ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT NON-TECHNICAL SUMMARY (NTS)

500MW Waad Al Shammal Wind Independent Power Plant

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1. INTRODUCTION

Waad Al Shammal Wind Park project (hereinafter "the Project") is located at a distance of approximately 30 km southeast of the city of Turaif and 150 km from Qurrayat city, in in the Norther Borders Province of Saudi Arabia. The location is mostly undeveloped with an area of approximately 88.1 km2. Waad Al Shammal allocated area is split between 10 sub-areas in 8 rows. The overall plant capacity is expected to be close to 516 MW.

The Project will include installation and operation of 190 wind turbines, which would result in an overall plant capacity of 798 MW. The total power generation capacity was expected to be equivalent to 2,787 MWh per yea1 (Master Plan, Waad Al Shammal wind energy park, Worley, September 2021). This design was the basis of the original Worley ESIA. Power evacuation and substation components are not part of the Project' scope but are considered associated facilities.

The proposed Project has been classified as Category 3 as per NCEC response to the Project

Figure 1-1 Project Location

Environmental Classification Form. The original ESIA for the windfarm development was prepared by Worley in 2021 and approval was obtained from the Saudi National Center for Environmental Compliance (NCEC) in accordance with local Saudi regulations. The NCEC issued the permit on August 9th, 2022, and it is valid until May 28th, 2025.

WSP was commissioned by the Client to review the original ESIA and amend the ESIA where required to meet the requirements of the following guidelines and standards for ESIAs:

- International Finance Corporation (IFC) Performance Standards (PSs);
- Equator Principles IV (EP IV);
- IFC Environment, Health & Safety (EHS) General Guidelines;
- IFC Environment, Health & Safety (EHS) Guidelines for Wind Energy; and
- The Japan Bank for International Cooperation (JBIC) Environmental Guidelines.

In undertaking this work, WSP recognizes the original work of Worley and has only amended the ESIA where strictly necessary to comply with the above requirements. The EPs refer to

the IFC PS as the benchmark for ESIA development. Therefore, the assessment has been

undertaken in line with the IFC PS requirement. It is important to note that the EP introduce additional considerations. This includes the requirement for a Climate Change Risk Assessment 9CCRA), which has been prepared specifically for this project.

To be consistent with the initial ESIA, this ESIA Addendum has followed the same assessment methodology as of the initial ESIA. Where relevant, assessments have been updated, and mitigation measures have been provided.

The current document is the Non-Technical Summary that provides a summary of the findings

contained in the ESIA Report. The updated ESIA Report contains more detailed information on the Project. It includes an Environmental and Social Management Plan (ESMP) which describes the monitoring and mitigation requirements for the duration of the project, including responsibilities and any legal requirements.

1.1. PROJECT DESCRIPTION

The proposed Project originally proposed the installation and operation of 190wind turbines, which results in an overall plant capacity of 798 MW. The total power generation capacity is expected to be equivalent to 2787 GWh per year2 (Master Plan, Waad Al Shammal wind energy park,
Worley, September 2021).

The current design, which has been assumed for the purpose of this amended ESIA summary prepared by WSP, is presented in Table 1-1.

	Current Design	Original Design
Generation capacity (MW)	500MW	798MW
Turbine Manufacturer (supplier)	Windey Energy Technology Group Co., LTD (OEM)	
Turbine model	WD200-7700	
Turbine hub height (m)	131	120
Turbine rated power (MW)	7.7	4.2
Rotor diameter (m)	197.3	150
Number of wind turbines	67	190
Number of substations	1	1

Table 1-1 Windfarm Design

It should be noted that the number of turbines of the windfarm is significantly reduced. Therefore, while the individual turbine size (in MW), turbine height and rotor diameter are increased in the new design, it is expected that the predicted environmental and social impacts of the new design will generally be reduced compared to those associated with the original design.

The Associated facilities to the Project include the following:

- A switching substation that will be constructed on the site.
- Connection from the switching substation to the transmission lines that already exist in close proximity to the site.

These assets will be developed, owned and operated by the Saudi Electricity Company (SEC) and are outside the scope of the ESIA. Hence, this ESIA does not cover the assessment of risks and impacts related to the proposed associated facilities i.e. the substation and transmission line (TL).
The Site shall be accessible via Arar-Turaif Highway (Highway #85) to the North of the Site. A new access road corridor connects the Highway with the site and IPP substation.

2. PROJECT BASELINE CONDITION

2.1. PHYSICAL ENVIRONMENT

2.1.1. CLIMATE

The climate in Eastern Region Province can be characterized as a hot dry climate in the Koppen Climate Classification system (Koppen, 1884) and is translated in the Volken & Brannaman classification (2011) as Baha, i.e., tropical, and subtropical desert climate. In addition, the province falls within the semi-tropical high-pressure belt, which has an influence in the region. In the winter, the arid northeast winds blow, making weather stable and cool in this season.

2.1.2. TEMPERATURE AND PRECIPITATION

As the region is a desert climate, it is expected that the temperature will vary diurnally and seasonally as well. In addition, as the province is one of the northern most provinces in Saudi Arabia, it is expected to be one of the coldest regions during the winter.

Future climate projection carried out as part of the climate risk assessment study in line with EP IV, reveal that temperatures in the region are projected to rise over the coming decades. Under high-emission scenarios, the number of days exceeding 45°C could increase from around 5 per year to as many as 39 by mid-century. This level of extreme heat may reduce turbine efficiency and increase wear on electrical components, especially during peak summer hours. While not expected to cause major performance issues, it may slightly reduce energy output and increase maintenance requirements.

2.1.3. WIND

Historical wind data has been obtained from data made available by the Saudi government from meteorological stations (Open Data website, accessed March 2021). In the Project area wind blows from the west throughout the year, with the exception of the months of November, December, and January, when the predominant wind direction is from the east.

Wind patterns are predominantly from the north and northeast, with average ground-level wind speeds around 4.6 m/s. At turbine hub height (131 meters), average wind speeds range from 8.0 to 8.4 m/s, supporting the site's suitability for wind energy generation.

