is located in a greenfield location in Karatau mountain region in Karauzyak District, in the Republic of Karakalpakstan, Republic of Uzbekistan. The site is situated around 730 km west of Tashkent, 83 km east of the city of Nukus, and 62 km north of the city of Urgench.

The allocated site boundary for the WTG is within a 1,678-hectare area located at an altitude ranging from approximately 260 - 345 m above sea level. As part of the Project, a new 200 kV overhead transmission line (OHTL) approximately 15.6 km in length will connect to an existing 220 kV OHTL near to the highway A380 and an access road approximately 12 km in length will connect the Project area with an existing road to the north-west which connects the A380 to the settlements Aimbed-Ishan and Karauzyak to the north.

The following figures depict the national and local context of the Project.



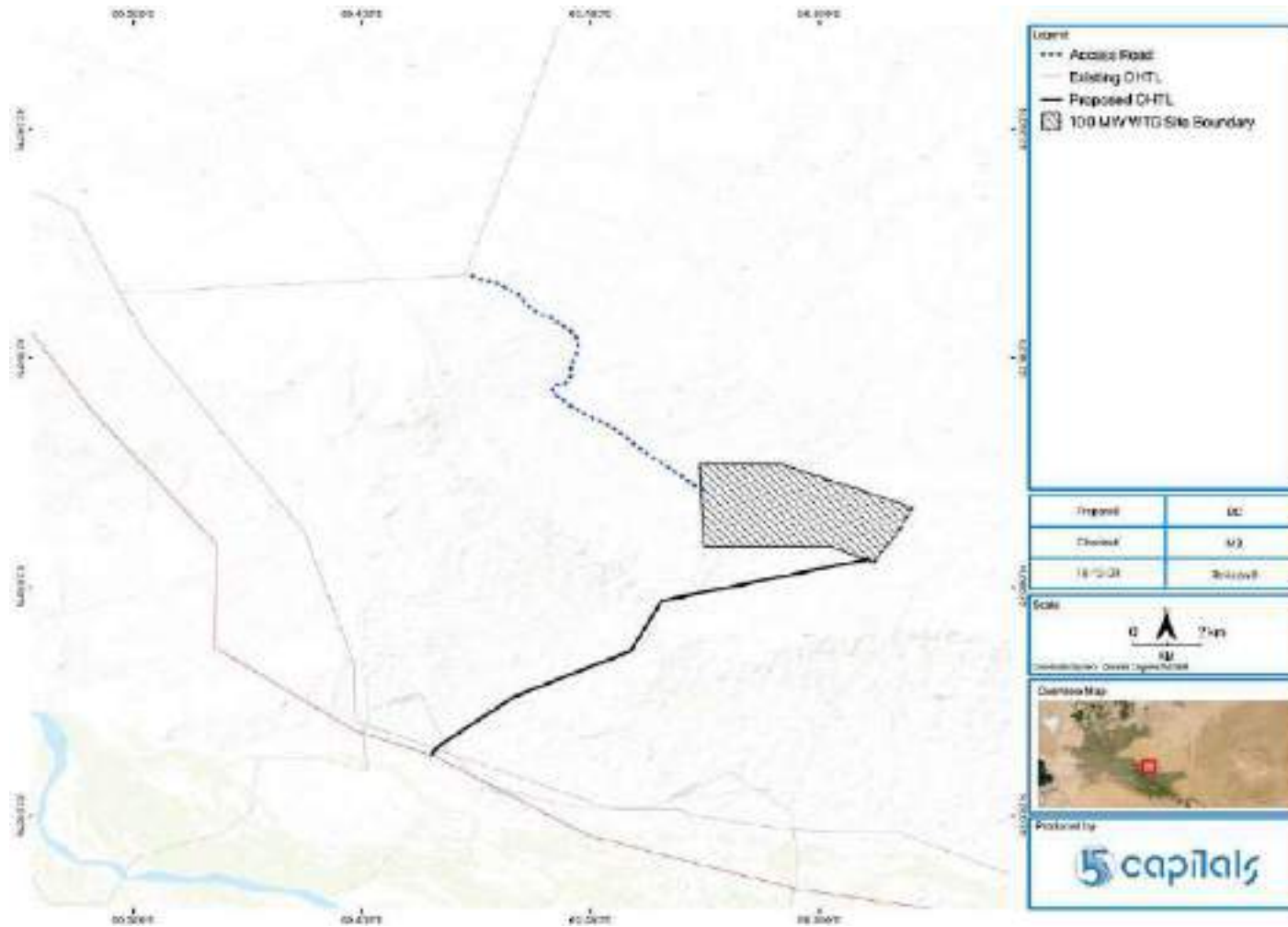


Figure 2-2 Project Location – Local Context

2.3 Land Use and Site Condition

2.3.1 Land Ownership

According to the 1998 Land Code of the Republic of Uzbekistan, all land in Uzbekistan is state property and permits for use of land are granted and monitored by the State through the rayon and oblast administrations.

A Land Lease Agreement (LLA) has been prepared between JSC National Electric Grid of Uzbekistan (JSC NEGU) and the Project Company for the WTG site and EI site¹.

2.3.2 Land Use and Site Condition

WIND FARM AREA

The site comprises semi-complex terrain composed of gentle ridges originating from a higher summit at the edge of the Karatau hills located in the west of the Project area. Land cover mainly consists of sandy ground and desert vegetation such as wormwood.

Juru Energy's ESA site visit (2020) observations indicate that the Project site is free from any permanent settlements or receptors, although agricultural activity and shepherd huts used on an intermittent basis were observed. Similar site conditions were observed by 5 Capitals during the site visit in December 2021, although no agricultural activities were observed in the site boundary allotted for the WTGs.



Figure 2-3 General View of Wind Farm Site

¹ It is important to note that the President of the Republic of Uzbekistan signed a Decree No. UP-6243 "On Measures to Ensure Equality and Transparency in Land Relations, Reliable Protection of Land Rights and Transforming them into a Marketable Asset" dated 08 June 2021. The Decree envisages changes in the land allotment procedure in Uzbekistan from 01 August 2021. The LLA has been preliminary updated to ensure compliance with the Decree No. UP-6243. However, since the Decree does not contain a detailed procedure for implementation of changes in land allotment and only provides for the relevant amendment of the Land Code of Uzbekistan and other related legal acts at the release of the LLA, the LLA is subject to review and update once the amendments to the Land Code and other related legal acts are adopted.

ACCESS ROAD

The route of the proposed access road is currently a dirt track which is assumed to be used primarily by the herders in the surrounding areas, a typical view of the access road track is shown in the following figure. During the site visit no vehicles were observed to be using the access road track.



Figure 2-4 Typical Access Road Conditions

OHTL

The OHTL route, moving away from the site, first passes through greenfield land identical to that of the land allotted for the WTG turbines, however, as it passes south over the Karatau hills it passes near to existing industrial facilities before connecting to the national grid close to the A380.

2.4 Potential Receptor Identification

2.4.1 Existing Potential Receptors

The Project site is undeveloped and located more than 15 km from the nearest permanent residential receptors and communities. Initial cultural, industrial and social receptors have been identified through a combination of site visits and desktop review. The following figure outlines their locations relative to the Project and the following table describes the receptors in further detail.

It is important to note that are different areas of influence for different types of receptors. For example, the cultural receptor of Chilpak Kala (C-1) is located 40 km from the wind farm site, however, it has still been considered as a potential receptor due to the fact that tourists and visitors to the cultural monument likely place a high value on views from this location. Whereas the area of influence for residential receptors is not considered to be 40 km. Further description and definitions for area of influence are provided in the relevant chapters.

In addition to the receptors shown in the following image and table, general receptors such as 'local populations' and 'A380 road users' will be included and assessed in the relevant

chapters. Please note that ecological and physical environment receptors (i.e., soil quality) have also not been included in the following table.

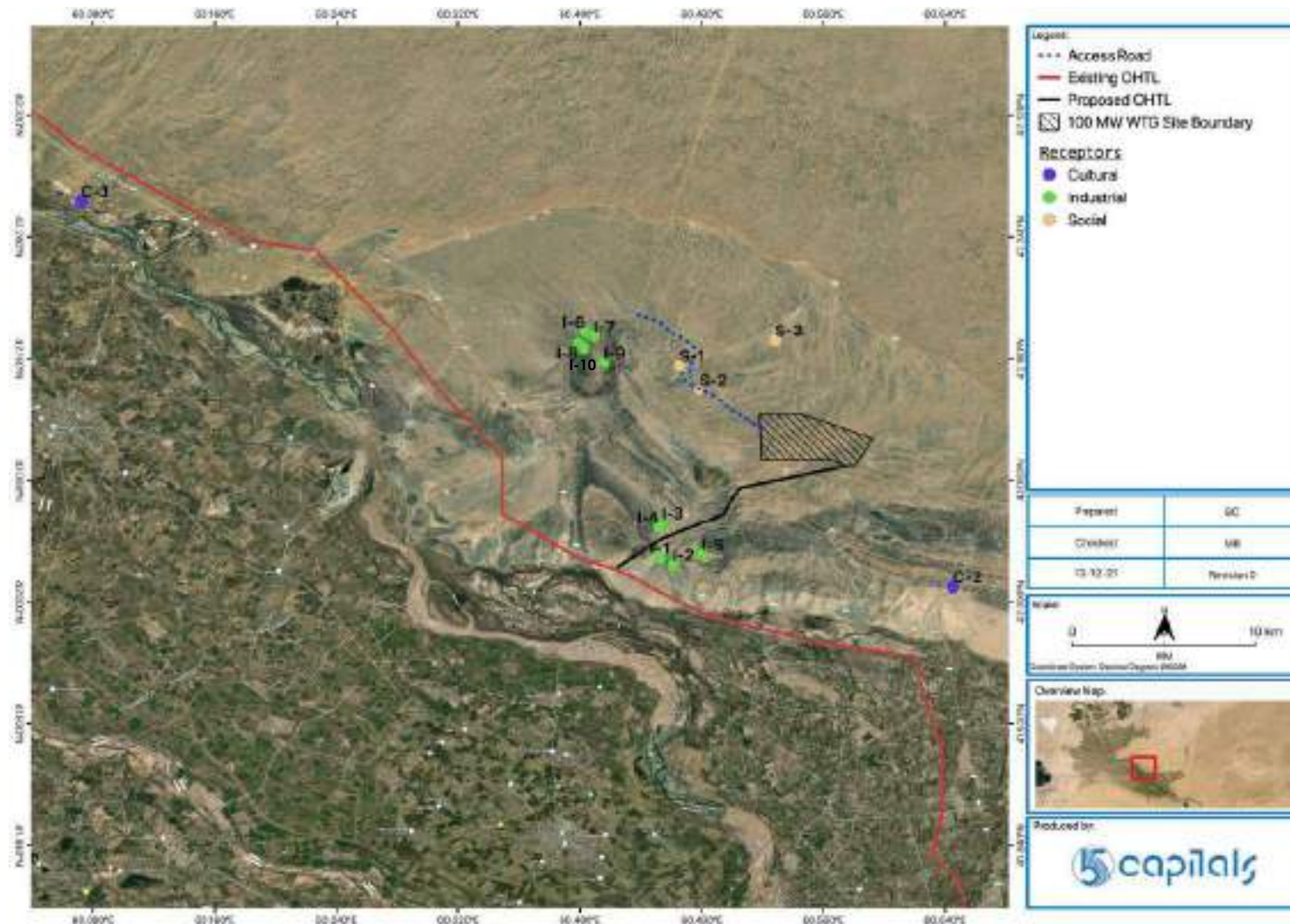


Figure 2-5 Cultural, Industrial and Social Receptors

Table 2-2 Existing Receptors

ID	RECEPTOR NAME	PROXIMITY TO PROJECT	DESCRIPTION	IMAGES
S-1	Summer Settlement	5.6 km from wind farm site boundary 0.6 km from access road	During the December 2021 site visit, three herder shelters were identified (S-1, S-2, S-3). Following communications with the herder, it was determined that one (1) herder family owns all three of these structures and only occupies one at a time. The herder also stated that shelter S-2 was built to guard the meteorological mast that is located adjacent.	  During the December 2021 site visit the summer settlement was abandoned. Remnants of previous use was evident such as ovens (left image) and ground markings from tent structure (right image).
S-2	Guard House for Meteorological Mast	3.8 km from wind farm site boundary Adjacent to access road	The herder informed the Project social consultants that, during the spring season, the number of herders in the area often increases.	
S-3	Winter Settlement	5.5 km from wind farm site boundary 4.4 km from access road		

ID	RECEPTOR NAME	PROXIMITY TO PROJECT	DESCRIPTION	IMAGES
I-1	Karakalpak Cement LLC Facility	0.8 km from OHTL route	The Karakalpak and Titan Cement factories are situated along the A380 road, around 9 km south of the wind farm site but relatively close to the proposed OHTL route.	
I-2	Titan Cement LLC Facility	1.6 km from OHTL route		
I-3	Mining area for Karakalpak Cement LLC	1 km from OHTL route		
I-4	Mining area for Karakalpak Cement LLC	0.8 km from OHTL route	Mining activities, including blasting, also occur immediately on the other side of the proposed OHTL route.	Landscape view of both the Karakalpak (left) and Titan Cement (right) facilities, with the stack emissions clearly visible.
I-5	Mining area of Kungrat Sodium Plant	2 km from OHTL route	This is a mining area of a Sodium plant located in Kugrad city, over 200 km from the Project.	-
I-6	FE Tebinbulak Metals LLC	3 km from access road	I-7 to I-10 are active vermiculite mines, whereas I-6 is exploration work to determine the feasibility for further mining work in the area. The exploration work includes geotechnical surveys and numerous subcontractors are currently active at site.	
I-7	Boston Talk LLC	2.8 km from access road		
I-8	Triumf Vermiculite LLC	3.8 km from access road		
I-9	Sverxbelproekt LLC	4.3 km from access road		
I-10	Nanolgreys LLC	3.7 km from access road		

Image of I-7.

ID	RECEPTOR NAME	PROXIMITY TO PROJECT	DESCRIPTION	IMAGES
C-1	Chilpak Kala monument	40 km from wind farm site boundary	Visitors to the cultural heritage monument may have a distant view of the Project.	
C-2	The Sultan Uwais Baba Complex	10 km from wind farm site boundary	Visitors to the cultural heritage site may have a distant view of the Project.	

2.4.2 Planned and Potential Developments

The following planned and potential developments in the region are summarised from Juru Energy ESA provided as part of the tender documentation (2021):

- **Karatau metal processing plant (including the expansion of the Karatau town)** Based on discussion with the administrative representative in Karatau and review of Presidential Decree 3473 (12 January 2018), the metal processing plant will generate up to 2000 jobs and it has a scheduled start date in 2024. The development of the metal processing plant includes a phased expansion of Karatau town. Current plans indicate the population of Karatau will increase from 3021 in 2019, to 5300 in 2041; and the town footprint will expand from 127 ha to 204 ha by 2041.
- **Mining operations and Wind Farms in the WDA (currently scheduled to be developed after the Project).** As stated previously, there is also the potential for at least a further 200 MW of wind generation to be developed in the broader WDA and areas adjacent to the site are allocated for future mining exploitation with the mineral rights currently owned by the State. However, following discussions with the State Committee on Industrial Safety of the Republic of Uzbekistan", dated 12/05/2020 it is understood that the mining areas are not actively earmarked for exploitation at this time. Nevertheless, if the rights to exploit minerals is exercised a buffer zone of at least 400 m around all the WTG must be maintained to preserve the operability and safety of the WTG's and a set back of at least 500 m between the WTG and any O&M buildings or accommodation facilities must also be maintained.
- New solid waste management facilities (in Nukus province, locations not specified).

2.5 Project Description

2.5.1 Wind Turbines Technology Overview

Currently, the Project will consist of 17 WTGs, located along the edges of the allotted site boundary, as shown in the following figure. Other balance of plant (BOP) items such as the laydown area and substation are also shown.

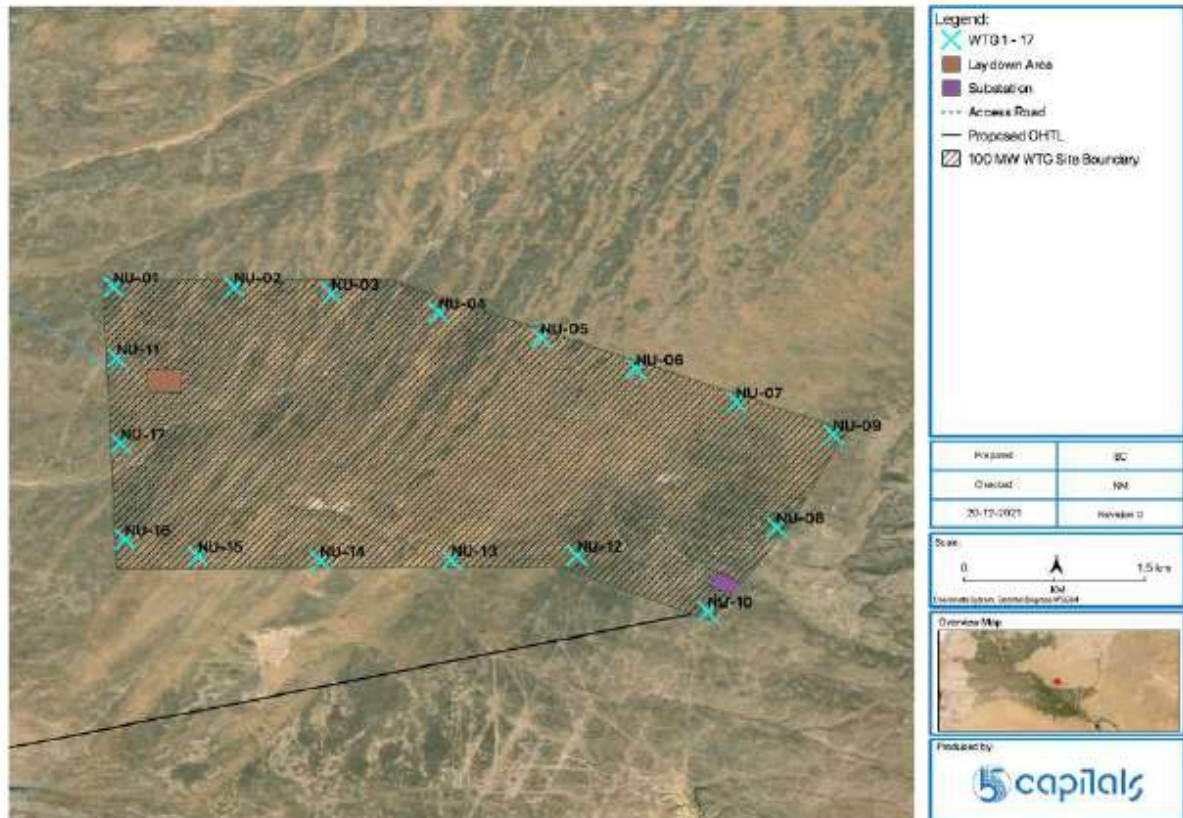


Figure 2-6 WTG and BOP Locations

WTG have been used to produce electricity on a commercial scale since the 1990s and are well established as a developed renewable energy technology. WTG harness the energy in the wind and convert it to electricity. The amount of energy produced by wind turbines increases dramatically with increased wind speed and modern turbines are able to adapt efficiently extract energy from the entire range of wind speeds.

Wind speeds increase with height above ground as turbulence intensity decreases at the same time. This allows turbines with higher hub-heights to produce more energy than a turbine with a lower height at the same location. In addition, longer blades (the rotor diameter from the turbine) significantly increase the swept area from which wind energy can be extracted.

The turbine technology, manufacturer and supplier for the proposed Project has not been defined at present.

The basic components of a wind turbine include the following components:

- Conical tubular tower sections made of steel;
- Rotor blades, made of fiberglass, reinforced epoxy and carbon fibres;
- Nacelle, which houses the generator and gearbox;
- Hub, which is the central point at which the three blades are connected to the nacelle;
- Generator, which converts mechanical energy into electricity;
- Gearbox;
- Converter; and
- Transformer.

Wind turbines are usually painted light-grey, with aviation safety lights at the top of the nacelle. The tips of the blades are sometimes painted orange or red to improve daytime visibility of the blade swept area while remaining unobtrusive to the character of the landscape as far as practical.

Turbines are fixed to the ground and stabilised using reinforced concrete platforms, which ensure that the turbine remains stable. Foundation platforms are constructed below ground level, and soil will be placed over the platform to return the visible area to nearly its original condition. A typical foundation diameter is 20 m, with a depth of 2.5 m, depending on the turbine design and the subsoil conditions.

Specific details regarding the wind turbines technology will be provided at the ESIA stage.

2.5.2 Technology Specifications from the PPA

The WTGs and all its components must be made in accordance with the Machinery Directive (2006/42/EC), EMC Directive (2004/108/EC) and must be CE marked.

The WTGs and its systems shall be designed, manufactured and tested according to the international norms and standards, such as the International Electrotechnical Commission standard IEC 6140001 Edition 4, Wind Turbines – Part 1: Design requirements. For an exhaustive list of standards and requirements please refer to the Power Purchase Agreement (PPA).

2.5.3 Project Facilities

POWER EVACUATION INFRASTRUCTURE

The power evacuation infrastructure includes switching station (substation) and the OHTL route of approximately 15.6 km length. The OHTL will connect to the national grid at the interconnection point on the existing OHTL 220 kV Takhiatash TPP – Khorezm substation.

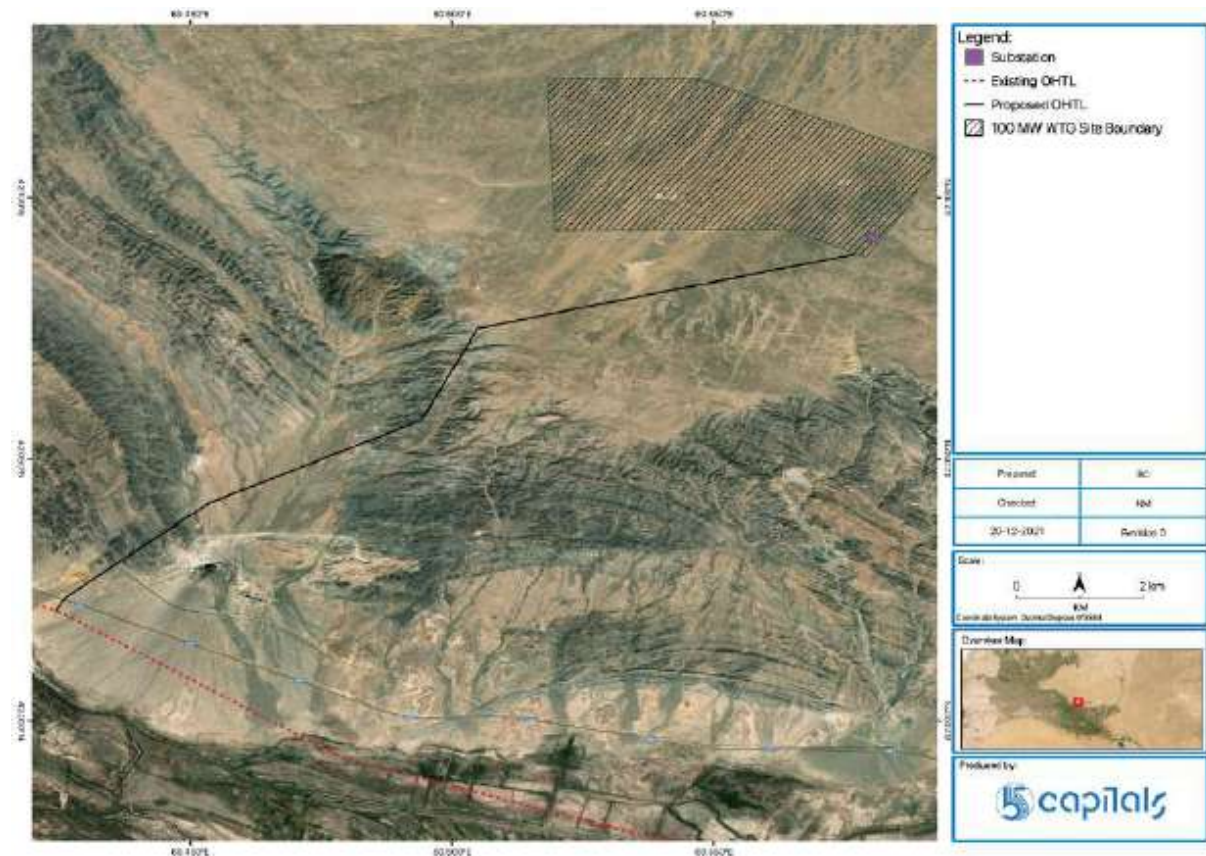


Figure 2-7 Power Evacuation Infrastructure

ACCESS ROAD

The site is separated from roads and the regional highway (the A380) by the Karatau hills. However, the Project includes the design and construction of an access road connecting the site to the local road, referred to as '4P190' which will connect to the A380 to the settlements Aimbed-Ishan and Karauzyak to the north.



Figure 2-8 Access Road

2.5.4 Ancillary/Support Facilities

Ancillary buildings will be required to:

- Support the operation of the Project
- Store spare parts
- Management wastes produced at the Project.

The following ancillary facilities will be included in the Project design:

- Site entrance and security building
- Administration building, offices and amenities (e.g., first aid room, kitchen, washrooms and prayer rooms etc.)
- Central Control Room
- HV relay buildings, MV switchgears room, MV/LV transformer room
- Security
- Lighting
- Access roads between turbines
- Parking

2.6 Construction of the Wind Farm

2.6.1 Construction Activities

Typical activities during the planning and construction phases for wind farms are listed below:

- Detailed Project planning and design and consideration of Project components by the EPC Contractor;
- Transportation of components (including the WTGs) to the Project site;
- Site preparation (comprising excavation, grading, levelling, and land clearing at WTG platforms) to create the access road and the flat land area required for installation of wind turbine towers and various project components;
- Primary Project construction work (comprising excavation and levelling etc.) for installation and laying of transmission cables, collector/switchgear, and the installation of electrical substation(s);
- Installation of WTGs;
- Additional facilities construction work (comprising excavation and levelling etc.) for access road, internal road network, construction of any building infrastructure; and
- Commissioning tests of electrical infrastructure (including wind turbine generators) and inspection of civil engineering quality records.

2.6.2 Construction Workforce

Information relating to the Project workforce is currently not confirmed, however, this will be included within the ESIA.

ACCOMMODATION

At this stage the location of workers' accommodation has not been finalised, however, based on the remoteness of the Project area it is likely that it will be located within or close to the Project footprint.

Based on experience from other construction sites, this accommodation is expected to be dedicated for EPC Contractor and possibly Project Company and other specialist staff. It is likely that the sub-contractors, if necessary, will need to arrange for alternative accommodation facilities for their workers, which may also be on, or off-site.

Further details of worker accommodation will be included in the ESIA.

2.7 Operation and Maintenance

Wind farms generally require limited operational activities such as the following:

- Operation and maintenance to include normal daily operation of equipment including maintenance (electromechanical and housekeeping) to optimise energy yield and life of the system;
- Remotely activated turbine shutdown during excessive wind speeds;
- Management of operations in relation to resident bird and bat species (summer and winter) and migration periods during Spring and Autumn (if required); and
- Routine planned preventative maintenance and unplanned maintenance (if required).

Further details regarding the operation and maintenance of the wind farm, including details on the workforce will be provided in the ESIA.

2.8 Project Milestone

The following table outlines key project milestones.

Table 2-3 Key Project Milestone/Timeline Dates

MILESTONE	DATE
Project Award	10 th October 2021
Signing of EPC & O&M Agreement	Q2 2022
Financial Close and Full Notice to Proceed (Construction)	17 th August 2022
Project Commercial Operation Date (PCOD)	17 th February 2024

3 REGULATORY FRAMEWORK

3.1 National Regulations

3.1.1 Constitution of Uzbekistan

The constitution of Uzbekistan has the following provisions relating to environmental aspects:

- Article 50: All citizens shall protect the environment.
- Article 54: Any property shall not inflict harm to the environment.
- Article 55: Land, subsoils, flora, fauna, and other natural resources are protected by the state and considered as resources of national wealth subject to sustainable use.

3.1.2 Uzbekistan Policy Framework for Wind Projects

The primary legislation for the development of the Wind Energy Projects is the Law of the Republic of Uzbekistan No. 537 "On Public-Private Partnership" dated 10th May 2019 and the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 259 "On Improving the Procedure for Implementing Public, Private Partnership Projects" dated April 26, 2020.

The Law of the Republic of Uzbekistan No. 539 "On the Use of Renewable Energy Sources" (RE Law) dated May 21, 2019; and the Law of the Republic of Uzbekistan No. 412-1 "On the Rational Use of Energy" dated April 25th, 1997 will also be applicable to the Project.

In October 2019, Uzbekistan issued an environmental strategy: Uzbekistan's Environmental Strategy 2030 (approved by the Decree of the President of the Republic of Uzbekistan No. 5863 dated October 30th 2019) which promotes renewable energy development.

The Strategy also contains measures to preserve the environment (air, water, land, soil, biodiversity etc) from anthropogenic impacts and other negative factors, expand protected areas and improve the environmentally safe systems of waste management.

3.1.3 President Decree № PD-4477 on the Strategy for the Transition of the Republic of Uzbekistan to a Green Economy in the period 2019-2030

This decree was adopted to fulfil Uzbekistan's obligations under the Paris Climate Agreement signed on April 19, 2017 and to implement the Action Strategy for five priority areas of development for 2017-2021.

This decree sets out a strategy for the transition of the Republic of Uzbekistan to a green economy for the period 2019-2030, aimed at improving energy efficiency, rational

consumption and conservation of natural resources, reducing greenhouse gas emissions, providing access to green energy, creating green jobs and ensuring climate sustainability. It sets several targets for this transition, including the further development of renewable energy sources, covering over 25% of total electricity generation.

3.1.4 Law on Nature Protection, 1992 as Amended in 2019

This law is the key national environmental law for the protection of the environment and the sustainable use of resources and the right for the population to a clean healthy environment. This law states legal, economic, and organisational basis for the conservation of the environment and the rational use of natural resources. Article 25 of this law states that the State Environmental Expertise (SEE) is a mandatory measure for environmental protection, preceded to decision making process. In addition, the law prohibits the implementation of any Project without approval from SEE.

3.1.5 Law on Environmental Control, 2013

The main objectives of this law include:

- Prevention, detection and suppression of violation of legislative requirements relating to environmental protection and rational use of natural resources.
- Monitoring the state of the environment, identifying situations that can lead to environmental pollution, irrational use of natural resources, pose a threat to the life and health of citizens.
- Determination of compliance with environmental requirements of any ongoing economic development activities.
- Ensuring compliance with the rights and legitimate interests of legal entities and individuals performing their duties in relation to environmental protection and sustainable use of natural resources.

3.1.6 Environmental Audit Law No. ZRU-678, 2021

The Environmental Audit Law was adopted to regulate environmental audits in the field of environmental protection and rational use of natural resources, including voluntary or mandatory environmental audits. The Law states that '*an environmental audit can be carried out on a voluntary form by businesses with low or insignificant (local) risk of environmental impact and on a mandatory form on an annual basis for businesses with high and medium risk of environmental impact*'.

An environmental audit is not a substitute for environmental control; however, in case of a positive conclusion of the audit, a business entity is not subject to an inspection by the State Committee on Ecology and Environmental Protection for one year, except for accidents and

emergencies, as well as in connection with the investigation of criminal cases or by order of the President of the Republic of Uzbekistan or the Cabinet of Ministers of the Republic of Uzbekistan. The environmental audit is carried out on the basis of a contract concluded between the environmental auditing organisation and the client of the environmental audit. The Law comes into force on March, 2022."

3.1.7 Law on the Rational Use of Energy, 1997

This law is fundamental to the development and functioning of the whole energy sector, including renewable energy. It defines a general legal framework to ensure the conservation of national energy resources and the efficient use of the available production capacity, fuel and energy. The law provisions are applicable to legal entities and individuals whose activities are related to the extraction, production, processing, storage, transportation, distribution and consumption of fuel and energy.

The law is aimed at achieving the following objectives:

- Ensuring efficient and environmentally friendly use of energy in its production and consumption;
- Ensure reliability, uniformity of measurements and metering of quantity and quality of energy production and consumption
- Governmental control and supervision over efficient energy production and consumption, its quality, the technical condition of energy equipment, energy supply systems and energy consumption.

The law has a particular article that defines the framework conditions for the use of renewable energy sources and aims to stimulate the development of renewable energy in Uzbekistan. The law authorises independent producers of electricity and heat from renewable energy sources to supply energy to the energy networks of energy supply organisations, which are obliged to accept energy from these producers at prices formed according to the established procedure. The prices are formed by an authorised body, currently the Ministry of Finance of the Republic of Uzbekistan.

3.1.8 Presidential Decree No. 5863 on Environmental Protection Strategy (30th October 2019)

The Strategy contains measures to preserve the environment (atmospheric air, water, land, soil, subsoil, biodiversity, protected areas) from anthropogenic impact and other negative factors, expand protected areas, and improve the environmentally safe system of waste management.

The Strategy approved 24 target tasks until 2030, which aim to increase the area of forest plantations, restoration and reclamation of disturbed lands, rational use of water resources, reduction of emissions into the air, protection and reproduction of biological resources, and improvement of the waste management system.

Through the implementation of the Strategy, the following are expected to be achieved:

- Increasing the area of forest plantations on the Uzbek part of the dried Aral Sea bed from 28% (0.9 million ha) to 60% (2 million ha);
- Reduction of pollutant emissions by 10% (from 2.492 million to 2.243 million tonnes);
- Converting 80% (about 6,500) of public transport to natural gas and electric propulsion;
- Increasing the area covered by forest from 3.2 million to 4.5 million hectares;
- Increasing the area of protected areas from 3.5 percent (1.5 million hectares) to 12 percent (5.4 million)
- Increasing the coverage of solid domestic waste collection and transportation services from 48% (16 million people) to 100%;
- Increasing solid domestic waste processing from 18% (1.3 million tonnes) to 65% (4.6 million tonnes).

Other relevant national laws and regulations to the Nukus 100 MW Wind Farm project include:

ENVIRONMENT

- The Law of the Republic of Uzbekistan "On water and water use" (1993) as amended in 2019.
- The Law of the Republic of Uzbekistan "On Ecological Expertise" (2001) as amended in 2017.
- The Law of the Republic of Uzbekistan "On Protection and Use of Vegetation" (1997) as amended in 2016.
- The Law of the Republic of Uzbekistan "On Protected Natural Reserves" (2004) as amended in 2019.
- The Law of the Republic of Uzbekistan "On Protection and Use of the Wildlife" (1997) as amended in 2016.
- The Law of the Republic of Uzbekistan "On Wastes" (2002) as amended in 2019.
- The Resolution of the Cabinet of Ministries of the Republic of Uzbekistan №541 "On further improvement of the environmental impact assessment mechanism".
- The Resolution of Cabinet of Ministries of the republic of Uzbekistan №820 "On measures to further improve the economic mechanisms for ensuring nature" dated on 11th October, 2018.

- The Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No 14. "On approval of the regulation on the procedure for the development and agreement of projects with environmental standards".
- Law "On Environmental Expertise" No.73-II of 25.05.2000 (as amended on 22.11.2018).
- The Law of the Republic of Uzbekistan "On Atmospheric Air Protection" (1996, amended on 13.03.2019)
- Resolution of Cabinet of Ministers of Republic of Uzbekistan No.95 "On approval of general technical regulations of environmental safety" (2020).

LABOUR AND EMPLOYMENT

- Ordinance No. 30-31 of the Ministry of Labour and Social Security and the Ministry of Health of the Republic of Uzbekistan approving the list of hazardous jobs mentioned in Article 355, for which the employment of persons under the age of eighteen years is prohibited
- Joint Decree of the Ministry of Labour and Social Protection of the Population (No. 7) and the Ministry of Healthcare (No. 1) of Uzbekistan dated 30 May 2001 to approve the list of occupations with unfavourable working conditions to which it is forbidden to employ persons under 18 years of age.
- Decree No. 133 of 11 March 1997 to approve normative acts necessary for the realization of the Labour Code of the Republic of Uzbekistan
- Decree of the Cabinet of the Ministers No. 1011 of 22 December 2017 "On Perfection of the Methodology of Definition of Number of People in Need of Job Placement, including the Methodology for Observing Households with Regard to Employment Issues, also for the Development of Balance of Labour Resources, Employment and Job Placement of Population".
- Decree of the Cabinet of the Ministers No. 965 of 5 December 2017 "On the Measures of Further Perfection of the Procedure of Establishment and Reservation of Minimum Number of Job Places for the Job Placement of Persons who are in need of Social Protection and Face Difficulties in Searching Employment and Incapable of Competing in Labour Market with Equal Conditions".
- Decree No. 964 of 5 December 2017 "On the Measures for Perfection of the Activity of Self-Government Bodies Aimed at Ensuring Employment, Firstly for the Youth and Women".

NATIONAL / LOCAL REQUIREMENTS OF EIA/ESIA;

The national Environmental Impact Assessment (EIA) procedure is principally required and regulated by the:

- Law "On Ecological Expertise" No.73-II of 25.05.2000 (as amended on 29.04.2011)
- Resolution of Cabinet of Ministers of Republic of Uzbekistan No.541 "On further improvement of the environmental impact assessment mechanism, 2020".

OVERHEAD TRANSMISSION LINES & SUBSTATION

- Resolution of Cabinet of Ministers of Republic of Uzbekistan No.95 "On approval of general technical regulations of environmental safety" (2020).
- Decree of the Cabinet of Ministers of the Republic of Uzbekistan No.1050 "On approval of Rules for Protection of Power Grid Facilities, 2018".
- San Rules & Norms No. 0236-07 "Sanitary norms and rules to ensure safety for people living near high voltage power transmission lines, 2007".
- San Rules & Norms No. 0350-17 "Sanitary norms and rules for the protection of atmospheric air in populated areas of the Republic of. Uzbekistan, 2017".

LAND RIGHTS, ACQUISITION AND RESETTLEMENT

- Civil Code of the Republic of Uzbekistan "Civil code" (№ 163- I, 21.12.1995, as amended on 22.01.2020);
- Land Code (1998 as amended 2010) (№ 598-I, 30.04.1998, as amended on 28.08.2019);
- Law of the Republic of Uzbekistan on State Land Cadastre No.666-I of 28.08.1998.

3.1.9 Environmental Regulator

The main regulatory body for national EIA in Uzbekistan is the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection of the Republic of Uzbekistan. The committee performs its activities on the basis of the following legal acts:

- Presidential Decree of April 21, 2017 No. UP-5024 "On improving the system of public administration in the field of ecology and environmental protection."
- Resolution of the President of the Republic of Uzbekistan of April 21, 2017 No. PP-2915 "On measures to ensure the organization of the activities of the State Committee of the Republic of Uzbekistan on Ecology and Environmental Protection".
- Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated January 15, 2019 No. 29 "On Approving the Provision on the State Committee of the Republic of Uzbekistan on Ecology and Environmental Protection".
- Resolution of the President of the Republic of Uzbekistan dated October 3, 2018 No. PP-3956 "On measures to ensure the organization of the activities of the State Committee of the Republic of Uzbekistan on Ecology and Environmental Protection".

3.2 International Conventions/Protocol

The proposed Project must comply with the environmental requirements of the following protocols and conventions listed in the Table below of which the Uzbekistan is a signatory:

Table 3-1 International Protocols and Conventions

NAME OF INTERNATIONAL PROTOCOL/CONVENTION	SIGNED/ RATIFIED	RELEVANCE TO THE PROJECT
UN Framework Convention on Climate Change	Accession: 20 June 1993	The Project will comply with all national standards for GHG emissions in order to contribute to Uzbekistan's targets.
Kyoto Protocol to UNFCCC	Ratified: 12 th October 1999	
Paris Agreement to UNFCCC	Signed: 19 th April 2017	
Montreal Protocol on Substances that Deplete the Ozone Layer (with London, Copenhagen, Montreal amendments)	Accession: 10 th June 1998	The Project will support Uzbekistan's contribution towards the protection of the ozone layer by refraining from use of ozone depleting substances.
Vienna Convention on the Protection of Ozone Layer	Accession: 18 May 1993	
UN (Rio) Convention on Biological Diversity	Accession: 19 th July 1995	The Project will implement mitigation and management measures to ensure the conservation and protection of terrestrial and canal ecology during the Project lifecycle.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Accession: 10 th July 1997	The Project staff and workers will be strictly forbidden from trading in any wild flora and fauna found in the Project site or outside the Project boundaries.
Convention on Migratory Species of Wild Animals	1 May 1998	The project will implement mitigation and management measures to ensure conservation of terrestrial and avian migratory species where identified.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	Accession: 7 th February 1996	The Project will be required to adhere to all national and international standards for hazardous waste generation and management.
United Nations Convention to Combat Desertification	Ratified: 31 August 1995	The Project will not result in accelerated desertification through sourcing of its materials and will contribute to sustainable development.
Paris Convention on Protection of the World Cultural and Natural Heritage	Succession: 13 th January 1993	The Project will implement mitigation and management measures where items/sites/monuments of cultural or natural heritage are identified within or near the Project boundaries and notify the relevant authorities immediately.
Stockholm Convention on Persistent Organic Pollutants	Accession: 28 th June 2019	The Project will implement control measures to eliminate any use of chemicals under Annex A and B and reduce the unintentional release of those under Annex C.

3.3 Project Requirements

ACWA Power will pursue an amount of Project Finance from financial institutions who either:

- Have their own internal E&S investment policies/guidelines;

- Are members of the collective environmental and social agreements such as the Equator Principles; or
- Align their E&S policies and guidelines with other established guidelines (such as the IFC Performance Standards).

In addition to the Project requiring alignment with the E&S policies and guidelines of those who are providing financing, the Project is required to be delivered in accordance with the European Bank for Reconstruction and Development (EBRD) Environmental and Social Policy (ESP) 2019 and supporting performance requirements, the Equator Principles IV 2020 and the technical performance criteria set out in certain World Bank Group Environmental, Health and Safety (EHS) Guidelines. The key E&S requirements are therefore summarised below.

3.3.1 EBRD

POLICY AND PERFORMANCE REQUIREMENTS

EBRD has an internal ESP (2019) and a set of specific Performance Requirement (PRs) covering key environmental and social components for consideration, assessment and management in their investments. These reflect EBRD's commitments to promote EU environmental standards as well as the European Principles for the Environment in their investments. The PRs are outlined below:

- PR1: Assessment and Management of Environmental and Social Impacts and Issues;
- PR2: Labour and Working Conditions;
- PR3: Resource Efficiency and Pollution Prevention and Control;
- PR4: Health and Safety;
- PR5: Land Acquisition, Involuntary Resettlement and Economic Displacement;
- PR6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- PR7: Indigenous People;
- PR8: Cultural Heritage;
- PR9: Financial Intermediaries, and
- PR10: Information Disclosure and Stakeholder Engagement

3.3.2 Equator Principles

The Equator Principles (EP) is a risk assessment framework used by financial institutions to determine, assess and manage the environmental and social risk in Project's financing.

Currently, over seventy-five major financial institutions from around the world have adopted the EPs. These financial institutions operate in more than 100 countries worldwide.

The Equator Principles were updated in 2006 (EPII), 2013 (EPIII) and a further update EPIV came into effect in October 2020. The EPs currently include provisions for the following:

- Principle 1: Review and Categorisation;
- Principle 2: Environmental and Social Assessment;
- Principle 3: Applicable Environmental and Social Standards;
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism;
- Principle 7: Independent Review;
- Principle 8: Covenants;
- Principle 9: Independent Monitoring and Reporting; and
- Principle 10: Reporting and Transparency.

APPLICABLE STANDARDS

EP IV establishes the minimum E&S standards to be adopted by EP Financial Institution (EPFIs) as those from IFC Performance Standards on Environmental and Social Sustainability (Performance Standards), the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) and/or the relevant host country laws, regulations and permits that pertain to environmental and social issues.

IFC Performance Standards

The IFC Performance Standards are a key component of the IFC's Sustainability Framework and directed towards clients (i.e. party responsible for implementing and operating the project that is being financed), providing guidance on how to identify risks and impacts. The IFC Performance Standards are designed to help avoid, mitigate, and manage risks and impacts throughout the life of a project as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities.

The IFC Performance Standards (2012) are listed below:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labour and Working Conditions

- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

WBG EHS Guidelines (2007)

The World Bank Group International Finance Corporation (IFC), Environmental, Health and Safety (EHS) General Guidelines of April 2007 superseded the World Bank Handbook issue of 1998.

In terms of specific guidelines to control environmental externalities (e.g. wastewater quality etc.), EHS guidelines have been set out by IFC and the World Bank Group to provide general guidelines for its members when involved in a project or when providing financial support to a project. These guidelines contain general and industry-specific examples of Good International Industry Practice (GIIP). In summary, it should be noted that the following IFC EHS Guidelines are relevant to this project:

- General EHS Guidelines, Environmental:
 - Air Emissions and Ambient Air Quality;
 - Energy Conservation;
 - Wastewater and Ambient Water Quality;
 - Water Conservation;
 - Hazardous Materials Management;
 - Waste Management;
 - Noise; and,
 - Contaminated Land.
- General EHS Guidelines, Occupational Health & Safety:
 - General Facility Design and Operation;
 - Communication and Training;
 - Physical Hazards;
 - Chemical Hazards;
 - Radiological Hazards;
 - Personal Protective Equipment (PPE);
 - Special Hazard Environment; and,
 - Monitoring.
- Community Health & Safety:

- Water Quality and Availability;
 - Structural Safety of Project Infrastructure;
 - Life and Fire Safety (L&FS);
 - Traffic Safety;
 - Transport of Hazardous Materials;
 - Disease prevention; and,
 - Emergency Preparedness and Response
- Industry Sector Guidelines, Power:
 - Electric Power Transmission and Distribution (2007); and
 - Wind Energy (2015).

3.4 Applicable Environmental Standards

Applicable standards required for Project compliance are included to the respective environmental parameter sections of this report. This includes national standards and those expected for the lenders.

3.4.1 Lenders Standards

An overview of the lender standards is presented below, whilst the applicable standards are presented in the respective environmental parameter sections of this report.

EBRD

In accordance with the EBRD ESP 2019, *'The EBRD, as a signatory to the European Principles for the Environment, is committed to promoting the adoption of EU environmental principles, practices and substantive standards by EBRD-financed projects, where these can be applied at the project level, regardless of their geographical location. When host country regulations differ from EU substantive environmental standards, projects will be expected to meet whichever is more stringent.'*

EPFIs

In accordance with EPIV, EPFI's require compliance with both national regulations/standards and the applicable World Bank Group EHS Guidelines relevant to the Project as stated previously.

3.5 EIA/ESIA Requirements

3.5.1 National Requirements

PROJECT CATEGORISATION

As per the Resolution of the Cabinet of Ministries of the Republic of Uzbekistan No. 541 'On measures for the further improvement of environmental impact assessment' dated 7.10.2020, Projects with a total capacity of 100 MW and more are categorised as Category II.

EIA PROCESS

In accordance with the resolution of the Cabinet of Ministries of the Republic of Uzbekistan No. 541 the national EIA process consists of three stages:

- Stage I: "A Preliminary Statement of the Environmental Impact ("PSEI") - this is performed at the planning stage of the proposed Project prior to the allocation of funds for development.
- Stage II: The "Statement of the Environmental Impact" ("SEI") - this is prepared following Stage 1 and where the outcome of Stage 1 identified the need for additional studies or analyses. The SEI shall be submitted to State committee on ecology and environmental protection prior to the Feasibility Study or financing of the Project and, therefore, prior to the beginning of construction.
- Stage III: The "Statement on Environmental Consequences" ("SEC") is the final stage of the SEE process and is performed prior to approval of the Project. The report describes in detail the changes in the project made as a result of the outcomes of Stage 1 and Stage 2, the comments received during public consultations, the environmental standards applicable to the project (as defined by the modelling and assessment process), the environmental monitoring requirements and the main conclusions.

State Ecological Expertise approval: The State Committee on Ecology and Environmental Protection provides their opinion at Stage I and II is a typically a mandatory document for project financing by Uzbek banks, other Lenders and for Project commissioning at Stage III. However, it is possible to obtain approval after Stage I should the submitted EIA be sufficiently detailed and comprehensive with respect to project information and baseline conditions. The conclusion of the State Committee is typically valid for three years from the date of its issuance. If the project is not implemented within three years from the date of issue of the conclusion, the EIA report needs to be revised and re-submitted for approval.

EBRD

In accordance with PR 1, there is a requirement for EBRD financed projects to undertake an appropriate Environmental and Social Assessment in order to:

- Identify and evaluate environmental and social impacts and issues of the Project.

- Adopt a mitigation hierarchy approach to address adverse environmental or social impacts and issues to workers, affected communities, and the environment from Project activities.
- Promote improved environmental and social performance of clients through the effective use of management systems.
- Develop an ESMS tailored to the nature of the Project, for assessing and managing environmental and social issues and impacts in a manner consistent with the relevant PRs.

According to PR 1 *"The ESIA will include an examination of technically and financially feasible alternatives to the sources of such impacts, including the non-project alternative, and document the rationale in selecting the particular course of action proposed. It will also identify potential improvement opportunities and recommend measures needed to avoid, or where avoidance is not possible, minimise and mitigate adverse impacts."*

EU EIA Legislation

EBRD is committed towards the promotion of the European Union's (EU) environmental requirements and is a signatory of the European Principles for the Environment. The Principles endorse and reinforce the European consensus on the values attached to the fundamental right for both present and future generations throughout the world to live in a healthy environment.

EIA Directive 85/337/EEC was introduced in 1985 and applied to a wide range of defined public and private projects. Since then, the initial Directive of 1985 and its three amendments have been codified by Directive 2011/92/EU of 13 December 2011. Directive 2011/92/EU was amended in 2014 by Directive 2014/52/EU.

Article 3 of the Directive states:

The environmental impact assessment shall identify, describe and assess in appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors:

- a) Population and human health;*
- b) Biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;*
- c) Land, soil, water, air and climate;*
- d) Material assets, cultural heritage and the landscape; and*
- e) The interaction between the factors referred to in points (a) to (d).*

The Project falls under Annex II of the EIA Directive as *'Installation for the harnessing of wind power for energy production (wind farms)'* while the OHTL is under Annex I *'Construction of overhead electrical power lines with a voltage of 220kV or more and a length of more than 15km'*. The Project will therefore undergo through a full EIA assessment.

EPFIs

According to EP2, *'The EPFI will require the client to conduct an appropriate Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and scale of impacts of the proposed Project'*.

4 APPROACH TO ESIA

4.1 Scope of Work and Key Deliverables

The key deliverables of the ESIA process for the lenders are:

- Environmental and Social Scoping Report;
- ESIA Report; and
- Livelihood Restoration Framework and Plan (if applicable).

The key deliverables of the EIA process as required by the national legislation are:

- Stage I – Preliminary Statement of the Environmental Impact (PSEI);
- Stage II – Statement of the Environmental Impact (SEI); and
- Stage III – Statement on Environmental Consequences (SEC)

The purpose of this Environmental & Social Scoping Report is to identify the key environmental and social issues and sensitive receptor sites at an early stage to ensure that the baseline surveys and assessment techniques for the subsequent ESIA address these issues. In addition, it identifies the structure and content of the ESIA.

The general content of the Environmental & Social Scoping report includes:

- The key features of the proposed project;
- The environmental and social assessment, documentation and approval requirements for the proposed project;
- A brief description of the existing environmental and social conditions of the project site and an evaluation of existing environmental information on the area;
- A gap analysis to determine the additional information that needs to be gathered;
- Potential environmental and social issues and constraints (and opportunities) associated with the proposed project facilities based on the existing information; and
- An outline of the terms of reference, structure and content of the ESIA Report.

4.2 ESIA Methodology

4.2.1 Scope of Assessment

ASSESSMENT OF THE PROJECT, FACILITIES AND OPERATIONAL ACTIVITIES

The primary study area comprises the Project footprint, which includes the proposed WTGs, associated roads (internal), substations, laydown areas, equipment and operational activities inside this area. This will also include the alignment of the OHTLs and the access road.

The study area is determined based on the Project and Project facilities' areas of influence, however, it is to be noted that this will depend upon the impact being assessed. This is further described in the subsequent sections.

CONSTRUCTION ACTIVITIES

Construction of the Project is expected to result in certain environmental and social impacts, which will be assessed in the ESIA.

Temporary Construction Facilities

Temporary construction facilities to include in the ESIA will be:

- Project offices and temporary facilities;
- Contractor compounds and laydown areas;
- Any temporary construction access road(s); and
- Expected construction transportation routes.

Temporary Construction Worker Accommodation

Where details concerning worker accommodation facilities are available, the ESIA will intend to assess related impacts.

It is however expected that the locations of such worker accommodation areas will not be fully confirmed at the ESIA stage. Where information is not available, the ESIA will establish management provisions for these areas to be in accordance with the IFC & EBRD Worker Accommodation: Processes and Standards (as a minimum).

4.2.2 Consideration of Project Alternatives

As a minimum the ESIA will include assessment of:

- No Project option;
- Site selection and layout of WTGs; and
- Alternative technology.

4.2.3 Baseline Studies

Forming an integral part of the ESIA, the baseline studies provide a benchmark of existing conditions and allow a platform for which Project potential impacts can be assessed.

The baseline studies will correspond to those outlined in this ESIA Scoping Report and in accordance with any comments received from the lenders (or regulator) following the scoping report review. The intention is for the studies to capture a representative baseline within the Project's potential area of influence (which will differ for between parameters).

The baseline studies will be described in each relevant chapter of the ESIA, with analysis provided, and necessary results/reports included to the main report or applicable appendices.

4.2.4 Stakeholder Engagement

REQUIREMENTS

National Requirements

According to the Resolution of Cabinet of Ministers of Republic of Uzbekistan No.541 "On further improvement of the environmental impact assessment mechanism", mandatory public consultations is required regarding the project's environmental impact assessment and planned activities relating to Category I and Category II projects.

Lender Requirements

Engagement with stakeholders is an essential part of the environmental and social assessment process and there are specific requirements for this stated by both EBRD. The main objective is to establish dialogue with those parties who may be involved in aspects of the Project or may have an interest in the outcome of the ESIA process.

STAKEHOLDER MAPPING & ESIA ENGAGEMENT PLANNING

This aim of the stakeholder mapping is to identify relevant stakeholders and to assess each stakeholder to understand their relevance so that consultation can be targeted and prioritised.

Due to the current COVID-19 pandemic, the typical face-to-face process for stakeholder engagement may be varied to contact stakeholders by video/phone calls as well as sending/receiving official letters. Due to uncertainty, the exact methods cannot be confirmed at this stage and several options are available as outlined in the following table. It is important to note that this table will be a 'live document' throughout the ESIA process and the information included at present is preliminary.

Table 4-1 Stakeholder Mapping & ESIA Engagement Planning

STAKEHOLDER GROUP	STAKEHOLDER BODIES	RELEVANCE TO PROJECT: IMPACT-BASED (A), INTEREST-BASED (I), OR DECISION MAKER (D)	AGENDA FOR CONSULTATIONS AND METHODS
Directly Affected Communities	Local communities – TBC after social surveys conducted.	A: The closest communities to the site with	Issues regarding the environmental and social impacts from the Project. Public Meetings/ Phone Calls
Land Users	Herders using the site	A: Adverse effect from construction activity and land use restriction.	Issues regarding the land use and ownership Formal Meetings & Bi-Lateral/ Phone Calls
Vulnerable Groups	At the moment there are no known vulnerable groups. The need for further inclusion in the ESIA process and the future SEP (to be developed) will be determined during the social and economic baseline studies. Focus Groups (if identified)		
Local governmental authorities	Council of Ministers of the Republic of Karakalpakstan	D: Responsible for development of the project	These organisations will have certain involvement with the Project development. No specific consultation planned for E&S elements Formal Meetings / Letter Correspondence / Phone Calls
State Companies	"National Power Networks of the Republic of Uzbekistan" JSC	D: Responsible for the operations and maintenance of Purchase Electric Facilities (PEF) following transfer from ACWA Power.	Ongoing Consultations with ACWA Power
Government Bodies	Ministry of Energy of the Republic of Uzbekistan (MoE)	D: Responsible for development of the project	Issues regarding overall process of the Wind Farm construction (if necessary, at the scoping stage) Formal Meetings / Letter Correspondence / Phone Calls (Consultation on-going between ACWA Power and MoE)
	Ministry of Transportation	I: Statutory consultees	Issues regarding the delivery of equipment and machinery (if necessary) Formal Meetings / Letter Correspondence / Phone Calls
	Ministry of Employment and Labour Relations of the Republic of Uzbekistan	I: Statutory consultees	Issues regarding the labour relations (if necessary, at the scoping stage)

STAKEHOLDER GROUP	STAKEHOLDER BODIES	RELEVANCE TO PROJECT: IMPACT-BASED (A), INTEREST-BASED (I), OR DECISION MAKER (D)	AGENDA FOR CONSULTATIONS AND METHODS
			Formal Meetings / Letter Correspondence / Phone Calls
	Ministry of Culture of the Republic of Uzbekistan	I: Statutory consultees	Issues regarding cultural and archaeological sites in the project area. Formal Meetings / Letter Correspondence / Phone Calls
	Ministry of Health	I: Statutory consultees Protection of employee and public safety; establishment of the sanitary zone along the OHTL and substation	Issues regarding health during the scoping process (if necessary, at the scoping stage) Formal Meetings / Letter Correspondence / Phone Calls
	Ministry of Emergency Situations of the Republic of Uzbekistan	I: Statutory consultees (Planning preparedness for emergencies)	Issues regarding the safety (if necessary, at the scoping stage) Formal Meetings / Letter Correspondence / Phone Calls
State Committees	State committee of the Republic of Uzbekistan on Ecology and Environmental protection	D: Statutory consultees. Control with National environmental policy and protection standards. Responsible for approval of the national EIA.	All issues regarding the preparation and submission of national EIA Formal Meetings / Letter Correspondence & Study Submissions / Phone Calls
	Institute of Archaeology	I: Statutory Consultees	Issues regarding cultural and archaeological sites in the project area. Formal Meetings / Letter Correspondence / Phone Calls
Research Institutions	Public research institutions working in the region especially in relation to the environmental impacts relating to the impact of WTG on birds and bats	I: Will be interested in the environmental impacts of the Project.	No specific consultation , but may have an interest in publicly disclosed documents
Media	List Regional and local mass media	I: Will potentially be involved in disseminating information about the Project.	Issues regarding the media cover of planned Project (if necessary, at the scoping stage) Public Meeting / Phone Calls / Letter Correspondence

STAKEHOLDER GROUP	STAKEHOLDER BODIES	RELEVANCE TO PROJECT: IMPACT-BASED (A), INTEREST-BASED (I), OR DECISION MAKER (D)	AGENDA FOR CONSULTATIONS AND METHODS
Political parties of environmental focus	Ecological party of Uzbekistan	I: Will be interested in the execution of the Project and its environmental impacts and mitigation measures.	No specific consultation, but may have an interest in publicly disclosed documents Formal Meetings / Letter Correspondence
NGOs	Uzbekistan Society for the protection of birds	I: interest in the development of the project	Issues regarding existing studies on birds in the region and project impacts. Letter Correspondence/Phone Calls
	Other NGOs at a global level	I: Will be interested in the execution of the Project and its environmental impacts and mitigation measures.	No specific consultation , but may have an interest in publicly disclosed documents
Financial institutions	EBRD and others TBC	D: Providing finance for the Project	On-going dialogue throughout the process to ensure EBRD Performance Requirements.

4.2.5 Stakeholder Engagement – Grievance Mechanism

From the national legislation level there is a centralised complaints mechanism (online portal) for all public utility providers that was opened in 2017 by Presidential Decree No. 728 of 15/09/2017. As this online portal is intended for wide range of issues brought to government attention, it is considered more appropriate to develop a single system/approach for receiving feedback and complains from stakeholders.

It is proposed to provide a grievance redress mechanism as part of the stakeholder engagement process specifically for the Project. This will be included in the agenda of meetings. Proposed approach:

- Applications/complaints from local individuals or groups will be accepted both in written and verbal forms after conducting the meeting with affected community.
- 5 Capitals alongside local consultant Juru Energy will manage the grievance mechanism during the ESIA phase, whilst responses and actions related to grievances will be determined by ACWA Power.

When necessary, the grievance may be passed onto the representatives of Public Administration, People's Representatives.

4.2.6 Impact Assessment & Significance Criteria

In order to obtain a credible assessment of environmental and social impacts, the assignment of “effect significance” to each identified impact needs to be a robust, consistent and transparent process. The methodology to assess ‘effect significance’ is outlined below and follows an International Best Practice based on the assumption that the significance of an impact on resources or receptors is considered to result from an interaction between three factors:

- The nature and magnitude of the impact (i.e., a change in the environment, social and/or health baseline conditions);
- The number of resources or receptors affected (i.e., humans and the environment); and
- The environmental value or sensitivity of those resources or receptors to the change.

A three-step approach has been used to determine the significance of environmental effects, as follows:

- Step 1 – Evaluation of value/sensitivity of resource or receptor;
- Step 2 – Assessing the magnitude of the impact on the resource or receptor; a
- Step 3 – Determining the significance of effects.

IDENTIFICATION AND EVALUATION OF SENSITIVE RECEPTORS

Sensitive receptors are defined as:

- Elements of the **environment** that are of value to the functioning of natural systems (i.e., areas or elements of ecological, landscape or heritage value, species, habitats and ecosystems, soil, air and water bodies or land-use patterns);
- **Human** receptors, such as stakeholders (i.e., users of dwellings, places of recreation, places of employment, community facilities or household relocation) and human systems (e.g., employment market, population disease susceptibility and disease communicability, exposure to toxicity of chemicals).

Table 4-2 Environmental Value of Receptor or Resources

VALUE (SENSITIVITY)	DESCRIPTION OF VALUE
Very High	High importance and rarity on an international scale and limited or no potential for substitution. The receptor has already reached its carrying capacity, so any further impact is likely to lead to an excessive damage to the system that it supports. Locations or communities that are highly vulnerable to the environmental impact under consideration or critical for society (e.g. indigenous peoples, hospitals, schools).
High	High importance and rarity on a national scale, and limited potential for substitution. The receptor is close to reaching its carrying capacity, so a further impact may lead to a significant damage to the system that it supports. Locations or communities that are particularly vulnerable to the environmental impact under consideration (e.g. residential areas, vulnerable/marginalized groups).
Medium	High or medium importance and rarity on a regional scale, limited potential for substitution. The receptor is already significantly impacted, but it is not close to reaching its carrying capacity. Further impacts will get increase the stress of the underlying system, but evidence does not suggest that it is about to reach a critical point. Locations or groups that are relatively vulnerable to the environmental impact under consideration (e.g. commercial areas).
Low (or Lower)	Low or medium importance and rarity on a local scale. The receptor is not significantly impacted and shows a large spare carrying capacity. Impacts are not likely to generate any noticeable stress in the underlying system. Locations or groups that show a low vulnerability to the environmental impact under consideration (e.g. industrial areas).
Very Low	Very low importance and rarity on a local scale. The receptor is not impacted and shows a very large spare carrying capacity. Impacts are very unlikely to generate any noticeable stress in the underlying system. Locations or groups that show a very low vulnerability to the environmental impact under consideration (e.g. industrial areas).

IDENTIFICATION AND EVALUATION OF POTENTIAL IMPACTS

During the evaluation undertaken, the following types of impacts will be considered:

- Direct Impacts - Potential impacts that may result from the construction, commissioning, and operations of the Project acting directly on an environmental or social receptor;
- Indirect Impacts – Potential impacts which are not a direct result of a Project activity, that may be realised later in time or at distances further removed from the project footprint, but are normally a result of a complex pathway;
- Cumulative Impacts – Changes to the environment that are caused by an action in combination with other past present and future actions.
- Beneficial Impacts – Those impacts that have a positive, desirable or favourable effect on the sensitive resources or receptors (e.g. landscape providing artificial habitat for a variety of species, jobs opportunities during the construction and/or occupation phases of a project);

- Adverse Impacts – Those impacts that are detrimental and have a negative influence on the environment, social structures, resources or other receptors;
- Secondary Impacts - Potential impacts that may result from the implementation of protection measures applied to mitigate potential direct impacts; and
- Event Related Impacts - Potential unplanned or accidental impacts stemming from an unintentional event such as fire, explosion, oil spill, etc.

DEFINING IMPACT MAGNITUDE

The magnitude of the impact will be defined wherever possible in quantitative terms. The magnitude of an impact has a number of different components, for example:

- The extent of physical change;
- The level of change in an environmental condition;
- The permanence of impact and the reversibility of the impacted condition;
- Its spatial footprint;
- Its duration, its frequency; and
- Its likelihood of occurrence where the impact is not certain to occur.

Where necessary, the determination of impact magnitude may be assisted through the use of computer modelling (as outlined in the Terms of Reference sections herein). The criteria used for identifying the magnitude of impacts is provided within the table below.

Table 4-3 Criteria for magnitude of Impacts

MAGNITUDE	DESCRIPTION OF MAGNITUDE
Major	Adverse: Loss of resource and/or quality and integrity; severe damage to key characteristics, features or elements. A major impact is usually large scale, permanent and irreversible. Beneficial: Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Moderate	Adverse: Significant impact on the resource, but not adversely affecting the integrity; Partial loss of/damage to key characteristics, features or elements. Moderate impacts usually extend above the site boundary, and are usually permanent, irreversible or cumulative. Beneficial: Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Minor	Adverse: Some measurable change in attributes quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Minor impacts usually are only noticeable within the site and are temporary and reversible. Beneficial: Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse: Very minor loss or detrimental alteration to one or more characteristics, features or elements. Beneficial: Very minor benefit to or positive addition of one or more characteristics, features or elements.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

4.2.7 Determining Significance of Effects

The significance of effects is a combination of the environmental value (or sensitivity) of a receptor or resource and the magnitude of the project impact value (change). In other words, it is this product of the impact acting on the receptor that produces an environmental effect. The following matrix provides criterion used for determining the significance of environmental effects through consideration of the potential magnitude of impact and sensitivity of the associated receptor.

Table 4-4 Criteria for Determining Significance of Effects

		MAGNITUDE OF IMPACT (DEGREE OF CHANGE)				
		No change	Negligible	Minor	Moderate	Major
SENSITIVITY OF RECEPTOR	Very High	Neutral	Minor	Moderate to Major	Major	Major
	High	Neutral	Minor	Minor to moderate	Moderate to Major	Major
	Medium	Neutral	Negligible to minor	Minor	Moderate	Moderate to Major
	Low	Neutral	Negligible to minor	Negligible to minor	Minor	Minor to moderate
	Very Low	Neutral	Negligible	Negligible to minor	Minor	Minor

As is evident from the matrix, in some cases the significance product is a range (i.e., a 'Minor' Magnitude and a 'Very High' Sensitivity results in a 'Moderate to Major' Significance). In these cases, professional judgement will be used to determine which significance the impact represents.

Table 4-5 Definition of Significance of Effects

SIGNIFICANCE CATEGORY	CRITERIA
Major (Adverse / Beneficial)	- The effect is large scale and would cause a large improvement or deterioration in the environment which will likely (but not exclusively) feature nationally or international important sites and features. - Adverse effects may be considered unacceptable due to exceeded of statutory limits and may require additional studies to ascertain if alternatives (in terms design and location) with the potential for lower impacts should be considered. These effects represent key factors in the decision-making process. - These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Moderate (Adverse / Beneficial)	- The effect gives rise to noticeable improvement or deterioration to the existing environment at a regional or local scale. - If adverse, are potential concerns to the project and may become key factors in the decision-making process. - Whilst the effects will be experienced, mitigation measures and detailed design work may reduce (or enhance) the effect. Some residual effects will still arise.
Minor (Adverse / Beneficial)	- The effect is small scale and would cause a small improvement or deterioration to the existing environment. - Adverse effects are undesirable but acceptable and within statutory limits and not likely to be key-decision making issues. - Mitigation measures are typically not required to mitigate such effects. - The cumulative effect of such issues may lead to an increase in the overall effects on a particular area or on a particular resource.
Negligible	- No discernible improvement or deterioration to the existing environment as a result of the Project will occur. - Local issue unlikely to be of importance in the decision-making process. - Effects do not exceed statutory limits. - They are of relevance in enhancing the subsequent design of the project and consideration of mitigation or compensation measures.
Neutral	- No effect or effect that is beneath the level of perception, within normal bounds of variation or within the margin of forecasting error. - No mitigation is required.

The approach to assigning significance to an effect relies on reasoned argument, professional judgement and cognisance to the advice and views of the appropriate regulators and organisation. For some disciplines, it is determined by comparison, wherever possible with locally, nationally or internationally accepted standards. If no standards are available then it is necessary to development Project specific limits, based on guidance or best practice as necessary.

4.2.8 Mitigation & Management Measures

A key component of the ESIA process is to explore practical ways of avoiding or reducing potentially significant impacts caused by development of the Project. These are commonly referred to as mitigation and management measures and will be included in the ESIA report and further incorporated in the future Construction Environmental and Social Management Plan (CESMP) and Operational Environmental and Social Management Plan (OESMP) documents that will be prepared by concerned parties. Mitigation will be aimed at preventing, minimising or managing significant adverse impacts to as low as reasonably practicable and enhancing and maximising any potential beneficial impacts of the Project.

The approach taken to identifying and incorporating mitigation measures into the Project will be based on a typical hierarchy of decisions and measures. This is aimed at ensuring that wherever possible, potential impacts are mitigated at source rather than mitigated through restoration after the impact has occurred.

4.2.9 Residual Impacts

The residual impacts section of the ESIA will consider the overall significance of impacts following the implementation of the mitigation & management measures not already included to the design. The significance of such impacts will be re-evaluated based upon the same criteria used to determine the impact significance stated above.

4.3 Framework for Environmental and Social Management

The ESIA will include a standalone framework to guide the Project parties in establishing structures for the management of Environmental and Social risks, impacts, opportunities and compliance associated with both the construction and operational phases of the Project.

The Framework will outline systematic structures and management programmes that will ultimately be prepared to comprise the respective construction and operational phase Environmental and Social Management Systems (ESMS).

This framework will ensure alignment with applicable elements of the established ACWA Power corporate level Health, Safety Security and Environment (HSSE) Management System Framework, which is intended to ensure consistent and structured HSSE project management between ACWA Power projects.

It is intended that the EPC Contractor and O&M Company will prepare their respective CESMP and OESMPs as part of their wider ESMS'.

4.4 ESIA Reporting Structure

In order to align the ESIA with the requirements for environmental and social assessment established by the various lenders and expectations of the Uzbekistan environmental regulator, the ESIA report is proposed to be presented in the following format developed by 5 Capitals:

- Volume 1: Non-Technical Summary
- Volume 2: ESIA - Main Text, Tables and Figures
- Volume 3: Framework for Environmental & Social Management
- Volume 4: Appendices

Volume 1 will include a Non-Technical Summary (NTS) of the ESIA, including the main outcomes, and conclusions.

Volume 2 will comprise the main text of the ESIA and full impact assessment, with mitigation, management and monitoring measures identified.

Volume 3 will provide the Framework for Environmental and Social Management as outlined above.

Volume 4 will comprise all technical appendices relevant to the studies and ESIA.

5 ESIA TERM OF REFERENCE

5.1 Air Quality

5.1.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

Ambient Air Quality

- The Law of the Republic of Uzbekistan “On Atmospheric Air Protection” (1996, amended on 10.10.2006)
- SanPiN № 0293-11 “Hygienic regulations. List of maximum permissible concentrations (MPC) of contaminants in the atmospheric air of inhabitant areas in the territory of the Republic of Uzbekistan”
- SanPiN Ruz No.0179-04 – ‘Hygienic norms: List Maximum Allowable Concentrations (MACs) of pollutants in ambient air of communities in the Republic of Uzbekistan

LENDER REQUIREMENTS

Ambient Air Quality

EBRD

- Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe.

Note: Not being a member State of the EU, it is noted that the Uzbekistan government does not manage ambient air quality in line with these standards, and as such the applicability of these standards in this ESIA assessment will only be for good practice benchmarking purposes, and not compliance assessment.

EPFIs

- WHO Ambient Air Quality Guidelines (as referenced by the World Bank Group General EHS Guidelines, 2007)

5.1.2 Initial Observations and Baseline Conditions

The proposed Project area is located in a remote region of Uzbekistan away from major population clusters. There are no major anthropogenic sources of air or dust emissions within 8 km of the wind farm site boundary, however, the site is prone to high winds and it is expected that natural ambient dust concentrations can be high due to the sandy soils and limited vegetation.

Within the wider region, there are vermiculite mines and cement factories typically located along the A380. Emissions from the stack of the two cement facilities were clearly visible during the December 2021 site visit, as shown in the following figure.



Figure 5-1 Stack Emissions from the Cement Plants

Visual observations by Juru Energy (2021) suggested that the mining operations contribute to elevated levels of dusts and particulates, likely resulting from a lack of dust abatement or control measures. The following image from December 2021 depicts stockpiling of excavated material at one of the vermiculite mining facilities.



Figure 5-2 Stockpiling at a Vermiculite Mine

The industrial facilities in the surrounding areas also require the frequent movement of Heavy Goods Vehicles (HGVs) often carrying materials which can be dispersed by wind if not properly covered and secured. Therefore, elevated particulate matter concentrations in the surrounding region are not uncommon.

5.1.3 Potential Impacts

Table 5-1 Potential Air Quality Impacts

Activity	Environmental Aspect	Impacts and Zone of Influence	Potential Receptors
Construction Phase			
Ground preparation and earthworks (for turbine pads, OHTL gantries and access road)	Dust/Particulate generation	Increased suspended particles in air and dust deposition (350 m from source – UK IAQM)	The local airshed and any herders present in the zone of influence
Vehicle movements on unpaved tracks			
Use of vehicles, mobile equipment and fuel driven plant	Emission of gases (e.g., NOx, SO2, CO2, BTEX etc.)	Increased concentration of gaseous pollutants (distinguishable from background within a of 200 m from source - DMRB)	
	Emissions of Greenhouse Gases (GHGs)	Contribution to global warming on a global scale	
Use of temporary sanitation facilities and wastewater containment	Odour from sanitary wastewater (only if poorly managed)	Only expected a maximum of 100 m from source for distributed and various temporary toilets/septic tanks.	
Storage of fuels, chemicals and other volatile substances	VOC emissions and odour (only if poorly managed)	Only expected a maximum of 100 m from source for small quantity and distributed storage during construction.	
Operational Phase			
Use of vehicles, mobile equipment and fuel driven plant for maintenance purposes	Emission of gases (e.g. NOx, SO2, CO2, BTEX.)	Increased concentration of gaseous pollutants (distinguishable from background within a of 200 m from source - DMRB)	Local airshed, any herders utilising the area
	Emissions of Greenhouse Gases (GHGs)	Contribution to global warming on a global scale	

5.1.4 Proposed ToR for the ESIA

BASELINE STUDIES

Baseline monitoring for ambient air quality is not proposed on the basis that a quantitative assessment will not be required to assess the limited expected potential impacts upon receptors and ambient air quality.

CONSTRUCTION PHASE IMPACTS ASSESSMENT

A qualitative assessment will be made concerning the potential impacts of construction dust, pollutant emissions and odour; relative to identified receptors that may (or may not) be in the zone of influence for wind turbine, OHTL and access road construction. Impacts from vehicular emissions along roads will also be considered. Impacts during construction are expected to be temporary and limited in extent.

Where potentially significant impacts are determined, applicable mitigation measures will be proposed in the ESIA for further incorporation to the EPC Contractor's CESMP. Such measures are expected to align with typical construction good practices for emissions management, including dust suppression mitigation for all soil moving or vehicle moving activities. GIP requires such mitigation measures to include water suppression, use of designated roads, and covered stockpiles etc.

Where information is available, an estimate regarding the consumption of fuel during the construction phase will be used to predict greenhouse gas emissions for the construction phase.

OPERATIONAL PHASE IMPACTS ASSESSMENT

No specific assessment of air quality impacts is proposed, as impacts from maintenance activities are not expected to be discernible at any receptors.

5.2 Noise & Vibration

5.2.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

- SanPin No. 0267-09 relating to rules on acceptable levels for habitable areas in Uzbekistan.
- SanPinNo. 0120-01 relating to noise levels from industrial equipment.
- SanPiN No. 0339-16. "Sanitary rules and norms of planning and development of settlements of Uzbekistan.
- SanPiN No. 0325-16 relating to sanitary standards for permissible noise levels in the workplace.

LENDER REQUIREMENTS

EBRD

- Directive 2002/49/EC relating to the assessment and management of environmental noise (the Environmental Noise Directive – END)
 - The Directive does not set limits or target values, nor does it prescribe the measures to be included in EU Member State (or Uzbekistan) action plans for noise, thus leaving such items at the discretion of the competent authorities.

EPFIs

- The World Bank Group General EHS Guidelines (2007) – Table 1.7.1.

5.2.2 Initial Observations and Baseline Conditions

NOISE AND VIBRATION

There are no significant anthropogenic sources of noise and vibration within 8 km of the Project site. In the broader area, traffic on the A380, and the mining and cement operations are the primary sources of noise and vibration. However, noise from these facilities is not expected to be discernible at site.

During the site visit in December 2021 the site was noted to be incredibly quiet with a lack of any noise sources apart from the movement of wind.

5.2.3 Potential Impacts

Table 5-2 Potential Noise & Vibration Impacts

Activity	Environmental Aspect	Impacts and Zone of Influence	Potential Receptors
Construction Phase			
Construction activities on-site and for access road and OHTL construction (including temporary plant and use of mobile equipment)	Noise propagation	Increased noise influence at receptors expected up to 500 m or to a maximum of 2 km in very calm and quiet ambient conditions.	Karakalpak Cement (I-1); Titan Cement (I-2); Summer herder settlement (S-1); Guard house for meteorological mast (S-2)
	Vibration	Impacts within the site footprint and immediately adjacent to the site.	
Movement of vehicles to the site (i.e., along access roads)	Noise propagation	Impacts along road corridors used by construction vehicles to the site. Particularly due to HGV movements	
Operational Phase			
Wind turbine operations (continuous, but varied depending on wind intensity)	Noise propagation	Increased noise influence at receptors primarily expected up to 500 m from turbines or to a maximum expected range of 2 km.	None
Crackling/corona noise from OHTL and electrical facilities	Noise propagation	Increased noise influence at receptors primarily expected up to 200 m from OHTL.	
Movement of vehicles for maintenance purposes	Noise propagation	Impacts along road corridors used by operational vehicles to the site. Few operational vehicles are expected, so impacts are likely to be minimal.	Guard house for meteorological mast (S-2)

5.2.4 Proposed ToR for the ESIA

BASELINE STUDIES

Two separate noise monitoring surveys are discussed below. Noise monitoring related to construction noise impacts assessment will be undertaken in all cases, however, more detailed noise monitoring for noise modelling purposes will only be undertaken where preliminary modelling of WTG operational impacts has identified the need for a detailed noise model at sensitive receptors.

Noise monitoring related to construction noise impacts assessment:

Baseline noise monitoring will be measured by Class 1 (Type 1) sound level meter Class 1 at four (4) locations and it will involve the following:

- Each location will be monitored for 24-hours continuously;
- The sound level meter will be placed on a tripod so that the microphone is 1.2 m to 1.6 m above the local ground level (and no closer than 3 m to any reflecting surface (e.g., wall) when measuring near a house, for example);
- Measurements will not be undertaken during periods of rain;
- There will be taken photo of the noise meter at each monitoring location and also at the nearest receptors (e.g., if near a house) at each location;
- Wind parameters and notes on noise influences (such as noise from any vehicle, human activity or from local infrastructure) will be recorded.

The raw data and graphical representations of the data will be included to the ESIA.

Following from the identification of receptors during the site visit, the baseline noise monitoring will be conducted at the following locations:

- Karakalpak Cement (I-1)
- Titan Cement (I-2)
- Summer herder settlement (S-1)
- Guard house for meteorological mast (S-2)

Noise monitoring for operational modelling assessment of noise impacts assessment:

Note: *If the preliminary noise model suggests that turbine noise at any sensitive receptor is likely to be above an LA_{90} of 35 (dB) (A) at a wind speed of 10 m/s at 10 m height during day and night time, then more detailed modelling be carried out, which would include a background ambient noise measurement survey outlined below.*

The EHS Guidelines for Wind Energy recommends screening the potential effects within 2 km from the sound sources. A preliminary screening assessment has been performed using windPRO tool, and it shows that noise levels are expected to drop to between 35 and 40 dB(A) within 1 to 1.5 km from each WTG (Juru Energy, 2021).

There are no permanent residential receptors within 10 km of the proposed WTGs, and the herder's shelters are all over 3.5 km from the wind farm site boundary, therefore it is unlikely there will be any operational noise issues on permanent residential receptors and as such detailed noise monitoring is not currently required. However, this will be confirmed with updated preliminary modelling using confirmed specifications and WTG locations.

CONSTRUCTION PHASE IMPACTS ASSESSMENT

Noise impacts during the construction phase will be assessed by using calculations established in BS 5228-1:2009 'Code of practice for noise and vibration control on construction and open sites – Noise'. This will be undertaken for construction works at a wind turbine pad & turbine erection location, an OHTL gantry footing & gantry erection location and an access road location. The predicted noise levels will be based on the expected construction equipment and will incorporate reductions in noise due to distance propagation.

Due to the number of turbines and OHTL gantry footings with near identical required construction works, this will be undertaken for one location each and will generate expected noise levels at set distances from these works. It will then be possible to evaluate potential noise impacts at receptors, where these are located within the zone of influence from the works.

Potential impacts will be based upon the degree of change in decibels at receptor locations and will also be compared against applicable noise standards. In situations where residential receptors are located in proximity to construction works, the ABC method stated in BS5228-1:2009 Part 1, paragraph E.3.2 would consider the existing ambient noise environment (the LAeq noise level environment) and identify the noise level needed to be exceeded that would result in a 'significant adverse' impacts.

Due to the remoteness of the Project site and works, vibration impacts are generally not expected and will not be assessed in the ESIA.

OPERATIONAL PHASE IMPACTS ASSESSMENT

Preliminary Noise Modelling Study

The preliminary noise modelling will be updated based on actual Project WTG locations and specifications, provided by ACWA Power. The updated preliminary modelling intends to determine if any sensitive receptors may be exposed to process noise contributions of ≥ 35 dB(A), however, considering the existing screening study and the distance to the noise sensitive receptors it is considered unlikely that any exceedances of the ≥ 35 dB(A) will occur.

Detailed Noise Modelling Study

If the preliminary noise model predicts that turbine noise impacts at any sensitive receptor is likely to be above an LA₉₀ of 35 (dB) (A) (at a wind speed of 10 m/s at 10 m height during day and night-time), then more detailed modelling would be conducted.

If detailed noise modelling is required, this will be undertaken using predictive modelling software such as DECIBEL, IMMI or CADNA(A), which are 3D models which incorporate terrain and also consider the cumulative impacts of all turbines. The software will also consider

parameters which interferes with sound propagation, i.e., noise shielding, acoustic reflection, ground acoustic attenuation, meteorology, wind direction, wind speed, acoustic diffraction and others. The input data for the model would include noise guarantee levels as provided by ACWA Power from the turbine manufacturer.

Modelling plots would be prepared and calculations of predicted noise at sensitive receptor locations will be made incorporating measured baseline conditions.

Other Noise Sources

Electrical Crackling/Corona Noise

No receptors have been identified in proximity to OHTL lines and/or substations, and therefore a calculation of corona noise is not required.

Vehicle Noise

Noises emanating from maintenance vehicles will be assessed qualitatively, these are expected to be few in number and likely not discernible from existing traffic flows.

5.3 Geology, Soils, Surface Water and Groundwater Quality

5.3.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

The following regulations are applicable to the storage of both hazardous materials and waste on the site, which may have an influence soil and groundwater quality:

- SanPiN № 0157-04 "Sanitary requirements to the storage and neutralization of solid domestic waste on special grounds in Uzbekistan"
- SanPiN No 0127-02 – "Sanitary rules for inventory making, classification, storing and rendering harmless of industrial wastes"
- SanPiN of the Republic of Uzbekistan dated 29/7/2002 No 0128-02 – "Hygienic classifier of toxic industrial wastes in the Republic of Uzbekistan"
- SanPiN of the Republic of Uzbekistan dated 16/11/2011 No 0300-11 "Sanitary Rules and Standards for managing collection, inventory, classification, treatment, storage and disposal of industrial waste in the context of Uzbekistan"

Further research will be undertaken into the applicability of any domestic soil and groundwater quality standards.

LENDER REQUIREMENTS

EBRD

Performance Requirement 3 on Resource Efficiency and Pollution Prevention and Control establishes general requirements for pollution prevention as follows:

- The assessment process must identify technically and financially feasible pollution prevention and control techniques that are best suited to avoid or minimise adverse impacts on human health and the environment. Such techniques will be appropriate to the nature and scale of the project's adverse impacts and issues; and
- The Project must meet the relevant EU substantive environmental standards, where these can be applied at the project level. Where no EU substantive environmental standards at project level exist, the Project will identify, in agreement with the EBRD, other appropriate environmental standards in accordance with GIP.

As there may be no defined soil and groundwater standards for Uzbekistan, it is proposed to benchmark existing soil and groundwater against the Dutch standards.

EPFIs

IFC Performance Standard 3 on 'Resource Efficiency and Pollution Prevention' requires the client and/or the Project to:

- Avoid or minimise adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities; and
- Prevent the release of pollutants to water and land due to routine, non-routine, and accidental circumstances, or when not feasible, minimize and/or control the intensity and mass flow of their release.

5.3.2 Initial Observation and Baseline Conditions

The following information is summarised from the geotechnical survey conducted by SpecialGeo (2021) and site observations during the December 2021 site visit.

TOPOGRAPHY

The site terrain is moderately undulating, with elevations ranging between 250 m and 320 m above Vertical Reference Datum (Baltic Height System 1977).



Figure 5-3 General Site Topography

GEOLOGY AND SOILS

The terrain surface conditions were found to be non-complex. The site is a desert (steppe) area with little to no vegetation, only small scrubs and grasses. In the low elevation areas, the shallow geological conditions typically comprise a thick (>30 m) overburden layer of “normal soils” such as dense sands, hard loam and clay soils. In the higher elevation areas, the shallow geological conditions tend to consist of bedrock at or very close to the ground level (<3 m). No special or unique geological or other topographical features were observed during site visits.

Initially, there are no obvious areas of current or past human activity to the land that may have resulted in contamination. Isolated impacts may occur at the seasonally used structures on-site for herders, although these were identified over 3 km away from the wind farm site boundary. In addition to this, at locations close (c. 400 m) to access road alignment near to

the main road connecting the A380 to the north (10 km from wind farm site boundary), there are examples of historic exploratory works understood to have been conducted by geologists. These are shown in the following figures



Figure 5-4 Historic Geological Exploration Near Access Road

Ground conditions mean the potential for soil erosion and dust generation during the Project construction phase are high.

HYDROLOGY

The Project area is part of the Amu-Darya hydrographic network, the Amu-Darya river passes more than five (5) km from the closest point on the OHTL route and over 15 km from the wind farm site boundary, shown diagonally on the following satellite image.

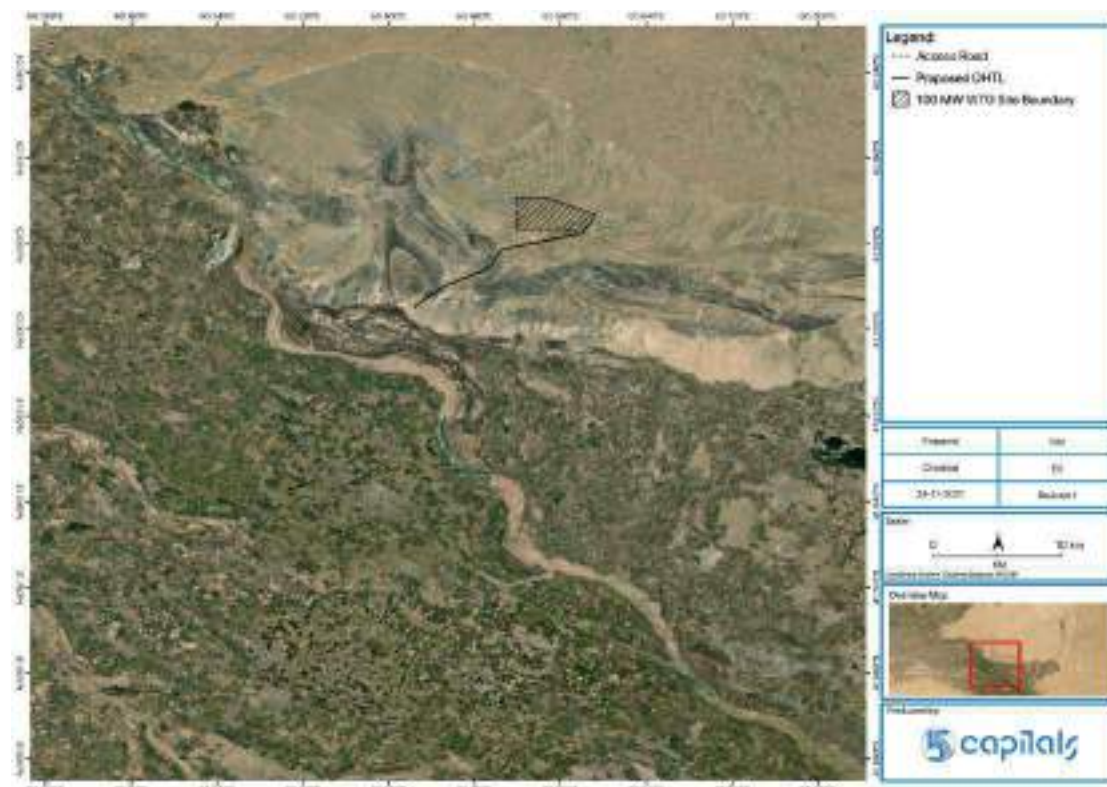


Figure 5-5 Amu-Darya River (Running Diagonally Top Left to Bottom Right)

No permanent surface water bodies or rivers are observed within 10 km of the site, however, seasonal stream beds are evident, these are typically inundated during the short rainy season, which lasts from June until the end of July. In the wider area, water supply is reliant on the Amu Darya River. Smaller villages along the north bank of the river are not connected to the mains supply system. It is reported that water for agricultural purposes is scarce due to increases in upstream water consumption (Juru Energy, 2021).

GROUNDWATER

Water boreholes located in the area are understood to have been constructed as part of a historical water pipeline project that is no longer in progress or developed to support livestock grazing. Evidence of this was observed 400 m from the access road alignment, where groundwater is being pumped up to provide drinking water for horses.



Figure 5-6 Groundwater Pumping for Livestock

No groundwater levels were encountered during any of the boreholes (BH) and trial pit (TP) construction activities, indicating that groundwater levels were lower than the respective BH/TP termination depths at the time of the field works.

Groundwater quality is unknown but expected to be unsuitable for drinking without pre-treatment.

SEISMIC HAZARD

The seismic hazard levels within the region are generally classified as 'low' with a 2% chance of a potentially damaging earthquake occurring in the next 50 years.

5.3.3 Potential Impacts

Table 5-3 Potential Soil, Geology and Groundwater Impacts

ACTIVITY	ENVIRONMENTAL ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Movement of vehicles, removal of vegetation, construction activities	Soil erosion	Areas in direct footprint of works or project related vehicle movements	Site soils
Site clearance and removal of any site soils	Legacy spills & leaks from (e.g. oils & greases, hydrocarbons and heavy metals)	Cross-contamination of soils which could occur in all construction areas.	Soil quality
Storage, handling and use of hazardous materials, chemicals, fuels and inadequate waste management	Potential spills & leaks associated with construction	Direct impacts to soil (and potentially groundwater if at shallow depths) with potential for runoff to flow paths	Site soils and potentially groundwater (if shallow)
Operational Phase			
Storage, handling and use of limited volumes of hazardous materials, chemicals, fuels, and inadequate waste management	Potential spills & leaks associated with operations	Direct impacts to soil (and potentially groundwater) with potential for runoff to flow paths.	Site soils and potentially groundwater (if shallow).

5.3.4 Proposed ToR for the ESIA

BASELINE STUDIES

Geology

Reference will be provided in the ESIA to available secondary data sources to identify the geological condition of the Project area. Where this has an impact upon the effects of potential pollution, pollution pathways or erosion, this will also be discussed in the relevant assessment sections of the ESIA.

Soil

The ESIA will include an Initial conceptual model to identify the risk of source-pathway-receptor linkage based on a Phase 1 land contamination walkover.

Topsoil samples will be collected at five (5) representative locations within the Project footprint (including the access road and OHTL). These samples will be taken from top 10 – 20 cm of topsoil (after scraping off the upper most layer) and will be analysed for a suite of physical parameters including pH, nutrients and metals.

Following site visit observations, the following locations are proposed for soil sampling analysis:

- One (1) location on the access road alignment close to examples of previous anthropogenic disturbance;
- One (1) location on the OHTL alignment close to anthropogenic disturbance close to cement factory activities; and
- Three (3) locations within the wind farm site boundary, covering the northern, southeastern and southwestern areas. The southwestern location point will also be close to the proposed substation.

Groundwater

The groundwater is at a depth of >30 m and therefore groundwater sampling and analysis is not proposed.

Impacts that could be attributable to the construction phase are common for any construction project and considered to be manageable through the implementation of a robust CESMP. As such, appropriate controls relating to construction processes will be included to the mitigation and management section of the ESIA. The same will be applied in the ESIA for the operation phase.

CONSTRUCTION PHASE IMPACTS ASSESSMENT

A qualitative assessment will be made concerning the potential impacts on soil and groundwater quality in the zone of influence for wind turbine, OHTL and access road construction. Potential impacts from flood risk will also be considered. Where potentially significant impacts are determined, applicable mitigation measures will be proposed in the ESIA for further incorporation in the EPC Contractor's CESMP. Such measures are expected to align with typical construction good practices for appropriate handling, transport and storage of chemicals and hazardous materials.

OPERATIONAL PHASE IMPACTS ASSESSMENT

Specific project impacts to soil, geology, surface water and groundwater are not expected during the operational phase as the site will be static and will not have direct interactions with these environmental parameters. Potential risks of concern during the operational phase are expected to be limited to the management and storage of hazardous materials/wastes/wastewater, chemicals and fuels and sanitary provision. Best practice mitigation and management will be proposed in the ESIA for incorporation in the CESMP.

5.4 Terrestrial Ecology and Avifauna

5.4.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

- The Law of the Republic of Uzbekistan "On Nature Protection" (1992)
- The Law of the Republic of Uzbekistan "On Protection and Use of Vegetation" (1997),
- The Law of the Republic of Uzbekistan "On Protected Natural Reserves" (2004)
- The Law of the Republic of Uzbekistan "On Protection and Use of the Wildlife" (1997)
- Decree of the Cabinet of Ministers "Regulation on the procedure for using plant world objects and passing licensing procedures in the field of using plant world objects" No. 290 of 10.10.2014
 - Sets out the requirements to obtain permission to cut wood and shrub plantations that are in the zone of the construction site.

LENDER REQUIREMENTS

EBRD

EBRD PR6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources establishes general requirements for the conservation of biodiversity and sustainable management of living natural resources covering aspects such as the assessment of issues and impacts on biodiversity.

Where applicable, the Project will intend to follow the targets set out by the EU Biodiversity Strategy including the Habitats Directive 92/43/EEC, the Birds Directive 2009/147/EC and the EU Regulation 1143/2014 on Invasive Alien Species. It is noted however that the targets are unlikely to be triggered by the Project due to the nature and scale of the Project and the existing ecological conditions within the Project site (primarily modified habitat due to farming).

EPFI's

The assessment of impacts upon terrestrial ecology is required with due consideration to IFC Performance Standard 6 on Biodiversity Conservation and Sustainable Natural Resource Management. PS6 establishes requirements for protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources.

5.4.2 Initial Observations and Baseline Conditions

AREAS OF CONSERVATION IMPORTANCE

The review of conservation areas within the project site included a review of the following databases:

- Protected Areas designated on World Database of Protected Areas (protectedplanet.net)
- Important Bird Areas (IBA) and Endemic Bird Areas (EBA) designated by Birdlife International (birdlife.org)
- Key Biodiversity Areas (KBAs) designated by the KBA Partnership (keybiodiversityareas.org)
- Wetlands of International Importance (Ramsar Sites) designated by Ramsar, none of which were found in the study area;
- Biosphere Reserves designated by UNESCO, none of which were found in the study area;
- AZE Sites designated by the Alliance for Zero Extinction, none of which were found in the study area; and
- Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) within Natura 2000; as laid out in the EU Habitats and Birds Directives, none of which were found within the study area.

The following table list the areas within the vicinity of the wind farm development project that are of conservation importance.

Table 5-4 Conservation Areas within 100 km of the Project Boundaries

NAME	DESIGNATION	PROXIMITY TO PROJECT AREA
Lower Amudarya Biosphere Reserve	Nationally Protected Area	15 km
Badai Tungai Nature Reserve	Nationally Protected Area	20 km
Muskinata (Uzbekistan-Turkmenistan)	Important Bird Area (IBA) Key Biodiversity Area (KBA)	60 km
Khorezm Fish Farm and Adjacent Lakes	Important Bird Area (IBA) Key Biodiversity Area (KBA)	96 km

As is evident from the table, the Lower Amudarya Biosphere Reserve is located 15 km from the project site and the Badai Tungai Nature Reserve is situated 20km south of the project site on the banks of the Amudarya River adjacent to the Lower Amudarya Biosphere Reserve. The reserve contains riparian vegetation, including poplar forests and is home of 91 species of birds and 21 species of mammals amongst which is the rare Tarim Red Deer.



Figure 5-7 Protected Area - Lower Amudarya Biosphere Reserve (15 km)



Figure 5-8 Badai-Tugai Nature Reserve (20km)

The two IBAs within 100 km of the project site, Muskinata on the Uzbekistan-Turkmenistan border and Khorezm Fish Farm and Adjacent Lakes, are known to host large populations of migratory and breeding birds, however no records of threatened species have been found at these sites. Their locations relative to the Project are shown in the following figure.



Figure 5-9 IBAs (Purple Polygons) within 100 km of the Project Site (Red Marker)

The trigger species resulting in their designation as IBAs are shown in the following figures.

Muskinata						TM033
Summary						
Text accessed						
Data table and detailed info						
Map						
Reference and further resources						
IBA Criteria						
Year of most recent IBA criteria assessment: 2007						
Populations of IBA trigger species						
Species	Current IUCN Red List Category	Season	Year(s) of estimate	Population estimate	IBA Criteria Triggered	
Pipit Courtlandt <i>Mercatoria pinnator</i>	LC	breeding	2007	1,000 individuals	A1	
Pallid Gull <i>Larus argentatus</i>	LC	breeding	2007	2 individuals	A3	
White-winged Woodpecker <i>Dendrocopos leucophaea</i>	LC	resident	2007	1 individuals	A3	
Great Tit <i>Parus major</i>	LC	resident	2007	25-40 individuals	A3	
Sylvia's Warbler <i>Sylvia borin</i>	LC	breeding	2007	5-8 individuals	A3	
Desert Scrub-warbler <i>Scolioecetes squameus</i>	LC	resident	2007	5 individuals	A3	
Desert Finch <i>Rhipidura thalassina</i>	LC	breeding	2007	15 individuals	A3	
Red-headed Bunting <i>Emberiza hortulana</i>	LC	breeding	2007	4 individuals	A3	

Note: This table presents the IBA criteria triggered and the species that triggered them at the time of assessment; the current IUCN Red List category may vary from that which was in place at that time.

Figure 5-10 IBA Trigger Criteria – Muskinata Forest (60 km) (BirdLife, 2022a)

Khorezm Fish Farm and adjacent lakes

UZ011

Summary | Field account | Data table and detailed info | Map | Reference and further resources

IBA Criteria

Year of most recent IBA criteria assessment: 2008

Populations of IBA trigger species

Species	Current IUCN Red List Category	Season	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Red-crowned Pochard <i>Nettion rufina</i>	LC	passage	2007	3,000-7,000 individuals	A4i
Clay-colored Plover <i>Pluvialis fulva</i>	LC	passage	2007	800-900 individuals	A4i
Black-headed Gull <i>Larus ridibundus</i>	LC	passage	2007	5,000-6,000 individuals	A4i
Pink's Gull <i>Larus roseus</i>	LC	passage	2007	3,000-4,000 individuals	A4i

Note: This table presents the IBA criteria triggered and the species that triggered them at the time of assessment. The current IUCN Red List category may vary from that which was in place at that time.

Figure 5-11 IBA Trigger Criteria – Khorezm Fish Farm and Adjacent Lakes (95 km) (BirdLife, 2022b)

The area and region do not have any assessed ecosystems under consideration for the IUCN Red List of Ecosystems, and there are no designated AZE sites or other factors that allude to high evolutionary function.

The habitats within the project area and surroundings appear to be relatively typical of the region, supporting low vegetation density. It is not anticipated that the ecosystems that will be affected are of regional or global significance.

AVIFAUNA (BIRDS)

The project lies within the West Asian-East African Flyway and the Central Asian Flyway.

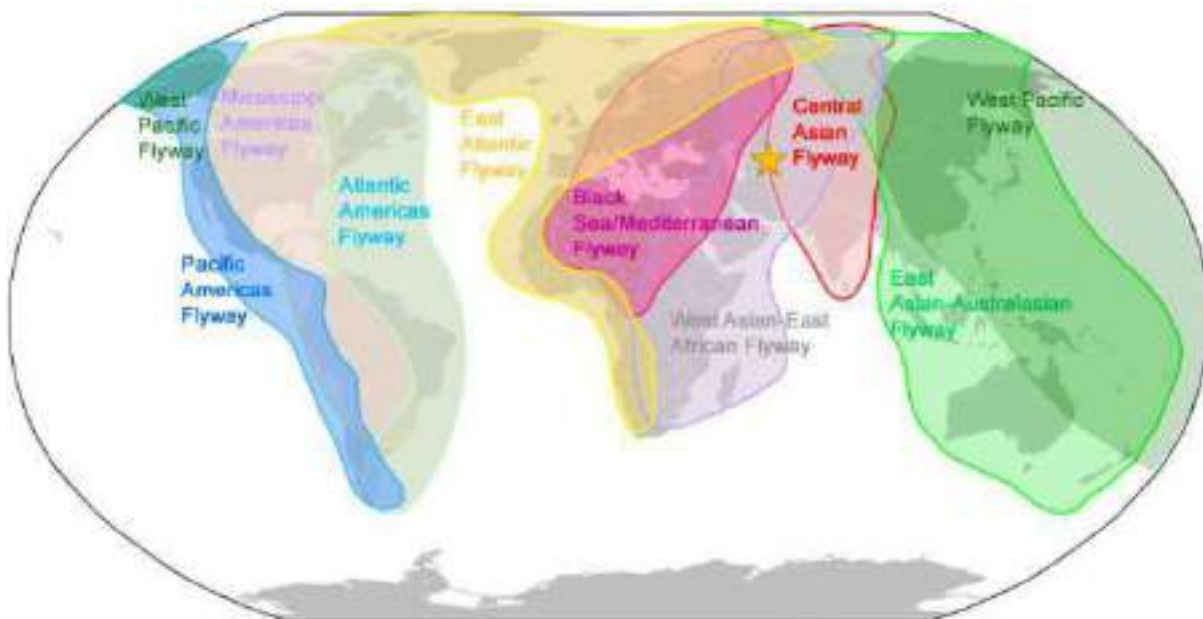


Figure 5-12 Global Migratory Flyways

An assessment of the landforms surrounding the project site enables predictions of general flight paths of migratory flocks*, which typically avoids expanses of flat desert and mountain features and follows along coastlines or river deltas to wetland staging areas and stopover sites. (*migratory flight path prediction is an imperfect science. Migration pathways vary by type of birds, species, age, and even individuals year by year. However, very broad, general patterns can be made based on these behavioural assumptions.)

The below figures provide indicative migratory flight paths for northbound spring migration and southbound autumn migration. Due to the unique position of the project location within a relatively expansive patch of desert habitat, with limited water sources apparent, it is anticipated that migratory flight traffic within the project's airspace would be relatively low. It is not considered likely that there would be large congregations or migratory flocks utilising the project area or adjacent desert and rocky outcrop habitat as a stopover or staging area.



Figure 5-13 Predicted Migratory Flight Paths Northbound (1/2)



Figure 5-14 Predicted Migratory Flight Paths Northbound (2/2)



Figure 5-15 Predicted Migratory Flight Paths Southbound

To date the following surveys at the wind farm have been undertaken:

Bird Vantage Point Surveys

- Two VP survey locations, collectively covering at least 95% of the polygon representing the wind turbine area, plus extension up to ca. 1 km outside of the wind turbine area (buffer) on all sides
- 3-hour VP surveys conducted by qualified regional ornithologists year-round from April 2020 to April 2021, with at least 36 hours of VP survey conducted at each survey point in each of four seasons, as follows:
 - Spring: March 16 – May 15 – 80.35 total VP survey hours conducted
 - Summer: May 16 – August 31 – 107.6 total VP survey hours conducted
 - Autumn: September 1 – November 15 – 72 total VP survey hours conducted
 - Winter: November 16 – March 15 – 75 total VP survey hours conducted

Specialised Houbara Bustard Surveys

- 4 days of survey in May 2020 – 11.25 km of driving transects
- 18 days of survey in June – August 2020 – 6 – 11 km of driving transects
- 12 days of survey in October – November 2020 – 12 x 2 km walking transects plus 12 – 15 km driving transect
- 12 days of survey in December 2020 – February 2021 – 12 x 2 km walking transects plus 12 – 15 km driving transect
- 6 days of survey during peak breeding display season March 21 – April 24, 2021

Raptor Nesting Surveys

- 4 days of survey in May 2020 – 2 transects covering mountains within 10 km of turbine area
- 18 days of survey in June – August 2020 - 2 transects covering mountains within 10 km of turbine area
- 7 days of survey in March – April 2021 – 4 transects collectively covering wind turbine area plus 5 km buffer

A summary of the survey results are provided in the following subsections.

Houbara Bustard Surveys

No Houbara Bustards were observed during any of the Houbara Bustard specific surveys. Neither was this species observed incidentally during any of the surveys performed at the wind farm.

It is, however, important to note that during bird baseline surveys conducted at a candidate site, adjacent to the Project Site on the west, three observations of Houbara Bustard were documented during the autumn (2019) season.

