AL-RAJEF 82 MW WIND POWER PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

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ABBREVIATIONS

AC	Alternating Current
AC	Anno Domini
BC	Before Christ
CARC	Civil Aviation Regulatory Commission
CBO	Community Based Organization
CO	Carbon Monoxide
DC	Direct Current
DEM	Digital Elevation Model
DLS	Department of Land and Survey
DoA	Department of Antiquities
DoS	Department of Statistics
EDCO	Electricity Distribution Company
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EOI	Expression of Interest
EPC	Engineering, Procurement, and Construction
ERM	Environmental Resources Management
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GoJ	Government of Jordan
GWh	Gigawatt Hour
GWRE	Green Watts Renewable Energy
IBA	Important Bird Area
IEA	International Energy Agency
IFC	International Finance Corporation
IFI	International Finance Institutions
ILO	International Labor Organization
IRRP	Instruction and Requirements for Proposal Preparation and Submission
IUCN	International Union for Conservation of Nature
JRTV	Jordan Radio and Television Corporation
JS	Jordanian Standard
JVA	Jordan Valley Authority
kWh	Kilowatt Hour
MCM	Million Cubic Meter
MEGA Jordan	Middle Eastern Geodatabase for Antiquities
MEMR	Ministry of Energy and Mineral Resources
MoA	Ministry of Agriculture

MoEnv	Ministry of Environment
MoH	Ministry of Health
MoL	Ministry of Labor
MoMA	Ministry of Municipal Affairs
MoT	Ministry of Transport
MoTA	Ministry of Tourism and Antiquities
MoU	Memorandum of Understanding
MPWH	Ministry of Public Works and Housing
MSDS	Material Safety Data Sheet
MW	Megawatt
MWI	Ministry of Water and Irrigation
NEPCO	National Electric Power Company
NGO	Non-Governmental Organization
NO_2	Nitrogen Dioxide
NPL	Noise Pressure Level
NRP	Natural Research Projects Limited
NTS	Non-Technical Summary
O&M	Operation and Maintenance
OHSP	Occupational Health and Safety Plan
OSHA	Occupational Safety and Health Administration
PDTRA	Petra Development and Tourism Region Authority
PM10	Particulate Matter smaller than 10.0 microns in diameter
PM2.5	Particulate Matter smaller than 2.5 microns in diameter
PPA	Power Purchase Agreement
PS	Performance Standard
REOI	Request for Expressions of Interest
RJAF	Royal Jordanian Air Force
RSCN	The Royal Society for the Conservation of Nature
SCADA	Supervisory Control and Data Acquisition
SNH	Scottish Natural Heritage Guideline
SO_2	Sulfur Dioxide
ToR	Terms of Reference
TRC	Telecommunication Regulatory Commission
TSP	Total Suspended Particulate
TWh	Terawatt Hour
VP	Vantage Point
WAJ	Water Authority of Jordan
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY IN ARABIC

ملخص تنفيذي

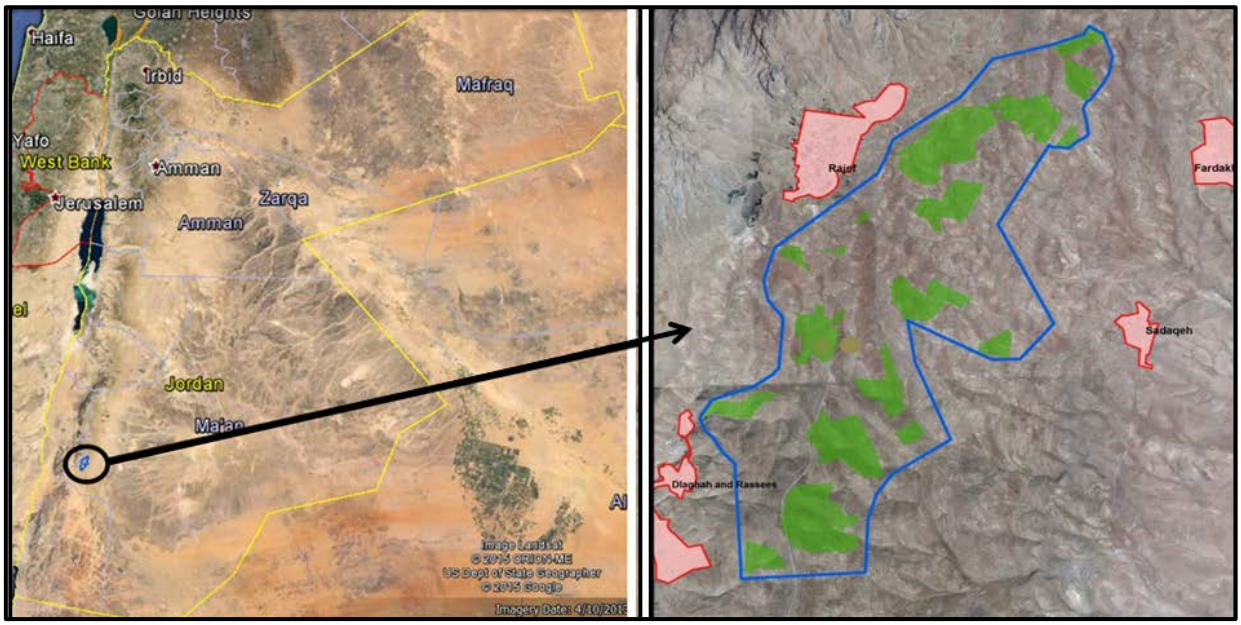
خلفية المشروع

1. تم تحديث الخطة الإستراتيجية لقطاع الطاقة في الأردن عام 2007، وقد اشتملت الخطة على رؤية لتطوير القطاع حتى عام 2020، وكان من مخرجاتها الرئيسية تنويع مصادر الطاقة، وزيادة إسهام الطاقة المتجددة إلى 7% عام 2015 ليصل إلى 10% عام 2020، والتي سيكون النصيب الأكبر منها لطاقة الرياح والطاقة الشمسية.
2. بناء على ما سبق ومنذ دخول " قانون الطاقة المتجددة وترشيد الطاقة رقم (13) لعام 2012" حيز التنفيذ، فقد ازداد قطاع الطاقة المتجددة في الأردن تقدماً. لقد أنشأ هذا القانون الأسس التي مكّنت القطاع الخاص من تقديم مقترحات مشاريع في مجال الطاقة المتجددة في الأردن إلى وزارة الطاقة والثروة المعدنية.
3. وقع الإختيار في هذه المرحلة، على شركة الطاقة الخضراء للطاقة المتجددة (GWRE) (والمشار إليها باسم المطوّر) من قبل وزارة الطاقة والثروة المعدنية، لتطوير مشروع طاقة الرياح المزمع إنشاؤه في محافظة معان باستطاعة مقدارها 82 ميجاواط (والمشار إليه فيما بعد بالمشروع).
4. يتطلب مشروع بهذا الحجم والطبيعة، ووفقاً لنظام "تقييم الأثر البيئي رقم 37 لعام 2005"، إجراء عملية تقييم الأثر البيئي والاجتماعي، من أجل الحصول على التصريح البيئي اللازم من وزارة البيئة للبدء بالأعمال الإنشائية والتشغيلية. وسيسعى المطوّر بالإضافة إلى ذلك، للحصول على التمويل اللازم لإقامة المشروع من المؤسسات المالية الدولية – كمؤسسة التمويل الدولية (IFC). ولهذا سيقوم بتطبيق الممارسات الدولية الجيدة في تصميم وإدارة مشروعه، وكذلك سيقوم باتباع المواصفات القياسية ذات العلاقة.
5. تعرض هذه الوثيقة النتائج الرئيسية لعملية تقييم الأثر البيئي والاجتماعي الذي أجري للمشروع، والذي تم إعداده وفقا "لنظام تقييم الأثر البيئي رقم (37) لسنة 2005"، "ولمعايير الأداء في الاستدامة البيئية والاجتماعية" لمؤسسة التمويل الدولية IFC، وللمبادئ التوجيهية "للبيئة والصحة والسلامة"(EHS).

وصف المشروع

(i) لمحة عن المشروع

6. يقع المشروع ضمن الحدود الغربية لمحافظة معان في جنوب الأردن على مرتفعات الشراه، على بعد حوالي 200 كم إلى الجنوب من العاصمة عمان. وأقرب القرى إلى موقع المشروع تشمل: (أ) قرى الراجف، ودلاغة ورصيص، وتقع على الحدود الغربية من موقع المشروع، و (ب) قرية الطيبة وتقع على بعد حوالى 3 كم إلى الشمال من موقع المشروع، و (ج) قرى فردخ وصدقة، وتقع على الحدود الشرقية لموقع المشروع على بعد حوالي 2.5 و 1.5 كم على التوالي كما هو مبين في الشكل (أ) أدناه.
7. تبلغ مساحة منطقة المشروع حوالي 6,7 كم^2 ، وسيتم استخدامها لتطوير مشروع مزرعة الرياح باستطاعة 82 ميجاواط. تتكون هذه المنطقة من 49 قطعة من الأراضي التي قامت شركة الطاقة الخضراء للطاقة المتجددة (GWRE) باستئجارها من أصحاب الأراضي في المجتمع المحلي (وخاصة في قرى الراجف، ودلاغة، والطيبة) (ممثلة باللون الأخضر في الشكل أدناه). وتنتشر هذه الأراضي المستأجرة على مساحة 26 كم^2 تشكّل حدود المشروع (ممثلة باللون الأزرق في الشكل أدناه).



شكل (أ): موقع المشروع

(ii) لمحة عن المكونات

8. يتكون العنصر الرئيسي للمشروع من توربينات الرياح. سيكون هناك 41 توربينة رياح موزعة على الأراضي المستأجرة، وتبلغ قدرة كل توربينة 2 ميجاواط. يبلغ ارتفاع محور التوربينة 80 متر، وقطر الجزء الدوار من 114متر، وبالتالي يكون ارتفاع القمة العليا للتوربينة عن الأرض 137متر.
9. سوف تتضمن المكونات الأخرى للمشروع ما يلي:

- **المعدات الكهربائية:** سيقوم المشروع بتغذية الكهرباء مباشرة إلى الشبكة الوطنية بالنسبة للمستخدمين النهائيين. هناك العديد من المعدات الكهربائية المطلوبة لتحويل الطاقة الكهربائية المنتجة من التوربينات إلى الشكل المناسب للربط على الشبكة الوطنية ذات الجهد المرتفع. ويشمل هذا محولات الضغط ومحولات التيار المتردد، وكابلات التوصيل.
- **البنية التحتية والمرافق:** وتشمل (أ) المكاتب المستخدمة في الأعمال ذات الصلة بالتشغيل اليومي العادي ومستودع لتخزين المعدات والآلات، (ب) شبكة الطرق للوصول إلى الموقع وإلى التوربينات. (ج) محطة فرعية لتجميع الكهرباء المولدة من التوربينات والربط مع الشبكة الوطنية من خلال خط نقل علوي.

(iii) توقيت المشروع

10. تشمل الأنشطة المتوقع حصولها خلال تطوير المشروع ثلاث مراحل متميزة هي: (أ) التخطيط والإنشاء، (ب) التشغيل و (ج) وقف التشغيل. وفيما يلي ملخص لكل منها:

- **التخطيط والإنشاء:** ويشمل في الأساس إعداد التصاميم التفصيلية للمشروع، ونقل مختلف مكونات المشروع إلى الموقع، وأنشطة إعداد الموقع لتركيب توربينات الرياح ومختلف المكونات الأخرى. وسيشمل إعداد الموقع القيام بالحفريات وإزالة العوائق من الأراضي. وسيضطلع بهذه الأنشطة متعهّد الأعمال الهندسية، والمشتريات، والإنشاءات (EPC) الذي يتم تعيينه من قبل المطوّر (المعروف باسم جاميسا Gamesa)؛
- **التشغيل:** يتطلب المشروع أنشطة تشغيلية محدودة تشمل أساسا التوربينات ومختلف المعدات الكهربائية. ويشمل ذلك على سبيل المثال صيانة التوربينات والجزء الدوار، تزييت الأجزاء، وغسيل ريش التوربينات، وصيانة المكونات الكهربائية وغيرها. وسيضطلع المتعهّد جاميسا المكلف بتشغيل المشروع أساساً بهذه الأعمال؛ و
- **وقف التشغيل:** سيكون لشركة الكهرباء الوطنية بموجب الاتفاقية التي ستوقع مع المطور لمدة 20 عاما، الاستمرار في العمل بسعر متفق عليه مع المطور بعد انتهاء مدّة الإتفاقية. وفي حال عدم التوافق على السعر يمكن لشركة الكهرباء الوطنية الاستغناء عن خدمات المتعهّد ووقف العمل بالمشروع.

11. وفقا للجدول الزمني الحالي، فمن المتوقع البدء بإنشاء المشروع في شهر اب 2016، وسوف تتطلب أعمال الإنشاء ما يقرب من 22 شهرا (إلى حزيران 2018). ولذلك فمن المتوقع أن يبدأ تشغيل المشروع في شهر حزيران 2018 لمدة 20 عاما.

تقييم الأثر البيئي الإجتماعي للمشروع

12. سينتج عن المشروع آثار بيئية واقتصادية إيجابية مهمة على المستوى الاستراتيجي والوطني بالنظر إلى التحديات الحالية التي تواجه قطاع الطاقة في الأردن. ومن الضروري مراعاة هذه الآثار الإيجابية الهامة وأخذها بعين الاعتبار، وتشمل ما يلي:

- يسمح المشروع لتنمية أكثر استدامة، ويظهر التزام الحكومة الأردنية بتحقيق استراتيجيتها في مجال الطاقة وتلبية الأهداف المحددة لمصادر الطاقة المتجددة؛

- سوف يسهم المشروع في زيادة أمن الطاقة من خلال الاعتماد على موارد طاقة طبيعية لا تنضب، والأهم من ذلك أنها مصادر مستقلة. وستخدم الكهرباء المتوقع توليدها من المشروع احتياجات الكهرباء السنوية لأكثر من 60،000 أسرة محلية؛
- سوف ينتج المشروع الطاقة النظيفة التي ستسهم في تخفيض تكاليف إنتاج الكهرباء بالمقارنة مع التكاليف الحالية المرتبطة بأنواع الوقود السائل، وبالتالي سيؤدي إلى انخفاض كبير في العجز المالي للحكومة في الأردن؛ و
- من المتوقع أن تحدّ الطاقة النظيفة التي يقوم المشروع بتوليدها من استهلاك زيت الوقود و / أو الغاز الطبيعي المستخدم حاليا في توليد الكهرباء من محطات الطاقة الحرارية في الأردن. وسوف يساعد هذا في الحد من انبعاثات غازات الدفيئة وكذلك الانبعاثات الملوثة للهواء – من المتوقع أن يسهم المشروع في الحد من انبعاث ما يعادل أكثر من 160،000 طن من غاز ثاني أكسيد الكربون سنويا.

13. ومن ناحية أخرى، سينتج عن إقامة المشروع بعض الآثار البيئية السلبية. وعلى الرغم من ذلك، تشير نتائج دراسة تقييم الأثر البيئي الإجتماعي إلى أن هذه الآثار على درجة ضئيلة من الأهمية، ويمكن التخفيف من آثارها بتطبيق الإجراءات المناسبة للمعالجة والمراقبة. سيتم أدناه باختصار مناقشة هذه الإجراءات المتبعة في المعالجة والمراقبة لكل من هذه الآثار البيئية والإجتماعية، كما سيتم عرضها بالتفصيل في خطة الإدارة البيئية والإجتماعية الواردة في وثيقة تقييم الأثر البيئي الإجتماعي .

14. سينتج عن المشروع التأثيرات على الأمور الاجتماعية البيئية التالية / والتي سيتم مناقشتها بالتفصيل من خلال هذا الملخص: المناظر الطبيعية والبصرية. استخدامات الأراضي؛ جيولوجية وهيدرولوجية الموقع؛ التنوع البيولوجي؛ الطيور؛ الخفافيش؛ علم الآثار والتراث الثقافي؛ نوعية الهواء والضجيج؛ البنية التحتية والمرافق العامة؛ الصحة والسلامة المهنية؛ صحة المجتمع، والسلامة والأمن؛ والظروف الاجتماعية والاقتصادية.

(i) المناظر الطبيعية والبصرية

وصف الوضع الحالي

15. يتكون موقع المشروع أساساً من سلسلة من التلال الصغيرة والنتوءات الجبلية على هضبة مرتفعات الشراة على ارتفاعات تتراوح بين 1550–1700 متر فوق مستوى سطح البحر. يمكن وصف المشهد في موقع المشروع بالجاف مع نتوءات صخرية متكررة على سفوح الجبال. ويعتبر موقع المشروع منطقة جرداء بشكل كبير مع قليل من شرائح النباتات والأشجار المتناثرة.

16. بالإضافة إلى ذلك، تم التدقيق في المناظر الطبيعية والطابع البصري للمناطق المحيطة بالمشروع. وتبين أن هناك مستقبل بصري رئيسي واحد في المنطقة (يقع على بعد 16 كم إلى الشمال الغربي)، وهو موقع البتراء للتراث العالمي – والذي يعتبر الموقع السياحي الرئيسي في الأردن المعروف بمدينة البتراء التي تضم الخزنة.

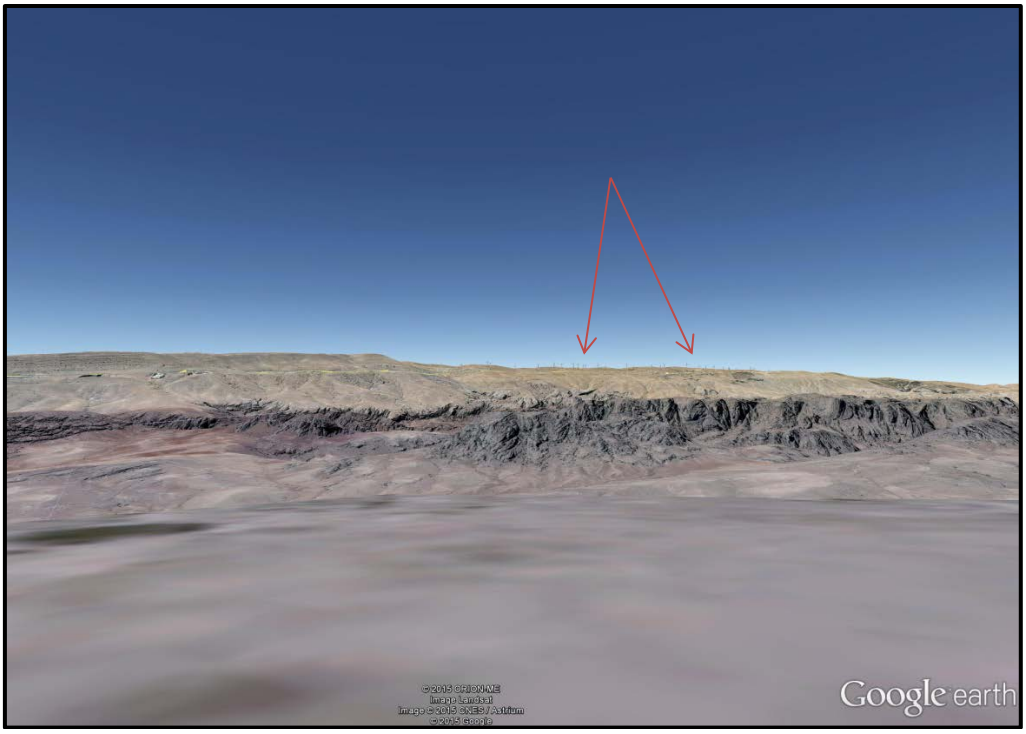
تقييم الآثار المحتملة وتحديد إجراءات التخفيف والمراقبة

17. إن التأثير الرئيسي المتوقع من المشروع هو خلال مرحلة التشغيل، ويتعلق بتفاعل المشروع مع طبيعة المناظر الطبيعية المحيطة وأية مستقبلات بصرية رئيسية قد تكون موجودة في الموقع.

18. لدراسة هذه الآثار تم إجراء نمذجة المشهد البصري من خلال برامج الكمبيوتر (WindPRO) الذي يهدف إلى تحديد عدد التوربينات التي يمكن أن تكون مرئية من المناطق المجاورة.

19. إن أهم نتائج التقييم تتعلق بالجزء الرئيسي من مواقع التراث العالمي (وهو مدينة البتراء)، حيث تقع المستقبلات البصرية الرئيسية الحساسة الأكثر أهمية، ولم يمكن تحديد أية رؤية لمزرعة الرياح من البتراء نظراً لوقوعها على أرضية وادي تحيط به الأودية الجانبية والجبال ذات السفوح الحادة.

20. بعض التوربينات يمكن أن تكون مرئية من مناطق أخرى في مواقع التراث العالمي، ولكن هذه المناطق محدودة بقمم السلاسل الجبلية، وهي مناطق معزولة ليست ذات جذب سياحي، باستثناء الموقع المعروف باسم جبل هارون (ضريح النبي هارون) – والذي يعتبر موقع سياحي صغير ضمن منطقة البتراء. ومع ذلك، فإن الوصول إلى هذه المناطق محدود جدا بسبب وجود المرتفعات الحادة و / أو الحاجة لفترة طويلة مرهقة من المشي للوصول إليها. وبالإضافة إلى ذلك، فإن مزرعة الرياح تكون بعيدة جدا إذا نُظر إليها من هذه المناطق، وبالكاد يمكن أن تُرى كما هو موضح في الشكل أدناه. وأخيرا، فمن المهم ملاحظة أن شركة الطاقة الخضراء للطاقة المتجددة (GWRE) قد حصلت على موافقة سلطة إقليم البتراء التنموي السياحي.



شكل (ب): منظر افتراضي من قمم موقع **التراث العالمي في البتراء لموقع المشروع**

(ii) استعمالات الأراضي

<u>وصف الوضع الحالي</u>

21. يتم من خلال تقييم الأثر البيئي الإجتماعي التحقق من الإستعمال الرسمي وغير الرسمي للأراضي في موقع المشروع كما هو مبين أدناه.

22. جرى من خلال تقييم الأثر البيئي الإجتماعي التحقق من التخطيط الرسمي لاستعمالات الأراضي الذي تم وضعه من قبل مختلف المؤسسات الحكومية (مثل وزارة الشؤون البلدية وسلطة إقليم البتراء التنموي السياحي، وزارة البيئة، وزارة الزراعة، الخ) وتبيّن أنه لا يوجد أي تعارض للمشروع مع هذه الخطط لاستعمالات الأراضي.

23. وفيما يتعلق باستخدام الأراضي الفعلي في موقع المشروع، فقد أجريت عدة زيارات للموقع، وأجريت كذلك مشاورات مفصلة مع المجتمعات المتأثرة بالمشروع لتحديد ما إذا كان موقع المشروع يوفر أية قيمة. وبناء على ذلك تم الإستنتاج أن المجتمع المحلي في قرى الراجف ودلاغة ورصيص يقومون بممارسة الأنشطة الزراعية والرعي خلال أوقات معينة من السنة في منطقة المشروع (ما بين شهري شباط وتموز). وبالإضافة إلى ذلك، فإن المنطقة معروفة بتواجد البدو فيها خلال أوقات معينة من السنة (ما بين شهري نيسان وأيلول) والذين يمارسون الرعي والأنشطة الزراعية.

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24. حيث أن المشروع لا يتعارض مع أي خطة رسمية جرى إعدادها لاستخدام الأراضي من قبل مختلف الجهات الحكومية المبينة أعلاه، فلن يكون للمشروع تأثيرات على الاستخدام الرسمي للأراضي.

25. وفيما يتعلق بالإستخدام غير الرسمي للأراضي، فيمكن أن يؤثر تطوير المشروع على الأنشطة التي تجري حاليا من قبل المجتمع المحلي والبدو القاطنين في المنطقة، بيد أن هذه الآثار تعتبر بسيطة وغير مهمة. كما أن مكونات المشروع ستستغلّ الحد الأدنى للغاية من منطقة المشروع (حوالي 7٪ من مساحة الأراضي المستأجرة و2٪ من إجمالي المساحة الواقعة ضمن حدود المشروع) – وبالتالي فإن الأنشطة الزراعية والرعوية التي يقوم بها المجتمع المحلي حاليا يمكن أن تستمر في المناطق غير المستغلة من المشروع والتي ليس فيها عوائق.

26. علاوة على ذلك، واستنادا إلى المشاورات التي جرت مع البدو، فقد تبيّن أنهم يتواجدون في منطقة الراجف خلال الفترة (بين شهري نيسان وأيلول) من كل عام، ولا يستقرون في نفس المنطقة كل عام. ولذلك، حتى وإن كانت بعض مكونات المشروع (على النحو الذي نوقش في وقت سابق تستغل الحد الأدنى من الأراضي) واقعة ضمن المنطقة التي يستقر فيها البدو حاليا، فيمكن للبدو ببساطة الإنتقال بخيامهم إلى المناطق المجاورة في السنوات اللاحقة (خلال مراحل الإنشاء والتشغيل). وعلاوة على ذلك، فلن تتأثر أنشطة الزراعة والرعي حيث يمكنها أن تستمر أثناء تطوير المشروع.

27. يتطلب تقييم الأثر البيئي الإجتماعي من مشغّل المشروع السماح للبدو المقيمين في المنطقة وكذلك لأفراد المجتمع المحلي بمواصلة الرعي والإستمرار بالأنشطة الزراعية في منطقة المشروع. إن التزام المطوّر بهذا الأمر وارد كأحد بنود اتفاقيات التأجير التي تم توقيعها مع أصحاب الأراضي من المجتمع المحلي.

(iii) جيولوجية وهيدرولوجية المنطقة

وصف الوضع الحالي

28. تتكون جيولوجيا منطقة المشروع بشكل عام من الحجر الجيري ودولوميت الحجر الجيري والدولوميت مع تداخلات من الحجر الجيري الرملي، والطباشير، والكلس، والجبس، والصوان والفوسفوريت. علاوة على ذلك، يقع المشروع ضمن ثلاثة أحواض مائية سطحية هي أحواض شمال وادي عربة، وجنوب وادي عربة، والجفر. ويبلغ التصريف السنوي لكل منها على التوالي 46 مليون متر مكعب، 8 مليون متر مكعب، و13 مليون متر مكعب. وبالإضافة لذلك، فإن المشروع يقع

ضمن حوض الجفر للمياه الجوفية والذي يبلغ إنتاجه السنوي المستدام بين حوالي 500 و 1000 متر مكعب من المياه / كيلومتر مربع.

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29. ترتبط التأثيرات الهامة المحتمل وقوعها على جيولوجية وهيدرولوجية المنطقة خلال مرحلة إنشاء وتشغيل المشروع بسوء إدارة النفايات (النفايات الصلبة ومياه الصرف الصحي والنفايات الخطرة، الخ) حيث يمكنها أن تتسبب في تلويث وإفساد التربة، والتي بدورها يمكن أن تلوث موارد المياه الجوفية. إلا أنه تم من خلال تقييم الأثر البيئي الإجتماعي اتخاذ تدابير التخفيف الملائمة التي تهدف إلى السيطرة على هذه الآثار، وضمان ممارسات التدبير المنزلي السليمة خلال مرحلة إنشاء وتشغيل المشروع.

(iv) التنوع الحيوي

وصف الوضع الحالي

30. تم إجراء مسح التنوع الحيوي في موقع المشروع، وتبين منه أن الموقع ذو أهمية بيئية منخفضة نظرا لطبيعة المنطقة؛ من حيث كونها قاحلة ومتدهورة بيئيا بشكل كبير مع تواجد القليل من شرائح النباتات والأشجار المتناثرة المتبقية من الغابات التي كانت تغطي جبل الراجف بأكمله في الماضي. وقد تدهورت بيئة الموقع بشكل كبير بسبب الرعي الجائر، وقطع الأشجار، وأعمال الحراثة التي كانت تمارس على نطاق واسع في أنحاء الموقع لعدة عقود.

31. وبالإضافة إلى ذلك، فإن معظم الأصناف النباتية والحيوانية التي تم تسجيلها في المنطقة لا تشكّل قلقاً، وتعتبر من الأصناف الموجودة عادة في مثل هذه المناطق. ومع ذلك، فهناك قضية مهمة يجب أن تؤخذ بعين الاعتبار وهي السلحفاة اليونانية والتي تعتبر مهددة على المستوى الوطني وتم تسجيل تواجدها في موقع المشروع.

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32. التأثير الرئيسي المتوقع من المشروع هو خلال مرحلة الإنشاء. وهذا يشمل التأثيرات الناجمة عن أنشطة إعداد الموقع التي يلزم إجراؤها لتركيب التوربينات ومختلف مكونات المشروع. ويمكن لمثل هذه الأنشطة أن تؤدي إلى تغيير موقع الموائل ويحتمل أن تحدث خللاً للأصناف النباتية والحيوانية. ومع ذلك، وكما ذكر في وقت سابق فإن الموقع يعتبر ذو أهمية بيئية منخفضة. ألا أنه لا بد من إجراء مسح مفصل قبل بدء أي أنشطة إنشائية لتحديد وجود أية سلاحف في المناطق المخصصة للإنشاءات. وفي حالة تسجيل أي تواجد للسلاحف، فإنه يجب أن يتم نقلها خارج موقع المشروع.

(v) الطيور

وصف الوضع الحالي

33. تم إجراء مسح أساسي للطيور في موقع المشروع في أربعة مواسم مختلفة تشمل ربيع وخريف عام 2012، خريف عام 2013، وربيع عام 2015. وكان الهدف من ذلك مراقبة وتسجيل عدد وسلوك الطيور المهاجرة والمقيمة التي تحلّق مارّة

بموقع المشروع. وقد تم خلال المسح إجراء ما مجموعه 547 ساعة رصد في فصل الربيع، و 250 ساعة في فصل الخريف.

34. كان العدد الإجمالي للطيور المهاجرة التي تم تسجيلها، استنادا إلى المسوحات التي أجريت حوالي 11،000 طائر تنتمي إلى 18 نوع رئيسي. و كان من بين هذه الأنواع خمسة أنواع فقط ذات وضع حماية من قبل الإتحاد الدولي لحماية الطبيعة IUCN، وكانت أعدادها صغيرة بشكل ملحوظ مقارنة بالأنواع الأخرى– حوالي 12 تمثل 0.1٪ من مجموع الطيور. إضافة لذلك، فقد أظهرت النتائج سيادة نوعين من الطيور هما : صقر العسل والصقر الحوام من بين مجموع الأعداد التي تم تسجيلها – وتمثّل نحو 94٪ من المجموع.

35. بلغت نسبة الطيور المهاجرة التي تم تسجيلها خلال فصل الربيع حوالي 97٪ مقارنة مع 3٪ فقط خلال فصل الخريف، مما يشير إلى أن موقع المشروع يُستخدم بكثافة أكبر من قبل الأنواع المهاجرة خلال فصل الربيع مقارنة مع فصل الخريف.

36. من ناحية أخرى، فإن الطيور المستهدفة المقيمة في موقع المشروع والتي تم تسجيلها في كافة الاستطلاعات تنتمي إلى ثلاثة أنواع فقط. وحالة هذه الأنواع لدى الإتحاد العالمي لحماية الطبيعة هي ليست ذات أولوية للحماية – ولكن هذه الأنواع تتكاثر بأعداد محدودة في الأردن وبالتالي تعتبر مهمة على المستوى الوطني. وقد تم تسجيل ما مجموعه 132 حالة في الموقع. ومع ذلك، فمن المهم أن نلاحظ أن السجلات لا تشير إلى عدد الطيور المختلفة من هذه الأنواع، حيث أن نفس الطيور المقيمة تستخدم المنطقة في أيام مختلفة.

37. ويخلص التقييم إلى أن موقع المشروع لا يقع ضمن منطقة حساسة للغاية كما هو موضح أدناه. وعند مقارنة النتائج بمناطق أخرى في الأردن، حيث أجريت دراسات مماثلة بهدف إنشاء مشاريع أخرى لطاقة الرياح (وحيثما كانت البيانات المتاحة) يتبين ما يلي:

- كان عدد من الطيور المهاجرة المسجلة صغير نسبيا، لا سيما بالمقارنة مع المناطق الأخرى الأقرب إلى أخدود وادي الأردن وما حوله (والذي يشكّل طريق الهجرة الرئيسي للطيور في الأردن)، حيث تم في هذه المناطق تسجيل عدد أكبر من ذلك بكثير مع تنوّع في الطيور المحلقة المهاجرة. وحيث أن المشروع يقع على مسافة من أخدود وادي الأردن وما حوله، فلا يعتبر ضمن المنطقة ذات المرور الكثيف للطيور المهاجرة؛ و
- يعتبر عدد وأنواع الطيور المقيمة ونشاطها في منطقة المشروع أقل بكثير مقارنة مع المناطق الأخرى، وخاصة تلك التي تقع بالقرب من المناطق الهامة للطيور (IBA) في الأردن. حيث تم تسجيل عدد أنواع أكبر ونشاط أعلى للطيور في مثل هذه المناطق، وخصوصا تلك التي تُحفظ لها سجلات محليًا (مثل النسر الأسمر).

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38. إن التأثير الرئيسي على الطيور هو خلال مرحلة التشغيل والتي ترتبط أساسا بمخاطر الاصطدام والضربات التي تتعرض لها الطيور المهاجرة والمقيمة المحلقة على حد سواء. وقد تكون لهذه المخاطر آثار بالغة الأهمية خاصة على بعض الأنواع التي تحفظ لها قيود دولية و/ أو محلية.

39. ومع ذلك، وللحد من هذه الآثار، فقد تم من خلال تقييم الأثر البيئي والاجتماعي الطلب بأن يتم تنفيذ خطة لرصد الطيور خلال مرحلة تشغيل للمشروع، والقيام بالمراقبة المستمرة من قبل علماء طيور مؤهلين في موقع المشروع، وعلى وجه الخصوص طوال فصلي الربيع والخريف. والهدف من الرصد هو إيقاف تشغيل التوربينات في الحالات التي يتم فيها

تحديد وجود خطر وشيك على قائمة من الأنواع الرئيسية ذات الاهتمام. بالإضافة إلى ذلك، يجب أن تستكمل خطة الرصد مع تنفيذ خطة للبحث عن الطيور النافقة أثناء تشغيل المشروع لإثبات فعالية عملية الرصد، ولتقدير العدد السنوي لوفيات الطيور التي تسببها التوربينات. وهناك تفاصيل إضافية عن خطة الرصد ووفيات الطيور في خطة الإدارة البيئية الإجتماعية ESMP.

(vi) الخفافيش

وصف الوضع الحالي

40. أجري مسح للخفافيش في موقع المشروع تبين منه أن نشاط الخفافيش منخفض جدا، حيث سجل وجود نوع واحد فقط مع حد أدنى من النشاط. ويعتبر هذا النوع من أقل الأنواع مدعاة للقلق، ومن الأنواع الأكثر شيوعا في الأردن، والتي تتواجد في كافة أنواع الموائل في جميع أنحاء البلاد.

41. ويعزى هذا النشاط المنخفض إلى الخصائص الطبيعية لموقع المشروع حيث أنه يقع في منطقة قاحلة ذات كثافة نباتية منخفضة جدا، لا توفر موائلا جاذباً لتغذية الخفافيش.

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42. إن تأثيرات المشروع الرئيسية على الخفافيش هي خلال مرحلة التشغيل والتي تنجم أساسا عن خطر تعرض الخفافيش للضربات والاصطدامات بالأجزاء الدوارة من توربينات الرياح أثناء التشغيل. وعلى كل حال، وكما هو مبين أدناه، فإن نشاط الخفافيش داخل موقع المشروع هو بالحد الأدنى، وبالتالي فيمكن اعتبار هذه الآثار طفيفة وغير ذات قيمة.

43. ومع ذلك، يجب على مشغل المشروع تنفيذ برنامج رصد وفيات الخفافيش الناتج عن توربينات الرياح لمدة 6 أشهر خلال مرحلة التشغيل الأولى للمشروع. ويجب رصد الوفيات مرة واحدة في الشهر، على أن يتضمن برنامج الرصد الملاحظات البصرية للخفافيش النافقة حول كل توربينات الرياح. واستنادا إلى نتائج الرصد، وفي حالة عدم تحديد أية قضايا مثيرة للقلق، فيمكن حينئذ وقف برنامج الرصد (وهذا هو السيناريو الأكثر احتمالا). وفي الحالة المستبعدة جدا التي يتم فيها تحديد أية قضية مثيرة للاهتمام (كأن تسجل نسبة عالية من وفيات الخفافيش) فيتوجب القيام بتحقيقات إضافية على مصادر جذب الخفافيش إلى الموقع (التي من المحتمل أن تكون ناتجة عن عوامل خارجية) وبناء على ذلك يجب اتخاذ التدابير المناسبة للحدّ من هذه الظاهرة.

(vii) الأثار والتراث الثقافي

وصف الوضع الحالي

44. أجري مسح للآثار والتراث الثقافي لموقع المشروع من قبل دائرة الآثار العامة. وقد تم من خلال المسح تحديد 18 مواقعاً اعتبرت ذات أهمية أثرية في منطقة المشروع بشكل عام (منها 6 مواقع تقع ضمن الأراضي المستأجرة). وتشمل هذه

المواقع بقايا الطرقات، وهياكل المباني وعناصر معمارية أخرى وغيرها، والتي تعود في تاريخها بشكل عام إلى الأنباط / الفترة الرومانية.

45. تعتبر مثل هذه المواقع هامة نظرا لقيمتها الأثرية والثقافية، ومع ذلك فهي ليست فريدة من نوعها أو مميزة، والأهم من ذلك أنها لن يؤثر على تطوير المشروع. ويمكن العثور على مثل هذه المواقع على نطاق واسع، وخاصة في منطقة البتراء والمناطق الجبلية الأخرى في الأردن.

تقييم الآثار المحتملة وتحديد تدابير التخفيف والرصد

46. التأثير الرئيسي المتوقع هو خلال مرحلة الإنشاء. وهذا يشمل التأثيرات الناجمة عن أنشطة إعداد الموقع التي من المقرر إجراؤها لتركيب التوربينات ومختلف مكونات المشروع. إن أنشطة مثل هذه يمكن أن تؤدي إلى اضطراب وأضرار في المواقع الأثرية إذا لم تؤخذ في الاعتبار بالشكل الصحيح.

47. تم في هذا المجال عند إعداد التصميم التفصيلي تجنّب تركيب أي من مكونات المشروع (تشمل التوربينات والطرق والمحطات الفرعية والمستودعات، الخ) في المناطق ذات الأهمية الأثرية، جنبا إلى جنب مع توفير منطقة عازلة مناسبة. وبالإضافة إلى ذلك، فقد تم من خلال تقييم الأثر البيئي الإجتماعي تحديد التدابير المناسبة للتخفيف والرصد، التي سيتم تنفيذها خلال مرحلة الإنشاء لضمان حماية هذه المواقع. وتشمل هذه التدابير التخطيط السليم للأنشطة – مثل الحركة الصحيحة للآلات والمعدات في المنطقة، وضمان التقيد بالسلوك السليم من قبل العمال، الخ

48. بالإضافة إلى ذلك، هناك فرصة خلال أعمال الإنشاء لاكتشاف بقايا أثرية مدفونة في الأرض. إن الإدارة غير السليمة في مثل هذه الحالات (إذا تم اكتشاف مثل هذه المواقع) قد تؤدي إلى الخلل أو إحداث الضرر في مثل هذه المواقع التي من المحتمل أن تكون ذات أهمية أثرية. ومع ذلك، تم من خلال تقييم الأثر البيئي الإجتماعي تحديد الإجراءات المناسبة "حسب فرصة وجودها" التي ينبغي تنفيذها عند اكتشاف مثل هذه البقايا في الأرض خلال مرحلة الإنشاء.

(viii) نوعية الهواء والضجيج

وصف الوضع الحالي

49. لقد تم رصد نوعية الهواء ومستويات الضجيج في منطقة المشروع والمستقبلات القريبة (وتشمل القرى القريبة من المشروع كالراجف، ودلاغة ورصيص، وفردخ، وصدقة). ولقد أظهرت النتائج بأن نوعية الهواء تقع ضمن الحدود القصوى المسموح بها للملوثات في الهواء المحيط (كما نصت عليه المواصفة القياسية الأردنية رقم 1140/2006– نوعية الهواء المحيط). بالإضافة إلى ذلك، فإن مستويات الضجيج في موقع المشروع هي أيضاً ضمن الحدود المسموح بها لهذه المنطقة (كما نصت عليه تعليمات الحد والوقاية من الضجيج لعام 2003). ومع ذلك، فقد تم تسجيل بعض التجاوزات، ولكنها لا تعزى إلى أي مصدر رئيسي لتوليد الضجيج أو التلوث، ولكنها تعزى إلى سرعات الرياح العالية في المنطقة، وعوامل أخرى ثانوية.

تقييم الآثار المحتملة وتحديد تدابير التخفيف والرصد

50. التأثير الرئيسي المتوقع هو خلال مرحلة الإنشاء. وهذا يشمل الآثار الناجمة عن أنشطة إعداد الموقع التي من المقرر إجراؤها لتركيب توربينات الرياح ومكونات المشروع الأخرى. ومن المتوقع أن ينتج عن هذه الأنشطة زيادة في مستوى الغبار والجسيمات والانبعاثات، والتي سوف تؤثر مؤقتا على نوعية الهواء المحيط. بالإضافة إلى ذلك، فمن المتوقع أن يكون استخدام الآلات والمعدات داخل موقع المشروع ومحيطه مصدرا للضجيج والاهتزازات.

51. إلا أنه تم من خلال دراسة تقييم الأثر البيئي الإجتماعي وضع الإجراءات الكافية الهادفة إلى السيطرة على انبعاث الغبار وإخماده، وكذلك إخماد مستويات الضجيج للتخفيف من حدة الآثار المترتبة على ذلك. ومن المهم أن نلاحظ أن هناك تأثيرات أخرى مهمة خلال مرحلة التشغيل المتعلقة بالضجيج الناتج عن توربينات الرياح، مما قد يؤثر على المستقبلات المجاورة (مثل قرية الراجف). وسيتم مناقشتها بشكل منفصل تحت بند صحة المجتمع والسلامة والأمن أدناه.

(ix) البنية التحتية والمرافق

وصف الوضع الحالي

52. يناقش هذا القسم المرافق والبنية التحتية لتوفير الخدمات وتشمل: (أ) الموارد المائية والمرافق العامة، (ب) مياه الصرف الصحي والنفايات الصلبة، ومرافق النفايات الخطرة؛ (ج) شبكات الطرق، و (د) والطيران، والاتصالات السلكية واللاسلكية والتلفزيون ووصلات الراديو.

أ. الموارد المائية والمرافق: من المرجح أن تكون إمدادات المياه للمشروع من منطقة الراجف التي يخدمها نظام إمدادات المياه من وادي موسى، والذي يتكون من شبكة إمدادات المياه و13 بئر يبلغ إجمالي إنتاجها السنوي 2,5 مليون متر مكعب.

ب. مياه الصرف الصحي والنفايات الصلبة، ومرافق النفايات الخطرة

– من المرجح أن يتم التخلص من مياه الصرف الصحي في محطات معالجة مياه الصرف الصحي في وادي موسى أو معان.

– من المرجح أن يتم التخلص من النفايات الصلبة في مكب نفايات البسطة (للنفايات البلدية) ومكب شعبة الضبع (لمخلفات البناء).

– من المرجح أن يتم التخلص من النفايات الخطرة في مرفق معالجة النفايات الخطرة في سواقة.

ج. شبكات الطرق: يتم الوصول إلى موقع المشروع أساسا من الطريق السريع رقم 15 (المعروف باسم "الطريق الصحراوي ") وهو الطريق الرئيسي في الأردن ويربط العاصمة عمان مع محافظات جنوب الأردن (العقبة، معان، الكرك، الطفيلة). من الطريق السريع رقم 15 هناك مخرج إلى الطريق السريع رقم 35 (أو المعروف باسم ' الطريق الملكي السريع') يؤدي مباشرة إلى موقع المشروع.

د. الطيران، الاتصالات السلكية واللاسلكية، والتلفزيون ووصلات الراديو

– أقرب مطار مدني في المنطقة هو مطار الملك حسين الدولي في العقبة على بعد حوالي 70 كم إلى الجنوب الغربي من موقع المشروع. وبالإضافة إلى ذلك، فإن أقرب قاعدة جوية عسكرية هي قاعدة الملك فيصل الجوية التي تقع على بعد

حوالى 65 كم إلى الشرق من موقع المشروع.
– توجد في الأجزاء الوسطى من موقع المشروع ثلاثة أبراج لشركات الاتصالات الأردنية (زين، أورانج، وأمنية).
– لا توجد أبراج للبث التلفزيوني والإذاعي في منطقة المشروع أو المناطق المحيطة بها

تقييم الآثار المحتملة وتحديد تدابير التخفيف والرصد

أ. الموارد المائية والمرافق: الاحتياجات المائية للمشروع خلال مراحل البناء والتشغيل تكاد تكون معدومة، ومن المتوقع أن يتم تزويدها بسهولة من دون أية قيود على المستخدمين الحاليين.
ب. مياه الصرف الصحي والنفايات الصلبة والنفايات الخطرة: كل هذه الكميات المتولدة أثناء مراحل الإنشاء والتشغيل هي في الحد الأدنى، ويتوقع أن يتم التعامل معها بسهولة عن طريق المرافق التي نوقشت أعلاه

ج. شبكات الطرق: أجرى مقاول الأعمال الهندسية والمشتريات والإنشاءات دراسة النقل التي حلّل من خلالها كافة الطرق الممكنة لنقل مكونات المشروع من ميناء العقبة حتى موقع المشروع. وتخلص الدراسة إلى أن الطريق المقترح لنقل مكونات المشروع ممكن، ولكن هناك العديد من المواقع على الطريق يجب أن تؤخذ بعين الاعتبار. وهذا يشمل بشكل رئيسي الجسور التي تحتاج إلى تجاوزها (بسبب الأحمال الثقيلة الشاحنات) من خلال الطرق الالتفافية الحالية المتاحة على الطرق السريعة، والكابلات العلوية التي يجب ان ترفع (بسبب ارتفاع حمولة الشاحنات) والإنحدار والميول على الطريق السريع الذي يجب أن يؤخذ بالإعتبار. ومن المتوقع من المقاول أن يلتزم بتنفيذ أحكام هذه الدراسة، وأن يقوم بالحصول على التصاريح اللازمة والتنسيق من السلطات المختصة بخصوص الأماكن المذكورة أعلاه قبل بدء أي أنشطة لنقل المعدات.

د. الطيران، الاتصالات السلكية واللاسلكية والإذاعة والتلفزيون ووصلات الراديو: أجريت الاتصالات الرسمية مع الجهات الحكومية ذات الصلة المسؤولة عن عناصر البنية التحتية عن هذه الأمور، وشمل لجنة تنظيم الطيران المدني، وهيئة تنظيم الاتصالات، والتلفزيون الأردني. ولم تثر أية قضايا ذات اهتمام من قبل تلك الجهات فيما يتعلق المشروع، ولكن هناك متطلبات إضافية روتينية يجب توفيرها من قبل المطور في مرحلة لاحقة من تطوير المشروع، وقد تم إبرازها في دراسة تقييم الأثر البيئي.

(x) الصحة والسلامة المهنية

وصف الوضع الحالي

53. فيما يتعلق بالصحة والسلامة المهنية، لا يعتبر وصف الوضع الحالي ذو صلة بالموضوع.

تقييم الآثار المحتملة وتحديد تدابير التخفيف والرصد

54. خلال مرحلة الإنشاء والتشغيل ستكون هناك مخاطر على الصحة والسلامة المهنية العامة للعمال والتي قد تزيد من خطر الإصابة أو الوفاة التي تنتج عن الحوادث. وهذا يشمل مخاطر العمل على ارتفاعات، والصدمات الكهربائية والحروق، وحركة الآلات، الخ

55. ومع ذلك، وللحد من هذه الآثار، فقد أعدّ مقاول الأعمال الهندسية والمشتريات والإنشاءات ومشغل المشروع خطة مفصلة للصحة والسلامة المهنية (OHSP) لمرحلة الإنشاء والتشغيل. والهدف من الخطة هو ضمان صحة وسلامة جميع العاملين من أجل الحفاظ على التقدم السلس والسليم للعمل في الموقع، ومنع وقوع الحوادث. ومن المتوقع أن يقوم كل من مقاول

الأعمال الهندسية والمشتريات والإنشاءات ومشغل المشروع باعتماد وتنفيذ توصيات / أحكام خطة الصحة والسلامة المهنية طوال مرحلة إنشاء وتشغيل المشروع.

(xi) الصحة المجتمعية والسلامة والأمن

وصف الوضع الحالي

56. فيما يتعلق بالصحة المجتمعية والسلامة والأمن، لا يعتبر وصف الوضع الحالي ذو صلة بالموضوع.

تقييم الآثار المحتملة وتحديد تدابير التخفيف والرصد

57. التاثيرات الرئيسية المتوقعة هي خلال مرحلة التشغيل، وترتبط بالضجيج وبوميض الظل الناتج عن التوربينات العاملة. ويمكن أن تكون هذه التأثيرات مصدرا للإزعاج والمضايقة لمستقبلات وسكان القرى المجاورة مثل قرية الراجف.

58. لدراسة هذه التأثيرات، تم استخدام نماذج البرمجيات (WindPRO) للتنبؤ بانتشار الصوت من توربينات الرياح والمستوى المتوقع من وميض الظل على المستقبلات المجاورة لتشمل قرى الراجف، ودلاغة ورصيص، والطيبة، وفردخ، وصدقة.

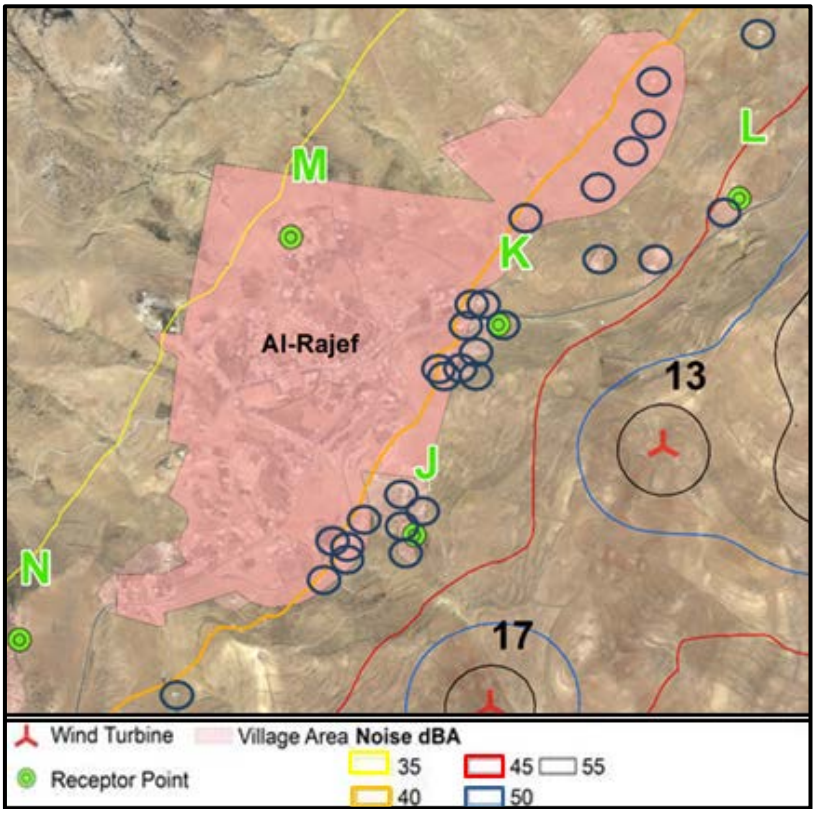
59. وفيما يتعلق بالضجيج، فقد اعتمد النموذج أكثر الافتراضات سلبية / أسوأ حالة ممكن حدوثها. تمت بعد ذلك مقارنة النتائج مع "تعليمات الحد والوقاية من الضجيج لعام 2003" الأردنية التي تتطلب أن يكون الحد الأقصى المسموح به لمستويات الضجيج في القرى 40dBA و 50dBA خلال النهار والليل على التوالي. وهذه التعليمات لها حدود أكثر شدّة بالمقارنة مع إرشادات مؤسسة التمويل الدولية.

60. يتبين من نتائج هذه النماذج أن الحد الأقصى الحدود المسموح به للضجيج والمحدد في التعليمات لن يتم تجاوزه في أي من القرى المجاورة، باستثناء أجزاء صغيرة محدودة في قرية الراجف – حيث سيتم تجاوز هذه الحدود خلال الليل فقط. وبإلقاء نظرة فاحصة على منطقة الراجف، تبدو هنالك أجزاء محدودة يتوقع حدوث مثل هذه تجاوزات فيها (وهي المناطق التي تقع حتى الخط البرتقالي 40dBA في الشكل أدناه) وتشمل بصورة رئيسية عدداً من المساكن (ملونة باللون الأزرق في الشكل أدناه). وهذه التجاوزات تحدث من عدد من التوربينات الموجودة في الجزء الشمالي الغربي من موقع المشروع فقط.

61. مرة أخرى، فمن المهم أن نلاحظ أن نتائج النمذجة أخذت في الاعتبار أكثر الإفتراضات سلبية / أسوأ حالة ، إلا أنه في الواقع فمن المتوقع أن تكون مستويات الضجيج أقل حدّة. ومع ذلك، ولضمان الامتثال لحدود التعليمات خلال الليل، يجب على المطور تنفيذ استراتيجية تشغيل منخفضة القوة لتوربينات الرياح التي تتسبب بالتجاوزات. ويجب أن تأخذ الاستراتيجية في الاعتبار عدة عوامل مثل: (أ) إجراء قياسات الأساس للضجيج في القرية قبل تشغيل التوربينات بحيث تغطي مجموعة من سرعات الرياح واتجاهات الرياح، (ب) اعادة هذه القياسات مرة أخرى بعد تشغيل التوربينات، (ج) بناء على ذلك، يمكن تحديد التخفيض المطلوب لقوة التوربينات (التشغيل عند الحد المتدني من الضجيج أو الإيقاف الكلي للتوربينات)، وتحديد الظروف التي يجب اتخاذ الإجراءات بموجبها (على سبيل المثال خلال الرياح الشرقية التي تتجاوز سرعتها 10 أمتار/ ثانية، يتوجب تشغيل التوربينة رقم 15 على وضع الضجيج المنخفض بمستوى 102dBA).

62. بالإضافة إلى ذلك، يجب وضع آلية للتظلم في الموقع للسماح للمجتمع المحلي بتقديم الشكاوى بشأن المضايقات المتعلقة بالضجيج الناتج عن التوربينات، (ولكن هذا من المستبعد جدا بمجرد تنفيذ استراتيجية التشغيل المخفضة). ومع

ذلك، وفي مثل هذه الحالات، فيتوجب تنفيذ تدابير تعويضية للحد من هذه التاثيرات من خلال مثلا استعمال نوافذ خافضة للصوت (زجاج مزدوج)، وغرس الأشجار والشجيرات، الخ.



شكل (ج): خطوط الضجيج في مواقع المستقبلات التي يحتمل تعرضها للتأثيرات في قرية الراجف

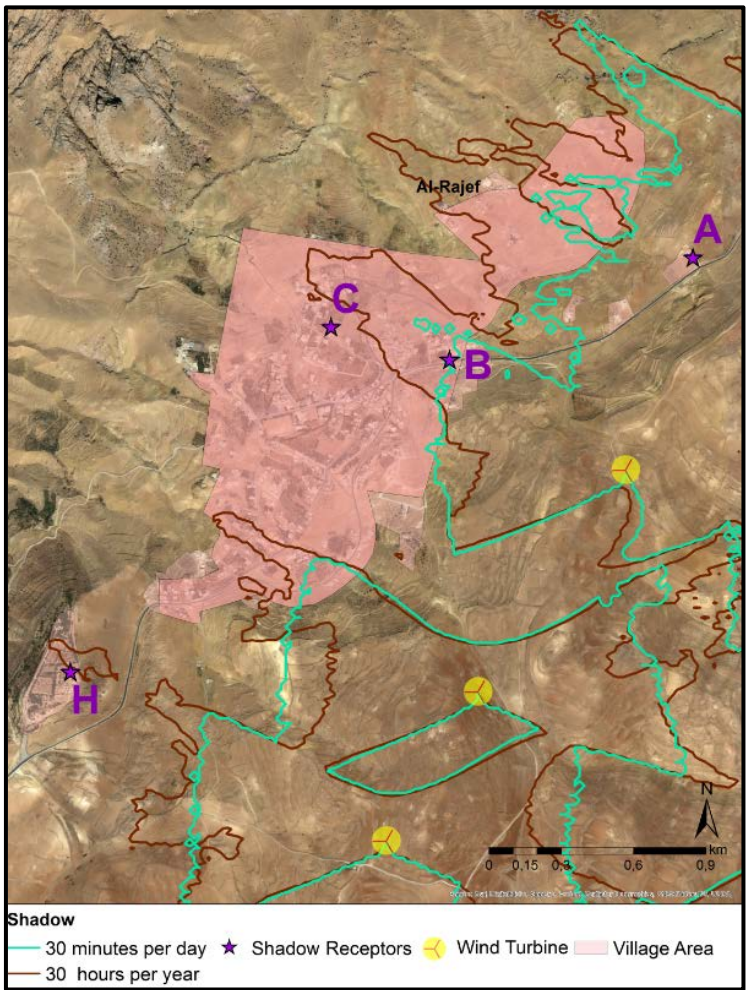
63. فيما يتعلق بوميض الظلال، فقد تم في النموذج أخذ أكثر الافتراضات سلبية / أسوأ الحالات. بعد ذلك، تمت مقارنة النتائج مع إرشادات مؤسسة التمويل الدولية لطاقة الرياح (IFC، 2015)، التي توصي بأن لا تتجاوز تأثيرات وميض الظل 30 ساعة في السنة و30 دقيقة يوميا.

64. تشير النتائج إلى أنه لا توجد قضايا ذات اهتمام في أي من القرى المجاورة باستثناء أجزاء محدودة في قرية الراجف التي من المتوقع أن تشهد أكثر من 30 ساعة في السنة، وأكثر من 30 دقيقة يوميا. وكما هو مبين في الشكل فإن حوالي 10 مبان فقط تقع في هذه المناطق.

65. ومع ذلك، فمن المهم أن نلاحظ أنه من المتوقع أن يستمر تأثير وميض الظل حوالي ثلث الوقت المقدّر لأسوأ حالة محسوبة. ويرجع ذلك إلى حقيقة أن هذا النموذج يفترض السيناريو الأسوأ الذي يكون فيه الجزء الدوار مواجهاً للشمس بشكل دائم. ومع ذلك، فإن اتجاه الرياح السائدة في منطقة المشروع، والتي تؤثر على زاوية الدوران، وبالتالي على مساحة وميض الظل، هو من الشمال الغربي. وهذا يعني أن وميض الظل سيحدث في الغالب في الاتجاه الجنوبي الشرقي، وبالتالي يكون خارج نطاق قرية الراجف.

66. ورغم ذلك، يجب أن تتوفر للمجتمع المحلي آلية للتظلم في الموقع للسماح لهم بتقديم الشكاوى بشأن المضايقات الناتجة عن وميض ظل التوربينات (ولكن هذا من المستبعد جدا بالنظر للتأثيرات الواقعية لوميض الظل). وفي مثل هذه الحالات، يجب أن تنفذ تدابير تعويضية للحد من هذه التأثيرات من خلال على سبيل المثال إيجاد منطقة خضراء عازلة كحاجز لوميض الظل و / أو توفير ستائر للنوافذ.

67. وتشمل التأثيرات الأخرى على صحة وسلامة المجتمع التأثيرات الناتجة عن وصول الجمهور إلى مكونات المشروع، و التأثيرات من تطاير الجليد عن مراوح التوربينات ولمعان الأبراج، وغيرها. ومع ذلك، تعتبر هذه التأثيرات غير ذات أهمية، وقد تم تحديد تدابير هامة ومناسبة للتخفيف والرصد في تقييم الأثر البيئي الإجتماعي للحدّ من هذه التأثيرات.



شكل (د): التواجد المكاني لوميض الظلال ومدته في قرية الراجف

(xii) الظروف الإجتماعية–الإقتصادية

وصف الوضع الحالي

68. يمكن تلخيص الظروف الاجتماعية والاقتصادية الرئيسية للمجتمعات المحلية القريبة من موقع المشروع (أساساً في قرى الراجف، ودلاغة ورصيص، والطيبة، وفردخ، وصدقة) على النحو التالي:

- الأنماط الرئيسية لسبل العيش وفرص العمل لتلك المجتمعات المحلية تشمل الخدمة العامة (وبشكل رئيسي في الخدمة العسكرية) وبشكل ثانوي في الصناعة والتجارة، ولكنها محدودة لتجارة التجزئة على نطاق صغير فقط (مثل تجارة التجزئة في المواد الغذائية والمشروبات). تشارك هذه المجتمعات أيضا في تربية الماشية والأنشطة الزراعية ولكن لأغراض الاكتفاء الذاتي بدلا من أن تكون مصدراً للدخل.

- إحدى التحديات الاجتماعية والاقتصادية الرئيسية التي تواجه تلك المجتمعات هي معدلات الفقر والبطالة المرتفعة نسبيا. ويعزى ذلك إلى عدة عوامل، والتي تشمل من بين أمور أخرى: (أ) عدم وجود مشاريع للإستثمار في القطاع الحكومي والخاص التي يمكن أن توظف العمالة، وبالتالي تؤثر بشكل إيجابي على معدلات الفقر فضلا عن مستويات البطالة. (ب) القاعدة الاقتصادية لتلك المجتمعات هي في المقام الأول الخدمة العسكرية التي تعتبر وظيفة منخفضة الراتب ؛ (ج) لم تستفد هذه المجتمعات من النمو في قطاع السياحة في منطقة البتراء كما هو الحال في مجتمعات أخرى في المنطقة (مثل وادي موسى).

تقييم الآثار المحتملة وتحديد تدابير التخفيف والرصد

69. أظهر المطور منذ بداية المشروع الالتزام والمسؤولية والمشاركة في تنمية المجتمع المحلي، من خلال توظيف مختلف أفراد المجتمع المحلي في هذه المرحلة من المشروع، وكذلك من خلال برامج المسؤولية الاجتماعية الأخرى التي تم تنفيذها بالفعل.

70. وفي مرحلة لاحقة، سيوفر المشروع نحو 200 فرصة عمل خلال مرحلة الإنشاء، وحوالي 30 فرصة عمل خلال مرحلة التشغيل. ويهدف المطور لتوظيف أفراد المجتمع المحلي إلى أقصى حد ممكن. وبالإضافة إلى ذلك، يلتزم المطور ببرامج المسؤولية الاجتماعية الأخرى تجاه المجتمع المحلي. وهذا يمكن أن يسهم إلى حد ما في تحسين البيئة المعيشية لسكان المنطقة ورفع مستوى معيشتهم.

71. ومع ذلك، فقد تم من خلال دراسة تقييم الأثر البيئي الإجتماعي تقديم توصيات إلى المطور تهدف لتعزيز هذه الآثار الإيجابية. ومنها التوصية للمطور باعتماد وتنفيذ خطة عمل تشمل العمل مع أعضاء المجتمع المحلي. ويجب أن تراعي الخطة كحد أدنى ما يلي:

- إدارة التوقعات بحيث تكون المجتمعات المحلية واقعية في الحصول على فرص عمل من المشروع، وتحدد بوضوح التزامات المطور المتعلقة بالتنمية الاجتماعية؛
- تحديد عدد فرص العمل للعمالة الماهرة وغير الماهرة التي تستهدف المجتمع المحلي خلال مرحلتي الإنشاء والتشغيل. ومن المتوقع أن يقدم المطورون تفاصيل المؤهلات والمهارات المطلوبة، والعقبات التي تواجه أفراد المجتمع المحلي وإلى أي مدى يمكن معالجتها من خلال بناء القدرات؛
- تقديم إجراءات تعيين شفافة للمجتمع المحلي. ويجب أن توفر مثل هذه الإجراءات تكافؤ الفرص للجميع، بمن فيهم النساء؛
- تقديم تفاصيل بالمجالات الإضافية التي يمكن لأفراد المجتمع المحلي المشاركة فيها، إلى جانب فرص العمل لمن لديهم المهارات والخبرات المطلوبة (على سبيل المثال تعيين المقاولين المحليين)؛ و
- ضمان الاتصال المستمر ونشر المعلومات بين المطورين وأفراد المجتمع المحلي في الوقت المناسب.

EXECUTIVE SUMMARY

BACKGROUND TO THE PROJECT

1. In 2007, the "Master Strategy of the Energy Sector in Jordan" was updated and provided a vision for the development of the energy sector till the year 2020, where one of its main outcomes was the need to diversify energy resources and increase the share of renewable energy to 7% in 2015 and 10% in 2020 – with the major share coming from wind and solar power.

2. In accordance with the above, the renewable energy sector in Jordan is gaining momentum since the "Renewable Energy and Energy Efficiency Law No. (13) of the year 2012" entered into force. This law established the basis in Jordan for the submission of renewable energy project proposals by the private sector to the Ministry of Energy and Mineral Resources (MEMR).

3. To this extent, Green Watts Renewable Energy (GWRE) (hereafter referred to as 'the Developer') has been selected by MEMR for the development of an 82Mega Watt (MW) Wind Power project in Ma'an Governorate (hereafter referred to as 'the Project').

4. The Ministry of Environment (MoEnv), in accordance with the "Environmental Impact Assessment Regulation No. (37) of 2005", requires a Project of this scale and nature to undertake an Environmental and Social Impact Assessment (ESIA) in order to obtain the environmental permit and commence with construction and operational activities. In addition, the Developer will be seeking financing for the Project from International Financial Institutions – such as the International Finance Corporation (IFC). Therefore, the Developer wishes to design and manage the Project in accordance with good international industry practice and standards.

5. This document provides the main outcomes of the ESIA that was undertaken for the Project and which was prepared in accordance with the "Environmental Impact Assessment Regulation No. (37) of 2005" and the IFC "Performance Standards in Environmental & Social Sustainability" and "Environment, Health, and Safety (EHS) Guidelines".

PROJECT DESCRIPTION

(iv) Project Location

6. The Project is located within the western borders of Ma'an Governorate in the South of Jordan on the Sherah highlands, approximately 200km south of the capital city of Amman. The closest villages to the Project site include: (i) Al-Rajef and Dlaghah & Rassees both of which are located on the western border of the Project site, (ii) Taybeh which is located around 3km to north of the Project site, and (iii) Fardakh and Sadaqah located to the eastern borders of the Project site at a distance of around 2.5 and 1.5 km respectively. Refer to Figure A below.

7. The Project area is approximately 7.6km^2 which will be used for the development of the 82MW Wind Farm Project. The 7.6 km^2 consists of 49 parcels of land that have been leased by GWRE from the local community land owners (mainly Al-Rajef, Dlaghah and Taybeh) for the development of the Project (represented in green in the figure below). Such leased lands are spread over an area of 26km^2 which represents the Project boundary (represented in blue in the figure below).

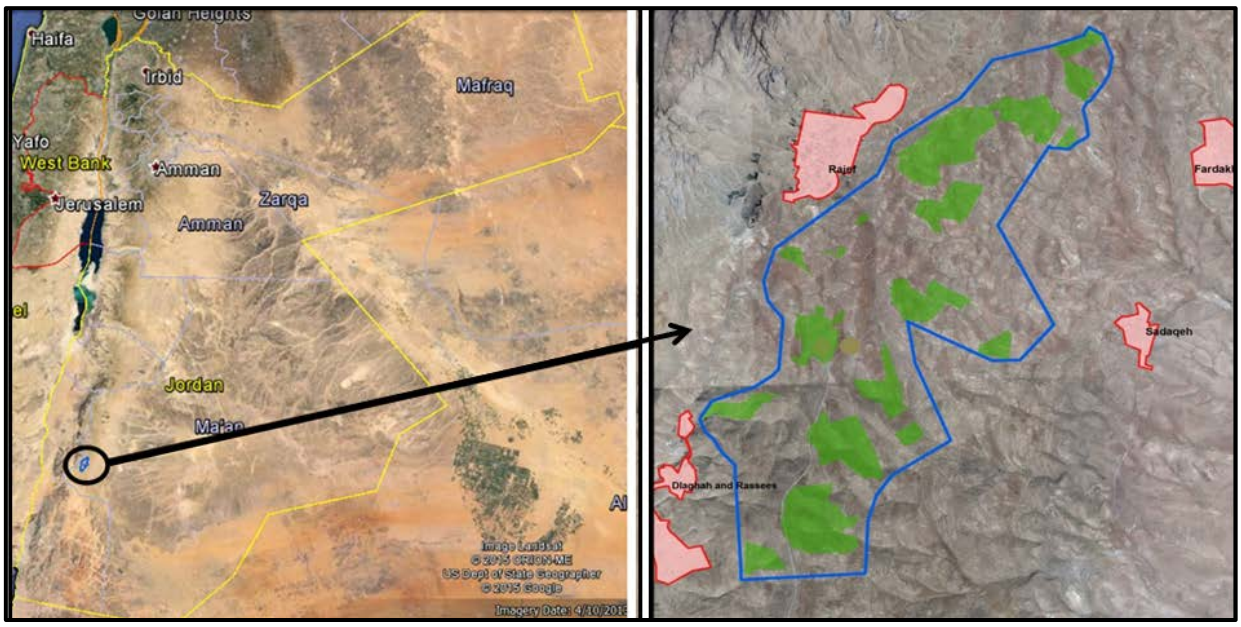


Figure A: Project Location

(v) Project Components

8. The key component of the Project includes the wind turbines. There will be 41 wind turbines spread over the leased lands, each with a 2.0MW capacity. The turbine model has a hub height of 80m, rotor diameter of 114m and thus a tip height of 137m.

9. Other Project components include the following:

- Electrical Equipment: the Project will feed electricity directly into the National Grid for end users. There are several electrical equipment which are required to convert the electricity produced from the turbines in a form that is appropriate for connection with the High Voltage National Grid. This includes transformers, inverters, and connection cables; and
- Infrastructure and Utilities: those include (i) offices used for normal daily operational related work and a warehouse for storage of equipment and machinery, (ii) road network for access to the site and turbines; (iii) substation which collects electricity generated from the turbines and connects with the national grid through an overhead transmission line.

(vi) Project Phases

10. The likely activities to take place during the Project development include three distinct phases: (i) planning and construction, (ii) operation and (iii) decommissioning each of which is summarized below.

- Planning and Construction: this mainly includes preparing a detailed design for the Project, transportation of the various Project components to the site, and site preparation activities for installation of the wind turbines and various other components. Site preparation will include excavations and land clearing activities. Such activities will be undertaken by an Engineering, Procurement, and Construction (EPC) Contractor appointed by the Developer (known as Gamesa);
- Operation: such a Project requires limited operational activities which mainly include maintenance of the turbines and the various electrical equipment. This includes for example, turbine and rotor maintenance, lubrication of parts, washing of blades, maintenance of electrical components, etc. Operation of the Project will be mainly undertaken by Gamesa; and
- Decommissioning: according to the agreement to be signed between the Developer and the National Electric Power Company (NEPCO) for 20 years, NEPCO has the option to acquire the Project at the

end of the term and continue operating it at a mutually agreed price with the Developer. If NEPCO and the Developer cannot agree on such a price, then the Project will be completely decommissioned.

11. According to the current timeline, construction of the Project is anticipated to commence around August 2016 and will require approximately 22 months for construction and commissioning (i.e. till June 2018). Operation of the Project is therefore anticipated to commence in June 2018 for a period of 20 years.

THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE PROJECT

12. The Project will result in crucial positive environmental and economic impacts on the strategic and national level given the current challenges the energy sector in Jordan is facing. Such positive impacts are important to consider and take into account and include the following:

- The Project allows for more sustainable development and shows the commitment of the Government of Jordan to realizing its Energy Strategy and meeting the set targets for renewable energy sources;
- The Project will contribute to increasing energy security through reliance on an indigenous, inexhaustible and mostly import-independent energy resource. The expected electricity generation from the Project will serve the annual electricity needs of more than 60,000 local households;
- The Project will produce clean energy which will contribute to lowering electricity generation costs when compared to the current costs associated with liquid fuels, and thus leads to a substantial decrease in the Government of Jordan's fiscal deficit; and
- The clean energy produced is expected to reduce consumption of fuel oil and/or natural gas currently used at thermal power plants for electricity generation in Jordan. This will help in reducing greenhouse gas emissions as well as air pollutant emissions – the Project is expected to offset more than 160,000 ton of CO_2 annually.

13. On the other hand, the Project will result in certain negative environmental impacts. Nevertheless, the ESIA concludes that such impacts do not pose any issues of concern, and through the implementation of the appropriate mitigation and monitoring requirements they are considered not significant. Such mitigation and monitoring measures are discussed briefly below for each environmental/social receptor, and are presented in details within the Environmental and Social Management Plan (ESMP) in the ESIA document.

14. The Project will result in impacts on the following environmental/social receptors each of which is discussed in details throughout this summary: landscape and visual; land use; geology and hydrology; biodiversity; birds (avi-fauna); bats; archeology and cultural heritage; air quality and noise; infrastructure and utilities; occupational health and safety; community health, safety and security; and socio-economic conditions.

(xiii) Landscape and Visual

Description of Baseline Environment

15. The Project site mainly consists of a series of small hills and ridges on the plateau of the Sharah highlands at altitudes ranging between 1550-1700m above sea level. The landscape of the Project site can be described as arid with frequent rock outcrops on hillsides. The Project site is barren and heavily degraded with few vegetation strips and scattered trees.

16. In addition, the landscape and visual character of the surrounding areas was investigated. There is only one key visual receptor in the area (located 16km to the northwest) which is the Petra World Heritage site – a major touristic site in Jordan known for the city of Petra which includes the Treasury (Khazneh).

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

17. The key anticipated impact from the Project is during the operation phase and which relates to the interaction of the Project with the character of the surrounding landscape and any key visual receptor which might be present.

18. To study such impacts a visibility analysis was undertaken through a computer software (WindPRO) which aims to identify the number of turbines that would be visible from nearby areas.

19. The most important outcome of the assessment is that from the main part of the Petra world heritage site, where the most important key visual sensitive receptor is located (i.e. Petra city), no views to the wind farm could be identified due to the fact that it is located at the ground of a valley surrounded with side-valleys and mountains with steep climbs.

20. Some turbines could be visible from other areas in the world heritage site, but those are limited to the tops of mountain ranges. Such areas are vacant with no touristic attractions, except for a site known as Jabal Haroun (Shrine of Prophet Aaron) – considered a minor touristic site in the Petra region. Nevertheless, accessibility to such areas is very limited due to the existence of steep climbs and/or the need for a long exhausting walking hike. In addition, views from such areas to the wind farm would be very distant and can hardly be seen as noted in the figure below. Finally, it is important to note that GWRE has obtained the approval of Petra Development and Tourism Region Authority (PDTRA) for the development of the Project.

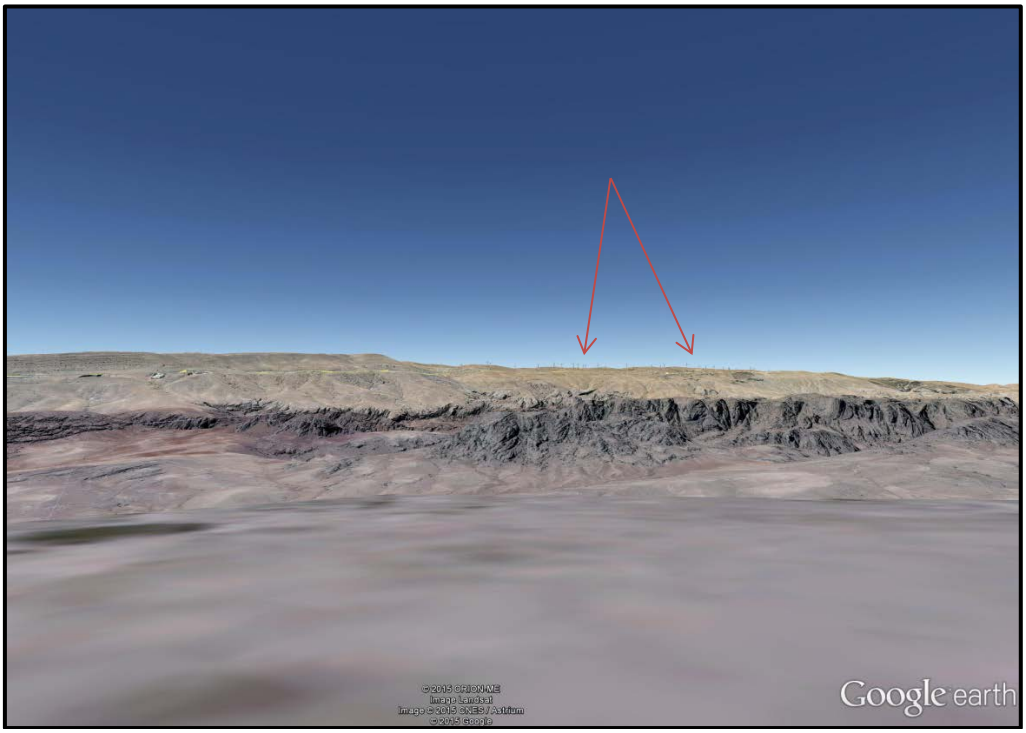


Figure B: Virtual View from Hilltops in Petra World Heritage Site towards the Project Site

(xiv) Land Use

Description of Baseline Environment

21. The ESIA investigated the formal and informal (or 'actual') land use of the Project site area as discussed below.

22. The ESIA investigated the formal land use planning as set by the various governmental institutions (such as the Ministry of Municipal Affairs, Petra Development and Tourism Region Authority, Ministry of Environment, Ministry of Agriculture, etc.) and concluded that there is no conflict with such set land use plans.

23. With regards to the actual land use of the Project site, several site visits were undertaken as well as detailed consultation with affected communities to determine if the Project site provides any value. Based on that it was concluded that the local community of Al-Rajef and Dlaghah & Rassees undertake agricultural and grazing activities during specific times of the year in the Project area (generally between February and July). In addition, the area in general is known for nomadic settlements during specific times of the year (generally between April and September) whom also undertake grazing and agricultural activities.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

24. Given that the Project does not conflict with any of the formal land use planning set by the various governmental entities above, there are no impacts on formal land use.

25. With regards to the informal land use, the Project development could affect the activities currently undertaken by the local community and nomads in the area. However, such impacts are minor and not significant. The Project components have a very minimal footprint (around 7% of the land leased areas and 2% of the total Project boundary area) – therefore agricultural and grazing activities currently undertaken by the local community can continue to take place in other undisturbed areas.

26. In addition, based on consultations with the nomads it was understood that they general occupy the Rajef region on a yearly basis (between April and September), but do not settle in the exact specific area every year. Therefore, even if some of the Project components (which as discussed earlier are of a minimal footprint) are within an area in which a nomad is currently settling, in later years (during construction and operation) nomads could simply set up their tents on other nearby areas. Moreover, their agriculture and grazing activities would not be affected as those can continue to be undertaken with the Project development.

27. The ESIA requires that the Project Operator allow nomadic settlers as well as local community members to continue with their grazing and agricultural activities in the Project area. The Developer is committed to such an issue as this was included as a term within the land lease agreements that were signed with the local community land owners.

(xv) Geology and Hydrology

Description of Baseline Environment

28. In general the geology of the Project area consists of limestone, dolomitic limestone and dolomite with intercalated beds of sandy limestone, chalk, marl, gypsum, chert and phosphorite. Moreover, the Project site is located within three surface water basins which include the North Wadi Araba, South Wadi Araba, and Jafr surface water basins; each of which has an annual discharge of 46 MCM, 8 MCM, and 13 MCM respectively. In addition, the Project site is located in the Jafr groundwater basin with a sustainable yield reported between about 500 and 1000 $m^3/km^2/year$.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

29. The only anticipated potential impacts during the construction and operation phase from Project on geology and hydrology are related to improper management of waste streams (solid waste, wastewater, hazardous waste, etc.) which could contaminate and pollute soil which in turn could pollute groundwater resources. However, the ESIA has identified adequate mitigation measures which aim to control such impacts and ensure proper housekeeping practices are implemented throughout the construction and operation phase of the Project.

(xvi) Biodiversity

Description of Baseline Environment

30. A biodiversity survey was undertaken at the Project site. The survey concludes that the site is of low ecological significance due to its natural setting; being barren and heavily degraded with few vegetation strips and scattered trees of remnant forests that use to prevail in the entire mountain of Al-Rajef. The site has been heavily degraded due to massive grazing, tree cutting and ploughing that have occurred extensively throughout the site for decades.

31. In addition, most recorded floral and faunal species are considered of least concern and common to such habitat areas. However, an important issue that must be taken into account is the Spur-thighed Tortoise which is considered threatened at the national level and was recorded within the Project site.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

32. The key impact anticipated from the Project is during the construction phase. This includes impacts from site preparation activities which are to take place for installation of the turbines and the various Project components. Such construction activities could result in the alteration of the site's habitat and could potentially disturb existing floral and faunal species. However, as stated earlier the site is considered of low ecological significance. Nevertheless, a detailed survey must be undertaken before commencement of any construction activities to identify the presence of any tortoises within assigned areas for construction. Should any tortoises be recorded, they should be relocated outside of the Project site.

(xvii) Birds (Avi-Fauna)

Description of Baseline Environment

33. A bird baseline survey was undertaken at the Project site in 4 different seasons to include spring 2012, autumn 2012, autumn 2013 and spring 2015. The objective was to observe and record the number and behavior of migratory and resident soaring birds passing through the Project site. A total of 547 monitoring hours were undertaken during the spring season and 250 hours during autumn.

34. Based on the surveys, the total number of target migratory birds recorded was around 11,000 belonging to 18 key species. Of those, only 5 had an IUCN conservation status and their numbers were significantly small – around 12 species representing 0.1% of the total. In addition, of 11,000 birds results shows that two species account for most of the records – the Honey Buzzard and the Steppe Buzzard, accounting to around 94% of the total.

35. The total number of migrating birds during the spring represents around 97% of the records compared to only 3% in autumn, indicating that the Project site is used much more heavily by migrant species during spring compared to autumn.

36. On the other hand, the target resident birds recorded throughout all the surveys belong to 3 species only. All those species have an IUCN status of Least Concern – however they have important breeding populations at the national level. In total, 132 records were noted. However, it is important to note that the records do not indicate the total number of different birds of such species, as the same resident individuals were constantly using the area at different days.

37. The assessment concludes that the Project site is not located within a highly sensitive area as explained below. Comparing the results to other areas in Jordan where similar studies were undertaken by other wind farm developments (and where data was available) reveals the following:

- The number of migratory birds recorded is relatively small, especially when compared to other areas that are closer to the rift valley and its margins (the main migration route in Jordan). In such areas a much higher number and diversity of migratory soaring birds were recorded. As the Project site is located at a distance from the rift valley and its margins it is not considered within an area of intensive passage of migratory birds; and
- Number of resident bird species and their activity in the Project area is much lower when compared to other areas, especially those located closer to Important Bird Areas (IBA) in Jordan. In such areas a higher number of species and higher activity was recorded especially of those with an important local conservation status (such as the Griffon Vulture).

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

38. The key impact on birds is during the operation phase and which is mainly related to risks of strikes and collision on both migratory and resident soaring birds. Such impacts could have crucial effects especially on certain species which have an international and/or local conservation status.

39. However, to control such impacts the ESIA requires that a birds monitoring plan is implemented during the operation phase of the Project. Monitoring must be undertaken at the Project site by qualified ornithologists' continuously and mainly throughout the spring and autumn season. The objective of the monitoring is for collision avoidance through observer-led turbine(s) shutdown in situations which pose an imminent risk on a list of key species of concern that has been identified. In addition, the monitoring plan must be complemented with a carcass search plan implemented during operation to demonstrate the effectiveness of the monitoring and allow an estimation of the annual number of bird deaths caused by the turbine. Additional details on the monitoring and carcass search plan is provided in the ESMP.

(xviii) Bats

Description of Baseline Environment

40. A bat survey was undertaken at the Project site. Bat activity was very low as only 1 species was recorded with minimal activity. This species is considered of lest concern and the most common species in Jordan that is found in all types of habitats across the country.

41. Such low activity is attributed to the natural characteristics of the Project site being arid with very low vegetation coverage, which do not offer an attractive feeding habitat for bats.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

42. The key impacts on bats are during the operation phase and which are mainly related to risk of bat strikes and collisions with rotors of the operating wind turbines. However, as noted below bat activity within the Project site is minimal and therefore such impacts are considered minor and not significant.

43. Nevertheless, the Project Operator must implement a bats mortality monitoring program for a duration of 6 months during the early operation phase of the wind turbines. The mortality monitoring

program must be undertaken once per month and must include carcass search through visual observations around each wind turbine. Based on the outcomes, should no issues of concern be identified, the monitoring program can be discontinued (this is the most likely scenario to occur). In the highly unlikely event that any issues of concern are identified (high bats mortality recorded) then additional investigations must take place on the sources of attraction of bats to the site (which are likely to be from external factors) and based on that appropriate mitigation measures must be identified.

(xix) Archeology and Cultural Heritage

Description of Baseline Environment

44. An archeology and cultural heritage survey was undertaken for the Project site by the Department of Antiquities (DoA). The survey identified 18 sites which were considered of archeological importance and which are located in the Project area in general (only 6 of which are located within the leased land areas). Such sites include remains of streets, building structures, architectural elements, etc. which generally date back to the Nabataean/Roman period.

