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# Roads Assessment for Wind Turbines Transfer to Maysan Provence - Iraq

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**Abstract**
Wind farm assessment project have several steps. This paper aim on the second step which is harvesting the roads properties from the loading point to the construction point. The difficulties of examining the roads whether they are appropriate or not for transporting wind turbine components. The selected site for establishing wind farm is located at Maysan province and has 262 km distance from Um – Qaser port. The results through applying remote sensing and GIS techniques on Landsat (30 m resolution) and QuckBird (0.6 m resolution) are summarized by (2 hard turn, 18 Bridges that crossing over, and 13 Bridges passing under).

**Keywords:** Roads assessment, GIS, Wind Turbines transfer.

# تقييم الطرق لنقل توربينات الرياح لمحافظة ميسان – العراق

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**الخلاصة:**
مشروع تقييم مزارع الرياح يحتاج الى عدة مراحل. هذا البحث يحدد المرحلة الثانية والتي تمثل جمع خصائص الطرق التي تربط بين نقطة التحميل وصولا الى نقطة البناء. ان الصعوبات في اختبار الطرق فيما اذا كانت ملائمة ام غير ملائمة لنقل اجزاء توربينات الرياح. ان الموقع المختار لانشاء مزرعة رياح يقع في محافظة ميسان والذي يبعد 262 كم عن ميناء ام قصر. ان النتائج التي تم الحصول عليها بعد تطبيق تقنيات التحسس النائي ونظم المعلومات الجغرافية على صورة Landsat (بدقة 30 م) و QuckBird ( بدقة 0.6 م) تتلخص ب ( 2 استدارة قوية، 18 جسور يتم العبور فوقها، 13 جسر يتم العبور من تحتها).

**الكلمات المفتاحية:** تقييم الطرق، GIS، نقل توربينات الرياح.

## Introduction

The aim of the world is to create a new life with less pollution while the increasing demands for energy. The one way to this goal is to harness the renewable energy sources. Planning for a full project needs to examine the variables that affect the production, cost of construction and the ability of establishment. Any project needs a series of researches that categorize the problems and trying to finds solutions for each problem.

This paper is a study on a part of wind farm establishment, which is the roads suitability for transporting turbines from the loading entrances (ports) to construction region. The procedure of this work done through implementation of remote sensing and GIS techniques.

Previous studies on the selected region were done to facilitate the wind power suitability and the existence of sufficient wind speed. The previous studies swept the Iraq country area and reached to specific locations that have the required properties to run the wind turbines economically feasible. One of the best location that been marked as a good place to establish wind farm is Maysan province [1]. This province lies at zone (38 N) with respect to UTM, and between (3511906 to 3527910) m northing

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and (686983.4 to 703045.9) m Easting as shown in Figure-1. The selected location has the coordinate (695652 m East, 3520127 m North) [2]. Locating the wind farm is very important factor, Its depends on the analysis and field studies