Future climate projection indicates that the average wind speeds are expected to remain largely stable, with no significant impact on energy generation. However, dust storms may become more frequent during spring and summer. These storms can reduce visibility and contribute to wearing on turbine blades and sensitive components, making protective design features important for long-term operation.

Parameter	Year											
	2007											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Direction	E	W	W	W	W	W	W	W	W	E	E	E
	2008											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Direction	E	W	W	W	W	W	W	W	W	W	E	E
	2009											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Direction	E	W	W	W	W	W	W	W	W	W	E	W
	2010											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Direction	W	W	W	W	W	W	W	W	Nne	W	E	E
Speed (knots)	7	9	9	8	8	9	10	8	8	6	5	7
	2011											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Direction	E	W	W	W	W	W	W	W	W	W	E	E
Speed (knots)	7	8	7	9	10	9	8	8	8	7	7	6
	2012											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Direction	W	W	W	W	W	W	W	W	W	Ese	E	Ese
Speed (knots)	7	10	10	9	10	9	8	8	8	7	8	7

Table 2-1 Wind Statistics from Turiaf

2.1.4. AIR QUALITY

The Project site is in a remote area, where existing pollution comes from a cement plant belonging to Northern Region Cement Company ca 7.5 km east, traffic on road #85 and dust particles resuspended by wind from sandy areas. Other significant contributors to regional air quality include the Waad Al Shamal power project (12.5 km north-east) and the Maaden and open cast Umm Wu 'al phosphate mines and the Waad Al Shamal Phosphate Industrial Complex (north of the site across road #85). The industrial complex houses various chemical processing plant like Phosphoric Acid Plant, Sulphuric Acid Plant, Purified Phosphoric Acid Plant, Sodium TriPolyPhosphate Plant, Mono and Dicalcium Phosphate Plant and the associated infrastructure required to process the extracted ore. Dust and suspended from these mining operations has the potential to contribute to the overall ambient air quality in the wider project area.

To establish baseline air quality, a Site visit was undertaken in November 2021, during which some field measurements were taken at 5 different locations within the boundaries of the proposed project site by Support Establishment for Environmental Services.

The results of air parameters measured at the site indicate that all the elements are within the permissible limit in accordance with the standards of environmental protection in the general environment system and its implementing regulations.

2.1.5. NOISE

Noise and vibration were monitored in 5 locations within the site boundaries. The recorded results of the monitoring indicate that all the elements are within permissible values in

accordance with the standards of environmental protection in the general environment system and its implementing regulations.

2.1.6. GEOLOGY AND SOIL

The Arabian Peninsula is a huge crustal plate composed of ancient sedimentary and volcanic rocks, deformed, metamorphosed, and injected by plutonic intrusions. The Arabian Peninsula consists of two major regions: Arabian Shield in the west and the Arabian Platform in the east.

2.1.7. HYDROLOGY AND WATER RESOURCES

The site is located within the Wadi as Sirhan basin. Wadi as Sirhan is a geographical depression that extends northwestward from the northwestern part of the map area to the Jordan border. In Wadi as Sirhan gravel fans and outwash plains are deposits of material eroded from the Quraymiz escarpment.

There are no permanent surface water bodies in the Project area and its surroundings as noted in the Preliminary Site Assessment Report. However, there is an extensive series of wadis in the wider area, which carry water during the sporadic rainfall events. Rainwater appears to accumulate in certain lower laying areas around the Project area. The closest one is less than 1.5 km to the southwestern corner of the Project area.

The recent, superficial, deposits in the area are expected to have limited potential to hold groundwater and are unlikely to represent a significant water resource. Similarly, the Aruma and Wasia Formations are generally thin and are expected to be above the prevailing water table. Water quality is expected to be poor in these formations, with high salinity. Wasia may be locally exploited but is highly variable. The Jubah is recognised in some areas as a minor aquifer but is not exploited in the area. The Tawil aquifer is the main hydrogeological unit to supply the water demands of the mining projects north of the wind project site. The overlying shales of the main Jouf formation are believed to confine both aquifer units at depth. The uppermost groundwater north of the wind project site was reported at 160 - 350m depth below ground level and is under confined conditions.

The town of Turaif is reportedly supplied with water from the Tawil aquifer, and via a pipeline from Al Jouf. Due to its high salinity, groundwater from the region is unlikely to be acceptable for potable water use without treatment (*Jacobs, 2013*). Groundwater was not encountered in the drilled boreholes at the time of this geotechnical site investigation. All boreholes drilled were drilled at 30 m depth.

2.2. BIOLOGICAL ENVIRONMENT

The Project is located in the Northern Border province approximately 30 km southeast of Turaif city. The area can be classified within the World-Wide Fund for Nature (WWF) eco-region called “Arabian Desert and East- Sahero- Arabian xeric shrub lands”. This is a desert eco-region characterized by very little biodiversity. The area is characterized by dry shrubs and Acacia trees and gravel plains. According to the habitat classification scheme of the International Union for Conservation of Nature (IUCN), the Project area can be classified as a Subtropical/Tropical Dry Shrubland.

The Project site is located within the boundaries of King Salman Royal Protected Area (KSRPA) which has a total area of 130,700 km²; and includes within its boundaries three environmentally protected areas:

- Harrat Al Harrah is located approximately 4 km to the south of the site
- At-Tubayq at approximately 130 km to the southeast of the site
- Al-Khunfah Protected Area which at 245 km south of the site.

2.2.1 SITE FLORA

According to the Preliminary Site Assessment Report for the proposed wind park site, vegetation is very limited across the site and was restricted to runnels of sand. The floristic community is dominated by the dwarf shrub Haloxylon salicornicum Figure 2-1. This plant species was not evaluated by the International Union for Conservation of Nature (IUCN).