Raptor Nesting Surveys

No raptor nests were discovered, nor were any observations of behaviours indicative of possible breeding activity collected during the survey effort, however, it is possible that some tier 1 target species, particularly Golden Eagles, but also possibly Steppe Eagles and Egyptian Vultures may nest in the mountains located to the south (within 5 km) of the Project area.

Bird Vantage Point Surveys and Collision Risk Modelling

The four-season, one-year VP survey effort resulted in a total of 59 species of birds observed within the survey area, including five species classified as tier 1 target species, and 7 species classified as secondary species.

The data resulting from the survey effort was used to conduct Collision Risk Modelling (CRM) analysis, using the Band model following Scottish Natural Heritage (SNH) guidance.

The results of the CRM analysis indicate that the Project has a low level of collision risk for sensitive bird species. Among tier 1 target species, a category that includes all bird species with elevated national and/or international conservation/protected status that potentially occur at the site, only three (3) species have been detected at the site during the VP survey effort, and none are predicted to experience an annual collision frequency greater than one fatality per 373 years under the most likely collision avoidance rate parameters modelled.

OTHER FAUNA

The fauna of the region includes typical desert species adapted to sandy environments. Common species observed during Juru Energy's two-day ecological walkover in May 2020 include the great gerbil, long-clawed ground squirrel, boreal and comb-toed jerboa. In addition, species such as the great horseshoe bat, squirrel, red-sand eel, five-fingered jerboa, rodents, and reptiles (e.g., central-turtle steppe agama, lizard, arrow-snake) were observed in the surrounding hills.

Regarding bats, thirteen species of bats are found in the Republic of Karakalpakstan and adjacent territory, and the common pipistrelle (*Pipistrellus pipistrellus* - LC) and the serotine bat (*Eptesicus serotinus* - LC) are particularly common. It is important to note that the majority of bats are concentrated in the lower reaches of the Amu Darya river and generally there are fewer species found within the desert areas, where the Project is sited. The Project site was also observed to not have favourable shelters (such as caves, buildings, springs) for bat species.

FLORA

The site is characterised by shrubby and semi-shrubby vegetation and wormwood formations. The following figure depicts the typical flora habitat observed at site.



Figure 5-16 Typical Flora Observed at Site

Previous studies and walkovers of the area have not identified any habitats classed as having high conservation value. The May 2020 site walkover by Juru Energy did not identify any CR or EN flora species and only one VU species; "*Euphorbia sclerocyathium*" which is a type of herb. According to the red book of Uzbekistan, the site may be home to some endemic and highly specialised plants; however, in general, the area can be considered to have low diversity.

5.4.3 Potential Impacts

Table 5-5 Potential Terrestrial Ecology & Avifauna Impacts

ACTIVITY	ENVIRONMENTAL ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Preparation of site, movement of construction vehicles etc.	Habitat & flora loss, with disturbance / direct mortality to fauna, introduction of pests / invasive species	Within the Project footprint and areas of associated facility works.	Habitats. Flora and Fauna.
Erection of Wind Turbines, installation of OHTL and construction of access roads,	Disturbance to fauna (including air, noise and lighting impacts)	Within 2 km of construction works	Fauna including avifauna and bats

ACTIVITY	ENVIRONMENTAL ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Operational Phase			
Operation of wind turbine	Collisions of birds and bats	Within the Project footprint, in proximity to each wind turbine generator	Avifauna & Bats
Installation of OHTL	Collision and electrocution of birds	Within the OHTL footprint	Avifauna

5.4.4 Proposed ToR for the ESIA

CRITICAL HABITAT SCREENING AND ASSESSMENT

‘Critical Habitat’ is a concept applicable to several international financial lending institutions, designed to enable the identification of areas of high biodiversity value in which development would be particularly sensitive and require special attention.

The initial step of a Critical Habitat Assessment (CHA) is a screening exercise, which identifies all possible biodiversity elements that could trigger criticality, that are relevant for the project area. Based on the findings of the screening exercise, if deemed to be required, a Critical Habitat Assessment is then undertaken.

The screening exercise is currently being undertaken and will inform the need for a CHA.

BASELINE STUDIES

Bird Surveys

As summarised above, bird surveys have been conducted for the wind farm. Further bird surveys are proposed for the OHTL corridor, which poses a potentially fatal collision risk to heavy-bodied birds, in addition to electrocution risk to raptors, vultures or other large birds.

The bird monitoring survey will include:

- A Vantage Point (VP) survey
- A Raptor nest search

VP Survey

The VP survey will comprise three (3) VPs, as shown in the following figure. 2-hour VP surveys will be conducted at each of these points on a monthly basis for 12 months. All three VPs will be covered per day. VP survey methods will generally follow SNH (2017) guidance for wind farm bird assessments, minus the elements that are specifically driven by the data requirements of collision risk modelling. The bird monitoring along the proposed OHTL corridor will cover all four

seasons: Winter (for wintering species), Spring (northward migration), Summer (breeding) and Autumn (southward migration).



Figure 5-17 OHTL VPs

Raptor Nest Search

In the desert surrounding the Project site, raptors nests in rocky and loess cliffs, in trees and power transmission poles.

The purpose of specialised raptor nest surveys will be to explore the cliffs along planned OHTL in search of nesting sites for birds of prey including old world vultures, falcons, all hawks, eagles, buzzards, kites and harriers. Walked surveys will be undertaken to establish nesting species, locations and any regular roosting sites. Where tracks and paths will allow, sightings and nest/roost sites will be recorded and their locations will be mapped. The survey will be conducted twice during the breeding season: at the end of February and in early April.

Bat Surveys

The bat survey will be conduct through the Spring, Summer and Autumn seasons and will include:

- Roost Search
- Transect Survey
- Static Detector Surveys

Roost Search

The aims of the Roost Search will be to identify and assess any potential bat roost sites within the wind farm site and OHTL corridor, and determine the risks of roost site destruction during the construction phase and bat fatalities and disturbance during construction and operation.

The survey area of the Roost Search is defined as the area within the boundaries of the baseline study area, taking into account the principles of area of influence as well as Ecologically Appropriate Area of Analysis (EAAA). All structures suitable for use by bats (trees/other structures) will be searched. All structures and features having potential to support roosting bats shall be identified and assessed with a detailed visual daytime inspection for evidence of roosting.

The roost search will also include the identification of detected bats species, their number and reproductive status (breeding / non-breeding individuals), and the presence of breeding colonies. In addition to measuring and photographing the detected species, mobile detectors will be used to make "reference" recordings of ultrasonic signals for the species identified manually. These "reference" signals will be used for further decoding of audio recordings of static and mobile detectors from stationary sites and transects, since some species of bats of Uzbekistan are absent in Europe and the parameters of ultrasonic signals are not known for them. The Roost Search will be undertaken for 4 days in June during the bats breeding season.

Transect Survey

The transect Surveys will identify the potential ecological function of the Project area for foraging/commuting/migrating bats and highlight any important habitat types (such as typical linear landscape features, areas with more vegetation, wet areas and streams/ditches etc.).

The transect routes will be identified by in country experts based on Project layout, accessibility for driven and walked transect and known habitats of possible importance for bats. The transect survey will be undertaken twice per month from April to October 2022. The data from the transect surveys will be analysed together with the data from the static bat detectors.

Static Detector Surveys

Four Wildlife Acoustics Song Meter SM4 bat static bat detectors will be used for two nights per month from April to October 2022 to record bat activity through the bat active season.

Data will be analysed by the bat specialist using Kaleidoscope Pro Auto Analysis (or similar software) and tabulated after cycle of deployments.

Two reports will be prepared based on the data collected by static bat detectors: Interim (April – June) and Final (July – October).

A lack of structures suitable for accommodating the bat detector at height was noted across the site and surrounding area. There is one meteorological mast located approximately 3.8 km from the nearest wind farm site boundary, however, it is not clear if permission will be granted to use this mast. If this is not possible then the detectors will be located at ground level at the following locations.



Figure 5-18 Preliminary Locations for Static Bat Detectors

Herpetological Survey

The aim of the field herpetological survey is to assess the status of reptiles and amphibians in the study area of the project territory (specification of the species and quantitative composition, territorial distribution, including places of concentration, the state of habitats). The survey will also establish the presence of critical species (e.g., the Russian tortoise (*Agrionemys horsfieldii* – IUCN VU)) and will estimate the species' population size. The main tasks of herpetological survey are following:

- Field herpetological survey and processing of field data;
- Analysis of any previous herpetological surveys and other available data (publications, reports, etc.);
- Compilation of the check-list of species recorded within the project site (in particular, threatened species included in the Red Data Book of Uzbekistan and/or the IUCN Red List).

Spring field studies will be carried out for four (4) days in April and for four (4) days in June within the project territory according to generally accepted zoological methods for identifying species composition.

April is the period of highest activity for amphibians and reptiles in Uzbekistan's climate conditions. This activity is associated with active nutrition after hibernation, the beginning of the breeding season and the abundance of food supply associated with intensive vegetation in April. In summer, a number species go back to hibernation.

The field research methodology reflects the following aspects: species composition in the study area; distribution across habitats; daily and seasonal changes in activity.

The research will combine stationary and transect survey methods. Locations for stationary surveys and transects will be selected in accordance with different types of habitats and will be determined during preparatory work based on the maps and literature data.

The quantitative assessment of reptiles and amphibians will be mainly based on the transect survey. The transect method consists in counting individuals along a fixed long line (transect), on both sides of it, with the duration of the survey determined by the known distance, which is selected depending on the type of reptile and the area but does not exceed 1 km in one way. In this case, all individuals encountered on the transect are registered, regardless of the distance they are identified at. The perpendicular distance is measured between the transect axis and each individual. The results obtained are used to calculate the density of recorded reptiles.

Mammal Survey

The survey for terrestrial mammals (excluding bats) will aim to establish the presence and absence of mammal species within the project territory and its surrounding areas. The survey will also establish the presence of mammals of concern (potential mammals of concern include the Jerboa (DD) and the Goitered gazelle (VU)) and confirm their population size. The following steps will be taken:

- Conducting a ground survey on mammal species (except for bats) throughout the study area which will take into account Aol and EAAA;
- Installing eight (8) non baited camera traps (from Winter 2021/2022 to the mid-Summer 2022);
- Collecting questionnaire data from local people on mammal species presence/absence, status and threats;
- Analysis of the preliminary field data including number of species and distribution; and
- Compiling a mammal species list based on field data, questionnaire data and data from literature sources, including endangered and non-endangered species.

The ground survey will be conducted in Winter (4 days in December) and in Spring (4 days in April). During ground survey the mammal species number and species composition will be studied by walking survey transect. The length of each walking transect will be 2 km in each monitoring point, the precise locations for transect surveys will be determined during preparatory work based on the maps and literature data.

During the field research, non-invasive methodology will be used, not related to the capture and killing of wild animals, including:

- visual observation of mammals both by eye and using 10x binoculars;
- registration of tracks of the vital activity of wild mammals, including animal tracks (paw footprints on the ground), faeces, diggings, burrows, dead animals, etc.
- taking photos of the animals, their tracks and traces of their vital activity, typical habitats etc.

The data collected by the camera traps will be analysed and included in a final survey report in July. Separate seasonal field reports (Winter and Spring) will be prepared after each seasonal survey.

Botanical Survey

A specialist will undertake a walkover for three days in April 2022 and three days in June 2022 to broadly categorise the habitat types of the project site and compile flora species lists. The proposed timeline is optimal for this region, because it corresponds to the peculiarities of seasonal vegetation development in this area and allows the most complete identification of the species composition of plants, especially rare species. A report will be prepared detailing the methods and results including details of habitat types present, basic habitat maps and any status of particular protected plant species (IUCN and Uzbekistan Red Data Book) will be included.

The report will, in part, compare the results of the 2022 survey to the results and assessment of any previous surveys undertaken (where applicable) to note changes in habitats and species recorded.

The main tasks of expert-botanist are following:

- field botanical survey and processing of field data;
- analysis of any previous botanical surveys and other available data (publications, reports, etc.) compared with the results of the 2022 survey;
- detailed description and GIS-based mapping of habitat types present within the project site;
- compilation of the checklist of plant species recorded within the project site (in particular, threatened species included in the Red Data Book of Uzbekistan and/or the IUCN Red List).

The field research on the project area will be conducted using the traditional methods of botanical survey commonly used for sampling and mapping of native non-forest vegetation, recognition of floristic composition and spatial patterns of plant communities.

Vegetation structure and species composition will be described from 50x50 m geobotanical sample plots (squares) chosen in an area with homogeneous vegetation. Sample plots (squares) will be located away from roads and boundaries between different vegetation communities (coordinates of these boundaries observed during the survey were recorded separately). For each square, photographs of the landscape and vegetation were taken using a digital camera and the following data will be recorded: location and physical environment (including GPS coordinates, elevation, topography, and soil), state of vegetation and disturbance factors (grazing, etc.), plant association, canopy cover (%), canopy height, all plant species present at the plot, their cover and abundance, phenological stage and height. Microcomplexes (e.g. along dry riverbeds) will be described separately. Coordinates of populations of endemic, red listed or alien species, number of individuals and area occupied by population also will be recorded.

Species cover and abundance will be determined using the Braun-Blanquet cover-abundance scale (1965) widely used in geobotanical and ecological studies as rapid visual assessment technique

Esri ArcGIS 10.1 software will be used for vegetation mapping. The vegetation map will be compiled in ArcGIS by visual interpretation of the satellite image using the field data, a topographical map (1:100.000) and a soil map of the region.

Summary of Survey Timeline

Table 5-6 Ecology Survey Timeline

SURVEYS		SEASON	TIMELINE
Bird surveys (along OHTL corridor)	Winter VP Survey	Winter 2021/2022	December 2021 – February 2022
	Spring Migration VP survey	Spring 2022	March – May 2022
	Raptors nest search survey	Spring 2022	February 2022; April 2022
	Summer VP survey	Summer 2022	June – August 2022
	Autumn Migration VP survey	Autumn 2022	September – November 2022
Bat surveys	Roost Search	Summer 2022	June 2022
	Transect survey	Spring 2022	April 2022 – October 2022
		Summer 2022	
	Static Detector Surveys	Autumn 2022	
		Spring 2022	April 2022 – October 2022
		Summer 2022	
		Autumn 2022	

SURVEYS		SEASON	TIMELINE
Habitat and flora surveys	Spring botanical/habitat survey	Spring 2022	April 2021
	Summer botanical/habitat survey	Summer 2022	June 2022
Mammal surveys	Ground survey	Winter 2021/2022	December 2021
	Ground survey	Spring 2021	April 2021
	Camera trapping	Winter 2021/2022 Spring 2022 Summer 2022	December 2021 – June 2022
Reptile surveys	Spring herpetological survey	Spring 2022	April 2022
	Summer herpetological survey	Summer 2022	June 2022

CONSTRUCTION PHASE IMPACTS ASSESSMENT

A qualitative impact assessment will be made in regard to construction phase impacts on habitats and terrestrial species based on the outcomes of the baseline surveys and the expected construction works. Potential construction-phase impacts that will be assessed against the baseline conditions as determined after surveying include, but are not limited to:

- Habitat loss and fragmentation;
- Biodiversity loss (direct mortality, lowered reproduction and survivorship);
- Biodiversity displacement;
- Biosecurity risks; and
- Environmental Quality (Air quality, noise, lighting, contamination).

OPERATIONAL PHASE IMPACTS ASSESSMENT

A qualitative impact assessment will be made in regard to operational phase impacts on habitats and terrestrial species based on the outcomes of the baseline surveys. Potential operation-phase impacts that will be assessed against the baseline conditions as determined after surveying include, but are not limited to:

- Bat turbine collision;
- Bird turbine collision;
- OHTL electrocution;
- OHTL collision;
- Vehicle collisions; and
- Proliferation of pests.

Collision Risk Modelling

As summarised above, collision risk modelling for avifauna has been undertaken based on the survey data collected for the Project. Updates to the CRM will be conducted once the specifications of the WTG are finalised.

5.5 Landscape and Visual Impacts

5.5.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

There are no known regulations or standards in Uzbekistan that provide requirements for landscape character, visual impacts and shadow flicker from wind turbines.

LENDER REQUIREMENTS

EPFIs

- IFC EHS Guidelines for Wind Energy (2015)

Landscape & Visual Impacts

The above EHS Guidelines for Wind Energy outline that *'preparing zones of visual influence maps and preparing wire-frame images and photomontages from key viewpoints is recommended to inform both the assessment and the consultation processes.'*

'Consideration should also be given to the proximity of turbines to settlements, residential areas, and other visual receptors to minimize visual impacts and impacts on residential amenity, where possible. All relevant viewing angles should be considered when considering turbine locations, including viewpoints from nearby settlements.'

Shadow Flicker

The above EHS Guidelines for Wind Energy, outline requirements for the modelling of shadow flicker to determine the duration and timing of shadow flicker occurrence under real weather conditions at specific receptors located within the zone of potential shadow flicker impact.

The guidelines require the model to predict flicker based on an astronomical worst-case scenario, which is defined as follows:

- There is continual sunshine and permanently cloudless skies from sunrise to sunset.
- There is sufficient wind for continually rotating turbine blades.
- Rotor is perpendicular to the incident direction of the sunlight.
- Sun angles less than 3 degrees above the horizon level are disregarded (due to likelihood for vegetation and building screening).
- Distances between the rotor plane and the tower axis are negligible.
- Light refraction in the atmosphere is not considered.

The IFC criteria for acceptability of flicker is:

- Not more than a combined 30 hours of flicker per year, and no more than 30 minutes of flicker on the worst-case day of the year.

5.5.2 Initial Observations and Baseline Conditions

LANDSCAPE AND VISUAL AMENITY

Based on initial site observations and review of satellite imagery, the general characteristics of the Project site is predominantly homogenous and undeveloped open landscape with low lying shrub and grass vegetation. Panoramic images from the site visit are shown below.



Figure 5-19 Panoramic View from the Access Road towards the Site



Figure 5-20 Panoramic View within the Site

The Project is located in an area of very low population density, upon review of existing data and discussions with local communities there are no highly valued viewpoints or landscapes within the site or the surrounding area.

A preliminary analysis of the zone of theoretical visibility (ZTV) with a 50 km radius has been undertaken. This has been conducted by selecting ten random points within the site boundary and assuming a hub height of 100 m. The following image depicts the ZTV using the topographical data included within ArcGIS online. The image shows locations from where 1 – 10 turbines would be visible, areas which have no colour assigned would not be able to see any turbines.

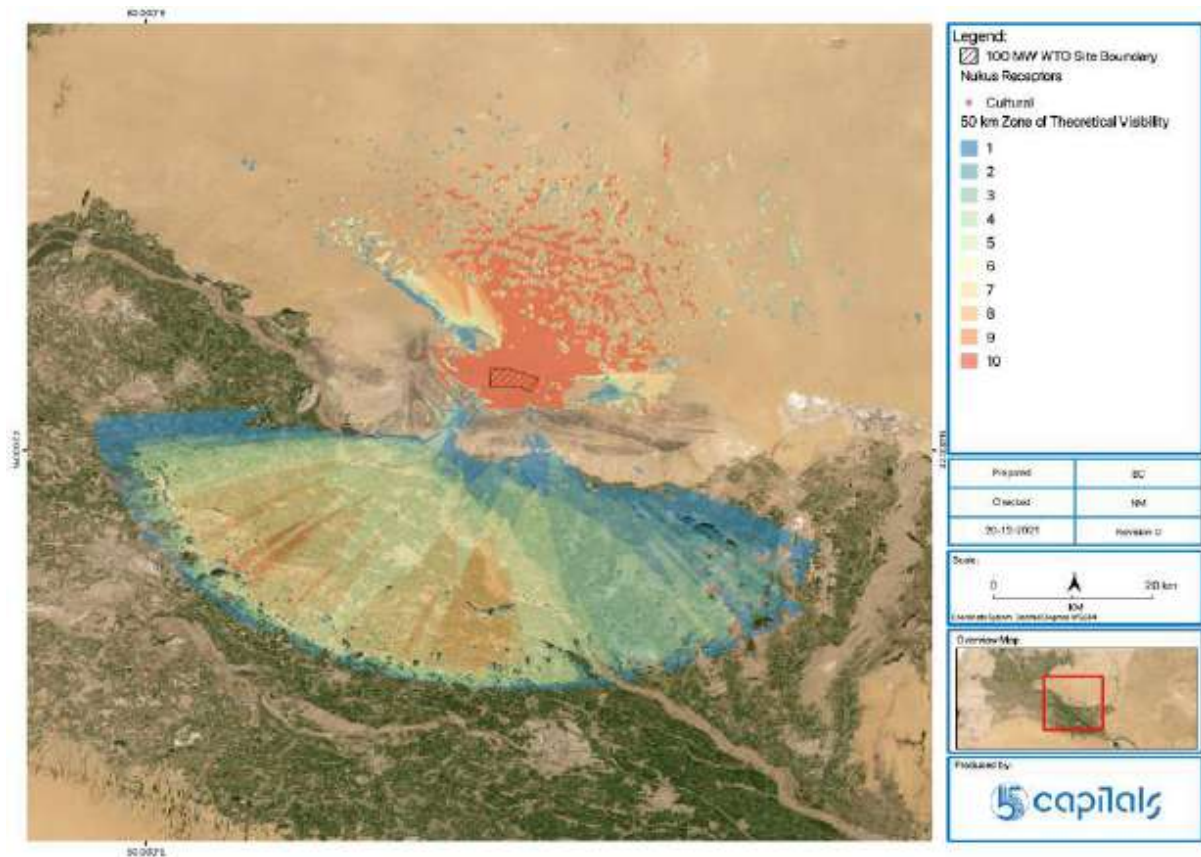


Figure 5-21 50 km Zone of Theoretical Visibility

As evident from the ZTV, the areas in which the most turbines are visible will be within the site and the immediate surroundings, and then to the north, where there are no visual receptors. According to the analysis, the two cultural sites in the area (Chilpak Kala monument (C-1) and the Sulton Uvays Baba Complex (C-2)) will not have visibility of the proposed development, and the site will not be visible for the vast majority of the A380 highway. This is shown in the following figure. Agricultural and residential receptors on the southern side of the Amu-Darya River have theoretical visibility of the Project, however, given the fact that they are over 20 km from the nearest WTG and there is no specific value placed on the view, they are not considered as visual receptors.

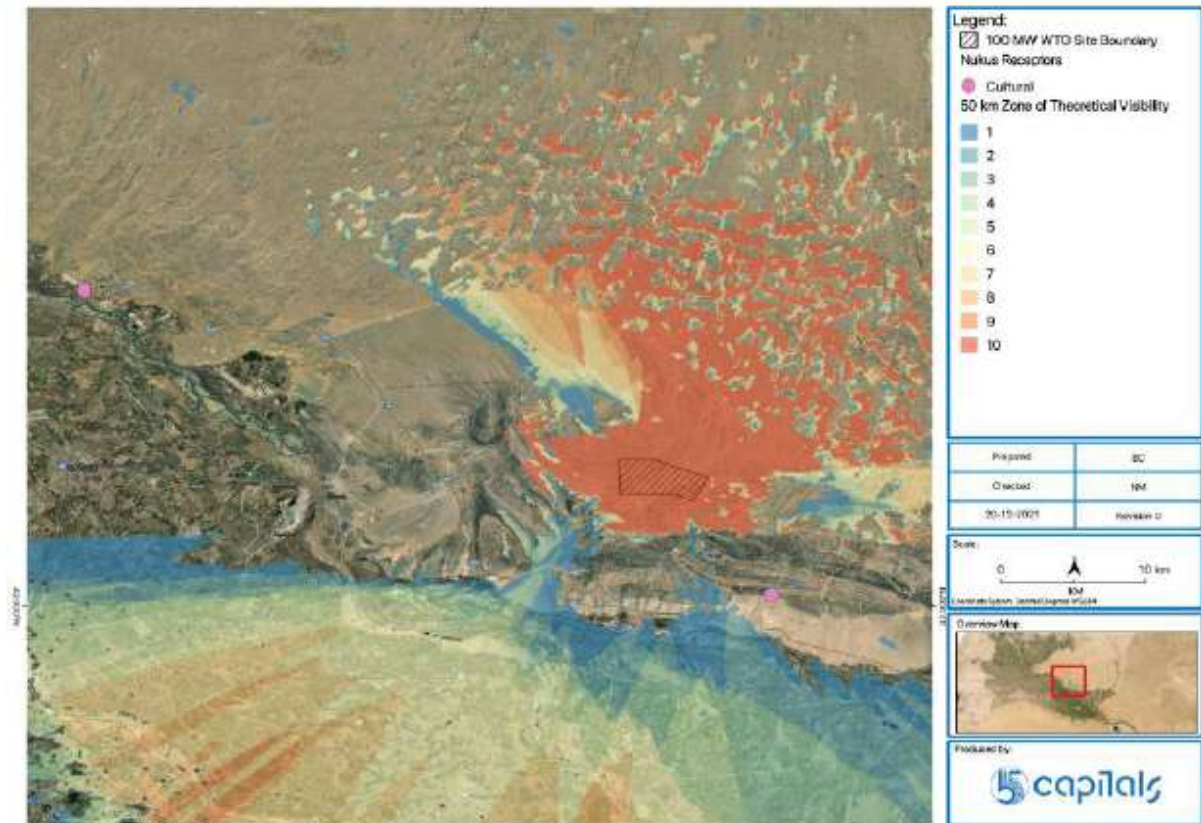


Figure 5-22 Local Zone of Theoretical Visibility

During the December 2021 site visit, both cultural sites were visited in order to determine if the ZTV was correct and if it was considered likely that the development of the Project would detract from their cultural significance. During the visit to Chilpak Kala the visibility was extremely poor, as shown in the following figure. It is understood that this is often the case during the cooler months.



Figure 5-23 Visibility at Chilpak Kala

Visibility was good at the Sultan Uwais Baba Complex and the following panoramic image was taken. Reviewing the image and the available topographical data, it is understood that the Project would be concealed by the hills highlighted in the image. It is also important to note that the wind farm site boundary is over 10 km from the Complex.



Figure 5-24 The Sultan Uwais Baba Complex Viewpoint

The construction and establishment of the OHTL will also result in landscape character changes and visual amenity impacts, however, as with the wind farm site, there are very few visual receptors. Closer to the A380, the OHTL will be visible to receptors such as those working at the cement factories, however, these are considered to be of low sensitivity and the landscape in this location is considered to be disturbed due to the proliferation of industrial activities.

To summarise, the nearest receptors that may be visually affected by changes to the landscape and visual amenity are:

- Herders (during grazing periods);
- Local road users who will occasionally have a view of the Project; and
- Receptors along the OHTL right of way (i.e., those working at the cement factories).

SHADOW FLICKER

An initial shadow flicker calculation was carried out by Juru Energy (2021). The model calculation showed the expected yearly shadow (flickering) hours at 2 km from the WTG will be less than 10 hours per year. No permanent residential receptors are located within 10 km of the nearest WTG, and therefore shadow flicker impacts are unlikely to be an issue for the Project, however, this will be reassessed once turbine specifications and locations are confirmed.

5.5.3 Potential Impacts

Table 5-7 Potential Landscape and Visual Impacts

ACTIVITY	ENVIRONMENTAL ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
General Construction Activities	Changes in Landscape Character	Area of project development and immediate surroundings that provide a buffer to this landscape area.	The wider landscape character as experienced by humans
	Visual impacts to receptors	Receptors with direct, or partial views of the construction works. Potentially extensive under good visibility conditions and dependent on topography.	Human receptors in the zone of influence (Herders, Local road users and receptors along the OHTL right of way)
Operational Phase			
Turbine Operation	Changes in Landscape Character	Area of project development and immediate surroundings that provide a buffer to this landscape area.	The wider landscape character as experienced by humans
	Visual impacts to receptors	Receptors with direct, or partial views of the turbines and OHTL. Potentially extensive under good visibility conditions and dependent on topography (due to height of the WTGs & OHTL, and due to the length of the OHTL).	Human receptors in the zone of influence (Herders, Local road users and receptors along the OHTL right of way)
Turbine operation during specific daytime periods (i.e. low sun) under certain meteorological conditions	Shadow flicker	Queensland Wind Farm Planning Guidelines (Australia), provide screening guidelines for modelling assessment, which only consider sensitive receptors within a distance equivalent to 265 maximum blade chords (the thickest part of the blade).	Human receptors in the zone of influence. At this stage it is considered likely that there are no receptors to shadow flicker impact.

5.5.4 Proposed ToR for the ESIA

BASELINE STUDIES

Landscape Character and Visual Amenity

A landscape character and visual amenity baseline survey will be undertaken to determine the landscape character within the study area. In addition, the ZTV will be updated with latest topographical data and turbine locations and subsequently, visual receptors (such as the cultural heritage sites) will be confirmed and panoramic photos will be taken at selected viewpoints surrounding the project site. The methodology will be based on the UK guidance for Landscape and Visual Impact Assessments.

Shadow Flicker

The baseline survey will be specific to those receptors screened as being required for shadow flicker modelling (if any). The baseline would inventorise local receptors in the potential area of impacts for flicker and characterise their type (i.e., commercial vs. residential etc.) and the alignment of any windows.

CONSTRUCTION & OPERATIONAL PHASE IMPACTS

Landscape and Visual Impacts

The ESIA will apply a measure of value/sensitivity to identified landscape character and visual receptors and determine the likely associated magnitude of impacts in order to quantify significance of impacts. The ESIA will also identify opportunities for mitigation to reduce the magnitude of any identified impacts.

OPERATIONAL PHASE IMPACTS

Shadow Flicker

As outlined above, there are no identified receptors within the screened range for shadow flicker impacts.

In the event that further surveys identify sensitive receptors within the screening area, the effects of shadow flicker will be assessed by predictive modelling software such as SHADOW (as part of Wind Pro software). The model will calculate how often and in which intervals a specific receptor will be affected by shadows generated by one or more wind turbines. These calculations are worst case scenarios (i.e., based on astronomical maximum shadow - calculations which are solely based on the positions of the sun relative to the wind turbine). Shadow-flicker effects on receptors will be expressed in terms of predicted frequency (hours per year). Shadow isolines on a 'shadow map' (i.e., contours indicating total number of hours of shadowing per average year) will be prepared. Based on the outcomes of the study, the results may be required to feedback into the project design in order to reduce potential impacts and highlight any necessary mitigation/management measures.

5.6 Solid Waste and Wastewater Management

Please note: this section considers the management of solid waste and wastewater and not its impacts to environmental receptors. Considerations of such impacts are made in the respective sections for Water Environment and Soil, Geology and Groundwater.

5.6.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

- The Law of the Republic of Uzbekistan “On Wastes” (2002)
- SanPiN № 0157-04 “Sanitary requirements to the storage and neutralization of solid domestic waste on special grounds in Uzbekistan”
- SanPiN No 0127-02 – “Sanitary rules for inventory making, classification, storing and rendering harmless of industrial wastes”
- SanPiN of the Republic of Uzbekistan dated 29/7/2002 No 0128-02 – “Hygienic classifier of toxic industrial wastes in the Republic of Uzbekistan
- SanPiN of the Republic of Uzbekistan dated 16/11/2011 No 0300-11 “Sanitary Rules and Standards for managing collection, inventory, classification, treatment, storage and disposal of industrial waste in the context of Uzbekistan
- Regulation “On the Procedure for the Disposal, Collection, Pay Settlement, Storage and Removal of Waste Industrial Oils” annexed to the Decree of the Cabinet of Ministers dated 04/09/2012 No.258

LENDER REQUIREMENTS

Solid Waste

EBRD

EBRD PR3 on Resource Efficiency and Pollution Prevention and Control establishes general requirements with regards to waste management as follows:

- The Project must strive to avoid the generation of hazardous and non-hazardous waste materials and reduce their harmfulness as far as practicable. Where waste generation cannot be avoided, the waste must be reused, recycled or recovered, or used it as a source of energy. Where waste cannot be recovered or reused, the waste must be treated and disposed of it in an environmentally sound manner;
- The Project must identify technically and financially feasible alternatives for the environmentally sound disposal of any hazardous waste considering the limitations applicable to trans boundary movement; and
- When waste disposal is transferred offsite and/or conducted by third parties, chain of custody documentation to the final destination must be obtained and only contractors that are reputable and legitimate enterprises licensed by the relevant regulatory agencies must be commissioned. The Project must ascertain whether

licensed disposal sites are being operated to acceptable standards. Where this is not the case, alternative disposal options must be considered, including the possibility of the Project developing its own recovery and disposal facilities at the project site.

EPFIs

Section 1.6 of “the IFC General EHS Guidelines” is entitled Waste Management and is applicable to all projects that generate, store or handle any quantity of waste; whilst Section 1.5 of the IFC EHS Guidelines covers Hazardous Materials Management. The waste management guidelines state that facilities that generate and store wastes should practice the following:

- Establish waste management priorities at the outset of activities;
- Identify EHS risks and impacts and consider waste generation and its consequences;
- Establish a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes;
- Avoid or minimize the generation of waste materials, as far as practicable;
- Identify where waste generation cannot be avoided but can be minimized or where opportunities exist for, recovering and reusing waste; and
- Where waste cannot be recovered or reused, identify means of treating, destroying, and disposing of it in an environmentally sound manner.

Wastewater

EBRD

EBRD PR3 on Resource Efficiency and Pollution Prevention and Control establishes general requirements for wastewater management as follows:

- The Project must seek to minimise water usage in order to minimise wastewater generation; and
- The Project must identify technically and financially feasible techniques for reusing and recycling effluents in accordance with GIP, which should be implemented as part of the project design.

EPFIs

The World Bank General EHS Guidelines (2007) establish general requirements for direct or indirect discharge of wastewater from utility operations or storm water to the environment.

‘Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or storm water should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment’.

However, wastewater effluent pollutant limits are only established for sanitary wastewater for discharge to the sanitary sewer systems. World Bank General EHS Guidelines (2007) (ref. Table 1.3.1 of IFC EHS Guidelines), provides indicative values for treated sanitary wastewater effluent.

5.6.2 Initial Observations and Baseline

Waste management in Uzbekistan is an issue as waste is being collected and disposed in dump sites in the absence of proper management practices and infrastructures including sorting facilities or landfills. In 2019, a Solid Waste Management Strategy for the period of 2019 – 2028 was put in force. According to the legislation ² “In the absence of sufficient waste management services only 40 - 50% of the municipal solid waste generated in rural settlements is being collected while these services are almost absent in the remote rural areas”. The objective of the strategy is to enhance the waste management services including transportation, storage, disposal and recycling.

Based on site visits observations and according to Juru Energy (2021), there is a lack of municipal waste management infrastructure within the Project site area and in Nukus Province and the wider Karakalpakstan, although projects to update the municipal infrastructure are understood to be in the pipeline.

5.6.3 Potential Impacts

Table 5-8 Potential Waste & Wastewater Impacts

ACTIVITY	ENVIRONMENTAL ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Project construction activities	Solid waste generation (hazardous and non-hazardous)	Overloading of regional waste management infrastructure, potential for pollution incidents if waste is not appropriately managed.	Waste facilities and environmental receptors
	Construction Wastewater		
Operational Phase			
Project operation activities	Small amounts of solid waste generation (hazardous and non-hazardous) from the operation of the administration facilities and activities of the employees	Suitable contractors and facilities for the handling and treatment of such wastes	Waste facilities and environmental receptors
	Sanitary and domestic wastewater generated from on-site administration areas		
		Stormwater	Potential runoff into any areas containing hazardous materials and eroded soil

² Resolution Of the President Of The Republic Of Uzbekistan Of April 17, 2019 No. Pp-4291 - Approval Of Strategy According To The Treatment Of Municipal Solid Waste In The Republic Of Uzbekistan For 2019-2028

5.6.4 Proposed ToR for the ESIA

BASELINE STUDIES

Details of available local waste/wastewater treatment/disposal sites and service providers will be outlined. In addition, suitable sites for the disposal of hazardous wastes and materials will be identified.

CONSTRUCTION AND OPERATIONAL PHASES IMPACTS ASSESSMENT

The ESIA will inventorise the types of waste and wastewater that is expected to be generated by the Project's construction and operation. Where estimates of waste and wastewater volumes are available these will be provided and broken to specific streams (at least to outline non-hazardous and hazardous streams, or other streams requiring special handling).

Based upon the availability of waste and wastewater service providers and disposal/treatment sites, an assessment can be made as to the needs for the management of such waste and wastewater streams.

The ESIA will include good practice mitigation and management measures for such waste streams, which can then be implemented on-site via the CESMP, OESMP and wider ESMS management programmes.

5.7 Traffic and Transportation

5.7.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

The Ministry of Transportation is responsible for all transport related activities and their requirements should be fully complied with in terms of routing of HGVs and site vehicles, licensing, road diversions, heavy/wide loads etc. Some of the relevant national requirements for the Project include:

- Law "About traffic safety" of the Republic of Uzbekistan August 19, 1999 No. 818-I (as amended on 29-12-2015): The main objective of this law is to ensure protection of life and health of citizens and their protection.
- Regulations on road safety during transportation of large and heavy loads by road transport (Annex No.2 to the Decree of Cabinet of Ministers No. 342 of December 26, 2011): This law determines the requirements of ensuring and coordinating traffic safety during the transportation of large size and heavy loads on public roads on the territory of the Uzbekistan. It also details the basic requirements for the technical condition equipment and furnishing of vehicles used for the transport of large and heavy loads as well as safety.

- Criteria and Procedure for Determining International Road Transportation of Loads (approved by the Decree of Ministry of Transport of the Republic of Uzbekistan and State Customs Committee of the Republic of Uzbekistan dated October 31, 2019, No. 6).
- Regulations on transport of loads by road in the Republic of Uzbekistan (Annex to Decree of Cabinet of Ministers No. 213 of 01.08.2014)

LENDER REQUIREMENTS

EBRD

The EBRD PR 4 on Health and Safety establishes management requirements with regards to traffic and road safety risks to workers and potentially affected communities. Relevant EU road and traffic safety management standards must therefore be taken into consideration.

“For Projects that operate moving equipment on public roads and other forms of infrastructure, the client will seek to prevent the occurrence of incidents and injuries to members of the public associated with operation of such equipment.”

EPFIs

The assessment will be undertaken with due consideration of the recommendations set out within the IFC/World Bank General EHS Guidelines (2007) Section 3.4 Traffic Safety, within Section 3: Community Health and Safety.

Separate considerations regarding Community Health and Safety are also provided in the IFC EHS Guideline for Wind Energy (2015). This includes relevant items for ‘Abnormal Load Transportation’.

5.7.2 Initial Observations and Baseline Conditions

The tarmacked highway (A380) that runs in a northwest/south-east direction west of the Project site is an international road that runs between the cities of Nukus and Bukhara. The roadway along the section that runs parallel to the site is in poor condition with numerous potholes and cut-outs. The road will require substantial rehabilitation and maintenance. The road is also frequently used by HGVs passing to and from the industrial facilities in the area. There is also a freight railway line that runs adjacent to sections of the A380 closest to the site. There are no airfields or airports within the region, however, there are two (2) helipads next to the vermiculite mining facilities, as shown in the following figure.



Figure 5-25 Helipads next to Mining Facility

5.7.3 Traffic and Logistics for Transportation of WTGs

A transportation routing survey for the WTGs and equipment is currently being undertaken. The outcome of this survey will be included in the ESIA.

5.7.4 Potential Impacts

Table 5-9 Potential Traffic & Transportation Impacts

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Movement of vehicles and machinery/equipment/staff	Transportation of equipment i.e., oversized wind turbines components (blades, turbine tower sections, transformers), cranes etc	Transportation of wide and heavy loads may present a challenge to other road users such as temporary lane closures or increased traffic.	Highway and local road users including local communities
	Increased vehicular flow (particularly HGVs)	Increase in number of vehicles transporting materials and workers may potentially increase the flow of traffic on local roads.	
		Increased potential for incidents and increased road safety risks to communities.	
Operational Phase			
Movement of operation phase vehicles	Increased vehicular flow	Transportation impacts are not expected to be significant but movement of maintenance materials, waste removal and staff may lead to minimal addition of vehicle flow on local roads.	Local road users and local communities

5.7.5 Proposed ToR for the ESIA

The ESIA will include the findings of the transportation/routing survey for the Project and the potential impacts upon the local transportation network and road users in particular.

As stated in the IFC EHS Guidelines for Wind Energy (2015), *'the logistics, traffic, and transportation study should assess impacts on existing offsite roadways, bridges, crossings over culverts, overpasses/underpasses, turning radii, and utilities, as well as whether surface replacements, upgrades, or resettlements will be required'*. Such requirements will be discussed with the client and their selected EPC Contractor to determine any specific mitigation requirements that will be provided as part of the Traffic Management Plan.

5.8 Cultural Heritage

5.8.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

The Ministry of Culture of the Republic of Uzbekistan is responsible for preserving, developing and promoting the cultural wealth and the national tourism attractions of the nations, nationalities and peoples of Uzbekistan.

Relevant legislation in Uzbekistan relating to archaeology and cultural heritage include:

- The Law of the Republic of Uzbekistan № 269-II dated August 2001 "On the protection and use of the sites and objects of cultural heritage."
- Resolution of the President of the Republic of Uzbekistan № RP-4068 dated December 19, 2018 "On measures for improving actions for protection of material cultural heritage objects."
- Resolution of the Cabinet of Ministers of the Republic of Uzbekistan № 846 dated October 4 2019 "On approval of the national list of real state sites and objects of material cultural heritage."

The above laws seek to protect and sites and objects of cultural heritage which are considered as part of the national heritage for all the people in Uzbekistan.

LENDER REQUIREMENTS

EBRD

EBRD Performance Requirement 8 recognises the importance of cultural heritage, both tangible and intangible for present and future generations. The aim is to protect cultural heritage and to guide clients in avoiding or mitigating adverse impacts on cultural heritage in the course of their business operations. The clients are expected to be precautionary in their approach to the management and sustainable use of cultural heritage.

EPFI's

In accordance with the Equator Principles, the assessment will refer to applicable IFC Performance Standards on Social and Environmental Sustainability, specifically with due consideration of Performance Standard 8 – Cultural Heritage. PS8 aims to protect the adverse impacts of project activities and support its preservation and to promote equitable sharing of benefits from the use of cultural heritage. Cultural heritage in this standard refers to:

- Tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values;
- Unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and
- Certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

5.8.2 Initial Observations and Baseline Conditions

There are two (2) cultural heritage sites within 45 km of the wind farm site boundary, their locations relative to the Project are shown in the following figure.



Figure 5-26 Cultural Heritage Sites

Chilpak Kala (C-1) located just over 40 km from the closest wind farm site boundary is a round roofless tower, 15 m high and 65 m in diameter, built at the top of the rounded natural hill. The Zoroastrian monument is more than 2200 years old and was a place to take the dead to allow their bodies to be scavenged by vultures. Recently, steps have been constructed up to the base of the monument to assist tourists visiting the site and two yurts are located at the bottom of the hill for ceremonies and other activities. In days of good visibility, the monument offers excellent panoramic view of the surroundings, including views to the Karatau hills, behind which the Project is situated. As stated in the Landscape and Visual Amenity Chapter, the Project is not visible from this location.



Figure 5-27 Chilpak Kala

The Sultan Uwais Baba Complex (C-2) is a collection of buildings and graveyards about 10 km away from the Project site. The shrine to Sultan Uwais Baba is one of the most sacred places in Karakalpakstan and is a popular place of pilgrimage amongst the people of Karakalpakstan and Khorezm. As stated in the Landscape and Visual Amenity section of this scoping report, the Project is not visible from this location.



Figure 5-28 The Sultan Uwais Baba Complex

An abandoned cemetery (10 to 15 graves) was identified approximately 4 km west of the site known as the Besmazar Tomb (42°06'16.2"N 60°28'19.1"E) was identified by Juru Energy (2021).

Discussions with nearby residents could not confirm the site's origin but states the site is not regularly attended.

5.8.3 Potential Impacts

Potential impacts described below are consistent for both the Project site and OHTL.

Table 5-10 Potential Cultural Heritage Impacts

ACTIVITY	ENVIRONMENTAL ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Earthworks	Excavations of soil	Potential damage or destruction of any unknown buried artefacts in footprint of all works	Unknown buried artefacts
Operational Phase			
Impacts to cultural heritage are not envisaged during the operational phase unless a cultural receptor is identified within proximity to the Project.			

5.8.4 Proposed ToR for the ESIA

BASELINE STUDIES

A combination of desk study review and site visit observations will be conducted to determine the presence / absence of any archaeological or tangible or intangible cultural heritage in the project's area of influence including the access road and OHTL.

Consultation will be conducted with relevant governmental bodies and institutes (i.e., the Ministry of Culture of the Republic of Uzbekistan and institute of Archaeological Research under the Science Academy of the Republic of Uzbekistan) in order to gain official confirmation regarding the absence/presence of archaeological and cultural heritage at the site and surrounding areas.

The socio-economic surveys will also help establish if the land has any specific physical cultural resources or other intangible cultural value.

CONSTRUCTION PHASE IMPACT ASSESSMENT

Unless specific cultural features of importance are identified in/or near to the footprint of works (including temporary facilities), there is not expected to be the need for a detailed assessment of impacts to cultural heritage in the ESIA.

The ESIA will rather establish the need for a 'Chance Finds Procedure' to be developed, so that any potential interactions with unknown buried archaeology can be managed in accordance with a defined process and the applicable regulatory stakeholders.

OPERATION PHASE IMPACT ASSESSMENT

An operation phase impact assessment for cultural heritage is not proposed due to the fact that there will not be the requirement for any additional land excavation or land take as a result of the operation phase. If a nearby feature of cultural importance is identified during the baseline surveys, and it is considered possible that the operation of the Project could detract from its value, then an operation phase impact assessment would be conducted.

5.9 Socioeconomics

5.9.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

The following laws are applicable concerning land rights, acquisition and resettlement:

- Civil Code of the Republic of Uzbekistan "Civil code"
- Land Code (1998 as amended 2010)
- Law of the Republic of Uzbekistan on State Land Cadastre No.666-I of 28.08.1998
- Presidential Decree "On Measures for The Efficient Use of Land and Water Resources in Agriculture"
- Resolution № 146 of the Cabinet of Ministers "On the Procedure for Compensation for Losses of Land Owners, Users, Tenants and Owners, As Well As Losses of Agricultural and Forestry Production".

LENDER REQUIREMENTS

EBRD

Performance Requirement 1 outlines the need for assessing social impacts as part of ESIA. This is interpreted to include socio-economic effects to individuals/groups/populations that may be impacted by a project.

Performance Requirement 5 on land acquisition, involuntary resettlement and economic displacement refers to Involuntary resettlement as both physical displacement (relocation or loss of shelter) and economic displacement (loss of assets or resources, and/or loss of access to assets or resources that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition and/or restrictions on land use.

Where resettlement is government led, PR5 requires, *'the client (to) collaborate with the responsible government agency, to the extent permitted by the agency, to achieve outcomes that are consistent with the objectives of this PR.'*

Performance Requirement 7 recognises that *'indigenous peoples are social groups with identities and livelihoods that are distinct from dominant groups in national societies. They may be among the most marginalised and vulnerable segments of the population.'* The PR requires the Project to determine the applicability of this PR as early on in the process as possible.

EPFI's

Several of the IFC Performance Standards have elements that relate to socio-economics. Key requirements for the assessment of socio-economic impacts are outlined in PS1, whilst PS5 on Land Acquisition and Involuntary Resettlement has important requirements relating to projects that acquire land or will necessitate physical or economic displacement to PAPs, including compensatory measures.

5.9.2 Initial Observations and Baseline Conditions

POLITICAL AND ADMINISTRATIVE STRUCTURE

The Republic of Karakalpakstan is a sovereign democratic republic, being a structural part of the Republic of Uzbekistan. Karakalpakstan's administrative centre is Nukus City, with the republic itself consisting of 15 districts. The Project is located in the Karauzyak district.

The constitution and the laws of Karakalpakstan were drafted in line with the constitution and the laws of Uzbekistan. The republic has its own flag, emblem and anthem. The Jokargy Kenes (Parliament) of Karakalpakstan, represented by the Chairman of Jokargy Kenes, offers overall guidance for the republic. The highest executive body of Karakalpakstan is the Council of Ministers approved by the Jokargy Kenes. The chairman of the Council of Ministers of Karakalpakstan is also a member of the Cabinet of Ministers of Uzbekistan.

POPULATION AND DEMOGRAPHICS

As of January 1st, 2018, Karakalpakstan's permanent population amounted to a total of 1,842,400 persons with a near 50% split of urban to rural (UNDP, 2018). Nukus is the largest city with 307,400 inhabitants.

The Karauzyak district has a population of 52,000, with the rural population 70.2% (36,500) and the urban population 29.8% (15,500). The population by year is shown in the following figure.

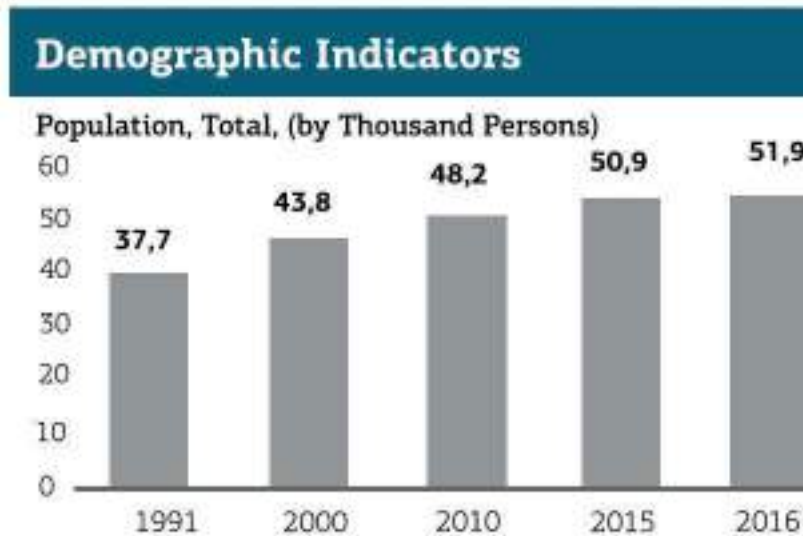


Figure 5-29 Karauzyak Population by Year (UNDP, 2018)

The project site is located more than 15 km from the nearest permanent residential receptors and communities. One of the nearest towns is Karatau, which has a population of 3,200 (2,020 women and 1,180 men).

ECONOMY AND EMPLOYMENT

Karakalpakstan Gross Domestic Product (GDP) share accounted for 3.3% of Uzbekistan's GDP. Karakalpakstan Gross Regional Product (GRP) for 2017 was 8,285.2 billion UZS in current prices, 5.7% higher than 2016 indicators. By the end of 2017, the GRP per capita was 4,527.7 thousand UZS, representing a 4.2% growth. The increase is due to the growth in the main sectors of the region's economy, namely:

- Agriculture, forestry and fisheries;
- Industry;
- Construction; and
- Services.

According to Juru Energy (2021) the main branches of industry in the area of influence include light industry, electricity generating industry, food industry, fuel industry, chemical and oil-chemical industry, flour milling industry and industry of construction materials. Information collected during the ESA site visit for the village of Bestam (a typical village along the Amu Darya River) indicates that the main agricultural activities are livestock rearing and agricultural farming. The main crops are tomato, carrot, onions, green pepper, pumpkin, and commercial trees, including apple, grapes, and pomegranate. Local markets are the primary way of selling crops in the area.

During the December 2021 site visit a number of vermiculite mines were identified to the west of the Project. In addition to this, two cement factories and a facility for oil storage are located south / southwest of the Project on the A380.



Figure 5-30 Oil Storage Facility

Third National Communication of the Republic of Uzbekistan under the UN Framework Convention on Climate Change (2016) states that the total potential of wind energy in Uzbekistan is estimated in the volume of 2.22 million t.o.e./year and that the highest values of total and technical potential are found within Karakalpakstan. As per the tender documentation it is understood that the region has been highlighted as an area with high wind energy potential and there will likely be future wind projects developed. In addition to this, areas surrounding the Project have been highlighted as mining concession areas.

LAND USE AND RESETTLEMENT

In Uzbekistan land is owned by the State and therefore no land acquisition is planned. Approximately 1,678 hectares of land for the Project will be allocated to the Project by the Government through a Land Lease Agreement.

Land use in the area around the WTG locations includes local shepherds who use the land for livestock grazing. Informal discussions with local herders during the ESA site visit by Juru Energy indicated that anywhere up to five (5) herders may use the general area for their livestock grazing on an ongoing basis and that the distance between the grazing pastures and the home properties of the shepherds is approximately 50 km. During the Scoping site visit in December 2021, only one (1) herder with three (3) shelters was identified within the site and surrounding area. The herder confirmed that the number of shepherds increases during the spring season but, following spring, the pastures get dry and are not suitable for grazing. The herder also stated that he had official permission to use the land provided by the local district, although this has not been verified. The following images depict location of the shelters (S-1, S-2, S-3) relative to the Project and then images of the herder's shelters and livestock.

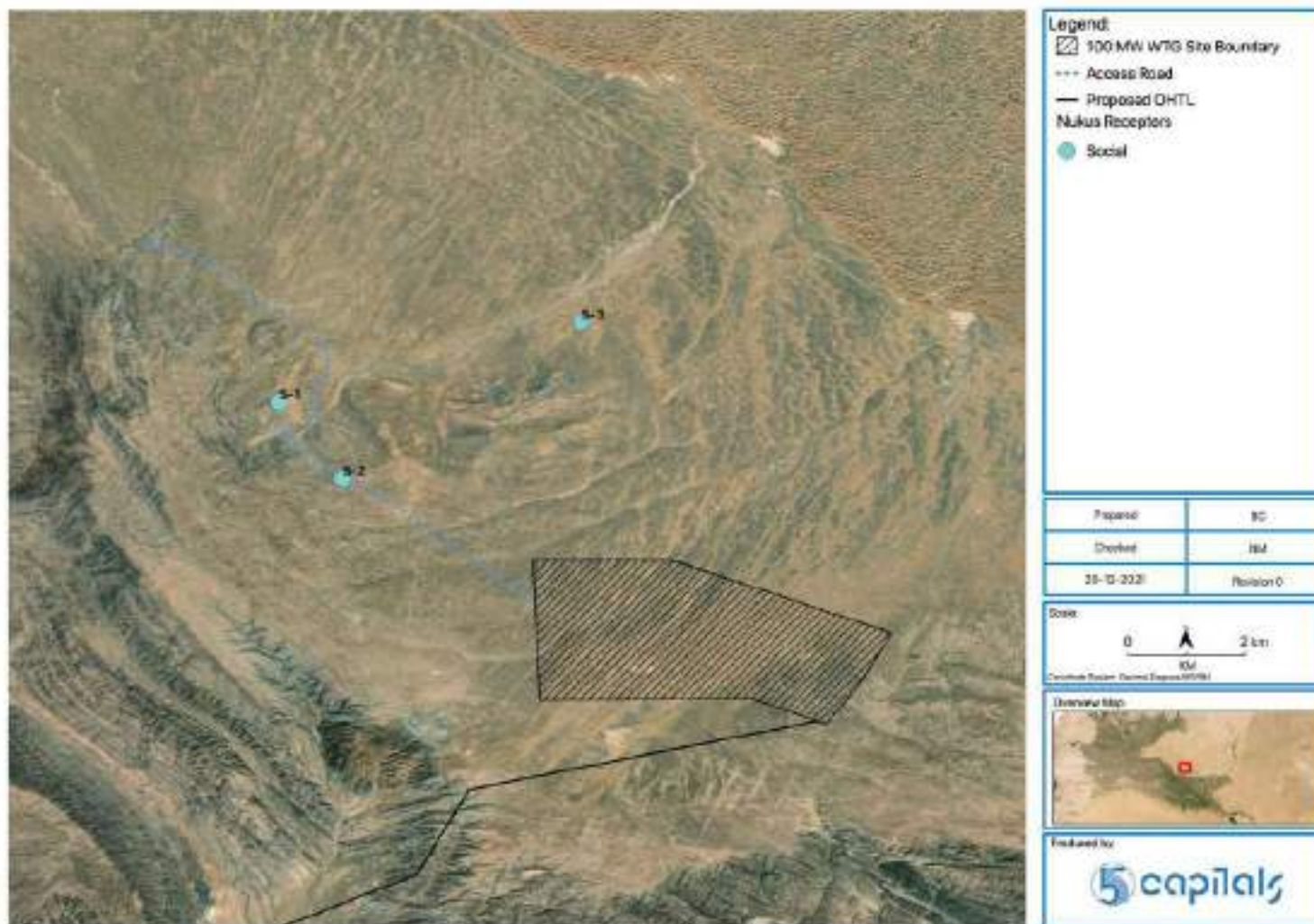


Figure 5-31 Location of Herder Shelters



Figure 5-32 Herding Activity at Site

PUBLIC SERVICES & UTILITIES

Juru Energy (2021) state that public services are limited in the project area.

Preliminary discussions during the ESA site visit indicate that in Karatau, there is one public school, a hospital and a kindergarten. Women are involved in housekeeping, agriculture, livestock activities, with men generally employed in the aggregate mining sector. During the field visit, local mahallya leaders indicated that the population has mid-level educational qualifications. The next nearest health facilities, local business and emergency response facilities are located in Nukus more than 80 km from the Project site. T

The village of Bestam (representative of villages in the area) has approximately 50 persons with one primary school (where children study up to grade 4). The nearest secondary school is about 7 km away in a neighbouring village.

Local medical facilities consist of one family and a rural clinic. Drinking water is typically supplied by hand pumps as the village is not connected to the mains supply system. The nearest religious building is approximately 8 km from the site.

There is no existing accommodation near the site suitable for housing construction workers, however, some hotels of adequate quality are found in Nukus city.

INDIGENOUS PEOPLES

The predominant ethnic group in the project area is understood to be the Karakalpaks, and the herder family spoken to during the December site visit is Karakalpak. National laws, specifically the Constitution of the Republic of Uzbekistan, does not officially recognise any IPs. Considering the applicability of PR7 to European ethnic groups, EBRD guidance states that “in practice, the PR [PR7] is deemed relevant only in Russia as it has been assessed that no group in other EBRD countries of operations (COO) is known to meet the five criteria set out in paragraph 10 of PR7”.

Uzbekistan is defined as a COO by EBRD; however, as a former soviet republic, Juru Energy (2021) have conducted a screening to understand better whether the Karakalpak exhibits traits that trigger any of the five EBRD criteria. The findings indicate that the Karakalpaks may be considered a distinct group with a distinct language but do not meet the other screening criteria such as collective attachment to geographically distinct habitats or customary cultural practices that are separate from those of the dominant society or culture. Therefore, PR7 has not been triggered, however, ensuring the Karakalpakstan language is used in project communication will be vital to maximising local employment opportunities and providing an effective communication strategy.

5.9.3 Potential Impacts

Table 5-11 Potential Socio-Economic Impacts

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Project construction	Project employment	Provision of temporary jobs during construction	Local populations
	Skills training to local communities and the Project workforce	Increase in skills sets of population	
	Use of local goods and services	Positive indirect benefits and uplift to local economy from increased local spending	Local businesses and populations
	Land use change	Local herders may not be able to use the site during the construction phase.	Herders
	Disruption of local customs	Influx of workers could potentially introduce new habits or practices that are not consistent with local beliefs	Local populations
Worker Influx	Increase of demand and purchasing locally may inflate process of basic commodities	Increased cost of living for local populations and benefits to local home owners	Local populations

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Operational Phase			
Plant operations	Project employment	Provision of employment	Local populations
	Skills training to local communities and the Project workforce	Increase in skills sets of population	

5.9.4 Proposed ToR for the ESIA

LAND USE

As specified in the 'Land Use and Site Condition' section the LLA between NEGU and the Project company has been drafted, it is expected that LLA would have been signed during the ESIA stage, and evidence of this will be provided.

SOCIO-ECONOMIC STATUS SURVEYS

A key task of the ESIA baseline surveys is to gather data to:

- Confirm use of land, including past uses (land registry, conditions of land agreements, land valuation, compensation procedures, resettlement issues and etc.).
- Identity socio-economic characteristics of the population in the project area – size, gender and age structure, ethnic composition (including minorities and their vulnerability assessment);
- Characterise the living standards of the population in the project area - size and structure of income, property/other assets and their use, poverty level, living conditions (housing type and amenity);
- Assess access to social (health care, education, social programs) and public (water pipe, sanitary facilities, heat, electricity and gas supply) services;
- Identify the availability of social and cultural facilities (roads, transport, retail outlets);
- Assess existing knowledge about the Project within the communities and land users.

A stakeholder matrix will be prepared and the matrix will determine suggested methods of communication, it is anticipated that the key stakeholders during the assessment will be:

- Seasonal shepherds who utilise the project surroundings and the wider mountain area for livestock grazing;
- Local industries including mining companies and cement factories; and
- Residents of nearby villages including Karatau.

A grievance redress mechanism will also be established as part of the stakeholder engagement process specifically for the Project.

LIVELIHOOD RESTORATION PLAN

Following consultations with stakeholders, the requirement for a Livelihood Restoration Plan (LRP) will be determined. An LRP will be required if involuntary resettlement (referring to both physical and economic displacement) occurs as a result of Project related land acquisition and/or restrictions on land use. The plan would include information relating to asset valuation and procedures for compensation payment under the existing legislation.

CONSTRUCTION PHASE IMPACTS ASSESSMENT

Worker Influx

The ESIA will aim to establish the likely extent of worker influx as a result of the Project, and how these workers will be housed and catered for to assess impacts upon local populations, particularly in terms of commodity prices.

Project Construction Positive Impacts

The outcomes of the survey of socio-economic condition are expected to highlight and target methods that can be implemented to enhance such benefits of local employment, training provisions and use of local business and services. Where applicable the ESIA will outline provisions that can be implemented during construction.

5.10 Community Health, Safety & Security

5.10.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

- Resolution of Cabinet of Ministers of Republic of Uzbekistan No.95 “On approval of general technical regulations of environmental safety” (2020).
 - Requires the implementation of environmental safety measures for the protection of flora and fauna. This includes the prevention of death of wildlife species due to magnetic fields of power transmission lines and sanitary protection zones.
 - Requires transformer substations in power transmission lines, their grids to have equipment (barriers, fences etc..) to prevent animals from entering the territory of the substation.
- Decree of the Cabinet of Ministers of the Republic of Uzbekistan No.1050 “On approval of Rules for Protection of Power Grid Facilities, 2018”.
 - This determines the procedure for establishing protected zones for power grid facilities, as well as special conditions for using land located within the protected zones and ensure the functioning and operation of the said facilities.

- Construction of power grid facilities with 110, 220 or 500kV in protected areas of state nature reserves, protected areas of nature parks and state biosphere reserves etc shall be allowed with the permission of the Cabinet of Ministers of the Republic of Uzbekistan.
- Protected zones of power grid facilities shall be established on both sides of the power transmission line from the outermost wires and along the perimeter of substations at the following distances for voltages:
 - o 110kV: 20 m;
 - o 220kV: 25 m; and
 - o 500kV: 30 m.
- San Rules & Norms No. 0236-07 "Sanitary norms and rules to ensure safety for people living near high voltage power transmission lines, 2007".
 - This regulation sets the requirements for ensuring public safety when overhead power lines pass over populated, unpopulated or inaccessible territories.
 - It requires sanitary norms and rules to be followed in the design, construction and operation of overhead power lines.
 - The distances corresponding to the projection onto the ground of the outer phase wires in a direction perpendicular to the overhead line as follows:
 - o Up to 110kV/m: 10 m;
 - o Up to 220kV/m: 15 m;
 - o Up to 330kV/m: 20 m;
 - o Up to 500kV/m: 30 m; and
 - o Up to 570kV/m: 40 m.

LENDERS REQUIREMENT

EBRD

Performance Requirement 4 establishes the importance of avoiding or mitigating adverse health and safety impacts and issues associated with project activities on workers, project affected communities and consumers. The objectives of EBRD PR4 are:

- To protect and promote the safety & health of workers by ensuring safe and healthy working conditions and implementing a health and safety management system, appropriate to the relevant issues and risks associated with the Project.
- To anticipate, assess and prevent or minimise adverse impacts on the health and safety of project affected communities and consumers during the project lifecycle from both routine and non-routine circumstances.
- EPFIs

IFC Performance Standard 4 establishes requirements to safeguard local communities from potential risks associated with the Project including impacts associated with introduction of

communicable disease, site access and operation, material use etc. The key objectives of PS4 are:

- To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances.
- To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.

5.10.2 Initial Observation and Baseline Conditions

The project site is located more than 15 km from the nearest permanent residential receptors and communities.

Informal discussions with local herders during the ESA site visit indicated that anywhere up to five (5) herders may use the general area for their livestock grazing on an ongoing basis and that, during the spring season, the number of shepherds may increase up to 15 to 20.

During the December 2021 Scoping site visit, only one herder was identified in the area surrounding the wind farm, at a distance of over 3 km from the boundary.

5.10.3 Potential Impacts

This chapter will outline and assess the impacts relating to the safety and security of the public who access the surrounding areas and may be subject to project related impacts. Secondary impacts relating to public health in terms of air quality, noise, waste etc., will be addressed in specific chapters elsewhere in this report.

Table 5-12 Potential Community, Health, Safety and Security Impacts

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Influx of workers	Community disgruntlement and conflict with staff and security (potentially including expatriate workers)	Conflict, disease spread, initially on a local basis (potentially wider)	Local populations (where this coincides with Project workers) and those herders that use the site.
	Community health risks		
	Gender Based Violence and Harassment/Sexual Exploitation & Abuse/Sexual Harassment	Risk posed to local women, young boys and girls by migrant workers from other parts of Uzbekistan and overseas.	
Construction Works	Exposure of community to construction and commissioning hazards	In areas of the WTGs and substation or at associated facilities that may not be fully	

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
	(including equipment, electrical hazards, hazardous materials, chemicals and fuels, hazardous wastes etc.)	secure, or where there are poor security management practices.	
	Emergency situations (e.g. fire, explosion etc.)	Project footprint and external to the Project areas (depending on type and magnitude of emergency)	Nearby residences and ecological receptors
Movement of construction vehicles	Increased vehicles on local road (particularly HGVs)	Increased potential for incidents and increased road safety risks to communities.	Local communities and other road users
Operational Phase			
Public Access	Safety issues may arise with public access to wind turbines (e.g., unauthorized climbing of the turbine)	WTG's	Public
Blade/ Ice Throw	Failure of the rotor blade can result in the "throwing of a rotor blade or part and during certain cold weather conditions accretion of ice on the blades and risk of pieces of ice thrown from rotor during operation or dropped if turbine is idle (IFC EHS Guideline on Wind Energy, 2015)	The IFC EHS Guideline on Wind Energy, 2015 outlines minimum set back distances should be 1.5 times the height of the turbine (tower + rotor radius).	Nearby land users (e.g. herders and farmers) and ecological receptors
Plant Operations	Emergency situations (e.g. structural damage and possible collapse, spills of any back up fuels (from operational buildings), unwarranted releases of wastewater etc.)	Project footprint (WTGs, access roads and substations) and external to the Project areas (depending on type and magnitude of emergency)	Nearby land users (e.g. herders and farmers) and ecological receptors

5.10.4 Proposed ToR for the ESIA

Reasonably foreseeable risks to community health, safety and security will be delineated in the ESIA and where appropriate, provisions for the management of such circumstances will be outlined, with applicable mitigation and management measures.

The ESIA will highlight the need for preparedness and response mechanisms for reasonably foreseeable emergency situation to be addressed in specific construction and operational phase management plans.

5.11 Human Rights, Labour & Working Conditions

5.11.1 Applicable Requirements & Standards

NATIONAL REGULATIONS

Labour and Working Conditions

- Ordinance No. 30-31 of the Ministry of Labour and Social Security and the Ministry of Health of the Republic of Uzbekistan approving the list of hazardous jobs mentioned in Article 355, for which the employment of persons under the age of eighteen years is prohibited
- Joint Decree of the Ministry of Labour and Social Protection of the Population (No. 7) and the Ministry of Healthcare (No. 1) of Uzbekistan dated 30 May 2001 to approve the list of occupations with unfavourable working conditions to which it is forbidden to employ persons under 18 years of age.
- Decree No. 133 of 11 March 1997 to approve normative acts necessary for the realization of the Labour Code of the Republic of Uzbekistan
- Decree of the Cabinet of the Ministers No. 1011 of 22 December 2017 "On Perfection of the Methodology of Definition of Number of People in Need of Job Placement, including the Methodology for Observing Households with Regard to Employment Issues, also for the Development of Balance of Labour Resources, Employment and Job Placement of Population".
- Decree of the Cabinet of the Ministers No. 965 of 5 December 2017 "On the Measures of Further Perfection of the Procedure of Establishment and Reservation of Minimum Number of Job Places for the Job Placement of Persons who are in need of Social Protection and Face Difficulties in Searching Employment and Incapable of Competing in Labour Market with Equal Conditions".
- Decree No. 964 of 5 December 2017 "On the Measures for Perfection of the Activity of Self-Government Bodies Aimed at Ensuring Employment, Firstly for the Youth and Women".

Human Rights

- As a member of the United Nations, Uzbekistan supports and implements all the main international instruments of the United Nations relating to the protection of human rights and freedoms, including UN Universal Declaration of Human Rights, Human Rights Council Resolution No. 30/15 on human rights and preventing and countering violent extremism, Convention on the Elimination of all Forms of Discrimination against Women among others.
- Uzbekistan's State Policy on human rights is aimed at preventing violations or any restriction on human rights and freedoms and at establishing the necessary organizational, legal, social, economic, spiritual and moral foundations for the protection of human rights.

LENDERS REQUIREMENT

EBRD

PR2 is applicable to Labour and Working Conditions and has the following key objectives:

- Respect and protect the fundamental principles and rights of workers;
- Promote the decent work agenda, including fair treatment, non-discrimination and equal opportunities of workers;
- Establish, maintain and improve a sound worker-management relationship;
- Promote compliance with any collective agreements to which the client is a party, national labour and employment laws;
- Protect and promote the safety and health of workers, especially by promoting safe and healthy working conditions; and
- Prevent the use of forced labour and child labour (as defined by the ILO) as it relates to project activities.

Concerning dedicated accommodation, compliance is required with:

- IFC & EBRD Workers Accommodation: Processes and Standards (2009).

In regard to human rights:

- According to EBRD's Environmental and Social Policy, EBRD is committed to the respect of human rights in the Project they finance. EBRD is also guided by the International Bill of Human Rights and the eight core conventions of the International Labour Organization.

EPFIs

The following applicable IFC Performance Standards aim to identify and ensure that social and economic impacts of a project are addressed in the relevant areas, in particular:

- Performance Standard 2: Labour and Working Conditions;

In accordance with IFC Performance Standard 2 (Labor and Working Conditions) there is a requirement to align with the following conventions:

- ILO Convention 29 on Forced Labor;
- ILO Convention 87 on Freedom of Association and Protection of the Right to Organize;
- ILO Convention 98 on the Right to Organize and Collective Bargaining;
- ILO Convention 100 on Equal Remuneration;
- ILO Convention 105 on the Abolition of Forced Labor;
- ILO Convention 138 on Minimum Age (of Employment);

- ILO Convention 182 on the Worst Forms of Child Labor;
- ILO Convention 111 on Discrimination (Employment and Occupation);
- UN Convention on the Rights of the Child, Article 32.1; and
- UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families.

In regard to human rights:

- In line with EP IV requirements, the United Nations Human Rights Guiding Principles apply to the Project. HRGP II on "The corporate responsibility to respect human rights" recognises that it is the responsibility of businesses and corporations to respect human rights. It is a global standard of expected conduct for all business enterprises wherever they operate. It exists independently of a States' ability and/or willingness to fulfil their human rights obligations and does not diminish those obligations.

5.11.2 Initial Observation and Baseline Conditions

Uzbekistan operates on the basis of its national policies, the constitution and applicable regulations concerning both human rights and labour & working conditions on the basis. Uzbekistan is a signatory of the International Labour Organisation (ILO).

Human Rights Watch an international NGO states that, 'Since Uzbekistan's President Shavkat Mirziyoyev assumed the presidency in 2016, the government has taken some concrete steps to improve the country's human rights record.'

5.11.3 Potential Impacts

Table 5-13 Potential Labour & Working Conditions Impacts

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Employment of staff	Contracting	Discrimination and exploitation. Risk of poorly formed contracts (or no contracts), risks of non-compliance with labour law and lender requirements, employment of labour that is forced or child labour.	Project workforce (PC, EPC Contractor and Sub-Contractors)
Day-to-day and specific construction & commissioning activities	Risks to worker occupational health and safety	Injury or death to workers where key risks are not suitably managed.	Project workforce
	Working Conditions	Poor conditions provided to workers with lack of welfare	Project workforce

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
		facilities, first aid, or other typical working amenities.	
	Gender Based Violence and Harassment/Sexual Exploitation & Abuse/Sexual Harassment	Within the workforce and potentially applicable to both women and men.	Project workforce
Worker Accommodation	Camps	Poor quality housing without access to all (or some/inadequate) required amenities and/or other non-compliance with the EBRD and IFC Worker Accommodation Guidelines.	Applicable to Project workforce requiring dedicated accommodation
Operational Phase			
Employment of staff	Contracting	Discrimination and exploitation. Risk of poorly formed contracts (or no contracts), risks of non-compliance with labour law and lender requirements, employment of labour that is forced or child labour.	Project workforce (PC, O&M Company and Sub-Contractors)
Day-to-day and specific operational and maintenance activities	Risks to worker occupational health and safety	Injury or death to workers where key risks are not suitably managed.	Project workforce
	Working Conditions	Poor conditions provided to workers with lack of welfare facilities, first aid, or other typical working amenities.	Project workforce

5.11.4 Proposed ToR for the ESIA

The ESIA will highlight applicable requirements and risks that the Project may encounter related to labour and working conditions, similar to those outlined above. This will also include necessary compliance requirements to meet lender guidelines.

It will aim to identify appropriate mitigation and management measures to ensure that such risks are minimised and/or appropriately managed throughout the entire project workforce and any key supply chains.

5.12 Climate Affairs

5.12.1 Applicable Requirements & Standards

NATIONAL REQUIREMENTS

Uzbekistan submitted its Third National Communication to the UNFCCC and it ratified the Paris Agreement in November 2018 which brought its Intended Nationally Determined Contribution (INDC) into effect for the period up to 2030. The long-term objective of the INDC is to decrease specific emissions of greenhouse gases per unit of GDP by 10% by 2030 from level of 2010. This envisages the support from the international organisations and financial, ensuring access to advanced energy saving and environmentally sound technologies and resource allocation for climate financing.

The ratification of the Paris Climate Agreement committed Uzbekistan to transitioning to a green economy, and adoption of the following normative documents:

- Decree of the President of the Republic of Uzbekistan. № PD-4477, dated October 4, 2019 "On approval of the Strategy on transition of the Republic of Uzbekistan to the "green" economy for the period 2019-2030".,
- Decree of the President of the Republic of Uzbekistan, № PD-5863, dated October 30, 2019, "On approval of the Concept of environmental protection of the Republic of Uzbekistan until 2030".

Priority areas of "The Strategy on transition of the Republic of Uzbekistan to the "green" economy for the period 2019-2030" regarding to the electricity producing industry are:

- Reconstruction and modernization of generating capacities of existing power plants with implementation of highly efficient technologies based on combined cycle gas and gas turbine units;
- Improvement of configurations and modernization of main power networks to increase the stability of the power system;
- Implementation of organizational and technical measures, including optimization of modes;
- Increasing the level of automatization of technological processes; and
- Full equipment of power consumption systems with automatic control and metering devices.

LENDER REQUIREMENTS

EBRD

According to EBRD Environmental and Social Policy, climate change shall be considered throughout the assessment process and identify appropriate climate resilience and adaptation measures to be integrated into the project design.

EBRD is committed to 'engage, whenever appropriate, in innovative investments and technical assistance to support no/low-carbon investments and climate change mitigation and adaptation opportunities, as well as identify opportunities to avoid, minimise or reduce greenhouse gas emissions in projects. EBRD requires its clients to assess risks caused by climate change to the projects. EBRD will also support its clients in developing climate adaptation measures and climate resilient investments as well as in managing risks caused by climate change'.

EPFIs

Equator Principles IV establishes that impacts to climate should be avoided where possible, and in support of the 2015 Paris Agreement recognises that EPFIs have a role to play in improving the availability of climate-related information.

Factors including climate change are required to be incorporated into the Project Review and Categorisation (EP1), while a key element of EP IV (under EP2 for Environmental and Social Assessment) is that an assessment of climate change risks is expected in an ESIA.

For projects that have Scope 1 & 2 GHG emissions of over 100,000 tonnes of CO₂ equivalent per annum, there are also other requirements linked to alternative analysis and client annual reporting on GHG emissions.

5.12.2 National Context

Uzbekistan is among the countries most vulnerable to climate change and has identified agriculture, economy, population health, energy, water resource management and disaster risk reduction as its most vulnerable sectors (WBG, 2021). Average annual air temperatures have risen steadily and significantly in Uzbekistan over the past century, albeit with no variation from year to year. From 1950 to 2013, temperatures rose at an average rate of 0.27°C per decade. Analysis in the total annual precipitation amount averaged by various regions of Uzbekistan for the period 1950-2013 show very low trends towards decreases.

Climate observations in Uzbekistan show that the number of days of high air temperature ($>40^{\circ}\text{C}$) has increased from the 1950's to 2000s. The number of days with low temperature (below either -15°C or -20°C) has decreased.

According to Third National Communication of the Republic of Uzbekistan under the UN Framework Convention on Climate Change (2016) the different regions of Uzbekistan face varying vulnerability to climate change. Karakalpakstan, where the Project is located, is classified as one of the three most vulnerable territories in Uzbekistan to climate change.

5.12.3 Climate Projections

Climate projection data is modelled data from the global climate model compilations of the Coupled Model Inter-comparison Projects (CMIPs), overseen by the World Climate Research Program. The following data is summarised from the World Bank Climate Change Knowledge Portal.

TEMPERATURE

- Climate change is expected to produce increases in monthly maximum temperatures across Uzbekistan. The model ensemble's estimate of warming under the highest emission pathway (RCP 8.5) is an average temperature increase of 2.4°C by mid-century and nearly 5°C by end of the century.
- The number of hot days in Uzbekistan is projected to increase by 28.6 days by 2040-2059 days, under an RCP 8.5 scenario.
- The number of tropical nights (minimum temperature above 20°C) is projected to increase by over 31 days by 2040-2059, under an RCP 8.5 scenario.

PRECIPITATION

- Uzbekistan will experience a high variability of rainfall across different agroecological and climatic zones.
- Across the country, however, there have been some spatial differences in precipitation trends, with annual precipitation declining between 50-100mm in some central and eastern districts and moderately increasing in areas surrounding the Aral Sea.
- Increased heat and precipitation variability will lead to increased evapotranspiration in summer months resulting in a decrease in river flowing conditions.
- Future projections suggest that increased glacier melting (glaciers in Central Asia have shrunk by 25% and are expected to shrink by another 25% over the next 20 years) is expected to impact water availability and river flow in the short to long term in Uzbekistan.

DROUGHTS

The risks of dry years and droughts is also anticipated to increase in Uzbekistan due to decreases in river runoff and increases in population growth. This will be especially prevalent in the downstream reaches of the rivers in the Amu-Darya River basin such as Karakalpakstan,

5.12.4 Key Vulnerabilities

According to the World Bank Climate Change Knowledge Portal (2021), impacts from climate change make Uzbekistan increasingly vulnerable to: droughts, high temperatures, heat waves, heavy precipitation, mudflows, floods, and avalanches.

The key vulnerabilities for Karakalpakstan and the Project are that:

- Summer months are expected to have high temperatures, prolonged heat waves, and expanded summer season. Heat waves, and increased frequency of the consecutive number of days above 39°C are expected to occur throughout the country. Climate warming is also expected to shift boundaries of spring frosts with potential for adverse impacts on the agricultural sector.
- Droughts may become more frequent due to river runoff decrease, particularly for areas with increased demand and consumption from economic development and population growth. This is especially relevant due to the Project's location to the Amu Darya.

5.12.5 Potential Impacts

Climate affairs impacts can be split into three distinct categories:

IMPACTS FROM THE PROJECT ON CLIMATE CHANGE

As a renewable energy Project, there will be a net-benefit impact with respect to climate change as a result of the Project, however, the development of the project, specifically the construction phase will still have impacts that can impact climate affairs. These are covered in the following table.

Table 5-14 Potential Climate Impacts Arising from the Project

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Construction Phase			
Construction activities, increase in traffic due to construction vehicles	Combustion of fossil fuels	GHG emissions	Global climate
Site preparation activities	Changing of topography and land cover	Change of water flows and potential increased risk of flooding	Downstream riverbeds / communities

ACTIVITY	ASPECT	IMPACTS AND ZONE OF INFLUENCE	POTENTIAL RECEPTORS
Operational Phase			
Use of maintenance vehicles	Combustion of fossil fuels	GHG emissions	Global climate

PHYSICAL IMPACTS FROM CLIMATE CHANGE ON THE PROJECT

The Project may also be at risk from the impacts arising from climate change such as increased temperatures and water droughts leading to risks to the construction workforce. Flash flooding due to increased rainfall intensity during the construction and operation phases may also lead to impacts as well as potential pollution incidents.

CLIMATE TRANSITION RISKS

There are no foreseeable climate transition risks due to the fact that the Project is a renewable energy project, which is a key part of wider global and national policies/agendas and 2030 Energy Strategy to reduce GHG emissions and improve Uzbekistan's energy mix from an environmental perspective.

5.12.6 Proposed ToR for the ESIA

CONSTRUCTION AND OPERATION PHASE ASSESSMENT

The ESIA will quantify GHG emissions from the use of construction plant and vehicles and the GHG emissions avoided by the operation of the Project. In addition, the ESIA will describe potential risks to the Project from climate change impacts in both the construction and operation phases and will propose appropriate mitigation and management measures to alleviate risks.

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B – SCEEP POSITIVE CONCLUSION



**O'ZBEKISTON RESPUBLIKASI EKOLOGIYA VA ATROF-MUHITNI
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ЗАКЛЮЧЕНИЕ

Государственной экологической экспертизы

По объекту: Оценка воздействия на окружающую среду строительства ветряной электростанции «ACWA Power Wind Karatau», мощностью 100 МВт в Караузякском районе Республики Каракалпакстан (проект ЗВОС).

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На государственную экологическую экспертизу представлены материалы первого этапа оценки воздействия на окружающую среду строительства ветряной электрической станции (ВЭС) «ACWA Power Wind Karatau», мощностью 100 МВт в Караузякском районе Республики Каракалпакстан.

Основанием для проектирования объекта является Постановление Президента Республики Узбекистан № ПП-169 от 18 марта 2022 года «О мерах по реализации проекта «Строительство и эксплуатация ветряной электростанции мощностью 100 МВт в Караузякском районе Республике Каракалпакстан на основе условий государственно-частного партнерства».

Реализация строительства и эксплуатация данной ветровой электростанции осуществляется компанией «ACWA Power» (Саудовская Аравия).

Настоящим проектом предусматривается строительство ВЭС мощностью 100 МВт с необходимыми зданиями и вспомогательными сооружениями и с созданием соответствующей инфраструктуры в Караузьякском районе Республики Каракалпакстан, а также строительство Высоковольтных Линий Электропередач (ВЛЭП) 220/220 кВ.

В рамках Проекта планируется строительство новой воздушной линии электропередач (ВЛ) 200 кВ (около 15,6 км), а также подъездной дороги длиной около 12 км.

Выделенный участок находится примерно в 83 км к юго-востоку от города Нукус. Ближайшие жилые постройки представлены временкой, расположенной в 5,5 км севернее объекта экспертизы. Железнодорожная станция «Караузяк» с несколькими жилыми строениями находится в 7,1 км западнее рассматриваемой территории. Недалеко от объекта строительства проходит автомагистраль А380, которая считается основным путем транспортировки компонентов в этот район.

Согласно постановлению Кабинета Министров РУз №541 от 07.09.2020 г., материалы оценки воздействия на окружающую среду для объектов II категории воздействия на ОС, представляемые на государственную экологическую экспертизу, должны содержать заключение общественного слушания о поддержке проекта, предложения и возражения общественности. Учитывая, что ВЭС мощностью 100 МВт относится к объектам II категории воздействия на окружающую среду, руководством строящейся ВЭС совместно с представителями Караузьякского районного хокимията, органов экологии и охраны окружающей среды, населением организовано и проведено общественное слушание, в ходе которого обсуждены с населением и общественностью вопросы реализации намечаемого проекта и воздействия его деятельности на окружающую среду.

На этапе строительства под ВЭС будет отведено 40 гектаров земли, расположенной в горном районе Каратау на высоте около 280 м над уровнем моря. При эксплуатации объекта площадь будет сокращена до 35 га. Данная площадь будет уменьшена на более поздней стадии после того, как будет готова окончательная планировка. Размер участка для проектируемой подстанции с воздушной изоляцией 33/220кВ считается 200м x200м.

Территория планируемой ВЭС представляет собой полусложный рельеф, состоящий из пологих гребней, берущих начало с более высокой вершины на краю холмов Каратау, расположенных на западе проектной территории.

Земельный покров в основном состоит из песчаного грунта и пустынной растительности, такой как полынь, что свидетельствует о более низкой высоте участка. Наблюдения, проведенные на территории проекта показывают, что на участке Проекта нет каких-либо постоянных поселений или реципиентов, хотя наблюдается некоторая сельскохозяйственная деятельность и периодически используемые пастушьи хивины.

Угловые координаты расположения площадки участка ВЭС:

- 1). $42^{\circ} 5'37.08''\text{C } 60^{\circ}31'10.92''\text{B};$
- 2). $42^{\circ} 7'21.25''\text{C } 60^{\circ}31'5.88''\text{B};$
- 3). $42^{\circ} 7'21.86''\text{C } 60^{\circ}32'50.59''\text{B};$
- 4). $42^{\circ} 6'27.15''\text{C } 60^{\circ}35'34.00''\text{B};$
- 5). $42^{\circ} 5'52.31''\text{C } 60^{\circ}35'13.29''\text{B};$
- 6). $42^{\circ} 5'17.94''\text{C } 60^{\circ}34'44.09''\text{B};$
- 7). $42^{\circ} 5'37.36''\text{C } 60^{\circ}33'48.15''\text{B}.$

Координаты углов поворота при прохождении трассы ВЛЭП:

- 1). $42^{\circ} 5'26.51''\text{C } 60^{\circ}34'19.65''\text{B};$
- 2). $42^{\circ} 4'29.37''\text{C } 60^{\circ}30'17.72''\text{B};$
- 3). $42^{\circ} 3'26.99''\text{C } 60^{\circ}29'39.09''\text{B};$
- 4). $42^{\circ} 2'29.67''\text{C } 60^{\circ}27'12.28''\text{B};$
- 5). $42^{\circ} 1'24.70''\text{C } 60^{\circ}25'34.30''\text{B};$
- 6). $42^{\circ} 1'15.43''\text{C } 60^{\circ}25'27.42''\text{B}.$

Лето выделенной территории для строительства отличается высокими температурами воздуха и низкой влажностью в сочетании с безоблачным небом. Весна короткая и дождливая, зима малоснежная, с неустойчивым снежным покровом. Среднегодовая температура по данным многолетних наблюдений составляет $13,6^{\circ}\text{C}$, абсолютная минимальная – минус $26,8^{\circ}\text{C}$, абсолютная максимальная $+45,0^{\circ}\text{C}$. Наиболее холодный месяц – январь, среднемесячная температура ($-4,6^{\circ}\text{C}$), наиболее жаркий – июль, среднемесячная температура $+29,14^{\circ}\text{C}$.

Ветры восточного направления составляют $16,4\%$, ветры северных направлений – $45,7\%$. Средняя скорость ветра составляет $1,93 \text{ м/с}$. В скоростном режиме преобладающими являются ветра со скоростью $0-1 \text{ м/с}$ – $55,01\%$ и чуть меньше со скоростью $2-3 \text{ м/с}$ – $25,9\%$ со скоростью $4-5 \text{ м/с}$ составляют – $15,6\%$, со скоростью $6-7 \text{ м/с}$ – $1,2\%$. Слабые ветры ($0-1 \text{ м/с}$) способствуют накоплению примесей от низких источников выбросов. Сильные летние ветра, характерные для районов с пустынным климатом, часто сопровождаются пыльными бурями и достигают скорости до 32 м/с . Резкое сокращение уровня Аральского моря привело к обнажению дна на площади порядка $1,5-2 \text{ млн. га}$. Это повлияло на увеличение числа дней с пыльными бурями.

Вода, попавшая на рассматриваемую территорию за счет атмосферных осадков, израсходуется на просачивание по трещинам и испарение. Пройденными горными выработками (по данным месторождений) подземные воды залегают на значительной глубине 100 м и более.

Наиболее значительные площади выделенной территории заняты кустарниковой и полукустарниковой растительностью и полынными формациями.

В ходе экологического исследования проектного участка не было выявлено ни одного вида флоры на грани исчезновения или вымирающих видов.

В рамках проекта планируется установить 16 единиц ветровых генераторов (турбин) серии «E171 6.5MW» высотой 120 метров от производителя «Envision» (КНР), мощностью 6,5 МВт.

Годовая выработка электроэнергии от планируемой ВЭС составит 392,237 МВт*ч в год, где на этапе строительства для ВЭС будет отведено 40 гектаров земли. При эксплуатации объекта площадь будет сокращена до 27 гектаров.

В инфраструктуру площадки ВЭС входят такие дополнительные и вспомогательные объекты: вход на территорию объекта и здание службы безопасности; административное здание, офисы и помещения; столовая; центральный пост управления; склад и мастерские; система безопасности; система освещения; подъездные дороги между ВЭУ; другие передвижные установки и транспортные средства.

«ACWA Power Wind Karatau» разработал план управления окружающей средой и план мониторинга окружающей среды во время строительства ветряной электростанции мощностью 100 МВт в Караузякском районе Республики Каракалпакстан, а также строительство Высоковольтных Линий Электропередач (ВЛЭП) 220/220 кВ, включающие мероприятия по сохранению естественной среды обитания (флора и фауна), качества воздуха, воды и почвы, верхнего слоя почвы, флоры и фауны, по гигиене и соблюдению безопасности рабочих, не допущению столкновения и поражения электрическим током птиц при эксплуатации ВЛЭП.

Ветрогенераторы располагаются на расстоянии друг от друга равным высоте нескольких башен. Это расстояние позволяет потоку ветра восстанавливаться, а турбулентность, создаваемая работой ротора одного ветряка, не влияет на работу соседнего ветряка, находящегося в подветренной стороне. Ветрогенераторы крепятся и стабилизируются с помощью железобетонных платформ. Фундаментные платформы строятся ниже уровня земли, и над платформой будет размещен грунт, чтобы вернуть видимую область почти в первоначальное состояние.

Принцип действия ВЭС заключается в преобразовании энергии ветра в механическую энергию и далее в электрическую энергию. Технология получения электроэнергии на ВЭС основана на следующих процессах: вращение лопастей с использованием ветра; при вращении лопастей их движение генератор преобразует в электричество, которое аккумулируется в батарее. В этом процессе преобразования отсутствуют выхлопные газы, сточные воды и отходы.

Ветряная турбина серии «E171 6.5 MW» имеет горизонтальную ось, три лопасти, фронтальный ротор, регулятор переменной скорости и переменного шага, синхронный генератор с прямым приводом на основе постоянных магнитов с внешним ротором, а также устройство подключения к сети.

Сила ветра приводит в движение лопасти, которые через специальный привод заставляют вращаться ротор. Благодаря наличию статорной обмотки, механическая энергия превращается в электрический ток. Аэродинамические особенности винтов позволяют быстро крутить турбину генератора.

Далее сила вращения преобразуется в электричество, которое аккумулируется в батарее. Чем сильнее поток воздуха, тем быстрее крутятся лопасти, производя больше энергии. Поскольку работа ветрогенератора основана на максимальном использовании альтернативного источника энергии, одна сторона лопастей имеет закругленную форму, вторая – относительно ровная. Когда воздушный поток проходит по закругленной стороне, создается участок вакуума. Это засасывает лопасть, уводя её в сторону. При этом создается энергия, которая и заставляет раскручиваться лопасти.

Проектом предусматривается строительство ВЛЭП 220 кВ, протяженностью 15,6 км, от проектируемой подстанции 33/220кВ ВЭС до существующей ВЛЭП 220 кВ, проходящей параллельно автодороге А380. Основным назначением ВЛЭП является процесс передачи электроэнергии от одного объекта к другому.

В качестве основного материала опор в проекте принят сборный железобетон и металл. Промежуточные опоры на ВЛ приняты металлические и железобетонные. Анкерно-угловые опоры приняты металлические.

Марка бетона для конструкций из вибрированного железобетона: по морозостойкости F100; по водонепроницаемости W4. Конструкции из вибрированного железобетона предполагается изготовить из бетона на сульфатостойком портландцементе.

Марка бетона центрифугированных стоек железобетонных опор: по морозостойкости F150; по водонепроницаемости W6. Бетон железобетонных центрифугированных стоек опор предполагается изготовить на сульфатостойком портландцементе. В связи с тем, что грунты на трассе ВЛ, в основном, представлены грунтами II-III группы, железобетонные опоры и фундаменты под металлические опоры устанавливаются в копаные котлованы.

Регулярное техническое обслуживание дорог будет включать в себя обводнение и сглаживание, необходимые для поддержания дорожного покрытия, а также осмотр и ремонт систем управления ливневыми водами, необходимых для обеспечения их надлежащего функционирования для борьбы с эрозией.

В период строительных работ на строительной площадке будет находиться до 150 человек. Для обслуживания ветряной электростанции будет задействовано 20 человек. Режим работы в три смены по 8 часов. В связи с тем, что график работы рабочего персонала ВЭС вахтовый, для размещения рабочего персонала предусматриваются временные жилые помещения.

В процессе строительства ВЭС планируются выбросы загрязняющих веществ в атмосферу, водопотребления и водоотведения, а также образование строительных отходов, которые следует рассчитать в соответствии с параметрами, представленными в ПКМ РУ, №40 от 28.01.2021 г. (приложения за №№3-7) «О мерах по дальнейшему совершенствованию порядка проведения работ со строительными отходами».

В период строительных работ ориентировочно будут поступать загрязняющие вещества 8 наименований в количестве: при строительстве ВЭС - 0,8096 г/с или 35,196 т/год; при установке опор при прокладке ВЛ - 0,6244 г/с или 12,171 т/год; при строительстве подстанции - 0,7656 г/с или 12,186 т/год.

Расчет приземных концентраций загрязняющих веществ, формируемых источниками выбросов при строительстве, показал, что максимальные концентрации загрязняющих веществ, наблюдаемые за границами, не превышают установленные квоты по Республике Каракашакстан.

Расход воды на питьевые нужды при проведении строительных работ ориентировочно (из расчета 25 л на 1 чел.) составит 3750 литров или 3,75 м³/сут. или 1312,5 м³/год. На пылеподавление вода будет привозиться водовозами из ближайшего сая, либо колодца. Согласно КМКС 2.04.01-98 для полива 1 м² грунтового покрытия расход воды составляет 3-5 литров. По техническим условиям при установке ветроустановок, диаметр фундамента составляет - 20 м. При таких условиях, для обеспыливания площадки строительства одной ветроустановки ориентировочно необходимо - 20,0 м² или 100,0 литров воды. Соответственно, на обеспыливание 16 площадок ВЭС, расход воды составит - 1,6 м³ где расход воды на обеспыливание является безвозвратной.

Источниками образования отходов являются: строительные работы; уборка временных помещений и строительных площадок.

Отходы, образующиеся при проведении строительных работ: отходы бетона и железобетона, 600 тонн - 5 класс опасности; отходы песка, 1200 тонн - 5 класс опасности; строительный щебень, потерявший потребительские свойства, 400 тонн - 5 класс опасности; бой строительного кирпича, 400 тонн - 5 класс опасности; отходы стальных электродов (отарки и остатки стальных сварочных электродов), 0,06 тонн - 5 класс опасности; отходы растворителей, красок, 0,03 тонн - 3 класс опасности; отходы смеси разнородных затвердевших пластмасс (тара из-под краски), 0,06 тонн - 3 класс опасности; обтирочный материал, загрязненный маслами (содержание масел менее 15%, 0,15 тонн - 4 класс опасности); бой кирпича, 0,22 тонн - 5 класс опасности; строительный мусор, 06 тонн - 4 класс опасности; ГБО (мусор от временных бытовых помещений несортированный, исключая крупногабаритный), 7,5 тонн - 4 класс опасности.

Эксплуатация новой ВЭС и ВЛ в Караузякском районе Республики Каракашакстан не будет сопровождаться принятием в окружающую среду загрязняющих веществ. Технологические процессы выработки, преобразования, передачи и распределения электроэнергии не сопровождаются выбросами загрязняющих веществ в атмосферу.

Выброс загрязняющих веществ в атмосферу происходит от оборудования, наполненного маслом, в виде углеводородов масла. Учитывая состав оборудования (на основе деятельности аналогичных подстанций) в целом на ПС 33/220 кВ установлено оборудования, содержащее масло и в них залито ориентировочно 62,78 тонн масла.

При эксплуатации маслonaполненного оборудования, через его неплотности будет происходить выброс углеводородов (CH) - масла

минерального происхождения неорганизовано. Выбросы углеводородов масла минерального составляют – 0,00005 т/с или 0,0017 т/год.

Анализ расчетов рассеивания показал, что максимальные концентрации углеводородов масла минерального, создаваемые выбросами от неорганизованных источников подстанции при эксплуатации ниже 0,001 ПДК, имеют следовые значения и не превышают установленные квоты для Республики Каракалпакстан.

Хозяйственно-питьевые и бытовые нужды складируются из расхода воды на питьевые нужды рабочего персонала, расхода воды на душевые кабинки для рабочего персонала, нужды столовой в приготовлении пищи, влажной уборки помещений, полива территории.

Вода на площадке ВЭС используется только в хоз-бытовых целях.

В связи с отсутствием источников централизованного водоснабжения в районе расположения ВЭС вода для хоз-питьевых нужд будет привозиться водовозами-цистернами. Объем цистерны водовоза – 8100 литров.

Общий расход воды для хозяйственно-питьевых и бытовых нужд составит в объеме 5,22 м³/сут. или 1630,3 м³/год, из них: на хозпитьевые нужды – 0,5 м³/сут. или 182,5 м³/год; на душевые нужды – 3,0 м³/сут. или 1095 м³/год; мытье полов – 0,48 м³/сут. или 175,2 м³/год; на нужды столовой – 0,24 м³/сут. или 87,6 м³/год; полив территории – 1,0 м³/сут. или 90 м³/год.

Хозбытовые сточные воды будут отводиться в биологический септик. Использование биосептика очень удобно при функционировании предприятия в условиях, где нет подключения к канализационным сетям.

От основных и вспомогательных участков ВЭС, а также при ремонтных работах, ориентировочно будут образовываться следующие виды отходов: отработанные лопасти ветрогенераторов (4 класс опасности, 72 тонн); отработанное трансформаторное масло (2 класс, 0,533 тонн); отработанный силикагель (4 класс, 0,02 тонн); лом черного металла (5 класс, 0,5 тонн); лом цветного металла (3 класс, 0,2 тонн); промасленная ветошь (4 класс, 0,05 тонн); отработанные светодиодные лампы (4 класс, 0,005 тонн); отходы бумаги (5 класс, 0,035 тонн); пищевые отходы столовой (5 класс, 2,4 тонн); твердые бытовые отходы (5, класс, 1,0 тонн); смет от уборки территории (4 класс, 42 тонн).

В настоящее время утилизация лопастей ветрогенераторов из композитных материалов, образующихся по истечению времени эксплуатации либо ликвидации объекта, является существенной проблемой ветроэнергетики. Предлагаемые методы утилизации лопастей генераторов находятся в стадии разработки, а применяемые методы (такие как механическое измельчение, сжигание и пиролиз) обладают рядом недостатков, что не позволило рассматриваемым проектом ЗВОС заглянуть о решении проблемы переработки лопастей в полной мере.

В качестве наиболее вероятных аварийных ситуаций проектом рассмотрены случаи пожара главного трансформатора и разлива горюче-смазочных, для предотвращения которых разработаны мероприятия, включающие: организацию бетонированной площадки для хранения дизтоплива, применение оборудования, арматуры и антисейсмических

трубопроводов, стойких к коррозионным свойствам грунтов, грунтовых и сточных вод. Для защиты птиц от поражения электрическим током, предотвращения перекрытия изоляции предусмотрены противоптичьих заградители. В качестве основного мероприятия предусматривается повышение видимости вращающихся лопастей в дневное время за счет нанесения контрастных полос на лопасти ВЭС.

Экологическая экспертиза проекта показала, что материалы содержат информацию, достаточную для принятия решения о допустимости проведения строительства ВЭС в объемах, предусмотренных проектом, а также соответствие требованиям природоохранного законодательства к первому этапу оценки воздействия на окружающую среду о допустимости реализации проекта.

Государственный комитет Республики Узбекистан по экологии и охране окружающей среды согласовывает проект заявления о воздействии на окружающую среду строительства ветряной электрической станции (ВЭС) «ACWA Power Wind Karatau» мощностью 100 МВт в Караузакском районе Республики Каракалпакстан.

До ввода объекта в эксплуатацию в соответствии с требованиями ПКМ РУз за №541 от 07.09.2020 г. следует разработать Заявление об экологических последствиях, содержащее экологические нормативы для всех видов воздействия проектируемых работ на окружающую среду, и представить на государственную экологическую экспертизу в установленном законодательством порядке.

ООО «JURU ENERGY CONSULTING» необходимо:

- в материалах ЗЭИ представить акт обследования предприятия, утвержденный Комитетом Республики Каракалпакстан по экологии и охране окружающей среды, о выполнении вышеуказанных мероприятий: оснащение ветротурбин датчиками вибрации и противоптичьим заградителем, готовность систем водоотведения и специальной заправочной площадки, также площадки временного хранения строительных и твердых бытовых отходов;

- своевременно выполнять план управления окружающей средой и план мониторинга окружающей среды во время строительства ветряной электростанции (ВЭС) «ACWA Power Wind Karatau» мощностью 100 МВт в Караузакском районе Республики Каракалпакстан;

- в целях минимизации воздействия на флору, фауну и орнитофауну для строительства ВЭС выбрать участки, имеющие наименьшее значение для биоразнообразия;

- при строительстве ВЭС ветряные турбины размещать с учетом размеров буферных зон археологических находок, строительные и земляные работы в буферных зонах проводить под непосредственным археологическим надзором;

- разработать генеральный план территории с нанесением источников выбросов, сбросов и отходов и представить технологическое обоснование источников выбросов, сбросов также отходов, их количества, и состава;

- разработать и утвердить в Комитете Республики Каракалпакстан по экологии и охране окружающей среды план технической и биологической рекультивации земель с последующим его выполнением после окончания строительных работ;

- предусматривать срезку почвенно-растительного слоя и обеспечивать его временное хранение до окончания строительных работ; использовать срезанный почвенно-растительный слой в период проведения благоустройства территории;

- обеспечить выполнение требований ПКМ РУз «О мерах по дальнейшему совершенствованию порядка проведения работ со строительными отходами» за №40 от 28.01.2021 г. (приложения за №№3-7), для хранения строительных отходов необходимо организовать специальное место с бетонированным полом и навесом, предусмотреть отсеки для раздельного хранения отходов;

- заключить договор с ГУП «Гёзи хууду» либо иными альтернативными компаниями (для содержания ТБО на санкционированном полигоне), с целью своевременного вывоза отходов.

Комитету Республики Каракалпакстан по экологии и охране окружающей среды следует взять на контроль:

- готовность специальной заправочной площадки, также площадки временного хранения строительных и твердых бытовых отходов;

- выполнение плана управления окружающей средой и плана мониторинга окружающей среды во время строительства ветряной электростанции (ВЭС) «ACWA Power Wind Karataş» мощностью 100 МВт в Караузякском районе Республики Каракалпакстан;

- разработку плана технической и биологической рекультивации земель с последующим его выполнением после окончания строительных работ;

- обеспечение выполнения требований ПКМ РУз «О мерах по дальнейшему совершенствованию порядка проведения работ со строительными отходами» за №40 от 28.01.2021 г. (приложения за №№3-7), для хранения строительных отходов необходимо организовать специальное место с бетонированным полом и навесом, предусмотреть отсеки для раздельного хранения отходов;

- заключение договора с ГУП «Гёзи хууду» либо иными альтернативными компаниями (для содержания ТБО на санкционированном полигоне), с целью своевременного вывоза жидких и твердых бытовых отходов.

Заместитель председателя

Ж. Казбеков

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**STATE COMMITTEE ON ECOLOGY AND ENVIRONMENTAL PROTECTION OF THE REPUBLIC
OF UZBEKISTAN**

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2020 – year 02.06 03-01/11-08-982, Tashkent

CONCLUSION

State ecological expertise

On the facility: Environmental impact assessment of construction of wind farm "ACWA POWER WIND KARATAU", capacity 100 MW in Karauzyak district of the Republic of Karakalpakstan (draft PZVOS).

Customer: JURU ENERGY CONSULTING LLC.

TIN: 303 454 532

Category: II, item 29, Decree of the Cabinet of Ministers of the Republic of Uzbekistan No. 541 of 07.09.2020.

Developer: "JURU ENERGY CONSULTING" LLC.

Expert: T.T. Durova.

Director
JURU ENERGY CONSULTING LLC
J.Sh. Ismailov

Copy: Committee of the Republic of Karakalpakstan on
ecology and environment protection

The materials of the first stage of the environmental impact assessment of the construction of wind power station (WPS) "ACWA POWER WIND KARATAU", capacity 100 MW in Karauzyak region of the Republic of Karakalpakstan are submitted for the state environmental expertise.

The basis for design of the facility is Decree of the President of the Republic of Uzbekistan No PP-169 dated March 18, 2022 "On measures for implementation of the project "Construction and operation of wind power plant with capacity of 100 MW in Karauzyak region of the Republic of Karakalpakstan based on conditions of public-private partnership".

Construction and operation of this wind farm is carried out by "ACWA POWER" (Saudi Arabia).

This project envisages construction of wind power plant with capacity of 100 MW with necessary buildings and auxiliary facilities and creation of appropriate infrastructure in Karauzyak district of the Republic of Karakalpakstan, as well as construction of High Voltage Transmission Lines (HVL) 220/220 kV.

Under the Project, it is planned to construct a new overhead power transmission line (OHTL) of 220 kV (about 15.6 km), as well as an access road of about 12 km long.

The allocated area is located approximately 83 km southeast of Nukus city. The nearest residential buildings are represented by a temporary house located 5.5 km to the north of the object of expertise. The railway station "Karauzyak" with several residential structures is located 7.1 km to the west of the examined area. Not far from the construction site passes the A380 highway, which is considered to be the main way of transporting components to the area.