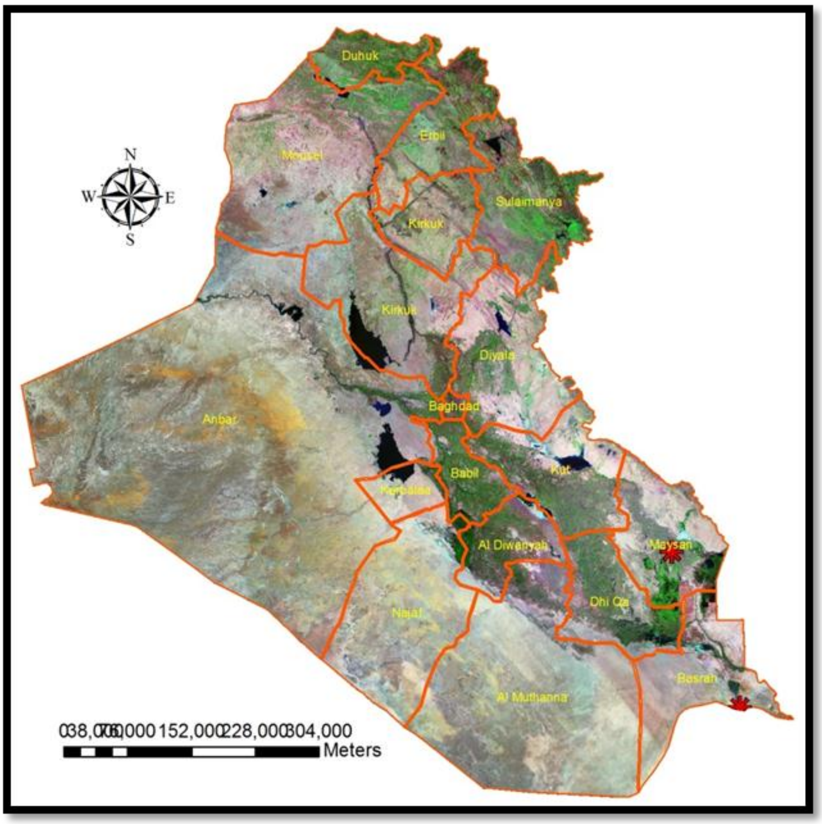


**Figure 1-** Iraq photomap with administrative boarders and intended wind farm

Installations wind farm is one of the important factors for any establishment of a long-term source of energy strategy, because it is natural and available as well as it generates clean energy, So there is no affect in environment in terms of pollution, which revered in a vast different sources of energy other such nuclear fuel and which generates remnants difficult to deal with.

The previous studies focused on finding the best location for establishing a wind farm, with respect to the following factors wind speed, the distance of project from residential areas, roughness of Terrain to prevent and reduce wind speed [1,2]. These studies used remote sensing and image processing method's to analyze wind behavior in Iraqi regions, these studies showed that Kut, Nasrya, Maysan, Basra and Nukhaib districts are appropriate for the construction of wind farms, the work in this research on Maysan distract. The wind farm project needs to be more accurate by overcome the other criteria like Birds killing, Noise, wind turbine transportation ability and proximity from power grid lines.

**Key Criteria**

Planning and implementation of a project needs to be assessing the required standards to success the project. These standards refer to the criteria that are broad in scope. The criterion relies on a number of elements, grouped to modeling a (wind power, roughness of the site, accessibility, electrical grid ….etc.). It is stated that, "...all...elements are inter-related and they should be considered as having an important influence on each other" [3]. Each criterion need to be studied separately, then they must grouped together with different weights of influence on the final decision.

**Power line proximity**

The proximity to national grid is a criterion that affects the whole project, because of the need to link up the renewable energy source as much as possible into the existing energy network. The difficulty in locating the existing electrical grid lines, because the digital form is not available. The proxy measure is to use a major roads network as a line network, because most power lines near the main roads.

**Description of Wind Turbine Components**

The turbine supplier would convey turbine units which consist of: the tower, nacelle, blades, and the other components required such as generators and transformers. The dimensional limitations, load limitations, construction component (e.g. trucks, graders, compaction equipment, cement trucks, etc.), and lifting equipment are required on site.

**The Turbines**

The **Vestas V66 – 1.65 MW** is chosen to ensure ease transport and installation which is light compared to other turbines ,that will reduces the costs of establishing foundations. The nacelle is lighter because its gearbox has an integrated main bearing that eliminates the need for a traditional main shaft. Blade weight is also kept to a minimum by using carbon together with glass fiber. The tower is lighter, too, as it uses magnets instead of welding to attach the tower internals to the tower wall, see Figure-2 and Table-1. The types that manufactured in the V66 have limitations described in Table-2.