Figure 2-1 Flora as observed on-site

2.2.2 SITE FAUNA

This report section is prepared based on the relevant information collected from different resources such as the Preliminary Site Assessment Report and specific site surveys (e.g. for birds), the National Centre for Wildlife's website, the National Strategy for Conservation of Biodiversity in the Kingdom of Saudi Arabia (Abuzinada et al., 2005), the IUCN Red List of Threatened Species, Birds of the Middle East by Richard Porter and Simon Aspinall (2013) in addition to other scientific publications and EIA reports for neighbouring sites.

2.2.3 MAMMALS

Based on a study of mammals carried out in Turaif a total of 15 species belonging to 9 families (Desert Hedgehog (Erinaceidae), Cape Hare (Leporidae), Cricetidae, Lessor Egyptian Jerboa (Dipodidae), Erethizontidae,Ruppell's Fox (Canidae), Arabian Ratel (Mustelidae), Arabian Striped Hyaena (Hyaenidae) and Sand Cat (Felidae)) could potentially be present in the project area (Paray & Al-Sadoon, 2018). During This study, among the 9 families Cricetidae was represented by 4 genera, Canidae by 3 genera, Dipodidae by 2 genera and remaining all families were represented by 1 genus each.

Harrat al Harrah protected area was surveyed and mammal species observed were documented by Seddon et al. (1997). A number of regionally threatened carnivores were recorded such as the Arabian Wolf (Canis lupus), and the Striped Hyena (Hyaena hyaena) (Mallon et al., 2011).

Some gazelle species were also recorded in the area such as Sand Gazelle (Gazella marica) and

Mountain Gazelle (Gazella gazella). Small mammals such as the Desert Hedgehog (Paraechinus aethiopicus), Lesser Egyptian Jerboa (Jaculus jaculus), Libyan Jird (Meriones libycus), and Dwarf Gerbil (Gerbillus nanus) were also recorded in the protected area.

According to the Preliminary Site Assessment Report, sheep and goats were observed during the site visit, as part of temporary livestock camps. Based on the above studies as well as surveys carried out as part of the Umm Wu'al Phosphate Project ESIA, excluding domestic species and livestock, a total of 19 wild mammal species may occur in the project area, of which a total of 7 are species of conservation concern at a global and regional level.

2.2.4 BATS

KSA is home to 30 Chiroptera species belonging to 21 genera within 9 families. (Pteropodidae, Rhinopomatidae, Rhinolophidae, Emballonuridae, Nycteridae, Hipposideridae, Miniopteridae, Molossidae, and Vespertilionidae)((Al Obaid, et al., 2023). The study by Al Obaid et al., (2018) indicated that the bat species of KS have six 96) major zoogeographical affinities; Afrotropical (eight species), Saharo-Sindian (three species), Afrotropical-Palaearctic (four species), Palaearctic (four species), oriental (one species), and Afrotropical-oriental (two species). The project area falls within the Saharo-Arabian phytogeographical regions.

Bats expected in the wider region of the Project area include species such as Egyptian Fruit Bat (Rousettus aegyptiacus), and Egyptian Mouse-tailed Bat (Rhinopoma cystops). These bats are common and have a wide distribution in Saudi Arabia. One species of bat was recorded in Harrat al Harrah protected area, the Desert Long-eared Bat (Otonycteris hemprichii) (Seddon et al., 1997).

A number of bat species were recorded during baseline surveys for neighbouring projects such as Dumat Al Jandal Wind Energy Park in the south, near Dumat al Jandal and Sakaka in Al Jouf Province. The species recorded were.

- Kuhl's Pipistrelle (Pipistrellus kuhliid)
- Desert Long-eared Bat (Otonycteris hemprichii),
- Sind Bat (Eptesicus nasutus) and/or Botta's Serotine (Eptesicus bottae), and
- Egyptian Free-tailed Bat (Tadarida aegyptiaca).

The Egyptian Fruit Bat has a broad habitat tolerance, as long as abundant food and roosting sites are available.

Botta's Serotine is found in a wide range of semi-arid habitats. It is a crevice dwelling species, and will inhabit buildings, ruins, and natural rock crevices.

The Desert Long-eared Bat is also known from arid and semi-arid habitats and considered to be well adapted to these climates. It roosts in rock fissures or human constructions such as buildings and tunnels.

Records of Sind Bat in Saudi Arabia are wide but patchy. This species has been recorded in crevices of walls and behind stones of ruined buildings, isolated in semi-desert terrain and sand dunes.

An investigation on bat species' global vulnerability to collision and mortality at wind energy parks revealed an association between some traits and higher collision rates. Species dispersing furthest had significantly greater collision rates than sedentary species, but roost site and hibernation were not significant predictors. Dispersal distance was defined as follows:

- Sedentary: less than 10 km
- Regional: 10-100 km
- Long distance: 100+ km (equating to migration)

The investigation also found that tree-roosting species had significantly higher collision rates than other species (Thaxter et al., 2017). Most species identified above are known to roost in caves, old buildings, crevices, wells, and such.

2.2.5 BIRDS

The peninsula is home to a plethora of bird species and an important stopover site for many migratory species. In the Northern Borders, resident birds include common and widespread species such as Rock Pigeon (Columba livia), Laughing Dove (Streptopelia senegalensis), Common Kestrel (Falco tinnunculus), Fan-tailed Raven (Corvus rhipidurus), Crested Lark (Galerida cristata), among others. The country holds an internationally important breeding population of the Critically Endangered Lappet-faced Vulture (Torgos tracheliotos) and hosts several other threatened species of birds of prey both on migration and during the winter months.

2.2.5.1. Migration

The Waad Al Shammal wind park site is notable for the presence of significant migratory bird flyways. The East Asian / East African Flyway is known to involve a broad corridor of movement, which is generally to the northeast in spring and to the southwest in autumn. This flyway has been described in literature (BirdLife International, 2010) although it is not well known and is particularly ill-defined in KSA. Birds using this broad flyway are considered likely to occur within the development site (Figure 2-2 – Yellow). A few hundred kilometers to the west of the site, another significant flyway extends from Europe to Africa called the Rift Valley / Red Sea Flyway (also known as the Black Sea Flyway) (Figure 2-2– Blue). This corridor of migration is relatively well-defined and studied although it is considered likely that birds using this corridor may also be recorded within the development site in northwest KSA. The Central Asian Flyway has also been identified as another broad corridor of bird movement which crosses from Europe into Asia (Figure 2-2 – Red). It is possible that birds using this flyway may also occur within the development site. Importantly, there is significant general migratory bird movement throughout the Arabian Peninsula in spring (northwards) and autumn (southwards) which may also result in increased bird activity within the development site during migration periods (Jacobs, 2021).