According to the Decree of the Cabinet of Ministers of RUz № 541 dated 07.09.2020, materials of the environmental impact assessment for facilities of II category of environmental impact, submitted for the state environmental expertise, should contain the conclusion of the public hearing to support the project, suggestions and objections of the public. Given that the WPP with capacity of 100 MW belongs to the objects of II category of environmental impact, the management of the WPP under construction together with representatives of the Karauzyak District Khokimiyat, environmental authorities and the population organized and held a public hearing, during which the issues of the planned project and the impact of its activities on the environment were discussed with the population and the public.

At the construction stage, 40 hectares of land located in the mountainous Karatau area at an altitude of about 280 m above sea level will be allocated for the WPP. During the operation of the facility, the area will be reduced to 35 hectares. This area will be reduced at a later stage after the final layout is ready. The size of the area for the designed 33/220kV overhead insulated substation is considered to be 200m x 200m.

The area of the planned WPP is a semi-complex terrain, consisting of gentle ridges originating from a higher peak on the edge of the Karatau hills, located in the west of the project area.

The land cover mainly consists of sandy soil and desert vegetation such as wormwood, indicating the lower elevation of the site. Observations made in the project area indicate that there are no permanent settlements or receptors in the project area, although some agricultural activity and occasional shepherd's huts are observed.

Vegetation of the surveyed area is characterized by scarce diversity of wild species, represented mainly by herbaceous forms (saltwort). About 38 herbaceous plants, which complete their development during the short wet period in spring, are noted in the area of WPP and OHTL location. Ephemerooids (perennial grasses), flowering in spring, whose flowers die off and only underground rhizomes, bulbs and tubers remain in summer. The project area is completely dominated by groups of desert vegetation types.

During the ecological study of the project site, no species of flora on the verge of extinction or endangered species were identified. According to the Red Book of Uzbekistan some endemic plants can be found in the area, but, in general, it can be considered that the site has low diversity of vegetation.

In the framework of the EIA project development, fauna of the WPP and OHTL sites was studied using Integrated Biodiversity Assessment Tool (IBAT), which was purchased for the project area and a 50 km buffer zone of 205 km². 22 species classified as vulnerable (VU) or above were identified.

The WPPs and OHTLs pose three main areas of potential risk to birds: mortality due to collision or interaction with turbine blades; direct habitat loss due to wind farm construction; displacement due to indirect habitat loss if disturbance causes birds to avoid the wind farm and its surroundings.

Birds regularly migrate north through Uzbekistan to their breeding grounds and back to southern countries for wintering, stopping in Uzbekistan only for rest and feeding. Their autumn migration usually starts in August and ends in November, spring migration starts in February and ends in May.

Collision risk modeling (CRM) was conducted using a model developed and refined by William Band to obtain quantitative predictions of estimated bird mortality on wind farms and transmission lines.

The following were determined based on the total timing of migration and breeding periods for target bird species in the region: spring (migration) April 25, 2020, May 15, 2020 and March 16, 2021 - April 25, 2021; summer (breeding) May 16 - August 31, 2020; fall (migration): September 1 - November 30, 2020; winter: December 1 - March 15, 2021.

Among the target bird species that potentially occur at the site, only three species were detected at the site during the site survey and are predicted not to encounter an annual collision rate exceeding one fatality in 28 years at the modeled most likely collision avoidance rate parameters. This reflects the extremely low numbers of target species recorded at the site during point of observation surveys at the WPP and overhead line installation site.

Overall, the collision risk modeling results indicate that the construction activities and subsequent operation of the WPP and overhead line have a low level of collision risk for sensitive bird species.

As part of the EIA, the construction company and the operating organization have requirements to prevent birds from collision with WPP and overhead power lines during the construction and operation phases. In particular: to prevent damage to nesting birds, the installation of WPP and overhead power lines should be carried out outside the bird breeding period; during the installation of wind power plants, the installation and development of infrastructure of WPP and overhead power lines must comply with environmental requirements (for example, to eliminate littering of adjacent areas with construction and other debris); during the operation of WPP it is necessary to illuminate blades along the length in spring and autumn in the twilight and nighttime periods.

Also when there are accumulations of soaring species, such as white stork, daytime birds, raptors, up to 5-20 and more individuals during intensive flights, there is a possibility of collision of birds with the blades of the wind turbines, in this connection it is recommended to reduce the rotation speed, or to suspend the rotation of WPP for a few days.

Angular coordinates of the WPP site location:

- 1). 42° 5'37.08 "C 60°31'10.92 "B;
- 2). 42° 7'21.25 "C 60°31'5.88 " B;
- 3). 42° 7'21.86 "C 60°32'50.59 "B;
- 4). 42° 6'27.15 "S 60°35'34.00 "B;
- 5). 42° 5'52.31 "S 60°35'13.29 "B;
- 6). 42° 5'17.94 "S 60°34'44.09 "B;
- 7). 42° 5'37.36 "C 60°33'48.15 "B.

Coordinates of turning angles when passing the overhead power line route:

- 1). 42° 5'26.51 "C 60°34'19.65 "B;
- 2). 42° 4'29.37 "S 60°30'17.72 "B;
- 3). 42° 3'26.99 "C 60°29'39.09 "B;
- 4). 42° 2'29.67 "C 60°27'12.28 "B;

5). 42° 1'24.70 "C 60°25'34.30 "B;

6). 42° 1'15.43 "C 60°25'27.42 "B.

Summers in the area allocated for construction are characterized by high temperatures and low humidity, combined with cloudless skies. Spring is short and rainy, while winter is light and snowy, with unstable snow cover. Average annual temperature according to data of long-term observations is 13,6°C, absolute minimum - minus 26,8°C, absolute maximum - +45,0°C. The coldest month is January. Average monthly temperature (-4.6°C), the hottest is July, with an average monthly temperature of +29.14°C.

Winds from eastern direction make up 16.4%, winds from northern directions - 45.7%. Average wind speed is 1.93 m/s.

Winds with speeds of 0-1 m/s are predominant in the velocity regime - 55.01% and slightly less in speeds of 2-3 m/s - 25.9% with speeds of 4-5 m/s accounting for 15.6% and 6-7 m/s - 1.2%. Weak winds (0-1 m/s) contribute to accumulation of impurities from low emission sources. Strong summer winds, characteristic of areas with desert climate, are often accompanied by dust storms and reach speeds of up to 32 m/s. A sharp decrease in the level of the Aral Sea led to the exposure of the bottom on an area of about 1.5-2 million hectares. This affected the increase in the number of days with dust storms.

Water that got to the area under consideration at the expense of atmospheric precipitation is used up by seepage through cracks and evaporation. Passed mining excavations (according to field data) groundwater is deposited at a significant depth of 100 m and more.

It is planned to install 16 units of wind generators (turbines) of "E171 6.5MW" series with a height of 120 meters from the manufacturer "Envision" (PRC) with the capacity of 6.5 MW each as part of the project.

The annual electricity production from the planned WPP will be 392.237 MW*h per year, where at the stage of construction for the WPP will be given 40 hectares of land. During the operation of the facility the area will be reduced to 27 hectares.

The WPP site infrastructure includes the following additional and auxiliary facilities: site entrance and security building; administration building, offices and premises; canteen; central control post; warehouse and workshops; security system; lighting system; access roads between wind turbines; other mobile units and vehicles.

"ACWA Power Wind Karatau" LLC developed environmental management plan and environmental monitoring plan for construction of 100 MW wind power plant in Karauzyak region of the Republic of Karakalpakstan, as well as construction of 220/220 kV High Voltage Transmission Lines (HVTL), including measures on preservation of natural habitat (flora and fauna), air, water and soil quality, topsoil, flora and fauna, on hygiene and safety of workers, prevention of collision and electrocution of birds during operation of high voltage power lines.

Wind turbines are located at a distance from each other equal to the height of several towers. This distance allows the wind flow to recover, and the turbulence created by the operation of the rotor of one wind turbine does not affect the operation of the neighboring wind turbine, which is in the leeward direction. The wind turbines are anchored and stabilized with reinforced concrete platforms. The foundation platforms are built below ground level, and soil will be placed over the platform to return the visible area almost to its original state.

The principle of the wind power plant is to convert wind energy into mechanical energy and then into electrical energy. The technology of generating electricity in WPP is based on the following processes: rotation of the blades using the wind: as the blades rotate their motion, the generator converts it into electricity, which is stored in the battery. There are no exhaust gases in this conversion process, no waste water or waste products.

E171 6,5 MW series wind turbine has a horizontal axis, three blades, frontal rotor, variable speed and variable pitch controller, direct-drive synchronous generator based on permanent magnets with external rotor, and mains connection device.

The wind power drives the blades, which through a special drive make the rotor rotate. Due to the presence of a stator winding, mechanical energy is converted into electric current. The aerodynamic features of the propellers allow the generator turbine to spin quickly.

Then the force of rotation is converted into electricity, which is stored in the battery. The stronger the air flow, the faster the blades spin, producing more energy. Since the operation of the wind generator is based on the maximum use of an alternative energy source, one side of the blades has a rounded shape, the other is relatively flat. When airflow passes over the rounded side, a vacuum section is created. This sucks the blade in, taking it sideways. This creates energy that causes the blades to spin out.

The project involves the construction of transmission line 220 kV, a length of 15.6 km from the projected substation 33/220kV WPP to the existing overhead power line 220 kV, passing parallel to the highway AZ80. The main purpose of the overhead power transmission line is to transmit electricity from one facility to another.

As the main material of the supports in the project is adopted precast concrete and metal. Intermediate supports on the overhead line are metal and reinforced concrete. Anchor-corner supports are made of metal.

Grade of concrete for structures made of vibrated reinforced concrete: on frost resistance F100; on water resistance W4. Structures of vibrated reinforced concrete are assumed to be made of concrete on sulfate-resistant Portland cement.

Concrete grade of centrifugal reinforced concrete supports: frost resistance F150; water resistance W6. Concrete of reinforced concrete centrifugal piers is supposed to be made on sulfate-resistant Portland cement. Due to the fact that the soils on the overhead line route are mainly soils of group II-III, the reinforced concrete supports and foundations for metal supports are installed in excavated pits.

Regular road maintenance will include watering and smoothing necessary to maintain the pavement, as well as inspection and repair of storm water management systems necessary to ensure their proper functioning for erosion control.

Up to 150 people will be on the construction site during the construction period. Twenty people will be employed to maintain the wind farm. The mode of operation is three shifts of 8 hours each. Due to the fact that the work schedule of the WPP personnel is on a rotational basis, temporary living quarters are provided to accommodate the workers.

In the process of WPP construction, emissions of pollutants into the atmosphere, water consumption and water disposal, as well as construction waste generation are planned, which should be calculated in accordance with the parameters presented in the Decree of the Cabinet of Ministers of the Republic of Uzbekistan № 40 dated 28.01.2021 (Annexes Nos. 3-7) "On measures to further improve the procedure of work with construction wastes".

During construction works, pollutants of 8 names will be tentatively received in the following amounts: during the construction of WPS - 0.8096 g/s or 35.196 t/year; during the installation of poles during construction of overhead line - 0.6244 g/s or 12.171 t/year; during substation construction - 0.7656 g/s or 12.186 t/year.

Calculation of surface concentrations of pollutants formed by emission sources during construction, showed that the maximum concentrations of pollutants observed outside the boundaries do not exceed the established quotas for the Republic of Karakalpakstan.

Water consumption for drinking needs during construction works is estimated (on the basis of 25 liters per person) to be 3,750 liters or 3.75 m³/day or 1,312.5 m³/year. For dust suppression, water will be brought by water trucks from the nearest sai or well. According to MCUZ 2.04.2001-98 for irrigation of 1 m² of ground cover water consumption is 3-5 liters. According to the technical conditions for the installation of wind turbines, the diameter of the foundation is - 20 m. Under these conditions, to dedust the construction site of one wind turbine roughly needs - 20.0 m² or 100.0 liters of water. Accordingly, the dedusting of 16 WPP sites, the consumption of water will be - 1.6 m³ where the consumption of water for dedusting is irretrievable.

Sources of waste generation are: construction work; cleaning temporary facilities and construction sites.

Wastes formed during construction work: concrete and reinforced concrete wastes, 600 tons - 5th class of hazard; sand wastes, 1200 tons - 5th class of hazard; building rubble that has lost its consumer properties, 400 tons - 5th class of hazard; building brick scrap, 400 tons - 5th class of hazard; steel electrode wastes (stubs and remains of steel welding electrodes), 0.06 tons - Hazard Class 5; solvent and paint wastes, 0.03 tons - Hazard Class 3; mixed mixture of dissimilar solidified plastics (paint packaging), 0.06 tons - Hazard Class 3; oil-contaminated cleaning material (oil content less than 15%, 0.15 tons - Hazard Class 4); broken brick, 0.22 tons - Hazard Class 5; construction waste, 06 tons - Hazard Class 4; MSW (unsorted garbage from temporary household premises, excluding bulky), 7.5 tons - Hazard Class 4.

The operation of the new WPP and OHTL in the Karauzyak district of the Republic of Karakalpakstan will not be accompanied by the introduction of pollutants into the environment. Technological processes of generation, transformation, transmission and distribution of electricity are not accompanied by emissions of pollutants into the atmosphere.

Emission of pollutants into the atmosphere occurs from oil-filled equipment in the form of hydrocarbons of oil.

Considering the composition of the equipment (based on the activities of similar substations) in general at the substation 33/220 kV installed equipment containing oil and they are filled with approximately 62.78 tons of oil.

During operation of oil-filled equipment, through its looseness there will be release of hydrocarbons (CH) - mineral oil in an unorganized way. Emissions of hydrocarbons of mineral oil are - 0.00005 g/s or 0.0017 tons / year.

The analysis of dispersion calculations showed that the maximum concentrations of mineral oil hydrocarbons created by - emissions from unorganized sources of substation during operation below 0.001 TLV, have trace values and do not exceed the established quotas for the Republic of Karakalpakstan.

Household drinking and domestic needs consist of water consumption for drinking needs of the working personnel, water consumption for shower cabins for the working personnel, needs of the canteen for food preparation, wet cleaning of the premises, watering of the territory.

Water at the WPP site is used only for domestic purposes.

In connection with the absence of centralized water supply sources in the area of WPP location, water for domestic needs will be brought by water tankers. The volume of water tank cars is 8100 liters.

The total water consumption for household and drinking needs will be 5.22 m³/day or 1630.3 m³/year: for utility-drinking needs - 0.5 m³/day or 182.5 m³/year; for showering needs - 3.0 m³/day or 1,095 m³/year; for floor washing - 0.48 m³/day or 175.2 m³/year; for canteen needs - 0.24 m³/day or 87.6 m³/year; for watering the territory - 1.0 m³/day or 90 m³/year.

Household wastewater will be disposed of in a biological septic tank. The use of bioseptic is very convenient for the operation of the enterprise in conditions where there is no connection to the sewage network.

From the main and auxiliary sections of the WPP, as well as during repair work, the following types of waste will be tentatively formed: waste wind turbine blades (Hazard Class 4, 72 tons); waste transformer oil (Class 2, 0.533 tons); waste silica gel (Class 4, 0.02 tons); black metal scrap (Class 5, 0.5 tons); nonferrous metal scrap (Class 3, 0.2 tons); oily rags (class 4, 0.05 tons); used LED lamps (class 4, 0.005 tons); paper waste (class 5, 0.035 tons); canteen food waste (class 5, 2.4 tons); solid household waste (class 5, 1.0 tons); sweepings from cleaning (class 4, 42 tons).

At present, the disposal of wind turbine blades made of composite materials, formed after the operation time or liquidation of the object, is a significant problem of wind energy. The proposed methods of disposal of generator blades are under development, and the methods used (such as mechanical grinding, incineration and pyrolysis) have a number of drawbacks, which did not allow the EIA project under consideration to declare the solution of the problem of blades

recycling in full.

As the most likely emergency situations, the project considers the cases of fire of the main transformer and spillage of fuel and lubricants, to prevent which developed measures include: the organization of a concreted area for storage of diesel fuel, the use of equipment, fittings and anti-seismic piping, resistant to corrosive properties of soil, groundwater and waste water. To protect birds from electrocution and to prevent overlapping of the insulation, anti-bird barriers are provided. As the main measure is provided to increase the visibility of rotating blades in the daytime by applying contrasting stripes on the blades of WPP.

The ecological expertise of the project showed that the materials contain the information sufficient for making decision about the admissibility of the WPP construction in the volumes, provided by the project, as well as the compliance with the requirements of the nature protection legislation to the first stage of the environmental impact assessment of the project admissibility.

The State Committee of the Republic of Uzbekistan on ecology and environmental protection approves the project statement on the environmental impact of construction of wind farm "ACWA Power Wind Karatau", capacity 100 MW in Karauzyak region of the Republic of Karakalpakstan.

Prior to commissioning the facility in accordance with the requirements of Decree of the Cabinet of Ministers of the Republic of Uzbekistan No.541 of 07.09.2020 a Statement of Environmental Consequences containing environmental standards for all types of environmental impacts of the projected works should be developed and submitted for state environmental review in accordance with the procedure established by the legislation.

JURU ENERGY CONSULTING LLC should:

- in the materials of PVE to submit an act of inspection of the enterprise, approved by the Committee of the Republic of Karakalpakstan on ecology and environmental protection, on the implementation of the above measures: equipping wind turbines with vibration sensors and anti-bird barrier, readiness of water disposal and special refueling site, also the site of temporary storage of construction and solid waste;

- The environmental management plan and the environmental monitoring plan during the construction of the 100 MW ACWA Power Wind Karatau wind farm in the Karauzyak district of the Republic of Karakalpakstan should be implemented in a timely manner;

- In order to minimize the impact on flora, fauna and ornithofauna for the construction of the WPP, select areas of the least importance for biodiversity:

- during the construction of wind turbines should be placed taking into account the size of the buffer zones of archaeological finds, construction and excavation work in the buffer zones, to be carried out under direct archaeological supervision;

- develop a master plan of the area with the drawing of sources of emissions, discharges and waste and submit a theological substantiation of the sources of emissions, discharges and waste, their quantity, and composition;

- develop and approve in the Committee of the Republic of Karakalpakstan on ecology and environment protection the plan of technical and biological reclamation of lands with its further implementation after finishing the construction works:

- to provide cutting of the topsoil and to ensure its temporary storage until the end of construction works; to use the cut topsoil during the period of improvement of the territory:

- ensure fulfillment of the requirements of the Decree of the Cabinet of Ministers of the Republic of Uzbekistan No 40 dated 28.01.2021 (Annexes No 3-7) "On measures to further improve the procedure of work with construction waste" to store construction waste it is necessary to arrange a special place with a concrete floor and a shed, to provide compartments for separate storage of waste

- To conclude a contract with SUE "Toza hudud" or other alternative companies (to maintain MSW at the sanctioned landfill), in order to remove waste in a timely manner.

The Committee of the Republic of Karakalpakstan on ecology and environmental protection should take control:

- readiness of the special filling site, also the site for temporary storage of construction and solid household waste;

- The implementation of the environmental management plan and the environmental monitoring plan during the construction of the wind farm " ACWA Power Wind Karatau", capacity 100 MW in Karauzyak district of the Republic of Karakalpakstan:

- Developing a plan for technical and biological land reclamation with subsequent implementation upon completion of construction works;

- Ensuring compliance with the requirements of the Decree of the Cabinet of Ministers of the Republic of Uzbekistan No.40 dated 28.01.2021 (Annexes No. 3-7 "On measures to further improve the procedure of work with construction waste"):

- Signing a contract with SUE "Toza Hudud" or other alternative companies (to maintain MSW in an authorized landfill), for the timely removal of liquid and solid waste.

Deputy Chairman J. Kazbekov

Executor: Shabanov A. Durova T.G.
Phone. 71 203 00 22 (internal 1016)

C – NOISE MODEL



Nukus Wind Farm, Uzbekistan Noise Assessment

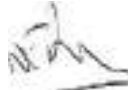
March 2022





Nukus Wind Farm, Uzbekistan

Noise Assessment

Revision	Date	Notes	Author	Checked	Approved
Ver. 2	28-03-22	Env - Noise	Sunil Patel	Nick Davey	Nick Davey
					

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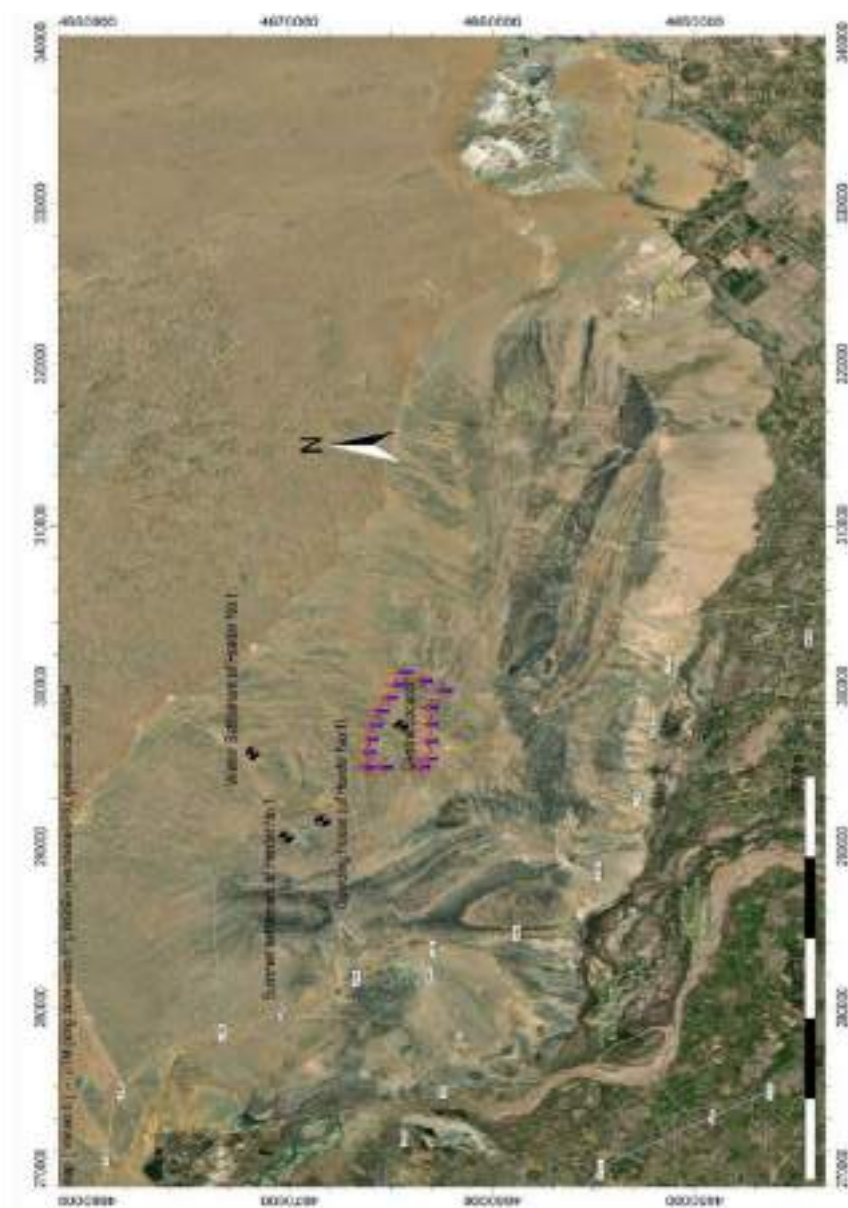
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3 Noise Assessment	5
4 Conclusions	11
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APPENDIX B – Wind Farm Layout & Receptor Details	14



1 INTRODUCTION

- 1.1 Entrant Ltd have been commissioned to provide a noise assessment for the project known as the 'Nukus Wind Farm (WF)', Uzbekistan. The project site is in the Karakalpakstan region, north-west of the country.
- 1.2 This noise assessment has been undertaken for the Nukus WF in accordance with the International Finance Corporation's (IFC) environmental guidance on Wind Energy projects.
- 1.3 The Nukus Wind Farm will comprise of a total of 16 Envision EN171, 6.5MW turbines.
- 1.4 The general site locations as well as potential receptors are presented in Figure 1.
- 1.5 This Report is necessarily technical in nature and contains terminology relating to acoustics and noise. Therefore, a glossary together with a brief introduction to the subject of noise has been provided in Appendix A.

Figure 1 Nukus WF Project





2 NOISE ASSESSMENT CRITERIA

IFC Guidance

- 2.1 The Environmental, Health and Safety' Guidelines for Wind Energy (2015) sets the following screening criteria for wind farms:

"Preliminary modelling should be carried out to determine whether more detailed investigation is warranted. The preliminary modelling can be as simple as assuming hemispherical propagation (i.e., the radiation of sound, in all directions, from a source point). Preliminary modelling should focus on sensitive receptors within 2,000 meters of any of the turbines in a wind energy facility."

*"If the preliminary model suggests that turbine noise at all sensitive receptors is likely to be below an **LA90 of 35 decibels (dB) (A) at a wind speed of 10 meters/second (m/s) at 10 m** height during day and night times, then this preliminary modelling is likely to be sufficient to assess noise impact; otherwise it is recommended that more detailed modelling be carried out, which may include background ambient noise measurements."*

- 2.2 The calculation methodology for assessment purposes is outlined in International Standard ISO 9613-2:1996 ('Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation'). The standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions favourable to sound propagation. The standard defines favourable conditions for light downwind propagation where the wind blows from all the turbines to the receiver(s) within an angle of +/-45 degrees from a line connecting each turbine to each receiver, at wind speeds between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion. In this respect, it is noted that at the wind speeds relevant to noise levels from wind turbines, atmospheric conditions do not favour the development of thermal inversions throughout the propagation path from the source to the receiver.



2.3 The general calculation method considers the following attenuation corrections:

- Geometric divergence
- Air absorption
- Reflecting obstacles
- Screening
- Vegetation
- Ground reflections

2.4 Attenuation due to the above factors is applied to the sound power levels of the noise sources to derive the resulting noise levels at the receptors.

2.5 Wind turbines are sound sources with special characteristics, such as wind speed dependent sound power levels, high source heights etc., which require special considerations. These parameter adjustments are chosen in combination (see Table 2.1) to give a more reliable calculation methodology.

Table 2.1 ISO9613 Parameters used in the noise assessment.

Calculation Parameter ISO 9613	Observation
Agr = -3 (Geometrical divergence)	Normal correction for wind farms
Cmet = 0 (Metrological corrections)	Normal correction for wind farms (downwind propagation)
Terrain obstacles correction = 0 (site specific)	Normal correction for wind farms (site specific for a worst-case assessment)
Temperature = 10 ⁰ C; Relative Humidity = 70%	Normal correction.
Correction of results from L _{Aeq,T} to L _{A90,T} by -2dB.	Normal correction in the UK and some other countries but not universally applied by all countries.
For propagation of turbine sound to a receptor across a valley with a concave profile, a correction of +3 dB must be applied.	Normal correction for wind farms.
Ground Absorption Factor, G=0.5	The normal correction for wind farms in the UK, Germany, NZ and Australia is G=0.5.



2.6 For measured noise levels, wind shear is computed using the following equation:

$$\text{Wind Speed}_{10m} = \text{Wind Speed}_{\text{hub ht}} \times \ln(10/0.05) / \ln(\text{hub height}/0.05)$$

2.7 Where Wind Speed_{10m} is the reference wind speed at 10m for the receptors and 0.05 is the standard ground roughness height.



3 NOISE ASSESSMENT

Turbine Data

3.1 The following data has been supplied by the manufacturers (120m hub height):

Figure 3.1 EN171 6.5MW Sound Power Level

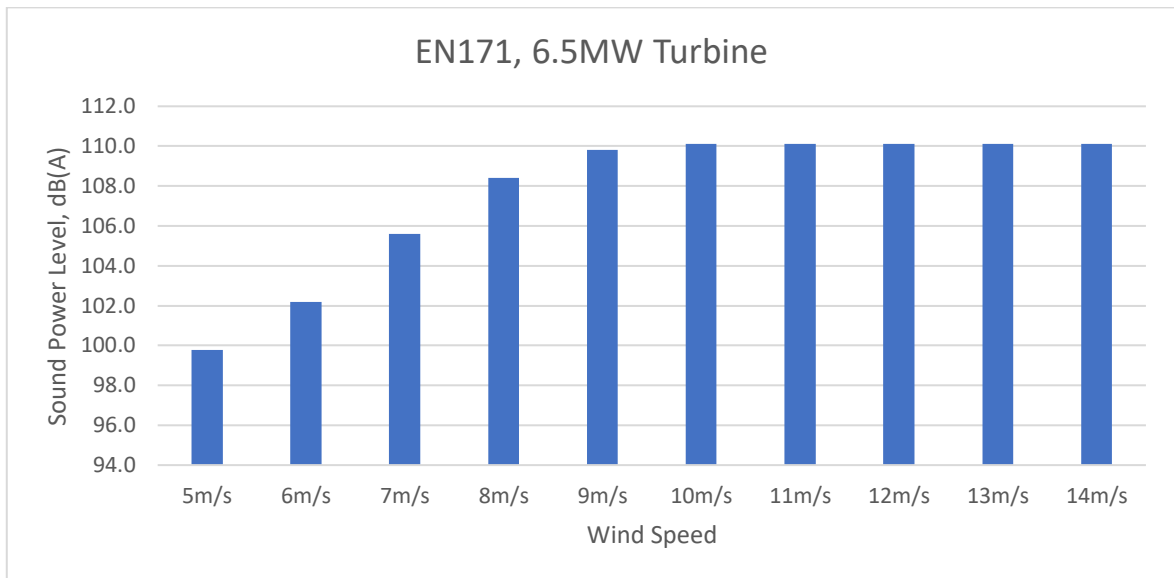
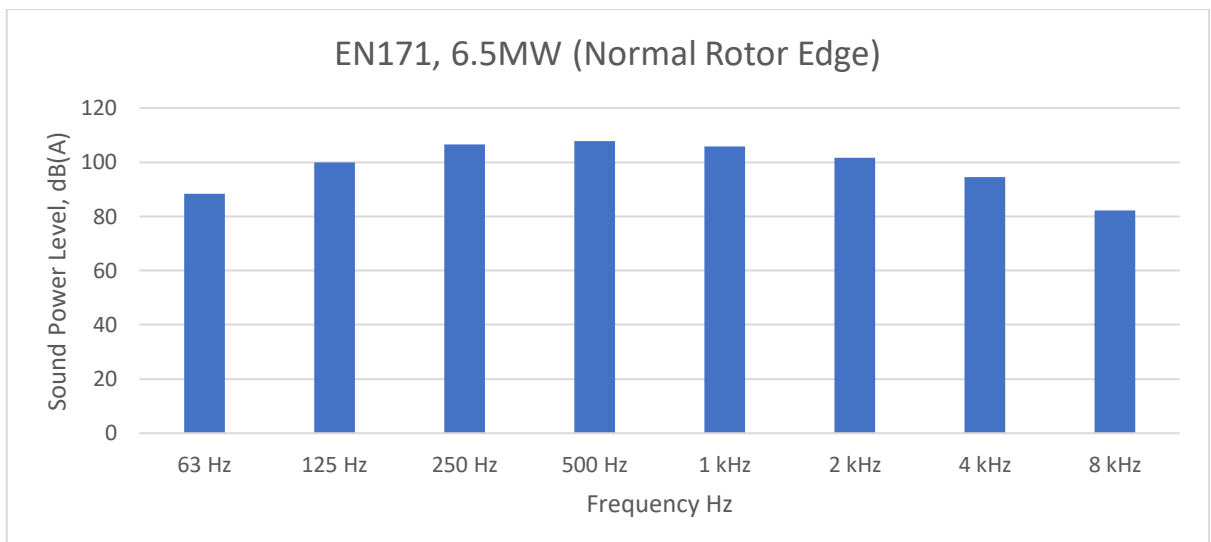


Figure 3.2 EN171 6.5MW Octave Data (10m/s)





- 3.2 The layout is presented in Appendix B. Receptor data is also contained in Appendix B.
- 3.3 All the above sound power levels are guaranteed by the manufacturer to have an uncertainty of +/-2.2 dB.

Other Acoustic Considerations

- 3.4 The IFC guidance does not consider other factors such as tonality, impulsiveness and amplitude modulation (AM). It is understood from the turbine manufacturers' advice that such factors will not be an issue for receptors beyond 300m from the nearest turbine (there are no receptors within 300m of the turbine).

Calculation of Noise Levels at Receptors

- 3.5 Noise levels at the receptors have been calculated using the noise-modelling suite IMMI2021 (recognised by the European Union and the UK Government), in accordance with the ISO 9613 prediction methodology (applied with the above-mentioned calculation modifications).
- 3.6 In addition to the uncertainty adjusted turbine sound power levels used in the calculations, the model also considers the effects of the topographical conditions throughout the area as well as applying a light downwind propagation correction to represent worst case. The model considers the noise 'emission' of each turbine and calculates the accumulative noise level at each receptor in accordance with the ISO9613 methodology discussed in Table 2.1.
- 3.7 The topography model was obtained from the (Space) 'Shuttle Radar Topography Mission', (SRTM), at 30m resolution. Noise levels have been calculated at the first-floor height (4m above ground). None of the receptors fit the 'concave' profile and therefore further corrections have not been added.
- 3.8 The results of the noise model (for Nukus WF) are shown below in Table 3.1. The difference in ground level to the first floor is not significant due to the high noise sources and therefore long slant distances as well as long horizontal distances and the limitations imposed on the ISO9613 methodology set out in Table 2.1. Noise maps are presented in Figures 3.3 to 3.4.

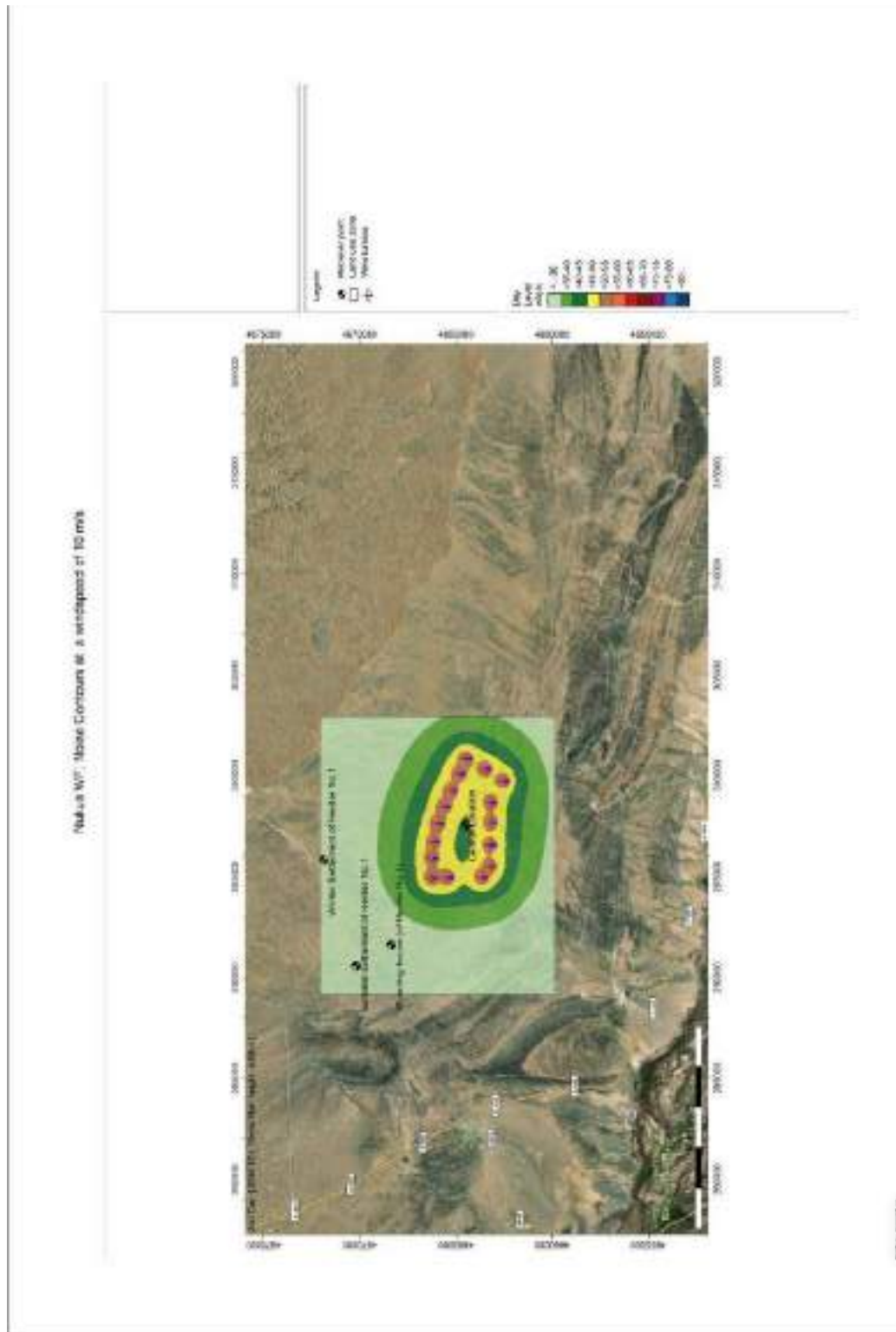


Table 3.1 Noise Levels at receptors, Nukus WF

					Noise Levels at Receptors, $L_{A90,T}$ dB (Day or Night)					
			Nearest Turbine Id	Distance to nearest Turbine	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	> 10 m/s
Receptor	X	Y		m						
Summer Settlement for Herder No. 1	290597	4670160	NU-01	5819	14.6	17.1	20.4	23.3	24.7	25.0
Guarding House for Herder No. 1	291633	4668349	NU-01	3897	19.3	21.8	25.1	28.0	29.4	29.7
Winter Settlement for Herder No. 1	295837	4671843	NU-02	5591	16.8	19.2	22.6	25.4	26.8	27.1
Central Location (for information only)	297548	4664470	NU-13	1288	34.3	36.7	40.1	42.9	44.3	44.6



Figure 3.4 Nukus WF Noise Contours, (10 m/s), $L_{A90,T}$





-
- 3.9 As can be seen from Table 3.1, there are no exceedances of the initial study criteria (it is noted the receptor labelled as the 'central location' is not a sensitive receptor and presented here for information only) and therefore further studies are not required.
- 3.10 It should also be noted that the noise output of a turbine varies with the wind speed and therefore the noise climate attributable to the wind farm will not always be at a worst-case output at 10m/s or greater.

Potential Mitigation Measures

- 3.11 The assessed sensitive receptors do not exceed the IFC initial screening criteria and therefore mitigation measures are not necessary.



4 CONCLUSIONS

- 4.1 A noise assessment for the Nukus WF project has been undertaken. This wind farm comprises of 16 Envision EN171 6.5MW turbines at a hub height of 120m.
- 4.2 The noise assessment has shown that all the sensitive receptors under consideration are within the IFC initial screening criteria. Further noise studies are therefore not necessary.



APPENDIX A – INTRODUCTION TO NOISE

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB.

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs. For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest.

The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq} . This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).



Table A1: Glossary of Terms

Term	Definition
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20 \mu\text{Pa}$.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).



APPENDIX B – WIND FARM LAYOUT & RECEPTOR DETAILS



Nukus WF Wind Farm Project (hub-height 120m)

WTG Description	Easting	Northing	Z
NU-01	294937	4666298	293.4
NU-02	295936	4666268	286.4
NU-03	296741	4666175	273.8
NU-04	297620	4665936	270
NU-05	298460	4665633	269.1
NU-06	299236	4665264	270
NU-07	300057	4664871	278.3
NU-08	300351	4663470	300
NU-09	300852	4664485	290
NU-10	299753	4662551	313.4
NU-11	294942	4665505	297.3
NU-12	298691	4663200	296.6
NU-13	297651	4663181	290
NU-14	296560	4663205	282.4
NU-15	295549	4663286	300
NU-16	294953	4663489	300



Receptor Data

Receptor	Easting	Northing	Z, m
Summer Settlement for Herder No. 1	290597	4670160	335.7
Guarding House for Herder No. 1	291633	4668349	350
Winter Settlement for Herder No. 1	295837	4671843	230
Central Location (for information only)	297548	4664470	275.6

D – SOIL ANALYSIS

Assessment of soil

UZBEKISTAN NUKUS 100 MW WPP PROJECT:

LOCAL SUPPORT IN THE DEVELOPMENT, SUBMISSION AND APPROVAL OF ESIA

CLIENT: 5CAPITALS

DATE: MARCH 2022

Juru Energy Ltd.

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March – 2022

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Abbreviations/Acronyms

ICP-MS – Inductively coupled plasma mass spectrometry

ISE's - Ion-selective electrodes

JE – Juru Energy

MS – Mass spectrometry

SE - State Enterprise

WF – Wind Farm

OHTL – Overhead transmission line

1. Methodology

1.1 Soil contamination survey

Walkover survey was conducted on February 9- 12, 2022 by local baseline expert Oleg Khegay.

1.2 Collection of soil and water samples

5 samples of soil and were collected on February 9- 12, 2022 at agreed locations with 5 Capitals. (Fig.1) In order to assess and study the state of soil contamination, samples from the selected sites were subjected to chemical and mass spectral analysis in certified laboratory.

Sampling was carried out in accordance with the established State standard 17.4.4.02-2017 "Nature protection. Soils. Methods for sampling and preparation of soil for chemical, bacteriological, helminthological analysis".

Table 1 Coordinates of collected soil samples

No.	Sample	Coordinates
1.	S1	42.189798° 60.447786°
2.	S2	42.041725° 60.454557°
3.	S3	42.114028° 60.544833°
4.	S4	42.097640° 60.529456°
5	S5	42.090387° 60.577399°



Figure 1 Location of soil sampling points

Sampling was carried out in accordance with the established State standard 17.4.4.02-2017 "Nature protection. Soils. Methods for sampling and preparation of soil for chemical, bacteriological, helminthological analysis"

2 Collection of soil samples



Figure 2 S1



Figure 3 S 2





Figure 4 S 3



Figure 5 S 4



Figure 6 S 5

3. Laboratory analysis of collected samples and results

3.1. Description of methods for measuring quality indicators of soil and water.

The samples were sent to a “Central laboratory” for analysis of the following parameters:

Table 3. Parameters for qualitative and quantitative analyses

Parameters for soils:	
• Chlorides (Cl⁻) • Nitrates (NO₃) • Metals: - Sodium (Na) - Potassium (K) - Arsenic (As) - Cadmium (Cd) - Chromium (Cr) - Copper (Cu) - Mercury (Hg) - Nickel (Ni) - Ferrum (Fe) - Lead (Pb) - Zinc (Zn)	

Basic physical and chemical methods were used to analyze pollutants:

- **Photometric** – based on chemical conversion of harmful substances (nitrates, aluminum, chromium (+6),) in color-intensive compounds when interacting with corresponding reagents, with subsequent measurements of the density of the colored compounds at a certain wavelength and allowing to make quick measurements with a sufficiently high accuracy;

- **Inductively coupled plasma mass spectrometry (ICP-MS)** – an analytical method that is used to detect metals and several non-metals in liquid samples at very low concentrations. MS analysis is the most sensitive of all modern multi-element analysis methods. The basic principle of mass spectrometry (MS) is to generate ions from inorganic or organic compounds, to distribute these ions by mass-to-charge ratio and to detect their qualitative and quantitative characteristics.

- **Potentiometry** – one of the electroanalytical methods. Potentiometry based on measures the difference in electrode potentials. One electrode is called the reference electrode and has a constant potential, while the other one is an indicator electrode whose potential changes with the composition of the sample. Therefore, the difference of potential between the two electrodes gives an assessment of the composition of the sample. Ion-selective electrodes (ISE's) possess a high degree of selectivity. In the laboratory, the electrode used is specific for chloride ion.

- **titrimetric** – a method of quantitative/mass analysis (chlorides), based on the measurement of the reagent solution volume of a precisely known concentration consumed for the reaction with the substance being determined;

3.2. Results of laboratory analysis

The results of laboratory analysis of the soil are presented in Table 2

Table 2 Results of chemical analysis of soils¹

Name of parameters	Locations					Detectable limits in mg/l	MPC in mg/kg	Compliance with established norms
	SQ1	SQ2	SQ3	SQ4	SQ5			
pH	8,00	8,00	8,00	8,00	8,00	1-14	N/A	N/A
Chloride (as Cl), %	0,062	0,054	0,033	0,046	0,034	N/A	N/A	N/A
Nitrate (NO ₃), mg/dm ³	18,00	28,00	15,00	16,00	13,00	10 ⁻⁶ -100* mg/kg	130.0 (gross content)	Comply
Sodium (Na), mg/kg	12000	8600	10000	8800	8900	40-110000mg/kg	N/A	N/A
Magnesium (Mg), mg/kg	12000	9800	6400	7000	10000	40-110000mg/kg	N/A	N/A
Potassium, mg/kg	16000	14000	18000	19000	16000	80-300000 mg/kg	N/A	N/A
Lead (Pb), mg/kg	13,0	22,0	13,0	12,0	12,0	0.1-4000 mg/kg	32.0	Comply
Manganese (Mn), mg/kg	400	1000	320	360	380	20-100000 mg/kg	1500.0 (gross content)	Comply
Copper (Cu), mg/kg	420	420	380	340	340	1,0-4000 mg/kg	3.0	Does not Comply
Zinc (Zn), mg/kg	45,0	52,0	43,0	43,0	43,0	1,0-4000 mg/kg	23,0	Does not Comply
Chromium (Cr), mg/kg	89,0	87,0	86,0	85,0	84,0	1,0-4000 mg/kg	6.0	Does not Comply
Iron (Fe), mg/kg	40000	73000	33000	38000	69000	60-3000000 mg/kg	N/A	N/A
Mercury (Hg), mg/kg	0.220	0.260	0.220	0.100	0.150	*	2.1	Comply
Nickel (Ni), mg/kg	53,0	81,0	42,0	42,0	74,0	1,0-4000	4.0	Does not Comply
Cadmium (Cd), mg/kg	<0,005	0,022	0,017	0,017	<0,005	0.005-4000 mg/kg	N/A	N/A
Aluminum (Al), mg/kg	49000	47000	47000	48000	51000	20-200000 mg/kg	N/A	N/A
Arsenicum (As) mg/kg	23,0	37,0	20,0	25,0	40,0	0.1-4000 mg/kg	N/A	N/A

¹ This table shows results for chemical parameters that were proposed to 5 C with in initial TP. The lab, in turn, conducted full mass spectrometry analysis for more parameters (only metals). Please refer to Annex for more information.

Annexes

Annex 1. Brief profile of the “Central laboratory”

The state enterprise "Central Laboratory" of the State Committee of the Republic of Uzbekistan on Geology and Mineral Resources began its activity in 1868.

Main activities:

- Development of regulatory documents regulating the procedure for performing analytical work.
- Analysis of soils, rocks, ores, minerals, natural waters.
- Development of measurement techniques.
- Development of standard samples of the composition of rocks, ores, products of technological processing and aqueous solutions of heavy metals.
- Production of acid and alkaline electrolytes.

The main methods of analysis: spectral, assay, chemical, neutron activation, mass spectrometry, mineralogical and all types of preparation of rocks for analysis.

SE "Central Laboratory" in 2015-2020 was accredited by the agency "Uzstandart" for technical competence and independence for compliance with the requirements of the standards O'ZDST ISO/IEC 17025, O'ZDST 16.5 and O'ZDST 16.3 and registered in the State Register of the National Accreditation System of the Republic of Uzbekistan. № UZ.AMT.07.MAI.672

- for the right to conduct tests according to O'z DSt ISO/IEC 17025,
- for the right to conduct the certification of MVI according to O'z DSt 16.5
- for the right to conduct the certification of CO according to O'z DSt 16.

Annex 2 National standards and regulations for soil

In accordance with the SanPiN No. 0272-09 "Sanitary rules and norms for compiling hygienic justifications for soil protection schemes from pollution in Uzbekistan" indicators of sanitary status of soils for enterprises and industrial zones are as follows:

- Ammonium nitrogen
- Nitrate nitrogen
- Chlorides
- pH
- Pesticides
- Heavy metals
- Oil and oil products
- Phenols are volatile
- Sulfur compounds
- Carcinogenic substances
- Radioactive substances
- Thermophilic bacteria
- Escherichia coli bacteria
- Clostridium perfringens
- Helminth eggs and larvae
- Larvae and pupae of synanthropic flies

In accordance with SanPiN № 0191-05 "Maximum allowable concentrations (MPC) and Approximate permissible concentrations of exogenous harmful substances in soil", the MPC of exogenous chemicals in the soils (in mg/kg) is as follows:

According to the general sanitary limiting indicator of harmfulness in mg/kg:	
1. BENZAPIRENE (gross content)	0.02
2. VANADIUM (gross content)	150.0
3. Manganese + VANADIUM (gross content)	1000.0
4. TUNGSTEN (moving forms)	10.0
5. CELTAN	1.0
6 COBALT (mobile forms)	5.0
7. COPPER (mobile forms)	3.0
8. Molybdenum (mobile forms)	10.0
9. NICKEL (mobile forms)	4.0
10. COAL FLOTATION WASTE (OFU) (gross content)	3000.0
11. LEAD (gross content)	32.0
12. SULFUR ELEMENTARY (gross content)	160.0
13. SULFURIC ACID (gross content)	160.0
14. PHOSPHATES	27.2
15. FURFUROL	3.0
16. CHROME (moving forms)	6.0
by air-migration limiting hazard indicator:	
17. ALFAMETHYLSTYROL	0.5
18. BENZENE	0.3
19. ISOPROTTILBENZENE	0.5
20. HYDROGEN SULFUR (gross content)	0.4
21. STYROL	0.1
22. FORMALDEHYDE	0.7
by water-migration limiting hazard indicator:	
23. LIQUID COMPLEX FERTILIZERS (gross content)	80.0
24. INTEGRATED GRANULATED FERTILIZERS (gross content)	120.0
25. Manganese: (gross content) (mobile forms)	1500.0 60.0
26. NITRATES (gross content)	130.0
27. POTASSIUM CHLORIDE (gross content)	560.0
by trans locational limiting hazard indicator:	

28. ACIDS (ortho, -meta, -pa)	0.3
29. ARROW (gross maintenance)	2.0
30. Mercury (gross content)	2.1
31. LEAD + MERCURY (gross content)	20.0+1.0
32. ANTIMONY (gross content)	4.5
33. TOLUOL	0.3
34. FLUORINE (water soluble forms)	10.0
35. ZINC	23.0

Annex 3 Original copy of the Accreditation Certificate

000592



СВИДЕТЕЛЬСТВО
О государственной регистрации юридического лица
(субъекта предпринимательства)

Настоящим подтверждается, что в Единый государственный реестр субъектов предпринимательства внесена запись о создании:

Государственное унитарное предприятия "MARKAZIY LABORATORIYA"
(Полное наименование юридического лица – субъекта предпринимательства с указанием организационно-правовой формы)
ГУП "MARKAZIY LABORATORIYA"
(Сокращенное наименование юридического лица)

23.03.2007 За регистрационным номером: 000592-04
(Число, месяц (полностью), год)

Идентификационный номер налогоплательщика (ИНН): 205174241

Организационно-правовая форма: Государственное унитарное предприятие

Местонахождение: Ташкентская область, Зангиатинский район, Эшангузар, А.ТЕМУР МФУ, MUSTAQILLIK KO'CHASI, 21-UY.

Свидетельство выдано: Ташкентская область, Зангиатинский район, ЦЕНТР ГОСУДАРСТВЕННЫХ УСЛУГ
(Полное наименование регистрирующего органа)



Unofficial translation of the Accreditation Certificate

THE CERTIFICATE

State registration of a legal entity (business entity)

It is hereby confirmed that the Unified State Register of Business Entities contains an entry on the creation of:

State unitary enterprise "MARKAZIY LABORATORIYA"

(Full name of legal entity - business entity, indicating the organizational and legal form)

SUE "MARKAZIY LABORATORIYA"

(Abbreviated name of legal person)

23.03.2007	registration number:	000592-04
(Number, month (cursive), year)		

Tax Identification Number (TIN):	205174241

Organizational-legal forms:	State unitary enterprise
Location:	Tashkent region, Zangiatinsk district, Eshanguzar, A.TEMUR MFY, MUSTAQILLIK STREET, 21-house
Issued by:	Tashkent region, Zangiata district, STATE SERVICES CENTER
(Full name of registering authority):	

Annex 4. Original copy of Protocol of chemistry analysis of soil

Unofficial translate of Protocol of chemistry analysis of water

Uzbekgeologorazvedka JSC "Central Laboratory"
111800, Tashkent region, Zangiatinsk district, Eshanguzar, Mustakillik street, 21
tel.933805415, 702027142

"Approved"
 Director of the
 SE "Central Laboratory"
 Mihaylov S.V.
 "8" September 2021

Protocol of measurements No. 66

for measuring according to letter No. JEC-OUT-22-70 of 17/02/2022 on testing of soil samples according to the State standard 26423-85, 26425-85

Customer - OOO JURU ENERGY CONSULTING

Marking and labeling data of the test object:

No.1 to No.5 – Soil

Date of receipt – 17-02-2022; of samples 5

Purpose, objectives of the tests - analysis of water according to the customer's assignment;

Environmental conditions: temperature 21,0°C, humidity 40%

Measuring instruments: scales AS 220/C Radwag, ionometer I-160MI, electronic hygrometer NTS-2.

The tests were carried out: 10-03-2022r -- 16-03-2022

Results of the analysis

Order No. 113 of-17-02-2022

No.	Parameters	Units	ND for measurements	Actual value				
				S1	S 2	S 3	S 4	S 5
				No.1	No.2	No.3	No.4	No.5
1	Hydrogen indicator	pH	26423-85	8,00	8,00	8,00	8,00	8,00
2	Chlorides	% ²	26423-85	0,062	0,054	0,033	0,046	0,034
3	NO3	mg/dm ³	-	28,00	15,00	16,00	13,00	28,00

Head of CAL (Chemical and Analytical Laboratory)7

Gusanova

² mass fraction of chloride ion is expressed in % per 100 g of soil, according to GOST 26425-85.

E – ECOLOGY REPORTS

Nukus 100 MW Wind Farm Bat Monitoring Final Report

**NUKUS WIND FARM:
BAT MONITORING
CLIENT: 5 CAPITALS
Date: November 2022**

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Materials and methods

Study area and bat calls recording

We used the stationary bat detectors Wildlife Acoustics Song Meter SM4 to monitor bats activity in Spring, Summer and Autumn (May, June, July, August, September, October) at four locations within the project site and additionally on two transects (Table 1, Fig. 1S in Attachments).

Table 1. Detector locations

Locations	Dates of work						Coordinates	
	May	June	July	August	September	October	°N	°E
SD1	22-23	12-13	9-10	7-8	24-25	15-16	42,11902	60,54111
SD2	22-23	12-13	9-10	7-8	24-25	15-16	42,10449	60,57647
SD3	22-23	12-13	9-10	7-8	24-25	15-16	42,10399	60,52
SD4	22-23	12-13	9-10	7-8	24-25	15-16	42,09036	60,5779
1 Transect	22	11	9	7	25	27	See Fig. 1S (Attachments)	
2 Transect	21	12	10	8	24	15	See Fig. 1S (Attachments)	

Detectors recorded data from 18:00 to 6:00.

Identification of bat calls

According to literature data about bats of Uzbekistan (Bogdanov, 1953; Benda et al., 2011; Gritsina et al., 2013), 9 species of bats are most likely to inhabit Nukus project area (Tabl. 2) as well as semi-arid ecosystems: *Rhinolophus bocharicus*, *Eptesicus bottae*, *Eptesicus gobiensis*, *Eptesicus serotinus*, *Hypsugo savii*, *Myotis davidii*, *Nyctalus noctula*, *Pipistrellus pipistrellus*, *Vespertilio murinus*.

Table 2. Species that were more likely to be found in the vicinity of Nukus (semi-arid ecosystems).

Species	IUCN Red List	Red Book of the Republic of Uzbekistan (2019)	Parameters of ultrasound calls (references)	Basic flight information (flight height; presence of migrations)	Level of collision risk (Rodrigues et al., 2015)
<i>Rhinolophus bocharicus</i>	LC (Least concern)	absent	no data (CF-type calls)	Most likely, <i>R. bocharicus</i> is a sedentary species, foraging low from the ground (like other horseshoe bats (Bogdanov, 1953; Rodrigues et al., 2015)).	low
<i>Eptesicus bottae</i>	LC	absent	Benda et al. (2012); Hackett et al. (2016)	<i>E. bottae</i> ranks among small- to medium-sized bats hunting its prey mostly in a slow hawking flight (Benda et al., 2012);	medium

				probably sedentary.	
<i>Eptesicus gobiensis</i>	LC	absent	no data	no data	medium
<i>Eptesicus serotinus</i>	LC	absent	Benda et al. (2012)	Medium height (Roemer et al., 2017); usually sedentary (Dietz, Kiefer, 2016)	medium
<i>Hypsugo savii</i>	LC	absent	Benda et al. (2012)	Medium height (Roemer et al., 2017); no data on migration (Dietz, Kiefer, 2016)	high
<i>Myotis davidii</i>	LC	absent	no data	Low height (Roemer et al., 2017); probably sedentary	low
<i>Nyctalus noctula</i>	LC	absent	Barataud (2015)	High height (Roemer et al., 2017); migrate (Dietz, Kiefer, 2016)	high
<i>Pipistrellus pipistrellus</i>	LC	absent	Benda et al. (2012)	Medium height (Roemer et al., 2017; Wellig et al., 2018); sedentary (Bogdanov, 1953; Dietz, Kiefer, 2016)	high
<i>Vespertilio murinus</i>	LC	absent	Barataud (2015)	High height (Roemer et al., 2017); usually migrate (Dietz, Kiefer, 2016)	high

Another 11 species known for Uzbekistan and neighboring countries (Tabl. 3) may be found in Nukus also (Benda et al., 2011; Benda et al., 2012; Dietz, Kiefer, 2016): *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Plecotus* sp. (Gritsina et al., 2013), *Myotis bucharensis*, *Myotis emarginatus*, *Myotis blythii*, *Myotis capaccinii*, *Barbastella caspica*, *Pipistrellus kuhlii*, *Otonycteris leucophaea*¹, *Tadarida teniotis*.

Table 3. The bat species inhabiting in Uzbekistan and neighboring countries and can be found in the vicinity of Nukus.

Species	IUCN Red List	Red Book of the Republic of Uzbekistan (2019)	Parameter of ultrasound calls	Basic flight information (flight height; presence of migrations)	Level of collision risk (Rodriguez et al., 2015)
<i>Rhinolophus ferrumequinum</i>	LC	absent	Benda et al. (2012)	Low height (Roemer et al., 2017); sedentary (Dietz, Kiefer, 2016)	low

¹ *Otonycteris hemprichi* does not inhabit Uzbekistan (Benda et al., 2011). It was indicated for Uzbekistan in the 20th century (Bogdanov, 1953), when the species *Otonycteris hemprichi* and *Otonycteris leucophaea* were not distinguished. Only *Otonycteris leucophaea* lives in Uzbekistan according to the modern concepts of taxonomists. From a formal point of view, this is a different species. Most likely, the authors of the essays in the Red Book of Uzbekistan (2019), have not being familiar with modern data (for example, Benda et al., 2011), and wrote down an "outdated" name that currently refers to other animals found, for example, in Iran (Benda et al., 2012). Both of these species are found in Iran.

<i>Rhinolophus hipposideros</i>	LC	Vulnerable, declining 2(VU:D)	Benda et al. (2012)	Low height (Roemer et al., 2017); sedentary (Dietz, Kiefer, 2016)	low
<i>Plecotus</i> sp. (Gritsina et al., 2013)	?	absent	Barataud (2015), Benda et al. (2012)	Low height (Roemer et al., 2017); sedentary	low
<i>Myotis bucharensis</i>	DD (data deficient)	Critically Endangered 1(CR)	no data	Low height (Roemer et al., 2017); probably sedentary	low
<i>Myotis emarginatus</i>	LC	absent	Barataud (2015)	Low height (Roemer et al., 2017); sedentary (Dietz, Kiefer, 2016)	low
<i>Myotis blythii</i>	LC	absent	Benda et al. (2012)	Low height (Wellig et al., 2018); sedentary (Dietz, Kiefer, 2016)	low
<i>Myotis capaccinii</i> (?)	VU (vulnerable)	absent	Benda et al. (2012)	Low height; short to middle-range migrant (Dietz, Kiefer, 2016)	low
<i>Barbastella caspica</i> (<i>Barbastella leucomelas</i>)	LC	absent	Benda et al. (2012); Hackett et al. (2016)	Probably low height; probably sedentary	medium
<i>Pipistrellus kuhlii</i>	LC	absent	Benda et al. (2012)	Low height (Roemer et al., 2017); sedentary (Dietz, Kiefer, 2016)	high
<i>Otonycteris leucophaea</i>	DD	Vulnerable, naturally rare 2(VU:R)	no data	Low height (Benda et al., 2012), probably sedentary	unknown
<i>Tadarida teniotis</i>	LC	Vulnerable, naturally rare 2(VU:R)	Benda et al. (2012)	High height (Wellig et al., 2018); no seasonal migration, foraging area up to 100 km distant from summer roost (Dietz, Kiefer, 2016)	high

Some of bat species inhabiting Uzbekistan are found in Europe also, and the parameters of ultrasound calls are known for the European populations of these species (Barataud, 2015; Dietz, Kiefer, 2016). For some bats of Uzbekistan, the parameters of ultrasonic calls are not known (Tabl. 2, 3). Determination of these species according ultrasonic calls is a complex process since manual identification is required.

For identification of bats by acoustic recordings we used Kaleidoscope Pro Auto Analysis program with "preloaded" parameters of ultrasonic calls from "European" bats found in

Uzbekistan for the primary processing of audio recordings. After that, we used the BatSound 4 program to measure the call parameters and check the identification of bat calls made by the Kaleidoscope Pro Auto Analysis program. We used bat calls parameters known for European bat populations (Barataud, 2015) and bat species from neighboring countries for Uzbekistan (Benda et al., 2012).

We identified bat calls to species whenever it was possible (the term “bat call” refers to one file with any bat species calls). Because the “border” between *Eptesicus serotinus* and *Eptesicus bottae* is unknown; we identified their calls only up to the genus level (*Eptesicus* sp.).

After that, for all bat calls we calculated "Relative abundance" and acoustic activity index (AI). Relative abundance is the frequency at which calls of some species are recorded among all types of calls (excluding noise, social calls and unidentified calls). Acoustic activity index (AI) is the average number of calls registered on one location for one day of monitoring (or 1 km of route for transects).

Results

The detectors recorded 3182 files (13.8 GB) during the entire operation period (Tabl. 4). Most of the files contained noises, not bats ultrasound calls. Therefore, an automatic filtering of calls from noise was carried out. Noisy files were excluded from work. Bat calls were recorded in 4 of the 4 locations where static detectors were installed (Table 4).

Table 4. The total number of files (include noisy files) recorded by passive detectors in locations.

Season	Locations	Dates	Work nights	Amount	
				files	Gb
Spring	SD1	22-23 May	2	52	0.21
Spring	SD2	22-23 May	2	94	0.26
Spring	SD3	22-23 May	2	99	0.42
Spring	SD4	22-23 May	2	61	0.16
Spring	1 Transect	22 May		67	0.19
Spring	2 Transect	21 May		19	0.03
Summer	SD1	12-13 June	2	50	0.22
Summer	SD2	12-13 June	2	24	0.08
Summer	SD3	12-13 June	2	75	0.33
Summer	SD4	12-13 June	2	21	0.09
Summer	1 Transect	11 June		60	0.33
Summer	2 Transect	12 June		141	1.12
Summer	SD1	9-10 July	2	78	0.35
Summer	SD2	9-10 July	2	41	0.18
Summer	SD3	9-10 July	2	125	0.49
Summer	SD4	9-10 July	2	34	0.13
Summer	1 Transect	9 July		130	1.3
Summer	2 Transect	10 July		80	0.7
Summer	SD1	7-8 August	2	63	0.25
Summer	SD2	7-8 August	2	51	0.2
Summer	SD3	7-8 August	2	48	0.19
Summer	SD4	7-8 August	2	48	0.19
Summer	1 Transect	7 August		70	0.59

Summer	2 Transect	8 August		103	0.87
Autumn	SD1	24-25 September	2	180	0.53
Autumn	SD2	24-25 September	2	79	0.19
Autumn	SD3	24-25 September	2	488	1.36
Autumn	SD4	24-25 September	2	427	0.99
Autumn	1 Transect	25 September		66	0.53
Autumn	2 Transect	24 September		91	0.73
Autumn	SD1	15-16 October	2	10	0.02
Autumn	SD2	15-16 October	2	11	0.03
Autumn	SD3	15-16 October	2	17	0.03
Autumn	SD4	15-16 October	2	45	0.11
Autumn	1 Transect	27 October		79	0.33
Autumn	2 Transect	15 October		55	0.1
	Total:		24	3182	13.8

The species composition of bats includes 2-3 species of bats: *Eptesicus sp.* (*Eptesicus bottae* + *Eptesicus serotinus*) and *Pipistrellus pipistrellus*. *Eptesicus sp.* – this is the most common species on the territory of the wind farm. *Pipistrellus pipistrellus* is less common. We analyzed bats calls number change at all locations during the period of operation of the detectors. Bat activity varied in different locations (Table 5). Evaluation of bat activity by stationary points and transects gives similar results (Table 6; Fig.1a, 1b).

Table 5. Bat calls recorded by detectors in locations.

Locations	Dates	Work nights	Eptesicus sp.	Pipistrellus pipistrellus	Total	Abundance, %		AI, calls/night
						Eptesicus sp.	P. pipistrellus	
SD1	22-23 May	2	28	19	47	59,6	40,4	24
SD2	22-23 May	2	6	35	41	14,6	85,4	21
SD3	22-23 May	2	42	38	80	52,5	47,5	40
SD4	22-23 May	2	4	24	28	14,3	85,7	14
Total, May:		8	80	116	196	40,8	59,2	24,5
SD1	12-13 June	2	29	21	50	58	42	25
SD2	12-13 June	2	10	13	23	43,5	56,5	12
SD3	12-13 June	2	35	39	74	47,3	52,7	37
SD4	12-13 June	2	10	11	21	47,6	52,4	11
Total, June:		8	84	84	168	50	50	21
SD1	9-10 July	2	75	1	76	98,7	1,3	38
SD2	9-10 July	2	37	2	39	94,9	5,1	19,5
SD3	9-10 July	2	93	1	94	98,9	1,1	47
SD4	9-10 July	2	29	3	32	90,6	9,4	16
Total, July:		8	234	7	241	97,1	2,9	30,1
SD1	7-8 August	2	32	26	58	55,2	44,8	29
SD2	7-8 August	2	22	20	42	52,4	47,6	21
SD3	7-8 August	2	22	25	47	46,8	53,2	23,5
SD4	7-8 August	2	23	22	45	51,1	48,9	22,5

<u>Total, August:</u>		<u>8</u>	<u>99</u>	<u>93</u>	<u>192</u>	<u>51,6</u>	<u>48,4</u>	<u>19,2</u>
SD1	24-25 September	2	36	17	53	67,9	32,1	26,5
SD2	24-25 September	2	3	11	14	21,4	78,6	7
SD3	24-25 September	2	84	9	93	90,3	9,7	46,5
SD4	24-25 September	2	5	12	17	29,4	70,6	8,5
<u>Total, September:</u>		<u>8</u>	<u>128</u>	<u>49</u>	<u>177</u>	<u>72,3</u>	<u>27,7</u>	<u>22,1</u>
SD1	15-16 October	2	0	1	1	0,0	0,0	0,5
SD2	15-16 October	2	2	2	4	50,0	50,0	2
SD3	15-16 October	2	0	1	1	0,0	100,0	0,5
SD4	15-16 October	2	5	3	8	62,5	37,5	4
<u>Total, October:</u>		<u>8</u>	<u>7</u>	<u>7</u>	<u>14</u>	<u>50,0</u>	<u>50,0</u>	<u>1,4</u>
Total, All season:		<u>48</u>	<u>632</u>	<u>356</u>	<u>988</u>	<u>64,0</u>	<u>36,0</u>	<u>20,6</u>

The average bat activity fluctuated during first 6 months of a 7 months long survey period. The highest bat activity was recorded in midsummer (July). It had reduced significantly in October, prior to the hibernation.

Bat activity according data registration from the static detectors

The activity of bats varied in different locations (Tab. 5). The highest level of bat activity (AI=47) was recorded at location "SD3" in July and September. The lowest level of bat activity (AI=0.5) was noted in October at location "SD1" and "SD3". In the rest of the park, the activity level ranged from AI = 2 (October 15-16) at location "SD2" to AI = 38 at location "SD1" (July 9-10). The lowest level of bat activity was at all static detectors in October.

Bat activity according to detectors from transects

According to ultrasound monitoring data, the activity of bats near transects changed over time. The peak of bat activity occurred on transect 1 in May and July (Tabl. 6), when AI was recorded equal to 3.2-3.3 bat call per 1 km of transect. Typically, the activity of bats ranges from 0-1.3 calls per kilometer of the route.

The calls of the genus *Eptesicus* (*Eptesicus bottae* + *Eptesicus serotinus*) were most often recorded in the territory of the planned wind farm. They were recorded on 10 transects out of 12. The calls of *P. pipistrellus* were less common (on five transects out of 12).

Table 6. Bat calls recorded by detectors on transects.

N tran-sect	Dates	Length of transect (km)	Eptesicus sp.	Pipistrellus pipistrellus	Abundance, %			AI, calls /km
					Total	Eptesicus sp.	P. pipistrellus	
1	22 May	6	1	19	20	5	95	3,3
2	21 May	8	0	0	0	0	0	0
Total, May:		<u>14</u>	<u>1</u>	<u>19</u>	<u>20</u>	<u>5</u>	<u>95</u>	<u>1,4</u>
1	11 June	6	8	0	8	100	0	1,3
2	12 June	8	2	5	7	28,6	71,4	0,9
Total, June:		<u>14</u>	<u>10</u>	<u>5</u>	<u>15</u>	<u>66,7</u>	<u>33,3</u>	<u>1,1</u>
1	9 July	6	7	12	19	36,8	63,2	3,2
2	10 July	8	2	0	2	100	0	0,3

Total, July:		<u>14</u>	<u>9</u>	<u>12</u>	<u>21</u>	<u>42,9</u>	<u>57,1</u>	<u>1,5</u>
1	7 August	6	4	0	4	100,0	0,0	0,3
2	8 August	8	4	3	7	57,1	42,9	0,4
Total, August:		<u>14</u>	<u>8</u>	<u>3</u>	<u>11</u>	<u>72,7</u>	<u>27,3</u>	<u>0,4</u>
1	25 September	6	7	0	7	100,0	0,0	0,6
2	24 September	8	9	6	15	60,0	40,0	0,9
Total, September:		<u>14</u>	<u>16</u>	<u>6</u>	<u>22</u>	<u>72,7</u>	<u>27,3</u>	<u>0,8</u>
1	27 October	6	0	0	0	0,0	0,0	0,0
2	15 October	8	2	0	2	0,0	0,0	0,1
Total, October:		<u>14</u>	<u>2</u>	<u>0</u>	<u>2</u>	<u>100,0</u>	<u>0,0</u>	<u>0,1</u>
Total, All season:		<u>84</u>	<u>46</u>	<u>45</u>	<u>91</u>	<u>50,5</u>	<u>49,5</u>	<u>0,54</u>

The dynamics of average bat activity on transects (Fig. 1b) was similar to those of stationary points (Fig. 1a). According to the averaged data, the highest activity of bats was noted in July (AI=1.5). In October, the activity level of bats dropped practically to zero.

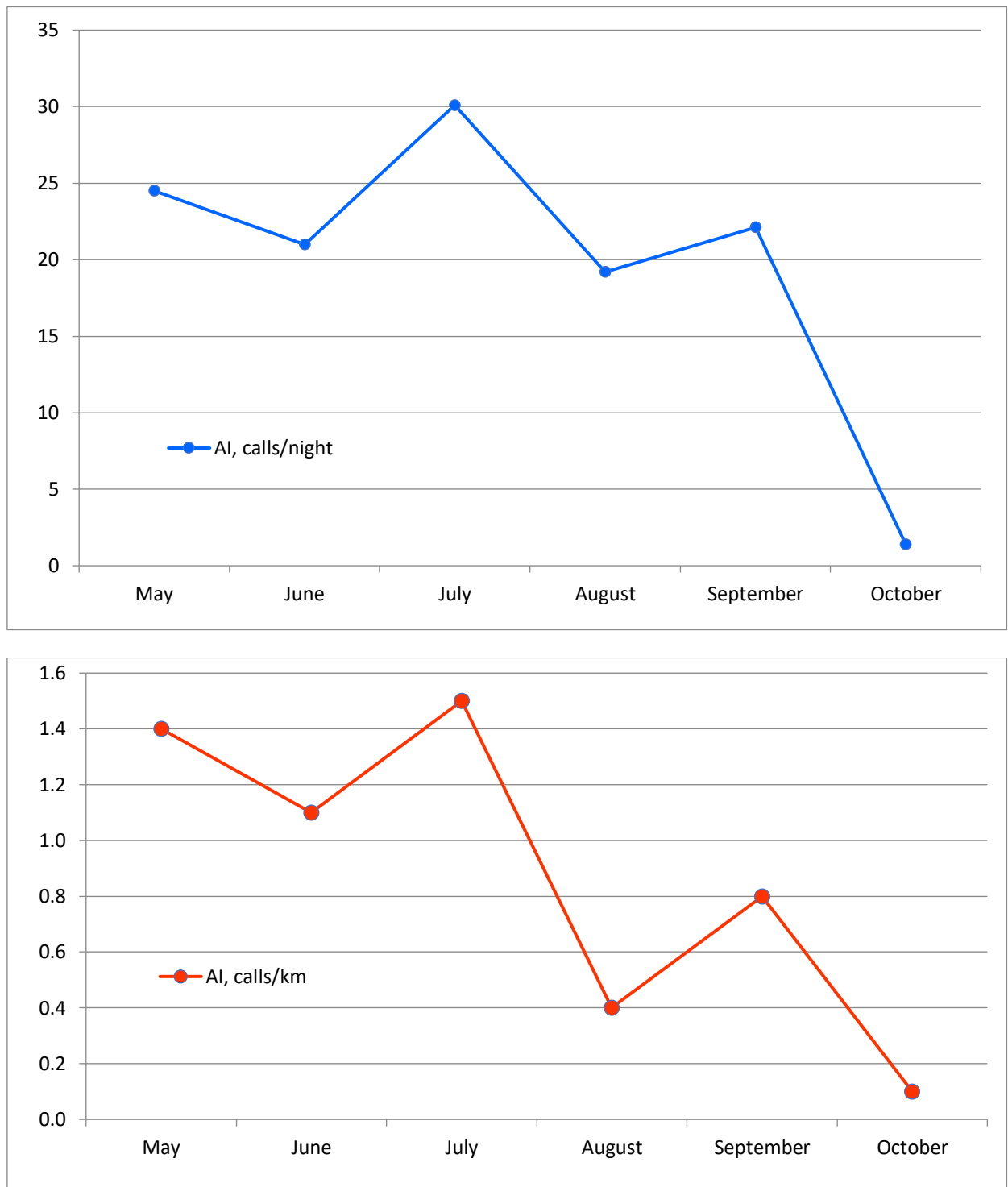


Figure. **1a** (top graph) – average bats activity from the static detectors by months; **1b** (bottom graph) – average bats activity according to detectors from transects by months.

Discussion

Ultrasonic calls of 2-3 species of bats were found in the project area: *Eptesicus sp.* (*Eptesicus bottae* + *Eptesicus serotinus*) and *Pipistrellus pipistrellus*. *Eptesicus sp.* – this is the most common species on the territory of the wind farm according to the accounting data on passive detectors. The calls of *P. pipistrellus* were less common.

All bat species, which calls were detected on the project area, are classified as LC ("Least concern", IUCN) and are not considered threatened. The Red Book of the Republic of Uzbekistan (2019) includes four bat species: *Rhinolophus hipposideros* (VU), *Tadarida teniotis* (VU), *Otonycteris hemprichi* (VU)², *Myotis burcharensis* (CE). The fact that none of these listed species was detected during the acoustic monitoring effort provides an indication that the Project is not likely to generate impacts to any protected species of bats.

But bats, whose calls have been recorded at the site, have a risk of collision with the wind turbine.

The two medium-flying species of the genus *Eptesicus* and *P. pipistrellus* have the medium risk of collisions (Roemer et al., 2017; Wellig et al., 2018).

According to monitoring data, bat activity is highest in the northwestern part of the site (stationary detectors SD1 and SD-3). Data collected from May to September show little fluctuation in bat activity in the project area, ranging from 19 to 30 calls per night. In October, the activity of bats reduced greatly. Most likely, bats fly away for the hibernating at this time. The greatest potential threat of collisions with wind turbine is possible in the northwestern part of the site during the entire warm period.

The potential negative impact of wind turbines on bats (death from collisions, barotrauma) in the project area can be minimized if use automated ultrasonic detectors to estimate the activity and identity of bats in the zone of highest mortality risk at wind turbine in order to formulate mitigation schemes, such as increased curtailment speeds to prevent casualties (Voigt et al., 2021). The economic damage from such stops will be minimal, because high bats activity in the project area most likely occurs at nights with low wind speed, when the efficiency of power generation is low (Arnett et al., 2011). As known, increase of the cut-in wind speed and / or feathering of blades during low wind speed conditions reduces bat mortality (Arnett et al., 2011). Cut-in wind speed and / or feathering of blades can be especially important in days when a high activity of bats is registered. This will prevent massive death of bats and the associated risks of "environmental" damage.

² *Otonycteris hemprichi* does not inhabit Uzbekistan (Benda et al., 2011). It was indicated for Uzbekistan in the 20th century (Bogdanov, 1953), when the species *Otonycteris hemprichi* and *Otonycteris leucophaea* were not distinguished. Only *Otonycteris leucophaea* lives in Uzbekistan according to the modern concepts of taxonomists. From a formal point of view, this is a different species. Most likely, the authors of the essays in the Red Book of Uzbekistan (2019), have not being familiar with modern data (for example, Benda et al., 2011), and wrote down an "outdated" name that currently refers to other animals found, for example, in Iran (Benda et al., 2012). Both of these species are found in Iran.

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Attachments

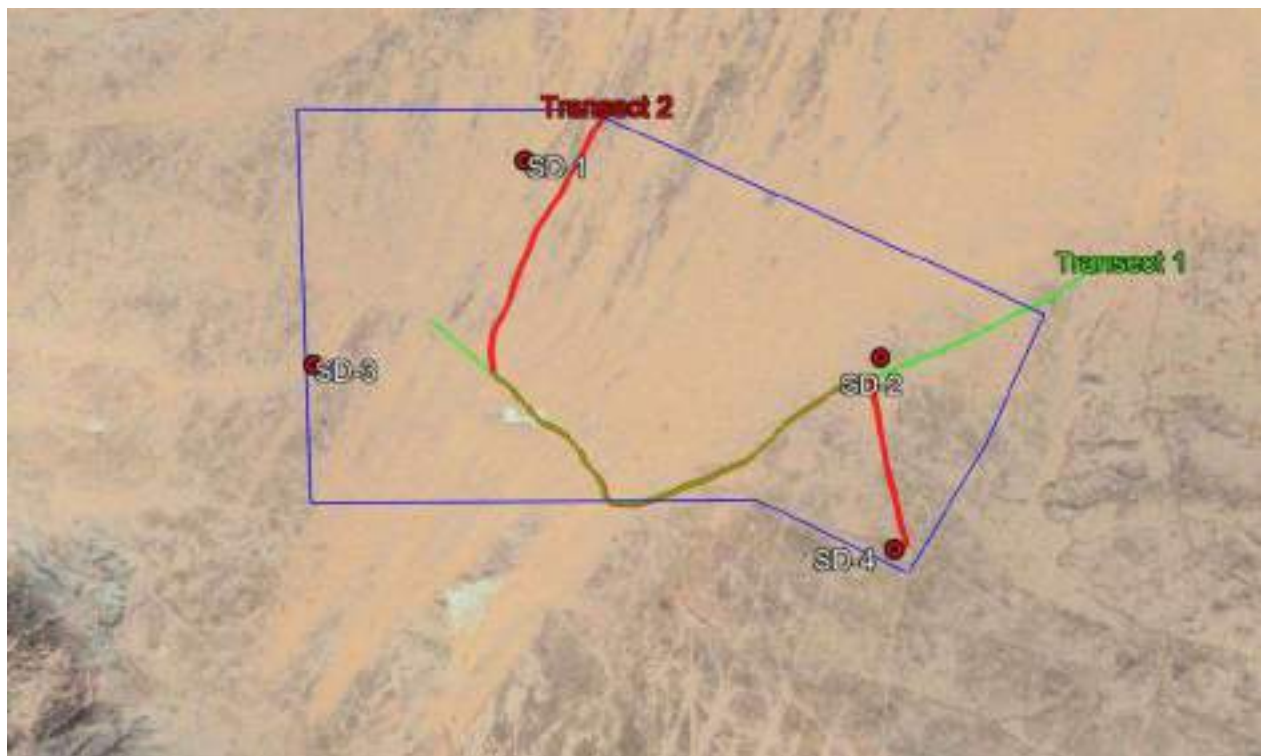


Fig. 1S. Locations of bat detectors (SD) and transects (green line – transect 1, red line – transect 2).

BIRD VP SURVEY REPORT AUTUMN 2022

**FOR THE PLANNED OHTL ASSOCIATED WITH
NUKUS 100 MW WIND FARM**



Client: 5 Capitals
Date: November 2022

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Introduction

In recent years, Uzbekistan has paid special attention to the development of renewable energy sources, which is reflected in the Law of the Republic of Uzbekistan No. ZRU-539 of 21.05.2019 "On use of renewable energy sources", as well as in the Decree of the President of the Republic of Uzbekistan No. PP-4422 of August 22, 2019 "On accelerated measures to improve energy efficiency of economic sectors and social sphere, introduction of energy-saving technologies and development of renewable energy sources".

In the framework of the Nukus 100 MW Wind Farm Project, bird survey was conducted along the planned OHTL in autumn (September, October, November) 2022. The purpose of ornithological monitoring was to conduct systematic field studies at 3 vantage points to assess bird species composition that occur along the planned OHTL, and also to identify birds of conservation interest under IUCN and Uzbekistan Redlist. This report presents the main findings of the survey.

Research Methods

Target species for the survey were identified during baseline survey conducted on the project site in April 2020 - April 2021. As a result of the observations, species of high concern were categorized as 'target species' and 'secondary species', the rest of the observed species were referred to as 'other species'. The list of species of high concern is given in the table below.

Table 1 List of target species and secondary species. Status category abbreviations are as follows: EN- endangered; VU – vulnerable; LC – least concern.

No	Latin name	English name	Uzbekistan Red Data Book status	IUCN Red List status
Target species				
1	<i>Neophron percnopterus</i>	Egyptian Vulture	VU	EN
2	<i>Aquila nipalensis</i>	Steppe Eagle	VU	EN
3	<i>Aquila heliaca</i>	Imperial Eagle	VU	VU
5	<i>Falco vespertinus</i>	Red-footed Falcon		VU
4	<i>Aquila chrysaetos</i>	Golden Eagle	VU	LC
Secondary species				
6	<i>Grus grus</i>	Common Crane	Not included	LC
7	<i>Circus aeruginosus</i>	Western Marsh-Harrier	Not included	LC
8	<i>Circus cyaneus</i>	Hen Harrier	Not included	LC
9	<i>Buteo lagopus</i>	Rough-legged Buzzard	Not included	LC
10	<i>Buteo buteo</i>	Common Buzzard	Not included	LC
11	<i>Buteo rufinus</i>	Long-legged Buzzard	Not included	LC
12	<i>Falco tinnunculus</i>	Common Kestrel	Not included	LC

VP survey method generally followed SNH (2017) guidance for wind farm bird assessments, minus the elements that are specifically driven by the data requirements of collision risk modelling.

Observations were made at 3 Vantage Points (VP) (Table 2). The duration of observations at each VP was 2 hours. Total duration of observations at one VP was 6 hours for the whole survey period, total duration for three VPs was 18 hours. The range of detection and detection of large species of birds of prey was up to 2 km, and small passerines from 50 to 100 m. The flight directions and altitude were taken into account.

During the observations, photographs and short video footage of birds were taken, which is used to confirm the correct identification of species and to obtain additional data on the number of individuals. The birds were observed through 10x binoculars and 60x Viking telescope. At all vantage points the coordinates were determined with the help of GPS "Garmin".

Points and numbering for VP survey in the project area have been agreed with Juru Energy. The points are located so as to cover the territory as completely as possible (Figure 1). The radius of observation areas was 2 km.



Figure 1. Location of Vantage points

Table 2. Summary of the Vantage Point autumn survey

Number	Coordinates	Date of observations	Duration of observations
Vantage points			
VP №1	42.036756 °N 60.446168 °E	25 September 16 October 6 November	6 hours
VP №2	42° 3'55.41°N 60°28'33.62°E (new VP)	25 September 16 October 6 November	6 hours
VP №3	42.083162 °N 60.544998 °E	25 September 16 October 6 November	6 hours

When the target species were found at observation points within a radius of 2 km, their quantity, time of detection, flight altitude, approximate distance as well as direction of flight were determined. For other species only detection time, quantity and flight altitude were determined. If possible, the observed birds were photographed.

Site Description

The project area is located on the territory of Karauzak district 120-140 km south of Nukus. The landscape of the project area is steppe and arid. The project area is located on the territory of the Sultanuizdag mountain range. Sultanuizdag (Uzbek: Sulton Uvays tizmasi) is a mountain range in Karakalpakstan (Uzbekistan), on the right bank of the Amu Darya. The range is located in the extreme southwest of Kyzylkum, separating the desert from the valley of the Amu Darya River. The length is over 50 km, the width is up to 25 km. The ridge has an almost latitudinal stretch in the east, which is replaced by a north-westerly one in its western part (Figure 2).



Figure 2: Sultanuizdag Mountain range

The maximum height reaches 473 metres. The massif consists of ridges composed of quartzite, gneiss, marble with granodiorite intrusions. The southern and western slopes are steep, while the northern and eastern slopes are gentler. Desert landscapes predominate. The annual precipitation is 80-100 mm. The annual temperature is 12-13°C, the average temperature in January is -5°C, -8°C, July 26-28°C. There is no constant running water. The valleys that cut through the ridge are completely waterless, very hot and windless in summer.

Accordingly, steppe, desert and mountain animal and plant species are found here. There are no wetlands in the area. During the migration seasons, however, other biotopes can be found. The gullies of the Sultanuizdag Upland are shelters for mammals and reptiles from critical temperatures and nesting places for birds.

The largest areas in Sultanuizdag are occupied by sagebrush formation. In the areas with compacted sands, white saxauls were widespread. These areas are characterized by large masses of acacia

trees, dense saxaul and shrub thickets and motley grasses. This biogeocenosis is favourable for nesting, egg laying, habitat and resting places for passerine birds.

A special group of plants from the project area are ephemeroïds, annual herbaceous plants that finish their development in a very short wet spring, and ephemeroïds, perennial herbs that flower in spring and die off in summer, leaving only underground rhizomes, bulbs and tubers. Medicinal plants, such as stinking ferula and garmala, are to be found.

The animal life in the northern part of the Kyzylkum desert is represented by typical desert species. Psammophilous species predominate here. Among reptiles, common here are the Central Asian tortoise, steppe agama, lizard, arrow snake; among birds there are falconiformes and passerines. It is important to note that cattle breeding or herding is developed here, shepherds build their yurts and they take care of their sheep, cows, horses and camels all year round.

Results from Vantage Points

According to the results of the ornithological survey, 30 bird species belonging to 6 orders (Table 3) were recorded at 3 Vantage points. These include the following species: *Circus cyaneus*, *Buteo lagopus*, *Buteo rufinus*, *Buteo buteo*, *Falco tinnunculus*, *Alektoris chukar*, *Grus grus*, *Pterocles orientalis*, *Columba livia*, *Bubo bubo*, *Athene noctua*, *Ammomanes deserti*, *Galerida cristata*, *Calandrella brachydactyla*, *Calandrella rufescens*, *Motacilla alba*, *Lanius excubitor*, *Acridotheres tristis*, *Pica pica*, *Corvus monedula*, *Corvus frugilegus*, *Corvus corone*, *Corvus cornix*, *Oenanthe isabellina*, *Oenanthe deserti*, *Luscinia svecica*, *Turdus philomelos*, *Passer montanus*, *Petronia petronia* u *Bucanetes githagineus* (Table 3, Table 4).

Table 3: List of orders and number of bird species recorded on the site

№	Russian name	Latin name	English name	Number of species
1	Соколообразные	Falconiformes	Falcons	5
2	Куруобразные	Galliformes	Pheasants	1
3	Журавлеобразные	Gruiformes	Cranes	1
4	Голубеобразные	Columbiformes	Pterocletes	2
5	Совообразные	Strigiformes	Owls	2
6	Воробьинообразные	Passeriformes	Passerins	19

Target species were not found in autumn. Among secondary species, 5 species were recorded in the study area: *Circus Cyaneus*, *Buteo Rufinus*, *Buteo Buteo*, *Falco Tinnunculus* and *Grus Grus*. The most abundant species among them were Common Crane *Grus Grus*, which is natural given the fact that autumn is a peak season of migration for this species. About 290 individuals were recorded on October 16. There could have been even more cranes in the study area, because as stated by local herders, thousands of cranes flew by every day in the autumn.

The remaining 25 species observed were those categorized as other species. Among them, numerous and widespread species were *Corvus Frugilegus* (90 individuals) and *Ammomanes Deserti* (45 individuals). *Calandrella brachydactyla* (30 individuals), *Galerida Cristata* (30 individuals) *Corvus Cornix* (28 individuals) and *Bucanetes Githagineus* (25 individuals) are considered as common species.

It should be mentioned that these estimates are comparative. These observations of birds were made only once a month, and this does not give a complete picture of species numbers and composition. Besides, it should be underlined, that observation point №1 is close to a cultural landscape. There are 2 cement plants nearby and a big road from Nukus to Beruniy. Therefore, bird species like *Columba Livia*, *Acridotheres Tristis*, *Pica Pica*, *Corvus Monedula*, *Corvus Cornix* and *Passer Montanus* can be found there.

Bird flight heights varied from 1-15 m for small passerines and larks, 15-40 m for chukars, pigeons, crows and small raptors (Common Kestrel), 50-100 m for medium raptors (*Circus Cyaneus*, *Buteo Buteo*, *Buteo Rufinus*) and up to 200 m for *Grus Grus*.

Table 4: List of species and number of individuals observed on vantage points in summer (R – resident, W – wintering, M – migrant, B – breeding species)

№	Bird species	Days, vantage points and number of species										Nature of stay
		25.09.2022			16.10.2022			06.11.2022			Total	
		№1	№2	№3	№1	№2	№3	№1	№2	№3		
1	Hen Harrier <i>Circus cyaneus</i>						2			1	3	MW
2	Rough-legged Buzzard <i>Buteo lagopus</i>							1			1	MW
3	Long-legged buzzard <i>Buteo rufinus</i>			2			1		1	2	6	BMW
4	Common Buzzard <i>Buteo buteo</i>				1						1	MW
5	Common Kestrel <i>Falco tinnunculus</i>									1	1	R
6	Chukar Partridge <i>Alectoris chukar</i>		9						7		16	R
7	Common Crane <i>Grus grus</i>				90	80	120				290	M
8	Black-bellied Sandgrouse <i>Pterocles orientalis</i>									5	5	BMW
9	Rock Dove <i>Columba livia</i>	9			14			24			47	R
10	Eurasian Eagle-owl <i>Bubo bubo</i>		1						1		2	R
11	Little Owl <i>Athene noctua</i>		2	1		1	1				5	R
12	Desert Lark <i>Ammomanes deserti</i>		7			12			26		45	BM
13	Crested Lark <i>Galerida cristata</i>	2		8	1		11	2		5	29	R
14	Greater Short-toed Lark <i>Calandrella brachydactyla</i>			10			13			7	30	BM
15	Lesser Short-toed Lark <i>Calandrella rufescens</i>			3			5				8	BMW
16	White Wagtail <i>Motacilla alba</i>	3									3	MW
17	Great Grey Shrike <i>Lanius excubitor</i>			1						1	2	R
18	Common Myna <i>Acridotheres tristis</i>	5						7			12	R
19	Common Magpie <i>Pica pica</i>	2			4			5			11	R
20	Eurasian Jackdaw <i>Corvus monedula</i>	7			18						25	R
21	Rook <i>Corvus frugilegus</i>	28			46			16			90	BMW
22	Carrion Crow <i>Corvus corone</i>	1			3			5			9	R
23	Hooded Crow <i>Corvus cornix</i>							28			28	MW
24	Isabelline Wheatear <i>Oenanthe isabellina</i>		1	2		2	4		3		12	BM
25	Desert Wheatear <i>Oenanthe deserti</i>			8			7				15	BM
26	Bluethroat <i>Luscinia svecica</i>			3			5				8	BM
27	Mistle Thrush <i>Turdus viscivoris</i>							2			2	M
28	Eurasian Tree Sparrow <i>Passer montanus</i>	12									12	R
29	Rock Sparrow <i>Petronia petronia</i>		12								12	R
30	Trumpeter Finch <i>Bucanetes qithagineus</i>		4			8			13		25	R

September Observations

Vantage Point №: 1

SPECIES TRACKING LOG

Date: 25.09.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 08³⁰-10³⁰

Weather:

Temperature: +15, +20, clear weather. Wind speed: 4-5 m/s. Precipitation: none.

Table 5: Observations on VP1 on 25.09.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rock Dove <i>Columba livia</i>	9	30	yes
2	Crested Lark <i>Galerida cristata</i>	2	3	no
3	White Wagtail <i>Motacilla alba</i>	3	5	no
4	Common Myna <i>Acridotheres tristis</i>	5	4	no
5	Common Magpie <i>Pica pica</i>	2	6	no
6	Eurasian Jackdaw <i>Corvus monedula</i>	7	11	no
7	Rook <i>Corvus frugilegus</i>	28	12	no
8	Carrion Crow <i>Corvus corone</i>	1	5	no
9	Eurasian Tree Sparrow <i>Passer montanus</i>	12	14	no

Vantage Point №: 2

SPECIES TRACKING LOG

Date: 25.09.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 11⁰⁰-13⁰⁰

Weather:

Temperature: +25, +30, clear weather. Wind speed: 5-6 m/s. Precipitation: none.

Table 6: Observations on VP2 on 25.09.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Chukar Partridge <i>Alectoris chukar</i>	9	30	yes
2	Eurasian Eagle-owl <i>Bubo bubo</i>	1	8	no
3	Little Owl <i>Athene noctua</i>	2	7	no
4	Desert Lark <i>Ammomanes deserti</i>	7	9	no
5	Isabelline Wheatear <i>Oenanthe isabellina</i>	1	2	no
6	Rock Sparrow <i>Petronia petronia</i>	12	11	no
7	Trumpeter Finch <i>Bucanetes githagineus</i>	4	7	no

Vantage Point №: 3

SPECIES TRACKING LOG

Date: 25.09.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14⁰⁰-16⁰⁰

Weather:

Temperature: +30, +33, clear weather. Wind speed: 7-8 m/s. Precipitation: none.

Table 7: Observations on VP3 on 25.09.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Lon-legged Buzzard <i>Buteo rufinus</i>	2	50	yes
2	Little Owl <i>Athene noctua</i>	1	5	no
3	Crested Lark <i>Galerida cristata</i>	3	2	no
		5	4	
4	Greater Short-toed Lark <i>Calandrella brachydactyla</i>	4	5	no
		6	3	
5	Lesser Short-toed Lark <i>Calandrella rufescens</i>	3	9	no
6	Great Grey Shrike <i>Lanius excubitor</i>	1	5	no
7	Isabelline Wheatear <i>Oenanthe isabellina</i>	2	3	no
8	Desert Wheatear <i>Oenanthe deserti</i>	8	6	no
9	Bluethroat <i>Luscinia svecica</i>	3	2	no

October Observations

Vantage Point №: 1

SPECIES TRACKING LOG

Date: 16.10.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 08⁴⁵-10⁴⁵

Weather:

Temperature: +11+15, clear weather. Wind speed: 5-6 m/s. Precipitation: none.

Table 8: Observations on VP1 on 16.10.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Common Buzzard <i>Buteo buteo</i>	1	50	yes
2	Common Crane <i>Grus grus</i>	90	150	yes
3	Rock Dove <i>Columba livia</i>	14	25	yes
4	Crested Lark <i>Galerida cristata</i>	1	2	no
5	Common Magpie <i>Pica pica</i>	4	5	no
6	Eurasian Jackdaw <i>Corvus monedula</i>	18	18	no
7	Rook <i>Corvus frugilegus</i>	46	20	no
8	Carrion Crow <i>Corvus corone</i>	3	6	no

Vantage Point №: 2

SPECIES TRACKING LOG

Date: 16.10.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 11³⁰-13³⁰

Weather:

Temperature: +15, +20, clear. Wind speed: 7-8 m/s. Precipitation: none.

Table 9: Observations on VP2 on 16.10.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Common Crane <i>Grus grus</i>	80	200	yes
2	Little Owl <i>Athene noctua</i>	1	5	no
3	Desert Lark <i>Ammomanes deserti</i>	12	15	no
4	Isabelline Wheatear <i>Oenanthe isabellina</i>	2	6	no
5	Trumpeter Finch <i>Bucanetes githagineus</i>	8	12	no

Vantage Point №: 3

SPECIES TRACKING LOG

Date: 16.10.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14³⁰-16³⁰

Weather:

Temperature: +20, +22, clear weather. Wind speed: 7-8 m/s. Precipitation: none.

Table 10: Observations on VP3 on 16.10.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Hen Harrier <i>Circus cyaneus</i>	2	35	yes
2	Long-legged Buzzard <i>Buteo rufinus</i>	1	60	yes
3	Common Crane <i>Grus grus</i>	120	200	yes
4	Little Owl <i>Athene noctua</i>	1	5	no
5	Crested Lark <i>Galerida cristata</i>	2	1	no
		4	3	
		5	2	
6	Greater Short-toed Lark <i>Calandrella brachydactyla</i>	5	3	no
		4	2	
		4	3	
7	Lesser Short-toed Lark <i>Calandrella rufescens</i>	2	1	no
		3	2	no
8	Isabelline Wheatear <i>Oenanthe isabellina</i>	4	3	no
9	Desert Wheatear <i>Oenanthe deserti</i>	7	6	no
10	Bluethroat <i>Luscinia svecica</i>	5	2	no

November Observations

Vantage Point №: 1

SPECIES TRACKING LOG

Date: 06.11.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 09⁰⁵-11⁰⁵

Weather:

Temperature: +6, +8, cloudy weather. Wind speed: 6-7 m/s. Precipitation: none.

Table 11: Observations on VP1 on 06.11.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged Buzzard <i>Buteo lagopus</i>	1	50	yes
2	Rock Dove <i>Columba livia</i>	24	35	yes
3	Crested Lark <i>Galerida cristata</i>	2	3	no
4	Common Myna <i>Acridotheres tristis</i>	7	5	no
5	Common Magpie <i>Pica pica</i>	5	7	no
6	Rook <i>Corvus frugilegus</i>	16	25	yes
7	Carrion Crow <i>Corvus corone</i>	5	30	yes
8	Hooded Crow <i>Corvus cornix</i>	28	30	yes
9	Mistle Thrush <i>Turdus viscivorus</i>	2	6	no

Vantage Point №: 2

SPECIES TRACKING LOG

Date: 06.11.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 11⁴⁰-13⁴⁰

Weather:

Temperature: +8, +10, cloudy weather. Wind speed: 6-7 m/s. Precipitation: none.

Table 12: Observations on VP2 on 06.11.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged Buzzard <i>Buteo rufinus</i>	1	70	yes
2	Chukar Partridge <i>Alectoris chukar</i>	7	30	yes
3	Eurasian Eagle-owl <i>Bubo bubo</i>	1	15	no
4	Desert Lark <i>Ammomanes deserti</i>	26	20	no
5	Isabelline Wheatear <i>Oenanthe isabellina</i>	3	6	no
6	Trumpeter Finch <i>Bucanetes githagineus</i>	13	15	no

Vantage Point №: 3

SPECIES TRACKING LOG

Date: 06.11.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14³⁰-16³⁰

Weather:

Temperature: +10, +12, cloudy weather. Wind speed: 6-7 m/s. Precipitation: none.

Table 13: Observations on VP3 on 06.11.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Hen Harrier <i>Circus cyaneus</i>	1	35	yes
2	Long-legged Buzzard <i>Buteo rufinus</i>	2	60	yes
3	Обыкновенная пустельга <i>Falco tinnunculus</i>	1	40	yes
4	Чернобрюхий рябок <i>Pterocles orientalis</i>	5	30	yes
5	Crested Lark <i>Galerida cristata</i>	3	2	no
		2	1	no
6	Greater Short-toed Lark <i>Calandrella brachydactyla</i>	4	2	no
		3	1	no
7	Great Grey Shrike <i>Lanius excubitor</i>	1	4	no

Summary

According to the results of the bird survey conducted during the autumn, 27 species of birds belonging to 6 orders were recorded at 3 vantage points. Of course, this number is small for such a large area. Perhaps it is due to the dryness of the area. In addition, there are no lakes, canals, etc. in the immediate area that would attract water birds.

As for the target species, they were not encountered in the autumn survey. However, this does not mean that the target species does not inhabit the Project area. After all, bird observations were carried out only once a month, and this does not give a complete picture of the species composition and number of birds in a certain area. Target species such as Golden Eagle, Steppe Eagle, Saker Falcon, etc. were observed in earlier surveys (winter, spring and summer seasons).

5 secondary species were recorded during the autumn survey: Hen Harrier *Circus cyaneus*, Long-legged Buzzard *Buteo rufinus*, Common Buzzard *Buteo buteo*, Common Kestrel *Falco tinnunculus* and Common Crane *Grus grus*. Among them, the most numerous species were migrating Common Cranes *Grus grus*.

The remaining 25 species observed were those categorized as other species. Among them, numerous and widespread species were *Corvus Frugilegus* (90 individuals) and *Ammomanes Deserti* (45 individuals). *Calandrella brachydactyla* (30 individuals), *Galerida Cristata* (30 individuals) *Corvus Cornix* (28 individuals) and *Bucanetes Githagineus* (25 individuals) are considered as common species.

Bird flight heights varied from 1-15 m for small passerines and larks, 15-40 m for chukars, pigeons, crows and small raptors (Common Kestrel), 50-100 m for medium raptors (*Circus Cyaneus*, *Buteo Buteo*, *Buteo Rufinus*) and up to 200 m for *Grus Grus*.

Apart from birds, other species of fauna were also noted during the study, including insects, reptiles (*Trapelus Sanguinolentus*) and mammals (*Citellus fulvus*, *Dipus sagitta* and *Vulpes Vulpes*).

Annex 1. Birds Recorded at Vantage Points



Hen Harrier *Circus cyaneus*



Common Buzzard *Buteo buteo*



Common Crane *Grus grus*



Rock Dove *Columba livia*



Desert Lark *Ammomanes deserti*



Crested Lark *Galerida cristata*



Common Myna *Acridotheres tristis*



Common Magpie *Pica pica*



Hooded Crow *Corvus cornix*



Desert Wheatear *Oenanthe deserti*



Isabellina Wheatear *Oenanthe isabellina*



Bluethroat *Luscinia svecica*



Mistle Thrush *Turdus viscivorus*

Annex 2. Other Animals Observed at Vantage Points



Dipus sagitta

Annex 3. General Photos from the Survey













BIRD VP SURVEY REPORT SUMMER 2022

**FOR THE PLANNED OHTL ASSOCIATED WITH
NUKUS 100 MW WIND FARM**



Client: 5 Capitals
Date: August 2022

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Introduction

In recent years, Uzbekistan has paid special attention to the development of renewable energy sources, which is reflected in the Law of the Republic of Uzbekistan No. ZRU-539 of 21.05.2019 "On use of renewable energy sources", as well as in the Decree of the President of the Republic of Uzbekistan No. PP-4422 of August 22, 2019 "On accelerated measures to improve energy efficiency of economic sectors and social sphere, introduction of energy-saving technologies and development of renewable energy sources".

In the framework of the Nukus 100 MW Wind Farm Project, bird survey was conducted along the planned OHTL in Summer 2022. The purpose of ornithological monitoring was to conduct systematic field studies at specific vantage points to assess bird species composition that occur along the planned OHTL, and also to identify birds of conservation interest under IUCN and Uzbekistan Redlist.

This report presents the main findings of the field surveys carried out in this area during the summer (June, July, August) 2022. Bird observations were carried out at 3 Vantage Points.

This report is a statement of work made by Juru Energy` local ornitologist Y.I. Ametov.

Research Methods

Target species for the survey were identified during baseline survey conducted on the project site in April 2020 - April 2021. As a result of the observations, species of high concern were categorized as 'target species' and 'secondary species', the rest of the observed species were referred to as 'other species'. The list of species of high concern is given in the table below.

Table 1 List of target species and secondary species. Status category abbreviations are as follows: EN- endangered; VU – vulnerable; LC – least concern.

No	Latin name	English name	Uzbekistan Red Data Book status	IUCN Red List status
Target species				
1	<i>Neophron percnopterus</i>	Egyptian Vulture	VU	EN
2	<i>Aquila nipalensis</i>	Steppe Eagle	VU	EN
3	<i>Aquila heliaca</i>	Imperial Eagle	VU	VU
5	<i>Falco vespertinus</i>	Red-footed Falcon		VU
4	<i>Aquila chrysaetos</i>	Golden Eagle	VU	LC
Secondary species				
6	<i>Grus grus</i>	Common Crane	Not included	LC
7	<i>Circus aeruginosus</i>	Western Marsh-Harrier	Not included	LC
8	<i>Circus cyaneus</i>	Hen Harrier	Not included	LC
9	<i>Buteo lagopus</i>	Rough-legged Buzzard	Not included	LC
10	<i>Buteo buteo</i>	Common Buzzard	Not included	LC

11	<i>Buteo rufinus</i>	Long-legged Buzzard	Not included	LC
12	<i>Falco tinnunculus</i>	Common Kestrel	Not included	LC

VP survey method generally followed SNH (2017) guidance for wind farm bird assessments, minus the elements that are specifically driven by the data requirements of collision risk modelling.