This turbine have a high-performance and can be supplied in a variety of hub heights (60-78 m) to accommodate site-specific needs, the rated power is 1650 kw and start generating from 4 m/s wind speed and cut off on 25 m/s, the normal rate of production is 15 m/s ,also this turbine provide with Opti Tip system and variable speed operation and the yaw bearing system enables the nacelle to rotate on top of the tower. This can maximize the power output by giving the optimal product in low wind speed

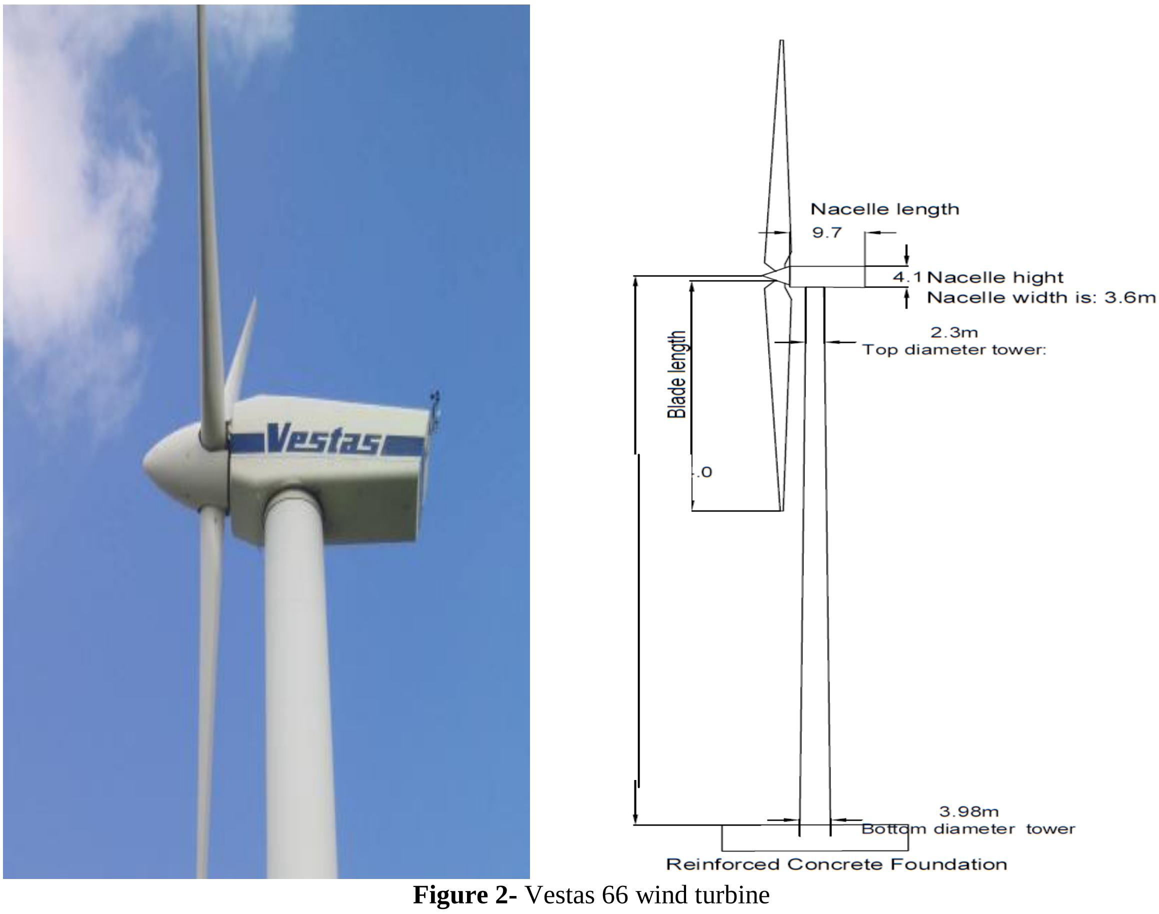


**Figure 2-** Vestas 66 wind turbine

**Table 1-** Vestas 66 descriptions [4]

| Part name | Dim&Wight | Describe |
|---|---|---|
| Rotor | 66m diameter<br>Weigth:22.8 ton | Rotor speed 19 RPM Rotational direction clockwise (front view), 3 blades & |
| Hub | Weigth:8500kg | Type is conical Steel tube |
| Blades | Length:33 m<br>Chord: 3.512 - 0.391 m | Material of blade Fiberglass reinforced epoxy and carbon fibers |
| Generator | Length max:2800mm<br>Diameter max:1100mm<br>Weigth max:8500kg | Generator 50 Hz and type Asynchronous, slip rings and VCRS Rated power:1.65 MW |
| Transformer | Length:2340mm<br>Weigth:8 ton | Rated Power:3160 kVA High voltage: 10 – 34.5 kV Frequency: 50 Hz |
| Gearbox | Diameter:2600mm<br>Weigth:23 ton | Type is planetary spur gear, stage 3, ratio 1:98 |
| Nacelle | Length: 9.65 m<br>Width: 3.6 m<br>Height: 4.05 m<br>Weight app.:53 ton | Other interior parts Yaw Gears, Yaw System, Sensors, Lightning Detector, Parking Brakes& Cooling System |
| Tower | Diameter:2.3-3.9m<br>Hub hight:60-78m<br>Weigth:141 ton | |

**Table 2-** Vestas 66 limitations

| | |
|---|---|
| Minimum Hub height | 60m |
| Maximum Hub height | 78m |
| Start wind speed | 4m/s |
| Normal wind speed | 15m/s |
| Cut off wind speed | 25m/s |

**Type of track**

To transport wind turbines to wind farms we need a special trucks and equipment suited to the transfer process and to avoid the problems or risks that we may face during transportation in terms of rugged road, sharp turns, the presence of depressions and other nods.

Normal truck is unable to transport wind turbine compound because of the abnormal length and weight (normal tracks transport 12.5m length and 40 ton WLL), as shown in Figure-3, therefore tracks is specially designed for this purpose, extra-long part (tower and blade) transported by semi-trailers able to expand 3 & 4 times from the initial length, heavy parts (nacelle) transported by multi axel low-loader, for example, SPZ-P trucks specifications [5] are available for (26 to 132 ton) load, (13 to 62m) long, and with variable number of axels ( single to 11 axels).