45. Such sites are considered important given their archeological and cultural value however they are not unique or distinctive and most importantly would not affect the Project development. Such sites can be found extensively especially in the Petra Region and other mountainous areas in Jordan.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

46. The key impact anticipated is during the construction phase. This includes impacts from site preparation activities which are to take place for installation of the turbines and the various Project components. Such construction activities could result in the disturbance and damage of such archeological sites if not taken into account properly.

47. To this extent, the detailed design prepared has avoided sitting any of the Project components (to include the turbines, roads, substation, warehouses, etc.) within such delineated areas of archeological importance along with an appropriate buffer zone. In addition, the ESIA has identified proper mitigation and monitoring measures to be implemented during the construction phase to ensure the protection of such sites. This includes measures such as proper planning of construction activities to take into account those sites – such as proper movement of machinery and equipment in the area, ensuring proper code of conduct is enforced by workers, etc.

48. In addition, there is a chance that throughout such construction activities, archaeological remains buried in the ground are discovered. Improper management (if such sites are discovered) could potentially disturb or damage such sites which could potentially be of archeological importance. Nevertheless, the ESIA identifies appropriate “chance-find” procedures which should be implemented should such remains in the ground be discovered throughout the construction phase.

(xx) Air Quality and Noise

Description of Baseline Environment

49. An air quality and noise baseline monitoring survey was undertaken at the Project site and nearby receptors (to include the villages near the Project such as Al-Rajef, Dlaghah & Rassees, Fardakh and Sadaqah). The monitoring concludes that parameters monitored for air quality are within the maximum allowable limits for pollutants (as stipulated within the Jordan Standard 1140/2006 - Ambient Air Quality). In addition, generally noise levels are also within the maximum allowable limits for noise set for the area (as stipulated within the Instruction for Reduction and Prevention of Noise of

2003). However, some exceedances were recorded but are not attributed to any major source of noise generation or pollution, but rather from high wind speeds in the area and other minor factors.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

50. The main impact anticipated is during the construction phase. This includes impacts from site preparation activities which are to take place for installation of wind turbines and other Project components. Such construction activities will likely result in an increased level of dust and particulate matter emissions, which will temporarily impact ambient air quality. In addition, the use of machinery and equipment are expected to be a source of noise and vibration within the Project site and its surrounding.

51. However, the ESIA has identified adequate dust control measures as well as noise suppression measures to control such impacts. It is important to note that there are other important impacts during the operation phase related to noise generated from wind turbines, which could affect nearby receptors (such as Al-Rajef village). Those are discussed separately under Community Health, Safety and Security below.

(xxi) Infrastructure and Utilities

Description of Baseline Environment

52. This section discusses utility and service supply infrastructure to include: (i) water resources and utilities; (ii) wastewater, solid waste, and hazardous waste utilities; (iii) road networks; and (iv) aviation, telecommunication, television and radio links.

a. *Water Resources and Utilities:* water supply to the Project will most likely be from the water supply to the Rajef area which is served by the Wadi Mousa water supply system which consists of 13 wells with a total supply capacity of 2.5MCM/year and a dedicated water supply network.

b. Wastewater, Solid Waste, and Hazardous Waste Utilities

- Wastewater from the Project will most likely be disposed at the Wadi Mousa or Ma'an WWTP.
- Solid waste will most likely be disposed at Al-Basta Landfill (for municipal waste) and Shabit Al Dabe landfill (for construction debris).
- Hazardous waste will likely be disposed at the Swaqa Hazardous Waste Treatment Facility.

c. *Road Networks:* the Project site is mainly accessed from Highway #15 (better known as the 'Desert Highway') which is the major route in Jordan and connects the capital city of Amman with the southern Governorate of Jordan (Aqaba, Ma'an, Karak, Al-Tafileh). From Highway #15 an exit is taken to Highway #35 (or better known as the 'King's Highway') which leads directly to the Project site.

d. Aviation, Telecommunication and Television and Radio Links

- The closest civil airport in the area is the King Hussein International Airport located in Aqaba and around 70km southwest of the Project site. In addition, the closest military air base is the King Feisal Airbase located around 65km to the east of the Project site.
- Within the central parts of the Project site are broadcasting towers for all three (3) Jordanian telecommunication companies (Zain, Orange, and Umniah).
- There are no television and radio broadcasting towers in the Project area or its surroundings.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

a. *Water Resources and Utilities:* water requirements of the Project during construction and operation are minimal and are expected to be easily supplied with no constraints on the existing users.

b. *Wastewater, Solid Waste and Hazardous Waste:* all such quantities generated during the construction and operation phase are minimal and are expected to be easily handled by the utilities discussed above.

c. *Road Networks:* the EPC Contractor has undertaken a Transport Study which analyzed the entire route for transportation of the Project components from the port of Aqaba till the Project site. The study concludes that the suggested route for the transportation of the Project components is feasible but there are several accommodations which must be taken into account. This mainly includes bridges which need to be bypassed (due to the heavy loads of trucks) through existing detours available on the highways, overhead utility cables which must be lifted (due to height of transporting trucks) and slants on the highway which must be filled. The EPC Contractor is expected to implement the provisions of the Study and coordinate and obtain the permits from the relevant authorities for the above accommodations required before commencement of any transportation activities.

d. *Aviation, Telecommunication and Television and Radio Links:* formal communications were established with the relevant governmental entities responsible for such infrastructure elements to include the Civil Aviation Regulatory Commission (CARC), Telecommunication Regulatory Commissions (TRC), and the Jordan Radio and Television Corporation (JRTV). No issues of concern were raised by those entities with regards to the Project, but there are routine additional requirements which must be provided by the Developer at a later stage of the Project development and which are highlighted within the ESIA study.

(xxii) Occupational Health and Safety

Description of Baseline Environment

53. With regards to occupational health and safety, a description of baseline environment is irrelevant.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

54. During the construction and operation phase there will be generic occupational health and safety risks to workers which increase the risk of injury or death due to accidents. This includes risks from working at heights, electric shocks and burns, moving machinery, etc.

55. Nevertheless, to control such impacts, the EPC Contractor and Project Operator have prepared a detailed Occupational Health and Safety Plan (OHSP) for the construction and operation phase. The objective is to ensure the health and safety of all personnel in order to maintain a smooth and proper progress of work at the site and prevent accidents. The EPC Contractor and Project Operator are expected to adopt and implement the recommendations/provisions of the OHSP throughout the Project construction and operation phase.

(xxiii) Community Health, Safety and Security

Description of Baseline Environment

56. With regards to community health, safety and security, a description of baseline environment is irrelevant.

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

57. The key impacts anticipated are during the operation phase and which are related to noise and shadow flicker from the operating turbines. Such impacts could potentially be a source of disturbance and nuisance to the receptors and residents of the nearby villages such as Al-Rajef.

58. To study such impacts, a modelling software was used (WindPRO) to predict the sound propagation from the Project's wind turbines and expected level of shadow flicker on the nearby receptors to include the villages of Al-Rajef, Dlaghah & Rassees, Taybeh, Fardakh and Sadaqah.

59. With regards to noise, the model took into account most adverse/worst-case assumptions. Results were then compared with the Jordanian "Instruction for Reduction and Prevention of Noise for 2003" which requires a maximum allowable limit of noise levels in villages of 50dBA and 40dBA during daytime and nighttime respectively. This Instruction has more stringent limits when compared to the IFC Guidelines.

60. Results of this modeling indicates that the maximum allowable limits for noise identified within the Instruction would not be exceeded in any of the nearby villages, with the exception of small limited parts at Al-Rajef village – where such limits will be exceeded during nighttime only. Taking a closer look at Al-Rajef area, the limited parts where such exceedances are expected (those areas which lie up till the 40dBA orange line in the figure below) mainly include a number of dwellings (highlighted in blue below in the figure below). Such exceedances are from a number of turbines only located in the northwestern part of the Project site.

61. Again it is important to note that the modeling results took into account a most adverse/worst-case assumptions where in reality noise levels are expected to be lower. Nevertheless, to ensure compliance with Instruction limits during nighttime, the Developer is required to implement a wind turbine reduced power operation strategy for the turbines causing exceedances. The strategy must take into account several factors such as: (i) undertaking baseline noise measurements at the village before operation to cover a range of wind speeds and wind directions, (ii) retake such measurements again once the turbines are operational, (iii) based on that, the required reduced power measures can be identified (operation in a noise-reduce mode or shut-off of the turbine) and the conditions in which they are required (e.g. during eastern winds that exceed 10m/s, turbine 15 must be operated in a noise-reduce mode of 102dBA) .

62. In addition, a grievance mechanism must be in place to allow the local community to submit complaints regarding nuisances related to noise from the turbines (however this is highly unlikely once the reduced power strategy is implemented). Nevertheless, in such cases compensation measures must be implemented to limit such impacts through for example sound reducing windows (double glazed), planting of trees and shrubs, etc.

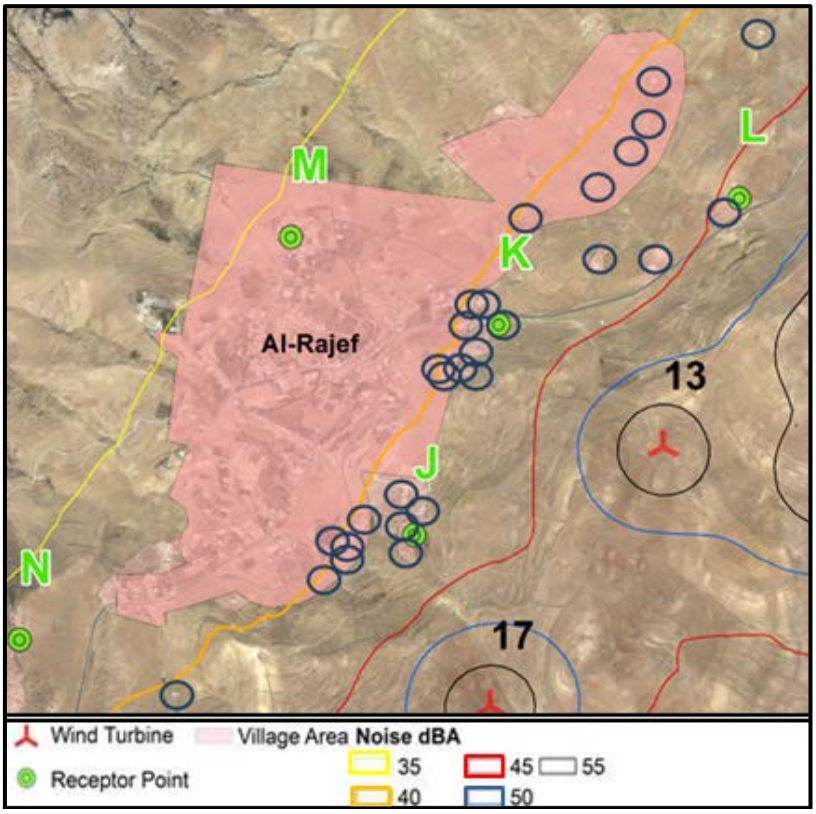


Figure C: Noise Contours for Potentially Affected Receptor Locations in Al-Rajef

63. As for shadow flicker, the model also took into account the most adverse/worst-case assumptions. Results were then compared with the IFC EHS Guidelines for Wind Energy (IFC, 2015) which recommend that shadow flicker effects not exceed 30 hours per year and 30 minutes per day.

64. The results indicate that there are no issues of concern in any of the nearby villages with the exception of limited parts in Al-Rajef village which are expected to experience more than 30 hours per year and more than 30 minutes per day. The figure shows that about 10 buildings only are situated in such areas.

65. However, it is important to note that a realistic shadow flicker effect is expected to last about one third of the calculated worst case time. This is due to the fact that the model assumes a worst case scenario which assumes that the rotor place is always facing the sun. However, in reality the prevailing wind direction in the Project area, which influences the position angle of the rotor place and therefore the area of shadow flicker, is from northwest. This means that shadow flicker will mostly occur in southeast direction, and therefore outside of Al-Rajef village.

66. Nevertheless, a grievance mechanism must be in place to allow the local community to submit complaints regarding shadow flicker nuisances from the turbines (however this is highly unlikely given realistic effects of shadow flicker). In such cases, compensation measures must be implemented to limit such impacts through for example introduction of vegetative buffers as a barrier for shadow flicker and/or providing window blinds.

67. Other impacts on community health and safety include impacts from public access to Project components, impacts from blade/ice throws from turbines, tower glints, and other. However, those are considered not significant and appropriate mitigation and monitoring measures have been identified in the ESIA to control such impacts.

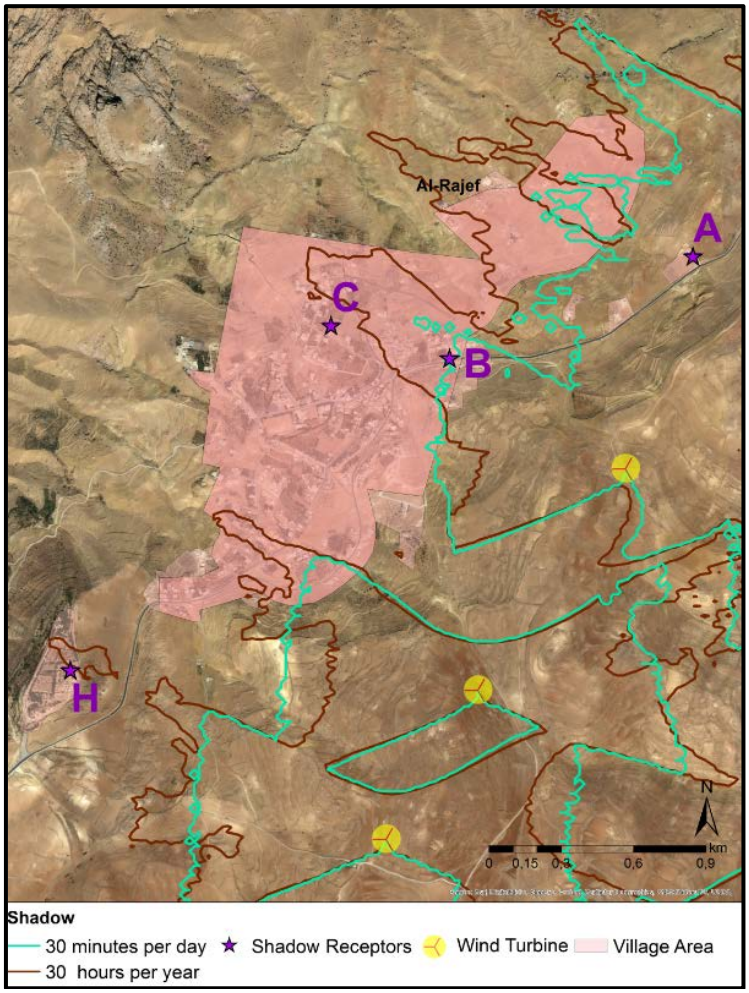


Figure D: Spatial Occurrence of Shadow Flicker and Duration in Al-Rajef

(xxiv) Socio-economic Conditions

Description of Baseline Environment

68. The main socio-economic conditions of those local communities near the Project site (mainly Al-Rajef, Dlaghah and Rassees, Taybeh, Fardakh, and Sadaqah) can be summarized as follows:

- The main livelihood and employment patterns of those local communities include public service (and mainly in military service) and secondarily in industry and trade but which is limited to small scale retail trade establishments only (such as retail trade in food and beverage). Such communities also engage in livestock raising and agricultural activities but for self-sufficiency purposes rather than as a source of income.
- One of the main socio-economic challenges facing those communities is the relatively high poverty and unemployment rates. This is attributed to several factors, which includes amongst others: (i) the lack of governmental and private sector investment projects that can employ labor and thus positively impact poverty as well as unemployment levels; (ii) the economic base of those communities is primarily military service which is considered a low paying job; (iii) such communities have not benefited from the growth in tourism sector in the Petra area similar to other communities within the region (such as Wadi Mousa).

Assessment of Potential Impacts and Identification of Mitigation and Monitoring Measures

69. From the onset of the Project, the Developer has shown commitment and responsibility towards local community development and engagement, through hiring various local community members at this stage of the Project as well as other social responsibility programs which were already implemented.

70. At a later stage, the Project will create around 200 job opportunities during the construction phase and around 30 job opportunities during the operation phase. The Developer is aiming to hire local community members to the greatest extent possible. In addition, the Developer is committed to other social responsibility programs towards the local community. This, to some extent, could contribute to enhancing the living environment for its inhabitants and elevate their standards of living.

71. Nevertheless, the ESIA has provided recommendations to the Developer which aim to enhance such positive impacts. The ESIA recommends that the Developer adopt and implement an Action Plan for working with the local community members. The Plan should at a minimum consider the following:

- Manage expectations so that local communities are realistic about opportunities from the Project and clearly identify commitments by Developer related to social development;
- Identify the number of skilled and unskilled job opportunities targeted to the local community throughout the construction and operation phases. The developers are expected to provide in details the qualifications and skills required and constraints of local community members and to which extent those could be addressed through capacity building;
- Present transparent recruitment procedures for the local community. Such procedures must provide equal opportunities for all, including females;
- Detail additional areas where local community members can be involved besides job opportunities provided they have the required skills and expertise (e.g. appointment of local contractors); and
- Ensure timely and continuous communication and dissemination of information between the developers and the local community members.

1. INTRODUCTION

1.1 Project Background

In 2007, the "Master Strategy of the Energy Sector in Jordan" was updated to provide a vision for the development of the energy sector till the year 2020, given the increasing energy demands and challenges facing the sector at that time. The updated Strategy became known as the "Updated Master Strategy of the Energy Sector in Jordan for the period (2007-2020)". One of the main outcomes of the "Updated Master Strategy" was the need to diversify energy resources and increase the share of renewable energy to 7% in 2015 and 10% in 2020 – with the major share coming from wind and solar power.

To this extent, and in accordance with "Updated Master Strategy", the renewable energy sector in Jordan is gaining momentum since a temporary Renewable Energy and Energy Efficiency Law was approved in March 2010 and officially entered into force in April 2012, known as the "Renewable Energy and Energy Efficiency Law No. (13) of the year 2012".

This law established the basis in Jordan for the submission of renewable energy project proposals to the Ministry of Energy and Mineral Resources (MEMR) by the private sector. In May 2011, MEMR issued a Request for Expressions of Interest (REOI) in order to promote the investment opportunities in renewable energy projects and to select the possible projects under the "Direct Proposal Submission Procedure" set out in the Law.

Developers have responded at the end of July 2011 by submitting Expressions of Interest (EOI) to MEMR. Following the evaluation of such EOI, MEMR invited the shortlisted developers to enter into a Memorandum of Understanding (MOU) with the objective to undertake all due diligence needed in order to submit a Proposal for the proposed projects.

Only those wind power projects will be selected for further development in accordance with the criteria and procedures developed by MEMR and set out in the "Instruction and Requirements for Proposal Preparation and Submission for Wind Power Projects". In 2015, and based on the "Direct Proposal Submission Procedure", MEMR selected 4 Wind Farm developers with whom it is currently undertaking negotiations.

Within this context, Green Watts Renewable Energy (GWRE) has participated in submitting an EOI to MEMR as part of the "Direct Proposal Submission Procedure" for the development of a Wind Farm Project in Ma'an Governorate. GWRE was selected by MEMR for the development of an 82 Mega Watt (MW) Wind Farm project, and has obtained the Cabinet approval on 20 September 2015 and is expected to sign a Power Purchase Agreement (PPA) in October 2015.

GWRE (also referred to as 'the Developer' throughout the document) proposes to develop a Wind Farm project of 82 MW capacity (hereafter referred to as 'the Project'). This document forms the Environmental and Social Impact Assessment (ESIA) of the Project in order to obtain the environmental permit from the Ministry of Environment (MoEnv). The ESIA has been prepared in accordance with the Jordanian "Environmental Impact Assessment Regulation No. (37) of 2005" and the "International Finance Corporation (IFC) Performance Standards in Environmental & Social Sustainability" (IFC, 2012) and Environment, Health, and Safety (EHS) Guidelines, including the EHS Guidelines for Wind Power (2015).

1.2 Project Location and Setting

The Project is located within the western borders of Ma'an Governorate in the South of Jordan, approximately 200km south of the capital city of Amman. More specifically, the Project site is located in the Sharah highlands – where the closest villages to the Project site are: (i) Al-Rajef and Dlaghah & Rassees both of which are located on the western border of the Project site, (ii) Taybeh which is located around

3km to north of the Project site, and (iii) Fardakh and Sadaqah located to the eastern borders of the Project site at a distance of around 2.5 and 1.5 km respectively as presented in Figure 1 below.

The Project area consists mainly of hilly areas at altitudes ranging from 1550-1700m above sea level. The Project area is around 7.6km^2 that is characterized as being barren and heavily degraded with few vegetation strips and scattered trees of remnant forests that use to prevail in the entire mountain of Al-Rajef area.

The Project site is mainly accessed through Highway #35 (better known as the 'King's Highway'); one of the highways which connects Ma'an Governorate with the capital city of Amman in the North – but is not the major one. Highway #35 runs through some parts of the Project site. In addition, within the site there are other access roads and several additional small agricultural roads.

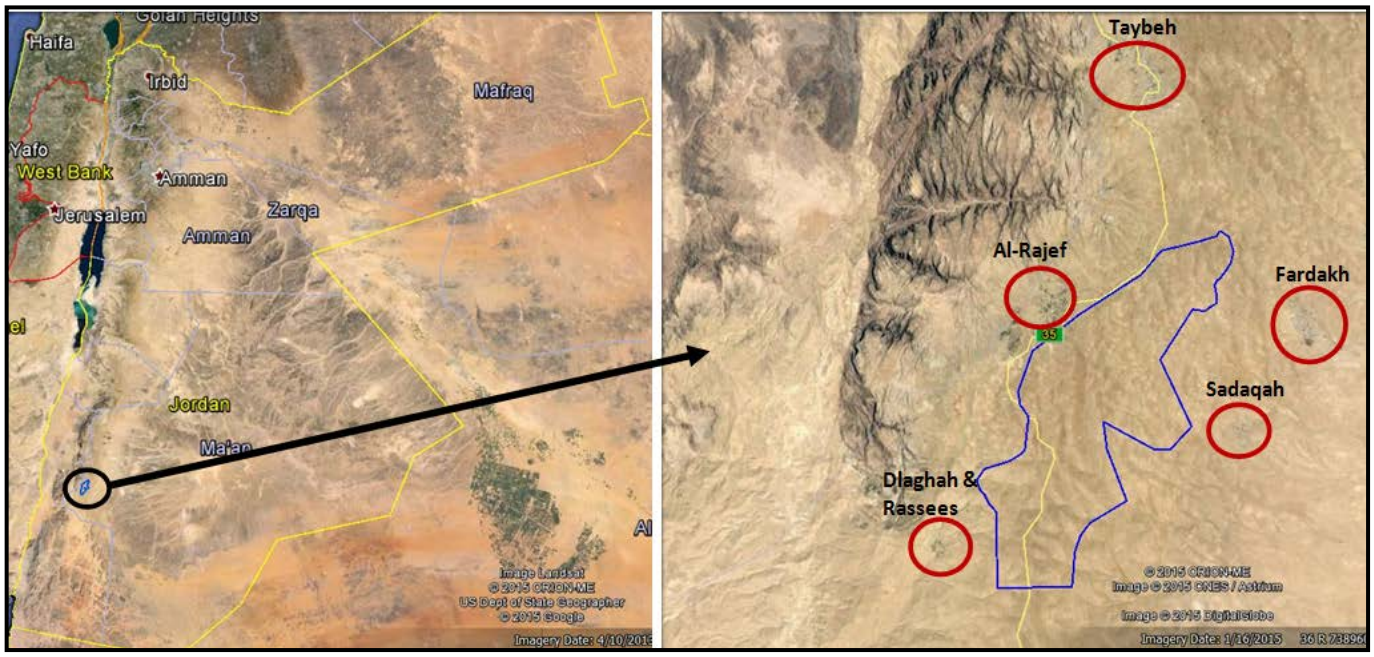


Figure 1: Overview of Project Location

1.3 The Environmental and Social Impact Assessment (ESIA) Report

The environmental clearance for this Project is governed by the Ministry of Environment (MoEnv), as stipulated by the "Environmental Impact Assessment Regulation No. (37) of 2005". The MoEnv requires the preparation of a comprehensive Environmental Impact Assessment (EIA) for such a Project before an environmental permit is granted, in order to commence with construction and operational activities.

The Developer will be seeking financing for the Project from prospective lenders, including international Financial Institutions (IFIs). Therefore the Developer wishes to design and manage the project in accordance with good international industry practice and standards. For the purpose of the ESIA this has therefore been developed in accordance with:

- IFC Environmental & Social Sustainability Performance Standards (IFC, 2012);
- IFC General Environment, Health, and Safety (EHS) Guidelines (IFC, 2007); and
- Applicable IFC Industry Sector EHS Guidelines – mainly the EHS Guidelines for Wind Energy (IFC, 2015).

ECO Consult was commissioned by GWRE to prepare the Environmental and Social Impact Assessment (ESIA) for the Project in order to apply for the necessary environmental permit. This report is the ESIA report to be submitted to the MoEnv. This ESIA is undertaken in accordance with the MoEnv's

"Environmental Impact Assessment Regulation No. (37) of 2005" and the IFC Performance Standards and EHS Guidelines.

1.4 Document Structure

The following table provides an overview of the Chapters within this ESIA document.

Table 1: Summary of the ESIA Content

Chapter	Description of Content
Chapter 2 – Project History and Alternatives	This chapter first provides an overview on the sequence and progression of the Project development. The chapter then moves on to investigates several alternatives to the Project development and the reasons for the preferred choice. This includes alternatives in relation to the Project site, selected technology, Project design, and finally investigates the 'no action alternative' – which assumes that the Project development does not take place.
Chapter 3 – Project Description	Provides a detailed description of the Project in relation to its location, the key project components and an overview of the proposed activities that are to take place during the various Project phases.
Chapter 4 – Regulatory & Policy Framework	Provides an overview of the environmental and social regulatory and policy framework applicable to the Project.
Chapter 5 – ESIA Approach and Methodology	Presents the methodology and approach that was adopted for the ESIA study.
Chapter 6 – Stakeholder Consultation and Engagement	Discusses in details the stakeholder consultation and engagement plans which were undertaken as part of the ESIA process for the Project and provides an overview of the findings. In addition, this Chapter also discusses the future stakeholder engagement and consultation plans which are to take place at a later stage.
Chapter 7 – Overview of Strategic Environmental and Economical Impacts	This Chapter provides an overview of the significant positive environmental and economical impacts that will result from the Project development on the strategic and national level. The Chapter also highlights the site specific negative environmental and social impacts anticipated from the Project throughout its various phases – each of which is discussed in details in the subsequent chapters.
Chapter 8 – Landscape and Visual	This Chapter first presents the baseline conditions within the Project site and surroundings in relation to landscape and visual, and then assesses the anticipated impacts from the Project throughout its various phases on such a receptor. Finally, for each identified impact a set of mitigation and monitoring requirements have been identified which aim to eliminate the impact and/or reduce it to acceptable levels.
Chapter 9 – Land Use	Similar to the above, this Chapter presents the baseline conditions in relation to land use to include both formal and informal (or actual land use of the site), assesses anticipated impacts and identifies a set of mitigation and monitoring requirements to eliminate the impact and/or reduce it to acceptable levels.
Chapter 10 – Geology and Hydrology (Soil & Groundwater)	Presents baseline conditions in relation to geology and hydrology (soil and groundwater), assesses anticipated impacts and identifies a set of mitigation and monitoring requirements to eliminate the impact and/or reduce it to acceptable levels.
Chapter 11 – Biodiversity	Presents baseline conditions in relation to biodiversity, assesses anticipated impacts and identifies a set of mitigation and monitoring requirements to eliminate the impact and/or reduce it to acceptable levels.
Chapter 12 – Birds (Avi-Fauna)	Presents baseline conditions in relation to birds (avi-fauna), assesses anticipated impacts and identifies a set of mitigation and monitoring requirements to eliminate the impact and/or reduce it to acceptable levels.
Chapter 13 – Bats	Presents baseline conditions in relation to bats, assesses anticipated impacts and identifies a set of mitigation and monitoring requirements to eliminate the impact and/or reduce it to acceptable levels.
Chapter 14 – Archeology and Cultural Heritage	Presents baseline conditions in relation to archeology and cultural heritage, assesses anticipated impacts and identifies a set of mitigation and monitoring requirements to eliminate the impact and/or reduce it to acceptable levels.
Chapter 15 – Air Quality and Noise	Presents baseline conditions in relation to air quality and noise, assesses anticipated impacts and identifies a set of mitigation and monitoring requirements to eliminate the impact

	and/or reduce it to acceptable levels.
Chapter 16 – Infrastructure and Utilities	Presents baseline conditions in relation to infrastructure and utilities. This includes: (i) water resources; (ii) wastewater services; (iii) solid waste services; (iv) hazardous waste services; (v) road networks; (vi) aviation, telecommunication, and television & radio links; and (vii) electricity networks. For each of those receptors the anticipated impacts have been assessed and a set of mitigation and monitoring requirements have been identified to eliminate the impact and/or reduce it to acceptable levels.
Chapter 17 – Occupational Health and Safety	Assesses anticipated impacts from the Project throughout its various phases on occupational health and safety and identifies a set of mitigation and monitoring requirements which aim to eliminate the impact and/or reduce it to acceptable levels.
Chapter 18 – Community Health, Safety and Security	Assesses anticipated impacts from the Project throughout its various phases on community health, safety and security – this includes impacts from noise of operating turbines and shadow flicker. For each impact a set of mitigation and monitoring requirements have been identified which aim to eliminate the impact and/or reduce it to acceptable levels.
Chapter 19 – Socio-economic Conditions	Presents baseline conditions in relation to socio-economic conditions, assesses anticipated impacts (which are mainly positive) and identifies certain requirements which aim to further enhance such impacts.
Chapter 20 – Summary of Anticipated Impacts	Provides a summary of all the identified impacts discussed throughout the previous Chapters which are anticipated throughout the various phases of the Project to include planning and construction phase, operation phase, and decommissioning phase.
Chapter 21 – Assessment of Cumulative Impacts	This Chapter investigates the cumulative impacts which could result from other known existing and/or planned developments in the area, and based on currently available information on such existing/planned developments.
Chapter 22 – Environmental and Social Management Plan (ESMP)	Presents the Environmental and Social Management Plan (ESMP) for the Project; which mainly summaries the impacts identified as well as the mitigation measures and monitoring requirements to be implemented throughout the various Project phases. In addition, this Chapter describes the institutional framework and procedural arrangement for the ESMP implementation.
Chapter 23 – Environmental Performance Requirements for NEPCO	The National Electric Power Company (NEPCO), which is the national electricity company of Jordan, will be responsible for designing and building the associated interconnection facilities for the Project – this will include a receiving NEPCO substation onsite and the high voltage overhead transmission line that will connect to the existing national grid. Given that at this stage detailed information is not available by NEPCO with regards to the layout of receiving NEPCO substation, grid connection plan and route for the overhead line, such project components have not been assessed within the ESIA. Nevertheless, this Chapter presents the Environmental & Social Performance Requirements which must be implemented by NEPCO at a later stage once such details are available. Such requirements aim to ensure that environmental and social issues are taken into account and adequately considered during the development of these facilities connected to the Project's development.

1.5 Project Proponent and Key Contributors

Different entities are involved in the planning and implementation of the Project. The responsibilities of each key entity which is of relevance to the ESIA are listed in the text below along with a general description of their roles.

- *Green Watts Renewable Energy (GWRE)*: is the Project proponent and developer and will be the owner of the Project;
- *Engineering, Procurement, and Construction (EPC) Contractor:* GWRE has appointed Gamesa Eolica ("Gamesa") as the Project's EPC Contractor, whom will be responsible for the development of the Project on a turnkey basis. Responsibilities include the preparation of the detailed design of the Project; supply of the material and equipment (turbines, cables, transformers, inverters, etc.); and construction of the Project and its various components (turbines, internal access roads, building infrastructure, connections, etc.);

- *Project Operator:* the duration of the Project is 20 years based on the PPA agreement to be signed between the Developer and NEPCO. An Operation and Maintenance (O&M) contract for the Project will be signed between the Developer and Gamesa for a duration of 15 years, and which may be extended for 20 years. In the case the O&M Contract is not extended for 20 years with Gamesa, O&M during the last 5 years will be undertaken by GWRE based on internal capabilities developed throughout the first 15 years;
- *National Electric Power Company (NEPCO):* is the national electricity company of Jordan responsible for the high voltage electric grid in the country and, for this Project, will be responsible for designing and building the associated interconnection facilities. This will include a receiving NEPCO substation onsite and the high voltage overhead transmission line that will connect to the existing national grid. At this stage, detailed information is not available by NEPCO with regards to the layout of receiving NEPCO substation, grid connection plan and route for the overhead line;
- *Ministry of Environment (MoEnv):* the official governmental entity responsible for protection of the environment in Jordan. The MoEnv is responsible for approval of the ESIA and making sure it complies with the "EIA Regulation No. (37) of the year 2005" and granting the environmental clearance for the Project; and
- *ECO Consult:* hereafter referred to as the 'ESIA Team' who is the ESIA Practitioner and the consultant commissioned by GWRE to prepare the ESIA for the Project in accordance with the requirements of the MoEnv and its "EIA Regulation No. (37) of the year 2005" as well as the IFC Performance Standards and EHS Guidelines. ECO Consult has commissioned Environmental Resources Management (ERM) to participate in the ESIA assessment specifically in relation to modeling and assessment of impacts related to visual, noise, and shadow flicker.

2. PROJECT HISTORY AND ALTERNATIVES

The "Environmental Impact Assessment Regulation No. (37) of 2005" requires that the ESIA shall identify and analyze alternatives, including but not limited to project site location, design, technology, no project alternative (which assumes that the Project development does not take place), and present the main reason for the preferred choice. In addition, the examination of alternatives is also considered to be a key element of the ESIA process under good international practice, including the "IFC Performance Standard 1" (IFC, 2012) and the associated "IFC Guidance Note 1" (IFC, 2012).

This chapter first presents the Project history and its development progression since the year 2009. The chapter then moves on to provide an analysis of certain alternatives to the Project development in relation to: (i) the Project site, (ii) the Project design, (iii) the chosen technology, and finally investigates (iv) the 'no action alternative' – which assumes that the Project development does not take place. Based on such alternatives considered, the preferred choice for the Project was chosen and which is presented later in "Chapter 3".

Throughout this chapter the application of the environmental and social mitigation hierarchy has been presented (avoid; reduce; mitigate and manage, and compensate and offset), given that environmental and social considerations have been part of the planning of the Project since its inception and a core element of the decision-making process.

2.1 Project History

This section presents the Project history and its development progression from the establishment of the renewable energy market in Jordan in 2009, and the process for the selection and development of the Project since 2012 up until the Cabinet approval of the PPA template for the Wind Projects under the Direct Proposal Submission – Stage I on 20 September 2015. Signing of the Power Purchase Agreement (PPA) is expected to take place in October 2015. The sequence of events is discussed in details below.

1. In 2007, the "Master Strategy of the Energy Sector in Jordan" was updated to provide a vision for the development of the energy sector till the year 2020. One of the main outcomes of the Updated Strategy was to increase the share of renewable energies in primary energy supply to 10% by 2020. To achieve this overall target, different renewable energy technologies have to be developed in the coming years, especially wind and solar power, where the single targets were set at 1200MW and 600MW respectively.
2. In 2009, the Government of Jordan (GoJ) began establishing a platform for renewable energy development in Jordan. This began by developing an enabling environment to support such developments, through establishing a legislative and institutional framework. One of the main outcomes was the temporary Renewable Energy and Energy Efficiency Law, which was approved in March 2010 and officially entered into force in April 2012 – known as the "Renewable Energy and Energy Efficiency Law No. (13) of the year 2012". The temporary law allowed and regulated the submission of direct proposals for renewable energy by the private sector. This opened up a new path for project developers for opportunities for renewable energy development.
3. In May 2011, the Government published a policy statement, combined with a Request for Expression of Interest (REOI), basically for wind and solar power projects. The REOI provided guidelines for potential investors with regard to the application. Apart from the technical boundaries, the REOI set the general framework in form of "Instructions for the Investors" and defined the major content of the Expression of Interest (EOI) to be delivered by the applicants. The EOI should comprise amongst other things the following: clear description of the bidder, project description, technical capability and experience of the bidder, and ability to raise debt and equity. Additionally, the REOI requested that each developer must select and propose their own land which: (i) should not be governmental owned (ii) developer should provide proof of either land ownership deeds or land lease agreements with the

owner. MEMR also guided the developers by creating a data room that included wind and solar maps which identified optimal locations for developments of solar and wind power projects in Jordan.

4. 64 EOIs (solar and wind) were submitted and evaluated. Applicants who were in compliance with the REOI requirements and the evaluation criteria and also demonstrated clear superiority in terms of technical and financial aspects were qualified. Based on that, 34 EOIs were qualified to invest in renewable energy projects; 12 of the shortlisted EOIs were developers interested in developing wind farms. The qualified applicants were then asked to sign a Memorandum of Understanding (MOU) with MEMR, which defined the cooperation between MEMR and the applicant during the project development phase.
5. GWRE were interested in submitting a Direct Proposal for the development of the 82MW wind farm project. After going through an extensive due diligence exercise – the Rajef Area was selected for the proposed Project and the Developer signed land lease agreements for the selected lands with the owners for 29 years. In July 2011, GWRE submitted an Expressions of Interest (EOI) to MEMR. This phase included several site alternatives that were considered and which aimed to take into account environmental and social consideration into account. The site alternatives are discussed in details in "Section 2.2" below. GWRE was amongst the 34 EOIs that made the final shortlist for potential renewable energy developers with MEMR.
6. After that, the shortlisted wind farm developers were given more than one year to submit a final technical and financial proposal in accordance with the "Instruction and Requirements for Proposal Preparation and Submission for Wind Power Projects" (IRRP).
7. Once shortlisted in April 2012 and after signing of the MOU, GWRE decided to develop the Project in a way that all technical assessments are involved from the beginning in a comprehensive and interlinked manner (technical, environmental and social, financial, etc.). As such, GWRE hired the technical, financial, and environmental consultants once shortlisted. Also GWRE approached different turbine providers and EPC contractors to provide proposals that are suitable for the Project. GWRE also approached potential International Financing Institutions' (IFI's) to integrate their requirements into the planning of the Project from the onset. An ongoing process of interaction and iteration between financier, Developer, and consulting teams has taken place ever since and the development of the Project proceeded taking into account the assessments of all involved consultants continuously throughout the Project up until this point. Throughout this phase, several design alternatives were considered which aimed to take into account environmental and social considerations into account. The design alternatives are discussed in details in "Section 2.3" below.
8. Based on a thorough screening and evaluation process, GWRE selected and awarded the contract to the preferred EPC Contractor in January 2014 (Gamesa).
9. In June 2014, GWRE submitted his technical and financial proposal to MEMR along with other three wind farm developers in accordance with the IRRP requirements.
10. MEMR and their consultants undertook different rounds of evaluation and negotiations with the Developers. In May 2015, the Developers were invited for final negotiation and to comment on the PPA in order to create a PPA common to all the Stage 1 Wind developers, subject to minor project specific conditions.
11. GWRE was the first to fulfill all the requirements of MEMR and NEPCO and was invited to sign the initial agreement with MEMR during the World Economic Forum Conference held in Jordan in May 2015.
12. Finally, on 20 September of 2015, GWRE got the Cabinet approval of the PPA template for the Wind Projects under the Direct Proposal Submission – Stage I. Signing of the Power Purchase Agreement (PPA) – is expected to take place in October 2015.

2.2 Site Selection Alternatives

MEMR has installed wind measurements stations throughout the Kingdom to undertake wind measurement campaigns. In 2009, MEMR assigned an international consultant to identify priority locations for wind farm developments based on the outcomes of such wind measurement stations. A wind map for Jordan has been created (Figure 2) which presents the priority development areas for wind farms. In general, such assigned areas are located in the south west of Jordan in Tafileh, Ma'an and Aqaba Governorates, in the north east of Jordan in Mafraq Governorate, and in the north of Jordan in Irbid Governorate.

The Project site is located within a priority area for wind farm development projects. However, GWRE has also considered other sites for the development of the Project which are located in such priority areas, but after going through a due diligence exercise, such areas were excluded based on the following rationale:

- Priority areas assigned in the north of Jordan (mainly in Irbid Governorate) were excluded as they were generally located in congested areas;
- Priority areas in Karak Governorate have been excluded for their rugged terrain and their distance from the national high voltage grid;
- Priority areas in Tafileh Governorate have been excluded given that most of the other wind farm developers have selected their projects in this Governorate;
- Priority areas in Aqaba Governorate have been excluded due to seismic hazards; and
- Other priority areas in Ma'an Governorate have been excluded because generally the lands available were public lands, whereas according to the requirements of the Direct Proposal Submission Procedure the lands must be privately owned.

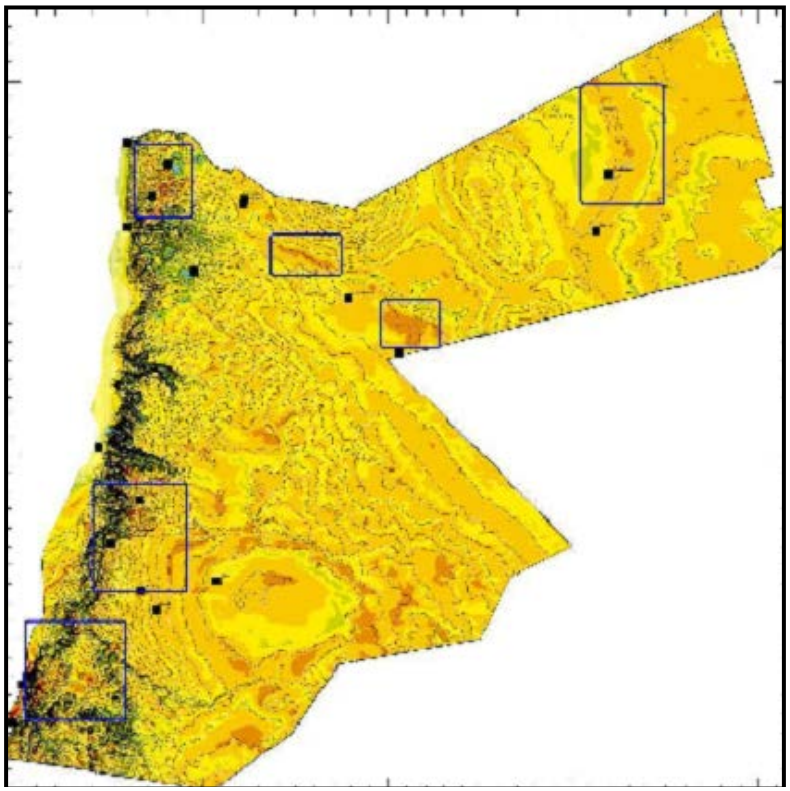


Figure 2: Wind Map of Jordan with Promising Location for Wind Farm Developments

Once the Rajef area was selected at the macro level, GWRE proceeded with a due diligence exercise at the site specific level. This involved consultations with the governmental and non-governmental organizations identified below. The objective was, amongst others, to avoid or reduce any impacts (including environmental and social) from the Project development which would guide the land selection process

within the Al-Rajef area. The outcomes of such consultations did not affect the selection of any specific land areas per se within the Project area but resulted in the identification of additional requirements which needed to be taken into account at a later stage of the Project development (i.e. throughout the ESIA study). *This presents the application of the environmental and social mitigation hierarchy of avoiding and reducing impacts that were considered by the Developer throughout the Project development process.*

- Department of Lands and Survey (DLS): to provide details on the lands in the area such as ownership (private vs. public), land owners, areas, etc.;
- Civil Aviation Regulatory Commission (CARC) and the Royal Jordanian Armed Forces (RJAF): to take into account any specific requirements related to the Project area in terms of aviation safety and security. This issue is discussed in further details in "Chapter 16".
- Telecommunication Regulatory Commission (TRC): to take into account any specific requirements related to the Project area in terms of telecommunication networks. This issue is discussed in further details in "Chapter 16".
- The Royal Society for the Conversation of Nature (RSCN): to take into account any specific requirements related to the Project area in terms of avi-fauna (birds) and biodiversity. This issue is discussed in further details in "Chapter 12".
- Petra Development and Tourism Region Authority (PDTRA): to take into account any specific requirements related to land use planning. This issue is discussed in further details in "Chapter 9".

GWRE then proceeded through undertaking several visits to meet with the community leaders in the area. Through the support and facilitation of the community leaders, GWRE undertook extensive consultations and discussions with the local community of the area (mainly Al-Rajef, Dlaghah & Rassees, and Taybeh) to introduce the Project. Generally, the local community showed support for the Project development from the onset and assisted GWRE in identifying lands in the area available for leasing for the proposed development. Ultimately, 49 parcels of lands were selected to be leased and the Developer signed 49 land lease agreement for the selected lands with the owners for 29 years (since the year 2011), and registered these leases with Department of Lands and Survey Office in Ma'an Governorate.

These 49 parcels are spread over an area of 26km^2 which represents the Project boundary. GWRE first opted for attached lands that were not spread over a big area; however this was not possible due to several factors that needed to be taken into account throughout the selection process of the lands. Such factors include, but not limited, to the following:

- Land parcels that are suitable technically for the development of the Project in terms of landscape, topography, wind capacity, etc.;
- Land parcels with available contact details for the owner to negotiate a land lease agreement;
- Land parcels with available information on ownership within the records of the DLS (some land parcels have unidentified and unknown ownership status);
- Land parcels where the owner is willing to lease for the proposed development;
- Land parcels with uncomplicated ownership status – some land parcels have many land owners making negotiating a lease agreement very difficult and complicated;
- Land parcels with uncomplicated inheritance status; and
- Land parcels that are empty with no facilities in place (some land parcels have existing facilities in place such as an olive mill).

2.3 Design Alternatives

As discussed earlier, in 2012 from the onset of the Project development, GWRE approached different turbine providers/EPC contractors for the Project's development. At that time, they provided preliminary designs for the layout of the turbines and technologies selected in accordance with the Project's specifications (available area, Project size, etc.). The technologies selected are summarized in the table below.

Table 2: Wind Turbine Alternatives Considered for the Project Development

Company	Technology	Project Size (MW)	Number of Turbines	Turbine Size (MW)	Hug Height (m)	Rotor Diameter (m)	Tip Height (m)
Vestas	V-100 1.8MW	81.0	45	1.8	95	100	145
	V-112 3.0MW	81.0	27	3.0	112	112	168
Alstom	ECO 122 T89	84.8	32	2.7	89	122	150
Gold Wind	GW109/2500	82.5	33	2.5	80	109	135
Gamesa	G97-2.0MW	84.0	42	2.0	78	97	127
	G90-2.0MW	84.0	42	2.0	78	90	123
Siemens	SWT-2.3-113	80.5	35	2.3	113	113	170

GWRE then requested that the above companies submit technical and financial proposals for development of the Project on a turnkey basis (EPC and O&M). The ESIA consultant (i.e. ECO Consult) was involved in this process by providing an "Environmental and Social Performance Requirements" which aimed to provide environmental and social performance requirements that must be taken into account by the bidders when preparing their proposals in terms of costs, design, timings, materials, equipment and facilities, construction methods, etc. Those who did not comply and meet with the bidding requirements were either excluded or given reduced evaluation scores.

In specific, the main requirements of the Performance requirements are discussed below. *The requirements discussed below present the application of the environmental and social mitigation hierarchy of avoiding and reducing impacts that were considered by the Developer throughout the Project development process.*

1. Avi-Fauna (Birds): at that time of the preparation of the Performance Requirements, two (2) avi-fauna migration monitoring surveys were undertaken (spring and autumn 2012). One of the main outputs of the surveys was the development of a sensitivity map which divided the Project site into three (3) categories – high, medium, low. The map was prepared taking into account the following criteria: (i) migration patterns over the site, (ii) number of birds flying within risk height, and (iii) conservation status of species. The Performance Requirements required that the detailed design avoid sitting any of the turbines within areas identified as high risk to the greatest extent possible. It is important to note that methodology for avi-fauna assessment has been an ongoing learning process since 2012 that has developed and evolved throughout the years – this issue is discussed in further details in "Chapter 12".
2. Archeology and Cultural Heritage: at that time an archeology survey was undertaken by the Department of Antiquities (DoA) for the entire Project site boundary (this includes the leased lands for the Project and the land areas between them for a total area of 26km^2). The survey identified several areas considered of archeological importance. The Performance Requirements required that the bidder's design avoid sitting any of the Project components (turbines, roads, building facilities, etc.) within such delineated areas.

3. Infrastructure and Utilities/Aviation Safety: the Performance Requirements required that the bidders take into account CARC requirements for navigational lighting obstacles. This issue is discussed in further details in "Chapter 16".
4. General requirements for management of waste streams, air quality and noise, biodiversity, occupational health and safety, etc.

At a later stage, the final EPC/O&M Contractor was selected by GWRE and which was Gamesa. Gamesa then provided two (2) detailed designs for the Project which entailed the same turbine specifications but slightly different layouts – layout A and layout B. The layouts are presented in Figure 3 below.

The ESIA consultant along with the technical consultant to the Developer was involved at this stage through undertaking a noise and shadow flicker modeling assessment for both layouts. The objective was to determine the better alternative which inflicted less noise and shadow flicker impacts to the local communities (Al-Rajef in particular given that it is the closest to the Project), while ensuring compliance with the applicable Statutory Requirements. The ESIA consultant recommended that Alternative B be considered due to the lower noise and shadow flicker impacts compared to Alternative A, given that it had a smaller number of turbines at the northwestern boundaries closer to the local community of Al-Rajef (other communities were generally unaffected by noise and shadow flicker in both layouts). Based on the above, and other technical factors, the final selected layout was alternative B.

Additional details on the outcomes of the noise and shadow flicker assessment for this final layout and the required additional mitigation measures which must be implemented are discussed in details in "Section 18.2". *The requirements discussed below present the application of the environmental and social mitigation hierarchy of avoiding and reducing impacts that were considered by the Developer throughout the Project development process.*

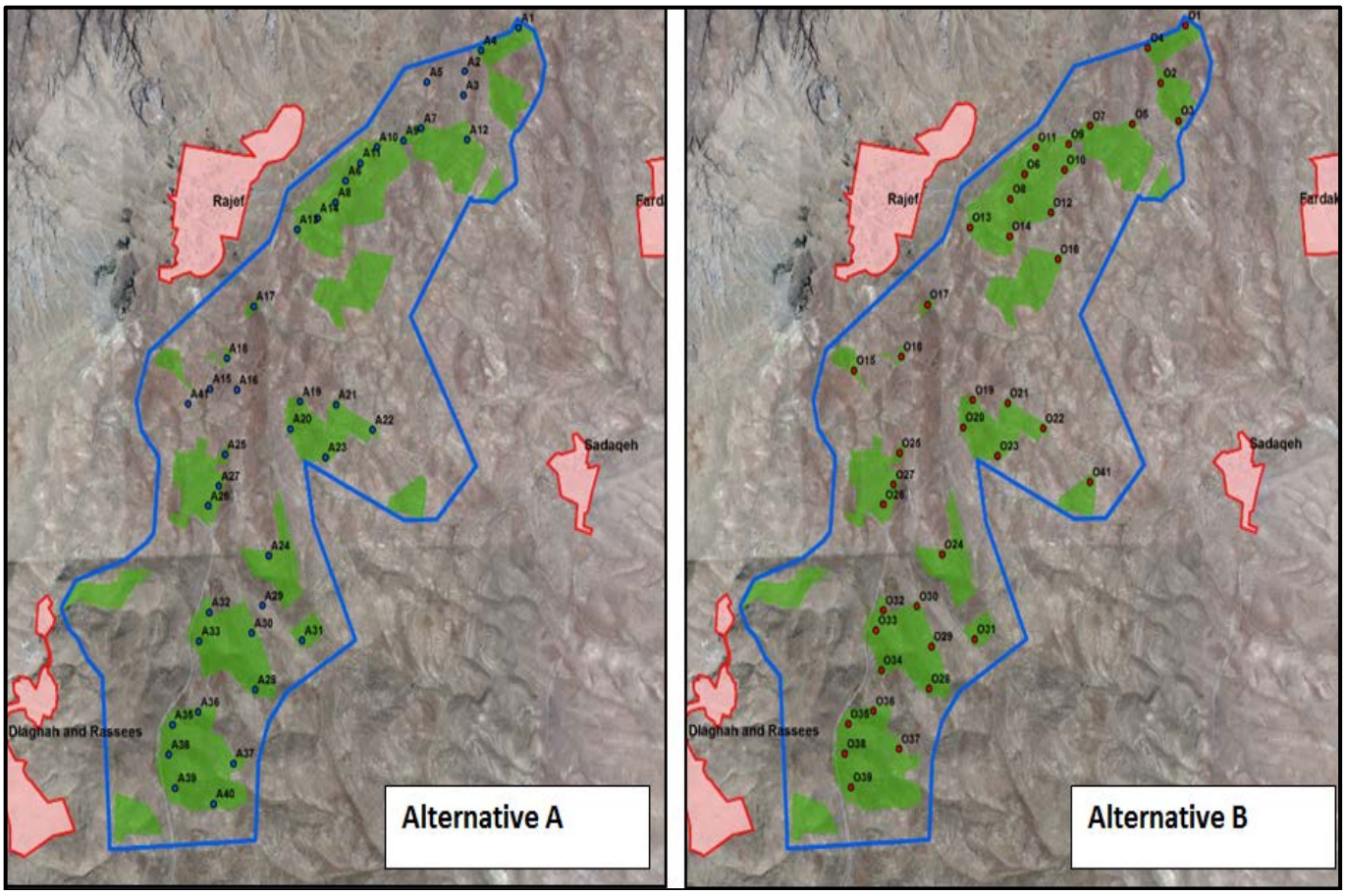


Figure 3: Alternative A and Alternative B for Turbine Layouts

2.4 Technology Alternatives

This section discusses several alternatives besides the development of a wind farm project. This mainly includes other renewable energy alternatives suitable for Jordan in general (mainly solar power projects), as well as other technological alternatives for power generation such conventional thermal power plants.

2.4.1 Solar Power Projects

Similar to the wind map which was prepared for Jordan, MEMR has also prepared a solar map which also presents the priority development areas for solar projects. Figure 4 below presents the location of the Project site in relation to those areas.

As noted in the figure, in general Jordan has abundant solar energy which is evident from the total annual solar irradiance – considered to be one of the highest in the world. Within Jordan, the southern region has the highest solar isolation in the country and the lowest diffuse irradiance, making it an ideal location for the development of solar projects. This is followed by other areas in the middle, northern and eastern parts which are also considered to have huge potential for development of solar projects.

On the other hand, the white regions in the map are considered to be the lowest; although they still have potential for development of solar projects, but the natural characteristics of those areas are likely to be considered unsuitable for the development of solar projects on a commercial scale as feasible as those in other areas denoted above. The Project site is located in the white areas as presented in the figure below.

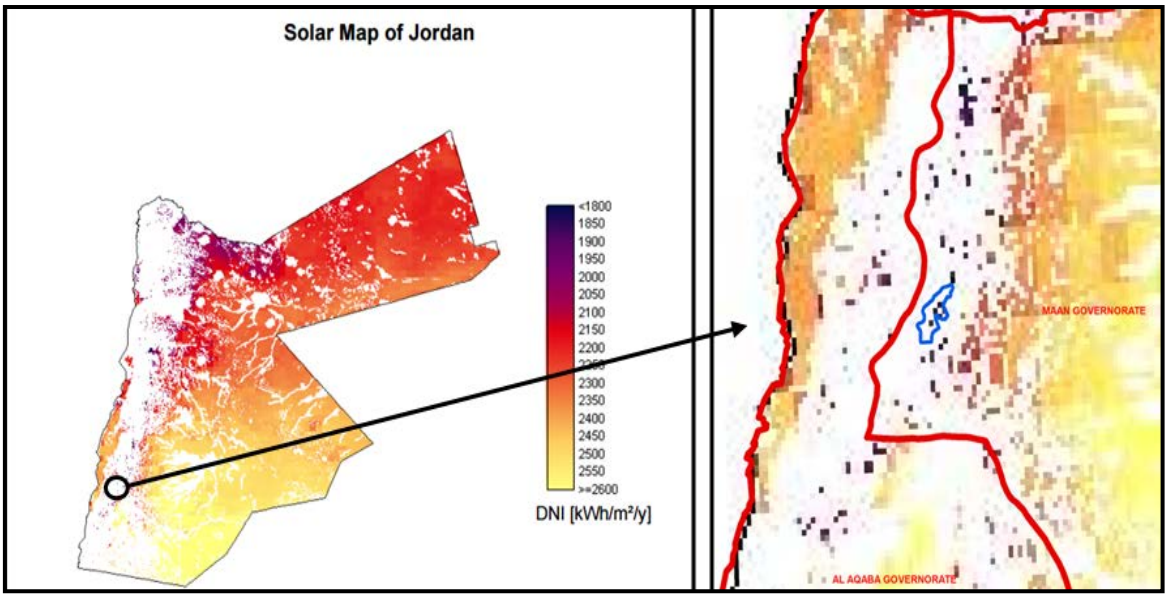


Figure 4: Solar Map of Jordan with Location of Project site

In addition, another important point to mention is that the Government of Jordan's "Updated Master Strategy of the Energy Sector in Jordan for the period (2007-2020)", advocates for the diversification of energy resources and increasing the share of renewable energy to 7% in 2015 and 10% in 2020. The Strategy advocates for the development of both solar and wind energy, and not just solar. Therefore, the development of such a Project is in line with the Government of Jordan's "Updated Master Strategy of the Energy Sector in Jordan for the period (2007-2020)".

2.4.2 Thermal Power Plants

Other energy generation alternatives suitable to be built in Jordan include conventional thermal power plants which are fueled with natural gas and/or heavy fuel oil, similar to others already existent in the country.

Despite the advantages that a solution of this kind would entail - such as a potential bigger energy generation capacity or the creation of more jobs during both construction and operation - the disadvantages would be significant; especially those related to environmental impacts. Conventional thermal power plans are well known for their environmental impacts when compared to this Project and could include significantly higher water consumption, generation of air pollutants and greenhouse gas emissions, etc. More importantly, as noted earlier such developments would not be in line with the Government of Jordan's "Updated Master Strategy of the Energy Sector in Jordan for the period (2007-2020)", which in broad terms advocates for the diversification of energy resources and increasing the share of renewable energy to 7% in 2015 and 10% in 2020.

2.5 No Project Alternative

The 'no project' alternative assumes that the 82MW Project will not be developed. Should this be the case, then the Project site area would remain the same. The land area would remain with its current characteristics – an area that is barren and heavily degraded with few vegetation strips and scattered trees of remnant forests that use to prevail in the entire mountain of Al-Rajef area.

Should the Project not move forward, then the Project-related negative environmental impacts discussed throughout this ESIA would be averted. However, as noted throughout the ESIA, generally such impacts do not pose any key issues of concern and can be adequately controlled and mitigated through the implementation of the Environmental and Social Management Plan (ESMP) discussed in "Chapter 22". Nevertheless, should the Project not move forward, then the significant and crucial positive economic and environmental benefits would not be realized. Such benefits include the following:

- Contribute to increasing energy security through development of local energy resources and reducing dependency on external energy sources;
- Producing clean energy contributes to lowering electricity generation costs compared to the current costs associated with liquid fuels and thus leads to a decrease in the Government of Jordan's fiscal deficit;
- This development allows for more sustainable development and shows the commitment of the Government of Jordan to realizing the energy strategy;
- The clean energy produced from renewable energy resources is expected to reduce consumption of alternative liquid fuels for electricity generation in Jordan, and will thus help in reducing greenhouse gas emissions, as well as air pollutant emissions; and
- Project is expected during the construction and operation phase to generate local employment and commit to other social responsibilities. As such, this is expected, to a certain extent, to subsequently enhance the socio-economic conditions and standards of living of the local communities.

In conclusion, an ESIA must investigate all potential positive and negative impacts from a project development. In the case of this Project, it is important to weigh the significant positive economic and environmental impacts incurred from the Project development, against the negative environment impacts anticipated at the site specific level – in which generally this ESIA concludes to be minor in nature and can be adequately controlled. The comparison in this chapter clearly concludes that the 'no project' alternative is not a preferable option.

3. PROJECT DESCRIPTION

This Chapter provides a detailed description of the Project in relation to its location, the key project components and an overview of the proposed activities that are to take place during the planning and construction, operation, and decommissioning phase.

3.1 Administrative Setup of Project Location

It is important to highlight the administrative setup as framed by district and municipal boundaries within Ma'an Governorate as those will be referred to many times throughout this document.

The Project site is located within Ma'an Governorate which consists of 4 main Districts (as highlighted in Table 3 below) and 4 main Sub-districts that belong to the District of Qasabit Ma'an. Of those, the Project is located within two areas to include the District of Petra and Eel Sub-district (which belongs to the District of Qasabit Ma'an). From a municipality perspective, most of the Project site is not located within any municipal administrative boundary; however a small part at the western border of the Project site is located within the Petra Development and Tourism Region Authority (PDTRA) administrative boundary.

Table 3: Administrative Setup of Ma'an Governorate

Governorate	District/Sub-District	Municipalities
Ma'an	District of Qasabit Ma'an *Eel Sub-district* *Al-Jafr Sub-district* *Mregha Sub-district* *Athroh Sub-district* District of Petra District of Al-Shobak District of Al-Husseiniyeh	Ma'an Municipality Al-Husseiniyeh Municipality Al-Sherah Al Jadeda Municipality Al-Jafr Municipality Al-Shobak Al Jadeda Municipality Eel Al Jadeda Municipality Al-Asha'ri Municipality Petra Development and Tourism Region Authority (PDTRA)

3.2 Project Location

The Project is located within the western borders of Ma'an Governorate in the South of Jordan, approximately 200km south of the capital city of Amman. The closest villages to the Project site include: (i) Al-Rajef and Dlaghah & Rassees both of which are located on the western border of the Project site, (ii) Taybeh which is located around 3km to north of the Project site, and (iii) Fardakh and Sadaqah located to the eastern borders of the Project site at a distance of around 2.5 and 1.5 km respectively. Refer to Figure 5 below.

The Project area consists mainly of hilly areas on the plateau of the Sharah highlands at altitudes ranging from 1550-1700m above sea level. The Project site is characterized as being barren and heavily degraded with few vegetation strips and scattered trees of remnant forests that use to prevail in the entire mountain of Al-Rajef area.

The Project site is mainly accessed through Highway #35 (better known as the 'King's Highway'); one of the highways which connects Ma'an Governorate with the capital city of Amman in the North – but is not the major one. Highway #35 runs through some parts of the Project site. In addition, within the site there are other access roads and several additional small agricultural roads.

The Project area is approximately 7.6km^2 which will be used for the development of the 82MW Wind Farm Project. The 7.6 km^2 consists of 49 parcels of land owned by different land owners, where such lands have been leased by GWRE for the development of the Project. Such leased lands are spread over an area of 26km^2 which represents the Project boundary as presented in the figure below.

In general, the Project area is considered vacant, except for the following:

- Three (3) telecommunication transmission towers located the central parts of the Project site; those towers belong to the thee (3) main telecommunication companies of Jordan – Orange, Zain and Umniah; and
- Within the area (but not within the leased lands) is: (i) an operating olive mill which is owned by a local community member of Al-Rajef village, (ii) a police station on Highway #35 and (iii) a small car repair workshop on Highway #35 that is owned by a local community member of Al-Rajef with a house next to it – the owner resides mainly in the village, and occasionally in this house.

The figure below presents the Project site boundary (represented in blue) and the land parcels which have been leased for the development of the Project (represented in green), the nearby surrounding villages, as well as the telecommunication transmission towers, olive mill, police station, and the car repair workshop.

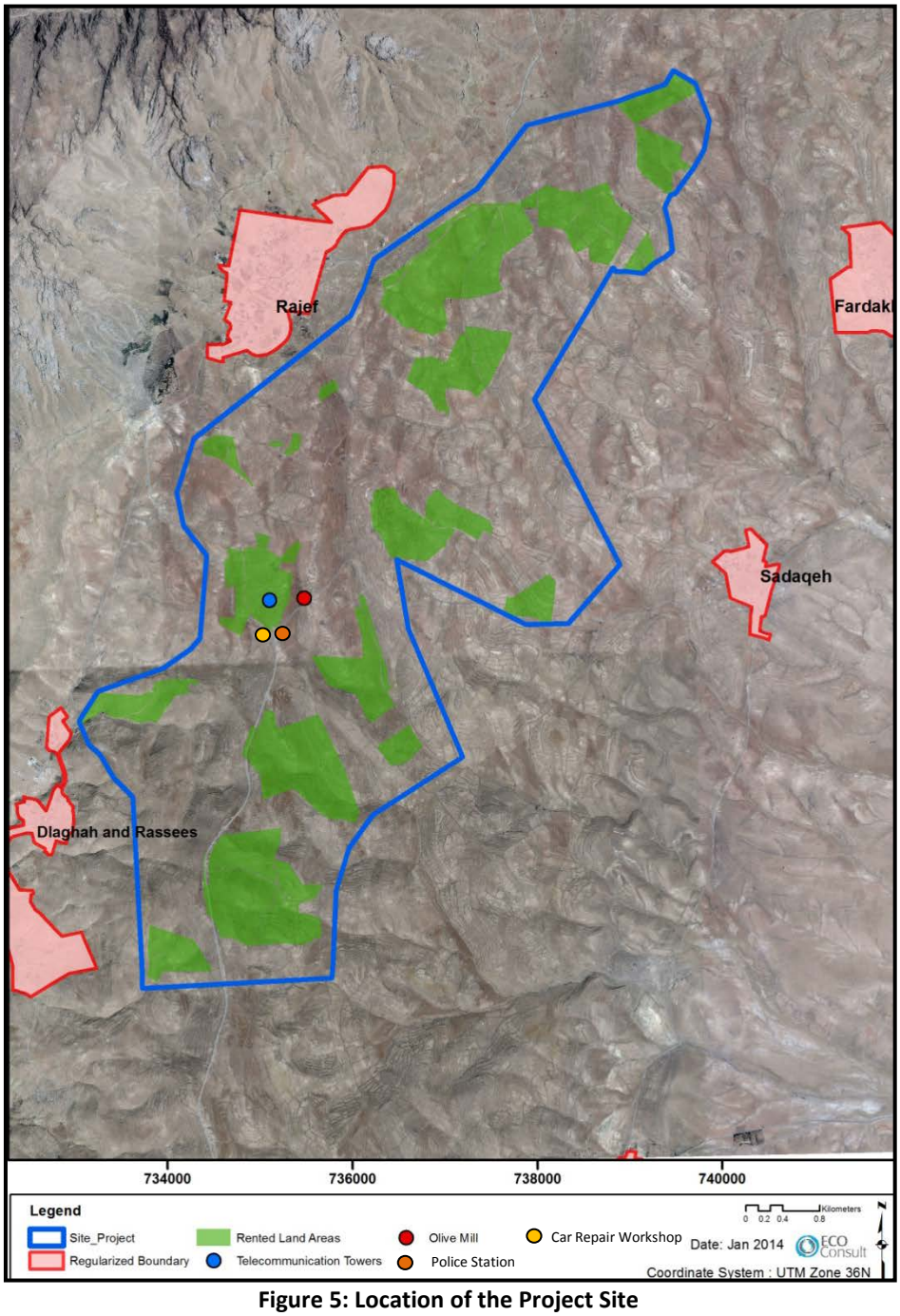


Figure 5: Location of the Project Site

Figure 6: Upper Left – Transmission Towers; Upper Right – Olive Mill; Lower Left – Police Station; Lower Right– Car Repair Workshop

3.3 Outline of Wind Turbine Technology

Wind turbine technology relies on harvesting the kinetic energy in wind (i.e. movement of wind) and turning it into mechanical energy which in turn is used for electricity generation. To capture wind, turbines consist of rotor blades which are elevated from the ground using towers to take advantage of faster and less turbulent wind. As wind speed increases, the rotor blade begins to rotate which then spins a shaft that is connected to a generator thereby converting wind energy to electricity.

Wind turbines produce Direct Current (DC) electricity from wind, which can be used for grid connected power generation. However, electricity at the grid is usually in a different form (known as Alternating Current (AC)) and thus inverters are used to convert DC current to AC current. In addition, wind turbines produce electricity at a certain voltage which must be matched to the grid it connects to. Therefore, transformers are used to convert the output to a higher voltage that matches the grid.

3.4 Project Components

Table 4 below provides a summary of the key Project components for the Project, along with a detailed description of each of those components to follow.

Table 4: Summary of Key Project Components

Component	Description
Project Generation Capacity (MW)	82
Technology Type	Wind Power
Number of Wind Turbines	41
Rated Power per Turbine (MW)	2.0

Rotor Diameter (m)	114m
Hub Height (m)	80m
Tip height (m)	137m
Project area to be covered	7.6 km^2
Infrastructure and Utilities	This includes: (i) internal road network; (ii) underground cables; (iii) warehouse and offices; (iii) substation; and (iv) associated facilities such as the high voltage overhead transmission line.

3.4.1 Wind Turbines

Generally, a wind turbine consists of a foundation, tower, nacelle, rotor blades, a rotor hub, and a transformer (Figure 9 (a) below). The foundation is used to bolt the tower in place. The tower contains the electrical conduits, supports the nacelle, and provides access to the nacelle for maintenance. Typically, three (3) blades are connected to the hub which then connects with the nacelle; the box-like component that sits atop the tower and which most importantly contains the gear box (which steps up the revolutions per minute to a speed suitable for the electrical generator) and the generator (which converts the kinetic energy into electricity).

The Developer went through an intensive process from the onset of the Project development for the selection of the EPC Contractor whom will be supplying the wind turbines and preparing the detailed design of the Project. Such a process took into account technical criteria as well as environmental considerations; this was discussed earlier in details in22 – Project Project History And Alternatives".

The final selected EPC Contractor for the Project was Gamesa whom will be supplying the Gamesa G114 2.0MW wind turbine. This turbine model has a hub height of 80m, rotor diameter of 114m and thus a tip height of 137m.

The EPC Contractor also prepared the detailed design for the Project which presents the layout of the wind turbines within the Project site. The detailed design has also been subject to an intensive process from the onset of the Project development which took into account technical criteria (wind resources in the specific Project site, spacing between the turbines to minimize wake effects which could lead to a decreased wind energy production, accessibility to the turbines, etc.) as well as environmental considerations; those have also been discussed earlier in details in22 – Project History And Alternatives".

According to the detailed design there will be 41 turbines spread out throughout the Project site as presented in Figure 7 below. Foundations will be constructed to bolt the tower of the turbine in place. The EPC Contractor will be constructing 41 foundations (one for each turbine), where each foundation will consist of a circular footing of 20.5m diameter and a depth of 2.9m. The foundation will be built with concrete reinforced with structural corrugated steel. In addition, each turbine is equipped with a transformer that converts/steps up the output from the turbine to a higher voltage (from 11kV to 33kV) to meet a specific utility voltage distribution level that is appropriate for connection with a substation (explained in details below). Each turbine will also be equipped with an inverter that will convert electricity from the turbine from DC current to AC current.

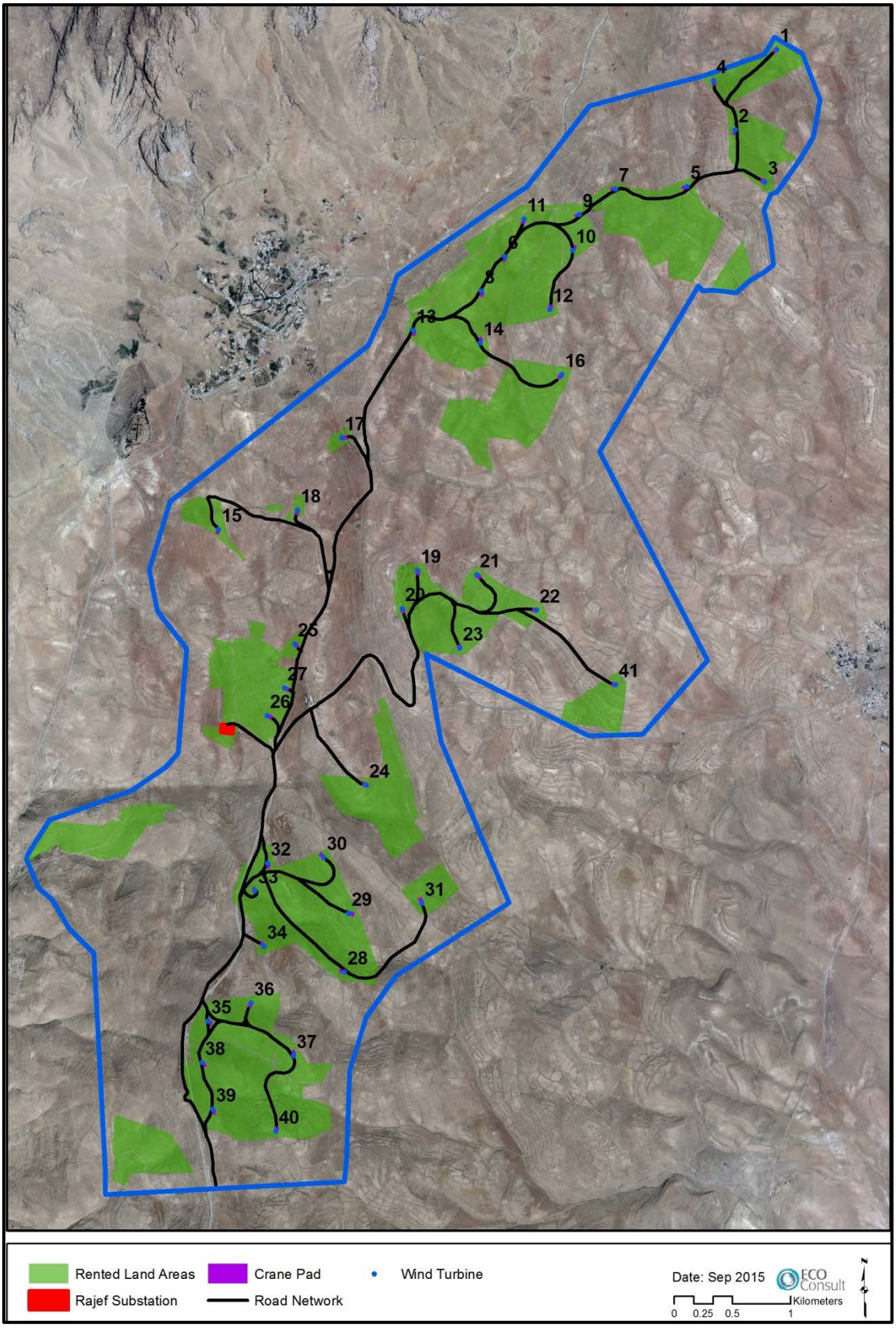


Figure 7: Final Detailed Layout of Turbines within the Project Site

3.4.2 *Infrastructure and Utilities*

The following highlights the infrastructure and utilities requirements of the Project.

- **Medium Voltage Cables:** The wind turbines will be connected through medium voltage cables (33kV) to Al-Rajef substation. The connection between the turbines and the substation will be made using underground transmission cables buried in ground by trenches. Such trenches will have a width of 6m and a depth of 1m. The total trenches required for the Project for the medium voltage cables is around 52km.
- **Communications Network:** the Project will have a Supervisory Control and Data Acquisition (SCADA) system for the remote operation of the facilities. A communication network will be installed which will consist of fiber optic cables connecting the turbines together to the SCADA system at Al-Rajef substation. The communication system will be installed in the same trenches as the MV cables discussed above.
- **Al-Rajef Substation:** The substation is a high voltage transformer substation that collects and converts the output from the turbines to a higher voltage (from 33 kV to 132 kV) that is appropriate for connection with the High Voltage National Grid (132 kV). The land for the Al-Rajef Substation has been secured within the Project area. A typical 33/132 kV substation is presented in Figure 10 below.
- Other infrastructure and utilities in the Project site will include the following:
  - **Building Infrastructure:** onsite building infrastructure will be required for the daily operation of the Project. Such buildings could include an administrative building (offices) used for normal daily operational related work, control room and a warehouse for storage of equipment and machinery such as spare parts, oil cartridges, fuel, lubricants, etc.;
  - **A crane pad** next to each wind turbine to accommodate cranes for the installation of the wind turbines and for maintenance activities during operation. The crane pads will be suitable to support loads required for the erection, assembly an operation and maintenance of the turbines. Each crane pad will be around 1,500m^2 in area (38m in width and 40m in length).
  - **Road network:** a road network will be required for installation of the turbines during the construction process and for ease of access to the turbines for maintenance purposes during operation. The internal roads are designed to follow the existing agricultural roads within the Project area to the greatest extent possible. The road network will have a width of 6m and a total length of 28.5km.
- **Associated Interconnection Facilities – the Overhead High Voltage Transmission Line**: Al-Rajef substation above will be connected to another receiving NEPCO substation which is a simple facility with safety breakers and control panels – mainly used to control the connection/disconnection of the Project to the grid. Based on preliminary information from NEPCO, Al-Rajef substation will connect with the NEPCO substation (which is located right next to Al-Rajef substation in which the land area has been secured), from which an overhead high voltage transmission line (132kV) will run and connect with the national grid at Mregha area (Figure 8 below). It is likely that the transmission line will run a distance of 11km. The receiving NEPCO substation and the overhead high voltage transmission line will be constructed and operated by NEPCO. It is important to note that detailed information is not available at this stage by NEPCO with regards to the layout of NEPCO substation, grid connections plans and route for the overhead line, etc. *Therefore, the ESIA has not considered within its study boundary the NEPCO substation and the overhead high voltage transmission line.*

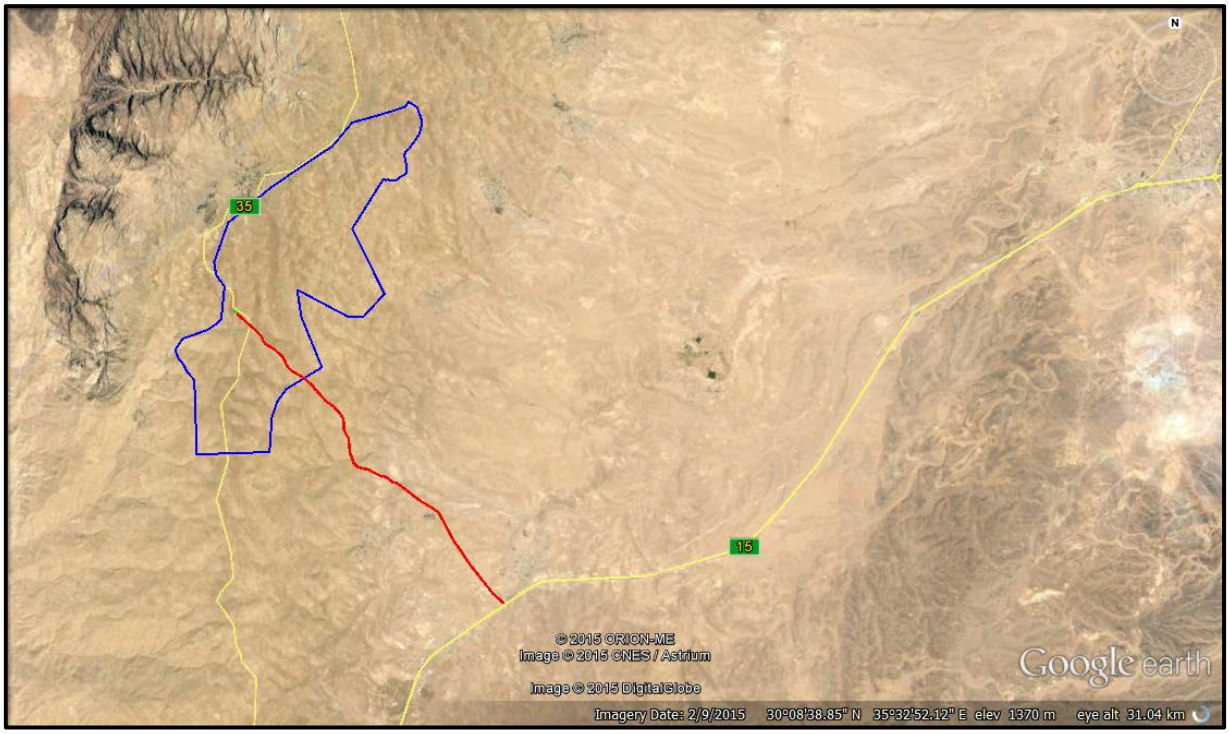


Figure 8: Preliminary Route for Overhead Line

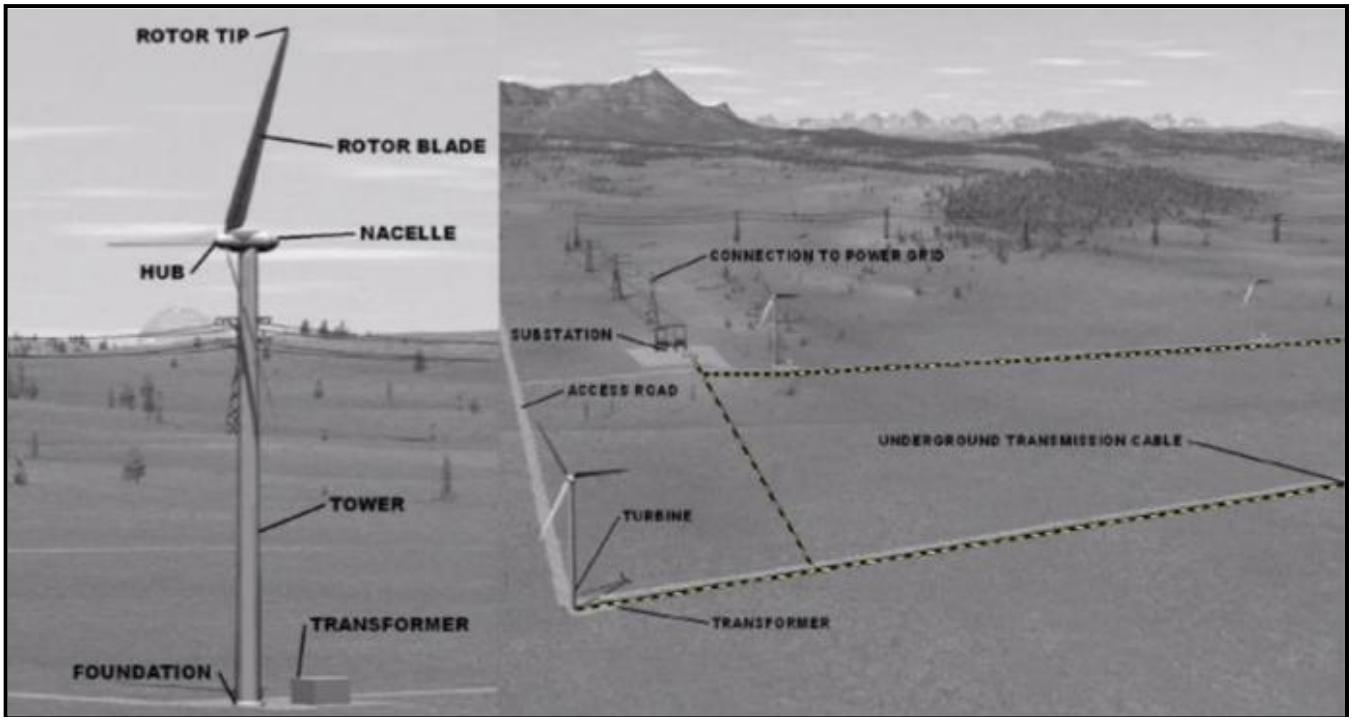


Figure 9: (a) Typical Structural Components of a Wind Turbine, (b) Typical Components of a Wind Farm (Source: EHS Guidelines for Wind Energy, IFC)

Figure 10: Typical 33/132kV Substation

3.5 Footprint of the Project Components

This section provides an estimate on the footprint of the Project taking into account the components discussed in the previous section. The number and figures have been based on the design details provided by the EPC Contractor.

As noted in the table below, the total are of disturbance for the Project is significantly small and is around 7% of the leased lands area (which is 7.6km^2) and around 2% of the total boundary of the Project area (which is around 26km^2).

Table 5: Footprint of the Project Components

Component	Footprint	Description
Turbines	0.07km^2	This includes the footprint for the foundation and the crane pad area for each of the 41 turbines. Each crane pad will be around 1,500m^2 in area (38m in width and 40m in length), whereas each foundation will consist of a circular footing of 20.5m diameter.
Al-Rajef Substation and Warehouse and Storage facilities	0.02 km^2	Includes footprint of the Rajef substation area and all building facilities.
Trenches for MV cables and communication cables	0.3 km^2	This includes trenches with a total length of 52km and a width of 6m.
Road networks	0.17 km^2	This includes the road network with a total length of 28.5km and a width of 6m. This does not take into account that the internal road network has been designed to reuse the existing agricultural roads to the greatest extent possible.
Total Project Footprint	**0.6km^2**	
Area of Leased Lands	**7.6km^2**	Project footprint is around 7% of the leased lands area.
Total Project site Boundary	**26km^2**	Project footprint is around 2% of the total boundary of the

Area		Project area.

3.6 Land Take Requirements and Land Use Context

The land selection process for the Project took place from the onset of the Project development. This has been previously discussed in" Chapter 22 –Project History And Alternatives" and is summarized again below.