Observations were made at 3 stationary points (Table 2). The duration of observations at each station (point) was 2 hours. Total duration of observations at one VP was 6 hours, total duration for three VPs was 18 hours.

The range of detection and detection of large species of birds of prey was up to 2 km, and small passerines from 50 to 100 m. The flight directions and altitude were taken into account.

During the observations, photographs and short video footage of birds were taken, which is used to confirm the correct identification of species and to obtain additional data on the number of individuals. The birds were observed through 10x binoculars and 60x Viking telescope. At all vantage points the coordinates were determined with the help of GPS "Garmin".

Points and numbering for stationary observation in the project area have been agreed with Juru Energy. The points are located so as to cover the territory as completely as possible (Figure 1). The radius of observation areas is 2 km. The time of the observation on the Vantage points is 2 hours.



Figure 1. Location of Vantage points

Table 2.Coordinates of the Vantage points and duration of bird observations

Number	Coordinates	Date of observations	Duration of observations
Vantage points			
VP №1	42.036756 'N 60.446168 'E	12 June 12 July 14 August	6 hours
VP №2	42.057134 'N 60.493878 'E	12 June 12 July 14 August	6 hours
VP №3	42.083162 'N 60.544998 'E	12 June 12 July 14 August	6 hours

When the target species were found at observation points within a radius of 2 km, their quantity, time of detection, flight altitude, approximate distance as well as direction of flight were determined. For other species only detection time, quantity and flight altitude were determined. If possible, the observed birds were photographed.

Site Description

The project area is located on the territory of Karauzak district 120-140 km south of Nukus. The landscape of the project area is steppe and arid.

The project area is located on the territory of the Sultanuizdag mountain range. Sultanuizdag (Uzbek: Sulton Uvays tizmasi) is a mountain range in Karakalpakstan (Uzbekistan), on the right bank of the Amu Darya. The range is located in the extreme southwest of Kyzylkum, separating the desert from the valley of the Amu Darya River. The length is over 50 km, the width is up to 25 km. The ridge has an almost latitudinal stretch in the east, which is replaced by a north-westerly one in its western part (Fig. 2).



Figure 2: Sultanuizdag Mountain range

The maximum height reaches 473 metres. The massif consists of ridges composed of quartzite, gneiss, marble with granodiorite intrusions. The southern and western slopes are steep, while the northern and eastern slopes are gentler. Desert landscapes predominate. The annual precipitation is 80-100 mm. The annual temperature is 12-13°C, the average temperature in January is -5°C, -8°C, July 26-28°C. There is no constant running water. The valleys that cut through the ridge are completely waterless, very hot and windless in summer.

Accordingly, steppe, desert and mountain animal and plant species are found here. There are no wetlands in the area. During the migration seasons, however, other biotopes can be found. The gullies of the Sultanuizdag Upland are shelters for mammals and reptiles from critical temperatures and nesting places for birds.

The largest areas in Sultanuizdag are occupied by sagebrush formation. In the areas with compacted sands, white saxauls were widespread. These areas are characterized by large masses of acacia trees, dense saxaul and shrub thickets and motley grasses. This biogeocenosis is favourable for nesting, egg laying, habitat and resting places for passerine birds.

A special group of plants from the project area are ephemeroïds, annual herbaceous plants that finish their development in a very short wet spring, and ephemeroïds, perennial herbs that flower in spring and die off in summer, leaving only underground rhizomes, bulbs and tubers. Medicinal plants, such as stinking ferula and garmala, are to be found.

The animal life in the northern part of the Kyzylkum desert is represented by typical desert species. Psammophilous species predominate here. Among reptiles, common here are the Central Asian tortoise, steppe agama, lizard, arrow snake; among birds there are falconiformes and passerines. It is important to note that cattle breeding or herding is developed here, shepherds build their yurts and they take care of their sheep, cows, horses and camels all year round.

Results from Vantage Points

According to the results of the ornithological survey, 27 bird species belonging to 6 orders (Table 3) were recorded at 3 Vantage points. These include the following species: *Circus cyaneus*, *Buteo rufinus*, *Aquila chrysaetos*, *Falco cherrug*, *Falco tinnunculus*, *Alektoris chukar*, *Pterocles orientalis*, *Columba livia*, *Bubo bubo*, *Athene noctua*, *Merops persicus*, *Hirundo rustica*, *Galerida cristata*, *Calandrella brachydactyla*, *Calandrella rufescens*, *Anthus campestris*, *Motacilla alba*, *Motacilla personata*, *Lanius excubitor*, *Sylvia nana*, *Oenanthe pleschanka*, *Oenanthe finschii*, *Oenanthe isabellina*, *Passer indicus*, *Passer montanus*, *Petronia petronia* and *Bucanetes githagineus* (Table 4).

Table 3: List of orders and number of bird species recorded on the site

№	Russian name	Latin name	English name	Number of species
1	Соколообразные	Falconiformes	Falcons	5
2	Курообразные	Galliformes	Pheasants	1
3	Голубеобразные	Columbiformes	Pterocletes	2
4	Совообразные	Strigiformes	Owls	2
5	Ракшеобразные	Coraciiformes	Rollers	1
6	Воробьинообразные	Passeriformes	Passerins	16
7	Соколообразные	Falconiformes	Falcons	5
8	Курообразные	Galliformes	Pheasants	1

Only 2 target species were found: **Golden Eagle *Aquila chrysaetos*** and **Saker Falcon *Falco cherrug***.

Golden Eagle *Aquila chrysaetos* is listed with LC (Least Concern) status in the IUCN Red List and with status 2 (VU: R): Vulnerable, naturally rare, sedentary, locally distributed South European and Central Asian subspecies in the Red Book of the Republic of Uzbekistan. Golden Eagle was found only three times: on June 12 and July 12 at the observation point 3 and on July 12 at the observation point 2. Only 4 individuals of this species were seen at the observation point 2, they were soaring in the sky at an altitude of about 150-250 m.

Saker Falcon *Falco cherrug* is listed in the Red Book of the Republic of Uzbekistan with status 1 (EN): endangered subspecies. The species is also listed in the IUCN Red List with EN (Endangered) status. The only individual Saker Falcon was seen at the second observation point. The bird was sitting on a mountain rock and after noticing us, flew away at a height of about 50 m.

Among secondary species, 3 species were recorded here: Hen Harrier *Circus cyaneus*, Long-legged Buzzard *Buteo rufinus*, and Common Kestrel *Falco tinnunculus*. Among them, *Buteo rufinus* is a numerous and widespread species. *Circus cyaneus* and *Falco tinnunculus* are considered as common species.

The remaining 22 species observed were those categorized as other species. Among them, the most numerous and widespread species were Indian sparrows *Passer indicus* (192 individuals). Greater

Short-toed Lark *Calandrella brachydactyla* (58), Crested Lark *Galerida cristata* (41) and Eurasian Tree Sparrow *Passer montanus* (47) are considered to be common species.

It should be mentioned that these estimates are comparative. These observations of birds were made only once a month, and this does not give a complete picture of bird numbers. Besides, it should be underlined, that observation point №1 is close to a cultural landscape. There are 2 cement plants nearby and a big road from Nukus to Beruniy. Therefore, cultural bird species like Rock Dove *Columba livia* and Eurasian Tree Sparrow *Passer montanus* can be found there.

Bird flight heights varied from 1-15 m for small passerines and larks, 15-70 m for small raptors (Saker Falcon, Common Kestrel), up to 100 m for medium raptors (Rough-legged Buzzard, Long-tailed Eagle) and up to 250 m for Golden Eagle.

Table 4: List of species and number of individuals observed on vantage points in summer

№	Bird species	Days, vantage points and number of species											Nature of stay
		12.06.2022			12.07.2022			14.08.2022			Total		
		№1	№2	№3	№1	№2	№3	№1	№2	№3			
1	Hen Harrier <i>Circus cyaneus</i>									2		2	MW
2	Long-legged buzzard <i>Buteo rufinus</i>	1		2			2	1	2	1		9	BMW
3	Golden eagle <i>Aquila chrysaetos</i>			1		2	1					4	R
4	Saker Falcon <i>Falco cherrug</i>		1									1	R
5	Common Kestrel <i>Falco tinnunculus</i>			1			1					2	R
6	Chukar Partridge <i>Alectoris chukar</i>		8			11			17			36	R
7	Black-bellied Sandgrouse <i>Pterocles orientalis</i>						8					8	BMW
8	Rock Dove <i>Columba livia</i>	4			6			16				26	R
9	Eurasian Eagle-owl <i>Bubo bubo</i>		1						2			3	R
10	Little Owl <i>Athene noctua</i>			1	1	1	2			1		6	R
11	Blue-cheeked Bee-eater <i>Merops persicus</i>	2		4			3			8		17	BM
12	Barn Swallow <i>Hirundo rustica</i>				4			8				12	BM
13	Crested Lark <i>Galerida cristata</i>			12			15			14		41	R
14	Greater Short-toed Lark <i>Calandrella brachydactyla</i>			20			14			24		58	BM
15	Lesser Short-toed Lark <i>Calandrella rufescens</i>			12			5			11		28	BMW
16	Tawny Pipit <i>Anthus campestris</i>				2	3	3		4	5		17	BM
17	White Wagtail <i>Motacilla alba</i>	3										3	MW
18	Masked Wagtail <i>Motacilla personata</i>				3							3	BM
19	Great Grey Shrike <i>Lanius excubitor</i>						2	1		3		6	R
20	Asian Desert Warbler <i>Sylvia nana</i>						4	6		2		12	BM
21	Pied Wheatear <i>Oenanthe pleschanka</i>	2	3		1	2		6	3			17	B
22	Finsch's Wheatear <i>Oenanthe finschii</i>	1	2		2	1			2			8	B
23	Isabelline Wheatear <i>Oenanthe isabellina</i>	2	3	7	3	2	5	3	3	6		34	BM
24	Indian Sparrow <i>Passer indicus</i>	13	19	25	9	21	20	32	31	22		192	BM
25	Eurasian Tree Sparrow <i>Passer montanus</i>	9			11			27				47	R
26	Rock Sparrow <i>Petronia petronia</i>		5						8			13	R
27	Trumpeter Finch <i>Bucanetes githagineus</i>					4			7			11	R

Note: R – resident, W – wintering, M – migrant, B – breeding species.

Observations

Vantage Point №: 1

SPECIES TRACKING LOG

Date: 12.06.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 08²⁰-10²⁰

Weather:

Temperature: +24, +26, clear weather. Wind speed: 5-6 m/s. Precipitation: none.

Table 5: Observations on VP1 on 12.06.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged buzzard <i>Buteo rufinus</i>	1	80	yes
2	Rock Dove <i>Columba livia</i>	4	25	yes
3	Blue-cheeked Bee-eater <i>Merops persicus</i>	2	10	no
4	White Wagtail <i>Motacilla alba</i>	3	4	no
5	Pied Wheatear <i>Oenanthe pleschanka</i>	2	5	no
6	Finsch's Wheatear <i>Oenanthe finschii</i>	1	3	no
7	Isabelline Wheatear <i>Oenanthe isabellina</i>	2	4	no
8	Indian Sparrow <i>Passer indicus</i>	13	9	no
9	Eurasian Tree Sparrow <i>Passer montanus</i>	9	8	no

Vantage Point №: 2

SPECIES TRACKING LOG

Date: 12.06.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 11¹⁰-13¹⁰

Weather:

Temperature: +30, +36, clear weather. Wind speed: 6-7 m/s. Precipitation: none.

Table 6: Observations on VP2 on 12.06.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Saker Falcon <i>Falco cherrug</i>	1	50	yes
2	Chukar Partridge <i>Alectoris chukar</i>	8	35	yes
3	Eurasian Eagle-owl <i>Bubo bubo</i>	1	25	yes
4	Pied Wheatear <i>Oenanthe pleschanka</i>	3	7	no
5	Finsch's Wheatear <i>Oenanthe finschii</i>	2	5	no
6	Isabelline Wheatear <i>Oenanthe isabellina</i>	3	4	no
7	Indian Sparrow <i>Passer indicus</i>	19	12	no
8	Rock Sparrow <i>Petronia petronia</i>	5	8	no

Vantage Point №: 3
SPECIES TRACKING LOG

Date: 12.06.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14⁴⁵-16⁴⁵

Weather:

Temperature: +36, +35, clear weather. Wind speed: 6-7 m/s. Precipitation: none.

Table 7: Observations on VP3 on 12.06.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged buzzard <i>Buteo rufinus</i>	2	60	yes
2	Golden Eagle <i>Aquila chrysaetos</i>	1	200	yes
3	Common Kestrel <i>Falco tinnunculus</i>	1	25	yes
4	Little Owl <i>Athene noctua</i>	1	6	no
5	Blue-cheeked Bee-eater <i>Merops persicus</i>	4	6	no
6	Crested Lark <i>Galerida cristata</i>	5	3	no
		7	8	no
7	Greater Short-toed Lark <i>Calandrella brachydactyla</i>	6	5	no
		9	9	no
		5	3	no
8	Lesser Short-toed Lark <i>Calandrella rufescens</i>	8	7	no
		4	3	no
9	Isabelline Wheatear <i>Oenanthe isabellina</i>	2	1	no
		4	3	no
		1	1	no
10	Indian sparrow <i>Passer indicus</i>	9	8	no
		5	3	no
		3	2	no
		8	7	no

Vantage Point №: 1

SPECIES TRACKING LOG

Date: 12.07.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 08⁰⁵-10⁰⁵

Weather:

Temperature: +26+29, clear weather. Wind speed: 4-5 m/s. Precipitation: none.

Table 8: Observations on VP1 on 12.07.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rock Dove <i>Columba livia</i>	6	35	yes
2	Little Owl <i>Athene noctua</i>	1	7	no
3	Barn Swallow <i>Hirundo rustica</i>	4	6	no
4	Tawny Pipit <i>Anthus campestris</i>	2	5	no
5	Masked Wagtail <i>Motacilla personata</i>	3	4	no
6	Pied Wheatear <i>Oenanthe pleschanka</i>	1	2	no
7	Finsch's Wheatear <i>Oenanthe finschii</i>	2	3	no
8	Isabelline Wheatear <i>Oenanthe isabellina</i>	3	5	no
9	Indian Sparrow <i>Passer indicus</i>	9	7	no
10	Eurasian Tree Sparrow <i>Passer montanus</i>	11	8	no

Vantage Point №: 2

SPECIES TRACKING LOG

Date: 12.07.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 10⁵⁰-12⁵⁰

Weather:

Temperature: +30, +37, clear. Wind speed: 5-6 m/s. Precipitation: none.

Table 9: Observations on VP2 on 12.07.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Golden Eagle <i>Aquila chrysaetos</i>	2	250	yes
2	Chukar Partridge <i>Alectoris chukar</i>	11	35	yes
3	Little Owl <i>Athene noctua</i>	1	7	no
4	Tawny Pipit <i>Anthus campestris</i>	3	5	no
5	Pied Wheatear <i>Oenanthe pleschanka</i>	2	4	no
6	Finsch's Wheatear <i>Oenanthe finschii</i>	1	3	no
7	Isabelline Wheatear <i>Oenanthe isabellina</i>	2	1	no
8	Indian Sparrow <i>Passer indicus</i>	21	12	no
9	Trumpeter Finch <i>Bucanetes githagineus</i>	4	3	no

Vantage Point №: 3

SPECIES TRACKING LOG

Date: 12.07.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14²⁰-16²⁰

Weather:

Temperature: +36, +37, clear weather. Wind speed: 5-6 m/s. Precipitation: none.

Table 10: Observations on VP3 on 12.07.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged Buzzard <i>Buteo rufinus</i>	2	80	yes
2	Golden Eagle <i>Aquila chrysaetos</i>	1	150	yes
3	Common Kestrel <i>Falco tinnunculus</i>	1	35	yes
4	Little Owl <i>Athene noctua</i>	2	4	no
5	Black-bellied Sandgrouse <i>Pterocles orientalis</i>	8	25	yes
6	Blue-cheeked Bee-eater <i>Merops persicus</i>	3	6	no
7	Crested Lark <i>Galerida cristata</i>	6	3	no
		9	5	no
8	Greater Short-toed Lark <i>Calandrella brachydactyla</i>	8	9	no
		6	5	no
9	Lesser Short-toed Lark <i>Calandrella rufescens</i>	5	7	no
10	Tawny Pipit <i>Anthus campestris</i>	3	2	no
11	Great Grey Shrike <i>Lanius excubitor</i>	2	4	no
12	Asian Desert Warbler <i>Sylvia nana</i>	4	5	no
13	Isabelline Wheatear <i>Oenanthe isabellina</i>	2	3	no
		3	5	no
14	Indian sparrow <i>Passer indicus</i>	7	6	no
		8	7	no
		5	3	no

Vantage Point №: 1

SPECIES TRACKING LOG

Date: 14.08.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 08¹⁵-10¹⁵

Weather:

Temperature: +23, +30, clear weather. Wind speed: 6-7 m/s. Precipitation: none.

Table 11: Observations on VP1 on 14.08.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged Buzzard <i>Buteo rufinus</i>	1	70	yes
2	Rock Dove <i>Columba livia</i>	16	25	yes
3	Barn Swallow <i>Hirundo rustica</i>	8	7	no
4	Great Grey Shrike <i>Lanius excubitor</i>	1	8	no
5	Asian Desert Warbler <i>Sylvia nana</i>	6	4	no
6	Pied Wheatear <i>Oenanthe pleschanka</i>	6	5	no
7	Isabelline Wheatear <i>Oenanthe isabellina</i>	3	7	no
8	Indian Sparrow <i>Passer indicus</i>	32	14	no
9	Eurasian Tree Sparrow <i>Passer montanus</i>	27	13	no

Vantage Point №: 2

SPECIES TRACKING LOG

Date: 14.08.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 10⁵⁵-12⁵⁵

Weather:

Temperature: +31, +35, clear weather. Wind speed: 7-8 m/s. Precipitation: none.

Table 12: Observations on VP2 on 14.08.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged Buzzard <i>Buteo rufinus</i>	2	70	yes
2	Chukar Partridge <i>Alectoris chukar</i>	17	35	yes
3	Eurasian Eagle-owl <i>Bubo bubo</i>	2	30	yes
4	Tawny Pipit <i>Anthus campestris</i>	4	3	no
5	Pied Wheatear <i>Oenanthe pleschanka</i>	3	6	no
6	Finsch's Wheatear <i>Oenanthe finschii</i>	2	5	no
7	Isabelline Wheatear <i>Oenanthe isabellina</i>	3	2	no
8	Indian Sparrow <i>Passer indicus</i>	31	12	no
9	Rock Sparrow <i>Petronia petronia</i>	8	6	no
10	Trumpeter Finch <i>Bucanetes githagineus</i>	7	5	no

Vantage Point №: 3

SPECIES TRACKING LOG

Date: 14.08.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14³⁰-16³⁰

Weather:

Temperature: +35, +34, clear weather. Wind speed: 7-8 m/s. Precipitation: none.

Table 13: Observations on VP3 on 14.08.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Hen Harrier <i>Circus cyaneus</i>	2	40	yes
2	Long-legged Buzzard <i>Buteo rufinus</i>	1	60	yes
3	Little Owl <i>Athene noctua</i>	1	6	no
4	Blue-cheeked Bee-eater <i>Merops persicus</i>	8	6	no
5	Crested Lark <i>Galerida cristata</i>	5	3	no
		9	5	no
6	Greater Short-toed Lark <i>Calandrella brachydactyla</i>	7	5	no
		11	13	no
		6	5	no
7	Lesser Short-toed Lark <i>Calandrella rufescens</i>	7	8	no
		4	5	no
8	Tawny Pipit <i>Anthus campestris</i>	5	4	
9	Great Grey Shrike <i>Lanius excubitor</i>	3	5	no
10	Asian Desert Warbler <i>Sylvia nana</i>	2	3	
11	Isabelline Wheatear <i>Oenanthe isabellina</i>	3	2	no
		2	1	no
		1	1	no
12	Indian sparrow <i>Passer indicus</i>	9	7	no
		6	3	no
		7	5	no

Summary

According to the results of the bird survey conducted during the summer, 27 species of birds belonging to 6 orders were recorded at 3 observation points.

2 target species - Golden Eagle *Aquila chrysaetos* and Saker Falcon *Falco cherrug* and 3 secondary species – Hen Harrier *Circus cyaneus*, Long-legged Buzzard *Buteo rufinus*, and Common Kestrel *Falco tinnunculus* were registered in the study area.

Remaining 22 species observed were other species, including cultivated bird species such as Rock Dove *Columba livia* and Eurasian Tree Sparrow *Passer montanus*.

Apart from birds, reptiles - Central Asian tortoise *Testudo horsfieldi*, steppe agama *Trapelus sanguinolentus* and mammals - yellow gopher *Citellus fulvus* and fox *Vulpes Vulpes* were seen during the survey.

Annex 1. Birds Recorded at Vantage Points



Hen Harrier *Circus cyaneus*



Long-legged Buzzard *Buteo rufinus*



Golden Eagle *Aquila chrysaetos*



Saker Falcon *Falco cherrug*



Chukar Partridge *Alectoris chukar*



Eurasian Eagle-owl *Bubo bubo*



Blue-cheeked Bee-eater *Merops persicus*



Crested Lark *Galerida cristata*



Greater Short-toed Lark *Calandrella brachydactyla*



Lesser Short-toed Lark *Calandrella rufescens*



Tawny Pipit *Anthus campestris*



White Wagtail *Motacilla alba*



Great Grey Shrike *Lanius excubitor*



Asian Desert Warbler *Sylvia nana*



Pied Wheatear *Oenanthe pleschanka*



Finsch's Wheatear *Oenanthe finschii*



Isabelline Wheatear *Oenanthe isabellina*



Indian Sparrow *Passer indicus*



Trumpeter Finch *Bucanetes githagineus*

Annex 2. Other Animals Observed at Vantage Points



Steppe Agama *Trapelus sanguinolentus*



Yellow Gopher *Citellus fulvus*



Fox *Vulpes vulpes*

Annex 3. General Photos of the Observed Area







BIRD VP AND RAPTOR NEST SURVEY REPORT SPRING 2022

**FOR THE PLANNED OHTL ASSOCIATED WITH
NUKUS 100 MW WIND FARM**



Client: 5 Capitals
Date: May 2022

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INTRODUCTION

In recent years, Uzbekistan has paid special attention to the development of renewable energy sources, which is reflected in the Law of the Republic of Uzbekistan No. ZRU-539 of 21.05.2019 "On use of renewable energy sources", as well as in the Decree of the President of the Republic of Uzbekistan No. PP-4422 of August 22, 2019 "On accelerated measures to improve energy efficiency of economic sectors and social sphere, introduction of energy-saving technologies and development of renewable energy sources".

In the framework of the Nukus 100 MW Wind Farm Project, bird survey was conducted along the planned OHTL in Spring 2022. The purpose of ornithological monitoring was to conduct systematic field studies at specific vantage points to assess bird species composition that occur along the planned OHTL, and also to identify birds that are of conservation interest under IUCN and Uzbekistan Redlist.

This report presents the main findings of the field surveys carried out in this area during the spring period (March, April, May) 2022. Bird observations were carried out at 3 Vantage Points.

This report is a statement of work made by Juru Enery` local ornitologist Y.I. Ametov.

Research methods

Target species for the survey were identified during baseline survey conducted on the project site in April 2020 - April 2021. As a result of the observations, species of high concern were categorized as 'target species' and 'secondary species', the rest of the observed species were referred to as 'other species'. The list of species of high concern is given in the table below.

Table 1 List of target species and secondary species. Status category abbreviations are as follows: EN- endangered; VU – vulnerable; LC – least concern.

No	Latin name	English name	Uzbekistan Red Data Book status	IUCN Red List status
Target species				
1	Neophron percnopterus	Egyptian Vulture	VU	EN
2	Aquila nipalensis	Steppe Eagle	VU	EN
3	Aquila heliaca	Imperial Eagle	VU	VU
5	Falco vespertinus	Red-footed Falcon		VU
4	Aquila chrysaetos	Golden Eagle	VU	LC
Secondary species				
6	Grus grus	Common Crane	Not included	LC
7	Circus aeruginosus	Western Marsh-Harrier	Not included	LC
8	Circus cyaneus	Hen Harrier	Not included	LC
9	Buteo lagopus	Rough-legged Buzzard	Not included	LC
10	Buteo buteo	Common Buzzard	Not included	LC
11	Buteo rufinus	Long-legged Buzzard	Not included	LC
12	Falco tinnunculus	Common Kestrel	Not included	LC

VP survey method generally followed SNH (2017) guidance for wind farm bird assessments, minus the elements that are specifically driven by the data requirements of collision risk modelling.

Observations were made at 3 stationary points (Table 2). The duration of observations at each station (point) was 2 hours. Total duration of observations at one VP was 6 hours, total duration for three VPs was 18 hours.

The range of detection and detection of large species of birds of prey was up to 2 km, and small passerines from 50 to 100 m. The flight directions and altitude were taken into account.

During the observations, photographs and short video footage of birds were taken, which is used to confirm the correct identification of species and to obtain additional data on the number of individuals. The birds were observed through 10x binoculars and 60x Viking telescope. At all vantage points the coordinates were determined with the help of GPS "Garmin".

Points and numbering for stationary observation in the project area have been agreed with Juru Energy. The points are located so as to cover the territory as completely as possible (Fig. 1). The radius of observation areas is 2 km. The time of the observation on the Vantage points is 2 hours.



Figure 1. Location of Vantage points

Table 2. Coordinates of the Vantage points and duration of bird observations

Number	Coordinates	Date of observations	Duration of observations
Vantage points			
VP №1	42.036756 'N 60.446168 'E	26 March 24 April 23 May	6 hours
VP №2	42.057134 'N 60.493878 'E	26 March 24 April 23 May	6 hours

VP №3	42.083162 'N 60.544998 'E	26 March 24 April 23 May	6 hours

Data was recorded on the survey forms:

- The location of the VP used
- Date of survey
- Surveyor name
- Start and End time of the VP session
- Weather condition
- For target species (all raptors, bustards, ducks, geese, pelicans, cranes, herons, waders and gulls, sandgrouses, owls, nightjars) - time of the record, number, flight altitude, approximate distance and direction of flight according compass
- For other species: time of the record, number, flight altitude
- Notes

SITE DESCRIPTION

The project area is located on the territory of Karauzak district 120-140 km south of Nukus. The landscape of the project area is steppe and arid.

The project area is located on the territory of the Sultanuizdag mountain range. Sultanuizdag (Uzbek: *Sulton Uvays tizmasi*) is a mountain range in Karakalpakstan (Uzbekistan), on the right bank of the Amu Darya. The range is located in the extreme southwest of Kyzylkum, separating the desert from the valley of the Amu Darya River. The length is over 50 km, the width is up to 25 km. The ridge has an almost latitudinal stretch in the east, which is replaced by a north-westerly one in its western part (Fig. 2).



Figure 2: Sultanuizdag Mountain range

The maximum height reaches 473 metres. The massif consists of ridges composed of quartzite, gneiss, marble with granodiorite intrusions. The southern and western slopes are steep, while the northern and eastern slopes are more gentle. Desert landscapes predominate. The annual precipitation is 80-100 mm. The annual temperature is 12-13°C, the average temperature in January is -5°C, -8°C, July 26-28°C. There is no constant running water. The valleys that cut through the ridge are completely waterless, very hot and windless in summer.

Accordingly, steppe, desert and mountain animal and plant species are found here. There are no wetlands in the area. During the migration seasons, however, other biotopes can be found. The gullies of the Sultanuizdag Upland are shelters for mammals and reptiles from critical temperatures and nesting places for birds.

The largest areas in Sultanuizdag are occupied by sagebrush formation. In the areas with compacted sands, white saxauls were widespread. These areas are characterized by large masses of acacia trees, dense saxaul and shrub thickets and motley grasses. This biogeocenosis is favourable for nesting, egg laying, habitat and resting places for passerine birds.

A special group of plants from the project area are ephemeroïds, annual herbaceous plants that finish their development in a very short wet spring, and ephemeroïds, perennial herbs that flower in spring and die off in summer, leaving only underground rhizomes, bulbs and tubers. Medicinal plants, such as stinking ferula and garmala, are to be found.

The animal life in the northern part of the Kyzylkum desert is represented by typical desert species. Psammophilous species predominate here. Among reptiles, common here are the Central Asian tortoise, steppe agama, lizard, arrow snake; among birds there are falconiformes and passerines. It is important to note that cattle breeding or herding is developed here, shepherds build their yurts and they take care of their sheep, cows, horses and camels all year round.

Results from Vantage points

According to the results of the ornithological survey, 32 bird species belonging to 8 groups were recorded at 3 Vantage points. These are: *Ardea cinerea*, *Buteo lagopus*, *Buteo rufinus*, *Aquila chrysaetos*, *Aquila nipalensis*, *Falco columbarius*, *Falco tinnunculus*, *Alektoris chukar*, *Grus grus*, *Pterocles alchata*, *Pterocles orientalis*, *Columba livia*, *Athene noctua*, *Merops persicus*, *Ammomanes deserti*, *Galerida cristata*, *Calandrella brachydactyla*, *Calandrella rufescens*, *Motacilla personata*, *Lanius excubitor*, *Corvus cornix*, *Corvus corone*, *Saxicola maurus*, *Oenanthe pleschanka*, *Oenanthe finschii*, *Oenanthe deserti*, *Oenanthe isabellina*, *Passer indicus*, *Passer montanus*, *Petronia petronia*, *Rhodospiza obsoleta* and *Emberiza hortulana* (Tables 3, 4, 5).

Table 3: List of orders and number of bird species recorded on the site

№	Russian name	Latin name	English name	Number of species
1	Аистообразные	Ciconiiformes	Storks	1
2	Соколообразные	Falconiformes	Falcons	6
3	Курообразные	Galliformes	Pheasants	1
4	Журавлеобразные	Gruiformes	Cranes	1
5	Голубеобразные	Columbiformes	Pterocletes	3
6	Совообразные	Strigiformes	Owls	1
7	Ракшеобразные	Coraciiformes	Rollers	1
8	Воробьинообразные	Passeriformes	Passerins	18

In the spring season, only 2 target species were recorded: **Golden Eagle *Aquila chrysaetos*** and **Steppe Eagle *Aquila nipalensis***. The Golden Eagle *Aquila chrysaetos* was recorded at almost every observation point. For example, we counted 6 birds of prey on 26 March at the second, on 24 April at the first and second, and on 23 May at the second and third Vantage points (see photo in Appendix). During the latter survey they were flying at a height of 150-200 m and 250 m in the sky, respectively. The Golden Eagle is included in the Red Book of the Republic of Uzbekistan with status 2 (VU:R): Vulnerable, naturally rare, sedentary, locally distributed South European and Central Asian subspecies. In addition, the species is listed on the IUCN Red List with status [LC-Least Concern].

Steppe Eagle *Aquila nipalensis* was encountered at only the third Vantage point, but one individual was seen on all three trips. During the observation period, the birds were soaring in the sky at a height of about 150-200 m. As a reminder, this rarest species is included in the Red Data Book of the Republic of Uzbekistan with status 2(VU:D): Vulnerable, declining, migratory Oriental subspecies. In addition, the species is included in the IUCN Red List with status [EN-Endangered].

Among secondary species, 3 species have been recorded here: Long-legged buzzard *Buteo rufinus* and Common Kestrel *Falco tinnunculus* and Common Crane *Grus grus*. Among these, *Grus grus* is a numerous species, while *Buteo rufinus* and *Falco tinnunculus* we consider common species, although we met them several times.

And the remaining 27 species we can name other species. Among them the most numerous and widespread species were Indian sparrow *Passer indicus* (121 individuals). And we considered the Common Calandrella *brachydactyla* (62), Tufted Galerida *cristata* (56) and Grey skylark *Calandrella rufescens* (46) common species. But we met only in deserts - at Vantage points 3. I would like to mention that these estimates are comparative. These observations of birds were made only once a month, and this does not give a complete picture of bird numbers. Besides, it should be underlined, that observation point №1 is close to a cultural landscape. There are 2 cement plants nearby and a big road from Nukus to Beruniy. Therefore, cultural bird species like Columba liviya rock pigeon, Corvus cornix hooded crow and Passer montanus eurasian tree sparrow can be found here.

Regarding one specimen of grey heron *Ardea cinerea*, it seems that it flew here by chance, as it is a waterbird.

Bird flight heights varied from 1-15 m for small passerines, skylarks, 15-70 m for small raptors (Merlin, Kestrel), up to 100 m for medium raptors (Rough-legged Buzzard, Long-tailed Eagle) and up to 300 m for Eurasian Crane, Golden Eagle, Steppe Eagle.

Table 4: List of species and number of individuals observed on vantage points in spring

№	Bird species	Days, vantage points and number of species											Nature of stay
		26.03.2022			24.04.2022			23.05.2022			Total		
		№1	№3	№2	№1	№2	№3	№1	№2	№3			
1	Grey heron <i>Ardea cinerea</i>	1										1	BMW
2	Rough-legged buzzard <i>Buteo lagopus</i>	1	1		1	1	2	2	2	1		11	MW
3	Long-legged buzzard <i>Buteo rufinus</i>			2		1	1	1		2		7	BMW
4	Golden eagle <i>Aquila chrysaetos</i>		1		1	1			2	1		6	R
5	Steppe eagle <i>Aquila nipalensis</i>			1			1			1		3	BMW
6	Merlin <i>Falco columbarius</i>			1								1	MW
7	Common kestrel <i>Falco tinnunculus</i>						1			2		3	R
8	Chukar <i>Alectoris chukar</i>		5			7		6	5			23	R
9	Common crane <i>Grus grus</i>	80	140	180								400	M
10	Pin-tailed sandgrouse <i>Pterocles alchata</i>		3									3	BM
11	Black-bellied sandgrouse <i>Pterocles orientalis</i>	5		7			5			13		30	BMW
12	Rock dove <i>Columba liviya</i>							7				7	R
13	Little owl <i>Athene noctua</i>							1	1	2		4	R
14	Blue-cheeked bee-eater <i>Merops persicus</i>							4	6	8		18	BM
15	Desert lark <i>Ammomanes deserti</i>				7	9		5	5			26	BM
16	Crested lark <i>Galerida cristata</i>			12			18			26		56	R
17	Greater short-toed lark <i>Calandrella brachydactyla</i>			6			22			34		62	BM
18	Mediterranean short-toed lark <i>Calandrella rufescens</i>			9			16			21		46	BMW
19	Masked Wagtail <i>Motacilla personata</i>	6								7		13	BM

20	Great grey shrike <i>Lanius excubitor</i>									1		1	R
21	Hooded crow <i>Corvus cornix</i>	2										2	MW
22	Carrion crow <i>Corvus corone</i>	3										3	R
23	Siberian stonechat <i>Saxicola maurus</i>						8		4	6		18	M
24	Pied wheatear <i>Oenanthe pleschanka</i>				8	6		4	3			21	B
25	Finsch's wheatear <i>Oenanthe finschii</i>				5	7		3	2			17	B
26	Desert wheatear <i>Oenanthe deserti</i>							6				6	BM
27	Isabelline wheatear <i>Oenanthe isabellina</i>		4	5		3	9	9	5	15		50	BM
28	Indian sparrow <i>Passer indicus</i>				14	8	17	23	26	33		121	BM
29	Eurasian tree sparrow <i>Passer montanus</i>							18				18	R
30	Rock sparrow <i>Petronia petronia</i>	7	8		4	5			7			31	R
31	Desert finch <i>Rhodospiza obsoleta</i>				6	4		8	6			24	BM
32	Ortolan bunting <i>Emberiza hortulana</i>						3					3	M
24	Pied wheatear <i>Oenanthe pleschanka</i>				8	6		4	3			21	B
25	Finsch's wheatear <i>Oenanthe finschii</i>				5	7		3	2			17	B
26	Desert wheatear <i>Oenanthe deserti</i>							6				6	BM
27	Isabelline wheatear <i>Oenanthe isabellina</i>		4	5		3	9	9	5	15		50	BM
28	Indian sparrow <i>Passer indicus</i>				14	8	17	23	26	33		121	BM
29	Eurasian tree sparrow <i>Passer montanus</i>							18				18	R
30	Rock sparrow <i>Petronia petronia</i>	7	8		4	5			7			31	R
31	Desert finch <i>Rhodospiza obsoleta</i>				6	4		8	6			24	BM
32	Ortolan bunting <i>Emberiza hortulana</i>						3					3	M

Note: R – resident, W – wintering, M – migrant, B – breeding species.

OBSERVATIONS

Vantage Point №: 1

SPECIES TRACKING LOG

Date: 26.03.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 08³⁰-10³⁰

Weather:

Temperature: +5+7, cloudy. Wind speed: 5-7 m/s. Precipitation: none. Max. Visibility (m): _

Table 5: Observations on VP1 on 26.03.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Grey heron <i>Ardea cinerea</i>	1	30	yes
2	Rough-legged buzzard <i>Buteo lagopus</i>	1	70	yes
3	Common crane <i>Grus grus</i>	80	150	yes
4	Black-bellied sandgrouse <i>Pterocles orientalis</i>	5	30	yes
5	Masked Wagtail <i>Motacilla personata</i>	6	5	no
6	Hooded crow <i>Corvus cornix</i>	2	7	no
7	Carrion crow <i>Corvus corone</i>	3	8	no
8	Rock sparrow <i>Petronia petronia</i>	7	6	no

Vantage Point №: 2

SPECIES TRACKING LOG

Date: 26.03.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 11²⁰-13²⁰

Weather:

Temperature: +8+12, cloudy. Wind speed: 7-9 m/s. Precipitation: none. Max. Visibility (m):

Table 6: Observations on VP2 on 26.03.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged buzzard <i>Buteo lagopus</i>	1	65	yes
2	Golden eagle <i>Aquila chrysaetos</i>	1	200	yes
3	Chukar <i>Alektoris chukar</i>	5	15	no
4	Common crane <i>Grus grus</i>	140	300	yes
5	Pin-tailed sandgrouse <i>Pterocles alchata</i>	3	25	yes
6	Isabelline wheatear <i>Oenanthe isabellina</i>	4	3	no
7	Rock sparrow <i>Petronia petronia</i>	8	7	no

Vantage Point №: 3

SPECIES TRACKING LOG

Date: 26.03.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14³⁰-16³⁰

Weather:

Temperature: +12+10, cloudy. Wind speed :8-10 m/s. Precipitation: none. Max. Visibility (m):

Table 7: Observations on VP3 on 26.03.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged buzzard <i>Buteo rufinus</i>	2	60	yes
2	Steppe eagle <i>Aquila nipalensis</i>	1	150	yes
3	Merlin <i>Falco columbarius</i>	1	40	yes
4	Common crane <i>Grus grus</i>	180	250	yes
5	Black-bellied sandgrouse <i>Pterocles orientalis</i>	7	25	yes
6	Crested lark <i>Galerida cristata</i>	8	6	no
		4	3	no
7	Greater short-toed lark <i>Calandrella brachydactyla</i>	6	3	no
8	Mediterranean short-toed lark <i>Calandrella rufescens</i>	9	7	no
9	Isabelline wheatear <i>Oenanthe isabellina</i>	3	2	no
		2	1	no

Vantage Point №: 1

SPECIES TRACKING LOG

Date: 24.04.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 08²⁰-10²⁰

Weather:

Temperature: +15+17, clear. Wind speed: 5-6 m/s. Precipitation: none. Max. Visibility (m): _

Table 8: Observations on VP1 on 24.04.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged buzzard <i>Buteo lagopus</i>	1	50	yes
2	Golden eagle <i>Aquila chrysaetos</i>	1	150	yes
3	Desert lark <i>Ammomanes deserti</i>	7	9	no
4	Pied wheatear <i>Oenanthe pleschanka</i>	8	5	no
5	Finsch's wheatear <i>Oenanthe finschii</i>	5	6	no
6	Indian sparrow <i>Passer indicus</i>	14	9	no
7	Rock sparrow <i>Petronia petronia</i>	4	7	no
8	Desert finch <i>Rhodospiza obsoleta</i>	6	4	no

SPECIES TRACKING LOGDate: 24.04.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 11¹⁰-13¹⁰**Weather:**

Temperature: +20+24, clear. Wind speed: 6-7 m/s. Precipitation: none. Max. Visibility (m):

Table 9: Observations on VP2 on 24.04.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged buzzard <i>Buteo lagopus</i>	1	65	yes
2	Long-legged buzzard <i>Buteo rufinus</i>	1	80	yes
3	Golden eagle <i>Aquila chrysaetos</i>	1	200	yes
4	Chukar <i>Alektoris chukar</i>	7	20	no
5	Desert lark <i>Ammomanes deserti</i>	9	8	no
6	Pied wheatear <i>Oenanthe pleschanka</i>	6	4	no
7	Finsch's wheatear <i>Oenanthe finschii</i>	7	5	no
8	Isabelline wheatear <i>Oenanthe isabellina</i>	3	2	no
9	Indian sparrow <i>Passer indicus</i>	8	4	no
10	Rock sparrow <i>Petronia petronia</i>	5	3	no
11	Desert finch <i>Rhodospiza obsoleta</i>	4	2	no

SPECIES TRACKING LOGDate: 24.04.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14²⁰-16²⁰**Weather:**

Temperature: +24+22, clear. Wind speed: 6-7 m/s. Precipitation: none. Max. Visibility (m):

Table 10: Observations on VP3 on 24.04.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged buzzard <i>Buteo lagopus</i>	2	50	yes
2	Long-legged buzzard <i>Buteo rufinus</i>	1	60	yes
3	Steppe eagle <i>Aquila nipalensis</i>	1	150	yes
4	Common kestrel <i>Falco tinnunculus</i>	1	40	yes
5	Black-bellied sandgrouse <i>Pterocles orientalis</i>	5	25	yes
6	Crested lark <i>Galerida cristata</i>	6	3	no
		5	2	no
		7	5	no
7	Greater short-toed lark <i>Calandrella brachydactyla</i>	12	9	no
		10	6	no
8	Mediterranean short-toed lark <i>Calandrella rufescens</i>	16	8	no
9	Siberian stonechat <i>Saxicola maurus</i>	8	5	no
10	Isabelline wheatear <i>Oenanthe isabellina</i>	2	1	no
		4	3	no
		3	2	no
11	Indian sparrow <i>Passer indicus</i>	9	5	no
		8	3	no
12	Ortolan bunting <i>Emberiza hortulana</i>	3	1	no

SPECIES TRACKING LOGDate: 23.05.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 08¹⁵-10¹⁵**Weather:**

Temperature: +19+21, clear. Wind speed: 6-7 m/s. Precipitation: none. Max. Visibility (m):

Table 11: Observations on VP1 on 23.05.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged buzzard <i>Buteo lagopus</i>	2	50	yes
2	Long-legged buzzard <i>Buteo rufinus</i>	1	60	yes
3	Chukar <i>Alectoris chukar</i>	6	25	yes
4	Rock dove <i>Columba livia</i>	7	30	yes
5	Little owl <i>Athene noctua</i>	1	15	no
6	Blue-cheeked bee-eater <i>Merops persicus</i>	4	20	no
7	Desert lark <i>Ammomanes deserti</i>	5	4	no
8	Pied wheateater <i>Oenanthe pleschanka</i>	4	3	no
9	Finsch's wheatear <i>Oenanthe finschii</i>	3	2	no
10	Desert wheatear <i>Oenanthe deserti</i>	6	8	no
11	Isabelline wheatear <i>Oenanthe isabellina</i>	9	7	no
12	Indian sparrow <i>Passer indicus</i>	23	6	no
13	Eurasian tree sparrow <i>Passer montanus</i>	18	12	no
14	Desert finch <i>Rhodospiza obsoleta</i>	8	6	no

SPECIES TRACKING LOGDate: 23.05.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 11²⁰-13²⁰**Weather:**

Temperature: +25+28, clear. Wind speed: 6-7 m/s. Precipitation: none. Max. Visibility (m):

Table 12: Observations on VP2 on 23.05.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged buzzard <i>Buteo lagopus</i>	2	75	yes
2	Golden eagle <i>Aquila chrysaetos</i>	2	150	yes
3	Chukar <i>Alektoris chukar</i>	5	30	yes
4	Little owl <i>Athene noctua</i>	1	8	no
5	Blue-cheeked bee-eater <i>Merops persicus</i>	6	5	no
6	Desert lark <i>Ammomanes deserti</i>	5	7	no
7	Siberian stonechat <i>Saxicola maurus</i>	4	6	no
8	Pied wheateater <i>Oenanthe pleschanka</i>	3	5	no
9	Finsch's wheatear <i>Oenanthe finschii</i>	2	7	no
10	Isabelline wheatear <i>Oenanthe isabellina</i>	5	3	no
11	Indian sparrow <i>Passer indicus</i>	26	8	no
12	Rock sparrow <i>Petronia petronia</i>	7	5	no
13	Desert finch <i>Rhodospiza obsoleta</i>	6	4	no

Vantage Point №: 3

SPECIES TRACKING LOG

Date: 23.05.2022. Observers: Y. Ametov, A. Tureyev. Survey start and end time: 14³⁵-16³⁵

Weather:

Temperature: +28+26, clear. Wind speed: 7-8 m/s. Precipitation: none. Max. Visibility (m):

Table 13: Observations on VP3 on 23.05.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged buzzard <i>Buteo lagopus</i>	1	50	yes
2	Long-legged buzzard <i>Buteo rufinus</i>	2	70	yes
3	Golden eagle <i>Aquila chrysaetos</i>	1	250	yes
4	Steppe eagle <i>Aquila nipalensis</i>	1	200	yes
5	Common kestrel <i>Falco tinnunculus</i>	2	30	yes
6	Little owl <i>Athene noctua</i>	2	5	no
7	Black-bellied sandgrouse <i>Pterocles orientalis</i>	13	30	yes
8	Blue-cheeked bee-eater <i>Merops persicus</i>	8	7	no
9	Crested lark <i>Galerida cristata</i>	7	4	no
		8	6	no
		11	9	no
10	Greater short-toed lark <i>Calandrella brachydactyla</i>	9	8	no
		13	12	no
		7	4	no
		5	2	no
11	Mediterranean short-toed lark <i>Calandrella rufescens</i>	13	9	no
		8	6	no
12	Masked Wagtail <i>Motacilla personata</i>	7	3	no
13	Great grey shrike <i>Lanius excubitor</i>	1	6	no
14	Siberian stonechat <i>Saxicola maurus</i>	6	3	no
15	Isabelline wheatear <i>Oenanthe isabellina</i>	3	2	no
		6	4	no
		2	1	no
		4	3	no
16	Indian sparrow <i>Passer indicus</i>	12	9	no
		7	4	no
		9	6	no
		5	3	no
16	Indian sparrow <i>Passer indicus</i>	12	9	no
		7	4	no
		9	6	no
		5	3	no

NEST SEARCH

In Kyzylkum desert raptors nests in rocky and loess cliffs, in trees (only Long-legged Buzzard) and power transmission poles.

The purpose of specialized raptor nest surveys was to explore the cliffs along planned OHTL in search of nesting sites for birds of prey including old world vultures, falcons, and all hawks, eagles, buzzards, kites, and harriers. Walked surveys were undertaken to establish nesting species, locations and any regular roosting sites. The identified nest sites were recorded and their locations were mapped. The survey was conducted twice during the breeding season: in April and May.



Figure 3 Planned OHTL point associated with Nukus 100 MW Wind Farm

Nests were searched in suitable nesting habitats along planned OHTL and its 2 km buffer zone (Fig. 3).

During the observations, the birds were photographed, which is used to confirm the correct identification of species. Birds were observed through 10x binoculars and 60x Viking telescopes. At all observation sites the coordinates were determined using a GPS "Garmin".

On April 25 2022 we found the only active nest in the area, which was known from the observations in 2019 - nest of the Golden Eagle *Aquila chrysaetos* at 2³⁵ pm approximately 11 km to the north-west of OHTL and 8,3 km from the Nukus WF border. Coordinates of the nest site were 42.09.313°N, 60.25.674°E. It is located among Sultanuizdag mountain massifs, on the right bank of the Amudarya River (Figures 4, 5)



Figure 4: Golden Eagle nesting site

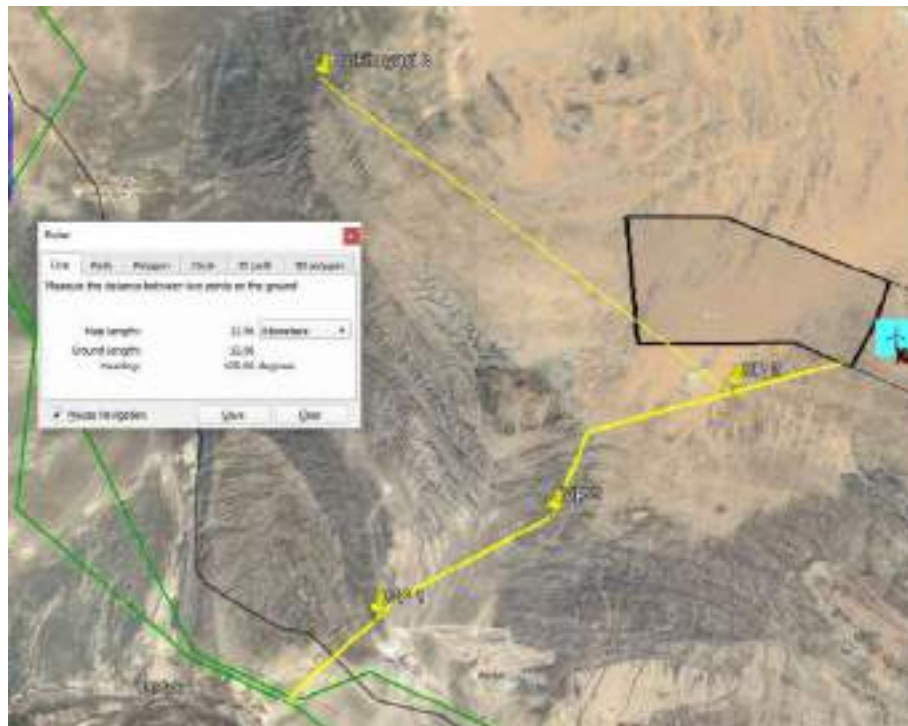


Figure 5: Golden Eagle nesting site location

The nest is located on top of a large rock on a steep cliff. At the time of finding the nest, there was a small downy chick of approximately 5-6 or 7-8 days old in the nest. In addition, the body remains of an unknown ground squirrel, the main food item, were found in the nest (figures below).

Both parents were near the chick and they were alternately feeding their chick. When they saw us, they flew away hovering over us. When we left the nest they returned to their chick.





On May 22 2022 at 11⁰⁵ am we revisited an active nest of *Aquila chrysaetos* located 12.5 km to the north of observation point VP3 which had been found on 25 April 2022. When we arrived at the nest site, we found both parents and an already much bigger chick on the nest (see figures below). The wing and tail feathers had already grown. In addition, the remains of an unidentified decapitated ground squirrel, the main food item, were found in the nest.

The parents were near the nestling, they were feeding their chick, but when they saw us, they flew away hovering over us. When we left the nest they went back to their chick.



CONCLUSIONS

According to the results of the ornithological survey conducted during the spring season (March, April and May), 32 bird species belonging to 8 families were recorded at 3 observation points. Of course, this is a small number of species for such a large area. This is probably due to the aridity of the area. Besides, there are no lakes, canals, etc. in the nearest area which would attract waterfowl. And small migratory birds mostly fly in a wide front and are not concentrated in one area.

Regarding target species, we recorded two species in the spring season - **Golden Eagle *Aquila chrysaetos*** and **Steppe Eagle *Aquila nipalensis***. Golden Eagle *Aquila chrysaetos* was seen at almost every observation point, while Steppe Eagle *Aquila nipalensis* was seen at only the third observation point, but one individual was seen on all three trips. During the survey these birds were soaring in the sky at heights of 150-200-250 m. As a reminder, these rare species are included in the Red Book of the Republic of Uzbekistan and in the IUCN Red List with different statuses.

Among secondary species, 3 species have been recorded here: Long-legged buzzard *Buteo rufinus* and Common Kestrel *Falco tinnunculus* and Common crane *Grus grus*. Among them *Grus grus* is a numerous species, while *Buteo rufinus* and *Falco tinnunculus* we consider common species, although we met them several times.

And the remaining 27 species we can name other species. Regarding the sighting of one individual grey heron *Ardea cinerea*, apparently it came here by chance, as it is a near-water bird.

Bird flight heights varied from 1-15 m - small passerines, skylarks, 15-70 m - small raptors (Merlin, Kestrel), to 100 m - medium raptors (Rough-legged Buzzard, Merlin) and up to 300 m (Eurasian Crane, Golden Eagle, Steppe Eagle).

During the survey, apart from birds, we observed insects, among reptiles - Central Asian tortoise *Testudo horsfieldi*, steppe agama *Trapelus sanguinolentus* and among mammals - yellow gopher *Citellus fulvus* and fox *Vulpes vulpes*.

As a result of the nest search along planned OHTL on April 25, 2022 we found an only active nest in the area - nest of the Golden Eagle *Aquila chrysaetos* approximately approximately 11 km to the north-west of OHTL and 8,3 km from the Nukus WF border. This is probably the only active nest located in the vicinity of the Nukus WF and associated OHTL. No other active or old nests were found during the nest search.

ANNEX 1. BIRDS RECORDED AT VANTAGE POINTS



Grey heron *Ardea cinerea*



Rough-legged buzzard *Buteo lagopus*



Long-legged buzzard *Buteo rufinus*



Golden eagle *Aquila chrysaetos*



Steppe eagle *Aquila nipalensis*



Chukar *Alektrois chukar*



Merlin *Falco Columbarius*



Common crane *Grus grus*



Pin-tailed sandgrouse *Pterocles alchata*



Blue-cheeked bee-eater *Merops persicus*



Desert lark *Ammomanes deserti*



Crested lark *Galerida cristata*



Greater short-toed lark *Calandrella brachydactyla*



Mediterranean short-toed lark *Calandrella rufescens*



Masked Wagtail *Motacilla personata*



Siberian stonechat *Saxicola maurus*



Pied wheatear *Oenanthe pleschanka*



Finsch's wheatear *Oenanthe finschii*



Isabelline wheatear *Oenanthe isabelline*



Indian sparrow *Passer indicus*



Desert finch *Rhodospiza obsoleta*



Ortolan bunting *Emberiza hortulana*

ANNEX 2. OTHER ANIMALS OBSERVED AT VANTAGE POINTS



Russian tortoise *Testudo horsfieldii*



Steppe agama *Trapelus sanguinolentus*



Yellow ground squirrel *Citellus fulvus*

ANNEX 3. GENERAL PHOTOS OF THE OBSERVED AREA









WINTER BIRD SURVEY

(DECEMBER-JANUARY-FEBRUARY)

FOR THE PLANNED OHTL ASSOCIATED WITH
NUKUS 100 MW WIND FARM



Client: 5 Capitals

Date: March 2022

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INTRODUCTION

In recent years, Uzbekistan has paid special attention to the development of renewable energy sources, which is reflected in the Law of the Republic of Uzbekistan No. ZRU-539 of 21.05.2019 "On use of renewable energy sources", as well as in the Decree of the President of the Republic of Uzbekistan No. PP-4422 of August 22, 2019 "On accelerated measures to improve energy efficiency of economic sectors and social sphere, introduction of energy-saving technologies and development of renewable energy sources".

In the framework of the Nukus 100 MW Wind Farm Project, bird survey was conducted along the planned OHTL in Winter 2021-2022. The purpose of ornithological monitoring was to conduct systematic field studies at specific vantage points to assess bird species composition that occur along the planned OHTL, and also to identify birds that are of conservation interest under IUCN and Uzbekistan Redlist.

This report presents the main materials of field studies conducted in this area during the winter period (December 2021, January 2022, February, 2022). Bird observations were carried out at 3 Vantage Points.

This report is a statement of work made by Juru Eneyr` local ornitologist Y.I. Ametov.

SITE DESCRIPTION

The project area is located on the territory of Karauzak district 120-140 km south of Nukus. The landscape of the project area is steppe and arid.

The project area is located on the territory of the Sultanuizdag mountain range. Sultanuizdag (Uzbek: *Sulton Uvays tizmasi*) is a mountain range in Karakalpakstan (Uzbekistan), on the right bank of the Amu Darya. The range is located in the extreme southwest of Kyzylkum, separating the desert from the valley of the Amu Darya River. The length is over 50 km, the width is up to 25 km. The ridge has an almost latitudinal stretch in the east, which is replaced by a north-westerly one in its western part (*Figure 1*).



Figure 1. Sultanuizdag Mountain range

The maximum height reaches 473 m. The massif consists of ridges composed of quartzite, gneiss, marble with granodiorite intrusions. The southern and western slopes are steep, while the northern and eastern slopes are gentle. Desert landscapes prevail.

Accordingly, it is home to steppe and desert species of animals and plants. There are no wetlands on the territory. However, during the migration period, representatives of other biotopes can also be found. Sultanuizdag upland ravines provide shelter for mammals and reptiles from critical temperatures, as well as nesting places for birds.

The largest areas in Sultanuizdag are occupied by *Artemisia* formation. White saxauls are common in areas with compacted sand. These areas are characterised by large acacia massifs, dense saxaul and bush thickets and motley grasses. This biogeocenosis is favourable for nesting, egg-laying and resting places for passerine species.

A special group of plants in the project area: ephemeroids are annual herbaceous plants that complete their development in a very short wet period of spring, and ephemeroids are perennial grasses that flower in spring, in summer their aboveground part dies off, there are only underground rhizomes, bulbs and tubers. Of the medicinal plants found - Ferula and Harmal.

The animal life of the northern part of Kyzylkum is represented by typical desert species. Here, psammophilous species predominate in the teriofauna. Among reptiles here are common: Russian tortoise, Steppe agama, Arrow snake; among birds - falconiform and passerines. It is important to note that cattle breeding or grazing is developed here, shepherds build their huts and all year round they take care of their sheep, cows, horses and camels.

SURVEY METHODS

VP survey method generally followed SNH (2017) guidance for wind farm bird assessments, minus the elements that are specifically driven by the data requirements of collision risk modelling.

Observations were made at 3 stationary points (Table 1). The duration of observations at each station (point) was 2 hours. Total duration of observations at one VP was 6 hours, total duration for three VPs was 18 hours.

The range of detection and detection of large species of birds of prey was up to 2 km, and small passerines from 50 to 100 m. The flight directions and altitude were taken into account.

During the observations, photographs and short video footage of birds were taken, which is used to confirm the correct identification of species and to obtain additional data on the number of individuals. The birds were observed through 10x binoculars and 60x Viking telescope. At all vantage points the coordinates were determined with the help of GPS "Garmin".

Points and numbering for stationary observation in the project area have been agreed with Juru Energy. The points are located so as to cover the territory as completely as possible (*Figure 2*). The radius of observation areas is 2 km. The time of the observation on the Vantage points is 2 hours.



Figure 2. Location of Vantage points

Table 1. Coordinates of the Vantage points and duration of bird observations

Number	Coordinates	Date of observations	Duration of observations
Vantage points			
VP №1	42.036756 'N 60.446168 'E	December, 31st January 23 February 19	6 hours
VP №2	42.057134 'N 60.493878 'E	December, 31st January 23 February 19	6 hours
VP №3	42.083162 'N 60.544998 'E	December, 31st January 23 February 19	6 hours

Data was recorded on the survey forms:

- The location of the VP used
- Date of survey
- Surveyor name
- Start and End time of the VP session
- Weather condition
- For target species (all raptors, bustards, ducks, geese, pelicans, cranes, herons, waders and gulls, sandgrouses, owls, nightjars) - time of the record, number, flight altitude, approximate distance and direction of flight according compass
- For other species: time of the record, number, flight altitude
- Notes

RESULTS OF THE SURVEY

Based on the results of the monitoring 22 bird species belonging to 5 orders were registered at 3 Vantage points. They include: *Egretta alba*, *Haliaeetus albicilla*, *Aquila nipalensis*, *Circus cyaneus*, *Buteo lagopus*, *Buteo rufinus*, *Falco columbarius*, *Falco tinnunculus*, *Pterocles orientalis*, *Columba livia*, *Athene noctua*, *Galerida cristata*, *Calandrella rufescens*, *Eremophila alpestris*, *Sturnus vulgaris*, *Corvus corone*, *Corvus frugilegus*, *Corvus cornix*, *Petronia petronia*, *Fringilla coelebs*, *Fringilla montifringilla* and *Spinus spinus* (Table 2, Table 3).

Table 2. List of orders and number of bird species recorded on the site

№	Russian name	Latin name	English name	Number of species
1	Аистообразные	Ciconiiformes	Storks	1
2	Соколообразные	Falconiformes	Falcons	7
3	Голубеобразные	Columbiformes	Pterocletes	2
4	Совообразные	Strigiformes	Owls	1
5	Воробьинообразные	Passeriformes	Passerins	11

The **Steppe Eagle *Aquila nipalensis*** was detected during the winter season. We observed one individual of this species on February 26th this year during a resurvey of the area near the Vantage point 3 (photo in the annexes). The bird was sitting on a pile of soil excavated by geologists. At that time, we witnessed an interesting incident. A fox appeared about 30-40 m away from the steppe eagle at that moment. On seeing the fox, the eagle immediately rose to its height and rushed towards the fox. The fox turned around in time, ran away immediately and barely survived. The Steppe Eagle, after seeing us, quickly rose to a height of about 100 m and flew southwards, reaching an altitude of about 150 m. This rare species is listed in the Red Book of the Republic of Uzbekistan with status 2 (VU:D): Vulnerable, shrinking, migratory oriental subspecies. In addition, the species is included in the IUCN Red List with status [EN-Endangered].

Apart from the Steppe Eagle in early February (03.02.2022) another rare endangered species, a **White-tailed Eagle *Haliaeetus albicilla*** was found on the territory of the Vantage point 1 (photo in the annexes). It was sitting on a hill and observing something, then 10 minutes later it noted us, flew away to the east at an altitude of about 80-100 m. This rare species is listed in the Red Book of the Republic of Uzbekistan with status 2(VU:R): Vulnerable, rare, migratory nominate subspecies. In addition, the species is included in the IUCN Red List with status [LC-List Concern]. It is protected in nature reserves at Sudochie Lake (nesting), Dengizkul, Karakyr, and Tuzkan (migration and wintering).

Circus cyaneus, *Buteo rufinus*, and *Falco tinnunculus* have also been recorded during the survey.

The remaining 17 species we could name as other species. The most numerous and widespread species were the wintering Chaffinch *Fringilla coelebs* (162 individuals), Common Starling *Sturnus vulgaris* (138), Rock Sparrow *Petronia petronia* (99) and Crested Lark *Galerida cristata* (98).

These species were encountered at all the Vantage points. And we consider the Rock Dove *Columba livia* (92), Hooded Crow *Corvus cornix* (65) and Brambling *Fringilla montifringilla* (61) to be common species.

In addition, it should be emphasised that VP1 is close to the cultural landscape. There are 2 cement factories nearby and a main road Nukus-Beruni. Therefore, rural cultural landscape species such as *Columba livia* are present in the area

Based on observations of Great White Egret *Egretta alba* and White-tailed Eagle *Haliaeetus albicilla*, it is likely that they arrived here accidentally or as migrants, as they usually are observed near waterbodies.

The flight height of birds ranged from 1 to 15 meters for small sparrows and larks, from 20 to 70 meters for small predators (Kestrels, Long-legged Buzzard), up to 100 meters for medium-sized predators (Black Kite, Rough-legged Buzzard) and 300 meters (Short-toed Snake Eagle, Steppe eagle, Golden eagle).

Table 3. List of species and number of individuals observed on vantage points in winter

№	Bird species	Days, vantage points and number of species											Nature of stay
		31.12.2021			23.01.2022			19.02.2022			Total		
		№1	№3	№2	№1	№2	№3	№1	№2	№3			
1	Great Egret <i>Casmerodius albus</i>							1				1	BMW
2	White-tailed Eagle <i>Haliaeetus albicilla</i>							1				1	BMW
3	Steppe Eagle <i>Aquila nipalensis</i>									1		1	BMW
4	Hen Harrier <i>Circus cyaneus</i>								1			1	MW
5	Rough-legged Buzzard <i>Buteo lagopus</i>				1							1	MW
6	Long-legged Buzzard <i>Buteo rufinus</i>		1				1					2	BMW
7	Merlin <i>Falco columbarius</i>	1										1	MW
8	Common Kestrel <i>Falco tinnunculus</i>									1		1	R
9	Black-bellied Sandgrouse <i>Pterocles orientalis</i>									9		9	BMW
10	Rock Dove <i>Columba livia</i>	37			19			36				92	R
11	Little Owl <i>Athene noctua</i>		1									1	R
12	Crested Lark <i>Galerida cristata</i>	12	9	7	17		7	21	11	14		98	R
13	Lesser short-toed Lark <i>Calandrella rufescens</i>	11	14							12		37	BMW
14	Horned Lark <i>Eremophila alpestris</i>	23										23	W
15	Common Starling <i>Sturnus vulgaris</i>					38	26	46	28			138	BMW
16	Carrion Crow <i>Corvus corone</i>			2			4					6	R
17	Rook <i>Corvus frugilegus</i>	12										12	BMW
18	Hooded Crow <i>Corvus cornix</i>	5		9	15	9	8	12	7			65	MW
19	Rock Sparrow <i>Petronia petronia</i>			10	28	17		19	25			99	R
20	Chaffinch <i>Fringilla coelebs</i>		9		34	29	14	26	32	18		162	MW
21	Brambling <i>Fringilla montifringilla</i>					16		21	24			61	MW
22	Eurasian Siskin <i>Spinus spinus</i>						12			16		28	MW

Note: R – resident, W – wintering, M – migrant, B – breeding species.

OBSERVATIONS

Vantage Point №: 1

Date: 31.12.2021. Observers: Y. Ametov, A. Tureyev, B. Nurimov. Survey start and end time: 08²⁵-10²⁵

Weather:

Temperature: -5-2 °C, clear. Wind speed: 3-4 m/s. Precipitation: no. Max. Visibility (m): _____

Table 4. Observations on VP1 on 31.12.2021

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Merlin <i>Falco columbarius</i>	1	45	yes
2	Rock Pigeon <i>Columba livia</i>	23	25	yes
		14	25	yes
3	Crested Lark <i>Galerida cristata</i>	7	5	no
		5	3	no
4	Lesser short-toed Lark <i>Calandrella rufescens</i>	4	5	no
		7	8	no
5	Horned Lark <i>Eremophila alpestris</i>	9	5	no
		6	4	no
		8	6	no
6	Rook <i>Corvus frugilegus</i>	12	13	no
7	Hooded Crow <i>Corvus cornix</i>	5	12	no

Vantage Point №: 3

Date: 31.12.2021. Observers: Y. Ametov, A. Tureyev, B. Nurimov. Survey starts and end time: 11⁰⁵-13⁰⁵

Weather:

Temperature: -2+4 °C, mostly clear. Wind speed: 4-5 m/s. Precipitation: no. Max. Visibility (m): _

Table 5. Observations on VP3 on 31.12.2021

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged Buzzard <i>Buteo rufinus</i>	1	80	yes
2	Little Owl <i>Athene noctua</i>	1	5	no
3	Crested Lark <i>Galerida cristata</i>	5	6	no
		4	3	no
4	Lesser short-toed Lark <i>Calandrella rufescens</i>	8	4	no
		6	5	no
5	Chaffinch <i>Fringilla coelebs</i>	9	7	no

Vantage Point №: 2

Date: 31.12.2021. Observers: Y. Ametov, A. Tureyev, B. Nurimov. Survey starts and end time: 13³⁵-15³⁵

Weather:

Temperature: +4+3 °C, mostly clear. Wind speed: 4-5 m/s. Precipitation: no. Max. Visibility (m): _

Table 6. Observations on VP2 on 31.12.2021

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Crested Lark <i>Galerida cristata</i>	7	7	no
2	Carrion Crow <i>Corvus corone</i>	2	6	no
3	Hooded Crow <i>Corvus cornix</i>	4	5	no
		5	7	no
4	Rock Sparrow <i>Petronia petronia</i>	10	8	no

Vantage Point №: 1

Date: 23.01.2022. Observers: Y. Ametov, A. Tureyev, B. Nurimov. Survey starts and end time: 08³⁰-10³⁰

Weather:

Temperature: -10-7 °C, clear. Wind speed: 4-5 m/s. Precipitation: no. Max. Visibility (m): _____

Table 7. Observations on VP1 on 23.01.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Rough-legged Buzzard <i>Buteo lagopus</i>	1	50	yes
2	Rock Dove <i>Columba livia</i>	19	25	yes
3	Crested Lark <i>Galerida cristata</i>	17	9	No
4	Hooded Crow <i>Corvus cornix</i>	15	30	Yes
5	Rock Sparrow <i>Petronia petronia</i>	28	10	No
6	Chaffinch <i>Fringilla coelebs</i>	34	12	No

Vantage Point №: 2

Date: 23.01.2022. Observers: Y. Ametov, A. Tureyev, B. Nurimov. Survey starts and end time: 11¹⁰-13¹⁰

Weather:

Temperature: -7-5 °C, clear. Wind speed: 5-6 m/s. Precipitation: no. Max. Visibility (m): _

Table 8. Observations on VP2 on 23.01.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Common Starling <i>Sturnus vulgaris</i>	38	30	Yes
2	Hooded Crow <i>Corvus cornix</i>	9	25	Yes
3	Rock Sparrow <i>Petronia petronia</i>	17	12	No
4	Chaffinch <i>Fringilla coelebs</i>	29	11	No
5	Brambling <i>Fringilla montifringilla</i>	16	9	No

Vantage Point №: 3

Date: 23.01.2022. Observers: Y. Ametov, A. Tureyev, B. Nurimov. Survey starts and end time: 13⁵⁵-15⁵⁵

Weather:

Temperature: -4-6 °C, clear. Wind speed: 5-6 m/s. Precipitation: no. Max. Visibility (m): _

Table 9. Observations on VP3 on 23.01.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Long-legged Buzzard <i>Buteo rufinus</i>	1	60	yes
2	Crested Lark <i>Galerida cristata</i>	7	4	no
3	Common Starling <i>Sturnus vulgaris</i>	26	25	yes
4	Carrion Crow <i>Corvus corone</i>	4	5	no
5	Hooded Crow <i>Corvus cornix</i>	8	6	no
6	Chaffinch <i>Fringilla coelebs</i>	14	8	no
7	Eurasian Siskin <i>Spinus spinus</i>	12	7	no

Vantage Point №: 1

Date: 19.02.2022. Observers: A. Tureyev, B. Nurimov. Survey starts and end time: 08⁵⁰-10⁵⁰

Weather:

Temperature: -2+5 °C, clear. Wind speed: 3-4 m/s. Precipitation: no. Max. Visibility (m): _____

Table 10. Observations on VP1 on 19.02.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Great White Egret <i>Egretta alba</i>	1	60	yes
2	White-tailed Eagle <i>Haliaeetus albicilla</i>	1	80	yes
3	Rock Dove <i>Columba livia</i>	36	25	yes
4	Crested lark <i>Galerida cristata</i>	13	8	no
		8	4	no
5	Common Starling <i>Sturnus vulgaris</i>	46	30	yes
6	Hooded Crow <i>Corvus cornix</i>	12	25	yes
7	Rock Sparrow <i>Petronia petronia</i>	19	9	no
8	Chaffinch <i>Fringilla coelebs</i>	26	11	no
9	Brambling <i>Fringilla montifringilla</i>	21	9	no

Vantage Point №: 2

Date: 19.02.2022. Observers: A. Tureyev, B. Nurimov. Survey starts and end time: 11³⁰-13³⁰

Weather:

Temperature: +6+10 °C, clear. Wind speed: 4-5 m/s. Precipitation: no. Max. Visibility (m): _

Table 11. Observations on VP2 on 19.02.2022

№	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Hen Harrier <i>Circus cyaneus</i>	1	50	yes
2	Common Starling <i>Sturnus vulgaris</i>	28	25	yes
3	Crested Lark <i>Galerida cristata</i>	11	7	no
4	Hooded Crow <i>Corvus cornix</i>	7	25	yes
5	Rock Sparrow <i>Petronia petronia</i>	25	11	no
6	Chaffinch <i>Fringilla coelebs</i>	32	12	no
7	Brambling <i>Fringilla montifringilla</i>	24	10	no

Vantage Point №: 3

Date: 19.02.2022. Observers: A. Tureyev, B. Nurimov. Survey starts and end time: 14¹⁵-16¹⁵

Weather:

Temperature: +10+8 °C, clear. Wind speed: 5-6 m/s. Precipitation: no. Max. Visibility (m): _

Table 12. Observations on VP3 on 19.02.2022

No	Species observed	Number of individuals	Estimated average flight height	Did individual fly inside risk height at all (25-175 m)?
1	Steppe Eagle <i>Aquila nipalensis</i>	1	175	yes
2	Common Kestrel <i>Falco tinnunculus</i>	1	50	yes
3	Black-bellied Sandgrouse <i>Pterocles orientalis</i>	9	30	yes
4	Crested Lark <i>Galerida cristata</i>	14	8	no
5	Lesser short-toed Lark <i>Calandrella rufescens</i>	12	7	no
6	Chaffinch <i>Fringilla coelebs</i>	18	9	no
7	Eurasian Siskin <i>Spinus spinus</i>	16	8	no

CONCLUSION

According to the results of the ornithological survey conducted during the winter season (December, January, and February), 22 bird species belonging to 5 orders were recorded at 3 Vantage points.

Certainly, this number is low for such a large area. Firstly, winter differs from other seasons by its cold climate, snow, etc., and secondly, there are no lakes and channels in the nearest area which would attract wetlands and other birds.

Therefore, such sparse and low abundance both in terms of species and numbers of birds was obtained.

We recorded 1 individual of Steppe Eagle *Aquila nipalensis* at VP 3; 1 individual of White-tailed Eagle *Haliaeetus albicilla* at VP 1 and also *Circus cyaneus*, *Buteo rufinus*, and *Falco tinnunculus*.

The remaining 17 species we can define as other species.

Based on observations of Great White Egret *Egretta alba* and White-tailed Eagle *Haliaeetus albicilla*, it is likely that they arrived here accidentally or as migrants, as usually they are observed near waterbodies.

The flight height of birds ranged from 1 to 15 meters for small sparrows and larks, 10-70 meters for small predators (Kestrels, Harrier, Merlin), up to 100 meters for medium-sized predators (Long-legged buzzard, Rough-legged Buzzard) and 300 meters (White-tailed Eagle, Steppe Eagle).

During the survey, in addition to birds, we noted some mammals, such as yellow gopher *Citellus fulvus*, Fox *Vulpes vulpes* and Tolai hare *Lepus tolai*.

ANNEX 1. BIRDS RECORDED AT VANTAGE POINTS



Rough-legged Buzzard *Buteo lagopus*



Steppe Eagle *Aquila nipalensis*



White-tailed Eagle *Haliaeetus albicilla*



Merlin *Falco columbarius*



Common Kestrel *Falco tinnunculus*



Rock Dove *Columba livia*



Crested lark *Galerida cristata*



Lesser short-toed Lark *Calandrella rufescens*



Carrion Crow *Corvus corone*



Hooded Crow *Corvus cornix*



Rock Sparrow *Petronia petronia*



Chaffinch *Fringilla coelebs*

ANNEX 2. OTHER ANIMALS OBSERVED AT VANTAGE POINTS



A frightened fox fleeing from a steppe eagle



Citellus fulvus coming out of hibernation

ANNEX 3. GENERAL PHOTOS OF THE OBSERVED AREA









Nukus 100 MW Wind Farm

REPTILE SURVEY



CLIENT: 5 CAPITALS

Date: July 2022

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INTRODUCTION

Uzbekistan is located in the central part of Central Asia and borders on four Central Asian countries – Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan, as well as Afghanistan in the south. Its geographical location at the junction of a number of biogeographic regions determines the age, diversity, origin and complex genetic relationships between the regional flora and fauna. The gene pool of wild animals inhabiting the territory of Uzbekistan is unique. The country is an important habitat for endemic species and subspecies of Central Asian animals. Most of it is represented by native fauna (Yunusov et al., 2015).

In the modern world, we are becoming increasingly more aware of sustainable nature management as the only correct way for the further development of mankind.

One of these approaches is the introduction and use of alternative energy sources.

It should be noted that Decree No. УП-5544 'On Approval of the Strategy for Innovative Development of the Republic of Uzbekistan for 2019-2021' issued by the President of the Republic of Uzbekistan on 21 September 2018 specifies that the share of electricity production using renewable energy sources will increase to at least 20% by 2025.

In addition, long-term targets for the development of RES and a plan for organizational and practical measures for further development of RES were approved in accordance with Decree No. ПП-4422 'On accelerated measures to improve the energy efficiency of economic and social sectors, the introduction of energy-saving technologies and the development of renewable energy sources' issued by the President of the Republic of Uzbekistan on 22 August 2019.

This decree determines an increase in the share of electricity production using renewable energy sources to at least 25% by 2030.

To achieve the targets, the government has developed a plan to build almost 10 GW of new renewable energy facilities, including 5 GW of solar (excluding the capacity of individual households), 3 GW of wind and 1.9 GW of hydroelectric power plants.

At the same time, the construction of new renewable energy facilities with a total capacity of more than 10 GW and the modernization of existing hydroelectric power plants will ensure the production of more than 37 billion kWh of electricity by renewable energy facilities (in 2018 – 5.9 billion kWh), as well as expected annual savings of more than 8.1 billion m³ of natural gas.

This report presents a faunistic overview of the territory projected for the construction of a wind power plant in the vicinity of a wind power plant in the area of Sultan-Uvays ridge, Republic of Karakalpakstan.

At this cameral stage, an overview of the fauna is provided, based on the literary, departmental, personal data and field data of the authors of the report.

PHYSIOGRAPHICAL DESCRIPTION OF THE RESEARCH AREA

The project area is located in Beruni and Karauzyak districts of the Republic of Karakalpakstan. It belongs to the Lower Amu Darya physico-geographical region, which includes the modern and ancient deltas of the river.

The territory borders the Ustyurt Plateau to the west, the Kyzylkum Desert to the east, the Aral Sea to the north, and Turkmenistan to the southwest.

The area is about 50 thousand sq.km. The relief of the Lower Amu Darya physio-graphical region is a lowland, the surface of which is slightly inclined and widens from southeast to northwest. The area extends from the Tuyamuyun gorge in the southeast to the Aral Sea in the northwest.

The length of the gorge in this direction is 400 km. Within Pitnak elevation (absolute height up to 200 m) Amudarya flows in narrow channel and forms Tuyamuyun gorge.

The delta spreads (width 10-12 km) below the gorge, with an absolute height of relief of 150 m.

From this direction the ancient delta of the Amu Darya starts, its width reaches 75-80 km.

The project area is located on the Sultan-Uvaiz (Sultanuizdag) Ridge and the adjacent section of the Kyzylkum desert. The ridge is located on the right bank of the Amudarya River at the extreme south-west of Kyzylkum, separating the desert from the river valley. It is more than 50 km long and up to 25 km wide. The ridge has an almost latitudinal extension in the east, changing to a northwestern extension in its western part. The maximum height reaches 473 m. The southern and western slopes are steep, while the northern and eastern slopes are more gentler. The massif consists of ridges composed of quartzite, gneiss, marble and granodiorite. Desert landscapes dominate. There is no constant running water. The valleys, cuts through the ridge, are completely waterless and very hot in summer.

The nature of all these mountains in Kyzylkum is rather similar. They are ridge-like, with strongly flattened contours. Their northern slopes descending first gently and then almost steeply and in large ledges. In the opposite direction, the southern slopes are hilly and extremely gently sloping toward the plain. They are ridge-like, with strongly flattened contours. Their northern slopes descending first gently and then almost steeply and in large ledges. In the opposite direction, the southern slopes are hilly and extremely gently sloping toward the plain. The slopes on either side of these mountains are usually flanked by many small savannahs. The stony slopes consist of ancient crystalline and metamorphic rocks. Genetically, the Kyzylkum Mountains are mostly remnants of Paleozoic rocks, eroded and dissected by denudation over a long period of time.

The project area is remote from major settlements, despite this, the level of impact on the environment is high. On the south side passes the international highway A380, the territory is crossed by numerous used dirt roads. Also, in the south-eastern part of the ridge is a holy place "Sultanbaba Mausoleum" is actively visited by pilgrims, livestock grazing. The most significant factor of concern and impact on the environment is the presence of several operating factories and quarries.

Along the Amu Darya, opposite the ridge there is a protected area - the Lower Amu Darya Biosphere Reserve, which on September 16, 2021, was included in the World Network of Biosphere Reserves under the UNESCO "Man and the Biosphere" (MAB) program. It is necessary to mention that earlier, the WWF program "Econet" proposed to create a national park "Sultanuwais Ridge" (#16), which is part of the Central Kyzylkum zone, and in 2012 it was also proposed to create a national park in the project area. The UNDP/GEF and the Government of the Republic of Uzbekistan project "Strengthening the sustainability of the national system of protected areas by focusing on nature reserves" has allocated according to botanical criteria (4 endemic species grow in the area (*Allium sultanuizdaghi*, *Scorzonera bungei*, *Lappula parvula*, *Cousinia umbilicata*) and 9 subendemic species (*Jurinea persimilis*, *Cleome quinquenervia*, *Astragalus holargyreus*, *Astragalus remanens*, *Limonium lessingianum*, *Calligonum zakirovii*, *Lappula aktaviensis*, *Salsola chiwensis*, *Astragalus ammodendron*) relic species *Asparagus turkestanicus*). The presence of these species characterizes the flora as relict and unique and was supposed to be a cluster area of the Lower Amu Darya Biosphere Reserve for the conservation of botanical diversity. However, in spite of the recommendations, the area was not included in the protected area list of Uzbekistan and continued to be developed for mining.

HISTORY OF THE STUDY OF THE REGION

The history of the study of reptiles inhabiting the territory of Uzbekistan, as was the case with other vertebrates in Central Asia, began with the trip of E. A. Eversmann and K. Pander from Orenburg to Bukhara (October 1820 – April 1821). The few and occasional collections of E. A. Eversmann, transferred to the University of Berlin, were processed by Prof. G. Lichtenstein and published in 1823 as an appendix to the work of E. A. Eversmann (Bogdanov, 1960).

Prof. G. Liechtenstein lists 18 species of reptiles (including 5 new ones) and 2 species of amphibians. In another work, G. Lichtenstein (1823) mentions 6 species of lizards and 2 species of snakes.

A. Lehmann in July 1841 crossed the Kuvan-Darya, crossed the Kyzylkum desert, visited Samarkand, then Bukhara, from where he traveled to the mountains to Iskanderkul and in early April went to Orenburg. Most interesting collections by A. Lehmann were mentioned by I.F. Brandt (1852), A.M. Nikolskii (1899a, 1905a, 1915, 1916, 1918). The latter indicates 2 species of amphibians and 22 species of reptiles.

N. A. Severtsov in 1866, 1867 and 1868 spent training camps near Tashkent. In the summer of 1874, he crossed the western part of the Kyzylkum and went to the Tashbai-Kazgan well and through the Beltau chink went to the lake. Kungradkul and on the Karakol channel, where it entered the system of the Amudarya delta channels. From here he went through the coastal sands to Nukus, Chimbay and along Kegeili to Kushkanatau, from where he returned to Nukus, then visited Turtkul, returned through Nukus in Klychkale to Kungradkul, from where he left for Yany-Darya.

The collections of N.A. Severtsov were used by him in compiling the book "Vertical and horizontal distribution of Turkestan animals." His materials were used by A. M. Nikolsky.

G. Ye. Grum-Grzhimailo traveled across Uzbekistan with his expedition in 1885 (see Fauna of the Uzbek SSR, vol. 2). His collections were processed by A. M. Nikolsky.

A. M. Nikolsky on June 10, 1886 from Kazalinsk through Kyzylkum left for Turtkul (formerly Petro-Aleksandrovsk). The route of his travels in Central Asia is indicated in the "Fauna of the Uzbek SSR", t. P. He used his fees when compiling reports.

L.A. Molchanov in 1911, studying the ornithological fauna in the Amu Darya delta below Nukus, collected several specimens of amphibians and reptiles, which entered the ZIN and were processed by A.M. Nikol'skii (1915, 1916, 1918).

S. F. Tsarevsky (1914) mentioned several specimens of reptiles caught in Uzbekistan, and in another work (1915) he talks about specimens of Desert sand boas caught in the same territory.

D. N. Evgenov and A. P. Parinkin on May 28, 1951, 6 km south of the village of Pitnyak, Khorezm region, obtained 24 specimens of Uzbekistan Toad-head Agama. The results of processing this collection in 1955 were presented in the article. However, this area is located more than 50 km northwest of the project area and is separated by the Amu Darya river bed. In this regard, we believe that Uzbekistan Toad-head Agama is not found in the project area.

O. P. Bogdanov in his work "Fauna of the Uzbek SSR. Amphibians and reptiles" (1960) provides data that he collected in Kyzylkum part of Khorezm region in 1949, 1950, 1954 and 1955.

N. N. Shcherbak (1974) studied racerunners (genus *Eremias*) throughout their habitat, including Kyzylkum part of Khorezm region.

The publication of D. A. Bondarenko and E. A. Peregontsev (2017) describes the spatial distribution of the Russian tortoise *Testudo horsfieldii* in Uzbekistan, including Kyzylkum part of Khorezm region.

Also, this report presents the author's personal data collected during field studies of the area in 2014, 2015, 2019 and 2021.

The list of reptiles is given according to the latest updated reptile database (http://www.reptile-database.org/data/Reptile_checklist_2019_07.xlsx.)

ANNOTATED LIST OF REPTILES INHABITING THE PROJECT AREA

The basis for compiling a list of the herpetofauna of the studied area was the modern list of the amphibian fauna of Uzbekistan, consisting of 5 species from one family and the list of reptile species of Uzbekistan, consisting of 62 species from 13 families.

CLASS AMPHIBIA

FAMILY BUFONIDAE

TURAN TOAD

***Bufotes turanensis* (Hemmer, Schmidtler & Böhme, 1978)**



Figure 1 Turan toad. Photo by T. V. Abduraupov

The length of the body with the head is up to 140 mm. The upper side is light grey-olive or greyish-green with or without black spots. The male has an internal resonator under the skin of the throat. During the mating season, the male has black calluses on the first two or three toes of the forepaws. The inner edge of the tarsus has a longitudinal skin fold. The pupil is horizontal. The toes of the hind paws are partly interconnected with the help of the swimming membrane. The parotid glands (parotids) are well developed behind the eyes. The caviar has the form of cords.

This is an economically important species, which destroys harmful insects in huge numbers. Local people sometimes catch it to use in traditional medicine.

In February and March toads lead a diurnal lifestyle. At this time, they bask in the sun or mate and spawn in irrigation canals, puddles and swamps. They then switch to a nocturnal lifestyle, which lasts until late autumn.

In the flatland part of the range most toads begin to hibernate in late October or early November and often appear on the surface of the earth only in mid-February, but most of them finish hibernating in early March.

Wintering places are animal burrows and various cavities in the ground.

The Turan toad is most active during the spawning period, which begins in late February and lasts until late May.

Habitats are highly diverse. The Turan toad occurs in river valleys, on the plains, in the foothills, in various agricultural fields, vegetable gardens, in human settlements and deserts with any types of sources of water, even seasonal ones, available. They hide in the burrows of various rodents and cracks in the ground.

Economically significant species. It eats harmful insects in huge quantities. Occasionally gathers by the local population for the preparation of traditional medicine.

In the Khiva oasis, the Turan toad was observed by M. N. Bogdanov (1882), in Turtkul by L. A. Molchanov (A. M. Nikolsky, 1918).

CLASS REPTILIA

FAMILY TESTUDINIDAE RUSSIAN TORTOISE

Testudo horsfieldii (Gray, 1844)



Figure 2 Russian tortoise. Photo by T. V. Abduraupov

The Russian tortoise is a vulnerable species endemic to Central Asia, whose numbers are decreasing. It is included in the IUCN Red List [VU] and the Red Book of the Republic of Uzbekistan 2(VU) (2019) and listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Carapace length is up to 286.4 mm. The carapace is flat, slightly serrated at the rear edge. The indentation on its front edge is not deep. Each of the front paws has four claws. The forearm is covered with six to seven transverse rows of tile-like mails. On the back of the thigh there are several horny tubercles concentrated in one group. The horny mails of the carapace are usually monochromatic, yellowish or brownish-olive, sometimes with wide black spots, more pronounced on the plastron. This species is endemic to Central Asia, where it inhabits lowlands and foothills (except drifting sands). In addition to Southern Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan and Tajikistan, it is distributed in Northern and Eastern Iran, Afghanistan, North-western China and Northern Pakistan (Ananyeva et al., 1998; Bogdanov, 1960, 1965).

It inhabits both sandy and clayey deserts, plains, mountain slopes, depressions and valleys, gorges and mountain steppe up to 1,150 m above sea level (Dal, 1936, 1937). Rarely

lives on agricultural lands – on the edges of irrigated and unirrigated fields, in vegetable gardens and orchards. Avoids places with dense grass cover, as well as areas grazed intensively by livestock.

This is a strictly diurnal species. In hot weather, it can be observed only in the morning and before sunset. In the middle of the day, animals hide from the heat in temporary shelters under shrubs, where they half burrow into the soil, into the holes of rodents or those dug by themselves. During the day, tortoises are capable of covering from 120 m to 2 km. At night they burrow into shallow pits, sometimes remaining on the surface of the ground.

After the winter diapause, tortoises appear on the surface in March—early April, in warm winters and in the south of the range – in February. Mating begins a few days after their emergence. The breeding season is extended from late March to late May. Newly emerged tortoises with a shell 30—50 mm long remain under the ground during the winter and usually appear on the surface next spring.

They grow slowly. Tortoises become mature at the age of 10—13 years, when their carapaces reach 11 cm in length. In natural environment they can live for at least 30 years.

In June, when ephemeral vegetation dries, the Russian tortoise enters a period of estivation (summer dormancy), for which it digs holes up to 1 m long. In deserts tortoises disappear by the end of May, but in the mountains or on irrigated lands, single individuals may be recorded in June and even July. Much more often, estivation flows into hibernation (winter dormancy).

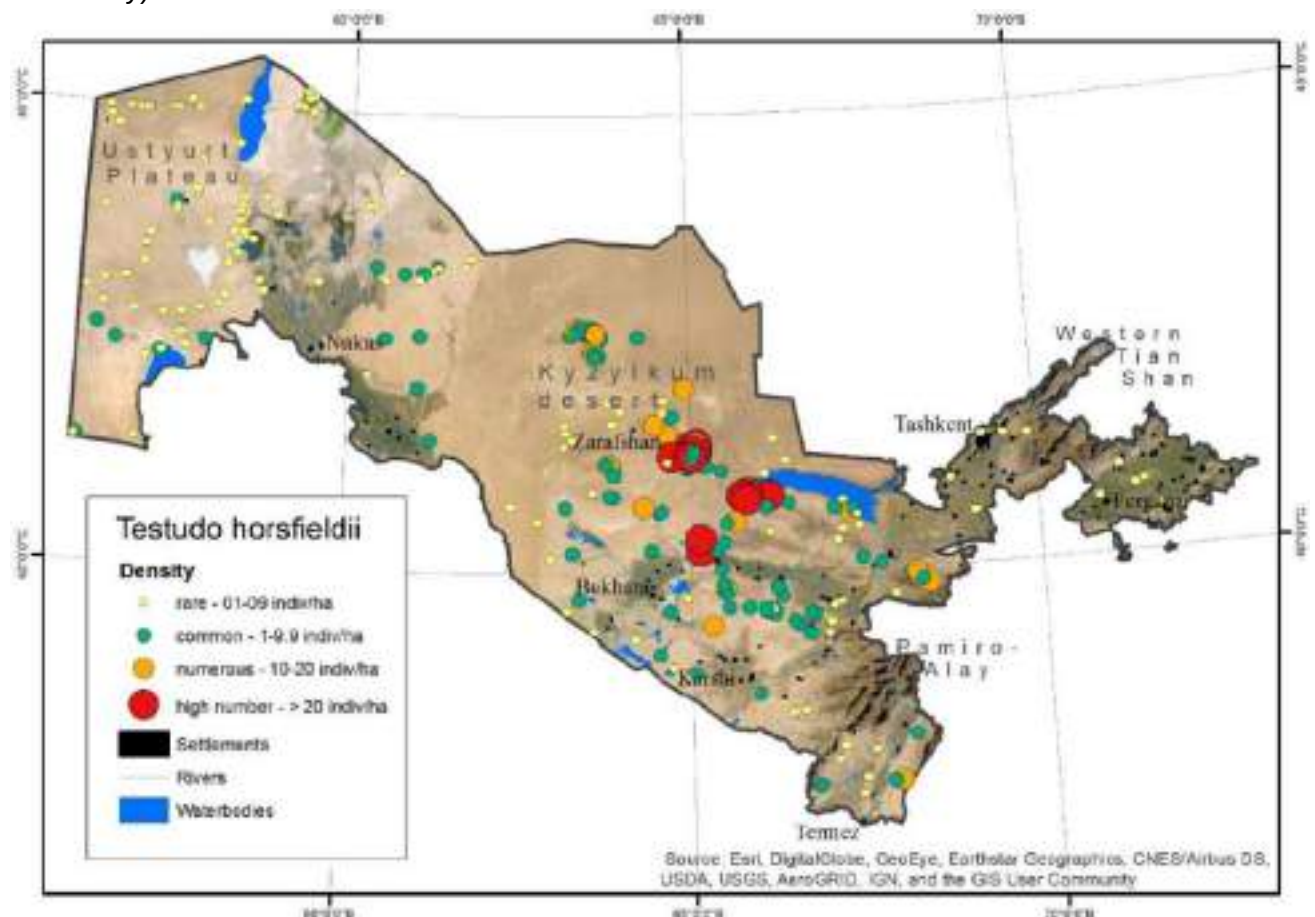


Figure 3 Map of the Russian tortoise population density in various parts of Uzbekistan

M.N. Bogdanov (1882) found turtles in the Kyzylkum desert, on the left bank of the Amu Darya, on the road from Kizilkak to the Bukantau foot. A.M. Nikolsky (1899a) saw great numbers of turtles on the way from Kazalinsk to Turtkul. Also noted by Mambetzhumaev (1972) in the Amu Darya valley near Kulatautugai.

The number of tortoises in the project area is quite low and is subject to significant fluctuations, which depend on winter and spring weather conditions, as well as the feeding rate of the biotopes where the animals live. The plowing of virgin lands, grazing of livestock, and the development of natural habitats have a significant effect on the decrease in the number (Bogdanov, 1965).

FAMILY GEKKONIDAE
TRANSCASPIAN BENT-TOED GECKO
***Mediodactylus russowi* (Strauch, 1887)**



Figure 4 Transcaspian bent-toed Gecko. Photo by T. V. Abduraupov

Small lizard, reaching a length of 53 mm. The tail is 0.69-1.02 times as long as the body. Females are somewhat larger than males. The body and head are slightly flattened. The pupil is vertical. The ear opening is oval and oblique. The muzzle is flat or nearly flat. The coloration of the upper surface of the body is ash-or brownish-gray with dark narrow transverse stripes and small dark spots on the upper surface of the head. The underside of the body is light.

The Transcaspian bent-toed Gecko is a typical arid landscape. Inhabits sandy and clayey semi-deserts and deserts, where it settles in saxaul forests, tugai, on steep slopes and on talus. In anthropogenic landscapes, it is common on the walls of dwellings and in abandoned buildings made of clay and stone.

Twilight and nocturnal activity. In spring, activity begins in late March - early April, when Transcaspian bent-toed Gecko hatch after wintering. In autumn, in the southern parts of the range, they leave for the winter at the beginning of November.

In Urgench, this species was found by L.A. Molchanov (A.M. Nikolsky, 1915) and A. Gerasimov (ZIN), in the same place and in Khazarasp - V.P. Kostin (1956). For the Central Kuzylkum, this species was indicated by A.M. Andrushko (1953).

CASPIAN THIN-TOED GECKO
***Tenuidactylus caspius* (Eichwald, 1831)**



Figure 5 Caspian Thin-toed Gecko. Photo by M.A. Gritsina

A medium-sized gecko with a body length of up to 75 mm and a tail length of up to 100 mm. The body and head are noticeably flattened, the muzzle is convex. The body is covered from above with flat small scales, among which there are large triangular tubercles in 12-14 regular longitudinal rows.

The coloration of the upper side of the body is brownish-gray with a yellowish tinge and with a pattern of five to six dark brown broken transverse stripes on the neck and body. The underside of the body is white, without spots.

One of the most eurytopic gecko species living in a wide range of habitats. The Caspian Thin-toed Gecko can settle in caves, in hilly areas, in the desert, on the plain, in rocky gorges and on the canopy of mountain slopes, where it rises to an altitude of 800 m above sea level. This lizard is common in karises, wells, cemeteries, buildings, adobe ruins, near residential buildings, as well as in clay and clay-saline deserts. Easily moves both horizontally and vertically.

The activity is twilight and nocturnal, but in the spring Caspian Thin-toed Gecko often appears during the daytime. In some years, on warm days, they come to the surface even in winter, but a massive exit is noted in late March - early April. Wintering takes place at the end of October. As shelters (including wintering ones), lizards use cracks in cliffs and rocks, voids between stones in talus and buildings, as well as rodent burrows.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

M.N. Bogdanov (1882) wrote that this gecko is widespread in the Kyzylkum mountains and the Khiva oasis. For Turtkul it is indicated by A.A. Strauch (1887) and A.M. Nikolsky (1899a). In Khiva, this species was obtained by V.V. Gusakovsky.

COMB-TOED GECKO
***Crossobamon eversmanni* (Wiegmann, 1834)**



Figure 6 Comb-toed Gecko. Photo by T. V. Abduraupov

A medium-sized gecko, body length up to 60 mm and tail length up to 80 mm. The body and large head are somewhat flattened. Thin, prehensile and unbreakable tail is covered with uniform scales. The fingers gradually become thinner towards their distal parts, and their lower surface is covered with one row of transversely widened, slightly ribbed or serrate plates along the free edge of the plates, equipped on the sides with fringes of long conical scales.

The color of the upper side of the body is sandy pinkish. The underside of the body is white. In juveniles, the limbs and the lower surface of the tail are light lemon or orange-lemon color.

Comb-toed Gecko is a typical psammophile that lives on fixed and semi-fixed sands with sparse vegetation (saxaul, kandym, sandy acacia, selin, etc.), less often it occurs on the slopes and at the base of the dunes, avoiding their bare tops. Usually these lizards do not live on clay and compacted soils, but occasionally they are found on small takyr between sandy ridges.

This species is characterized by a twilight-nocturnal lifestyle. On the surface in spring, lizards appear in mid-March, are active until the second half of October.

They dig their own burrows with a length of 70-110 cm as shelters, sometimes they use minks of large beetles. Comb-toed Gecko is able to jump from branch to branch, using a tenacious long, flexible and unbreakable tail. Sexual maturity occurs the next year after hatching. Mating was noted in mid-April; this process in different individuals continues until early June. During the mating season, lizards actively use sound communications (weak squeak). The period of oviposition (1-2 per clutch) is extended, lasts about two months (from late May to late July).

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

M.N. Bogdanov (1882) found this species in Kyzylkum, in the Kaike tract, and L.S. Zimin and V.V. Gusakovsky in Khiva.

COMMON WONDER GECKO
***Teratoscincus scincus* (Schlegel, 1858)**



Figure 7 Common Wonder Gecko. Photo by T. V. Abduraupov

Quite large geckos, body length up to 116 mm. The ratio of body length to tail length varies from 0.15 to 2.13. A large, broad and tall head with a blunt muzzle and very large protruding eyes that glow with a bright red light in the dark, which is usually used for night observations. The covers of the body and tail are very delicate and easily damaged when touched. The tail is relatively short, fleshy, brittle. It is also characterized by easily damaged integuments, which are also capable of subsequently regenerating.

The upper side of the body is sulphurous-yellowish or pale greenish; with a complex pattern of brown or dark brown stripes and spots. On the sides there is a rusty-red color, a dark longitudinal stripe, below it the sides acquire a lilac-smoky shade. The underside of the body is white with a lemon-yellow bloom on the throat.

Like the Comb-toed Gecko, it is a psammophile and lives on similar surfaces. Occasionally, it was noted on dense soils adjacent to sands, on plakors and takyrs.

The activity is strictly nighttime regardless of the season. The first active individuals were found in the middle of March in the southern Kyzylkum. Each gecko has an individual site, these lizards are strictly territorial and aggressive, fights of males during the mating season are common. Common Wonder Gecko hibernates at the end of September - mid-November, depending on climatic conditions.

Common Wonder Gecko becomes sexually mature 18-20 months after hatching, when the body length reaches 68-70 mm. As a shelter, it uses its own burrows of a rather complex structure, consisting of a main passage, a system of snorkels and a chamber where lizards spend the daytime, and also lay eggs and hibernate. The hole is sealed with a special cork. Sometimes it lives together with dung beetles, uplifted and small jerboa, midday gerbil. Mating takes place in late April - mid-May, egg-laying in early June. There are 1-2 eggs in a clutch. There are known cases of communal laying.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

A.M. Nikolskiy (1915) reports on specimens of collections of A. Lehmann and A.P. Fedchenko in Kyzylkum. M.N. Bogdanov (1882) caught a gecko near Alty-Kuduk, as reported by S.F. Tsarevsky (1914).

FAMILY AGAMIDAE

STEPPE AGAMA

***Trapelus sanguinolentus aralensis* (Lichtenstein, 1823)**



Figure 8 Steppe Agama. Photo by T. V. Abduraupov

This is a medium-size lizard. The total length of the steppe agama does not exceed 300 mm, with the length of the body with the head up to 120 mm and the tail 1.3—2 times longer than the body.

Steppe Agama inhabits sandy, clayey and stony deserts and semi-deserts, preferring areas with shrubby or semi-woody vegetation. It is also found on gentle rocky slopes in the foothills, along the edges of loosely fixed sands, along river banks and in tugai, along the edges of human settlements and roadsides. It shelters in the burrows of gerbils, sousliks, jerboas, hedgehogs and tortoises, cavities under stones and cracks in the soil. In the hot season, agamas often climb on the branches of shrubs, thus protecting themselves from overheating on the soil heated by the sun. Males survey their site from an elevated position, protecting it from the invasion of competitors. After wintering, these lizards appears in mid-February, March or early April, depending on the weather at that time. Males leave their winter shelters earlier than females.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

In Uzbekistan, it is widely distributed in arid zones. In the ZIN collection there is one specimen obtained by V.V. Gusakovsky in Khiva. For the Kyzylkum desert, this species was noted by M.N. Bogdanov (1882), for the central part of this desert - A.M. Andrushko (1953).

LICHTENSTEIN'S TOADHEAD AGAMA
***Phrynocephalus interscapularis* Lichtenstein & Martens, 1856**



Figure 9 Lichtenstein's Toadhead Agama. Photo by T. V. Abduraupov

A small lizard, one of the smallest species of the genus, the size of the body from the tip of the snout to the tip of the tail usually does not exceed 9 cm. The body is very slender, the tail is strongly flattened throughout. Characterized by the development on the hind edge of the femur and on the sides of the base of the tail of a series of strongly prickly white scales, forming a kind of fringe.

Lichtenstein's Toadhead Agama is a typical inhabitant of naked and scattered, almost devoid of vegetation sands. This strictly psammophilic lizard is usually found in the form of isolated settlements on island dunes, often located quite far from each other (up to tens of kilometers). Usually it adheres to the tops of dunes, only occasionally running over to areas of more fixed sands with sandy acacia, saxaul and other sparse vegetation. The abundance is generally high everywhere.

Minks are used as shelters, which are an inclined passage up to 20 cm long, with a small slot-like entrance. It can also plunge into the sand, pushing it apart with the help of rapid oscillatory movements of the body, which has special folds of skin along the edges, directing sand particles to the back. Individual plots vary from 30 to 180 sq. m.

Activity begins in the middle - end of February in spring, in the more northern parts of the range - in the second half of March. It feeds mainly on various insects, mainly ants.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

In Kyzylkum, it is celebrated by M.N. Bogdanov (1882) and A.P. Fedchenko (1871).

SUNWATCHER TOAD-HEADED AGAMA***Phrynocephalus helioscopus sergeevi* Solovyeva, Dunayev & Poyarkov, 2012.**

Figure 10 Sunwatcher toad-headed agama. Photo by T. V. Abduraupov

The length of the body with the head in newborns is 18–25 mm, males – up to 57 mm, females – up to 62 mm. The upper surface of the muzzle drops at the front, which descends almost vertically to the lips. When viewed from above, the nostrils are not visible. The tail, flattened and widened at the base, abruptly becomes thinner and round in cross section. The colour of the body and the pattern are very variable: the upper side varies from ash-grey to dark grey or brown-grey and has transverse dark brown, brown or black spots. These spots are poorly developed or sometimes absent. On the upper surface of the neck there are 2 small, more or less oval red or pink spots, with blue or light blue fringes. The tops of the tail and limbs are often covered with transverse spots and stripes.

The first individuals of the Sunwatcher toad-headed agama appear in early March after wintering. The last ones were recorded in November before the winter. It is active in the daytime throughout the warm season.

It sometimes rises to foothills up to 778 m above sea level. Prefers hard soils with sparse vegetation.

A. M. Nikolsky (1915) indicates specimens collected by N. A. Severtsov from Khodzhakul, Dzhana-Darya, Karmakchi, Daryalyk. Kh.S. Salikhbaev (From the Academy of Sciences of the Republic of Uzbekistan) caught these lizards in Kyzyl-Dzhar.

UZBEKISTAN TOAD-HEADED AGAMA
Phrynocephalus rossikowi Nikolsky, 1898



Figure 11 Uzbekistan Toad-Headed Agama. Photo by A. A. Shestopal

Body length up to 48mm, tail up to 59mm. Males are larger than females. The upper surface of the muzzle abruptly passes into the anterior part, which descends almost vertically to the lip. When viewed from above, the nostrils are not visible.

The scales of the ridge are slightly enlarged with small sharp spines turned up. Separate groups of scales on the back and base of the tail are strongly thickened, with raised free edges. Scales of lower surface of body and head without ribs. There is no transverse skin fold on the upper surface of the neck.

The tail is flattened from top to bottom throughout.

The body is reddish-gray above with four large oval brown, brown or black-brown spots on the sides of the neck and body. The same color group of thickened and raised scales on the back. In addition, there are more or less round white spots on the back with a blurred dark rim. Tail and legs above with dark transverse stripes, white below. There are three indistinct dark stripes on the underside of the tail. The end of the tail is brown or dark brown.

It lives only in the lower reaches of the Amu Darya. (Takhtakupyr, Beruni, Elikkala, Amudarya regions, etc.).