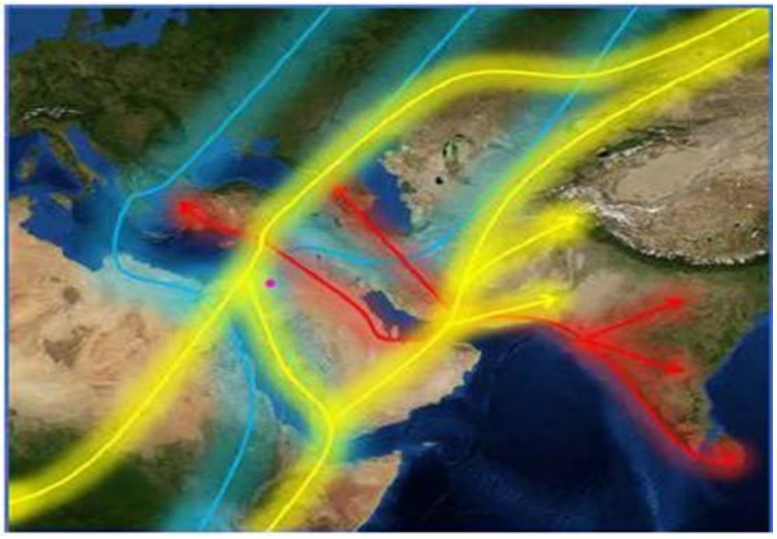

Figure 2-2 East Asia/East Africa Flyway (Jacobs 2021)

2.3. ARCHAEOLOGICAL AND CULTURAL ENVIRONMENT

According to a brochure released by Saudi Commission for Tourism and National Heritage, the Northern Borders Province has many archaeological and historical sites distributed over a large area of its territory. Pre-Islamic history in its archaeological sites in Arar including Budainah, Badnah Valley and Shadhi Valley, among other historical sites in the Amarah Palace, which was built during the rule of King Saud. In Turaif, the bases of Doukarah Palace, which dates back to the pre-Islamic era are considered the most famous historical sites. Every year, Turaif city holds a falconry festival (location on Figure 3-7) where many participants from Saudi Arabia and the Gulf gather to show off their birds and falconry skills. The sixth (last) edition was held in February 2020. The festival includes many events such as musical performances, art galleries, exhibits among many others (*Youm7, accessed February 2021*).

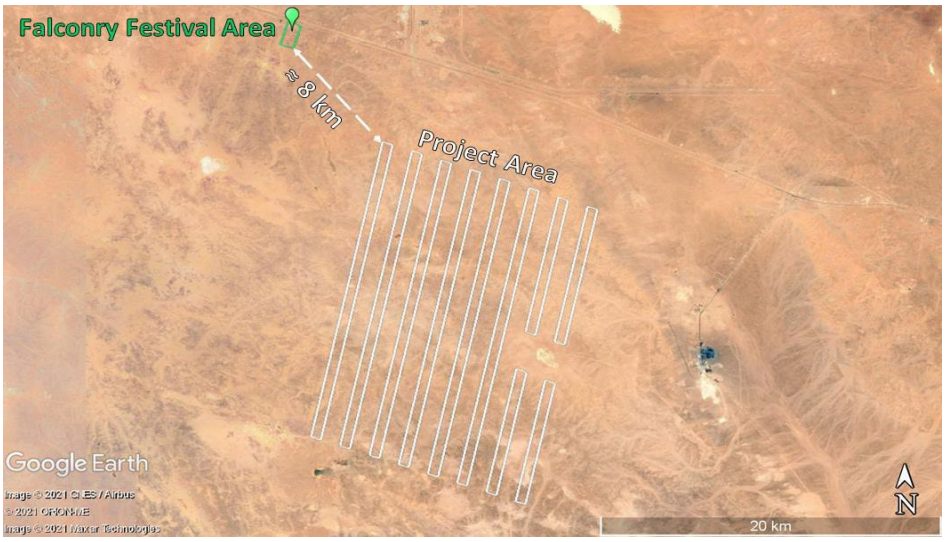

Figure 2-3 Distance between location of festival area and project site

2.4. Social Environment

The Project site is located in the Northern Borders Province, the least populated region of Saudi Arabia bordering Iraq and Jordan. Its capital is Arar. It has an area of 111,797 km². The region is sub-divided into three governorates: Arar, Rafha and Turaif. The Project is in Turaif Governorate. According to the Statistical Yearbook of 2019, the total population in Northern Borders Province was 383,051. The closest town is Turaif city 30 km northwest from the Project site. The main governorate of the province is Arar; the city with the same name is located about 195 km southeast of the Project site. Hazem Aljalamid is located about 102 km east of the site.
In Turaif, there are number of schools. These include general education, Quran memorization, and secondary schools. For higher educational services, Northern Borders Province has one (1) public university in Arar with one branch in Tuarif Governorate.

According to the statistics released by GAStat, there are a total of 11 public hospitals in Northern Borders Province. These hospitals have a total number of 1,410 beds with a team of 2,748doctors and nurses. There are an additional 57 public primary care centres in the province, and additionally 27 private clinics. Also, there are 12 red crescent centres and 26 ambulances with 132 paramedics. In Turaif, there are 5 public hospitals, with 200 hospital beds with a team of 460 doctors and nurses. Additionally, there are 5 public primary care centres and 5 private clinics. Also, there are 2 red crescent centres and 5 ambulances. Table 5-19 presents information on the medical teams distributed among the hospitals and clinics in Turaif.