The Rajef area was selected after the Developer undertook a due diligence exercise which took into account various other priority areas for wind farm development project in Jordan. Once the Rajef area was selected, the Developer proceeded with a due diligence exercise at the site specific level which involved consultations with various governmental and non-governmental organizations. The objective was to identify any high level potential impacts (including environmental and social) which could be avoided or reduced from an early stage through the land selection process within the Al-Rajef area. After that, the Developer met with community leaders in the area and undertook extensive consultations and discussions with the local community of the area (mainly Al-Rajef, Dlaghah & Rassees, and Taybeh). The local community assisted the Developer in identifying lands in the area available for leasing for the proposed development, and based on that (as well as other technical factors), 49 parcels of lands were selected to be leased and the Developer signed 49 land lease agreement with the owners for 29 years (since the year 2011). Refer to "Chapter 2–Project History And Alternatives" for additional detail on the site selection process.

In addition, as part of the ESIA study (as discussed later in "Section 9.1"), the 'ESIA Team' investigated the formal and informal land use of the Project site. It was concluded that there is no conflict with the formal land use planning for the areas set by the various relevant governmental institutions.

The 'ESIA Team' also investigated the informal land use and whether the Project site is of any specific value to the local community (such as agricultural activities, grazing, etc.) as well as nomadic tribes which could inhabit the area. Based on consultations undertaken onsite with the local community as well as the nomads (refer to "Section 9.1" for additional details) the following was concluded:

- The area in general is used by the local community (mainly those of Al-Rajef and Dlaghah & Rassees) during specific times of the year for grazing and agricultural activities. Such activities are either undertaken by the land owner (each in his own land) or other local community members who work for the land owner or other local community members who work in agreement with the land owner; and
- There are nomads which inhabit the area during specific times of the year during which they undertake grazing and agricultural activities.

More importantly, based on such consultations it was evident that the local community and the nomads were generally informed about the Project, and were very supportive. In addition, as the assessment concludes (refer to "Section 9.1") there are no issues of concern in relation to the actual land use of the site.

3.7 Overview of Project Phases

This section presents the likely activities to take place during the Project development and which will include three distinct phases: (i) planning and construction, (ii) operation and (iii) decommissioning each of which is summarized below.

3.7.1 Planning and Construction Phase

The typical activities that will take place during the planning and construction phase for wind farms include the following:

- Preparation of the detailed design and layout of wind turbines within the Project site in addition to the various other infrastructure/utility elements (buildings, roads, Al-Rajef substation, etc.);
- Transportation of wind turbine components to the Project site. The components are expected to be transported to the Port of Aqaba and then transported by road to the Project site;
- Site preparation of the turbine foundation. Such activities are limited to relatively small individual footprints of the foundations and will include excavations and land clearing activities for bolting of the tower to the foundation;
- Installation of turbine components to include tower assembly, hub, rotor, and nacelle lift and rotor assembly which most likely will occur through onsite mobile cranes;
- In addition to the erection of each turbine, there is additional construction work (which could include excavations, land clearing activities, electrical work, etc.) that must be conducted to connect each turbine to the power grid, this could include the installation and laying of transmission and communication cables, and the installation of Al-Rajef substation; and
- Other construction works (which could include excavations, land clearing activities, etc.) for the potential access road construction or upgrade and for the building infrastructure (warehouse and offices).

There is additional construction works to be undertaken for the associated facilities by NEPCO discussed earlier, and which include the NEPCO substation and the overhead high voltage transmission line. Details and information are not available or finalized at this stage by NEPCO with regards to the layout of substation, grid connections plans and route for the overhead lines, etc. *Therefore, the ESIA has not considered within its study boundary the NEPCO substation and the overhead high voltage transmission line.*

3.7.2 Operation Phase

Wind turbines generally require limited operational activities as this mainly includes the following:

- Commissioning tests of the wind farm which usually involves standard electrical tests for the electrical infrastructure as well as the turbine, and inspection of routine civil engineering quality records. Careful testing at this stage is vital if a good quality wind farm is to be delivered and maintained. Commissioning of an individual turbine can take little more than two days with experienced staff;
- Normal daily operation of the wind farm. The long-term availability of a commercial wind turbine is usually in excess of 97 percent (i.e. 97% of the time, the turbine will be available to work); and
- Maintenance will also take place through a dedicated team. Typical routine maintenance time for a modern wind turbine is 40 hours per year. Non-routine maintenance may be of a similar order. Although minimal, maintenance activities may include turbine and rotor maintenance, lubrication of parts, washing of blades, maintenance of electrical components, full generator overhaul, etc.

3.7.3 Decommissioning Phase

According to the PPA agreement to be signed between the Developer and NEPCO for 20 years, NEPCO has the option to acquire the Project at the end of the PPA term and continue operating it at a mutually agreed price with the Developer. If NEPCO and the Developer cannot agree on such a price, then the Project will

be completely decommissioned. Therefore, there are two (2) scenarios for the decommissioning phase of the Project as follows:

- NEPCO acquisition: the most dominant scenario is that once selected, a well-sited wind farm remains in operation, as well as the tracks, gates, distribution network tie-ins and local maintenance resources; it's cheaper to repower a site than to establish a new site. This means that an out-of-date wind turbine is replaced with a working turbine of equivalent or even better faceplate generation capacity. As such, wind farms will generally see replacement of old turbines and emplacement of new wind turbines in adjacent areas; or
- Decommissioning: in the case of complete decommissioning of a wind turbine, which is a low-likelihood scenario, the tower and blades of the removed wind turbine will be taken down by crane, disassembled into components, and then the turbine will be refurbished at source and used elsewhere for another Project. The base will typically be left in place and covered by gravel and peat or loam. Tracks used for maintenance vehicles will be restored and can be kept as agricultural routes (given that the road network will be mostly built on the existing agricultural routes). Gates and fences will be removed.

3.7.4 Project Schedule

According to the current timeline information available by the Developer, once the PPA is signed in October, construction of the Project is anticipated to commence around August 2016, and will require approximately 22 months for construction and commissioning (i.e. till June 2018). Operation of the Project is therefore anticipated to commence in June 2018 for a period of 20 years as agreed with NEPCO and based on the PPA signed.

3.8 Workforce and Training

According to information provided by the Developer, the Project will require the following workforce throughout the construction and operation phase:

- Around 200 job opportunities during the construction phase for a duration of approximately 23 months. This will mainly include around 40 skilled job opportunities (to include engineers, technicians, consultants, surveyors, etc.) and 160 unskilled job opportunities (mainly laborers but will also include a number of security personnel). It is important to note that the EPC Contractor is aiming to bring in local contractors from Ma'an Governorate and therefore does not plan to include any construction camps onsite; and
- Around 30 job opportunities during the operation phase for a duration of 20 years. This will include around 15 skilled job opportunities (such as engineers, technicians, administrative employees, etc.) and 15 unskilled job opportunities (such as security personnel, drivers, etc.).

Taking the above into account, the Developer is aiming to hire local community members to the greatest extent possible throughout the construction and operation phase for skilled and unskilled jobs. Based on preliminary information provided by the Developer, this will include around 15 job opportunities during the construction phase (for security and administrative assistance) in addition to unskilled construction workers (however the exact numbers have not been determined at this stage).

During the operation phase, this will include around 15 job opportunities for the local communities (to include security, drivers, and administrative assistance), and the Developer will be providing a capacity building and training programs for around 10 selected local community members to ensure they are equipped with the skills and qualifications required for the O&M of the Project. It is important to note that

the information discussed above is based on preliminary information – the final numbers and details on such job opportunities and their nature will be finalized at a later stage.

The Developer is committed to adhering to transparent recruitment procedures which includes all local community members (to include Al-Rajef, Dlaghah & Rassees, Taybeh, Fardakh, and Sadaqah). In addition, The Developer is also committed to other social responsibility programs and plans to the local community. Those are discussed in further details in "Chapter 19 – Socio-economic Conditions".

3.9 Resource Use Efficiency

The objective of this section is to demonstrate how the Project development has endeavored to optimize the use of all natural resources (fossil fuels, water, etc.) involved in the Project processes.

1. One of the key positive impacts of the Project, as far as resource efficiency, is that it will be utilizing wind energy to produce electricity. The Project is expected to be of an installed capacity of 82MW and will contribute to supplying electricity to the national grid for the use of bulk suppliers and help meet the increasing electricity demands throughout the Kingdom – as opposed to meeting such increasing demands through electricity production from conventional thermal power plants using fossil fuels. The Project is expected to provide 256 Gigawatt Hour (GWh) of electricity per year, which is enough to power over 60,000 average local households in Jordan. This has been based on taking into account that in 2014 (latest statistic) the annual electricity consumption of households in Jordan was 6,580 GWh (MEMR, 2015) while the number of households in 2014 in Jordan was 1,590,762 (DoS, 2015) and thus the average annual electricity consumption can be assumed to be around 4,100 Kilowatt Hour (kWh).

   To this extent, the generation of electricity through a renewable source will offset greenhouse gas emissions as opposed to generating electricity from conventional thermal power plants – which is currently utilized for producing electricity in Jordan through the burning of natural gas and/or heavy fuel oil. According to the International Energy Association's (IEA) "Carbon Dioxide (CO_2) Emissions from Fuel Combustion" (IEA, 2013) the CO_2 emitted per kWh for electricity generation in Jordan in 2011 was estimated at around 0.64kg. The Project is expected to provide around 256 GWh of electricity per year; this will offset more than 160,000 ton of CO_2 per year, apart from the reduction of air pollutants emitted from conventional thermal power plants – such as ozone, sulfur dioxide (SO_2), Nitrogen Dioxide (NO_2), particulate matter, and other gases which are the cause of some serious environmental concerns such as smog, acid rain, health effects, and many others.

2. The nature of operation of wind farms does not entail the use of significant amounts of water resources during the construction and operation phase. Thus, the water requirements of the Project are minimal and mainly required for the potable use by workers during the construction and operation phase – which are also considered to be relatively small in number. In addition, water will be required during the operation phase for washing of the blades as discussed earlier in "Section 3.7.23.7.2". Washing operations are expected to take place once every 3 -5 years and therefore only 4-6 times during the Project's lifetime. Each wash is expected to consume around 41m^3 of water only for the whole wind farm, thus around a minimum of 160m^3 and a maximum of 250m^3 throughout the Project lifetime.

   Other important water efficiency measure for the Project is mainly related to Al-Rajef substation. According to the Developer, the Rajef substation will be using a closed cycle water cooling system which does not rely on an open water source – thus conserving and reducing the water requirements of the Project.

4. REGULATORY AND POLICY FRAMEWORK

This chapter first provides an overview of the environmental clearance process for the Project as governed by the Ministry of Environment (MoEnv). The Chapter then discusses the regulatory context which is directly related to environmental compliance which must be adhered to by all parties involved in the Project throughout the planning and construction, operation, and decommissioning. The Chapter goes on to summarize the relevant international agreements and conventions to which Jordan is a signatory. Finally, as the Project is seeking financing from prospective lenders, this Chapter highlights the environmental and social policies and requirements of the IFC which must be adhered to by the Developer.

4.1 Jordanian Environmental Clearance Process

The process for environmental clearance and obtaining the environmental permit for this Project as required by the MoEnv is stipulated by the "Environmental Protection Law No. (52) of 2006", "Environmental Impact Assessment Regulation No. (37) of 2005", and the "Instructions for Site Selection of Development Projects for the year 2012".

Generally, the environmental clearance process, as governed by the MoEnv, is a two (2) step process. First, the developer of the Project, and prior to commencement of the ESIA study, must apply for a site approval permit in accordance with the "Instructions for Site Selection of Development Projects of 2012". The second step involves undertaking the ESIA study for the Project in accordance with the "Environmental Impact Assessment Regulation No. (37) of 2005".

Both steps are discussed in additional details below.

4.1.1 Location/Site Approval Permit and Environmental Assessment Requirements

- ***Location/Site Approval Permit Application:*** The Project Owner/Developer applies to the 'Central Licensing Committee' within the MoEnv of the intention to undertake a development project using the application form available at the MoEnv. The 'Central Licensing Committee' includes representatives from the MoEnv as well as other governmental authorities to include: Ministry of Agriculture, Ministry of Health, Ministry of Water and Irrigation, Ministry of Municipal Affairs, Greater Amman Municipality, Energy and Minerals Regulatory Commission, and the Jordan Food and Drug Administration. The application lists the information required by the 'Central Licensing Committee' and which includes:
  - General information on the location of the project supported by a site map;
  - A brief description of the planned project, purpose and nature, capacity, major components, etc.;
  - Implementation schedule for the proposed project at different phases and other.
- ***Location/Site Approval Permit Decision:*** The 'Central Licensing Committee', upon receipt of the application, evaluates the data submitted and undertakes a site visit to determine the appropriateness of the site for the proposed development. Generally, this is decided based on requirements from the MoEnv stipulated within the "Instructions for Site Selection of Development Projects for the year 2012" stipulated in accordance to Article No. 4 of the "Environmental Protection Law No. 52 for the Year 2006". The 2012 instructions identify requirements on the setting of development projects and minimum distances that must be respected in relation to nearby sensitive receptors. On broad terms, Article (34) of the Instruction requires that renewable energy projects be located a distance of at least 1km from organized boundaries (urban areas) and/or populated areas. Based on the findings of the site visit, the Committee either approves the site for the development of the project or rejects the site.

  In accordance with the above, the MoEnv undertook a site visit to the Project site in August 2013. Based on the visit, the 'Central Licensing Committee' has approved the Project site for the

development on the condition that a 1km setback distance is respected from the closest turbine to the organized boundary of the nearest villages. Based on the final layout prepared (refer to Figure 7), around 4 turbines are located within the 1km setback distance from the organized boundary of Al-Rajef, the closest of which is around 700m.

In relation to the above, it must be stated that there are no international best practices which set a minimum setback distance requirements for wind power projects, and such setback distances vary from one country to another. Generally, wind power projects are mainly expected to comply with the relevant legislation related to allowable noise levels and shadow flicker hours which are usually studied and taken into account (typically during an ESIA study), and then an appropriate setback distance is assigned to the Project. Each project differs in terms of the setback distance required depending on the nature of the site and surrounding sensitive receptors.

It is important to note that the "Instruction for Site Selection of Development Projects of 2012" is issued by the Minister of Environment and it is within the authority of the Minister to change the requirements based on renewable energy experiences and practices in Jordan.

To this extent, a meeting was held with the Minister of Environment along with ECO Consult and GWRE. The main outcome of the meeting was that the Minister will allow that the outcome of the ESIA study (in relation to noise and shadow flicker modeling) dictate the necessary setback distance between the closest turbine and the village boundary; rather than adhering to a 1km setback distance as required by the Instruction. The Minister and his technical team were rather receptive to such an approach. In addition, the Ministry is seriously considering revising such setback requirements within the "Instruction for Site Selection of Development Projects of 2012".

- ***Screening Decision/ESIA Requirement:*** As part of the same decision process, the 'Central Licensing Committee' determines whether or not the proposed development project is subject to a formal Environmental Assessment procedure. The EIA Regulation lists the projects that require a full EIA or a Preliminary Environmental Impact Assessment study. Any project which may have a significant impact on the environment is classified into Category 1 which refers to projects in Annex 2 of this regulation. Category 1 projects require the preparation of a comprehensive EIA before permission to operate (or license to begin construction) can be given. Annex 2 of the Regulation requires that any project generating energy/electricity is requested a comprehensive EIA study.

  In accordance with the above, the MoEnv has officially requested that GWRE undertake a comprehensive ESIA study for the Project.

4.1.2 EIA Study & Environmental Permit

- ***EIA Technical Committee:*** in the case of a Project where the 'Central Licensing Committee' rule that EIA is required, then the matter is transferred from the 'Central Licensing Committee' at MoEnv to the 'EIA Technical Committee' within the same Ministry and the ESIA Study procedures are officially started. The 'EIA Technical Committee' also includes representatives from the MoEnv as well as other governmental authorities to include: Ministry of Agriculture, Ministry of Health, Ministry of Water and Irrigation, Ministry of Municipal Affairs, Ministry of Public Works and Housing, Ministry of Planning and International Cooperation, Ministry of Energy and Mineral Resources, Ministry of Industry and Trade, and the Environmental Societies Association (which forms the umbrella for the all environmental NGO's in Jordan).

- ***EIA Study Phases:*** In summary, two successive phases of activities are involved in the completion of a comprehensive EIA study in Jordan:

  - Scoping Phase: which includes the submission of a Pre-Scoping Report, undertaking a scoping session, and submission of a Scoping Report/Terms of Reference (ToR) approved by MoEnv for the Study; and
  - Assessment Phase: which includes undertaking the baseline studies, evaluation and assessment of

impacts, and the development of an environmental management plan.

- ***Scoping Phase:*** The scoping phase proceeds with the submission of a Pre-scoping report to the Ministry. This provides the MoEnv with all available information about the Project as well as the nature of impacts expected to result from the project and the relevant persons affected in order to initiate the EIA process by calling for a Scoping and Consultation Session. Then a scoping session is undertaken and following this a Scoping Report/ToR is submitted to the MoEnv which will include the issues addressed in the Pre-scoping Report in addition to other valid comments raised by the stakeholders during the scoping session. The report will also include a detailed Terms of Reference (ToR) that will present the methodology that will be adopted for the EIA study. This report must be approved by MoEnv, prior to undertaking the EIA study.

  In accordance with the above, the scoping session for the Project was held on 3 September 2013 and the ToR was submitted and approved on 3 November 2013.

- ***Assessment Phase:*** The assessment phase is carried out in accordance with the approved ToR by the MoEnv and involves undertaking the baseline studies, impact assessment and development of management plans for various components that are expected to be impacted by the project and its activities. The EIA (or in this case termed the ESIA) document is the output of the assessment, prepared in accordance with the ToR.

- ***Approval of EIA:*** Upon submission of the EIA document, the EIA Technical Committee reviews the report and either approves the study and grants the environmental clearance for the Project or rejects the Project if the study indicates that the implementation of the Project would cause significant impacts on the environment and/or the EIA fails to identify plans for reducing adverse impacts. In order to issue the environmental permit for the Project environmental clearance is required.

  In accordance with the above, this report is the Draft ESIA report that is submitted to the MoEnv for review in October 2015.

4.2 Summary of Jordanian and Environmental and Social Regulatory Context

This section lists those legislations that are directly related to environmental and social compliance that must be adhered to by all parties involved in the Project throughout the planning and construction, operation, and decommissioning phase. These legislations include: (i) those issued by MoEnv (laws, regulations and instruction), and (ii) the relevant national legislations issued by other line ministries (laws, regulations, instructions, standards).

Table 6 below lists the key relevant legislation and regulator/entity relevant to each of the environmental and social parameter being studied and assessed within this ESIA. Throughout the following Chapters, reference to the requirements set out within those legislation is provided under each relevant parameter.

Table 6: Legislative Context for Each Parameter being Studied and Assessed within this ESIA

Parameter	Responsible Regulator/Entity and Relevant Legislations
Pre-ESIA Compliance Requirements	
Site Selection Process	▪ Ministry of Environment: - Environmental Protection Law No. 52 of 2006 - Instruction for Site Selection of Development Projects for the year 2012
ESIA and Post ESIA Requirements	
Landscape and Visual	▪ Ministry of Environment: - Environmental Protection Law No. 52 of 2006
Land Use	▪ Ministry of Municipal Affairs - Municipalities Law No. Law No. 13 for the year 2011 - Land Use Planning Regulation no. (6) for the Year 2007 ▪ Petra Development and Tourism Region Authority (PDTRA) - Petra Development and Tourism Region Authority Law of 2009

	▪ Ministry of Environment: - Environmental Protection Law No. 52 for the year 2006 ▪ Ministry of Agriculture - Agriculture Law No. 44 for the year 2002
Geology and Hydrology (soil and groundwater)	▪ Ministry of Environment - Environmental Protection Law No. 52 for the year 2006 - Solid Waste Management Regulation No. (27) of 2005 - Management, Transportation, & Handling of Harmful & Hazardous Substances Regulation No. (24) of 2005, - Instruction for Management and Handling of Consumed Oils for 2003 - Instruction for Hazardous Waste Management for the year 2003 ▪ Ministry of Water and Irrigation - Water Authority Law No. 18 for the year 1988 and it's amendments thereof - Groundwater Control Regulation No. 85 for 2002 and its amendments thereof - Instructions for the Protection of Water Resources Allocated for Drinking Purposes for 2006 ▪ Ministry of Health - Public Health Law No. 47 for the year 2008 ▪ Jordan Institution for Standards and Metrology (JISM) - Jordanian Standard 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials
Biodiversity	▪ Ministry of Environment: - Environmental Protection Law No. 52 for the year 2006 ▪ Ministry of Agriculture - Agriculture Law No. 44 for the year 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008
Birds	▪ Ministry of Environment: - Environmental Protection Law No. 52 for the year 2006 ▪ Ministry of Agriculture - Agriculture Law No. 44 for the year 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008
Bats	▪ Ministry of Environment: - Environmental Protection Law No. 52 for the year 2006
Archeology	▪ Department of Antiquities - Antiquities Law No. 21 of 1988 and its amendments No. 23 for 2004
Air Quality and Noise	▪ Ministry of Environment - Environmental Protection Law No. 52 for the year 2006 - Air Protection Regulation No. 28 for 2005 - Instruction for Reduction and Prevention of Noise for 2003 ▪ Jordan Institution for Standards and Metrology (JISM) - JS 1140-2006 Ambient Air Quality
Infrastructure and Utilities	▪ Ministry of Water and Irrigation - Water Authority Law No. 18 for the year 1988 and it's amendments thereof - Groundwater Control Regulation No. 85 for 2002 and its amendments thereof ▪ Ministry of Municipal Affairs - Municipalities Law No. Law No. 13 for the year 2011 ▪ Ministry of Environment: - Environmental Protection Law No. 52 for the year 2006 - Instruction for Hazardous Waste Management for the year 2003 ▪ Ministry of Interior - Traffic Law No. 49 for the year 2008 - Regulations for the Registration and Licensing of Vehicles No. 104 for 2008 - Regulation for Maximum Dimensions, Weights and Total Engine Power for Vehicles No. 42 of 2002 - Instructions for Allowable Speed Limits for 2002 ▪ Civil Aviation Regulatory Commission - Civil Aviation Law No. 41 for the year 2007 ▪ Telecommunication Regulatory Commission - Telecommunications Law No.21 for the year 2011

	▪ Jordan Radio and Television Corporation Jordan Radio and Television Corporation Law No. 35 for the year 2000
Occupational Health and Safety	▪ Ministry of Labor - Labor Law No. 8 for the year 1996 and its amendments - Regulation of Protection and Safety from Industrial Tools and Machines and Work Sites No. 43 for 1998 and its amendment thereof - Formation of Committees and Supervisors of Occupational Health and Safety Regulation No. 7 for 1998 - Instructions for the Protection of Workers against the Risks of the Work Environment - Regulation for Preventive and Curative Health Care for Workers in Establishments No. 42 for 1998 and its amendments thereof - Regulation for the Fees of Work Permits for Non-Jordanians No. 36 for 1997 and its amendments thereof
Community Health, Safety, and Security	▪ Ministry of Environment - Environmental Protection Law No. 52 for the year 2006 - Instruction for Reduction and Prevention of Noise for 2003 ▪ Ministry of Health - Public Health Law No. 47 for the year 2008

4.3 Jordanian Institutional Set-up

This section identifies the institutional and administrative framework of entities involved in environmental management in Jordan. Environmental management is mainly the responsibility of the Regulator, MoEnv, in accordance with the "Environment Protection Law No. (52) of 2006". However, other regional and national entities are involved through providing a supporting role to the MoEnv such as the Ministry of Agriculture, Ministry of Water and Irrigation, Ministry of Health, etc. The role of each of those entities is summarized in Table 7 below.

Table 7: Institutional and Administrative Framework

Entity	Mandate
Ministry of Environment (MoEnv)	Responsible for protecting the environment through setting policies and legislation as well as ensuring enforcement, through licensing, monitoring and inspection processes. It is responsible for designating and supervising the management of national parks, reserves and other protected areas although it may delegate these tasks to other bodies. The Ministry is also responsible for developing relevant information management programs, raising public awareness, and promoting co-operation with relevant national, regional and international parties. The MoEnv chairs two national committees that relate to project planning and approval decisions, namely: the 'Central Licensing Committee' and the 'EIA Committee'. In 2006, MoEnv established the Environmental Rangers (Police) department to spearhead enforcement of environmental regulation.
Ministry of Agriculture (MoA)	Responsible for managing public rangelands and forests, protecting soil resources, pastureland and flora, permitting pesticides, protecting and managing wildlife, issuing fishing and hunting licenses, determining capacity and setting 'take' limits.
Ministry of Municipal Affairs (MoMA)	Responsible for monitoring the financial, administrative and organizational performance of Jordan's municipalities (city, town and village local authorities), and supports them in planning and infrastructure development within their boundaries.
Ministry of Health (MoH)	Responsible for the health sector in Jordan, and for community health and safety. It operates most hospitals and clinics and collects data on health indicators.
Ministry of Labor (MoL)	Responsible for the protection of workers' health and safety and has requirements on health checks, provision and use of protective equipment and operational procedures for employees in different types of industry.
Water Authority of Jordan (WAJ)	Responsible for the regulation and protection of Jordan's surface and groundwater resources, including monitoring and protecting water against pollution, in addition to water supplies, irrigation and sewerage. Groundwater, aquifer management and abstraction monitoring and licensing are the responsibility of WAJ.

Governorate of Ma'an	The country is divided into a series of 12 administrative Governorates each headed by an appointed Governor. Governorates are further divided into districts and sub districts. Key government services (health, education, security, etc.) are organized within Governorate divisions. Governors are also responsible for maintaining law and order, but since 2001, have a new mandate to include coordination of economic development in their regions. The Governors now chair two governorate-level bodies. An Executive Council (comprising the Governor, representatives of line Ministries in the Governorate and local mayors) is tasked with the general coordination of socio-economic planning in the Governorate, and a Consultative Council (comprising local notables, private sector representatives, NGOs and community leaders) acts as a link with the local community. Governorates report to the central Ministry of the Interior. The Project is located within Ma'an Governorate.
Local Municipalities / Petra Development and Tourism Region Authority (PDTRA)	Jordan has 93 local municipalities, providing local government services such as waste collection, street cleaning, street and road maintenance, public lighting, culture and sports. Municipalities are run by a mayor who answers to a locally elected municipal council. Municipalities vary greatly in size from populations of less than 5,000 people, to greater than 100,000 people, and also vary greatly in capacity. Municipalities report to the central Ministry of Municipal Affairs. The Project site located within the PDTRA but outside of the municipal administrative boundary. The PDTRA is a legal, financial, and administrative independent Authority founded in 2009 and which aims to develop the Petra Region touristically, economically, socially, culturally while contributing to local community development.
Royal Society for the Conservation of Nature (RSCN)	The RSCN is an environmental NGO. It is empowered to establish and manage protected environmental reserves as well as Important Bird areas under the supervision of the MoEnv.

4.4 International Agreements

The Government of Jordan is signatory to a number of important international agreements which relate to the topics addressed in this ESIA, and has already incorporated many of the provisions in national legislation, often indicating that where the national law is inconsistent with international agreements to which Jordan is a signatory, the requirements of the international agreement will prevail. Accordingly, the terms of international agreements to which Jordan is a party are an important part of the legal framework within which the Project operates. Key treaties and obligations are described below.

4.4.1 International Agreements on Biodiversity, Flora and Fauna

These include the following:

- Convention on Biological Diversity (1993) - signed by Jordan in 1993. Under this agreement, signatories are required to develop plans and policies for the protection and monitoring of biodiversity and to integrate these into national plans for development;
- Convention on Migratory Species (1979) - signed by Jordan in 2000. Signatories are required to protect migratory species throughout the migration range by coordinated efforts and research;
- Agreement on the Conservation of African-Eurasian Migratory Water birds (1995) - came into force in 1999 when ratified by a number of at least fourteen Range States, comprising seven from Africa and seven from Eurasia. The Agreement covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973) - objective of this convention is to save many and varied forms of wild fauna and flora by regulating trade in specimens of species of wild fauna and flora;
- International Plant Protection Convention (1970) - the objective of this convention is to prevent the international spread of pests and plant diseases;

- UN Convention to Combat Desertification - the objective is to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification through effective action at all levels;
- Stockholm Convention on Persistent Organic Pollutants (POP) (2004) - the objective of this Convention is to protect human health and the environment from persistent organic pollutants;
- Ramsar Convention (1971) (formally, the Convention on Wetlands of International Importance, especially as Waterfowl Habitat) - is an international treaty for the conservation and sustainable utilization of wetlands, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value; and
- Cartagena Protocol (2004) - The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement on biosafety, as a supplement to the Convention on Biological Diversity. The Biosafety Protocol seeks to protect biological diversity from the potential risks posed by genetically modified organisms resulting from modern biotechnology.

4.4.2 International Agreements on Energy and Climate Change

These include the following:

- UN Framework Convention on Climate Change (UNFCCC) 1992 - the UNFCCC was established so as to begin to consider what can be done to reduce global warming and to cope with whatever temperature increases are inevitable, aiming to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system;
- Kyoto Protocol to the UN Framework Convention on Climate Change (1997) - establishes a legally binding commitment for the reduction of four greenhouse gases produced by industrialized nations, as well as general commitments for all member countries; and
- UNEP Montreal Protocol on Substances that Deplete the Ozone Layer (1987) - an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion.

4.4.3 International Agreements on Cultural Heritage

These include the following:

- Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention, 1972) - the primary mission of the Convention is to identify and protect the world's natural and cultural heritage considered to be of outstanding universal value.

4.4.4 Other International Agreements Relating to Environmental Protection

This mainly includes the following:

- Basel Convention on the Trans-boundary Movements of Hazardous Wastes and Their Disposal - designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries.

4.4.5 *Obligations Relating to Membership of the International Labor Organization (ILO)*

The International Labor Organization sets guidelines and requirements relating to labor relations and workers' rights. Jordan has ratified a range of ILO Conventions that are relevant to the Project. These are set out in the Box below.

List of ILO Conventions ratified by Jordan and relevant to the Project

- C 29 Forced Labor Convention, 1930 (No.29) ratified 06:06:1966
- C 81 Labor Inspection Convention, 1947 (No. 81) ratified 27:03:1969
- C 98 Right to Organize and Collective Bargaining Convention, 1949 (No.98) ratified 12:12:1968
- C100 Equal Remuneration Convention, 1951 (No.100) ratified 22:091966
- C105 Abolition of Forced Labor Convention, 1957 (No.105) ratified 31:03:1958
- C 106 Weekly Rest (Commerce and Offices) Convention, 1957 (No.106) ratified 23:07:1979
- C 116 Final Articles Revision Convention, 1961 (No.116) ratified 04:07:1963
- C 117 Social Policy (Basic Aims and Standards) Convention, 1962 (No. 117) ratified 07:03:1963
- C 118 Equality of Treatment (Social Security) Convention, 1962 (No. 118) ratified 07:03:1963
- C 119 Guarding of Machinery Convention, 1963 (No.119) ratified 04:05:1964
- C 120 Hygiene (Commerce and Offices) Convention, 1964 (No. 120) ratified 11:03:1965
- C 122 Employment Policy Convention, 1964 (No. 122) ratified 10:03:1966
- C 124 Medical Examination of Young Persons Convention, 1965 (No.124) ratified 06:06:1966
- C135 Workers' Representatives Convention, 1971 (No.135) ratified 23:07:1979
- C 142 Human Resources Development Convention, 1975 (No.142) ratified 23:07:1979
- C 144 Tripartite Consultation (International Labor Standards) Convention, 1976 (No. 144) ratified 05:08:2003
- C 147 Merchant Shipping (Minimum Standards) Convention, 1976 (No. 147) ratified 01:04:2004
- C 150 Labor Administration Convention, 1978 (No. 150) ratified 10:07:2003
- C 159 Vocational Rehabilitation and Employment (Disabled Persons) Convention, 1983 (No. 159) ratified 13:05:2003
- C 185 Seafarers Identity Documents Convention (Revised), 2003 (No. 185) ratified 09:08:2004
- C 111 Discrimination (Employment and Occupation) Convention, 1958 (No. 111) ratified 04:07:1963
- C 138 Minimum Age Convention, 1973 (No. 138) species at 16 years ratified 23:03:1998
- C182 Worst Forms of Child Labor Convention, 1999 (No.182) ratified 20:04:2000

4.5 Requirements for Project Financing

In addition to Jordanian requirements, the international standards which are applicable to the Project include the "International Finance Corporation Policy on Social and Environmental Sustainability" (IFC, 2012) including the IFC Performance Standards (PS) and the Environmental, Health & Safety (EHS) Guidelines.

The "IFC Policy on Social and Environmental Sustainability" (IFC, 2012) sets out the environmental, health & safety and community requirements for projects financed by IFC. Through the implementation of the Equator Principles, IFC requirements have become the *de facto* international environmental and social performance benchmark for project financing.

IFC requirements are set out in its Performance Standards (PSs) of Social and Environmental Sustainability, which are summarized in Table 8 below.

Table 8: Overview of IFC Performance Standards of Social and Environmental Sustainability

IFC Performance Standard	Key Points Relevant to the Project
PS1: Assessment and Management of Environmental and Social Risks and Impacts	PS1 underscores the importance of managing social and environmental performance throughout the life of a project by using a dynamic social and environmental management system. Specific objectives of this Performance Standard are: ▪ To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence; ▪ To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment; ▪ To ensure that affected communities are appropriately engaged on issues that could potentially affect them; and ▪ To promote improved social and environment performance of companies through the effective use of management systems.
PS2: Labor and Working Conditions	The requirements set out in this PS have been in part guided by a number of international conventions negotiated through the International Labor Organization (ILO) and the United Nations (UN). Specific objectives of this Performance Standard are: ▪ To establish, maintain and improve the worker-management relationship; ▪ To promote the fair treatment, non-discrimination and equal opportunity of workers and compliance with national labor and employment laws; ▪ To protect the workforce by addressing child labor and forced labor; and ▪ To promote safe and healthy working conditions, and to protect and promote the health of workers.
PS 3: Resource Efficiency and Pollution Prevention	This Performance Standard outlines a project approach to pollution prevention and abatement in line with international available technologies and practices. It promotes the private sector's ability to integrate such technologies and practices as far as their use is technically and financially feasible and cost-effective in the context of a project that relies on commercially available skills and resources. Specific objectives of this Performance Standard are: ▪ To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities; and ▪ To promote the reduction of emissions that contribute to climate change.
PS 4: Community Health, Safety and Security	This PS recognizes that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development. However, projects can also increase risks arising from accidents, releases of hazardous materials, exposure to diseases, and the use of security personnel. While acknowledging the public authorities' role in promoting the health, safety and security of the public, this PS addresses the project sponsor's responsibility in respect of community health, safety and security.
PS 5: Land Acquisition and Involuntary Resettlement	Involuntary resettlement refers both to physical and economic displacement as a result of project-related land acquisition. Where involuntary resettlement is unavoidable, appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented.
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	This Performance Standard reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote the use of renewable natural resources in a sustainable manner. This Performance Standard addresses how project sponsors can avoid or mitigate threats to biodiversity arising from their operations as well as sustainably manage renewable natural resources. Specific objectives of this Performance Standard are: ▪ To protect and conserve biodiversity; and ▪ To promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities.
PS 7: Indigenous Peoples	Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from dominant groups in national societies.
PS 8: Cultural Heritage	Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to protect irreplaceable cultural heritage and to guide project sponsors on protecting cultural heritage in the course of their business operations.

In addition, IFC has produced a comprehensive range of Environment, Health & Safety (EHS) Guidelines. Not only is there a General EHS Guideline document, but there are also sector-specific EHS guideline document for Wind Energy. This EHS guidance document provides detailed management and technical recommendations with regards to Industry-Specific Impacts and Management (Environmental performance; Occupational health and safety; and Community health and safety) and Performance Indicators and Monitoring (Environmental performance; and Occupational health and safety). A summary of the relevant guidelines to this project include the following:

- *General EHS Guidelines (IFC,2007)*: Provide common guidance's and information to users on EHS issues that are potentially applicable to all industry sectors; and
- *EHS Guidelines for Wind Energy (IFC, 2015):* Provide guidance's and information to users on EHS issues related to onshore and offshore wind energy facilities. The Guideline provides a summary of EHS impacts associated with wind energy facilities along with recommendations for their management as well as performance indicators and monitoring programs for environmental, occupational health and safety and community health and safety. Where relevant, the requirements of this guideline are reiterated clearly in subsequent chapters that discuss the environmental attributes they relate to where national legislations are not available.

Where the IFC are investors in a project, as part of their review of environmental and social risks and impacts of a proposed investment, they use a process of environmental and social categorization. The same categorization is also applied under Equator Principles (EP) III (June 2013) by Equator Principle Financial Institutions (EPFIs). The category also specifies IFC's institutional requirements for disclosure in accordance with IFC's Access to Information Policy. The main applicable categories are:

- Category A: Business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented;
- Category B: Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures; and
- Category C: Business activities with minimal or no adverse environmental or social risks and/or impacts.

It is considered that the Project is likely to be categorized as a Category B project.

5. ESIA APPROACH AND METHODOLOGY

This chapter of describes the approach and methodology that was adopted for the ESIA study including the following:

- Approach to screening and scoping phases;
- Approach for the analysis of alternatives;
- Approach to stakeholder engagement;
- Approach to determining the spatial and temporal study area;
- Methodology for assessment of the baseline environmental and social conditions;
- Methodology used to assess the potential environmental and social impacts of the Project – including the approach to determining significance, development of mitigation measures and the assessment of residual effects;
- Approach used for the assessment of cumulative and trans-boundary effects; and
- Approach for development of an Environmental and Social Management Plan (ESMP).

5.1 Screening, Scoping & Assessment

The ESIA process for the Project has followed the environmental clearance process outlined in "Chapter 4", as summarized below:

- ***Location/Site Approval Permit & Screening Decision:*** the Central Licensing Committee has approved the site for the development of the Project conditional that a comprehensive EIA study is undertaken before commencement of any construction or operational activities.
- ***Scoping Phase:*** the scoping session for the Project was held on 3 September 2013. In addition, the Scoping Report/ToR was submitted to the MoEnv and was approved on 3 November 2013.
- ***Assessment Phase:*** The assessment phase has been carried out in accordance with the approved ToR by the MoEnv. This ESIA report is the output of this assessment for submission to the MoEnv for approval.

5.2 Analysis of Alternatives

The "Environmental Impact Assessment Regulation No. (37) of 2005" requires that the ESIA shall identify and analyze alternatives, including but not limited to project site location, process and technological alternatives, no project alternative (which assumes that the Project development does not take place), and present the main reason for the preferred choice. The examination of alternatives is also considered to be a key element of the ESIA process under good international practice, including the "IFC Performance Standard 1" (IFC, 2012) and the associated "IFC Guidance Note 1" (IFC, 2012). Environmental and social considerations have been part of the planning of the Project and a core element of the decision-making process.

The application of the environmental and social mitigation hierarchy (avoid; reduce; mitigate and manage, and compensate and offset) was considered throughout the Project development process and as part of the consideration of alternatives.

The analysis of alternatives has already been presented in "Chapter 2". The chapter discussed and compared several alternatives to the Project development in relation to: (i) the Project site, (ii) the chosen technology, (iii) the Project design, and finally investigated the 'no action alternative' – which assumes that the Project development does not take place.

5.3 Stakeholder Engagement

Stakeholder consultation and engagement is an essential part of the ESIA process, and has been carried out in accordance with the regulatory requirements in Jordan and international best practice – to include requirements identified within the "EIA Regulation No. (37) of 2005" as well as "IFC Performance Standard 1" (IFC, 2012). The previous and future stakeholder consultation and engagement for the Project are summarized below and discussed in detail in "Chapter 6".

The stakeholder consultation and engagement for the Project to date has included both: (i) high level consultations and (ii) detailed engagement and consultations. The high level consultation mainly includes the undertaking of a scoping session, and which is considered high level as various stakeholder groups representing various entities are consulted at once. The scoping session that was undertaken included stakeholder groups such as national governmental entities, local governmental entities, non-governmental organizations, academic and research institutions, and local community representatives.

The detailed engagement and consultation focused on a single stakeholder group at a time in order to take their specific concerns into account throughout the ESIA study. This included: (i) local community and nomads through onsite consultations; (ii) other stakeholders to include governmental and non-governmental organizations consulted and engaged through bi-lateral meetings, e-mail communication, phone communication, and formal letters.

"Chapter 6"also discusses future stakeholder engagement and consultations which are to take place once the ESIA has been approved by the MoEnv. This includes (i) the disclosure of the ESIA to stakeholders with regards to the findings and recommendations proposed within the ESIA study as well as the disclosure of the Non-Technical Summary (NTS) and Stakeholder Engagement Plan (SEP); and (ii) implementation of the Stakeholder Engagement Plan (SEP) by the Developer describes the planned stakeholder consultation activities and engagement process.

5.4 Delineation of Study Boundaries and Scope of Assessment

5.4.1 Definition of Spatial Study Area

The overall Study Area for the ESIA represents the potential area of influence of the Project. This is '*the area over which significant effects of the Project could reasonably occur, either on their own, or in combination with those of other developments and projects'*.

In general terms, the study area for the Project ESIA includes the footprint of Project disturbance as demarcated in blue in Figure 11 below. However, for certain environmental and social parameters (such as landscape and visual, infrastructure and utilities, socio-economics, etc.), the study area goes beyond the actual footprint of the Project site, and therefore an appropriate thematic study area is determined for each theme on a case by case basis. Such a thematic study area is clearly identified within the relevant chapter it relates to throughout this ESIA.

In identifying these thematic study areas, the type and degree of the potential direct and indirect effects were taken into consideration. The core area where direct effects are likely to occur was determined, as well as the wider area of influence where indirect, combined and cumulative effects are likely to occur on the surrounding areas and communities.

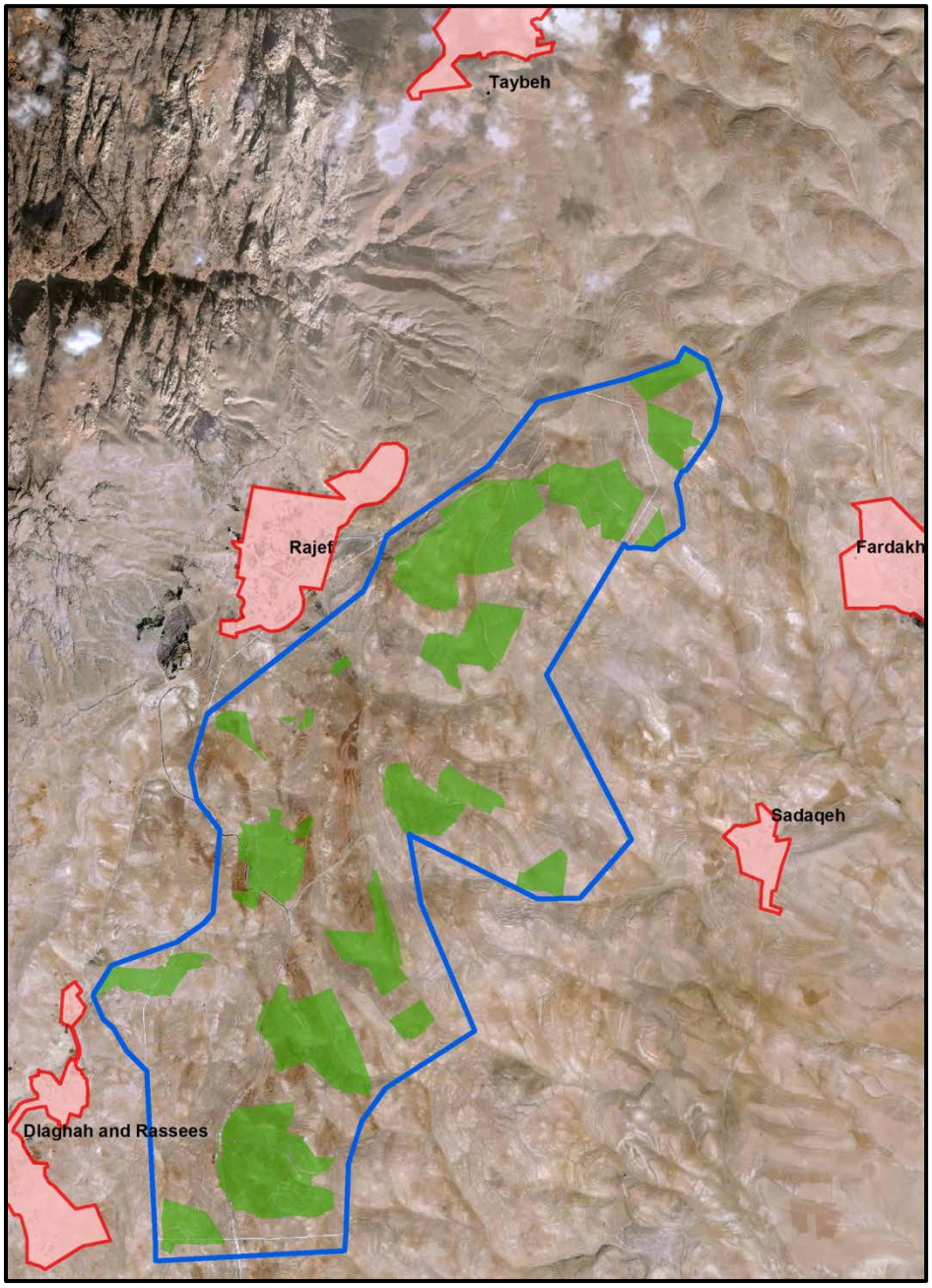


Figure 11: Study Area

5.4.2 Temporal Scope of the Assessment

The Project will be developed in a three phase sequence as follows. The potential impacts are assessed throughout the various Project phases.

- Planning and Construction Phase;
- Operation Phase; and
- Decommissioning Phase.

It is important to note that the ESIA study does not cover the associated interconnection facilities and the activities that will be undertaken for their construction and operation. Such associated interconnection facilities include the NEPCO receiving substation and the high voltage overhead transmission line. Such activities will be undertaken by NEPCO. Detailed information is not available at this stage by NEPCO –

which include methods of construction, layout of the receiving NEPCO substation, right of way, detailed grid connections plans and route for the overhead line, etc.

Such activities were not considered due to the fact that details and information are not available at this stage. Nevertheless, within "Chapter 23", a set of Environmental Performance Requirements have been identified which must be considered by NEPCO at a later stage once such details become available. Such performance requirements aim to ensure that environmental and social issues are taken into account and adequately considered.

(i) *Planning and Construction Phase*

This includes onsite construction activities which will be undertaken by the EPC Contractor. This mainly includes preparing the detailed design and layout of the Project, transportation of Project components onsite, as well as onsite site preparation and construction activities for installation of wind turbines, foundations, internal access roads, buildings, etc.

(ii) Operation Phase

This includes activities to be undertaken by the Project Operator. Activities expected to take place mainly include the normal daily operation of the Project and the routine maintenance activities.

(iii) Decommissioning Phase

It has not been determined yet, whether at the end of the PPA term (which is set for 20 years) NEPCO would take ownership of the Project and continue operating it, or whether the Project will be completely decommissioned by the Developer.

Nevertheless, should the Project be completely decommissioned, then generally the anticipated impacts throughout the decommissioning phase are similar in nature to impacts assessed during the construction phase – and specifically in impacts related to soil and groundwater (from improper management of waste streams), air quality and noise, and occupational health and safety. Therefore, the assessment of impacts for those receptors and mitigation identified during the construction phase is assumed to apply to this phase in particular without the need to reiterate or emphasize this throughout this chapter.

5.5 Environment & Social Baseline Conditions

As part of the ESIA process, the baseline environmental and social conditions of the study area were established. Describing the baseline includes identifying and defining the importance and sensitivity of the various environmental and social resources and receptors likely to be impacted, i.e. within the study area. Understanding the value or sensitivity of the resources and receptors to impacts and changes is an important consideration when determining the significance of effects, and allows for better identification of the most appropriate measures that could be employed to avoid impacts, and to mitigate any adverse impacts.

The description of environmental and social baseline conditions has considered a wide range of data and information gathered from various sources, including:

- Desk-based studies and literature reviews;
- Data from statutory and non-statutory stakeholders; and
- Field surveys and site investigations.

These studies have covered all the environmental and social aspects related to the Project. The baseline conditions are treated as those conditions which would prevail in the absence of the Project.

Studies of the environment and social baseline are described under each chapter respectively and include the following: landscape and visual; land use; geology and hydrology (soil & groundwater); biodiversity; birds (avi-fauna); bats; archaeology and cultural heritage; air quality and noise; infrastructure and utilities; and socio-economic conditions. Within each chapter, the methodology which was undertaken for assessment of the each of those baseline conditions is described in detail.

5.6 Impact Assessment Methodology

Given the scale and type of the Project, the ESIA commences with an assessment of the positive environmental and economic impacts on the strategic and national level given the current challenges the energy sector in Jordan faces – as highlighted in "Chapter 7".

It then moves forward into the main body of the ESIA undertaking the assessment of impacts on environmental and social parameters for each receptor under the relevant chapter, from "Chapter 8" to "Chapter 19". The following section provides a description of the approach, methodology and process adopted for the impact assessment presented within this ESIA.

5.6.1 Approach to Assessment of Impacts

The adverse and beneficial environmental and social impacts of the Project have been identified and assessed against the established baseline. A consistent approach to the assessment of impacts was followed to enable environmental and social impacts to be broadly compared across the ESIA. A set of generic criteria were used to determine significance (see below) which were applied across the various environmental social and environmental parameters.

As far as possible, environmental and social impacts were quantified. Where it was not possible to quantify impacts, a qualitative assessment was conducted using professional experience, judgment and available knowledge, and including the consideration of stakeholder views. Where there were limitations to the data, and/or uncertainties, these have been recorded in the relevant chapters, along with any assumptions that were taken during the assessment.

In order to determine the significance of each impact, two overall factors are considered:

- The importance and/or sensitivity of the environmental and social receiving parameter, as determined during the assessment of baseline conditions; and
- Magnitude and Nature of the impact.

5.6.2 Sensitivity of the Receiving Parameter:

Receiving parameter sensitivity was determined using information taken from the baseline description on the importance, significance or value of the social or environmental component under examination. It is important to understand the sensitivity of the receiving parameter, as this is a measure of the adaptability and resilience of an environmental parameter to an identified impact. The following categories of sensitivity were applied to the assessment:

- *High*: The environmental parameter/receptor is fragile and an impact is likely to leave it in an altered state from which recovery would be difficult or impossible.

- *Medium*: The parameter/receptor has a degree of adaptability and resilience and is likely to cope with the changes caused by an impact, although there may be some residual modification as a result; and
- *Low*: The parameter/receptor is adaptable and is resilient to change.

5.6.3 Magnitude and Nature of the Impact:

The magnitude of the impact is the scale of change which the impact may cause compared to the baseline and how this change relates to accepted thresholds and standards. The following categories were applied to the assessment:

- *High*: a large change compared to variations in the baseline. Potentially a clear breach of accepted limits;
- *Medium*: change which may be noticeable and may breach accepted limits; and
- *Low*: when compared with the baseline, change which may only just be noticeable. Existing thresholds would not be exceeded.

Furthermore, in determining the magnitude of the impact it is important to take into account and consider several other factors which define the nature of the impact. This includes the following:

Type of Impact

- *Positive*: applies to impacts that have a beneficial environmental result, such as enhancement of the existing environmental conditions; and
- *Negative*: applies to impacts that have a harmful aspect associated with them such as loss or degradation of environmental resources.

Type of Effect

- *Direct*: applies to impacts which can be clearly and directly attributed to a particular environmental or social parameter (e.g. generation of dust directly impacts air quality); and
- *Indirect*: applies to impacts which may be associated with or are subsequent to a particular impact on a certain environmental or social parameter (e.g. high levels of dust could entail nuisance and health affects to construction workers onsite).

Duration (how long the stressor or its effect last)

- *Short Term*: applies to impacts whose effects on the environment will disappear within a 1 year period, or once construction activities are completed;
- *Medium Term*: applies to impacts whose effects on the environment will disappear within a 5 year period; and
- *Long Term*: applies to impacts whose effects on the environment will disappear in a period greater than 5 years.

Reversibility

- *Reversible*: applies to impacts whose significance will be reduced and disappeared over time (either naturally or artificially), once the impacting activity ceases; and
- *Irreversible*: applies to impacts whose significance will not be reduced nor disappeared over time (either naturally or artificially), once the impacting activity ceases.

5.6.4 Assessing the Significance of the Impacts

The concept of 'significance' is central to the ESIA process and aids the identification and categorization of environmental and social effects. As noted, in order to determine impact significance, the sensitivity of each environmental and social parameter/receptor is considered in combination with the magnitude of the impact. Table 9 below demonstrates how these parameters are considered in the assessment of significance.

Table 9: Determination of Significance

Magnitude and Nature of Impact / Sensitivity of Receiving Parameter/Receptor	Low	Medium	High
Low	Not significant	Minor	Minor
Medium	Minor	Minor	Moderate
High	Minor	Moderate	Major

While the above matrix provides a framework for the determination of significance, and enables comparison across environmental and social parameters, a degree of professional judgement must be used and some parameter-specific factors to be considered in making the determination of significance.

Below provides additional guidance to the degrees of significance used in this ESIA. Note that positive impacts are defined, but are not rated for significance.

- *Major significance*: requires thorough investigation in the ESIA. These impacts have been studied extensively by consulting expertise in the areas of the identified impacts to design needed mitigation and environmental management measures. Moreover, conducting specific studies and assessments to some of the key issues identified;
- *Moderate significance*: requires reasonable investigation in the ESIA. These impacts have been studied by expertise in the areas of the identified impacts to design needed mitigation and environmental management measures.
- *Minor significance*: must be listed, and addressed in some way, but which did not require detailed assessment in the ESIA.
- *Not significant*: for completeness, impacts which have been included in the assessment but determined not to be significant, are rated formally as 'not significant'.

5.6.5 Management Measures

Based on the impact assessment undertaken a set of management measures are identified for each impact which aims to address it. Management measures include the following:

- Additional Requirements: those are generally regulatory requirements which have been identified and which must be taken into account at a later stage.
- Additional Studies: for certain environmental/social receptors additional studies must be undertaken at a later stage. Such studies and their scope, timing, etc. have been highlighted were relevant.
- Mitigation Measures: a vital step in the ESIA process is the identification of measures that can be taken to ensure that impacts are mitigated or reduced to acceptable levels. The ESIA will firstly consider the significance of any impacts caused by the Project and then assigned mitigation options through applying the following hierarchy:
  - Avoiding or 'designing out' impacts wherever possible;

- Considering alternatives or modifications to the design to reduce the impacts wherever possible;
- Applying measures to minimize and manage impacts on the receptor; *then*
- As a last resort, identifying fair compensation, remediation and offsetting measures to address any potentially significant residual effects.

Some negative impacts can be easily mitigated, whilst others cannot or are too difficult and costly to mitigate. The various potential impacts are described in this ESIA, along with the provision of 'feasible mitigation measures' that can be implemented.

- Recommendations: for positive impacts it is not possible to identify mitigation measures, but rather recommendations have been identified which aim to enhance the positive impact.

5.6.6 Assessment of Residual Effects

If there are mitigation measures it is then necessary to make an assessment of the 'residual significance' after mitigation has been taken account. A re-assessment of Project impacts is then made, taking into account the effect of the proposed mitigation measures in order to determine the significance of the *residual effects*. Residual effects are discussed for each environmental and social theme in the ESIA chapters, and their significance determined and summarized in an Impact Assessment Table.

5.7 Assessment of Cumulative Impacts

For each of the impacts assessed, the ESIA investigates the cumulative impacts which could result from incremental impacts from other known existing and/or planned developments in the area, and based on currently available information on such existing/planned developments.

5.8 Development of an Environmental and Social Management (ESMP) Plan

Based on the results of the impact assessment, development of management measures, and development of monitoring plan, an ESMP was compiled into a single table that details all of the above. The ESMP will be a key document and will list the environmental/social requirements and detail the procedures necessary for managing the significant environmental/social issues connected to proposed Project activities. The ESMP will be developed specifically to provide flexibility in the nature and exact location of operations, while ensuring all potential impacts are identified and properly mitigated and monitored throughout the later stages of the Project. This ESMP can be used as a stand-alone document during the different phases of the Project by Developer, MoEnv, and other responsible parties.

6. STAKEHOLDER CONSULTATION AND ENGAGEMENT

This Chapter discusses in details the stakeholder consultation and engagement plans which were undertaken as part of the ESIA process for the Project and provides an overview of the findings. In addition, this Chapter also discusses the future stakeholder consultation and engagement plans which are to take place at a later stage of the ESIA process as well the Project development.

6.1 Introduction

Stakeholder engagement is an integral part of ESIA good practice and is a statutory requirement of the national EIA legal framework in Jordan and within the International Finance Corporation's (IFC's) Policy on Environmental and Social Sustainability and Performance Standards. The Developer is committed to a technically and culturally-appropriate approach to consultation and engagement with all stakeholders affected either directly or indirectly by the Project. The consultation program for the Project is based on informed consultation and participation in line with IFC requirements with affected people, and is designed to be both fair and inclusive. Consultation activities have been an ongoing process since the commencement of the ESIA study in April 2012.

A stakeholder is defined as any individual or group who is potentially affected by the proposed Project or can themselves affect the proposed Project directly or indirectly. Stakeholder consultation is an inclusive process for sharing information that enables stakeholders to understand the risks, impacts, and opportunities of a development or project, allowing them to express their views and articulate their perceptions towards it.

6.2 Objectives

The objective of stakeholder consultation is to ensure that a participatory approach takes place, which in turn documents concerns of all stakeholder groups and makes sure that such concerns are considered, responded to, and incorporated into the decision making process of the development. Stakeholder consultation needs to be a two-way communication process that imparts information to stakeholders, but also obtains additional and on-the-ground information from them. Stakeholder consultation and engagement must take place at the inception phase of the ESIA process and implemented all through the study period.

The specific objectives of this chapter are to:

- Summarize national and international legal & policy requirements for stakeholder engagement;
- Describe and identify the stakeholders affected and/or with an interest in the Project;
- Summarize stakeholder engagement and consultation conducted to date. In addition describe how the views and issues raised have informed and influenced the development of the Project; and
- Outline the future plans and approach to stakeholder engagement.

6.3 Requirements and Policy Requirements for Stakeholder Engagement

6.3.1 Jordanian Legal & Policy Standards

The Jordanian legal requirements for consultation and engagement are mainly included within the "EIA Regulation No. (37) of 2005". The requirements of the Regulation are summarized below.

The Regulation requires that for those projects which the MoEnv requires a comprehensive ESIA study, a scoping session must be held from the onset of the ESIA for all stakeholders whom may be potentially affected by the Project. The objective of the session is to provide the stakeholder groups with all available information on the Project and the surrounding environment, in order to allow them to participate in investigating and identifying the potential impacts which may arise from the Project so that their concerns are taken into account throughout the ESIA study.

To this extent, the MoEnv generally requires that the following stakeholder groups be invited to participate in the scoping session: (i) national governmental entities, (ii) local governmental agencies, (iii) Non-Governmental Organizations, (iv) academic and research institutions, and (v) local community representatives.

In addition, the Regulation specifies that the outcomes of the ESIA study is to be announced to stakeholders and the public in a manner that the Ministry deems appropriate, and this is dealt with on a case by case basis – taking into account the type and nature of the project development. This is usually determined by the MoEnv once the ESIA study is reviewed and approved.

6.3.2 Requirements in IFC Performance Standards on Environmental & Social Sustainability (2012)

The IFC Performance Standards form part of their Sustainability Framework, where the "IFC Performance Standard 1" (IFC, 2012) sets out the following recommendations for stakeholder engagement:

- Stakeholder Engagement is an on-going process that may involve: stakeholder analysis & planning, disclosure & dissemination of information, consultation & participation, grievance mechanism, and on-going reporting to Affected Communities.
- A Stakeholder Engagement Plan (SEP) must be developed and implemented that is scaled to the project risks and impacts and development stage, and be tailored to the characteristics and interests of the Affected Communities.
- Affected Communities will be provided with access to relevant information on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such communities and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.
- When Affected Communities are subject to identified risks and adverse impacts from a project, a process of consultation will be undertaken in a manner that provides the Affected Communities with opportunities to express their views on project risks, impacts and mitigation measures, and allows the client to consider and respond to them.
- The extent and degree of engagement should be commensurate with the project's risks and adverse impacts and concerns raised by Affected Communities.
- The consultation process will be tailored to language preferences of Affected Communities, their decision-making process, and the needs of disadvantaged or vulnerable groups.
- For projects with potentially significant adverse impacts, the client will conduct an informed consultation and participation.
- A grievance mechanism will be established to receive and facilitate resolution of Affected Communities' concerns and grievances about the client's environmental and social performance.
- As it is considered that the GWRE Wind Power Project is likely to be categorized as a Category B project under the IFC requirements, it will be disclosed for a minimum of 30 days.

6.4 Stakeholder Identification and Analysis

The Project has been identifying potential stakeholders since it began the development of the ESIA program in April 2012. The Project has a wide range of stakeholders ranging from national government and other bodies involved in the permitting and ESIA process, in addition to communities within the area of influence of the Project. As such stakeholders have been identified at all geographic levels, including national, regional and local levels.

The two principal categories of stakeholders are as follows:

- Affected Communities, defined as the local community as well as other people directly affected by the Project and/or those who have been identified as most vulnerable to change and who need to be engaged in identifying impacts and their significance, as well as in decision-making on mitigation and management measures.

  In specific, within the affected communities, vulnerable groups must be identified. Vulnerable groups include those expected to be disproportionally affected by the Project, and therefore require special consideration throughout the consultation process. Vulnerable groups are project specific and depend on a range of issues which must be understood such as project location, socio-economic and demographic context, as well as the nature of the development and type of impacts anticipated. The vulnerable groups within this context were identified by the 'ESIA Team'. Such vulnerable groups include the following:

  - Women groups: due to cultural norms in Jordan (and specifically within the context and setting of the Project area), the participation of women groups in the decision-making process is limited which could result in overlooking any specific concerns they might have.
  - Nomadic tribes: those are people that travel in different areas on a seasonal basis with no fixed residence. As they could not be present in an area year round, this could limit their participation in the decision-making process which could result in overlooking any specific concerns they might have.

- Other Interested Parties, defined as people and organizations that are interested in the Project and/or could affect the Project in some way. Those generally include governmental and non-governmental organizations.

6.4.1 Affected Communities

The affected communities have been identified based on: (i) detailed understanding of the Project site location, its nature, administrative setup and the nearby surrounding receptors, and (ii) the nature of the anticipated impacts from the Project throughout its various phases. Based on the above, the affected communities include the local communities of the Project area and nomads.

(i) Local Communities

As discussed earlier, the Project site is located within Ma'an Governorate and specifically within several districts/sub-districts to include the District of Petra and Eel Sub-district (which belongs to the District of Qasabit Ma'an), all of which host several community settlements.

The community settlements that are likely to be affected by the Project development logically includes those located within the vicinity of the Project site. However, given the relatively large number of settlements located within the vicinity of the Project site, the exact communities to be considered were identified and determined based on the rationale to include those that are anticipated to be impacted the most from the Project's activities (during construction and operation). This in turn was determined based on the detailed understanding of the nature and extent of the Project's impacts. The main anticipated impacts which could affect the nearby communities (which are discussed in further details in each of the

relevant chapter) include: (i) land use impacts from Project development, (ii) visual impacts from the presence of the turbines and, (iii) noise and shadow flicker generated from the operating turbines. In addition, the socio-economic conditions of these local communities are also anticipated to be impacted (mainly in a positive matter) from such a development.

Such community were determined to include: (i) Al-Rajef and Dlaghah & Rassees both of which are located on the western border of the Project site, (ii) Taybeh which is located around 3km to north of the Project site, and (iii) Fardakh and Sadaqah located to the eastern borders of the Project site at a distance of around 2.5 and 1.5 km respectively. Those local communities are presented in Figure 12 below.

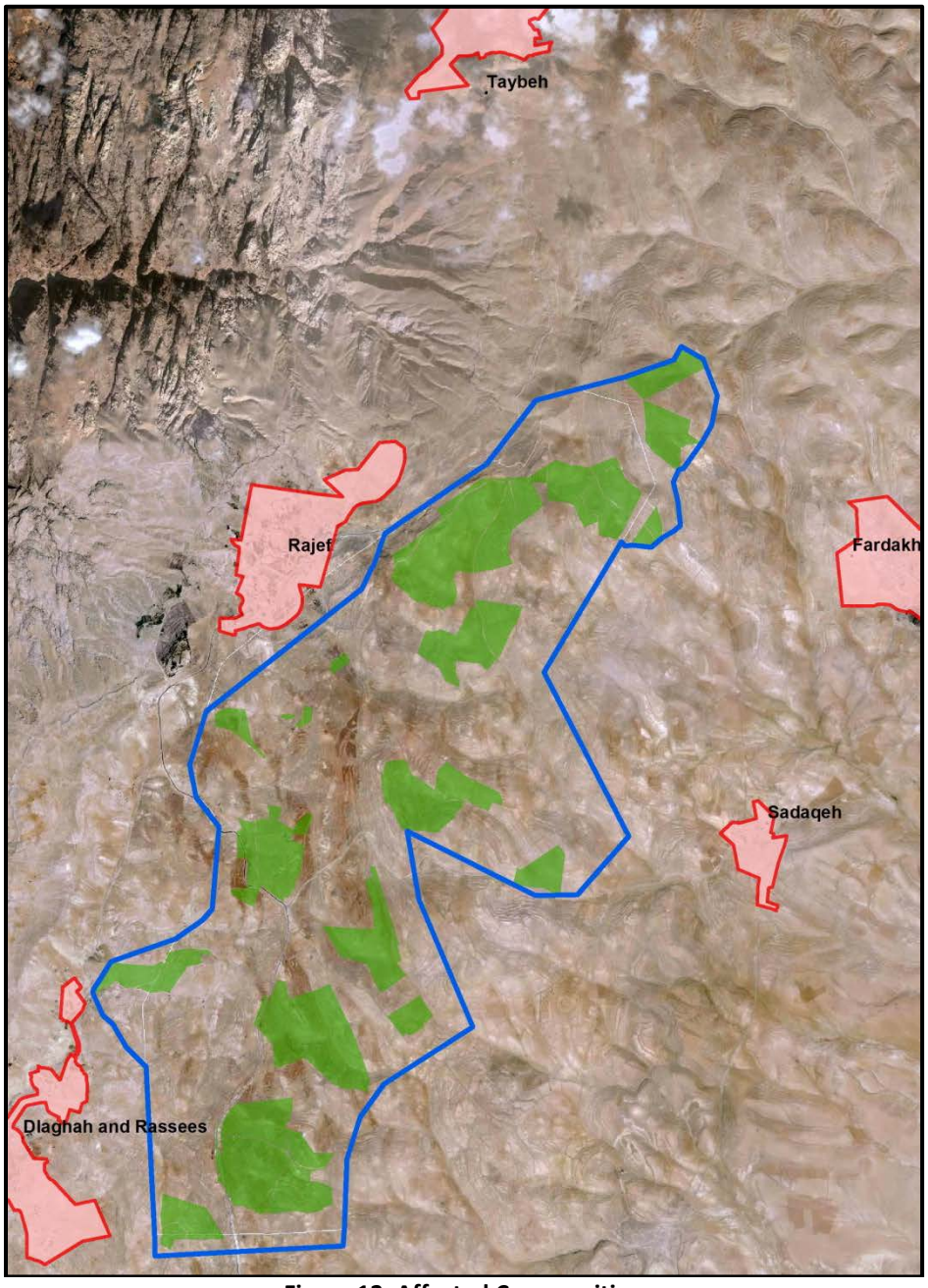


Figure 12: Affected Communities

(ii) Nomads

Based on the understanding of the area in general, it is known that there is nomadic activity within the Project site and its surrounding areas. Similarly, the main anticipated impacts which could affect the nomads (which are discussed in further details in each of the relevant chapter) include: (i) land use impacts

from Project development, (ii) visual impacts from the presence of the turbines and, (iii) noise and shadow flicker generated from the operating turbines

6.4.2 Other Interested Parties/Stakeholders

Other interested parties and stakeholder groups were identified based on the understanding of the Project location, nature of activities which are to take place, type of development, and the potential environmental and social impacts and how they could potentially affect certain stakeholder groups.

(i) Jordanian Governmental Stakeholders (National and Local)

National and local government stakeholders include Ministries, Directorates, and other agencies that generally have a regulatory role in ensuring the implementation and compliance of projects with the various applicable legislations under the mandate of the relevant legislations. In addition, such entities are involved in the permitting and ESIA process. Thus, such stakeholders have the potential to influence the authorization of the Project and assist in its delivery.

More specifically, it is important to note that the majority of these governmental entities (mainly ministries) are part of the 'EIA Technical Committee' which will review this ESIA study for approval and granting of environmental clearance.

Table 10 below provides a list of the key national and regional level government stakeholders along with a summary as far as possible of their key areas of interest.

Table 10: List of Key Governmental Stakeholders

Governmental Entity	Interest in/Influence on the Project
National Governmental Entities	
Ministry of Environment (MoEnv)	The governmental body responsible for protection of the environment in Jordan. In addition, the MoEnv is responsible for approval of the ESIA and making sure it complies with the "EIA Regulation No. (37) of 2005" and granting the environmental clearance for the Project.
Ministry of Energy and Mineral Resources (MEMR)	The governmental body responsible for the development of the private sector renewable energy projects in Jordan to include this Project in specific.
Ministry of Agriculture (MoA)	The governmental body responsible for managing rangelands and forest as well as protecting and managing wildlife. For this project this includes land use issues related to grazing reserves and forest lands as well as potential impacts related to biodiversity.
Ministry of Municipal Affairs (MoMA)	The governmental body responsible for setting and designating land uses in Jordan which identifies certain activities and projects which are to be allowed. For this Project, this mainly includes issues related to designated land use of the Project site.
Ministry of Health (MoH)	The governmental body responsible for the health sector in Jordan, including public health and safety. For this Project this mainly includes issues related to the public health of the nearby communities and nuisance prevention from the Project (from issues such as noise, shadow flicker, waste management, wastewater management, etc.).
Ministry of Tourism and Antiquities (MoTA) / Department of Antiquities (DoA)	The governmental body responsible for tourism development and protection of antiquities in Jordan. For this Project, this mainly includes potential impacts related to archeology and cultural heritage related to the Project.
Ministry of Transport (MoT)	The governmental body responsible for regulating and monitoring the road transport sector and services. For this Project, this mainly includes potential impacts related to infrastructure and utilities – mainly transportation of Project components to the Project site and any impacts on roads capacity and safety.
Ministry of Water and Irrigation (MWI) / Water Authority of Jordan (WAJ)	The governmental body responsible for the overall monitoring of the water sector and water supply. For the Project this mainly includes issues related to the water requirements and supply to the Project.
Ministry of Labor	The governmental body responsible for health and safety of workers and labor in Jordan.

(MoL)	For this Project, this mainly includes issues related to occupational health and safety.
Civil Aviation Regulatory Commission (CARC)	Governmental body responsible for civil aviation safety, security and regulatory compliance. For this Project, this includes issues related to civil aviation safety from wind turbines.
Royal Jordanian Air Force (RJAF)	Governmental body responsible for military aviation safety and security. For this Project, this includes issues related to military aviation safety from wind turbines.
Telecommunication Regulatory Commission (TRC)	TRC is the official entity for regulating the telecommunications and information technology services in the Kingdom. For this Project in specific, this includes any potential impacts from the wind turbines on telecommunication transmission networks in the area.
Jordan Radio and Television Corporation (JRTV)	JRTV is the state broadcaster of Jordan for radio and television transmission networks. For this Project in specific, this includes any potential impacts from the wind turbines on the radio/television transmission networks in the area.
National Electric Power Company (NEPCO)	Responsible for designing and building the substation, together with high voltage overhead lines and the connection to the existing grid.
Local Governmental Entities	
Ma'an Governorate	The official governmental body responsible for key government services (health, education, security, etc.) as well as coordination of for socio-economic development in the region. For this project this mainly includes issues related to socio-economic development on the area from the Project.
Petra Development and Tourism Region Authority (PDTRA)	The PDTRA is a legal, financial, and administrative independent Authority founded in 2009 and which aims to develop the Region touristically, economically, socially, culturally while contributing to local community development. In addition, the PDTRA is also responsible for providing infrastructure and utility services to Petra such as waste collection, public lighting, etc. For this Project this mainly includes issues related to socio-economic development of the area from the Project as well as land use and planning issues.

(ii) Non-Governmental Organizations and Academic Institutions

Other interested parties considered during the ESIA related consultation include those who have the potential to influence the authorization of the Project and assist in its delivery. This mainly includes Non-Government Organizations (NGOs).

Table 11: List of Key NGO and Academic Institutional Stakeholders

Stakeholder	Interest in/influence on the Project
Environmental Societies Association	The Association forms the umbrella for the all environmental NGO's in Jordan and is also a member of the 'EIA Technical Committee' which will review this ESIA study for approval and granting of environmental clearance.
The Royal Society for the Conservation of Nature (RSCN)	The RSCN is an environmental NGO having a mandate for the conservation of Jordan's biodiversity and natural resources. In addition, it is empowered to establish and manage protected environmental reserves as well as Important Bird areas under the supervision of the MoEnv. For this project this includes land use issues related to environmental reserves and important birds areas as well as potential impacts from the project on biodiversity and birds.

6.5 Stakeholder Consultation and Engagement To-Date

The table below highlights the stakeholder groups as identified earlier, and the consultation/engagement method which has been undertaken for each group. As noted in the table below this mainly includes high level consultations as well as detailed engagement and consultations.

The high level consultation mainly includes the scoping session, and which is considered high level as various stakeholder groups representing various entities are consulted at once (such as national governmental entities, local governmental entities, non-governmental organizations, etc.). The detailed

engagement and consultation tends to focus on a single entity within a stakeholder group at a given time, whose concerns need to be taken into account throughout the ESIA study.

Table 12: Methodology for Stakeholder Engagement

No.	Stakeholder Group	Consultations/Engagement to Date	Future Consultations/Engagement ("Section 6.66.6")
1	**Affected Communities**		
a	Local community	▪ High level – Scoping Session ▪ Detailed Engagement – Onsite consultation	▪ Local Community Disclosure session (gender specific to include women)
b	Nomads	▪ Detailed Engagement – Onsite consultation (gender specific to include women)	None
2	Other Interested Parties/Stakeholders	▪ High level – Scoping Session ▪ Detailed Engagement –meetings, e-mail communication, etc.	▪ Disclosure session

6.5.1 High Level Consultation – Scoping Session

In accordance with MoEnv's "EIA Regulation No. (37) of 2005", a scoping session must be held for those projects which require a comprehensive EIA study; as the case with this Project. In coordination with the MoEnv, the Scoping Session for the Project was held on 3 September 2013 at the Le Meridian Hotel in Amman. The list of invitees was identified jointly by the MoEnv and the ESIA team.

The list of invites mainly included the following stakeholders: (i) national governmental entities (various ministries and other governmental entities), (ii) Local Governmental Agencies (e.g. Ma'an Governorate, local government institution such as Ma'an Water Directorate, etc.), (iii) Non-Governmental Organizations (environmental and social development), (iv) Academic and Research Institutions, and (v) local community representatives which were identified in collaboration with the local community leaders.

The ESIA Team documented all records of the scoping session to include transcripts, minutes of meetings, list of participants and attendees, comments and so on. This was presented in detail in the ToR report submitted to the MoEnv. Selected photos from the session are shown in Figure 13 below.

In general, the objectives of the scoping session include the following:

- Introduce the Project and its various components to the stakeholders and provide them with all available information about the Project;
- Present the various anticipated impacts from the Project throughout its various phases and allow stakeholders to participate in the process of scoping environmental impacts of the Project;
- Early consideration of stakeholders concerns and fears regarding the nature, scale and impacts of the Project; and
- Present the suggested methodology for the ESIA and allow stakeholders to comment on the scope of work and methodology.

Throughout the scoping session, the following presentations were given:

- A welcome speech by **Eng. Izzat Abu Hamra, Director of the Licensing and Guidance Directorate of MoEnv**, in which Mr. Abu Hamra briefly explained the ESIA process and stressed on the importance of the scoping session which aims to take into account the concerns and comments of the stakeholders throughout the ESIA study. In addition, Mr. Abu Hamra emphasized the importance of renewable energy projects to Jordan.
- A presentation of the Project components by **Yazan Abu-Hantash, General Manager of GWRE,** in which Mr. Abu-Hantash started by welcoming the attendees to the Scoping Session after which he

discussed the challenges Jordan faces in meeting its energy requirements. Mr. Abu-Hantash briefly discussed MEMR's adopted energy strategy which includes investments in renewable energy to reduce dependence on imported energy sources thus being a major component of establishing Jordan's energy security. In addition, he presented the outline concept for the Project and its components, and introduced the Project location and specifications of the site. Finally, he briefly discussed the activities expected to take place during the various Project phases as well as the timeline for the implementation of the Project.

- A presentation by **Lana Zu'bi, ECO Consult.** Ms. Zu'bi reiterated the objectives of the scoping session and the main Project components as discussed earlier. She explained the importance of this ESIA process in identifying the benefits of this Project to the country and weighing them against the implications on the environment and in designing mitigation of the impacts, which must be considered in the design and implementation of the Project. Ms. Zu'bi discussed in details the anticipated negative environmental impacts during the various Project phases and the methodology that will be adopted throughout the ESIA study for assessing those impacts on those key sensitive receptors. There was time for questions and answers following this presentation as well as a facilitated discussion, moderated by Ms. Zu'bi.

Figure 13: Selected Photos from the Scoping Session of 3 September 2013

The following table presents the main issues raised by the stakeholders throughout the scoping session and also highlights how those comments were taken into account and incorporated throughout the ESIA study.

Table 13: Summary of Comments raised during Scoping Session and Response

Attribute	Comment	Response
Landscape and Visual	Concerns were raised regarding potential visual impacts from the turbines on the City of Petra – a well-known World Heritage Site.	This issue has been addressed in "Chapter 8 - Landscape and Visual". The City of Petra is located around 16 kilometers north of the Project site. In addition, Petra is known to be surrounded by mountainous areas, and therefore the topographical difference between the Petra site and the Project area would make it impossible for the turbines to be visible. In addition, as presented in "Chapter 8" and in order to confirm the above, as part of the impact assessment, visual simulation software was used to undertake a visibility analysis of the Project from key sensitive visual receptors in the area and indicate which turbines would be visible from each receptor. The assessment concludes that no

		views to the wind farm could be identified form the City of Petra due to the fact that it is located at the ground of the valley surrounded with side-valleys and mountains with steep climbs.
Geology and Hydrology (Soil and Groundwater)	A concern was raised regarding potential impacts from the Project on the water resources in the area.	The only foreseen impact from the Project on water resources in the area is mainly related to improper management of waste streams generated (to include solid waste, wastewater, hazardous waste and hazardous materials), which could result in potential contamination and pollution of water resources. Such an issue has been discussed in "Chapter 10" and appropriate mitigation and monitoring measures to ensure such impacts are controlled.
Birds	At the time of undertaking the scoping session (September 2013), the spring and fall survey for migratory birds for the site has already been undertaken to include 115 hours of observations during the spring season and 250 hours during the fall (in 2012). Issues were raised suggesting that Guidelines have been developed by the Royal Society for the Conservation of Nature (RSCN) and BirdLife International requiring 40 hours of observations per week (amounting to 8 hours per day) throughout the migration seasons and that additional monitoring must be undertaken throughout next spring/fall season to compensate for the difference in monitoring hours required.	In specific the methodology for avi-fauna surveys and monitoring has continuously changed since the Project inception in 2012 and has been a continuous learning process throughout the course of the Project development. Such a learning process was challenging and complex due to the fact that there are no wind farm developments in Jordan from which previous experiences can be learnt from and more importantly the absence of local as well as international guidelines/procedures. In specific, when the RSCN Guidelines were issued in 2013 it was unclear whether they should be followed or not as it was uncertain whether they will be adopted by the MoEnv (eventually they were not). Nevertheless, ECO Consult aimed to further increase the monitoring hours to comply with the requirements of the Guidelines discussed above to the greatest extent possible. Additional monitoring was undertaken during autumn 2013 amounting to 160 hours and during spring 2015 amounting to 432 hours. This issue is discussed in further details in "Chapter 12".
Infrastructure and Utilities	Road Networks – A stakeholder required that the ESIA investigate risks related to transportation of Project components on road networks.	"Chapter 16.2-Infrastrucutre and Utilities"/"Section 16.2.5" discusses the potential impacts from the Project on the road networks and discusses appropriate mitigation and monitoring measures to eliminate or reduce such impacts to acceptable levels.
Occupational Health and Safety	A stakeholder required that the ESIA study investigate the risks related to occupational health and safety during the various phases of the Project.	17"Chapter 17 - Occupational Health and Safety" discusses the potential impacts from the Project on the occupational health and safety and discusses proper mitigation and monitoring measures to eliminate or reduce such impacts to acceptable levels.
Community Health, Safety and Security	Some concerns were raised regarding the cumulative effects of noise from all the wind turbines of the Project on the nearby communities such as Al-Rajef village.	"Chapter 18 - Community Health, Safety and Security" discusses the potential impacts from noise from the wind turbines on the nearby communities. The chapter includes a comprehensive assessment of impacts from noise through the use of a computer modeling software which predicted the expected noise propagation levels cumulatively in intervals surrounding the turbines and predict the expected levels at the nearby receptors. The section also discusses mitigation and monitoring measures to ensure that impacts are eliminated and/or reduced to acceptable levels and comply with the maximum allowable requirements for noise levels by the relevant authorities.
Socio-Economic Development	Some stakeholders stressed on the importance of socio-economic development by the Project to those local communities in the area.	"Chapter 19 - Socio-Economic Conditions" investigates and characterizes in details the current socio-economic conditions of the area. In addition, the chapter assesses the anticipated positive impacts from the Project and discusses the current and future plans of the Developer to support and engage the local community

		throughout the Project (such as employment opportunities, capacity building programs, etc.). Finally, the ESIA provides recommendations for a Stakeholder Engagement Plan to be implemented by the developer during the various Project phases.
General Comments	A question was raised whether the ESIA will study the various potential impacts from the connection lines from the substation within the Project area to the national network.	The overhead high voltage transmission line will connect from the Project site to the national grid and will be constructed and operated by NEPCO. Details and information are not finalized at this stage by NEPCO with regards to the final grid connections plans and route for the overhead lines. Given the lack of final and detailed information, the inclusion of those components in the ESIA is not possible. Nevertheless, the ESIA does identify a set of Environmental Performance Requirements which must be implemented by NEPCO once such details are available which aim to ensure that environmental issues are taken into account and adequately considered. Those are presented in "Chapter 23".

6.5.2 Detailed Engagement – Affected Community Onsite Consultations

This section presents the onsite consultations that were undertaken with the local community as well as the nomads in the area.

(i) Local Community

Based on several site visits undertaken to the Project site it was noticed that there is local community activity within the area which mainly includes grazing and agricultural activities. In general, such activities are restricted to the local community members of Al-Rajef and Dlaghah & Rassees only (although the lands in the area are also owned by people from Taybeh community however such activities are not undertaken by them onsite).

Onsite consultations and discussions were undertaken onsite in June 2013 as it is considered the phase which entails the highest onsite land activities by the local community members (refer to Figure 14). Such consultations and discussion entailed visiting each area where activity was noticed, to the greatest extent possible, starting from south to the north of the Project area. It is important to note no women groups were noticed to undertake such onsite activities by the local community.

The objective of the consultations included:

- Introduce the Project and its various components;
- Understand, characterize and assess the activities undertaken onsite (the outcomes of such discussions is presented in details in "Chapter 9 – Land Use");
- Understand, characterize and assess their socio-economic conditions and patterns (the outcomes of such discussions is presented in details in "Chapter 19"); and
- Present and discuss the potential impacts of the Project which could affect their activities onsite in order to take into account their thoughts and concerns on such issues. This mainly includes impacts on land use and impacts from shadow flicker and noise. The outcomes of such consultations are discussed in further details in "Chapter 9 – Land Use" and "Chapter 18 – Community Health, Safety and Security".

In summary, throughout such discussions it was evident that local community members were all very well informed about the Project and were very supportive. More importantly, no key issues of concern were raised by the local communities on any of the impacts highlighted above.

Figure 14: Selected Photos of Onsite Local Community Consultations

(ii) Nomads

Based on several site visits undertaken to the Project site, nomadic activity was noticed in the area. Nomads are known to move around on a seasonal basis. Generally, nomads inhabit areas with a cooler climate during spring/summer (between April and September) and which are productive lands to enable them to undertake grazing and agricultural activities (such as Rajef area which located on the Sherah highlands). After October, as the weather becomes colder they move to other warmer areas such as Wadi Araba or Jafr.

Consultations were undertaken onsite throughout the period in which nomads were known to inhabit the area (Figure 15). Such consultations and discussion entailed visiting each area where nomads were noticed, to the greatest extent possible, starting from south to the north of the Project area. It is important to note that consultations with nomads were gender specific – therefore specific consultations were undertaken with women of each of the nomadic groups consulted by a female specialist of the 'ESIA Team'. However, due to cultural norms in Jordan photos of consultations with women groups were not undertaken.

The objective of the consultations included:

- Introduce the Project and its various components;
- Understand, characterize and assess the activities undertaken onsite (the outcomes of such discussions is presented in details in "Chapter 9 – Land Use");
- Understand, characterize and assess their socio-economic conditions (the outcomes of such discussions is presented in details in "Chapter 19"; and
- Present and discuss the potential impacts of the Project which could affect their activities onsite in order to take into account their thoughts and concerns on such issues. This mainly includes impacts on

land use and impacts from shadow flicker and noise. The outcomes of such consultations are discussed in further details in "Chapter 9 – Land Use" and "Chapter 18 – Community Health, Safety and Security".

In summary, throughout such discussions it was noticed that generally the nomads were informed about the Project (less so by women specifically) and were supportive. More importantly, no key issues of concern were raised in relation to any of the impacts highlighted above.