It lives among very sparse vegetation on loamy soils covered with fine gravel. It also occurred in sandy areas with somewhat more developed grass and shrub vegetation.

There have been no meetings on the territory of Uzbekistan for about 40 years. On gravelly soils at the foot of the remains of Sultanuezdag in the 70s of the last century, up to 22 ind./ha were counted.

In the vicinity of Sultan-Uvais, this species was observed by a number of authors: in the vicinity of Lake Khodzhakul at the foot of Sultanuizdag (Bogdanov, 1960); in the vicinity of the village of Ispas (Shcherbak, 1984); environs of the Kipchak forestry (Bogdanov, 1960); vicinity of the Beshtobe Upland (Lim, 1965); neighborhood of the Chilpyk-kala fortress (Lim, 1965).

FAMILY LACERTIDAE
RAPID RACERUNNER
Eremias velox velox (Pallas, 1771)



Figure 12 Rapid Racerunner. Photo by T. V. Abduraupov

The length of the body with the head is up to 84 mm (males) and up to 81 mm (females). In juveniles, three even black-brown or black stripes run along the back, with the central one forking on the neck; one stripe of the same colour with light round spots on it can be found on each side of the body. In adults (the main background of the upper part of the body is grey or sandy, often with an olive or brown tint) these stripes break into separate spots, while the sides of the body display light, black-edged, rounded spots, which in the front part of the body (especially in males) turn blue. It should be borne in mind that the pattern of this lizard varies greatly from individual to individual. The belly and throat are white. In juveniles, the bottom of the tail and sometimes the small scales on the thighs and legs are red or red-orange.

Economically significant species. One of the most widely distributed and abundant species of Racerunners in the Palaearctic. It is widespread on the territory of Uzbekistan.

After hibernation, first individuals appear in the second half of March, most of them in early April. Hibernation begins in late October – early November. In summer, they are active mainly in the morning and evening hours.

In Uzbekistan, Rapid Racerunner is a typical inhabitant of river valleys, where it is most abundant. However, it also occurs in a wide range of other biotopes, which it inhabits depending on the presence of other species of Racerunners.

Rapid Racerunner was recorded in Khiva by V.V. Gusakovsky (ZIN) and Piasetsky (A.M. Nikolsky, 1915), and V.P. Kostin (ISIP Academy of Sciences of the Ukrainian SSR) - near lake Uzunkul (Khazarasp district, Khorezm region).

STRIPED RACERUNNER
Eremias lineolata (Nikolsky, 1897)



Figure 13 Striped racerunner. Photo by T. V. Abduraupov

Body length with head up to 54 mm, males up to 54 mm, females up to 50 mm. There are no noticeable differences in the coloration of young and adults. The main background of the upper surface of the body is sand-gray. Four or six narrow (very rarely, approximately from the middle of the body, there is also a seventh) even brown or dark brown stripes running along the back, starting from the posterior edge of the parietal scutes; they pass to the tail and merge there in pairs; in the case of the development of four stripes, there is usually a short fifth, expressed in the cervical region, and sometimes in the back of the body and tail; in the case of six stripes, the two middle ones, the narrowest, are brought closer to each other. One of the same color, but wider, starting from the eyes, runs along the sides of the body to the front half of the tail; usually an indistinct narrow brown strip also extends near the border of the lateral scale with the ventral scutes. Head dorsally with or without small dark spots. ruled Limbs dorsally with light rounded or oval spots on a dark brown or brown background. The underside of the body is white.

Recorded by L.A. Molchanov (ZIN) - in the lower reaches of the Amu-Darya in Beltau, Kubetau, Kushkanatau, Tokmaktau and along the Irkin-Darya; N.A. Rashkevich (From the Academy of Sciences of the Republic of Uzbekistan) - in the Shakal tugai, located 7 km north of Nukus; Gusev (ZIN) - in the vicinity of Sheykhaman, Kara-Uzyak district.

RETICULATE RACERUNNER
***Eremias grammica* (Lichtenstein, 1823)**



Figure 14 Reticulate Racerunner. Photo by T. V. Abduraupov

A medium-sized lizard with a body length of up to 93 mm and a little more than one and a half times, a long tail. The toes bear on the sides long, more or less triangular scales that form combs. The main background of the upper part of the body is gray with a brownish or slightly greenish tint. The back, neck, upper side of the base of the tail and legs are covered with a black-gray or dark brown mesh pattern, often with individual black specks.

Inhabits sandy deserts, inhabiting mainly various kinds of scattered and weakly fixed sands with sparse herbaceous and shrubby vegetation. In some places it temporarily enters the areas of takyr and soddy salt marshes bordering on the sands. It uses the burrows of desert rodents as shelters, as well as its own burrows up to 1 m long and up to 70 cm deep, usually dug at the base of the bushes. They are able to quickly bury themselves in loose sand and move in its thickness for distances of up to 2-3 m.

In the north of the range, it is active from early April to mid-October. In its southern regions, wintering lasts no more than three months - from December to February, but even during this period, in the presence of warm weather, at times it can leave the wintering shelters for heating under the sun.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

This foot-and-mouth disease was caught by L. S. Barshchevsky (ZIN) in Turtkul, V. V. Gusakovsky in Khiva, V. P. Kostin (from the Academy of Sciences of the Uzbek SSR) - at the lake Uzunkul, Khazarasp region, Khorezm region.

SAND RACERUNNER
***Eremias scripta scripta* (Strauch, 1867)**



Figure 15 Sand Racerunner. Photo by T. V. Abduraupov

A small, very slender lizard up to 62 mm in body length and approximately twice as long as a thin tail. On one of the sides of the second to fourth toes of the hind legs, there is a ridge of ribbed ones protruding towards the scales. The main background of the upper body is sandy gray. Along the back there are 7, less often 5 narrow brown or dark brown stripes, the middle ones of which are usually dissected into separate, more or less sinuous, elongated along the spots, filling the middle of the back.

Inhabits sandy deserts, inhabiting mainly inter-barnian depressions and semi-fixed sands with ephemeral herbaceous and shrubby vegetation with a predominance of saxaul, tamarisk, juzgun, sandy acacia and other characteristic psammophylls. It often keeps on the slopes and ridges of dunes. Burrows of burrowing animals, including insects, as well as their own burrows up to 1 m long and up to 15 cm deep, usually dug out at the base of shrubs, serve as refuges.

Usually, several times a day, it digs out small temporary burrows on clean sand. It can also "dive" into the sand and move at a shallow depth under its surface for some time. It climbs well on bushes, helping itself with a long tail and jumping from branch to branch. In spring they appear in late March - early April, hiding for the winter in late September - mid-October.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

According to A. M. Nikolsky (1915), it was found by L. S. Barshchevsky in Turtkul. L. A. Molchanov (ZIN) mined Sand Racerunner in the Amu Darya delta in Kushkanatau. V.P. Kostin (IZIP Academy of Sciences of the Uzbek SSR) - at the lake. Dunguz-Uldy, Khazarasp region, Khorezm region. L. S. Zimin (ZIN) - in the village of Ravat near Khiva. For Kyzylkum, this type is indicated by M.N. Bogdanov (1882) and A.M. Nikolsky (1905) according to the collections of N.A. Severtsov and D.K. Glazunov.

ARALO-CASPIAN RACERUNNER
Eremias intermedia (Strauch, 1876)



Figure 16 Aralo-Caspian Racerunner. Photo by T. V. Abduraupov

A small lizard with a body length of up to 65 mm and about one and a half times longer tail. The main background of the upper side of the body is dark gray with a brownish tint. On the body there are longitudinal rows of round or elongated white or light gray spots, framed by circles of black or dark gray color.

In most of the range, it inhabits leveled fixed sands and inter-barnian depressions with saxaul, tamarisk, camel thorn and other sparse herbaceous and shrub vegetation. It also occurs in the anthropogenic landscape. It takes refuge in the holes of rodents, turtles, small own burrows up to 60 cm long.

After wintering, they appear on the surface in late February - early March. In the hot summer months in June-July, adults practically cease to be found on the surface in places and, apparently, go into a state of summer hibernation. It has been suggested that the absence of adult lizards during this period is explained by their natural mass mortality at the end of the breeding cycle. The last individuals hibernate in late October - early November.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

M.N. Bogdanov (1882) noted this species in the Kyzyl Kum desert, including the area under study. L. A. Molchanov (ZIN) found Aralo-Caspian Racerunner in the Khiva oasis, along the Amu Darya river bed.

FAMILY VARANIDAE
CASPIAN MONITOR
Varanus griseus caspius (Eichwald, 1831)



Figure 17 Caspian Monitor. Photo by T. V. Abduraupov

The species decreasing in numbers is included in the Red Book of the Republic of Uzbekistan (2019) with status 2 (VU: D).

The largest lizard in Uzbekistan and neighboring countries. The length of the body with the head is up to 520 mm. The upper side of the body is greyish-brown, yellowish-brown or reddish-brown, with numerous dark dots and specks. On the upper side of the neck there are two or three longitudinal brown stripes, and on the back and tail there are several transverse stripes of the same colour. In youngsters, the stripes are very pronounced, they are black or almost black.

After hibernation, the first individuals appear relatively late – in early to mid-April. Active all day throughout April. In May, they are active in the morning and evening hours. They go into hibernation in September-October. Often the Caspian Monitor has an estivation in summer, which gradually turns into winter hibernation. They begin estivating in late June—early July.

It inhabits mainly fixed and semi-fixed sands, clay and stony-gravelly soils, visits solonchaks.

In Kyzylkum, this species was noted by M.N. Bogdanov (1882) and A.M. Andrushko (1953). However, in recent years, the number of the species has greatly decreased, in a number of places it has completely disappeared, in this regard, we assume a possible habitation of the species in the project area, which must be verified by field studies.

FAMILY BOIDAE
DESERT SAND BOA
Eryx miliaris (Pallas, 1773)



Figure 18 Desert sand boa. Photo by T. V. Abduraupov

Desert Sand Boa is a near-threatened, sporadically distributed subspecies, included in the Red Data Book of the Republic of Uzbekistan (2019) with the status 3(NT); also included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

A medium-size snake. Females reach 720 mm in length, males are somewhat smaller – 550-580 mm. Tail length – 50-70 mm. The tail is short and blunt.

It lives mainly in sand deserts, where it prefers drifting and semi-fixed dunes, as well as more or less loose soils in deserts and semi-deserts with wormwood-saltwort communities and saltwort populations. It is less common on takyr with patches of vegetation near sands and on relatively hard loess and clay soils, near ruins, on the slopes of gullies and at the borders of irrigated lands. Often occurs near colonies of Gerbils, whose burrows it uses to shelter. It is able to plunge into the sand quickly, head first, and "swim" under its surface, leaving a characteristic trail in the form of a serpentine bulge. The upward-looking eyes allow the Desert Sand Boa to examine the surface without raising its head above the sand.

Active from April to October. In the hot season, it leads a nocturnal and crepuscular lifestyle. It uses the holes of rodents as a refuge, therefore it often settles in colonies of Gerbils. The breeding season is in late March. In June-July, the female gives birth to 4—10 babies up to 12—14 cm long. It feeds on lizards, rodents and small birds.

Currently, the number is decreasing due to increased poaching (used in folk medicine), as well as economic development of land.

We assume a low abundance of Desert Sand Boa constrictor in the study area.

This species was noted in the delta of the Amu Darya River - V. Galitsky (ZIN), along the border of the Khodjeilinsky and Nazarpaysky tugays - Kh.S. Salikhbaev (1950), and also in the sands of the Khiva oasis - by M.N. Bogdanov (S.F. Tsarevsky, 1915).

FAMILY COLUBRIDAE
SPOTTED DESERT RACER
Platyceps karelinii (Brandt, 1838)



Figure 19 Spotted Desert Racer. Photo by M. V. Pestov

A very slender snake of medium size with a relatively long tail: body length of females up to 865 mm, tail length, respectively, up to 270 mm; in males, body length up to 680 mm and tail length up to 235 mm. The tip of the muzzle is sharpened. The head is relatively weakly demarcated from the body. The coloration of the upper side of the body is light ash-gray with a yellowish or brownish tint. One row of narrow black or blackish transverse stripes running along the back, 1-3 scales not reaching the abdominal scutes. In the back of the body, the stripes become narrower, on the tail, sometimes they completely disappear.

The Spotted Desert Racer is biotopically related mainly to the plains, where it is found in all types of deserts.

In spring, they are active during the daytime, and from June to August, the activity becomes twilight-night and morning. After wintering, the first active snakes appear in the third decade of February, mass emergence in early April. Autumn activity continues until the end of November. Mating takes place in late April - mid-May.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

Spotted Desert Racer is indicated for the Khiva oasis, the Amu Darya river and the strip of desert closest to it by M.N. Bogdanov (1882). It was also obtained by it in Kyzylkum near the well of Alty-Kuduk. S. F. Tsarevsky (1914) cites M. N. Bogdanov's collections from Kyzylkum, the Khiva oasis, tugaya Meshekli (right bank of the Amu Darya river).

DIADEM SNAKE
***Spalerosophis diadema* (Schlegel, 1837)**



Figure 20 Diadem snake. Photo by T. V. Abduraupov

Large, rather slender snakes with a body size of up to 1500 mm. The tail is 4-5 times shorter than the body. The head is clearly demarcated from the neck. The tip of the muzzle is rounded. The coloration of the upper body is light gray or light brown. Along the ridge there is one row of brown or brown, more or less rhombic or oval spots, more pronounced in young snakes, in which they are also limited by a light border.

The most preferred biotopes of Diadem snake are sandy and clayey deserts; they are also found, although much less frequently, on hilly areas and on mountain slopes. It uses holes of rodents, turtles, cracks in the soil, bushes as shelters.

Annoyed individuals mimic a cobra's threat pose by aggressively lifting and inflating the front of their torso. Activity, depending on the climatic conditions of the season, day or night, one or two peaks. They leave wintering in late February - early March, activity continues until November.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

M.N. Bogdanov (1882) found Diadem snake in Kyzyl Kum between Alty-Kuduk and Uch-Uchak.

SAND RACER
***Psammophis lineolatus* (Brandt, 1838)**



Figure 21 Sand Racer. Photo by T. V. Abduraupov

The length of the body with the head is up to 840 mm (males) and up to 710 mm (females). The number of abdominal scales – 181—204, sub-caudal scales – 83—105 pairs. The body is thin. The upper surface of the muzzle is concave, with a longitudinal groove. The upper side of the body is olive-grey or sandy-grey, the edges of the scales are lighter than their central parts; four dark stripes run from the head along the body; in some individuals, only traces of these stripes in the form of dark or black lines along the scales may remain. Sometimes the pattern on the body is missing. The belly is white with greyish, brownish or olive-grey spots, larger at the front of the body.

Single individuals appear after hibernation in February. Most of them emerge in late March-early April. At this time, the snakes are active all day. In May, the activity is observed in the morning and evening hours. They go into hibernation in October-November.

The Sand Racer inhabits all lowlands, from where it penetrates into foothills up to 1,100—1,200 m above sea level; however, it prefers more fixed and drifting sands, pebbly plains, mountains and broken grey soils near settlements. The sand racer is more often observed in places where areas with dense vegetation alternate with open patches. Therefore, in places with dense vegetation, it can always be found on low precipitous slopes, mounds and so on.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

Kh. S. Salikhbaev (1950) gives the Sand Racer for the Khodjeilinsky and Nazarpaysky tugays. MN Bogdanov (S.F. Tsarevsky, 1914) mined a Sand racer in the Kyzyl-Takyr tract (Khiva oasis). For the Kyzyl Kum desert, this species is given by M. N. Bogdanov (1882).

FAUNISTIC COMPLEXES OF THE PROJECT AREA

Each of the types of habitats in the study area is characterized by a specific set of species – a faunal complex of amphibians and reptiles that has formed historically in the area. Each species is adapted to a specific set of environmental factors and this determines its relationship with specific ecosystems and habitats. Within any faunal complex, two groups of species can be distinguished:

1. Species closely related to a limited set of environmental factors (stenobiotic species). These are species characteristic only of a particular type of habitat. When the combination of conditions is favorable, the characteristic species can be quite numerous and common. Any change in habitat conditions negatively affects the distribution and population status of the characteristic species. Therefore, they are indicators of the degree of how natural habitats are conserved/disturbed. In the project area, these mainly include psammophilic species (Comb-toed Gecko, Common Wonder Gecko, Lichtenstein's Toad-head Agama, Reticulate racerunner and Sand Racerunner), semi-aquatic species (Turan Toad).
2. Species that can adapt to a wider range of habitats (eurybiontic species). This determines their wide distribution and occurrence in various types of habitats, higher resistance to anthropogenic impacts. Many species from this group are economically important, can reach high numbers and serve as food for predators, including rare species. Such species inhabiting the project area include Russian Tortoise, Caspian Bent-Toed Gecko, Steppe Agama, Rapid Racerunner and Spotted desert racer.

In addition to these faunistic complexes, it should be noted that synanthropic species of reptiles live in territories near the villages, to which Transcaspian bent-toed gecko can be referred. The rare Caspian Monitor (UzRDB, 2019) and the Diadem snake forage occasionally in villages. Rapid Racerunner and Steppe Agama, and Sand Racer inhabit heaps of soil taken from canals and ditches along fields, as well as precipitous slopes and the territory along them.

RESULTS OF THE SPRING 2022 FIELD SURVEY

The field visit to the project area in the area of Nukus 100 MW Wind farm (the Sultan-Uvais outliers) was carried out from April 16 to April 19, 2022. During the field trip, data on reptiles of the study area were collected from 6 points. More than 12 km of routes were completed (Figure 22).



Figure 22 Map of reptile survey points and tracks on the project territory

It is worth noting that the weather conditions were not ideal for the reptiles survey – a cool wind was blowing and it was cloudy (Figure 23). In this regard, the activity of reptiles was low.



Figure 23 Cloudy and windy weather on the project area. Point SU_Herp-1. Photo by T. V. Abduraupov

Table 1. Primary data and the density of reptiles at the survey points in the area of Nukus 100 MW wind Farm (the area of Sultan-Uvays ridge, Republic of Karakalpakstan) April 2022

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
SU_Herp-1				Hummocky sands with rubble lenses, Artemisia-Ferula association	1 km	16.04.22	C28,6°	C32,7°	30%
1	<i>Testudo horsfieldii</i> Russian tortoise	6	4,16						
2	<i>Trapelus sanguinolentus</i> Steppe agama	2	1,4						
3	<i>Teratoscincus scincus</i> Common Wonder Gecko	12	9,6						

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
4	<i>Eremias lineolata</i> Striped racerunner	2	2,2						
5	<i>Eremias intermedia</i> Aralo-Caspian racerunner	4	3,6						
6	<i>Varanus griseus caspius</i> Caspian Monitor	Present according to local people	—						
7	<i>Psammophis lineolatus</i> Sand racer	1	1						
SU_Herp-2				Hilly sandy foothills, Artemisia association	1 km	17.04.22	C24,2°	C27,1°	38%
1	<i>Testudo horsfieldii</i> Russian tortoise	7	5,47						
2	<i>Eremias lineolata</i> Striped racerunner	2	1,8						
3	<i>Eremias intermedia</i> Aralo-Caspian racerunner	4	3,8						
4	<i>Varanus griseus caspius</i> Caspian Monitor	Present according to local people	—						
SU_Herp-3				Hilly sandy foothills, Artemisia association	1 km	17.04.22	C23,5°	C32,9°	39%
1	<i>Testudo horsfieldii</i> Russian tortoise	3	1,62						
2	<i>Trapelus sanguinolentus</i> Steppe agama	2	1,4						
3	<i>Eremias lineolata</i> Striped racerunner	3	3,5						
4	<i>Eremias intermedia</i> Aralo-Caspian racerunner	5	4,6						
SU_Herp-4				Hilly sub-sandy foothills, Artemisia association	1 km	17.04.22	C24,2	C34,1°	37%

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
1	<i>Testudo horsfieldii</i> Russian tortoise	2	1,8						
2	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	2	4,6						
3	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2	1,7						
4	<i>Eremias lineolata</i> Striped racerunner	1	1						
5	<i>Psammophis lineolatus</i> Sand racer	1	1						
SU_Herp-5				Hilly sub-sandy foothills, Artemisia association	1 km	C26,2	C42,7°	34%	C26,2
1	<i>Testudo horsfieldii</i> Russian tortoise	2	1,4						
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2	1,7						
	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	2	3,7						
SU_Herp-6				Hilly sub-sandy foothills, Artemisia association	1 km	18.04.22	C24,4°	C32,2°	32%
1	<i>Testudo horsfieldii</i> Russian tortoise	1	1,4						
2	<i>Trapelus sanguinolentus</i> Steppe agama	2	0,9						

During the spring field trip, we found 8 species of reptiles in the project area, of which only 2 species - Russian tortoise and Caspian Monitor, is listed in the Red Book of the Republic of Uzbekistan (2019). It should be mentioned that we marked the Caspian Monitor only according to the data from local residents (shepherds). At the same time, this data from local people cannot be considered basic and are only additional data. During the entire trip, we also did not notice traces of the Caspian Monitor in the project area.

In spring, in the project area, the dominant species of reptiles are Russian tortoise and Aralo-Caspian racerunner, which were found in sufficient numbers at almost every survey sites.

In general, the composition of the herpetofauna of the Nukus site is standard for desert areas.

RESULTS OF THE SUMMER 2022 FIELD SURVEY

The last field visit to the project area in the area of the remnants of Sultan-Uvais was carried out from June 24 to June 27, 2022. During the field visit, data were collected on reptiles in the construction area of wind farms, the site of the proposed power line and the road leading to the power plant. 6 points were examined along the proposed power transmission line, 6 points along the road and 14 points along the main territory for the construction of wind farms. More than 37.5 km of routes were covered (fig. 24).



Figure 24. Map of reptile counting points and tracks in the project area

It is worth noting that the summer trip took place in ideal weather conditions for the registration of reptiles. During the period of this trip, the maximum number of species was found in the project area, except of course Russian tortoise. By combining these data with spring data, a complete list of reptile species living in the project area can be obtained.

Table 2. Primary data and the density of reptiles at the accounting points in the area of projected transmission line of wind power plant on Sultan-Uvays ridge, Republic of Karakalpakstan June of 2022

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
	SU_PL-1			Fixed sands, Artemisia- Halocnemum- Haloxylon association	1 km	24.06.22	C31,2°	C24,2°	29%

1	<i>Trapelus sanguinolentus</i> Steppe agama	1							
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	5							
SU_PL-2				Hilly sandy massif, Artemisia association	1 km	24.06.22	C33,7°	C43,2°	29%
1	<i>Teratoscincus scincus</i> Common Wonder Gecko	18							
2	<i>Crossobamon eversmanni</i> Comb-toed gecko	7							
3	<i>Phrynocephalus mystaceus</i> Secret toadhead Agama	4							
4	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	10							
5	<i>Eryx miliaris</i> Desert sand boa	5							
SU_PL-3				Gravelly plain with an intersection of fixed sands, Artemisia - Halocnemum association	1 km	24.06.22	C36,2°	C45,3°	21%
1	<i>Trapelus sanguinolentus</i> Steppe agama	2							
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	3							
SU_PL-4				Rocks, dry gorge, Artemisia - Halocnemum association	1 km	24.06.22	C36,4	C46,2°	21%
1	<i>Trapelus sanguinolentus</i> Steppe agama	2							
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	1							
3	<i>Tenuidactylus caspius</i> Caspian thin-toed gecko								
SU_PL-5				Rubble plain with minimal vegetation cover, sparse Artemisia, Halocnemum and Haloxylon bushes	1 km	24.06.22	C38,2°	C47,0°	20%
0	-								

SU_PL-6				Clay plain with minimal vegetation cover sparse Artemisia and Haloxylon bushes	1 km	24.06.22	C38,7°	C48,6°	19%
0	-								

Table 3. Primary data and the density of reptiles at the accounting points in the area of projected road of wind power plant on Sultan-Uvays ridge, Republic of Karakalpakstan June of 2022

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
SU_R_1				Hummocky sands with rubble lenses, Artemisia-Haloxylon-Peganum association	1 km	25.06.22	C34,1°	C37,7°	36%
1	<i>Teratoscincus scincus</i> Common Wonder Gecko	3							
2	<i>Trapelus sanguinolentus</i> Steppe agama	1							
3	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2							
SU_R_2				Hilly sandy foothills, Artemisia association	1 km	25.06.22	C32,5°	C37,3°	36%
1	<i>Teratoscincus scincus</i> Common Wonder Gecko	4							
2	<i>Trapelus sanguinolentus</i> Steppe agama	1							
3	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2							
SU_R_3				Hilly sandy foothills, Artemisia association	1 km	25.06.22	C31,7°	C35,2°	37%
1	<i>Teratoscincus scincus</i> Common Wonder Gecko	3							
SU_R_4				Hilly sub-sandy foothills, Artemisia association	1 km	25.06.22	C31,1°	C33,4°	38%

1	<i>Teratoscincus scincus</i> Common Wonder Gecko	5							
2	<i>Trapelus sanguinolentus</i> Steppe agama	2							
3	<i>Phrynocephalus mystaceus</i> Secret toadhead Agama	2							
4	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	4							
5	<i>Eremias intermedia</i> Aralo-Caspian racerunner	3							
6	<i>Eryx miliaris</i> Desert sand boa	6							
SU_R_5				Hilly sub-sandy foothills, Artemisia association	1 km	25.06.22	C29,7°	C31,6°	38%
1	<i>Teratoscincus scincus</i> Common Wonder Gecko	4							
SU_R_6				Hilly sub-sandy foothills, Artemisia association	1 km	25.06.22	C28,3°	C29,2°	38%
0	-								

Table 4. Primary data and the density of reptiles at the accounting points in projected construction site area of wind power plant on Sultan-Uvays ridge, Republic of Karakalpakstan June of 2022

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
NU-1				Sub-sandy plain, Artemisia association	1 km	27.06.22	C32,5°	C38,6°	22%
1	<i>Trapelus sanguinolentus</i> Steppe agama	1							
2	<i>Eremias lineolata</i> Striped racerunner	3							
3	<i>Psammophis lineolatus</i> Sand racer	1							
NU-2				Sub-sandy plain, Artemisia association	1 km	27.06.22	C33,7°	C39,8°	22%

1	<i>Eremias intermedia</i> Aralo-Caspian racerunner	3							
NU-3				Hummocky sands with rubble lenses, Artemisia-Haloxylon-Peganum association	1 km	27.06.22	C34,4°	C41,2°	21%
1	<i>Teratoscincus scincus</i> Common Wonder Gecko	6							
2	<i>Crossobamon eversmanni</i> Comb-toed gecko	3							
3	<i>Trapelus sanguinolentus</i> Steppe agama	1							
3	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	6							
4	<i>Eremias intermedia</i> Aralo-Caspian racerunner	3							
NU-4				Hummocky sands with rubble lenses, Artemisia-Haloxylon-Peganum association	1 km	27.06.22	C35,5°	C43,7°	20%
1	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	5							
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	3							
3	<i>Eremias lineolata</i> Striped racerunner	3							
NU-6				Hummocky sands with rubble lenses, Artemisia-Haloxylon-Peganum association	1 km	26.06.22	C28,3°	C31,2°	24%
1	<i>Teratoscincus scincus</i> Common Wonder Gecko	6							
2	<i>Trapelus sanguinolentus</i> Steppe agama	1							
3	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	4							
4	<i>Eremias lineolata</i> Striped racerunner	3							
NU-7				Hilly sandy massif, Artemisia association	1 km	25.06.22	C27,5°	C28,6°	31%
1	<i>Teratoscincus scincus</i> Common Wonder Gecko	7							
2	<i>Trapelus sanguinolentus</i> Steppe agama	1							

3	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	6							
4	<i>Phrynocephalus mystaceus</i> Secret toadhead Agama	2							
5	<i>Eremias lineolata</i> Striped racerunner	3							
6	<i>Eryx miliaris</i> Desert sand boa	1							
NU-8				Sub-sandy plain, Artemisia association	1 km	25.06.22	C28,7°	C31,4°	31%
0	-								
NU-9				Hilly sandy foothills, Artemisia association	1 km	25.06.22	C31,8°	C36,5°	29%
1	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2							
NU-10				Sub-sandy plain, Artemisia association	1 km	25.06.22	C35,3°	C47,6°	25%
1	<i>Trapelus sanguinolentus</i> Steppe agama	2							
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	3							
NU-11				Hilly sub-sandy foothills, Artemisia association	1 km	27.06.22	C29,3°	C33,2°	23%
1	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	5							
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2							
3	<i>Eremias lineolata</i> Striped racerunner	3							
NU-12				Sub-sandy plain, Artemisia association	1 km	26.06.22	C31,3°	C38,5°	22%
1	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2	1,7						
NU-13				Hilly sandy massif, Artemisia association	1 km	26.06.22	C33,6°	C40,6°	21%
1	<i>Trapelus sanguinolentus</i> Steppe agama	2	0,9						
2	<i>Phrynocephalus interscapularis</i>	8							

	Lichtenstein's Toadhead Agama								
NU-15				Hilly sandy massif, Artemisia association	1 km	26.06.22	C35,7°	C44,8°	20%
1	<i>Eremias lineolata</i> Striped racerunner	2							
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	3							
	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	4							
NU-16				Sub-sandy plain, Artemisia association	1 km	26.06.22	C37,2°	C48,4°	19%
1	<i>Trapelus sanguinolentus</i> Steppe agama	1							

During the summer field trip, we found 10 species of reptiles in the project area, of which only 1 species - Desert sand boa, is listed in the Red Book of the Republic of Uzbekistan (2019). It should be noted that Desert sand boa is quite numerous in the project area (fig. 25). Species included in the IUCN Red List were not found by us during the field trip.



Figure 25. Desert sand boa on project site in June

Among the diurnal reptile species, in the summer, the dominant species in the project area are Aralo-Caspian racerunner (fig. 26.) and Steppe agama (fig. 27.). These species are found in almost all of the biotopes represented. However, in sandy areas, Lichtenstein's Toadhead Agama (fig. 28.) is the dominant species. Among the nocturnal reptile species, the dominant species is the Common Wonder Gecko (fig. 30.), which is found here not only on sands, but also on hard soils.

	
<i>Fig. 26. Aralo-Caspian racerunner on project site in June</i>	<i>Fig. 27. Steppe agama on project site in June.</i>
	
<i>Fig. 28. Lichtenstein's Toadhead Agama on project site in June.</i>	<i>Fig. 29. Secret toadhead Agama on project site in June.</i>
	
<i>Fig. 30. Common Wonder Gecko on project site in June.</i>	<i>Fig. 31. Comb-toed gecko on project site in June.</i>

Despite repeated attempts to find the Uzbek toad-headed agama in the project area, this species was not found by us. Even in the presence of suitable habitats.

CONCLUSION

According to the secondary data and the spring field survey data, at the moment, on the territory of Nukus 100 MW Wind Farm, there are 1 amphibian species and 21 reptile species belonging to 7 families (Table 5). The total number of amphibian species comprises 20% of the

total diversity of the amphibian fauna of Uzbekistan, reptiles – 33,9%. Among them, 4 species are included in the Red Book of the Republic of Uzbekistan (2019) (19,1 % of the total number of species inhabiting the project area), 2 species are included in the Red List of the International Union for Conservation of Nature (IUCN Red List) (9,5% of total number of species inhabiting the project area) and 3 species – in the Appendices to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (14,3% of the total number of species inhabiting the project area).

As a result of the processing of literary sources, narrow-range endemic species of reptiles have not been identified for this area. However, it should be noted that a fairly large number of reptile species inhabit the rather limited project area, which is associated with the presence of sandy massifs on it. Most of the species from the list are widespread throughout the republic.

Table 5. List of reptile species inhabiting the project territory

№	Species	Species presence acc. to literary sources	Author's earlier personal data	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
Amphibians								
Family <i>Bufo</i> idae (toads)								
1	Turan Toad <i>Bufo</i> es turanensis	+	+	Common	UZ, TJ, TM			
Reptiles								
Family <i>Testudin</i> idae (tortoises)								
1	Russian tortoise <i>Testudo</i> horsfieldii	+	+	Common		2 (VU)	VU	II
Family <i>Gekkon</i> idae (geckoes)								
2	Transcaspian bent-toed gecko <i>Mediodactylus</i> russowi	+	+	Common				
3	Caspian Bent-Toed Gecko <i>Tenuidactylus</i> caspius	+	+	Common				
4	Comb-toed gecko <i>Crossobamon</i> eversmanni	+	+	Low numerous	UZ, TJ, TM, KZ, IR, AF			
5	Common Wonder Gecko <i>Teratoscincus</i> scincus	+	+	Common	UZ, TJ, TM, KG, IR,CN			
Family <i>Agami</i> dae (agamas)								
6	Steppe agama <i>Trapelus</i> sanguinolentus	+	+	Common				
7	Sunwatcher toad-headed agama <i>Phrynocephalus</i> helioscopus	+	+	Low numerous				
8	Uzbekistan toad-headed agama <i>Phrynocephalus</i> rossikowi	+		Low numerous	UZ, TM	1(EN)	EN	
9	Lichtenstein's Toadhead Agama <i>Phrynocephalus</i> interscapularis	+	+	Numerous	UZ, TM, KZ, AF, IR			
10	Secret toadhead Agama <i>Phrynocephalus</i> mystaceus	+	+	Common				

№	Species	Species presence acc. to literary sources	Author's earlier personal data	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
Family <i>Lacertidae</i> (true lizards)								
11	Rapid Lizard <i>Eremias velox</i>	+	+	Numerous				
12	Striped racerunner <i>Eremias lineolata</i>	+	+	Common				
13	Aralo-Caspian racerunner <i>Eremias intermedia</i>	+	+	Common				
14	Reticulate racerunner <i>Eremias grammica</i>	+	+	Numerous				
15	Sand racerunner <i>Eremias scripta</i>	+	+	Common				
Family <i>Varanidae</i> (monitor lizards)								
16	Caspian Monitor <i>Varanus griseus caspius</i>	+	+	Rare		2 (VU:D)		I
Family <i>Boidae</i> (Boas)								
17	Desert sand boa <i>Eryx miliaris</i>	+	+	Rare		3 (NT)		II
Family <i>Colubridae</i> (colubrid snakes)								
18	Sand racer <i>Psammophis lineolatus</i>	+	+	Common				
19	Spotted whip snake <i>Hemorrhois ravergeri</i>	+		Common				
20	Spotted desert racer <i>Platyiceps karelinii</i>	+		Low numerous				
21	Diadem snake <i>Spalerosophis diadema</i>	+	+	Low numerous				

Notes: UzRDB – species/subspecies listed in the Red Data Book of Uzbekistan (2019) (2 (VU) – vulnerable; 2 (VU:D) – vulnerable, declining; 3 (NT) – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (EN – endangered; VU – vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; IR – Iran; KZ – Kazakhstan; PK – Pakistan; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

The large number of reptile species potentially present in the project area (1/3 of all species in Uzbekistan, according to literary sources) is due to several factors: 1. The large project area; 2. The territory is located on several different biotopes; 3. The main part of the project area is located on sandy massifs and the foothill part of the Sultan-Uvays ridge, which are densely populated with various species of reptiles.

In total, during 2 field visits to the project area, we recorded 12 species of reptiles here - 8 species during the spring field visit and 10 during the summer visit. Of these, three species are listed in the Red Book of the Republic of Uzbekistan - Russian tortoise, Caspian Monitor and Desert sand boa. Also, all these 3 species are included in the Appendices to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Also, among these species, 1 species - Russian tortoise is included in the Red List of the International Union for Conservation of Nature (IUCN Red List).

We were unable to find Uzbekistan toad-headed agama during the all field trips in April and in June 2022, despite numerous attempts and a seemingly suitable biotope for this species, as well as the availability of literature data on encounters in this region. It is also worth adding that the weather conditions during the summer field trip were optimal for this species.

We also did not find the Caspian Monitor in the project area, however, interviews with local residents (shepherds) showed that this species probably lives in this area.

The project area is quite densely populated with Russian tortoise – this species was shown by a spring field survey in this area, and Desert sand boa – this species was shown by a summer field survey in this area.

RECOMMENDATIONS

Safety and environmental protection must be priorities in any activity, for which it is necessary, after assessing potential threats, in this case to biodiversity, to make efforts to carry out activities aimed at minimizing potential damage. It should be noted that construction period is the most dangerous for reptiles. In this regard, we recommend the following actions:

1. Seasonality of work. The construction work must take into consideration the reptiles' activity features. That is, it is advisable that all construction work should be carried out at a time when all reptiles came out of hibernation (winter dormancy). In this period, reptiles do not have permanent burrows and can leave the construction site in advance. If the works begins in the hibernation period, underground wintering chambers can be damaged and then the reptile is doomed to death.
2. Construction works must be carried out strictly within the territory designated for the purpose.
3. All trenches must be levelled (filled with earth) after the termination of the construction; trenches should not be used as barriers to protect the territory, so that animals should not be captured there.
4. When the construction stage is over, it is necessary to monitor regularly populations of terrestrial animals in the existing research sites within the project territory.
5. The so-called 'closed zones' (protected with a fence) must be organized in the territory of the objects, where no activity should be allowed. This territory should be representative from the point of view of the biotope and the presence of a protected species. It would serve both a buffer zone of the object and, at the same time, a kind of protected area where animals can live undisturbed.
6. Creation/support of a reptile's nursery, with the function of rehabilitation and breeding of rare species, such as Caspian Desert Monitor and Russian tortoise. After the construction work, it is possible to resettle these animals back to the reclaimed areas from the nursery. This nursery could help in preserving rare narrow-area endemic reptile species.
7. The Russian tortoises must be removed from the construction site to nearby areas with similar biotopes. Moreover, after the removal, the construction site must be enclosed in a solid corrugated metal fence to prevent the tortoises' possible returning to the construction site.

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Nukus 100 MW Wind Farm

REPTILE SURVEY



CLIENT: 5 CAPITALS

Date: May 2022

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INTRODUCTION

Uzbekistan is located in the central part of Central Asia and borders on four Central Asian countries – Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan, as well as Afghanistan in the south. Its geographical location at the junction of a number of biogeographic regions determines the age, diversity, origin and complex genetic relationships between the regional flora and fauna. The gene pool of wild animals inhabiting the territory of Uzbekistan is unique. The country is an important habitat for endemic species and subspecies of Central Asian animals. Most of it is represented by native fauna (Yunusov et al., 2015).

In the modern world, we are becoming increasingly more aware of sustainable nature management as the only correct way for the further development of mankind.

One of these approaches is the introduction and use of alternative energy sources.

It should be noted that Decree No. УП-5544 'On Approval of the Strategy for Innovative Development of the Republic of Uzbekistan for 2019-2021' issued by the President of the Republic of Uzbekistan on 21 September 2018 specifies that the share of electricity production using renewable energy sources will increase to at least 20% by 2025.

In addition, long-term targets for the development of RES and a plan for organizational and practical measures for further development of RES were approved in accordance with Decree No. ПП-4422 'On accelerated measures to improve the energy efficiency of economic and social sectors, the introduction of energy-saving technologies and the development of renewable energy sources' issued by the President of the Republic of Uzbekistan on 22 August 2019.

This decree determines an increase in the share of electricity production using renewable energy sources to at least 25% by 2030.

To achieve the targets, the government has developed a plan to build almost 10 GW of new renewable energy facilities, including 5 GW of solar (excluding the capacity of individual households), 3 GW of wind and 1.9 GW of hydroelectric power plants.

At the same time, the construction of new renewable energy facilities with a total capacity of more than 10 GW and the modernization of existing hydroelectric power plants will ensure the production of more than 37 billion kWh of electricity by renewable energy facilities (in 2018 – 5.9 billion kWh), as well as expected annual savings of more than 8.1 billion m³ of natural gas.

This report presents a faunistic overview of the territory projected for the construction of a wind power plant in the vicinity of a wind power plant in the area of Sultan-Uvays ridge, Republic of Karakalpakstan.

At this cameral stage, an overview of the fauna is provided, based on the literary, departmental, personal data and field data of the authors of the report.

PHYSIOGRAPHICAL DESCRIPTION OF THE RESEARCH AREA

The project area is located in Beruni and Karauzyak districts of the Republic of Karakalpakstan. It belongs to the Lower Amu Darya physico-geographical region, which includes the modern and ancient deltas of the river.

The territory borders the Ustyurt Plateau to the west, the Kyzylkum Desert to the east, the Aral Sea to the north, and Turkmenistan to the southwest.

The area is about 50 thousand sq.km. The relief of the Lower Amu Darya physio-graphical region is a lowland, the surface of which is slightly inclined and widens from southeast to northwest. The area extends from the Tuyamuyun gorge in the southeast to the Aral Sea in the northwest.

The length of the gorge in this direction is 400 km. Within Pitnak elevation (absolute height up to 200 m) Amudarya flows in narrow channel and forms Tuyamuyun gorge.

The delta spreads (width 10-12 km) below the gorge, with an absolute height of relief of 150 m.

From this direction the ancient delta of the Amu Darya starts, its width reaches 75-80 km.

The project area is located on the Sultan-Uvaiz (Sultanuizdag) Ridge and the adjacent section of the Kyzylkum desert. The ridge is located on the right bank of the Amudarya River at the extreme south-west of Kyzylkum, separating the desert from the river valley. It is more than 50 km long and up to 25 km wide. The ridge has an almost latitudinal extension in the east, changing to a northwestern extension in its western part. The maximum height reaches 473 m. The southern and western slopes are steep, while the northern and eastern slopes are more gentler. The massif consists of ridges composed of quartzite, gneiss, marble and granodiorite. Desert landscapes dominate. There is no constant running water. The valleys, cuts through the ridge, are completely waterless and very hot in summer.

The nature of all these mountains in Kyzylkum is rather similar. They are ridge-like, with strongly flattened contours. Their northern slopes descending first gently and then almost steeply and in large ledges. In the opposite direction, the southern slopes are hilly and extremely gently sloping toward the plain. They are ridge-like, with strongly flattened contours. Their northern slopes descending first gently and then almost steeply and in large ledges. In the opposite direction, the southern slopes are hilly and extremely gently sloping toward the plain. The slopes on either side of these mountains are usually flanked by many small savannahs. The stony slopes consist of ancient crystalline and metamorphic rocks. Genetically, the Kyzylkum Mountains are mostly remnants of Paleozoic rocks, eroded and dissected by denudation over a long period of time.

The project area is remote from major settlements, despite this, the level of impact on the environment is high. On the south side passes the international highway A380, the territory is crossed by numerous used dirt roads. Also, in the south-eastern part of the ridge is a holy place "Sultanbaba Mausoleum" is actively visited by pilgrims, livestock grazing. The most significant factor of concern and impact on the environment is the presence of several operating factories and quarries.

Along the Amu Darya, opposite the ridge there is a protected area - the Lower Amu Darya Biosphere Reserve, which on September 16, 2021, was included in the World Network of Biosphere Reserves under the UNESCO "Man and the Biosphere" (MAB) program. It is necessary to mention that earlier, the WWF program "Econet" proposed to create a national park "Sultanuwais Ridge" (#16), which is part of the Central Kyzylkum zone, and in 2012 it was also proposed to create a national park in the project area. The UNDP/GEF and the Government of the Republic of Uzbekistan project "Strengthening the sustainability of the national system of protected areas by focusing on nature reserves" has allocated according to botanical criteria (4 endemic species grow in the area (*Allium sultanuizdaghi*, *Scorzonera bungei*, *Lappula parvula*, *Cousinia umbilicata*) and 9 subendemic species (*Jurinea persimilis*, *Cleome quinquenervia*, *Astragalus holargyreus*, *Astragalus remanens*, *Limonium lessingianum*, *Calligonum zakirovii*, *Lappula aktaviensis*, *Salsola chiwensis*, *Astragalus ammodendron*) relic species *Asparagus turkestanicus*). The presence of these species characterizes the flora as relict and unique and was supposed to be a cluster area of the Lower Amu Darya Biosphere Reserve for the conservation of botanical diversity. However, in spite of the recommendations, the area was not included in the protected area list of Uzbekistan and continued to be developed for mining.

HISTORY OF THE STUDY OF THE REGION

The history of the study of reptiles inhabiting the territory of Uzbekistan, as was the case with other vertebrates in Central Asia, began with the trip of E. A. Eversmann and K. Pander from Orenburg to Bukhara (October 1820 – April 1821). The few and occasional collections of E. A. Eversmann, transferred to the University of Berlin, were processed by Prof. G. Lichtenstein and published in 1823 as an appendix to the work of E. A. Eversmann (Bogdanov, 1960).

Prof. G. Liechtenstein lists 18 species of reptiles (including 5 new ones) and 2 species of amphibians. In another work, G. Lichtenstein (1823) mentions 6 species of lizards and 2 species of snakes.

A. Lehmann in July 1841 crossed the Kuvan-Darya, crossed the Kyzylkum desert, visited Samarkand, then Bukhara, from where he traveled to the mountains to Iskanderkul and in early April went to Orenburg. Most interesting collections by A. Lehmann were mentioned by I.F. Brandt (1852), A.M. Nikolskii (1899a, 1905a, 1915, 1916, 1918). The latter indicates 2 species of amphibians and 22 species of reptiles.

N. A. Severtsov in 1866, 1867 and 1868 spent training camps near Tashkent. In the summer of 1874, he crossed the western part of the Kyzylkum and went to the Tashbai-Kazgan well and through the Beltau chink went to the lake. Kungradkul and on the Karakol channel, where it entered the system of the Amudarya delta channels. From here he went through the coastal sands to Nukus, Chimbay and along Kegeili to Kushkanatau, from where he returned to Nukus, then visited Turtkul, returned through Nukus in Klychkale to Kungradkul, from where he left for Yany-Darya.

The collections of N.A. Severtsov were used by him in compiling the book "Vertical and horizontal distribution of Turkestan animals." His materials were used by A. M. Nikolsky.

G. Ye. Grum-Grzhimailo traveled across Uzbekistan with his expedition in 1885 (see Fauna of the Uzbek SSR, vol. 2). His collections were processed by A. M. Nikolsky.

A. M. Nikolsky on June 10, 1886 from Kazalinsk through Kyzylkum left for Turtkul (formerly Petro-Aleksandrovsk). The route of his travels in Central Asia is indicated in the "Fauna of the Uzbek SSR", t. P. He used his fees when compiling reports.

L.A. Molchanov in 1911, studying the ornithological fauna in the Amu Darya delta below Nukus, collected several specimens of amphibians and reptiles, which entered the ZIN and were processed by A.M. Nikol'skii (1915, 1916, 1918).

S. F. Tsarevsky (1914) mentioned several specimens of reptiles caught in Uzbekistan, and in another work (1915) he talks about specimens of Desert sand boas caught in the same territory.

D. N. Evgenov and A. P. Parinkin on May 28, 1951, 6 km south of the village of Pitnyak, Khorezm region, obtained 24 specimens of Uzbekistan Toad-head Agama. The results of processing this collection in 1955 were presented in the article. However, this area is located more than 50 km northwest of the project area and is separated by the Amu Darya river bed. In this regard, we believe that Uzbekistan Toad-head Agama is not found in the project area.

O. P. Bogdanov in his work "Fauna of the Uzbek SSR. Amphibians and reptiles" (1960) provides data that he collected in Kyzylkum part of Khorezm region in 1949, 1950, 1954 and 1955.

N. N. Shcherbak (1974) studied racerunners (genus *Eremias*) throughout their habitat, including Kyzylkum part of Khorezm region.

The publication of D. A. Bondarenko and E. A. Peregontsev (2017) describes the spatial distribution of the Russian tortoise *Testudo horsfieldii* in Uzbekistan, including Kyzylkum part of Khorezm region.

Also, this report presents the author's personal data collected during field studies of the area in 2014, 2015, 2019 and 2021.

The list of reptiles is given according to the latest updated reptile database (http://www.reptile-database.org/data/Reptile_checklist_2019_07.xlsx.)

ANNOTATED LIST OF REPTILES INHABITING THE PROJECT AREA

The basis for compiling a list of the herpetofauna of the studied area was the modern list of the amphibian fauna of Uzbekistan, consisting of 5 species from one family and the list of reptile species of Uzbekistan, consisting of 62 species from 13 families.

CLASS AMPHIBIA

FAMILY BUFONIDAE

TURAN TOAD

***Bufo turanensis* (Hemmer, Schmidtler & Böhme, 1978)**



Figure 1 Turan toad. Photo by T. V. Abduraupov

The length of the body with the head is up to 140 mm. The upper side is light grey-olive or greyish-green with or without black spots. The male has an internal resonator under the skin of the throat. During the mating season, the male has black calluses on the first two or three toes of the forepaws. The inner edge of the tarsus has a longitudinal skin fold. The pupil is horizontal. The toes of the hind paws are partly interconnected with the help of the swimming membrane. The parotid glands (parotids) are well developed behind the eyes. The caviar has the form of cords.

This is an economically important species, which destroys harmful insects in huge numbers. Local people sometimes catch it to use in traditional medicine.

In February and March toads lead a diurnal lifestyle. At this time, they bask in the sun or mate and spawn in irrigation canals, puddles and swamps. They then switch to a nocturnal lifestyle, which lasts until late autumn.

In the flatland part of the range most toads begin to hibernate in late October or early November and often appear on the surface of the earth only in mid-February, but most of them finish hibernating in early March.

Wintering places are animal burrows and various cavities in the ground.

The Turan toad is most active during the spawning period, which begins in late February and lasts until late May.

Habitats are highly diverse. The Turan toad occurs in river valleys, on the plains, in the foothills, in various agricultural fields, vegetable gardens, in human settlements and deserts with any types of sources of water, even seasonal ones, available. They hide in the burrows of various rodents and cracks in the ground.

Economically significant species. It eats harmful insects in huge quantities. Occasionally gathers by the local population for the preparation of traditional medicine.

In the Khiva oasis, the Turan toad was observed by M. N. Bogdanov (1882), in Turtkul by L. A. Molchanov (A. M. Nikolsky, 1918).

CLASS REPTILIA

FAMILY TESTUDINIDAE

RUSSIAN TORTOISE

Testudo horsfieldii (Gray, 1844)



Figure 2 Russian tortoise. Photo by T. V. Abduraupov

The Russian tortoise is a vulnerable species endemic to Central Asia, whose numbers are decreasing. It is included in the IUCN Red List [VU] and the Red Book of the Republic of Uzbekistan 2(VU) (2019) and listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Carapace length is up to 286.4 mm. The carapace is flat, slightly serrated at the rear edge. The indentation on its front edge is not deep. Each of the front paws has four claws. The forearm is covered with six to seven transverse rows of tile-like mails. On the back of the thigh there are several horny tubercles concentrated in one group. The horny mails of the carapace are usually monochromatic, yellowish or brownish-olive, sometimes with wide black spots, more pronounced on the plastron.

This species is endemic to Central Asia, where it inhabits lowlands and foothills (except drifting sands). In addition to Southern Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan and Tajikistan, it is distributed in Northern and Eastern Iran, Afghanistan, North-western China and Northern Pakistan (Ananyeva et al., 1998; Bogdanov, 1960, 1965).

It inhabits both sandy and clayey deserts, plains, mountain slopes, depressions and valleys, gorges and mountain steppe up to 1,150 m above sea level (Dal, 1936, 1937). Rarely

lives on agricultural lands – on the edges of irrigated and unirrigated fields, in vegetable gardens and orchards. Avoids places with dense grass cover, as well as areas grazed intensively by livestock.

This is a strictly diurnal species. In hot weather, it can be observed only in the morning and before sunset. In the middle of the day, animals hide from the heat in temporary shelters under shrubs, where they half burrow into the soil, into the holes of rodents or those dug by themselves. During the day, tortoises are capable of covering from 120 m to 2 km. At night they burrow into shallow pits, sometimes remaining on the surface of the ground.

After the winter diapause, tortoises appear on the surface in March—early April, in warm winters and in the south of the range – in February. Mating begins a few days after their emergence. The breeding season is extended from late March to late May. Newly emerged tortoises with a shell 30—50 mm long remain under the ground during the winter and usually appear on the surface next spring.

They grow slowly. Tortoises become mature at the age of 10—13 years, when their carapaces reach 11 cm in length. In natural environment they can live for at least 30 years.

In June, when ephemeral vegetation dries, the Russian tortoise enters a period of estivation (summer dormancy), for which it digs holes up to 1 m long. In deserts tortoises disappear by the end of May, but in the mountains or on irrigated lands, single individuals may be recorded in June and even July. Much more often, estivation flows into hibernation (winter dormancy).

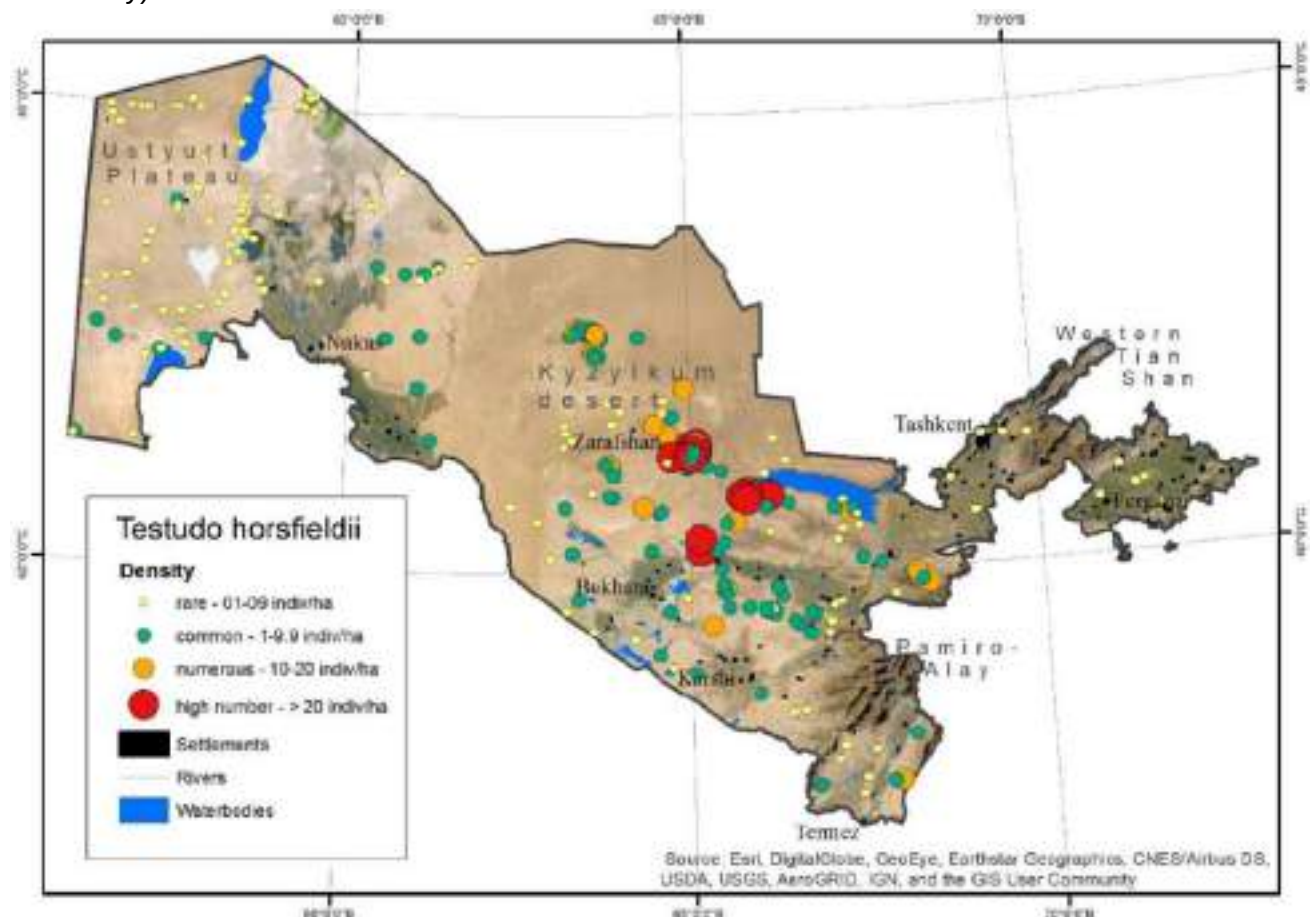


Figure 3 Map of the Russian tortoise population density in various parts of Uzbekistan

M.N. Bogdanov (1882) found turtles in the Kyzylkum desert, on the left bank of the Amu Darya, on the road from Kizilkak to the Bukantau foot. A.M. Nikolsky (1899a) saw great numbers of turtles on the way from Kazalinsk to Turtkul. Also noted by Mambetzhumaev (1972) in the Amu Darya valley near Kulatautugai.

The number of tortoises in the project area is quite low and is subject to significant fluctuations, which depend on winter and spring weather conditions, as well as the feeding rate of the biotopes where the animals live. The plowing of virgin lands, grazing of livestock, and the development of natural habitats have a significant effect on the decrease in the number (Bogdanov, 1965).

FAMILY GEKKONIDAE
TRANSCASPIAN BENT-TOED GECKO
***Mediodactylus russowi* (Strauch, 1887)**



Figure 4 Transcaspian bent-toed Gecko. Photo by T. V. Abduraupov

Small lizard, reaching a length of 53 mm. The tail is 0.69-1.02 times as long as the body. Females are somewhat larger than males. The body and head are slightly flattened. The pupil is vertical. The ear opening is oval and oblique. The muzzle is flat or nearly flat. The coloration of the upper surface of the body is ash-or brownish-gray with dark narrow transverse stripes and small dark spots on the upper surface of the head. The underside of the body is light.

The Transcaspian bent-toed Gecko is a typical arid landscape. Inhabits sandy and clayey semi-deserts and deserts, where it settles in saxaul forests, tugai, on steep slopes and on talus. In anthropogenic landscapes, it is common on the walls of dwellings and in abandoned buildings made of clay and stone.

Twilight and nocturnal activity. In spring, activity begins in late March - early April, when Transcaspian bent-toed Gecko hatch after wintering. In autumn, in the southern parts of the range, they leave for the winter at the beginning of November.

In Urgench, this species was found by L.A. Molchanov (A.M. Nikolsky, 1915) and A. Gerasimov (ZIN), in the same place and in Khazarasp - V.P. Kostin (1956). For the Central Kuzylkum, this species was indicated by A.M. Andrushko (1953).

CASPIAN THIN-TOED GECKO
Tenuidactylus caspius (Eichwald, 1831)



Figure 5 Caspian Thin-toed Gecko. Photo by M.A. Gritsina

A medium-sized gecko with a body length of up to 75 mm and a tail length of up to 100 mm. The body and head are noticeably flattened, the muzzle is convex. The body is covered from above with flat small scales, among which there are large triangular tubercles in 12-14 regular longitudinal rows.

The coloration of the upper side of the body is brownish-gray with a yellowish tinge and with a pattern of five to six dark brown broken transverse stripes on the neck and body. The underside of the body is white, without spots.

One of the most eurytopic gecko species living in a wide range of habitats. The Caspian Thin-toed Gecko can settle in caves, in hilly areas, in the desert, on the plain, in rocky gorges and on the canopy of mountain slopes, where it rises to an altitude of 800 m above sea level. This lizard is common in karises, wells, cemeteries, buildings, adobe ruins, near residential buildings, as well as in clay and clay-saline deserts. Easily moves both horizontally and vertically.

The activity is twilight and nocturnal, but in the spring Caspian Thin-toed Gecko often appears during the daytime. In some years, on warm days, they come to the surface even in winter, but a massive exit is noted in late March - early April. Wintering takes place at the end of October. As shelters (including wintering ones), lizards use cracks in cliffs and rocks, voids between stones in talus and buildings, as well as rodent burrows.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

M.N. Bogdanov (1882) wrote that this gecko is widespread in the Kyzylkum mountains and the Khiva oasis. For Turtkul it is indicated by A.A. Strauch (1887) and A.M. Nikolsky (1899a). In Khiva, this species was obtained by V.V. Gusakovsky.

COMB-TOED GECKO
***Crossobamon eversmanni* (Wiegmann, 1834)**



Figure 6 Comb-toed Gecko. Photo by T. V. Abduraupov

A medium-sized gecko, body length up to 60 mm and tail length up to 80 mm. The body and large head are somewhat flattened. Thin, prehensile and unbreakable tail is covered with uniform scales. The fingers gradually become thinner towards their distal parts, and their lower surface is covered with one row of transversely widened, slightly ribbed or serrate plates along the free edge of the plates, equipped on the sides with fringes of long conical scales.

The color of the upper side of the body is sandy pinkish. The underside of the body is white. In juveniles, the limbs and the lower surface of the tail are light lemon or orange-lemon color.

Comb-toed Gecko is a typical psammophile that lives on fixed and semi-fixed sands with sparse vegetation (saxaul, kandym, sandy acacia, selin, etc.), less often it occurs on the slopes and at the base of the dunes, avoiding their bare tops. Usually these lizards do not live on clay and compacted soils, but occasionally they are found on small takyrs between sandy ridges.

This species is characterized by a twilight-nocturnal lifestyle. On the surface in spring, lizards appear in mid-March, are active until the second half of October.

They dig their own burrows with a length of 70-110 cm as shelters, sometimes they use minks of large beetles. Comb-toed Gecko is able to jump from branch to branch, using a tenacious long, flexible and unbreakable tail. Sexual maturity occurs the next year after hatching. Mating was noted in mid-April; this process in different individuals continues until early June. During the mating season, lizards actively use sound communications (weak squeak). The period of oviposition (1-2 per clutch) is extended, lasts about two months (from late May to late July).

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

M.N. Bogdanov (1882) found this species in Kyzylkum, in the Kaike tract, and L.S. Zimin and V.V. Gusakovsky in Khiva.

COMMON WONDER GECKO
Teratoscincus scincus (Schlegel, 1858)



Figure 7 Common Wonder Gecko. Photo by T. V. Abduraupov

Quite large geckos, body length up to 116 mm. The ratio of body length to tail length varies from 0.15 to 2.13. A large, broad and tall head with a blunt muzzle and very large protruding eyes that glow with a bright red light in the dark, which is usually used for night observations. The covers of the body and tail are very delicate and easily damaged when touched. The tail is relatively short, fleshy, brittle. It is also characterized by easily damaged integuments, which are also capable of subsequently regenerating.

The upper side of the body is sulphurous-yellowish or pale greenish; with a complex pattern of brown or dark brown stripes and spots. On the sides there is a rusty-red color, a dark longitudinal stripe, below it the sides acquire a lilac-smoky shade. The underside of the body is white with a lemon-yellow bloom on the throat.

Like the Comb-toed Gecko, it is a psammophile and lives on similar surfaces. Occasionally, it was noted on dense soils adjacent to sands, on plakors and takyrs.

The activity is strictly nighttime regardless of the season. The first active individuals were found in the middle of March in the southern Kyzylkum. Each gecko has an individual site, these lizards are strictly territorial and aggressive, fights of males during the mating season are common. Common Wonder Gecko hibernates at the end of September - mid-November, depending on climatic conditions.

Common Wonder Gecko becomes sexually mature 18-20 months after hatching, when the body length reaches 68-70 mm. As a shelter, it uses its own burrows of a rather complex structure, consisting of a main passage, a system of snorkels and a chamber where lizards spend the daytime, and also lay eggs and hibernate. The hole is sealed with a special cork. Sometimes it lives together with dung beetles, uplifted and small jerboa, midday gerbil. Mating takes place in late April - mid-May, egg-laying in early June. There are 1-2 eggs in a clutch. There are known cases of communal laying.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

A.M. Nikolskiy (1915) reports on specimens of collections of A. Lehmann and A.P. Fedchenko in Kyzylkum. M.N. Bogdanov (1882) caught a gecko near Alty-Kuduk, as reported by S.F. Tsarevsky (1914).

FAMILY AGAMIDAE

STEPPE AGAMA

***Trapelus sanguinolentus aralensis* (Lichtenstein, 1823)**



Figure 8 Steppe Agama. Photo by T. V. Abduraupov

This is a medium-size lizard. The total length of the steppe agama does not exceed 300 mm, with the length of the body with the head up to 120 mm and the tail 1.3—2 times longer than the body.

Steppe Agama inhabits sandy, clayey and stony deserts and semi-deserts, preferring areas with shrubby or semi-woody vegetation. It is also found on gentle rocky slopes in the foothills, along the edges of loosely fixed sands, along river banks and in tugai, along the edges of human settlements and roadsides. It shelters in the burrows of gerbils, sousliks, jerboas, hedgehogs and tortoises, cavities under stones and cracks in the soil. In the hot season, agamas often climb on the branches of shrubs, thus protecting themselves from overheating on the soil heated by the sun. Males survey their site from an elevated position, protecting it from the invasion of competitors. After wintering, these lizards appears in mid-February, March or early April, depending on the weather at that time. Males leave their winter shelters earlier than females.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

In Uzbekistan, it is widely distributed in arid zones. In the ZIN collection there is one specimen obtained by V.V. Gusakovsky in Khiva. For the Kyzylkum desert, this species was noted by M.N. Bogdanov (1882), for the central part of this desert - A.M. Andrushko (1953).

LICHTENSTEIN'S TOADHEAD AGAMA
***Phrynocephalus interscapularis* Lichtenstein & Martens, 1856**



Figure 9 Lichtenstein's Toadhead Agama. Photo by T. V. Abduraupov

A small lizard, one of the smallest species of the genus, the size of the body from the tip of the snout to the tip of the tail usually does not exceed 9 cm. The body is very slender, the tail is strongly flattened throughout. Characterized by the development on the hind edge of the femur and on the sides of the base of the tail of a series of strongly prickly white scales, forming a kind of fringe.

Lichtenstein's Toadhead Agama is a typical inhabitant of naked and scattered, almost devoid of vegetation sands. This strictly psammophilic lizard is usually found in the form of isolated settlements on island dunes, often located quite far from each other (up to tens of kilometers). Usually it adheres to the tops of dunes, only occasionally running over to areas of more fixed sands with sandy acacia, saxaul and other sparse vegetation. The abundance is generally high everywhere.

Minks are used as shelters, which are an inclined passage up to 20 cm long, with a small slot-like entrance. It can also plunge into the sand, pushing it apart with the help of rapid oscillatory movements of the body, which has special folds of skin along the edges, directing sand particles to the back. Individual plots vary from 30 to 180 sq. m.

Activity begins in the middle - end of February in spring, in the more northern parts of the range - in the second half of March. It feeds mainly on various insects, mainly ants.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

In Kyzylkum, it is celebrated by M.N. Bogdanov (1882) and A.P. Fedchenko (1871).

SUNWATCHER TOAD-HEADED AGAMA***Phrynocephalus helioscopus sergeevi* Solovyeva, Dunayev & Poyarkov, 2012.**

Figure 10 Sunwatcher toad-headed agama. Photo by T. V. Abduraupov

The length of the body with the head in newborns is 18–25 mm, males – up to 57 mm, females – up to 62 mm. The upper surface of the muzzle drops at the front, which descends almost vertically to the lips. When viewed from above, the nostrils are not visible. The tail, flattened and widened at the base, abruptly becomes thinner and round in cross section. The colour of the body and the pattern are very variable: the upper side varies from ash-grey to dark grey or brown-grey and has transverse dark brown, brown or black spots. These spots are poorly developed or sometimes absent. On the upper surface of the neck there are 2 small, more or less oval red or pink spots, with blue or light blue fringes. The tops of the tail and limbs are often covered with transverse spots and stripes.

The first individuals of the Sunwatcher toad-headed agama appear in early March after wintering. The last ones were recorded in November before the winter. It is active in the daytime throughout the warm season.

It sometimes rises to foothills up to 778 m above sea level. Prefers hard soils with sparse vegetation.

A. M. Nikolsky (1915) indicates specimens collected by N. A. Severtsov from Khodzhakul, Dzhana-Darya, Karmakchi, Daryalyk. Kh.S. Salikhbaev (From the Academy of Sciences of the Republic of Uzbekistan) caught these lizards in Kyzyl-Dzhar.

UZBEKISTAN TOAD-HEADED AGAMA
Phrynocephalus rossikowi Nikolsky, 1898



Figure 11 Uzbekistan Toad-Headed Agama. Photo by A. A. Shestopal

Body length up to 48mm, tail up to 59mm. Males are larger than females. The upper surface of the muzzle abruptly passes into the anterior part, which descends almost vertically to the lip. When viewed from above, the nostrils are not visible.

The scales of the ridge are slightly enlarged with small sharp spines turned up. Separate groups of scales on the back and base of the tail are strongly thickened, with raised free edges. Scales of lower surface of body and head without ribs. There is no transverse skin fold on the upper surface of the neck.

The tail is flattened from top to bottom throughout.

The body is reddish-gray above with four large oval brown, brown or black-brown spots on the sides of the neck and body. The same color group of thickened and raised scales on the back. In addition, there are more or less round white spots on the back with a blurred dark rim. Tail and legs above with dark transverse stripes, white below. There are three indistinct dark stripes on the underside of the tail. The end of the tail is brown or dark brown.

It lives only in the lower reaches of the Amu Darya. (Takhtakupyr, Beruni, Elikkala, Amudarya regions, etc.).

It lives among very sparse vegetation on loamy soils covered with fine gravel. It also occurred in sandy areas with somewhat more developed grass and shrub vegetation.

There have been no meetings on the territory of Uzbekistan for about 40 years. On gravelly soils at the foot of the remains of Sultanuezdag in the 70s of the last century, up to 22 ind./ha were counted.

In the vicinity of Sultan-Uvais, this species was observed by a number of authors: in the vicinity of Lake Khodzhakul at the foot of Sultanuizdag (Bogdanov, 1960); in the vicinity of the village of Ispas (Shcherbak, 1984); environs of the Kipchak forestry (Bogdanov, 1960); vicinity of the Beshtobe Upland (Lim, 1965); neighborhood of the Chilpyk-kala fortress (Lim, 1965).

FAMILY LACERTIDAE
RAPID RACERUNNER
Eremias velox velox (Pallas, 1771)



Figure 12 Rapid Racerunner. Photo by T. V. Abduraupov

The length of the body with the head is up to 84 mm (males) and up to 81 mm (females). In juveniles, three even black-brown or black stripes run along the back, with the central one forking on the neck; one stripe of the same colour with light round spots on it can be found on each side of the body. In adults (the main background of the upper part of the body is grey or sandy, often with an olive or brown tint) these stripes break into separate spots, while the sides of the body display light, black-edged, rounded spots, which in the front part of the body (especially in males) turn blue. It should be borne in mind that the pattern of this lizard varies greatly from individual to individual. The belly and throat are white. In juveniles, the bottom of the tail and sometimes the small scales on the thighs and legs are red or red-orange.

Economically significant species. One of the most widely distributed and abundant species of Racerunners in the Palaearctic. It is widespread on the territory of Uzbekistan.

After hibernation, first individuals appear in the second half of March, most of them in early April. Hibernation begins in late October – early November. In summer, they are active mainly in the morning and evening hours.

In Uzbekistan, Rapid Racerunner is a typical inhabitant of river valleys, where it is most abundant. However, it also occurs in a wide range of other biotopes, which it inhabits depending on the presence of other species of Racerunners.

Rapid Racerunner was recorded in Khiva by V.V. Gusakovsky (ZIN) and Piasetsky (A.M. Nikolsky, 1915), and V.P. Kostin (ISIP Academy of Sciences of the Ukrainian SSR) - near lake Uzunkul (Khazarasp district, Khorezm region).

STRIPED RACERUNNER
Eremias lineolata (Nikolsky, 1897)



Figure 13 Striped racerunner. Photo by T. V. Abduraupov

Body length with head up to 54 mm, males up to 54 mm, females up to 50 mm. There are no noticeable differences in the coloration of young and adults. The main background of the upper surface of the body is sand-gray. Four or six narrow (very rarely, approximately from the middle of the body, there is also a seventh) even brown or dark brown stripes running along the back, starting from the posterior edge of the parietal scutes; they pass to the tail and merge there in pairs; in the case of the development of four stripes, there is usually a short fifth, expressed in the cervical region, and sometimes in the back of the body and tail; in the case of six stripes, the two middle ones, the narrowest, are brought closer to each other. One of the same color, but wider, starting from the eyes, runs along the sides of the body to the front half of the tail; usually an indistinct narrow brown strip also extends near the border of the lateral scale with the ventral scutes. Head dorsally with or without small dark spots. Limbs dorsally with light rounded or oval spots on a dark brown or brown background. The underside of the body is white.

Recorded by L.A. Molchanov (ZIN) - in the lower reaches of the Amu-Darya in Beltau, Kubetau, Kushkanatau, Tokmaktau and along the Irkin-Darya; N.A. Rashkevich (From the Academy of Sciences of the Republic of Uzbekistan) - in the Shakal tugai, located 7 km north of Nukus; Gusev (ZIN) - in the vicinity of Sheykhaman, Kara-Uzyak district.

RETICULATE RACERUNNER
***Eremias grammica* (Lichtenstein, 1823)**



Figure 14 Reticulate Racetrack Lizard. Photo by T. V. Abduraupov

A medium-sized lizard with a body length of up to 93 mm and a little more than one and a half times, a long tail. The toes bear on the sides long, more or less triangular scales that form combs. The main background of the upper part of the body is gray with a brownish or slightly greenish tint. The back, neck, upper side of the base of the tail and legs are covered with a black-gray or dark brown mesh pattern, often with individual black specks.

Inhabits sandy deserts, inhabiting mainly various kinds of scattered and weakly fixed sands with sparse herbaceous and shrubby vegetation. In some places it temporarily enters the areas of takyr and soddy salt marshes bordering on the sands. It uses the burrows of desert rodents as shelters, as well as its own burrows up to 1 m long and up to 70 cm deep, usually dug at the base of the bushes. They are able to quickly bury themselves in loose sand and move in its thickness for distances of up to 2-3 m.

In the north of the range, it is active from early April to mid-October. In its southern regions, wintering lasts no more than three months - from December to February, but even during this period, in the presence of warm weather, at times it can leave the wintering shelters for heating under the sun.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

This foot-and-mouth disease was caught by L. S. Barshchevsky (ZIN) in Turtkul, V. V. Gusakovsky in Khiva, V. P. Kostin (from the Academy of Sciences of the Uzbek SSR) - at the lake Uzunkul, Khazarasp region, Khorezm region.

SAND RACERUNNER
Eremias scripta scripta (Strauch, 1867)



Figure 15 Sand Racerunner. Photo by T. V. Abduraupov

A small, very slender lizard up to 62 mm in body length and approximately twice as long as a thin tail. On one of the sides of the second to fourth toes of the hind legs, there is a ridge of ribbed ones protruding towards the scales. The main background of the upper body is sandy gray. Along the back there are 7, less often 5 narrow brown or dark brown stripes, the middle ones of which are usually dissected into separate, more or less sinuous, elongated along the spots, filling the middle of the back.

Inhabits sandy deserts, inhabiting mainly inter-barnian depressions and semi-fixed sands with ephemeral herbaceous and shrubby vegetation with a predominance of saxaul, tamarisk, juzgun, sandy acacia and other characteristic psammophylls. It often keeps on the slopes and ridges of dunes. Burrows of burrowing animals, including insects, as well as their own burrows up to 1 m long and up to 15 cm deep, usually dug out at the base of shrubs, serve as refuges.

Usually, several times a day, it digs out small temporary burrows on clean sand. It can also "dive" into the sand and move at a shallow depth under its surface for some time. It climbs well on bushes, helping itself with a long tail and jumping from branch to branch. In spring they appear in late March - early April, hiding for the winter in late September - mid-October.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

According to A. M. Nikolsky (1915), it was found by L. S. Barshchevsky in Turtkul. L. A. Molchanov (ZIN) mined Sand Racerunner in the Amu Darya delta in Kushkanatau. V.P. Kostin (IZIP Academy of Sciences of the Uzbek SSR) - at the lake. Dunguz-Uldy, Khazarasp region, Khorezm region. L. S. Zimin (ZIN) - in the village of Ravat near Khiva. For Kyzylkum, this type is indicated by M.N. Bogdanov (1882) and A.M. Nikolsky (1905) according to the collections of N.A. Severtsov and D.K. Glazunov.

ARALO-CASPIAN RACERUNNER
Eremias intermedia (Strauch, 1876)



Figure 16 Aralo-Caspian Racerunner. Photo by T. V. Abduraupov

A small lizard with a body length of up to 65 mm and about one and a half times longer tail. The main background of the upper side of the body is dark gray with a brownish tint. On the body there are longitudinal rows of round or elongated white or light gray spots, framed by circles of black or dark gray color.

In most of the range, it inhabits leveled fixed sands and inter-barnian depressions with saxaul, tamarisk, camel thorn and other sparse herbaceous and shrub vegetation. It also occurs in the anthropogenic landscape. It takes refuge in the holes of rodents, turtles, small own burrows up to 60 cm long.

After wintering, they appear on the surface in late February - early March. In the hot summer months in June-July, adults practically cease to be found on the surface in places and, apparently, go into a state of summer hibernation. It has been suggested that the absence of adult lizards during this period is explained by their natural mass mortality at the end of the breeding cycle. The last individuals hibernate in late October - early November.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

M.N. Bogdanov (1882) noted this species in the Kyzyl Kum desert, including the area under study. L. A. Molchanov (ZIN) found Aralo-Caspian Racerunner in the Khiva oasis, along the Amu Darya river bed.

FAMILY VARANIDAE
CASPIAN MONITOR
Varanus griseus caspius (Eichwald, 1831)



Figure 17 Caspian Monitor. Photo by T. V. Abduraupov

The species decreasing in numbers is included in the Red Book of the Republic of Uzbekistan (2019) with status 2 (VU: D).

The largest lizard in Uzbekistan and neighboring countries. The length of the body with the head is up to 520 mm. The upper side of the body is greyish-brown, yellowish-brown or reddish-brown, with numerous dark dots and specks. On the upper side of the neck there are two or three longitudinal brown stripes, and on the back and tail there are several transverse stripes of the same colour. In youngsters, the stripes are very pronounced, they are black or almost black.

After hibernation, the first individuals appear relatively late – in early to mid-April. Active all day throughout April. In May, they are active in the morning and evening hours. They go into hibernation in September-October. Often the Caspian Monitor has an estivation in summer, which gradually turns into winter hibernation. They begin estivating in late June—early July.

It inhabits mainly fixed and semi-fixed sands, clay and stony-gravelly soils, visits solonchaks.

In Kyzylkum, this species was noted by M.N. Bogdanov (1882) and A.M. Andrushko (1953). However, in recent years, the number of the species has greatly decreased, in a number of places it has completely disappeared, in this regard, we assume a possible habitation of the species in the project area, which must be verified by field studies.

FAMILY BOIDAE
DESERT SAND BOA
Eryx miliaris (Pallas, 1773)



Figure 18 Desert sand boa. Photo by T. V. Abduraupov

Desert Sand Boa is a near-threatened, sporadically distributed subspecies, included in the Red Data Book of the Republic of Uzbekistan (2019) with the status 3(NT); also included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

A medium-size snake. Females reach 720 mm in length, males are somewhat smaller – 550-580 mm. Tail length – 50-70 mm. The tail is short and blunt.

It lives mainly in sand deserts, where it prefers drifting and semi-fixed dunes, as well as more or less loose soils in deserts and semi-deserts with wormwood-saltwort communities and saltwort populations. It is less common on takyr with patches of vegetation near sands and on relatively hard loess and clay soils, near ruins, on the slopes of gullies and at the borders of irrigated lands. Often occurs near colonies of Gerbils, whose burrows it uses to shelter. It is able to plunge into the sand quickly, head first, and "swim" under its surface, leaving a characteristic trail in the form of a serpentine bulge. The upward-looking eyes allow the Desert Sand Boa to examine the surface without raising its head above the sand.

Active from April to October. In the hot season, it leads a nocturnal and crepuscular lifestyle. It uses the holes of rodents as a refuge, therefore it often settles in colonies of Gerbils. The breeding season is in late March. In June-July, the female gives birth to 4—10 babies up to 12—14 cm long. It feeds on lizards, rodents and small birds.

Currently, the number is decreasing due to increased poaching (used in folk medicine), as well as economic development of land.

We assume a low abundance of Desert Sand Boa constrictor in the study area.

This species was noted in the delta of the Amu Darya River - V. Galitsky (ZIN), along the border of the Khodjeilinsky and Nazarpaysky tugays - Kh.S. Salikhbaev (1950), and also in the sands of the Khiva oasis - by M.N. Bogdanov (S.F. Tsarevsky, 1915).

FAMILY COLUBRIDAE
SPOTTED DESERT RACER
***Platyceps karelinii* (Brandt, 1838)**



Figure 19 Spotted Desert Racer. Photo by M. V. Pestov

A very slender snake of medium size with a relatively long tail: body length of females up to 865 mm, tail length, respectively, up to 270 mm; in males, body length up to 680 mm and tail length up to 235 mm. The tip of the muzzle is sharpened. The head is relatively weakly demarcated from the body. The coloration of the upper side of the body is light ash-gray with a yellowish or brownish tint. One row of narrow black or blackish transverse stripes running along the back, 1-3 scales not reaching the abdominal scutes. In the back of the body, the stripes become narrower, on the tail, sometimes they completely disappear.

The Spotted Desert Racer is biotopically related mainly to the plains, where it is found in all types of deserts.

In spring, they are active during the daytime, and from June to August, the activity becomes twilight-night and morning. After wintering, the first active snakes appear in the third decade of February, mass emergence in early April. Autumn activity continues until the end of November. Mating takes place in late April - mid-May.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

Spotted Desert Racer is indicated for the Khiva oasis, the Amu Darya river and the strip of desert closest to it by M.N. Bogdanov (1882). It was also obtained by it in Kyzylkum near the well of Alty-Kuduk. S. F. Tsarevsky (1914) cites M. N. Bogdanov's collections from Kyzylkum, the Khiva oasis, tugaya Meshekli (right bank of the Amu Darya river).

DIADEM SNAKE
***Spalerosophis diadema* (Schlegel, 1837)**



Figure 20 Diadem snake. Photo by T. V. Abduraupov

Large, rather slender snakes with a body size of up to 1500 mm. The tail is 4-5 times shorter than the body. The head is clearly demarcated from the neck. The tip of the muzzle is rounded. The coloration of the upper body is light gray or light brown. Along the ridge there is one row of brown or brown, more or less rhombic or oval spots, more pronounced in young snakes, in which they are also limited by a light border.

The most preferred biotopes of Diadem snake are sandy and clayey deserts; they are also found, although much less frequently, on hilly areas and on mountain slopes. It uses holes of rodents, turtles, cracks in the soil, bushes as shelters.

Annoyed individuals mimic a cobra's threat pose by aggressively lifting and inflating the front of their torso. Activity, depending on the climatic conditions of the season, day or night, one or two peaks. They leave wintering in late February - early March, activity continues until November.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

M.N. Bogdanov (1882) found Diadem snake in Kyzyl Kum between Alty-Kuduk and Uch-Uchak.

SAND RACER
***Psammophis lineolatus* (Brandt, 1838)**



Figure 21 Sand Racer. Photo by T. V. Abduraupov

The length of the body with the head is up to 840 mm (males) and up to 710 mm (females). The number of abdominal scales – 181—204, sub-caudal scales – 83—105 pairs. The body is thin. The upper surface of the muzzle is concave, with a longitudinal groove. The upper side of the body is olive-grey or sandy-grey, the edges of the scales are lighter than their central parts; four dark stripes run from the head along the body; in some individuals, only traces of these stripes in the form of dark or black lines along the scales may remain. Sometimes the pattern on the body is missing. The belly is white with greyish, brownish or olive-grey spots, larger at the front of the body.

Single individuals appear after hibernation in February. Most of them emerge in late March-early April. At this time, the snakes are active all day. In May, the activity is observed in the morning and evening hours. They go into hibernation in October-November.

The Sand Racer inhabits all lowlands, from where it penetrates into foothills up to 1,100—1,200 m above sea level; however, it prefers more fixed and drifting sands, pebbly plains, mountains and broken grey soils near settlements. The sand racer is more often observed in places where areas with dense vegetation alternate with open patches. Therefore, in places with dense vegetation, it can always be found on low precipitous slopes, mounds and so on.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

Kh. S. Salikhbaev (1950) gives the Sand Racer for the Khodjeilinsky and Nazarpaysky tugays. MN Bogdanov (S.F. Tsarevsky, 1914) mined a Sand racer in the Kyzyl-Takyr tract (Khiva oasis). For the Kyzyl Kum desert, this species is given by M. N. Bogdanov (1882).

FAUNISTIC COMPLEXES OF THE PROJECT AREA

Each of the types of habitats in the study area is characterized by a specific set of species – a faunal complex of amphibians and reptiles that has formed historically in the area. Each species is adapted to a specific set of environmental factors and this determines its relationship with specific ecosystems and habitats. Within any faunal complex, two groups of species can be distinguished:

1. Species closely related to a limited set of environmental factors (stenobiontic species). These are species characteristic only of a particular type of habitat. When the combination of conditions is favorable, the characteristic species can be quite numerous and common. Any change in habitat conditions negatively affects the distribution and population status of the characteristic species. Therefore, they are indicators of the degree of how natural habitats are conserved/disturbed. In the project area, these mainly include psammophilic species (Comb-toed Gecko, Common Wonder Gecko, Lichtenstein's Toad-head Agama, Reticulate racerunner and Sand Racerunner), semi-aquatic species (Turan Toad).
2. Species that can adapt to a wider range of habitats (eurybiontic species). This determines their wide distribution and occurrence in various types of habitats, higher resistance to anthropogenic impacts. Many species from this group are economically important, can reach high numbers and serve as food for predators, including rare species. Such species inhabiting the project area include Russian Tortoise, Caspian Bent-Toed Gecko, Steppe Agama, Rapid Racerunner and Spotted desert racer.

In addition to these faunistic complexes, it should be noted that synanthropic species of reptiles live in territories near the villages, to which Transcaspian bent-toed gecko can be referred. The rare Caspian Monitor (UzRDB, 2019) and the Diadem snake forage occasionally in villages. Rapid Racerunner and Steppe Agama, and Sand Racer inhabit heaps of soil taken from canals and ditches along fields, as well as precipitous slopes and the territory along them.

RESULTS OF THE SPRING 2022 FIELD SURVEY

The field visit to the project area in the area of Nukus 100 MW Wind farm (the Sultan-Uvais outliers) was carried out from April 16 to April 19, 2022. During the field trip, data on reptiles of the study area were collected from 6 points. More than 12 km of routes were completed (Figure 22).



Figure 22 Map of reptile survey points and tracks on the project territory

It is worth noting that the weather conditions were not ideal for the reptiles survey – a cool wind was blowing and it was cloudy (Figure 23). In this regard, the activity of reptiles was low.



Figure 23 Cloudy and windy weather on the project area. Point SU_Herp-1. Photo by T. V. Abduraupov

Table 1 Primary data and the density of reptiles at the survey points in the area of Nukus 100 MW wind Farm (the area of Sultan-Uvays ridge, Republic of Karakalpakstan) April 2022

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
SU_Herp-1				Hummocky sands with rubble lenses, Artemisia-Ferula association	1 km	16.04.22	C28,6°	C32,7°	30%
1	<i>Testudo horsfieldii</i> Russian tortoise	6	4,16						
2	<i>Trapelus sanguinolentus</i> Steppe agama	2	1,4						
3	<i>Teratoscincus scincus</i> Common Wonder Gecko	12	9,6						

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
4	<i>Eremias lineolata</i> Striped racerunner	2	2,2						
5	<i>Eremias intermedia</i> Aralo-Caspian racerunner	4	3,6						
6	<i>Varanus griseus caspius</i> Caspian Monitor	Present according to local people	—						
7	<i>Psammophis lineolatus</i> Sand racer	1	1						
SU_Herp-2				Hilly sandy foothills, Artemisia association	1 km	17.04.22	C24,2°	C27,1°	38%
1	<i>Testudo horsfieldii</i> Russian tortoise	7	5,47						
2	<i>Eremias lineolata</i> Striped racerunner	2	1,8						
3	<i>Eremias intermedia</i> Aralo-Caspian racerunner	4	3,8						
4	<i>Varanus griseus caspius</i> Caspian Monitor	Present according to local people	—						
SU_Herp-3				Hilly sandy foothills, Artemisia association	1 km	17.04.22	C23,5°	C32,9°	39%
1	<i>Testudo horsfieldii</i> Russian tortoise	3	1,62						
2	<i>Trapelus sanguinolentus</i> Steppe agama	2	1,4						
3	<i>Eremias lineolata</i> Striped racerunner	3	3,5						
4	<i>Eremias intermedia</i> Aralo-Caspian racerunner	5	4,6						
SU_Herp-4				Hilly sub-sandy foothills, Artemisia association	1 km	17.04.22	C24,2	C34,1°	37%

No	Species	No. of recorded animals	Population density on the site, inds/ha	Biotope	Transect length	Date and time	Air temperature	Soil temperature	Humidity, %
1	<i>Testudo horsfieldii</i> Russian tortoise	2	1,8						
2	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	2	4,6						
3	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2	1,7						
4	<i>Eremias lineolata</i> Striped racerunner	1	1						
5	<i>Psammophis lineolatus</i> Sand racer	1	1						
SU_Herp-5				Hilly sub-sandy foothills, Artemisia association	1 km	C26,2	C42,7°	34%	C26,2
1	<i>Testudo horsfieldii</i> Russian tortoise	2	1,4						
2	<i>Eremias intermedia</i> Aralo-Caspian racerunner	2	1,7						
	<i>Phrynocephalus interscapularis</i> Lichtenstein's Toadhead Agama	2	3,7						
SU_Herp-6				Hilly sub-sandy foothills, Artemisia association	1 km	18.04.22	C24,4°	C32,2°	32%
1	<i>Testudo horsfieldii</i> Russian tortoise	1	1,4						
2	<i>Trapelus sanguinolentus</i> Steppe agama	2	0,9						

In general, the composition of the herpetofauna of the Nukus site is standard for desert areas.

CONCLUSION

According to the secondary data and the spring field survey data, at the moment, on the territory of Nukus 100 MW Wind Farm, there are 1 amphibian species and 20 reptile species belonging to 7 families (Table 1). The total number of amphibian species comprises 20% of the total diversity of the amphibian fauna of Uzbekistan, reptiles – 32,2%. Among them, 4 species are included in the Red Book of the Republic of Uzbekistan (2019) (20 % of the total number of species inhabiting the project area), 2 species are included in the Red List of the International Union for Conservation of Nature (IUCN Red List) (10% of total number of species inhabiting the project area) and 3 species – in the Appendices to the Convention on International Trade in

Endangered Species of Wild Fauna and Flora (15% of the total number of species inhabiting the project area).

As a result of the processing of literary sources, narrow-range endemic species of reptiles have not been identified for this area. However, it should be noted that a fairly large number of reptile species inhabit the rather limited project area, which is associated with the presence of sandy massifs on it. Most of the species from the list are widespread throughout the republic.

Table 2 List of reptile species inhabiting the project territory

№	Species	Species presence acc. to literary sources	Author's earlier personal data	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
Amphibians								
Family <i>Buonidae</i> (toads)								
1	Turan Toad <i>Bufotes turanensis</i>	+	+	Common	UZ, TJ, TM			
Reptiles								
Family <i>Testudinidae</i> (tortoises)								
1	Russian tortoise <i>Testudo horsfieldii</i>	+	+	Common		2 (VU)	VU	II
Family <i>Gekkonidae</i> (geckoes)								
2	Transcaspian bent-toed gecko <i>Mediodactylus russowi</i>	+	+	Common				
3	Caspian Bent-Toed Gecko <i>Tenuidactylus caspius</i>	+	+	Common				
4	Comb-toed gecko <i>Crossobamon eversmanni</i>	+		Low numerous	UZ, TJ, TM, KZ, IR, AF			
5	Common Wonder Gecko <i>Teratoscincus scincus</i>	+	+	Common	UZ, TJ, TM, KG, IR,CN			
Family <i>Agamidae</i> (agamas)								
6	Steppe agama <i>Trapelus sanguinolentus</i>	+	+	Common				
7	Sunwatcher toad-headed agama <i>Phrynocephalus helioscopus</i>	+	+	Low numerous				
8	Uzbekistan toad-headed agama <i>Phrynocephalus rossikowi</i>	+		Low numerous	UZ, TM	1(EN)	EN	
9	Lichtenstein's Toadhead Agama <i>Phrynocephalus interscapularis</i>	+		Numerous	UZ, TM, KZ, AF, IR			
Family <i>Lacertidae</i> (true lizards)								
10	Rapid Lizard <i>Eremias velox</i>	+	+	Numerous				
11	Striped racerunner <i>Eremias lineolata</i>	+	+	Common				
12	Aralo-Caspian racerunner <i>Eremias intermedia</i>	+	+	Common				
13	Reticulate racerunner <i>Eremias grammica</i>	+	+	Numerous				
14	Sand racerunner	+	+	Common				

№	Species		Species presence acc. to literary sources	Author's earlier personal data	Abundance	Endemism	Conservation status		
							UzRDB	IUCN	CITES
	<i>Eremias scripta</i>								
Family <i>Varanidae</i> (monitor lizards)									
15	Caspian <i>Varanus caspius</i>	Monitor <i>griseus</i>	+	+	Rare		2 (VU:D)		I
Family <i>Boidae</i> (Boas)									
16	Desert sand boa <i>Eryx miliaris</i>		+	+	Rare		3 (NT)		II
Family <i>Colubridae</i> (colubrid snakes)									
17	Sand racer <i>Psammophis lineolatus</i>		+	+	Common				
18	Spotted whip snake <i>Hemorrhois ravergieri</i>		+		Common				
19	Spotted desert racer <i>Platyceps karelinii</i>		+		Low numerous				
20	Diadem snake <i>Spalerosophis diadema</i>		+	+	Low numerous				

Notes: UzRDB – species/subspecies listed in the Red Data Book of Uzbekistan (2019) (2 (VU) – vulnerable; 2 (VU:D) – vulnerable, declining; 3 (NT) – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (EN – endangered; VU – vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; IR – Iran; KZ – Kazakhstan; PK – Pakistan; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

The large number of reptile species potentially present in the project area (1/3 of all species in Uzbekistan) is due to several factors: 1. The large project area; 2. The territory is located on several different biotopes; 3. The main part of the project area is located on sandy massifs and the foothill part of the Sultan-Uvays ridge, which are densely populated with various species of reptiles.

We were unable to find Uzbekistan toad-headed agama during a field trip in April 2022, despite numerous attempts and a seemingly suitable biotope for this species, as well as the availability of literature data on encounters in this region. However, it is also necessary to carry out research in the summer period, since during the spring field visit the weather was not stable and it was possible that the temperatures were quite low for this species.

We also did not find the Caspian Monitor in the project area, however, interviews with local residents (shepherds) showed that this species probably lives in this area.

The project area is quite densely populated with Russian tortoise - this was shown by a spring field study in this area.

RECOMMENDATIONS

The Summer field surveys will provide more data on the reptile species composition of the Project area.

But in any case, safety and environmental protection must be priorities in any activity, for which it is necessary, after assessing potential threats, in this case to biodiversity, to make efforts to carry out activities aimed at minimizing potential damage. It should be noted that construction period is the most dangerous for reptiles. In this regard, we recommend the following actions:

1. Seasonality of work. The construction work must take into consideration the reptiles' activity features. That is, it is advisable that all construction work should be carried out at a time when all reptiles came out of hibernation (winter dormancy). In this period, reptiles do not have permanent burrows and can leave the construction site in advance. If the

works begins in the hibernation period, underground wintering chambers can be damaged and then the reptile is doomed to death.

2. Construction works must be carried out strictly within the territory designated for the purpose.
3. All trenches must be levelled (filled with earth) after the termination of the construction; trenches should not be used as barriers to protect the territory, so that animals should not be captured there.
4. When the construction stage is over, it is necessary to monitor regularly populations of terrestrial animals in the existing research sites within the project territory.
5. The so-called 'closed zones' (protected with a fence) must be organized in the territory of the objects, where no activity should be allowed. This territory should be representative from the point of view of the biotope and the presence of a protected species. It would serve both a buffer zone of the object and, at the same time, a kind of protected area where animals can live undisturbed.
6. Creation/support of a reptile's nursery, with the function of rehabilitation and breeding of rare species, such as Caspian Desert Monitor and Russian tortoise. After the construction work, it is possible to resettle these animals back to the reclaimed areas from the nursery. This nursery could help in preserving rare narrow-area endemic reptile species.
7. It is necessary to conduct large-scale work to study the current state of populations and the boundaries of the areal of the Southern Even-fingered Gecko throughout Uzbekistan
8. The Russian tortoises must be removed from the construction site to nearby areas with similar biotopes. Moreover, after the removal, the construction site must be enclosed in a solid corrugated metal fence to prevent the tortoises' possible returning to the construction site.

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Nukus 100 MW Wind Farm

Environmental & Social Impact Assessment (ESIA): MAMMAL SURVEY



CLIENT: 5 CAPITALS

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INTRODUCTION

During construction of any linear infrastructure there is a direct impact on the environment, all objects of animate and inanimate nature, mammals are affected as well. When planning construction, the condition of populations inhabiting the territory should be assessed, and this primarily includes threatened and endemic species. Further, it is necessary to develop a number of steps to mitigate the impact of construction and subsequent operational activities.

This report contains a literature review designed to prepare a list of mammal species inhabiting the project area, as well as the results of the field study carried out on Nukus 100 MW Wind Farm area as well as planned 220 kV transmission line and along planned 15,6 km access road.

The site was visited from December 17-20, 2021. The main goal of the visits was to install trail cameras and collect data on mammals inhabiting the project area through observations.

GEOGRAPHICAL FEATURES OF THE STUDY AREA

The project area is located in Beruni and Karauzyak districts of the Republic of Karakalpakstan (Figure 1). It belongs to the Lower Amu Darya physico-geographical region, which includes the modern and ancient deltas of the river.

The territory borders the Ustyurt Plateau to the west, the Kyzylkum Desert to the east, the Aral Sea to the north, and Turkmenistan to the southwest.

The area is about 50 thousand sq.km. The relief of the Lower Amu Darya physio-graphical region is a lowland, the surface of which is slightly inclined and widens from southeast to northwest. The area extends from the Tuyamuyun gorge in the southeast to the Aral Sea in the northwest.

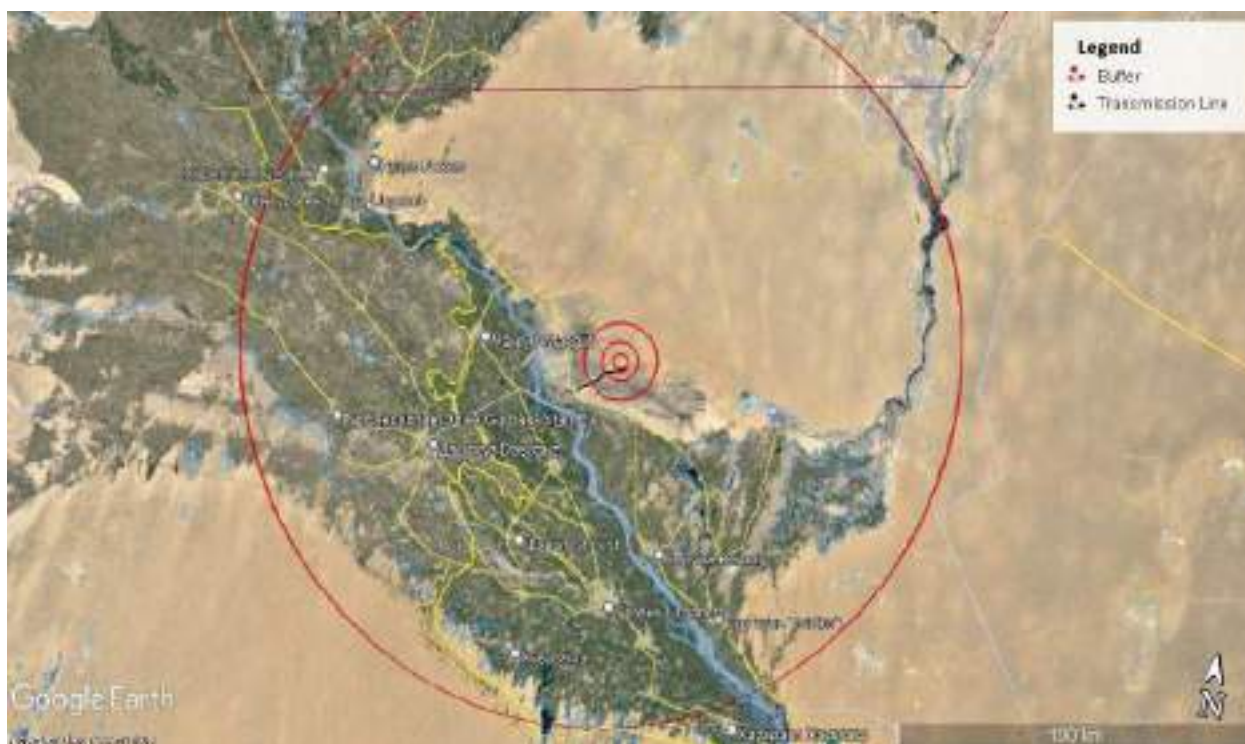


Figure 1. Google Earth satellite image of the location of the Karatau site

The length of the gorge in this direction is 400 km. Within Pitnak elevation (absolute height up to 200 m) Amudarya flows in narrow channel and forms Tuyamuyun gorge.

The delta spreads (width 10-12 km) below the gorge, with an absolute height of relief of 150 m.

From this direction the ancient delta of the Amu Darya starts, its width reaches 75-80 km.

The project area is located on the Sultan-Uvaiz (Sultanuizdag) Ridge and the adjacent section of the Kyzylkum desert (Figure 1, Figure 2). The ridge is located on the right bank of the Amudarya River at the extreme south-west of Kyzylkum, separating the desert from the river valley. It is more than 50 km long and up to 25 km wide. The ridge has an almost latitudinal extension in the east, changing to a northwestern extension in its western part. The maximum height reaches 473 m. The southern and western slopes are steep, while the northern and eastern slopes are more gentler. The massif consists of ridges composed of quartzite, gneiss, marble and granodiorite. Desert landscapes dominate. There is no constant running water. The valleys, cuts through the ridge, are completely waterless and very hot in summer.

The nature of all these mountains in Kyzylkum is rather similar. They are ridge-like, with strongly flattened contours. Their northern slopes descending first gently and then almost steeply and in large ledges. In the opposite direction, the southern slopes are hilly and extremely gently sloping toward the plain. They are ridge-like, with strongly flattened contours. Their northern slopes descending first gently and then almost steeply and in large ledges. In the opposite direction, the southern slopes are hilly and extremely gently sloping toward the plain. The slopes on either side of these mountains are usually flanked by many small savannahs. The stony slopes consist of ancient crystalline and metamorphic rocks. Genetically, the Kyzylkum Mountains are mostly remnants of Paleozoic rocks, eroded and dissected by denudation over a long period of time.



Figure 2. Topographic map of the Karatau area

The project area is remote from major settlements, despite this, the level of impact on the environment is high. On the south side passes the international highway A380, the territory is crossed by numerous used dirt roads. Also, in the south-eastern part of the ridge is a holy place "Sultanbaba Mausoleum" is actively visited by pilgrims, livestock grazing. The most significant factor of concern and impact on the environment is the presence of several operating factories and quarries.



Figure 3. Google Earth satellite image of the Karatau site.

Habitats of mammals in the project area (Figure 3) are represented by the following biotopes: hilly semi-fixed sands (Figure 4, Figure 6), rubbly uplands (Figure 5), ridgy-hilly sands (Figure 7), rocky gorges (Figure 8), loess cliffs and gorges (Figure 9), clay slopes and ravines (Figure 10), takyr (Figure 11).



Figure 4. Hilly semi-fixed sands



Figure 5. Rubbly uplands



Figure 6. Semi-fixed hilly sands



Figure 7. Ridgy-hilly sands



Figure 8. Rocky gorges



Figure 9. Loess cliffs and gorges



Figure 10. Clay slopes and ravines



Figure 11. Takyr¹

Along the Amu Darya, opposite the ridge there is a protected natural area - the Lower Amu Darya Biosphere Reserve, which on September 16, 2021, was included in the World Network of Biosphere Reserves under the UNESCO "Man and the Biosphere" (MAB) program. It is necessary to mention that earlier, the WWF program "Econet" proposed to create a national park "Sultanuwais Ridge" (#16), which is part of the Central Kyzylkum zone, and in 2012 it was also proposed to create a national park in the project area. The UNDP/GEF and the Government of the Republic of Uzbekistan project "Strengthening the sustainability of the national system of protected areas by focusing on nature reserves" has allocated according to botanical criteria (4 endemic species grow in the area (*Allium sultanuizdaghi*, *Scorzonera bungei*, *Lappula parvula*, *Cousinia umbilicata*) and 9 subendemic species (*Jurinea persimilis*, *Cleome quinquenervia*, *Astragalus holargyreus*, *Astragalus remanens*, *Limonium lessingianum*, *Calligonum zakirovii*, *Lappula aktaviensis*, *Salsola chiwensis*, *Astragalus ammodendron*) relic species *Asparagus turkestanicus*. The presence of these species characterizes the flora as relict and unique and was supposed to be a cluster area of the Lower Amu Darya Biosphere Reserve for the conservation of botanical diversity. However, in spite of the recommendations, the area was not included in the protected area list of Uzbekistan and continued to be developed for mining.

LITERATURE REVIEW ON MAMMALS INHABITING THE PROJECT AREA

Below is a list of mammals indicated in literature sources as inhabiting mostly adjacent desert areas near the project site (Table 1). The list contains 32 mammalian species belonging to 5 orders potentially occurring in the project area with references to the information source:

Insectivorous (4 species), Lagomorphs (1), Rodent (14), Carnivorous (10), Ungulates (3).

Bat species are not included in the list.

The statuses of species in the project area are preliminary and need to be clarified through fieldwork in all seasons of the year and analysis of the data obtained from camera traps.