According to the Statistical Yearbook (Ministry of Environment, Water, and Agriculture 2020), the

main sources of water for domestic use in the Northern Borders Province are groundwater. The total volume of water distributed for domestic use in 2020 reached approximately 38 million m^3. The report also states that the province has 13 groundwater wells, and 11 dams with a capacity reaching 64,837,796 m^3. The total length of the water network pipes in the Northern Borders is 2,782.53 km, with 33,540 connected houses in the province. As for sanitation networks, the province has about 641.60 km of pipelines, with 22,800 connected houses.

There are 3 wastewater treatment plants, the volume of wastewater treated by these plants in 2020 was 8,269,038 m3. It should be noted that only 0.68% of the treated water was reused according to the Statistical Yearbook of 2020.

The project site is largely undeveloped, covering approximately 88.1 km^2. According to the Preliminary Site Assessment report, few temporary livestock camps were observed within the project area, with no permanent dwellings or buildings. Apart from the residential camp of Waad Al Shammal industrial city (25 km to the north) and a nearby construction camp (6 km to the north), there are no permanently inhabited settlements recorded in the project area.

The baseline information identifies key human rights concerns such as the prohibition of child labor, the importance of fair employment practices ensuring equal opportunity and treatment, the provision of timely wages in compliance with labor laws, and the prohibition of forced or compulsory labor. It is important to note that Saudi Arabia does not permit collective bargaining, trade unions, strikes, or public demonstrations

3. PROJECT IMPACTS

3.1. IMPACTS DURNG CONSTRUCTION PHASE

Construction activities involve a number of separate operations, including mobilization, land clearing (grubbing and vegetation removal), top-soil stripping, cut-and-fill operations (i.e., earthmoving), access road(s) construction, ground excavation, foundation treatment, buildings and structures erection, electrical and mechanical installation, landscaping.

Construction activities will generate air emissions primarily from fugitive dust due to soil disturbance, and engine exhaust from heavy equipment and vehicles. These emissions include criteria pollutants, volatile organic compounds (VOCs), greenhouse gases (GHGs), and small amounts of hazardous air pollutants (HAPs). Fugitive dust is expected to have a greater impact on ambient air quality than engine exhaust. Soil disturbance from heavy equipment used for access road construction and/or re-contouring of land will result in greater emissions and adverse air quality impacts. However, given the long distances to inhabited areas, construction activities would probably contribute minimally to concentrations of air pollutants at the nearest human receptors.

Construction of the wind power facility could significantly impact soil resources within the footprints of all structures and infrastructure, including turbines, buildings, roads, and fencing. Direct adverse impacts of construction activities mainly include soil compaction, soil horizon mixing, soil erosion and deposition by wind, soil erosion by water and surface runoff. Soil contamination could also result from the release of contaminants related to the use of trucks and mechanical equipment machinery, from improper storage and handling, and from the application of chemical stabilizers to control fugitive dust emissions. During construction works, transfer of contaminated soils from one location to another (cross- contamination) may occur, thereby extending the area of any contamination that may have occurred due to poor management.

Key noise-generating construction activities include site preparation (back-filling, leveling, vegetation removal), construction and installation (concrete casting, steel erection, turbine installation), and drainage/road paving.

The climate change risk assessment has been undertaken in accordance with the Equator Principles IV (EQ IV) requirements to evaluate physical climate risks to key project receptors during the construction phase. Given that the project's Scope 1 and Scope 2 emissions are expected to be less than 100,000 tones, this assessment focuses exclusively on physical risks and excludes transitional risk assessments.
During the construction phase, key climate-related risks include high temperatures, dust storms, and heavy rainfall which would impact worker safety, equipment functionality, and site accessibility. Projected increases in mean seasonal temperatures, combined with the heightened frequency and intensity of heatwaves, present a significant challenge. Specifically, temperatures exceeding 45°C are anticipated, particularly during peak hours between April and October, posing a direct threat to worker safety. The extreme heat is anticipated to have an impact on workers due to prolonged outdoor exposure during construction of wind turbines without adequate rest and shade. This creates unsafe working conditions, increasing the likelihood of heat-related illnesses such as heatstroke and fatigue.

Increased dust storms and wind speeds are anticipated to impact site access, roads, and construction equipment. These conditions may hinder construction activities and pose health risks to workers due to dust exposure. Unsafe working conditions and restricted working hours resulting from these events could lead to project delays, extended timelines, and increased operational costs, potentially incurring contract penalties. Climate projections suggest only a slight reduction in annual average wind speeds, indicating minimal impact on future electricity generation.
Turbine construction requires substantial groundwork including excavation and pouring of large concrete foundations for the turbine towers. Access roads will also be constructed to allow heavy vehicles to reach turbine location. This construction will lead to a direct loss, alteration and fragmentation of existing habitats. The construction phase, including the setup and dismantling of equipment, will involve removing or partially disturbing topsoil and some deeper soil layers. However, the overall land used for wind farm construction is relatively small, leaving most of the area undisturbed.

Nighttime lighting and in appropriate disposal organic waste (e.g. food, water) will attract species of the desert. Insects will be attracted by light and birds / bats attracted by insects. Foxes, lizards, etc. reptiles and mammals could be found near the construction sites.

Birds in active flight are not expected to be affected during the construction phase. The noise and dust emissions at distinct construction sites might bring birds to alter their flight path however, this is not considered a significant impact.

The Project site is located on land owned by the Ministry of Energy and is designated as an industrial area. It is predominantly vacant and undeveloped, with the exception of a small number of temporary livestock camps. Consequently, the Project does not entail any land acquisition or involuntary resettlement issues. The construction phase will involve the operation of various machinery and heavy equipment on site, leading to an increase in ambient noise levels, which may affect on-site workers. Additional noise sources include the delivery of construction materials and equipment, as well as the daily transport of workers from off-site accommodation. Furthermore, air quality may experience a temporary reduction due to the generation of dust and gaseous emissions from construction activities.

The site contains the identified ruins of a potential mosque. The significance and impact will be

assessed prior to the start of construction. Chance finds procedure would be out in place and the same have been included in the management plans and project's CESMP.