Figure 15: Selected Photos of Onsite Consultations with Nomads

6.5.3 Detailed Engagement – Other Stakeholder Engagement Activities

Throughout the ESIA process various stakeholders were engaged and consulted. From the onset of the ESIA study, and in accordance with the issues and impacts anticipated from the Project throughout its various phases, the key stakeholder groups that needed to be consulted, involved, and collaborated with on a detailed level were identified.

Such engagement was intended for various purposes and which included to: (i) introduce the project and its overall concept and components, (ii) understand thoughts, views, and concerns from the Project development, (iii) collection of relevant data for assessment of baseline conditions and anticipated impacts from the Project, (iii) discussion on anticipated impacts, (iv) discussion on proposed mitigation measures, etc.

Such stakeholder groups were engaged and consulted through one or more of the following communication protocols: (i) bi-lateral meetings, (ii) e-mail communication, (iii) phone communication, and (iv) formal letters.

Table 14 below presents the entities which were engaged and consulted and the purpose of such engagement. Generally, the outcomes of such consultations are presented and included within the Section that the attribute relates to.

Table 14: List of Other Consultations during the ESIA

Entity	Attribute	Objective of Consultation
Ministry of Environment (MoEnv)	General	Ongoing discussions on the ESIA process as well as general concerns and impacts from Project development.
Ministry of Agriculture (MoA)	Land Use	Current and future land use planning in relation to agriculture.
Ministry of Municipal Affairs (MoMA)	Land Use	Current and future land use planning in Project area as set by MoMA.
Ministry of Water and Irrigation (MWI)	Geology and Hydrology	Collection of secondary data on site geology and hydrology
	Infrastructure and Utilities	Collection of secondary data on infrastructure and utilities related to water resources and networks, wastewater networks and treatment plants, etc.
Department of Antiquities (DoA)	Archeology and Cultural Heritage	Collection of any available secondary on archeological resources on the area. In addition, coordinate with them to undertake archeological survey for the Project site.
The Royal Society for the Conservation of Nature (RSCN)	Land Use	Current and future land use planning in relation to areas of critical environmental concern.
Civil Aviation Regulatory Commission (CARC)	Land Use	Discussion on potential impacts from the Project on civil aviation safety.
Royal Jordanian Air Force (RJAF)	Land Use	Discussion on potential impacts from the Project on military aviation safety.
Telecommunication Regulatory Commission (TRC)	Land Use	Collection of existing telecommunication networks in the area and discussion on potential impacts from the Project.
Jordan Radio and Television Corporation (JRTV)	Land Use	Collection of existing radio and television networks in the areas and discussion on potential impacts from the Project.
Petra Tourism and Development Region Authority (PDTRA)	Socio-economic	Understand thoughts, views, and concerns from the Project development.
		Collection of secondary data on socio-economic indicators for Petra District in general and nearby communities. In addition, meetings were undertaken to characterize and understand the socio-economic conditions in reality of those local communities.
		Socio-economic development and plans for local community engagement.
	Land Use	Collection of secondary data available on land use planning for area by PDTRA.
	Infrastructure and Utilities	Collection of information on existing infrastructure element in the area such as municipal approved landfills.

6.5.4 Local Community Disclosure Session

A disclosure session was undertaken on 30 March 2016 at the Rajef Association for Special Education located at Al-Rajef village. Local community representatives from the main community settlements near the Project site as identified within the ESIA were invited to attend and participate in the disclosure session – to include Al-Rajef village, Dlaghah and Rassess village, Sadaqeh Village, Fardakh Village and Taybeh Village.

The disclosure session was gender specific in which a separate session was held for men and women.

The disclosure session included a presentation on the details of the Project to include its location, main Project components, Project layout and turbine locations, and Project phases (construction, operation, and decommissioning). In addition, the ESIA study, its purpose, objective and scope were discussed.

The presentation then moved on to briefly discuss the environmental and social receptors that were studied and the main outcomes and results of the ESIA – to include (i) birds; (ii) biodiversity; (iii) bats; (iv) archeology and cultural heritage; (v) air quality; (vi) infrastructure and utilities; (vii) occupational health and safety; and (viii) geology and hydrology. In addition, the potential impacts and the proposed mitigation and monitoring measures identified in the ESIA were discussed in details for those impacts which are directly related to the local community to include: (i) landscape and visual; (ii) land use; (iii) community health, safety and security; (iv) socio-economic conditions.

There was time for questions and answers following this presentation as well as a facilitated discussion. The main questions and issues raised are summarized in the table below along with the responses provided. Representative photos of the disclosure session are presented in the figure below (representative photos of the women disclosure session were taken but no consent was given to publish the photos as part of the report). The main outcomes and proceedings of the disclosure session are summarized below

Figure 16: Representative Photos of the Local Community Disclosure Session for Men

Table 15: Summary of Comments and Responses for the Local Community Disclosure Session for Men and Women

Attribute	Comment	Response
Men Session		
Land Use	A stakeholder inquired whether the construction activities will affect the entire land areas of the Project.	It was explained that construction activities for the Project will be undertaken in very limited areas for the turbine locations and other infrastructure requirements such as roads. Those represent a very small footprint which is around 7% of the total leased lands area and 2% of the entire Project site boundary area.
Birds	Several stakeholders stated that based on their experiences and observations throughout the years, they haven't seen many migrating birds passing through the area. The stakeholders then inquired about the mitigation and monitoring measures that will be implemented in case migrating birds pass through the Project site.	The results of the baseline studies and importance of the site in terms of migration routes was explained in details (as presented in "Chapter 12"). In addition, the mitigation and monitoring measures were explained as discussed in details in "Section 12.3.2" and which includes in particular the observer led turbine shutdown monitoring which will be undertaken during the operation phase.

Community, Health, Safety and Security – Noise	Several stakeholders asked about the sources of noise from the turbines. In addition, they inquired about the measures that will be implemented to ensure that unacceptable noise limits from the turbines will be met.	The sources of noise generation from the wind turbines were explained in that they include mechanical noise generated from the generator and gear box as well as aerodynamic noise generated from the movement of the blades and which depends on several factors such as wind speed and direction. However, it was also explained that advances in engineering designs of turbines have significantly reduced their noise emissions. Nevertheless, the results of the modelling were explained and presented in further details along with the mitigation measures and specifically the reduced power operation strategy that will be implemented for the wind turbines (refer to "Section 18.2.1" for additional details).
Socio-Economic Conditions	Stakeholders discussed in general their support for the Project. They stated that they have no objection on the development of the project and no issues of concern in relation to impacts from noise, shadow flicker, landscape and visual, land use, etc. They expressed their expectations from the development in terms of providing job opportunities to the local communities and other possible measures which could improve socio-economic conditions in the area.	It was stated that the Developer is committed to social responsibility and local community engagement and development. The Developer will be aiming to hire local community members for the Project to the greatest extent possible during both the construction and operation phase and is also considering social responsibility programs targeted to the local communities. It was explained that these details will be developed at a later stage and also stated that the ESIA recommends that this is put into an action plan to be created and implemented by the Developer. Additional details on such issues and the requirements for the Action Plan is provided in "Section 19.2".
Women Session		
Community, Health, Safety and Security	A stakeholder inquired about the safety concerns from the turbines and specifically about blade throws possibility during times of very high wind speed.	It was stated that the overall risk of such an incident is extremely low. The design of the project and setting of the turbines has taken into account a safety setback distance for all types of falling hazards and which includes a safety setback distance from all road networks in the Project area and a safety setback distance from adjacent lands at each turbine. Finally and most importantly, the wind turbines will automatically stop working after a certain wind speed is reached to mitigate such risks.
Socio-economics	A stakeholder suggested that job opportunities that are targeted to the local communities must include women groups as they are affected by relatively high unemployment rates and cannot find jobs in the area.	It was stated that this will be taken into account as the ESIA recommends that the Developer prepare and implement an action plan for working with the local community which must take into account presenting a transparent, fair and well-advertised recruitment procedures for the local communities and which must include females as well. Additional details on the requirements for the Action Plan are provided in "Section 19.2".
Other	Throughout the session the stakeholders raised no issues of concern on potential impacts from landscape and visual, land use, noise, shadow flicker.	

6.6 Future Stakeholder Engagement and Consultation

Future stakeholder engagement and consultations will mainly include the following, each of which is discussed in further details below: (i) disclosure of the ESIA document and (ii) implementation of the Stakeholder Engagement Plan (SEP) by the Developer.

6.6.1 Disclosure of the ESIA document

The final ESIA, Non-Technical Summary (NTS) and the SEP will be disclosed on the Developer's website. In addition, hard copies of these documents will be available at the following locations:

- Ministry of Environment;
- Ma'an Governorate – Local Development Unit; and
- Petra Tourism and Development Region Authority (PDTRA).

The ESIA will be disclosed for a minimum 30 day disclosure period.

6.6.2 Stakeholder Engagement Plan

Stakeholder Engagement is an on-going process that involves: stakeholder analysis & planning, disclosure & dissemination of information, consultation & participation, grievance mechanism, and on-going reporting to Affected Communities. A Stakeholder Engagement Plan (SEP) is developed and implemented that is scaled to the Project risks and impacts and development stage, and be tailored to the characteristics and interests of the Affected Communities and key stakeholders.

The SEP for the Project describes the planned stakeholder consultation activities and engagement process and includes the following:

- Define the Project's approach to future stakeholder engagement;
- Identify stakeholders within the area influenced by the Project;
- Profile identified stakeholders to understand their priorities;
- Propose an action plan for future engagement with identified stakeholders; and
- Set out the grievance/project complaints mechanism.

7. OVERVIEW OF STRATEGIC ENVIRONMENTAL AND ECONOMICAL IMPACTS

It is understood that the Project will results in several site specific environmental and social impacts on various receptors throughout the Project phases to include planning and construction phase and operation phase. Such impacts are discussed in the subsequent chapters for each environmental receptor respectively and which include the following:

- Landscape and Visual;
- Land Use;
- Geology and Hydrology (Soil and Groundwater);
- Biodiversity;
- Birds (Avi-Fauna);
- Bats;
- Archeology and Cultural Heritage;
- Air Quality and Noise;
- Infrastructure and Utilities;
- Aviation, Telecommunication and Television & Radio Links;
- Occupational Health and Safety;
- Community Health, Safety and Security; and
- Socio-economic conditions.

Nevertheless, the Project will results in significant and crucial positive environmental and economic impacts on the strategic and national level given the current challenges the energy sector in Jordan is facing which have serious implications on Jordan's energy security as well as major economic burdens to the Jordanian economy.

Such positive impacts are important to highlight, consider, and take into account before investigating the potential negative environmental impacts anticipated from the Project, as discussed in the following sections.

The anticipated positive environmental and economic impacts on the strategic level are discussed and highlighted below.

7.1 Master Strategy of Energy Sector in Jordan

The energy demand in Jordan is characterized with a rapid increase to cope with the development. The expected demand for primary energy in 2020 will amount to 15 million tons of oil equivalent, compared to 7.6 million tons of oil equivalent in 2007. Similarly, electricity demand in 2020 is 5,770 MW compared to 2,100 MW in 2007; and average increase of 300MW per year (MEMR, 2007).

To meet the energy demand and the challenges of the energy sector a comprehensive energy strategy was approved by the Cabinet in December 2004 revised in 2007 – "Master Strategy of Energy Sector in Jordan". The Strategy is to provide a vision for development of energy sector over the next ten years. The Strategy studied all options and alternatives for securing all types of energy from the following points of views: (i) the optimal options to cope with the energy demands and its investment cost, (ii) reforming and restructuring the energy sector to open the market for competition, and (iii) expanding on renewable energy projects and implementing energy conservation programs.

To this extent, the future goals of the Strategy can be summarized as follows:

- Reduce the dependence on foreign energy sources (energy independence);
- Security of supply with energy production based on a variety of sources;
- The target for 2015 is for domestic resources to cover 25% of demand reducing imports to 75%;
- The target for 2020 is for domestic resources to cover 39% of demand reducing imports to 61% and achieving energy production from additional energy sources; and
- Promote renewable energy sources to share to 7% in the primary energy mix in 2015, and 10% in 2020. This is to be met through 600-1000 MW from wind energy and 300-600 MW from solar energy.

To promote renewable energy sources and in order to open the way for private sector to effectively participate in the implementation of renewable energy project, the Renewable Energy and Energy Efficiency Law was issued and officially entered into force in April 2012. With this law, and for the first time in Jordan, investors had the opportunity to identify and develop renewable grid-connected electricity production through the Direct Proposal Submission as discussed earlier in "Chapter 2".

In line with the above, this development allows for more sustainable development and shows the commitment of the Government of Jordan to realizing its energy strategy and meeting the set targets for renewable energy sources.

7.2 Energy Security

Recently, most policy makers around the world are grappling with issues related to energy security, energy poverty, and an expected increase in future demand for all energy sources – and Jordan is no exception. Almost certainly, the most spoken words by policy makers and government bodies in Jordan in the last couple of years revolved around 'energy security', which is one of the key goals of the Master Strategy of Energy Sector in Jordan discussed above.

Currently, the Jordanian local energy resources are very limited commercially and Jordan is highly dependent on imported energy, as the total imported energy amounted to 97% of Jordan's total energy needs.

In line with the above, the Project in specific will contribute to increasing energy security through reliance on an indigenous, inexhaustible and mostly import-independent energy resource. The estimated electricity generation from the Project is 256 GWh per year, on average; which will serve the annual electricity needs of more than 60,000 local households.

This has been based on taking into account that in 2014 (latest statistic) the annual electricity consumption of households in Jordan was 6,580 GWh (MEMR, 2015) while the number of households in 2014 in Jordan was 1,590,762 (DoS, 2015) and thus the average annual electricity consumption can be assumed to be around 4,100 Kilowatt Hour (kWh).

7.3 Economic Benefits

The reliance on imported energy as discussed earlier above has led to major economic burdens to the Jordanian economy. Over the past year, Egyptian gas supplies through the Jordan Gas Transmission Pipeline (JGTP) have been severely interrupted. To substitute the shortfall in Egyptian gas supply, Jordan had to rely to more expensive alternative fuels (imported fuel oil, diesel, gasoline) for power generation resulting in significant economic implications to the Government of Jordan's energy bill. In 2012, the cost of imported energy amounted to 20% of Jordan's Gross Domestic Product (GDP).

In line with the above, the Project will produce clean energy which will contribute to lowering electricity generation costs compared to the current costs associated with liquid fuels and thus leads to a substantial decrease in the Government of Jordan's fiscal deficit.

7.4 Environmental Benefits

The negative environmental impacts from generating electricity through conventional fossil fuel burning at thermal power plants are very well known. This most importantly includes air pollutant emissions such as ozone, Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), particulate matter, and other gases which are the cause of some serious environmental concerns such as smog, acid rain, health effects, and many others.

In addition, the burning of fossil fuels results in carbon dioxide emissions; a primary greenhouse gas emitted through human activities which contributes to global warming. The main human activity that emits CO_2 is the combustion of fossil fuels for electricity production and transportation. Concurrently, global climate change has become an issue of concern and so reducing greenhouse gas emissions have also emerged as primary issues to be addressed as the world searches for a sustainable energy future.

Generating electricity through wind power is rather pollution-free during operation. Compared with the current conventional way of producing electricity in Jordan through thermal power plants using heavy fuel oil and/or natural gas, the clean energy produced from renewable energy resources is expected to reduce consumption of fossil fuels, and will thus help in reducing greenhouse gas emissions, as well as air pollutant emissions. The Project will on average displace more than 160,000 metric tons of CO_2 annually.

This estimation was based on figures provided by the International Energy Association's (IEA) "Carbon Dioxide (CO_2) Emissions from Fuel Combustion" (IEA, 2013). According to the report, CO_2 emitted per kWh for electricity generation in Jordan in 2011 (latest statistic) is around 0.64kg. Given that the Project is expected to provide around 256 GWh of electricity per year**,** then the Project will displace more than 160,000 metric tons of CO_2 annually.

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8. LANDSCAPE AND VISUAL

This Chapter first provides an assessment of baseline conditions within the Project site and surroundings in relation to landscape and visual and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

8.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to landscape and visual receptors and presents the outcomes and results.

8.1.1 Baseline Assessment Methodology

The baseline assessment of the Project site was based on several site visits undertaken by the 'ESIA Team' to the Project site and its surrounding areas which aimed to characterize the landscape, topography, and visual character and receptors of the Project site and surrounds. In addition, the assessment was also based on communications and collection of relevant secondary data from governmental authorities on key visual receptors in the area (such as the PDTRA).

8.1.2 Results

The Project site mainly consists of a series of small hills and ridges on the plateau of the Sharah highlands at altitudes ranging between 1550-1700m above sea level. Generally, the Project site has no sudden changes in topography, however in some parts ridges are characterized by relatively steep slopes exceeding 17 degrees.

The western border of the Project site overlooks to the west an escarpment consisting of steep slopes which eventually descend to Wadi Araba (which is southern part of the Jordan Rift Valley). Figure 17 below presents a 3-D terrain model which presents the general topography of the Project site and nearby areas including the steep slopes to the west.

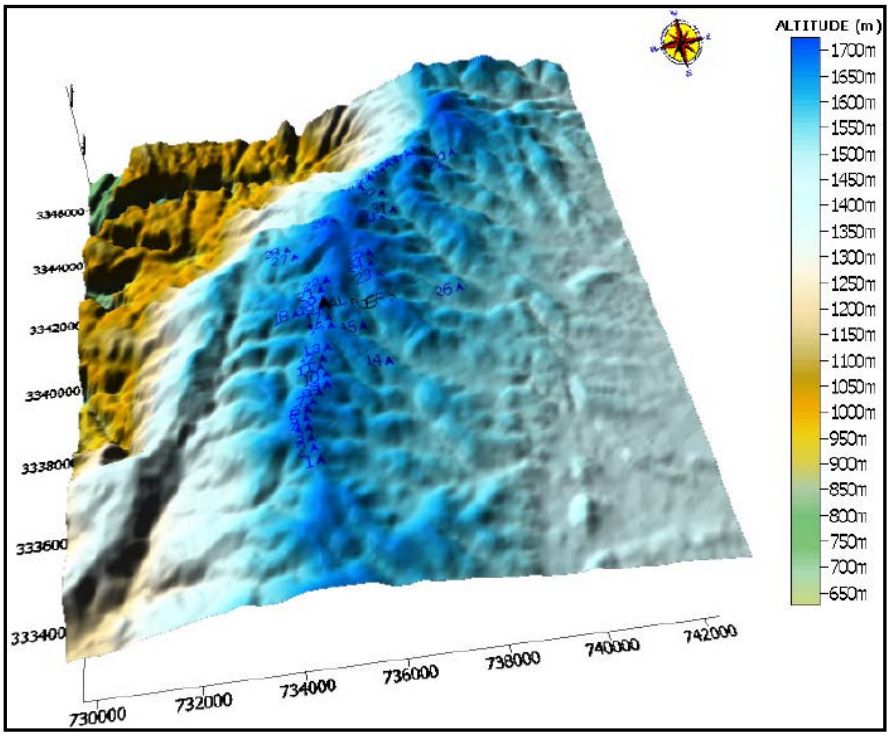

Figure 17: 3-D Terrain Model of the Project Site and Nearby Areas

The landscape of the Project site can be described as arid with frequent rock outcrops on hillsides. The Project site is barren and heavily degraded with few vegetation strips and scattered trees of remnant forests that use to prevail in the entire mountain of Al-Rajef. The site has been heavily degraded due to massive grazing, tree cutting and ploughing which have most likely occurred extensively throughout the site for many decades.

Figure 18 below presents the various dominant landscape covers as well as topographical conditions within the Project site.

Figure 18: General Topography and Landscape of the Project Site

The Project site is mainly accessed through Highway #35 (better known as the 'King's Highway'); one of the highways which connects Ma'an Governorate with the capital city of Amman in the North – but not the major one. Highway #35 runs through some parts of the Project site. In addition, within the site there are other access roads and several additional small agricultural roads.

Within the Project site itself there are no key visual receptors or particular structures of interest such as recreational activities, environmental reserves, remarkable/unique historical or cultural sites, or other natural structures normally seen as valuable by the human perception. The leased lands of the Project site are vacant, except for the following:

- Three (3) telecommunication transmission towers located the central parts of the Project site; those towers belong to the thee (3) main telecommunication companies of Jordan – Orange, Zain and Umniah; and
- Within the area (but not within the leased lands) is: (i) an operating olive mill which is owned by a local community member of Al-Rajef village, (ii) a police station on Highway #35 and (iii) a small car repair workshop on Highway #35 that is owned by a local community member of Al-Rajef with a house next to it – the owner resides mainly in the village, and occasionally in this house

As for the surrounding area of the Project site, the landscape and visual character can be divided into four (4) main types as summarized in the table below and as presented in Figure 19 below as well. The Project site itself is located within the plateau landscape (landscape C).

Table 16: Landscape Types Surrounding the Project Site

Landscape	Description
Petra World Heritage Site (Landscape A)	This landscape represents the boundary of the Petra world heritage site as defined by UNESCO – which most importantly includes the city of Petra which includes the Treasury (Khazneh). There are other minor touristic sites within the heritage site besides Petra city (which are considered less attractive and definitely not as touristic) – this mainly includes Jabal Haroun (Shrine of Prophet Aaron). It is believed that Moses' brother Aaron was buried in this place. A mosque stands in the spot with its white dome visible from most areas in and around Petra. Nevertheless, the area is situated in a narrow valley with side-valleys, cliff like with steep climbs. The heritage area extends to the west of Highway #35. The village of Wadi Musa is situated between the Highway and the heritage area and is comprised of many hotels and other touristic facilities. The world heritage site is evaluated as highly sensitive on landscape characteristics due to its extraordinary touristic value and scenic views.
Wadi Araba (or Jordan Rift Valley) (Landscape B)	This landscape includes Wadi Araba (the southern part of the Jordan rift valley) and its escarpment which provides dynamic and partly 'dramatic' scenery around Petra. The area between the escarpment and Highway #35 has been included in this landscape type, since scenic views valued by tourists extend from Highway #35 to the West. Therefore, this landscape is evaluated to have a medium sensitivity due to its scenic views.
Plateau (Landscape C)	This landscape is located to the east of Highway#35 and is characterized as a wide, barren-like slightly undulating plateau. The scenery is monotonous and has no particular structures of interest or any key visual receptors. Furthermore, this type of landscape extends to the north and south far beyond the area of interest with not much change in its characteristics. Since there is only limited agricultural land-use in this landscape, the value of the landscape to the local communities also is not very high. Given all of the above, this area is considered to have a low sensitivity.
Village Areas (Landscape D)	The landscape type refers to the villages in the vicinity of the Project (such as Al-Rajef, Dlaghah & Rassees, Fardakh, Sadaqah, etc.). Touristic high valued views or any other key visual receptors are not known in those villages surrounding the Project site. For people living in the villages, scenic views are less relevant in their everyday lives. However, given the continuous presence of the residents, the village areas are evaluated to have a medium sensitivity.

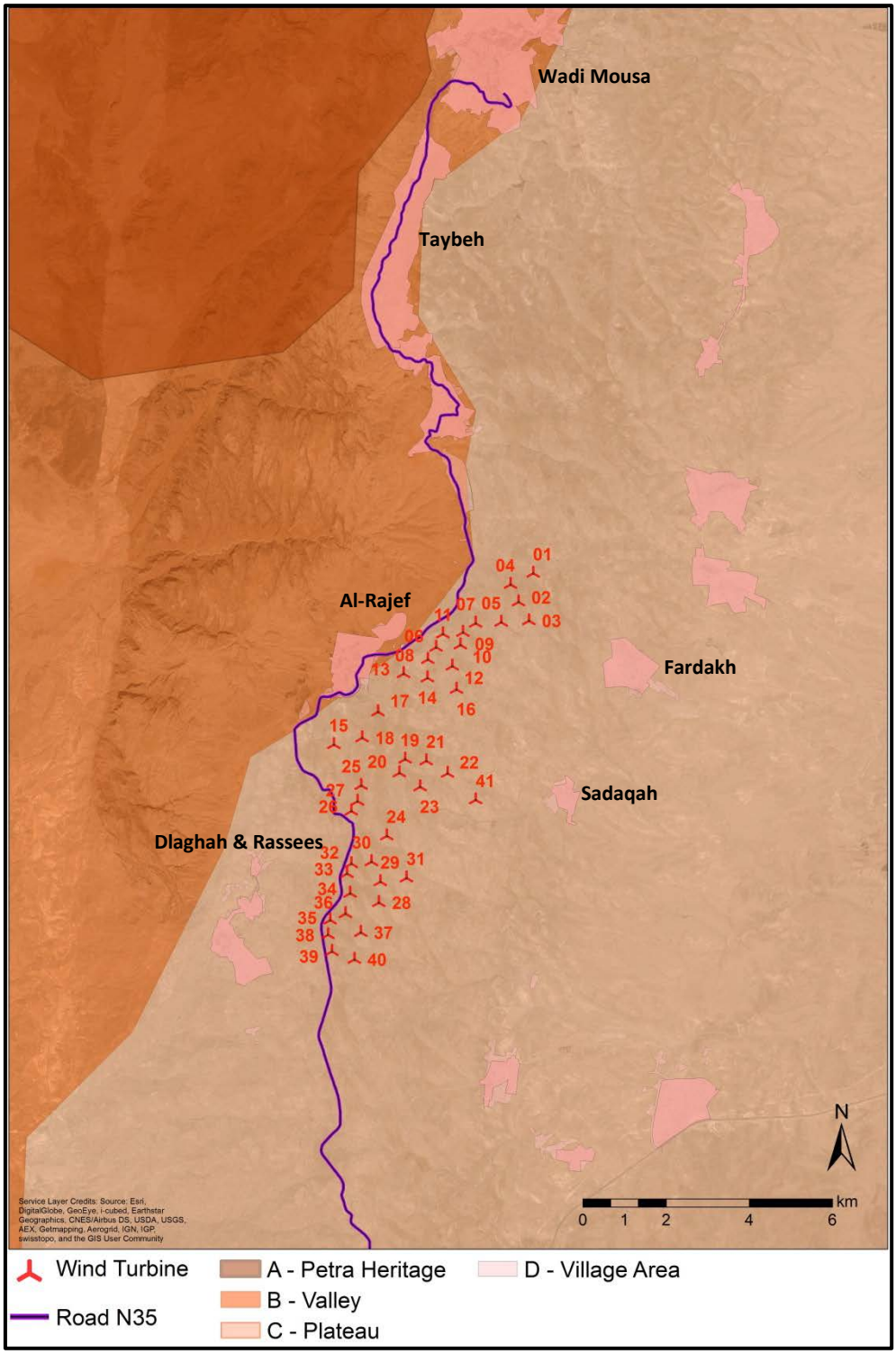

Figure 19: Selection of Principle Landscape Types in the Project's Surrounding

8.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on landscape and visual during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

8.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, leveling, excavation, grading, etc.

Construction activities would create a temporary effect on the visual quality of the site and its surroundings. The visual environment during the construction phase would include the presence of elements typical of a construction site such as equipment and machinery to include cranes, excavators, trucks, front end loaders, compactors and other.

However, as discussed in "Section 8.1", the Project site itself is considered an area with no particular structures of interest or any key visual receptors – such as recreational activities, environmental reserves, remarkable/unique historical or cultural sites, or other natural structures normally seen as valuable by the human perception. In addition, any visual impacts to the surrounding landscapes are unlikely, and if so then they will be only temporary affected and will definitely not exceed the impacts anticipated during the operation phase as discussed in "Section 8.2.2" below.

The visual environment created during the construction period would be temporary, of a short-term duration, limited to the construction phase only. For the duration of construction the visual impacts will be of a negative nature and will be noticeable within the Project site, and therefore of a medium magnitude. As there are no key sensitive visual receptors which would be affected the receiving environmental is determined to be of a low sensitivity. Given all of the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor during the construction phase and which include:

- Ensure proper general housekeeping and personnel management measures are implemented which could include:
  - Ensure the construction site is left in an orderly state at the end of each work day.
  - To the greatest extent possible construction machinery, equipment, and vehicles that are not in use should be removed in a timely manner and kept in locations to reduce visual impacts to the area.
  - Ensure proper storage, collection, and disposal of waste streams generated as discussed in detail in "Section 10.2".

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor and which include:

- Inspections of the works should be carried out at all times to ensure the above measures are implemented.

8.2.2 Potential Impacts during the Operation Phase

Visual impacts associated with wind energy projects typically concern the turbines themselves (e.g. color, height, and number of turbines) and impacts relating to their interaction with the character of the surrounding landscape and the visual receptor which might be present. Turbines are tall structures that can

be seen from several kilometers away and impose a change on the landscape of the area where they are installed. However, visual impacts depend on several factors such as distance, size, visibility, landscape and geography, and the presence of potential sensitive visual receptors.

Discussed below is the methodology that was adopted for the assessment of impacts of the wind turbines on the landscape and visual character of the Project site and its surrounding, and the results and outcomes of the assessment.

(i) Impact Assessment Methodology

The impact assessment was based on two (2) main methods and approaches which include the visibility analysis method and the photorealistic simulation method, both of which are discussed in further details below.

a. Visibility Analysis

The theoretical visibility analysis describes the area over which the planned turbine installations might have an influence or an effect upon the visual environment, i.e. the wind turbines can be noticed as elements of the landscape.

The visibility analysis for this Project was conducted by the means of a calculation with WindPRO software (version 2.9; Sep 2014, Module ZVI), based on a Digital Elevation Model (DEM) (SRTM) (USGS, 2000). The SRTM DEM provides elevation information with a spatial resolution of 25m and a vertical accuracy of <16 m.

The view shed calculation was conducted by calculating the view lines from observation points at defined elevation for each turbine (e.g. hub height, rotor tip maximum) looking towards the ground. Visibility was calculated for ground level grid cells with a size of 25x25 m. Where the view line hits a ground cell, visibility between this cell and the respective turbine was counted. As this visible relationship is bi-directional, the result also represents the visibility of the turbine from the subject grid cell. The view shed calculation was conducted for each turbine location. As result, each grid cell contains the information on which turbines are visible from that cell. The number of turbines in the view from each cell is counted for an impact magnitude classification.

The following assumptions have been made prior to the calculation:

- View shed calculations were limited to an area of 25kmx25km around the planned turbines given that beyond this distance, a visual impact can be considered to be negligible;
- The observation point of the turbine was anticipated at an elevation of 137m above the ground (hub height plus rotor blade length); and
- Screening objects such as trees, buildings or small changes in topography (e.g. road cuttings) reducing the visibility of the Project have not been taken into account.

Given the assumptions and simplifications of the visibility analysis, the results should be regarded as indicative. In general, partly seen objects are accounted for as being completely visible, since the modeling does not differentiate between a partly and a completely seen object; only the general entire object height is the calculation reference for the visibility analysis. Having only a small part of the turbine (e.g. rotor tip or only the uppermost part of the tower) viewable will be a lesser change than the entire turbine. Both, however, are counted equally in the visibility analysis. The assessment of selected viewpoints described in the next section accounts for such effects for the selected views, but on the other side cannot cover all areas where visibility may occur.

The hub at a height of 80 m can be seen as the major reference for a turbine's visibility. In order to also consider the rotor blade above the hub, the maximum tip height can be taken as a worst case. However, in this case a turbine will be counted even if nothing else but its tip can be seen beyond a ridge. Therefore, it should be noted that the results may show some overestimate in the counts of visible turbines.

b. Photomontage Methodology (Photorealistic Simulation)

Photomontages are used to illustrate the likely view of the visible structures of a proposed project as they would be seen when a photograph is taken from a selected viewpoint. Hence, the photomontage focuses on a singular view and how it will be influenced by a project.

For the Project, five (5) viewpoints were selected in the course of a visit to the area in November 2014. Viewpoints were selected at locations assumed to be highly disadvantageous in terms of the visual impact due to presence of receptors (villages or dwellings). Viewpoints were selected in order to provide exemplary photographic views which show the degree of visual impacts at these viewpoints by means of photomontage. Thereby an impression can be provided on the wind turbines' visual presence. Moreover, it can be shown, whether the turbines can be seen in total or only partially.

Photographs were taken with a digital single lens reflex (SLR) camera and a 28mm digital lens (35mm equivalent). For each viewpoint, a computer rendered image was generated from a digital model of the wind farm by using WindPRO (Module VISUAL).

For the simulation, the horizontal viewing angle of 60° was chosen, which displays existing objects more realistically than a wide panorama field (in which objects further than 500m from the viewer appear understated).

c. Assessment of the Impacts

As discussed earlier in "Chapter 5", to assess an impact entails assessing two main criteria – the sensitivity of the receiving parameter of the impact and the magnitude of the impact itself. Throughout this section, the impacts have been assessed for each of the landscape types identified and discussed in "Section 8.1.2" and Table 16 – which also identifies the sensitivity of each of those landscape types which are likely to be impacted: (i) Petra world heritage site; (ii) Wadi Araba (Jordan rift valley); (iii) plateau; and (iv) village areas.

In addition, the magnitude of each impact is determined according to the rationale discussed in Table 17 below.

Table 17: Determination of the Magnitude of the Visual Impact

Magnitude of Impact	Less than 6 turbines	6 to 15 turbines	More than 15 turbines
	…can be seen in a distance of…		
Negligible	more than 6 km	more than 12 km	more than 20 km
Low	between 2 and 6 km	between 4 and 12 km	between 6 and 20 km
Medium	between 1 and 2 km	between 2 and 4 km	between 3 and 6 km
High	up to 1 km	up to 2 km	up to 3 km

It is important to note that the impacts discussed throughout this section are not necessarily considered negative. For wind farm projects the aesthetic perception by viewers is quite different; it can be positive or negative, depending on the individual's attitude to the principle and presence of wind generation. Aesthetic issues are by their nature highly subjective. For some viewers, such turbines could be regarded as manmade structures with visual burdens while to others it represents a positive impact in the sense that they introduce a break in the otherwise dull and monotonous view. Such views could be perceived

positively by adding a new interesting scenic feature for the viewer (e.g. 'arid landscape with high-tech') or implementing modern power generation industries by renewable 'clean' energy in the area.

Finally, it must be noted that the assessment takes into account two (2) key visual receptors and which include: (i) the residents living in the nearby villages (to include Al-Rajef, Dlaghah & Rassees, etc.) and (ii) tourists travelling on Highway #35 to/from Petra city and enjoying scenic views along the highway.

(ii) Results

Figure 20 below presents the results of the visibility analysis undertaken for the Project and the surrounding landscape areas. The results show that visibility of a larger number of wind turbines (more than 20) is mainly expected at areas within the wind farm and to the east given that in such areas the plateau only gently declines. On the other hand, high counts to the west are only expected on hillsides of mountain ranges facing the Project site.

Discussed below are the detailed results and outcomes of the visibility analysis for each of the landscape types to include: (i) Petra World Heritage Site; (ii) Wadi Araba (Jordan Rift Valley); (iii) Plateau; and (iv) village areas.

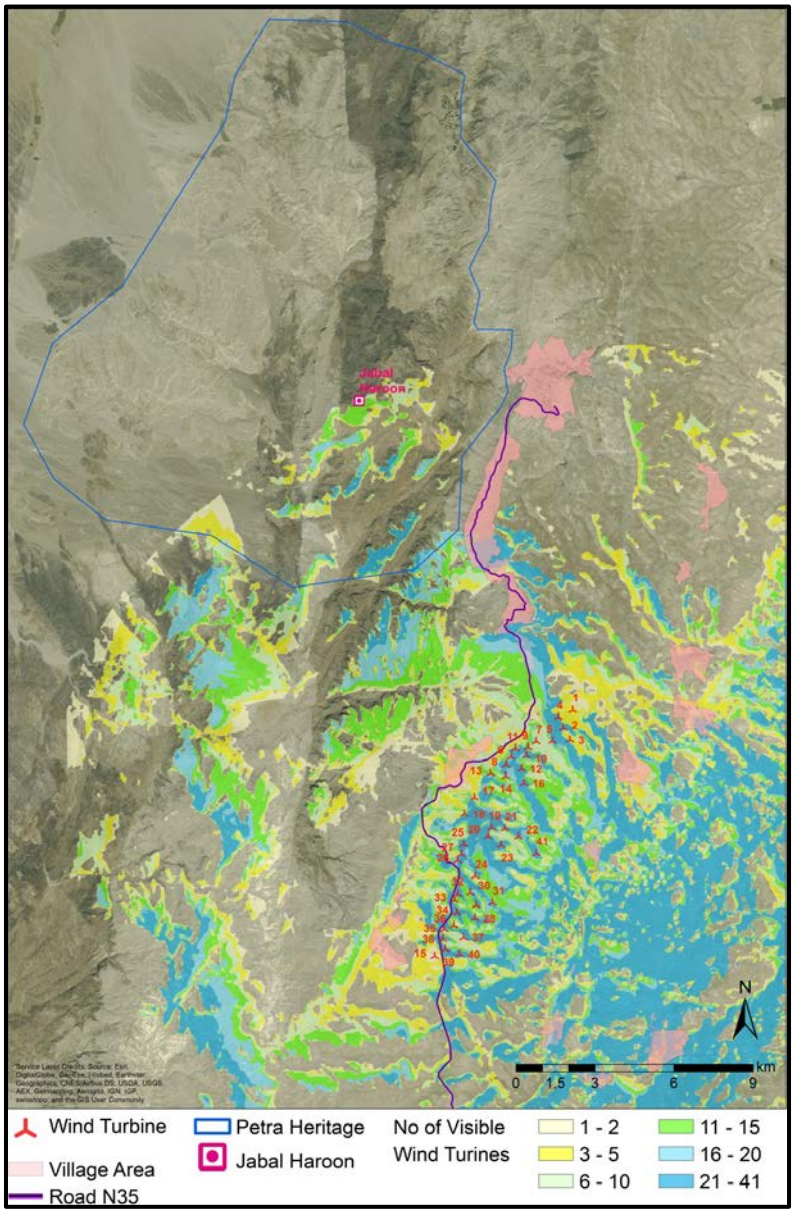

Figure 20: Results of the Visibility Analysis (overall 25 km x 25 km area)

a. Landscape A – Petra World Heritage Site

The main area of the Petra world heritage (that is Petra City) is located at around 16 km north of the Project site; however the shortest distance of between a turbine and the heritage property's boundary is 7km. Figure 21 below shows in details the results of the visibility analysis of the Petra world heritage site and its surroundings.

The most important outcome of the assessment is that from the main parts of the Petra world heritage site, where the most important key visual sensitive receptor is located (i.e. Petra city), no views to the wind farm could be identified due to the fact that it is located at the ground of the valley surrounded with side-valleys and mountains with steep climbs.

As noted in the figure below, views to the wind farm will only be possible in limited areas which represent the tops of the mountain ranges when looking to the Southeast into the direction of the wind farm plateau. In addition, some slopes of the south-eastern range will provide views of the wind farm.

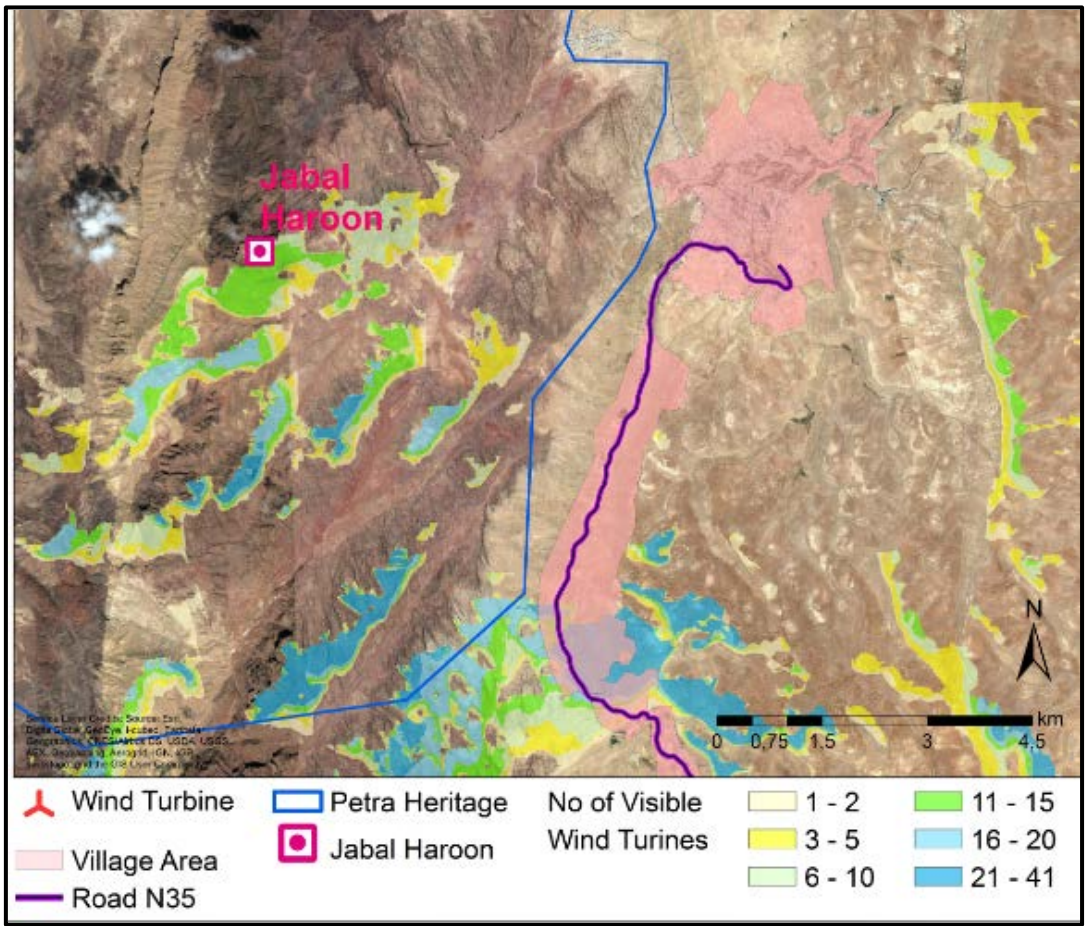

Figure 21: Results of the Visibility Analysis (Petra World Heritage Site)

The main receptor from which wind turbines would be visible from the tops of the mountain ranges within the heritage site is Jabal Haroun (Shrine of Prophet Aaron). However, it is very important to note that accessibility of the respective ranges and hilltops is very limited due to the existence of steep climbs or the need for an exhausting walking hike – such as that undertaken to the top of Jabal Haroun. Therefore, not many tourists visit such places, and it is not considered to be a main source of attraction (as opposed to Petra city). In addition, as presented in Figure 22 below, the view from Jabal Haroun to the wind farm would be very distant and can hardly be seen.

Finally, it is also important to note that GWRE has obtained the approval of Petra Development and Tourism Region Authority (PDTRA) for the development of the Project – refer to "Section 9.1.2" for additional details

In addition, EBRD and its Environmental Advisor (WSP) met with PDTRA during the due diligence assignment undertaken for the Project during April 2016. Throughout the meeting they discussed the Petra World Heritage Site and the potential visual impacts on the nomination criteria of the site.

PDTRA indicated that the Project site is located outside of the Petra World Heritage Site and its buffer zone respectively. The PDTRA Chief Commissioner agreed to coordinate directly with UNESCO to discuss this matter.

PDTRA connected ECO Consult with the UNESCO local representative in order to discuss this further. ECO Consult provided UNESCO with a Project brief along with the outcomes of the visual assessment as presented above. Their initial response was that due to the location of the Project outside of the Petra World Heritage Site and its buffer zone no issues of concern are anticipated.

Finally, ECO Consult also contacted the PDTRA Chief Commissioner and inquired about the relevance of the Ministry of Tourism and Antiquities (MoTA) on the above matter and whether they should be involved and consulted. The Chief Commissioner stated that MoTA are irrelevant as the Petra World Heritage Site is under the direct responsibility of the PDTRA.

The visual environment created during the operation phase on the Petra world heritage site is of a long-term duration. Given the lack of a visual impact on the most important parts of the Petra world heritage site (mainly Petra city), but a potential, long distance visibility of more than 15 turbines from hilltops (such as Jabal Haroun), the impact is considered of low magnitude. Nevertheless, the receiving environment is considered of high sensitivity due to the touristic receptors in the heritage area. Therefore, visual impacts on the Petra world heritage Site are considered of minor significance.

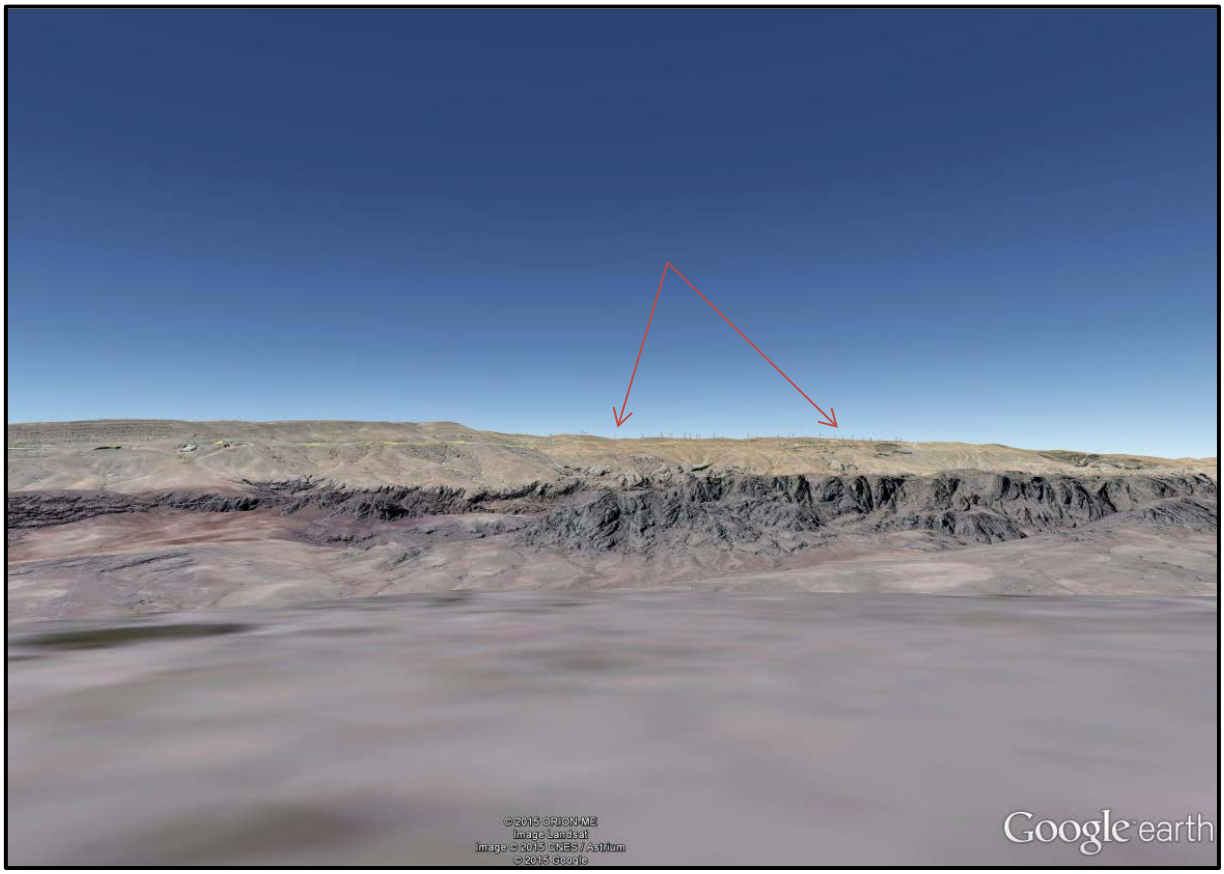

Figure 22: Virtual View from Jabal Haroun towards the Project Site (Source: *Google Earth with simulation of the Project with WindPRO)*

b. Landscape B – Wadi Araba (Jordan Rift Valley)

As discussed in Section this landscape is modeled by Wadi Araba and its escarpment which provides dynamic and partly 'dramatic' scenery around Petra.

Any views from such areas to the wind farm will only be possible in limited areas which represent the top of mountain ranges when looking to the east into the direction of the wind farm plateau. In addition, some slopes of the eastern range will provide views of the wind farm. However, it is very important to note that such areas are generally unoccupied and do not entail any key visual receptors. Accessibility of the respective ranges and hilltops is very limited due to the existence of steep climbs or the need for an exhausting walking hike.

However, the scenic views of the valley are valued by tourists as they travel on Highway #35 to and from Petra area. However, given that the wind farm project is located to the east of the road, such views are not affected by the presence of the turbines.

The visual environment created during the operation phase is of a long-term duration. Given the long distance visibility of turbines from hilltops the impact is considered of low magnitude. Nevertheless, the receiving environment is considered of medium sensitivity due to the scenic views valued by tourists traveling along the highway. Therefore, visual impacts are considered of minor significance.

c. Landscape C – the Plateau

As discussed in Section this landscape this mostly located to the east of Highway#35 and is a wide, desert-like slightly undulating plateau. The scenery is monotonous and has no particular structures of interest or any key visual receptors. Furthermore, the type of landscape extends to the north and south far beyond the area of interest with not much change in its characteristics.

There will be visual impacts on this landscape mainly in the eastern areas of the wind farm given that the plateau only gently declines. As noted in Figure 20, in many areas 21-40 turbines are visible. However, of key particular importance are tourists traveling along Highway #35 to and from the Petra region. Along the Highway, in the 3 km section between the village of Taybeh and the wind farm area, the number of visible turbines is in the range of 6 to 15. After that, from the north of the Project area till the middle part (till turbine number 26 – refer to Figure 20) less than 10 turbines are visible. The subsequent 4 km after that has over 15 turbines visible.

It is important to keep in mind that the length of such impacts is short compared to the entire north-south extension of the landscape type, which is also considered monotonous with no particular structures of interest or any key visual receptors.

Again, it is also important to reiterate that aesthetic issues are by their nature highly subjective. For some tourists, such turbines could be regarded as manmade structures with visual burdens while to others it represents a positive impact in the sense that they introduce a break in the otherwise dull and monotonous view.

The visual environment created during the operation phase on the plateau is of a long-term duration. Given that there will be a noticeable change in this landscape by the turbines where a large number of turbines will be visible in short distance, such an impact is considered of high magnitude, but given that this landscape is monotonous and has no particular structures of interest or any key visual receptors it is considered of low sensitivity. Therefore, visual impacts on the plateau are considered of minor significance.

d. Landscape D - Village Areas

This landscape type refers to the villages in the vicinity of the Project where the turbines are expected to be visible and which includes: (i) Taybeh (ii) Al-Rajef (iii) Dlaghah & Rassees (iv) Fardakh.

It is important to note that particular or touristic high valued views are not known in those villages. For people living in the villages, scenic views are less relevant in their everyday lives. As discussed earlier, subjective perception of the Project by individual residents might range from negative to positive. However, given the continuous presence of the residents, the sensitivity of the village areas is evaluated as medium sensitivity.

The analysis below discusses the outcomes of the visibility analysis as well as the assessment of the photomontage methodology at the selected viewpoints. All viewpoints were selected in the nearby village to the Project site as follows: (i) Taybeh – 2 viewpoints (ii) Al-Rajef – 1 viewpoint (iii) Dlaghah & Rassees – 1 viewpoint (iv) Fardakh – 1 viewpoint.

All viewpoints were selected at locations assumed to be highly disadvantageous in terms of the visual impact and with presence of receptors (villages or dwellings). The views, therefore, have to be understood as exemplary.

It is important to note that as part of the disclosure session that was held with the local communities (refer to "Section 6.5.4" for additional details) the outcomes of the visual assessment discussed below were presented and discussed. No objections were raised with regards to the visual impacts from the Project on those villages.

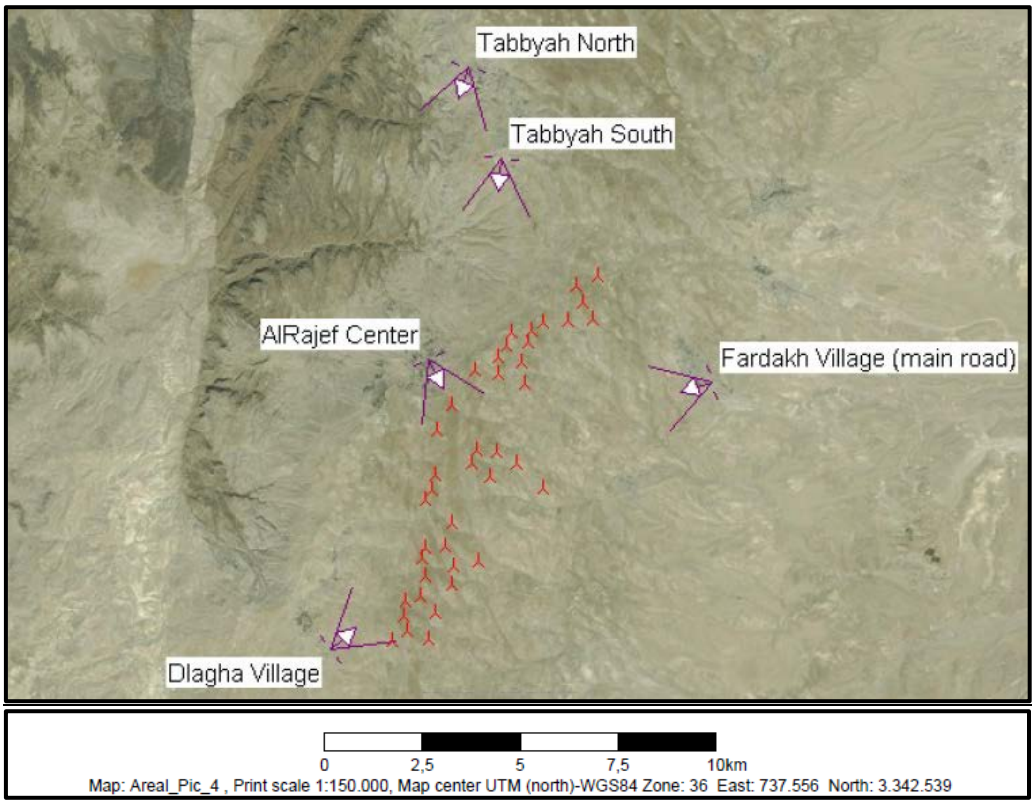

Figure 23: Location of Viewpoints and View Angles

Taybeh Village

The results of the visibility analysis (refer to Figure 20) reveals that in large parts of the village no turbines are visible. Only in the most northern and southern parts, where the dwellings are situated on top of a ridge, large parts of the wind farm (more than 15 turbines) will be visible at a distance (6-9 km for the

northern parts and 4-7 km for the southern parts). Furthermore, up to 15 turbines may be visible from the sparsely populated southern outskirts (2 - 5 km).

With regards to the photorealistic simulation, as discussed earlier 2 points were taken within the village. Viewpoint number 1 is located in the northern part of Taybeh, a part of the village that is situated at higher elevation than the majority of the village. From this viewpoint, 10 to 15 wind turbines are lining up along the ridge above Al-Rajef (refer to Figure 24 below). They are visible from Taybeh as new elements at the skyline. The distance from the viewpoint to the nearest wind turbine is approximately 6 to 8 km.

Viewpoint number 2 is located at the southern boundary of Taybeh at a location where the view opens to the landscape. The viewpoint is close to Highway #35 which also is a touristic route. From this viewpoint, 15 or more wind turbines are lining up along the ridge above Al-Rajef (refer to Figure 25). They are clearly visible as new elements at the skyline. The distance from the viewpoint to the nearest wind turbine is approximately 4 km.

Taking the above into account, the visual environment created during the operation phase on the village is of a long-term duration. In a worst case scenario, at certain areas there will be a noticeable change given the distance and number of the turbines, therefore such an impact is considered of medium magnitude, but the receiving environment is of medium sensitivity. Therefore, visual impacts are considered of minor significance.

Figure 24: Viewpoint No. 1 – Taybeh Village North (viewing angle 60°)

Figure 25: Viewpoint No. 2 – Taybeh Village South (viewing angle 60°)

Al-Rajef

The results of the visibility analysis (refer to Figure 20) reveals that from Al-Rajef village mostly less than 5 turbines can be seen behind the ridge. The distance of the village area to the nearest turbines is around 1 km, with few dwellings being as close as 700m. From some elevated spots in the village up to 20 turbines come in view, but such spots are located at a distance of up to 5 km; however in reality it is expected that for many of them only part of the rotor blade will be visible.

With regards to the photorealistic simulation, as discussed earlier 1 point was taken within the village. The viewpoint was located in an area considered to be the center of Al-Rajef village. From this viewpoint, the upper parts of two wind turbines are very well visible beyond the ridge east of the village (refer to Figure 26 below). The distance from the viewpoint to the turbines is approximately 1 km.

According to the methodology for assessing the magnitude of the visual impact, such an impact should be evaluated as high based on the turbines' short distance. However, not considered within this evaluation are impact-reducing effects due to incomplete visibility of turbines – such as those modeled in the photorealistic simulation in the figure below. For the visual impact on the view and its perception by the residents, a partly visible turbine might be less intrusive than a completely visible one.

Further, orientation of the rotors versus the view line can make a difference. But since the prevailing wind direction is from the north-west, the associated most frequent rotor orientation is perpendicular to the view line (as it is shown in the figure below). Only for the rare wind directions from northeast or southwest, the rotor orientation minimizes the visual impact in about 10% of the annual daytime hours. A significant impact reducing effect, hence, is not to be expected from rotor orientation.

Taking the above into account, the visual environment created on the village is of a long-term duration. Such an impact is considered of high magnitude, but the receiving environment is of medium sensitivity. Therefore, visual impacts are considered of moderate significance.

Figure 26: Viewpoint No. 3 – Al-Rajef Centre, view towards South-East (viewing angle 60°)

Dlaghah & Rassees

The results of the visibility analysis (refer to Figure 20) reveals that the village of Dlaghah & Rassees is located in a small valley, and thus mostly only 1 or 2, from some places up to 5, turbines may be visible only with the closest distances between 1.5 and 2.5km.

With regards to the photorealistic simulation, as discussed earlier 1 point was taken within the village. The viewpoint is located in the southern part of the village with a view to the northeast. From this viewpoint, only the uppermost parts (blades) of three turbines can be seen (refer to Figure 27), two of them exhibit only the rotor tips. The distance from the viewpoint to the turbines is approximately 1.5 to 2.5 km.

According to the methodology for assessing the magnitude of the visual impact, such an impact should be evaluated as medium based on the turbines' distance. However, due to the actual very limited visual effect as noted in the figure below (where such views are expected to be the typical views from visible areas in the village), the visual impact on the view and its perception by the residents is expected to be much lower. Moreover, at this viewpoint, orientation of the rotors versus the view line can make a difference in the visual impact. Since perpendicular orientation of the rotors will occur only for the rare wind directions from northeast or southwest, the maximum impact refers to only about 10% of the annual hours. Therefore, in this case the magnitude of the impacts can be changed to low.

Taking the above into account, the visual environment created during the operation phase on the village is of a long-term duration. Such an impact is considered of low magnitude, but the receiving environment is of medium sensitivity. Therefore, visual impacts are considered of minor significance.

Figure 27: Viewpoint No. 4 – Dlaghah – View from the residential area toward the North-East (viewing angle 60°)

Fardakh

The results of the visibility analysis (refer to Figure 20) reveals that the village of Fardakh is located in a small valley, and therefore no more than 6 turbines can be seen but only from certain spots. The closest turbine to the village is at a distance of about 3km.

With regards to the photorealistic simulation, as discussed earlier 1 point was taken within the village. The viewpoint is located at the main road of Fardakh with a view to the west. From this viewpoint, only the uppermost parts (blades) of two turbines can be seen (refer to figure below). The distance from the viewpoint to the turbines is approximately 3.5 km.

According to the methodology for assessing the magnitude of the visual impact, such an impact should be evaluated as low based on the turbines' distance. This remains so given the actual very limited visual effect as noted in the figure below (where such views are expected to be the typical views from visible areas in the village). Taking the above into account, the visual environment created during the operation phase on the village is of a long-term duration. Such an impact is considered of low magnitude, but the receiving environment is of medium sensitivity. Therefore, visual impacts are considered of minor significance.

Figure 28: Viewpoint No. 5 – Fardakh – View from village main street toward the West (viewing angle 60°)

Mitigation Measures

The following identifies the mitigation measures to be applied by the during the construction phase:

- Avoid including lettering, company insignia, advertising or graphics on the turbines.

As noted throughout the assessment for the majority of the visual impacts are considered minor. There are no mitigation measures per se that can be implemented to eliminate the visual impacts from the turbines, but the measures discussed above are expected to lessen the visual burden – therefore the residual significance is expected to remain minor. However, it is important to note again that there are no key issues of concern in terms of the visual impacts.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase:

- Inspection of the works to ensure the above measures are implemented.

9. LAND USE

This Chapter first provides an assessment of baseline conditions within the Project site and surroundings in relation to land use (to include both formal and informal) and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

9.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to land use (to include both formal and actual) and presents the outcomes and results.

9.1.1 Baseline Assessment Methodology

The baseline assessment of the 'formal' land use was based on collection of secondary data and land use plans set by the relevant governmental authorities – to include Ministry of Municipal Affairs (MoMA), Petra Development and Tourism Region Authority (PDTRA), Ministry of Environment (MoEnv), and the Ministry of Agriculture (MoA).

Understanding and characterizing the informal or 'actual' land use of the Project site was mainly based on several site visits undertaken by the 'ESIA Team' to the Project site. The objective of such site visits was to investigate the actual land use of the site, and determine if it provides any certain value to the affected communities in the areas (e.g. agricultural activities, grazing, etc.). Based on such site visits, it was noticed that there was local community as well as nomadic activity within the Project area; therefore detailed consultations and discussions were undertaken onsite with each.

Consultations with the local community were undertaken onsite in June 2013 as it is considered the phase which entails the highest onsite land activities by the local community members. Such consultations and discussion entailed visiting each area where activity was noticed, to the greatest extent possible, starting from south to the north of the Project area. At each area, detailed discussions were undertaken with the local community members visited with the objective of (amongst other as stated previously in "Section 6.56.5.2"): (i) introduce the Project and its various components; (ii) understand, characterize and assess the activities undertaken onsite; (iii) present the potential impacts which could affect their activities onsite and take into account their thoughts and concern on the Project development. It is important to note that no women groups were noticed to undertake such onsite activities by the local community.

Similarly, another consultation was undertaken onsite in August 2015 with the nomads with a similar methodology and objective to that above. However, consultations with nomads were gender specific – therefore specific consultations were undertaken with women of each of the nomadic groups consulted by a female specialist of the 'ESIA Team'.

9.1.2 Formal Land Use

The formal land use of the Project site was investigated based on available plans set by the relevant governmental authorities. This includes the following: (i) land use planning by MoMA, (ii) Petra Region Planning by PDTRA, (iii) planning for areas of critical environmental concern by MoEnv, and (iv) and forest lands and grazing reserves planning by MoA.

(i) Land Use Planning by MoMA

The Project might conflict with the allowed land use set for the area by MoMA which designates specific land uses in Jordan where only certain activities are allowed. This issue has been investigated and the results are presented below.

In accordance with the "Law for the Organization of Cities, Villages and Buildings No. 79 for 1966", MoMA designated specific land uses for areas in the Kingdom that are within organized boundaries (urban areas). However, at that time, no land use plans were developed for areas that lay outside of the organizational boundaries and therefore, in 2006 a project to prepare a land use map for such areas began. The output was the National Land Use Master Plan of 2007; which is a recent attempt to produce a harmonized land use plan for those areas that are outside of organized boundaries. Accordingly, the "Land Use Planning Regulation No. 6 of 2007" was issued to regulate land use for those areas outside of organized boundaries and to divide territories by using zoning cryptography as follows:

- Agricultural areas sector, identified by the symbol (A);
- Rural areas sector, identified by the symbol (B);
- Marginal areas sector, identified by the symbol(C);
- Desert areas sector, identified by the symbol (D); and
- Forest areas.

Figure 29 below presents the location of the Project site and the land use plan set within the National Land Use Master Plan of 2007.

The Project site is located outside of the organized boundaries of Al-Rajef, Dlaghah & Rassees, Fardakh and Sadaqah which are represented in pink in the figure below; where such organized boundaries have assigned land use categories in the "Law for the Organization of Cities, Villages and Buildings No. 79 for 1966". However, as the Project site is located outside organized boundaries it is considered as areas outside planning zones with assigned land use categories set in accordance with the Regulation No. 6 of 2007.

According to Figure 29 below and the Regulation No. 6 of 2007, the Project site is classified as a Marginal Area of the 1st (C1), 2nd (C2), and 3rd (C3) degree. C1 areas are described in Article [8(a)–1] of the Regulation as "areas suitable for forestry and grazing", and C2 areas are described in Article [8(a)–2] of the Regulation as "areas suitable for grazing", while C3 areas are described in Article [8(a)–3] of the Regulation as "areas suitable for grazing and forestry". However, Article [8(b)–1] of the Regulation specifically says "In those areas (referring to areas classified as Marginal Areas) the following land uses are allowed; "the use for public services which include electric power generation facilities and its transmission and distribution".

To this extent, it is evident that the Project site does not conflict with MOMA's land use plan; in fact, the designated land use for the area allows for the development of such a Project.

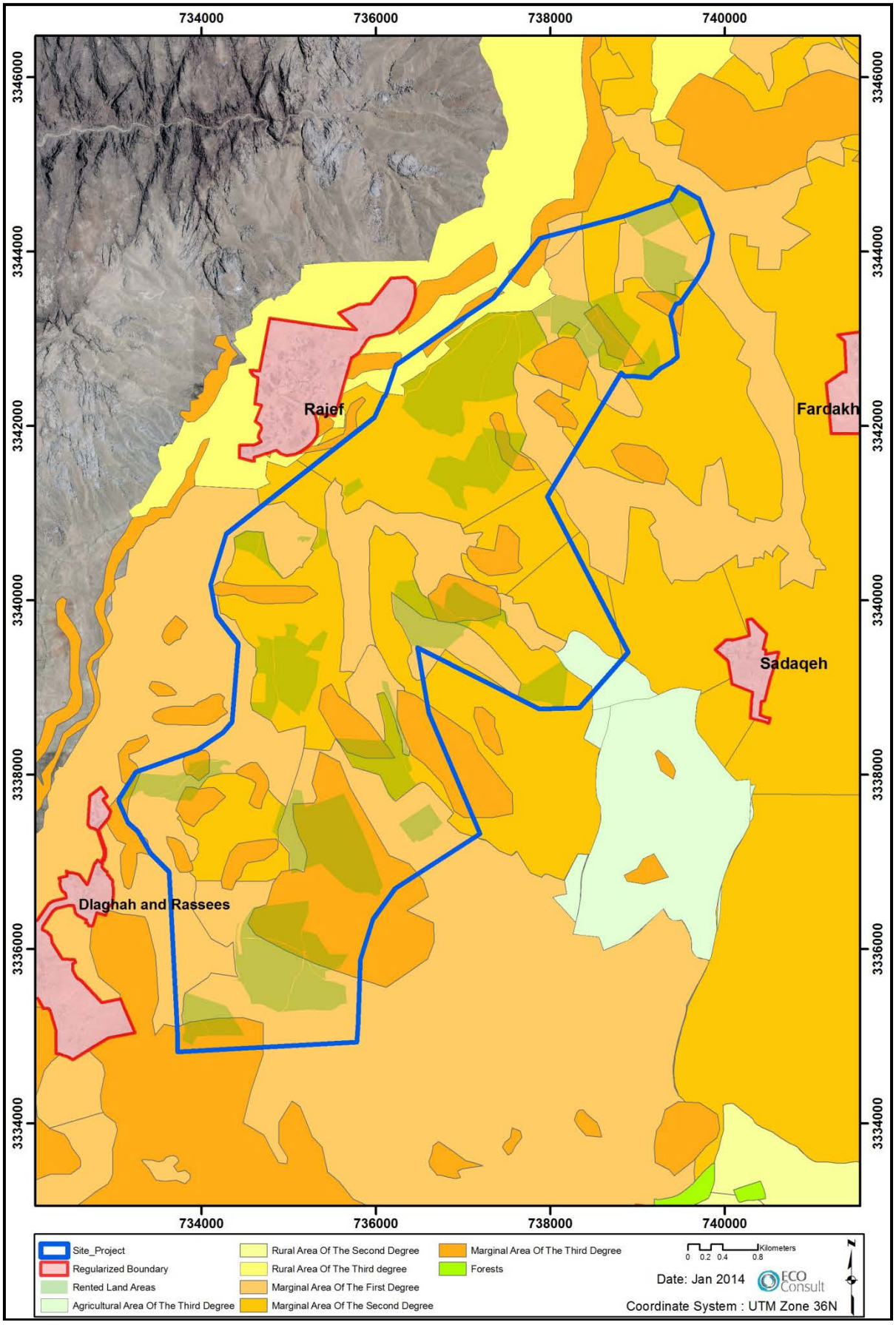

Figure 29: MoMA National Land Use Master Plan for the Project Site and its Surroundings

(ii) Petra Development Tourism Region Authority (PDTRA)

The PDTRA is a legal, financial, and administrative independent Authority founded in 2009 which aims to develop the Region touristically, economically, socially, culturally while contributing to local community development.

The boundary of the Region as set by the 'Petra Development and Tourism Region Authority Law of 2009' includes the villages of Al-Rajef and Dlaghah & Rassees (the closest to the Project site) as well as other villages to include Taybeh, Baidha, Umm Sayhoun, and Wadi Mousa.

In 2011, the PDTRA prepared a Strategic Master plan for the Region, "The Strategic Master Plan for Petra Region" (ATC Consultants, 2012). The overall objective of the study was to provide the Region with a strategic plan that guides planned development in an efficient, balanced, and sustainable way over the next 20 years for the benefit of the local community. The study also includes individual reports for each of the six communities located within the Region which provide strategic area plans taking into account the characteristics of each of the communities.

Development priorities for the Region and each community were prepared by combing land sensitivity and growth efficiency maps. Such criteria (which include factors such as topography, hydrology, forests, archaeological sites, infrastructure, etc.) were used to identify land areas where development can occur with the least impact on important archeological and natural resources and allowing for the greatest ease and efficiency of providing public services.

The section below provides an overview of the strategic area plans for Al-Rajef and Dlaghah & Rassees (ATC Consultants, 2012).

- ***Al-Rajef***: The overall vision for Al-Rajef is to develop from a relatively disadvantaged community with insufficient infrastructure into an economically, socially, and institutionally well developed community that benefits from both tourism and indirectly with tourism related facilities providing jobs for the local population.

  Generally, in order to formulate such visions the Master Plan recommends to put special emphasize on the development of a proposed Arts and Crafts Center including a Design Institute which would create unique handicraft products for the entire Petra Region. In addition, it is proposed that the agriculture sector be further developed through cultivating a greater variety of vegetables and the introduction of flower farming. The Plan also emphasizes on the importance of improving local infrastructure of Al-Rajef to achieve such goals; this includes health care provisions, education and schooling, telecommunication, public transportation, and connections to sewer networks.

- ***Dlaghah & Rassees*****:** the overall vision for Dlaghah & Rassees is to develop from a poor community with insufficient infrastructure into an economically, socially, and institutionally well developed community that is involved in and receives benefits from the development of tourism in the south of Petra Region.

  Generally, in order to formulate such visions, the Master Plan states that the main potential for Dlaghah & Rassees' future is to manage the development of a conservation area (proposed by RSCN) and of tourism products linked to traditional Bedouin culture. The Plan also emphasizes on the importance of improving local infrastructure to achieve such goals especially that the village is greatly in need of improved facilities and services to improve their standard of living; this includes connections to sewer networks, water supply for agriculture, public transportation, education and schooling.

As illustrated in Figure 30 below, minor parts of the Project site (located within the western area) are located within the PDTRA boundary. To this extent, it is important to note that GWRE has undertaken direct communications with PDTRA regarding the proposed Project; PDTRA, through a formal letter, provided their approval for the Project development. The letter is presented in Annex I. ***To this extent, there are no issues of concern in relation to PDTRA's planning of the Petra Region.***

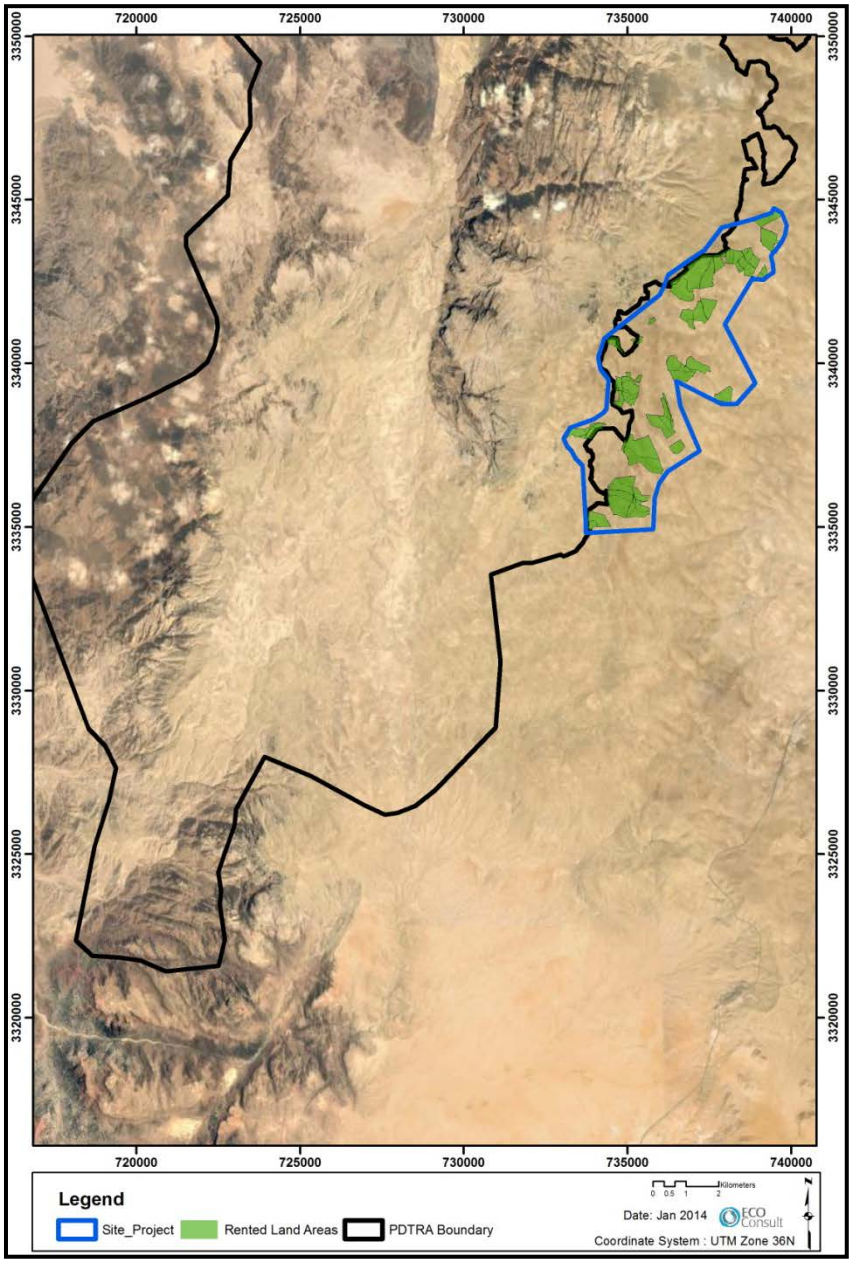

Figure 30: Project site in Relation to the PDTRA Boundary

(iii) Areas of Critical Environmental Concern Planning by MoEnv

The Project could potentially conflict with the use of current or planned nearby specially designated areas such as wilderness areas, areas of critical environmental concern, and/or special recreation management areas. The Ministry of Environment (MoEnv) has the responsibility of establishing natural reserves, national parks, and any site of special environmental significance for protection and management.

However, the MoEnv delegates such responsibilities to the Royal Society for the Conservation of Nature (RSCN). In accordance with the above, the RSCN has designated four (4) categories for areas of environmental concern as highlighted below. Those have been assigned based on detailed reviews prepared by the RSCN and which include: (i) National Network of Protected Areas in Jordan and (ii) Important Bird Areas of the Hashemite Kingdom of Jordan.

- Established Reserves: in accordance with the "National Network of Protected Areas in Jordan" the RSCN has established a number of reserves which have been announced as protected areas and are currently managed and operated by the RSCN;

- Proposed Reserves: areas proposed within the "National Network of Protected Areas in Jordan" as protected areas but have not been announced as reserves yet and currently are not managed or operated by the RSCN;
- Reserves Under Establishment: areas proposed within the "National Network of Protected Areas in Jordan" as protected areas and are announced as so, but are still underway to be established, operated, and managed by the RSCN; and
- Important Bird Areas (IBA's): areas proposed within "Important Bird Areas of the Hashemite Kingdom of Jordan".

Taking the above into account, the RSCN prepared a comprehensive plan that identifies the location of the reserves and IBA's discussed above. Figure 31 below presents the closest areas in relation to the Project site. As noted in the figure, there are no areas of critical environment concern within Project area or its immediate surroundings; there are no established, under establishment, proposed reserves or IBA's. A number of preservation areas exist further away from the Project site with the closest delineation being around 6km away; those mainly include three (3) IBA's - Petra (6km north of the Project site), Jerba (12km north of the Project site), and Wadi Araba (17km west of the Project site).

To this extent, it can be concluded that no conflict exists between the Project site and the MoEnv/RSCN planning context. The Project site is not located within established/planned reserves or important bird areas.

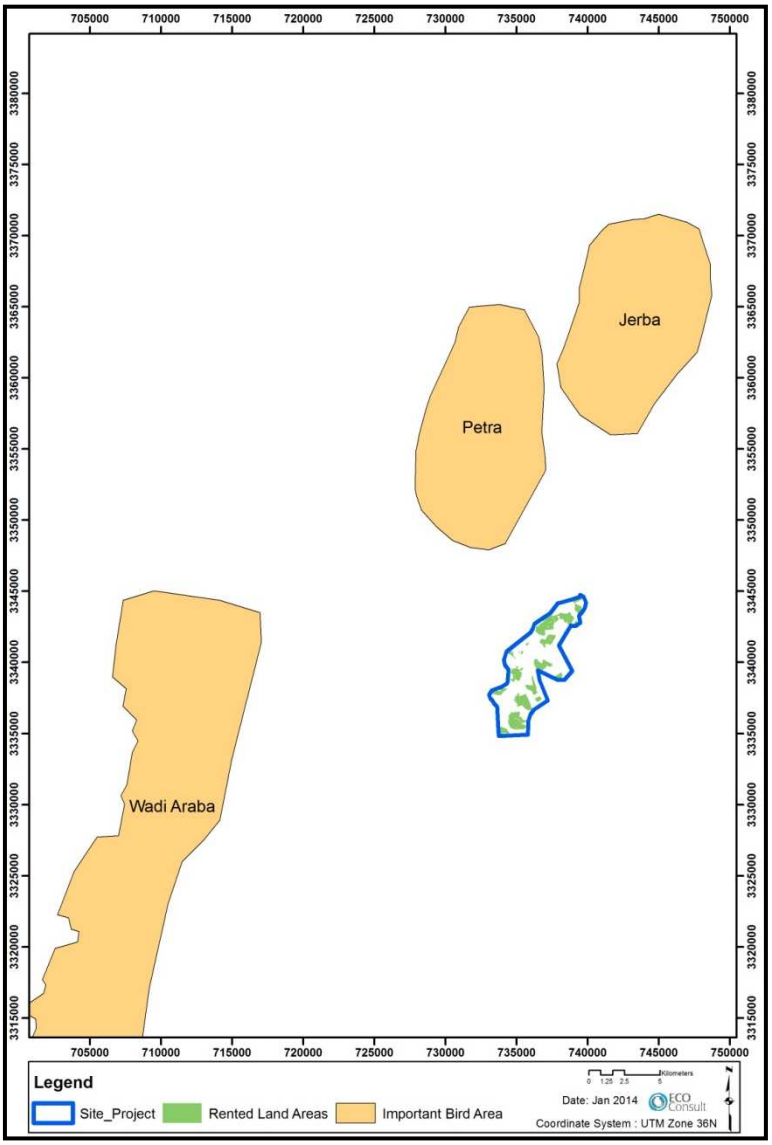

Figure 31: Areas of Critical Environmental Concern in Relation to Project Site

(iv) Forest Lands, Grazing Reserves, and Agricultural Development Planning by MoA

The Project might conflict with current or proposed planning policies of the Ministry of Agriculture (MoA) for the general area. The most important planning issues that must be investigated include potential conflict with: (i) rangelands and grazing reserves, (ii) forest lands, and (iii) agricultural development projects of the MoA.

The MoA, Department of Forestry, and Sherah Agricultural Development Directorate (the agricultural directorate responsible for the area within which the Project is located) have been consulted on the above and the outcomes are discussed throughout this section.

a. Rangelands and Grazing Reserves

With regards to rangelands, the "Agriculture Law No. (44) of the year 2002", through article 36 states "lands registered in the name of the Treasury of the Kingdom and any other lands of the State where the average annual rainfall is less than 200mm shall be considered range lands". Article 38 states "it shall be prohibited to delegate rangelands to any person or allocate lease or exchange these lands" while Article 39 states "it shall be prohibited to abuse rangelands either by plowing or planting or by erecting buildings or structures". However, according to discussions with the Rangeland Directorate in the MoA, given that the Project site is registered as a privately owned land (and not registered in the name of Treasury) the Project site is excluded from being classified as a range land.

In addition, given the widespread of areas which could be classified as rangelands in Jordan, the MoA is entitled to planning grazing reserves in Jordan on rangelands which have the potential to serve as grazing areas. According to discussions with the Rangeland Directorate in the MoA, there are currently thirty four (34) grazing reserves distributed throughout the Kingdom that cover an area of around 80, 000 Dunums. Such reserves are planned and established for sustainable grazing and prevention of overgrazing which generally reduce the usefulness, productivity, and biodiversity of the land and is one cause of desertification and erosion.

Within the area, only one (1) grazing reserve exists known as Ayshya Grazing Reserve located approximately 7km south of the Project site (Figure 32). Ayshya Grazing Reserve was established in 1981 and is around 10,000 Dunums of which only around 4,000 is currently cultivated with pasture vegetation for the local livestock raisers in the area to use as grazing lands.

In addition, there are four (4) planned areas to be established as grazing reserves in the Kingdom for an additional area of 60,000 Dunums. From those, only one is located in Ma'an Governorate and specifically in Al-Jafr Sub-district located approximately 60km east of the Project Site. Those have not established yet as currently the Ministry lacks the budget to establish and operate those reserves.

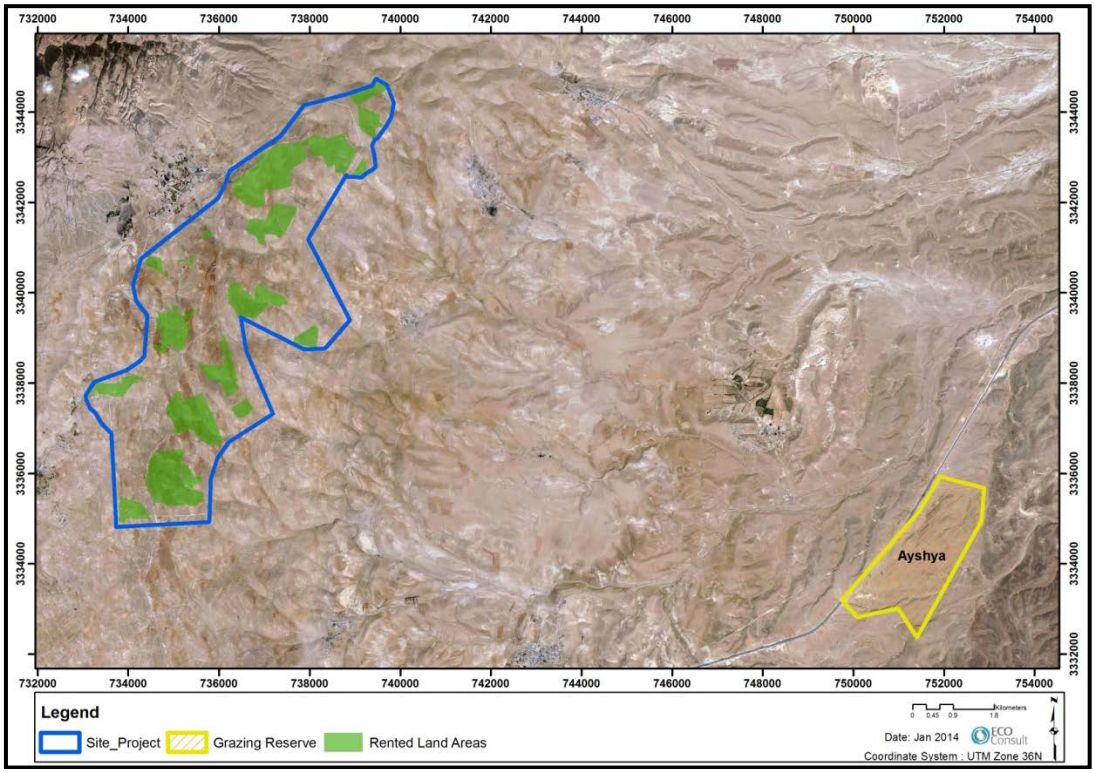

Figure 32: Grazing Reserves in Relation to Project Site

b. Forest Lands

According to the "Agriculture Law No. (44) of the year 2002" Forest Lands are "lands of the State that are registered as forests and the lands of the State that are allocated for forestry purposes". Article 32 of the Law states " it shall be prohibited to abuse forest lands whether by erecting permanent or temporary residences, buildings or structures thereon, or digging wells or caves, or installing water, electricity or telephone lines, or opening sewage lines or canals therein, or by cultivation or plowing, or by grazing therein, without a license".