¹ Dried clay areas

Table 1 List and status of mammal species inhabiting the project area²

ID	Species	IUCN Red list	UzRDB (2019)	CITES	CMS	Endemism	Status in the site	Source
1.	Long-eared hedgehog <i>Hemiechinus auritus</i> Gmelin, 1770						C	Ишунин, Павленко, 1966; Захидов, 1971; Stubbe, et al, 2021
2.	Brandt's hedgehog <i>Paraechinus hypomelas</i> (Brandt, 1836)		NT				L	Ишунин, Павленко, 1966; Захидов, 1971; Кашкаров, 2019
3.	Lesser white-toothed shrew <i>Crocidura suaveolens</i> Pallas, 1811						L	Захидов, 1971; Воложенинов 1981; Palomo et al, 2016
4.	Piebald Shrew <i>Diplomesodon pulchellum</i> Lichtenstein, 1823						L	Захидов, 1971; Tsytsulina, K., Formozov, N. & Sheftel, B. 2016
5.	Tolai hare <i>Lepus totai</i> Pallas, 1778						C	Захидов, 1971; Соколов, и др., 1994; Черногаев, 1992
6.	Long-clawed ground squirrel <i>Spermophilopsis leptodactylus</i> (Lichtenstein, 1823)						N	Колесников, 1953; Ишунин, Павленко, 1966; Захидов, 1971; Черногаев, 1992
7.	Yellow ground squirrel <i>Spermophilus fulvus</i> (Lichtenstein, 1823)						C	Ишунин, Павленко, 1966; Захидов, 1971; Черногаев, 1992
8.	Small five-toed Jerboa <i>Allactaga elater</i> Lichtenstein, 1825						C	Ишунин, Павленко, 1966; Захидов, 1971; Шенброд, 1995; Shenbrot et al, 2016
9.	Bobrinski's Jerboa <i>Allactodipus bobrinskii</i> Kolesnikov, 1937					TM, UZ	R	Шенброд, 1995; Gromov, I.M. and Erbaeva, M.A. 1995; Cassola, F. 2016.
10.	Hairy-footed Jerboa <i>Dipus sagitta</i> (Pallas, 1773)						C	Шенброд, 1995; Gromov, I.M. and Erbaeva, M.A. 1995; Batsaikhan et al. 2016
11.	<i>Blanford's Jerboa</i> <i>Jaculus Blanfordi</i> (Murray, 1884)					IR, PK. TM, UZ	R	Ишунин, Павленко, 1966; Шенброд, 1995; Shenbrot, G. & Molur, S. 2016

² **Red Book of Uzbekistan** – species/subspecies listed in the Red Book of the Republic of Uzbekistan (2019) (CR – Critically Endangered ; VU - Vulnerable; NT – Near Threatened); **IUCN** – species included in the Red List of endangered species of the International Union for Conservation of Nature (VU – vulnerable species; NT – Near Threatened); **CITES I, II** – species included in Annex (I, II) of the Convention on International Trade in Endangered Species of Fauna and Flora ; **Endemism**: AF-Afghanistan, KZ – Kazakhstan; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan. Status: U - unknown, C - common; N - numerous; R - rare, L - limited. * See species profile to clarify the status of the species in the territory

ID	Species	IUCN Red list	UzRDB (2019)	CITES	CMS	Endemism	Status in the site	Source
12.	Lichtenstein's Jerboa <i>Eremodipus lichtensteini</i> (Vinogradov, 1927)					KZ, TM, UZ	R	Шенброд, 1995; Gromov, I.M. and Erbaeva, M.A. 1995; Cassola, 2016
13.	Comb-toed Jerboa <i>Paradipus ctenodactylus</i> Vinogradov, 1929					KZ, TM, UZ	L	Шенброд, 1995; Gromov, I.M. and Erbaeva, M.A. 1995; Cassola, F. 2016
14.	Migratory, Grey Hamster <i>Cricetulus migratorius</i> Pallas, 1773						C	Ишунин, Павленко, 1966; Захидов, 1971; Cassola, F. 2016.
15.	Mole Vole <i>Ellobius talpinus</i> Pallas, 1770						C	Ишунин, Павленко, 1966; Rusin, 2016
16.	House Mouse <i>Mus musculus</i> Linnaeus, 1758						N	Ишунин, Павленко, 1966; Захидов, 1971
17.	Libyan Jird (Gerbil) <i>Meriones libycus</i> Lichtenstein, 1823						C	Ишунин, Павленко, 1966; Захидов, 1971
18.	Midday jird <i>Meriones meridianus</i> (Pallas, 1773)						C	Ишунин, Павленко, 1966; Захидов, 1971
19.	Great gerbil <i>Phomomys opimus</i> (Lichtenstein)						C	Ишунин, Павленко, 1966; Захидов, 1971
20.	Corsac Fox <i>Vulpes corsac</i> Linnaeus, 1768		2(VU:D)				R	Захидов, 1946; Ким, 1953; Ишунин, 1961; Павланиязов, 1990
21.	Fox, Red Fox <i>Vulpes vulpes</i> Linnaeus, 1758						C	Ишунин, 1961; Ишунин, Павленко, 1966; Захидов, 1971; Павланиязов, 1974; Черногаев, 1992
22.	Golden or Indian Jackal <i>Canis aureus</i> Linnaeus, 1758						U	There is no literature data about presence of this species on the project area, but it is abundant along the Amu Darya river and therefore can visit the project area occasionally
23.	Wolf <i>Canis lupus</i> Linnaeus, 1758			II			U	Ишунин, 1961; Павланиязов, 1974; Павланиязов, 1990
24.	Weasel <i>Mustela nivalis</i> Linnaeus, 1766						R	Ишунин, 1961; Павланиязов, 1990
25.	Marbled Polecat <i>Vormela peregusna</i> Guldenstaedt, 1770	VU	2(VU:D)				R	Ким, 1953; Захидов, 1971; Павланиязов, 1974; Богданов, 1978; Abramov,

ID	Species	IUCN Red list	UzRDB (2019)	CITES	CMS	Endemism	Status in the site	Source
								A.V., Kranz, A. & Maran, T. 2016; Митропольская, Кашкаров, 2017; Кашкаров, 2019
26.	Steppe Polecat <i>Mustela eversmanii</i> Lesson, 1827		2(VU:D)				R	Ким, 1953; Захидов, 1971; Павланиязов, 1974; Черногаев, 1992; Митропольская, Кашкаров, 2016; Митропольская, Кашкаров, 2017; Митропольская, Кашкаров, 2019
27.	Asiatic wild Cat <i>Felis silvestris ornata</i> Gray, 1832			II			C	Ishunin, 1961, 1987; Ишунин, Павленко, 1966; Павланиязов, 1974; Захидов, 1971; Гептнер, Слудский, 1972; Слудский, 1973; Черногаев, 1992
28.	Sand cat <i>Felis margarita</i> Loche, 1858		NT	II			U	Ишунин, 1961; Гептнер и Слудский, 1972; Слудский, 1973; Павланиязов, 1974; Павланиязов, 1990; Грицына, 2019
29.	Caracal <i>Caracal caracal</i> (Schreber, 1776)		CR	I			R	Слудский, 1973; Гептнер, Слудский 1972; Грицына, 2012; Грицына, 2016; Gritisina, 2018; Грицына, 2019
30.	Bactrian (Bukhara) Red Deer <i>Cervus hanglu bactrianus</i> Lydekker, 1900		1(EN)	II	I/II		C	Мамбетуллаева, и др., 2016; Чикин, Мармазинская, 2019
31.	Severtsov's (Kyzylkum) Argali <i>Ovis ammon</i> (Linnaeus, 1758) <i>ssp. severtzovi</i> Nasonov, 1914*	NT	2(VU:D)	II	II	KZ, UZ	U	Ишунин, 1970; Быкова и др, 2020
32.	Goitered Gazelle <i>Gazella subgutturosa</i> (Güldenstädt, 1780)	VU	VU:D		II		R	Мармазинская, Грицына, 2017; Мармазинская, 2019

Below are species profiles for 9 rare mammal species potentially inhabiting the project area, included in the Red Book of the Republic of Uzbekistan (2019) and with threat status on the IUCN RedList:

1. ***Paraechinus hypomelas* Long-eared hedgehog** is included in the Red Data Book of the Republic of Uzbekistan (2019) as a near threatened, mosaically distributed, naturally low number species. It inhabits areas of plains with dissected relief, depressions and remnants of low mountains, margins of oases. Abundance is 0.4-1.7, in some places up to 2-3 individuals per hectare, on the average in the area not more than 0.1 individuals per hectare. It is reported as an inhabitant of the Sultan Uvayz Range (Ishunin and Pavlenko, 1966; Kashkarov, 2019), however, the number is unknown; up-to-date information is not available. It is highly probable that the hedgehog inhabits the project area, but it is not abundant, field studies during the warm season are required to clarify its status.
2. ***Vulpes corsac* Corsac Fox** is included in the Red Data Book of the Republic of Uzbekistan (2019) as a vulnerable, decreasing, mosaically distributed subspecies. It prefers to settle in clay areas of the desert and in foothills. Previously, the population in Kyzylkum was estimated to be about 20-30 individuals per 100 sq. km. The current number of the population is unknown now, but it is obvious that there is a widespread decreasing tendency. Corsac inhabits the Amu Darya basin. It is widely, but unevenly distributed in Kyzylkum, in its northwestern part, 1.5 to 2 individuals per 1000 km of counting routes were recorded in the 60-80s (Ишунин, 1961; Захидов, 1946; Ким, 1953; Павланиязов, 1990; Chernogaev, 1992; Mitropolskaya, Kashkarov, 2016; Mitropolskaya, Kashkarov, 2017; Mitropolskaya, 2019). Habitation in the project area is possible.
3. ***Vormela peregusna* Marbled Polecat** is included in the Red Data Book of the Republic of Uzbekistan (2019) as a vulnerable, decreasing, widely but sporadically distributed, naturally low number of species. Marbled Polecat is also included in the IUCN Red List with VU the status and considered as decreasing species. There is a general global decreasing trend in terms of both population and distribution areas. It inhabits different types of deserts and semi-deserts. It resides in the burrows of great gerbils, long-clawed and yellow ground squirrels. Approximate numbers throughout the country are estimated at 5,000 individuals. The Polecat is abundant throughout the middle and lower reaches of the Amu Darya. It is widely dispersed in the northern and western Kyzylkum. For example, in the 1960s-80s in the northwestern part of Kyzylkum, 1-3 individuals were caught per 1000 trap-nights (Kim, 1953; Ishunin, 1961; Pavlaniyazov, 1974; Bogdanov, 1978; Pavlanyazov, 1990; Abramov, A.V., Kranz, A. & Maran, T. 2016; Mitropolskaya, Kashkarov, 2017; Kashkarov, 2019).
4. ***Mustela eversmanii* Steppe Polecat** is included in the Red Data Book of the Republic of Uzbekistan (2019) as a vulnerable, decreasing, mosaically distributed species, inhabiting clay deserts, adyrs and foothills, it is rarely noted in sandy deserts. In all habitats this species is associated with settlements of yellow ground squirrel. Naturally, it is not abundant on plains and extremely rare in foothill habitats. Nowadays, more than 60 % of historical range is within agricultural development area, and this species remains only on undeveloped fragments of clay desert and foothills. It is widespread in the northern and western Kyzylkum. Previously (in the 30s-40s), up to 1,500 pelts per year were harvested throughout Karakalpakstan, but then the level of catching declined sharply. In the 60s and 80s, 1-2 individuals per 1000 trap-nights were caught in northwestern Kyzylkum (Ким, 1953; Ишунин, 1961; Павланиязов, 1990; Pavlanyazov, 1990; Chernogaev, 1992;

Mitropolskaya, Kashkarov, 2016; Mitropolskaya, Kashkarov, 2017; Mitropolskaya, Kashkarov, 2019).

5. ***Felis margarita* Sand cat** is included in the Red Data Book of the Republic of Uzbekistan (2019) as a near-threatened, mosaically distributed subspecies, also included in CITES Appendix II. To date, the total number of the Sand cat in the territory of the Republic is unknown, but it is undoubtedly has become a rare cat in need of protection. From 1962 to 1986, in northwest Kyzylkum the abundance of barchan cats per 100 km of survey route varied from 1 to 3.6 individuals.

An increase of numbers - 2-3 individuals per 100 km of survey route was observed in 1962, 1965 and 1968, and a low number (1 individual per 100 km) - in 1963, 1967, 1970, 1972 and 1979. Six cats were captured in the southwestern part of Kyzylkum in Balykbai Mountain, 50 km to the southeast from Takhtakupyr settlement (42.830481°60.818661°). Obviously, in Uzbekistan, the Barkhan cat is common and inhabits all sandy areas, from the northern to the southern borders of the Republic. It should be mentioned that in 1958, 917 pelts were stocked in Uzbekistan (Gritsina et al., Слудский, 1961; Слудский, 1973; Павланиязов, 1974; Mitropolskaya, Kashkarov, 2017; Gritsina, 2019), now sightings of the species across the territory are rare, in the Republic of Karakalpakstan there have been no reliable sightings for the last 20 years. However, this is primarily due to limited surveys, the secrecy of the species and of course, due to the rareness of the barchan cat. To identify the status, there is a need to carry out surveys with photo traps, which may take several years.

6. ***Caracal caracal* Caracal** is included in the Red Data Book of Uzbekistan (2019) as a locally distributed subspecies on the verge of extinction and is listed in Annex I of CITES. The caracal is distributed in the northeastern part of the Kyzylkum desert, in the western part of the delta, and in the lower reaches of the Amu Darya river. There are indications of sightings of the caracal in the territory of the Lower Amu Darya Biosphere Reserve (Geptner and Sludskiy, 1972; Sludskiy, 1973; Pavlaniyazov, 1974; Gritsina et al., 2016; Gritsina, 2019;). The biotope in the project area is suitable for caracal habitat.

7. ***Gazella subgutturosa* Goitered Gazelle** is listed in the Red Data Book of Uzbekistan (2019) as a vulnerable, declining, mosaic widespread subspecies. Included in the IUCN Red List with VU status and in Annex II of CMS. The current population throughout the Republic can be tentatively estimated at 4,000 individuals. The North Kyzylkum gazelle population inhabits the sands south of the Aral Sea in the area of the old channels of the Zhanadarya and Akchadarya, the vicinity of lakes Zholdirbas and Akpetki, the Beltau hills, and the Taskuduk sands. It is conditionally separated from the Central Kyzylkum region in the east and southeast by the border between Navoyi region and Karakalpakstan.

The actual border is the canal and its spills, which stretch from the Turtkul oasis to the Zhanadarya riverbed almost parallel to the border. In the south, the spread is limited by the Turtkul-Beruni-Elikkala oasis.

In the northeast, the North Kyzylkum population is divided by the state border into two parts - the Uzbekistan and Kazakhstan. In the Sultanuvayz Mountains (42°8'9.05 "N 60°26'26.42 "E), a group of gazelles of adult males and a yearling was observed on 11 May 2017 in a wide gorge with gentle slopes (as reported by V. Soldatova, A. Ten); on 12 May 2017 in the same gorge - one individual, whose sex could not be identified (Marmazinskaya, Gritsina, 2017). Gazelle continues to be observed on the Sultan Uvayz Ridge, but its numbers are not high.

8. ***Cervus hanglu Bactrian (Bukhara) Red Deer*** is included in the Red Book of the Republic of Uzbekistan (Мармазинская, Чикин 2009) with status 1 (EN) - endangered, locally distributed subspecies. It is included in Appendix II of CITES as a transboundary migrant and is under Bonn Convention. The Program and Action Plan for conservation and protection of the species was approved at the international level (2002). The reintroduced population of Bukhara deer inhabits the territory of the Lower Amu Darya Biosphere Reserve, according to the last estimate the number is about 2112 individuals (Cornelis et al. 2020). In the spring period, deer cross the road to Nukus and in search of food go to the Sultan-Uvais remnant. Such behavior of deer in the Baday-Tugay area has been observed for a long time it is explained not by the lack of food in tugai, but rather by behavioral characteristics of this species – Bukhara deer always go out to graze in early-spring ephemerals in the surrounding tugai deserts and remaindered uplands. Therefore, the presence of deer in the territory is noted in spring, and along the sai³ on the southern side of the ridge closest to the "Badai-tugai" section of the Lower Amudarya Biosphere Reserve.
9. ***Ovis ammon severtzovi, Ovis ammon (Linnaeus, 1758) ssp. severtzovi Nasonov, 1914 Severtsov's sheep*** – a reducing, mosaically distributed subspecies, endemic of Central Asia. In the past, it inhabited the territory of Kazakhstan; at present, it is preserved in Uzbekistan; there are records on the territory of Tajikistan and Kyrgyzstan. It is included in the IUCN Red List (NT), the Red Book of Uzbekistan with status 2 (VU:D), and Appendix II of CITES. Currently, it is preserved in the Nuratau and Aktau ranges and the Tamdytau Ridge; it is also recorded in the Turkestan Ridge and probably in the Malguzar Ridge (Red Book of the Republic of Uzbekistan, 2019). In the 1960s and 1970s, the Severtsov's sheep inhabited almost all remnant mountains of the Kyzylkum desert (Kulzhuktau, Auminzatau, Tamdytau and Bukantau elevations, including the Aktau mountain range) and the Sultanuizdag mountain range, possibly the elevations of the Beltau plateau and the middle course of the Tuyamuyun river, but it was completely exterminated (Ишунин, 1970). More recently, there was information about the existence of a small group of argali in the spurs of the Sultanuizdag mountain (Karatau mountain, the right bank of the Amu Darya River), which previously belonged to the range of Severtsov ram, but it requires confirmation (Быкова и др, 2020). I provide this species in this report taking into account the available data, however, I consider the presence of the sheep in the area unlikely.

Thus, the area planned for construction may potentially be inhabited by 8 species of mammals included in the Red Book of the Republic of Uzbekistan (2019) – Brandt hedgehog, Corsac fox, Marbled polecat, Steppe polecat, Sand cat, Caracal, Bactrian (Bukhara) Red Deer and Gazelle, as well as one species - Severtsov sheep, considered extinct in the territory more than 30 years ago, began to be noted according to survey data, there are no other facts actually proving its presence, in this regard, I propose to consider extinct for the territory until the evidence base is obtained and not taken into account in further analysis.

The IUCN Red List with the status of threat includes two species - Marbled Polecat and Gazelle. Five species - Wolf, Steppe and Sand cats, Caracal and Bukhara deer (Severtsov deer) - are included in CITES annexes. Two species - gazelle and Bukhara deer are included in CMS.

4 species are Central Asian endemics - Comb-toed, Blanford's, Lichtenstein's, and Bobrinski's Jerboa. (Table 1). The following species are potentially the most typical and most abundant for

³ Sai – a small mountain stream

most of the project area: Brandt hedgehog, Long-clawed ground squirrel, Small five-toed Jerboa, Midday jird, Great gerbil, Red fox, and Wild cat.

MATERIALS AND METHODS

Research methods were divided into two phases: preparatory work before leaving the field was the analysis of detailed topographic maps of the area (scale: 1:100 000, 1:200 000) and satellite images of *Google Earth*. The maps were used to determine locations (GPS coordinates) of potential sites for setting up trail cameras, observations of the area and for walking transects. The data were then transferred to the LocusPro smartphone program for further use in the field.

Field works, the following approaches were used to conduct zoological work:

Car Route Transects (CRT). Observations were made during all movements by car. The length of the vehicle transect was recorded using LocusPro. In case of mammal records, coordinates of the place of registration, time and species of the animal were recorded.

Walking transects (WT), were carried out in pre-planned areas and during the search for places to install camera traps. The length of the route in one biotope was from 500 m to 1800 m. The width of the transects for tracks, spoors, and burrows was 5 m: for medium-sized mammals, 200-500 m, depending on the landscape. The length of the transect was determined using LocusPro. Start and end time of the transect, the biotope, the presence/absence and the type of anthropogenic impact were recorded. During the transect surveys, the data obtained was entered into a field journal. In addition, animals and traces of their life activities were photographed (if possible). Binocular was used to survey the area during the transect walkover and at all points where stops were made (Figure 12).



Figure 12. Locations of walking transects in Winter 2021 and Spring 2022

The most important part of the survey was the **installation of trail cameras**, which we consider one of the most efficient and effective modern tools to monitor wild animals. The trail cameras were installed along the future transmission line, windfarm area and in the surrounding areas. In advance, using google images and topographic maps, areas with different biotopes were selected (sky islands, hillocks, ravines, and rubbly, clayey, fine-medium and coarse hilly, etc. types of deserts). In those areas where the biotope is rather monotonous, trail cameras were installed at a distance of 2-7 km from each other. In the terrain, we looked for places that would better respond to the following demands : possibility of hiding the camera and the use of terrain by animals (the presence of tracks, trails). When installing trail cameras, all vegetation, to which the camera motion sensor can possibly react was carefully weeded out. If the camera was installed in a rocky terrain, it was camouflaged with stones, if it was mounted on bushy vegetation, we watered the strap and covered it with soil. The key camera settings were as follows: capture number 3, trigger interval 1 second, sensitivity (normal or low depending on terrain). Given that the purpose of installing trail cameras was not to perform «*site use*» and «*occupancy*» for target species, but to identify as many species present in the area as possible, we used a bait - canned "sprats", which have a very tart specific smell attracting mammals. For safety reasons, on each camera we put a piece of paper with an alert for the "finder" about the plans to build wind power park Nukus with a capacity of 100 MW, as well as conducted research work and contact phone numbers.

In total, 190,9 km were covered by vehicle routes, 8 trail cameras were installed, the length of the walking transect survey was 20,9 km. Annex 1 and 2 provide detailed information about the locations and camera installation.

Equipment

A smartphone (BV9900E) with the LocusPro program, Google Hybrid and Marshruty.ru map underlays were used for terrain orientation and track recording. Nikon Aculon 10x42 binocular was used for terrain observation. Photography was done using a smartphone (BV9900E) and a Nikon D7200 SLR camera with a Nikkor 500 mm lens. 8 Bushnell (model 119930B/119930CWM) cameras were equipped with 32 GB SanDisk Ultra micro SD HC 1 memory cards and Duracell Belgium (alkaline) batteries.

All the information obtained was recorded in a notebook, and the locations of mammal surveys and trail cameras were mapped in the LocusPro smartphone application.

RESULTS

During the field trip, areas most suitable for mammal habitat - ravines, shallow gorges, depressions in the terrain were surveyed. As a result, presence of 8 species was confirmed, 3 of which are included in the Red Data Book of Uzbekistan (2019) – Corsac fox, Caracal and Goitered gazelle. The IUCN Red List with the status of threat includes one species, the Goitered gazelle, which is also included in the CMS list. Two species - Wild cat and Caracal are included in CITES annexes. All the data obtained is based on indirect evidence - presence of animals was determined by traces of their life activities (excrement, feces, tracks, burrows). There were no animals observed visually.

The number of recorded species (eight) is rather preliminary. The list of species will be significantly expanded for several reasons:

a) The survey was conducted in winter (December), and a number of common mammal species were not found in hibernation, for example, Long-eared and Brandt's hedgehog, all species of jerboas, rarer - Migratory, Grey Hamster, Piebald Shrew, etc.

Given the presence of a large number of burrows of various sizes, the territory is rich enough with rodents, and for determination of the species, night surveys in the hot period of the year should be carried out.

b) We have not found a number of species indicated by previous researchers because of the short timeline for surveys, as well as due to the secretive nature of species, especially rare ones. The results of the use of photo traps will make the survey more complete.

It should be noted that there is no need to confirm the visits of Bukhara deer to the remnant in the spring period, as this phenomenon is regularly noted by the staff of the Lower Amudarya Biosphere Reserve. However, it is not clear how often do reindeer come out from tugai massifs, the frequency of their visits and the number of individuals are also not precise, which is of high interest.

Table 2. Routes and registered mammal species

No. of WT	N	E	Route length in m	Species type	Traces of life activity
WT_1	The surrounding area of the Dushebulak well is a sandy desert, slowly passing into clay foothills, covered with black saxaul bushes. Geological pits pass through the area, garbage (bottles, rags) is lying around, livestock, including free-living horses are grazing. At the time of the visit, there was a strong wind.				
	42.177499	60.448094	1800	Gerbil sp (<i>Meriones</i> sp)	16 burrows
				Jerboa sp	8 burrows
				Yellow ground squirrel (<i>Spermophilus fulvus</i>)	8 burrows
				Goitered Gazelle (<i>Gazella subgutturosa</i>)	1 chain of traces of one individual
WT_2	The vicinity of the well Dushebulak. The route along the sai, which at the beginning is a typical sandy area covered with saxaul, gradually sai narrows, branches off and becomes stony. Livestock grazing was observed.				
	42.170059	60.465037	900	Great gerbil (<i>Phombomys opimus</i>)	2 colonies
				Gerbil sp (<i>Meriones</i> sp)	3 burrows
				Red Fox (<i>Vulpes vulpes</i>)	trace (1 chain); excrement (2); scrapings (4); burrow (1)
				Asiatic wild Cat (<i>Felis silvestris ornate</i>)	burrow
WT_3	Surroundings of Ashykudyk well. The start of the route along a high barkhan covered with acacia and ferrula. The sandy area passes gently into the stony foothills with sandy covering and rocky outcrops. Livestock grazing and a motorcycle with firewood are observed. Very strong wind.				
	42.151323	60.468803	1400	Red Fox (<i>Vulpes vulpes</i>)	1 habitable burrow
WT_4	The route along a rocky sai with a sub-sandy bottom. Of the vegetation, mainly several species of <i>Artemisia</i> . Livestock grazing. Fresh tracks of large dog were noted. Very strong wind.				
	42.145154	60.454877	1000	Gerbil sp (<i>Meriones</i> sp)	4 single burrows
				Great gerbil (<i>Phombomys opimus</i>)	2 colonies
				Red Fox (<i>Vulpes vulpes</i>)	Excrement in the shells of 9 turtles
WT_5	The route southwest of the well Ashykuduk along the stone and clay sai, located between the ridges. The main vegetation is <i>Artemisia</i> . Livestock grazing.				
	42.143849	60.467453	800	Yellow ground squirrel (<i>Spermophilus fulvus</i>)	2 burrows
				Gerbil sp (<i>Meriones</i> sp)	14 single burrows

				Red Fox (<i>Vulpes vulpes</i>)	Scrapes (2); Excrement (1)			
WT_6	Northeast of the Aigykuduk well. Sandy area with artemisia and ferrula association, rare bushes of acacia. Livestock grazing. Very strong wind, no traces on the surface.							
	42.140580	60.485729	900	Gerbil sp (<i>Meriones</i> sp) Jerboa sp	5 single burrows 3 single burrows			
WT_7	The route along a shallow ravine covered with wormwood with clay sides up to 1 meter high. Around it is a sandy desert, overgrown with Artemisia association. Livestock grazing is carried out.							
	42.127368	60.495739	1200	Jerboa sp	5			
				Gerbil sp (<i>Meriones</i> sp)	12			
				Red Fox (<i>Vulpes vulpes</i>)	scrapes			
Asiatic wild Cat (<i>Felis silvestris ornate</i>)				burrow				
WT_8	A sandy area overgrown with Artemisia, Halimodendron, Ferula, and occasional acacia bushes. Livestock grazing is carried out.							
	42.115325	60.520629	1000	Gerbil sp (<i>Meriones</i> sp) Goitered Gazelle (<i>Gazella subgutturosa</i>)	Single burrows 6 2 chains of two individuals			
WT_9	A sandy area overgrown with Artemisia, Halimodendron, Ferula, and occasional acacia bushes. Livestock grazing is carried out.							
	42.114288	60.530281	800	Red Fox (<i>Vulpes vulpes</i>) Goitered Gazelle (<i>Gazella subgutturosa</i>)	trace single track			
Sub-sandy desert, passing into medium-hilly sands, covered with sparse saxaul bushes. Livestock grazing is carried out.								
WT_10	42.122308	60.545638	800	Gerbil sp (<i>Meriones</i> sp) Tolai hare (<i>Lepus totai</i> Pallas, 1778) Red Fox (<i>Vulpes vulpes</i>)	Single burrows 7 trace of one individual 2 chains of traces			
				A takyr depression, in which water accumulates seasonally (during precipitation periods). It is a temporary water hole for animals. There is a sandy desert around it, covered with Artemisia, Saxaul, Ferula. Livestock grazing is carried out.				
				42.099567	60.538930	800	Red Fox (<i>Vulpes vulpes</i>)	scrapes
WT_12	Takyr surrounded by sandy desert covered with Artemisia and sparse saxaul bushes. Livestock grazing is carried out.							
	42.087240	60.538292	800	Yellow ground squirrel (<i>Spermophilus fulvus</i>) Red Fox (<i>Vulpes vulpes</i>)	3 burrows scrapes			

WT_13	Rock massif. The route passed through a mixed-type way - clay areas interspersed with rocky areas. There is no cattle grazing in winter, probably in spring, early summer and during the autumn vegetation period. There was a strong fog at the time of the visit.				
	42.064582	60.603638	800	Great gerbil (<i>Phomomys opimus</i>)	2 large inhabited colonies
				Red Fox (<i>Vulpes vulpes</i>)	Excrement (2)
WT_14	Say with clay sides, in some places up to 2.5 meters high and rock outcrops. The bottom of the sai is sandy, covered by Artemisia bushes, rare saxaul bushes and acacia. Livestock grazing is carried out.				
	42.100580	60.595584	1000	Great gerbil (<i>Phomomys opimus</i>)	2 inhabited colonies
				Yellow ground squirrel (<i>Spermophilus fulvus</i>)	2 burrows
				Red Fox (<i>Vulpes vulpes</i>)	Excrement (1)
WT_15	Shallow sand, Artemisia, ferrula. Livestock grazing is carried out.				
	42.111115	60.579195	800	Jerboa sp	burrows (4)
				Corsac Fox (<i>Vulpes corsac</i> Linnaeus, 1768)	Excrement (1)
WT_16	Shallow sand, Artemisia, ferrula. Livestock grazing is carried out.				
	42.098509	60.564888	800	Gerbil sp (<i>Meriones</i> sp)	burrows (8)
				Jerboa sp	burrows (7)
				Red Fox (<i>Vulpes vulpes</i>)	Excrement (1)
WT_17	Shallow sand, Artemisia, ferrula. Livestock grazing is carried out.				
	42.088063	60.557788	800	Gerbil sp (<i>Meriones</i> sp)	burrows (15)
				Jerboa sp	burrows (5)
WT_18	Sub-sandy stony desert. It should be noted that there are numerous settlements of rodents here, in comparison with other surveyed sites. Livestock grazing is carried out, including traces of a medium-sized dog.				
	42.091165	60.576759	1200	Yellow ground squirrel (<i>Spermophilus fulvus</i>)	3 burrows
				Great gerbil (<i>Phomomys opimus</i>)	9 colonies

				Gerbil sp (<i>Meriones</i> sp)	11 burrows
				Jerboa sp	17 burrows
				Red Fox (<i>Vulpes vulpes</i>)	Excrement (2)
WT_19	Clay-sandy sai, with rock outcrops on the sides, there are branches in different directions. The bottom of the sai is mostly sandy. There is a road leading to the highway along the main channel. Livestock grazing is carried out.				
	42.065440	60.502454	1000	Great gerbil (<i>Phombomys opimus</i>)	2 colonies
				Red Fox (<i>Vulpes vulpes</i>)	Excrement (6) Traces (3) Burrow (1)
				Goitered Gazelle (<i>Gazella subgutturosa</i>)	Fresh tracks of two individuals and fresh excrement in two places.
WT_20	Middle hilly sandy desert, covered with saxaul and acacia bushes. Livestock grazing is carried out.				
	42.133993	60.540781	500	Red Fox (<i>Vulpes vulpes</i>)	Traces
WT_21	Rocky site, with large areas of completely rocky bottom, in some places sub-sand and sub-clay.				
	42.099000	60.472000	800	Red Fox (<i>Vulpes vulpes</i>)	burrows
				Caracal Caracal/ caracal (Schreber, 1776)	A small hole with fresh tracks of one individual
WT_22	A shallow rocky sai with a sandy bottom, covered with saxaul				
	42.131814	60.435069	500	Great gerbil (<i>Phombomys opimus</i>)	2 colonies
				Red Fox (<i>Vulpes vulpes</i>)	Excrement (2) Scrapes (1)
WT_23	Sub-sandy desert overgrown with wormwood and geological excavations				
	42.064419	60.527155	500	Red Fox (<i>Vulpes vulpes</i>)	Excrement (1)

Walking transects, April-May 2022					
WT_1	Sub-sandy desert with Artemisia association. Livestock grazing is carried out.				
	42.11061	060.52997	700 m	Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	1
				Midday Gerbil (<i>Meriones meridianus</i>)	1
				Red Fox (<i>Vulpes vulpes</i>)	scrapes
WT_2	Sub-sandy desert with Artemisia association. Livestock grazing is carried out.				
	42.09116	060.58357	3000 m	Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	12 burrows
				Great Gerbil (<i>Rhombomys opimus</i>)	3 colonies
				Jerboa sp	12 burrows
				Midday Gerbil (<i>Meriones meridianus</i>)	9 burrows
				Tolai Hare (<i>Lepus tolai</i>)	Traces (1)
				Red Fox (<i>Vulpes vulpes</i>)	Scrapes
				Goltered Gazelle (<i>Gazella subgutturosa</i>)	Traces (1)
WT_3	Shallow sand, Artemisia, Ferrula. The ands are overgrazed. Shepherds' houses on both sides				
	42,10089	60,57797	1500 m	Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	3 burrows
				Jerboa sp	10 burrows
				Tolai Hare (<i>Lepus tolai</i>)	Traces (1)
WT_4	Sub-sandy desert with Artemisia association. Livestock grazing is carried out.				
	42,10511	60,59171	1000 m	Long-eared Hedgehog (<i>Hemiechinus auritus</i>)	Traces (1)
				Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	2 + 4 burrows
				Jerboa sp	7 burrows
				Red Fox (<i>Vulpes vulpes</i>)	Scrapes

WT_5	Middle hilly sandy desert, covered with Saxaul and Acacia bushes. Livestock grazing is carried out.				
	42,10753	60,55930	800 m	Long-eared Hedgehog (<i>Hemiechinus auritus</i>)	Traces (1)
				Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	2
				Tolai Hare (<i>Lepus tolai</i>)	Traces (1)
WT_6	Sandy desert with <i>Ferula</i> and <i>Artemisia</i> association. Livestock grazing is carried out.				
	42,09687	60,52855	1000 m	Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	3
				Jerboa sp	4 burrows
				Tolai Hare (<i>Lepus tolai</i>)	Traces (1)
WT_7	Sub-sandy desert with <i>Artemisia</i> association and with Saxaul. Livestock grazing is carried out.				
	42.11803	60.51327	1000 m	Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	2
				Jerboa sp	12 burrows
				Red Fox (<i>Vulpes vulpes</i>)	Traces (2)
WT_8 (power line)	From beginning	Till the end	12 000 m	Great gerbil (<i>Phomomys opimus</i>)	1 colonie
				Zaisan Mole Vole (<i>Ellobius tancrei</i>)	5 colonies
				Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	6
				Jerboa sp	6 burrows
				Red Fox (<i>Vulpes vulpes</i>)	Traces (2)
				Goitered Gazelle (<i>Gazella subgutturosa</i>)	excrements in 3 places.
WT_9	A shallow sai with a sandy bottom, covered with Saxaul and part of sandy desert. Livestock grazing is carried out.				
	42.13178	60.49335	800 m	Long-eared Hedgehog (<i>Hemiechinus auritus</i>)	Traces (1)
				Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	7 burrows and 3 YGS
				Zaisan Mole Vole (<i>Ellobius tancrei</i>)	1 colonie

				Tolai Hare (<i>Lepus tolai</i>)	Traces (5)
				Asiatic wild Cat (<i>Felis silvestris ornate</i>)	Traces (1)
WT_10	Sub-sandy desert with <i>Artemisia</i> association and with <i>Saxaul</i> . Livestock grazing is carried out.				
	42.13879	60.48133	900 m	Yellow Ground Squirrel (<i>Spermophilus fulvus</i>)	10 burrows and 5 YGS
				Red Fox (<i>Vulpes vulpes</i>)	Traces (2)
WT_11	Sandy desert with with <i>Saxaul</i> . Livestock grazing is carried out.				
	42.11641	60.54834	1200	Tolai Hare (<i>Lepus tolai</i>)	Traces (2)
				Red Fox (<i>Vulpes vulpes</i>)	Traces (2)
				Asiatic wild Cat (<i>Felis silvestris ornate</i>)	Traces (1)
				Goitered Gazelle (<i>Gazella subgutturosa</i>)	excrements in 1 place
Night transects					
2 nights	access road and WF area	overall 45 km	Long-eared Hedgehog (<i>Hemiechinus auritus</i>)	2	
			Tolai Hare (<i>Lepus tolai</i>)	2	
			Hairy-footed Jerboa (<i>Dipus sagitta</i>)	3	
			Small Five-toed Jerboa (<i>Allactaga elater</i>)	5	
			<i>Eremodipus lichtensteini</i>	3	
			Midday Gerbil (<i>Meriones meridianus</i>)	2	
			Red Fox (<i>Vulpes vulpes</i>)	1	
Oral data					
3 shepherds from different «camps»	42.10509	60.59171	There were goitered gazelles, but a very small number. Wolves hunt and attack livestock every few years, in 2020, 40 sheep were killed. This winter there were no wolf attacks. There were hares, foxes, wild cats and another species of cat - fluffy, merging in color with sand (perhaps they saw a Sand cat)		
2 shepherds	42.09999	60.53966	Few of goitered gazelles, a lot of foxes, tolai Hare		

More details on each species observed during the field trip are given below:

1. *Hemiechinus auritus* Long-eared Hedgehog (Fig.13) is a common and widespread species in the territory of Uzbekistan, especially in the Kyzylkum desert. Traces were recorded on three walking transects in Spring time (Tabl.2, Fig.14) The density of traces was 0,12 /1 km and during night counts, the density was 0,02 indiv/1km.



Figure 13. Long-eared Hedgehog



Figure 14. Long-eared Hedgehog registration places

2. ***Lepus tolai* Tolai Hare** is a common and widespread species in the territory of Uzbekistan. However, it is not abundant in the project area. It was recorded on seven walking transects, (Tabl.2, Figure 17) where the density of traces was 0,25 /1 km. During night counts, the density was 0,47 indiv/1km. It is obvious that in the project area the hare prefers to settle in places with shrub vegetation, in hilly sands with bushes of saxaul, acacia, and sticks to inter-hillocks (6).



Figure 15. Tracks of a tolai hare in the sand



Figure 16. Habitats of the hare in the project area

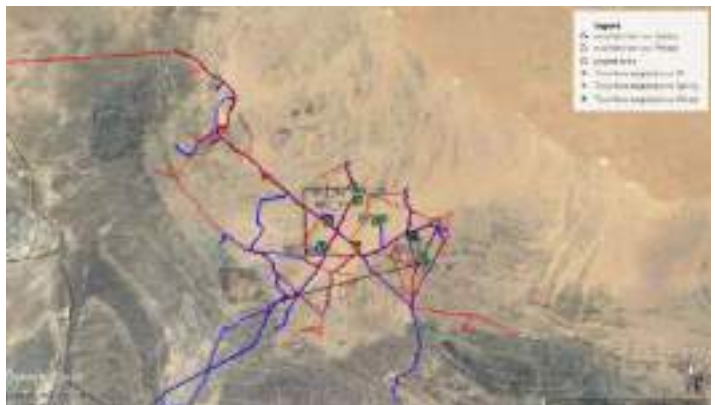


Figure 17. Tolai hare registration places

3. ***Spermophilus fulvus* Yellow ground squirrel** is a common species, numerous in suitable habitats, lives in sparse colonies. It hibernates during the winter. Yellow squirrel is characterized by two types of burrows - nesting (wintering) burrows with a characteristic vertical entrance (Figure 18), and temporary burrows with a slanted entrance hole (Figure 19). In the project area, there were settlements in 16 locations (Tabl.,2, Figure 20) the density of animals in the spring time was 1,004 indiv/1km. All the settlements were confined to clay, sub-clay and sub-sandy areas of the project area.



Figure 18. Yellow ground squirrel 's wintering burrow



Figure 19. Temporary Yellow ground squirrel burrow

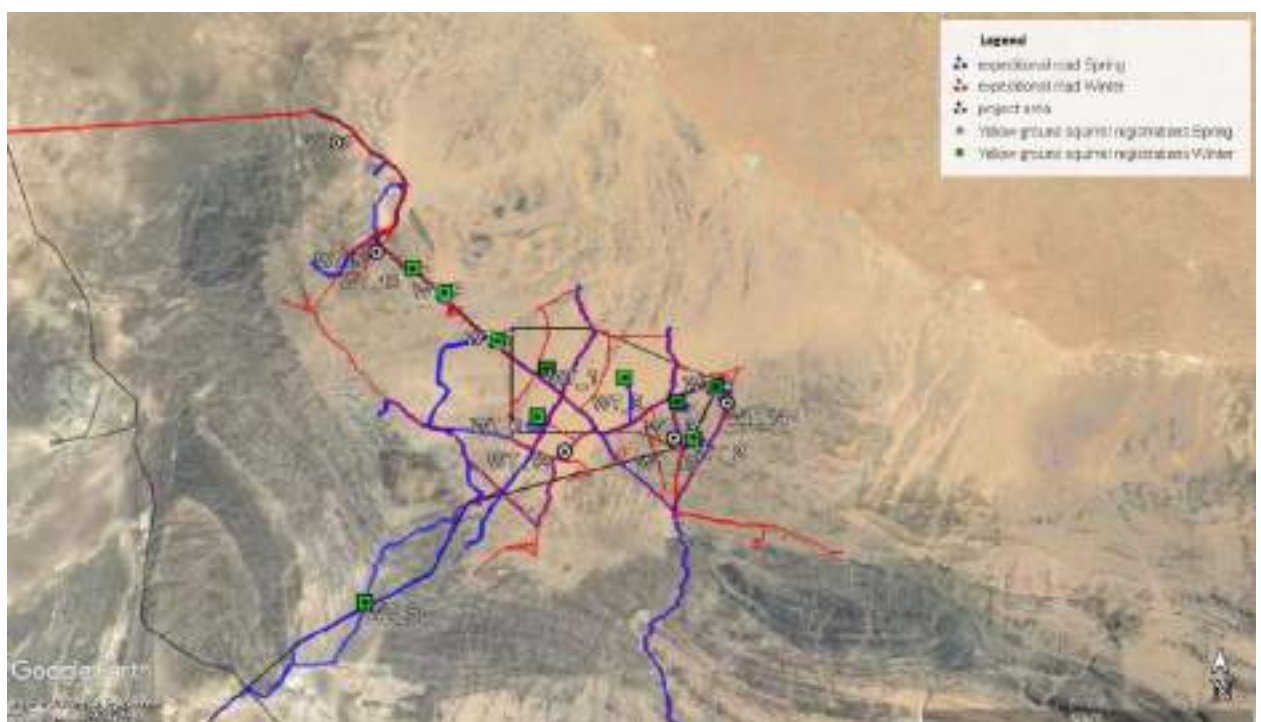


Figure 20. Yellow ground squirrel registration places



Figure 21. Yellow Ground Squirrel (Adults)



Figure 22. Yellow Ground Squirrel (Juveniles)

Small five-toed Jerboa *Allactaga elater* (Figure 23) a common species of the deserts of Uzbekistan. Inhabits flat areas of clay and rubble deserts. It prefers areas with a very poor

vegetation cover or lives on the edges of takyrs, solonchaks. The species be found in fixed sands, but avoids solid sand masses. In the project area during night counts, the density was 0,04 indiv/1 km.



Figure 23. Small five-toed Jerboa



Figure 24. Small five-toed Jerboa registration places

4. **Hairy-footed Jerboa *Dipus sagitta*** (Fig.25) It lives among various types of sands, from sand dunes to hilly sands. It may be found in takyrs while feeding. Secretive, but rather ordinary species of Kyzylkum. In the project area during night counts, the density was 0,06 indiv/1 km



Figure 25. Hairy-footed Jerboa



Figure 26 Hairy-footed Jerboa registration places

5. Lichtenstein's Jerboa *Eremodipus lichtensteini* (Figure 27) endemic in Kazakhstan, Turkmenistan and Uzbekistan. Lives in various types of sandy desert. In the project area during night counts, the density was 0,06 indiv/1 km.



Figure 27. Lichtenstein's Jerboa (photo by Roman Nazarov)

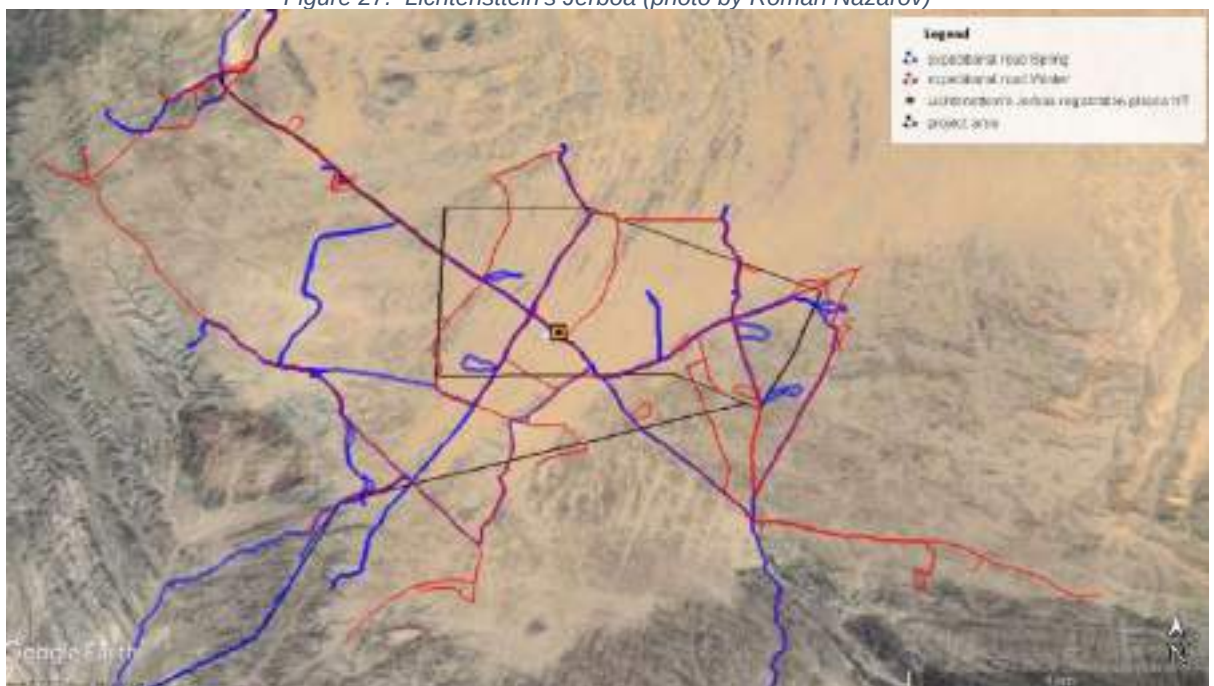


Figure 28. Lichtenstein's Jerboa registration places

6. Zaisan Mole Vole *Ellobius tancrei* a common inhabitant in suitable biotopes. It leads an underground lifestyle, they come out to the surface very rarely, at night. In the project area on 44 km walking transects (0,2 colony/100 ha)



Figure 29. Zaisan Mole Vole colony

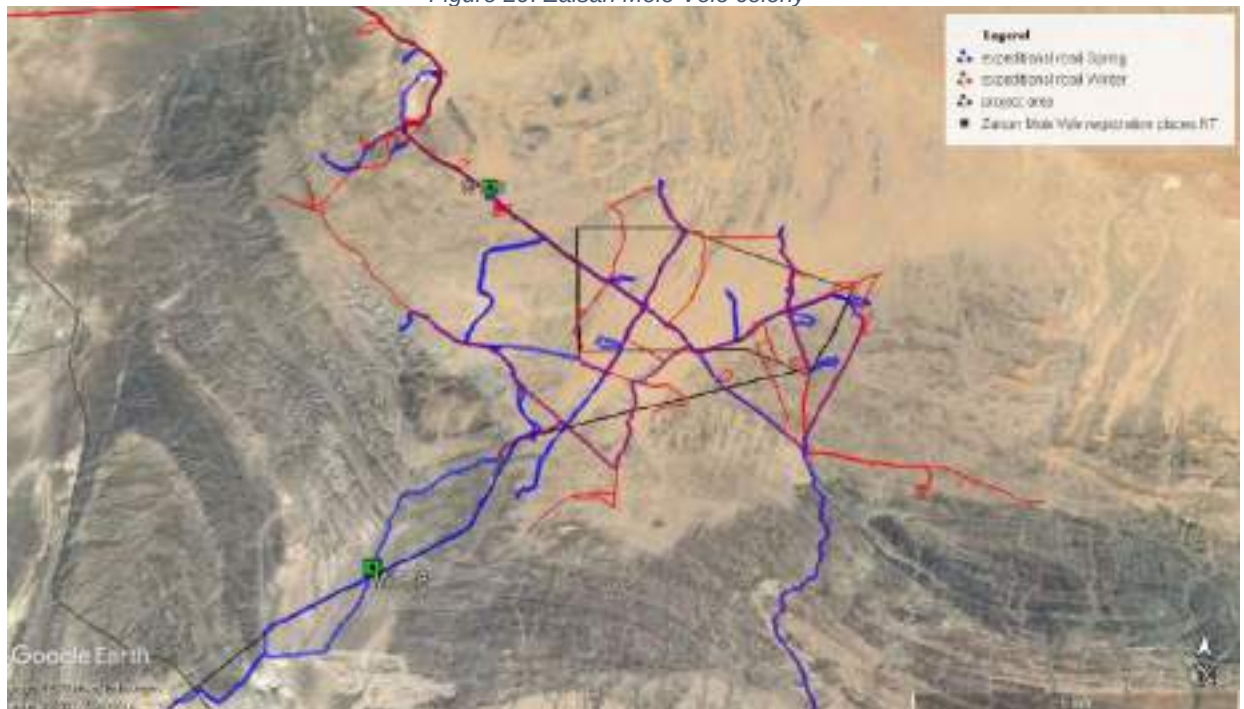


Figure 30 Zaisan Mole Vole registration places

7. **Midday Gerbil *Meriones meridianus*** (Figure 31) typical inhabitant of different types of sands, especially those overgrown with shrubs. In the project area during night counts, the density was 0,04 indiv/1 km (Table.2, Figure 32).



Figure 31 Midday Gerbil



Figure 32 Midday Gerbil registration places

8. **Great Gerbil *Phomomys opimus*** the species is numerous and widespread during periods of population growth, but during natural depressions, sporadic animals and colonies remain. It inhabits areas with sandy, clay and rubbly soils. The species does not occur on takyr, solonchaks⁴ and loose sands without vegetation. Colonies consist of multiple outcrops that are well distinguished on the soil surface and are easily distinguishable from burrows of other rodent

⁴ solonchak – a saline marsh

species (Figure 33, Figure 34). In recent years, depression of the great gerbil has been observed throughout Uzbekistan. In general, the situation of the great gerbil in the project area is quite favorable - 25 inhabited colonies on 44 km walking transects (1,1 colony/100 ha) (Figure 35), which is a good accompanying factor for the life activity of predatory mammals and birds.



Figure 33. Colonies of Great Gerbil



Figure 34. Colonies of Great Gerbil

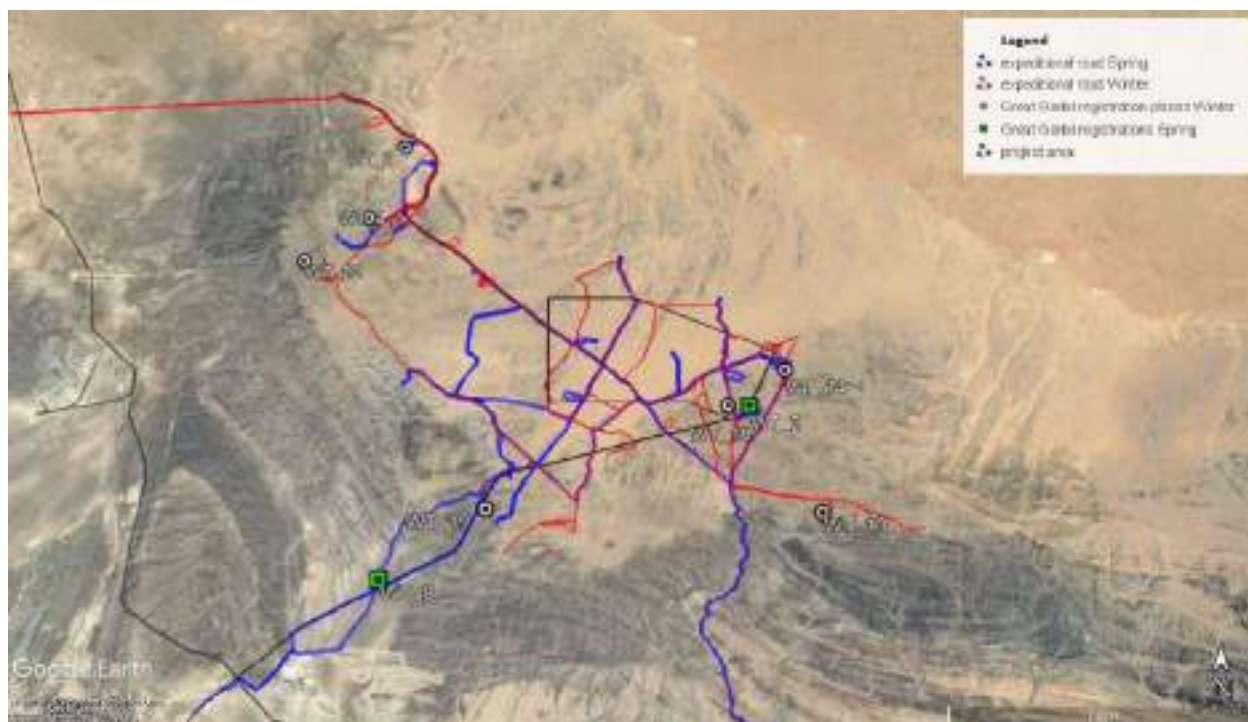


Figure 35. Registration places of Great Gerbil

9. **Corsac Fox *Vulpes corsac*.** Excrements of this rare fox were found in the area closest to the main sandy massifs on the shallow hilly sands overgrown with *Artemisia* (WT_15-Winter) (Table 2., Figure 36). The density of traces was 0,021 per 1 km. The small number of Corsacs is completely compensated by the abundance of Karagan fox, who is a serious food competitor and a species superior over Corsac, including in terms of size.



Figure 36. Corsac excrement



Figure 37. The place of registration of the corsac in the project area

10. Red Fox *Vulpes vulpes* – a common and locally abundant species, widespread throughout the project area. Evidence of its presence were burrows (Figure 39), scrapes, excrements, as well as tracks (Figure 38) that were found at most of the surveyed sites – in 26 WT out of 34 { (Tabl 2). The density of traces was 0,25 per 1 km. During night counts, the density was 1,028 indiv/1km. The species inhabits all habitat types available within the project area.



Figure 38. Traces of a fox on the sand



Figure 39. Burrows and scrapes of the fox



Figure 40. Fox excrement in a tortoise shell

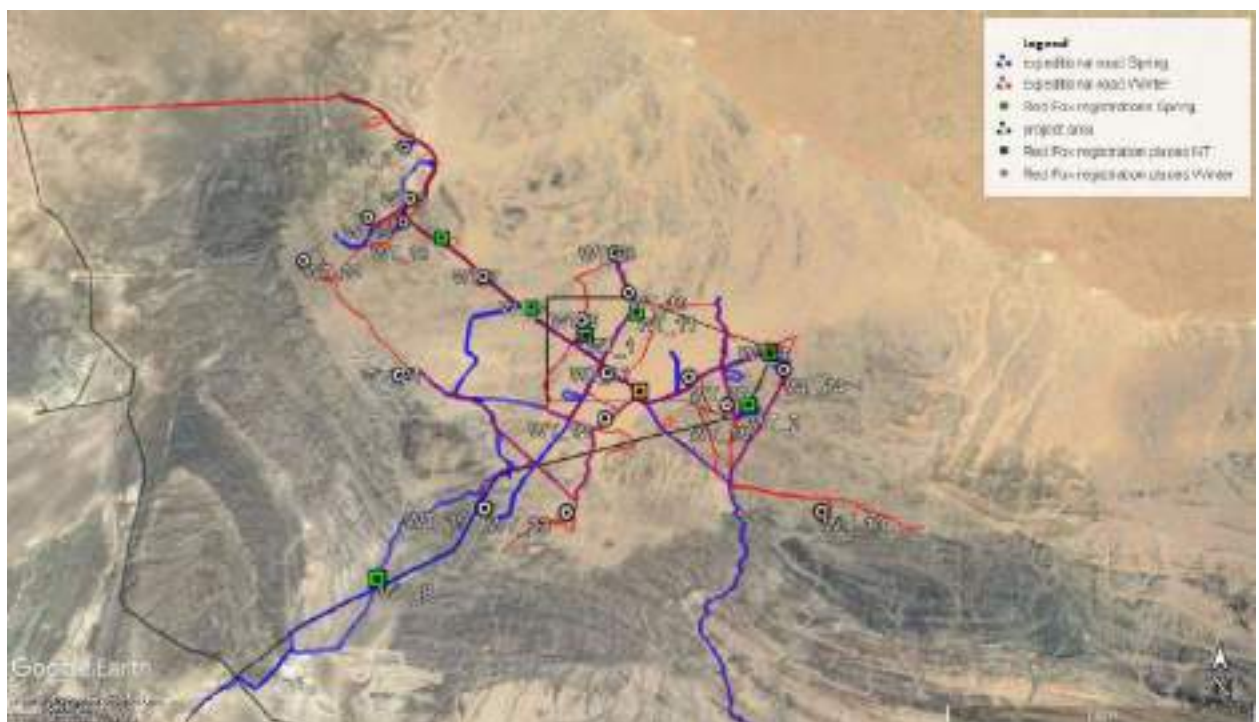


Figure 41. Distribution of Karagan fox in the project area.

11. Asiatic wild Cat (*Felis silvestris ornate*) is a common species in Uzbekistan, well adapted to disturbance and close proximity to humans. A common species in the project area, two burrows (Figure 42, Figure 43) were found during the survey (WT_2 and 7 in Winter and traces – WT_9 and WT_11 in Spring (tabl.2). The density of traces was 0,022 per 1 km



Figure 42. Wild cat burrow



Figure 43.. Wild cat burrow



Figure 44. The place of registration of the wild cat

12. Caracal *Caracal caracal* – is a rare species and finding traces of life activity is of considerable scientific interest. Fresh tracks were found in a small depression on route WT_21 (Figure 45, Figure 46) under a rock with a sand drift from the sai. The traces detected were round, which is typical for felines, 8x8 cm in size (smaller in reality, the traces were visually enlarged due to loose soil) (Figure 47), and there were no footprints of claws that could have been left on loose soil (except for cheetahs, claws of felines do not leave footprints on soil). These arguments suggest that these traces are more likely to belong to the caracal.



Figure 45. A hollow beneath a rock with caracal traces

Probably, this place is also used by the caracal as a lying place. It is typical for caracals to dig a small hole in which they rest.

A camera trap was installed near the place of discovery, but it was not possible to point the camera directly on the place where the traces were found. Due to the lack of fixing places, the camera was installed on the rock above the traces, which should make it possible to take pictures of cat in case it visits this place regularly.



Figure 46. Caracal traces



Figure 47. Caracal traces



Figure 48 Registration places of the Caracal

13. **Goitered Gazelle** *Gazella subgutturosa* is a rare species for the whole country. Vulnerable small population inhabits the project area and needs constant protection and monitoring. Excrement (Figure 51) and traces (Figure 49, Figure 50) were found at 4 sites, WT_1,8,9 and 19 (Winter) and at 3 sites, WT_2,8,11 (Spring) (Tabl. 3). The density of traces was 0,21 per 1 km. The estimated number is about 10-35 individuals depending on the season. The maximum number was noted in winter, during the presence of shepherds and livestock – the number decreases, goitered gazelles migrate deep into the desert. This was confirmed by field data and shepherd interviews.



Figure 49. Gazelle traces



Figure 50. Chain of gazelle traces



Figure 51. Fresh Goitered Gazelle feces

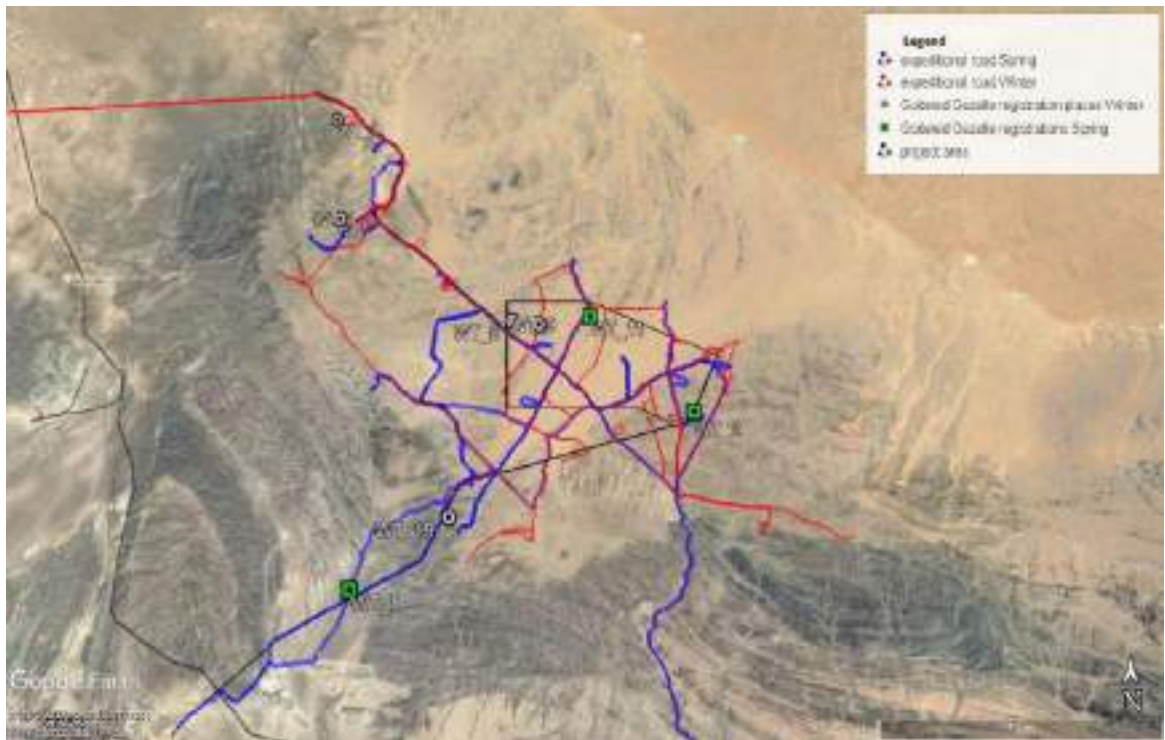


Figure 52 Registration places of the Goitered Gazelle

Results of camera trap installation.

During the survey, 8 camera traps were installed in December 2021, in different biotopes, allowing coverage of a diverse complex of mammals. The memory cards were checked in February 2022, next in May, and 2 additional cameras were installed and 2 relocated. In total cameras been worked in 12 different locations in the project area. Annexes 1 and 2 provide detailed information about the locations and methods of camera installation. Camera traps been collected in the end of June 2022.



Figure 53 Location of trail cameras in the project area

Not all camera traps worked from the time of installation in December until removal in June. One camera (Annex 3) was taken by a shepherd, which he returned, However, it did not work for some time.

In total from 10 camera traps from 12 locations provided data on the presence of 8 species of mammals, 2 species of reptiles, 3 species of birds (there are more species of birds, but the most numerous and endemic were indicated) also livestock, shepherds dogs, humans in the area (tabl.3)..

Table 3. Camera traps locations and species list

Camera number	Species
JEP01	Gazella subgutturosa, Sperophilus fulvus, Vulpes vulpes, Livestock, Canis familiaris
JEP02	Agrionemys horsfieldii, Trapelus sanguinolentus, Dipodidae sp., Hemiechinus auritus, Lepus tolai, Meriones meridianus, Sperophilus fulvus, Vulpes vulpes, Canis familiaris, Birds, Livestock and People
JEP03	Dipodidae sp, Livestock
JEP04	Podoces panderi, Steppe Grey Shrike, Hemiechinus auritus, Lepus tolai, Sperophilus fulvus, Vulpes vulpes, Livestock and People
JEP05	Vulpes vulpes, Canis familiaris, Livestock
JEP06	Vulpes vulpes, Livestock and People
JEP07	Athene noctua, Birds, Sperophilus fulvus, Felis silvestris ornata, Vulpes vulpes, Canis familiaris, Livestock
JEP08	Alectoris chukar, Birds, Felis silvestris ornata, Vulpes vulpes, Sperophilus fulvus
JEP09	Alectoris chukar, Birds, Vulpes vulpes
JEP10	Testudo horsfieldii, Alectoris chukar, Lepus tolai, Vulpes vulpes, Canis familiaris, Livestock
JEP11	Alectoris chukar, Birds, Sperophilus fulvus, Vulpes vulpes, Felis silvestris ornate, Canis familiaris
JEP12	Testudo horsfieldii, Trapelus sanguinolentus, Birds, Lepus tolai, Vulpes vulpes Canis familiaris

In total 58423 images were obtained. Total number of days in camera trapping is 2576.

Rare mammal recorded by camera traps

The goitered gazelle, despite the presence of traces and excrement in different places of the project area, was recorded by only one camera trap JEP01 (Figure 56). On 06/02/2022, images were obtained of a female (Figure 54), 05/05/2022 and 06/06/2022 - a young male with a peculiarly curved horn (Figure 55). In two individuals.

Other rare species have not been recorded. As in the WT, the most numerous species of mammals are the Red fox and Yellow ground squirrel. Typical for the territory - Long-eared Hedgehog, Wild Cat The presence of Corsac Fox and Caracal (previously found traces) in the project area was not confirmed by camera traps, but this does not mean their absence - after all, confirming the presence of a species in the area is often much easier than its absence.



Figure 54 Goitered gazelle female



Figure 55 Goitered gazelle young male



Figure 56 Goitered gazelle registration place by camera trap

Noted threats to biodiversity

In general, as mentioned above, there are a number of significant threats to mammals in the area. Unregulated grazing is observed everywhere, and it is known to be the main cause of degradation of the soil and vegetation cover, which directly affects the biodiversity as a whole. It should be noted that grazing is carried out in the spring season. In winter, summer and autumn, grazing is minimal, which significantly reduces pressure on the territory and the level of disturbance for wildlife.

Along the road there is regularly chaotically scattered garbage.

There are consequences of development in the area - the automobile road, consequences of geological survey work (remnant uplands).

There are numerous abandoned and active quarries and factories along the southern part of the ridge, which results in thick dust, a constant background of noise, and uninterrupted truck traffic.

In addition to the above, poaching is possible, which is an important limiting factor in the number of mammals. Camera traps took a picture of a man with a gun (Figure 57).



Figure 57 Man with a gun in the project area

However, in spite of such pressure, the area is extremely important as a habitat for a number of vertebrates, including rare ones.

CONCLUSION

According to the literature data, about 32 species of mammals belonging to 5 groups inhabit the surveyed territory. Out of these, 7 species are included in the Red Data Book of the Republic of Uzbekistan (2019), 2 species are included in the IUCN Red List with the status of threat, 5 species are included in CITES annexes, 2 species of CMS and 4 species are Central Asian endemics.

The survey confirmed the direct and indirect presence of 14 species, 3 of which are included in the Red List of Uzbekistan (2019) – Corsac Fox, Caracal and Goitered Gazelle. The Goitered gazelle is included in the IUCN Red List with threat status. Three species – Asiatic Wild cat, Caracal and Goitered gazelle - are included in CITES annexes.

Any anthropogenic intervention, especially construction, alters the environment and ecosystems. It is possible to reduce the degradation and pressure on vertebrate populations caused by the construction of modern infrastructure with proper and long-term planning of activities. Wildlife will be impacted not only during the facility operation, but also initially during construction activities. In this regard, during the construction works and further during the operation period, a set of measures should be established to reduce the pressure on the environment as much as possible.

Table 3 List of mammals recorded in December 2021 and April-May 2022

	NAME OF SPECIES		IUCN /RDB STATUS	TOTAL NO. OBSERVED
	LATIN	ENGLISH		DENSITY
1	<i>Hemiechinus auritus</i>	Long-eared Hedgehog	-	0,12 /1 km on walking transects and during night counts - 0,02 indiv/1km.
2	<i>Lepus tolai</i>	Tolai Hare	-	0,25 / 1 km and during night counts - 0,47 indiv/1km
3	<i>Spermophilus fulvus</i>	Yellow ground squirrel	-	1,004 indiv/1km
4	<i>Allactaga elater</i>	Small five-toed Jerboa	-	0,04 indiv/1 km
5	<i>Dipus sagitta</i>	Hairy-footed Jerboa	-	0,06 indiv/1 km
6	<i>Eremodipus lichtensteini</i>	Lichtenstein's Jerboa	-	0,06 indiv/1 km
7	<i>Ellobius tancrei</i>	Zaisan Mole Vole	-	0,2 colony/100 ha
8	<i>Midday Gerbil</i>	Meriones meridianus	-	0,04 indiv/1 km
9	<i>Phombomys opimus</i>	Great Gerbil	-	1,1 colony/100 ha
10	<i>Vulpes corsac</i>	Corsac Fox	2(VU: D) (RDB)	0,021 /1 km.
11	<i>Vulpes vulpes</i>	Red Fox	-	0,25 /1 km and during night counts 1,028 indiv/1km.
12	<i>Felis silvestris ornate</i>	Asiatic wild Cat	-	0,022 /1 km
13	<i>Caracal caracal</i>	Caracal	CR (RDB)	0,021/ 1 km.
14	<i>Gazella subgutturosa</i>	Goitered Gazelle	VU / VU:D /CMS II	0,21 / 1 km. The estimated number is about 10-35 individuals depending on the season

RECOMMENDATIONS TO REDUCE THE NEGATIVE IMPACT ON MAMMALS FROM THE CONSTRUCTION

- To mitigate the impact of vehicular traffic, it is necessary to install warning signs for drivers, introduce speed limits and subsequently organize monitoring to identify the most vulnerable places where animals cross the road. Ideally, organize safe crossing locations;

- Upon completion of construction and expansion of facilities, remove (bury) all trenches and do not use ditches as fencing to prevent animals from getting into them;
- It is necessary to establish a systematic biological monitoring. It is desirable to carry out research in different seasons of the year;
- It is mandatory to carry out educational work with the personnel, both those who will be engaged in the construction of facilities, and those involved in their operation. Employees should be informed about the importance of preserving wildlife and the rules of conduct in their habitats. If rare or endangered species of animals are found on the territory or in the immediate vicinity, it is necessary to inform the relevant state environmental protection agencies.
- Comply with all environmental and regulatory acts in the design of facilities and structures, and further construction.

Below are recommendations for construction work

Spring period: the least favorable for construction work is the end of March-April, due to the fact that this time falls on the breeding season of all mammals. For insectivores, hares and rodents, spring is the first breeding season, which, depending on the species, occurs up to 3 times a year. For predators that breed once a year, this period is very important. It must be said that all predators inhabiting the project area breed in burrows, the destruction of which during construction work will lead to the death of still immature cubs, which will begin to leave the burrows only in June.

In this regard, if possible, carry out construction work outside the spring period or conduct a field trip to the territory immediately before construction work and mark all existing burrows and rodent settlements that should not be affected by construction work.

Summer period: during the summer period, some groups of mammals are characterized by hibernation, which helps to survive the dry and hot period of the year. Often it can be observed in rodents deprived of a full-fledged and water-rich food in the summer. Thus, the destruction of burrows will lead to the death of their inhabitants. For predators, summer is the time when young animals begin to learn to hunt with adult animals and leave their burrows. The most favorable month for work is **August**.

Autumn period: The autumn period is important for all groups of mammals, especially for those species that hibernate for the winter, it is before hibernation that animals feed heavily and accumulate large reserves of nutrients in the form of fat. Families of the majority of predatory mammals disintegrate by the end of autumn, the young are settled throughout the territory.

Winter period: most species of rodents and hedgehogs are in hibernation, which will not allow them to leave their holes. In mammals, the rut occurs at this time and, in general, they are dispersed throughout the territory. The only option is not to disturb the rodent burrows during construction work. For mammals, this period is not critical.

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Pictures from camera traps:



Red fox with yellow ground squirrel



Yellow ground squirrel



Red fox in the snow



Tolai hare



Steppe turtle



Jerboa sp



Steppe agama



Ground-jay



Asiatic wild Cat



Asiatic wild Cat



Red fox with coat



Chukars in the snow



Sheppard's dogs



Red Fox



Family oa desert Shrikes



Pictures in the shepherd's house (from a remote camera trap)



Pictures in the shepherd's house (from a remote camera trap)



Shepherd's selfie

Annex 1

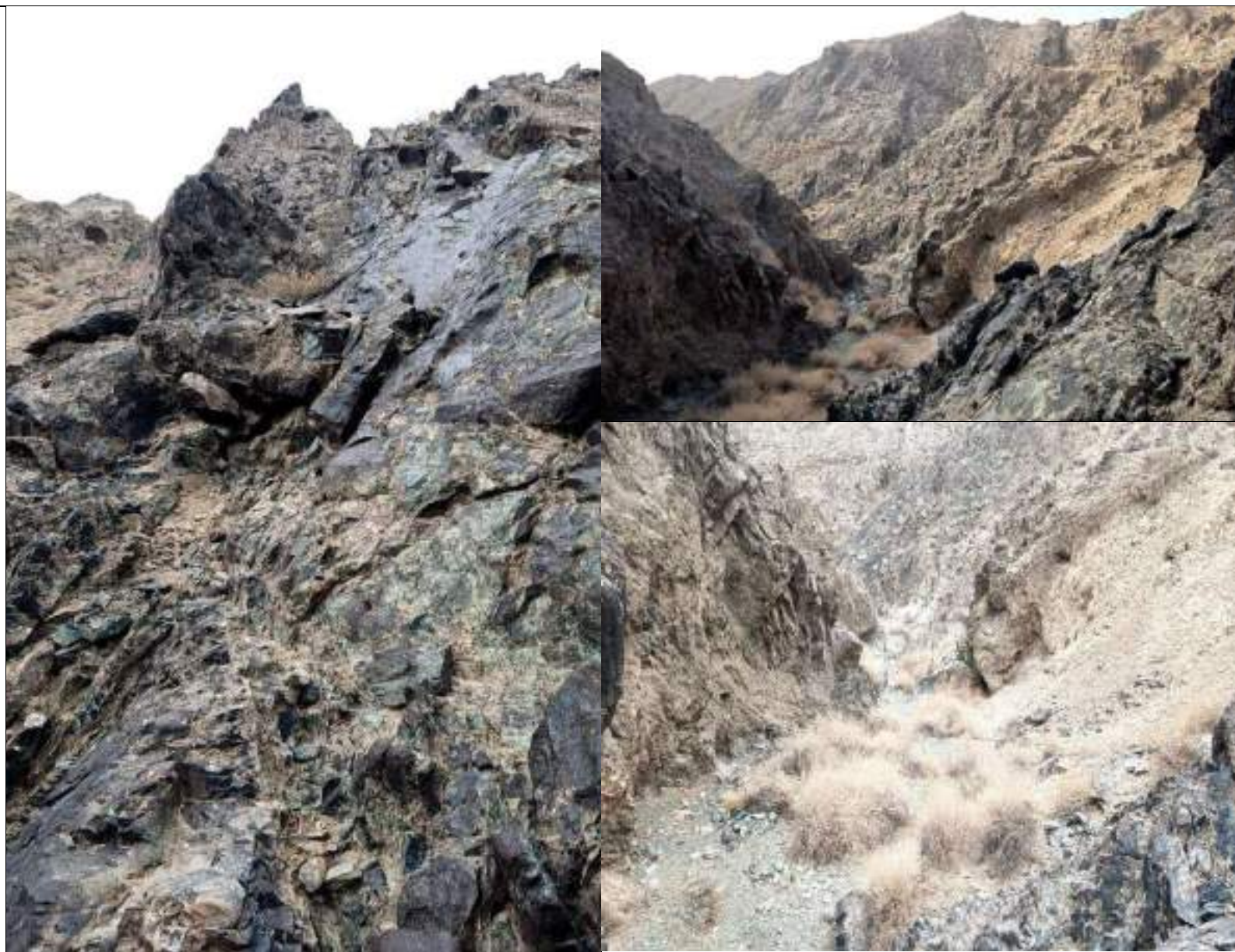
Table 4.Camera traps installed along the project area

Camer a No.	Camera ID	Picture of the installation place	
		View of a camera	View of the trail / Camera viewpoint
1	JE-Pht-16_ID_1		

2	B220211201620_ID_4		
3	JE-Pht-18_ID_3		

4

JE-Pht-14_ID_2



5

B220211202728_ID
6



6

B220211201432_ID
7



7	JE-Pht-15_ID_8		
8	JE-Pht-17_ID_5		

**Nukus 100 MW
Wind Farm**

BOTANICAL SPRING SURVEY

CLIENT: 5 CAPITALS

Date: June 2022

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1 Introduction

The project area of Nukus 100 MW Wind Farm is situated in the northwestern part of the range Sultan Uvays (also called Sultanuizdag), in Beruniy district of Karakalpakstan, Republic of Uzbekistan (Figure 1). The terrain is gentle to more or less rugged, with sandy, loamy, loamy-skeleton and stony slopes. Within the wind park area, the elevations are 275–315 m.s.l., the lowest point of proposed power line at its connection with an existing line is 98 m.s.l.

The range Sultan Uvays is an insular relic low mountain chain, stretching on about 70 km in the sub-latitudinal direction between the valley of Amudarya and sands of Kyzylkum. Sultan Uvays belongs to the northwestern group of low mountains of Kyzylkum. Its highest point is the mount Ashchytay (478 m.s.l.) located in the northwestern part of the range. Sultan Uvays has a rather gentle northern slope and a steep, stony, strongly eroded southern slope.

The climate is arid and sharply continental, with dry, hot summers, relatively severe winters and low rainfall. The mean temperature of January is near -5°C , the mean temperature of July is $+27^{\circ}\text{C}$, the lowest temperature recorded in this area is -34°C (1969), the highest recorded temperature is $+45^{\circ}\text{C}$, and a mean annual precipitation is approximately 100 mm. According to the Köppen climate classification (Kottek & al., 2006), this region has cold arid desert climate (BWk). The soil is represented by gray-brown desert soils and fixed sands.

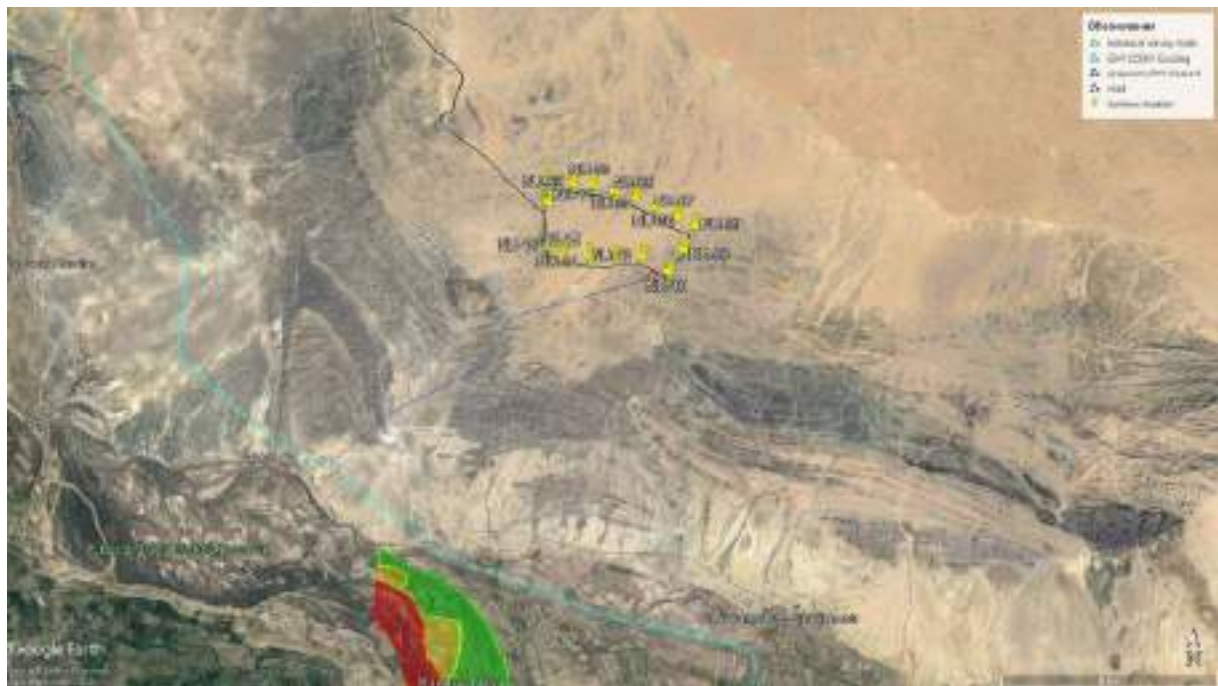


Figure 1. Project area. Note: red fill – the core area of the Lower Amudarya Biosphere Reserve; yellow fill – buffer zone of the biosphere reserve; green fill – transition zone of the biosphere reserve.

At the foot of the northwestern part of Sultan Uvays, in the Amudarya floodplain, there is Baday-tugay riparian forest protected in the core zone of Lower Amudarya Biosphere Reserve (LABR). The total area of biosphere reserve is 68,717.8 hectares, it is divided into three functional zones, core, buffer and transitional. The strictly protected core zone covers 11,568 hectares (including the former Baday-Tugay Nature Reserve). The buffer zone covers 6,731 ha, and transition zone (or economic development zone) is 50,418 ha (Ismatov, 2013; Protected areas, 2022; Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 243, 2011; UNEP-WCMC, 2022). This is one of the largest areas of natural riparian (tugay) ecosystems in Central Asia. In 2021, this protected area was included to the World Network of Biosphere Reserves by MAB UNESCO

(<https://en.unesco.org/biosphere/aspac/lower-amudarya-state>). The biosphere reserve is situated 13 km to the south of the wind park project area (Figure 1).

In accordance with TOR, the main tasks of expert-botanist are following:

- carrying out the field botanical survey and processing of field data;
- analysis of any previous botanical surveys and other available data (publications, reports, etc.) compared with the results of the field survey conducted in 2022;
- detailed description and GIS-based mapping of habitat types present in the project area, compilation of Habitat map and LULC (Land Use – Land Cover) map;
- compilation of the check-list of plant species recorded in the project area (in particular, threatened species included in the Red Data Book of Uzbekistan and/or the IUCN Red List);
- reporting.

2 Literature review

The flora of the desert Kyzylkum (including the Sultan Uvays range) has been well studied. The history of botanical research in this region has about two centuries. The first surveys of the flora and vegetation has been conducted in the middle of the 19th Century by European and Russian naturalists (Ch. Pander, E. Ewersmann, A. Lehmann, I.G. Borszczow, S.M. Smirnov, and others) who took part in several Russian diplomatic missions to Bukhara and Khiva Khanates. The history of botanical research of the 19th Century and early 20th Century has been described in great details by Russian botanist Vladimir Lipsky in his work “Flora of Central Asia, i.e. Russian Turkestan and Bukhara and Khiva Khanates” (1902–1905). A huge amount of herbarium material collected from this region is kept mainly in the National Herbarium of Uzbekistan in Tashkent (TASH), Herbarium of the Komarov Botanical Institute in St. Petersburg (LE), Herbarium of the Lomonosov Moscow State University (MW) and Herbarium of Institute of Botany and Phytointroduction in Almaty (AA).

In 1908–1917, the Migration Department of Russian government organized a number of large-scale expeditions for investigation of soils and vegetation of Central Asia within the framework of colonization of this region. In particular, a special expedition headed by Nikolay Dima explored the Amudarya River basin. Thus, in 1913, Russian botanist Mikhail Popov carried out a short-term survey in Sultan Uvays and later published “Botanical-geographical sketch of the mountains Sultanuizdag” with the checklist of 121 plant species (1958).

In 1928, Central Asian State University organized a reconnaissance expedition to northwestern Kyzylkum and lower reaches of Amydarya, headed by I.M. Krashenninnikov. In 1931, K.D. Muravlyansky, Sh.M. Agabobyan and M.A. Kasimenko studied rangelands and fodder plants of Kyzylkum (including Sultan Uvays and its surroundings). In 1932, the Karakalpak complex expedition headed by geobotanist A.G. Poretsky was established for the systematic and purposeful study of the flora and vegetation of Kyzylkum, especially, desert pastures. Several famous botanists (F.N. Russanov, K.S. Afanassiev and others) participated in this expedition, collected extensive herbarium material, and made a great contribution to the investigation of the flora and ecosystems of northwestern and central parts of the Kyzylkum desert (including project area). The published materials of the Karakalpak expedition gave the first detailed description of the vegetation cover of this territory.

One of the first estimates of the flora of Sultan Uvays was published by R. Abdurakhmanov (1967), who reported 240 plant species.

In 1962–1967, P.K Zakirov explored the flora and vegetation of the low mountains of Kyzylkum and the range Nuratau and published a monograph “Botanical geography of Nuratau Range and low mountains of Kyzylkum” (1971). This book contains detailed descriptions of the vegetation and a check-list of the flora with 556 species of vascular plants recorded for low mountains of Kyzylkum in total. Among them, 246 species have been listed for the Sultan Uvays. P.K. Zakirov also identified 26 plant associations of 6 formations in the vegetation of Sultan Uvays and compiled a geobotanical map.

According to B. Sherbaev (1978, 1988), the flora of the Karakalpak part of the Kyzylkum Desert includes 732 species of vascular plants, among them 444 species from 226 genera and 51 families are recorded for Sultan Uvays range (nearly twice that amount given by Abdurakhmanov and Zakirov). An unpublished check-list of the flora of Sultan Uvays with 448 plant species was compiled within the framework of research project “Botanical geography of Uzbekistan” (Tojibaev et al., 2017) performed by the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan. Shomurodov et al. (2018) studied populations of rare and endemic plants of the low mountains of Kyzylkum, including Sultan Uvays.

Several books devoted to the flora of the Republic of Karakalpakstan also contain the data on the flora and vegetation of the project area (Bondarenko, 1964; Turemuratov, 1978; Erezhepov, 1978; Korovina et al., 1982, 1983; Maylun, 1987–1990). A number of publications devoted to the vegetation of Kyzylkum desert, Uzbekistan and Central Asia (Korovin, 1961, 1962; Vegetation cover of Uzbekistan, 1971–1984; Rachkovskaya et al., 2003; Gintzburger et al., 2003; Tojibaev et al., 2017; Shomurodov et al., 2018; Shomurodov, 2018), as well as fundamental taxonomical treatments, including “Flora of the U.S.S.R.” (1934–1964, in 30 volumes), 1st edition of the “Flora of Uzbekistan” (1941–1962, in 6 volumes), “Conspectus Florae Asiae Mediae” (1963–2015, in 11 volumes), and recently published first three volumes of the 2nd edition of the “Flora of Uzbekistan” (2016, 2017, 2019), should also be mentioned among the most important sources of botanical information.

The most recent floristic study in Sultan Uvays carried out by R. Esemuratova (2021, 2022) revealed 526 species of vascular plants, belonging to 257 genera and 55 families. The majority of species recorded for this region are typical for desert zone of Central Asia and more or less common and widely spread. Following 11 species are included in the Red Data Book of Uzbekistan (2019):

Astragalus centralis E. Sheld. (Fabaceae), category 2 (rare, endangered species) in the Red Data Book of Uzbekistan (2019). Perennial plant, national endemic and endemic to relic mountains of Kyzylkum. Flowering in April-May, fruiting in May-June. Grows on gravelly and stony slopes. According to data by Esemuratova (2021, 2022), this species was recorded on north-eastern slope of Sultan Uvays Range.

Astragalus holargyreus Bunge (Fabaceae), category 1 (disappearing, critically endangered species) in the Red Data Book of Uzbekistan (2019). Perennial plant, national endemic and endemic to relic mountains of Kyzylkum. Flowering in May, fruiting in June. Grows on rocks and stony slopes. According to data by Esemuratova (2021, 2022), this species was recorded on north-eastern slope of Sultan Uvays Range.

Ferula kyzylkumica Korovin (Apiaceae), category 3 (reducing, vulnerable species) in the Red Data Book of Uzbekistan (2019). Perennial plant, national endemic and endemic to relic mountains of Kyzylkum with a disjunction in the Nuratau Mountains. Flowering in May, fruiting in June. Grows on outcrops of variegated beds, gravelly and stony slopes. According to data by Esemuratova (2021, 2022), this species was recorded on north-eastern slope of Sultan Uvays.

Lagochilus vvedenskyi Kamelin & Zukerw. (Lamiaceae), category 3 (reducing, vulnerable species) in the Red Data Book of Uzbekistan (2019). Perennial plant, national endemic and endemic to relic mountains of Kyzylkum. Grows on eroded slopes. Flowering in June, fruiting in July–August. According to data by Esemuratova (2021, 2022), this species was recorded on north-eastern slope of Sultan Uvays.

Lappula aktaviensis Popov & Zakirov (Boraginaceae), category 1 (disappearing, critically endangered species) in the Red Data Book of Uzbekistan (2019). Annual plant, national endemic and endemic to relic mountains of Kyzylkum. Grows on rocks, outcrops of variegated beds, gravelly and stony slopes. Flowering in April, fruiting in May. According to data by Esemuratova (2021, 2022), this species was recorded on north-eastern slope of Sultan Uvays.

Lappula parvula Nabiev & Zakirov (Boraginaceae), category 2 (rare, endangered species) in the Red Data Book of Uzbekistan (2019). It is annual plant endemic to Sultan Uvays and endemic of Uzbekistan, which grows on sandy piedmonts of Sultan Uvays. Flowering in April, fruiting in May. According to herbarium and published data, the nearest known location of *L. parvula* is the surroundings of the village Karatau.

Lepidium subcordatum Botsch. & Vved. (Brassicaceae), category 2 (rare, endangered species) in the Red Data Book of Uzbekistan (2019). It is perennial herb, national endemic of Uzbekistan, endemic to low mountains of Kyzylkum and plateau Ustyurt. It grows on stony and skeleton slopes and sandy piedmonts of remnant uplands and on outcrops of variegated beds. Flowering in April–May, fruiting in May–June. The nearest known location of *L. subcordatum* is situated in the surroundings of the Sultan Uvays cemetery and in the surroundings of the village Taldyk.

Scorzonera bungei Krasch. & Lipsch. (Asteraceae), category 2 (rare, endangered species) in the Red Data Book of Uzbekistan (2019). It is perennial herb, national endemic of Uzbekistan, endemic to low mountains Sultan Uvays and plateau Ustyurt growing on stony and gypsaceous slopes and rocks. Flowering in April, fruiting in May. The nearest known locations of this species are situated in the surroundings of the Sultan Uvays cemetery and on north-eastern slope of Sultan Uvays.

Silene tomentella Schischk. (Caryophyllaceae), category 2 (rare, endangered species) in the Red Data Book of Uzbekistan (2019). It is perennial herb, national endemic of Uzbekistan and endemic to relic mountains of Kyzylkum. Grows on stony slopes and rocks. Flowering in April–May, fruiting in May–June. According to data by Esemuratova (2021, 2022), this species was recorded on north-eastern slope of Sultan Uvays.

Stipa aktauensis Roshev. (Poaceae), category 2 (rare, endangered species) in the Red Data Book of Uzbekistan (2019). Perennial, national endemic and endemic to relic mountains of Kyzylkum. Grows on gravelly and stony slopes and rocks. Flowering and fruiting in April–June. According to data by Shomurodov et al. (2018), the nearest known location of this species is situated on north-eastern slope of Sultan Uvays.

Xylosalsola chiwensis (Popov) Akhani & Roalson (*Salsola chiwensis* Popov, Amaranthaceae), category 2 (rare, endangered species) in the Red Data Book of Uzbekistan (2019). It is a semishrub growing on grey-brown gypsaceous and marl soils in Ustyurt and Sultan Uvays. This species occurs in Uzbekistan and Turkmenistan. Flowering in July, fruiting in September. The nearest known location of this species is situated in the surroundings of the village Karatau.

Threatened species included in the IUCN Red List with the status of CR, EN or VU, are not known for the flora of Sultan Uvays.

According to the published data (Zakirov, 1971; Vegetation cover of Uzbekistan, 1971–1984; Geographical atlas of Uzbekistan, 2012), the vegetation of the Sultan Uvays range is represented

with plant communities with domination of saltworts (*Xylosalsola arbuscula* (*Salsola arbuscula*), *Oreosalsola arbusculiformis* (*S. arbusculiformis*), *Caroxylon orientale* (*Salsola orientalis*)), *Caroxylon gemmascens* (*Salsola gemmascens*)), sagebrush (*Artemisia diffusa*, *A. terrae-albae*, *A. turanica*), species of *Astragalus* section *Ammodendron* (*Astragalus unifoliolatus*, *A. villosissimus*), and with participation of *Anabasis eriopoda*, *Anabasis salsa*, *Calligonum junceum*, *Climacoptera* sp., *Convolvulus fruticosus*, *C. hamadae*, *Haloxylon ammodendron*, *Halothamnus subaphyllus*. These communities are typical for gypsaceous, loamy-skeleton, sometimes saline or gypsaceous grey-brown desert soil of the low mountains of Kyzylkum. Large areas (particularly on the southern slope) are strongly covered with gravel and practically devoid of vegetation, except for single individuals of *Ephedra* sp., *Artemisia terrae-albae*, *Anabasis salsa*, *Anabasis annua*, *Haloxylon ammodendron*, *Salsola* sp., *Atraphaxis spinosa*, *Halothamnus subaphyllus*, *Halimocnemis longifolia*, *Halimocnemis macrantha*, *Halogeton glomeratus*. Psammophilous communities with domination of desert shrubs (*Haloxylon persicum*, *H. ammodendron*, *Ammodendron conollyi*, *Calligonum aphyllum*, *C. caput-medusae*, *C. leucocladum*, *C. microcarpum*, *Xylosalsola arbuscula* (*Salsola arbuscula*), *Xylosalsola richteri* (*Salsola richteri*), *Astragalus villosissimus*), sagebrush (*Artemisia diffusa*, *A. terrae-albae*), and desert sedge (*Carex physodes*) are represented on the sandy northern piedmonts of the Sultan Uvays. Psammophilous vegetation, particularly desert woodlands, forms a unique landscape of sandy deserts of Central Asia. The roots of plants, especially, the desert sedge, form a dense network fixing sands. In this connection, sowing of saxaul for sand fixation along the roads running through sandy deserts is recommended (Babayev, 1986).

3 Materials and methods

The field survey was carried out April 28–30, 2022, by traditional methods of botanical research commonly used for sampling and mapping of native non-forest vegetation, recognition of floristic composition and spatial patterns of plant communities (Field geobotany, 1959–1976; Granitov, 1980; Kent, 2011). All proposed turbine locations (NU-01 to NU-16) within the project site were inspected, as well as the north slope of Sultan Uvays range along the planned electric line. The structure of plant communities was studied on 100x100 m geobotanical sample plots; check-lists of plant species recorded for each sample plot and a summary check-list of the flora of wind park project area were compiled.

For each sample plot, photographs of the landscape and vegetation were taken using a digital camera, and following data were recorded: location and physical environment (including GPS coordinates, elevation, topography, and soil type), state of vegetation, type of land use and disturbance factors (grazing, roads, etc.), plant community, canopy cover (%), all plant species present at the plot, their cover and abundance, phenological stage and height. Species abundance was determined using the Braun-Blanquet cover-abundance scale (+ – occasional and less than 1% cover of the sample plot area; 1 – abundant with low cover, or less abundant but with higher cover, 1–5% of the sample plot area; 2 – abundant with >5–25% of the sample plot area, irrespective of the number of individuals; 3 – >25–50% cover of the sample plot area, irrespective of the number of individuals; 4 – >50–75% cover of the sample plot area, irrespective of the number of individuals; 5 – >75% cover of the sample plot area, irrespective of the number of individuals) and the DACFOR scale: D – Dominant; A – Abundant, C – Common, F – Frequent, O – Occasional, R – Rare.

The final check-list of plant species recorded for the project area was compiled (Annex 1), and botany data template (MS Excel table) was filled. Species in the checklist are arranged in taxonomical order in accordance with the APG system (APG IV, 2016). Accepted scientific names

are provided in accordance with the online global databases Plants of the World Online (www.plantsoftheworldonline.org/), International Plant Names Index (www.ipni.org) and Global Biodiversity Information Facility (www.gbif.org), as well as with recently published treatments of different taxonomical groups of the flora of Uzbekistan (Sennikov, 2016, 2017, 2019).

Plant species were identified using special literature, as “Conspectus Florae Asiae Mediae” (1963–1993), “Flora of Uzbekistan” (1941–1963, 2016, 2017, 2019) and “Flora of USSR” (1934–1964). Available publications and online databases (Nikitin, 1983; IUCN/ISSG, 2014; CABI, 2017; Sennikov et al., 2018) were used for identification of alien species, while the Red Data Book of Uzbekistan (1984, 1998, 2006, 2009, 2019) and the IUCN Red List (www.iucnredlist.org) were used for identification of threatened species.

It should be noted that currently only 258 taxa of more than 4380 species recorded for the flora of Uzbekistan were assessed by IUCN, 16 species of them were included in the IUCN Red List as threatened (5 – CR, 8 – EN, 3 – VU), 8 of them are redlisted at the national level. The majority of species has not yet been assessed by IUCN and belongs to NE category – Not Evaluated.

To date, 5 editions of the Red Data Book of Uzbekistan have been published. The first (1984) included 163 plant species, the second (1998) – 301, the third (2006) – 302, the fourth (2009) – 321, and an actual, fifth edition (2019), includes 314 plant species. National categories of threatened plants are follows: 0 (probably extinct species) – corresponds to EX or EW categories of the IUCN Red List (www.iucnredlist.org), 1 (endangered, disappearing species) – meets CR category of IUCN, 2 (rare species) – meets EN category of IUCN and 3 (vulnerable, declining species) – corresponds to VU or NT category of IUCN.

For the purposes of implementation of IFC Performance Standard 6, habitats are divided into modified, natural, and critical. Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area’s primary ecological functions and species composition. Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area’s primary ecological functions and species composition. Critical habitats are a subset of modified or natural habitats.

As defined by the International Finance Corporation (IFC) Performance Standard 6 (PS6) and EBRD Performance Requirement 6 (PR6), critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes. Numerical thresholds have been defined for the first four critical habitat criteria (i.e., CR/EN species; endemic/restricted-range species; migratory/congregatory species; threatened and unique ecosystems); these thresholds are based on these published by IUCN in “A Global Standard for the Identification of Key Biodiversity Areas” (2016) and “IUCN Red List Categories and Criteria” (2012). For Criterion 5, there are no numerical thresholds.

Criterion 1 is triggered by species listed as CR or EN on the IUCN Red List, and nationally/regionally listed species assessed using similar criteria. Criterion 2 is triggered by habitats of significant importance for endemic or restricted-range species. Criterion 3 (migratory species) is inapplicable for plants. As for Criterion 4, unfortunately, the officially approved national list of highly threatened and/or unique ecosystems and habitats does not exist in Uzbekistan. But the National Biodiversity Conservation Strategy (1998), National reports on biodiversity conservation (2006, 2015) and other documents (Ismatov, 2013) indicated that the problem of conservation of all types of forest ecosystems (including desert shrublands) is a very critical issue

in Uzbekistan. A specific legislation, management and forest protection measures are present at the national level.

According to the IFC Guidance Note 6, quantitative thresholds of critical habitat are following:

Criterion 1. CR/EN species: a) areas that support globally important concentrations of an IUCN red-listed EN or CR species ($\geq 0.5\%$ of the global population and ≥ 5 reproductive units); (b) areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds of $\geq 0.5\%$ of the global population and ≥ 5 reproductive units; (c) as appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species (in countries that adhere to IUCN guidance).

Criterion 2. Endemic / restricted range species: (a) areas that regularly hold $\geq 10\%$ of the global population size AND ≥ 10 reproductive units of a species. For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EOO less than 50,000 square kilometers (km^2).

The habitat and LULC maps were created using QGIS 3.18 free software on the basis of visual interpretation of Google Earth free satellite imagery, topographic maps (1:100,000, available online for free at <http://loadmap.net/>), and the data of field survey.

4 Results of the field survey

A field survey has been conducted 28–30 April 2022. Following habitat types and vegetation communities were identified within the project area:

- Weakly inclined, gentle hilly northern slope of relic low mountains with sedge-saltwort-sagebrush vegetation on sabulous-loamy grey-brown desert soil – this habitat type is represented within the wind park area and along the upper part of the planned power line;
- Fixed shallow wavy and hilly sands with sedge-*Ferula*-saltwort-winterfat-sagebrush vegetation, sometimes with *Calligonum* and solitary black saxaul – this habitat type is represented within the wind park area;
- Steep dry stony southern slope of relic low mountains with rugged terrain and sparse petrophytic vegetation – xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*), and annuals – this habitat type occurs along the middle part of planned power line;
- Weakly inclined piedmonts with sedge-sagebrush-saltwort and saltwort vegetation on loamy and skeleton, sometimes gypsaceous grey-brown desert soil, dissected with gravelly dry beds of temporary streams – this habitat type is represented in the lower part of planned power line;
- Transformed (anthropogenic) habitat with sparse communities of wild rue, camel thorn and annuals – this habitat type is represented in the lower part of planned power line, in the surroundings of cement factory, railway and road A-380.

Thus 4 types of natural and 1 transformed are present within the project area. According to IUCN Habitats Classification Scheme, ver. 3.1 (<https://www.iucnredlist.org/resources/habitat-classification-scheme>), all these habitats belong to the type 8 (Desert), subtype 8.2 (Desert – Temperate). According to the IUCN Global Ecosystem Typology ver. 2.0 (2020), the habitats of the project area belong to T5 Deserts and semi-deserts biome and T5.4 Cool deserts and semi-

deserts ecosystem functional group of terrestrial realm. The map of habitats and LULC map were created (Figure 2). During the field survey, all habitat types were inspected.

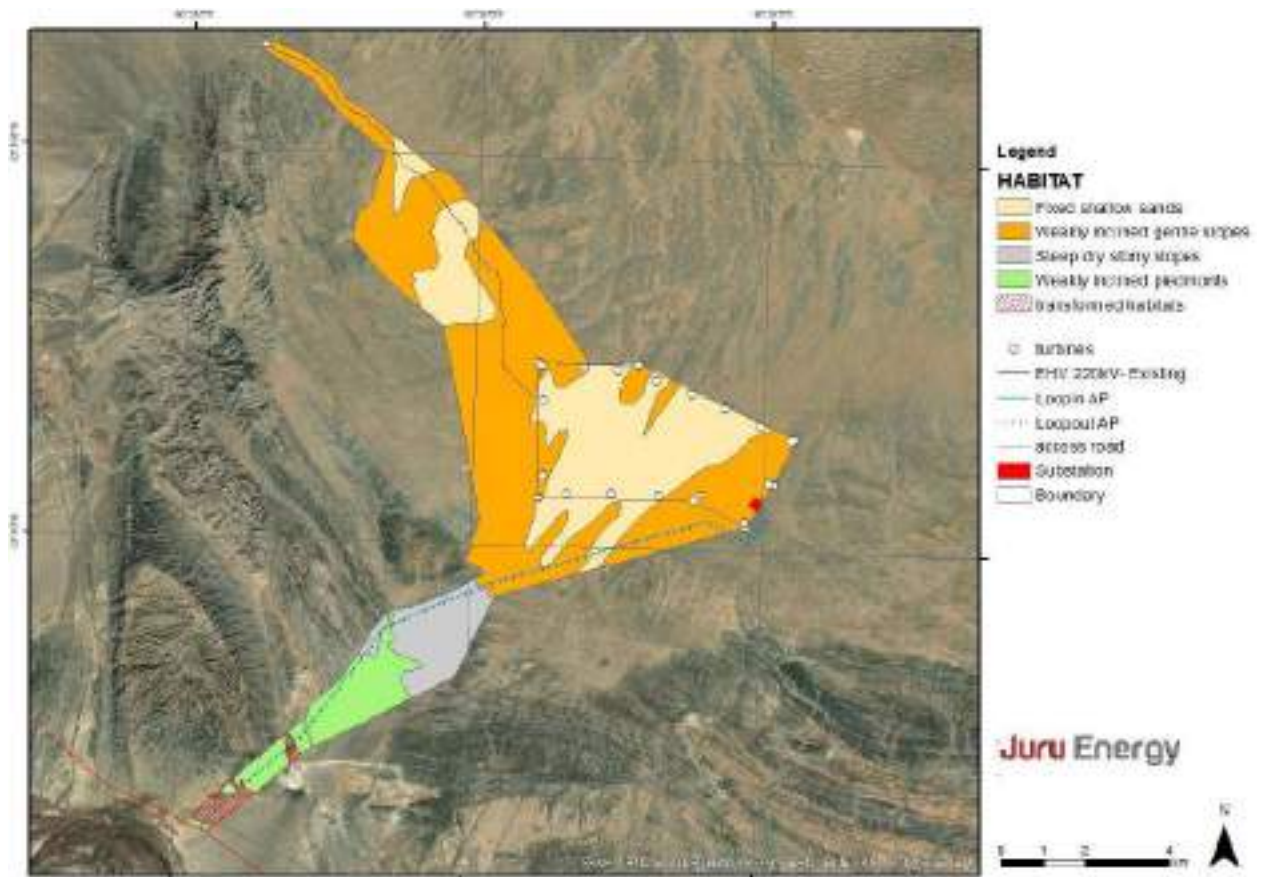


Figure 2 Map of habitats of the project area

It has been found, that the wind park area is covered mainly with dwarf shrub and semishrub vegetation with domination of sagebrush (*Artemisia diffusa*, *A. turanica*), saltworts (*Oreosalsola arbusculiformis* (*Salsola arbusculiformis*), *Caroxylon orientale* (*Salsola orientalis*), *Xylosalsola arbuscula* (*Salsola arbuscula*)), winterfat (*Krascheninnikovia ceratoides*), desert sedge (*Carex physodes*), on some plots with *Ferula foetida*, *Calligonum leucocladum* or with black saxaul (*Haloxylon ammodendron*). The canopy cover is 20–40% on gentle northern slope and 10–20% (sometimes less than 10%) on steep and stony southern slope. These native plant communities with sparse canopy cover and rather low species diversity are typical for insular low mountains of Kyzylkum including the Sultan Uvays range (Zakirov, 1971; Vegetation cover of Uzbekistan, 1971–1984). All natural habitats of the project area have low to medium level of anthropogenic disturbance connected mainly with use of pastures and roads. Transformed habitat is represented with areas of weakly inclined piedmonts of the Sultan Uvays where the landscape was transformed as a result of construction and exploitation of infrastructure (railway, road A-380, power line) and cement factory, and natural vegetation communities were significantly or completely destroyed and replaced by sparse secondary communities of wild rue (*Peganum harmala*), camel thorn (*Alhagi pseudalhagi*) and annuals (*Ceratocephala falcata*, *Ceratocarpus arenarius*, etc.).