During construction, the key labor and human rights risks identified are limited to non-discrimination, workplace safety, and labour right issues. Additionally, construction activities are anticipated to pose safety risk to local communities, however these are limited to construction period only.

3.2. IMPACTS DURING OPERATION PHASE

During operational phase, only limited number of workers and limited vehicle movement will be required. Furthermore, vehicles movement is expected only during the maintenance activities. A significant advantage of this project is that it does not release air pollutants (such as NOx and SO2) that typical power plants would. As a result, the project has a positive impact on air quality.

During operational phase, the rotating wind turbines are the main noise generating source during operation, and thus a preliminary noise model was conducted for the project site. WindFarmer5 software, a standard industry tool, was used for the preliminary noise impact assessment. As per the assessment, both offsite receptors (North Region Cement Company and Al Ayouni Construction Company Camp) experience noise levels significantly below 20 dB(A) (specifically 16 dB(A) and 18.3 dB(A) respectively), placing them outside the lowest plotted noise range. Furthermore, along the northern border of Harrat Al-Harrah, 4 km south of the site, the contribution from operating turbines is not expected to exceed 25 dB(A).

The climate change risk assessment for operation has been undertaken in accordance with the Equator Principles IV (EQ IV) requirements. During the operational phase, increased mean seasonal temperatures, heatwaves, and extreme heat pose significant risks to both mechanical and electrical equipment, and to personnel. Equipment risks include overheating of wind turbine components, leading to reduced efficiency, increased maintenance needs, and accelerated wear and tear. Temperatures exceeding 45°C may trigger automatic turbine shutdowns to prevent damage, resulting in reduced power generation, revenue loss, and increased maintenance costs throughout the project's lifecycle. Furthermore, extreme heat conditions may pose a serious health risk to workers and project staff during maintenance and repair activities

During operational phase, it is anticipated that impact due to high wind speed and dust storm may pose risk to mechanical and electrical equipment due to decrease in lifespan of wind turbine blades due to increase in wear and tear. Furthermore, Infiltration and accumulation of dust on ventilation systems and equipment inside the nacelle could trigger premature power derating during high temperatures. These issues could lead to increased repair costs, revenue loss from downtime, and a slight reduction in energy output.

Dust storms may pose several risks, including hindered site access, disrupted construction activities, and potential health impacts to workers due to eye irritation and respiratory issues. Frequent dust storm may result in work stoppages especially during severe dust storms and could also lead to project delays and increased operational costs. Despite these risks, climate projections indicate only a marginal decrease in annual average wind speeds, suggesting minimal impact on overall electricity generation.

The operation phase of the project is anticipated to have notable impacts on the biological environment, particularly avifauna and bats. The site holds high importance for migratory birds, with substantial numbers of nationally and internationally significant species, especially migratory raptors.

Conservative collision risk modeling indicates major impacts for key bird species, including Steppe Buzzards, European Honey Buzzards, Black Kites, and the Endangered Steppe Eagles, with multiple annual collisions predicted. For bats, collision with operating turbines is a key risk, especially for migratory species. due to the assumed presence of sensitive species like Kuhl's Pipistrelle and Egyptian Free-tailed Bats, which are vulnerable to collisions and barotrauma due to their flight patterns.

Non-routine events, such as spills, fires, explosions, and vehicle accidents, pose potential impacts across various environmental and social aspects during all project phases. While the risk of blade throw is extremely low, Occupational Health and Safety (OHS) impacts for on-site workers are assessed as High significance, primarily due to the severe consequences associated with working at height, in remote locations, and during lifting operations.

4. MITIGATION MEASURES

4.1. MITIGATION OF IMPACTS DURING CONSTRUCTION

- During construction, to avoid impact to nearby land, the contractor will follow the clearly defined transportation routes for transportation related activities. Transport routes will be identified, and training will be provided to the drivers and other employees on the designated routes in order to protect the environment and reduce encroachment on adjacent land, reduce dust fall across the site due to the movement of trucks on undesignated sand tracks and also protect the visual aesthetics of the landscape.
- Construction activities will be limited to demarcated areas. A dust control plan accompanied with dust monitoring would be developed and implemented at site. Furthermore, during construction, site fencing with barriers for uncovered stockpiles will be covered to minimize dust mobilisation.
- Emissions from the diesel generators that will probably be used for power generation on site during construction will be minimised by using low-sulfur diesel (<1.5%) as required by IFC General EHS guidelines (2007).
- A "chance find" procedure would be implemented, and potential mosque ruins on-site would be surveyed and assessed prior to start of construction. Construction will not be allowed within 200m of identified assets.
- Quantitative noise assessment would be carried out to verify compliance with standards during construction, especially at the southern wind park site boundary and at 4 km south from that boundary, along the northern border of Harrat al-Harrah Key Biodiversity Area.
- Construction and decommissioning traffic will be managed as per the requirements of IFC EHS Standard 3.0: Community Health and Safety and IFC EHS Standard 4.0: Construction and Decommissioning.
- Occupational health and safety hazards during the construction, operation, and decommissioning of wind energy facilities are generally similar to those of most large industrial facilities and infrastructure projects. The project will follow the IFC EHS Guidelines for Wind Energy (2015) to ensure the health.
- Unnecessary removal of vegetation will be avoided. The condition of surface soils and vegetation cover will be maintained as far as practicable. Proper organic waste management will be implemented to prevent attracting fauna. Light generation during night periods will be minimized to avoid attracting fauna and potential deviations from migrating routes.
- A field survey will be conducted before starting construction, to ensure that there are no reptiles, mammals, or ground nesting birds at the site. Egyptian spiny tailed lizards and burrows surveys would be undertaken for the Egyptian spiny tailed lizard prior to the construction of internal roads, crane lifting pads and the construction of wind turbine generator foundations.