However, according to discussion with the Department of Forestry, given that the Project site is registered as a privately owned land (and not registered in the name of Treasury) the Project site is excluded from being classified as a forest land. In addition, the Department of Forestry was consulted regarding registered forest lands in the area; the nearest forest lands are located further away to the west of the Project site with a total area of 544 Dunums.

The law also refers to private forests as "forest trees, bushes, and plants growing on privately owned lands". Article 27(c) states "According to technical conditions and criteria specified by the Minister, owners of private forests shall be permitted to invest their forests through pruning or replacement of forest trees with fruit trees provided that they obtain a license from the Ministry and pay the pre-set fees". In addition, Article 34 (a-1) states "it shall be prohibited to cut Forest Trees or bushes or wild plants without a license from the Minister".

Based on the site visit undertaken by ECO Consult the Project site is characterized as being barren and heavily degraded with few scattered trees (a maximum of 10 trees were recorded scattered throughout the site) of remnant forests that use to prevail in the entire mountain of Al-Rajef. The site has been heavily degraded due to massive grazing, tree cutting and ploughing that have occurred extensively throughout the site and most likely for many decades.

In accordance with the above, and according to discussion with the Department of Forestry and Sherah Agricultural Development Directorate, once a final detailed design has been prepared by the EPC

Contractor for all the Project components, *and only if construction activities require any forest trees in the Project site be removed*, then the developer must submit an application to the Sherah Agricultural Development Directorate in order to obtain their approval. The application must provide the final design details of the Project, the expected number of trees that will be removed, along with a proper justification as to why they need to be removed (e.g. possible conflict with certain Project components). The Directorate will review the application and officials would inspect the site.

However, according to discussions with the Sherah Agricultural Development Directorate, given the current conditions of the site (being barren and heavily degraded with few scattered forest trees) it is highly likely that such an approval will be granted should it be required.

c. Agricultural Development Projects

Within Al-Rajef, agricultural development is within the responsibility of Al-Sherah Region Agricultural Development Directorate. The directorate is mainly responsible for agricultural development and directing development efforts for this purpose through exploiting Al-Sharah region. Such projects include the following:

1) Development of agricultural areas on privately owned lands. Famers whom own lands in the area which are currently not utilized and wish to develop their lands into agricultural areas can submit an application to the Directorate, whom in turn funds the farmers during the first three (3) years in establishing their farm to include implementation of soil erosion measures, water harvesting measures, and cultivation of the land (field crops, fruit trees, etc.).
2) Development of agricultural areas on lands that belong to the Public Treasury and which are registered to the MoA. The Directorate also develops farms on such lands through cultivating the land with field crops (barley, wheat, trefoil, etc.) or fruit trees (olive, pistachio, apricot, etc.). The farms are managed and operated by the Directorate and their products are either sold for end use consumption (fruits) or for livestock production facilities (field crops) that are owned by the MoA.

The Directorate was contacted regarding any potential agricultural development projects within the area, which has confirmed that within the Project site and its surroundings there are no current/planned agricultural development projects implemented by the Al-Sherah Region Agricultural Development Directorate.

To this extent, it can be concluded that no conflict exists between the Project Site and the Ministry of Agriculture's planning context, specifically for rangelands/grazing reserves, forest lands, and agricultural development projects. However, should the Project require any trees within the site be removed during the construction phase then the approval of the Sherah Agricultural Development Directorate is required. Given that the site is barren and heavily degraded with few scattered trees, it is highly likely that such an approval will be granted if required.

9.1.3 Actual Land Use

This section first provides a recap on the land selection process by the Developer and the local community (which was previously discussed in "Chapter 2"), and then presents in details the actual land use of the Project area by the local community and the nomads.

The lands within the Project area are owned by the community members of Al-Rajef, Dlaghah & Rassees, and Taybeh. The land selection and leasing process took place from the onset of the Project development, and involved detailed discussions and consultations by the Developer and the local community members. Generally, the local community showed support for the Project development from the onset and assisted GWRE in identifying lands in the area available for leasing for the proposed development. Based on that (as

well as other technical factors), 49 parcels of lands were selected, and the Developer signed 49 land lease agreement with the owners for 29 years.

Nevertheless, it is important to investigate the actual land use of the Project site as it could provide certain value to other local community members besides the lands owners (e.g. agricultural activities, grazing, etc.) as well as nomads whom use the area.

The land use pattern in the Project area was characterized based on detailed consultations with the local community members onsite as well as nomads. Figure 33 below provides an overview of the land use pattern which is explained in further details throughout this section.

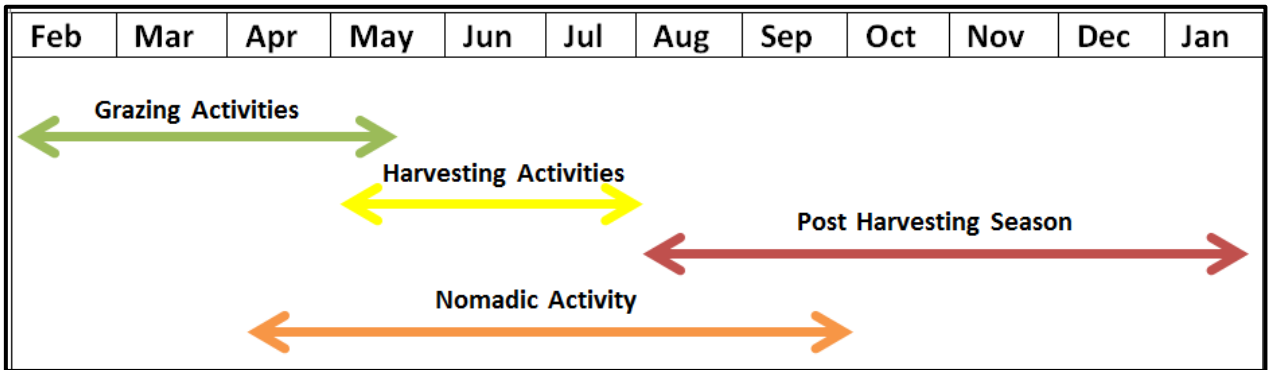

Figure 33: Land Use Pattern of the Project Area

(i) Local Communities

Based on discussions onsite, it was understood that the various activities and land uses which occur within the Project area is restricted to the local community members of Al-Rajef and Dlaghah & Rassees, whom as discussed earlier own those lands. Although local community members of Taybeh also own some lands, they generally do not undertake any activities onsite.

The local community members of Al-Rajef and Dlaghah & Rassees belong to two (2) main tribes: Al-Rawajfeh (from Al-Rajef) and Saidiyyin (from Dlaghah & Rassees). Based on the detailed discussions with the local communities onsite, it was understood that two (2) main activities are undertaken within the Project area –grazing and agriculture. Such activities can be categorized into three (3) phases depending on the time of year in which they occur as detailed below.

1) *Grazing Activities (February – early May):* throughout this season grazing activities take place throughout the Project area. Generally, this mainly includes day trips to the area where afterwards the local communities return to their villages (Al-Rajef or Dlaghah). Grazing activities take place openly in any area, as anyone is allowed to enter the lands without permission from the land owner.
2) *Harvesting Activities (May – July):* this is the season with highest land activity where the area in general is harvested with wheat and barley. Throughout this season harvesting activities take place in each of the local community member's designated land area. Harvesting activities are undertaken by land owners themselves, or through other local community members in agreement with the land owner, or by local community members hired by the land owner. Generally, throughout this period, the local communities undertake their harvesting activities and return to their village (Rajef or Dlaghah) on a daily basis. Onsite tents are common throughout this period, but are mainly used for resting throughout the day.
3) *Post Harvesting Season (August – January):* throughout the season no one inhabits the area especially by the end of September when the nomads leave (discussed in further details below). However, occasional day trips for grazing by the local community are possible, although they depend more on fodder to feed their livestock throughout this period.

(ii) Nomads

Certain nomadic tribes are known to inhabit the Rajef area including areas within the Project site. The nomads in the area mainly belong to 2 main tribes– (i) the majority of the nomads consulted belonged to the Saidiyyin tribe (however those do not live in Dlaghah & Rassees, they move around between the Rajef area and Wadi Araba which is located further west of the Project site); and (ii) to a lesser extent the other nomads belonged to the Howeitat tribe (those move around between the Rajef area and the eastern parts of Ma'an Governorate such as Jafr and Mregha, Mdawarah, etc.).

Such nomads move around on a seasonal basis. They move to Rajef area during spring/summer time (between April and September) due to: (i) its cooler climate; (ii) productive lands in which they can undertake agricultural and/or grazing activities; and (iii) availability of water resources. Throughout this period they reside in the Rajef area by setting tents in which they live (Figure 34 below). By the end of September, as the weather becomes colder, they move back to warmer areas (such as Wadi Araba or Jafr). Transportation activities between Rajef and other areas are undertaken by trucks.

Based on consultations, it was understood that the nomads in general occupy the Rajef area each year, but do not settle in the exact specific area each year. They generally reside in lands through agreement with the land owner or on other public lands in the area. Throughout this period, some of the nomads undertake grazing activities only. As discussed earlier, grazing can take place openly in any area as anyone is allowed to enter the lands without permission form the land owner. Other nomads undertake grazing activities in addition to agricultural activities (similar to the patterns of the local community this is undertaken mainly during May, June and July). Agricultural activities by the nomads are undertaken in agreement with the land owner or on other public lands in the area.

Figure 34: Top Left – Harvesting Activities by Local Communities; Top Right – Nomadic Tent; Bottom Left – Nomadic Livestock; Bottom Right – Grazing Activities by Nomads in the Area

9.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on the formal land use and actual land use. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

Given that the impacts from the Project on land use are similar in nature throughout the various Project phases, those have been discussed collectively throughout this section.

9.2.1 Impacts on Formal Land Use during the Planning and Construction Phase

As discussed earlier in "Section 8.1.29.1.2", the Project site does not conflict with any of the relevant governmental entities' formal planning context and which includes the following:

- MOMA: the Project site does not conflict with MOMA's land use plan, in fact the designated land use for the area allows for the development of such a Project.
- PDTRA: there are no issues of concern in relation to PDTRA's planning for the Petra Region.
- MoEnv/RSCN: the Project site does not conflict with the MoEnv's/RSCN's planning context as it is not located within established/planned reserves or important bird areas.
- MoA: The Project site does not conflict with the MoA's planning context, specifically for rangelands/grazing reserves, forest lands, and agricultural development projects. However, there are additional requirements from the MoA which must be taken into account by the Developer – those are discussed below.

To this extent, there are no anticipated impacts from the Project on the formal land use plans set for the area. However, there are additional requirements from the MoA which must be met and which are discussed below.

Additional Requirements

As discussed earlier, the Project site is characterized as being barren and heavily degraded with few scattered trees (a maximum of 10 trees were recorded scattered throughout the site) of remnant forests that use to prevail in the entire mountain of Al-Rajef. According to discussion with the Department of Forestry and Sherah Agricultural Development Directorate, once a final detailed design has been prepared for the Project components, *and only if construction activities require any forest trees in the Project site be removed*, then the EPC Contractor must submit an application to the Sherah Agricultural Development Directorate in order to obtain their approval.

The application must provide the final design details of the Project, the expected number of trees that will be removed, along with a proper justification as to why they need to be removed (e.g. possible conflict with certain Project components). The Directorate will review the application and officials would inspect the site. However, according to discussions with the Sherah Agricultural Development Directorate, given the current conditions of the site (being barren and heavily degraded with few scattered forest trees) it is highly likely that such an approval will be granted if required.

Monitoring and Reporting Requirements

Once obtained and if required, the EPC Contractor is required to submit the official letter of approval of Sherah Agricultural Directorate.

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9.2.2 Impacts on Actual Land Use during the Construction and Operation Phase

Besides potential impacts on the formal land use context set for the area, there are other potential impacts on the actual (or informal) land use of the Project site. Inappropriate selection of a Project site could entail certain impacts on the local community and nomads given that such lands could provide certain value such as agricultural activities, grazing, etc. – whether it be the land owners or other local community members or nomads whom use the lands but do not necessary own it.

Inappropriate selection of a site without properly understanding the actual land use patterns could disturb ongoing activities taking place and ultimately resulting in impacts such as physical displacement, loss of sources of income, and other.

Taking all of the above into account, the potential impacts on the formal land use are discussed below on the potentially affected communities to include the local community grazers and farmers, as well as the nomads, all of which are discussed in details below.

- Local Community Grazers: grazers that use the area are all from the local community members of Al-Rajef and Dlaghah & Rassees – some of them are land owners in the area while others are not. As discussed earlier, grazing activities are undertaken throughout the spring season and to a lesser extent through the post-harvesting season. Grazing activities happen throughout the entire area in general and openly in any land. Such grazing activities are not expected to be affected by the Project development due to the following:
  - Given the very small footprint in which construction and operation activities will take place. The footprint of the Project site has been calculated to be around 7% of the total leased lands area and 2% of the entire Project site boundary area (refer to "Section 3.5").
  - The land lease agreement between the Developer and the land owners allows the right for the land owners to continue with their activities onsite (agriculture, grazing) as currently undertaken.
  - Widespread lands of similar habitats in the Rajef area that are used for grazing.
- Local Community Farmers: harvesting activities take place between May and July and such activities are undertaken in each of the local community member's designated land area. Harvesting activities are undertaken by land owners themselves, or through other local community members in agreement with the land owner, or by local community members hired by the land owner.

  Land owners whom undertake harvesting activities in their lands will not be affected given that they are willingly leasing their lands for the Project development and are aware that small individual footprints within their lands will be utilized during the construction and operation phase for the Project development. In addition, the land owners have been financially compensated by the Developer for lease of their lands. Land owners have been compensated an amount of 26JoD per 1000m^2 per year, while each 1000m^2 generates on average 1.5JoD only to the land owner from agricultural activities.

  Other local community members besides the land owners (either those whom harvest the land in agreement with the land owner or those whom work for the land owner) are also unlikely to be affected. This is due to the fact that the footprint of the Project site is minimal as discussed earlier, and it is expected that harvesting activities will continue as currently being undertaken around those areas.

In addition to the all of the above, it is important to note also that the consultations undertaken with the local community onsite revealed that they were all very well informed about the Project and very supportive and had no objections. In addition, they understood that the Project would only affect small limited footprints, and this would generally not affect their activities undertaken onsite.

- Nomads: nomads usually inhabit the Rajef area from April till September. The Project development will not affect their settling in the area as further explained. The nomads in general occupy the Rajef area each year, but do not settle in the exact specific area each year. Therefore, even if some of the Project components (which as discussed earlier are of a minimal footprint) are within an area in which a nomad is currently settling, in later years (during construction and operation) nomads could simply set

up their tents on other nearby areas. Moreover, based on discussions with the nomads they understood that the footprint of the Project site is minimal and also did not mind at all moving around in the Rajef area. However, it is important to note that there could be other areas besides the actual footprint of the Project which they might have to avoid due to nuisances (from shadow flicker and noise – this issue is discussed in further details in "Chapter 18").

In addition, agriculture and grazing activities undertaken by the nomads would not be affected by the Project development. Similar to the rationale discussed for the local communities, this is due to the minimal footprint of the Project site and the widespread lands of similar habitats in the area.

Given all of the above, the potential impacts on actual land use would of a short-term duration during the construction phase and of long term duration during the operation phase. Given that there are grazing and agricultural activities taking place by the local community and nomadic settlers in the area, the receiving environment is considered of medium sensitivity. However, the impacts will be of a negative nature, and low magnitude given the small limited footprint of land use that will be affected from the Project development. Given all of the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor and Project Operator during the construction and operation phase:

- Allow all local community members to continue with their grazing and agricultural activities in the Project area as normal, as well as nomadic settlers (that is besides those areas of the actual footprint of the Project site);
- A detailed grievance mechanism for the local community as well as nomads must be prepared. The local community and nomads must be made aware of the grievance mechanism available to submit complaints against any potential prohibition of access to the Projects area with no legitimate reason (e.g. safety and security reasons). Should complaints be submitted they should be followed up and handled appropriately

Following the implementation of the mitigation measures, the residual significance can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the Project Operator during the operation phase:

- Inspections to ensure local community and nomads are allowed to continue with their activities in the area.
- In case a complaint is submitted, a report must be prepared detailing the nature of the complaint, how it was handled and the follow-up measures undertaken.

10. GEOLOGY AND HYDROLOGY (SOIL & GROUNDWATER)

This Chapter first provides an assessment of baseline conditions within the Project site and surroundings in relation to geology and hydrology and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

10.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to geology and hydrology and presents the outcomes and results.

10.1.1 Baseline Assessment Methodology

The assessment was based on review of secondary data available from the Ministry of Water and Irrigation (MWI). This includes data and records available from the MWI as well as a study; "Ma'an Water and Wastewater Master Plan" (CDM International, 2013), which investigates geological, hydrogeological, and hydrological conditions within Ma'an Governorate including the Project area in general.

10.1.2 Results

According to Ma'an Water and Wastewater Master Plan (CDM International, 2013) groundwater for potable use in Jordan is obtained primarily from regional bedrock aquifers. Although groundwater is abstracted from shallow alluvial deposits in some locations, these are of minor significance. The three major bedrock systems include:

- Tertiary-Quaternary Shallow Aquifers
- Upper Cretaceous Limestone Aquifers
- Ram-Zarqa Kurnub Aquifers

The majority of wells in Ma'an Governorate including the Petra Region are located within A7/B2 aquifer. The A7/B2 aquifer is within the Upper Cretaceous Limestone Aquifer, bounded by the B3 aquitard above and the A5/A6 aquitard below. This aquifer is the most important in Jordan from a water supply perspective; it extends over most of the country, has high permeability and storability, and receives significant recharge from precipitation. The aquifer includes the sequence of the Wadi As Seer Limestone (A7), the Wadi Umm Ghudran Formation (B1), the Amman Silicified Limestone and the Al Hisa Phosphorite formations (B2). It consists of limestone, dolomitic limestone and dolomite with intercalated beds of sandy limestone, chalk, marl, gypsum, chert and phosphorite. The aquifer can be characterized as karst, with caverns and voids through which groundwater movement can be very rapid with limited filtering.

The groundwater quality of the A7/B2 aquifer is good. The report notes an increasing trend in nitrate concentrations in the A7/B2 aquifer due to surface infiltration of agricultural fertilizers and wastewater.

The Project site is located in the Jafr groundwater basin with a sustainable yield reported between about 500 and 1000 m^3/km^2/year. Based on reported 2009 data, abstractions totaled 30.6 Million Cubic Meters (MCM), well in excess of the sustainable yield. The renewable water component of this was estimated in the amount of 9 MCM/y in the upper portion which has surface communication that allows recharge. The balance of 21 MCM/y abstracted is considered non-renewable water resulting in aquifer depletion.

Estimates are reported to suggest that the Jafr basin could continue to supply 18 MCM/yr of non-renewable water for a period of 50 years.

Comparison of the 2009 total abstractions of 30.6 MCM in the basin with the total supply well abstractions of 9.2 MCM suggests 30 percent of the water abstracted is for potable water, the remaining is likely used for agriculture.

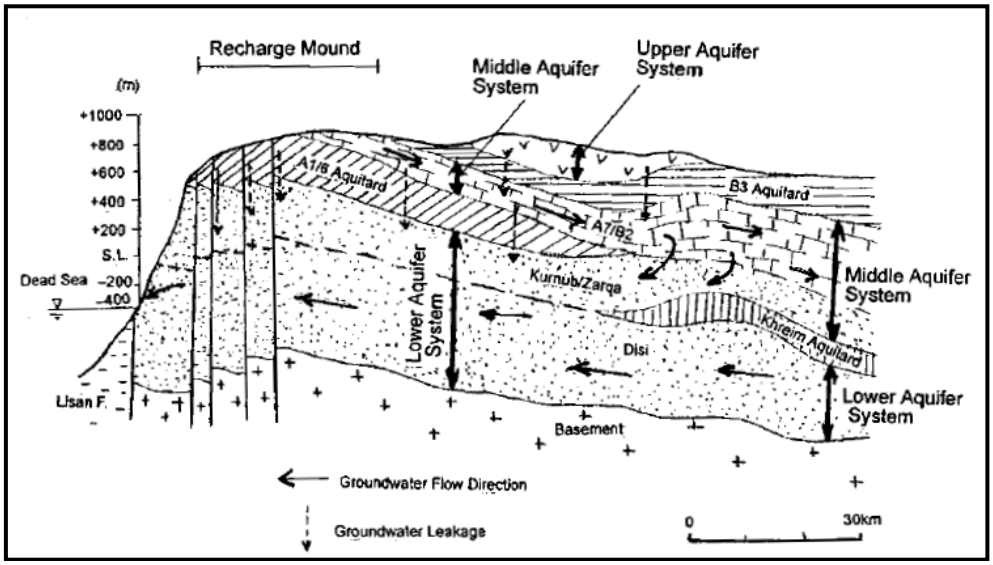

Figure 35: Schematic Section of Regional Groundwater Flow in Central Jordan

In addition, the Project site is located within three surface water basins which include the North Wadi Araba, South Wadi Araba, and Jafr surface water basins; each of which has an annual discharge of 46 MCM, 8 MCM, and 13 MCM respectively. Figure 36 below presents the Project site and the surface water basins.

The figure below also presents the wadis and drainage pattern within the Project area. As noted in the figure below, several wadis exist within the eastern parts of the Project site, which are part of the Jafr surface water basin. Those wadis drain eastwards eventually towards Al-Wehaideh Dam – a dirt dam located approximately 19km from the Project site. Within the western parts of the Project site, a wadi also exists and which is part of the South Wadi Araba Surface Water Basin. The wadi drains westwards and eventually drains into Wadi Araba.

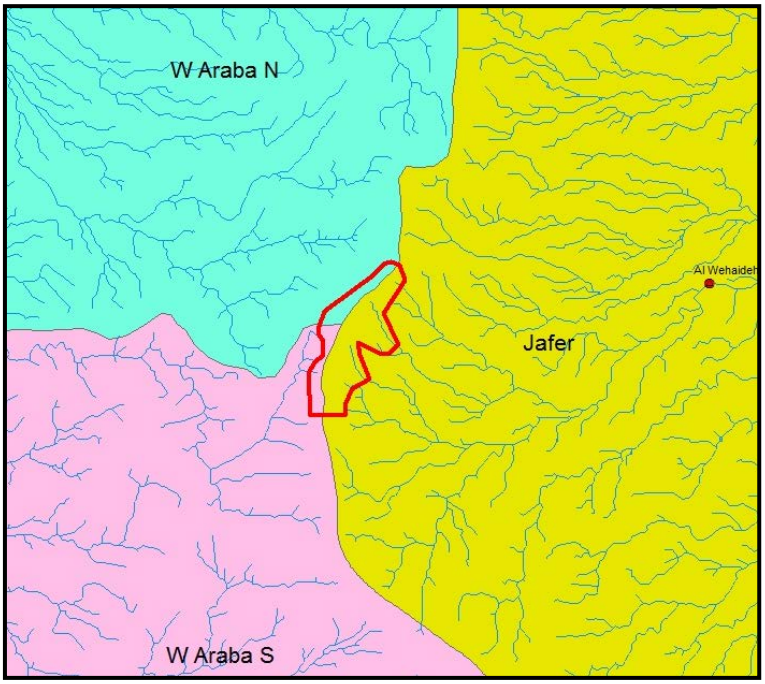

Figure 36: Surface Water Basins and Wadis within Project Area

10.2 Assessment of Potential Impacts

This section provides an assessment of the potential impacts on geology and hydrology (soil and groundwater) from the Project's various phases to include planning and construction phase and operation phase.

The only foreseen impacts from the Project activities on soil and groundwater are related to those impacts from improper management of waste streams.

Given the generic nature of the impacts for both phases of the Project (construction and operation) those have been identified collectively throughout this section. Generally, this includes potential impacts from improper housekeeping practices (e.g. improper management of waste streams, improper storage of construction material and of hazardous material, etc.).

Improper housekeeping practices during construction and operation (such as illegal disposal of waste to land) could contaminate and pollute soil which in turn could pollute groundwater resources. This could also indirectly affect flora/fauna and the general health and safety of workers (from being exposed to such waste streams). Generally, such impacts can be adequately controlled through the implementation of general best practice housekeeping measures as highlighted throughout this section, and which are expected to be implemented by the EPC Contractor throughout construction phase and Project Operator during the operation phase.

The potential impacts from improper management of waste streams could be of a long-term duration throughout the construction and operation phase. Such impacts are negative in nature, and are considered of low magnitude they are generally controlled through the implementation of general best practice housekeeping measures. The receiving environment is considered of medium sensitivity. Given all of the above, such an impact is considered to be of minor significance.

Following the implementation of the mitigation measures highlighted throughout this Section, the residual significance can be reduced to not significant.

10.2.1 Solid Waste Generation

Solid waste is expected to be generated from construction and operational activities. Solid waste generated will likely include construction waste (such as debris) and municipal solid waste (during construction and operation such as cardboard, plastic, food waste, etc.).

Municipal solid waste generated will likely be collected and stored onsite and then disposed to the closest municipal approved landfill (Al-Basta Landfill – refer to "Section 16.1.4" for additional details on this landfill); whereas the construction waste will be stored onsite and then disposed at the closest municipal approved debris landfill (Shabit Al Dabe Landfill which accepts construction waste - refer to "Section 16.1.4" for additional details on this landfill) or, if possible, reused in the construction activities.

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase unless stated otherwise:

- Coordinate with PDTRA or hire a competent private contractor for the collection of solid waste from the site to the municipal approved landfill (the closest landfill being Al-Basta for municipal waste and Shabit Al Dabe for construction waste);
- Prohibit fly-dumping of any solid waste to the land;

- Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste";
- EPC Contractor only - during construction, distribute a sufficient number of properly contained containers clearly marked as "Construction Waste" for the dumping and disposal of construction waste. Where possible, the EPC Contractor must seek ways to reduce construction waste by reusing materials (for example through recycling of concrete for road base coarse);
- Implement proper housekeeping practices on the construction site at all times; and
- Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. The numbers within the records are to be consistent to ensure no illegal dumping at the site or other areas.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase unless stated otherwise:

- Inspection of waste management practices onsite;
- Review of records and manifests for volume of waste generated to ensure consistency; and
- Regular environmental reporting on implementation of the waste management practices onsite.

10.2.2 Wastewater Generation

Wastewater is mainly expected to include black water (sewage water from toilets and sanitation facilities), as well as grey water (from sinks, showers, etc.) generated from workers during the construction and operation phase. Wastewater quantities are expected to be minimal. It is expected that wastewater will be collected and stored in fully contained septic tanks and then collected and transported by transportation tankers to be disposed at either Wadi Mousa Waste Water Treatment Plant (WWTP) or Ma'an WWTP – refer to "Section 16.1.3" for additional details on those WWTP's.

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities, to include the EPC Contractor during the construction phase and the Project Operator during the operational phase, unless stated otherwise:

- Coordinate with Petra and Wadi Mousa Water Directorate to hire a private contractor for the collection of wastewater from the site to either Wadi Mousa WWTP or Ma'an WWTP;
- Prohibit illegal disposal of wastewater to the land;
- Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas;
- EPC Contractor only - ensure that constructed septic tanks during construction and those to be used during operation are well contained and impermeable to prevent leakage of wastewater into soil; and
- Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase, unless stated otherwise:

- Inspection of wastewater management practices onsite;
- Review of records and manifests for volume of wastewater generated to ensure consistency; and
- Regular environmental reporting on implementation of the wastewater management practices discussed above.

10.2.3 Hazardous Waste Generation

Hazardous waste is expected to be generated throughout both the construction and operation phase and this could include simple materials such as consumed oil, chemicals, paint cans, etc. Given the nature of the Project, hazardous waste quantities are expected to be relatively low. Nevertheless, hazardous waste generated will likely be collected and stored onsite and then disposed at the 'Swaqa Hazardous Waste Treatment Facility' which is managed by the MoEnv – refer to "Section 16.1.5" for additional details on this Treatment Facility.

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities to include the EPC Contractor during the construction phase the Project Operator during the operational phase, unless stated otherwise.

- Coordinate with the MoEnv and hire a private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility;
- Follow the requirements for management and storage as per the 'Instructions for Hazardous Waste Management and Handling of the Year 2003' of the MoEnv;
- Prohibit illegal disposal of hazardous waste to the land;
- Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing; and
- Maintain records and manifests that indicate volume of hazardous waste generated onsite, collected by contractor, and disposed of at the Swaqa Facility. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase, unless stated otherwise:

- Inspection of hazardous waste management practices onsite;
- Review of records and manifests for volume of hazardous waste generated to ensure consistency; and
- Regular environmental reporting on implementation of the hazardous waste management practices onsite.

10.2.4 Hazardous Material

The nature of construction and operational activities entail the use of various hazardous materials such as oil, chemicals, and fuel for the various equipment and machinery. Improper management of hazardous material entails a risk of leakage into the surrounding environment either from storage areas or throughout the use of equipment and machinery.

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities to include the EPC Contractor during the construction phase the Project Operator during the operational phase, unless stated otherwise.

- Ensure that hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of hard impermeable surface, flame-proof, accessible to authorized personnel only, locked when not in use, and prevents incompatible materials from coming in contact with one another. The provisions of the Jordanian Standard (JS) 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials must be adhered to;
- Maintain a register of all hazardous materials used and accompanying Material Safety Data Sheet (MSDS) must present at all times. Spilled material should be tracked and accounted for;
- Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc.);
- Regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage (such as refueling) must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material;
- Ensure that a minimum of 1,000 liters of general purpose spill absorbent is available at hazardous material storage facility. Appropriate absorbents include elite, clay, peat and other products manufactured for this purpose; and
- If spillage on soil occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase, unless stated otherwise.

- Inspection for storage of hazardous materials to include inspections for potential spillages or leakages; and
- Report any spills and the measures taken to minimize the impact and prevent from occurring again.

11. BIODIVERSITY

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to biodiversity and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

It is important to note that biodiversity assed in this Chapter excludes birds (avi-fauna) and bats, which are discussed separately in "Chapter 12" and "Chapter 1213" respectively.

11.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to biodiversity and presents the outcomes and results.

11.1.1 Baseline Assessment Methodology

The baseline assessment of the Project site was based on a literature review and a field survey, each of which is discussed in details below.

(i) Literature Review

This was based on previous studies, data, surveys, and records available in published scientific papers, books, and journals on flora and fauna species recorded within the study region in general.

(ii) Field Survey

A four (4) day field survey was undertaken at the Project site during early summer time for flora and fauna from 29 June 2012 – 2 July 2012. The survey was undertaken onsite throughout this period as generally the biodiversity of the site is considered to be the highest and thus most representative of the site. The field survey mainly included the following methods:

- Field observations: the site was examined carefully for the presence of active animals, animal signs and tracts, active burrows, remains or any other vital signs that indicate the activity of animals. In addition the site was surveyed for occurring plant species which were noted and recorded to include number of species, coverage interception per species, etc.;
- Line transects: transects in many areas of the project site of over 100 m long were undertaken for the detailed assessment of flora and fauna species. Observed species were recorded and photographed as possible; and
- Interviews with local people: local people of the area were interviewed and asked questions regarding well known fauna species that are likely to be present within the site. A book with illustrations and images of fauna species were shown throughout the process in order to accurately confirm their presence.

(iii) Fauna & Flora Species' status

Floral species recorded onsite had no international conservation status as they were not assessed by the International Union for the Conservation of Nature (IUCN). Therefore, their status classification was based on an extensive national level study named "Jordan Country Study on Biological Diversity: Plant Biodiversity and Taxonomy" (Dawud Al Eisawi, 2000). This is the only study conducted to date that assessed the conservation status of flora species.

The fauna species status was assigned based on their conservation status within the Mediterranean region according to the IUCN Red Data Books: "The Status and Distribution of Mediterranean Mammals" (Temple & Cuttelod, 2009) and "The Status and Distribution of Reptiles and Amphibians for the Mediterranean Basin" (Cox *et al*., 2006). In Jordan, currently there are no official assigned conservation status for faunal species (to include mammals, reptiles and amphibians). However, local conservation statuses of faunal species were assigned based on the expert's extensive experience, knowledge and studies undertaken with regards to the ecology and biodiversity of Jordan.

11.1.2 Results

In accordance with the methodology discussed above, the results below discuss the findings and outcomes for flora and fauna based on the literature review and field survey.

(i) Flora

From a bio-geographical perspective, the study site is located on the edge of the arid Mediterranean that is in contact with the Irano-turanian zone (which surrounds the Mediterranean zone eastwards). Such bio-geographical regions in Jordan are classified as steppe rangelands which are best used as grazing lands.

Generally, the Project site is barren with some rocky habitats, and few vegetation strips mainly consisting of White Wormwood (*Artemisia herba-alba)* and scattered trees of remnant forests that use to prevail in the entire mountain of Al-Rajef. The site has been heavily degraded due to massive grazing, tree cutting, and ploughing that have occurred extensively throughout the site most likely for many decades.

More specifically, from a biodiversity perspective, the site can be divided into four parts that are identified and presented in Figure 37 below. In addition, the field survey recorded 17 plant species within the site all of which are common to such habitat areas and none of which are considered rare or endangered.

1) The most southern site is characterized by a narrow strip of the White Wormwood (*Artemisia herba-alba)* that grows commonly on the steppes of the Mediterranean regions. The majority of this site is degraded.
2) The central site is characterized by marginally vegetated area dominated by White Wormwood (*Artemisia herba-alba)* whereas the rest of the site is barren with some rocky out crops.
3) The east mid-central site is entirely barren with some rocky habitats.
4) The most northern site extends along sharp cliffs overlooking Al-Rajef village and extends eastwards. It is characterized by a mixture of both White Wormwood (*Artemisia herba-alba)* and heavily grazed Thorny Burnet (*Sarcopoterium spinosum).* However, the bulk of the site is barren with very low or no vegetation cover.

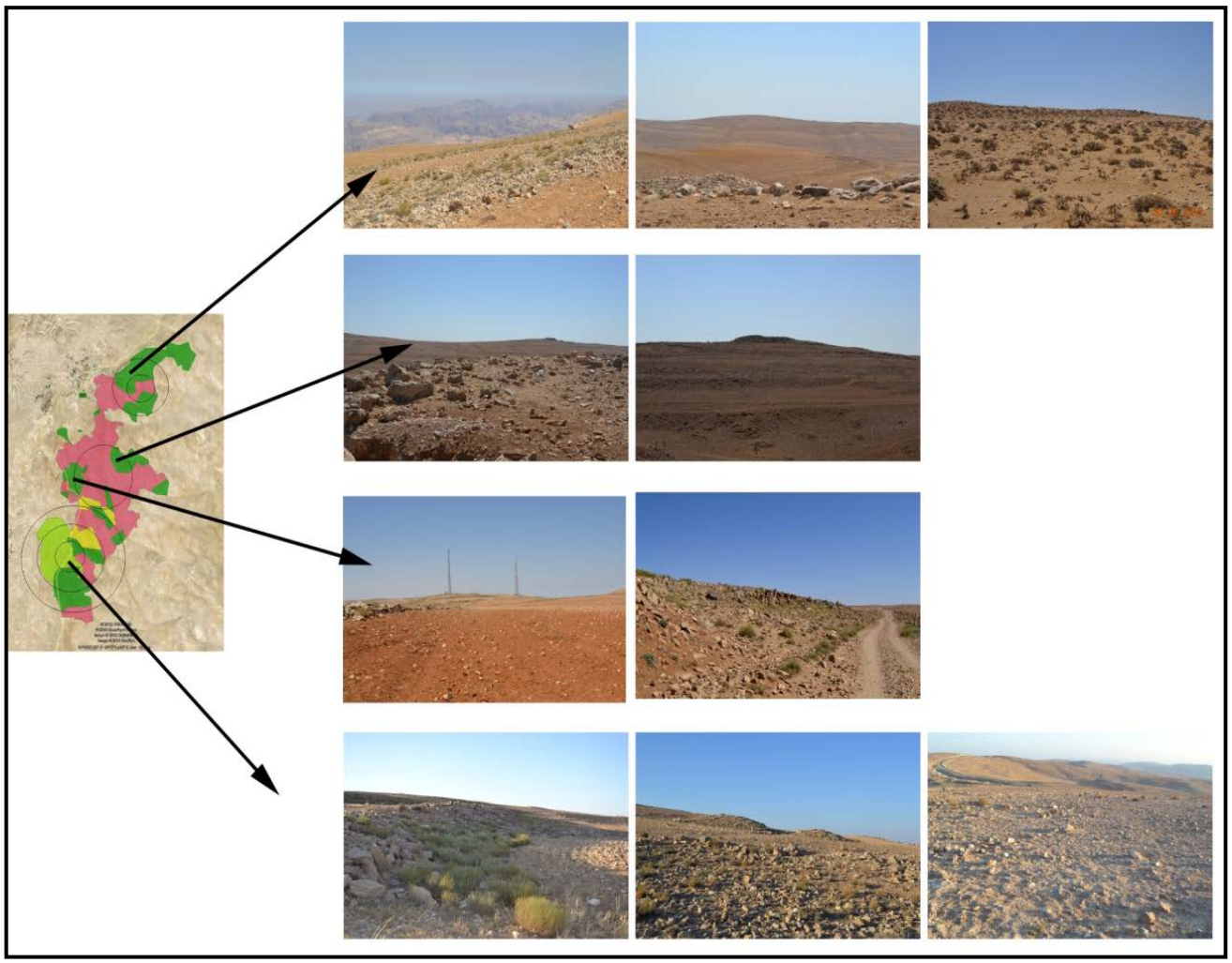

Figure 37: Main Habitats Observed in the Project Site

(ii) Fauna

The specific outcomes of the field survey in relation to faunal species are discussed below and which includes mammals and reptiles & amphibians.

a. Mammals

Based on the site survey, five (5) species of small mammals were recorded as presented in the table below all of which were considered of Least Concern according to the IUCN status, and common to such area habitats. This includes four rodents: (i) Eastern Spiny Mouse, (ii) Wagner's Gebril, (iii) Tristrams's Jird, (iv) Middle East Blind Mole Rat; and one hedgehog: (i) East European Hedgehog.

Table 18: List of Mammals Recorded in the Project Site

Common Name	Scientific Name	IUCN status	Local Status
Eastern Spiny Mouse	*Acomys dimidiatus*	Least Concern	Common
Wagner's Gerbil	*Dipodillus dasyurus*	Least Concern	Common
Tristrams's Jird	*Meriones tristrami*	Least Concern	Common
Middle East Blind Mole Rat	*Spalax ehrenbergi*	Least Concern	Common
East European Hedgehog	*Erinaceus concolor*	Least Concern	Common

The field survey indicated that the Eastern Spiny Mouse's distribution was confined to rocky areas and the sharp edges overlooking Al-Rajef village in the northern areas, whereas the Middle East Blind Mole Rat's distribution was limited at higher altitudes and scattered mounds were observed across the arid as well as the vegetated parts of the study site. In addition, burrows of both Wagner's Gerbil and Tristram's Jird were located in open areas with scarce vegetated areas. The presence of East European Hedgehog was based on noticed foot prints as well as to descriptions provided by the locals.

On the other hand, the presence of carnivores was only confirmed by interviews with the local people that indicated the presences of the Wolf, the Red Fox, the Hyena, and the Badger. All of the identified species have an IUCN status of Least Concern except for the Striped Hyena which is considered Vulnerable but most of them are threatened at the local level – generally due to hunting activities. However, it must be noted that all those carnivores do not inhabit the site (as no suitable hiding places for them was noticed) but rather only pass by the area while hunting for food.

Table 19: List of Carnivores in the Area

Common Name	Scientific Name	IUCN status	Local Status
Wolf	*Canis lupus*	Least Concern	Threatened
Red Fox	*Vulpes vulpes*	Least Concern	Common
Striped Hyena	*Hyaena hyaena*	Vulnerable	Threatened
Eurasian Badger	*Meles meles*	Least Concern	Threatened

Finally, based on the literature review of mammals in the area there are several species which are known to typically inhabit such areas of similar habitat, and which would be present within the Project site. Generally, most of the species recorded throughout the literature review are considered of Least Concern according to the IUCN status and are common to such habitat areas (refer to Annex II for additional details).

b. Reptiles and Amphibians

Based on the site survey nine (9) species of reptiles were recorded all of which had an IUCN status of Least Concern and common to such area habitats (except for the Tortoise which is considered threatened). This includes three (3) species of snakes: (i) Javelin Sand-boa (ii) Crowned Dwarf Snake (iii) The Coin Snake; two (2) geckos: (i) Elegant Thin-toad Gecko (ii) *Hemidactylus dawudazraqi;* one(1) agamid: (i) Starred Agama; one (1) lacertid: (i) Snake-eyed Lizard; one (1) toad: (i) the Green Toad and one (1) amphibian: (i) the Spur-thighed Tortoise.

Table 20: List of Reptiles and Amphibians Recorded in the Project Site

Common Name	Scientific Name	IUCN status	Local Status
Javelin Sand-boa	*Eryx jaculus*	Least Concern	Common
Crowned Dwarf Snake	*Eirenis coronella*	Least Concern	Common
The Coin Snake	*Hemorrhois nummifer*	Least Concern	Common
N/A	*Hemidactylus dawudazraqi*	Least Concern	Common
Elegant Thin-toad Gecko	*Stenodactylus sthenodactylus*	Least Concern	Common
Starred Agama	*Laudakia stellio*	Least Concern	Common
Snake-Eyed Lizard	*Ophisops elegans*	Least Concern	Common
Green Toad	*Bufo viridis*	Least Concern	Common
Spur-thighed Tortoise	*Testudo greacea*	Least Concern	Threatened

The Javelin Sand-boa was seen in the southern blocks of the Project site in areas with loose soil (Figure 38B), whereas the Crowned Dwarf Snake was found in the arid regions of the site (Figure 38A). A large specimen of the Coin Snake was also observed.

Two species of nocturnal geckos were observed to include the Elegant Thin-toad Gecko and *Hemidactylus dawudazraqi* (Figure 38C and Figure 38D). The Elegant Thin-toad Gecko was the most common gecko with

relatively high density compared to *Hemidactylus dawudazraqi* that was confined to areas with small block rooms.

The Starred Agama was the most common reptiles across the study area (Figure 39A). It was found along rocky outcrops in large numbers and was active around noon time, some as single males while other were in pairs. Of the lacertids, the Snake-eyed Lizard (Figure 39B) was the second most reptiles observed. It was recorded across the study area in hard substratum, near rocky areas as well in loose soil. Finally, the Green Toad was found in a small well located in the southern most borders of the study area (Figure 39C).

On the other hand, one amphibian species was recorded within the site; the Spur-thighed Tortoise (Figure 39D). Two of those species were seen aestivating (similar to hibernation but during summer time) and were buried in the soil along a rocky area within the central part of the site. The locals indicated that this tortoise is quite common in the area during spring.

In general all of the recorded species onsite have an IUCN status of Least Concern and are also considered common to such habitats. However, a key species which needs to be taken into account is the Spur-thighed Tortoise. Although it is considered of Least Concern according to the IUCN Red List of Threatened Species, it is threatened at the national level as it has been subject to extensive harvesting (for collection and selling purposes) and thus was listed within the "Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.(43) for the year 2008". This Regulation prohibits the hunting of certain species in Jordan to include the Spur-thighed Tortoise. In addition, in Jordan, the Spur-thighed Tortoise represents the last southern range distribution of this species (i.e. it cannot be found anywhere in southern regions after Jordan).

Finally, based on the literature review of reptiles and amphibians in the area there are several species which are known to typically inhabit such areas of similar habitat, and which would be present within the Project site. Generally, most of the species recorded throughout the literature review are considered of Least Concern according to the IUCN status and common to such habitat areas (refer to Annex II for additional details).

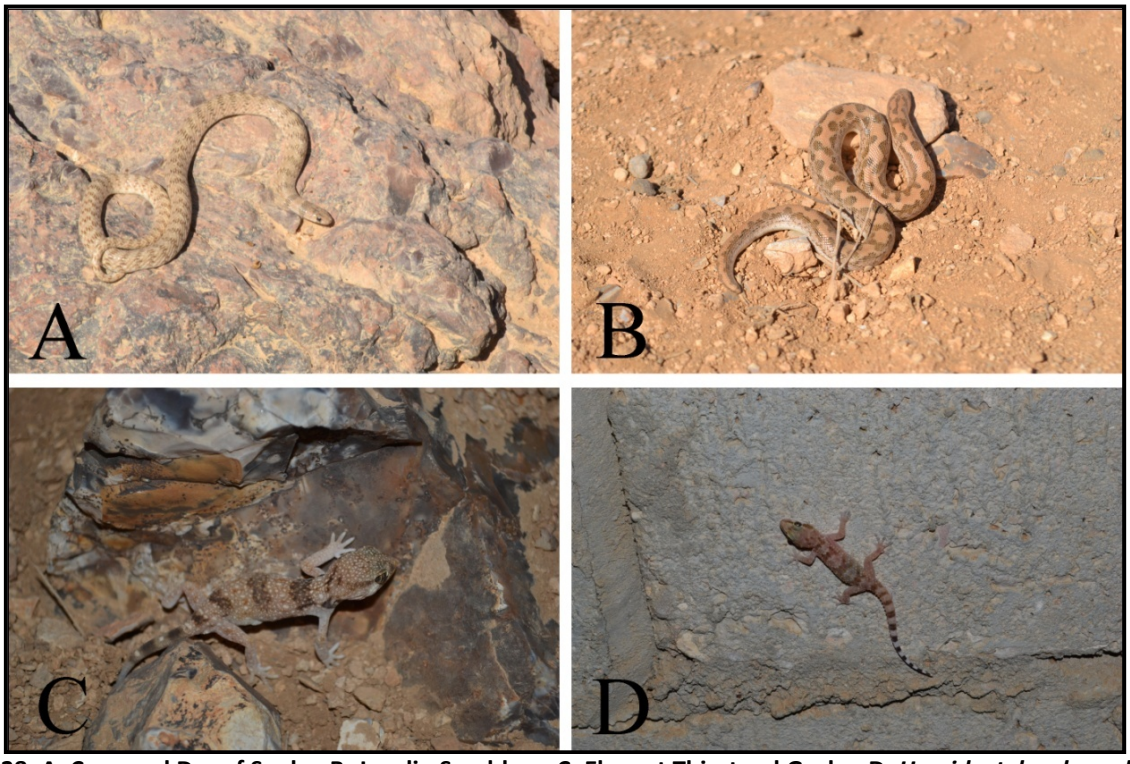

Figure 38: A. Crowned Dwarf Snake. B. Javelin Sand-boa. C. Elegant Thin-toad Gecko. D. *Hemidactylus dawudazraqi*.

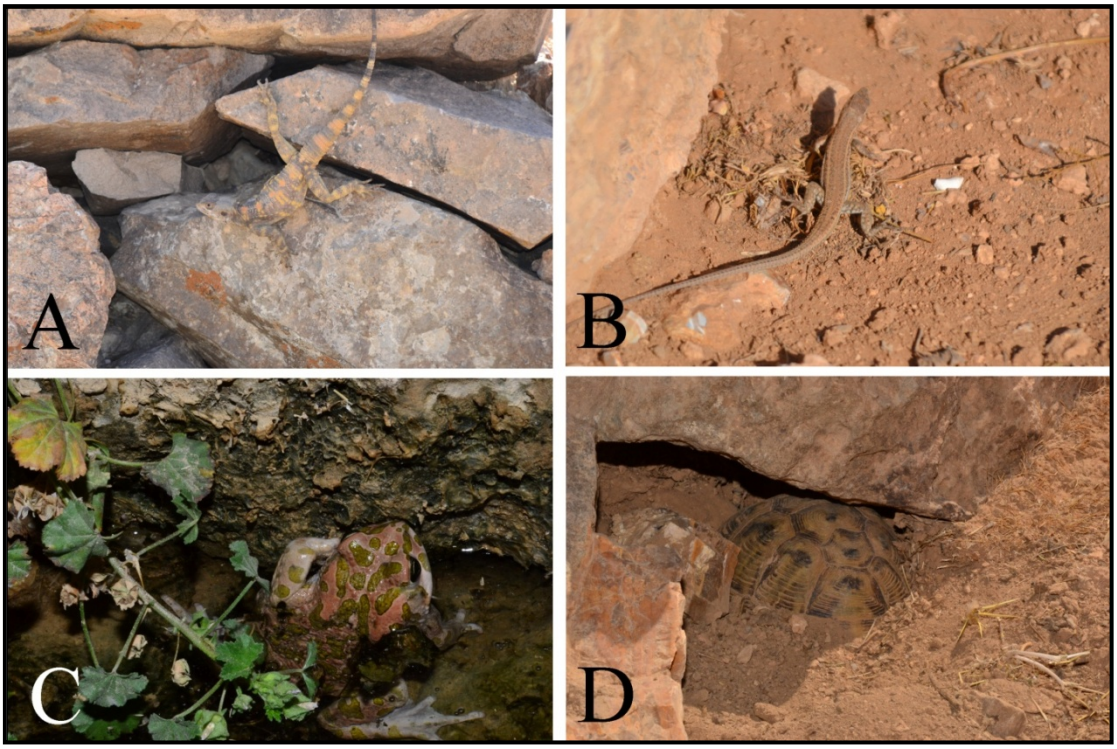

Figure 39: A. Starred Agama. B. Snake-eyed Lizard. C. Green Toad. D. Spur-thighed Tortoise.

11.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on biodiversity during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

11.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, leveling, excavation, grading, etc.

Such activities are limited to the relatively small individual footprints of these facilities and the actual area of disturbance is relatively minimal. Nevertheless, such activities would likely result in the alteration of the site's habitat and thus potentially disturb existing habitats. Other impacts on the biodiversity of the site are mainly from improper management of the site which could include improper conduct and housekeeping practices by workers (i.e. hunting of animals, discharge of hazardous waste to land, etc.).

However, as discussed in the baseline section, generally the site is considered of low ecological significance due to its natural setting; characterized by being barren and heavily degraded with few vegetation strips and scattered trees of remnant forests that use to prevail in the entire mountain of Al-Rajef. The site has been heavily degraded due to massive grazing, tree cutting and ploughing that have occurred extensively throughout the site and most likely for many decades.

In addition, no endangered or rare flora/fauna species or sensitive habitats have been observed within the Project site and most recorded floral and faunal species are considered of least concern and common to such habitat areas. In addition, as discussed in "Section 9.1.2", the Project site is not located within or near areas of critical environment concern (to include environmental reserves of important bird areas), where

the closest is around 6km away from the site. Nevertheless, an important issue that must be taken into account is the Spur-thighed Tortoise which is considered threatened at the national level. Given all of the above, the potential impacts on biodiversity created during the construction phase would of a long-term duration as they would result in a permanent change in the natural biodiversity of the site. Such impacts are considered of negative nature and of a medium magnitude given that the change in the natural biodiversity of the site will be noticeable in limited individual footprints. However, as the site is considered of low ecological significance, the receiving environmental is determined to be of a low sensitivity. Given all of the above, such an impact is considered to be of minor significance.

Additional Studies/Surveys and Mitigation Measures

The following identifies the additional studies and mitigation measures to be applied by the EPC Contractor during the construction phase and which include:

- Based on the final detailed design of the Project, all areas where construction activities will take place and that will be disturbed will be identified. Before construction activities commence, the EPC Contractor must undertake a detailed survey (through an ecological expert) to identify the presence of any active tortoises as well as potential hibernation/aestivation sites (during summer and winter) within all assigned areas to be disturbed by construction. Should any tortoises be located, they should be relocated to distant areas (outside of construction active areas) with similar habitat characteristics to the species to ensure that they would not return to the Project site, taking into account the home range for the species.
- Should as part of the Project any fencing be erected, it must be ensured that it allows for the natural movement of small faunal species within the area. This could include for example a fence with an appropriate gap between the ground level and the first rail or strand (around 30cm);
- Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel and good housekeeping which include the following:
  - Prohibit hunting at any time and under any condition by construction workers onsite;
  - Ensure proper storage, collection, and disposal of waste streams generated as discussed in detail in “Section 10.2”;
  - Restrict activities to allocated construction areas only, including movement of workers and vehicles to allocated roads within the site and prohibit off-roading to minimize disturbances; and
  - Avoid unnecessary elevated noise levels at all times. In addition, apply adequate general noise suppressing measures as detailed in “Section15.2”.

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- Reporting on outcomes of fauna survey and actions undertaken (e.g. relocation measures to areas outside of construction activities).
- Inspection of the works should be carried out at all times.

11.2.2 Potential Impacts during the Operation Phase

The only impacts anticipated during the operation phase are related to improper management of the site as discussed earlier. This could include improper conduct and housekeeping practices by workers (i.e. hunting of animals, discharge of hazardous waste to land, etc.).

The potential impacts on biodiversity would of a long-term duration throughout the operation phase of the Project. Such impacts are of negative nature and of a medium magnitude. However, as the site is considered of low ecological significance, the receiving environmental is determined to be of a low sensitivity. Given all of the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the Project Operator during the operation phase and which include:

- Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel and good housekeeping which include the following:
  - Prohibit hunting at any time and under any condition by workers onsite;
  - Ensure proper storage, collection, and disposal of waste streams generated as discussed in detail in "Section 10.2"; and
  - Restrict activities to allocated areas only, including movement of workers and vehicles to allocated roads within the site and prohibit off-roading to minimize disturbances.

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the Project Operator during the operation phase and which include:

- Inspection of the works should be carried out at all times.

12. BIRDS (AVI-FAUNA)

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to birds (avi-fauna) and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation and monitoring measures, additional requirements, etc.) have been identified to eliminate or reduce the impact to acceptable levels.

Before discussing the outcomes of the above, it is important to state that the potential impact of wind turbines on birds is considered one of the key issues related to wind farm developments which must be thoroughly addressed within the ESIA.

Specifically related to this Project, such an issue has been a continuous learning process throughout the course of the Project development since its inception in 2012 in all aspects related to the ESIA study – to include the baseline assessment and design of monitoring baseline surveys, assessment of potential impacts, design of mitigation and monitoring measures, etc. Such a learning process was challenging and complex, due to the fact that there are no wind farm developments in Jordan from which previous experiences can be learnt from and built on, the absence of local guidelines/procedures on such issues (to include baseline assessment and survey designs, assessment of impacts, design of mitigating and monitoring requirements, etc.), and the lack of international guidelines/procedures (e.g. IFC's EHS Guidelines for Wind Energy).

Summarized below is the learning process and the sequence of events which have occurred over the Project development since its inception in relation to birds assessment. Those are important to understand and take into account before the main outcomes of the assessment are discussed throughout this Chapter.

1. An initial birds monitoring program was designed in spring 2012. At that time there were no local requirements or guidelines from any governmental or non-governmental entity for birds monitoring nor were there any international best practice guidelines which could be taken into account. Therefore, at that time the monitoring program was designed by ECO Consult's international bird expert and local expert based on available and established international avi-fauna survey methods for wind farm developments – i.e. the Scottish Natural Heritage (SNH) Guidelines. Such Guidelines require a minimum of 36 hours of observations at each vantage point for each season (breeding, non-breeding, migratory) (SNH, 2005). ECO Consult aimed to go above and beyond the SNH Guidelines and during the 2012 spring season, 115 hours of observations were undertaken – amounting to around 38 hours of observation per vantage point (where at that time 3 vantage points were selected). At that time, the adoption of the SNH Guidelines was considered reasonable and sufficient given that Project site is not considered within a highly sensitive area in terms of avi – fauna; the Project site is not located in an IBA and is located at a distance from the rift valley and its margins – which is considered the main route for migratory birds passing through Jordan. In autumn 2012, additional monitoring was undertaken amounting to 90 hours of observations (around 30 hours at each vantage point).
2. At that time and based on the results of the spring and autumn 2012, ECO Consult prepared a bird's risk mapping for the Project site based on: (i) migration patterns over the site, (ii) number of birds flying within risk height (risk height was determined based on several scenarios for wind turbines' tip height and rotor diameter), and (iii) conservation status of species. The main objective of the map was to delineate areas of high sensitivity, medium sensitivity and low sensitivity.

   The map was included within the Report titled 'EPC Environmental Performance Requirements' prepared by ECO Consult for GWRE in 2014 – the objective of the report was to identify the main environmental requirements which must be taken into account by the EPC bidders for the Project. One of the requirements stated within the Report was that the map must serve as an additional guide throughout the detailed design of the preferred bidder when placing wind turbines and it is recommended to avoid locating wind turbines in areas considered of high risk to the greatest extent possible. The final layout prepared by the selected EPC Contractor has taken into account such a requirement to the greatest extent possible. This represents the first step of mitigation hierarchy

(avoid; reduce; mitigate and manage, and compensate and offset) taken into account – and which is to reduce such an impact to the greatest extent possible.

3. Later on as wind farm developments starting gaining more attention in Jordan, the RSCN and BirdLife International – Middle East Regional Office (Jordan) developed the 'Draft Guidelines for Bird Monitoring for Wind Farms' requiring 40 hours of observations per week throughout the migration seasons (amounting to 8 hours per day). At that point, it was unclear whether such guidelines or requirements should be followed or not as it was uncertain whether they will be adopted by the MoEnv – eventually they were not.
4. Nevertheless, ECO Consult aimed to further increase the monitoring hours already undertaken in 2012 to comply with the requirements of the Guidelines discussed above to the greatest extent possible (and also to increase observation hours, as in autumn 2012 the hours did not cover the minimum hours required by the SNH Guidelines) – however meeting such requirements entirely was impossible given the lack of qualified ornithologists in Jordan and the several wind farm developments to which birds surveys needed to be undertaken (besides this Project). Nevertheless, additional monitoring was undertaken during autumn 2013 amounting to 160 hours to further compliment the outcomes and observations of the 2012 autumn survey. No additional observation were carried out in spring 2013 as due to several reasons the ESIA study was paused in late 2012 and recommenced in July 2013.
5. In late 2014, based on experiences and lessons learned from the first wind farm development Project to be implemented in Jordan (the Tafileh Wind Farm Project) a new modified methodology for bird's survey was developed. Such a methodology was developed by international experts in the design of avi-fauna surveys for wind farm development Projects (Natural Research Projects Limited [NRP]). In addition, as part of another ongoing project being implemented by the IFC known as "Cumulative Impacts Assessment and Management of the Wind Energy Sector in the Tafileh Region", such an adjusted methodology was discussed and agreed with local prominent avi-fauna experts as well as other local stakeholders (such as the RSCN and BirdLife International – Middle East Regional Office (Jordan).

   The modified methodology takes into account the updated SNH Guidelines (SNH, 2014) but more importantly also takes into account the local context of Jordan and its importance for birds migrations within the Jordan Rift Valley. Ever since, such a modified methodology has been carried out for all proposed wind farm development sites in Jordan, and has become the main methodology for avi-fauna assessment. However, it is important to note that to date it has not been officially accepted by any governmental entity (such as the MoEnv).
6. In 2015 the EPC Contractor for the Project was selected and a final layout for the turbines was prepared and provided. In order to ensure that monitoring undertaken previously in 2012 and 2013 covers all the turbine locations, a view shed coverage map was prepared which takes into account the visibility of the turbines from the established vantage points. Based on the map, it was noted that the vantage points did not cover all the turbine locations according to the final layout provided (a total of 9 turbines were not covered). Therefore, an additional spring survey was undertaken using new vantage points that would compensate for the gap in previous surveys (for the 9 turbines) but also provide additional data for 28 turbines already covered in previous surveys. The survey methodology was undertaken in accordance with the modified NRP methodology discussed earlier for a total of 432 hours of watch and is considered the most comprehensive survey undertaken for the Project.

12.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to birds and presents the outcomes and results. As this section presents the outcomes in detail, "Section 12.2" presents a summary of the results and the main conclusions of baseline conditions in the Project site.

12.1.1 Baseline Assessment Methodology

The baseline conditions were mainly evaluated through a spring and autumn survey conducted onsite which aimed to observe the numbers and behavior of birds within or passing through the wind farm to include: (1) migratory soaring birds (2) resident soaring birds, and (3) non-soaring birds breeding within the site itself; mainly ground dwelling birds such as larks.

The methodology adopted is discussed in further details below for each season separately to include: (i) spring 2012; (ii) autumn 2012; (iii) autumn 2013; and (iv) spring 2015.

(i) Spring 2012

The spring 2012 survey is the first avi-fauna monitoring survey undertaken for the Project. At that time there were no local requirements or guidelines from any entity for birds monitoring nor were there any international best practice guidelines which could be taken into account. Therefore, at that time the monitoring program was designed by ECO Consult's international bird expert and local expert based on available and established international avi-fauna survey methods for wind farm developments – i.e. the Scottish Natural Heritage (SNH) Guidelines. Such Guidelines require a minimum of 36 hours of observations at each vantage point for each season (breeding, non-breeding, migratory) (SNH, 2005).

The following discusses the methodology adopted for the spring survey which includes direct observations at vantage points as well as casual observations, each of which is discussed below.

a. Direct Observations at Vantage Points

Observations from fixed vantage points were used to record the number and behavior of diurnal soaring birds over the site, mainly of migratory raptors and storks as well as resident soaring birds. Equipment required for this method includes binoculars, telescope, stop watch, GPS and thermometer.

At that time the Developer had 7 preliminary layouts for the turbines from 5 EPC Contractors, with no final EPC Contractor selected yet or a final turbine layout available. The objective was to selected vantage points onsite which would cover to the greatest extent possible all turbine locations for all preliminary layouts. Therefore, three (3) vantage points were selected for spring observations close to the western border of the site to observe birds migrating from south/southwest towards north/northeast during spring. The vantage points also allowed the observations of various resident soaring bird activities. The location of the vantage point is presented in Figure 40 below. Each vantage point was relatively elevated and allowed observations to occur to a distance of 2 km, thus the three points were sufficient for covering most areas of the Project site.

Spring surveys were carried out between early March and May to cover the main peaks of the spring migration season with around 115 hours of observations distributed over the entire period. One to two sessions were carried out approximately once every week. Observations occurred over a range of times and wind conditions.

ECO Consult aimed to go above and beyond the SNH Guidelines and during the 2012 spring season 115 hours of observations were undertaken – amounting to around 38 hours of observation per vantage point (where at that time 3 vantage points were selected). Such SNH Guidelines were considered sufficient given that Project site is not considered within a highly sensitive area in terms of avi – fauna; the Project site is not located in an IBA and is located at a distance from the rift valley and its margins – which is considered the main route for migratory birds passing through Jordan.

The following data was collected in the field during vantage point observations.

A. Activity sampling (each hour)

- Weather conditions: cloud, mist, wind (Beaufort), precipitation, visibility, temperature

- Bird activity (mainly non-target species)

B. Focal Sampling (each record of a soaring bird)

- Species and number of individuals

- Start time of record

- Height band*

- Notes on behavior of birds at the site

- Direction / route of soaring birds drawn as arrows on map of site

* Given that the Developer had 7 preliminary layouts with 7 different turbine module specifications, the height bands would differ for each turbine height. Therefore, two (2) height bands have been identified based on two scenarios with different wind turbine tip height; the first for a tip height of 135m and the second for a tip height of 180m in accordance with the range of turbine modules considered for the Project.

- Height bands for 135 m tip height. This is the collision risk height estimated for a turbine that has an approximate tower height of 85m and blade length of 50m. The height bands are defined as follows: 1 = 0 – 20m; 2 = 20 – 135m; 3 > 135m. Height band 2 is the band/zone coinciding with the rotor swept area (including a turbulence effect and margin of error of 15m below the rotor swept area); and
- Height bands for 180m tip height. This is the collision risk height estimated for a turbine that has an approximate tower height of 120m and blade length of 60m. The height bands are defined as follows: 1 = 0 – 45m; 2 = 45 – 180m; 3 > 180m. Height band 2 is the band/zone coinciding with the rotor swept area (including a turbulence effect and margin of error of 15 m below the rotor swept area).

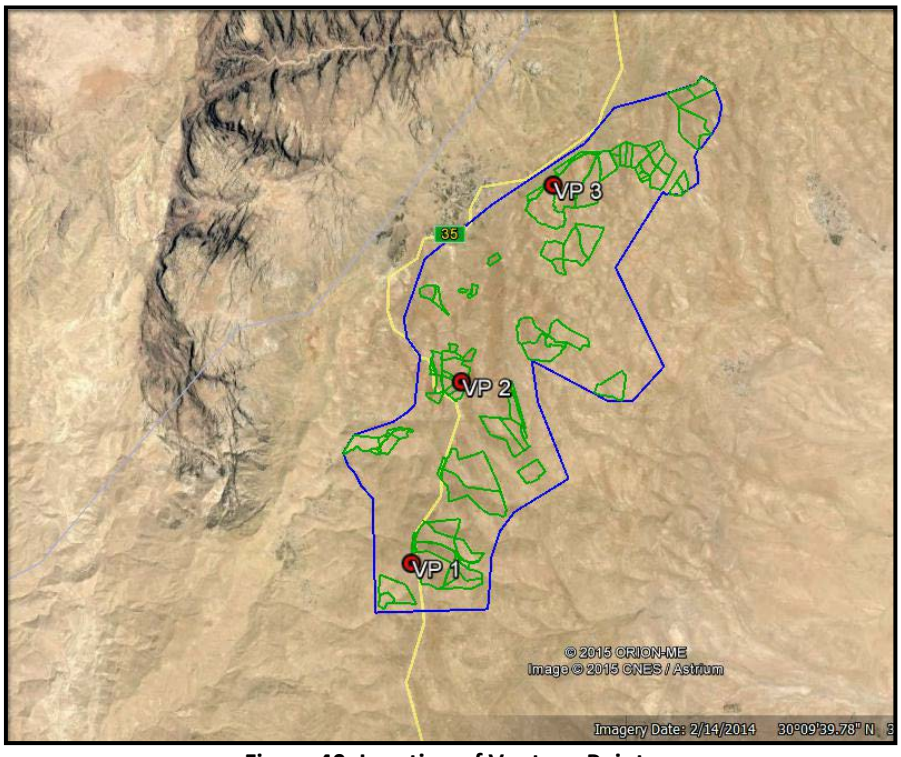

Figure 40: Location of Vantage Points

b. Casual Observations

In addition to observations from vantage points, all non-soaring resident and visiting birds using the site for feeding, roosting or breeding during spring and autumn were recorded through casual observations and walkthroughs undertaken throughout the Project site during.

c. Species Status and Importance

The conservation status of the birds (migratory and resident) recorded throughout the survey was based on their global status according to the IUCN Red List of Threatened Species. However, currently there is no assigned conservation status for birds at the national level; therefore, the local status of the recorded species was based on the agreed informal status of birds species amongst key prominent ornithologists in Jordan and which is based on previous surveys and studies undertaken in Jordan.

d. Target Species

At a later stage in 2015, a modified methodology was adopted (which is discussed in further details below). However, one of the key changes the modified methodology takes into account is the identification of target species to be recorded. The modified methodology assigns primary and secondary target species as the species for which flight activity information is recorded during any watch at a vantage point. Primary target species are species which have higher importance to impact survey and therefore merit the recording of detailed data on their flight activity.

1. *Primary target species* are categorized into Category A species (species of the highest importance to impact survey) and Category B species. The information recorded for *Category A* and *Category B* species is exactly the same, the only difference is that should an infrequent occasion when individuals of both categories are visible at the same time, the observer must focus on watching *Category A* species.

2. *Secondary target species* are species which have lower importance to impact survey and therefore do not merit the recording of detailed data on their flight activity. Not collecting detailed data on these common species frees up time for the observer to focus on searching for and recording information on the flight activity of primary target species. During this survey, all secondary species were treated as casual records and were not inserted in the flight activity data analysis.

The list of species was decided based on extensive consultations between local prominent avi-fauna experts and international experts in the design of avi-fauna surveys for wind farm development Projects (Natural Research Projects Limited [NRP]). The list of target species was based on three (3) key factors: (i) the global conservation status of the species according to the IUCN Red List of Threatened Species; (ii) the avoidance rate of the species in relation to wind turbines based on available information internationally; (iii) the national status of the species and its importance locally.

Although the modified methodology was adopted at a later stage (in 2015), however the rationale above of selection of target species was adopted for the listing and presentation of results for spring 2012 data as well as autumn 2012 and autumn 2013 (discussed later).

Table 21: Target Species to be Recorded by Flight Activity Surveys

Category A Primary Species	Category B Primary Species	Secondary Species
Egyptian Vulture	Barbary Falcon	Brown-necked Raven
Griffon Vulture	Black Kite	Common Kestrel
Bonelli's Eagle	Black Stork	Eurasian Sparrowhawk
Booted Eagle	Common Crane	Fan-tailed Raven
Eastern Imperial Eagle	Common Raven	Marsh Harrier
Golden Eagle	Crested Honey-buzzard	Rock Dove
Lesser Spotted Eagle	Steppe Buzzard	All bee-eater species
Short-toed Snake-eagle	Eleonora's Falcon	All sandgrouse species
Spotted Eagle	Hen Harrier	All swift species
Steppe Eagle	Hobby	All wader species
Verreaux's Eagle	European Honey-buzzard	All waterbird species
Long-legged Buzzard	Lanner	
	Lesser Kestrel	
	Levant Sparrowhawk	
	Montagu's Harrier	
	Osprey	
	Pallid Harrier	
	Peregrine	
	Red-footed Falcon	
	Saker Falcon	
	Sooty Falcon	

(ii) Autumn 2012

The autumn 2012 survey is the second avi-fauna monitoring survey undertaken for the Project. The methodology adopted is exactly the same as that of the spring 2012 survey. The methodology adopted for the autumn survey included direct observations at vantage points (Figure 40 above) to observe birds migrating from north/northeast towards south/southwest during autumn, as well as casual observations.

The autumn survey was carried out between end of August till early November to cover the main peaks of the autumn migration season for a total of 90 hours of observations.

(iii) Autumn 2013

It is important to note that the ESIA for the Project was paused in late 2012 and recommenced in July 2013. Throughout such times, wind farm developments starting gaining more attention in Jordan with many discussions taking place amongst various stakeholder groups (MoEnv, RSCN, BirdLife International – Middle East Regional Office (Jordan), etc.) with regards to their environmental impacts in general and birds in specific.

Given that there were no local guidelines/procedures for birds monitoring in Jordan, and given that each wind farm developer at that stage was undertaking monitoring based on a different methodology, the RSCN and BirdLife International – Middle East Regional Office (Jordan), aimed to develop guidelines for birds monitoring for wind farms which take into account the importance of Jordan as a main route for migratory birds. To this extent, they developed the 'Draft Guidelines for Bird Monitoring for Wind Farms' which on broad terms require 40 hours of observations per week throughout the migration seasons (amounting to 8 hours per day). At that point, it was unclear whether such guidelines or requirements should be followed or not as it was uncertain whether they will be adopted by the MoEnv – eventually they were not.

Nevertheless, with the recommencement of the ESIA study in July 2013, ECO Consult aimed to further increase the monitoring hours already undertaken in autumn 2012 to comply with the requirements of the Guidelines discussed above to the greatest extent possible – however meeting such requirements entirely was impossible given the lack of qualified ornithologists in Jordan and the several wind farm developments to which birds surveys needed to be undertaken (besides this Project). In addition, the survey also aimed to increase the monitoring hours as in the previous survey (autumn 2012), the hours did not also cover the SNH Guidelines requirements.

Therefore, in autumn 2013 additional monitoring was undertaken for the Project. The autumn 2013 survey is the third avi-fauna monitoring survey undertaken for the Project. The methodology adopted is exactly the same as that of the spring 2012 survey. The methodology adopted for the autumn survey included direct observations at vantage points (Figure 40 above) to observe birds migrating from north/northeast towards south/southwest during autumn, as well as casual observations.

The autumn survey was carried out between end of August till early November to cover the main peaks of the autumn migration season for a total of 160 hours of observations (for a total of 250 hours of observations with autumn 2012).

(iv) Spring 2015

In 2015 GWRE appointed the EPC Contractor (Gamesa) and a final layout for the turbines was prepared and provided. In order to ensure that monitoring undertaken previously through 2012 and 2013 covers all the turbine locations within the final turbine layout, a view shed coverage map was prepared which takes into account the visibility of the turbines from the established vantage points. Based on the map it was noted that the vantage points did not cover all the turbine locations according to the final layout provided. Therefore, an additional spring survey was undertaken using new vantage points that would compensate for the gap in previous surveys but also provide additional data for a number of turbines already covered in previous surveys.

In addition, in 2015 and based on experiences learnt from the Tafileh Wind Farm Project (the first wind farm in Jordan) a modified methodology was developed which takes into account the updated SNH Guidelines (SNH, 2014) but more importantly also takes into account the local context of Jordan and its importance for birds migrations – as the Jordan Rift Valley is considered to be the second most important migration flyway for soaring birds in the world.

Such a methodology was developed by international experts in the design of avi-fauna surveys for wind farm development Projects (Natural Research Projects Limited [NRP]). In addition, the modified methodology was also discussed and agreed with local prominent avi-fauna experts as well as other local stakeholders (such as the RSCN and BirdLife International – Middle East Regional Office (Jordan). Such a modified methodology has been carried out for all proposed wind farm development sites in Jordan and has become the main methodology for avi-fauna assessment. However, it is important to note that to date it has not been officially accepted by any governmental entity (such as the MoEnv).

Putting things into perspective, it is important to note that this does not mean that the modified methodology for this survey is correct while all others methodologies are incomplete or wrong – but this survey is regarded as the most comprehensive given that the level of effort was higher than all previous surveys reaching up to 3 times compared to that of spring 2012 for example.

a. Direct Observations at Vantage Points

Observations from fixed vantage points were used to record the number and behavior of diurnal soaring birds over the site, mainly of migratory raptors and storks as well as resident soaring birds. Equipment required for this method includes binoculars, telescope, stop watch, GPS and thermometer.

Spring surveys were carried out between early March till end of May to cover the spring migration season with around 432 hours of observations distributed over the entire period over four time strata – early morning, late morning, early afternoon, and late afternoon. Additionally, the migration season was divided into three periods; low activity period from March 1 until March 21, a high activity period from March 22 until May 15 and another low activity period from May 16 until May 31. During the study, the total number of hours that was achieved was 404.5 hours – some of the effort was lost due to weather conditions where visibility was not suitable to carry out the observations.

As discussed earlier, the main reason for carrying out this survey was the fact that previous surveys have not fully covered all turbine locations based on the final layout prepared by the EPC Contractor. The main gap is the eastern part of the Project site which has not been previously covered fully and thus the flight activity has not been properly assessed.

To take such an issue into account, the first step was to identify the turbines that were not covered by the vantage points that were used in the previous surveys. A few assumptions had to be set in order to be able to identify the gaps in coverage. These assumptions are as follows:

- Range of coverage: it was assumed that the range of coverage for birds recorded is 2km, similar to the current survey; and
- Field of coverage: it was assumed that the field of coverage for the three vantage points is 180° instead of 360°, while the aspect of coverage was defined to cover the maximum possible number of turbines. Such an assumption is made given that a 360° field of coverage could entail an observer to cover areas unequally since there would be a tendency to watch areas where it is believed the birds would be passing by more than others. For instance, if the survey is carried out in spring, the observer would normally tend to be watching the southern part of the vantage point's circle much more than the northern part – which could result in missed records in the northern part.

Taking the above assumptions into account and undertaking a view shed mapping reveals that the total number of turbines not covered by the previous surveys are 14 – of which 5 are located in the most north-eastern part of the Project site, 3 to the west of VP2, 2 northeast of VP2, 2 southeast of VP2, 1 located southeast of VP2 and northeast of VP3, and 1 located southwest of VP3 (refer to Figure 41 below). Based on the results, a site visit was undertaken for ground verifications of the result and it was decided that out of those 14 turbines only 7 were actually not visible.

- The 2 turbines located southeast of VP2 have been excluded in the view shed map because they are located outside of the 2km range of coverage at a distance of 2.1km. However, a 100m distance would not affect the observer's ability to spot and identify bird species. Therefore, these turbines are assumed to be covered by VP2.
- The turbine which is located southwest of VP3 was excluded in the view shed map given the terrain of the area. However, based ground verifications (based on a site visit undertaken) it was noted that the blades and rotor are visible from VP3.
- The three turbines located west of VP2 have been excluded from the view shed map because they lie outside of the 180° field of coverage of VP2. However, based on ground verifications (based on a site visit undertaken) it was noticed that those are very close to VP 2 (less than 2km) and lie just slightly outside of the field of coverage – but would actually be visible at least partially from observations undertaken.

Therefore, additional vantage points were required to cover the 5 turbines located in the most north-eastern part of the Project site as well as the 2 located northeast of VP2. Based on that, three additional vantage points were selected (VP4, VP5 and VP6) which aimed to cover those 7 turbines. The first two vantage points, 4 and 5, share the same coordinates but each one has a different 180 field of coverage and were selected to cover the 5 turbines in the northeast. VP6 was located to cover the two turbines located northeast of VP2.

The new vantage points that were used in the survey of spring 2015 did not only compensate for the gaps in previous surveys, but also provided additional data for 12 turbines which were already covered in previous surveys. VP4 covered 1 more turbine in addition to the 3 turbines it was supposed to cover, while VP5 covered 4 turbines in addition to the 2 turbines it was set to cover, and finally VP6 covered 7 turbines in addition to the 2 turbines it was set to cover. So in total, the new vantage points that were used in the survey of spring 2015 covered a total of 19 turbines although they were set to cover 7 turbines, which would make up almost half the 41 turbines of the wind farm.

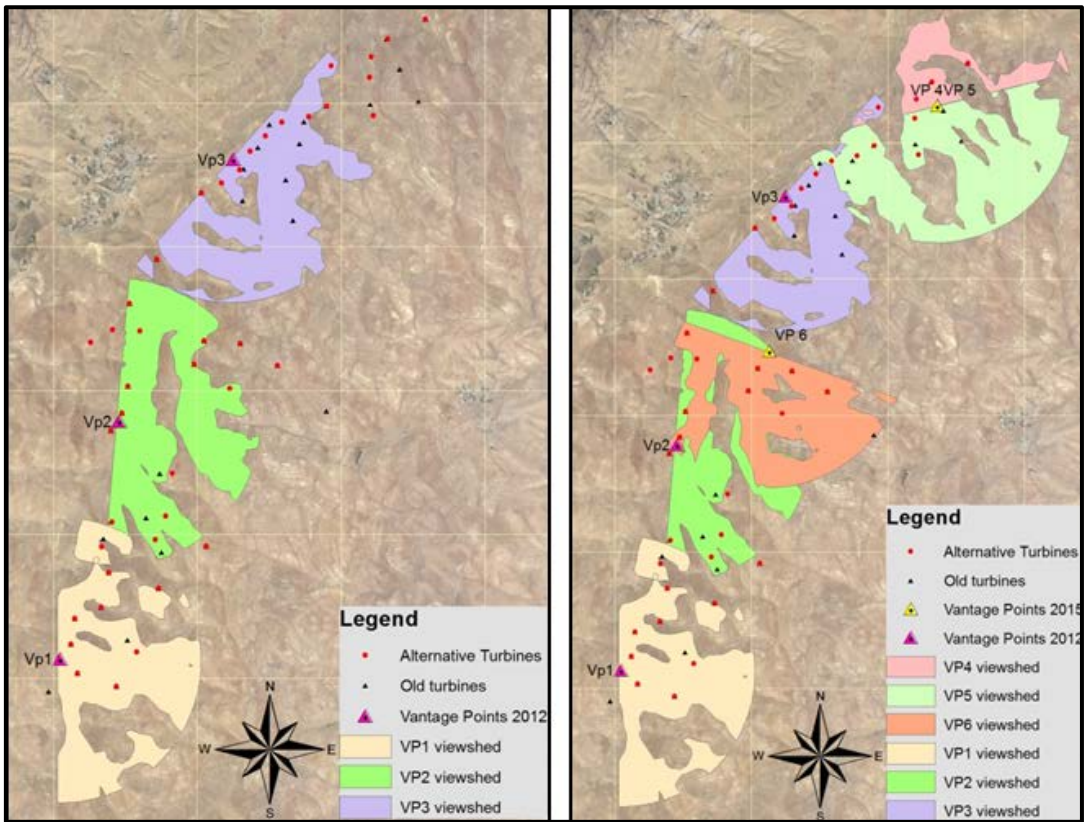

Figure 41: Left – Location of Old Vantage Points and View Shed Coverage; Right – Location of All Vantage Points and View Shed Coverage

The main modifications introduced to the spring 2015 survey and how they compare to the methodology adopted for the previous surveys are highlighted in the table below.

Table 22: Modifications Introduced to the Methodology Used in Previous Bird Surveys

Methodology for Previous Surveys	Modifications introduced into survey of spring 2015
Hours of Coverage	
A total of 115 hours of watch were covered throughout the survey (38 hours for each of VP2 and VP3 and 39 hours for VP1).	A total of 432 hours of watch to be covered, divided equally among VPs and time strata. Of this, 404.5 hours were covered in the survey (138 hours in VP4, 133 hours in VP5 and 133.5 hours in VP6). Some of the effort was lost due to weather conditions where visibility was not suitable to carry out the observations.
Division of Effort throughout Season	
The whole monitoring period was generally treated equally in regard to division of effort.	The season was divided into a high-activity period from March 22 until May 15 where 75% of the watch hours were carried out, and two low-activity periods from March 1 until March 21 and from May 16 until May, where the remaining 25% of the watch hours were covered.
Range of Coverage	
There was no pre-defined maximum for the field of vision. All birds of the target species that were observed in the field of view of the observer that	A pre-defined field of vision of 2km limit was set for observers. This was introduced since it was believed that this distance is acceptable for an experienced observer to be able

were inside the borders of the Project site were recorded.	to identify the bird observed to the species level, while any bird further than that would be difficult to identify.
Field of Coverage	
The field of coverage was a complete circle (360°). Normally, the observer would have to cover areas unequally since there would be a tendency by the observer to watch areas where it is believed the birds would be passing by more than others. For instance, if the survey is carried out in spring, the observer would normally tend to be watching the southern part of the vantage point's circle much more than the northern part – which could result in missed records in the northern part.	The field coverage was only half a circle (180°) with a fixed degree of aspect. This approach would ensure that the observer would be in any time of his watch session be able to cover the whole 180° equally without the need to turn around and move. The main factor that defines the degree of aspect at which the vantage point is covering, is the coverage of the turbines of the wind farm.
Time Stratification	
The total number of hours of all watches across the three vantage points was almost equal throughout the different surveys. Still, the day was not divided into time strata and consequently the number of hours of watch per the different parts of the day was not pre-defined or taken into account. This has resulted in that the time of start and end of watches depended on personal preference of the observer. The observer travels between the three vantage points to cover them during one day at different times of the day but not according to specific division of time of daylight.	The total number of hours of all watches across the three vantage points was almost equal. If there was any difference it was mainly due to weather conditions that has caused a watch to be stopped or paused. Daylight hours were divided into four main time strata; early morning (EM) from 06.00-09.00, late morning (LM) from 09.00-12.00; early afternoon (EA) from 12.00-15.00; and late afternoon (LA) from 15.00-18.00 or sunset. Similar to the previous method, the observer travels between the vantage points to cover them throughout the day, but this is done according to a certain schedule in order to cover all vantage points for an equal total of hours at the different time strata mentioned earlier.
Duration of Watches	
The duration of the watch at a single VP ranged between 3 -4 hours.	The duration of a continuous watch ranged between 1hour and 3hours but never exceeded this limit. The main reason behind that is to provide enough rest for the observer.
Rest Time	
No specific rest time between watches at different vantage points apart from the transportation time.	A minimum of one hour of rest after each 3hour watch. The resting period could be decreased to half-an-hour if the preceding watch was for two hours or less.

Moreover, the modified methodology takes into account the target species to be recorded and assigns primary and secondary target species – which was previously discussed in the spring 2012 section.

Observers at VPs positioned themselves to minimize their effects on bird behavior. A viewing arc not exceeding 180 degrees was scanned using a combination of naked eye and 10x binoculars. A spotting scope was used when required to aid species identification.

For Category A and B primary species flights, focal sampling data are recorded for all flights seen as follows:

- The search area is scanned until a primary target species is detected at which point it is followed until it ceases flying or is lost from view.
- The time the target bird was detected and the flight duration are recorded to the nearest second.
- The flight route is plotted in the field onto 1:25,000 scale maps.
- The bird's flight height above ground level is estimated at the point of first detection and thereafter at 15-second intervals, with the aid of a count-down interval timer with an audible alarm.
- Flight heights are classified as <20m, 20-140m, or >140m above ground level taking into account the turbines specifications of the EPC Contractor.

- The flight lines of Primary target species are recorded in the field on specially designed blank field maps. Each mapped flight line is given a reference number that cross-references to the information recorded for that flight on the corresponding recording form
- Focal observations of primary target species take priority over other species, secondary or other.

If during the course of recording the flight activity for a Category B primary species a Category A primary species (i.e. any vulture or eagle species) is seen, the observer should note the time, cease watching the Category B primary species and immediately switch to observing the Category A primary species. This is because information on Category A primary species is considered to have greater importance for the Project's impact survey.

The observer also separately records if any perched primary or secondary target species are seen. Perched birds are recorded only for the time in which they are first noted, i.e. if the bird remains perched, it is not recorded until it becomes airborne again.

b. Casual Observations / Species Status and Importance

Similar to the methodology for the previous surveys.

12.1.2 Results

(i) Spring 2012

Twelve (12) target species were recorded including nine (9) which are solely passage migrants in the area, one passage migrant which is also summer visitor in the area (Short-toed Snake Eagle), and two resident species which breed in nearby cliffs along the escarpment (Long-legged Buzzard and Raven). Table 23 below presents the list of target species recorded onsite.