In total, 85 plant species were recorded within the project area. One of them is nationally redlisted *Lepidium subcordatum* (Brassicaceae), national endemic and endemic to relic mountains of Kyzylkum and plateau Ustyurt, assessed as rare, endangered species (category 2) in the Red Data Book of Uzbekistan (2019). Two small populations (8 and 11 generative specimens) of this

plant have been found on the northern slope of Sultan Uvays along the planned electric line (Figure 3), the distance between these two populations is 150 meters:

42.07062° N 60.500841° E – 8 generative specimens of *Lepidium subcordatum*.

42.071833° N 60.500191° E – 11 generative specimens of *Lepidium subcordatum*.



Figure 3. Locations of nationally redlisted endemic *Lepidium subcordatum*

According to published and herbarium data, 21 localities of *Lepidium subcordatum* are known to date, one of them is situated on the Ustyurt Plateau and 20 on relic mountains of Kyzylkum, including 4 locations known for the Sultan Uvays Mountains (Figure 4).



Figure 4. Known locations and geographical range of *Lepidium subcordatum*

Its geographical range (EOO) calculated using Google Earth measurement tool is 47,129 square kilometers, and this plant can be considered as restricted-range species. The area of occupancy (AOO) calculated using 2 x 2 km (4 km²) grid cells according to IUCN methodology, is 84 km² (two populations in the wind park project area falls into one grid cell). About 2000 plants were

recorded in the Navoi Province and about 700 in the Bukhara Province (Shomurodov et al., 2018; Tojibaev et al., 2019, 2020), but the information about population size for the Sultan Uvays Mountains and Ustyurt Plateau is absent. Thus, the project site contains 4.76% of global population of *Lepidium subcordatum* (calculated as proportion of AOO and of known localities) or 0.7% of known number of individuals. Taking into account these facts, this endemic species does not trigger Critical habitat Criterion 2 (habitat of significant importance to endemic and/or restricted-range species) because the project area contains less than 10% of its global habitat and population. Collection of seeds and sowing in the same habitat away of the power line is an option for protection and/or relocation of this rare plant.

Within the area of planned wind farm and along the access road, nationally or globally redlisted, or local endemic plants were not found. Most of species recorded for the project areas are typical for desert zone of Central Asia and more or less common and widely spread.

All natural habitats of project area are used by the local people mainly as rangelands. The human impact within the project site is connected mainly with cement factory, as well as with infrastructure (railway, roads, power lines), and with development of small quarries in southern foothills of Sultan Uvays.

Descriptions of plant communities recognized within planned locations of wind turbines and along the planned electric line are presented below (Tables 1–19). Photographs are represented in Annex 2.

Table 1. Check-list of plants recorded for sedge-saltwort-sagebrush community (Artemisia diffusa, A.turanica, Caroxylon orientale (Salsola orientalis), Carex physodes) on sandy desert soil (turbine NU-01, 42.121962 N 60.51933 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Arnebia transcaspica</i>	annual	10–15	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Bromus tectorum</i>	annual	10–15	F	+	flowering
<i>Carex physodes</i>	Perennial	10–15	A	1	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Climacoptera sp.</i>	annual	10–15	O	+	vegetation
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	C	+	flowering
<i>Goldbachia laevigata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Goldbachia sabulosa</i> (<i>Spirorrhynchus sabulosus</i>)	annual	20–25	O	+	Flowering, fruiting
<i>Haloxylon ammodendron</i>	Small tree	100–120	O	1	vegetation
<i>Heterocaryum szovitsianum</i>	perennial	10–15	O	+	Flowering, fruiting

<i>Koelpinia linearis</i>	annual	10–15	R	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	+	vegetation
<i>Lachnoloma lehmanii</i>	annual	15–20	R	+	Flowering, fruiting
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Flowering, fruiting
<i>Microcephala lamellata</i>	annual	10–15	R	+	Flowering
<i>Nonea caspica</i>	annual	5–7	O	+	flowering
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	O	1	vegetation
<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Scorzonera sericeolanata</i>	perennial	15–20	O	+	flowering
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Strigosella intermedia</i>	annual	7–10	R	+	flowering
<i>Strigosella turkestanica</i>	annual	15–20	O	+	flowering
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	O	+	Flowering, fruiting
<i>Tulipa sogdiana</i>	Perennial	10–15	R	+	fruiting

Table 2. Check-list of plants recorded for sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale* (*Salsola orientalis*), *Carex physodes*) on sandy desert soil (turbine NU-02, 42.121924 N 60.531331 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Arnebia transcaspica</i>	annual	10–15	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Bromus tectorum</i>	annual	10–15	F	+	flowering
<i>Carex physodes</i>	Perennial	10–15	A	1	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	C	1	vegetation
<i>Ceratocarpus arenarius</i>	annual	7–10	O	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering

<i>Ferula foetida</i>	perennial	40–50	F	1	Vegetation, fruiting
<i>Haloxylon ammodendron</i>	Small tree	100–120	R	+	vegetation
<i>Heterocaryum szovitsianum</i>	perennial	10–15	O	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	+	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Flowering, fruiting
<i>Strigosella turkestanica</i>	annual	15–20	O	+	flowering
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	O	+	vegetation

Table 3. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary black saxaul (*Haloxylon ammodendron*) on fixed wavy shallow sands (turbine NU-03, 42.12133 N 60.540971 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Arnebia transcaspica</i>	annual	10–15	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	flowering
<i>Bromus tectorum</i>	annual	10–15	F	+	flowering
<i>Carex physodes</i>	Perennial	15–20	D	2	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	flowering
<i>Ferula foetida</i>	perennial	40–50	C	1	Vegetation, fruiting
<i>Haloxylon ammodendron</i>	Small tree	100–120	R	+	vegetation
<i>Heterocaryum szovitsianum</i>	perennial	10–15	O	+	Flowering, fruiting

<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	A	2	vegetation
<i>Scorzonera sericeolanata</i>	perennial	15–20	O	+	flowering
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	C	1	vegetation

Table 4. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) on fixed wavy shallow sands (turbine NU-04, 42.119458 N 60.551966 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	flowering
<i>Carex physodes</i>	Perennial	15–20	C	1	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	O	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	flowering
<i>Ferula foetida</i>	perennial	40–50	C	1	Vegetation, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	A	2	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Microcephala lamellata</i>	annual	10–15	R	+	Flowering

<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	O	+	vegetation
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	O	+	Flowering, fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	1	vegetation

Table 5. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-05, 42.116807 N 60.562386 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun- Blanquet	
<i>Arnebia decumbens</i>	annual	15–20	R	+	flowering
<i>Arnebia transcaspica</i>	annual	10–15	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	O	+	vegetation
<i>Astragalus harpilobus</i>	annual	7–10	R	+	flowering
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	flowering
<i>Astragalus villosissimus</i>	semishrub	35–40	R	+	Flowering, fruiting
<i>Bromus tectorum</i>	annual	10–15	F	1	flowering
<i>Calligonum leucocladum</i>	shrub	50–100	O	1	flowering
<i>Carex physodes</i>	Perennial	15–20	D	2	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	R	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	flowering
<i>Ferula foetida</i>	perennial	40–100	O	1	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Goldbachia laevigata</i>	annual	10–15	R	+	Flowering, fruiting

<i>Goldbachia sabulosa</i> (<i>Spirorrhynchus sabulosus</i>)	annual	15–20	O	+	Flowering, fruiting
<i>Haplophyllum bungei</i>	perennial	20–25	R	+	vegetation
<i>Heliotropium acutiflorum</i>	annual	10–15	R	+	flowering
<i>Heliotropium arguzioides</i>	perennial	15–20	R	+	flowering
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	R	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	R	+	Flowering, fruiting
<i>Koelpinia linearis</i>	annual	10–15	R	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Nonea caspica</i>	annual	5–7	O	+	flowering
<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Strigosella turkestanica</i>	annual	15–20	R	+	flowering
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	1	vegetation

Table 6. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-06, 42.11358 N 60.572041 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun- Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	R	+	vegetation
<i>Arnebia decumbens</i>	annual	15–20	O	+	flowering
<i>Arnebia transcaspica</i>	annual	10–15	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	C	1	vegetation
<i>Astragalus flexus</i>	perennial	15–20	R	+	flowering
<i>Astragalus harpilobus</i>	annual	7–10	O	+	flowering
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	flowering

<i>Astragalus villosissimus</i>	semishrub	35–40	R	+	Flowering, fruiting
<i>Bromus tectorum</i>	annual	10–15	F	1	flowering
<i>Calligonum leucocladum</i>	shrub	50–100	O	1	flowering
<i>Carex physodes</i>	Perennial	15–20	D	2	fruiting
<i>Caroxylon orientale (Salsola orientalis)</i>	shrub	35–40	O	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	F	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Delphinium campitocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	flowering
<i>Ferula foetida</i>	perennial	40–100	F	1	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Goldbachia laevigata</i>	annual	10–15	R	+	Flowering, fruiting
<i>Goldbachia sabulosa (Spirorrhynchus sabulosus)</i>	annual	15–20	O	+	Flowering, fruiting
<i>Haplophyllum bungei</i>	perennial	20–25	R	+	vegetation
<i>Heliotropium acutiflorum</i>	annual	10–15	R	+	flowering
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	flowering
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypocoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Koelpinia linearis</i>	annual	10–15	R	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Nonea caspica</i>	annual	5–7	R	+	flowering
<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Stipagrostis karelinii</i>	Perennial	35–40	R	+	vegetation
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Strigosella turkestanica</i>	annual	15–20	O	+	flowering

<i>Tulipa sogdiana</i>	Perennial	10–12	R	+	fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	vegetation

Table 7. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on fixed wavy shallow sands (turbine NU-07, 41.110178 N 60.582378 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	O	+	vegetation
<i>Arnebia decumbens</i>	annual	15–20	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	flowering
<i>Calligonum leucocladium</i>	shrub	50–100	R	+	flowering
<i>Carex physodes</i>	Perennial	15–20	A	1	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	vegetation
<i>Ceratocarpus arenarius</i>	annual	7–10	O	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	R	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	F	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	O	+	flowering
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	flowering
<i>Ferula foetida</i>	perennial	40–100	F	1	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Goldbachia laevigata</i>	annual	10–15	R	+	Flowering, fruiting
<i>Heliotropium arguzioides</i>	perennial	15–20	R	+	flowering
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Iris longiscapa</i>	perennial	10–15	R	+	fruiting
<i>Isatis emarginata</i>	annual	15–20	R	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	R	+	Flowering, fruiting

<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	R	+	Flowering, fruiting
<i>Tulipa sogdiana</i>	Perennial	10–12	R	+	fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	vegetation

Table 8. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on sabulous-loamy grey-brown desert soil (turbine NU-08, 42.098034 N 60.585573 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	R	+	vegetation
<i>Allium caspium</i>	Perennial	15–17	R	+	flowering
<i>Arnebia decumbens</i>	annual	15–20	O	+	flowering
<i>Arnebia transcaspica</i>	annual	10–15	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	flowering
<i>Carex physodes</i>	Perennial	15–20	A	1	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	vegetation
<i>Ceratocarpus arenarius</i>	annual	7–10	F	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	F	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	R	+	flowering
<i>Delphinium campitocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	O	+	flowering
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	flowering
<i>Ferula foetida</i>	perennial	40–100	F	1	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Goldbachia laevigata</i>	annual	10–15	R	+	Flowering, fruiting
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	flowering
<i>Hypecoum pendulum</i>	annual	15–20	F	+	Flowering, fruiting

<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Strigosella intermedia</i>	annual	10–15	R	+	flowering
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	R	+	Flowering, fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	vegetation

Table 9. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Caroxylon orientale*, *Carex physodes*) on sandy desert soil (turbine NU-09, 42.107179 N 60.591333 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Arnebia decumbens</i>	annual	15–20	O	+	flowering
<i>Arnebia transcaspica</i>	annual	10–15	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	O	+	vegetation
<i>Astragalus harpilobus</i>	annual	7–10	R	+	flowering
<i>Bromus tectorum</i>	annual	10–15	F	+	flowering
<i>Carex physodes</i>	Perennial	15–20	A	1	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	vegetation
<i>Ceratocarpus arenarius</i>	annual	7–10	F	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	F	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	R	+	flowering
<i>Cousinia hamadae</i>	Perennial	20–25	R	+	vegetation
<i>Delphinium camptocarpum</i>	annual	15–20	F	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Ferula foetida</i>	perennial	50–100	O	+	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Heliotropium acutiflorum</i>	annual	10–15	R	+	flowering
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	flowering

<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	F	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	R	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	R	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Flowering, fruiting
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Strigosella turkestanica</i>	annual	15–20	O	+	flowering
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	R	+	Flowering, fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	O	1	vegetation

Table 10. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on sabulous-loamy grey-brown desert soil (turbine NU-10, 42.089532 N 60.578714 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	O	+	vegetation
<i>Allium caspium</i>	Perennial	15–17	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	flowering
<i>Bromus tectorum</i>	annual	10–15	O	+	flowering
<i>Carex physodes</i>	Perennial	15–20	D	2	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	flowering
<i>Ferula foetida</i>	perennial	40–70	F	1	Vegetation, fruiting

<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	R	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	R	+	Flowering, fruiting
<i>Koelpinia linearis</i>	annual	10–15	R	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Nonea caspica</i>	annual	5–7	R	+	flowering
<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Streptoloma desertorum</i>	annual	15–20	R	+	Flowering, fruiting
<i>Strigosella turkestanica</i>	annual	15–20	R	+	flowering
<i>Tulipa sogdiana</i>	Perennial	10–12	R	+	fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	vegetation

Table 11. Check-list of plants recorded for sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on sandy desert soil (turbine NU-11, 42.114379 N 60.519746 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	R	+	vegetation
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Bromus tectorum</i>	annual	10–15	F	1	flowering
<i>Calligonum leucocladum</i>	shrub	50–100	O	1	flowering
<i>Carex physodes</i>	Perennial	15–20	A	1	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	C	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Cousinia hamadae</i>	Perennial	20–25	O	+	vegetation
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering

<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	flowering
<i>Ferula foetida</i>	perennial	40–100	F	1	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	F	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Koelpinia linearis</i>	annual	10–15	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	C	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Flowering, fruiting
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Tulipa sogdiana</i>	Perennial	10–12	R	+	fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	O	1	vegetation

Table 12. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*) with *Ferula foetida*, winterfat (*Krascheninnikovia ceratoides*) and solitary *Calligonum leucocladium* on fixed shallow wavy sands (turbine NU-12, 42.0905074 N 60.565698 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Arnebia decumbens</i>	annual	10–15	O	+	flowering
<i>Arnebia transcaspica</i>	annual	10–15	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Astragalus harpilobus</i>	annual	7–10	R	+	flowering
<i>Bromus tectorum</i>	annual	10–15	F	1	flowering
<i>Calligonum leucocladium</i>	shrub	50–100	R	+	flowering
<i>Carex physodes</i>	Perennial	15–20	C	1	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	vegetation

<i>Ceratocarpus arenarius</i>	annual	7–10	O	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	R	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Ferula foetida</i>	perennial	50–100	O	1	Vegetation, fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Flowering, fruiting
<i>Nonea caspica</i>	annual	5–7	R	+	flowering
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	O	1	vegetation
<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Scorzonera sericeolanata</i>	Perennial	10–15	R	+	vegetation
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	10–15	R	+	Flowering, fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	O	1	vegetation

Table 13. Check-list of plants recorded for sedge-Ferula-winterfat-sagebrush community (*Artemisia diffusa*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on fixed shallow wavy sands (turbine NU-13, 42.094741 N 60.553437 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	O	+	vegetation
<i>Allium caspium</i>	Perennial	15–17	R	+	flowering
<i>Arnebia decumbens</i>	annual	10–15	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	flowering
<i>Astragalus villosissimus</i>	semishrub	35–40	O	+	Flowering, fruiting
<i>Bromus tectorum</i>	annual	10–15	F	+	flowering
<i>Carex physodes</i>	Perennial	15–20	C	1	fruiting

<i>Caroxylon orientale (Salsola orientalis)</i>	shrub	35–40	O	+	vegetation
<i>Ceratocarpus arenarius</i>	annual	7–10	R	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Ferula foetida</i>	perennial	50–100	C	1	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Goldbachia laevigata</i>	annual	15–20	R	+	Flowering, fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	20–25	F	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Nonea caspica</i>	annual	5–7	R	+	flowering
<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Silene nana</i>	annual	7–10	R	+	flowering
<i>Streptoloma desertorum</i>	annual	20–25	O	+	Flowering, fruiting
<i>Xylosalsola arbuscula (Salsola arbuscula)</i>	shrub	50–70	R	+	vegetation

Table 14. Check-list of plants recorded for sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-14, 42.094905 N 60.540022 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	F	1	vegetation
<i>Allium caspium</i>	Perennial	15–17	R	+	flowering
<i>Arnebia decumbens</i>	annual	15–20	O	+	flowering

<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	flowering
<i>Astragalus villosissimus</i>	semishrub	35–40	O	+	Flowering, fruiting
<i>Bromus tectorum</i>	annual	10–15	F	1	flowering
<i>Calligonum leucocladum</i>	shrub	50–100	R	+	flowering
<i>Carex physodes</i>	Perennial	15–20	A	1	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Ferula foetida</i>	perennial	50–100	C	1	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	R	+	fruiting
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	flowering
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Koelpinia linearis</i>	annual	10–15	R	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Stipagrostis karelinii</i>	Perennial	35–40	R	+	vegetation
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	vegetation

Table 15. Check-list of plants recorded for sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-15, 42.094569 N 60.527351 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	

<i>Allium caspium</i>	Perennial	15–17	R	+	flowering
<i>Arnebia decumbens</i>	annual	15–20	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	flowering
<i>Bromus tectorum</i>	annual	10–15	F	1	flowering
<i>Calligonum leucocladum</i>	shrub	50–100	R	+	flowering
<i>Carex physodes</i>	Perennial	15–20	A	1	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	C	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	C	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	C	+	flowering
<i>Ferula foetida</i>	perennial	50–100	A	2	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	O	+	fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	F	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	A	2	vegetation
<i>Lappula spinocarpos</i>	annual	10–15	R	+	Flowering, fruiting
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Stipagrostis karelinii</i>	Perennial	35–40	O	+	vegetation
<i>Strigosella turkestanica</i>	annual	15–20	O	+	flowering
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	vegetation

Table 16. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-16, 42.098134 N 60.520634 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Allium caspium</i>	Perennial	15–17	R	+	flowering

<i>Arnebia decumbens</i>	annual	15–20	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	flowering
<i>Bromus tectorum</i>	annual	10–15	F	1	flowering
<i>Calligonum leucocladum</i>	shrub	50–100	R	+	flowering
<i>Carex physodes</i>	Perennial	15–20	A	1	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	C	+	fruiting
<i>Chamaesphacos ilicifolius</i>	annual	7–10	O	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	C	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	C	+	flowering
<i>Ferula foetida</i>	perennial	40–100	C	1	Vegetation, fruiting
<i>Gagea divaricata</i>	perennial	7–10	O	+	fruiting
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	flowering
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypocoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	F	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	C	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Stipagrostis karelinii</i>	Perennial	35–40	R	+	vegetation
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	vegetation

Table 17. Check-list of plants recorded for sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*), sometimes with winterfat (*Krascheninnikovia ceratoides*) and *Ferula foetida* on sabulous-loamy grey-brown desert soil (upper part of planned electric line, between 42.090651 N 60.571974 E and 42.070571 N 60.505003 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	O	+	vegetation
<i>Alhagi pseudalhagi</i>	Perennial	25–30	O	+	vegetation
<i>Anabasis turkestanica</i>	semishrub	15–20	R	+	vegetation

<i>Arnebia decumbens</i>	annual	10–15	O	+	flowering
<i>Arnebia transcaspica</i>	annual	10–15	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	flowering
<i>Bassia eriophora</i>	annual	10–15	O	+	flowering
<i>Bromus tectorum</i>	annual	10–15	O	+	flowering
<i>Carex physodes</i>	Perennial	15–20	A	1	fruiting
<i>Caroxylon orientale (Salsola orientalis)</i>	shrub	30–35	F	1	vegetation
<i>Ceratocarpus arenarius</i>	annual	7–10	O	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Cousinia hamadae</i>	Perennial	20–25	R	+	vegetation
<i>Cuminum setifolium</i>	annual	10–15	R	+	fruiting
<i>Delphinium camptocarpum</i>	annual	10–15	R	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering
<i>Ferula foetida</i>	perennial	40–50	O	+	Vegetation, fruiting
<i>Goldbachia laevigata</i>	annual	12–15	O	+	Flowering, fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	15–20	O	+	Flowering, fruiting
<i>Koelpinia linearis</i>	annual	10–15	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	30–35	O	+	vegetation
<i>Lachnoloma lehmanii</i>	annual	15–20	O	+	Flowering, fruiting
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Flowering, fruiting
<i>Microcephala lamellata</i>	annual	10–15	R	+	flowering
<i>Nonea caspica</i>	annual	5–7	O	+	flowering
<i>Octoceras lehmannianum</i>	annual	10–15	R	+	Flowering, fruiting
<i>Oreosalsola arbusculiformis (Salsola arbusculiformis)</i>	shrub	35–40	F	2	vegetation

<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Scorzonera sericeolanata</i>	Perennial	10–15	O	+	vegetation
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Strigosella intermedia</i>	annual	7–10	O	+	flowering
<i>Strigosella turkestanica</i>	annual	15–20	O	+	flowering
<i>Tulipa sogdiana</i>	Perennial	10–12	O	+	fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	40–50	O	+	vegetation

Table 18. Check-list of plants recorded for sparse community of xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*) and ephemers on steep dry stony southern slope of Sultan Uvays Range (middle part of planned electric line, between 42.070571 N 60.505003 E and 42.051806 N 60.479849 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	20–25	R	+	vegetation
<i>Alhagi pseudalhagi</i>	Perennial	30–35	O	+	vegetation
<i>Alyssum desertorum</i>	annual	5–7	O	+	fruiting
<i>Anabasis eriopoda</i>	semishrub	15–20	R	+	vegetation
<i>Arnebia transcaspica</i>	annual	10–15	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	C	1	vegetation
<i>Astragalus subbijugus</i>	perennial	10–15	R	+	fruiting
<i>Astragalus villosissimus</i>	semishrub	30–35	O	+	flowering
<i>Atraphaxis spinosa</i>	shrub	35–40	O	1	fruiting
<i>Bassia eriophora</i>	annual	10–15	O	+	flowering
<i>Bromus tectorum</i>	annual	10–15	O	+	flowering
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	30–35	F	1	vegetation
<i>Ceratocarpus arenarius</i>	annual	7–10	O	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Cousinia hamadae</i>	Perennial	25–30	O	+	vegetation
<i>Cuminum setifolium</i>	annual	10–15	O	+	fruiting
<i>Cynanchum acutum</i> subsp. <i>sibiricum</i>	Perennial, liana	35–40	R	+	vegetation
<i>Ephedra lomatolepis</i>	shrub	20–25	O	1	vegetation
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	flowering

<i>Eremopyrum distans</i>	annual	7–10	O	+	flowering
<i>Ferula foetida</i>	perennial	40–50	R	+	Vegetation, fruiting
<i>Haloxylon ammodendron</i>	Small tree	120–150	R	+	vegetation
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hyoscyamus pusillus</i>	annual	7–10	R	+	fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Jurinea multiloba</i>	perennial	20–25	R	+	Flowering
<i>Koelpinia linearis</i>	annual	10–15	R	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	1	vegetation
<i>Lachnoloma lehmanii</i>	annual	15–20	O	+	Flowering, fruiting
<i>Lallemantia royleana</i>	annual	5–7	O	+	flowering
<i>Lappula spinocarpos</i>	annual	10–15	O	+	Flowering, fruiting
<i>Lepidium subcordatum</i>	Perennial	20–25	R	+	flowering
<i>Leptaleum filifolium</i>	annual	5–7	O	+	Flowering, fruiting
<i>Lomelosia olivieri</i> (<i>Scabiosa olivieri</i>)	annual	10–15	O	+	Flowering
<i>Lycium ruthenicum</i>	shrub	30–40	O	1	Flowering
<i>Matthiola tatarica</i>	Perennial	20–25	R	+	fruiting
<i>Nonea caspica</i>	annual	5–7	R	+	flowering
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	C	2	vegetation
<i>Paracaryum physodes</i>	annual	7–10	O	+	Flowering, fruiting
<i>Poa bulbosa</i>	Perennial	12–15	F	+	fruiting
<i>Scorzonera sericeolanata</i>	Perennial	15–20	O	+	vegetation
<i>Strigosella intermedia</i>	annual	7–10	O	+	flowering
<i>Takhtajianantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	O	+	Flowering, fruiting
<i>Tulipa sogdiana</i>	Perennial	10–12	R	+	fruiting
<i>Ziziphora tenuior</i>	annual	5–7	O	+	flowering
<i>Zygophyllum miniatum</i>	Perennial	10–15	O	+	fruiting

Table 19. Check-list of plants recorded for sedge-Astragalus-winterfat-sagebrush-saltwort community (Artemisia diffusa, A.turanica, Caroxylon orientale, Oreosalsola arbusculiformis, Krascheninnikovia ceratoides, Astragalus villosissimus, Carex physodes) with camelthorn (Alhagi pseudalhagi), Russian box thorn (Lycium ruthenicum), Calligonum junceum and black saxaul (*Haloxylon aphyllum*) on loamy-skeleton grey-brown desert soil (lower part of planned electric line, between 42.051806° N 60.479849° E and 42.021156° N 60.424323° E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	25–30	R	+	vegetation
<i>Aeluropus litoralis</i>	Perennial	10–15	R	+	fruiting
<i>Alhagi pseudalhagi</i>	Perennial	30–35	F	1	vegetation
<i>Alyssum desertorum</i>	annual	5–7	O	+	fruiting
<i>Anabasis eriopoda</i>	semishrub	15–20	O	+	vegetation
<i>Arnebia decumbens</i>	annual	10–15	O	+	flowering
<i>Arnebia transcaspica</i>	annual	10–15	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	C	1	vegetation
<i>Astragalus subbijugus</i>	perennial	10–15	R	+	fruiting
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	flowering
<i>Astragalus villosissimus</i>	semishrub	35–40	F	1	flowering
<i>Atraphaxis spinosa</i>	shrub	35–40	O	1	fruiting
<i>Bassia eriophora</i>	annual	10–15	O	+	flowering
<i>Bromus tectorum</i>	annual	10–15	F	+	flowering
<i>Calligonum junceum</i>	shrub	40–50	F	1	flowering
<i>Capparis spinosa</i>	Perennial	30–35	R	+	vegetation
<i>Carex physodes</i>	Perennial	15–20	F	1	fruiting
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	vegetation
<i>Ceratocarpus arenarius</i>	annual	7–10	F	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	fruiting
<i>Convolvulus fruticosus</i>	semishrub	30–35	O	+	flowering
<i>Convolvulus erinaceus</i>	semishrub	25–30	O	+	flowering
<i>Cousinia hamadae</i>	Perennial	25–30	O	+	vegetation
<i>Cuminum setifolium</i>	annual	10–15	O	+	fruiting
<i>Ephedra lomatolepis</i>	shrub	20–25	O	1	vegetation
<i>Ephedra strobilacea</i>	shrub	70–100	R	+	flowering
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	flowering
<i>Eremopyrum distans</i>	annual	7–10	F	+	flowering

<i>Erodium oxycarrhynchum</i>	annual	10–15	O	+	flowering
<i>Ferula foetida</i>	perennial	40–50	O	+	Vegetation, fruiting
<i>Goldbachia laevigata</i>	annual	15–20	O	+	Flowering, fruiting
<i>Haloxylon ammodendron</i>	Small tree	120–150	O	1	vegetation
<i>Haplophyllum bungei</i>	perennial	20–25	R	+	vegetation
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	flowering
<i>Heliotropium dasycarpum</i>	perennial	10–15	O	+	vegetation
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	Flowering, fruiting
<i>Hyoscyamus pusillus</i>	annual	7–10	O	+	fruiting
<i>Hypecoum pendulum</i>	annual	15–20	O	+	Flowering, fruiting
<i>Isatis emarginata</i>	annual	20–25	O	+	Flowering, fruiting
<i>Isatis minima</i>	annual	20–25	O	+	Flowering, fruiting
<i>Koelpinia linearis</i>	annual	10–15	O	+	Flowering, fruiting
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Lachnoloma lehmanii</i>	annual	15–20	F	+	Flowering, fruiting
<i>Lallemantia royleana</i>	annual	5–7	O	+	flowering
<i>Lappula spinocarpos</i>	annual	10–15	O	+	Flowering, fruiting
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Flowering, fruiting
<i>Lomelosia olivieri</i> (<i>Scabiosa olivieri</i>)	annual	15–20	O	+	Flowering
<i>Lycium ruthenicum</i>	shrub	40–50	F	1	Flowering
<i>Matthiola chenopodiifolia</i>	annual	12–15	O	+	flowering
<i>Microcephala lamellata</i>	annual	10–15	R	+	flowering
<i>Nonea caspica</i>	annual	5–7	O	+	flowering
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	C	2	vegetation
<i>Peganum harmala</i>	Perennial	25–30	O	+	vegetation
<i>Poa bulbosa</i>	Perennial	12–15	F	+	fruiting
<i>Roemeria hybrida</i>	annual	7–10	R	+	flowering
<i>Scorzonera sericeolanata</i>	Perennial	15–20	O	+	vegetation
<i>Streptoloma desertorum</i>	annual	15–20	O	+	Flowering, fruiting

<i>Strigosella intermedia</i>	annual	10–15	O	+	flowering
<i>Strigosella turkestanica</i>	annual	15–20	O	+	flowering
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	O	+	Flowering, fruiting
<i>Ziziphora tenuior</i>	annual	5–7	O	+	flowering
<i>Zygophyllum miniatum</i>	Perennial	10–15	R	+	fruiting

5 Conclusion

Following habitat types and vegetation communities can be identified within the project area:

- Weakly inclined, gentle hilly northern slope of relic low mountains with sedge-saltwort-sagebrush vegetation on sabulous-loamy grey-brown desert soil – this habitat type is represented within the wind park area, along access road and along the upper part of the planned power line;
- Fixed shallow wavy and hilly sands with sedge-*Ferula*-saltwort-winterfat-sagebrush vegetation, sometimes with *Calligonum* and solitary black saxaul – this habitat type is represented within the wind park area;
- Steep dry stony southern slope of relic low mountains with rugged terrain and sparse petrophytic vegetation – xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*), and annuals – this habitat type occurs along the middle part of planned power line;
- Weakly inclined piedmonts with sagebrush-saltwort and saltwort vegetation on loamy and skeleton, sometimes gypsaceous grey-brown desert soil, dissected with gravelly dry beds of temporary streams – this habitat type is represented in the lower part of planned power line;
- Transformed (anthropogenic) habitat with sparse communities of wild rue, camel thorn and annuals – this habitat type is represented in the lower part of planned power line, in the surroundings of cement factory, railway and road A-380.

The map of habitats and LULC map were created. During the field survey, all habitat types were inspected. The main type of landuse within the project area is use of rangelands for livestock.

In total, 85 plant species were recorded within the project area. One of them is nationally redlisted endemic, *Lepidium subcordatum* (Brassicaceae), assessed as rare, endangered species (category 2) in the Red Data Book of Uzbekistan (2019). Two small populations (8 and 11 generative specimens) of this plant have been found on the northern slope of Sultan Uvays along the planned electric line. This endemic species does not trigger Critical habitat Criterion 2 (habitat of significant importance to endemic and/or restricted-range species) because the project area contains less than 10% of its global habitat and population. Collection of seeds and sowing in the same habitat away of the power line is an option for protection and/or relocation of this rare plant.

Within the area of planned wind farm and along the access road, nationally or globally redlisted, or local endemic plants were not found. Most of species recorded for the project area are typical for desert zone of Central Asia and more or less common and widely spread.

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Annex 1. Check-list of flora

Plant species	Life form	Abundance	Distribution	Habitat	IUCN status	National status
Ephedraceae						
1. <i>Ephedra lomatolepis</i>	shrub	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Least Concern (LC)	none
2. <i>Ephedra strobilacea</i>	shrub	R–O	Regional	weakly inclined piedmonts, sands	Least Concern (LC)	none
Liliaceae						
3. <i>Gagea divaricata</i>	perennial	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
4. <i>Tulipa sogdiana</i>	Perennial	R–O	Regional	All types, except for transformed	Not Evaluated (NE)	none
Iridaceae						
5. <i>Iris longiscapa</i>	perennial	R	Regional	All types, except for transformed	Not Evaluated (NE)	none
Amaryllidaceae						
6. <i>Allium caspium</i>	Perennial	R	Regional	gentle northern slope	Not Evaluated (NE)	none
Cyperaceae						
7. <i>Carex physodes</i>	Perennial	D–F	Regional	All types	Not Evaluated (NE)	none
Poaceae						
8. <i>Aeluropus litoralis</i>	Perennial	R	Regional	Weakly inclined piedmonts (along dry riverbeds)	Least Concern (LC)	none
9. <i>Bromus tectorum</i>	annual	F–O	Transcontinental	All types	Not Evaluated (NE)	none
10. <i>Eremopyrum bonaepartis</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
11. <i>Eremopyrum distans</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
12. <i>Poa bulbosa</i>	Perennial	F–O	Transcontinental	steep stony slopes, weakly	Not Evaluated (NE)	none

				inclined piedmonts		
13. <i>Stipagrostis karelinii</i>	Perennial	R–O	Regional	sands	Not Evaluated (NE)	none
Papaveraceae						
14. <i>Hypocoum pendulum</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
15. <i>Roemeria hybrida</i>	annual	R	Regional	All types	Not Evaluated (NE)	none
Ranunculaceae						
16. <i>Ceratocephala falcata</i>	annual	F–R	Regional	All types	Not Evaluated (NE)	none
17. <i>Delphinium camptocarpum</i>	annual	R–F	Regional	All types, except for transformed	Not Evaluated (NE)	none
Zygophyllaceae						
18. <i>Zygophyllum miniatum</i>	Perennial	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Fabaceae						
19. <i>Alhagi pseudalhagi</i>	Perennial	R–F	Regional	All types	Not Evaluated (NE)	none
20. <i>Astragalus flexus</i>	perennial	R	Regional	sands	Not Evaluated (NE)	none
21. <i>Astragalus harpilobus</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
22. <i>Astragalus subbijugus</i>	perennial	R	Endemic	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
23. <i>Astragalus unifoliolatus</i>	semishrub	R–O	Regional	except for seep stony slopes and transformed	Not Evaluated (NE)	none
24. <i>Astragalus villosissimus</i>	semishrub	F–R	Regional	All types, except for transformed	Not Evaluated (NE)	none
Euphorbiaceae						
25. <i>Euphorbia turczaninowii</i>	annual	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
Geraniaceae						
26. <i>Erodium oxyrrhynchum</i>	annual	R–O	Regional	weakly inclined piedmonts, sands	Not Evaluated (NE)	none
Nitrariaceae						

27. <i>Peganum harmala</i>	Perennial	R–O	Regional	All types	Not Evaluated (NE)	none
Rutaceae						
28. <i>Haplophyllum bungei</i>	Perennial	R	Regional	All types, except for transformed	Not Evaluated (NE)	none
Capparaceae						
29. <i>Capparis spinosa</i>	perennial	R	Regional	Weakly inclined piedmonts (along dry riverbeds), transformed	Least Concern (LC)	none
Brassicaceae						
30. <i>Alyssum desertorum</i>	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
31. <i>Goldbachia laevigata</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
32. <i>Goldbachia sabulosa</i> (<i>Spirorrhynchus sabulosus</i>)	annual	R–O	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
33. <i>Isatis emarginata</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
34. <i>Isatis minima</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
35. <i>Lachnoloma lehmanii</i>	annual	R–F	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
36. <i>Lepidium subcordatum</i>	perennial	R	Endemic	steep stony slopes	Not Evaluated (NE)	UzRDB 2 (rare species)
37. <i>Leptaleum filifolium</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
38. <i>Matthiola chenopodiifolia</i>	annual	R–O	Regional	weakly inclined piedmonts	Not Evaluated (NE)	none
39. <i>Matthiola tatarica</i>	perennial	R	Regional	steep stony slopes	Not Evaluated (NE)	none
40. <i>Streptoloma desertorum</i>	annual	R–O	Regional	sands	Not Evaluated (NE)	none
41. <i>Strigosella intermedia</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
42. <i>Strigosella turkestanica</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
Polygonaceae						

43. <i>Atraphaxis spinosa</i>	shrub	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
44. <i>Calligonum junceum</i>	shrub	F–O	Regional	weakly inclined piedmonts	Not Evaluated (NE)	none
45. <i>Calligonum leucocladum</i>	shrub	O–R	Regional	sands	Not Evaluated (NE)	none
Caryophyllaceae						
46. <i>Acanthophyllum elatius</i>	Perennial	R–F	Regional	All types, except for transformed	Not Evaluated (NE)	none
47. <i>Silene nana</i>	annual	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
Amaranthaceae						
48. <i>Anabasis eriopoda</i>	semishrub	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
49. <i>Anabasis turkestanica</i>	semishrub	R	Regional	gentle northern slope	Not Evaluated (NE)	none
50. <i>Bassia eriophora</i>	annual	O	Regional	All types	Not Evaluated (NE)	none
51. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	semishrub	F–R	Regional	All types	Not Evaluated (NE)	none
52. <i>Ceratocarpus arenarius</i>	annual	F–R	Regional	All types	Not Evaluated (NE)	none
53. <i>Climacoptera</i> sp.	annual	O	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
54. <i>Haloxylon ammodendron</i> (<i>Haloxylon aphyllum</i>)	Small tree	R–O	Regional	All types, except for transformed	Not Evaluated (NE)	none
55. <i>Krascheninnikovia ceratoides</i>	semishrub	A–R	Regional	All types	Not Evaluated (NE)	none
56. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	semishrub	A–R	Regional	gentle northern slope, steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
57. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	Shrub	F–R	Regional	gentle northern slope, sands, weakly inclined piedmonts	Not Evaluated (NE)	none

Boraginaceae						
58. <i>Arnebia decumbens</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
59. <i>Arnebia transcaspica</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
60. <i>Heliotropium acutiflorum</i>	annual	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
61. <i>Heliotropium arguzioides</i>	Perennial	R–O	Regional	Except for steep stony slopes	Not Evaluated (NE)	none
62. <i>Heliotropium dasycarpum</i>	Perennial	R–O	Regional	weakly inclined piedmonts, transformed	Not Evaluated (NE)	none
63. <i>Heterocaryum szovitsianum</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
64. <i>Lappula spinocarpos</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
65. <i>Nonea caspica</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
66. <i>Paracaryum physodes</i>	annual	R–O	Regional	steep stony slopes	Not Evaluated (NE)	none
Convolvulaceae						
67. <i>Convolvulus erinaceus</i>	semishrub	R–O	Regional	weakly inclined piedmonts	Not Evaluated (NE)	none
68. <i>Convolvulus fruticosus</i>	semishrub	R–O	Regional	weakly inclined piedmonts	Not Evaluated (NE)	none
Solanaceae						
69. <i>Hyoscyamus pusillus</i>	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
70. <i>Lycium ruthenicum</i>	Shrub	R–F	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Lamiaceae						
71. <i>Chamaesphacos ilicifolius</i>	annual	R–O	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
72. <i>Lallemantia royleana</i>	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
73. <i>Ziziphora tenuior</i>	annual	R–O	Regional	steep stony slopes,	Not Evaluated (NE)	none

				weakly inclined piedmonts		
Asteraceae						
74. <i>Artemisia diffusa</i>	semishrub	C–D	Regional	All types, except for transformed	Not Evaluated (NE)	none
75. <i>Artemisia turanica</i>	semishrub	C–O	Regional	All types, except for transformed	Not Evaluated (NE)	none
76. <i>Cousinia hamadae</i>	perennial	R–O	Regional	All types	Not Evaluated (NE)	none
77. <i>Jurinea multiloba</i>	perennial	R	Regional	steep stony slopes	Not Evaluated (NE)	none
78. <i>Koelpinia linearis</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
79. <i>Microcephala lamellata</i>	annual	R	Regional	All types	Not Evaluated (NE)	none
80. <i>Scorzonera sericeolanata</i>	perennial	R–O	Regional	gentle northern slope, steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
81. <i>Takhtajaniant ha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	R–O	Regional	gentle northern slope, steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Caprifoliaceae						
82. <i>Lomelosia olivieri</i> (<i>Scabiosa olivieri</i>)	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Apiaceae						
83. <i>Cuminum setifolium</i>	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
84. <i>Ferula foetida</i>	Perennial	A–R	Regional	All types, except for transformed	Not Evaluated (NE)	none

Annex 2. Illustrations



*Photo 1. Sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Caroxylon orientale* (*Salsola orientalis*), *Carex physodes*) on sandy desert soil (turbine NU-01, 42.121962 N 60.51933 E).*



*Photo 2. Sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Caroxylon orientale* (*Salsola orientalis*), *Carex physodes*) on sandy desert soil (turbine NU-02, 42.121924 N 60.531331 E).*



Photo 3. Sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary black saxaul (*Haloxylon ammodendron*) on fixed wavy shallow sands (turbine NU-03, 42.12133 N 60.540971 E).



Photo 4. Sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) on fixed wavy shallow sands (turbine NU-04, 42.119458 N 60.551966 E).



Photo 5. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-05, 42.116807 N 60.562386 E).



Photo 6. Photo 6. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-06, 42.11358 N 60.572041 E).



Photo 7. Sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on fixed wavy shallow sands (turbine NU-07, 42.110178 N 60.582378 E).



Photo 8. Sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on sabulous-loamy grey-brown desert soil (turbine NU-08, 42.098034 N 60.585573 E).



Photo 9. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Caroxylon orientale*, *Carex physodes*) on sandy desert soil (turbine NU-09, 42.107179 N 60.591333 E).



Photo 10. Sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on sabulous-loamy grey-brown desert soil (turbine NU-10, 42.089532 N 60.578714 E).



Photo 11. Sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on sandy desert soil (turbine NU-11, 42.114379 N 60.519746 E).



Photo 12. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*) with *Ferula foetida*, winterfat (*Krascheninnikovia ceratoides*) and solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-12, 42.0905074 N 60.565698 E).



Photo 13. Sedge-Ferula-winterfat-sagebrush community (*Artemisia diffusa*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on fixed shallow wavy sands (turbine NU-13, 42.094741 N 60.553437 E).



Photo 14. Sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-14, 42.094905 N 60.540022 E).



Photo 15. Sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-15, 42.094569 N 60.527351 E).



Photo 16. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-16, 42.098134 N 60.520634 E).



Photo 17. Sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*) on sabulous-loamy grey-brown desert soil in upper part of planned electric line (between 42.090651° N 60.571974° E and 42.070571 N 60.505003 E).



Photo 18. Steep dry stony southern slope with sparse xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*) and ephemers (middle part of planned electric line, between 42.070571° N 60.505003° E and 42.051806 N 60.479849 E).



Photo 19. Sedge-Astragalus-winterfat-sagebrush-saltwort community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Krascheninnikovia ceratoides*, *Astragalus villosissimus*, *Carex physodes*) with *Calligonum junceum* on loamy-skeleton grey-brown desert soil (lower part of planned electric line, between 42.051806° N 60.479849° E and 42.021156° N 60.424323° E).



Photo 20. Sedge-Astragalus-winterfat-sagebrush-saltwort community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Krascheninnikovia ceratoides*, *Astragalus villosissimus*, *Carex physodes*) with *Calligonum junceum* and black saxaul (*Haloxylon aphyllum*) on loamy-skeleton grey-brown desert soil (lower part of planned electric line, between 42.051806° N 60.479849° E and 42.021156° N 60.424323° E).



Photo 21. Transformed habitat in surroundings of cement factory (lower part of planned electric line).



*Photo 22. Sedge-saltwort-sagebrush vegetation (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Carex physodes*) on sabulous-loamy grey-brown desert soil, gentle hilly northern slope of relic low mountains Sultan Uvays along the access road.*



Photo 23. *Artemisia diffusa*, the main dominant species of the vegetation of project area.



Photo 24. Nationally redlisted endemic *Lepidium subcordatum* on steep dry stony southern slope of relic low mountains Sultan Uvays (42.071833° N 60.500191° E).

**Nukus 100 MW
Wind Farm**

**BOTANICAL SUMMER
SURVEY**

CLIENT: 5 CAPITALS
Date: June 2022

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Introduction

The project area of Nukus 100 MW Wind Farm is situated in the northwestern part of the range Sultan Uvays (also called Sultanuizdag), in Beruniy district of Karakalpakstan, Republic of Uzbekistan. At the foot of the northwestern part of Sultan Uvays, in the Amudarya floodplain, 13 km to the south of the project area, there is situated the Lower Amudarya Biosphere Reserve (LABR), a protected area was included to the World Network of Biosphere Reserves by MAB UNESCO (Figure 1). This protected area and the physiography of the project region were described in the report on the spring botanical survey (Beshko, 2022).



Figure 1. Project area.

In accordance with TOR, the main tasks of expert-botanist are following:

- carrying out the field botanical survey and processing of field data;
- analysis of any previous botanical surveys and other available data (publications, reports, etc.) compared with the results of the field survey conducted in 2022;
- detailed description and GIS-based mapping of habitat types present in the project area, compilation of Habitat map and LULC (Land Use – Land Cover) map;
- compilation of the check-list of plant species recorded in the project area (in particular, threatened species included in the Red Data Book of Uzbekistan and/or the IUCN Red List);
- reporting.

. Literature review

An essay on the history of botanical research and detailed review of literature devoted to the flora and vegetation of Sultan Uvays range were presented in the report on the spring botanical survey (Beshko, 2022).

The spring botanical survey was carried out April 28–30, 2022. All planned turbine locations (NU-01 to NU-16) were inspected, as well as the north slope of Sultan Uvays range along the planned electric line. The structure of plant communities was

studied on 100x100 m geobotanical sample plots; check-lists of plant species recorded for each sample plot and a summary check-list of the flora of project area were compiled. In total, 85 plant species were recorded within the project area, including one nationally redlisted species, *Lepidium subcordatum* (Brassicaceae), national endemic and endemic to relic mountains of Kyzylkum and plateau Ustyurt, assessed as rare, endangered species (category 2) in the Red Data Book of Uzbekistan (2019). Two small populations (8 and 11 generative specimens) of this plant have been found on the northern slope of Sultan Uvays along the planned electric line. The analysis performed in accordance with the International Finance Corporation (IFC) Performance Standard 6 (PS6) and EBRD Performance Requirement 6 (PR6) showed that *Lepidium subcordatum* does not trigger Critical habitat Criterion 2 (habitat of significant importance to endemic and/or restricted-range species) because the project area contains less than 10% of its global habitat and population. Within the area of planned wind farm and along the access road, nationally or globally redlisted, or local endemic plants were not found.

Five habitat types (4 natural and 1 transformed) were identified and mapped within the project area (Figure 2):

- Weakly inclined, gentle hilly northern slope of relic low mountains with sedge-saltwort-sagebrush vegetation on sabulous-loamy grey-brown desert soil – this habitat type is represented within the wind park area and along the upper part of the planned power line;
- Fixed shallow wavy and hilly sands with sedge-Ferula-saltwort-winterfat-sagebrush vegetation, sometimes with *Calligonum* and solitary black saxaul – this habitat type is represented within the wind park area;
- Steep dry stony southern slope of relic low mountains with rugged terrain and sparse petrophytic vegetation – xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*), and annuals – this habitat type occurs along the middle part of planned power line;
- Weakly inclined piedmonts with sedge-sagebrush-saltwort and saltwort vegetation on loamy and skeleton, sometimes gypsaceous grey-brown desert soil, dissected with gravelly dry beds of temporary streams – this habitat type is represented in the lower part of planned power line;
- Transformed (anthropogenic) habitat with sparse communities of wild rue, camel thorn and annuals – this habitat type is represented in the lower part of planned power line, in the surroundings of cement factory, railway and road A-380.

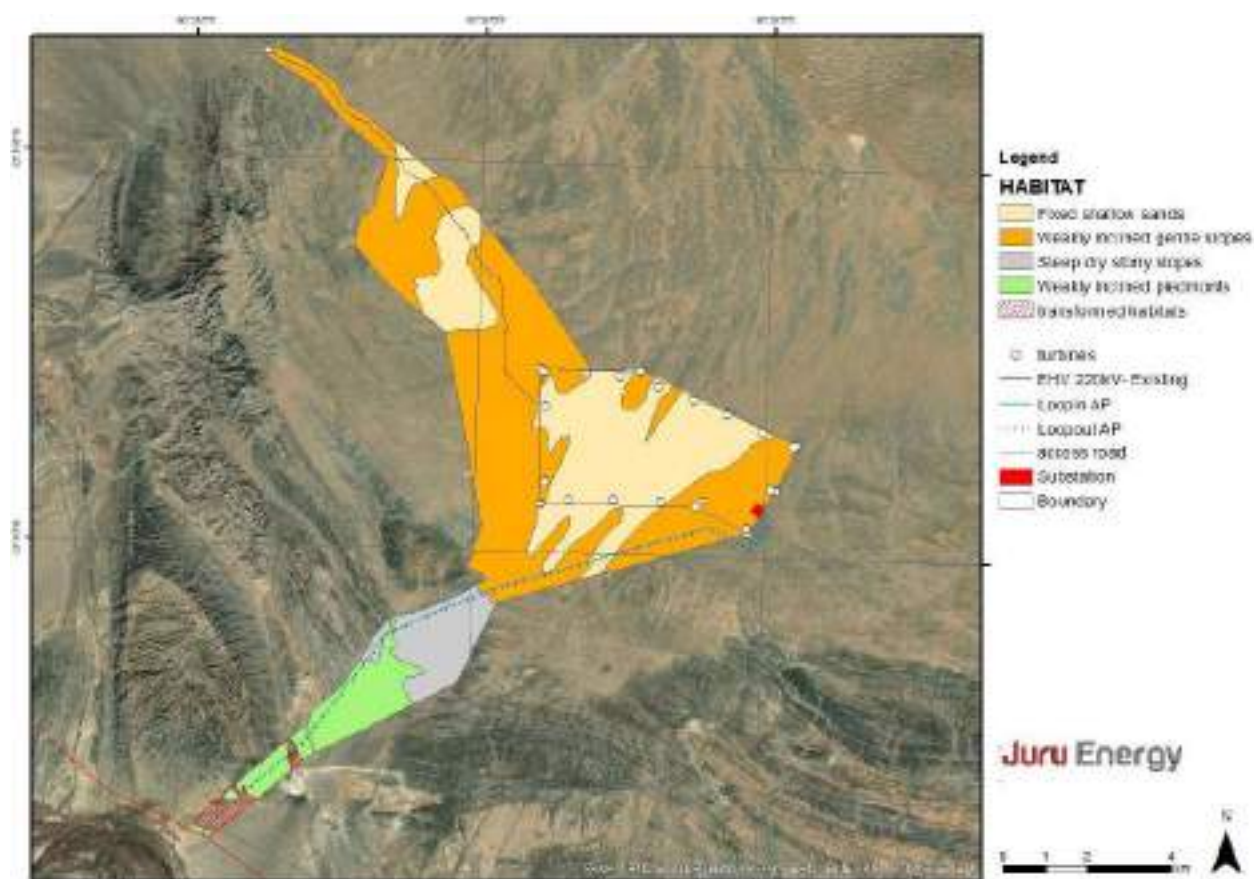


Figure 2. Map of habitats of the project area

According to IUCN Habitats Classification Scheme, ver. 3.1 (<https://www.iucnredlist.org/resources/habitat-classification-scheme>), all these habitats belong to the type 8 (Desert), subtype 8.2 (Desert – Temperate). According to the IUCN Global Ecosystem Typology ver. 2.0 (2020), the habitats of the project area belong to T5 Deserts and semi-deserts biome and T5.4 Cool deserts and semi-deserts ecosystem functional group of terrestrial realm.

The habitat/LULC map was created using QGIS 3.18 free software on the basis of visual interpretation of Google Earth free satellite imagery, topographic maps (1:100,000, available online for free at <http://loadmap.net/>), and the data of field survey.

Materials and methods

The summer field survey was carried out June 30, 2022, by traditional methods of botanical research commonly used for sampling and mapping of native non-forest vegetation, recognition of floristic composition and spatial patterns of plant communities (Field geobotany, 1959–1976; Granitov, 1980; Kent, 2011). All planned turbine locations (NU-01 to NU-16) were inspected, as well as the planned electric line and access roads. The structure of plant communities was studied on 100x100 m geobotanical sample plots; check-lists of plant species recorded for each sample plot and a summary check-list were compiled.

For each sample plot, photographs of the landscape and vegetation were taken using a digital camera, and following data were recorded: location and physical environment (including GPS coordinates, elevation, topography, and soil type), state of

vegetation, type of land use and disturbance factors (grazing, roads, etc.), plant community, canopy cover (%), all plant species present at the plot, their cover and abundance, phenological stage and height. Species abundance was determined using the Braun-Blanquet cover-abundance scale (+ – occasional and less than 1% cover of the sample plot area; 1 – abundant with low cover, or less abundant but with higher cover, 1–5% of the sample plot area; 2 – abundant with >5–25% of the sample plot area, irrespective of the number of individuals; 3 – >25–50% cover of the sample plot area, irrespective of the number of individuals; 4 – >50–75% cover of the sample plot area, irrespective of the number of individuals; 5 – >75% cover of the sample plot area, irrespective of the number of individuals) and the DACFOR scale: D – Dominant; A – Abundant, C – Common, F – Frequent, O – Occasional, R – Rare.

The final check-list of plant species recorded during the spring and summer surveys was compiled (Annex 1), and botany data template (MS Excel table) was filled. Species in the checklist are arranged in taxonomical order in accordance with the APG system (APG IV, 2016). Accepted scientific names are provided in accordance with the online global databases Plants of the World Online (www.plantsoftheworldonline.org/), International Plant Names Index (www.ipni.org) and Global Biodiversity Information Facility (www.gbif.org), as well as with recently published treatments of different taxonomical groups of the flora of Uzbekistan (Sennikov, 2016, 2017, 2019).

Plant species were identified using special literature, as “Conspectus Florae Asiae Mediae” (1963–1993), “Flora of Uzbekistan” (1941–1963, 2016, 2017, 2019) and “Flora of USSR” (1934–1964). Available publications and online databases (Nikitin, 1983; IUCN/ISSG, 2014; CABI, 2017; Sennikov et al., 2018) were used for identification of alien species, while the Red Data Book of Uzbekistan (1984, 1998, 2006, 2009, 2019) and the IUCN Red List (www.iucnredlist.org) were used for identification of threatened species.

It should be noted that currently only 258 taxa of more than 4380 species recorded for the flora of Uzbekistan were assessed by IUCN, 16 species of them were included in the IUCN Red List as threatened (5 – CR, 8 – EN, 3 – VU), 8 of them are redlisted at the national level. The majority of species has not yet been assessed by IUCN and belongs to NE category – Not Evaluated.

To date, 5 editions of the Red Data Book of Uzbekistan have been published. The first (1984) included 163 plant species, the second (1998) – 301, the third (2006) – 302, the fourth (2009) – 321, and an actual, fifth edition (2019), includes 314 plant species. National categories of threatened plants are follows: 0 (probably extinct species) – corresponds to EX or EW categories of the IUCN Red List (www.iucnredlist.org), 1 (endangered, disappearing species) – meets CR category of IUCN, 2 (rare species) – meets EN category of IUCN and 3 (vulnerable, declining species) – corresponds to VU or NT category of IUCN.

For the purposes of implementation of IFC Performance Standard 6, habitats are divided into modified, natural, and critical. Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area’s primary ecological functions and species composition. Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area’s primary ecological functions and species composition. Critical habitats are a subset of modified or natural habitats.

As defined by the International Finance Corporation (IFC) Performance Standard 6 (PS6) and EBRD Performance Requirement 6 (PR6), critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant

concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes. Numerical thresholds have been defined for the first four critical habitat criteria (i.e., CR/EN species; endemic/restricted-range species; migratory/congregatory species; threatened and unique ecosystems); these thresholds are based on those published by IUCN in “A Global Standard for the Identification of Key Biodiversity Areas” (2016) and “IUCN Red List Categories and Criteria” (2012). For Criterion 5, there are no numerical thresholds.

Criterion 1 is triggered by species listed as CR or EN on the IUCN Red List, and nationally/regionally listed species assessed using similar criteria. Criterion 2 is triggered by habitats of significant importance for endemic or restricted-range species. Criterion 3 (migratory species) is inapplicable for plants. As for Criterion 4, unfortunately, the officially approved national list of highly threatened and/or unique ecosystems and habitats does not exist in Uzbekistan. But the National Biodiversity Conservation Strategy (1998), National reports on biodiversity conservation (2006, 2015) and other documents (Ismatov, 2013) indicated that the problem of conservation of all types of forest ecosystems (including desert shrublands) is a very critical issue in Uzbekistan. A specific legislation, management and forest protection measures are present at the national level.

The habitat and LULC maps were created using QGIS 3.18 free software on the basis of visual interpretation of Google Earth free satellite imagery, topographic maps (1:100,000, available online for free at <http://loadmap.net/>), and the data of field survey.

Results of the field survey

The summer survey 2022 was conducted June, 30, and confirmed the results of vegetation description and habitat mapping performed in April 2022 (5 types of habitats and their boundaries). In June, all habitat types were resurveyed. Some corrections were made in the checklists of species recorded within survey plots and in the general checklist of flora. The main difference between spring and summer aspect of vegetation of the project area is the high abundance of ephemers and ephemeroids (first of all, desert sedge, *Carex physodes*) and low abundance of annual saltworts in spring season. After end of growing season (late April-early May), ephemers and ephemeroids fade quickly and begin a long dormant period which continues for nine months. Since at the end of June the dry above-ground part of these plants has already been eaten by livestock and scattered by the wind, their abundance decreased, as well as the canopy cover. On the contrary, annual saltworts (*Salsola*, *Suaeda*, *Climacoptera*, *Halimocnemis*, *Ceratocarpus* and other annual representatives of the family Amaranthaceae) begin their vegetation in late spring, bloom and bear fruit in summer and autumn.

It has been confirmed, that following habitat types and vegetation communities are represented in the project area:

- Weakly inclined, gentle hilly northern slope of relic low mountains with sedge-saltwort-sagebrush vegetation on sabulous-loamy grey-brown desert soil – this habitat type is represented within the wind park area and along the upper part of the planned power line;
- Fixed shallow wavy and hilly sands with sedge-*Ferula*-saltwort-winterfat-sagebrush vegetation, sometimes with *Calligonum* and solitary black saxaul – this habitat type is represented within the wind park area;

- Steep dry stony southern slope of relic low mountains with rugged terrain and sparse petrophytic vegetation – xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*), and annuals – this habitat type occurs along the middle part of planned power line;

- Weakly inclined piedmonts with sedge-sagebrush-saltwort and saltwort vegetation on loamy and skeleton, sometimes gypsaceous grey-brown desert soil, dissected with gravelly dry beds of temporary streams – this habitat type is represented in the lower part of planned power line;

- Transformed (anthropogenic) habitat with sparse communities of wild rue, camel thorn and annuals – this habitat type is represented in the lower part of planned power line, in the surroundings of cement factory, railway and road A-380.

It has been confirmed, that the vegetation of the project area is dominated by sagebrush (*Artemisia diffusa*, *A. turanica*), saltworts (*Oreosalsola arbusculiformis* (*Salsola arbusculiformis*), *Caroxylon orientale* (*Salsola orientalis*), *Xylosalsola arbuscula* (*Salsola arbuscula*)), desert sedge (*Carex physodes*), on some plots sub-dominants are *Ferula foetida*, *Calligonum leucocladum* or black saxaul (*Haloxylon ammodendron*). The canopy cover is 10–20% (sometimes 30%) within the wind farm area and 5–10% or less (almost 0) along the planned electric line on steep and stony southern slope of Sultan Uvays range.

The small trees of black saxaul (*Haloxylon ammodendron*) occurring sporadically within the project area are represented by both natural populations and plantations created in the past to protect against wind erosion. The places where the sowing of saxaul was carried out (often unsuccessfully) can be well identified on a satellite image by parallel furrows running at intervals of 80–100 m.

In total, 95 plant species of 26 families were recorded within the project area during the spring and summer surveys, none of them are globally threatened, and one species is redlisted at the national level. During the spring survey, two small populations (8 and 11 generative specimens) of nationally redlisted *Lepidium subcordatum* (Brassicaceae) have been found on the northern slope of Sultan Uvays along the planned electric line (Beshko, 2022). In June, this plant has already finished its growing season and its aerial part has dried up and scattered by the wind. Thus, only 2 and 3 specimens of *Lepidium subcordatum* were recorded in the same two localities, respectively. Within the area of planned wind farm and along the access road, nationally or globally redlisted, or local endemic plants were not found. Most of species recorded for the project area are typical for desert zone of Central Asia and more or less common and widely spread.

As it was noted in the the report on the spring botanical survey, all natural habitats of project area are used by the local people mainly as rangelands for sheeps, horses and camels. June survey showed that due to lack of water, only small herds of horses and camels remain in the project area at summer. Shepherds with large flocks of sheep use the pastures seasonally.

Descriptions of plant communities made in June within locations of wind turbines and along the planned electric line are presented below (Tables 1–19). Photographs are represented in Annex 2.

Table 1. Check-list of plants recorded for sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale* (*Salsola orientalis*), *Carex physodes*) with solitary black saxaul (*Haloxylon ammodendron*) on sandy desert soil (turbine NU-01, 42.121962 N 60.51933 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation

<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Carex physodes</i>	Perennial	10–15	F	1	dried
<i>Ceratocephala falcata</i>	annual	5–6	R	+	dried
<i>Climacoptera turcomanica</i>	annual	25–30	O	+	fruiting
<i>Corispermum lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Halimocnemis latifolia</i>	annual	10–12	F	1	flowering
<i>Haloxylon ammodendron</i>	Small tree	100–120	O	1	vegetation
<i>Heterocaryum szovitsianum</i>	perennial	10–15	R	+	dried
<i>Horaninovia ulicina</i>	annual	15–20	R	+	vegetation
<i>Koelpinia linearis</i>	annual	10–15	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	+	vegetation
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	O	1	flowering
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Strigosella turkestanica</i>	annual	15–20	R	+	dried
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	R	+	dried
<i>Tulipa sogdiana</i>	Perennial	10–15	R	+	dried

Table 2. Check-list of plants recorded for sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale* (*Salsola orientalis*), *Carex physodes*) with solitary black saxaul (*Haloxylon ammodendron*) and *Ferula foetida* on sandy desert soil (turbine NU-02, 42.121924 N 60.531331 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Carex physodes</i>	Perennial	10–15	F	1	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	C	1	flowering
<i>Ceratocarpus arenarius</i>	annual	15–20	O	+	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	R	+	dried
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Ferula foetida</i>	perennial	40–50	O	+	dried
<i>Haloxylon ammodendron</i>	Small tree	100–120	R	+	vegetation
<i>Heterocaryum szovitsianum</i>	perennial	10–15	R	+	dried
<i>Hypocoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried

<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	+	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Strigosella turkestanica</i>	annual	15–20	R	+	dried
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	O	+	flowering

Table 3. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary black saxaul (*Haloxylon ammodendron*) and *Calligonum* on fixed wavy shallow sands (turbine NU-03, 42.12133 N 60.540971 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Arnebia transcaspica</i>	annual	10–15	R	+	dried
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	R	+	dried
<i>Calligonum leucocladum</i>	shrub	50–70	R	+	vegetation
<i>Carex physodes</i>	Perennial	15–20	A	1	dried
<i>Ceratocarpus arenarius</i>	annual	15–20	O	+	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	dried
<i>Chamaesphacos ilicifolius</i>	annual	7–10	R	+	dried
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	40–50	C	1	dried
<i>Haloxylon ammodendron</i>	Small tree	100–120	R	+	vegetation
<i>Heliotropium arguzioides</i>	perennial	15–20	R	+	fruiting
<i>Heterocaryum szovitsianum</i>	perennial	10–15	R	+	dried
<i>Hypocoum pendulum</i>	annual	15–20	R	+	dried
<i>Iris songarica</i>	perennial	25–30	R	+	vegetation
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	A	2	vegetation
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	C	1	flowering

Table 4. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary black saxaul (*Haloxylon ammodendron*), sand acacia (*Ammodendron conollyi*) and *Calligonum* on fixed wavy shallow sands (turbine NU-04, 42.119458 N 60.551966 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	R	+	flowering
<i>Ammodendron conollyi</i>	Small tree	70–100	R	+	vegetation
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation

<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Bromus tectorum</i>	annual	10–15	R	+	dried
<i>Calligonum leucocladum</i>	shrub	50-70	R	+	vegetation
<i>Carex physodes</i>	Perennial	15–20	F	1	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	O	+	flowering
<i>Ceratocarpus arenarius</i>	annual	15–20	O	+	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	R	+	dried
<i>Corispermum lehmannianum</i>	annual	15–20	O	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	40–50	F	1	dried
<i>Hypecoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	A	2	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	O	+	flowering
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Streptoloma desertorum</i>	annual	15–20	R	+	Dried
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	1	flowering

Table 5. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-05, 42.116807 N 60.562386 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	O	+	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	fruiting
<i>Astragalus villosissimus</i>	semishrub	35–40	R	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Calligonum leucocladum</i>	shrub	50–100	O	1	fruiting
<i>Carex physodes</i>	Perennial	15–20	A	1	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	Flowering
<i>Ceratocephala falcata</i>	annual	5–6	R	+	Dried
<i>Corispermum lehmannianum</i>	annual	15–20	O	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	dried
<i>Eremopyrum distans</i>	annual	7–10	F	+	dried

<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	40–100	O	+	dried
<i>Haplophyllum bungei</i>	perennial	20–25	R	+	fruiting
<i>Heliotropium arguzioides</i>	perennial	15–20	R	+	fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Horaninovia ulicina</i>	annual	15–20	R	+	vegetation
<i>Hypecoum pendulum</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	1	flowering

Table 6. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-06, 42.11358 N 60.572041 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	C	1	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	fruiting
<i>Astragalus villosissimus</i>	semishrub	35–40	R	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Calligonum leucocladum</i>	shrub	50–100	O	1	fruiting
<i>Carex physodes</i>	Perennial	15–20	A	1	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	O	+	flowering
<i>Ceratocephala falcata</i>	annual	5–6	O	+	dried
<i>Corispermum lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	40–100	O	+	dried
<i>Haplophyllum bungei</i>	perennial	20–25	R	+	fruiting
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	fruiting
<i>Horaninovia ulicina</i>	annual	15–20	R	+	vegetation
<i>Hypecoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Stipagrostis karelinii</i>	Perennial	35–40	R	+	fruiting

<i>Strigosella turkestanica</i>	annual	15–20	R	+	dried
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	flowering

Table 7. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on fixed wavy shallow sands (turbine NU-07, 42.110178 N 60.582378 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	O	+	flowering
<i>Allium sabulosum</i>	Perennial	15–20	R	+	fruiting
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Calligonum leucocladum</i>	shrub	50–100	R	+	fruiting
<i>Carex physodes</i>	Perennial	15–20	C	1	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	flowering
<i>Ceratocarpus arenarius</i>	annual	10–15	O	+	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	R	+	dried
<i>Chrozophora sabulosa</i>	annual	15–20	R	+	fruiting
<i>Corispermum lehmannianum</i>	annual	15–20	O	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	R	+	dried
<i>Eremopyrum distans</i>	annual	7–10	R	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	40–100	O	+	dried
<i>Haplophyllum bungei</i>	perennial	20–25	R	+	fruiting
<i>Heliotropium arguzioides</i>	perennial	15–20	R	+	fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Hypocoum pendulum</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Stipagrostis karelinii</i>	Perennial	35–40	R	+	fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	flowering

Table 8. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on sabulous-loamy grey-brown desert soil (turbine NU-08, 42.098034 N 60.585573 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Bromus tectorum</i>	annual	10–15	R	+	dried
<i>Carex physodes</i>	Perennial	15–20	C	1	dried

<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	flowering
<i>Ceratocarpus arenarius</i>	annual	10–15	F	1	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	F	+	Dried
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Ferula foetida</i>	perennial	40–100	O	+	Dried
<i>Halimocnemis latifolia</i>	annual	10–12	R	+	flowering
<i>Halimocnemis macrantha</i>	annual	10–12	R	+	flowering
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	fruiting
<i>Hypocoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia</i> <i>ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	dried
<i>Streptoloma desertorum</i>	annual	15–20	O	+	dried
<i>Strigosella intermedia</i>	annual	10–15	R	+	dried
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	R	+	dried
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	flowering
<i>Ziziphora tenuior</i>	annual	5–6	O	+	Dried

Table 9. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Caroxylon orientale*, *Carex physodes*) on sandy desert soil (turbine NU-09, 42.107179 N 60.591333 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun- Blanquet	
<i>Alhagi pseudalhagi</i>	Perennial	25–30	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	A	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	O	+	vegetation
<i>Atraphaxis spinosa</i>	shrub	25–30	R	+	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Calligonum leucocladum</i>	shrub	40–50	R	+	vegetation
<i>Carex physodes</i>	Perennial	15–20	C	1	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	flowering
<i>Ceratocarpus arenarius</i>	annual	10–15	F	1	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	F	+	dried
<i>Corispermum</i> <i>lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Cousinia hamadae</i>	Perennial	20–25	R	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Ferula foetida</i>	perennial	50–100	O	+	dried
<i>Halimocnemis latifolia</i>	annual	10–12	O	+	flowering
<i>Halimocnemis macrantha</i>	annual	10–12	O	+	flowering
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	fruiting

<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Hypecoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Strigosella turkestanica</i>	annual	15–20	R	+	dried
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	R	+	dried
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	O	1	flowering

Table 10. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on sabulous-loamy grey-brown desert soil (turbine NU-10, 42.089532 N 60.578714 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	O	+	flowering
<i>Anabasis aphylla</i>	semishrub	20–25	R	+	vegetation
<i>Anabasis turkestanica</i>	semishrub	10–15	R	+	vegetation
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Carex physodes</i>	Perennial	15–20	C	+	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	flowering
<i>Ceratocarpus arenarius</i>	annual	10–15	O	+	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	R	+	dried
<i>Cousinia hamadae</i>	Perennial	20–25	R	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Ferula foetida</i>	perennial	40–70	O	+	dried
<i>Halimocnemis latifolia</i>	annual	10–12	O	+	flowering
<i>Halimocnemis macrantha</i>	annual	10–12	O	+	flowering
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Hypecoum pendulum</i>	annual	15–20	R	+	dried
<i>Koelpinia linearis</i>	annual	10–15	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	dried
<i>Tulipa sogdiana</i>	Perennial	10–12	R	+	dried
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	flowering

Table 11. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladium* on sandy desert soil (turbine NU-11, 42.114379 N 60.519746 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	R	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Calligonum leucocladium</i>	shrub	50–100	O	1	fruiting
<i>Carex physodes</i>	Perennial	15–20	C	1	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	flowering
<i>Ceratocarpus arenarius</i>	annual	10–15	O	+	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	Dried
<i>Chamaesphacos ilicifolius</i>	annual	7–10	R	+	Dried
<i>Corispermum lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Cousinia hamadae</i>	Perennial	20–25	O	+	flowering
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Euphorbia turczaninowii</i>	annual	7–10	R	+	dried
<i>Ferula foetida</i>	perennial	40–100	O	+	dried
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Hypocoum pendulum</i>	annual	15–20	O	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Koelpinia linearis</i>	annual	10–15	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	C	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	O	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	O	1	flowering

Table 12. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*) with *Ferula foetida*, winterfat (*Krascheninnikovia ceratoides*) and solitary *Calligonum leucocladium* on fixed shallow wavy sands (turbine NU-12, 42.0905074 N 60.565698 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Calligonum leucocladium</i>	shrub	50–100	R	+	fruiting
<i>Carex physodes</i>	Perennial	15–20	F	1	dried
<i>Caroxylon orientale</i>	shrub	35–40	F	1	flowering

<i>(Salsola orientalis)</i>					
<i>Ceratocarpus arenarius</i>	annual	10–15	O	+	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	dried
<i>Corispermum lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	dried
<i>Eremopyrum distans</i>	annual	7–10	F	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	50–100	O	+	dried
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Dried
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	O	1	flowering
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	O	1	vegetation

Table 13. Check-list of plants recorded for sedge-Ferula-winterfat-sagebrush community (*Artemisia diffusa*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on fixed shallow wavy sands (turbine NU-13, 42.094741 N 60.553437 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	O	+	flowering
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	fruiting
<i>Astragalus villosissimus</i>	semishrub	35–40	O	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Carex physodes</i>	Perennial	15–20	F	1	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	O	+	flowering
<i>Ceratocarpus arenarius</i>	annual	10–15	O	+	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	dried
<i>Corispermum lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	F	+	dried
<i>Eremopyrum distans</i>	annual	7–10	F	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	50–100	O	+	dried
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Horaninovia ulicina</i>	annual	15–20	R	+	vegetation
<i>Hypocoum pendulum</i>	annual	20–25	R	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia</i>	semishrub	35–40	F	1	vegetation

<i>ceratoides</i>					
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	R	+	flowering

Table 14. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-14, 42.094905 N 60.540022 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	F	1	flowering
<i>Anabasis aphylla</i>	semishrub	25–30	R	+	vegetation
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	fruiting
<i>Astragalus villosissimus</i>	semishrub	35–40	O	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Calligonum leucocladum</i>	shrub	50–100	R	+	fruiting
<i>Carex physodes</i>	Perennial	15–20	F	1	dried
<i>Ceratocarpus arenarius</i>	annual	7–10	R	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	R	+	dried
<i>Chamaesphacos ilicifolius</i>	annual	7–10	R	+	dried
<i>Corispermum lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	50–100	F	1	dried
<i>Halimocnemis latifolia</i>	annual	10–12	O	+	flowering
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Horaninovia ulicina</i>	annual	15–20	R	+	vegetation
<i>Hypocoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Koelpinia linearis</i>	annual	10–15	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Stipagrostis karelinii</i>	Perennial	35–40	R	+	Fruiting
<i>Streptoloma desertorum</i>	annual	15–20	R	+	dried
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	flowering

Table 15. Check-list of plants recorded for sedge-Ferula-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-15, 42.094569 N 60.527351 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Allium sabulosum</i>	Perennial	15–20	R	+	fruiting
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	flowering
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Calligonum leucocladum</i>	shrub	50–100	R	+	fruiting
<i>Carex physodes</i>	Perennial	15–20	A	1	dried
<i>Ceratocarpus arenarius</i>	annual	7–10	R	+	vegetation
<i>Ceratocephala falcata</i>	annual	5–6	O	+	dried
<i>Corispermum lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	50–100	F	1	dried
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Horaninovia ulicina</i>	annual	15–20	R	+	vegetation
<i>Hypocoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	A	2	vegetation
<i>Lappula spinocarpos</i>	annual	10–15	R	+	dried
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Stipagrostis karelinii</i>	Perennial	35–40	O	+	fruiting
<i>Strigosella turkestanica</i>	annual	15–20	R	+	dried
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	flowering

Table 16. Check-list of plants recorded for sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-16, 42.098134 N 60.520634 E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Artemisia diffusa</i>	semishrub	25–30	D	2	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	O	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	F	1	dried
<i>Calligonum leucocladum</i>	shrub	50–100	R	+	fruiting
<i>Carex physodes</i>	Perennial	15–20	A	1	dried
<i>Ceratocarpus arenarius</i>	annual	7–10	O	+	vegetation

<i>Ceratocephala falcata</i>	annual	5–6	C	+	dried
<i>Corispermum lehmannianum</i>	annual	15–20	R	+	fruiting
<i>Delphinium camptocarpum</i>	annual	15–20	O	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	C	+	dried
<i>Eremopyrum distans</i>	annual	7–10	C	+	dried
<i>Euphorbia turczaninowii</i>	annual	10–12	R	+	dried
<i>Ferula foetida</i>	perennial	40–100	C	1	dried
<i>Halimocnemis latifolia</i>	annual	10–12	O	+	flowering
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	dried
<i>Horaninovia ulicina</i>	annual	15–20	R	+	vegetation
<i>Hypocoum pendulum</i>	annual	15–20	O	+	dried
<i>Isatis emarginata</i>	annual	15–20	O	+	dried
<i>Isatis minima</i>	annual	15–20	F	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	C	1	vegetation
<i>Leptaleum filifolium</i>	annual	5–7	R	+	dried
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Stipagrostis karelinii</i>	Perennial	35–40	R	+	fruiting
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50–70	F	2	flowering

Table 17. Check-list of plants recorded for sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*), sometimes with winterfat (*Krascheninnikovia ceratoides*) and *Ferula foetida* on sabulous-loamy grey-brown desert soil (upper part of planned electric line, between 42.090651° N 60.571974° E and 42.070571° N 60.505003° E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	30–35	O	+	flowering
<i>Alhagi pseudalhagi</i>	Perennial	25–30	O	+	flowering
<i>Anabasis turkestanica</i>	semishrub	15–20	R	+	vegetation
<i>Artemisia diffusa</i>	semishrub	25–30	A	2	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	F	1	vegetation
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	fruiting
<i>Bassia eriophora</i>	annual	10–15	O	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	O	+	dried
<i>Carex physodes</i>	Perennial	15–20	F	+	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	30–35	F	1	flowering
<i>Ceratocarpus arenarius</i>	annual	10–15	F	1	fruiting
<i>Ceratocephala falcata</i>	annual	5–6	R	+	dried
<i>Cousinia hamadae</i>	Perennial	20–25	R	+	flowering
<i>Cuminum setifolium</i>	annual	10–15	R	+	dried
<i>Delphinium camptocarpum</i>	annual	10–15	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Ferula foetida</i>	perennial	40–50	O	+	dried
<i>Goldbachia laevigata</i>	annual	12–15	R	+	dried

<i>Halimocnemis latifolia</i>	annual	10–12	O	+	flowering
<i>Halimocnemis macrantha</i>	annual	10–12	R	+	flowering
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	dried
<i>Hypecoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis emarginata</i>	annual	15–20	R	+	dried
<i>Isatis minima</i>	annual	15–20	R	+	dried
<i>Koelpinia linearis</i>	annual	10–15	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	30–35	O	+	vegetation
<i>Lachnoloma lehmanii</i>	annual	15–20	O	+	fruiting
<i>Leptaleum filifolium</i>	annual	5–7	F	+	Dried
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	F	2	flowering
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Salsola paulsenii</i>	annual	20–25	R	+	vegetation
<i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	40–50	O	+	flowering

Table 18. Check-list of plants recorded for sparse community of xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*) and ephemers on steep dry stony southern slope of Sultan Uvays Range (middle part of planned electric line, between 42.070571° N 60.505003° E and 42.051806° N 60.479849° E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	20–25	R	+	flowering
<i>Alhagi pseudalhagi</i>	Perennial	30–35	O	+	flowering
<i>Alyssum desertorum</i>	annual	5–7	R	+	dried
<i>Anabasis eriopoda</i>	semishrub	15–20	R	+	vegetation
<i>Anabasis turkestanica</i>	semishrub	15–20	R	+	vegetation
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	C	1	vegetation
<i>Astragalus subbijugus</i>	perennial	10–15	R	+	dried
<i>Astragalus villosissimus</i>	semishrub	30–35	O	+	fruiting
<i>Atraphaxis spinosa</i>	shrub	35–40	R	+	fruiting
<i>Bassia eriophora</i>	annual	10–15	O	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	R	+	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	30–35	F	1	flowering
<i>Ceratocarpus arenarius</i>	annual	7–10	F	1	Fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	Dried
<i>Cousinia hamadae</i>	Perennial	25–30	O	+	flowering
<i>Cuminum setifolium</i>	annual	10–15	O	+	Dried
<i>Cynanchum acutum</i> subsp. <i>sibiricum</i>	Perennial, liana	35–40	R	+	Fruiting
<i>Ephedra lomatolepis</i>	shrub	20–25	O	1	Fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Ferula foetida</i>	perennial	40–50	R	+	dried

<i>Halimocnemis latifolia</i>	annual	10–12	O	+	flowering
<i>Halimocnemis macrantha</i>	annual	10–12	O	+	flowering
<i>Halothamnus subaphyllus</i>	semishrub	40–50	R	+	vegetation
<i>Haloxylon ammodendron</i>	Small tree	120–150	R	+	vegetation
<i>Heterocaryum szovitsianum</i>	annual	10–15	O	+	dried
<i>Hyoscyamus pusillus</i>	annual	7–10	R	+	dried
<i>Hypecoum pendulum</i>	annual	15–20	O	+	dried
<i>Koelpinia linearis</i>	annual	10–15	R	+	Dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	O	1	vegetation
<i>Lachnoloma lehmanii</i>	annual	15–20	O	+	dried
<i>Lallemantia royleana</i>	annual	5–7	O	+	dried
<i>Lappula spinocarpos</i>	annual	10–15	O	+	dried
<i>Lepidium subcordatum</i>	Perennial	20–25	R	+	dried
<i>Leptaleum filifolium</i>	annual	5–7	O	+	dried
<i>Lomelosia olivieri</i> (<i>Scabiosa olivieri</i>)	annual	10–15	O	+	Dried
<i>Lycium ruthenicum</i>	shrub	30–40	O	1	Fruiting
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	C	2	Flowering
<i>Poa bulbosa</i>	Perennial	12–15	O	+	dried
<i>Strigosella intermedia</i>	annual	7–10	O	+	dried
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	O	+	dried
<i>Tulipa sogdiana</i>	Perennial	10–12	R	+	dried
<i>Ziziphora tenuior</i>	annual	5–7	O	+	dried
<i>Zygophyllum miniatum</i>	Perennial	10–15	O	+	dried

Table 19. Check-list of plants recorded for sedge-Astragalus-winterfat-sagebrush-saltwort community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Krascheninnikovia ceratoides*, *Astragalus villosissimus*, *Carex physodes*) with camelthorn (*Alhagi pseudalhagi*), Russian box thorn (*Lycium ruthenicum*), *Calligonum junceum* and black saxaul (*Haloxylon aphyllum*) on loamy-skeleton grey-brown desert soil (lower part of planned electric line, between 42.051806° N 60.479849° E and 42.021156° N 60.424323° E)

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
<i>Acanthophyllum elatius</i>	Perennial	25–30	R	+	fruiting
<i>Aeluropus litoralis</i>	Perennial	10–15	R	+	dried
<i>Alhagi pseudalhagi</i>	Perennial	30–35	F	1	flowering
<i>Allium sabulosum</i>	perennial	15–20	R	+	fruiting
<i>Alyssum desertorum</i>	annual	5–7	O	+	dried
<i>Anabasis aphylla</i>	semishrub	15–20	R	+	vegetation
<i>Anabasis eriopoda</i>	semishrub	15–20	O	+	vegetation
<i>Anabasis turkestanica</i>	semishrub	15–20	R	+	vegetation
<i>Artemisia diffusa</i>	semishrub	25–30	C	1	vegetation
<i>Artemisia turanica</i>	semishrub	25–30	C	1	vegetation
<i>Astragalus subbijugus</i>	perennial	10–15	R	+	dried
<i>Astragalus unifoliolatus</i>	semishrub	35–40	R	+	fruiting

<i>Astragalus villosissimus</i>	semishrub	35–40	F	1	fruiting
<i>Atraphaxis spinosa</i>	shrub	35–40	O	1	fruiting
<i>Bassia eriophora</i>	annual	10–15	O	+	fruiting
<i>Bromus tectorum</i>	annual	10–15	F	+	dried
<i>Calligonum junceum</i>	shrub	40–50	F	1	fruiting
<i>Capparis spinosa</i>	Perennial	30–35	R	+	fruiting
<i>Carex physodes</i>	Perennial	15–20	O	+	dried
<i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	shrub	35–40	F	1	Flowering
<i>Ceratocarpus arenarius</i>	annual	10–15	F	1	Fruiting
<i>Ceratocephala falcata</i>	annual	5–6	O	+	Dried
<i>Climacoptera lanata</i>	annual	25–30	O	+	fruiting
<i>Climacoptera turcomanica</i>	annual	25–30	O	+	fruiting
<i>Convolvulus fruticosus</i>	semishrub	30–35	O	+	Fruiting
<i>Convolvulus erinaceus</i>	semishrub	25–30	O	+	Flowering
<i>Cousinia hamadae</i>	Perennial	25–30	O	+	Flowering
<i>Cuminum setifolium</i>	annual	10–15	O	+	Dried
<i>Ephedra strobilacea</i>	shrub	70–100	R	+	fruiting
<i>Eremopyrum bonaepartis</i>	annual	7–10	O	+	Dried
<i>Eremopyrum distans</i>	annual	7–10	O	+	dried
<i>Ferula foetida</i>	perennial	40–50	O	+	dried
<i>Goldbachia laevigata</i>	annual	15–20	R	+	dried
<i>Halimocnemis latifolia</i>	annual	10–12	F	1	flowering
<i>Halimocnemis macrantha</i>	annual	10–12	O	+	flowering
<i>Haloxylon ammodendron</i>	Small tree	120–150	O	1	vegetation
<i>Haplophyllum bungei</i>	perennial	20–25	R	+	Fruiting
<i>Heliotropium arguzioides</i>	perennial	15–20	O	+	Fruiting
<i>Heliotropium dasycarpum</i>	perennial	10–15	O	+	Fruiting
<i>Heterocaryum szovitsianum</i>	annual	10–15	R	+	Dried
<i>Hyoscyamus pusillus</i>	annual	7–10	R	+	dried
<i>Hypocoum pendulum</i>	annual	15–20	R	+	dried
<i>Isatis emarginata</i>	annual	20–25	R	+	dried
<i>Isatis minima</i>	annual	20–25	R	+	dried
<i>Koelpinia linearis</i>	annual	10–15	R	+	dried
<i>Krascheninnikovia ceratoides</i>	semishrub	35–40	F	1	vegetation
<i>Lachnoloma lehmanii</i>	annual	15–20	O	+	fruiting
<i>Lallemantia royleana</i>	annual	5–7	R	+	dried
<i>Lappula spinocarpos</i>	annual	10–15	R	+	dried
<i>Leptaleum filifolium</i>	annual	5–7	O	+	dried
<i>Lomelosia olivieri</i> (<i>Scabiosa olivieri</i>)	annual	15–20	R	+	Dried
<i>Lycium ruthenicum</i>	shrub	40–50	F	1	Fruiting
<i>Matthiola chenopodiifolia</i>	annual	12–15	R	+	dried
<i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	35–40	C	2	Flowering
<i>Peganum harmala</i>	Perennial	25–30	O	+	Fruiting
<i>Salsola aperta</i>	annual	25–30	R	+	vegetation
<i>Salsola paulsenii</i>	annual	20–25	O	+	vegetation

<i>Strigosella intermedia</i>	annual	10–15	R	+	dried
<i>Strigosella turkestanica</i>	annual	15–20	R	+	dried
<i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15–20	R	+	dried
<i>Ziziphora tenuior</i>	annual	5–7	O	+	dried
<i>Zygophyllum miniatum</i>	Perennial	10–15	R	+	Dried

Conclusion

The summer survey 2022 was conducted June, 30, and confirmed the results of vegetation description and habitat mapping performed in April 2022 (5 types of habitats and their boundaries):

- Weakly inclined, gentle hilly northern slope of relic low mountains with sedge-saltwort-sagebrush vegetation on sabulous-loamy grey-brown desert soil – this habitat type is represented within the wind park area, along access road and along the upper part of the planned power line;

- Fixed shallow wavy and hilly sands with sedge-*Ferula*-saltwort-winterfat-sagebrush vegetation, sometimes with *Calligonum* and solitary black saxaul – this habitat type is represented within the wind park area;

- Steep dry stony southern slope of relic low mountains with rugged terrain and sparse petrophytic vegetation – xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*), and annuals – this habitat type occurs along the middle part of planned power line;

- Weakly inclined piedmonts with sagebrush-saltwort and saltwort vegetation on loamy and skeleton, sometimes gypsaceous grey-brown desert soil, dissected with gravelly dry beds of temporary streams – this habitat type is represented in the lower part of planned power line;

- Transformed (anthropogenic) habitat with sparse communities of wild rue, camel thorn and annuals – this habitat type is represented in the lower part of planned power line, in the surroundings of cement factory, railway and road A-380.

According to IUCN Habitats Classification Scheme, ver. 3.1 (2022), all these habitats belong to the type 8 (Desert), subtype 8.2 (Desert – Temperate). According to the IUCN Global Ecosystem Typology ver. 2.0 (2020), the habitats of the project area belong to T5 Deserts and semi-deserts biome and T5.4 Cool deserts and semi-deserts ecosystem functional group of terrestrial realm.

The territory of planned wind farm area and upper part of planned power line currently is used only as a rangeland (seasonal for sheep and year-round for horses and camels). The territory in the surroundings of lower part of planned power line is used for cement factory and infrastructure (railway, electric lines and roads). The small trees of black saxaul (*Haloxylon ammodendron*) occurring sporadically within the project area are represented by both natural populations and plantations created in the past to protect against wind erosion.

Some corrections were made in the checklists of species recorded within survey plots and in the general checklist of flora. In total, 95 plant species of 26 families were recorded within the project area, none of them are globally threatened, and one species is redlisted at the national level.

During the spring survey, two small populations (8 and 11 generative specimens) of nationally redlisted endemic *Lepidium subcordatum* (Brassicaceae) assessed as rare, endangered species (category 2) in the Red Data Book of Uzbekistan (2019) have been found on the northern slope of Sultan Uvays along the planned electric line. In June, this plant has already finished its growing season and its aerial part has dried up and

scattered by the wind. During the summer survey, only 2 and 3 specimens of *Lepidium subcordatum* were recorded in the same two localities, respectively. The analysis performed in accordance with the International Finance Corporation (IFC) Performance Standard 6 (PS6) and EBRD Performance Requirement 6 (PR6) and represented in the spring report showed that *Lepidium subcordatum* does not trigger Critical habitat Criterion 2 (habitat of significant importance to endemic and/or restricted-range species) because the project area contains less than 10% of its global habitat and population. Collection of seeds and sowing in the same habitat away of the power line is an option for protection and/or relocation of this rare plant.

Within the area of planned wind farm and along the access road, nationally or globally redlisted, or local endemic plants were not found. Most of species recorded for the project area are typical for desert zone of Central Asia and more or less common and widely spread.

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ANNEX 1. Check-list of flora

Plant species	Life form	Abundance	Distribution	Habitat	IUCN status	National status
Ephedraceae						
1. <i>Ephedra lomatolepis</i>	shrub	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Least Concern (LC)	none
2. <i>Ephedra strobilacea</i>	shrub	R–O	Regional	weakly inclined piedmonts, sands	Least Concern (LC)	none
Liliaceae						
3. <i>Gagea divaricata</i>	perennial	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
4. <i>Tulipa sogdiana</i>	Perennial	R–O	Regional	All types, except for transformed	Not Evaluated (NE)	none
Iridaceae						
5. <i>Iris longiscapa</i>	perennial	R	Regional	All types, except for transformed	Not Evaluated (NE)	none
6. <i>Iris songarica</i>	perennial	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
Amaryllidaceae						
7. <i>Allium caspium</i>	Perennial	R	Regional	gentle northern slope	Not Evaluated (NE)	none
8. <i>Allium sabulosum</i>	Perennial	R	Regional	weakly inclined piedmonts, sands	Not Evaluated (NE)	none
Cyperaceae						
9. <i>Carex physodes</i>	Perennial	D–F	Regional	All types	Not Evaluated (NE)	none
Poaceae						
10. <i>Aeluropus litoralis</i>	Perennial	R	Regional	Weakly inclined piedmonts (along dry riverbeds)	Least Concern (LC)	none
11. <i>Bromus tectorum</i>	annual	F–O	Transcontinental	All types	Not Evaluated (NE)	none
12. <i>Eremopyrum bonaepartis</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
13. <i>Eremopyrum distans</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
14. <i>Poa bulbosa</i>	Perennial	F–O	Transcontinental	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
15. <i>Stipagrostis karelinii</i>	Perennial	R–O	Regional	sands	Not Evaluated (NE)	none
Papaveraceae						
16. <i>Hypecoum pendulum</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
17. <i>Roemeria</i>	annual	R	Regional	All types	Not	none

<i>hybrida</i>					Evaluated (NE)	
Ranunculaceae						
18. <i>Ceratocephala falcata</i>	annual	F–R	Regional	All types	Not Evaluated (NE)	none
19. <i>Delphinium camptocarpum</i>	annual	R–F	Regional	All types, except for transformed	Not Evaluated (NE)	none
Zygophyllaceae						
20. <i>Zygophyllum miniatum</i>	Perennial	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Fabaceae						
21. <i>Alhagi pseudalhagi</i>	Perennial	R–F	Regional	All types	Not Evaluated (NE)	none
22. <i>Astragalus flexus</i>	perennial	R	Regional	sands	Not Evaluated (NE)	none
23. <i>Astragalus harpilobus</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
24. <i>Astragalus subbijugus</i>	perennial	R	Endemic	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
25. <i>Astragalus unifoliolatus</i>	semishrub	R–O	Regional	except for seep stony slopes and transformed	Not Evaluated (NE)	none
26. <i>Astragalus villosissimus</i>	semishrub	F–R	Regional	All types, except for transformed	Not Evaluated (NE)	none
Euphorbiaceae						
27. <i>Chrozophora sabulosa</i>	annual	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
28. <i>Euphorbia turczaninowii</i>	annual	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
Geraniaceae						
29. <i>Erodium oxyrrhynchum</i>	annual	R–O	Regional	weakly inclined piedmonts, sands	Not Evaluated (NE)	none
Nitrariaceae						
30. <i>Peganum harmala</i>	Perennial	R–O	Regional	All types	Not Evaluated (NE)	none
Rutaceae						
31. <i>Haplophyllum bungei</i>	Perennial	R	Regional	All types, except for transformed	Not Evaluated (NE)	none
Capparaceae						
32. <i>Capparis spinosa</i>	perennial	R	Regional	Weakly inclined piedmonts (along dry riverbeds), transformed	Least Concern (LC)	none
Brassicaceae						
33. <i>Alyssum desertorum</i>	annual	R–O	Regional	steep stony slopes, weakly inclined	Not Evaluated (NE)	none

				piedmonts		
34. <i>Goldbachia laevigata</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
35. <i>Goldbachia sabulosa</i> (<i>Spirorrhynchus sabulosus</i>)	annual	R–O	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
36. <i>Isatis emarginata</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
37. <i>Isatis minima</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
38. <i>Lachnoloma lehmanii</i>	annual	R–F	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
39. <i>Lepidium subcordatum</i>	perennial	R	Endemic	steep stony slopes	Not Evaluated (NE)	UzRDB 2 (rare species)
40. <i>Leptaleum filifolium</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
41. <i>Matthiola chenopodiifolia</i>	annual	R–O	Regional	weakly inclined piedmonts	Not Evaluated (NE)	none
42. <i>Matthiola tatarica</i>	perennial	R	Regional	steep stony slopes	Not Evaluated (NE)	none
43. <i>Streptoloma desertorum</i>	annual	R–O	Regional	sands	Not Evaluated (NE)	none
44. <i>Strigosella intermedia</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
45. <i>Strigosella turkestanica</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
Polygonaceae						
46. <i>Atraphaxis spinosa</i>	shrub	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
47. <i>Calligonum junceum</i>	shrub	F–O	Regional	weakly inclined piedmonts	Not Evaluated (NE)	none
48. <i>Calligonum leucocladum</i>	shrub	O–R	Regional	sands	Not Evaluated (NE)	none
Caryophyllaceae						
49. <i>Acanthophyllum elatius</i>	Perennial	R–F	Regional	All types, except for transformed	Not Evaluated (NE)	none
50. <i>Silene nana</i>	annual	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
Amaranthaceae						
51. <i>Anabasis aphylla</i>	semishrub	R–O	Regional	gentle northern slope, sands, weakly inclined piedmonts	Not Evaluated (NE)	none

52. <i>Anabasis eriopoda</i>	semishrub	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
53. <i>Anabasis turkestanica</i>	semishrub	R	Regional	gentle northern slope	Not Evaluated (NE)	none
54. <i>Bassia eriophora</i>	annual	O	Regional	All types	Not Evaluated (NE)	none
55. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	semishrub	F–R	Regional	All types	Not Evaluated (NE)	none
56. <i>Ceratocarpus arenarius</i>	annual	F–R	Regional	All types	Not Evaluated (NE)	none
57. <i>Climacoptera lanata</i>	annual	R–O	Regional	weakly inclined piedmonts, transformed	Not Evaluated (NE)	none
58. <i>Climacoptera turcomanica</i>	annual	R–O	Regional	gentle northern slope, sands, weakly inclined piedmonts, transformed	Not Evaluated (NE)	none
59. <i>Corispermum lehmannianum</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
60. <i>Halimocnemis latifolia</i>	annual	R–F	Regional	All types	Not Evaluated (NE)	none
61. <i>Halimocnemis macrantha</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
62. <i>Haloxylon ammodendron</i> (<i>Haloxylon aphyllum</i>)	Small tree	R–O	Regional	All types, except for transformed	Not Evaluated (NE)	none
63. <i>Horaninovia ulicina</i>	annual	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
64. <i>Krascheninnikovia ceratoides</i>	semishrub	A–R	Regional	All types	Not Evaluated (NE)	none
65. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	semishrub	A–R	Regional	gentle northern slope, steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
66. <i>Salsola aperta</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
67. <i>Salsola paulsenii</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
68. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	Shrub	F–R	Regional	gentle northern slope, sands, weakly inclined piedmonts	Not Evaluated (NE)	none
Boraginaceae						
69. <i>Arnebia decumbens</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none

70. <i>Arnebia transcaspica</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
71. <i>Heliotropium acutiflorum</i>	annual	R	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
72. <i>Heliotropium arguzioides</i>	Perennial	R–O	Regional	Except for steep stony slopes	Not Evaluated (NE)	none
73. <i>Heliotropium dasycarpum</i>	Perennial	R–O	Regional	weakly inclined piedmonts, transformed	Not Evaluated (NE)	none
74. <i>Heterocaryum szovitsianum</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
75. <i>Lappula spinocarpus</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
76. <i>Nonea caspica</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
77. <i>Paracaryum physodes</i>	annual	R–O	Regional	steep stony slopes	Not Evaluated (NE)	none
Convolvulaceae						
78. <i>Convolvulus erinaceus</i>	semishrub	R–O	Regional	weakly inclined piedmonts	Not Evaluated (NE)	none
79. <i>Convolvulus fruticosus</i>	semishrub	R–O	Regional	weakly inclined piedmonts	Not Evaluated (NE)	none
Solanaceae						
80. <i>Hyoscyamus pusillus</i>	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
81. <i>Lycium ruthenicum</i>	Shrub	R–F	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Lamiaceae						
82. <i>Chamaesphacos ilicifolius</i>	annual	R–O	Regional	gentle northern slope, sands	Not Evaluated (NE)	none
83. <i>Lallemantia royleana</i>	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
84. <i>Ziziphora tenuior</i>	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Asteraceae						
85. <i>Artemisia diffusa</i>	semishrub	C–D	Regional	All types, except for transformed	Not Evaluated (NE)	none
86. <i>Artemisia turanica</i>	semishrub	C–O	Regional	All types, except for transformed	Not Evaluated (NE)	none
87. <i>Cousinia hamadae</i>	perennial	R–O	Regional	All types	Not Evaluated (NE)	none

88. <i>Jurinea multiloba</i>	perennial	R	Regional	steep stony slopes	Not Evaluated (NE)	none
89. <i>Koelpinia linearis</i>	annual	R–O	Regional	All types	Not Evaluated (NE)	none
90. <i>Microcephala lamellata</i>	annual	R	Regional	All types	Not Evaluated (NE)	none
91. <i>Scorzonera sericeolanata</i>	perennial	R–O	Regional	gentle northern slope, steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
92. <i>Takhtajaniant ha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	R–O	Regional	gentle northern slope, steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Caprifoliaceae						
93. <i>Lomelosia olivieri</i> (<i>Scabiosa olivieri</i>)	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
Apiaceae						
94. <i>Cuminum setifolium</i>	annual	R–O	Regional	steep stony slopes, weakly inclined piedmonts	Not Evaluated (NE)	none
95. <i>Ferula foetida</i>	Perennial	A–R	Regional	All types, except for transformed	Not Evaluated (NE)	none

ANNEX 2. Illustrations



Photo 1. Sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Caroxylon orientale* (*Salsola orientalis*), *Carex physodes*) with solitary black saxaul on sandy desert soil (turbine NU-01, 42.121962 N 60.51933 E).



Photo 2. Sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A.turanica*, *Caroxylon orientale* (*Salsola orientalis*), *Carex physodes*) with solitary black saxaul and *Ferula foetida* on sandy desert soil (turbine NU-02, 42.121924 N 60.531331 E).



Photo 3. Sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary black saxaul (*Haloxylon ammodendron*) and *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-03, 42.12133 N 60.540971 E).



Photo 4. Sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary black saxaul (*Haloxylon ammodendron*), sand acacia (*Ammodendron conollyi*) and *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-04, 42.119458 N 60.551966 E).



Photo 5. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Carex physodes*) with *Ferula foetida* and solitary black saxaul (*Haloxylon ammodendron*) and *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-05, 42.116807 N 60.562386 E).



Photo 6. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed wavy shallow sands (turbine NU-06, 42.11358 N 60.572041 E).



Photo 7. Sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on fixed wavy shallow sands (turbine NU-07, 42.110178 N 60.582378 E).



Photo 8. Sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on sabulous-loamy grey-brown desert soil (turbine NU-08, 42.098034 N 60.585573 E).



Photo 9. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Caroxylon orientale*, *Carex physodes*) on sandy desert soil (turbine NU-09, 42.107179 N 60.591333 E).



Photo 10. Sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on sabulous-loamy grey-brown desert soil (turbine NU-10, 42.089532 N 60.578714 E).



Photo 11. Sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on sandy desert soil (turbine NU-11, 42.114379 N 60.519746 E).



Photo 12. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*) with *Ferula foetida*, winterfat (*Krascheninnikovia ceratoides*) and solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-12, 42.0905074 N 60.565698 E).



Photo 13. Sedge-*Ferula*-winterfat-sagebrush community (*Artemisia diffusa*, *Caroxylon orientale*, *Ferula foetida*, *Carex physodes*) on fixed shallow wavy sands (turbine NU-13, 42.094741 N 60.553437 E).



Photo 14. Sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-14, 42.094905 N 60.540022 E).



Photo 15. Sedge-*Ferula*-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Ferula foetida*, *Carex physodes*) with solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-15, 42.094569 N 60.527351 E).



Photo 16. Sedge-saltwort-winterfat-sagebrush community (*Artemisia diffusa*, *Krascheninnikovia ceratoides*, *Xylosalsola arbuscula*, *Carex physodes*) with *Ferula foetida* and solitary *Calligonum leucocladum* on fixed shallow wavy sands (turbine NU-16, 42.098134 N 60.520634 E)



Photo 17. Sedge-saltwort-sagebrush community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*) on sabulous-loamy grey-brown desert soil in upper part of planned electric line (between 42.090651° N 60.571974° E and 42.070571° N 60.505003° E)



Photo 18. Steep dry stony southern slope with sparse xerophytic shrubs (*Atraphaxis spinosa*), sagebrush (*Artemisia turanica*), black saltwort (*Oreosalsola arbusculiformis*) and ephemers (middle part of planned electric line, between 42.070571° N 60.505003° E and 42.051806° N 60.479849° E)



Photo 19. Sparse sedge-sagebrush-saltwort community (*Artemisia diffusa*, *A. turanica*, *Caroxylon orientale*, *Oreosalsola arbusculiformis*, *Carex physodes*) with solitary *Astragalus villosissimus* and *Calligonum junceum* on loamy-skeleton grey-brown desert soil (lower part of planned electric line, between 42.051806° N 60.479849° E and 42.021156° N 60.424323° E)



Photo 20. Transformed habitat in surroundings of the road A-380 and cement factory, the lower part of planned electric line (42.025627° N 60.429289° E)



Photo 21. Sedge-saltwort-sagebrush vegetation (*Artemisia diffusa*, *A.turanica*, *Caroxylon orientale*, *Carex physodes*) on sabulous-loamy grey-brown desert soil, gentle hilly northern slope of relic low mountains Sultan Uvays along the access road (42.187533° N 60.440713° E)



Photo 22. The riparian forest belonging to the Lower Amudarya Biosphere Reserve (on the background) and an existing electric line, the lower part of planned electric line (42.02337° N 60.42595° E)

Uzbekistan Wind IPP Tender

**100 MW WIND BASED POWER GENERATION PROJECT IN QORAO'ZAK DISTRICT, REPUBLIC OF
KARAKALPAKSTAN, REPUBLIC OF UZBEKISTAN**

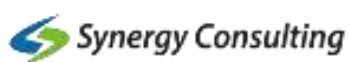
Summary – Bird Baseline Survey

April 2020 - April 2021

July 2021



Advisors



Capitalized terms defined in this RFP shall have the same meaning when used in this template unless otherwise stated.

Summary of Baseline Survey Methods and Sampling Effort

The bird baseline study for the Project was designed by Caleb Gordon (international ornithologist), with the objective of aligning the study with Good International Industry Practice (GIIP), as well as the typical requirements of Development Finance Institutions (DFI). As such, the study was aligned with the biodiversity-related policies¹²³⁴ and sector-specific guidance⁵ of leading DFI, with specific detail on GIIP and DFI requirements for bird baseline studies at wind farms based on additional guidance documents⁶⁷ that are often viewed as international standards in the sector, as well as Caleb Gordon's experience with typical DFI requirements for such studies.

The final baseline survey areas, methods, and sampling parameters are described in the workplan document⁸ that was developed for the Project. Survey effort and results were described in full detail in the final report that were produced by the local ornithologists, as well as evaluation memorandum produced by International ornithologist for the final report. The baseline study included the following sampling effort:

- Bird Vantage Point (VP) Surveys
 - Two VP survey locations, collectively covering at least 95% of the polygon representing the wind turbine area, plus extension up to ca. 1 km outside of the wind turbine area (buffer) on all sides (see map figure in workplan)
 - 3-hour VP surveys conducted by qualified regional ornithologists year-round from April 25, 2020 through April 25, 2021, with at least 36 hours of VP survey conducted at each survey point in each of four seasons, as follows:
 - Spring: March 16-May 15⁹ – 80.35 total VP survey hours conducted
 - Summer: May 16-August 31 – 107.6 total VP survey hours conducted
 - Autumn: September 1-November 15 – 72 total VP survey hours conducted
 - Winter: November 16-March 15 – 75 total VP survey hours conducted

¹ International Finance Corporation (IFC), 2012. Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources. January 1, 2012, World Bank Group, Washington, DC.