- A translocation plan will be compiled and permits from the National Center for Wildlife (NCW) will be obtained prior to any translocation and the translocation will follow best practices for humane relocation. Core habitats for mammal species of conservation concern will be mapped and no-go zones will be designated around key mammal habitats to avoid impacting on them. If avoidance is not possible artificial dens will be installed if any dens are disturbed.
- A pre-construction survey would be undertaken if required, for bats to understand bat species diversity, activity patterns, and roosting behaviors before wind farm construction begins.
- Construction activities will be scheduled outside of key bat activity periods, such as dawn and dusk, to minimize disturbances. This measure is particularly important for species like Kuhl's Pipistrelle and the Egyptian Free-tailed Bat, which are most active during these times.
- Transportation on and to/from the site will be minimized through efficient transport management to minimize noise and vehicle pollution. Machinery will be maintained on a regular basis to ensure smooth efficient running to control emissions and leakages
- Signage and diligent supervision of contractors will be implemented across the site
- Hazardous materials used during the construction stage would be adequately managed, to minimize the potential risk of spillage. The project would follow recommendations included in IFC EHS guidelines and Performance Standards related to the storage of materials in double bunded areas and on hard surfacing, and the use of containment measures such as oil interceptors and spill kits.
- All labour facilities would promote fair labour practices. Labour camp would be provided with dedicated areas for food preparation, personal hygiene, and healthcare and suitable waste management facilities, sewage collection and removal facilities and health, safety, and security programs. Inspection schedules and independent audits would be carried out to ensure that standards are achieved and maintained.
- Climate Change Measures would be implemented for the following:
    - Extreme Heat:
        - Machinery will be shut down when not in use and stored in cool, dry places. Training will be provided to workers on handling equipment prone to overheating.
    - High Wind and Dust Storms:
        - Construction hours will be adjusted based on forecasted dust storms.
        - A dust management plan, emergency preparedness plan, and occupational health and safety plan will be developed and implemented.
        - Stop-work activities will be issued during high-speed winds.
        - Dust control measures and air quality monitoring will be implemented on-site, and materials will be covered where feasible.
    - Extreme Precipitation and Flood:
        - An emergency stockpile of essential materials will be maintained. Evacuation of the construction site will occur during rainfall flood warnings. Elements will be relocated or protected to minimize scour.
        - Drainage elements, such as concrete pipe culverts, will be installed at wadi intersections. Deliveries and critical operations will be scheduled around weather forecasts, and temporary flood barriers will be provided in high-risk areas.
- The project would implement several mitigation measures, ensuring contractor compliance with labor laws (which includes developing HR policies and grievance mechanisms), developing and implementing a security management plan, occupational health and safety plan, and supply chain management plan.

4.2. MITIGATION OF IMPACTS DURING OPERATION

- Standard mitigation measures will be adopted to reduce landscape and visual impacts to minimize impacts on landscape and visual receptors. These would include all of the turbines having the same rotor diameter and hub height and turning in the same direction at broadly the same speed. Tubular steel towers reduce visual clutter and are preferred to lattice or pylon-like generator towers. Turbine transformers, in line with larger turbine designs, would normally be mounted within the machines to reduce visual clutter. If the transformers are external to the turbines, then an appropriate colour which diminishes their visual impact should be adopted in relation to the characteristics of the site and surrounding landscape. The turbines would all be a similar colour and finish so as to promote visual integration.
- Wind turbines will be subject to continuous monitoring and regular maintenance to ensure the likelihood of blade throw remains extremely low. Consultations with stakeholders, owners, and operators of communication towers will be carried out to determine if local adjustment of turbines is required.
- Bird surveys, compliant with IFC and international best practices, will be carried out prior to construction, building upon existing studies. Low wind speed curtailment (by raising cut-in speed and/or feathering turbine blades) will be considered and implemented, potentially including a slight increase in cut-in speed to achieve significant reductions in bat fatalities.
- Active turbine management, such as curtailment and shut-down-on-demand procedures, will be considered as part of the mitigation strategy and factored into financial modelling. Operational mitigation methods will be adaptive and guided by a well-developed post-construction monitoring program. Curtailment and shut-down-on-demand measures will initially be conducted as an experiment, with control turbines not curtailed, and both sets carefully monitored to verify fatality reduction. Technology-led turbine shut-down will be considered in certain cases, subject to observer-led ground-truthing and evaluation through adaptive management.
- Artificial features that could attract birds and bats to the wind energy facility (e.g., water bodies, perching/nesting areas, novel feeding areas, roosting habitats) will be avoided. Cavities in walls or buildings will be capped or fixed to remove potential bat roosting sites.
- Attracting birds to predictable food sources, such as on-site or off-site waste disposal areas, will be avoided; these measures may also extend to the wind park's surroundings.
- Freewheeling will be eliminated and non-blinking, low intensity lighting will be sued on turbines to be less attractive to nocturnal birds and bats.
- Landscaping on the site should include indigenous/native plants that have minimum water and fertilizer requirements. An integrated pest management plan should be developed which uses organic pest management products in preference to large-scale pesticides.
- Transport routes on site and training will emphasize that vehicles and employees should keep to the designated routes in order to prevent unnecessary land encroachment, thus protecting the natural resources and reducing dust emissions, limit speeds in areas eventually known to be occupied by special status species and minimize foot traffic in undisturbed areas
- Waste management plan will be developed and implemented to prevent attraction of birds to the site, including prohibiting indiscriminate dumping and ensuring waste streams are disposed of appropriately.
- To protect large birds, it is recommended that transmission lines be separated by at least the wingspan of the birds to avoid short circuiting during perching and take-off from transmission line towers. Use “raptor safe” designs for power line poles to reduce electrocution risk, such as appropriate insulating material on phase conductors. Install bird flight diverters on transmission lines and guy wires from meteorological masts to reduce bird collisions. Consider underground powerlines, if possible.