Most of the migratory species recorded have an IUCN status of Least Concern except for the Egyptian Vulture (considered endangered) and Saker Falcon (considered vulnerable); however only a total of 2 birds were recorded throughout the survey (1 Egyptian Vultures and 1 Saker Falcon). With regards to the resident species and visiting migrants they all had an IUCN status of Least Concern, but some are known to have small breeding population sizes in Jordan.

The flight behavior of 772 birds crossing the proposed wind farm site was observed during this entire survey period. The most common species was Steppe Buzzard (41 % of all soaring birds recorded at site) followed by Honey Buzzard (27%). The proportion of soaring birds flying over the site involved in a potential risk situation was around 51% of the total.

Table 24 below presents a summary of the vantage point data along with number of birds flying at risk height (at height band 2) for the 137m tip height turbine.

Table 23: List of Target Species Recorded Onsite during Spring Survey (PM = Passage Migrant, SV = Summer Visitor, R = Resident)

Common name	Scientific Name	Occurrence	IUCN Conservation Status	Local Status
Short-toed Snake Eagle	*Circateus gallicus*	PM, SV	Least Concern	Breeding population of national importance
Steppe Eagle	*Aquila nipalensis*	PM	Least concern	Not applicable
Booted Eagle	*Hieraaetus pennatus*	PM	Least concern	Not applicable
Egyptian Vulture	*Neophron percnopterus*	PM	Endangered	Not applicable
Black Kite	*Milvus migrans*	PM	Least concern	Not applicable
European-Honey buzzard	*Pernis apivorus*	PM	Least concern	Not applicable

Steppe Buzzard	*Buteo buteo vulpinus*	PM	Least concern	Not applicable
Long-legged Buzzard	*Buteo rufinus*	R	Least Concern	Breeding population of national importance
Levant Sparrow Hawk	*Accipiter brevipes*	PM	Least Concern	Not applicable
Saker Falcon	*Falco cherrug*	PM	Vulnerable	Not applicable
White Stork	*Ciconia ciconia*	PM	Least Concern	Not applicable
Common Raven	*Corvus corax*	R	Least Concern	Breeding population of national importance

Table 24: Summary of 2012 Spring Survey Data at all Vantage Points

Species	VP1 (South)		VP2 (Centre)		VP3 (North)		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
Short-toed Snake-eagle	4	1 (25)	9	9 (100)	9	1 (11)	**22**	**11 (50)**
Steppe Eagle	7	2 (29)	5	2 (40)	8	5 (63)	**20**	**9 (45)**
Booted Eagle	0	0 (0)	0	0 (0)	2	2 (100)	**2**	**2 (100)**
Egyptian Vulture	0	0 (0)	1	1 (100)	0	0 (0)	**1**	**1 (100)**
Black Kite	13	11 (85)	2	2 (100)	17	11 (65)	**32**	**24 (75)**
European-Honey buzzard	24	22 (92)	165	110 (67)	16	1 (6)	**205**	**133 (65)**
Steppe Buzzard	24	11 (46)	224	162 (72)	72	27 (38)	**320**	**200 (63)**
Long-legged Buzzard	6	4 (67)	3	3 (100)	3	3 (100)	**12**	**10 (83)**
Levant Sparrow hawk	0	0 (0)	150	0 (0)	0	0 (0)	**150**	**0 (0)**
Saker Falcon	0	0 (0)	1	1 (100)	0	0 (0)	**1**	**1 (100)**
White Stork	0	0 (0)	2	2 (100)	1	1 (100)	**3**	**3 (100)**
Common Raven	1	1 (100)	0	0 (0)	3	1 (33)	**4**	**2 (50)**
TOTALS	**79**	**52 (66)**	**562**	**292 (52)**	**131**	**52 (40)**	**772**	**396 (51)**

a. Resident Birds

Almost all parts of the area (mainly the central and northern parts) were used by foraging raptors to include the Long-legged Buzzard and Common Raven in search for food. The resident birds represent only 5% of the total birds recorded and it can be assumed that the various records of those resident birds involve partially the same individuals as those breeding raptors were frequently observed foraging in the site. In addition, some records of the Short-toed Snake-eagle (a migratory bird but is also a summer visitor in the area) were also observed foraging in limited parts within the northern area of the Project site. Figure 45 at the end of this section presents the activity area of these birds within the Project site.

b. Migratory Birds

The total number of recorded migratory birds of the 9 target species represents 95% of the total recorded birds. Steppe Buzzard, Honey Buzzard and Levant Sparrow hawk were the most abundant migrant species

accounting together for almost 90% of soaring migratory birds crossing the site during spring migration. After early May, the field survey was ended as the passage of the latest raptors during spring migration (mainly Honey Buzzards) came to an end.

It must be noted that generally the passage of migrant species varies significantly from day to day, with around 50% of the total birds from the total observation period passing in one day. The numbers of migrant raptors (regardless of their height) appeared to be correlated to wind direction and temperature; large numbers of migrants were observed during very warm or hot weather (above 19ºC) with slight to moderate westerly winds. Raptor migration was usually very low in stormy weather and in the morning before 10 am. Exceptions were when temperature was relatively high already in the morning.

Figure 42 below presents the main trajectories of migration routes of birds crossing the site. The thickness of the line is an indication of the relative number of birds, and the solid or dashed line indicates whether the bird is at risk height or above. The first line (unnumbered in the figure below) passes outside of the Project area, where the migrating raptors continue in a northerly direction without crossing the site as they prefer to follow the upper edge of the escarpment rather than crossing the high plateau of Al-Rajef. The number of these birds was very high (a magnitude of thousand) and given that they were outside of the Project area they weren't counted.

Line number 1 mostly passes outside of the Project area as well. Similarly, migrating raptors arriving at the western borders of the site often continue in a northerly direction, mostly without crossing the site. The number of birds passing within the Project area was accounted for. The birds entering the Project site at the northern part from line 1 were small in numbers (a magnitude of ten as indicated by the line thickness) and as they start moving east from the escarpment they are within risk height, but the number of birds in potential risk situations declines because most migrating soaring birds gain height while migrating east (above 200 m), especially when thermals occur during warm or hot weather conditions.

Most of the birds that enter the site and cross it, especially during suitable conditions moved along the trajectories number 2-3 (a magnitude of a hundred). Similarly, as they enter the site from the escarpment they are within the risk height but the number of birds in potential risk situations declined as they move east and north-east, because most migrating soaring birds gain height (above 200 m) especially when thermals occur during warm or hot weather conditions. Finally, a few birds along line number 4 (a magnitude of ten), enter the site within risk height but similarly gain height as they migrate east.

Based on the outcomes of the above, ECO Consult prepared a bird's risk mapping for the Project site based on: (i) migration patterns over the site, (ii) number of birds flying within risk height (risk height was determined based on several scenarios for wind turbines' tip height and rotor diameter), and (iii) conservation status of species. The main objective of the map was to delineate areas of high sensitivity, medium sensitivity and low sensitivity.

In general, the outcomes of the above shows a declining number of birds flying at risk height towards the east of the Project site because most migrating soaring birds gain height over the site while migrating towards the north-east or east, especially when thermals occur during warm or hot weather conditions. Therefore, the majority of the high sensitive areas are found on the most central-western border of the site, where most of the migratory birds enter the site. In addition, the breeding raptors were mostly found within these high sensitive areas as well, however they were small in numbers.

The map was included within the Report titled 'EPC Environmental Performance Requirements' prepared by ECO Consult for GWRE in 2014 – the objective of the report was to identify the main environmental requirements which must be taken into account by the EPC bidders for the Project. One of the requirements stated within the Report was that the map must serve as an additional guide throughout the detailed design of the preferred bidder when placing wind turbines and it is recommended to avoid locating wind turbines in areas considered of high risk to the greatest extent possible. The final layout prepared by the selected EPC Contractor has taken into account such a requirement to the greatest extent possible. This represents the first step of mitigation hierarchy (avoid; reduce; mitigate and manage, and

compensate and offset) taken into account – and which is to reduce such an impact to the greatest extent possible.

Figure 42: Main Migratory Routes within the Project Site

c. Secondary Species and Non-Soaring Birds

Other secondary species were recorded onsite through vantage point observations. This mainly includes Kestrels appeared to be concentrated in the northwestern and central parts of the area where semi-colonial breeding appeared to occur in small cliffs and was the only species nesting within the site. The Kestrel is a resident species which was considered a secondary species in the assessment given that it has an IUCN status of Least Concern and is also considered common to such areas and its population is increasing.

Non-soaring birds were also recorded onsite on casual observations. Non-soaring resident and visiting bird's diversity was generally low (and the area was rather homogenous, i.e. the community of breeding birds did not vary much). The local bird community is generally dominated by Temminck's horned lark and Isabelline Wheatear, and in sections with rocky outcrops by Mourning wheatear and Desert Lark. Crested lark was also frequent and common. Other species observed included Rock Dove, Rock Martin, and Pallid Swift. Non-soaring migrant passerines stopping over in the site (e.g. warblers) were more common and diverse were there was more dense vegetation including shrubs. Migrating Ortolan buntings were particularly abundant during April, and numerous flocks were seen daily resting or diurnally migrating at various heights from 1 – 50 meters above the ground. All species are considered of Least Concern according to the IUCN and common to such area habitats.

(ii) Autumn 2012

Nine (9) target species were recorded including seven (7) which are solely passage migrants in the area and two (2) resident species which usually inhabit the escarpment / rift margins. Table 25 below presents the list of target species recorded onsite.

All of the migratory species recorded have an IUCN status of Least Concern. With regards to the resident species they all have an IUCN status of Least Concern but are known to have small breeding population sizes in Jordan.

The flight behavior of 52 bird records crossing the proposed wind farm site was observed during this entire survey period. The majority of the records were for migratory raptors, accounting for around 47 birds (around 90%) most of which flew at risk height.

Table 25 below presents a summary of the vantage point data along with number of birds at height band 2 for the 137 m tip height turbine.

Table 25: List of Target Species Recorded onsite during Autumn Survey (PM = Passage Migrant, R = Resident)

Common name	Scientific Name	Occurrence	IUCN Conservation Status	Local Status
European Honey-buzzard	*Pernis apivorus*	PM	Least Concern	Not applicable
Lesser Spotted Eagle	*Aquila pomarina*	PM	Least Concern	Not applicable
Booted Eagle	*Hieraaetus pennatus*	PM	Least Concern	Not applicable
Black Kite	*Milvus migrans*	PM	Least Concern	Not applicable
Hen Harrier	*Circus cyaneus*	PM	Least Concern	Not applicable
Montague's Harrier	*Circus pygarus*	PM	Least Concern	Not applicable
Long-legged Buzzard	*Buteo rufinus*	R	Least Concern	Breeding population of national importance
Steppe Buzzard	*Buteo buteo vulpinus*	PM	Least Concern	Not applicable
Common Raven	*Corvus corax*	R	Least Concern	Breeding population of national importance

Table 26: Summary of Autumn Survey Data at all Vantage Points

Species	VP1 (South)		VP2 (Centre)		VP3 (North)		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
European Honey-buzzard	3	3 (100)	1	1 (100)	10	9 (90)	**14**	**13 (93)**
Lesser Spotted Eagle	0	0 (0)	0	0 (0)	1	1 (100)	**1**	**1 (100)**
Booted Eagle	1	1 (100)	0	0 (0)	0	0 (0)	**1**	**1 (100)**
Black Kite	1	1 (100)	12	12 (100)	10	10 (100)	**23**	**23 (100)**
Hen Harrier	0	0 (0)	1	1 (100)	0	0 (0)	**1**	**1 (100)**
Montagu's Harrier	2	2 (100)	0	0 (0)	2	2 (100)	**4**	**4 (100)**
Long-legged Buzzard	1	1 (100)	0	0 (0)	0	0 (0)	**1**	**1 (100)**
Steppe Buzzard	1	1 (100)	0	0 (0)	2	2 (100)	**3**	**3 (100)**
Common Raven	0	0	4	4	0	0	**4**	**4 (100)**
TOTALS	**9**	**9 (100)**	**18**	**18 (100)**	**25**	**24 (96)**	**52**	**51 98)**

a. Resident Birds

Only 2 resident species were recorded throughout the survey for a total of 5 records only, the Long-legged Buzzard and the Common Raven. Those were recorded foraging within the site, coming from the escarpment area to the eastern parts of the proposed wind farm site. Figure 45 at the end of this section presents the activity area of the resident birds within the Project site.

b. Migratory Birds

The number of migratory soaring birds recorded during the autumn survey was significantly small. In autumn, around 47 migratory birds were recorded all of which had a conservation status of Least Concern.

In autumn, the migratory birds were noticed to fly mostly at risk height. Black Kites and Honey Buzzard were the most abundant migrant species accounting together for around 80% of migratory birds crossing the site mainly in September – whereas migration almost ceased totally at the site in October. The timing of migrating birds was distributed throughout the day, mainly from 8 am until 3 pm and the number of migrant raptors did not appear to be correlated to any wind direction.

The migration direction was generally from northeast towards south and southwest within the general area; however within the Project site all the birds had scattered and arbitrary routes and no clear patterns for routes could be identified.

c. Secondary Species and Non-Soaring Birds

Other secondary species were recorded onsite through vantage point observations. This mostly includes The Fan-tailed Raven which was recorded in high activity (around 850 records) and most of which flew at risk height. The Fan-tailed Raven is a resident species which was considered a secondary species in the assessment given that it has an IUCN status of Least Concern and is also considered common to such areas and its population is increasing.

The Fan-tailed Raven usually breeds at lower altitudes and rises in large flocks to search for food onto the mountain plateau including the site during the non-breeding season. During its non-breeding season, the Fan-tailed Raven usually leaves its breeding site and rises to higher altitude in large flocks in late summer/autumn searching for food most probably due to the decrease of available food at lower altitudes resulting from drought conditions after the long dry summer.

The Fan-tailed Raven was mostly recorded on the mid-western part of the site and to a lesser extent at the northwestern parts of the site. Some recorded flocks were up to 200 birds indicating that a large proportion of the resident population along the rift margins in the area use the site during its non-breeding season in autumn. However, it is important to note that the large number of birds recorded for the Fan-tailed Raven (around 850) do not belong to *different* birds but rather to the *same* resident individuals that were nearly constantly using the area at different days.

Given all of the above, a map has been prepared (Figure 43) that presents the air space and areas where Fan-tailed Raven was observed soaring within the site. It must be noted that such areas generally coincide with the high/medium sensitive areas that were identified as part of the sensitivity map prepared and which was discussed earlier.

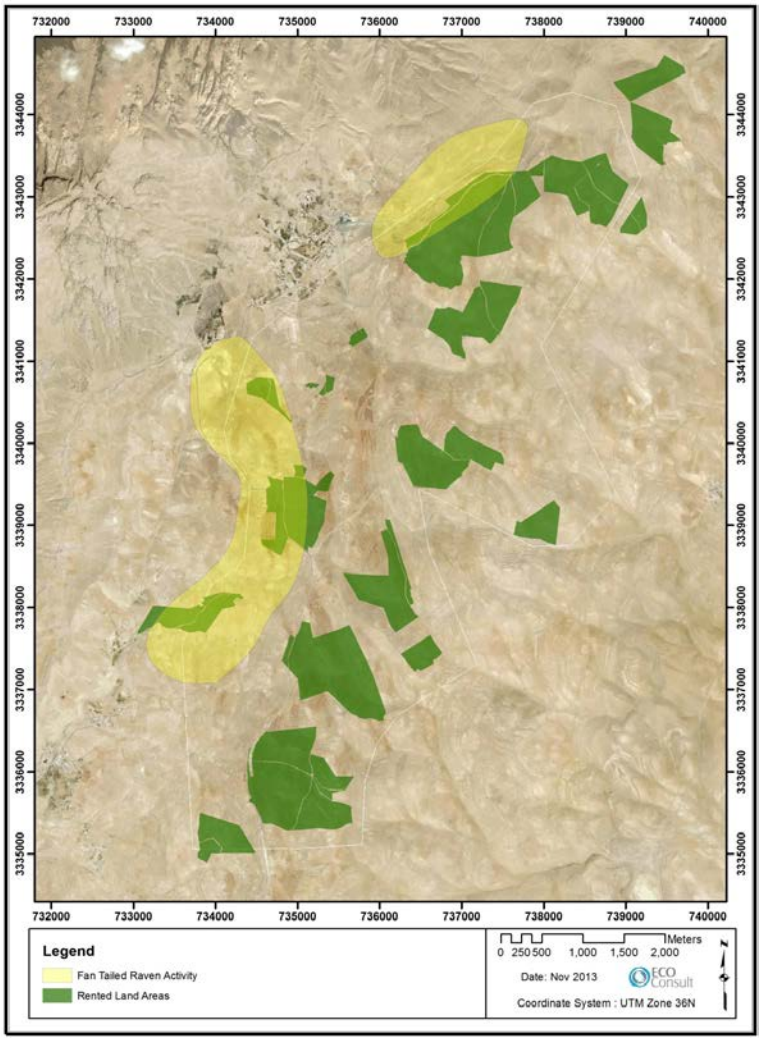

Figure 43: Fan-tailed Raven Activity within the Project Site

Non-soaring birds were also recorded onsite based on casual observations. It was noticed that mostly the western and to some extent the central parts of the site were visited by finches in search of food, mainly seeds of thistles *Artemisia*. These finches include the Pale Rosefinch (*Carpodacus synoicus*) and the Syrian Serin (*Serinus Syriacus*) both of which were feeding on *Artemisia* fruits and seeds. Both were found to be feeding close to or on the ground (around 10m above ground). Although the Pale Rosefinch is considered of Least Concern, the Syrian Serin has a global status of Vulnerable (according to IUCN Red List) and is considered endangered at the national level.

(iii) Autumn 2013

Ten (10) target species were recorded including five (5) which are solely passage migrants in the area, two (2) which are passage migrants and also winter visitors, and three (3) resident species which usually inhabit the escarpment / rift margins. Table 27 below presents the list of target species recorded onsite.

Most of the migratory species recorded have an IUCN conservation status of Least Concern except for the Egyptian Vulture (considered endangered) and Eastern Imperial Eagle (considered vulnerable); however only a total of 2 birds were recorded throughout the survey (one of each). With regards to the resident species they all have an IUCN status of Least Concern, but are known to have small breeding population sizes in Jordan.

The flight behavior of 206 birds crossing the proposed wind farm site was observed during this entire survey period. The most common species was Steppe Buzzard (68% of all soaring birds records at site)

followed by the Raven (15% of all soaring birds recorded at site); however it is highly important to note that the various records of the Raven observed do not indicate the total numbers of different birds of this species, as the same resident individual were constantly using the area at different days. Most of the records throughout the survey were recorded at risk height (around 90% of all records). Table 28 below presents a summary of the vantage point data along with number of birds flying at risk height (at height band 2) for the 135m tip height turbine.

Table 27: List of Target Species Recorded onsite during Autumn Survey (PM = Passage Migrant, WV = Winter Visitor, R = Resident)

Common name	Scientific Name	Occurrence	IUCN Conservation status	National Conservation Status
Griffon Vulture	*Gyps fulvus*	R	Least Concern	Breeding population of national importance
Egyptian Vulture	*Neophron percnopterus*	PM	Endangered	Not applicable
Eastern Imperial Eagle	*Aquila heliacal*	PM; WV	Vulnerable	N/A
Steppe Eagle	*Aquila nipalensis*	PM	Least Concern	Not applicable
Short-toed Eagle	*Circateus gallicus*	PM, WV	Least Concern	Breeding population of national importance
Black Kite	*Milvus migrans*	PM	Least Concern	Not applicable
Montague's Harrier	*Circus pygarus*	PM	Least Concern	Not applicable
Long-legged Buzzard	*Buteo rufinus*	R	Least Concern	Breeding population of national importance
Steppe Buzzard	*Buteo buteo vulpinus*	PM	Least Concern	Not applicable
Common Raven	*Corvus corax*	R	Least Concern	Breeding population of national importance

Table 28: Summary of Autumn Survey Data at all Vantage Points

Species	VP1 (South)		VP2 (Centre)		VP3 (North)		Totals	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
Griffon Vulture	0	0 (0)	0	0 (0)	1	0 (0)	1	0 (0)
Egyptian Vulture	0	0 (0)	1	1 (100)	0	0 (0)	1	1 (100)
Eastern Imperial Eagle	1	1 (100)	0	0 (0)	0	0 (0)	1	1 (100)
Steppe Eagle	0	0 (0)	4	3 (75)	2	1 (50)	6	4 (67)
Short-toed Eagle	1	0 (0)	2	1 (50)	1	1 (100)	4	2 (50)
Black Kite	1	1 (100)	1	1 (100)	5	5 (100)	7	7 (100)
Montagu's Harrier	3	3 (100)	0	0 (0)	0	0 (0)	3	3 (100)
Long-legged Buzzard	7	7 (100)	2	2 (100)	2	2 (100)	11	11 (100)
Steppe Buzzard	0	0 (0)	137	137 (100)	4	4 (100)	141	141 (100)
Common Raven	2	2 (100)	19	5 (26)	10	10 (100)	31	17 (55)
TOTALS	**15**	**14 (93)**	**166**	**150 (90)**	**25**	**23 (92)**	**206**	**187 (91)**

a. Resident Birds

Resident species recorded include the Long-legged Buzzard and the Common Raven all of which were observed to be using the area for forging. The Long legged Buzzards were seen to be actively forging in the area but most notably following certain routes over specific slopes to the west of VP3 and the western escarpment of VP1.

Most importantly, the highest records were that of the Common Raven. Records of the raven were observed occasionally in the area, but the largest activity was noted in the area roughly between VP3 and VP2. It is important to note that for the resident species, the large numbers of birds recorded (especially for the Ravens) do not belong to different birds but are most likely to the same resident individuals that were nearly constantly using the area at different days. In addition, the Short-toed Snake-eagle (a migratory bird but is also a winter visitor in the area) was also observed foraging in limited parts within the northern area of the Project site. Figure 45 at the end of this section presents the activity area of these birds within the Project site.

Only 1 record of the griffon vulture was noted. The griffon vulture was only passing through the site (and was not forging or using the site) and was recorded at a very high altitude (above risk height) heading north – most probably towards Dana area.

b. Migratory Birds

Of the total birds recorded throughout the survey, a total of 163 birds were migratory with most of the records belonging to the Steppe Buzzards (86% of the migratory records). The majority of the migratory birds were recorded at risk height. All of the migratory species recorded have an IUCN status of Least Concern except for the Egyptian Vulture (considered endangered) and Eastern Imperial Eagle (considered vulnerable); however only a total of 2 birds were recorded throughout the survey

Due to the relatively low number of migratory birds recorded, it was impossible to identify any significant peaks where birds were concentrated except for a single instance; there was a single afternoon where a significant number of the total birds recorded was observed (10 October 2013) – where a total of 142 (141 Steppe Buzzards and a single Steppe Eagle) were recorded on that day which represent around 84% of the total migratory birds recorded. The birds recorded on that specific afternoon passed over VP2 arriving from the northwest. They only appeared after quite sudden change in wind direction from southeastern to mild southwestern winds and passed over the site in twenty minutes. Other than this 'flush' of passage the total number of migratory birds recorded (around 23) is significantly small. In addition, there were certain watch sessions where no birds were recorded.

There is no main specific migration route which could be identified within the Project site as the majority of the birds followed a north to south trajectory with areas covering most of the Project site – however the flush of passage recorded on 10 October 2013 followed a north to south trajectory on the eastern and central parts of the Project site.

c. Secondary Species and Non-Soaring Birds

Other secondary species were recorded onsite through vantage point observations. This mainly includes 17 Common Kestrels and 2 Eurasian Sparrowhawks which were observed occasionally foraging around all vantage points and specifically around VP3 and VP2. Such resident species are considered secondary species in the assessment given that they have an IUCN status of Least Concern and is also considered common to such areas and its population is increasing.

Non-soaring birds were also recorded onsite on casual observations. Several species of Wheaters were recorded regularly throughout the site. The species include the Northern Wheater (*Oenanthe oenanthe*), Isabelline Wheater (*Oenanthe isabellina*), Black-eared Wheater (*Oenanthe hispanica*), and Mourning Wheater *(Oenanthe lugens*).

Other species were also recorded regularly throughout the survey include the Rock Martin (*Ptyonoprogne fuligula*), Crested Lark (*Galerida cristata*), and the Rock Dove (*Columbia livia*). Finally, a few passage passerines were also recorded and which include the Black Redstart (*Phoenicurus ochruros*), Red-rumped Swallow (*Hirundo daurica*), and Spotted Flycatcher (*Muscicapa striata*).

All species are considered of Least Concern according to the IUCN and common to such area habitats.

(iv) Spring 2015

Sixteen (16) target species were recorded including thirteen (13) which are solely passage migrants in the area, two passage migrant which is also summer visitor in the area (Short-toed Snake Eagle and the Lesser Kestrel), and one resident species (Long-legged Buzzard). Table 29 below presents the list of target species recorded onsite.

Most of the migratory species recorded have an IUCN status of Least Concern except for the Egyptian Vulture (considered endangered), Greater Spotted Eagle (considered vulnerable), Eastern Imperial Eagle (considered Vulnerable), and the Pallid Harrier (considered Near Threatened); however only a total of 8 birds were recorded throughout the survey (2 Egyptian Vultures, 1 Greater Spotted Eagle, 3 Eastern Imperial Eagle, and 2 Pallid Harrier). With regards to the resident species and visiting migrants they all had an IUCN status of Least Concern, but are known to have small breeding population sizes in Jordan.

The flight behavior of 9,957 birds crossing the proposed wind farm site was observed during this entire survey period. The most common species was by far the European Honey-buzzard (91 % of all soaring birds recorded) followed by Steppe Buzzard (6%) – together they account for 97% of all the records. The proportion of soaring birds flying over the site involved in a potential risk situation was around 94% of the total. Table 30 below presents a summary of the vantage point data along with number of birds flying at risk height.

Table 29: List of Target Species Recorded Onsite during Spring Survey (PM = Passage Migrant, SV = Summer Visitor, R = Resident)

Common name	Scientific Name	Occurrence	IUCN Conservation status	Local Status
European Honey-buzzard	*Pernis apivorus*	PM	Least Concern	Not applicable
Egyptian Vulture	*Neophron percnopterus*	PM	Endangered	Not applicable
Short-toed Snake-eagle	*Circaetus gallicus*	PM, SV	Least Concern	Breeding population of national importance
Greater Spotted Eagle	*Aquila clanga*	PM	Vulnerable	Not applicable
Lesser Spotted Eagle	*Aquila pomarina*	PM	Least Concern	Not applicable
Eastern Imperial Eagle	*Aquila heliaca*	PM	Vulnerable	Not applicable
Steppe Eagle	*Aquila nipalensis*	PM	Least Concern	Not applicable
Booted Eagle	*Hieraaetus pennatus*	PM	Least Concern	Not applicable
Montagu's Harrier	*Circus pygargus*	PM	Least Concern	Not applicable
Pallid Harrier	*Circus macrourus*	PM	Near Threatened	Not applicable
Levant Sparrowhawk	*Accipiter brevipes*	PM	Least Concern	Not applicable
Black Kite	*Milvus migrans*	PM	Least Concern	Not applicable
Steppe Buzzard	*Buteo buteo vulpinus*	PM	Least Concern	Not applicable
Long-legged Buzzard	*Buteo rufinus*	R	Least Concern	Breeding population of national importance
Lesser Kestrel	*Falco naumanni*	PM, SV	Least Concern	Breeding population of

				national importance
Peregrine Falcon	*Falco peregrinus*	PM	Least Concern	Not applicable

Table 30: Summary of Spring Survey Data at all Vantage Points

Species	VP4		VP5		VP6		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Total	At risk height (%)
European Honey-buzzard	8,873	8,854 (99)	120	114 (95)	35	3 (9)	**9,028**	**8,971**
Egyptian Vulture	2	2 (100)	0	0 (0)	0	0 (0)	**2**	**2**
Short-toed Snake-eagle	1	0 (0)	2	2 (100)	3	2 (67)	**6**	**4**
Greater Spotted Eagle	1	0 (0)	0	0 (0)	0	0 (0)	**1**	**0**
Lesser Spotted Eagle	9	2 (22)	4	3 (75)	0	0 (0)	**13**	**5**
Eastern Imperial Eagle	1	0 (0)	1	0 (0)	1	0 (0)	**3**	**0**
Steppe Eagle	49	32 (65)	8	6 (75)	5	4 (80)	**62**	**42**
Booted Eagle	0	0 (0)	0	0 (0)	1	1 (100)	**1**	**1**
Montagu's Harrier	0	0 (0)	0	0 (0)	2	0 (0)	**2**	**0**
Pallid Harrier	1	1 (100)	1	0 (0)	0	0 (0)	**2**	**1**
Levant Sparrowhawk	1	1 (100)	0	0 (0)	27	1 (4)	**28**	**2**
Black Kite	19	5 (26)	5	5 (100)	2	2 (100)	**26**	**12**
Steppe Buzzard	413	143 (35)	161	100 (62)	45	33 (73)	**619**	**276**
Long-legged Buzzard	23	12 (52)	21	17 (81)	24	20 (83)	**68**	**49**
Lesser Kestrel	36	4 (11)	38	15 (40)	20	20 (100)	**94**	**39**
Peregrine Falcon	1	0 (0)	1	1 (100)	0	0 (0)	**2**	**1**
Total	9,430	9,056 (96)	362	263 (73)	165	86 (52)	**9,957**	**9,405 (94)**

a. Resident Birds

As noted the only resident birds recorded throughout the survey was the Long-legged Buzzard. 68 birds were recorded of which 49 were at risk height. Records are almost equal at all vantage points. Long-legged Buzzard was observed using the area for forging mainly in areas all around the vantage points. It is highly important to note that that the various records observed do not indicate the total number of different birds of this specie, as the same resident individuals were constantly using the area at different days.

In addition, some records of the Short-toed Snake-eagle (a migratory bird but is also a summer visitor in the area) and the Lesser Ketrel (a migratory bird but is also a summer visitor in the area) were observed foraging in limited parts within the northern area of the Project site. Figure 45 at the end of this section presents the activity area of these birds within the Project site.

b. Migratory Birds

In spring 2015, out of a total of 9,957 birds that were recorded in the study 9,028 birds were European Honey-buzzards – accounting for around 91% of all records. The second highest recorded species was Steppe Buzzard with 619 birds recorded– accounting for 6% of all records. Another species that is worth noting in spring 2015 is Lesser Kestrel with a total of 94 birds – accounting for around 1% of all records.

A detailed analysis of the data was undertaken and the main outcomes of the survey can be summarized as follows:

- The most significant observation is the flux of European Honey-buzzards where 9,028 birds were recorded – accounting for around 91% of all records. A huge flux passed over the northernmost part of the Project site at VP4 during the first week of May, where 8,873 birds were recorded– accounting for around 90% of all records with a high percentage of birds at collision height. As the European Honey-buzzard makes up more than 90% of the total birds counted throughout the survey, its distribution across the time strata plays a role in defining the distribution of the species recorded as a whole across the strata; where 99% of the birds recorded were recorded in the late morning and early afternoon time strata. The main route of passage of the European Honey-buzzards was from the southwest towards northeast as noted in the figure below.

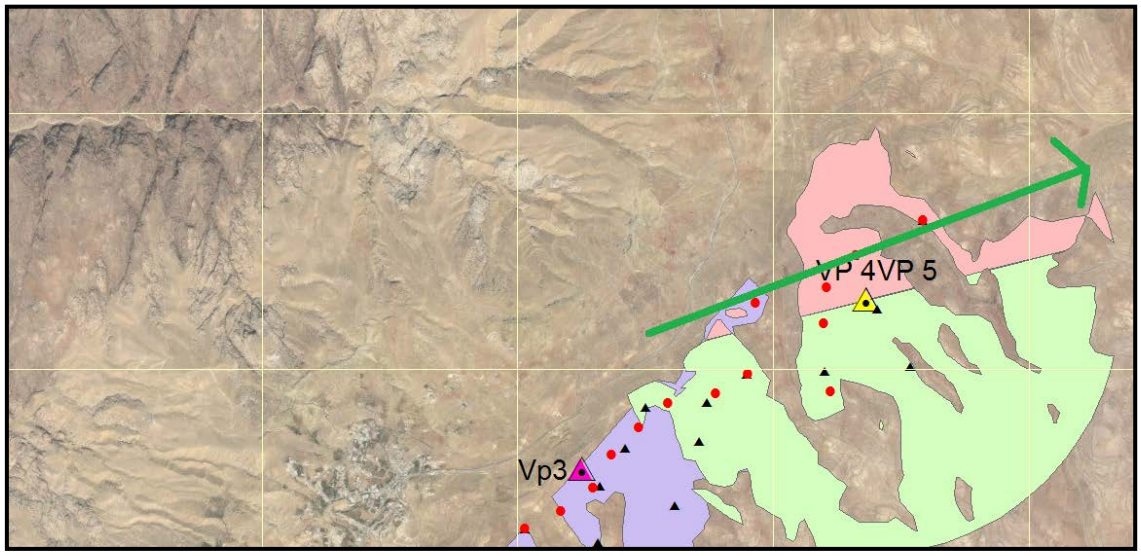

Figure 44: Map showing the route of the main passage of European Honey-buzzards over the area of VP4

- Apart from European Honey-buzzards, a total of 929 birds were recorded making up around 9% of the total birds recorded, 446 of which were recorded at collision risk height.
- Looking at the number of birds recorded regardless of the species, the peak of migration over the Project was over the first week of May between the 2nd and 7th, where 90.1% of the birds were recorded over that period. A much smaller peak could also be noticed in the last week of March.
- Looking at the records of the different species at the different vantage points, VP4, located in the northernmost part of the Project site had a total of 9,434 birds in 141 records, making up 94.7% of the species recorded – refer to Table 30 above.
- Looking at the bird records over one hour durations, it can be seen that the peak of migration over daylight is during broad daylight, between 1100 and 1300 hours, where 93.4% of the birds were recorded.
- The time spent by all birds recorded of all target species (9957 birds) reached a total of 10,963,755 seconds. 62.3% of this time was spent at the band of high collision risk of turbines, between 20-140m.
- The time strata with the highest numbers of birds passing through at collision risk height is the late morning sessions and early morning sessions at 99% and 93% respectively.

c. Secondary Species and Non-Soaring Birds

During spring 2015, secondary species recorded from vantage points and casual observations included 104 Common Kestrels, a single Eurasian Sparrowhawk, 23 Brown-necked Ravens and 454 Rock Doves. Three swift species were recorded with 1425 Pallid Swifts, 160 Common Swifts and four Alpine Swifts. Additionally, at least 240 European Bee-eaters were also recorded. Additionally, 32 species of non-target species were recorded from the vantage points including several passerine and non-passerine species. These included several resident breeders including Chukar, Collared Dove, Little Owl (a single record), Rock Martin, Tawny Pipit, Crested Lark, Desert Lark, Temminck's Lark, Mourning Wheatear, Isabelline Wheatear, Crested Lark, Hoopoe, Tristram's Starling, Pale Rock Sparrow, Rock Sparrow, Linnet, and House Sparrow. Passage migrants included a wide range of species including Barn Swallow, Red-rumped Swallow, Crag Martin, House Martin, Rufous-tailed Rock Thrush, Ortolan Bunting, Short-toed Lark, Calandra Lark, European Roller, Black-eared Wheatear, Northern Wheatear, Woodchat Shrike and Blackcap. No specific counts were done for these species as they were not part of the target species.

(v) Resident Bird Activity

The figure below presents the resident bird activity (as well as migratory birds that are summer or winter visitor in the area) based on the outcomes of all the surveys undertaken and which were discussed in details earlier.

As noted, highest activity was mainly for the Long-legged Buzzard and Common Raven, both of which were observed foraging in the Project area, mostly during all seasons in which the surveys were undertaken. The main activity area of these two species is presented in the figure below.

In addition, the Lesser Kestrel (a migratory bird but is also a summer visitor in the area) was recorded foraging within the Project area in limited parts within the northern areas of the Project site, but only during the spring 2015 survey. In addition, the Short-toed Snake-eagle (a migratory bird but is also a summer visitor in the area) was also recorded foraging within the Project area in limited parts within the northern areas of the Project site, only during spring 2012 and autumn 2013 survey.

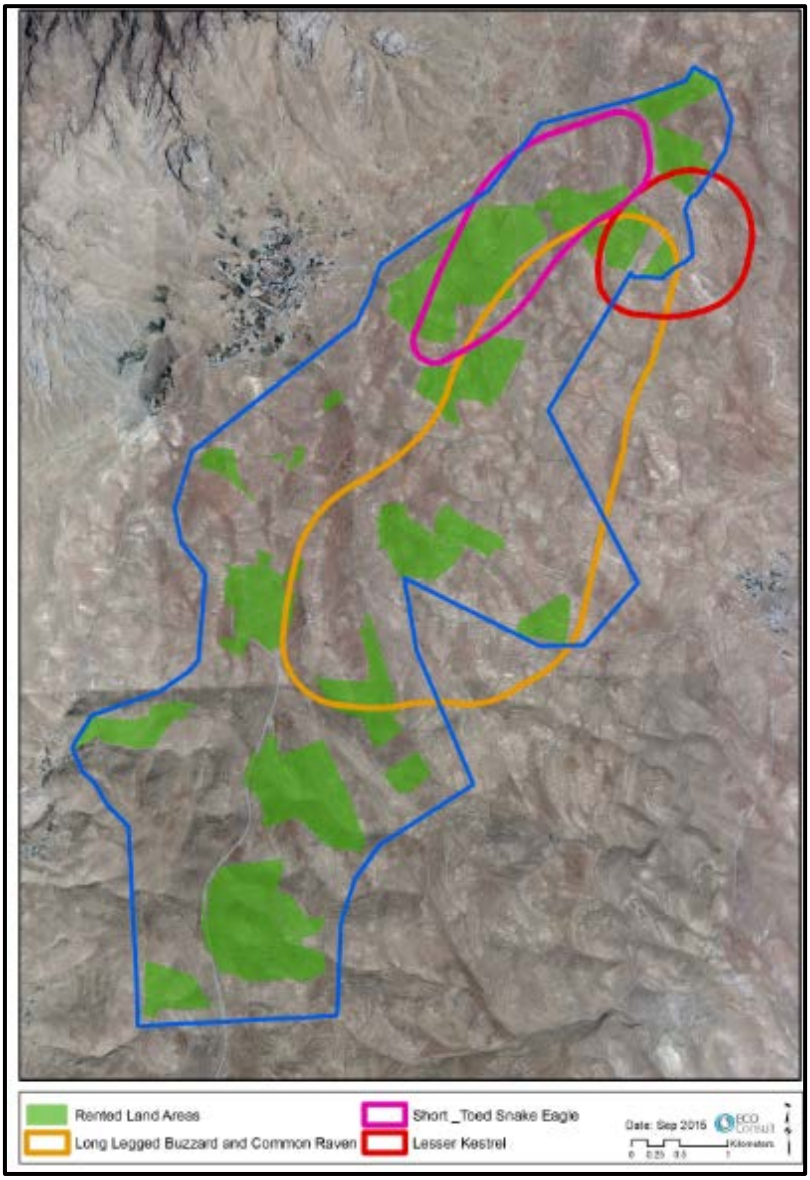

Figure 45: Resident Bird Activity within the Project Area

12.2 Summary of Outcomes and Conclusions of Avi-Fauna Baseline Results

This section presents the main outcomes of all the surveys undertaken for the Project site and which were presented in details in the previous section. In addition, the main conclusions of the baseline results are also discussed.

1. The total number of target migratory birds recorded throughout all the surveys is around 11,000 which belong to 18 species (547 hours of observations in spring and 250 hours of observations in autumn). Of those, only 5 had an IUCN conservation status and their numbers were significantly small – around 12 records representing 0.1% of the total birds. Those include: (i) Egyptian Vulture (Endangered) - 4 records; (ii) Saker Falcon (Vulnerable) – 1 record; (iii) Eastern Imperial Eagle (Vulnerable) – 4 records; (iv) Greater Spotted Eagle (Vulnerable) – 1 record; (v) Pallid Harrier (Near Threatened) – 2 records.

2. Of those 11,000 birds, results show that two species account for most of the numbers – the Honey Buzzard and the Steppe Buzzard both accounting to around 94% of the records. This is followed by the Levant Sparrow hark, accounting to around 2% of the records. All those species have an IUCN status of Least Concern.

3. The total number of target migratory birds recorded during the spring season represents around 97% of the total records, compared to 3% in autumn only. This indicates that the Project site is much more heavily used by migrant species during spring compared to autumn.

4. The target resident birds recorded throughout all the surveys belong to 3 species only. All those species have an IUCN status of Least Concern – however they have important breeding populations at the national level. In total, 132 records were noted and which include the following: (i) long legged buzzard – 92 records; (ii) Common Raven – 39 records; and Griffon Vulture – 1 record. However, it is important to note that the various records do not indicate the total numbers of different birds of such species, as the same resident individuals were constantly using the area at different days.

5. It is understood that monitoring surveys undertaken provide a sampling tool for the type and number of species that pass by or use the site (both resident and migratory). Therefore, a forecast analysis was undertaken to predict the total number of birds which would be passing by or use the site throughout the entire spring and autumn migration season. The results are presented in the table below.

   The table first presents average birds per hour using the site based on data from surveys (this was calculated by dividing the total number of birds recorded throughout the survey by the number of monitoring hours undertaken for each season separately). Statistical analysis was then undertaken to determine the ±95% confidence interval for this average rate. To determine the total average number of birds which would pass by or use the Project site in any given season, the average bird per hours value is multiplied by 1188 for spring (representing the total number of daylight hours in spring available for flying by migratory/resident birds) and 748 for autumn (representing the total number of daylight hours in autumn). The maximum and minimum values are determined by multiplying the confidence ratio by 1188 and 748 for spring and autumn respectively.

   As noted in the table, in any given season the average number of birds over Rajef are expected to be around 25,600 species in spring (with a maximum of 43,100 and a minimum of 6,800) and 750 in autumn (with a maximum of 1,500 and a minimum of 85). Similar to the results of the survey, this indicates that site is much more heavily used by migrant species in spring compared to autumn. In addition, the majority of the records also belong to two main species which account for around 80-85% of the records – the Honey Buzzard and the Steppe Buzzard.

Taking all of the above into account, comparing the numbers in the forecast table below as well as the actual results and outcome of the surveys to other areas in Jordan where similar studies were undertaken (mainly by other wind farm developers and where data was publicly available) indicates that the Project site is not located within a highly sensitive area in terms of avi-fauna. This is due to the following:

- The number of migratory birds is relatively small, especially when compared to other areas which are closer to the rift valley and its margins (considered the main migration route in Jordan). In such areas a much higher number and diversity of migratory soaring birds (including those with a conservation status) were recorded. The numbers were also compared with another study which was undertaken by BirdLife International at Eilat (which is located within the main migration route of the rift valley). The study recorded nearly 900,000 migratory soaring birds in spring 2015 (Dan Alon, 2015). Taking all of the above into account, as the Project site is located at a distance from the rift valley and its margins, it is not considered to be located in an area with intensive passage of traffic of migratory soaring birds during the spring and autumn migration.
- Resident bird species and their activity in the Project area is much lower when compared to other studies especially for locations located closer to IBA's. In such areas a higher number of species and higher activity of resident birds was recorded especially of those with an important local conservation status (such as the Griffon Vulture). The Project site is not located within or near any IBA (the closest of which is the Petra IBA located around 6km north of the Project site). This indicates that the Project site is not located within an area of critical habitat for resident birds.

Table 31: Forecast Analysis of Migratory and Resident Birds within the Project Site

Species	Season	Birds/h	Confidence -95%	Confidence +95%	Number of Birds	Min	Max
Short-toed Eagle	Autumn	0.03	0.00	0.052	20	1	39
	Spring	0.04	-0.01	0.093	32	0	69
Black Kite	Autumn	0.01	-0.01	0.020	5	0	15
	Spring	0.11	0.02	0.195	79	13	146
Egyptian Vulture	Autumn	0.01	-0.01	0.034	10	0	25
	Spring	0.03	-0.02	0.079	22	0	59
Griffon Vulture	Autumn	0.02	0.00	0.043	15	0	32
	Spring	0.00	-	-	0	0	0
Imperial Eagle	Autumn	0.01	-0.01	0.021	5	0	16
	Spring	0.00	-	-	0	0	0
Levant Sparrowhawk	Autumn	0.02	-0.01	0.052	16	0	39
	Spring	0.01	-0.01	0.033	10	0	25
Long Legged Buzzard	Autumn	0.06	0.01	0.116	48	9	87
	Spring	1.08	0.57	1.599	810	424	1196
Montagu's Harrier	Autumn	0.01	-0.01	0.020	5	0	15
	Spring	0.01	0.00	0.024	7	0	18
Steppe Buzzard	Autumn	0.78	0.10	1.455	581	74	1089
	Spring	1.69	1.18	2.207	1266	880	1651
Steppe Eagle	Autumn	0.06	-0.01	0.126	43	0	94
	Spring	0.26	0.12	0.394	192	90	295
Honey Buzzard	Autumn	0.00	-	-	0	0	0
	Spring	26.35	5.41	47.289	19709	4046	35372
Lesser Kestrel	Autumn	0.00	-	-	0	0	0
	Spring	0.22	0.13	0.316	167	98	236
Pallid Harrier	Autumn	0.00	-	-	0	0	0
	Spring	0.02	-0.01	0.039	12	0	44
Lesser-spotted eagle	Autumn	0.00	-	-	0	0	0
	Spring	3.50	1.78	5.219	2618	1332	3904
Eastern Imperial Eagle	Autumn	0.00	-	-	0	0	0
	Spring	0.01	-0.03	0.063	7	0	47
Spotted Eagle	Autumn	0.00	-	-	0	0	0
	Spring	0.04	-0.04	0.119	30	0	89
Peregrine Falcon	Autumn	0.00	-	-	0	0	0
	Spring	0.01	0.00	0.015	5	0	11
Total Spring					**25,600**	**6,800**	**43,100**
Total Autumn					**750**	**85**	**1,500**

12.3 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on birds during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

12.3.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, leveling, excavation, grading, etc.

Such activities in particular could impact avi-fauna which use the site for foraging and as a feeding ground– to include soaring and non-soaring resident and visiting birds. As discussed throughout the baseline section, several species of resident and visiting birds were recorded foraging within the site some of which are considered important at the national level such as Short-toed Snake Eagle. In addition, based on casual observations several species of non-soaring birds were also recorded some of which have an IUCN status and are also important at the national level – such as the Syrian Serin.

Nevertheless, such construction activities would not result in any major alteration of the site's habitats and thus would not affect the foraging and feeding area of such species, given that such activities are limited to the relatively small individual footprint of these facilities and where the actual area of disturbance is relatively minimal. In addition, the Project site does not hold any specific or significant value as a feeding habitat for birds – as discussed earlier in "Section 11.1" the Project site is considered of low ecological significance due to its natural setting; characterized by being barren and heavily degraded. Taking the above into account, such impacts can be further controlled throughout the mitigation measures identified previously in "Section 11.2.1"; thus this issue will not be discussed further.

On the other hand, there are additional potential impacts during the construction phase on breeding birds within the site. Construction activities could disturb existing habitats of birds breeding and/or nesting within the Project site.

Such potential impacts are created during the construction phase only and thus are of short-term duration. However, such impacts are considered of negative nature and of a low magnitude given that the construction activities' actual area of disturbance is relatively minimal. In addition, given that breeding activities are likely within the Project site, the receiving environmental is determined to be of a medium sensitivity. Given all of the above, such an impact is considered to be minor significance.

Additional Studies/Survey and Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor during the construction phase and which include:

- Before construction commences, a breeding survey must be undertaken at the Project site during the breeding season (which lasts from March till mid-May). The survey must be undertaken by a qualified ornithologist and must be based on point counts that are spread over the entire Project site. At each point count all breeding activities must be recorded. The survey must aim to identify any breeding areas of importance within the Project site. Should such areas be recorded, then construction activities must be properly planned to avoid any disturbance to such areas during the breeding season. Construction activities may commence in other areas but through the implementation of proper housekeeping measures to reduce such impacts. This includes:

- Restrict activities to allocated construction areas only with no breeding activities, including movement of workers and vehicles to allocated roads within the site and prohibit off-roading to minimize disturbances.
- Prohibit hunting of birds at any time and under any condition by construction workers onsite.
- Implement proper measures which would prevent attraction of birds to the site. This includes measures such as prohibiting illiterate dumping and ensuring waste streams are disposed appropriately in accordance with the measures identified in "Section 10.2".
- Avoid unnecessary elevated noise levels at all times. In addition, apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants

for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirement

The following summarizes the monitoring requirements for the Projects which must be undertaken and which include:

- Submit breeding survey report which identifies any areas of breeding importance within the Project site.

12.3.2 Potential Impacts during the Operation Phase

Wind turbines are associated with impacts on birds from risks of strikes and collision on both migratory soaring birds (which could pass over the site during the spring and fall migration seasons) and resident soaring birds in the area. Those are mainly big and heavy birds and thus are in special risk, because of their reduced ability to avoid wind turbines, especially in times of reduced sight distances (sandstorms, fog, rain, etc.) or strong winds. Such impacts could lead to serious injuries and, in most cases, death of the birds. Generally, such impacts depend on several factors but could affect the population levels of certain species especially those with international/national critical conservation status.

This section provides a qualitative assessment of such impacts. As discussed previously, to determine the significance of an impact it is important to understand the sensitivity of the receiving environment and the magnitude of the impact both of which are discussed in further details below.

(i) Sensitivity of the Project Site

The baseline assessment has recorded around 11,400 migrating birds over the Project site along with resident bird activity in the area. Some of those recorded species have an important status on the international or national level. Forecast analysis also predicts the activity of around 25,600 migratory and resident bird species during the spring and 750 during autumn.

Nevertheless, as discussed previously in “Section 12.112.2” the baseline assessment concludes that the site is not considered within a highly sensitive area in terms of avi-fauna. Comparing these results to other areas reveals that the Project site is not considered to be within an intensive migration route nor within high resident bird activity – especially when compared to areas closer to the rift valley and its margins. Taking all of the above into account, the receiving environment is considered of medium sensitivity.

(ii) Magnitude of the Impact

Deaths and strikes of migratory and soaring birds with turbines are expected with a higher risk in particular during the spring season when compared to autumn. However, the magnitude of such impacts differs from species to species. The magnitude of the impact was determined on each species of concern recorded throughout surveys undertaken for the Project. The magnitude of the impact aims to determine the significance of collision risks of each bird species with operating wind turbines. However, to determine the magnitude three main factors were considered to include the following:

1. The numbers of birds recorded within the Project site and in particular those which are at risk height;
2. The conservation status of the species (international IUCN status and local status and importance);
3. The avoidance behavior and collision risk of recorded species. There is no data in Jordan on avoidance behavior and collision risks of birds with wind turbines. Therefore, such information was based on experiences from Europe – mainly the Strait of Gibraltar in the Western Palearctic flyway, a migration bottleneck between Europe and Africa. Real fatality rates from such area are recorded where nearly 800 turbines and 65 wind farms are operational with experience after monitoring wind farms over 15 years. The database employed involved around 12,000 fatalities from this area but also from other sites where migration does occur in such a visible way "Improvement of Post Construction Monitoring at Spanish Wind Farms. Lessons Learned after 15 Years" (Camina, 2015).

As noted in the table below, out of all the species recorded there are 5 species with a high impact magnitude. This includes the Honey Buzzard and Steppe Buzzard which are considered with a high magnitude given the huge numbers in which they were recorded onsite which could result in high numbers of fatalities in a single even (especially that from previous experiences in Europe such species have had high collision risks). The other high magnitude species (Griffon Vulture, Short-toed Snake Eagle and Long-Legged Buzzard) were considered so because from previous experience in Europe they had high collision risks and also because such species have important conservation status on the international and/or national level; therefore biological significance of a loss is very high.

In addition, there are additional 7 species with a medium impact magnitude. This first (Black Kite, Levant Sparrow Hawk, Steppe Eagle, Lesser Spotted Eagle), are considered of a medium magnitude given the large numbers in which they were recorded onsite (but comparatively much less than the Honey and Steppe Buzzards) which could result in relatively high numbers of fatalities in a single even (previous experiences in Europe for such species have shown medium-low collision risks). The other medium magnitude species have important conservation statuses intentionally and locally and therefore biological significance of a loss is high – however those have low collision risks and good avoidance behavior.

The remainder of the species are considered of low impact magnitude, as that they have no important international or local conservation status, have high avoidance rates, and were recorded in low numbers within the Project site.

Therefore, the magnitude of the impact in general ranges between low – high depending on the species of concern as noted in the table below.

Table 32: Magnitude of Impacts on Bird Species

Species	Magnitude of Impact	Justification
▪ Honey Buzzard ▪ Steppe Buzzard	High	▪ Very large numbers of migrants in flocks with very frequent passes. ▪ High collision rates of such species with turbines ▪ May cause high number of fatalities in a single event.
▪ Griffon vulture ▪ Short-Toed Snake Eagle ▪ Long-Legged Buzzard	High	▪ High collision rates of such species with turbines ▪ Biological significance of a loss is very high due to its important international and/or local status
▪ Black kite ▪ Levant Sparrow Hawk ▪ Steppe Eagle ▪ Lesser Spotted Eagle	Medium	▪ Large numbers of migrants in flocks with frequent passes. ▪ Observed collision rates of this species is medium-low ▪ May cause high number of fatalities in a single event
▪ Egyptian Vulture ▪ Greater Spotted Eagle ▪ Eastern Imperial Eagle	Medium	▪ Considered threatened species with an important international and/or local status ▪ Observed collision rates of this species is medium-low
▪ Remaining species	Low	▪ All other species are considered of low impact magnitude, as that they have no important international or local conservation status, have high

		avoidance rates, and were recorded in low numbers within the Project site.

Given all of the above, the potential impacts on birds created during the operation phase would of a long-term duration as they are as long as the wind turbines are operating. Such impacts are considered of negative nature and range from a low magnitude to a high magnitude (high magnitude has been taken into account as a worst case scenario). However, the receiving environmental is determined to be of a medium sensitivity. Given all of the above, such an impact is considered to be of moderate significance.

Mitigation and Monitoring Measures

The following identifies the mitigation and monitoring measures to be applied by the Project Operator during operation phase. This mainly includes the undertaking of: (i) avi-fauna monitoring and turbine shutdown; (ii) onsite avi-fauna carcass search; and (iii) onsite carcass search (other than birds).

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

(i) Avi-Fauna Monitoring and Turbine Shutdown

Monitoring during the operation of the wind farm must be completed in order to inform the actual impact caused by the wind farm on resident and migratory birds. The monitoring must be undertaken with the primary objective of collision avoidance but also secondary for migration monitoring behavior (similar to the methodology undertaken in spring 2015 for this Project).

Monitoring must take place during the spring migration season (from early March till end of May) and autumn migration season (from early September till mid-November). Throughout this period, monitoring must take place continuously on a daily basis.

Monitoring must be undertaken onsite by qualified ornithologist to observe all migrating and resident birds. It is anticipated that a minimum of 3 vantage points will be required to undertake such monitoring (however this can be determined and confirmed at a later stage based on onsite conditions when the turbines are in place). Observers must have the flexibility to move, independently from each other, between the 3 main vantage points and the secondary ones if necessary and when required for better judgement to prevent potential collision of birds with turbines.

Monitoring must take place to prevent potential collision of birds with the wind turbines, through individual shutdown of turbine(s) which pose an imminent collision risk to birds. Imminent risk is identified as (a) bird(s) flying at risk height and within a buffer distance of 500m from the turbine(s). However, this should be verified and confirmed during the actual operation of the Project taking into account the actual turbine shutdown time as well as other onsite conditions.

Individual temporary turbine(s) shut-down will be enacted by the observers calling through to the control room once an imminent risk is identified and until the birds are out of the risk area. This should take place based on two main conditions and which include the following:

a. **Condition 1**: the passage of an individual bird species of global or national significance will require the individual temporary shutdown of the concerned turbine(s). Species under this conditions were previously highlighted in Table 32 and include:

Common name	Scientific name
Globally threatened species	
Egyptian Vulture	*Neophron percnopterus*
Eastern Imperial Eagle	*Aquila heliaca*
Greater Spotted Eagle	*Aquila clanga*

Species of national significance	
Griffon Vulture	*Gyps fulvus*
Other species with high collision risk	
Short-toed Eagle	*Circaetus gallicus*
Long-legged Buzzard	*Buteo rufinus*

b. **Condition 2**: the passage of ten or more individuals of the species provided below will require the individual temporary shutdown of the concerned turbine(s). Species under this conditions were previously highlighted in Table 32 and include:

Common name	Scientific name
Honey Buzzard	*Pernis apivorus*
Steppe Buzzard	*Buteo buteo vulpinus*
Black Kite	*Milvus migrans*
Levant Sparrowhawk	*Accipiter brevipes*
Steppe Eagle	*Aquila nipalensis*
Lesser Spotted Eagle	*Aquila pomarina*

Observers must record in a log sheet in details the following: species involved, number/ID of turbines ordered for shutdown, time of dispatch of shutdown call, time of actual shutdown. After the risk situation is over the observer must also record the following: time of dispatch of operation resumption, time of actual operation resumption, outcome of event (collision or avoidance), and the avoidance behavior of bird(s).

In addition, to the above monitoring must also take place during summer and winter (mainly for resident bird activity) through the same methodology discussed above. However, during this time it is likely that less than 3 vantage points will be required to cover the site – however this can be determined and confirmed at a later stage based on onsite conditions when the turbines are in place.

Taking the above into account, an annual report must be prepared with all the findings and outcomes based on all records for that year and shut-down events and their effectiveness. In addition, the report must also determine whether any changes on the frequency of the monitoring are required – to include effectiveness of the vantage points and observation hours.

In addition, as discussed earlier, the monitoring is also intended for migration monitoring behavior. Therefore, the report must also detail all migratory and resident bird activity and patterns, numbers, etc. (similar to the methodology for the spring 2015 survey of this Project).

The above monitoring plan must be undertaken during the first 3 years of operation. After the third year the monitoring plan will be reviewed and re-evaluated. For example, based on the results it could be decided that summer and winter monitoring should be discontinued or its frequency reduced due to low risk of collisions onsite and good avoidance behavior by bird species.

(ii) Avi-Fauna Carcass Search during Operation

During the operation phase, mortality rate surveys must be undertaken through carcass search surveys covering the entire wind farm. The carcass search will demonstrate the effectiveness of mitigation measures such as turbine shut down and allow an estimation of the annual number of bird deaths caused by the turbine.

a. Carcass Removal and Searcher Efficiency Trials

Before commencement of the avi-fauna carcass search during the operation phase, a carcass removal and searcher efficiency trial test must be undertaken. The objective of this test is to factor and adjust for carcasses that are removed from the Project site from external factors (such as animals that might feed on such carcasses) as well as for searcher efficiency in locating carcasses.

Tests of carcass removal and searcher efficiency must take place during 15 consecutive days. Carcasses will be placed and dispersed over the Project area, avoiding saturation which could attract animals to the site. They should be checked every day over fifteen days or until the entire carcasses have been removed if earlier.

At the same time, searchers should not be familiar with carcass location and will perform the carcass search annotating how many of the placed carcasses they find. After the trial of each person, the carcasses will be checked again to see if they are still there (and were not recorded by the searcher) or have been removed (by animals). Based on the above, the carcass removal and searcher efficiency rates can be calculated.

b. Carcass Search Surveys

Carcass search surveys shall be carried out by the beginning of the operation phase on a weekly basis during the spring and autumn migration season and twice per month during the summer and winter season. A plot area of 100mX100m would be set around each turbine to search for carcasses. The plot will be covered with search transects 10 m apart, with the searcher looking 5 m on either side.

All found carcasses must be recorded in a log sheet with information to include the following: species, sex, age, condition, cause of death (to the greatest extent possible), coordinates, date, and photos as appropriate, condition (intact, scavenged, feather spots, etc.)

An annual report must be prepared with the results and outcomes to complement the report prepared for the migration monitoring as discussed earlier.

The above carcass search surveys must be undertaken during the first 3 years of operation. After the third year, the carcass search survey will be reviewed and re-evaluated. For example, based on the results it could be decided that autumn surveys should be discontinued or its frequency reduced due to absence of carcasses recorded.

(iii) Onsite Carcass Search (other than birds)

The Project Operator must implement a carcass search plan (other than birds) for any carrion which could be present onsite to prevent attraction of birds to the site (such as the Griffon vulture and Egyptian vulture which rely on livestock and medium-large size mammals to feed on). The plan should cover the entire Project site and surrounding areas and must commence with the operation of the Project. This should be undertaken on a monthly basis but particular attention should be paid during the season when nomads are in the area (from April till September). Nomads raise livestock and carcasses could be in the area throughout such times. Such a plan should be implemented throughout the first 2 years of operation of the Project after which it could be reviewed and revaluated (e.g. if not carcasses are recorded during the first 2 years it can be discontinued).

13. BATS

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to bats and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

13.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to bats and presents the outcomes and results.

13.1.1 Baseline Assessment Methodology

The baseline assessment of the Project site was based on a literature review and a field survey, each of which is discussed in details below.

(i) Literature Review

This was based on previous studies, data, surveys, and records available in published scientific papers, books, and journals on bats of Jordan. All available data known in the study area and adjacent regions were tabulated.

(ii) Field Survey

Field survey was undertaken at the Project site through the use of bat detectors. The field survey was undertaken over four (4) days in early summer from 29 June 2012 – 2 July 2012 for a total of twelve (12) hours spread throughout the survey period. This is regarded as the most suitable time of year to assess bat activity as bats become active after the period of hibernation which may last from December to March after which they are active from early May till late November. During this period, bats feed and reproduce giving birth in June and thereafter. In addition, throughout this period of the year the biodiversity of the site is the highest which would enable to assess the site's habitat in providing a feeding area for bats which is highly correlated in determining bat activity. In addition, the survey was undertaken during nighttime as bats usually rest and sleep during the day and are active during night as they search for prey to feed on.

The survey was undertaken through a Magenta (Bat Mk11b) bat detector with frequency range 10-110 KHz. Upon detecting bat activity, coordinates were recorded using Garmin (GPSMAP 62S) global positioning device. Three (3) locations were selected within the Project site each with a 0.5, 1, 1.5 and 2km radius to cover most of the Project site to the greatest extent possible (refer to Figure 46 below).

In addition, careful inspections were undertaken during the day throughout the Project site to identify potential roosting sites which might be inhabited by bats during the day for rest and sleep and such areas were inspected for bat signs and remains or any other vital signs that indicate bat activity (e.g. fecal remains).

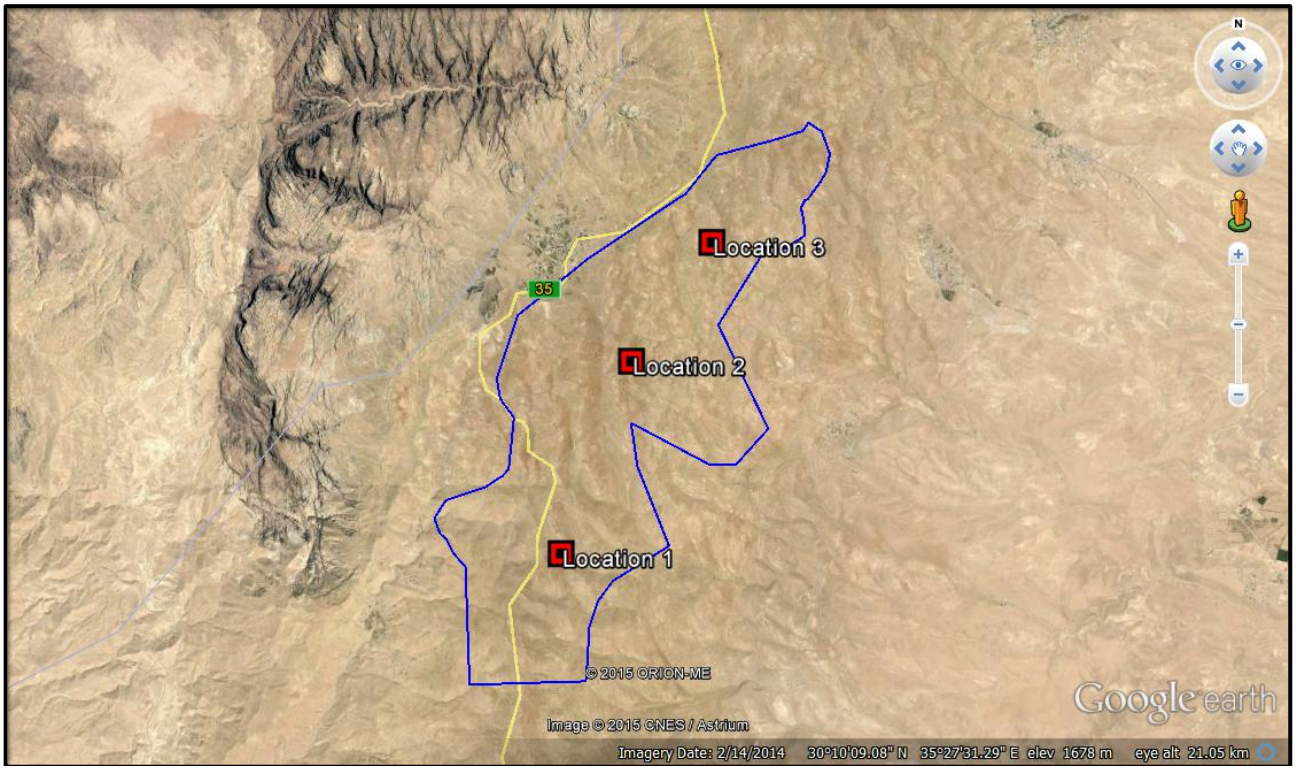

Figure 46: Location of Monitoring Sites for Bat Detection

(iii) Bats Species' status

Bats species status was assigned based on their conservation status within the Mediterranean region according to the IUCN Red Data Books: "The Status and Distribution of Mediterranean Mammals" (Temple & Cuttelod, 2009). In addition, their local status was based on an assessment undertaken by the bats expert in collaboration with RSCN – where such an assessment was undertaken in accordance with IUCN criteria. However, the results for this assessment have not been published yet.

13.1.2 Results

The field survey recorded one species of resident bat, Kuhl's Pipistrelle (*Pipistrellus kuhlii).* The detector recorded signals at around 40 KHz that belong to Kuhl's Pipistrelle (Figure 48). This species has an IUCN status of Least Concern, and is the most common species in Jordan and is found in all types of habitats across the country ranging from extreme deserts, semi-arid to Mediterranean and forested areas and is found frequently in houses, small caves, and crevices around human habitation (Amr, 2012).

Throughout the survey conducted, its activity was recorded at only two locations within the Project site as presented in Figure 47 below. The first location (site 1) where this species was observed lied within the central part of the Project site, close to the boundaries of the block with transmission towers and near the olive mill. At this site, three bats were recorded that remained active for a certain period of time after 10 pm. The second location (site 2) was located at the north western boundary of the Project site were around four bats were recorded that were active for more than half an hour. No bat activity was recorded elsewhere within the study site over the course of the survey.

At both sites, bats were detected while feeding on nocturnal insects that gathered around light poles. At the first site, bats were seen while feeding and maneuvering close to two main light poles in the area, whereas at the second site bats were also observed and detected maneuvering within this site as they were feeding close to the light poles at the major road passing through Al-Rajef village. It is important to

understand that bats maneuver in an area before attacking their prey. Therefore, although at the second site there were no light poles, however the area (site 2) is considered to be within their maneuvering range for feeding on insects near the light poles on the main road passing through Al-Rajef village.

An interesting observation is that only light poles with white bulbs attracted insects and thus recorded bat activity, whereas no bat activity was noted in areas with yellow bulb light poles. The bats recorded were estimated to be at a height of around 20m.

It important to note that bat activity is correlated to insect activity. Where insects are present it is likely that bat activity will be recorded given that they feed on them. Within the site, nocturnal insect activity was very low, if not absent, in most of the study area due to the arid nature of the Project site and the very low vegetation coverage. Vegetation coverage is the main source for many insects (e.g. moths) where they breed and feed.

The limited insect activity in the Project site is attributed to rather external sources and not from the natural habitat of the site. At the first site water and waste stored within the grounds of the olive mill provided a breeding site for insects that becomes active at night, whereas at the second site septic tanks, water tanks and animal manure in Al-Rajef village provides a breeding habitat for many insects. Thus, bats are mostly associated with such habitats as feeding areas.

In addition, field observations were undertaken throughout the site to determine bat activity and identify potential roosting sites that might be inhabited by bats during the day for rest and sleep. Potential roosting sites such as deserted military bunkers and small enclaves were examined during the day for presence of bat activity, and none was found. In addition, no fecal remains were observed at any of those sites. Therefore, no roosting sites for Kuhl's Pipistrelle or any other bat species exist within the site. It seems that the Kuhl's Pipistrelle uses the Project site as a feeding ground only, coming from nearby areas. This species is known to roost in places such as houses and electricity wooden boxes.

Finally, based on the literature review of bat species in the area there are 11 species which are known to typically inhabit such areas of similar habitat. Generally, most of the species recorded throughout the literature review are considered of Least Concern according to the IUCN and are common to such habitat areas (refer to Annex II for additional details).

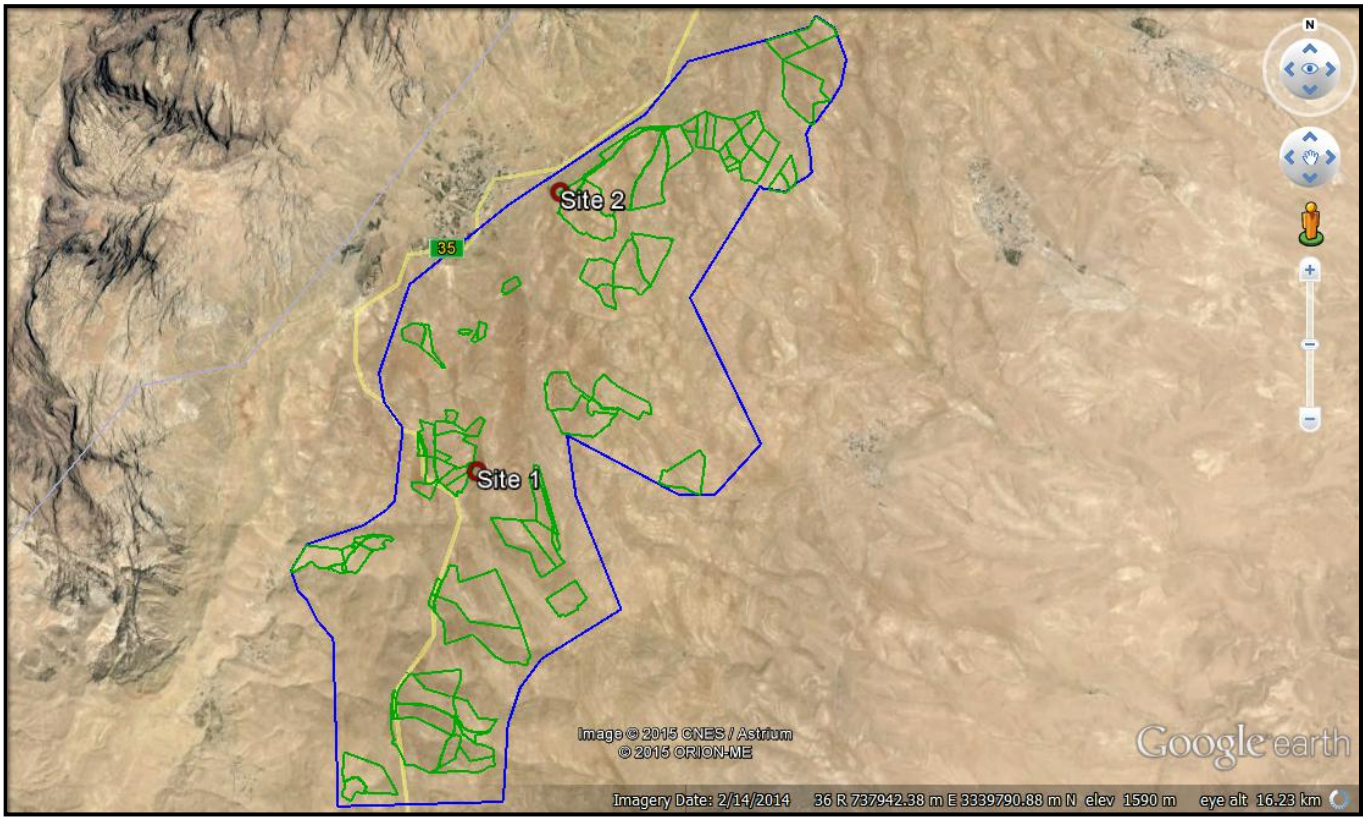

Figure 47: Location of Bat Activity within the Project Site

Figure 48: Kuhl's Pipistrelle

13.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on bats during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

13.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, leveling, excavation, grading, etc.

Such activities are limited to the relatively small individual footprints of these facilities and the actual area of disturbance is relatively minimal. Nevertheless, such activities would likely result in the alteration of the site's habitat and thus potentially impacts bats; particularly through loss of hunting habitats for bats as well as roosting sites.

However, as discussed in the baseline section, bat activity is correlated to insect activity. Where insects are present it is likely that there will be bat activity given that they feed on them. Within the site, nocturnal insect activity was very low, if not absent, in most of the study area due to the arid nature of the Project site and the very low vegetation coverage. Vegetation coverage is the main source for many insects (e.g. moths) where they breed and feed. Thus, the natural characteristics of the site do not offer an attractive feeding habitat for bats. In addition, as discussed in the baseline section, no roosting sites for bats were recorded within the Project site.

Given all of the above, the potential impacts on bats created during the construction phase would of a long-term duration as they would result in a permanent change in the natural biodiversity of the site. However, such impacts are considered of negative nature and of a low magnitude given that the site is not used by bats as a feeding ground and no roosting sites were recorded. In addition, given the very limited bat activity, the receiving environmental is determined to be of a low sensitivity. Given all of the above, such an impact is considered to be not significant. To this extent, no mitigation measures have been identified.

13.2.2 Potential Impacts during the Operation Phase

The potential impacts from the Project during operation are mainly related to risk of bat strikes and collisions with rotors of the operating wind turbines.

Many reports have corroborated the findings of bat collisions with wind turbines; this includes reports in Germany (Dürr 2001; Trapp *et al.* 2002; Dürr & Bach 2004), Sweden (Ahlén, 2002) and Spain (Alcalde, 2003). Evidences that turbines do not only kill bats from local populations but also from populations at far distance were established (Voigt *et al*., 2012). Moreover, there are reports with findings on collisions of bat species similar to that recorded onsite (Kuhl's Pipistrelle) from a wind farm project in Spain (Alcalde, 2003).

Nevertheless, it is important to put things into perspective. As discussed in the baseline section and previously, bat activity within the Project site was minimal and very low. Only one (1) species of bats was recorded with minimal activity (Kuhl's Pipistrelle) – where such a species is considered of lest concern and the most common species in Jordan that is found in all types of habitats across the country.

The natural characteristics of the Project site being arid with very low vegetation coverage do not offer an attractive feeding habitat for bats. Based on such a rationale, bat activity is expected to remain low given the arid nature of the site. The sources of attraction is attributed to rather external sources from water and waste stored within ground of olive mill found onsite as well as septic tanks, water tanks and animal manure in Al-Rajef village – both of which provided a breeding habitat for many insects which attracts bats. Thus, bats are mostly associated with such habitats as feeding areas. Such sources can be controlled in order to further reduce bat activity within the Project site (as discussed in the mitigation measures below).

Given all of the above, the potential impacts on bats created during the operation phase would of a long-term duration. Such impacts are considered of negative nature and of a low magnitude given that a risk of collision of the species recorded does not entail any significant impacts (species recorded is very common

and considered of least concern). In addition, given the very limited bat activity the receiving environmental is determined to be of a low sensitivity. Given all of the above, such an impact is considered to be not significant.

Additional Studies/Surveys and Mitigation and Monitoring Measures

Before commencement of operational activities, Project Operator is required to implement proper and adequate management measures for those sources which could attract bats to the Project site to the greatest extent possible.

This includes coordination with the olive mill owner to properly cover waste streams stored onsite and also with Rajef village to cover and maintain the septic tanks (which act as a source for attracting insects' onsite and in turn bats).

In addition, a bat mortality monitoring program must be established during the initial Project operation phase. The program must be undertaken by an expert and must include the following components:

- An additional two (2) days bat assessment must be undertaken during their active period, before commencement of operational activities and after the above management measures are implemented. The assessment must be undertaken with the use of bat detectors. In addition, the assessment must also include inspections for potential roosting sites within the Project area. The objective of this assessment is to reconfirm that the Project site is an unattractive habitat for bats as it was established throughout the baseline study in this ESIA and also to determine if the implemented management measures were effective in further reducing the limited bat activity onsite;
- Bats mortality monitoring program for a duration of six (6) months during the early operation phase of the wind turbines (this must take into account that the hibernation period for bats lasts from December to March after which they are active from early May till late November). The mortality monitoring program must be undertaken once per month and must include carcass search through visual observations around each wind turbine with a radius of 200-300m around each turbine; and
- Based on the outcomes of the mortality monitoring program, should no issues of concern be identified then the mortality monitoring program can be discontinued (this is the most likely scenario to occur). In the highly unlikely event that any issues of concern are identified (high bats mortality recorded) then additional investigations must take place on the sources of attraction of bats to the site (which will most likely be from external sources) and based on that appropriate mitigation measures must be identified.

14. ARCHEOLOGY AND CULTURAL HERITAGE

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to archeology and cultural heritage and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

14.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to archeology and cultural heritage and presents the outcomes and results.

14.1.1 Baseline Assessment Methodology

The baseline assessment of the Project site was based on a literature review and a field survey, each of which is discussed below.

(i) Literature Review

Literature review included a comprehensive review of archives, publications, and studies on previous archaeological work and surveys undertaken in the area, and which are available at the Department of Antiquities' (DoA) database. This also includes the search of the official register and database of all archeological/cultural sites of Jordan known as the Middle Eastern Geodatabase for Antiquities – Jordan (MEGA Jordan).

(ii) Field Survey

The field survey was undertaken by the DoA; the official governmental entity in Jordan responsible for the protection, conservation, and preservation of antiquities in accordance with the "Antiquities Law No. 21 for 1988 and its amendments No. 23 for 2004".

The objective of the field survey was to ascertain the presence of any archaeological remains within the Project site. The survey was undertaken from 17 July – 23 July 2013 for the entire Project site boundary (this includes the leased lands for the Project and the land areas between them as well for a total area of 26km^2). The survey area was divided into topographic zones: hilltops, plateau, hill slopes and wadi bottoms. The ground was walked by 4-5 people from the DoA, spaced at an interval of 15 to 20 m in order to inspect the entire ground surface. Each pass walked by the team was called a 'transect', which covered the entire survey area. Any sites of interest were recorded by sketch plans and /or a photograph as appropriate. Whilst walking these transects, GPS coordinates were taken. The results of the survey were analyzed by categorizing the sites and making an assessment of their significance. The result of the survey was a full listing of the archaeological sites, archaeological features, and survey results of the Project area using maps and photographs where appropriate.

Based on the outcomes of the DoA survey, ECO Consult also took a reassessment survey to confirm the results of the survey undertaken by the DoA. The site assessment was undertaken by an archeological expert on 9 January 2014. Throughout the site visit, a similar methodology to that adopted by the DoA was established; the area was divided into transects at intervals of 15m to 20m and the entire ground surface was inspected, and any sites of archeological interest were recorded.

14.1.2 Results

In accordance with the methodology discussed above, the results first provide an overview of the archeological history of the Petra area in general. The results then present the outcomes of the archeological importance of the Project site in specific based on the DoA survey and the reassessment survey undertaken by ECO Consult.

(iii) Overview of the Archeological History of the Petra Region

The (semi) arid central plateau of southern Jordan (such as the Petra Region and its surroundings) witnessed several cultures which existed from the Paleolithic period up to modern times – this includes Nabataean, Roman, Byzantine and Islamic periods.

The area, in general, is believed to be rich in archaeological remains which belong to such periods. However, two very important cultures are worth mentioning and which include the Edomites and Nabataeans as discussed below.

The Edomites occupied the southern area of Jordan between Karak and Aqaba. Their main centers were in the Tafileh and Petra region. The Edomite culture lasted between the 13th century BC (Before Christ) and 6th century BC. Archeological research and surveys within and around the Petra region has revealed hundreds of site occupied by the Edomites.

The Nabataean culture replaced the Edomite culture throughout the period which lasted from the 4th century BC till the 6th century AD (Anno Domini) – that is during the Hellenistic, Roman and Byzantine period. Their capital city was the ancient city of Petra (a UNESCO World Heritage Site) which most notably includes the treasury (Al Khazneh). In addition, throughout this period the vicinity of the Petra region was settled by people, whom practiced agriculture activities intensively.

(iv) Archeological Assessment of the Project Site

Based on the results of the baseline assessment, the DoA identified 18 sites which were considered of archeological importance. Mainly, such sites include settlement sites with features such as remains of streets, building structures, architectural elements, etc. which generally date back to the Nabataean/Roman period. Table 33 below discusses briefly each of those sites. In addition, Figure 49 below presents a map with the location of each of those sites.

As noted in Table 33 below, most of the sites were relatively of small areas (with the exception of site 12). In addition, only 6 of the 18 identified sites lie within the leased land areas for the Project development; those include sites 9, 10, 12, 16, 17, 18 – with an area of 328m^2, 3,880m^2, 168,805m^2, 13,650m^2, 8,992m^2, and 3,589m^2 respectively. Site 12 was the largest recoded site.

Table 33: List of Archeological Sites Recorded within the Project Area

Site	Period	Brief Description	Area (m^2)
1	Roman	A rectangular structure which features indoor architectural division walls built of two rows of stones and which represent defensive towers.	294
2	Roman	A rectangular structure which features indoor architectural divisions for defensive military purposes.	1,210
3	Nabataean / Roman	A Roman street which leads to a site which includes foundations of buildings of different architectural shapes.	5,254
4	Nabataean / Roman	A group of adjacent structures representing one architectural unit and which include a number of rooms and which may represent a settlement. In addition, pottery shards were identified dating back to the Nabataean/Roman period.	1,313
5	Nabataean / Roman	A structure representing many architectural units and which includes a number of rooms. An old road was recorded which connects to the existing structure. In addition, a set of watchtowers in the form of piles were recorded.	914
6	Nabataean / Roman	A Nabataean/Roman settlement called 'Khirbet Tomb Shaker'. The foundations are still in place and which consist of two rows of dark colored sand stones.	21,019
7	Nabataean / Roman	A Nabataean/Roman settlement called 'Khirbet Al Saqriah'. The foundations are still in place and which consist of rows of dark colored sand stones.	15,952
8	Nabataean / Roman	Remains of a settlement and which include a number of walls and architectural divisions built of sandy stones spread over a wide area.	1,435
9	**Nabataean / Roman**	**A road surrounded by walls on both ends which extend for 53m to the south of a square building structure.**	**328**
10	**Nabataean/Roman, Byzantine and late Islamic**	**The site is called 'Sayil Mughaidah' and features architectural elements and multiple stones of various sizes which likely date back to the Nabataean/ Roman, Byzantine and late Islamic periods.**	**3,880**
11	Nabataean / Roman	A settlement located in front of an old road with very large architectural and multiple internal divisions built of large solid shaped sand stones.	4,128
12	**Nabataean / Roman**	**Several settlements including architectural units built of stone and limestone. In addition, flint stones and pottery shards were recorded. Also, within the site, 3 small houses have been recorded built from archaeological elements and materials (e.g. stones)**	**168,805**
13	Nabataean / Roman	A settlement which includes large architectural units and multiple internal divisions built of huge semi slimmed stones. In addition, an old road which is 3m wide was recorded.	2,240
14	Nabataean / Roman	A settlement which includes compounds of rooms and cabins built of solid limestone. The divisions inside the building show a number of rooms and agricultural wall stones. Remains of an old stream which is 51m long ends at the settlement. In addition, pottery shards were recorded.	6,175
15	Early Bronze, Nabataean and Roman	A settlement which includes structures built of natural rocks, with a circular stone structure probably used for collecting rain water or crops. In addition, pottery shards were recorded.	409
16	**Nabataean / Roman**	**A settlement which includes architectural elements and multiple compartments. In addition, a rebuilt circular stone structure was recorded using archaeological stones of the site.**	**13,650**
17	**Stone Age, Chalcolithic, Early Bronze age, Roman and Nabataean**	**A settlement located in a low area on the top of a plateau and includes a group of separate architectural units and interior divisions of limestone. In addition, flint stones and pottery shards were recorded which could date back to the Stone Age, Chalcolithic, and Early Bronze age as well as the Roman and Nabataean period.**	**8,992**
18	**Nabataean / Roman**	**A settlement with modern and heritage buildings. The settlement includes a group of architectural units with divisions of internal compartments built of limestone and flint stones. In addition, a square shaped water tank has been recorded.**	**3,584**

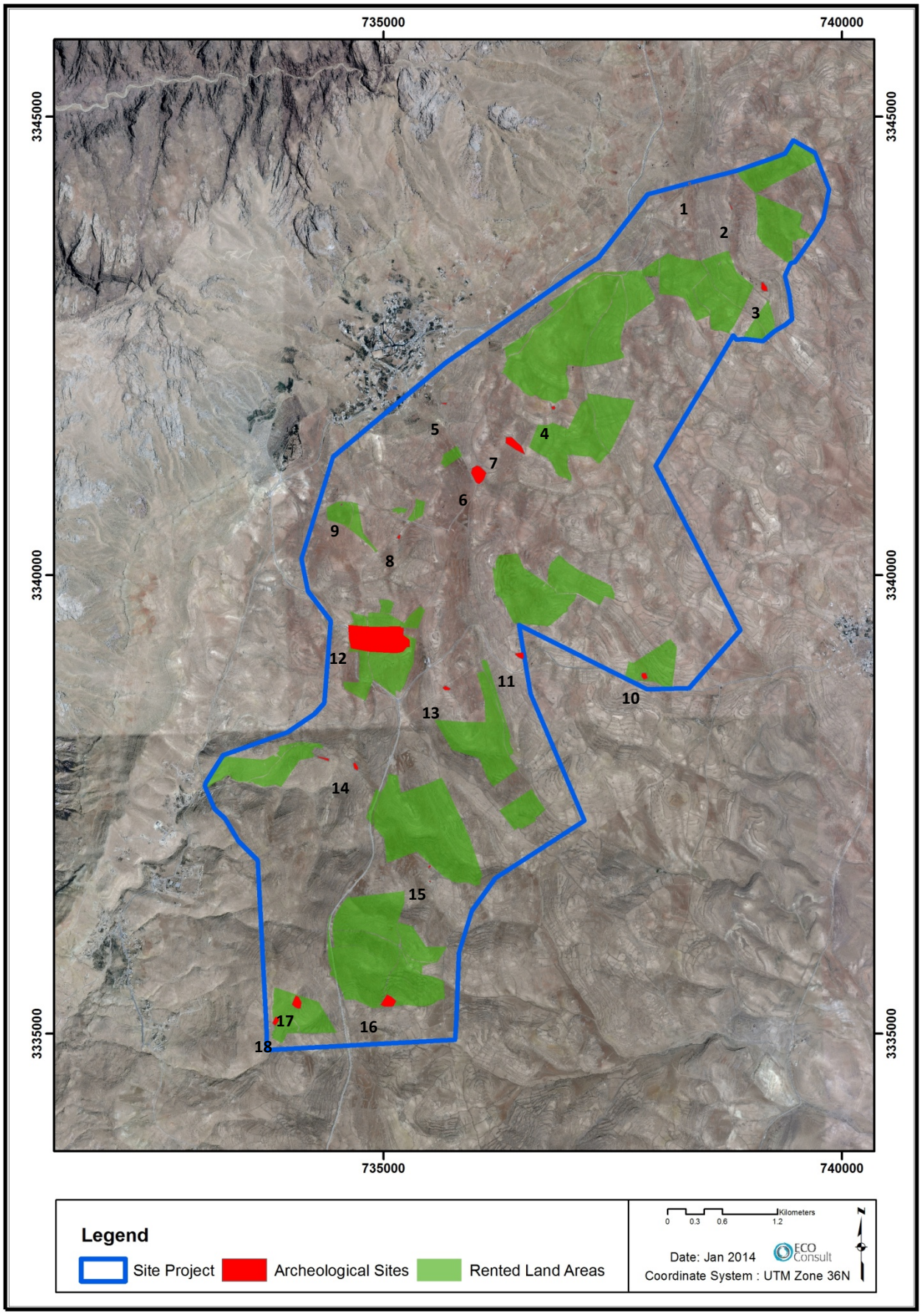

Figure 49: Archeological Sites Recorded within the Area by the DoA

A reassessment of the archeological survey for Site 12 undertaken by the DoA was conducted by ECO Consult, through an archeological expert. Only Site 12 was selected, given its relatively large area of around 168,805m^2 (based on the DoA assessment) when compared to other areas recorded, and the fact that it lies within lands leased for the Project development.