² International Finance Corporation (IFC), 2019. International Finance Corporation's Guidance Note 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources. Updated June 27, 2019. World Bank Group, Washington, DC

³ European Bank of Reconstruction and Development (EBRD), 2014. EBRD Performance Requirement 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources.

⁴ European Bank of Reconstruction and Development (EBRD), (undated). Guidance Note: EBRD Performance Requirement 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources.

⁵ International Finance Corporation (IFC), 2015. Environmental, Health, and Safety Guidelines for Wind Energy. August 7, 2015. World Bank Group, Washington, DC

⁶ Scottish Natural Heritage, 2017. Recommended bird survey methods to inform impact assessment of onshore wind farms. V2, March, 2017.

⁷ Band, B., 2012. Using a collision risk model to assess bird collision risks for offshore windfarms. Produced for the Crown Estate, Strategic Ornithological Support Services programme, project SOSS-02, including accompanying Collision Risk spreadsheet and worked example.

⁸ See final workplan dated March 3, 2021.

⁹ Spring VP survey effort was split between two calendar years, with late spring sampled from April 25-May 15, 2020 and early spring sampled from March 16-April 25, 2021.



100 MW Wind IPP

- Target species list initially developed based on desktop review and expert input, revised as needed to accommodate additional species observed
- Observation and data recording procedures following Scottish Natural Heritage guidance¹⁰, in order to produce suitable input data for Collision Risk Modeling (CRM)
- Houbara Bustard (HB) Surveys
 - 4 days of survey in May, 2020 – 11.25 km of driving transects
 - 18 days of survey in June-August, 2020 – 6-11 km of driving transects
 - 12 days of survey in October – November, 2020 – 12 x 2 km walking transects plus 12-15 km driving transect
 - 12 days of survey in December, 2020 – February, 2021 – 12 x 2 km walking transects plus 12-15 km driving transect
 - 6 days of survey during peak breeding display season March 21-April 24, 2021, following specialized protocol for courtship display surveys provided by national expert, Dr. Anna Ten
 - 18 survey points covering wind turbine area plus 2 km buffer
 - 30 minute point count surveys conducted 2-3x per point during peak breeding season, during peak display hours (first 3 hours after sunrise, final 2 hours before sunset)
- Raptor Nesting (RN) Surveys
 - 4 days of survey in May, 2020 – 2 transects covering mountains within 10 km of turbine area
 - 18 days of survey in June-August, 2020 - 2 transects covering mountains within 10 km of turbine area
 - 7 days of survey in March-April, 2021 – 4 transects collectively covering wind turbine area plus 5 km buffer

Summary of Key Baseline Survey Results

Houbara Bustard Surveys

No Houbara Bustards were observed during any of the HB surveys. Neither was this species observed incidentally during any of the surveys performed at the Project Site. Given the level of overall bird survey effort conducted at the site from April, 2020 through April, 2021, including year-round specialized survey effort for HB, and an intensive HB survey following a specific protocol recommended by leading national experts on the HB, conducted during its peak courtship season when displaying males are most conspicuous and readily observed, the Project baseline survey provides a reasonably strong indication that the wind turbine component of the Project does not have a high risk of impacting this protected species (nationally “Vulnerable”¹¹, globally “Vulnerable”¹²), which can be hypothesized to be potentially sensitive to collisions with wind turbines/towers and/or displacement effects as a result of the installation of wind turbines. Nonetheless, there are two important caveats regarding potential risks to this species associated with the Project, in spite of the absence of observations of the species during the baseline survey effort.

¹⁰ Scottish Natural Heritage, 2017. Recommended bird survey methods to inform impact assessment of onshore wind farms. V2, March, 2017.

¹¹ Uzbekistan Federal Government, 2019. Uzbekistan Red List of Threatened Species

¹² IUCN Red List of Threatened Species. Accessed 16 June, 2021



First, it is important to note that during bird baseline surveys conducted at the “Nukus” candidate site, adjacent to the Project Site on the west, three observations of Houbara Bustard were documented during the autumn (2019) season. This indicates that the species could be present at the Project Site as well, at least on an occasional, low-density basis, particularly in light of the fact that HB is a notoriously cryptic species that can easily elude detection, particularly on surveys conducted outside of its courtship season in early spring.

Second, the baseline surveys conducted in the Project wind turbine area (plus 2 km buffer) are not sufficient to rule out risk to HB along the Overhead Power Transmission Line (OHTL) that will be constructed in order to connect the Project to the national power grid. The survey effort summarized in this memorandum did not include any surveys along the OHTL route. Collisions with aerial power lines are well-known to be an important source of anthropogenic fatality in some bustard species, hence specialized HB surveys along the OHTL route may be required in the future in order to address this potential element of risk that was not covered in the current baseline study.

Raptor Nesting (RN) Surveys

No raptor nests were discovered, nor were any observations of behaviors indicative of possible breeding activity collected during the RN survey effort. While this provides an indication that raptor/vulture nesting within the Project area and 5 km radius (RN survey area) is minimal, at most, it is important to note that the ground-based survey methods that were applied have a limited ability to detect nests located in inaccessible locations, particularly on cliffs, which is the preferred nesting substrate for many eagles, vultures, and other raptors. For this reason, the possibility that some nesting of raptor/vulture target species may occur within the survey area cannot be ruled out, and for species that were observed regularly during the survey, the RN survey observations are suggestive that nesting activity near the Project Site is possible, though spring observations may also indicate migratory activity. During the RN surveys, the surveyors recorded all observations of target and secondary species, and these observations are listed in Table 1. For some cliff-nesting target species, notably Steppe Eagle, Golden Eagle, and Egyptian Vulture, the number of observations of these species during the RN surveys was equal to, or greater than the number of observations collected during the VP surveys, even though the latter entailed an order of magnitude higher level of survey effort, as measured by the total number of hours of observation. This seemingly paradoxical result is likely a product of the larger survey area for the RN survey compared with the VP survey, and the fact that the former included the mountains located to the south of the Project wind turbine area, whereas the latter survey covered only the Project wind turbine area plus a buffer extending up to a kilometer. Many raptor and vulture species, including the three target species mentioned above, are likely to prefer the mountain/cliff habitats included within the broader RN survey area over the relatively flat terrain included within the VP survey area (wind turbine area). As such, while the observations gathered during the RN survey effort do not negate the generally low level of collision risk predicted by the CRM analysis on the basis of the VP survey data, they do indicate that collision risk to these target species would likely be significantly higher were the Project located closer to the mountains, where it is possible that all three of these target species may nest.

Vantage Point (VP) Surveys

The four-season, one-year VP survey effort resulted in a total of 59 species of birds observed within the survey area, including five species classified as tier 1 target species, and 7 species classified as secondary species (Table 1). The effort level and observations/data gathering protocols of this effort met, or exceeded the recommendations and guidance of Scottish Natural Heritage (SNH)¹³. VP survey

¹³ Scottish Natural Heritage, 2017. Recommended bird survey methods to inform impact assessment of onshore wind farms. V2, March, 2017.



data were used to perform a Collision Risk Modeling (CRM) analysis¹⁴, using the Band model¹⁵, and following SNH guidance¹⁶ for such analysis for all tier 1 and secondary target species observed during the VP survey effort¹⁷. The results of the CRM for all modeled species are presented in Table 2. The risk implications of the VP survey observations, as well as the outputs of the CRM, are integrated within the general summary of bird risk for the Project, presented in the next section of this report.

Bird Risk Summary

Overall, the results of bird baseline surveys indicate that the Project has a *low level of collision risk for sensitive bird species*. Among the five tier 1 target species documented at the Site, only three species were detected within the VP survey effort, and hence included within the CRM analysis. None of these are predicted to experience an annual collision frequency greater than one fatality per 373 years under the most likely collision avoidance rate parameters modeled (Table 2). This reflects the extremely low abundance of tier 1 target species recorded during the VP surveys at the Site. It is important to note that the results of the RN survey indicate that some tier 1 target species, particularly Golden Eagles, but also possibly Steppe Eagles and Egyptian Vultures may nest in the mountains located to the south of the Project area. The Project does present some risk of collision for these, and other tier 1 target species that prefer to nest and/or forage in mountainous terrain. Collision risk would be significantly higher for such species were the Project located within, or closer to the mountains. Among tier 2 target species, a category that includes all other raptors and selected additional large bird species that could potentially be sensitive issues for the Project, if impacted, only seven species were detected at the site during the VP survey effort. Of these, the Common Crane (*Grus grus*) was predicted to experience the highest collision rates, with 3 or 5 collisions predicted per year, depending on the turbine technology, using the most realistic collision avoidance parameter (Table 2). However, the collision rates predicted for Common Crane in the CRM are most likely overestimates, produced by a combination of a small sample size artifacts, overly conservative input data assumptions, and overly conservative collision avoidance parameter estimates (see final CRM report for full discussion). Among the other tier 2 target species modeled, only the Eurasian Marsh-Harrier (*Circus aeruginosus*) Long-legged Buzzard (*Buteo rufinus*), and Eurasian Kestrel (*Falco tinnunculus*) were predicted to experience a collision more frequently than once per 68 years, under the most realistic collision avoidance rate scenarios modeled, and none of these species were predicted to experience a collision more frequently than once per 19 years (Table 2). In summary, on the basis of the bird baseline study conducted for the Project, the Project is predicted to have relatively minor impacts to birds. Nonetheless, it must be noted that impact predictions based on any pre-construction baseline survey contain a significant degree of uncertainty, particularly in a country such as Uzbekistan, where wind energy development is so new, and there is therefore very little pre-existing information about the susceptibility of the nation's fauna to adverse impacts as a result of wind energy development. For this reason, the baseline survey results should not be considered to preclude the need for rigorous operations-phase impact monitoring following GIIP,

¹⁴ See International ornithologist CRM analysis reports, dated 8 February, 2021 (interim CRM) and 28 May, 2021 (final CRM)

¹⁵ Band, B. (2012). Using a collision risk model to assess bird collision risks for offshore windfarms. Produced for the Crown Estate, Strategic Ornithological Support Services programme, project SOSS-02, including accompanying Collision Risk spreadsheet and worked example.

¹⁶ Scottish Natural Heritage. (2010). Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model.

¹⁷ Note that two of tier 1 target species were observed only in the RN survey effort, or in the case of Imperial Eagle, a single time during the VP survey effort at a distance outside of the pre-defined maximum reliable observation radius, hence these two species were not included in the CRM analysis, as the number of observations, or "bird minutes" included as data inputs for these two species would be zero.



accompanied by management plans and/or other commitments to ensure that unanticipated impacts will be mitigated and/or managed appropriately, as warranted.

Residual Gaps in Relation to GIIP for Wildlife Baseline Surveys at Wind Farms

The bird baseline surveys conducted at the Site between April 2020 and April 2021 and summarized in this memorandum represent a complete and comprehensive bird baseline survey covering the wind turbine area of the Project, well-aligned with GIIP and with the policies and typical requirements of the DFIs. However, it is important to note that requirements for wildlife baseline studies at wind farms are not 100% standardized or specified in any guidance documents, and there can be variation among lenders in the specific baseline survey elements and parameters that are required for any given wind farm, based on specific environmental conditions of the site and/or specific sensitivities of lenders and their technical advisors/staff. Furthermore, when considering the Project as a whole, as it may be considered/evaluated by lenders, there are at least two items that have not yet been completed, and that are likely/possible to be required by lenders in order to complete a full biodiversity baseline survey for the Project, as follows:

- Bat baseline survey within the wind turbine area
- Surveys for bird species potentially sensitive to power line impacts (raptors, vultures, bustards, water birds) along the OHTL route

It is important to note that the Seller may be responsible for completing these, as well as other biodiversity survey elements, in the preparation of the ESIA for the Project and/or to satisfy lender requirements.



Table 1. Summary of bird observations gathered during the bird baseline study conducted at the Project between April, 2020 and April, 2021. Uzbek and Global status is “least concern” or unlisted, unless otherwise indicated. Status category abbreviations are as follows: NT = Near Threatened; VU = Vulnerable; EN = Endangered. Data in the columns represent total numbers of observations for the specified survey type. All of the species observed during any of the surveys are included within the table. Species that were never observed during the surveys are not included in the table. Color coding of rows indicates species’ Project-specific sensitivity status, as follows: orange = target species; yellow = secondary species; white = other species

Scientific Name	Common Name	Uzbek status ¹⁸	Global status ¹⁹	Houbara Bustard Survey	Raptor Nesting Survey	Vantage Point Surveys ²⁰				Total Observations
						Spring ²¹	Summer	Autumn	Winter	
<i>Alectoris chukar</i>	Chukar					10	6	24	19	59
<i>Columba livia</i>	Rock Pigeon					3		25	191	219
<i>Streptopelia turtur</i>	European Turtle-Dove	VU	VU					38		38
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse					24	12	204	45	285
<i>Caprimulgus aegyptius</i>	Egyptian Nightjar						2			2
<i>Grus grus</i>	Common Crane							2850		2850
<i>Neophron percnopterus</i>	Egyptian Vulture	VU	EN		1					1
<i>Aquila nipalensis</i>	Steppe Eagle	VU	EN		5	2		2	1	10
<i>Aquila heliaca</i>	Imperial Eagle	VU	VU		1				1 ²²	2
<i>Aquila chrysaetos</i>	Golden Eagle	VU			11	1	1	2	2	17
<i>Circus aeruginosus</i>	Eurasian Marsh-Harrier				6	2	17		1	26
<i>Circus cyaneus</i>	Hen Harrier					2		4	1	7
<i>Buteo lagopus</i>	Rough-legged Hawk					1		12	4	17

¹⁸ Uzbekistan Federal Government, 2019. Uzbekistan Red List of Threatened Species

¹⁹ IUCN Red List of Threatened Species, accessed 16 June, 2021

²⁰ For target and secondary species, only observations occurring within the species-specific maximum reliable observation radius were included within the CRM and are listed in this table, with the exception of one observation of an Imperial Eagle at >1km distance, included here as a notable incidental observation

²¹ Includes all data from spring sampling in 2020 and 2021, combined

²² This observation occurred outside of the specified maximum reliable observation radius, hence it was not included in the CRM analysis, and therefore Imperial Eagle was not included in the CRM, as there were no observations of this species inside of the observation radius during the VP survey effort

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PPPDA
PPP Development Agency

Summary – Bird Baseline Survey

Scientific Name	Common Name	Uzbek status ¹⁸	Global status ¹⁹	Houbara Bustard Survey	Raptor Nesting Survey	Vantage Point Surveys ²⁰				Total Observations
						Spring ²¹	Summer	Autumn	Winter	
<i>Buteo buteo</i>	Common Buzzard							13		13
<i>Buteo rufinus</i>	Long-legged Buzzard				1			60	4	65
<i>Athene noctua</i>	Little Owl					17	30	29	15	91
<i>Upupa epops</i>	Eurasian Hoopoe					13	1			14
<i>Merops persicus</i>	Blue-cheeked Bee-eater					64	209			273
<i>Falco tinnunculus</i>	Eurasian Kestrel				10	24	16	42	14	106
<i>Falco vespertinus</i>	Red-footed Falcon		NT		1	1				2
<i>Lanius phoenicuroides</i>	Red-tailed Shrike							3		3
<i>Lanius excubitor</i>	Great Gray Shrike					18		36	9	63
<i>Pica pica</i>	Eurasian Magpie					2				2
<i>Podoces panderi</i>	Turkestan Ground-Jay							2		2
<i>Corvus frugilegus</i>	Rook					200			2	202
<i>Corvus corone</i>	Carrion Crow						8	4	50	62
<i>Corvus cornix</i>	Hooded Crow					18		10	121	149
<i>Eremophila alpestris</i>	Horned Lark								317	317
<i>Calandrella brachydactyla</i>	Greater Short-toed Lark					389	323	548		1260
<i>Melanocorypha yeltoniensis</i>	Black Lark								5	5
<i>Alaudala rufescens</i>	Lesser Short-toed Lark					567	386	610	266	1829
<i>Alauda arvensis</i>	Eurasian Skylark							2		2
<i>Galerida cristata</i>	Crested Lark					79	63	48	155	345
<i>Hippolais languida</i>	Upcher's Warbler					2	20			22
<i>Hirundo rustica</i>	Barn Swallow					54	35			89
<i>Phylloscopus trochilus</i>	Willow Warbler							26		26
<i>Phylloscopus collybita</i>	Common Chiffchaff							120		120



Scientific Name	Common Name	Uzbek status ¹⁸	Global status ¹⁹	Houbara Bustard Survey	Raptor Nesting Survey	Vantage Point Surveys ²⁰				Total Observations
						Spring ²¹	Summer	Autumn	Winter	
<i>Phylloscopus trochiloides</i>	Greenish Warbler							101		101
<i>Sylvia nana</i>	Asian Desert Warbler					10	4	176		190
<i>Sylvia curruca</i>	Lesser Whitethroat							67		67
<i>Sylvia communis</i>	Greater Whitethroat							128		128
<i>Sturnis vulgaris</i>	European Starling								1600	1600
<i>Phoenicurus phoenicurus</i>	Common Redstart					2				2
<i>Saxicola maurus</i> ²³	Siberian Stonechat					8		17		25
<i>Oenanthe oenanthe</i>	Northern Wheatear					14		46		60
<i>Oenanthe isabellina</i>	Isabelline Wheatear					582	431	552		1565
<i>Oenanthe deserti</i>	Desert Wheatear					27		163		190
<i>Oenanthe pleschanka</i>	Pied Wheatear					3	2			5
<i>Passer ammodendri</i>	Saxaul Sparrow							2		2
<i>Passer domesticus</i>	House Sparrow					128	390			518
<i>Passer hispaniolensis</i>	Spanish Sparrow						2			2
<i>Passer montanus</i>	Eurasian Tree Sparrow							35		35
<i>Motacilla alba</i> ²⁴	White Wagtail					33		75	28	136
<i>Anthus campestris</i>	Tawny Pipit					3				3
<i>Fringilla coelebs</i>	Common Chaffinch								105	105
<i>Fringilla montifringilla</i>	Brambling								57	57
<i>Rhodospiza obsoleta</i>	Desert Finch								44	44

²³ In some of the local ornithologists' reports, African Stonechat (*Saxicola torquatus*) was reported, but these are all likely observations of Siberian Stonechat, as African Stonechat does not normally occur north of southernmost Saudi Arabia, and as a species was listed in the Autumn report with the common name "African Stonechat" but with the latin name of Siberian Stonechat (*Saxicola maurus*).

²⁴ Includes observations of conspecific "masked" wagtail



Scientific Name	Common Name	Uzbek status ¹⁸	Global status ¹⁹	Houbara Bustard Survey	Raptor Nesting Survey	Vantage Point Surveys ²⁰				Total Observations
						Spring ²¹	Summer	Autumn	Winter	
<i>Spinus spinus</i>	Eurasian Siskin								20	20
<i>Emberiza bruniceps</i>	Red-headed Bunting					8				8

Table 2: Estimated rates of collisions per year for bird species at the Project, predicted by Band Collision Risk Modeling analysis, under a range of Collision Avoidance (CA) parameter values and for two distinct technology scenarios (Siemens-Gamesa [S-G] and Vestas, see final CRM report for details). Color coding of species by project-specific sensitivity level follows that of Table 1.

English Common Name	Using lower bound CA value				Using most realistic CA value				Using upper bound CA value			
	Collisions/year		Years to 1 collision		Collisions/year		Years to 1 collision		Collisions/year		Years to 1 collision	
	S-G	Vestas	S-G	Vestas	S-G	Vestas	S-G	Vestas	S-G	Vestas	S-G	Vestas
Steppe Eagle	0.00809	0.0118	124	85	0.00179	0.00260	559	384	0.000426	0.000620	2350	1610
Golden Eagle	0.0110	0.0121	91	83	0.00243	0.00268	412	373	0.000577	0.000638	1730	1570
Red-footed Falcon	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Eurasian Marsh-Harrier	0.143	0.267	7	4	0.0286	0.0534	35	19	0.00286	0.00534	350	187
Hen Harrier	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Common Buzzard	0.0103	0.0177	97	56	0.00234	0.00402	427	249	0.000468	0.000805	2140	1240
Long-legged Buzzard	0.232	0.400	4	2	0.0528	0.0910	19	11	0.0106	0.0182	95	55
Rough-legged Hawk	0.0367	0.0643	27	16	0.00833	0.0146	120	68	0.00167	0.00293	600	342
Common Crane	17	27	<1	<1	3	5	<1	<1	2	3	<1	<1



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Summary – Bird Baseline Survey

English Common Name	Using lower bound CA value				Using most realistic CA value				Using upper bound CA value			
	Collisions/year		Years to 1 collision		Collisions/year		Years to 1 collision		Collisions/year		Years to 1 collision	
	S-G	Vestas	S-G	Vestas	S-G	Vestas	S-G	Vestas	S-G	Vestas	S-G	Vestas
Eurasian Kestrel	0.0670	0.115	15	9	0.0163	0.0281	61	36	0.000528	0.000905	1900	1110

F – COLLISION RISK MODEL

**CRM ANALYSIS UPDATE FOR
NUKUS 100 MW WIND FARM PROJECT IN KARAUZAK DISTRICT,
REPUBLIC OF KARAKALPAKSTAN, REPUBLIC OF UZBEKISTAN**

Bird Collision Risk Modelling Analysis Update

April 2020 - April 2021

Revision #5

August 2022

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List of Abbreviations

Acronym	Description
CA	Collision Avoidance
CRM	Collision Risk Modelling
Project	100MW Wind Power Project in Karauzak District, Republic of Karakalpakstan, Republic of Uzbekistan
SNH	Scottish Natural Heritage
VP	Vantage Point

1. Introduction

Collision Risk Modelling (“CRM”) using the model developed and refined by William Band, has become a standard method in international industry practice for obtaining quantitative predictions of estimated fatality rates of birds at wind farms, where suitable field observation data from Vantage Point (“VP”) surveys have been collected, conforming to the data input assumptions of the Band (2012) model, and following the guidance for such surveys and subsequent CRM promulgated by Scottish Natural Heritage (SNH 2017). The Band CRM predicts the expected collision rates of particular bird species or species groups at a given wind farm based on the specific dimensions and physical characteristics of the rotors, the birds, the wind farm, and the density of bird flights recorded in the wind farm area. The latter parameter is termed “bird density” and is derived from the VP survey data, further differentiated with regard to the altitude of the birds’ flights relative to the rotor swept altitudes of the rotors. While the basic mechanism of the Band model does not incorporate the ability or tendency of birds to alter their flight paths in response to the presence of wind turbines (avoidance), such behaviour is believed to be a very important dynamic influencing actual bird collision rates at wind farms (Cook et. al. 2012), hence a “collision avoidance rate” parameter is typically applied for each bird species or species group when conducting CRM for wind farms using the Band model (Whitfield and Madders 2006a, 2006b, Garvin et al. 2011, Band 2012, SNH 2014, Whitfield and Urquhart 2015).

We conducted CRM using the Band (2012) model for the purpose of obtaining quantitative predictions of collision risk during migratory, winter, and breeding seasons for target bird species, as well as selected additional species, based on their observed patterns of seasonal abundance and use of airspace at the site, as described by observations gathered during VP surveys. We performed this analysis separately for each of four seasons, based on VP survey data gathered at the 100MW Wind Power Project in Karauzak District, Republic of Karakalpakstan, Republic of Uzbekistan (“Project”) site between April, 2020 and April, 2021. Seasons were defined based on general timing of migratory and breeding periods for target bird species within the region as follows:

Spring (migration): April 25, 2020 - May 15, 2020 and March 16, 2021 - April 25, 2021¹

Summer (breeding): May 16 - August 31, 2020

Autumn (migration): September 1 - November 30, 2020

Winter: December 1 – March 15, 2020

The VP survey protocol was developed with guidance from international ornithologist, and intended to conform with SNH (2017) recommendations, in order to provide input data suitable for performing CRM with the Band (2012) model. In addition to guidance in the form of an initial set of recommendations, international ornithologist also reviewed and commented on a draft workplan, geospatial information regarding the selection and placement of a suitable number of VP survey locations, and monthly and quarterly VP survey summary reports. Furthermore, international ornithologist also provided templates for the VP field survey data sheet and a data compilation spreadsheet, and instructions for monthly and quarterly VP survey reporting for use by the local ornithologist, Yakub Ametov, as well as requests for additional species-specific data inputs necessary for the CRM, based on field observations and expert judgment of Mr. Ametov

¹ VP surveys were initiated at the site on April 25, 2020, and were then supplemented in 2021 with surveys conducted from the beginning of March through April 25, 2021, hence the spring seasonal VP survey data analysed consists of an amalgam of data gathered in 2020 and 2021, collectively covering the entire spring season.

and associates whom he enlisted to conduct some of the VP surveys. While this communication provides some assurance that the input data used for this CRM effort conforms to SNH guidance and the model's input assumptions, the reliability of the results of this CRM is ultimately dependent on the qualifications and diligence of the field observers, as well as the veracity of their results, as they were reported to international ornithologist by Mr. Ametov.

The species for which CRM was conducted included all “target” and “secondary” bird species that were observed at the site within the VP survey effort. Target species were defined to include all species with conservation concern or protected status on either the national² or international³ “red lists”. Secondary species were defined to include all other raptors and vultures that could potentially occur at the site, as well as selected additional large-bodied birds that could become a significant risk concern for the Project, if seriously impacted. The list of such species was developed with input from regional bird experts, and was intended to include all potentially high- or moderate- sensitivity bird species that could occur at the site. This list was also updated on an ongoing basis, as needed, specifically with the inclusion of any target or secondary species that were observed at the site during the survey effort, that were not initially anticipated as likely to occur at the site. The species included within the CRM for the Project are shown in Table 1, along with their national and international conservation status, their Project-specific priority level⁴, and the total number of VP survey observations that were included within the CRM analysis for each season⁵.

Table 1: Summary of conservation/sensitivity status and numbers of VP survey observations in each season for each bird species included within the CRM analysis for the Project

Scientific Name	English Common Name	Uzbek status ⁶	IUCN status ⁷	VP Observations			
				Spring	Summer	Autumn	Winter
<i>Aquila nipalensis</i>	Steppe Eagle	VU	EN	2		2	1
<i>Aquila chrysaetos</i>	Golden Eagle	VU		1	1	2	2
<i>Falco vespertinus</i>	Red-footed Falcon		NT	1			
<i>Circus aeruginosus</i>	Eurasian Marsh-Harrier			2	17		1
<i>Circus cyaneus</i>	Hen Harrier			2		4	1
<i>Buteo buteo</i>	Common Buzzard					13	
<i>Buteo rufinus</i>	Long-legged Buzzard					60	4
<i>Buteo lagopus</i>	Rough-legged Hawk			1		12	4
<i>Grus grus</i>	Common Crane					2850	
<i>Falco tinnunculus</i>	Eurasian Kestrel			24	16	42	14

Conservation/protected status are as follows: EN = Endangered; VU = Vulnerable; NT = Near Threatened; (blank) = Least Concern (IUCN) or not-listed nationally. Color-coding of species' project-sensitivity classification is as follows: orange = target species; yellow = secondary species.

² Uzbekistan Federal Government, 2019. Uzbekistan Red List of Threatened Species

³ IUCN Red List of Threatened Species, accessed April 15, 2020

⁴ Project-specific priority levels are defined in the Project's workplan, and are based on consideration of likely susceptibility to wind farm impacts and likelihood of occurrence at the site, as well as national and international conservation (protected) status.

⁵ Note that observations that were recorded outside of the maximum reliable observation radius were regarded as “incidental” observations, and were excluded from the analysis.

⁶ Uzbekistan Federal Government, 2019. Uzbekistan Red List of Threatened Species

⁷ IUCN Red List of Threatened Species, accessed 10 August, 2020

2. Model Input Data

Data inputs for the CRM analysis were derived from the results of the VP surveys, as well as various additional sources, depending on the type of information needed. Specific sources and pertinent assumptions for each type of input data used in the CRM are described further below.

2.1 Turbine and wind farm data

Specific physical parameters of the turbines, towers, and the specific model input values used to represent the turbine technology and layout currently under consideration were used as inputs for the CRM analysis and are detailed and explained in Table 2.

Table 2: Model input data on physical characteristics of the turbines, towers, and wind farm configuration used in the Collision Risk Modelling analysis

Parameter	Value(s) used in Modelling	Explanation
Turbine model	Envision 171-6.5	turbine technology under consideration for the wind farm
# blades	3	from manufacturer's specifications
Rotation speed (rpm)	8.52	Average value from range reported by manufacturer
Rotor radius (m)	85.5	from manufacturer's specifications
Hub height (m)	100	from manufacturer's specifications
Percent of time operational	Monthly values ranging from 63.8% to 85.0%	Project specific data not available, representative values taken from SOSS example
Maximum blade width (m)	4.5	from manufacturer's specifications
Pitch (degrees)	47.5	Representative value ⁸
# turbines	16	Proposed # turbines
Latitude	42.1	Approximate midpoint of Project area
Area of wind farm	19.14 km ²	Rough approximation from polygon of Project area
Rotor swept altitude range (risk height, m)	14.5-185.5	Based on rotor diameter and hub height

2.2 Data on Physical and Observational Characteristics of Birds

In addition to bird densities derived from VP survey data, CRM using the Band model requires certain data on the physical and observational characteristics of each modelled species of bird. Input values used in the CRM analysis are presented in Table 3. As a general rule, data on physical dimensions of birds were derived from Cornell Lab of Ornithology's Birds of the World⁹, while information specific to the VP survey observations, such as maximum effective radius of observation/identification were provided by the local ornithologist, Yakub Ametov, based on his observations at the site and expert judgment.

⁸ Pitch is adjustable on the turbine model selected for the analysis, as well as most currently available wind turbines, depending on wind speed. A representative value was used, based on a range of values reported for various turbine models at typical, commercially useful wind speeds

⁹ <https://birdsoftheworld.org/bow/home>, accessed on 5-9 August, 2020 and 4-14 January, 2021

Table 3. Physical and observational characteristics of each bird species included within the CRM analysis for the Project

Scientific Name	English Common Name	Length (m)	Wingspan (m)	Flight type ¹⁰	Flight speed (m/sec) ¹¹	Detection distance (km) ¹²
<i>Aquila nipalensis</i>	Steppe Eagle	0.70	1.9	gliding	7.7	1
<i>Aquila chrysaetos</i>	Golden Eagle	0.77	2.03	gliding	11.9	1
<i>Falco vespertinus</i>	Red-footed Falcon	0.30	0.71	flapping	12.8	0.3
<i>Circus aeruginosus</i>	Eurasian Marsh-Harrier	0.48	1.3	gliding	11.2	0.5
<i>Circus cyaneus</i>	Hen Harrier	0.46	1.1	gliding	9.1	0.5
<i>Buteo buteo</i>	Common Buzzard	0.46	1.23	gliding	11.6	0.8
<i>Buteo rufinus</i>	Long-legged Buzzard	0.53	1.3	gliding	11.6	0.8
<i>Buteo lagopus</i>	Rough-legged Hawk	0.54	1.37	gliding	10.5	0.8
<i>Grus grus</i>	Common Crane	0.95	1.6	gliding	15.0	2
<i>Falco tinnunculus</i>	Eurasian Kestrel	0.31	0.68	flapping	10.1	0.3

Color-coding of species' project-sensitivity classification is as follows: orange = tier 1 target species; yellow = tier 2 target species.

2.3 VP Survey Data Used to Derive Bird Density

Bird density inputs in CRM analysis represent the density of birds flying within the surveyed area at any given moment in time. These values are calculated based on the observations gathered during the VP surveys, and then further differentiated based on the percent of such flights that occurred within "risk height" equivalent to the range of altitudes swept by the turbines to be installed. The effective survey area is based on the area covered by an idealized vantage point, but varies among species based on the maximum effective detection radius (Table 3). For target species, the paths and altitudes of each individual birds' flights were plotted every 15 seconds while the birds were inside of the specified observation radius (up to 2 km from the observer). For these species, the bird density was calculated by dividing the total number of fractional minutes of the birds' presence flying within the specified observation radius, by the total number of minutes of VP survey observation for the period, and then dividing that by the effective survey area, as a function of the species-specific maximum reliable detection radius. For observations of secondary species, only a single, representative flight height was recorded for each observation of an individual or flock observed flying within the specified observation radius during the VP surveys. In order to calculate the number of "observation minutes" for such species, we estimated representative observation durations by calculating the time it would take a bird to transit the entire diameter of the surveyed area, defined by species-specific detection distances, at species-specific flight speeds (Table 3). Summaries of the VP survey data used to calculate bird density values in each season are presented in Tables 4-7. Note that these tables show cumulative values for each season, but in the CRM analysis, the data are broken down further by month.

¹⁰ The model does not permit inclusion of multiple flight styles, hence only the most prevalent flight type was used for each species, based on general flight tendencies of the species

¹¹ Flight speeds derived from Alerstam et. al. (2007)

¹² Maximum reliable detection distance estimated for each species by Y. Ametov based on his observations during the VP survey effort, and accounting not only for the distance at which each species could be reliably observed, but also the distance at which each species could be reliably distinguished from other species (identified)

Table 4. Observational data from the Vantage Point surveys used to derive bird density inputs for the spring season (cumulative observations from April 25 – May 15, 2020 and March 16 – April 25, 2021) CRM analysis for the Project

Scientific Name	English Common Name	Number of observations ¹³	% at rotor swept height ¹⁴	Total bird minutes	Effective survey area (km ²)
<i>Aquila nipalensis</i>	Steppe Eagle	2	80	0.75	3.14
<i>Aquila chrysaetos</i>	Golden Eagle	1	50	0.25	3.14
<i>Falco vespertinus</i>	Red-footed Falcon	1	100	0.39	0.283
<i>Circus aeruginosus</i>	Eurasian Marsh-Harrier	2	100	1.49	0.785
<i>Circus cyaneus</i>	Hen Harrier	2	100	1.83	0.785
<i>Buteo lagopus</i>	Rough-legged Hawk	1	100	1.27	2.01
<i>Falco tinnunculus</i>	Eurasian Kestrel	24	100	11.9	0.283

For all species, the total duration of observations was equivalent to the total of 80.35 hours, or 4821 minutes of VP survey effort conducted at the Project during the spring season (both years, combined). Color coding of species by project-specific priority level follows that of Table 1.

Table 5. Observational data from the Vantage Point surveys used to derive bird density inputs for the summer season Collision Risk Modelling analysis for the Project

Scientific Name	English Common Name	Number of observations ¹⁵	% at rotor swept height ¹⁶	Total bird minutes	Effective survey area (km ²)
<i>Aquila chrysaetos</i>	Golden Eagle	1	50	0.5	3.14
<i>Circus aeruginosus</i>	Eurasian Marsh-Harrier	17	100	12.6	0.785
<i>Falco tinnunculus</i>	Eurasian Kestrel	16	100	7.92	0.283

For all species, the total duration of observations was equivalent to the total of 108 hours, or 6455 minutes of VP survey effort conducted at the Project during the summer season. Color coding of species by project-specific priority level follows that of Table 1.

¹³ Observations of birds that were further from the observer than the maximum detection distance are regarded as incidental observations, and were not included in the CRM analysis

¹⁴ Percentage in rotor swept height values (Q2r parameter) were generated using observations from all seasons, combined, in order to ameliorate small sample size effects, and then input into the CRM for each season

¹⁵ Observations of birds that were further from the observer than the maximum detection distance are regarded as incidental observations, and were not included in the CRM analysis

¹⁶ Percentage in rotor swept height values (Q2r parameter) were generated using observations from all seasons, combined, in order to ameliorate small sample size effects, and then input into the CRM for each season

Table 6. Observational data from the Vantage Point surveys used to derive bird density inputs for the autumn season Collision Risk Modelling analysis for the Project

Scientific Name	English Common Name	Number of observations ¹⁷	% at rotor swept height ¹⁸	Total bird minutes	Effective survey area (km ²)
<i>Aquila nipalensis</i>	Steppe Eagle	2	80	1	3.14
<i>Aquila chrysaetos</i>	Golden Eagle	2	50	0.75	3.14
<i>Circus cyaneus</i>	Hen Harrier	4	100	3.66	0.785
<i>Buteo buteo</i>	Common Buzzard	13	100	14.9	2.01
<i>Buteo rufinus</i>	Long-legged Buzzard	60	100	69.0	2.01
<i>Buteo lagopus</i>	Rough-legged Hawk	12	100	15.2	2.01
<i>Grus grus</i>	Common Crane	2850	21	6330	12.6
<i>Falco tinnunculus</i>	Eurasian Kestrel	42	100	20.8	0.283

For all species, the total duration of observations was equivalent to the total of 72 hours, or 4320 minutes of VP survey effort conducted at the Project during the autumn season. Color coding of species by project-specific priority level follows that of Table 1.

Table 7. Observational data from the VP surveys used to derive bird density inputs for the winter season CRM analysis for the Project

Scientific Name	English Common Name	Number of observations ¹⁹	% at rotor swept height ²⁰	Total bird minutes	Effective survey area (km ²)
<i>Aquila nipalensis</i>	Steppe Eagle	1	80	0.50	3.14
<i>Aquila chrysaetos</i>	Golden Eagle	2	50	1.25	3.14
<i>Circus aeruginosus</i>	Eurasian Marsh-Harrier	1	100	0.74	0.785
<i>Circus cyaneus</i>	Hen Harrier	1	100	0.92	0.785
<i>Buteo rufinus</i>	Long-legged Buzzard	4	100	4.60	2.01
<i>Buteo lagopus</i>	Rough-legged Hawk	4	100	5.08	2.01
<i>Falco tinnunculus</i>	Eurasian Kestrel	14	100	6.93	0.283

For all species, the total duration of observations was equivalent to the total of 75 hours, or 4500 minutes of VP survey effort conducted at the Project during the winter season. Color coding of species by project-specific priority level follows that of Table 1.

2.4 Collision Avoidance Parameter

Published, validated collision avoidance (“CA”) parameters are not available for most of the target species we modelled at the Project, yet the CA parameter is well-known to be a very important parameter in Band CRM analysis, with outcomes very sensitive to slight variation in CA (Cook et. al., 2012). For each species included within the CRM analysis for the Project, we developed a

¹⁷ Observations of birds that were further from the observer than the maximum detection distance are regarded as incidental observations, and were not included in the CRM analysis

¹⁸ Percentage in rotor swept height values (Q2r parameter) were generated using observations from all seasons, combined, in order to ameliorate small sample size effects, and then input into the CRM for each season

¹⁹ Observations of birds that were further from the observer than the maximum detection distance are regarded as incidental observations, and were not included in the CRM analysis

²⁰ Percentage in rotor swept height values (Q2r parameter) were generated using observations from all seasons, combined, in order to ameliorate small sample size effects, and then input into the CRM for each season

“most realistic” CA parameter value, bounded by a “conservative” low parameter estimate, and a high estimate, reflecting an upper bound, based on a comprehensive review of available literature, interpreted with species- and site-specific information. The values used for each species are presented in Table 8, and then a brief explanation/justification is presented for each species below.

Table 8. Collision avoidance parameters used in the bird CRM analysis for the Project

Scientific Name	English Common Name	Lower bound value	Most realistic value	Upper bound value
<i>Aquila nipalensis</i>	Steppe Eagle	0.981	0.9958	0.999
<i>Aquila chrysaetos</i>	Golden Eagle	0.981	0.9958	0.999
<i>Falco vespertinus</i>	Red-footed Falcon	0.873	0.969	0.999
<i>Circus aeruginosus</i>	Eurasian Marsh-Harrier	0.95	0.99	0.999
<i>Circus cyaneus</i>	Hen Harrier	0.95	0.99	0.999
<i>Buteo buteo</i>	Common Buzzard	0.978	0.995	0.999
<i>Buteo rufinus</i>	Long-legged Buzzard	0.978	0.995	0.999
<i>Buteo lagopus</i>	Rough-legged Hawk	0.978	0.995	0.999
<i>Grus grus</i>	Common Crane	0.98	0.9988	0.9993
<i>Falco tinnunculus</i>	Eurasian Kestrel	0.873	0.969	0.999

Color coding of species by project-specific sensitivity categories follows that of Table 1.

Eagles in the genus *Aquila*

The Golden Eagle (*Aquila chrysaetos*) has been the subject of several empirical research studies designed toward the objective of defining the most appropriate CA parameters for use with this species in modelling its risk of colliding with wind turbines, using the Band CRM. The low bound CA parameter value of 0.981 selected for the present analysis, corresponds to the lowest CA value estimated for Golden Eagles in Whitfield and Madders, 2006a, based on their analysis of data from wind farms in California. This value is likely to be conservative, underestimating the true extent of Golden Eagles’ avoidance of collisions with wind turbines, as Whitfield and Madders (2009) suggested that a CA parameter of 0.99 is “precautionary” for this species. The CA value selected as “most likely” for the present analysis, 0.9958, corresponds to the mean adjusted CA estimate for Golden Eagles at the Altamont Wind Facility in California, USA, presented by Whitfield and Madders (2009), and is very close to the median CA value for this species of 0.995, presented by Whitfield and Madders (2006a), and the value of 0.99 recommended by SNH (2018). The upper bound CA value of 0.999 for Golden Eagles was selected based on the upper bound of 100% CA presented for Golden Eagles by Whitfield and Madders (2006a). No published estimates of CA were available for Steppe Eagle (*Aquila nipalensis*), so we used the same CA values for this species as we did for Golden Eagle, based on the similarity of these two congeneric species in terms of size, shape, behaviour, and flight morphology.

Eurasian Kestrel and Red-footed Falcon

We represented these two species in the model using a range of CA values developed for the American Kestrel (*Falco sparverius*) based on the analysis of Whitfield and Madders (2006a), with 0.873 representing the lower bound CA value, 0.969 representing the median value (note that this is close to the value of 0.95 recommended for Eurasian Kestrel by SNH [2018], and 0.999 substituted for 1 (100% avoidance), as the upper bound CA value.

Harriers (genus *Circus*)

We used published CA values empirically derived for the Hen Harrier (*Circus cyaneus*) to represent the collision avoidance tendencies of both of the *Circus* species observed during the VP surveys at the Project. In their review of wind farm impacts to Hen Harriers, Whitfield and Madders (2006b) concluded that a CA value of 0.95, used by some authors for this species, was “too low,” suggesting that a value of 0.99 was “more realistic.” Accordingly, we used the value of 0.95 as a lower bound CA value, and 0.99 as our most likely value, which is consistent of the value of 0.99 recommended for Hen Harrier by SNH (2018). We used a CA value of 0.999 as the upper bound for modelling harrier collision risk in our analysis, corresponding to the median CA value for *Circus cyaneus* presented in Whitfield and Madders (2006a).

Hawks and Buzzards in the genus *Buteo*

No published CA values were available for the three *Buteo* species observed during the VP surveys at the Project, hence we relied on CA values empirically derived for a congener, the Red-tailed Hawk (*Buteo jamaicensis*) by Whitfield and Madders (2006a), as follows: lower bound – 0.978; median value (or “most likely” in our analysis) – 0.995; upper bound – 0.999 (substituted for the value of 1, or 100% avoidance, presented as the upper bound CA value by Whitfield and Madders [2006a]).

Common Crane

The primary basis for selection of CA values for this species were the results of Drachmann et. al. 2021, who generated empirically-derived CA parameter values for Pink-footed Goose and Common Crane based on an observational data set from an onshore wind farm in Denmark. In Drachmann et. al.’s study, no collisions of Common Crane were recorded during the two year study period, in spite of 696 observed flight tracks of the species through the wind farm area, hence the CA value for Common Crane based on their empirical dataset is 1 (100% avoidance). However, Drachmann et. al. also included CA parameter estimates based on hypothetical scenarios in which one Common Crane fatality was recorded per year. This led to CA parameter estimates of 0.9988 and 0.9993 in the two years of their study. We used these two values as our “most realistic” and upper bound values, respectively, using the SNH recommended default value of 0.98 as our lower bound value (SNH 2018).

3. Results and Conclusions

The results of the CRM analysis for the Project are summarized in Tables 9-13. Tables 9-12 present each of the single season CRM results for each modelled species for each technology scenario, and Table 13 presents the cumulative collision risk predictions of the CRM analysis for the entire, year-long survey period. The cumulative results were generated by adding the values for the four seasons together for each species, hence preserving the natural between-season variation in risky flight behaviour deriving from the empirical data.

3.1 Collision Risk in Tier 1 Target Species

The CRM analysis predicts that none of the tier 1 target species are likely to experience collision frequencies greater than 1 per 28 years (Table 13), based on the CRM results for collision risk models using the most realistic collision avoidance parameters. *At this level of predicted collision*

risk, the Project does not raise significant concerns for potential impacts to any of these species. The strength and certainty of this conclusion are limited by the uncertainties inherent in predicting bird fatality rates using CRM. Nonetheless, these results provide a reasonably firm basis for characterizing collision risk to tier 1 target species from the Project, given the strength of the observational data set on which they are based. The lack of observations of most of the tier 1 target species in the VP survey data set, and the scarcity of the observations of Steppe and Golden Eagles, as well as Red-footed Falcon (Table 1), indicate that the area is not heavily used by any tier 1 target species.

3.2 Collision Risk in Tier 2 Target Species

Among the results for tier 2 target species, the results for Eurasian Kestrel and Common Crane, two common and widespread species that do not have elevated conservation status at either the national or international levels, stand out as distinct from the rest, with predicted collision fatality rates of 5 per year and 0.223 per year for the Kestrel and Crane, respectively, under the most realistic collision avoidance rate scenarios (Table 13). By contrast, no other species modelled had a collision rate higher than one fatality per four years under the most realistic collision avoidance scenarios, and only three other species had predicted collision rates greater than once per 10 years under the most realistic scenarios (Table 13). The CA values used for Eurasian Kestrel in our analysis are derived from studies of American Kestrel. The American Kestrel is closely related to the Eurasian Kestrel, similar in size and behaviour, and it is known to be highly susceptible to collisions with wind turbines (AWWI 2019), likely due to its tendency to hover at heights within the lower reaches of the rotor swept zone of wind turbines, as it hunts for small prey on the ground. The CA values used for Common Crane in our CRM analysis were largely based on the results of Drachmann et. al. (2021). With regard to Common Crane, it is worth noting that the prediction of relatively low fatality rates in spite of fairly high numbers of wind farm transits during autumn migration is consistent with wind farm fatality patterns in a closely-related and similarly abundant New World congener, the Sandhill Crane. In a compilation of 193 bird fatality studies from 130 wind farms in North America conducted between 2002 and 2017, zero Sandhill Crane fatalities were reported among 5,658 total bird fatalities that could be identified to species level (AWWI 2019). Similarly, zero fatalities of Common Cranes were documented in Drachmann et. al.'s (2021) study at an onshore wind farm in Denmark. This suggests that these species of cranes possess a set of behavioural and/or morphological characteristics that render them relatively unsusceptible to wind turbine collisions, even in situations where they have a fairly high degree of exposure (in the form of wind farm transits).

Three additional tier 2 target species were moderately abundant at the site, and may be exposed to moderate levels of collision risk: Eurasian Marsh-Harrier, for which collision risk is concentrated in summer; Long-legged Buzzard, for which risk is concentrated in autumn migration; and Hen Harrier, for which collision risk is concentrated during migratory seasons. The significance of this risk is considered low for these species, as they are all widespread, abundant raptors with no elevated conservation status at either the national, or international level, and the predicted level of collision impact is, therefore, not likely to cause a population-level effect.

3.3 Summary

Overall, the results of the CRM analysis indicate that the Project has a low level of collision risk for sensitive bird species. Among tier 1 target species, a category that includes all bird species with elevated national and/or international conservation/protected status that potentially occur at the site, only three species have been detected at the site during the VP survey effort, and none

are predicted to experience an annual collision frequency greater than one fatality per 28 years under the most likely collision avoidance rate parameters modelled (Table 13). This reflects the extremely low abundance of tier 1 target species recorded at the site during the VP surveys at the Site. Among tier 2 target species, a category that includes all other raptors and selected additional large bird species that could potentially be sensitive issues for the Project, if impacted, only seven species have been detected at the site during the VP survey effort. Of these, the Eurasian Kestrel (*Falco tinnunculus*) and Common Crane (*Grus grus*) were predicted to experience the highest collision rates, with 5 and 0.223 collisions predicted per year for the Kestrel and Crane, respectively, using the most realistic collision avoidance parameters (Table 13). Among the other tier 2 target species modelled, only the Eurasian Marsh-Harrier (*Circus aeruginosus*) Long-legged Buzzard (*Buteo rufinus*), and Hen Harrier (*Circus cyaneus*) were predicted to experience a collision more frequently than once per 10 years, under the most realistic collision avoidance rate scenarios modelled (Table 13). None of the collision rates predicted under any of the modelling scenarios raise significant bird collision risk concerns for the Project.

Table 9. Estimated rates of collisions per spring season for bird species at the Project, predicted by Band CRM analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/spring	Years to 1 spring collision	Collisions/spring	Years to 1 spring collision	Collisions/spring	Years to 1 spring collision
Steppe Eagle	0.00664	150	0.00147	680	0.000349	2870
Golden Eagle	0.00567	176	0.00125	800	0.000298	3360
Red-footed Falcon	0.144	6	0.0351	28	0.00113	885
Eurasian Marsh-Harrier	0.152	6	0.0304	32	0.00304	328
Hen Harrier	0.137	7	0.0273	36	0.00273	366
Common Buzzard						
Long-legged Buzzard						
Rough-legged Hawk	0.0472	21	0.0107	93	0.00215	465
Common Crane						
Eurasian Kestrel	6	<1	1	1	0.0446	22

Color coding of species by project-specific sensitivity level follows that of Table 1. Note that this table is based on VP data from an aggregate of two partial spring seasons of VP surveys conducted in 2020 (April 25, 2020 - May 15, 2020) and 2021 (March 16, 2021 - April 25, 2021). Rows are included for all modelled species, but information is only presented in the table for species that were observed during the Spring VP surveys.

Table 10: Estimated rates of collisions per summer season for bird species at the Project, predicted by Band CRM analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/summer	Years to 1 summer collision	Collisions/summer	Years to 1 summer collision	Collisions/summer	Years to 1 summer collision
Steppe Eagle						
Golden Eagle	0.00180	555	0.000398	2510	0.0000948	10,500
Red-footed Falcon						
Eurasian Marsh-Harrier	0.899	1	0.180	5	0.0180	55
Hen Harrier						
Common Buzzard						
Long-legged Buzzard						
Rough-legged Hawk						
Common Crane						
Eurasian Kestrel	4	<1	0.987	1	0.0318	31

Color coding of species by project-specific sensitivity level follows that of Table 1. Rows are included for all modelled species, but information is only presented in the table for species that were observed during the summer VP surveys.

Table 11: Estimated rates of collisions per autumn season for bird species at the Project, predicted by Band Collision Risk Modelling analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/autumn	Years to 1 autumn collision	Collisions/autumn	Years to 1 autumn collision	Collisions/autumn	Years to 1 autumn collision
Steppe Eagle	0.00662	151	0.00146	684	0.000348	2870
Golden Eagle	0.00309	323	0.000682	1470	0.000162	6170
Red-footed Falcon						
Eurasian Marsh-Harrier						
Hen Harrier	0.330	3	0.0659	15	0.00659	151
Common Buzzard	0.145	6	0.0330	30	0.00659	151
Long-legged Buzzard	0.755	1	0.172	5	0.0343	29
Rough-legged Hawk	0.175	5	0.0398	25	0.00797	125
Common Crane	3.72	<1	0.223	4	0.130	7
Eurasian Kestrel	8	<1	2	<1	0.0636	15

Color coding of species by project-specific sensitivity level follows that of Table 1. Rows are included for all modelled species, but information is only presented in the table for species that were observed during the autumn VP surveys.

Table 12: Estimated rates of collisions per winter season for bird species at the Karatau I Wind Energy Project, predicted by Band Collision Risk Modelling analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/winter	Years to 1 winter collision	Collisions/winter	Years to 1 winter collision	Collisions/winter	Years to 1 winter collision
Steppe Eagle	0.00870	114	0.00192	520	0.000458	2180
Golden Eagle	0.00756	132	0.00167	598	0.000398	2510
Red-footed Falcon						
Eurasian Marsh-Harrier	0.157	6	0.0315	31	0.00315	317
Hen Harrier	0.0757	13	0.0151	66	0.00151	662
Common Buzzard						
Long-legged Buzzard	0.0737	13	0.0168	59	0.00335	298
Rough-legged Hawk	0.100	10	0.0227	44	0.00454	220
Common Crane						
Eurasian Kestrel	5	<1	1	1	0.0425	23

Color coding of species by project-specific sensitivity level follows that of Table 1. Rows are included for all modelled species, but information is only presented in the table for species that were observed during the winter VP surveys.

CRM analysis update for Nukus 100 MW WF

Table 13: Estimated rates of collisions per year for bird species at the Project, predicted by Band CRM analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/year	Years to 1 collision	Collisions/year	Years to 1 collision	Collisions/year	Years to 1 collision
Steppe Eagle	0.0220	45	0.00485	206	0.00116	862
Golden Eagle	0.0181	55	0.00401	249	0.000954	1050
Red-footed Falcon	0.144	6	0.0351	28	0.00113	885
Eurasian Marsh-Harrier	1	1	0.242	4	0.0242	41
Hen Harrier	0.542	1	0.108	9	0.0108	92
Common Buzzard	0.145	6	0.0330	30	0.00659	151
Long-legged Buzzard	0.829	1	0.188	5	0.0377	26
Rough-legged Hawk	0.322	3	0.0733	13	0.0147	68
Common Crane	3.72	<1	0.223	4	0.130	7
Eurasian Kestrel	23	<1	5	<1	0.183	5

Color coding of species by project-specific sensitivity level follows that of Table 1.

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G – SHADOW FLICKER MODEL

Nukus Wind Farm, Uzbekistan
Shadow Flicker Assessment

March 2022





Nukus Wind Farm, Uzbekistan

Shadow Flicker Assessment

Revision	Date	Notes	Author	Checked	Approved
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1 INTRODUCTION

- 1.1 Entran Ltd have been commissioned to provide a 'Shadow Flicker' assessment for the project known as the 'Nukus Wind Farm (WF)', Uzbekistan. The project site is in the Karakalpakstan region, north-west of the country.
- 1.2 This 'Shadow Flicker' assessment has been undertaken for the Nukus WF in accordance with the International Finance Corporation's (IFC) environmental guidance on Wind Energy projects.
- 1.3 The Nukus Wind Farm will comprise of a total of 16 Envision EN171, 6.5MW turbines.
- 1.4 The general site locations as well as potential receptors are presented in Figure 1.
- 1.5 Wind turbines can cause 'Shadow Flicker' when the sun passes behind a moving blade and casts a shadow on the window of nearby premises. Shadow flicker for the purposes of assessment is described as:

Shadow-flicker from wind turbines is defined as alternating changes in light intensity caused by rotating blades casting shadows on the ground and stationary objects such as a window at a dwelling. No shadow will be cast when the sun is obscured by clouds/fog or when the turbine is not operating. Shadow-flicker can occur in project area homes when the turbine is located near a home and is in a position where the blades interfere with very low-angle sunlight. The most typical effect is the visibility of an intermittent light reduction in the rooms of the home facing the wind turbines and subject to the shadow-flicker. Such locations are here referred to as shadow-flicker receptors. Obstacles such as terrain, trees, or buildings between the wind turbine and a potential shadow-flicker receptor significantly reduce or eliminate shadow-flicker effects.

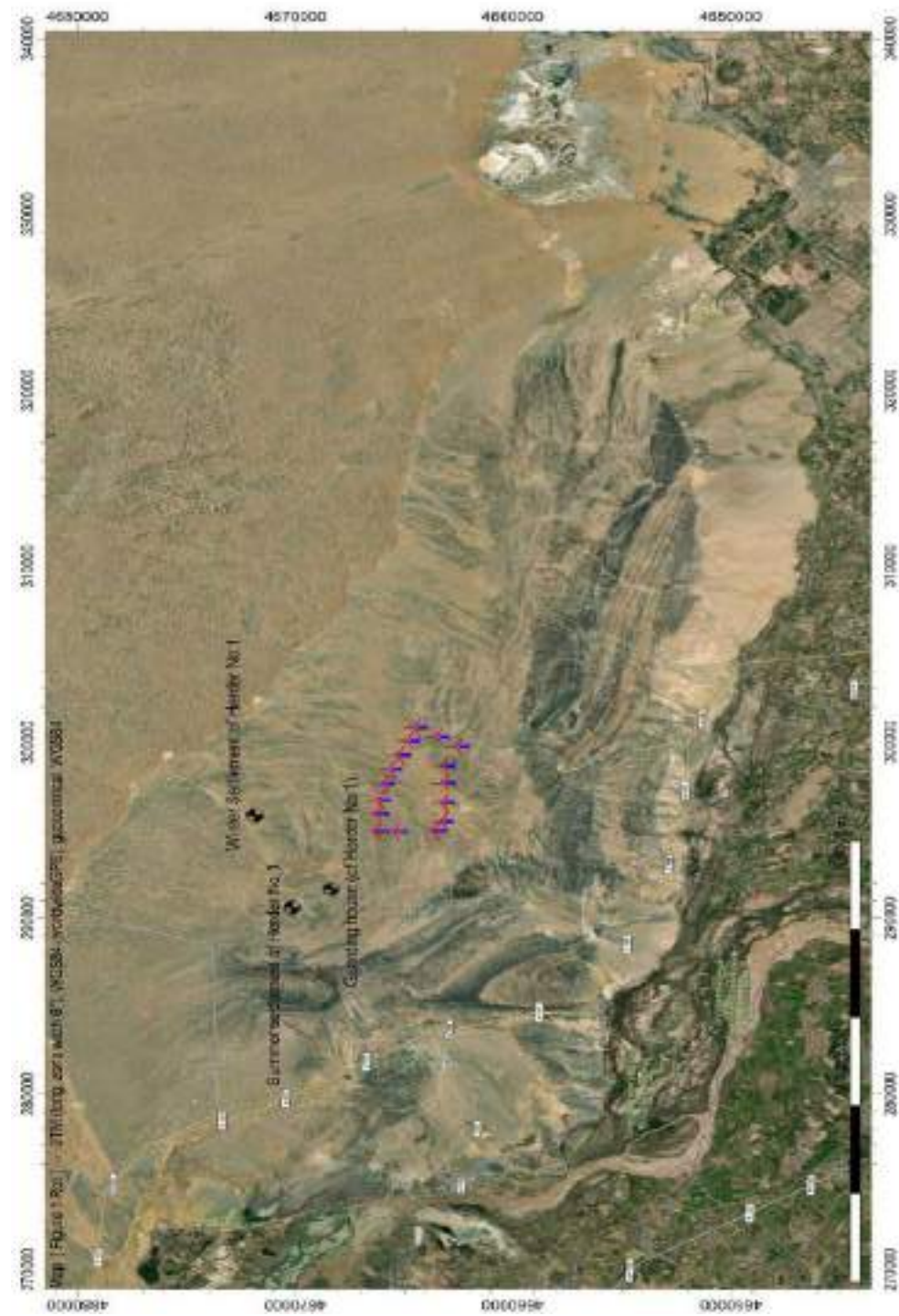
- 1.6 Shadow flicker will depend on the following variables:
 - The turbine hub height and rotor diameter;
 - The distance from the turbines;
 - The direction of the residence relative to the turbines;
 - The time of year and wind direction;
 - The proportion of daylight hours in which the turbines operate; and



-
- The frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon).

1.7 The wind farm project has more than one turbine which can therefore result in more than one turbine affecting a specific receptor at any time and therefore increase the shadow flicker intensity or frequency. This potential effect has been taken into account within this assessment.

Figure 1 Nukus WF Project





- 1.8 The assessment of receptors potentially susceptible to shadow flicker (e.g. human settlements) within a distance of ten rotor diameters from proposed turbine locations is internationally considered to be an acceptable distance limit for the shadow flicker studies. However, for a robust approach, all human settlements within a 6000m radius of any given turbine location have been included for analysis.

Table 1.1 Identification of Sensitive Sites

Receptor	Description	Easting	Northing	Nukus WF Project	
				Nearest Turbine	Nearest Distance, m
A	Summer Settlement for Herder No. 1	290597	4670160	NU-01	5819
B	Guarding House for Herder No. 1	291633	4668349	NU-01	3897
C	Winter Settlement for Herder No. 1	295837	4671843	NU-02	5591



2 SHADOW FLICKER ASSESSMENT CRITERIA

IFC Guidance

- 2.1 The Environmental, Health and Safety' Guidelines for Wind Energy (2015) sets the following screening criteria for wind farms:

If it is not possible to locate the wind energy facility/turbines such that neighbouring receptors experience no shadow flicker effects, it is recommended that the predicted duration of shadow flicker effects experienced at a sensitive receptor not exceed 30 hours per year and 30 minutes per day on the worst affected day, based on a worst-case scenario.

In order to assess compliance with the recommended limits, shadow flicker should be modelled and predicted based on an astronomical worst-case scenario, which is defined as follows:

- *There is continual sunshine and permanently cloudless skies from sunrise to sunset.*
- *There is sufficient wind for continually rotating turbine blades.*
- *Rotor is perpendicular to the incident direction of the sunlight.*
- *Sun angles less than 3 degrees above the horizon level are disregarded (due to likelihood for vegetation and building screening).*
- *Distances between the rotor plane and the tower axis are negligible.*
- *Light refraction in the atmosphere is not considered.*

- 2.2 In addition to the above recommended scenario, an assessment has also been made to consider actual site conditions based upon long-term sunshine statistics.



3 SHADOW FLICKER MODELLING

- 3.1 Shadow flicker was modelled using WindPRO (v3.5), an industry-leading software package for the design and planning of wind energy projects. The model software considers the sun's path with respect to every turbine location during every minute over a complete year. Any shadow flicker caused by each turbine is then aggregated for each receptor for the entire year.
- 3.2 The input parameters for the model include:
- the turbine locations and dimensions;
 - the receptors location; and
 - the size of windows on each receptor and the direction that the windows face.
- 3.3 The turbine and receptor locations are presented in Appendix A. The topography model used for the assessment was obtained from the (Space) 'Shuttle Radar Topography Mission', (SRTM), at 30m resolution.
- 3.4 The relevant turbine data is presented in Table 3.1.

Table 3.1 Turbine Details

Turbine Model	Rotor Diameter, m	Hub Height, m	Blade Length, m	Rotor Swept Area, m ²	Rotor Speed Range, rpm
EN171 (6.5MW)	171	120	83.9	22965	7.1 – 9.94



3.5 The following scenarios are considered:

- As per IFC's worst-case; and
- A realistic scenario based upon site data (e.g long term average sunshine hours rather than the worst-case IFC scenario of constant sunshine).

3.6 For the IFC worst-case scenario, the following is considered:

- there is a clear sky 365 days per year;
- the turbine blades were assumed to be rotating for 365 days per year;
- The effect of shadow flicker was not calculated where the sun lies less than 3 degrees above the horizon;
- the receptor is occupied at all times;
- no screening (from either trees or man-made obstacles) is taken into account; and
- all receptors have a 1 m x 1 m window facing directly towards the turbine;

3.7 These assumptions result in a robust but conservative estimation:

- unlikely to have clear skies all year around;
- screening can mask shadows from the turbines;
- all the turbines may not be operational all year;
- turbine blades will not face the shadow receptor all year (as blades will face the direction of wind to be fully efficient);
- shadow receptors may not be occupied during a shadow flicker event; and
- the intensity of any shadow flicker event will be diminished by the intervening distance.

3.8 For a more realistic consideration, long term weather conditions were obtained from Aralskoe More meteorological dataset and the sunshine probability used for the model is set out in Table 3.2. Other meteorological sites in the immediate vicinity do not have a complete set of the required data.

Table 3.2 Sunshine Hours for Realistic Scenario

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
4.02 Hrs	5.86 Hrs	6.74 Hrs	8.73 Hrs	10.85 Hrs	12.6 Hrs	12.09 Hrs	11.15 Hrs	9.89 Hrs	6.83 Hrs	4.33 Hrs	3.17 Hrs

3.9 However, as the geographical extent of the study is large, screening (trees or man-made obstacles) has not been considered for the realistic scenario.



4 SHADOW FLICKER RESULTS

4.1 The following shadow flicker effects will result for the receptors under consideration (see receptor details presented in Appendix A):

Table 4.1 Shadow Flicker Occurrence at Each Receptor (Nukus WF project)

Shadow receptor	X	Y	Shadow, worst case		Max shadow	Shadow, expected values Shadow hours
			per year	per year	hours per day	per year
			[h/year]	[days/year]	[h/day]	[h/year]
A Summer Settlement for Herder No. 1	290597	4670160	0.00	0	0.00	0.00
B Guarding House for Herder No. 1	291633	4668349	0.00	0	0.00	0.00
C Winter Settlement for Herder No. 1	295837	4671843	0.00	0	0.00	0.00

4.2 As can be seen for the above results, none of the assessed locations exceed the IFC worst-case criteria (30 hours per year or less than 30 mins per day).

4.3 The above shadow flicker effects are shown graphically in Appendix B.

Mitigation

4.4 The assessed receptors do not exceed the IFC worst-case criteria and therefore mitigation measures are not necessary.



5 CONCLUSIONS

- 5.1 A shadow flicker assessment for the Nukus WF project has been undertaken. This wind farm comprises of 16 Envision EN171 6.5MW turbines at a hub height of 120m.
- 5.2 The shadow flicker assessment has shown that all assessed receptors are within the IFC worst-case guidelines. Further mitigation is therefore not necessary.



APPENDIX A – WIND FARM LAYOUT & RECEPTOR DETAILS



Nukus WF Wind Farm Project (hub-height 120m)

Shadow Flicker Model Label (WindPro Output)	WTG Description	Easting	Northing	Z
1	NU-01	294937	4666298	293.4
2	NU-02	295936	4666268	286.4
3	NU-03	296741	4666175	273.8
4	NU-04	297620	4665936	270
5	NU-05	298460	4665633	269.1
6	NU-06	299236	4665264	270
7	NU-07	300057	4664871	278.3
8	NU-08	300351	4663470	300
9	NU-09	300852	4664485	290
10	NU-10	299753	4662551	313.4
11	NU-11	294942	4665505	297.3
12	NU-12	298691	4663200	296.6
13	NU-13	297651	4663181	290
14	NU-14	296560	4663205	282.4
15	NU-15	295549	4663286	300
16	NU-16	294953	4663489	300



Receptor Data

Receptor	Easting	Northing	Z, m
A Summer Settlement for Herder No. 1	290597	4670160	335.7
B Guarding House for Herder No. 1	291633	4668349	350
C Winter Settlement for Herder No. 1	295837	4671843	230



APPENDIX B SHADOW FLICKER CONTOUR MAPS

[see attachment]

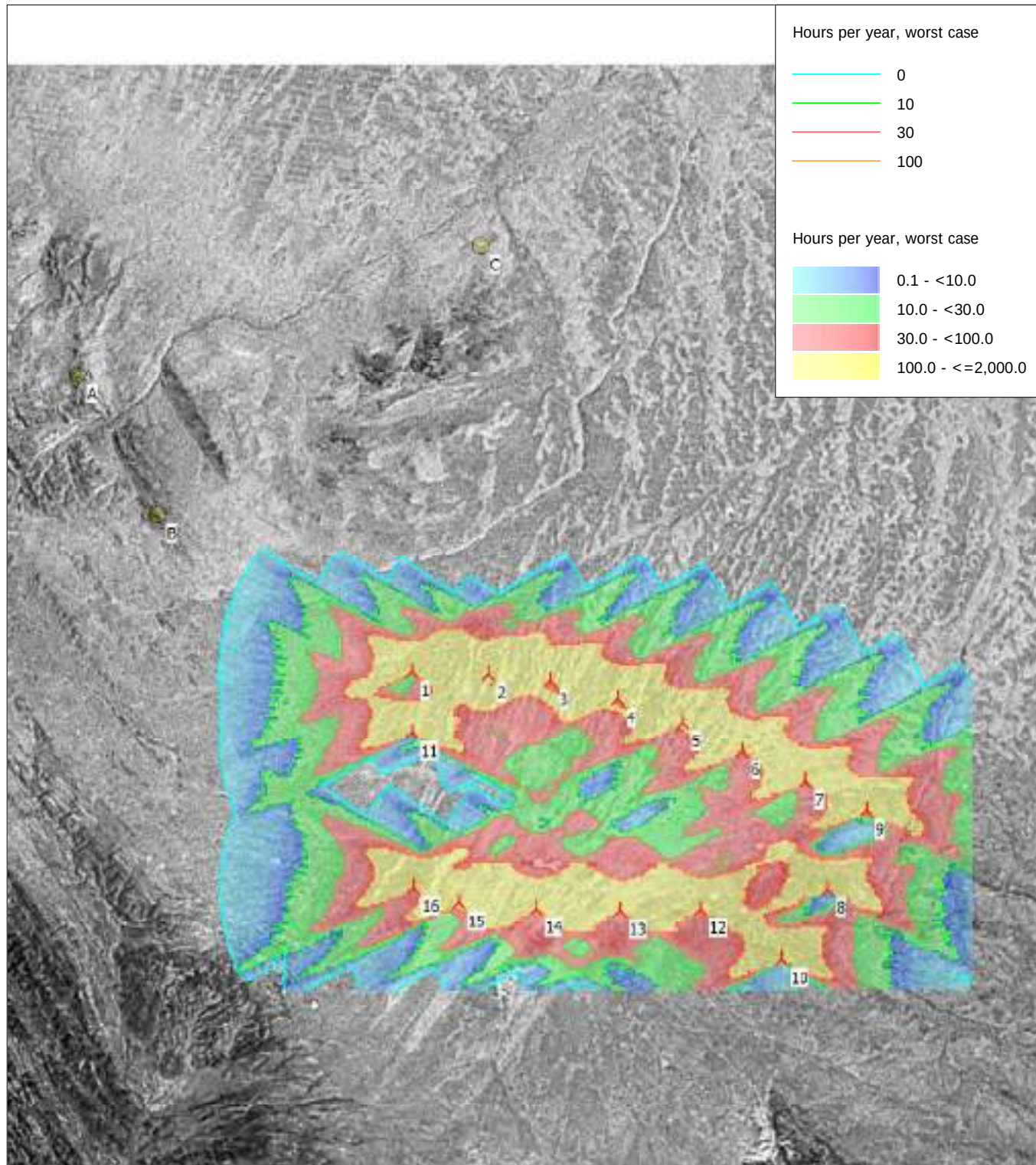
Project:
Nukus

Licensed user:
Entran Ltd
2nd & 3rd Floors, Northgate House Upper Borough Walls
GB-BATH BA1 1RG

Calculated:
30/03/2022 15:52/3.5.576

SHADOW - Map

Calculation: Nukus



0 1 2 3 4 km

Map: OnlineMap_20_20.00_0, Print scale 1:75,000, Map center UTM (north)-WGS84 Zone: 41 East: 296,400 North: 4,667,430
New WTG Shadow receptor
Flicker map level: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo (1)
Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1.5 m

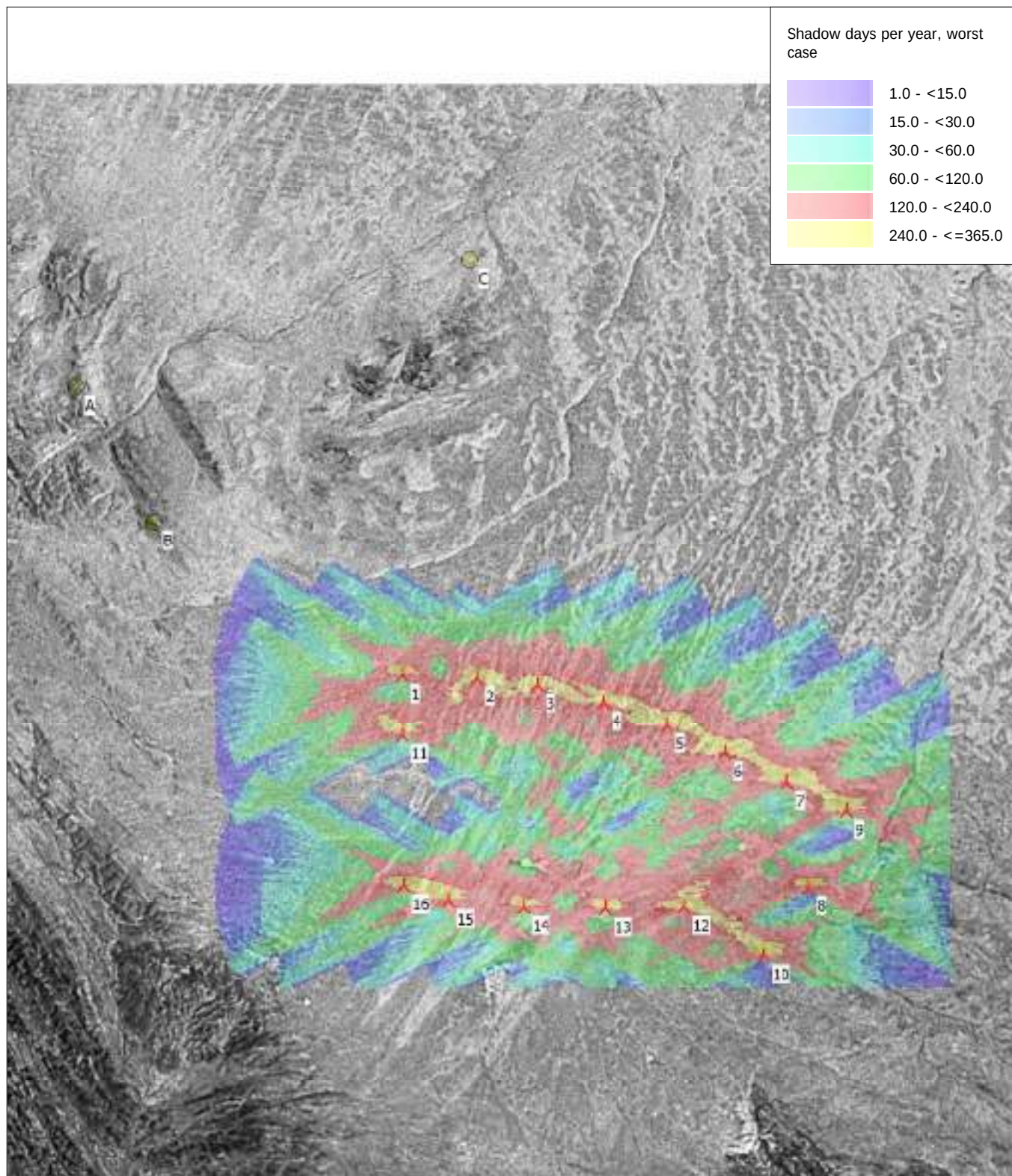
Project:
Nukus

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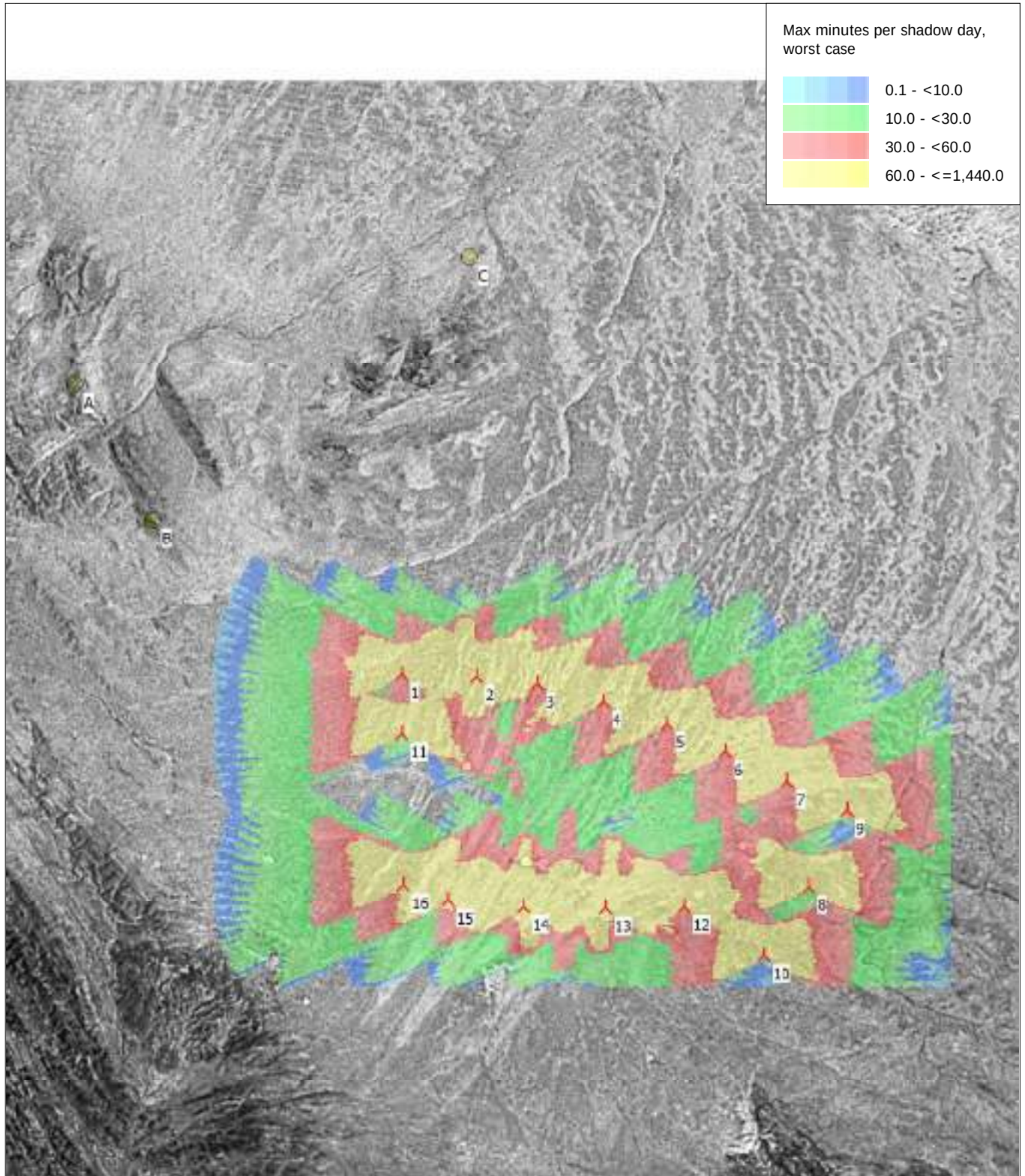
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New WTG

Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo (1)

H - ARCHAEOLOGY AND CONCLUSION

ACADEMY OF SCIENCES OF THE REPUBLIC OF UZBEKISTAN
KARAKALPAK BRANCH OF THE
KARAKALPAK HUMANITIES SCIENTIFIC RESEARCH INSTITUTE

APPROVED by

Director of Karakalpak Branch of the
Karakalpak Humanities Scientific Research Institute of Academy of Sciences of the
Republic of Uzbekistan (KRHI KKB AS Uz)

A.I. Alniyazov _____
" ____ " _____ 2022

Report on
Archaeological Survey conducted by Sultanuizdag Archaeological
Expeditionary Unit in 2022

Head of the Unit _____ A. Iskanderova

Authors of the Report:	
Iskanderova A.	_____
Khashimov H.	_____
Yagodin V.V.	_____
Toreniyazov A.	_____
Bekbauliev A.	_____
Khodjalepesov. I.	_____

Nukus 2022

Abstract

Report on Archaeological survey conducted by Sultanuizdag Archaeological Expeditionary Unit of the Karakalpak Humanities Research Institute in 2022 (Iskanderova A.).

The report consists of 1 volume of 24 pages: text - 14 pages, illustrations - 4 pages (8 illustrations), annexes - 6 pages (4 annexes).

Karakalpak Humanities Research Institute of the Karakalpak Branch of the Academy of Sciences of the Republic of Uzbekistan.

Key words: Republic of Karakalpakstan, Karauzyak district, lower reaches of the Amu Darya, Sultan-Uizdag mountain range, mounds, Middle Ages, archaeological exploration.

Archaeological exploration headed by A. Iskanderova was carried out in May 2022 in the Karauzyak district of the Republic of Karakalpakstan. The purpose of the research was to find and preliminarily study objects located in a few kilometers northeast of the Sultan-Uizdag mountain range, where the wind power plant is planned for construction. In addition, objective of the research was to survey the power transmission line that will be laid along the Sultan-Uizdag mountain range in the area of the Jamansay tract. During visual observation of location of facilities planned for construction, it was found that the territory was covered with a thick sand layer blown from the Kyzylkum desert, and fixing archaeological sites on the day surface was visually impossible.

- 1) The territory for the wind power plant construction (wind-power generator turbines) and power lines stretching for over 15 km were surveyed during the research. Nearby territories in the construction area were also explored.
- 2) The archaeological exploration revealed no visual archaeological sites (settlements, burial sites, production facilities, etc.) in the territory of the abovenamed planned construction facilities. Single fragments of ceramic material were found in the turbine construction area. In the adjacent areas of wind-power generators and power lines planned for construction, 2 sites known to science can be attributed to archaeological and cultural heritage sites.
- 3) The exploration revealed a collection of artefactual remains, including 73 fragments of pottery ceramics.

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2 Introduction

Basis of the works in 2022. The research program included two missions. The first was initiated as an exploration mission, the task of which was to familiarize with prospects for a comprehensive research of this category of archaeological sites in the Sultan-Uizdag mountains, search and map new archaeological sites, and clarify coordinates of those already known.

The second mission was to determine buffer zones for preservation of recorded archaeological sites during exploration.

The field exploration works were carried out on the basis of the "Open sheet ", No. 0090, dd. April 12, 2022, issued by the Head of the Directorate of Cultural Heritage of the Republic of Uzbekistan in the name of A. Iskanderova (Attachment 1).

Field works dates. The works were carried out from May 16 to May 31, 2022.

Karakalpak Humanities Research Institute of the KKB of Academy of Sciences of the Republic of Uzbekistan

Iskanderova A.J., Candidate of Historical Sciences - Head of the Expeditionary Unit

Yagodin V.V. - Head of the Expeditionary Unit

Toreniyazov A. - researcher

Bekbauliev A. - Researcher

Khodjalepesov I. - researcher

Tajimuratov M. - driver of the expedition car

National Center of Archeology, Samarkand Institute of Archeology of the Academy of Sciences of the Republic of Uzbekistan.

Khoshimov H. PhD. - Senior Researcher

Financing and logistics of the field research. The field work was financed and carried out on the basis of the economic contract No. 1/22 dd. April 14, 2022 for archaeological research in the territory of the Republic of Uzbekistan, signed by ACWA POWER WIND KARATAU and the KRHI KKB AS Uz, aimed to carry out archaeological research in Karauzyak district of the Republic of Karakalpakstan in the wind power plant construction site in the area of the Sultan-Uizdag mountain range.

Besides, the archaeological exploration in the Sultan-Uizdag range territory is included in the scope of the planned topic of the Archeology Department: “The lower reaches of the Amu Darya in antiquity and the Middle Ages. The first centuries of our era - XIV century. (The matters of material and spiritual culture). Logistical support was provided by the KRHI KKB AS Uz

Methods. The archaeological research is carried out in accordance with the generally accepted requirements for archaeological exploration. The exploration archaeological works were carried out using cartography methods. The topographic plans of the area and maps of the location of the discovered and previously known archaeological sites were made using remote sensing data and GPS surveys with subsequent processing, as well as walking tours in the surveyed territories.

Artefacts found as a result of the archaeological research will undergo the office study process (restoration, photographing, drawing, pictures, processing on graphic editors). Subsequently, the artefacts will be described with determining historical and cultural periods and their functional purposes.

The report has been drawn up in four copies. The first copy resides in the scientific archive of the Department of Archeology of the KKNiIGN KCO AS RUz. (Nukus). The second copy resides in the Main Scientific and Production Department of the Department of Cultural Heritage of the Republic of Uzbekistan (Tashkent). The third copy resides in the scientific archive of the National Center for Archeology of the Academy of Sciences of the Republic of Uzbekistan (Tashkent).

2.1 Goals and Objectives of the Research

The purpose of the research was to carry out archaeological research (explorations) for presence (absence) of sites with the signs of historical and cultural heritage sites in the surveyed

area (the Sultan-Uizdag mountain range and the territory to the northeast of the range); obtaining modern scientific data on presence of archaeological heritage sites in the survey area, and planning measures to ensure their safety.

Tasks of the research:

- collection of historical and archival information about presence of cultural heritage sited within the survey area;
- carrying out the field (in-situ) archaeological survey (exploration) of the specified area;
- documentation of the research process;
- office and desk processing of the received data;
- writing a scientific report on exploration results

2.2 Regulatory and Legal Basis of the Field Work

The legal basis of the research is legislation of the Republic of Uzbekistan in the field of protection and use of monuments. In the Republic of Uzbekistan, archaeological monuments are public property under state protection, used in the interests of culture, science and public education. In the regulatory framework, several laws were approved providing for protection and preservation of cultural heritage monuments.

The Law “On Protection and Use of Cultural Heritage Sites” adopted on August 20, 2001. In 2009, the law was amended to protect intangible cultural heritage along with tangible cultural heritage.

The Law "On Protection and Use of Archaeological Heritage Sites" adopted on October 14, 2009.

Decree of the Cabinet of Ministers of the Republic of Uzbekistan No. 269 dd. July 29, 2009
“On measures to further improve protection and use of cultural heritage sites”

“Regulation on archaeological excavations and exploration and preservation of archaeological finds in the territory of the Republic of Uzbekistan”, approved by the Ministry of Culture and Sports, the Academy of Sciences and Academy of Arts of the Republic of Uzbekistan in 2009.

3 Brief historical and geographical background of the research area

The Sultan-Uizdag range is located in the central part of the Republic of Karakalpakstan on the right bank of the Amudarya River. The Sultan-Uizdag is a system of low mountains with a height of 300-400 m above sea level. It is elongated in the form of a 8-12 km-wide and 60 km-long strip. On the left bank of the Amu Darya, there is the Djumyr Tau Mountain; the system ends near the ancient settlement of Ayaz Kala 1, 364 meter-high Karatau Mountain. To the west of this range there is the 329 meter-high Kazantau Mountain. To the west of the Kazantau Mountain there is 473 meter-high Ashshyttau (Karachengel) Mountain, the highest point of Sultauiz-dag. In the very west, on the right bank of the Amu Darya, there is another massif of Sheikh Jeli mountains which are 250 meters high. The range appeared as a result of eruption of Paleozoic rocks and Mesozoic sedimentary rocks (Kogan, 1962, p. 628). From the north, the range is surrounded by the sands of Kyzylkum, and in the northwest, there is Khodjakol Lake (which has now dried up).

The Sultan-Uizdag has several wells with fresh water, the vegetation is sparse, mainly thickets of saxaul in the valleys (Visnevsky, 1940, p. 3-5). The Sultan-Uizdag minerals include talc, marble, turquoise, mineral paints, copper, marl, gold, etc. (Vikhansky, 1938, p. 31).

The earliest information indirectly indicating the minings in the South Aral Sea is building inscriptions of Darius I about construction of a palace in Susa, which mention the stone “Akhshaina” brought from the South Aral Sea (Abaev, 1945. p. 130). Researchers suggest that the Akhshain stone may be turquoise (Avdiev, 1953, p. 548). There are also opinions that this stone is marble, which was used to decorate walls of palaces in Susa (Pugachenkova, 1970).

Writings of the authors of the IX-XI centuries indicate that turquoise stone was exported from the territory of Khorezm (Book, 1828). European travellers who visited the South Aral Sea in the XVIII-XIX centuries also mention the mountains near Khiva, containing silver and gold ores (Mushketov, 1886, p. 76).

Khorezm archaeological and ethnographic expedition headed by Academician S.P. Tolstov in the late 1950s of the 20th century, explored the archaeological sites of the Sultan-Uizdag such as Ayazkala, Gyaurkala, Burlykala, Djanpykkala, flag-towers, mine workings, etc. Researches of Sultauizdag mining began in 1960, (Tolstov, Jdanko, Itina, 1963, p. 6). In 1965-1971, archaeological researches of the Sultan-Uzdag massif were carried out by the archaeological unit of archeology and ethnography sector of the Institute of History and Language of the Karakalpak branch of the Academy of Sciences of the UzSSR headed by Manylov Yu.P. The

unit works included investigation, description, photographing, shooting of settlements, flag-towers, and workings to the plan. In the course of archaeological work, several archaeological sites previously unknown to science were discovered and described as ossuary and burial mounds. Research of the Sultan-Uizdag mountain range by Yu. P. Manylov discovered a number of previously unknown archaeological sites (Manylov, 1972; Yusupov, Manylov, 1968. p.61-67).

In 2015-2018, a group of archaeologists of the Karakalpak-Australian archaeological expedition carried out archaeological explorations and excavations of archaeological sites at the Sultan-Uizdag range. In 2015, archaeological explorations were carried out on the mountain range in the Kazgansai tracts and partly - in the Jamansay tract and Kazantau Mountain. The purpose of this exploration was to determine exact geographical coordinates of steatite stone workings on previously known to science sites and to search for new archaeological sites. The archaeological works clarified location of archaeological sites, determined coordinates of steatite workings on the Kazantau Mountain (height - 329 m). Besides, several new sites were discovered, such as separate burial mounds and Beshmazar burial ground. Judging by the visual inspection, the Beshmazar burial ground consists of two types of burial structures: barrows and Muslim ground burials with tombstones (Amirov et al., 2019, p. 48-52). Two ground burials were recorded in the Jamansay tract; during a visual inspection of the nearby territories no other burial sites were recorded, which proves that these burials are single (Amirov et al., 2019, pp. 47-48). In 2017-2018, participants of the International Expedition (M. Minardi, Khodjalepesov I.) excavated an ossuary burial ground on the top of the mountain ranges of the south-eastern Sultan-Uizdag (Khodjanliyazov et al., 2018. P. 37-43). According to fragments of ossuaries, it can be assumed that the ossuary burial dates back to the 3rd-4th centuries A.D.

In the field season of 2018, an archaeological site of a burial culture was excavated on one of the mountain peaks in the south-eastern part of the range (Khodjanliyazov et al., 2019, P. 42-49). The excavation resulted in obtaining new scientific data on the burial culture, relating to the golden age of Zoroastrianism. Scientific evidence proves that the site excavated in 2018 is a naus. The above scientific results indicate that the Sultan-Uizdag mountain range territory had been settled and mineral extraction had been practiced since ancient times, as evidenced by few written sources of various authors. Finds of ossuary burial grounds and burial structures on top of the mountains and fragments of ossuaries indicate that mountain tops were used for construction of burial sites in Late Antiquity.

4 Archaeological surveys

Planning of the archaeological survey began with routing. The route was laid taking into account the existing roads leading to the construction site of the wind power plant and power transmission lines. The Nukus-Uchkuduk road led from the A-380 Nukus-Turtkul highway to the wind turbine construction area and then the route led to the trade road. The research area covered the north-eastern part of the mountain range about 2 km from the Sultan-Uizdag. Besides, the exploration was carried out on the mountain range itself along laying of the power transmission line (Fig. 1, Fig. 2). First of all, the turbine construction territory was surveyed. The research area of the wind generators construction is a plain covered with a thick layer of sand blown from the Kyzyl-Kum desert (Fig. 3). The research was carried out according to the marks where 16 wind turbines will be built; as a result of the archaeological research, no traces or remains of archaeological sites were visually recorded on the surface, such as burial structures, individual buildings, wells, workings for fossil wealth, etc. But during inspection of the territory, many fragments of archaeological artefacts in the form of fragments of ceramic vessels were recorded. Fragments of ceramic material were found near turbines No. NU-13, NU-14 and NU-15. In the area of a turbine under the technical number NU-09, a scattering of ceramic fragments was found, as well as the slag fragments. Judging by the available visually discovered artefacts, it can be assumed that there may possibly be a pottery kiln at this mark, but there are no clear traces of evidence that more accurately characterizes presence of an ancient production facility. As a result of a visual inspection at the construction site of wind turbines, 19 points of accumulation of ceramic fragments (in single and mass form) were recorded. The largest number of finds is recorded in the central part of the area, developed for production purposes (Fig. 4). These are finds of ceramics with identification numbers No. 4-9, No. 10, No. 15 (see Table 1). In addition, a small single fragment of ceramic finds was recorded in the area of turbine NU-15 (Fig. 2). No traces of an archaeological site and fragments of archaeological artefacts were recorded in the area of the electrical substation construction.

The second research target was a survey of over 15 km-long power transmission lines. The survey of the power transmission line started from the starting point at the electrical substation construction area. The power transmission line will stretch from the desert area, along the foothills and further along the mountain ranges to the Nukus-Turtkul highway. The power line was surveyed taking into account preservation of a 50-meter buffer zone on both sides of the power line. As a result of the archaeological exploration and visual inspection of the area, no

archaeological sites were found. The research did not record any fragments of archaeological artefacts, except for a single find under No. 13 (Fig. 4, Fig. 5), (see Table 1).

Ceramic finds are mostly the fragments of gray-clay pottery, with few fragments of red-clay pottery. Ceramic materials are fragments of vessels body sides, handles and bottoms. No diagnostic fragments were found.

According to the typology, technological properties and ornamentation of ceramic products, they can be relatively dated to the XII-XIV centuries A.D. Perhaps these finds are mainly due to the rapid development of the Sultan-Uizdag range territory in the medieval period. In the Middle Ages, talcum peach was mined here, which was used to make household vessels and talc boilers. Workings and mines for extraction of talcum peach were investigated by Yu. P. Manylov in the 70s. of the last century (Manylov, 1972, p. 222-232). Then it was found that such boilers were especially widespread in the Middle Ages. More accurate geographic coordinates of talcum peach workings were obtained during exploration in 2015. The main place of extraction of this stone was the Kazantau Mountain (Amirov et al., 2019, p. 50-52). As a result of exploration in 2015, a number of workings, temporary camps of miners and unfinished boilers were recorded. This proves that not only raw materials were mined here, but possibly the product itself was processed or manufactured (Fig. 8). As a result of the construction area survey, 73 fragments of artefactual ceramic material dating back to the same historical and cultural period were found.

Table 1: List of archaeological artefacts and coordinates found at the construction site of the power plant and power transmission line

Name	xcoord	ycoord	zcoord	id	finding
Sul-01 Ceramics	60,528824	42,118895	259,51	1	1
Sul-02	60,527202	42,120423	259,9	2	1
Point 12Sul-03	60,527047	42,120788	261,39	3	1
Point 23Sul_04	60,545566	42,11	251,45	4	1
Point 24Sul-05	60,541853	42,107314	247,45	5	38
Point 25Sul-06	60,541794	42,10722	252,08	6	4
Point 26Sul-07	60,539181	42,105259	248,27	7	1
Point 27Sul-08	60,53833	42,10472	241,32	8	2
Point 9 Sul-13	60,516014	42,078066	266,55	13	1
Point 1Sul-09	60,537263	42,104212	246	9	1

Point 10MyJ-10	60,579844	42,100333	263,01	10	1
Point 16Sul-11	60,526918	42,094305	277,15	11	1
Point 17 Sul-11	60,526766	42,094178	278,2	11	1
Point 19Sul-12	60,519744	42,104446	259,1	12	1
KER1	60,56722504	42,11524498	268,602509	14	1
KEP2 HF	60,56463	42,10420199	285,11731	15	1
KEP3 HANDLE	60,55141803	42,09453799	290,928101	16	1
KER4 BOTTOMS	60,53919503	42,09782504	280,772552	17	1
Placer Scatting	60,58987998	42,10603997	295,494781	18	11
KER6	60,52510296	42,095518	308,198822	19	7
KER7	60,52196603	42,09660497	308,635162	20	1

5 Archaeological sites located in the adjacent territory

As mentioned above, archaeological sites of various categories and historical and cultural periods - from antiquity to the Middle Ages - have been recorded in the mountain range territory. In 2015, members of the Karakalpak-Australian archaeological expedition carried out exploration at the Kazansay and Jamansay tracts, which identified workings of steatite rocks previously known to science. At the Jamansay tract, 5 km north of the A-380 Nukus-Turtkul highway, two ground burials were recorded (see Table 2) (Amirov et al., 2019. P. 48-49). These burials are single, and cannot be dated without excavations, since there is no surfacing material, but judging by the southwest and northeast orientation, it can be assumed that they are Muslim (Fig. 6). These ground burials are located 650 meters from the power transmission line, which will not affect the sites safety during construction.

Besides, the explorations discovered Beshmazar burial ground (the planned name during the exploration). The burial ground is located 640 meters from Beshmazar well. The burial ground is located 3900 m from the construction site of the wind power plant. Topographically, it is divided into two groups. The south-eastern part of the burial ground consists of ground burials with or without stone stelae. The burials are located in rows, the orientation is western; 33 burials were recorded, judging by the artefactual ceramic material, they can be attributed to the 11th-13th centuries. The north-western part of the ground burial consists of burial mounds,

with stone banks of 4 to 6 meters in diameter (Fig. 7). The largest burial marrow is covered with a sheet of white coarse calico. Perhaps this burial marrow is a place of pilgrimage for local shepherds or residents.

Table 2: List of archaeological sites in the adjacent construction sites of the wind power plant and power transmission line

Site name	Status	Category	Distance from the construction site (meters)	Coordinates	Type of impact during the project activities
Ground burials	Archaeological site	Burial structures	651 m	N42°03'26,6454" E60°28'37,4820"	no integrity impact
Burial Beshmazar	Archaeological site	Burial structures	3900 m	N42°06'16,8300" E60°28'19,4400"	no integrity impact

6 Conclusion

On the basis of economic agreement No. 1/22 dd. April 14, 2022, concluded between the Karakalpak Humanities Research Institute and ACWA POWER WIND KARATAU LLC on archaeological exploration in Karauzyak district in the Sultan-Uizdag mountain range territory, archaeological explorations were carried out from May 16 to May 31, 2022 at the construction sites of the wind power plant (turbine construction sites) and power transmission line. The development area for industrial purposes covers the north-eastern part of the Sultan-Uizdag mountain range and is an area covered with up to 3-meter thick wind-blown sand in some places. In the last century, the Sultan-Uizdag mountain range territory was explored by geologists and archaeologists.

According to the data of the archaeological works in the ridge territory, a number of archaeological sites of various types, from burial to settlement, were found. The latest researches of the mountain range territory were carried out in 2015-2018. The works discovered a number of archaeological sites unknown to science. But the mountain range territory is still not all over explored by archaeologists. The archaeological works were also complicated by dense development of the territory for industrial purposes. At present, the mountain range is actively explored and processed by geologists and industrial enterprises engaged in extraction of minerals such as marble, vermiculite, etc. The mountain range is completely cut by exploratory trenches of geologists-researchers.

As a result of the research, an archaeological survey (exploration) was carried out for presence (absence) of sites with signs of historical and cultural heritage (archaeological monuments) in Karauzyak district in the Sultan-Uizdag mountain range.

The area of the industrial development site, as well as the territories adjacent to it, were inspected visually and surveyed in the areas of possible location of archaeological sites.

Turbine (about 100 meters in diameter) and power line (50 meters on both sides) construction sites were visually surveyed. As a result of the survey, no sites with signs of a cultural (archaeological) heritage site in the design and construction area of the industrial development facility were visually identified, since the area was covered with 3-m thick wind-blown sand. The recorded remains of archaeological artefacts in the form of fragments of ceramic vessels dating back to the 12th-14th centuries A.D. at some points of the planned construction (outside the above survey areas) is the prerogative for new comprehensive research. It should be noted that, in case of discovery of archaeological sites during construction (discovered under the sand layer), these sites must be archaeologically researched. It should be noted that in the adjacent territories of the industrial development, several archaeological sites were identified as burial structures (mounds and soil burials), facilities of a settlement type, which are underexplored and need archaeological research and preservation.

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8 Illustrations



Figure 1. Scheme-map of location of the wind power plant and power transmission line construction



Figure 2. Map and point locations of wind generators and power transmission line



Figure 3. Landscape of wind power plant construction site



Figure 4. Map and marking points of archaeological artefact finds



Figure 5. Fragments of artefact ceramics from the wind power plant (turbines) construction site



Figure 6. Ground burials in the adjacent territory of the power transmission line



Figure 7. Beshmazar burial ground. Group of burial mounds



Figure 8. Unfinished talc-chlorite boilers

[illegible][illegible]

Madaniy meros
agentligining
madaniy meros
boshqarmalarida qayd
etilmasa haqiqiy emas



"Tasdiqlayman"
Madaniy meros agentligi direktori

Sh. Nurulloev
2022 y.

RUXSATNOMA № 117

Ushbu **RUXSATNOMA** Fanlar akademiyasi Milliy arxeologiya markazining. 06.04.2022-yildagi 01-186-sonli xatiga binoan

Arxeolog A. Iskandarovaga

(ismi-sharifi, familiyasi)

Qoraqalpog'iston Respublikasi Qorako'zak tumani Sulton Uvays tog' tizmalarida arxeologik qidiruv ishlarini olib borish uchun.

O'zbekiston Respublikasi Turizm va madaniy meros vazirligi huzuridagi Madaniy meros agentligida qayd etildi.

Bosh arxeolog

da qayd etildi.

(Hududiy madaniy meros boshqarmasi)

(boshqarma boshlig'i familiyasi, ismi, sharifi, sana)

Arxeologik qazishmalarni asrashga

sanada

Topshirdim

Hezratova A. Allom

Qabul qildim

Sh. Nurulloev

Tasdiqlash uchun (boshqarma boshlig'i) arxeologik ashyolarning pasporti, nomi, davri, surati, holati ko'rsatilgan holdagi ro'yxatini boshqarma boshlig'i qilmadi.

Annex 2

Академия наук Республики
Узбекистан Каракалпакское
отделение Каракалпакский научно-
исследовательский институт
гуманитарных наук



УТВЕРЖДАЮ
Начальник управления культурного
наследия Республики Каракалпакстан



АКТ ПРИЕМА № 1

археологических находок с разведок в районе горного хребта Султан-Уиздаг

Караузякский район РК

административный адрес

01.06.2022

г. Нукус

Мы, нижеподписавшиеся,

археолог,

Искандерова А.

ф.и.о.

Начальник управления культурного
наследия Республики Каракалпакстан
Шарипов К.

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начальник Уникального объекта
"Собрание археологических,
нумизматических и антропологических
материалов с музеем "Археология
Приаралья" Ягодин В.В.

ф.и.о.

Составили настоящий акт на 4 страницах, в трех экземплярах о том, что археолог
сдал, а начальник Уникального объекта принял на постоянное хранение следующие
археологические предметы, найденные при разведке

в районе горного хребта Султан-Уиздаг

"РУХСАТНОМА" № 117, выданный 06.04.2022

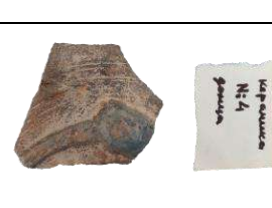
"ОЧИҚ ВАРАҚА" № Т/Р: 0090, выданный 12.04.2022

Всего по акту принято предметов 73

Каталог найденных предметов на 3 листах прилагается

List of findings discovered during exploration in Sultan-Uizdag mountain range in 2022

Mass discoveries						
	Name of discovery	Part	Number of fragments	Date	Location of a discovery	Photo
1	Ceramics	Side	1	12-14 centuries	N42°07,134' E60°31,729'	
2	Ceramics	Bottom	1	12-14 centuries	N42°07,223' E60°31,632'	
3	Ceramics	Fragment of a handle	1	12-14 centuries	N42°07,247' E60°31,623'	
4	Ceramics	Fragment of a handle	1	12-14 centuries	N42°06,600' E60°32,734'	
5	Ceramics	Side	38	12-14 centuries	N42°06,439' E60°32,511'	

6	Ceramics	Neck	1	12-14 centuries	N42°06,316' E60°32,351'	
7	Ceramics	Fragments of a handle and a side	2	12-14 centuries	N42°06,283' E60°32,300'	
8	Ceramics	Fragment of a collar	1	12-14 centuries	N42°06,253' E60°32,236'	
9	Ceramics	Fragments of a handle and a side	4	12-14 centuries	N42°06,434' E60°32,506'	
10	Ceramics	Fragment of a handle	1	12-14 centuries	N42°06,548' E60°34,020'	
11	Ceramics	Fragment of a collar	1	12-14 centuries	N42°06,151' E60°33,526'	
12	Ceramics	Fragment of a handle	1	12-14 centuries	N42°05,403' E60°33,510'	
13	Ceramics	Bottom	1	12-14 centuries	N42°05,521' E60°32,211'	

14	Ceramics	Side	11	12-14 centuries	N42°06,362' E60°32,353'	
15	Ceramics	Side	7	12-14 centuries	N42°05,731' E60°32,506'	
16	Ceramics	Side	1	12-14 centuries	N42°05,796' E60°31,318'	
Total			73			

List of the artefacts found during exploration in the Sultan-Uizdag mountain range in 2022

№	Item name	Dating	Quantity	State of preservation
1	Ceramic items	12-14 centuries	73	Fragments
Total: 73 (seventy-three) items				

Handed over _____
signature

Accepted _____
signature

Initial conclusions on archaeological exploration and mapping of the wind plant construction site on the Sultan-Uizdag ridge, located in the territory of Karauzyak district of the Republic of Karakalpakstan, under a joint agreement between ACWA POWER WIND KARATAU LLC and Karakalpak Humanities Scientific Research Institute under the KBB of the Academy of Sciences of the Republic of Uzbekistan.

CONCLUSION

On the basis of economic agreement No. 1/22 dd. April 14, 2022, concluded between the Karakalpak Humanities Research Institute and ACWA POWER WIND KARATAU LLC on archaeological exploration in Karauzyak district in the territory of the Sultan-Uizdag mountain range, archaeological explorations were carried out from May 16 to May 31, 2022 at the construction sites of the wind power plant (turbine construction sites) and power transmission line.

The development area for industrial purposes covers the north-eastern part of the Sultan-Uizdag mountain range and is an area covered with up to 3-meter thick wind-blown sand in some places. In the last century, the territory of the Sultan-Uizdag mountain range was explored by geologists and archaeologists.

According to the data of the archaeological works in the ridge territory, a number of archaeological sites of various types, from burial to settlement, were found. The latest researches of the mountain range territory were carried out in 2015-2018. The works discovered a number of archaeological sites unknown to science. But the mountain range territory is still not all over explored by archaeologists. The archaeological works were also complicated by dense development of the territory for industrial purposes. At present, the mountain range is actively explored and processed by geologists and industrial enterprises engaged in extraction of minerals such as marble, vermiculite, etc. The mountain range is completely cut by exploratory trenches of geologists-researchers.

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