- Hazardous materials used during the construction stage will be adequately managed to minimize spillage risk, following IFC EHS guidelines and Performance Standards for storage (double-bunded areas, hard surfacing) and containment (oil interceptors, spill kits).
- Spills will be addressed immediately per the appropriate spill management plan, initiating soil clean-up and removal if needed.
- The site, access roads, and ancillary facilities will be regularly monitored for invasive non-native plant species establishment, and control measures will be initiated immediately upon evidence of introduction or spread.
- Vegetation management will be limited, favoring mechanical controls over herbicides/pesticides. Where required, herbicide/pesticide use will be limited to non-persistent, immobile types and applied in accordance with label and permit directions.
- A minimum of five (5) years post construction monitoring by experienced ornithologists during peak activity periods. Bird monitoring should include:
  - Migratory bird surveys focussing on the behaviour of target species
  - Wintering bird surveys focussing on prolonged wintering presence
  - Carcass counts
- A minimum of five (5) years post construction bat monitoring by experienced ecologist during peak activity period to undertake the following:
  - Acoustic Monitoring:
  - Deploy ultrasonic bat detectors for a minimum of to 5 years post-construction.
  - Monitor bat presence and activity patterns.
- Bat Carcass Monitoring:
  - Regularly search for bat remains near operating turbines.
  - Record patterns of mortality in relation to weather conditions, timing, and operational factors.
- Climate Change Measures:
  - Extreme Heat:
    - Machinery will be shut down when not in use and stored in a cool, dry place.
    - Training and instructions will be provided for workers on handling equipment prone to overheating.
    - Further studies at hub height will be carried out to analyze the combined effects of temperature and wind on energy yield for proactive planning and optimal turbine performance.
  - High Wind Speeds and Dust Storms:
    - Critical access routes will be paved or soil compacted where feasible.
    - Vehicle speeds will be limited, and movement restricted during extreme dust storms. Workers will be provided with protective gear.
    - Real-time weather monitoring will be implemented, and emergency response protocols, including safe zones and communication channels, will be established.
    - Training will educate workers on dust storm hazards and safe evacuation procedures. Dust control measures and air quality monitoring will be implemented on-site, and materials will be covered where feasible. Supervisors will issue stop-work activities during high-speed winds.
  - Extreme Precipitation and Flood:

- An emergency stockpile of essential materials and equipment will be maintained to sustain operations. Evacuation of the construction site will occur in the event of rainfall flood warnings.
- Elements will be relocated or protected to minimize scour from high flow velocities.
- Drainage elements, such as concrete pipe culverts, will be installed at intersections with wadis. Deliveries and critical operations will be scheduled around weather forecasts, and temporary flood barriers (e.g., sandbags, inflatable flood walls) will be provided in high-risk areas.

– Risks related to workers' rights and fair employment practices will be addressed through measures ensuring contractor compliance with labor laws and IFC requirements, regular monitoring of management plans (security, OHS, supply chain), and ongoing worker training.

5. STAKEHOLDER ENGAGEMENT

The Stakeholder Engagement Plan was prepared for the project. This plan involves identification of all stakeholder groups and interested factions with a channel of communications between the stakeholder groups and the Project developer. The SEP included various engagement methods for the different proposed activities. The action plan also details some proposed grievance mechanisms for the project developer in order to monitor grievances and identify any recurrent issues or escalating conflicts. Including but not limited to the following:

- Implementing a grievance mechanism and ensure the responsiveness of this mechanisms to concerns and complaints
- Receiving and logging all comments and complaints associated with the project
- Responding to such complaints and comments wither verbally or in writing

Lastly, the SEP emphasizes the importance of monitoring stakeholder engagement activities in order to ensure that the consultation and disclosure efforts are sufficient and effective throughout the process.

5.1. PUBLIC CONSULTATION/Engagement to date

Engagement/Public consultation were conducted as part of the ESIA process. This engagement took place on 4 August 2021. Due to COVID-19 pandemic restrictions, the meeting was held through means of video conference.The meeting was attended by representatives from different stakeholders including but not limited to:

- National Centre for Environmental Compliance (NCEC)
- National Centre for Wildlife (NCW)
- Ministry of Environment, Water and Agriculture (MEWA)
- Ministry of Tourism
- The Public Authority for Transport
- Ministry of Transport and Logistic Services
- Ministry of Municipal, Rural Affairs and Housing
- Saudi Railway Company
- Ministry of Defence
- Communications and Information Technology Commission (CITC)
- The Saudi Authority for Industrial Cities and Technology Zones (MODON)
- General Authority of Civil Aviation (GACA)
- Heritage Commission

- Saudi Ports Authority

During the session, the different Project aspects were discussed including but not limited to components as well as the potential positive and negative impacts of the Project. Attendees were supportive of the concept of the renewable energy program and the development of the proposed Project.

6. PROJECT JUSTIFICATION

Overall, the Project is considered to have a relatively low impact on the environment project (see Table 8-1) provided that the CSMP is implemented correctly. All mitigation and monitoring measures will be managed through CSMP which will be further developed in line with regulatory and lender requirements during the construction phase. Ultimately, the introduction of the Project will facilitate the diversification of energy supply in KSA and will improve the country's sustainability targets, aiding with the reduction of GHG emissions, and aiding with meeting Saudi Arabia's 2030 renewable energy target, equivalent to 58.7 GW of electricity from renewable sources by 2030. Thus, resulting in an overall positive impact on the environment and a lessening of KSA's dependence on non-renewable energy sources.

Aspect	Gains	Losses
Environmental	— GHGs reduction (approximately 572,260 tonnes of CO2 per year) — Energy production from renewable resources	Limited negative impacts on the environment (e.g., increased noise levels) during construction and operation phases as detailed in Section 6. However, applying the proposed mitigation measures outlined in Section 7.1 will further minimize these impacts.
Social	— Energy production (798 MW) — Job opportunities creation during the different phases of the project — Purchasing of materials, especially during the construction phase will have indirect positive impacts on the local community due to the improved economic conditions	Limited nuisance to the local community and onsite workers especially during construction phase is expected. However, these impacts are limited in duration and magnitude as well. More details are presented in Section 6. However, applying the proposed mitigation measures outlined in Section 7.1 will further minimize these impacts
Economic	— Purchasing of materials, especially during the construction phase will have direct positive impacts on the local economy — Power generation (approximately 798 MW)	Not applicable