The objective of the reassessment was to evaluate these results and the importance of the site, and thus confirm whether the entire area is of archeological value.

Based on the revaluation undertaken for Site 12, it was confirmed that parts of the site are of archeological importance; however this does not include the entire 168,805m^2 recorded by the DoA. Several archeological sites were recorded which generally are similar to the observations recorded by the DoA; however those are confined to an area of approximately 34,579m^2 – 20% of the original area only. Based on the reassessment, the 34,579m^2 considered of archeological importance can be divided into two main areas; Area A and Area B both of which are summarized below.

- Area A: this area is around 12,655m^2.This site is known by the local community as 'Khirbet um el Tilian' or 'Khirbit Mulhim'. The Khirbeh contains 3 small houses built 100 years ago; according to discussions with the local community the houses were built by the great grandfather of the owner of the land (Figure 50). The people whom used to live within those complexes raised livestock and cultivated the surrounding lands. Several animal pens are still visible in the area adjacent to the houses. The houses are considered archeologically important as they were built from archaeological elements and materials (e.g. stones) which date back to the Nabataean/Roman period. In addition, the houses are considered of cultural significance, as they tell the story of the local people whom have inhabited this land for the past hundred years.

  In addition to the complex of houses, several archaeological features were recorded. This includes several walls which are distributed within the area, some of which are still standing to about 0.7m in height; these walls are located within the vicinity of the previous mentioned complex of houses. Such walls have most likely been part of domestic structures which were built for dwelling rooms. The walls have been disturbed by recent human activities. Those walls date back to the Nabataean/Roman period. Several natural and manmade caves were also located within the Khirbeh. Finally, high concentrations of pottery shards were found which date back to the Iron II, Roman, and Byzantine age.
- Area B: this area is around 5,241m^2 and consists of 6 recorded sites which share the same characteristics. Each site (Figure 51) is circular in shape, ranging in size between 15-25m in diameter and is built from big boulder stones. Only the lower foundations are still visible, some are still standing up to 1 m above the ground. Based on some ethnographic observations, those sites have most likely been used for agricultural activities.

Within the remaining parts of Site 12, the detailed inspections have not identified a single record of any remains of potential archeological or cultural value (e.g. flint tools, pottery shards or other archeological features such as cisterns, isolated buildings, enclosures, terraces, old roads, burial cairns and stone heaps, etc.).

Figure 50: Complex of Houses in Area A

Figure 51: One of the Sites recorded in Area B

Based on the reassessment undertaken for Site 12, it was recommended that out of the initial 168,805m^2 area identified by the DoA, that only an area of 34,579m^2 is to be considered of archeological importance; this includes Area A and Area B as well as the areas in-between. Figure 52 below presents the initial area denoted by the DoA and the new area (consisting of Area A and Area B) denoted by the reassessment. Therefore, Figure 53 below presents the updated list of sites within the entire Project area which are considered of archeological importance – that is after taking into account the adjusted Site 12 area.

Nevertheless, given all of the above, such sites are considered important given their archeological and cultural value and should be protected from potential damage or destruction throughout the various project activities (as discussed later in details below). However, it is important to note that the expert did not consider such sites unique nor distinctive archeological features and most importantly would not affect the Project development; such sites can be found extensively especially in the Petra Region and in such mountainous areas which have most likely had ancient/old human presence especially during the Nabataean/Roman era due to its agricultural potential.

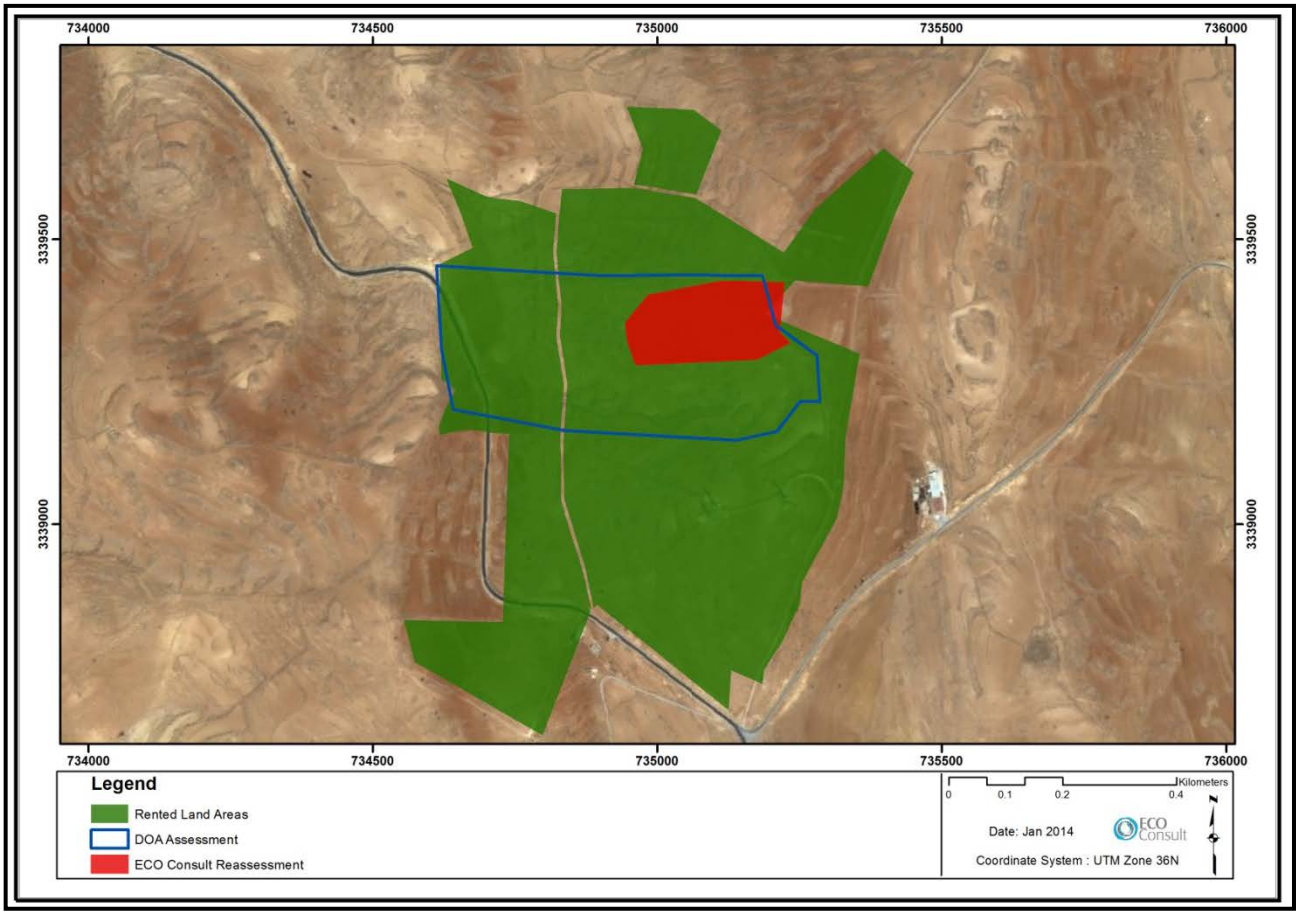

Figure 52: Reassessment of Site 12 results

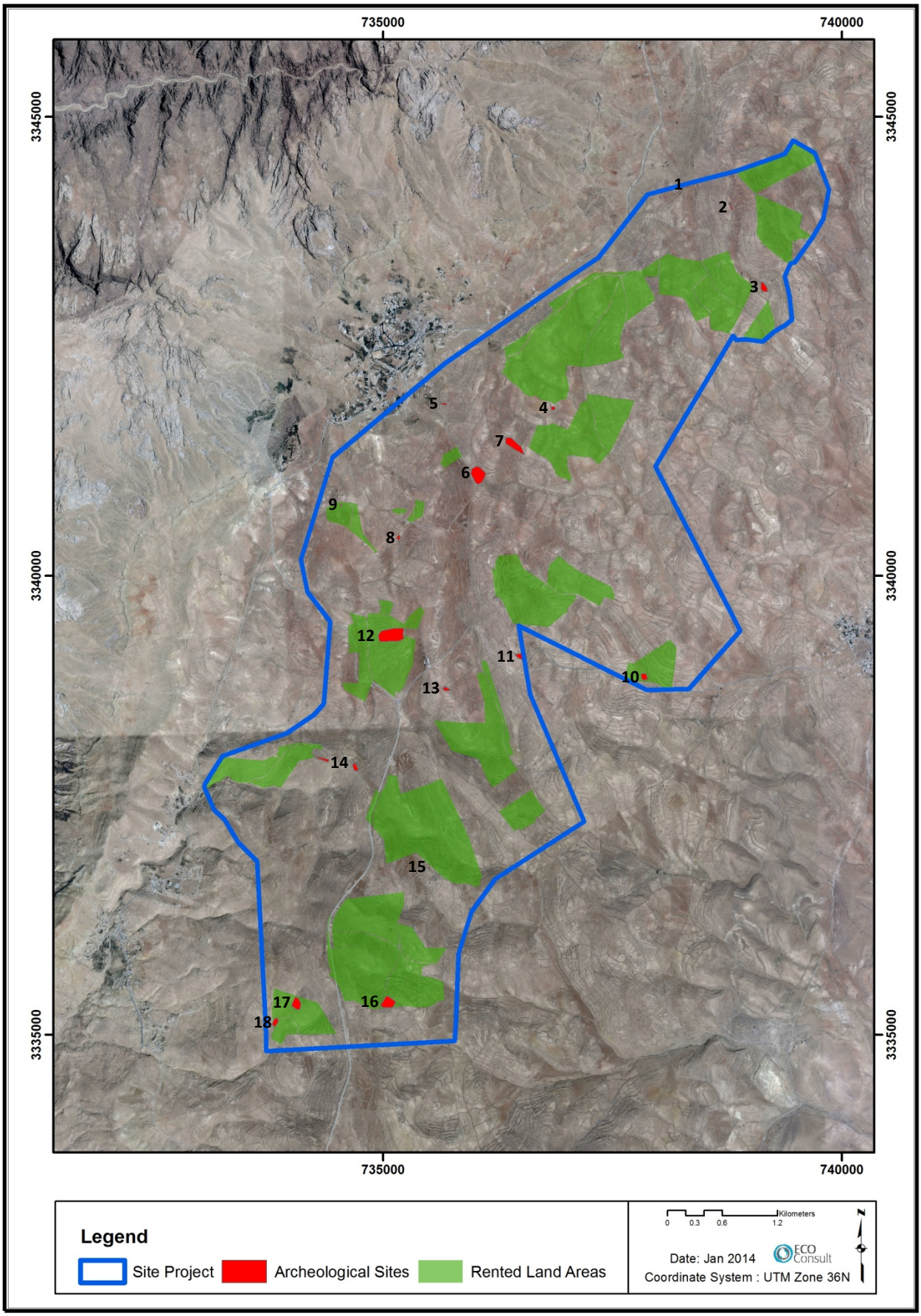

Figure 53: Final Archeological Sites Recorded within the Area

14.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on archeology and cultural heritage during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

14.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, leveling, excavation, grading, etc.

Although such activities are limited to the relatively small individual footprints of these facilities and the actual area of disturbance is relatively minimal, if such activities are improperly managed they could damage or disturb archaeological remains present on the surface of the Project site. As discussed in the baseline section (refer to "Section 14.1"), there were 18 archeological sites recorded within the Project area which generally date back to the Nabataean/Roman period, of which 6 are located within the leased land areas for the Project development. Nevertheless, such activities to be undertaken throughout the construction phase are not limited to the leased land areas as other areas could be affected (e.g. from transportation activities) and thus damage to archeological sites outside of leased land areas is possible as well.

Such sites recorded (refer to Figure 53) are considered important given their archeological and cultural value, and should be protected from potential damage or destruction throughout the various project activities. However, they are not considered unique nor distinctive archeological features and most importantly would not affect the Project development; such sites can be found extensively especially in the Petra Region and in such mountainous areas which have most likely had ancient/old human presence especially during the Nabataean/Roman era due to its agricultural potential.

In addition, there is a chance that throughout such construction activities, archaeological remains buried in the ground are discovered. Improper management (if such sites are discovered) could potentially disturb or damage such sites which could potentially be of archeological importance.

Given all of the above, the potential impacts on archaeology created during the construction period would of a short-term duration as they are limited to the construction phase only. The impacts will be of a negative nature, and medium magnitude if improperly managed as it is possible once a site is damaged or disturbed it cannot be restored. In addition, given the presence of archaeological remains in the Project area, the receiving environment is considered of medium sensitivity. Given all of the above, such an impact is considered to be of moderate significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor during the construction phase and which include:

- The detailed designs being prepared by the EPC Contractor have avoided sitting any of the Project components (to include the turbines, roads, transmission lines, warehouses, etc.) within such delineated areas of archeological importance (Figure 53) to avoid damage to those sites. Exact coordinates of such areas have been provided in AUTOCAD format for the EPC Contractor to take into account during the detailed design of the Project. Similarly, the final detailed design must adhere to such a requirement as well.

- Properly plan construction activities to take into account the identified archeological locations to ensure they are protected from any potential damage. This could include for example proper movement of vehicles and machinery into/out of the site to avoid those areas, ensure that all vehicles are on established roads and prohibit off-roading, prohibit movement of vehicles near those areas during the various construction activities, etc.
- Ensure that the Code of Conduct, awareness raising, and training developed for construction workers and personnel involved in the construction phase of the Project to emphasizes the presence of archeological locations in the area - this could include providing information on their locations, prohibit any improper conduct which could disturb/ damage those locations, etc.
- Implement appropriate chance find procedures. Throughout the construction phase and as the case with any Project development that entails such construction activities there is a chance that potential archaeological remains in the ground are discovered. It is expected that appropriate measures for such chance find procedures are implemented which are standard requirements by the DoA as required by the "Antiquities Law No. 21 for 1988 and its amendments No. 23 for 2004". Those mainly require that construction activities be halted in the specified area of findings and the area fenced, while immediately notifying the DoA. No additional work will be allowed before the Department assesses the found potential archaeological site and grants a clearance to resume the work. Construction activities can continue at other parts of the site if no potential archaeological remains were found. If found, same procedures above apply.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- Inspections of construction activities to ensure that archeological locations are avoided throughout the construction activities and proper code of conduct is enforced.
- Inspection of actions taken in case of new discoveries, including fencing, limiting access to site, and contacting the DoA. Report should be prepared and submitted to the DoA in such a case which details the above.

14.2.2 Potential Impacts during the Operation Phase

Potential impacts during the operation phase are limited to improper management of operation activities which could potentially disturb or damage the archeological locations identified as discussed earlier. This could include for example improper movement of vehicles and machinery into/out of the site, improper conduct by operation workers, etc.

Given all of the above, the potential impacts on archaeology are of a long -term duration throughout the Project operation phase. The impacts will be of a negative nature, and medium magnitude if improperly managed as it is possible once a site is damaged or disturbed it cannot be restored. However, operation and maintenance activities are expected to occur at designated areas only (turbine locations, substation, etc.) using access roads established during the construction phase, therefore the receiving environment is considered of low sensitivity. Given all of the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the Project Operator during the operation phase and which include:

- Properly plan operation and maintenance activities to take into account the identified archeological locations to ensure they are protected from any potential damage. This could include for example proper movement of vehicles and machinery into/out of the site to avoid those areas, ensure that all vehicles are on established roads and prohibit off-roading, prohibit movement of vehicles near those areas during the various operation and maintenance activities, etc.
- Ensure that the Code of Conduct, awareness raising, and training developed for workers and personnel involved in the operation phase of the Project to emphasizes the presence of archeological locations in the area – this could include providing information on their locations, prohibit any improper conduct which could disturb/ damage those locations, etc.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the Project Operator during the operation phase and which include:

- Continuous monitoring of operation activities to ensure that a proper code of conduct is enforced.

15. AIR QUALITY AND NOISE

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to air quality and noise and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

15.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to air quality and noise and presents the outcomes and results.

15.1.1 Baseline Assessment Methodology

Assessment of baseline conditions was based on onsite air quality and noise monitoring undertaken at the Project site. Additional details are discussed below.

(i) Selection of Parameters

Baseline assessment for air quality and noise was undertaken through onsite monitoring, which was conducted in two phases: (i) at the Project site and (ii) at nearby receptors which are likely to be affected from the Project development (i.e. the villages surrounding the Project site to include Al-Rajef, Dlaghah & Rassees, Fardakh and Sadaqah).

Justification for selection of parameters is detailed below for each of the Project site as well as nearby receptors.

Monitoring at the Project site was undertaken for the following parameters: (i) gases to include Carbon Monoxide (CO), Sulphur Dioxide (SO_2) and Nitrogen Dioxide (NO_2), (ii) Suspended Particulate Matter to include Total Suspended Particulate (TSP), Particulate Matter smaller than 10.0 microns in diameter (PM10) and Particulate Matter smaller than 2.5 microns in diameter (PM2.5) and (iii) Noise Pressure Levels (NPL). These parameters were selected based on the following rationale:

- Such parameters are likely to be present within the Project site given its characteristic and attributes. Suspended particulate matter is expected given the barren nature of the site. On the other hand, pollutants (such CO, SO_2, and NO_2) are expected onsite but rather at minimal concentrations as the site is relatively in a remote area; nevertheless motor emissions particularly from vehicles passing casually through the site (or from the main road) could be a source of such pollutants. Finally, noise levels are expected from vehicular movement and to some extent from surrounding areas and activities (e.g. Al-Rajef village).
- Such parameters are likely to be affected mainly during the Project's construction and operational activities. All air pollutant parameters selected are expected to be slightly impacted and increase specifically during the Project's construction activities. Emissions from vehicles and machinery used onsite and their movement onsite will increase gaseous emissions, suspended particulate matter, as well as noise pressure levels.

On the other hand, monitoring at nearby receptors was limited to Noise Pressure Levels (NPL) only. One of the key impacts from the Project would be the impacts from noise from the operating wind turbines on the nearby sensitive receptors (i.e. resident within the villages), which is discussed in further details later. In order to ensure a thorough assessment of anticipated impacts on the nearby receptors, noise baseline

measurements must be established. However, no air quality measurements were undertaken given that it is highly unlikely that such receptors would be affected from air quality impacts given the nature of the Project.

Monitoring undertaken at the Project site was conducted continuously for 24 hours at 3 different monitoring sites that represent the Project site (north, center and south). Monitoring was conducted from the 20 June – 23 June 2012. In addition, monitoring undertaken at nearby receptors was conducted between 8 December – 10 December 2014 at 6 different locations for 1 hour during daytime and 1 hour during nighttime at each location.

The main objectives of the monitoring conducted include the following:

- Establish ambient air quality baseline conditions and background data to assess the existing level of pollution within the Project site;
- Establish noise level conditions and background data to assess the existing noise levels within the Project site;
- Identify the main sources of air pollutants as well as noise sources within the Project site or from surrounding areas which might affect air quality and noise, thus avoiding potential liability to the Project from any existing level of pollution.;
- Define inter-relationship of source of pollution, atmospheric parameter and measurable manifestations in order to evaluate the character and magnitude of existing problems (if any); and
- Establishing baseline conditions in terms of both ambient air quality and noise ensures thorough identification and logical assessment of anticipated impacts on air quality and noise from the Project's construction and operational activities as detailed later.

Table 34 below summarizes the location of each monitoring point and other logistical information.

Table 34: Air Quality and Noise Monitoring Points

Attribute	Coordinates (UTM)	Starting Sampling Time	Ending Sampling Time	Duration of Monitoring	Parameters Monitored
Project Site					
Point 1 (North of Project Site)	0737076 3343120	3:00 PM	3:00 PM	24 hours	CO, SO_2, NO_2, TSP, PM10, PM2.5, NPL
Point 2 (Center of Project Site)	0735256 3339392	4:00 PM	4:00 PM	24 hours	CO, SO_2, NO_2, TSP, PM10, PM2.5, NPL
Point 3 (South of Project Site)	0734954 3335326	5:00 PM	5:00 PM	24 hours	CO, SO_2, NO_2, TSP, PM10, PM2.5, NPL
Nearby Receptors					
At Al-Rajef Village North	0736286 3343179	2:15 PM 6:00 PM	3:15 PM 7:00 PM	1 hour daytime + 1 hour nighttime	NPL
At Al-Rajef Village South	0735099 3341890	2:30 PM 6:20 PM	3:30 PM 7:20 PM	1 hour daytime + 1 hour nighttime	NPL
At Dlaghah and Rassees North	0732935 3336478	3:45 PM 6:10 PM	4:45 PM 7:10 PM	1 hour daytime + 1 hour nighttime	NPL
At Dlaghah and Rassees South	0733190 3335068	3:40 PM 6:00 PM	4:40 PM 7:00 PM	1 hour daytime + 1 hour nighttime	NPL
At Fardakh	0741217 3342389	12:00 PM 7:00 PM	1:00 PM 8:00 PM	1 hour daytime + 1 hour nighttime	NPL
At Sadaqah	0740017 3339400	3:40 PM 6:00 PM	4:40 PM 7:00 PM	1 hour daytime + 1 hour nighttime	NPL

(ii) Selection of Locations

Proper selection of monitoring sites is crucial as an inappropriate location may result in data that may not meet the objectives of monitoring and could be of limited value. Several factors need to be taken into account when selecting the sites to include the objectives of monitoring, size of the area to be covered, variability of pollutant concentration over the area to be covered, pollutants to be monitored and possible sources of pollutants. The following was considered for site selection:

- Three (3) sites within the Project area were considered in order to represent the Project area to the greatest extent possible (north, center and south).
- Six (6) sites were considered within the nearby surrounding receptors (i.e. the villages surrounding the Project site which are likely to be impacted from the Project development to include Al-Rajef, Dlaghah and Rassees, Fardakh and Sadaqah). Such location were selected after taking into account proximity to the Project and relative area of the receptor affected; to this extent 2 monitoring points were selected at Al-Rajef village (north and south), 2 points at Dlaghah and Rassees (north and south), 1 point at Fardakh, and 1 point at Sadaqah.
- All points selected were considered representative areas where concentrations of selected air quality parameters and noise are expected to reflect the real concentrations of various pollutants.
- Logistical issues such as the particular method of instrument used for sampling, resources available, physical access and security against loss and tampering were also taken into account.
- The monitoring instruments were located in such a place where free flow of air is available and taking into account the direction of prevalent wind and topography of the site.
- Air sampling points of intake were located at a height of 1.2 meter above ground level, whereas noise measurements were performed at about 1.5 meter above ground level.

The location of the monitoring points is presented in Figure 54 below.

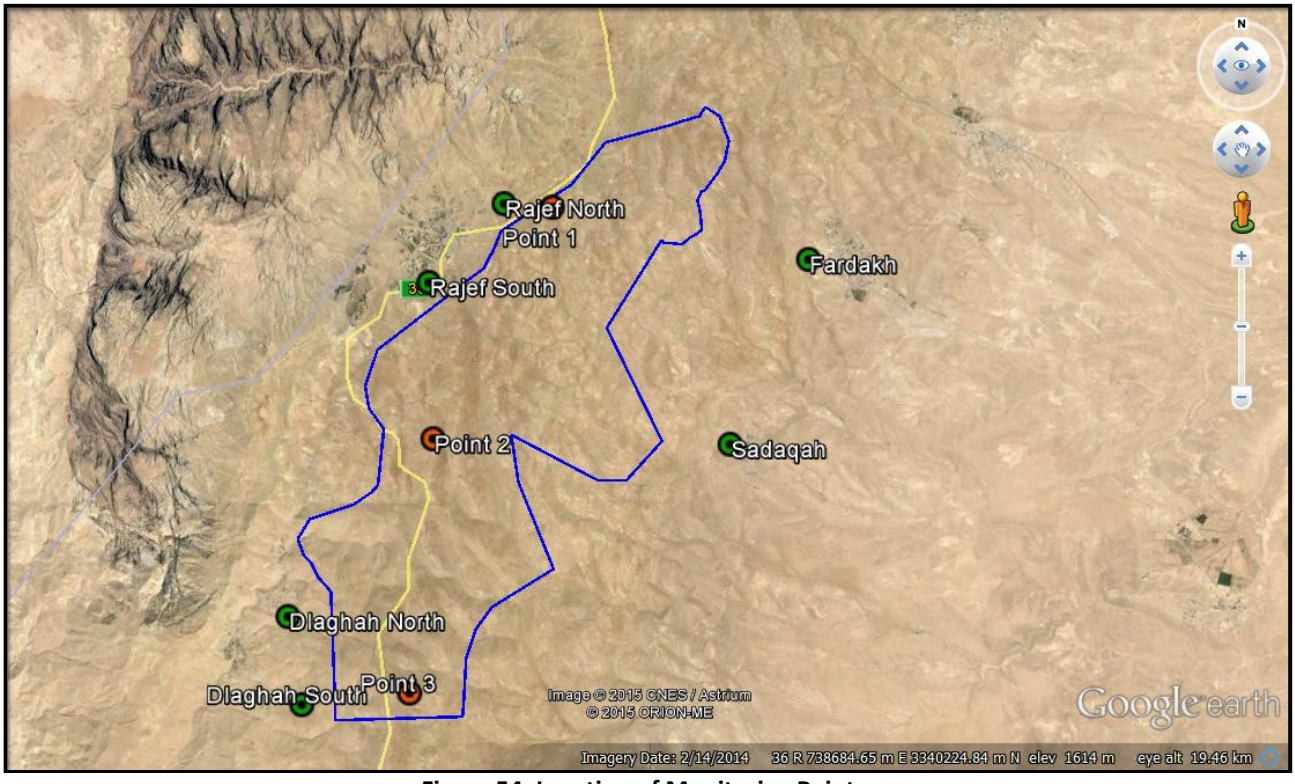

Figure 54: Location of Monitoring Points

(iii) Legislative Requirements

Results of the monitoring conducted were compared against the relevant legislations in Jordan that govern the subject matter to include the following:

- Air quality results were compared against the Ambient Air Quality Jordanian Standard (JS) 1140/2006. This standard specifies the maximum allowable limits of pollutant concentration in ambient air. The standard also presents guidelines and methods that have to be followed when conducting monitoring for ambient air quality.
- Instruction for Reduction and Prevention of Noise for 2003. This instruction is issued by the Ministry of Environment and specifies the maximum allowable limits of noise levels within various areas to include cities, suburbs, villages, industrial areas and other.

15.1.2 Results

This section presents the results of the monitoring conducted at each monitoring site for both: (i) the Project site and (ii) nearby surrounding receptors.

Table 35 below presents a summary of the results for the monitoring conducted at each of the monitoring points. The table presents the average, maximum, and minimum values recorded, and the maximum allowable limits for air pollutants as stipulated within the JS 1140/2006 and the maximum allowable limits for noise levels as stipulated within the Jordanian Instruction for Reduction and Prevention of Noise of 2003.

To avoid confusion in reading the air quality results in the table below, it must be noted that the average daily concentration (summation of all concentrations at each hour divided by 24) for a pollutant is equivalent to the 24-hour concentration. When comparing results with the Jordanian Standard, the hourly concentration must be compared (that is the results at every hour) with the maximum allowable hourly limits, and the 24-hour concentration (or average daily concentration) with the 24-hour maximum allowable limits. With regards to noise levels, the Instruction specifies a maximum allowable limit for the day average (7:00 am till 6:00 pm) and night average (from 7:00 pm till 6:00 am), and this is calculated by summing all recorded levels at each hour for the day and night respectively and dividing it by 12 hours. Results are then compared with the maximum allowable limits for rural areas (which best represents the Project Site) and which require a level of 50dBA during day and 40dBA during night.

Overall, the results for air quality monitoring are all well within the limits specified within the JS 1140/2006, where none of the monitored parameters exceeded any of the maximum allowable limits.

With regards to the gases, recorded concentrations at all sites of CO, SO_2 and NO_2 were within, and even significantly lower, than the maximum allowable hourly and 24-hour limits specified within the JS 1140/2006. With regards to the suspended particulate matter which includes TSP, PM10 and PM 2.5, there are no hourly concentrations specified within the Jordanian Standard but only 24-hour maximum allowable concentrations. Recorded 24-hour concentrations at all sites where within the 24-hour limit specified within the JS 1140/2006.

Finally, with regards to noise, all daytime average noise levels at all sites are within the limits specified within the Instruction; however during nighttime values recorded at several points were slightly above the allowed limits – this includes Project Site North and Center, Dlaghah and Rassees North and South.

Table 35: Summary of Monitoring Results

Location	Parameters Measured							
	Gases (ppm)			Dust (µg/m3)			Noise (dBA)	
	CO	SO_2	NO_2	TSP	PM10	PM2.5	Day	Night
Project Site North								
Average (24h)	0.36; 0.41; 0.33*	2.8×10^{-3}	5.7×10^{-3}	186	91	18	47**	41**
Max (hourly)	0.43	4.4×10^{-3}	12.5×10^{-3}	325	153	31	52	45
Min (hourly)	0.29	2.3×10^{-3}	2.5×10^{-3}	98	32	6	38	32
Project Site Center								
Average (24h)	0.33; 0.36; 0.35*	2.7×10^{-3}	5.1×10^{-3}	101	36	9	48**	41**
Max (hourly)	0.44	3.0×10^{-3}	10.8×10^{-3}	126	49	15	61	51
Min (hourly)	0.30	2.4×10^{-3}	3.2×10^{-3}	81	16	6	38	33
Project Site South								
Average (24h)	0.46; 0.49; 0.38*	2.9×10^{-3}	7.3×10^{-3}	70	33	16	41**	39**
Max (hourly)	0.52	4.7×10^{-3}	11.7×10^{-3}	113	60	24	50	46
Min (hourly)	0.35	2.5×10^{-3}	3.4×10^{-3}	53	19	8	34	33
Al-Rajef Village North								
Average (1h)	-	-	-	-	-	-	38**	33**
Max (per 3s)	-	-	-	-	-	-	57	47
Min (per 3s)	-	-	-	-	-	-	32	30
Al-Rajef Village South								
Average (1h)	-	-	-	-	-	-	36	35
Max (per 3s)	-	-	-	-	-	-	56	49
Min (per 3s)	-	-	-	-	-	-	31	31
Dlaghah and Rassees North								
Average (1h)	-	-	-	-	-	-	44**	41**
Max (per 3s)	-	-	-	-	-	-	66	57
Min (per 3s)	-	-	-	-	-	-	30	30
Dlaghah and Rassees South								
Average (1h)	-	-	-	-	-	-	46**	43**
Max (per 3s)	-	-	-	-	-	-	65	57
Min (per 3s)	-	-	-	-	-	-	34	31
Fardakh								
Average (1h)	-	-	-	-	-	-	40**	38**
Max (per 3s)	-	-	-	-	-	-	57	54
Min (per 3s)	-	-	-	-	-	-	31	30
Sadaqah								
Average (1h)	-	-	-	-	-	-	39**	38**
Max (per 3s)							54	51
Min (per 3s)							31	31
JS 1140/2006 Limits								
Hourly	**26ppm**	**0.3ppm**	**0.21ppm**	**No value**	**No value**	**No value**	**N/A**	
24-hour	**9 ppm***	**0.14 ppm**	**0.08 ppm**	**260 µg/m3**	**120 µg/m3**	**65 µg/m3**		
Instruction on Reduction and Prevention of Noise for 2003								
Rural (dBA)	**N/A**						**50 day**	**40 night**

*Based on 8-hours as required by JS 1140/2006

**Daytime is from 7:00 am till 6:00 pm and nighttime is from 7:00 pm till 6:00 am

(i) Gases - Carbon Monoxide (CO), Sulfur Dioxide (SO_2), and Nitrogen Dioxide (NO_2)

The results for each of the gaseous pollutants are summarized below. Generally, results were consistent and similar at all sites with no significant variations recorded. Results are significantly lower to maximum allowable limits stipulated within JS 1140/2006 as detailed below:

- *Carbon Monoxide*. When hourly results are compared to the JS 1140/2006, the results are significantly lower to the maximum allowable hourly concentration value of 26ppm – where the highest recorded value of 0.52ppm represents only 2% of the value stipulated within the JS 1140/2006 only; whereas the highest recorded average 8-hour concentration of 0.49ppm represents only 5% of the maximum allowable limit stipulated within the JS 1140/2006 of 9ppm.
- *Sulfur Dioxide*. When hourly results are compared to the JS 1140/2006, the results are significantly lower to the maximum allowable hourly concentration value of 0.3ppm – where the highest recorded value of 0.0047ppm represents around 2% of the value stipulated within the JS 1140/2006 only; whereas the highest recorded average daily concentration of 0.0029ppm represents around 2% of the maximum allowable limit stipulated within the JS 1140/2006 of 0.14ppm.
- *Nitrogen Dioxide*. When hourly results are compared to the JS 1140/2006, the results are significantly lower to the maximum allowable hourly concentration value of 0.21ppm – where the highest recorded value of 0.0125ppm represents around 6% of the value stipulated within the JS 1140/2006 only; whereas the highest recorded average daily concentration of 0.0073ppm represents around 9% of the maximum allowable limit stipulated within the JS 1140/2006 of 0.08ppm.

The low concentration of the above gaseous pollutants is attributed to the characteristics of the site being in a relatively remote area; no point sources of emissions within the site or the surrounding area were noticed and no off-road vehicular movement was recorded onsite throughout the monitoring period which could especially affect results at monitoring sites.

The main source of all of the above gaseous pollutant emissions is attributed to their natural formation and/or represent their trace values in the atmosphere. The results indicate rather very low concentrations especially when compared to the maximum allowable hourly and 24-hour concentrations within JS 1140/2006.

(ii) Suspended Particulate Matter - TSP, PM10, and PM 2.5

As presented in Table 35 at all sites the average daily concentrations of all three parameters were within the maximum allowable limits stipulated within the JS 1140/2006 of 260µg/m^3, 120µg/m^3 and 65µg/m^3 respectively. It must be noted that the JS 1140/2006 has no limits for maximum allowable hourly concentrations.

Throughout the monitoring period no point sources of emissions within the site or the surrounding areas were noticed and no off-road vehicular movement was recorded onsite (which can be an important contributor to suspended particulates).

Thus, the main source of suspended particulates (to include TSP, PM10 and PM2.5) can be attributed to the natural characteristics of the site (being an arid area) and related to dust blown by wind, especially when wind speed exceeds 5m/s.

Results indicate rather variable concentrations of suspended particulate (TSP, PM10 and PM2.5) at all sites and at different times of the day, with generally higher recorded values at the northern site. As stated earlier the main source of suspended particulate matter is dust blown by wind which affects TSP, PM10 and PM2.5. Such variations are explained by variations in wind speed and direction which is highly correlated to recorded values. Instances with higher wind speeds that can disturb the dust tend to record higher values when compared to instances with stable or clam wind. Therefore, wind speed is an important factor in determining concentration of suspended particulate matter in the Project site.

(iii) Noise Pressure Level

In addition, presented in Table 35 above, are the average noise levels during the day and night within the Project site as well as the nearby receptors to the Project site – i.e. the villages of Al-Rajef, Dlaghah & Rassees, Fardakh, and Sadaqah.

The results of the monitoring were compared to the maximum allowable limits stipulated within the Instruction for Reduction and Prevention of Noise for 2003 which specifies a maximum allowable limit in Rural Areas of 50dBA during daytime and 40dBA during nighttime. As noted, during daytime all average noise levels at all sites are within the limits specified within the Instruction; however during nighttime values recorded at several sites are slightly above the allowed limits. This includes the following receptors: (i) Project Site North, (ii) Project Site Center, (iii) Dlaghah and Rassees North, (iv) Dlaghah and Rassees South.

Nevertheless, it is important to note that the results are typical for inhabited rural areas, and no major source of noise generation or pollution was noticed or recorded at any of the monitoring sites. The main source of noise emissions can be attributed to the following:

- Wind speed exceeding 5m/s can significantly affect baseline noise levels; such conditions were noticed rather frequently throughout the monitoring duration. This factor affects established noise levels within the site and can vary from one hour to the next and from day to day and could explain the variation in results obtained.
- Specifically at the villages monitoring points, other factors which could have affected the results include singular events like wind gusts (as discussed above), vehicular activity on the main roads (which was limited) as well as sounds from people or animals passing by.

15.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on air quality and noise during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

15.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, leveling, excavation, grading, etc.

Although such activities are limited to the relatively small individual footprints of these facilities and the actual area of disturbance is relatively minimal. Nevertheless, such activities will likely result in an increased level of dust and particulate matter emissions, which in turn will directly and temporarily impact ambient air quality. If improperly managed, there is a risk of nuisance and health effects to construction workers onsite and to a lesser extent to the nearby surrounding receptors from windblown dust (such as the residents of the village). In addition, construction activities will likely entail the use of vehicles, machinery and equipment (such as generators, compressors, etc.) which are expected to be a source of other pollutant emissions (such as SO_2, NO_2, CO, etc.) which would also have minimal direct impacts on ambient air quality.

In addition, all the above activities will likely include the use of machinery and equipment such as generators, hammers, compressors, etc. and which are expected to be a source of noise and vibration

generation within the Project site and its surroundings. If improperly managed, there is risk of nuisance and health affects to construction workers onsite and to a lesser extent to the nearby surrounding receptors (such as the village or the Reserve).

The above impacts are anticipated to be temporary and of short-term nature as they are limited to the construction period only. Such impacts are of a negative nature, and will be noticeable and therefore of medium magnitude. However, the impacts will be dispersed and are reversible as air quality would revert back to baseline conditions after construction works is completed and thus the receiving environment is considered of low sensitivity. Given the above such an impact is considered of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor during the construction phase:

- Based on inspections and visual monitoring undertaken, if dust or pollutant emissions were found to be excessive due to construction activities, the source of such emissions should be identified and adequate control measures must be implemented;
- Comply with the Occupational Safety and Health Administration (OSHA) requirements and the Jordanian Codes to ensure that for activities associated with high dust and noise levels, workers are equipped with proper Personal Protective Equipment (e.g. masks, eye goggles, breathing masks, ear muffs, etc.);
- Apply basic dust control and suppression measures which could include:
  - Regular watering of roads for dust suppression;
  - Proper planning of dust causing activities to take place simultaneously in order to reduce the dust incidents over the construction period.
  - Proper management of stockpiles and excavated material (e.g. watering, containment, covering, bundling).
  - Proper covering of trucks transporting aggregates and fine materials (e.g. through the use of tarpaulin).
  - Adhering to a speed limit of 15km/h for trucks on the construction site.
- Develop a regular inspection and scheduled maintenance program for vehicles, machinery, and equipment to be used throughout the construction phase for early detection of issue to avoid unnecessary pollutant emissions.
- Based on inspections and visual monitoring undertaken, if noise levels were found to be excessive from construction activities, the source of such excessive noise levels should be identified and adequate control measures must be implemented; and
- Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- Inspection and visual monitoring of the works should be carried out at all times. In addition, periodic inspections should be conducted at nearby sites (e.g. Al-Rajef road/village) to determine whether harmful levels of dust and noise from construction activities exist; and
- Reporting of any excessive levels of pollutants/dust or noise and the measures taken to minimize the impact and prevent it from occurring again.

15.2.2 Potential Impacts during the Operation Phase

The main foreseen impacts during the operation phase is that related to the noise generated from the operating wind turbines and its potential impact on the health and safety of the nearby surrounding receptors – such as the villages of Al-Rajef, Dlaghah & Rassees, Fardakh and Sadaqah. Given that they related to community health, safety and security, such impacts have been discussed in details in "Chapter 18 - Community Health, Safety and Security" along with other relevant impacts such as shadow flicker.

16. INFRASTRUCUTRE AND UTILITIES

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to infrastructure and utilities and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

16.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to infrastructure and utilities as well as the outcomes and results.

The components discussed in relation to infrastructure and utilities include the following: (i) water resources; (ii) wastewater services; (iii) solid waste services; (iv) hazardous waste services; (v) road networks;(vi) aviation, telecommunication and television & radio link; and (vi) electricity networks, each of which is discussed separately below.

16.1.1 Baseline Assessment Methodology

The baseline assessment was based on collection of secondary data and plans available as well as discussions and consultations mainly with representatives from various governmental authorities and utility service providers as discussed in details throughout this section.

16.1.2 Water Resources

The water sector in Jordan is governed by the Ministry of Water and Irrigation (MWI), the Water Authority of Jordan (WAJ), and the Jordan Valley Authority (JVA). MWI is the official body responsible for the overall monitoring of the water sector, water supply and wastewater system, and the formulation of national water strategies and policies. Whereas JVA is responsible for the socio-economic development of the Jordan Rift Valley, including water development and distribution for irrigation.

WAJ assumes all responsibilities related to water and wastewater structures including design, construction, operation, maintenance and administration. Within Petra District, the Petra and Wadi Mousa Water Directorate is the responsible entity representing WAJ.

According to the "Ma'an Water and Wastewater Master Plan" (CDM, 2013), ten water systems supply water to the various localities within Ma'an Governorate, which are summarized in Table 36 below. The systems vary significantly in size, with the population served ranging from 300 people to 38,000 people.

Table 36: Water Supply Systems in Ma'an Governorate

Water Supply System	Water Sources			Water Tanks		Pump Stations			Pipe Length km	Per Capita Supply lpcd
	Wells No.	Capacity m^3/hr	Pumpage MCM/yr	No.	Capacity m^3	Stations No.	Pumps No.	Capacity m3/hr		
Ma'an City	14	690	3.421	4	7,250	2	5	1,000	142	283
Wadi Mousa	***13***	***590***	***2.513***	***6***	***15,300***	***4***	***12***	***2,804***	***199***	***181***
Shobak	7	380	0.789	4	1,120	3	10	925	79	157
Al-Manshiyya	2	90	0.242	1	100	1	2	80	20	155
Wahida	2	75	0.488	1	50	0	0	0	1.4	2,160
Al-Muraygha	2	50	0.362	2	520	1	3	400	38	121
Al -Muhamadiyya	2	50	0.037	1	300	1	2	430	8	335
Al -Husayniyya	3	190	0.680	3	220	1	1	50	26	180

Al -Jafr	2	130	0.584	1	500	1	3	172	5	237
Al -Mudawwara	1	50	0.123	1	200	0	0	0	21	202
Total	**48**	**2,295**	**9.239**	**24**	**25,560**	**14**	**38**	**5,861**	**540**	**216**

All the water supply comes from wells, which typically pump into water tanks, from which water is pumped to other water tanks or directly to customers. Some customers receive water by gravity flow from water tanks, while others receive water directly from pump stations. Ma'an Governorate has the highest level of Non-Revenue Water (NRW) in Jordan, amounting to 55% of the water pumped from wells in 2009. Within the Governorate, the average per capita supply is 216 lpcd (liters/capita/day), far in excess of the MWI consumption allowance of 100 lpcd for urban areas.

Water is rationed to customers in accordance with a weekly schedule. Some customers receive water continuously, while others receive water two or three days each week. The pumpage from wells varies significantly by season, at half the annual rate in winter and 50% higher than the annual rate in summer.

All villages within Project area (to include Al-Rajef, Dlaghah & Rassees, Fardakh, and Sadaqah) are located within the Wadi Mousa water supply system which consists of 13 wells located within 3 well fields (Jathah, Al-Qa', and Athroh field). The wells collectively have a capacity of 590m^3/hr with a pumpage of 2.5 MCM/yr. The wells are generally very deep, ranging between 103m and 259 m and averaging about 140 m in depth. Table 37 below summarizes the characteristics of the water supply wells part of the Wadi Mousa system.

Table 37: Characteristics of Water Supply Wells of Wadi Mousa System

Groundwater Well	Pumpage Annual (MCM/yr)	Monthly Variation (m^3/d)			Pump Capacity (m^3/hr)	Well Depth (m)
		Avg	Max	Min		
Jathah Field						
Jathah Well 1	0.237	650	1,076	378	50	118
Jathah Well 2	0.260	712	1,162	244	20	144
Jathah Well 3	0.455	1,248	1,764	468	50	103
Jathah Well 4	0.470	1,288	1,951	465	50	126
Jathah Well 5	0.191	522	674	76	50	170
Jathah Well 6	0.095	259	362	3	50	165
Subtotal	*1.708*	*4,679*	*6,356*	*2,272*	*270*	
Al-Qa' Field						
Al-Qa' Well 1	0.017	46	254	0	25	151
Al-Qa' Well 2	0.072	198	282	56	25	111
Al-Qa' Well 3	0.127	349	919	209	15-25	200
Al-Qa' Well 4	0.204	559	971	0	50	158
Al-Qa' Well 5	0.075	206	235	140	100	112
Al-Qa' Well 6	0.000	0	0	0	50	
Subtotal	*0.496*	*1,358*	*2,324*	*774*	*270*	
Adhruh Field						
Adhruh Well 7	0.301	848	902	691	50	259
Total	***2.513***	***6,886***	***4,105***	***590***		

The system is supplemented by 6 water tanks with a total capacity of 15,300m^3 (capacity ranges between 300m^3 and 4,500m^3) and 4 pump stations collectively consisting of 12 pumps with a capacity of 2,804m^3/hr. The total pipe length is 199km and the per capital supply 181 liter per capita per day, slightly lower than the Governorate average.

The Jathah, Al-Qa' and Athroh well fields pump to tanks, where Al-Qa' and Jathah Tank function as storage tanks at the wells transmission system while the rest of the tanks act as storage tanks in the distribution system. Table 38 below summarizes the characteristics of the water tanks and pumps part of the Wadi Mousa system.

Table 38: Characteristics of the Tanks and Pumps of Wadi Mousa System

Tank	Capacity (m^3)	Pump Characteristics	
		No. of Pumps	Flow (m^3/hr)
Wadi Mousa New Tank	3,000	0	0
Wadi Mousa Old Tank	300	1	20
Al-Qa' Tank	4,500	5	288;288;288;150;150
Al-Taybeh Tank	2,000	0	0
Ail Tank	4,500	3	180;180;180
Jathah Tank	1,000	3	360;360;360
Total	***15,300***	***12***	***2,804***

The figure below presents the Wadi Mousa Water Supply system in relation to the Project site. The figure presents the water network and the water wells. As noted in the figure, the water network is around 150m from the leased land areas within the Project site near Al-Rajef, and is around 25m from the leased land areas near Dlaghah & Rassees – this distance is measured aerially and does not take into account topographical distances.

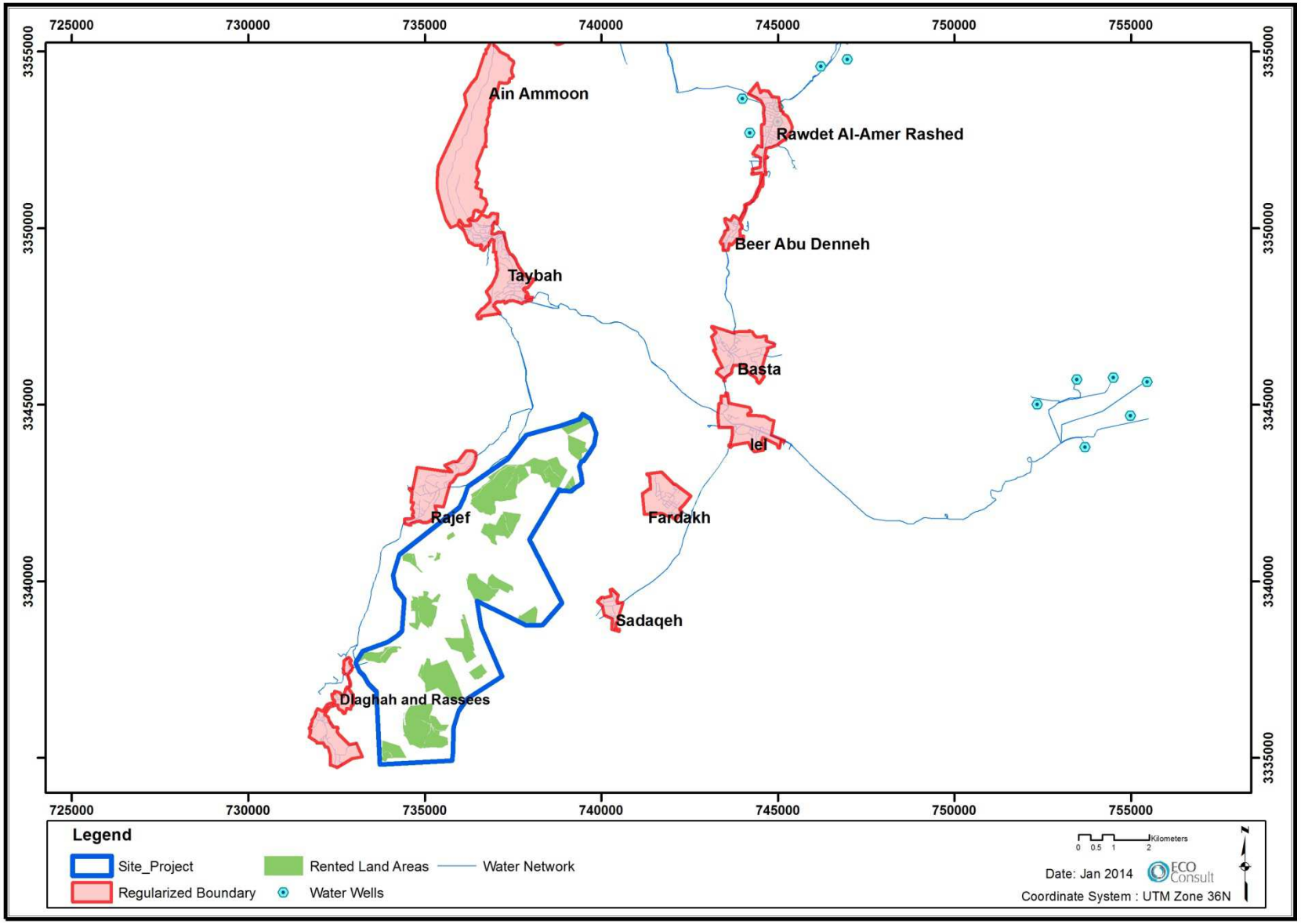

Figure 55: Wadi Mousa Water Supply System

16.1.3 Wastewater Services

The same entities that govern the water sector are responsible for the wastewater as well. MWI is the official body responsible for the overall monitoring of the water sector, water supply and wastewater system, and the formulation of national water strategies and policies. WAJ assumes all responsibilities related to wastewater structures, and within Petra District, Petra and Wadi Mousa Water Directorate is the responsible entity representing WAJ.

Ma'an City and Wadi Mousa have the only wastewater collection and treatment systems within Ma'an Governorate. The Wadi Mousa wastewater network serves the Petra hotel industry and several surrounding communities which include At-Taybeh, Al-Baida and Bdoul. The system also includes a wastewater treatment plant which serves those communities - Wadi Mousa WWTP. The WWTP was constructed in 2003 with a design capacity of 3,400 m^3/day. The major process units include oxidation ditch reactors, final clarifiers, polishing ponds and sludge drying beds. The WWTP currently receives around 2,640 m^3/day and serves around 85% of the population as well as the Petra tourism trade. The WWTP is relatively new and in good conditions.

The Ma'an wastewater network serves around 75% of the population of Ma'an city and also includes a WWTP – Ma'an WWTP. Waste stabilization ponds were constructed to provide wastewater treatment in 1988, and in 2008 the ponds were replaced by an extended aeration activated sludge plant. The major process units include an equalization tank, aeration tanks, settling tanks, polishing lagoons, and sludge drying beds. The WWTP has a design capacity of 5,772m^3/day and currently receives around 2,260 m^3/day. The WWTP is relatively new and in good conditions.

Figure 56 below presents the location of both WWTPs (Wadi Mousa and Ma'an) in relation to the Project site. The Wadi Mousa WWTP is located 25km to the north of the Project site while Ma'an WWTP is also located 25km to the east of the Project site.

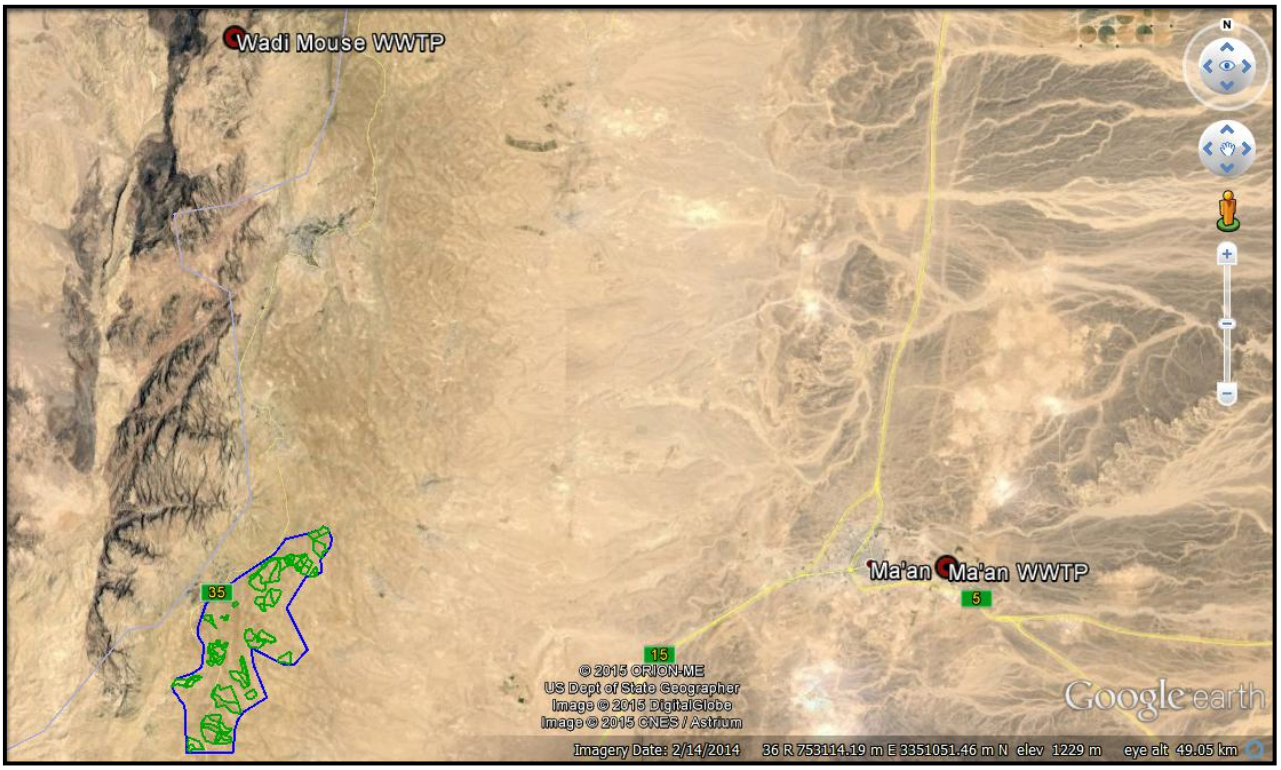

Figure 56: Location of WWTP in relation to Project Site

16.1.4 Solid Waste Services

In Jordan, solid waste management is undertaken primarily by the public sector. Solid waste is managed through the operation of landfills (or dumpsites). In accordance with the "Municipalities Law Mo.13 of 2007", solid waste management is the responsibility of local municipalities under the umbrella of the Ministry of Municipal Affairs (MoMA) – this includes the collection of municipal solid waste, transportation, and final disposal to landfills.

Within the Project area, the PDTRA is the responsible entity for collection and transportation of solid waste within the PDTRA area for final disposal – (which includes the nearby villages from the Project site such as Al-Rajef). There is only one authorized landfill which can be utilized for disposal of solid waste by the PDTRA – known as Al-Basta Landfill.

This landfill is located around 10km to the east of the Project site. According to discussions with PDTRA, the landfill has an area of approximately 300 Dunums and receives around 30 tons of solid waste per day – the majority of which is from the PDTRA. Solid waste is disposed in trenches after which the trench is covered with soil. There are is no specific number on the total capacity which the landfill can handle, however it is expected to remain operational till the year 2040.

In addition, according to discussions with PDTRA, there is also only one authorized landfill for disposal of construction debris – known as Shobit Al Dabe construction waste landfill. The landfill is located around 20 km from the Project site to the north east. According to discussion with PDTRA, the landfill has an area of around 6dunums and has sufficient capacity to handle construction debris.

16.1.5 Hazardous Waste Services

In accordance with the "Environmental Protection Law No.(52) of the year 2006" and the "Instruction for Management and Handling of Hazardous Waste of 2003", hazardous waste must be transported and disposed at landfills which are approved by the MoEnv.

In Jordan, there is currently one landfill for disposal of hazardous waste – the Swaqa Hazardous Waste Treatment Facility. The facility is located in Al-Karak Governorate, around 70km south of the capital city of Amman and 130km to the north of the Project site. The facility is operated and managed by the MoEnv.

According to discussion with the '"Hazardous Substances and Waste Management Directorate" of the MoEnv, the facility is located on an area of around 8,500 Dunums and receives around 8-10 tons per day of hazardous waste. Currently disposal of hazardous waste is undertaken through either land-filling of stabilized and inert hazardous waste in specially lined cells, while for other types of waste which require physical-chemical treatment or incineration they are stored in safe storage spaces. Such storage spaces are temporarily until the second phase of the facility construction is implemented.

The second phase mainly involves physical-chemical treatment and incineration facilities which mainly aim to improve handling and management of hazardous waste which requires treatment or incineration. Construction is expected to be completed by 2016.

In addition, there is currently a pilot project for disposal and management of electronic waste at Swaqa. Electronic waste is currently collected and stored at the landfill, and there are plans for collaborating with private entities for implementing recycling programs for such electronic waste streams.

Currently, there are no additional plans by the MoEnv for hazardous waste management in Jordan.

16.1.6 Road Networks

The Ministry of Public Works and Housing (MPWH), operating under the "Regulation of Organization and Management of the MPWH No. 55 of 1996", is the governmental authority responsible for the construction and development of the public road network in Jordan. The Ministry is also responsible for connecting cities, villages, and communities together in addition to maintaining the network in good technical conditions. Within the Petra District, the Petra Public Works Directorate assumes the responsibilities of the MPWH.

The Project site could be accessed from Highway #15 (better known as the 'Desert Highway') which is the major route in Jordan and connects the capital city of Amman with the southern Governorate of Jordan (Aqaba, Ma'an, Karak, Al-Tafileh). This highway is heavily travelled on a daily basis by large vehicles (trailers and trucks) transporting materials to/from the capital city of Amman and the Port of Aqaba (as well as other industrial establishments in the southern Governorates of Jordan). The Project site is located at about 100 km road distance from the Port of Aqaba northward.

Components for wind energy projects are usually transported by sea from the manufacturing country to the country of installation and are then loaded in existing ports to trucks which maneuver their way through existing roads to the installation site.

With regards to the Project, the wind turbine components will arrive to the Port of Aqaba in the south of Jordan. Figure 57 and Figure 58 below presents the transportation route from the Port of Aqaba to the Project site. The transport will follow Highway #15 a distance of around 85km after which a western highway (Highway #35 or better known as the 'King's Highway' which starts just south of the Project site and leads all the way north to capital city of Amman) connects from Highway #15 and leads directly to the Project site. Highway #35 is accessed from an exit on Highway #15 (the Petra and Wadi Mousa Exit; refer to Figure 59) and will run around 15km leading to the Project site.

From Highway #35, the Project area in general is currently serviced by 3 paved roads (each with a width of approximately 8m) and many other unpaved agricultural tracks which are used by the local community.

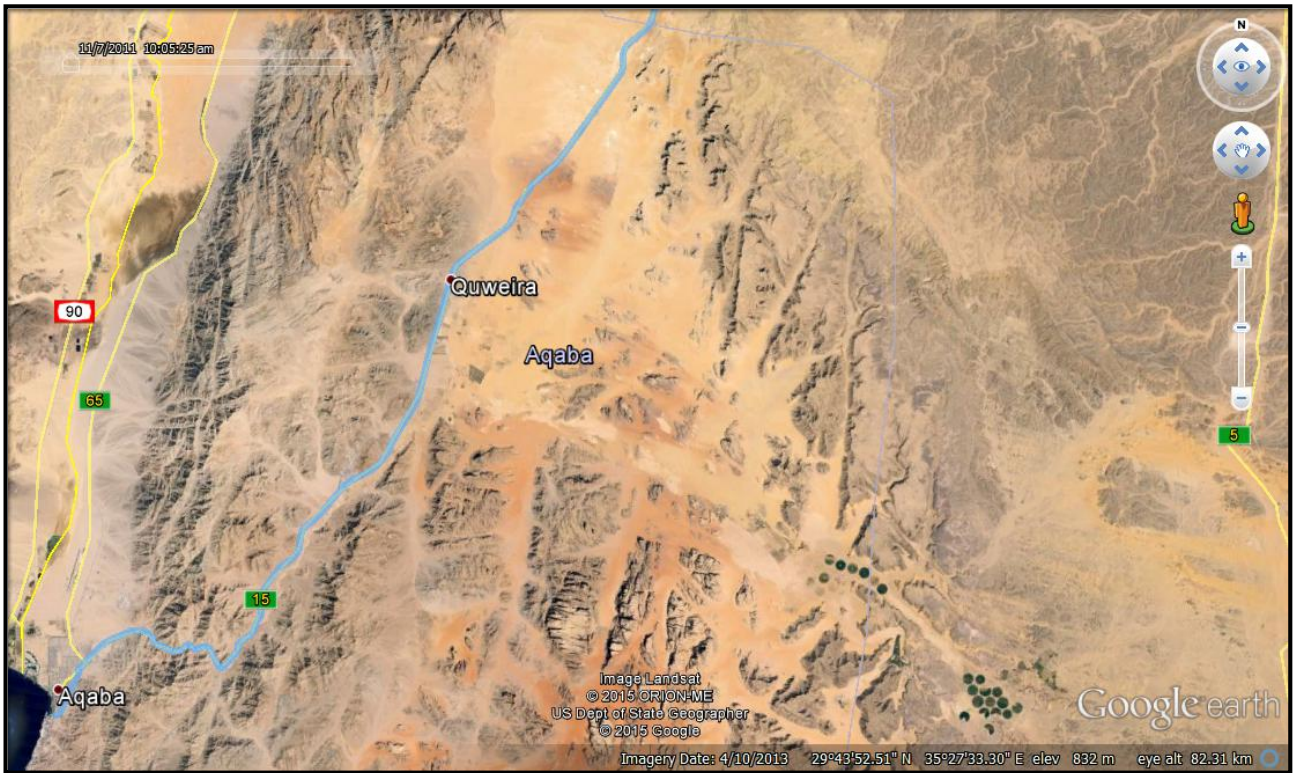

Figure 57: Southern Section of the Transportation Route

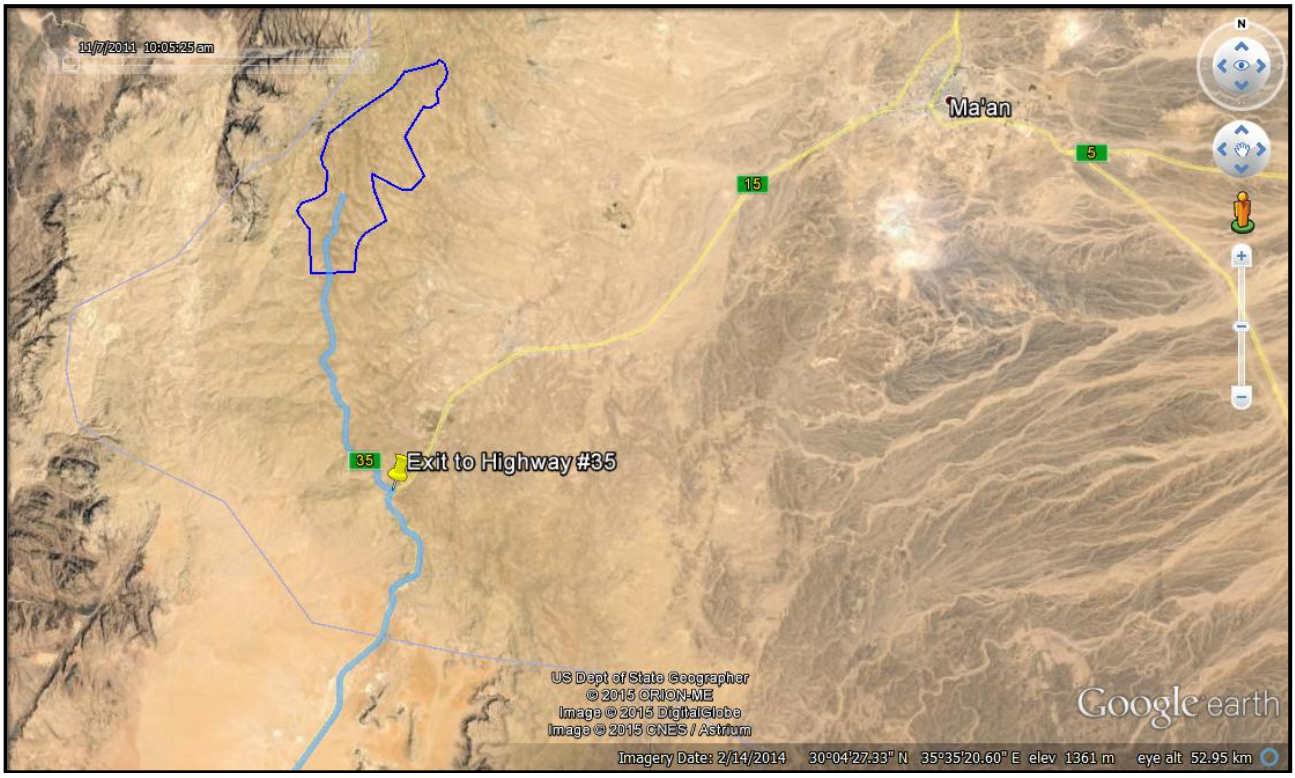

Figure 58: Northern Section of the Transportation Route

Figure 59: Exit to Highway #35 from Highway #15

16.1.7 Aviation, Telecommunication and Television & Radio Links

In order to understand what infrastructure related to aviation, telecommunication and television & radio within the Project area in general, official communications were established with the relevant governmental entities that govern the subject matter and which include the following:

- ***Civil Aviation Regulatory Commission (CARC)/ Royal Jordanian Air Force (RJAF):*** CARC is the official governmental authority responsible for the development of civil aviation safety and security and environmental regulatory compliance; whereas the RJAF is responsible for all military air bases in Jordan;
- ***Telecommunication Regulatory Commission (TRC):*** the TRC is the official entity for regulating the telecommunications and information technology services in the Kingdom to guarantee the provision of high-standard information and communications technology services to end users; and
- ***Jordan Radio and Television Corporation (JRTV)***: JRTV is the state broadcaster of Jordan for radio and television transmission.

Presented below are the infrastructure elements in the Project area in relation to aviation, telecommunication, and television and radio links respectively.

(i) Aviation (Civil and Military)

The closest civil airport in the area is the King Hussein International Airport located in Aqaba and around 70km southwest of the Project site as presented in the figure below. The other civil airport in Jordan is the Queen Alia International Airport located further north in Amman and around 180km from the Project site.

In addition, with regards to military air bases, in the south of Jordan there is only one military airport located within Ma'an Governorate at Al-Jafr area, known as King Feisal Airbase. This air base is located around 65km to the east of the Project site.

For security reasons, information on radars in the area was not provided neither by CARC nor RJAF.

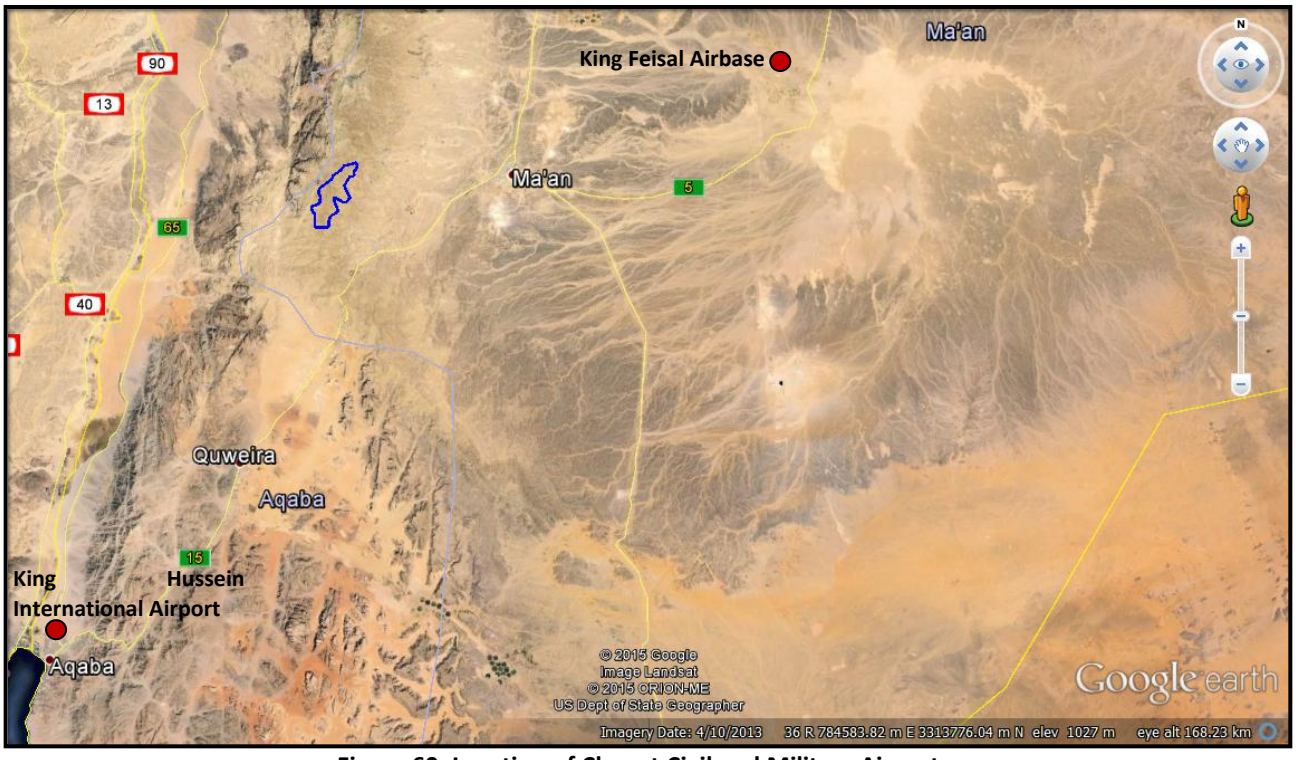

Figure 60: Location of Closest Civil and Military Airports

(ii) Telecommunication Links

Within the central parts of the Project site, and specifically within the leased lands for the Project, are broadcasting towers for all three (3) Jordanian telecommunication companies to include Zain, Orange, and Umniah. The location of these broadcasting towers is presented in Figure 61 below.

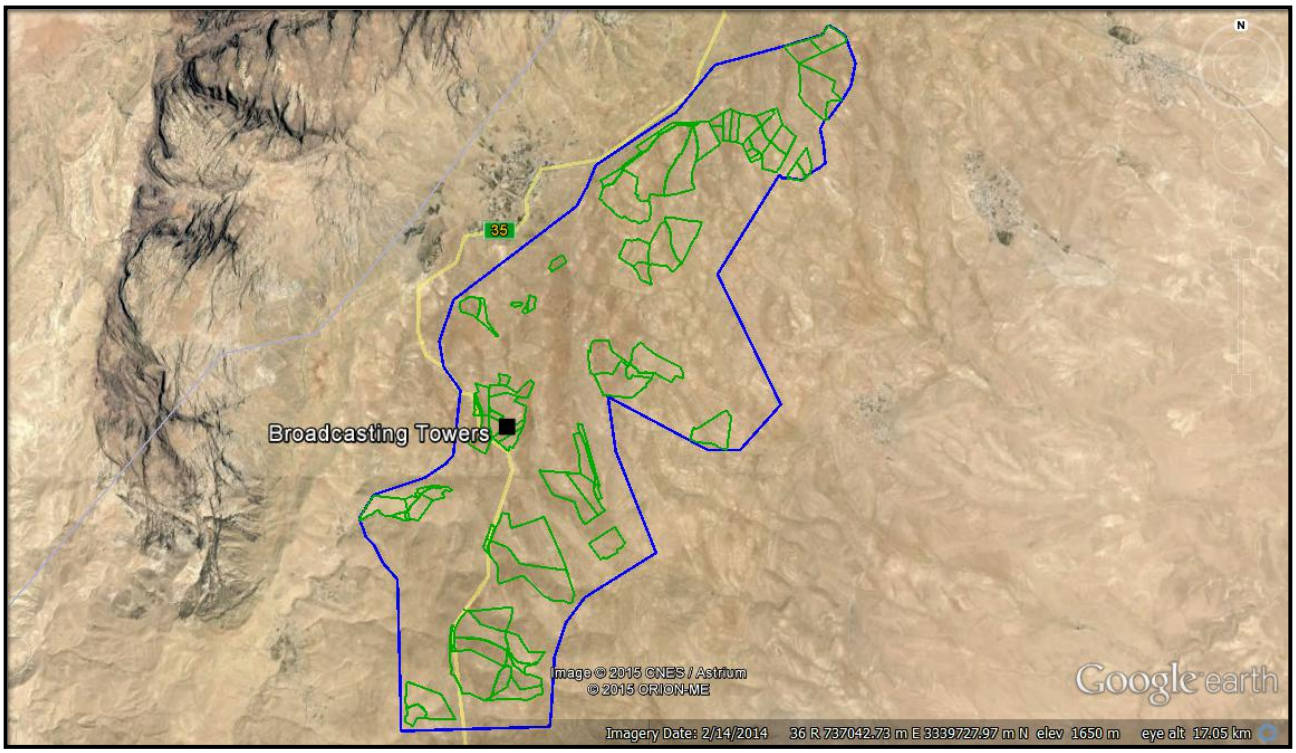

Figure 61: Location of Broadcasting Towers within the Project Site

(iii) Television and Radio Links

Based on official communications with JRTV, there are no television and radio broadcasting towers in the Project area or its surroundings.

16.1.8 Electricity Networks

The electricity structure in Jordan is compromised of the following stakeholders:

- Three generation companies, namely: the Central Electricity Generating Company (CEGCO), the Samra Electricity Power Generation Company (SEPGCO), and the Amman East Power Company (AES Jordan PSC).
- The National Electric Power Company (NEPCO) which is responsible for transmission of electricity through high voltage lines; and
- Three distribution companies responsible for distribution of electricity through medium and low voltage lines: the Jordanian Electric Power Company (JEPCO), the Irbid District Electricity Company (IDECO) and the Electricity Distribution Company (EDCO).

The electricity system is regulated by the Electricity Regulatory Commission (ERC), while the Ministry of Energy and Mineral Resources (MEMR) is responsible for political decisions.

The total generated electricity in Jordan in 2014 (latest statistic) was 18.7TWh (MEMR, 2015). Jordan transmits electricity through high voltage lines (400 and 132 kV) under the responsibility of NEPCO and

distributes electricity through medium and low voltage lines (33/11/4 kV) under the responsibility of the respective distribution companies mentioned above. There are about 2,200 circuit-km of transmission lines currently operated at 132 kV, which represents about 73% of the total networks, while 809 circuit-km of transmission lines are operated at 400 kV.

The Project will connect with the high voltage national grid (132kV) through an overhead high voltage transmission line which will be designed and built by NEPCO. Based on preliminary information from NEPCO it is likely that the transmission line will run a distance of 11km and connect at the Mregha area as shown in the figure below.

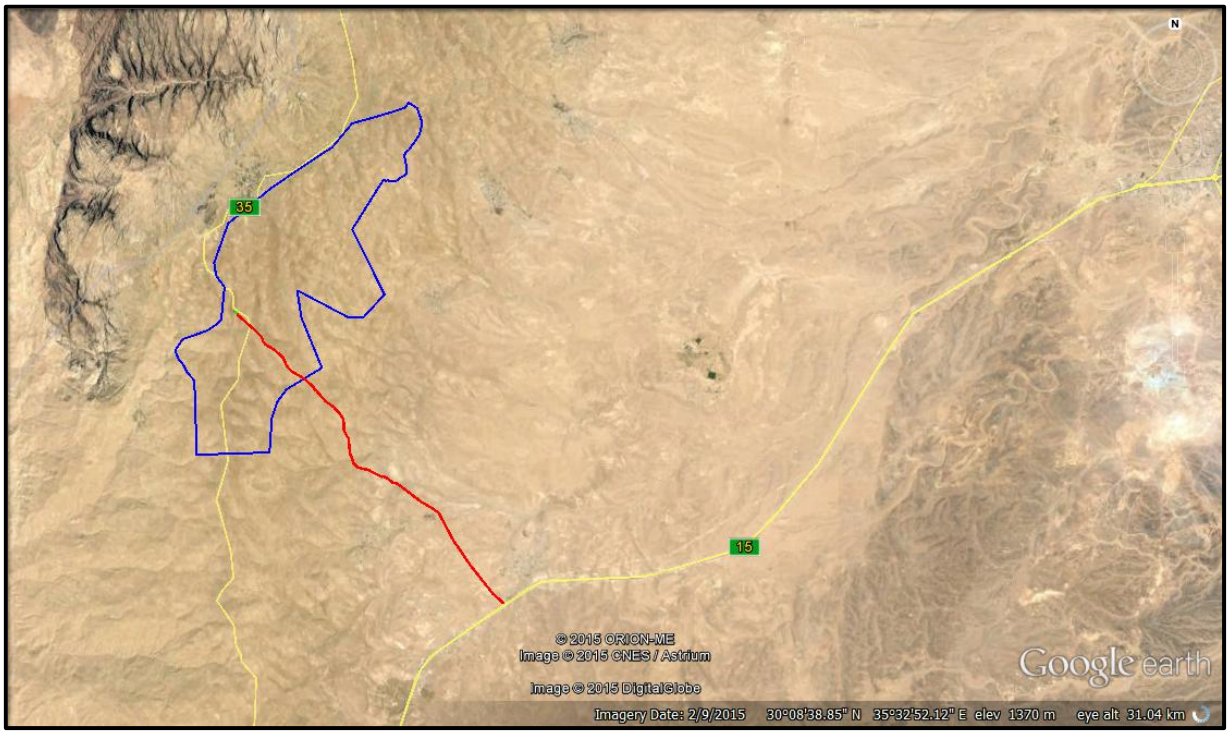

Figure 62: Preliminary Route for Overhead Line

16.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on infrastructure and utilities during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

16.2.1 Potential Impacts on Water Resources during the Construction and Operation Phase

It is expected that the Project throughout the construction and operation phase will require water for potable usage (drinking, personal cleaning, etc.) and non-potable usage (e.g. cleaning of turbines).

During the construction phase, the potable water requirements for around 200 workers onsite is not expected to exceed 50 liters per capita per day for a duration of 22 months. Thus, the daily water consumption is likely to be around 10,000 liters per day – or $10m^3$ per day. In addition, during the construction phase water for non-potable usage will be required which has been estimated to be around $164m^3$/ day. The table below presents the anticipated water requirements for the Project for non-potable use based on information provided by the EPC Contractor.

Table 39: Estimated Water Requirements of the Project for Non-Potable Use during the Operation Phase

Non-Potable Use	Estimated Quantity (m^3)
Cleaning of components and utilities	82
Dust control	5,000
Roads and platforms compacting	80,000
Concrete for Foundations	25,000
Total per construction period (22 months equivalent to round 670 days)	110,000
Total per day	165

Therefore, the total water requirements during the construction phase are likely to be around 175m^3/ day. The water requirements throughout the construction phase will be required temporary (for construction period only) and are considered minimal and not significant.

In addition, water will be required during the operation phase and mainly for drinking and other personal use of onsite staff (around 30 personnel). Similarly, potable water requirements for the onsite workers is not expected to exceed 50 liters per capita per day – thus a daily water consumption is likely to be around 1,500 liters per day – or 1.5m^3 per day.

During operation, water will also be required for the cleaning of the blades. According to information provided by the EPC Contractor, and based on previous experiences from Projects in areas of similar habitats, it is expected that the cleaning will take place once every 3 – 5 years, thus amounting to 4 – 6 times during the lifetime of the Project. The amount of water required per wash is 41m^3 (for all 41 turbines); thus the maximum amount of water required during the lifetime of the Project is around 250m^3 (assuming 6 washes are undertaken) – amounting to around 0.04m^3 per day.

Therefore, the total water consumption during operation is likely to be around 1.6m^3/day for a duration of 20 years.

Putting things into perspective, the total annual water supplied to the villages in the Project area by the Wadi Mousa water supply system (to include the villages of Al-Rajef, Dlaghah & Rassees, Fardakh, and Sadaqah) is 2.513 MCM. The annual water requirements of the Project during the construction phase is around 65,000m^3 per year representing less than 3% of the total water supply to the area, while the annual water requirements of the Project during the operation phase is around 580m^3 representing less than 0.03% of the total water supply to the area.

Comparing the numbers above clearly reveals that the water requirements of the Project are rather considered to be negligible and are expected to be easily met by the Petra and Wadi Mousa Water Directorate.

Taking all of the above into account, the anticipated impacts on the local water resources and utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operation phase. Such impacts are of a negative nature, and are expected to be of low magnitude and of low sensitivity given the minimal water requirements of the Project. To this extent, the impact is considered not significant.

To this extent, there are no mitigation measures to be applied. However, there are additional requirements that must be taken into account as detailed below.

Additional Requirements

The following identifies additional requirements to be taken into account by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Coordinate with the Petra and Wadi Mousa Water Directorate to secure the water requirements of the Project, which are considered to be minimal amounts.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and the Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.

16.2.2 Potential Impacts on Wastewater Disposal Utilities during the Construction and Operation Phase

The Project is expected to generate wastewater during both the construction and operation phases to include black water (sewage water from toilets and sanitation facilities) and grey water (from sinks, showers, etc.). Wastewater quantities generated are expected to be minimal and not significant at all during both phases of the Project and are likely to be easily handled by the WWTP (either Wadi Mousa or Ma'an WWTP, both of which have sufficient capacity).

Generally, the approximate estimated wastewater to be generated from the Project can accounted as follows. Throughout the construction phase, 200 construction workers are expected, whereas during the operation phase 30 workers are expected. The water requirements per capita during the construction and operation is not expected to exceed 50 liters per day; and taking into account an 80% wastewater generation factor per capita – then the anticipated wastewater to be generated during construction and operation is around 8,000 l/d and 1,200l/d (8m^3/d and 1.2m^3/d).