**Figure 3-** Examples of wind turbine components dimensions. Continue…


**Figure 3-** Examples of wind turbine components dimensions.

The dimensional requirements of the vehicles/loads used during the construction phase (length/ height) may require alterations to the existing road infrastructure (e.g. widening on corners), accommodation of street furniture (e.g. street lighting, traffic signals, telephone lines, etc.) and protection and upgrade of road related structures (e.g. bridges, culverts, etc.) which may be susceptible to abnormal loading. The equipment will be transported to the site using appropriate national roads and dedicated access/haul road to the site itself.

**The Land Way**

There are different methods and techniques in the transfer of wind turbine equipment by land, sea and air, and for this study, especially for Iraq, we will look to the road transport and through Iraq's various ports where air transport is very expensive and maritime transport is not available locally either overland transport, Iraq have a good network of road transport lines local and international.

After selecting the port, which is loading it to transport equipments, we studied the roads leading to the site of the project by using the methods of remote sensing systems, and computer software arcGIS (Geographic Information Systems). Detailed study had been make to find the suitable way by knowing the nodes over turns, bridges, and other Road obstructions.

**Results and Discussions**

The southern Um Qasr port has 21 docks and established at 1960. This port is more convenient because of the cranes ability and load capability commensurate with the needed equipment.

This study reached a good point of view that facilitates the transportation of the turbines items. There are three types of nods described in this study:

**1-** Hard turns.
**2-** Bridges that truck cross over.
**3-** Bridges that truck pass underneath.

Figure-4 illustrated the path (road) that the trucks should passing through. The first kind of nods (hard turns) illustrated in Figure-5, while the second kinds of nods (bridges that the truck cross over) shown in Figure-6. Bridged that the truck pass underneath (third kinds of nods) are shown in Figure-7. Table-3 illustrated the nods that face transportation from the port down to wind farm location.

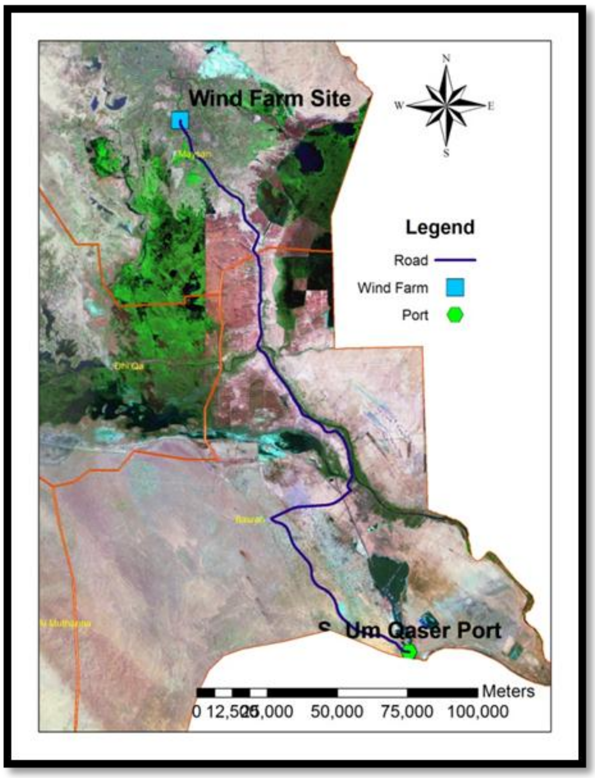


**Figure 4-** The studied road from port to site

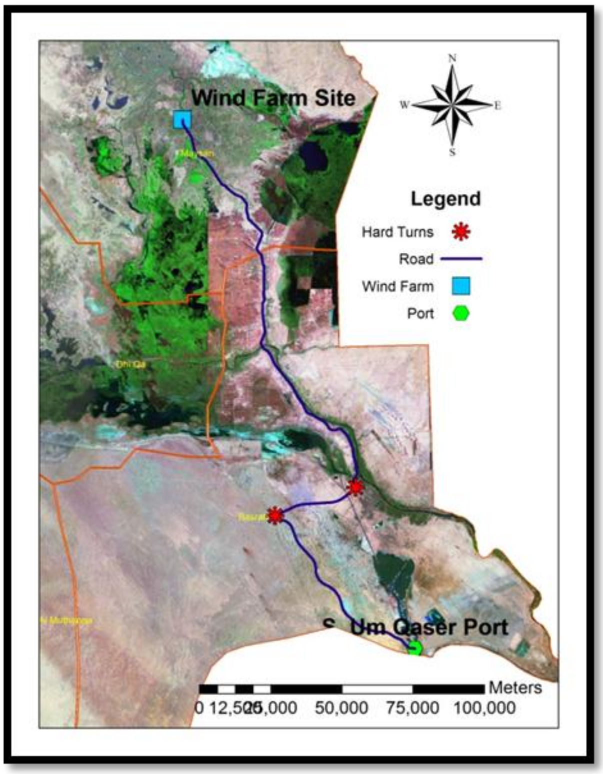


**Figure 5-** Hard turns nods

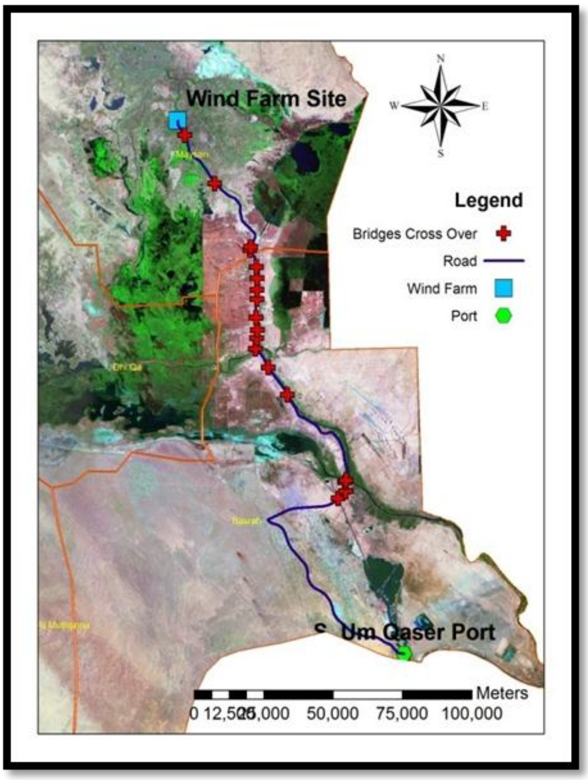


**Figure 6-** Bridges cross over nods

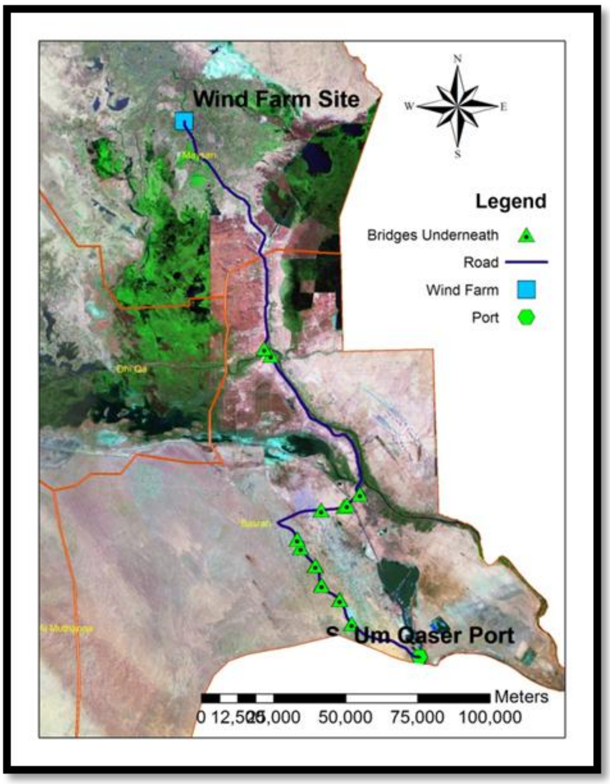


**Figure 7-** Bridges pass underneath nods

**Table 3-** the nods that faces transporting from port to wind farm location

| starting from port to reach Maysan | No of Bridges that pass underneath | No of Bridges that crosses | No of turnarounds | Road length |
|---|---|---|---|---|
| Southern Um-Qasr port | 13 | 18 | 2 | 261.855 k |

**1-** Hard turns: the Figure-8 and Figure-9 shows the turns should be considered while transporting the equipment's.

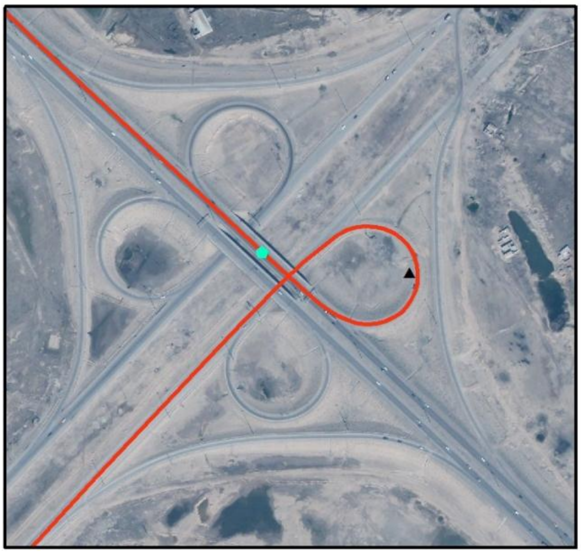

**Figure 8-** turn number 1

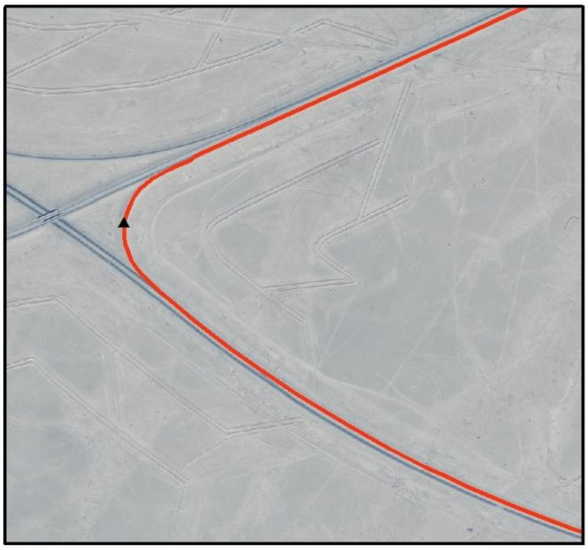

**Figure 9-** turn number 2

**2-** Bridges cross: the Figure-10 shows the bridges that the trucks crossing over and should be considering the convexity of the bridges.

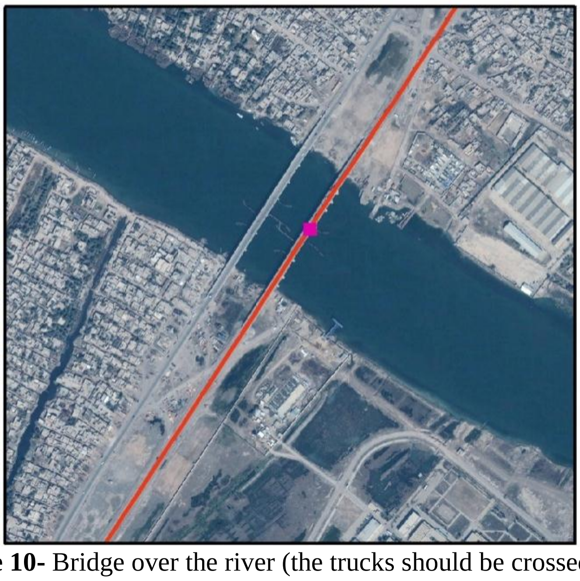

**Figure 10-** Bridge over the river (the trucks should be crossed over)

**3-** Bridges underneath: the bridges that the trucks passing underneath are shown in Figure-11 and Figure-12.

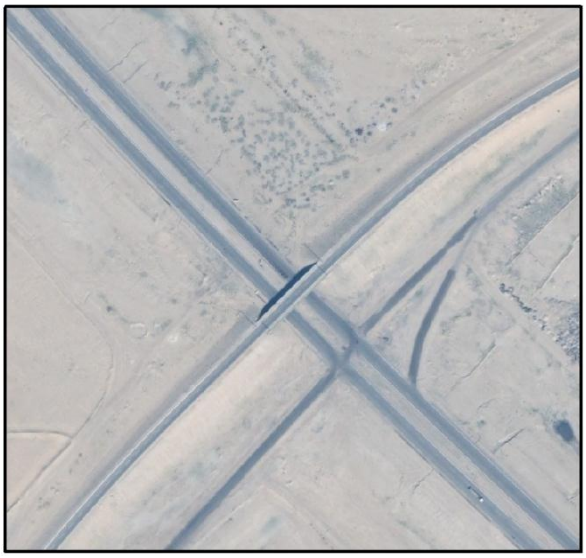

**Figure 11-** Bridge number 3

**Figure 12-** Bridges on the road

The nods that been identified have different solutions depend on what if there is another way or by using appropriate instrument. The hard turn lies outside the urban city which is very easy to modify the turns if it's necessary. The bridges that the trucks passing underneath have a height 5.4 m, and it is a sufficient for most wind turbine part. The nacelle has about 4 m height and should be consider the type of truck to be no more than 5.3 m height with the load. The last types of nods are the bridges that the trucks crossing over have different long and different convexity, for that it should be a site visit for each bridge to be evaluated.

**Conclusion**

This study showed the possibility of transporting the wind turbines equipments from the sea port to the construction site (Maysan province). Southern Um-Qasr port is the best choice to receive wind turbine equipments [6]. The nods down to the construction region: will face 2 turns, 18 bridges that crosses over and 13 bridges that pass underneath. The conclusion that been made from this study was done by using a high resolution satellite images ( 0.6 m ) and with a previous knowledge for the studied area.

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