The wastewater generated will most likely be collected by tankers from the Project and disposed at the either Wadi Mousa or Ma'an WWTP; the first has a current design capacity of 3,400 m^3/day and currently receives around 2,640m^3/ day while the second has design capacity of 5,772 m^3/day and currently receives around 2,260m^3/ day. Comparing the volume of wastewater generated from the Project during the construction and operation phase and the volume of wastewater handled at either of the WWTP's reveals that such quantities are negligible.

Taking all of the above into account, the anticipated impacts on wastewater utilities are considered of short-term duration during the Project construction phase and of long-term duration during the Operation phase. Such impacts are of a negative nature, and are expected to be of low magnitude given the minimal wastewater quantities generated, and of low sensitivity as they will be easily handled by the WWTP. Given the above impact is considered not significant.

To this extent, there are no mitigation measures to be applied. However, there are additional requirements that must be taken into account as detailed below.

Additional Requirements

The following identifies the mitigation measures to be applied by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Coordinate with the Petra and Wadi Mousa Water Administration for disposal of wastewater at either Wadi Mousa or Ma'an WWTP.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and the Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.

16.2.3 Potential Impacts on Solid Waste Disposal Utilities during the Construction and Operation Phase

The Project is expected to generate solid waste during both the construction and operation phases to include construction waste (mainly during construction to include dirt, rocks, debris, etc.) as well as general municipal waste (such as food, paper, glass, bottles, plastic, etc.). Solid waste quantities generated are expected to be minimal and not significant at all during both phases of the Project and are likely to be easily handled by Al-Basta Landfill (for municipal waste) and Shabit Al Dabe landfill (for construction debris).

The approximate estimated municipal solid waste to be generated from the Project can accounted as follows. Throughout the construction phase, 200 construction workers are expected. The average theoretical municipal solid waste generation in Jordan is 0.85kg/capita/day (SWEEPNET, 2010) (this number is rather high but can be assumed as a worst case scenario). Thus, the anticipated municipal solid waste is estimated to be around 170kg/day. In addition, construction waste is likely to be around 100kg/day to include waste such as cables, metal, wood, etc.

Similarly, during operation solid waste will mainly include municipal waste. Around 30 workers are expected and based on the average theoretical municipal solid waste generation in Jordan (0.85kg/capita/day) (SWEEPNET, 2010) the estimated municipal solid waste is 25kg/day for a duration of 20 years.

Comparing those numbers to the daily amount of solid waste currently handled by Al-Basta Landfill reveals that such quantities are negligible and are expected to be easily handled by the Landfill; the landfill receives around 30 tons of solid waste per day. Thus the project during the construction and operation phase is expected to contribute to an increase of less than 1% of the total daily waste currently handled by the Landfill.

In addition, according to discussions with PDTRA Shabit Al Dabe landfill has sufficient capacity to easily handle construction debris generated from the Project.

Taking all of the above into account, the anticipated impacts on solid waste utilities are considered of short-term duration during the Project construction phase and of long-term duration during the Operation phase. Such impacts are of a negative nature, and are expected to be of low magnitude given the minimal solid waste quantities generated, and of low sensitivity as they will be easily handled by the landfill. Given the above impact is considered not significant.

To this extent, there are no mitigation measures to be applied. However, there are additional requirements that must be taken into account as detailed below.

Additional Requirements

The following identifies additional requirements to be taken into account by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Coordinate with PDTRA or hire a competent private contractor for the collection of solid waste from the site to the municipal approved landfill (Al-Basta for municipal waste and Shabit Al Dabe for construction debris).

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and the Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.

16.2.4 Potential Impacts on Hazardous Waste Disposal Utilities during the Construction and Operation

The exact quantities of hazardous waste that will be generated from the Project are not determined, but given the nature of construction and operation they are expected to be minimal and not significant at all during both Project phases. Such hazardous waste streams include simple types of waste such as oil, chemicals, and fuel for the various equipment and machinery. Hazardous waste quantities are likely to be easily handled by the Swaqa Hazardous Waste Treatment Facility; which is the major and only hazardous waste landfill in Jordan.

Taking all of the above into account, the anticipated impacts on hazardous waste utilities are considered of short-term duration during the Project construction phase and of long-term duration during the Operation phase. Such impacts are of a negative nature, and are expected to be of low magnitude given the minimal hazardous waste quantities generated, and of low sensitivity as they will be easily handled by the landfill. Given the above impact is considered not significant.

To this extent, there are no mitigation measures to be applied. However, there are additional requirements that must be taken into account as detailed below.

Additional Requirements

The following identifies additional requirements to be taken into account by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Coordinate with MoEnv to hire a competent private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and the Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.

16.2.5 Potential Impacts on Road Networks during the Construction Phase

Wind turbines are manufactured in factories and transported to the installation site where they are assembled. Wind turbine components have big dimensions and weight and their transport poses a challenge to the existing roads and infrastructure. The Project's wind turbine blades have a length of 57m and are usually transported in one piece. Tower components can have a transport height of up to 5m. Nacelles are also usually transported in one piece and can have a weight of more than 70 tones.

Components for wind energy projects are usually transported by sea from the manufacturing country to the country of installation and are then loaded in existing ports to trucks which maneuver their way through existing roads to the installation site.

As discussed earlier in the baseline section, with regards to the Project, the wind turbine components will arrive to the Port of Aqaba in the south of Jordan. Transportation route will follow Highway #15 a distance of around 85km after which a western highway (Highway #35 or better known as the 'King's Highway') connects from Highway #15 and leads directly to the Project site.

Given the increasing size, weight, and length of components of the wind turbines, proper transportation and logistical solutions could be required for managing the heavy-load long-haul requirements. If improperly planned and managed, the trucks hauling the various heavy Project components may damage the existing roads, highways and bridges, utility lines (e.g. electricity lines), and could also be a public safety concern for other vehicles on the road.

Taking all of the above into account, the anticipated impacts on road networks are considered of short-term duration during the Project construction phase. Such impacts are of a negative nature, and if such impacts are improperly managed, then they are expected to be of high magnitude and medium sensitivity. Given the above impact is considered of moderate significance.

Mitigation Measures

The EPC Contractor has undertaken a transport study for the Project which analyzed and studied the entire route for transportation of the Project components from the port of Aqaba till the Project site. The assessment has taken into account worst case scenarios for transportation of Project components for blade lengths, tower sections, etc. The total transportation route is approximately 100km.

Based on the results of the study, it was concluded that the transportation route will first follow the road network from the port of Aqaba and then connects with Highway #15. The route will then follow Highway #15 a distance of around 85km after which Highway #35 is taken which leads directly to the Project site. Highway #35 is accessed from an exit on Highway #15 and will run around 15km leading to the Project site.

From there, the road will link with an entrance point from which it will connect with the road network that will be established for the Project site. The study investigated several alternatives for the entrance point location – 2 southern entrance points (entrance point 1 and 2) and one northern entrance point. However, the study recommended that for ease of access to the area, entrance point 1 is the most feasible option. The other options involve much more obstacles along the way and require adjustments and civil works to be completed.

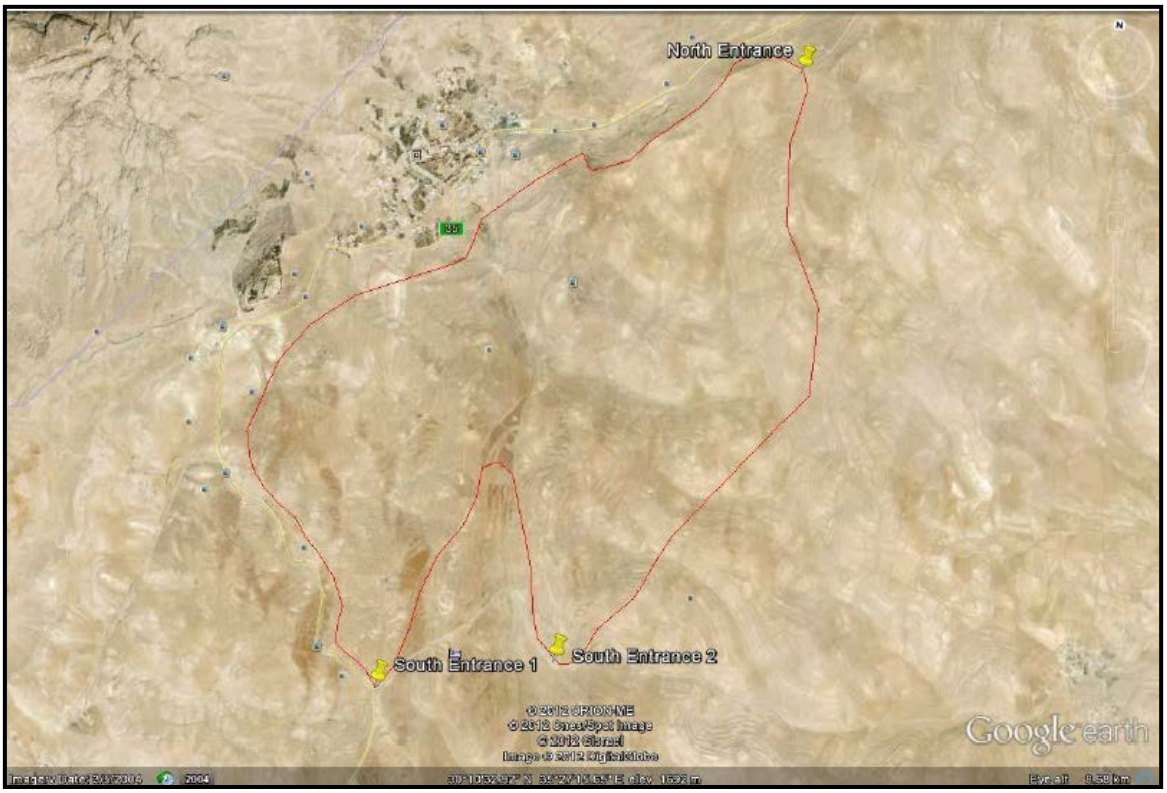

Figure 63: Alternatives for the Entrance Point for the Project Site

The study concludes that the suggested route for the transportation of the Project components is feasible. However, there are several accommodations which need to be taken into account throughout the route as discussed in the table below. The study states that the coordination with and permits from the relevant authorities for such accommodations must be acquired. The study also recommends that the road survey is re-conducted 2 months prior to the arrival of the Project components to the port of Aqaba, and also recommends that at that point a dry run is undertaken.

Table 40: Obstacles along the Transportation Route and the Suggested Solution

Obstacle	Description	Solution
Bridges	There are several bridges along the route in which transportation trucks must drive above. According to the study, the bridges are capable of handling a weight of 100 tons, however the Ministry of Public Works and Housing requires that all cargo trucks exceeding 60 tons must bypass bridges. There will be cargo trucks exceeding 60 tons for the Project.	Bridges will be bypassed through existing detours available at each bridge (refer to Figure 64 below). Certain bypasses require crossing roads which have center barriers. For those, the center barriers will be removed. This will be achieved in coordination and escort of traffic police. Other bypasses require moving against traffic for a small length of the road. This will be achieved with the coordination and escort of traffic police.
Overhead Utility Cables	Along the route there are utility cables which need to be taken into account as their height will not accommodate the height of the trucks transporting the Project's components.	Utility lines will need to be lifted or disconnected while passing under. These will be done in coordination with and the escort of the relevant electricity company.
Slants in the road	At 3 points along the route there is a sharp slant in the road as the road goes down and then up. Due to the length of the blades, they might hit the road at the back end of the road.	The bottom most point of the slant will be filled so that the angle doing down the slant and then up is diminished. This will be achieved in coordination and escort of the Ministry of Public Works and Housing.

Figure 64: Bridges that will be Bypassed and the Bypass route and Other Obstacles in Place (utility lines)

The EPC Contractor is expected to adopt and implement the recommendations/provisions of the transport plan throughout the transportation activities. Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- Submission of poof of coordination and permits from the Traffic Department, Ministry of Public Works and Housing, and the relevant electricity company in advance before any transportation activities are undertaken.

16.2.6 Potential Impacts on Aviation, Telecommunication and Television & Radio Links during the Planning and Construction Phase

Improper planning and site selection of the Project could impact and affect infrastructure elements related to aviation, telecommunication and television & radio links in the surrounding area. Those are discussed in further details below.

(i) Aviation

Any tall structure could impact aircraft safety if located near airports or known flight paths. In addition, such structures could potentially interfere with certain electromagnetic transmissions associated with air transport, for example primary radar and secondary surveillance radar. Wind turbines have the potential to impact the surveillance systems used to detect and identify aircraft approaching, overlying or leaving Jordanian airspace and for which a Recognized Air Picture (RAP) is produced.

In order to safeguard aerodromes and/or airports, GWRE established formal communications with the official governmental authorities responsible for the development of civil aviation safety and security and environmental regulatory compliance; the Civil Aviation Regulatory Commission (CARC). In accordance with the "Civil Aviation Law No. 41 of the year 2007", Article 27(e) requires that any entity which intends to construct a facility of a height greater than 40m obtain the approval of CARC.

GWRE provided CARC with preliminary information available on the Project to include the location and components to obtain the required approval for the Project site. CARC (along with a representative from the Royal Jordanian Air Force (RJAF)) reviewed the information and issued official letters (presented in Annex I) stating that it does not object on the Project development based on the following:

- GWRE must provide CARC with the final coordinates of the Project site and the turbines once available, for them to adjust their navigational procedures.
- GWRE must continuously coordinate with RJAF on any technical adjustment on the Project.

In addition, CARC have established requirements for navigational lighting obstacles for wind farm developments which require the installation of necessary warning lights. Those requirements must be adhered to and are summarized in their Publication AN-14-I (Chapter 6) (http://carc.gov.jo/images/filemanager/AMM%202%20chapter%206.pdf). Such requirements have become common practice for wind farm developments.

To this extent, there are no impacts associated from the Project on aviation safety. However, there are additional requirements which must be taken into account by the Developer and EPC Contractor as highlighted below.

Additional Requirements

As discussed earlier, although there are no impacts from the Project on aviation safety, there are additional requirements which must be taken into account by the EPC Contractor. This mainly includes taking into account throughout the detailed design the navigational lighting obstacles for wind farm developments in accordance with CARC's requirements, and providing CARC with the final coordinates of the wind turbines onsite once finalized.

(ii) Telecommunication and Television & Radio Links

The Project may impact telecommunications and radio/television systems in the area. Such systems use a variety of electromagnetic signals, commonly described as radio waves. Uses primarily include television (TV), radio, mobile telephony, microwave communications and radar. Interference with electromagnetic signals can potentially occur when existing telecommunication and radio/television systems are not adequately considered during a wind farm's design and development. Interference of electromagnetic signals can cause distorted sound, image or data transmission.

To this extent, formal communications have been established with the two (2) main regulatory authorities responsible for the telecommunication and radio/television systems in Jordan to include; (1) Telecommunication Regulatory Commission (TRC) and (2) Jordan Radio and Television Corporation (JRTV).

a. Telecommunication Regulatory Commission (TRC)

In 2012, GWRE established formal communication with the TRC to introduce the Project and discuss any concerns they might have for the proposed site, and identify any further requirements or approvals for this Project. The TRC is the official entity for regulating the telecommunications and information technology services in the Kingdom to guarantee the provision of high-standard information and communications technology services to end user at reasonable prices.

The TRC have notified the telecommunication service providers in Jordan (to include Zain, Orange, and Umniah) of the Project through issuing formal letters to those entities. The TRC have provided the operators with information about the Project for them to indicate whether the Project would affect any of their infrastructure elements in the area. Umniah has responded to the TRC officially stating that the Project does not affect the company's infrastructure in the area. The official letter is presented in Annex I. To date, Zain and Orange have not responded.

Based on ECO Consult's previous experiences in communications with TRC regarding wind power projects, generally the TRC assumes no objection from the Project development as they consider the response of one company (Umniah) to be sufficient – and should the other companies have any objections they would have notified the TRC (which to date they haven't given that communications with the companies date back to 2012). In addition, it is important to note that within the Project site, there are broadcasting towers for all three companies located next to each other (Zain, Orange, and Umniah), and given that Umniah have not objected on the Project, it is highly unlikely that the other companies would, as should they have any objections they would have replied and notified the TRC. Nevertheless, Zain and Orange's official response must be incorporated and updated at a later stage; however no issues of concern are anticipated in this regard.

Additional Requirements

The EPC Contractor is expected to continue coordination with the TRC to obtain the official response from the remaining telecommunication service providers – mainly Orange and Zain. Nevertheless, no issues of concern are anticipated in this regard.

b. Jordan Radio and Television Corporation (JRTV)

Similarly, ECO Consult established formal communications with JRTV to introduce the Project, discuss any concerns they might have for the proposed site, and identify any further requirements or approvals for this Project. JRTV is the state broadcaster of Jordan for radio and television transmission. JRTC has officially responded that they have no objection on the Project development and that the Project will not affect their transmission in the area. The official letter from JRTV is presented in Annex I.

To this extent, there are no impacts associated from the Project on telecommunication and television & radio links. In addition, there are no additional requirements to be considered.

16.2.7 Potential Impacts on Electricity Networks during the Operation Phase

The Project is expected to an installed capacity of 82 MW and will connect with the National Grid 132kV line through high voltage overhead transmission line. The high voltage overhead transmission line and the connection to the existing grid will be designed and built by NEPCO.

To this extent, the Project is expected to entail positive impacts on the electricity network as it will contribute to supplying electricity to the National Grid for end users and help meet the increasing electricity demands throughout the Kingdom. The Project is expected to provide 256 GWh of electricity per year, which is enough to power over more than 60,000 average local households in Jordan.

Additional positive impacts include amongst others: (i) contributing to increasing energy security through development of local energy resources and reducing dependency on external energy sources, (ii) producing electricity which contributes to lowering electricity generation costs compared to the current costs associated with liquid fuels and thus leads to a substantial decrease in the Government of Jordan's fiscal deficit (iii) the Project will produce 'clean' energy which will help Jordan reduce its carbon footprint by displacing more than 160,000 metric tons of carbon dioxide per year.

17. OCCUPATIONAL HEALTH AND SAFETY

This Chapter assesses the anticipated impacts from the Project throughout its various phases on occupational health and safety. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

17.1 Assessment of Baseline Conditions

Assessment of baseline conditions related to occupational health and safety is considered irrelevant.

17.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities occupational health and safety. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels. Throughout this section, the impacts during the construction and operation phase have been discussed collectivity due to the similarity in nature of the impacts.

Throughout the construction phase there will be generic occupational health and safety risks to workers, as working on construction sites increases the risk of injury or death due to accidents. The following risks are generally associated to construction sites and apply for the construction of the Project and could include:

- Slips and falls;
- Working at heights;
- Struck-by objects;
- Moving machineries;
- Working in confined spaces and excavations;
- Exposure to chemicals, hazardous or flammable materials;
- Particularly for wind power projects, workers are potentially exposed to electric shocks and burns when touching live components; and
- Taking into account the Project site, construction workers are expected to work relatively hot weather conditions (and thus are exposed to certain risks such as dehydration, heat exhaustion, and heat stroke) and very cold weather conditions (and thus are exposed to certain risks such cold stress, slippery roads during frost days, etc.).

Similarly, throughout the operation phase, there are occupational health and safety risks to workers from the various operation and maintenance activities expected to take place for the Project. The following risks are generally associated to such a Project and which could include:

- Working at heights during maintenance activities
- Exposure to a variety of hazards such as electric shock, and thermal burn hazards;
- Exposure to chemicals, hazardous or flammable materials; and
- Taking into account the Project site, maintenance activities are expected to take place in relatively hot weather conditions (and thus workers are exposed to certain risks such as dehydration, heat exhaustion, and heat stroke) and very cold weather conditions (and thus workers are exposed to certain risks such cold stress, slippery roads during frost days, etc.).

Such impacts are considered of short-term duration during the construction phase and of long-term duration throughout the Project operation phase, of a negative nature. A wind farm construction site is associated with an inherently high occupational health and safety risks some of which have considerable consequences (fatality through fall from heights) – but such impacts are generally controlled through the implementation of general best practices; to this extent such impacts are considered of medium magnitude and high sensitivity. Given the above such an impact is considered of moderate significance.

Mitigation Measures

The EPC Contractor has prepared an Occupational Health and Safety Plan (OHSP) regarding the Project's construction, commissioning and operation and maintenance works. The objective of the Plan is to ensure the health and safety of all personnel in order to concur and maintain a smooth and proper progress of work at the site and prevent accident which may injure personnel or damage property of the EPC Contractor and all involved sub-contractors.

In summary, the OHSP provides details on the following components.

- Identification of roles and responsibilities of the personnel involved within the Project to include the EHS manager, Project manager, site manager, health and safety manager, EHS coordinator, subcontractors, workers, etc.;
- Identifies in details information in relation to emergency measures and plans, communication protocols, first aid instructions and facilities, training programs, occupational health and safety culture, inspection programs, monitoring and reporting requirements, incident management, etc.
- Identifies in details the activities that are expected for the Project (e.g. civil works, electrical wiring, material transport and unloading, wind turbine mechanical assembly, wind turbine electrical installation, commissioning, maintenance, etc.) and lists the specific jobs which are to be undertaken under each activity and the hazards which may be associated for each (electric hazards, working with machinery, vertical works, etc.);
- For each of the activities above, the OHSP identifies the preventive equipment and systems that must be in place to eliminate or reduce such risks. This includes: (i) collective protective equipment (safety signs, traffic signs, hand signs, marking and signaling of work in progress, etc.); (ii) personal protective equipment (this includes the compulsory equipment for any worker or visitor onsite and obligatory equipment based on the tasks being carried out) (iii) detailed safety measures on how the task should be implemented in a safe manner to reduce any occupational health and safety risks.

The EPC Contractor and the Project Operator are expected to adopt and implement the recommendations/provisions of the OHSP throughout the Project construction and operation phase. Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor and Project Operator during the construction and operation phase:

- Inspection to ensure the implementation of the provisions of the Occupational Health and Safety Plan and assess compliance with its requirements; and
- Regular Reporting on the health and safety performance onsite in addition to reporting of any accidents, incidents and/or emergencies and the measures undertaken in such cases to control the situation and prevent it from occurring again.

18. COMMUNITY HEALTH, SAFETY AND SECURITY

This Chapter assesses the anticipated impacts from the Project throughout its various phases on community health, safety and security. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

18.1 Assessment of Baseline Conditions

Assessment of baseline conditions related to community health, safety and security is considered irrelevant.

18.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on community health, safety and security during the operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels. There are no foreseen impacts on community health, safety and security during the construction and planning phase.

It is important to note that community referred to throughout this section mainly includes the local communities surrounding the Project site and which are anticipated to be impacted. Those mainly include Al-Rajef, Taybeh, Dlaghah & Rassees, Fardakh and Sadaqah.

In particular, the potential impacts on community health and safety which are discussed throughout this section include the following:

- Potential impacts from noise of wind turbines during operation;
- Potential impacts from low frequency noise, infrasound and vibration of wind turbines during operation;
- Potential impacts from shadow flicker of wind turbines during operation;
- Potential Impacts from blade and tower glint of wind turbines during operation;
- Potential impacts from blade/ice throws during operation; and
- Potential impacts from public access to Projects components during operation.

18.2.1 Potential Impacts from Noise of Wind Turbines during Operation

Perception of noise can result from sound emissions generated from operation of the wind turbines. The sound originates from mechanical and aerodynamic effects, where mechanical sound is generated by the machinery of the nacelle (e.g. generator, gear box) and aerodynamic sound emanates from the movement of air around the turbine blades and tower.

Such sound emissions could potentially be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment. Therefore, to assess the anticipated impacts, a noise prediction model was employed.

The section below discusses the methodology that was adopted for the modeling and also presents the outcomes and results.

(i) Impact Assessment Methodology

This section presents the impact assessment methodology in relation to the noise prediction model. This section discusses the modeling methodology and the relevant legislations against which the results are evaluated.

a. Noise Modeling Methodology

The sound propagation from the Project's wind turbines has been modeled by employing the WindPRO software (Version 2.9 as of March 2014) which provides a comprehensive package of modules for wind farm project design and planning.

The calculation of noise impact was carried out according to the commonly used International Organization for Standardization (ISO) 9613-2 (ISO, 1996). Sound pressure levels in the vicinity of the wind farm were calculated from the wind turbines' sound power levels and under consideration of the reduction of sound levels by various geometrical and sound attenuation effects during propagation; e.g. geometry (i.e. directional correction, distance), air absorption, meteorological conditions, terrain, shielding by barriers or buildings.

The norm allows for two different calculation approaches:

- Standard Calculation Method: the method considers frequency-dependent sound power levels (e.g. octave-divided) and frequency-dependent air absorption factors. A ground factor G is used that describes the porosity of the ground surface: G=0 stands for hard ground (e.g. road, industrial or city are, water) and G=1 for porous ground (e.g. grass, farmland, plantation, loose soil). As per "Section 7.3.1" of the Norm the method is applicable only for almost flat or only slightly sloped terrain.
- Alternative Calculation Method: the method is generally based on a reference frequency of 500 Hz. A specific ground factor need not be set, but propagation above porous or mixed (mainly) porous ground is presumed for applying the method. The method is applicable in case the evaluation standard is an A-weighted sound pressure level and the sound is a mixture of tones and not characterized by a pure tone.

Given the highly undulating terrain in the vicinity of the Project, the Alternative Calculation Method was applied. Furthermore, the Alternative Method is more appropriate given that the evaluation uses A-weighted standards (as indicated by dBA), the wind turbines' sound has no specified pure tones, and the ground of the region is predominately porous (acoustically soft).

The following Project-related parameters were applied for the sound propagation modeling for the Project:

- The modeling was undertaken on the final layout of the wind turbines as provided by the Developer;
- The noise levels were calculated for the standard receptor height of 5m above ground level as per ISO 9613-2;
- The modeling took into account the baseline (or background) noise levels in the area at each nearby receptor location – to include Al-Rajef, Dlaghah & Rassees, Fardakh and Sadaqah. To determine background levels in modeling, 10% lowest level measures at all receptor locations were taken which gives mean levels of 35dBA for daytime and 33dBA from nighttime. The 10% lowest levels in terms of noise statistics are indicated as L90 (90% of measured values exceed the L90-value). The L90 is the widely used index for elimination of measured data which are affected by some occasional noise impact caused by e.g. passing vehicles, machines, shouting, barking, people talking, insects flying by. Refer to "Section 15.1" for the detailed results of the baseline noise levels.

  It is important to keep in mind that the baseline noise levels that were taken into account for the modeling exercise represents a snapshot of the existing conditions (based on a one time monitoring

undertaken at the various receptor locations with certain climatic conditions at that time). In reality, baseline levels will continuously change depending on several factors such as changing climatic conditions (e.g. higher wind speeds will increase noise baseline levels) – therefore this would affect the actual generated noise levels at the receptors during the actual operation of the turbines.

- For consideration of the topography, a digital terrain model with 25m resolution was applied;
- The nominal sound power level of each turbine (Gamesa G114) was set at 106 dBA as specified by the manufacturer for 95% rated power which is reached at a wind speed of 10 m/s;
- Reference measurements for determining a nominal sound power level are obtained from turbine monitoring which implies some measurement uncertainty. Furthermore, variations in turbine manufacturing may cause deviation from the nominal level. In order to cover such uncertainties, a value of 2 dBA was determined in accordance with the IoA Guideline used in the UK. Hence, a range between 104 and 108 dBA is assumed for the sound power level of the wind turbines. In the modeling, the most adverse level of 108 dBA was used for each turbine; and
- As air absorption coefficient at 500 Hz a value of 2.2 dB/km was used representing the average meteorological conditions for the region (+13°C, ca. 50% atmospheric humidity).

For the results obtained with WindPRO/ISO 9613-2 it is important to note that the following aspects of the modeling result in conservative, over-estimated values by applying worst-case assumption for computation and which include:

- The results are calculated only for the maximum sound power level (108 dBA). As noted in the figure below, in reality, for lower wind speeds the noise level is reduced by up to 10 dBA (i.e. from 106 dBA at 7 m/s or more to around 96 dBA at 4.5 m/s at the reference height of 10 m). Therefore, the calculation over-estimates for wind speeds below 7 m/s.

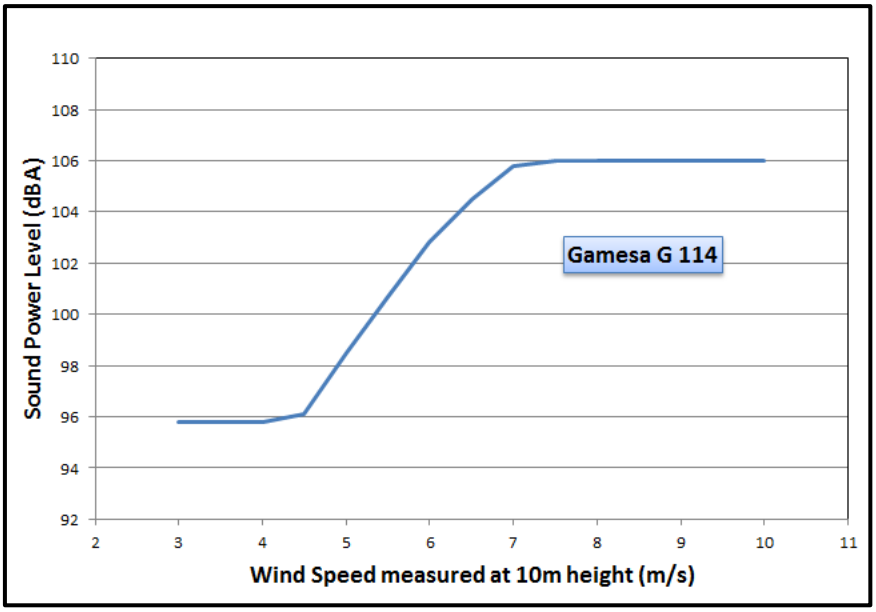

Figure 65: Sound Power Level at Various Wind Speeds for Gamesa G114

- Sound pressure levels are always determined for a downwind situation, meaning that the wind is blowing from the source in direction to the receptor (meteorological coefficient C0=0). Sound levels for an upwind situation are lower.
- Shielding effects from building structures were not taken into account; and
- Attenuation effects by vegetation were not taken into account.

b. Legislative Requirements

The results of the noise modeling exercise that was undertaken were compared against several relevant national and international legislations and standards which are related to the subject matter. Those are discussed in details below along with the requirements of each legislation and standard.

- *Jordanian Instruction for Reduction and Prevention of Noise for 2003.* This Instruction is issued by the MoEnv and identifies the maximum allowable limits of noise levels in various zones during daytime and nighttime – such as cities, village, industrial areas, etc.

  With regards to this Project in specific, the maximum allowable limits of noise in rural villages are the limits applicable as presented in the table below.

Table 41: Maximum Allowable Noise Levels in Villages according to Jordanian Instruction

Zone	Permissible limits L_{eq} (dBA) *	
	Daytime	Nighttime
Residential areas in (rural) villages	50	40

*Calculated as average over the 12 hours of day or night time. Daytime is from 7:00 – 18:00 and nighttime is from 18:00 – 7:00

- IFC EHS Guidelines. The IFC General EHS Guideline (IFC, 2007) also identifies maximum allowable limits of noise in given areas. The Guideline differentiates between only two land use categories; either residential or industrial areas. The applicable limits for this Project in specific would be the limits set for the residential areas.

Table 42: Maximum Allowable Noise Levels according to IFC EHS Guidelines

Zone	Permissible limits L_{eq} (dBA) *	
	Daytime (7:00 – 22:00)	Nighttime (22:00 – 7:00)
Residential, Institutional and Educational	55	45
Industrial and Commercial	70	70

As noted in the table above, it is obvious that the applicable Jordanian Instruction limits for noise levels at villages are more stringent than the limits of the IFC guidelines for residential areas.

In addition, the IFC EHS Guidelines on Wind Energy (IFC, 2007) states that noise impacts should not exceed the levels presented in the General EHS Guidelines, nor result in a maximum increase in background levels of 3 dBA at the nearest receptor location. The 3 dBA requirement provides protection of a silent environment, but can become highly challenging to comply with in case of low background levels below e.g. 35 dBA. This is why in some European countries (e.g. guidelines for noise from wind farms in Ireland and the United Kingdom) an increment of 5 dBA is defined, which instead is limited only to cases where a set standard (e.g. 40 dBA) will be exceeded by the wind farm noise. However, it is important to note that the IFC have recently published an update to the IFC EHS Guidelines on Wind Energy (IFC, 2015) where the 3 dBA criterion is not included anymore.

(iii) Results

As discussed earlier, the noise prediction modeling software WindPRO 2.9 based on ISO 9613-2 was employed to assess the noise impact from the wind farm operation. The modeling was based on the final layout of the wind turbines as provided by the Developer.

Potentially noise-sensitive receptors are located in the villages surrounding the Project site. Separate receptor locations (labeled A to Q) were selected in each of the surrounding villages as presented in the figure below, for evaluation of noise prediction results. Most of the points were selected on the closest

boundaries of the villages to the Project site – the villages area (represented in pink in the figure below) are based on the official organized boundary of the village.

In addition, 2 additional points were selected outside of the organized boundary of Al-Rajef (point L and Q) as based on several visits undertaken to the site it was noticed that several dwellings (around 3-5 houses) lie within such areas – those are houses occupied by people from the local community of Al –Rajef.

Table 43: Receptor Points and Village they Represent

Receptor Points	Village
A and B	Sadaqah
C, D, E, F, G and P	Dlaghah & Rassees
H and I	Fardakh
J, K, L, M, N and Q. Points L and Q are located outside of the organized boundary of Al-Rajef but include several dwellings (3-5 houses) which are occupied by people from Al-Rajef.	Al–Rajef
O	Taybeh

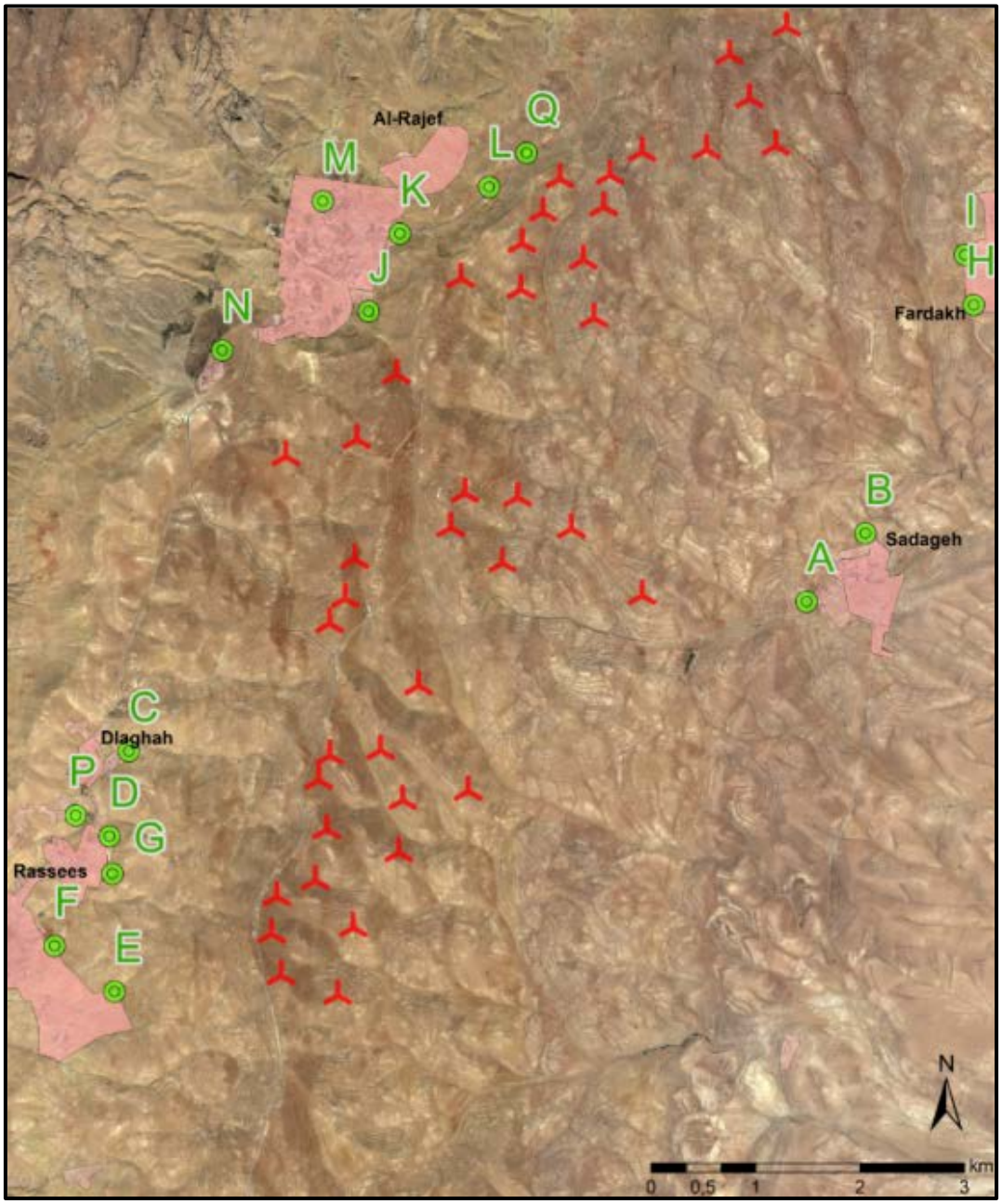

Figure 66: Locations of Receptor Points Selected for Evaluation of Noise Prediction Results

Table 44 below provides a summary of the noise prediction results. In addition, Figure 67 shows the entire project region with sound pressure level contours.

The table below presents the modeled sound pressure level from all the turbines on the various receptors identified earlier (without taking into account background noise levels).

Comparison of the modeling results in the table below with the Jordanian Instruction daytime limit of 50 dBA, reveals that the limit will not be exceeded at any location or any village area. However, comparison of the modeling results in the table below with the Jordanian Instruction nighttime limit of 40 dBA reveals that exceedance is likely but only in limited areas in the eastern parts of Al-Rajef; i.e. at the nearest receptor locations J, K, L, and Q – refer to the 40dBA line in Figure 67 below which presents those limited areas where exceedance is expected. Again, it is important to reiterate that receptors L and Q are outside of the regularized boundaries.

Besides the computed sound levels of the wind turbines, a noise limit can be exceeded due to its cumulation with background noise. Due to the logarithmic dB-scale, addition of background noise levels may become significant only in the case that both levels have comparable values (e.g. 35 dBA plus 35 dBA add to 38 dBA). For the Project such cumulation of noise from wind turbines combined with the measured background levels of 35 and 33 dBA (for day and night) may lead to an exceedance of the night time limit only for levels of between 39 and 40 dBA. In other words, due to the logarithmic scale, the summation of 47.0 dBA (the maximum modeled sound pressure level) will not cause exceedance of the daytime 50 dBA standard since the summation results in 49.2 dBA. Similarly, the background level of 33 dBA will require a wind farm level of 39 dBA to reach the 40 dBA night time standard, and thus this is only exceeded again at points J, K, L, and Q.

However, it is important to note that the modeling took into account the baseline values based on the monitoring undertaken. Such monitoring represents a snapshot of the existing conditions (based on a one time monitoring undertaken at the various receptor locations with certain climatic conditions at that time). In reality, baseline levels will continuously change depending on several factors such as changing climatic conditions (e.g. higher wind speeds will increase noise baseline levels) – therefore this would affect the actual generated noise levels at the receptors during the actual operation of the turbines. For example assuming a level of e.g. 42 dBA for strong winds would result in exceedance of limits during nighttime without taking into account sound pressure levels from the operating turbine.

Other than those locations identified above (receptor locations J, K, L, and Q) no other village receptors will experience an exceeding of a Jordan limit value by cumulative consideration of the background noise. Again, refer to the 40dBA line in Figure 67 below which presents those limited areas where exceedance is expected.

Taking a closer look at Al-Rajef area, the limited parts where the exceedance is expected (those areas which lie up till the 40dBA orange line in the figure below) reveals that they mainly include a number of dwelling – a rough estimate is possibly between 20-30 houses; note that this figure is based on observations on the latest map on Google which means new constructions may exist and all buildings were marked without knowing their exact usage. Nevertheless, the remainder of the village is in compliance with the Jordanian Instruction limits for both daytime and nighttime.

The modeling results reveal that the wind turbine responsible for the potential exceeding of the night time noise standard at location Q is mainly wind turbine number 11, but also secondarily from turbines 6 – 10. These are also the relevant wind turbines causing exceedances for locations K and L; location J is mostly affected by turbine number 17.

Comparison of the results with the General EHS Guidelines for residential areas of 55 dBA at daytime and 45 dBA at night time (which are considered less stringent when compared to the Jordanian limits), will only result in exceedances at receptor locations L and Q at nighttime – while receptors K and L would be within the limits.

Table 44: Sound Pressure Levels Predicted for Selected Receptor Points

Village	Receptor Location	Shortest Distance to Wind Turbine (km)	Modeled Sound Pressure Level [Leq (dBA)]	Sum with Background (Leq in dBA)*		Exceeding the Jordanian Instruction	
				Daytime	Nighttime	40 dBA (night time)	50 dBA (daytime)
Sadaqah	A	1.6	33	37	36	No	No
	B	2.2	31	36	35	No	No
Dlaghah & Rassees	C	1.8	35	38	37	No	No
	D	1.7	35	38	37	No	No
	E	1.6	35	38	37	No	No
	F	2.1	32	37	36	No	No
	G	1.6	35	38	37	No	No
	P	2.1	33	37	36	No	No
Fardakh	H	2.4	29	36	35	No	No
	I	2.1	31	36	35	No	No
Al-Rajef	***J***	***0.7***	***42***	***42***	***42***	***Yes***	***No***
	K	***0.7***	***41***	***42***	***42***	***Yes***	***No***
	L	***0.6***	***46***	***46***	***46***	***Yes***	***No***
	M	1.5	36	39	38	No	No
	N	1.2	37	39	38	No	No
	Q	***0.4***	***47***	***48***	***47***	***Yes***	***No***
Taybeh	O	1.7	34	38	37	No	No

**Background Noise levels were determined as 35 dBA during daytime and 33 dBA during nighttime.*

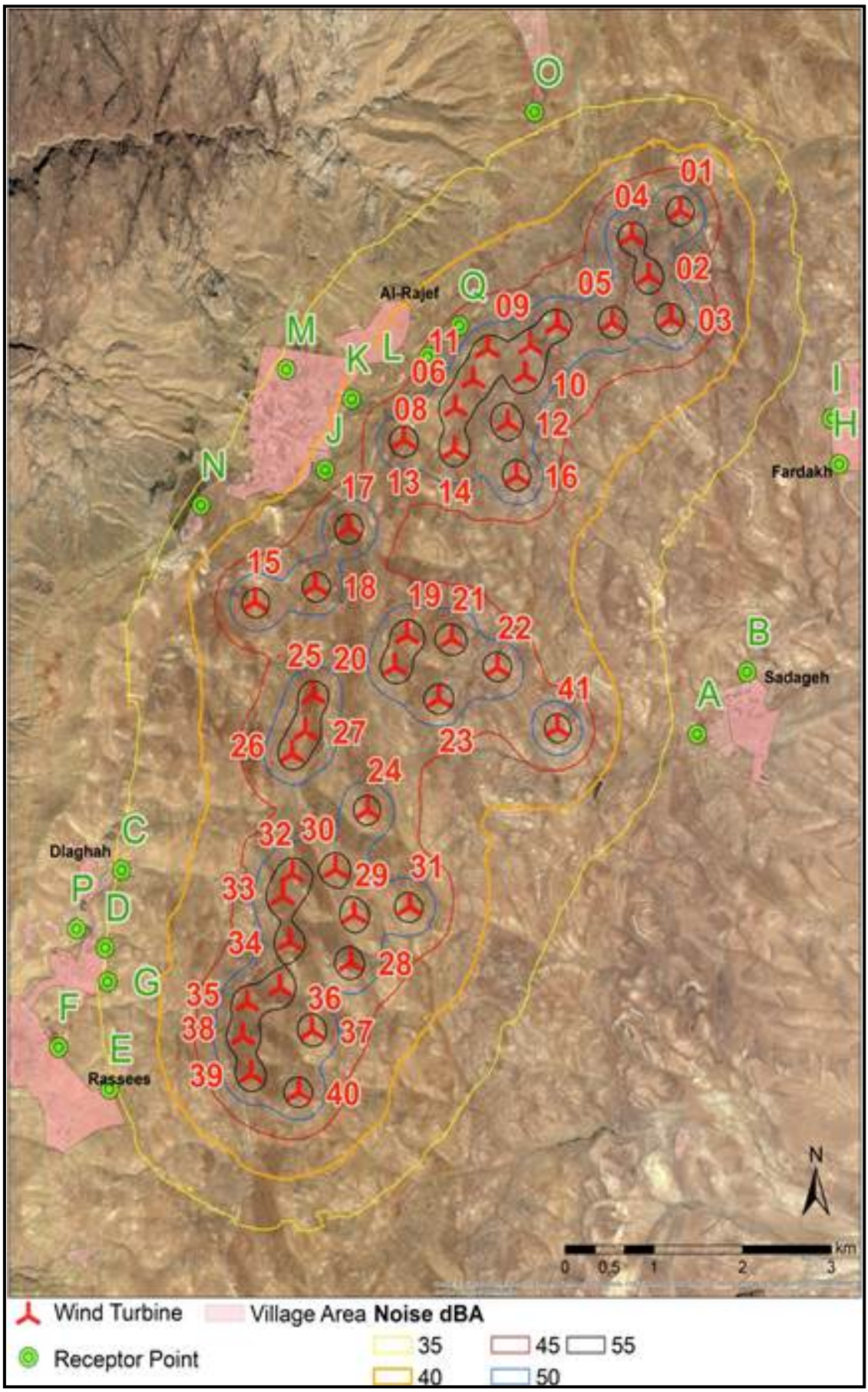

Figure 67: Noise Contours for the Project; 41 Turbines of type G114, 2MW, 80m hub height

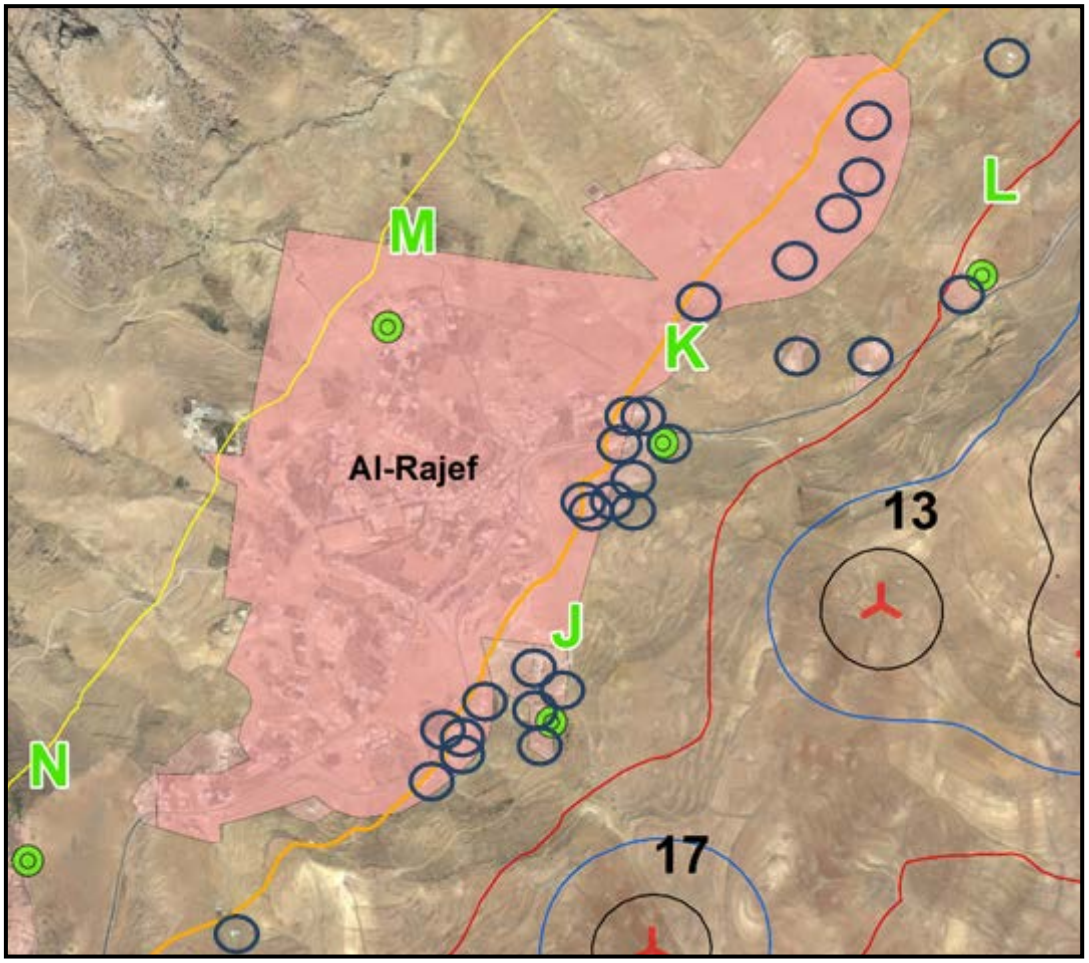

Figure 68: Noise Contours for Potentially Affected Receptor Locations in Al-Rajef

Taking the above into account it is important to reiterate that the modeling results obtained from the noise prediction are considered conservative, most adverse/worst-case approach for the propagation of the wind turbine's sound. This is due to several assumptions and approaches which were taken into account during the modeling and which discussed below. Nevertheless, even in such worst case scenario assumptions, results of this modeling indicates that there are no issues of concern in any of the nearby villages with regards to noise from the wind turbines, with the exception of small limited parts in Al-Rajef village where limits will be exceeded during nighttime only.

- The modeling was based on the maximum sound power level of the wind turbine at highest wind speeds only (106 dBA for ≥7 m/s measured at 10m height). In reality, for lower wind speeds the noise level is reduced by up to 10 dBA (i.e. from 106 dBA at 7 m/s or more to around 96 dBA at 4.5 m/s at the reference height of 10 m). Therefore, the calculations over-estimate for wind speeds below 7 m/s;
- The wind turbine type's nominal sound power level was conservatively enhanced by an uncertainty margin of 2 dBA. Since an uncertainty margin can also act to lower levels, the overall uncertainty gives a range from 104 to 108 dBA, but nevertheless the 108 dBA figure was used for the modeling;
- Shielding effects by building structures are not considered. Attenuation effects by vegetation are also not considered;
- Masking of wind turbine noise by background noise that increases with wind speed could not be taken into account throughout the modeling;
- The calculation method is based on downwind situation, meaning that sound is supported by the wind coming from direction of the wind turbine. In the calculation, thus, the wind is approaching the receptor always directly from any wind turbine in the surrounding, which in reality is not possible due to the spatial distribution of the turbines. Hence, reduced sound levels due to directivity of sound at the sources are not considered in the calculation. As an example for receptor location Q, the stronger winds

causing sound power levels greater than 100 dBA at the turbines are coming from north-easterly to south-easterly directions with an annual abundance of about 15% of all night time hour; and

- Upwind or cross-wind situations reduce the sound levels by several dBA. Further, strong turbulent wind disturbs propagation of the sound and, hence, reduces the sound level at a reference point.

It is also important to note that modeling results are to be considered as being indicative, since some conservative assumptions are inherent to the calculations and other aspects like masking or wind speed abundances cannot be realistically determined (given that climatic conditions such as wind speed are expected to continuously change and which could affect the actual noise levels). Furthermore, the actually installed individual turbine's sound power level may deviate from the generalized value used in the modeling.

In reality, for many hours of the year it is expected that the actual noise impact be some dBA lower than calculated, but nevertheless the Jordanian night time limit is still expected to be exceeded in limited parts of the eastern areas of Al-Rajef village during high wind speed periods.

Taking all of the above into account, such impacts are considered of long-term duration as they will occur throughout the operation phase of the Project and of a negative nature. In addition, given that there will be only limited small areas in the eastern parts of Al-Rajef village where exceedance beyond acceptable limits are likely to occur during nighttime only, such an impact is considered of medium magnitude. However, the receiving environment is considered of high sensitivity given that it entails sound emissions which could potentially be a source of disturbance and nuisance to the receptors and residents. Given the above, such an impact is considered to be of moderate significance.

Mitigation Measures, Compensation Measures and Monitoring Requirements

Discussed below are the mitigation measures to be applied by the Project Operator and Developer during the operation phase.

In order to achieve compliance with the Jordanian nighttime noise limit of 40 dBA, a reduced power operation strategy for the wind turbines causing the exceedance of the noise limits at Al-Rajef village must be implemented (i.e. from 7pm till 6am) . Such a strategy would likely involve turbines 6 -11 and 17 – which are the main cause of exceedance of limits as discussed previously.

Therefore, in order to implement a proper and effective reduced power strategy, the exact conditions need to be determined on the ground and in reality. The strategy must include the following measures:

1. As discussed earlier, baseline noise levels greatly affect the generated noise levels at the receptors. Therefore, In order to provide sufficient information on background noise levels, comprehensive measurements shall be performed prior to start of operation of the wind farm and without any construction noise. Measurements shall be performed at locations near receptor points Q, J, K, and L. The measurements shall cover the range of wind speeds (4 - 10 m/s) for all wind directions (45° sectors) at day and night time;
2. Once the turbines are in operation, noise levels must be measures again at locations near receptor points Q, J, K, and L. The measurements shall cover the range of wind speeds (4 - 10 m/s) for all wind directions (45° sectors) at day and night time;
3. Based on the above, the exact required reduced power measures can be identified in addition to the situations in which they are required , in which applicable standards are exceeded (e.g. during eastern winds that exceed 10m/s, turbine 17 must be operated in a noise-reduce mode of 102dBA); and
4. It will be then assumed that such reduced power measures are implemented in the situations that would lead to standards being exceeded. However, successful implementation of the reduced power measures shall be demonstrated during operation by additional monitoring at the receptor locations for those wind situations identified as potentially exceeding the Jordanian limit values. The

measurements should be accompanied by an investigation on perception of the wind turbine noise by the residents.

Such a reduced power strategy above will ensure that the Jordanian nighttime limit of 40 dBA is met.

Additional measures must be implemented should noise levels still be perceived as annoying by the local community as discussed below. First, the Developer/Project Operator must aim to discuss the effects of noise from turbines to the local community of Al-Rajef and present the results of the worst-case scenario analysis undertaken above, and identify the areas where exceedances are expected and the outcomes of the reduced power operation strategy developed.

In addition, a detailed grievance mechanism for the local community must be prepared. The local community of Al-Rajef must be made aware of the grievance mechanism available to submit complaints regarding nuisances related to noise from the turbines. Once such nuisances and conditions are verified on the ground, appropriate compensation measures must be implemented to limit such impacts. This could include provision of noise shielding at receptor locations; e.g. sound reducing windows (double glazed) and planting of trees and shrubs.

Finally, it is important to note that as part of the disclosure session that was held with the local communities (refer to "Section 6.5.4" for additional details) the outcomes of the noise modelling assessment discussed above were presented and discussed as well as the proposed mitigation measures and monitoring requirements. No objections were raised with regards to the noise impacts from the Project.

Following the implementation of these measures, the significance of the residual impact can be reduced to not significant.

To this extent, it is important to note that the technical consultant to the Developer undertook a study to determine the impacts of operating the turbines from a reduced power mode on the generated energy from the Project. The study took into account the following:

- Operating the turbines in 3 reduced mode options (sound power level from the turbines of 105 dB, 104 dB, and 102dB);
- Noise modes discussed above were applied to the turbines discussed earlier (6 -11 and 17 as well as 14); and
- It was assumed that such reduced mode option will be applied during nighttime (18.00 to 07.00), when wind speed is between 3-10m/s, and when wind is coming from the sector 110 to 150 degrees or 90 – 180 degrees.

Based on the above, the study concludes that the reduced power mode of the turbines will result in a loss on the gross production of approximately 0.03 % to 0.06 % only.

Other Affected Communities

In addition to the villages discussed above, there are other affected communities which could be impacted by the noise generated from the turbines during operation.

As discussed earlier in "Section 9.1.3", local communities from Al-Rajef and Dlaghah & Rassees undertake agricultural and grazing activities during specific seasons of the year (generally between February and July). However, noise from the turbines would not affect their grazing and agricultural activities. In addition, potential impacts and nuisances from the turbines on those local communities undertaking such activities are considered temporary and not significant, given that those local communities do not reside in the area; once they undertake such activities they return to their villages (Rajef or Dlaghah).

In addition to the above, there some nomads that occupy the Rajef area from April till September and whom also undertake agriculture and grazing activities. Noise from the turbines would not affect their grazing and agricultural activities. In addition, potential impacts and nuisances from the turbines on the nomads are considered not significant. Nomads in general occupy the Rajef area on a yearly basis, but do not settle in the exact specific area each year. Therefore, in areas where high noise levels are expected from the turbines, the nomads could simply set up their tents on other nearby less affected areas. Based on consultations with the nomads the concept of noise from wind turbines was explained and the general response was that they did not mind at all moving around the Rajef area to less affected areas from noise.

Mitigation Measures and Monitoring Requirements

The Developer/Project Operator must develop informative maps in Arabic of noise propagations from the turbines in accordance with results highlighted throughout this chapter. Such maps must be published on information boards within the wind farm to allow nomads to build up their tents in less affected areas. Continuous inspections must take place to ensure that such informative maps are in place especially before the nomads arrive to the area (generally in April).

In addition, the Project Operator must aim to explain the noise propagation maps to the nomads in the area and identify where such maps are posted.

18.2.2 Potential Impacts from Low Frequency Noise, Infrasound and Vibration of Wind Turbines during Operation

Comprehensive research on low frequency noise (frequency below160 Hz) and infrasound (below 20 Hz) has been published by the UK Department for Environment, Food & Rural Affairs and which concludes that there are no direct health effects at the levels of low frequency noise generated by wind turbines (DEFRA, 2003).

It has been repeatedly shown from measurements of low frequency noise and infrasound from wind turbines undertaken over the past decade (in the UK, Denmark, Germany, and the USA), and as agreed by experienced acoustics professionals, that the levels of infrasound emitted from modern wind turbines even within the wind farm sites are at very low levels below the threshold of perception (DELTA, 2010).

WindPRO provides a sound propagation calculation for these low frequencies as required by Danish regulations. Calculation with this approach revealed no exceedance of the Danish low frequency limit (20 dBA indoors) at any village around the Project.

Wind turbines are not typically a source of high level vibration. Vibration levels are reduced rapidly with distance to the source. A comprehensive study of vibration measurements in the vicinity of a wind farm undertaken in 1997 found that vibration levels were already at distances of 100 m below 10% of the value recommended as exposure limit for critical buildings such as laboratories housing precision measurement instruments (UK Department of Trade and Industry, 1997). Therefore, no vibration impacts are expected during operation beyond 100m. It can be anticipated that vibration from the Project's wind turbines will not be perceivable at the nearest residential buildings.

Taking all of the above into account, such impacts are considered of long-term duration as they will occur throughout the operation phase of the Project and of a negative nature. However, the impact is considered to be of low magnitude and low sensitivity. Given the above, such an impact is considered to be not significant. To this extent, no mitigation measures are required and no additional requirements have been identified.

18.2.3 Potential Impacts from Shadow Flicker of Wind Turbines during Operation

Shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow several hundred meters away from the turbines location. As the rotor blades rotate, shadows pass over the same point causing an effect known as 'shadow flicker'. Of course, shadow length can change depending on the angle of the sun in the sky, but even if the object is large and the sun is low in the sky, the shadow will only stretch a certain distance – after that, the light bends around the object and the shadow becomes diffuse (weak).

Four conditions must occur simultaneously for a wind turbine to cause shadow flicker:

- The sun must be shining and there is no cloud cover;
- The moving object must be between the observer and the sun;
- The observer has to be close enough to the object to be in its shadow; and
- The blades have to be facing directly toward or away from the sun (so they are moving across the source of the light relative to the observer).

Shadow flicker could potentially be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment. Therefore, to assess the anticipated impacts, a shadow flicker prediction model was employed.

The section below discusses the methodology that was adopted for the modeling and also presents the outcomes and results.

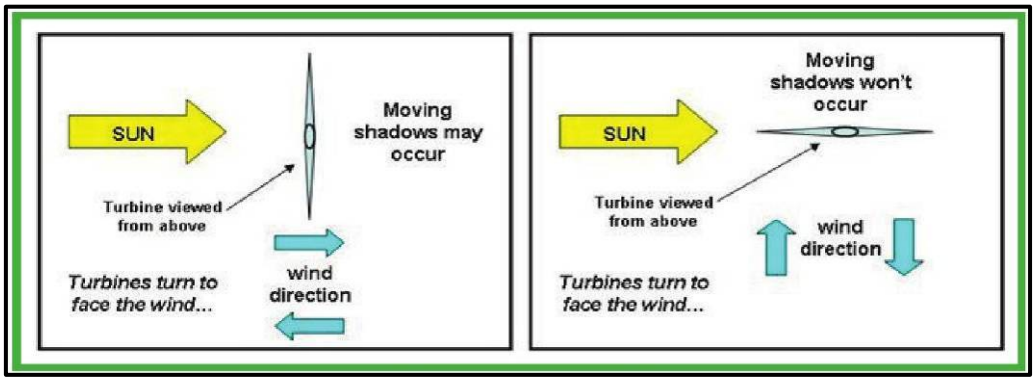

Figure 69: Relation between Position of Sun, Wind Direction and Occurrence of Shadows

(i) Impact Assessment Methodology

This section presents the impact assessment methodology in relation to shadow flicker prediction model. This section discusses the modeling methodology and the relevant legislations against which the results are evaluated.

a. Shadow Flicker Modeling Methodology

A modeling of shadow flicker was performed to calculate potential impacts on villages of the Project area using the software WindPRO version 2.9, Sep. 2014. It is important to note that a worst case scenario was applied for the model, using the following assumptions:

- Clear sky without cloud cover from sunrise until sunset;
- The rotor plane is always facing the sun;

- The turbines are always in operation; and
- There is a direct line of sight between the turbine and the receptor (i.e. there is a window at the receptor that overlooks the turbine with no obstructions in place).

b. Legislative Requirements

There are no Jordanian requirements on limits of shadow flicker from wind turbines. However, the IFC EHS Guidelines for Wind Energy (IFC, 2015) recommends 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 affect day, based on a worst-case scenario. Therefore, the assessment has considered the limit for shadow flicker of 30 minutes duration per day and 30 hours per year.

(ii) Results

As discussed earlier, the noise prediction modeling software WindPRO 2.9 was employed to assess the shadow flicker impact from the wind farm operation. The modeling was based on the final layout of the wind turbines as provided by the Developer.

Potentially sensitive receptors are located in the villages surrounding the Project site. Separate receptor locations (labeled A to I) were selected in each of the surrounding villages as presented in the figure below, for evaluation of shadow flicker prediction results. Most of the points were selected on the boundaries of the villages closest to the Project site – the villages area (represented in pink in the figure below) are based on the official organized boundary of the village.

In addition, 1 additional point was selected outside of the organized boundary of Al-Rajef (point A) as based on several visits undertaken to the site it was noticed that several dwellings (around 3-5) lie within such areas – those are houses occupied by people from the local community of Al –Rajef.

Table 45: Receptor Points and Village they Represent

Receptor Points	Village
D and E	Sadaqah
F and G	Dlaghah & Rassees
I	Fardakh
A, B, C and H. Point A is located outside of the organized boundary of Al-Rajef but include several dwellings (3-5 houses) which are occupied by people from Al-Rajef.	Al–Rajef
J	Inside Projects site at the Olive mill

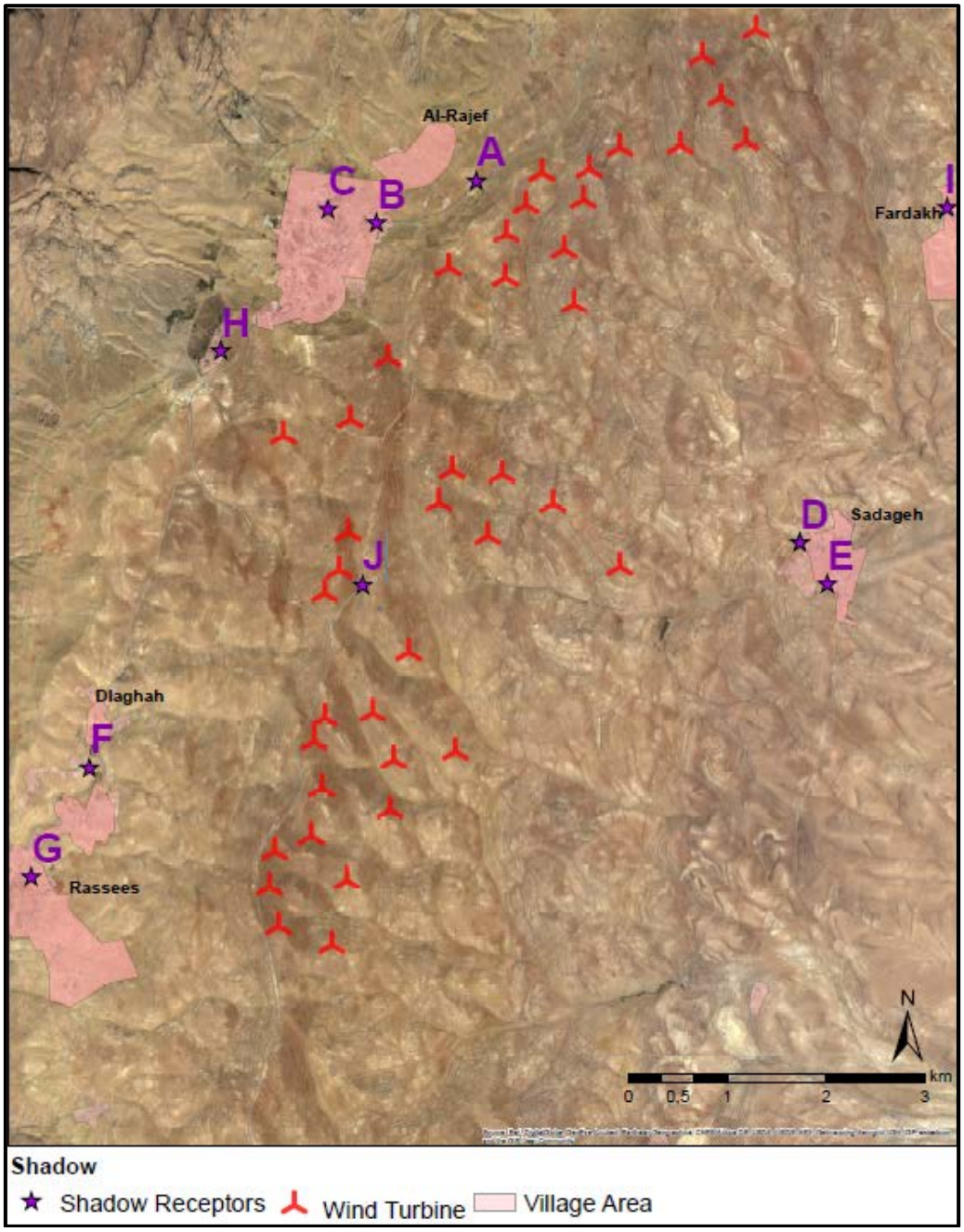

Figure 70: Location of Receptor Points for Shadow Flicker Modeling

The results of the modeling are presented in Figure 71 below indicating the area where shadow flicker can be expected and the maximum number of hours this nuisance will last. As noted in the figure, the results indicate that there are no issues of concern in any of the nearby villages or receptors points with regards to shadow flicker from the wind turbines, with the exception of Al-Rajef village as discussed in details below.

The figure shows that in some areas of Al-Rajef shadow flicker will occur exceeding the limits. At the nearest dwellings in the northwest and west of the Project (approx. 500-1000 m) the effect can occur more than 30 hours per year and more than 30 minutes per day. The exact areas in Al-Rajef village are presented in Figure 72 below. The figure shows that about 10 buildings only are situated in the area with 30 hours per year and 30 minutes per day – however neither the use of these buildings, the presence and height of windows and the relevance of their orientation are known.

The most noticeable occurrences, shown in Figure 72 below are:

- Turbine 6, between 7 and 8 a.m. in January/February and October/November at one receptor (A);

- Turbine 11, between 7 and 8 a.m. in April and August at three receptors (A, B, C);
- Turbine 13, between 7 and 8 a.m. between November and mid-February at two receptors (B, C); and
- Turbine 26, between 4 and 6 p.m. in February/March and September/October at one receptor (J).

It is important to highlight again that the results of the modeling are based on a worst case scenario as recommended by the IFC EHS Guidelines for Wind Energy (IFC, 2015). Such worst case scenario assumes:

- Clear sky without cloud cover from sunrise until sunset;
- The rotor plane is always facing the sun;
- The turbines are always in operation; and
- There is a direct line of sight between the turbine and the receptor (i.e. there is a window at the receptor that overlooks the turbine with no obstructions in place).

However, a realistic shadow flicker effect is expected to last about one third of the calculated worst case time, which would result in less than 30 hours per year and 30 minutes per day of possible nuisance by shadow flicker at the affected areas in Al-Rajef village. In the worst case scenario calculations it was assumed that the rotor place is always facing the sun – however in reality the prevailing wind direction in the Project area, which influences the position angle of the turbine and therefore the area of shadow flicker, is from northwest, which means shadow flicker will mostly occur in southeast direction, where dwellings are unlikely to be affected. There are no dwellings in the southeast direction and where there is (such as Fardakh and Sadaqah for certain turbines) they are located at a distance from the turbines where shadow flicker impacts are unlikely to affect them. Shadow flicker will have the highest effect when entering through constraint openings such as windows and thus the direction of windows at nearby houses will also influence the perception of shadow flicker effects.

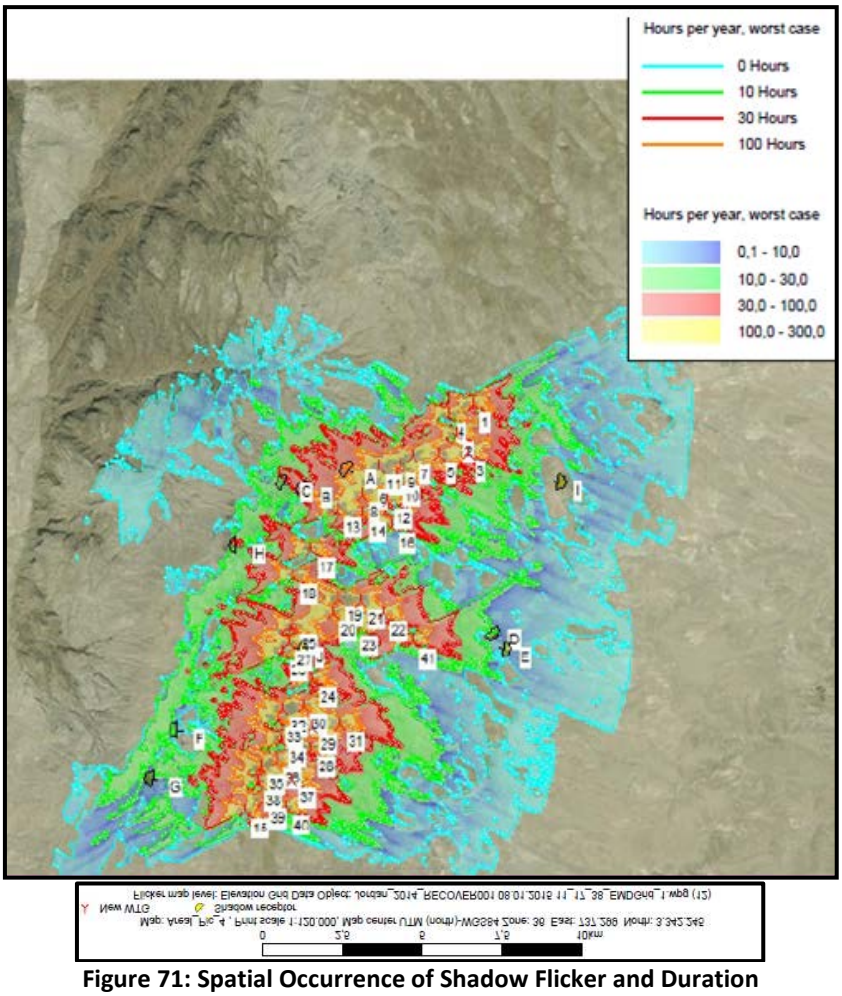

Figure 71: Spatial Occurrence of Shadow Flicker and Duration

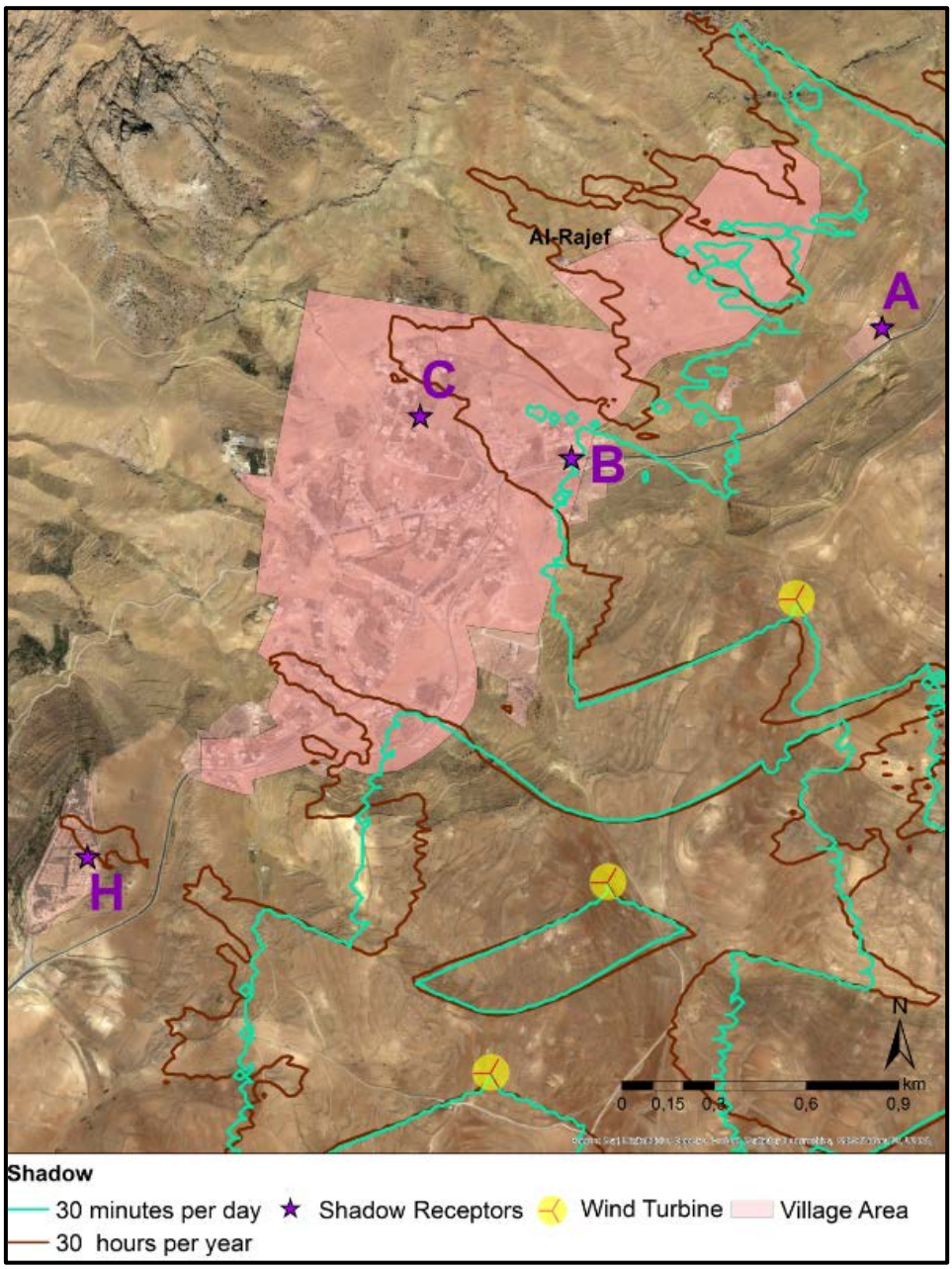

Figure 72: Spatial Occurrence of Shadow Flicker and Duration in Al-Rajef

Taking all of the above into account, such impacts are considered of long-term duration as they will occur throughout the operation phase of the Project and of a negative nature. In addition, given that there will be only limited small areas of Al-Rajef village where exceedance beyond acceptable limits are likely to occur (estimated to be around 10 houses only) and due to the fact that realistic shadow flicker effect is expected to last about one third of the calculated worst case time, such an impact is considered of low magnitude. However, the receiving environment is considered of high sensitivity given that it entails sound emissions which could potentially be a source of disturbance and nuisance to the receptors and residents. Given the above, such an impact is considered to be of minor significance.

Shadow flicker impacts are typically concerned on fixed and permanent sensitive receptors such as villages in which such impacts are of long-term duration (as discussed earlier). Although there could be potential for shadow flicker impacts on the road in the area (particularly Highway #35) however this is unlikely to be an issue of concern. Potential shadow flicker impacts from turbines on roads are temporary and short-term duration and highly unlikely to cause annoyance or more importantly impacts a driver's ability to operate a vehicle whilst travelling along the roads.

Mitigation and Compensation Measures / Monitoring and Reporting Requirements

The Developer/Project Operator must aim to introduce the effects of shadow flicker to the local community of Al-Rajef and present the results of the worst-case scenario analysis undertaken above, and identify the areas where shadow flicker is expected. However, as noted earlier the realistic shadow flicker effect is expected to last about one third of the calculated worst case time, which would result in significantly less nuisance by shadow flicker at the expected affected areas in Al-Rajef village.

In addition, a detailed grievance mechanism for the local community must be developed. The local community of Al-Rajef must be made aware of the grievance mechanism available to submit complaints regarding shadow flicker nuisances. Once such nuisances and conditions are verified on the ground, appropriate compensation measures must be implemented by the Developer to limit such impacts. This could include the introduction of vegetative buffers as a barrier for shadow flicker and/or providing window blinds.

Finally, it is important to note that as part of the disclosure session that was held with the local communities (refer to "Section 6.5.4" for additional details) the outcomes of the shadow flicker modelling assessment discussed above were presented and discussed as well as the proposed mitigation measures and monitoring requirements. No objections were raised with regards to the shadow flicker impacts from the Project.

Following the implementation of these measures, the significance of the residual impact can be reduced to not significant.

Other Affected Communities

In addition to the villages discussed above, there are other affected communities which could be impacted by shadow flicker generated from the turbines during operation.

As discussed earlier in "Section 9.1.3", local communities from Al-Rajef and Dlaghah & Rassees undertake agricultural and grazing activities during specific seasons of the year (generally between February and July). However, shadow flicker from the turbines would not affect their grazing and agricultural activities. In addition, potential impacts and nuisances from the turbines on those local communities undertaking such activities are considered temporary and not significant, given that those local communities do not reside in the area; once they undertake such activities they return to their villages (Rajef or Dlaghah).

In addition to the above, there some nomads that occupy the Rajef area from April till September and whom also undertake agriculture and grazing activities. Shadow flicker from the turbines would not affect their grazing and agricultural activities. In addition, potential impacts and nuisances from the turbines on the nomads are considered not significant. Nomads in general occupy the Rajef area on a yearly basis, but do not settle in the exact specific area each year. Therefore, in areas where high shadow flicker is expected from the turbines, the nomads could simply set up their tents on other nearby less affected areas. Based on consultations with the nomads the concept of shadow flicker from wind turbines was explained and the general response was that they did not mind at all moving around the Rajef area to less affected areas.

Mitigation Measures and Monitoring Requirements

The Developer/Project Operator must develop informative maps in Arabic of shadow flicker from the turbines in accordance with results highlighted throughout this chapter. Such maps must be published on information boards within the wind farm to allow nomads to build up their tents in less affected areas. Continuous inspections must take place to ensure that such informative maps are in place especially before the nomads arrive in the area (generally in April).

The Developer/Project Operator must aim to explain the shadow flicker propagation maps with the nomads in the area and identify where such maps are posted.

18.2.4 Potential Impacts from Blade and Tower Glint of Wind Turbines during Operation

Blade or tower glint occurs when the sun strikes a rotor blade or the tower at a particular orientation. This can impact a community, as the reflection of sunlight off the rotor blade may be angled toward nearby residences.

According to the IFC EHS Guidelines on Wind Energy (IFC, 2007), blade glint is a temporary phenomenon for new turbines only, and typically disappears when blades have been soiled after a few months of operation.

Taking all of the above into account, such impacts are considered of short-term duration as they will occur only temporary throughout the operation phase of the Project and of a negative nature. However, based on the location of the turbines in relation to nearby residential housing and the only temporary occurrence (if occurring at all) such an impact is considered of low magnitude and medium sensitivity. Given the above, such an impact is considered of moderate significance.

Mitigation Measures

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- Consideration should be given to the use of non-reflective finishes to ensure potential impacts are not significant.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to *not significant*

Monitoring and Reporting Requirements

The following presents the mitigation measures that are to be implemented by the Project Operator during the construction phase of the Project and which include:

- Inspections and visual monitoring to ensure that non-reflective finishes have been used.

18.2.5 Potential Impacts from Blade/Ice Throws during Operation

There are potential impacts from blade throws and ice throws from the wind turbines, where if such incidents occur they could affect the public safety of the residents of the nearby villages in the area as well as other potential receptors – for example vehicles passing on the highway within the Project area where some turbines are located, grazers from the local community passing next to turbines, etc.

According to the IFC EHS Guidelines on Wind Energy (IFC, 2015), a failure in the rotor blade can result in the 'throwing' of a rotor blade – however the overall risk of such an event is extremely low. In addition, if ice accretion occurs in blades, which can happen in certain weather conditions in cold climates, then pieces of ice can be thrown from the rotor during operation, or dropped if the turbine is idling. In the Project site, icing is expected to be a very low frequency occurrence based on the review of the climatic data for the region, and thus overall risk of such incidents is extremely low.

In addition, the EPC Contractor as part of the detailed design for setting of the wind turbines, has taken into account a safety setback distance for all types of falling hazards to include highly unlikely event of a blade/ice throws which entails the following: (i) a safety setback distance of tip height +10m from all road networks in the Project area (a distance of around 150m); and (ii) a safety setback distance of ½ rotor diameter from adjacent lands at each turbine (a distance of around 60m).

Taking all of the above into account, such impacts are considered of long-term duration as they will occur throughout the operation phase of the Project and of a negative nature. However, given that the overall

risk of such events is extremely low and the fact that safety setback distance have been assigned, such an impact is considered of low magnitude. However, the receiving environment is considered of high sensitivity given that it entails potential public safety concerns to the nearby residents and villages. Given the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- Present to the local communities the risks related to blade/ice throws and the likelihood of occurrence of such events. In addition, inform the local communities of the safety distance that must be kept from the turbines to ensure their public safety from events related to blade and ice throws;
- Ensure that regular maintenance of the wind turbines takes place according to set schedule to prevent any unforeseen events from occurring such as blade throws; and
- Install post signs at least 200 meters from the wind turbine in all directions which provide informative information in English and Arabic language about risks from such events.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to *not significant.*

Monitoring and Reporting Requirements

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- Inspections and visual monitoring to ensure that maintenance activities of turbines take place according to set schedule, and to ensure that warning signs and posts are installed on the ground.

18.2.6 Potential Impacts from Public Access during Operation

The final impact related to community health, safety and security is mainly related to public access of unauthorized personnel to the various Project components. Such access could results in safety issues such as unauthorized climbing of the turbine, safety hazards from substations (electric shock, thermal burn hazards, exposure to chemicals and hazardous materials, etc.) and others.

Such impacts are considered of long-term duration throughout the Project operation phase, of a negative nature, and are expected to be of medium magnitude and high sensitivity given that it entails potential public safety concerns which in extreme cases they could entail permanent impacts (e.g. death or permanent disability). Given the above such an impact is considered of moderate significance.

Mitigation Measures

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- A Security Risk Assessment should be developed for the Project and which takes into account the following:
  - Each turbine to be fitted with locked doors to prevent unauthorized access to the turbines;
  - Substation area to be completely fenced with concrete walls to prevent unauthorized access;
  - Onsite guards within the entire Project site at all times to ensure the safety and security of the Project as well a preventing unauthorized access to any of the Project components. However, it must be ensured that all onsite guards are adequately trained to deal with unauthorized trespassing

incidents. In addition, guards must refrain from using excessive force, unless situation extremely requires so.

- Present to the local communities the public safety hazards of the turbines and the various other Project components.
- Post informative signs on the turbines and other Project components (substation) about public safety hazards and emergency contact information.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to *not significant.*

Monitoring and Reporting Requirements

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- Inspections and visual monitoring to ensure above measures are in place; and
- Reporting of any trespassing incidents and the measures undertaken in such cases to control the situation and prevent it from occurring again.

19. SOCIO-ECONOMIC CONDITIONS

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to the socio-economic conditions and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, recommendations, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

19.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to socio-economic conditions as well as the outcomes and results.

19.1.1 Baseline Assessment Methodology

The socio-economic conditions were investigated for those local communities within the Project area as presented in the figure below. This includes Al-Rajef, Dlaghah & Rassees, Taybeh, Fardakh and Sadaqah (those have been referred to as 'local communities' throughout this chapter).

It is important to reiterate the administrative setup as framed by the district boundaries within Ma'an Governorate as those will be referred to many times throughout this chapter. The Project site is located within Ma'an Governorate which consists of 4 main Districts and 4 main Sub-districts that belong to the District of Qasabit Ma'an. Of those, the local communities are located within Petra District (Al-Rajef, Dlaghah & Rassees and Taybeh) and Eel sub-district which belongs to Qasabit Ma'an District (to include Fardakh and Sadaqah).

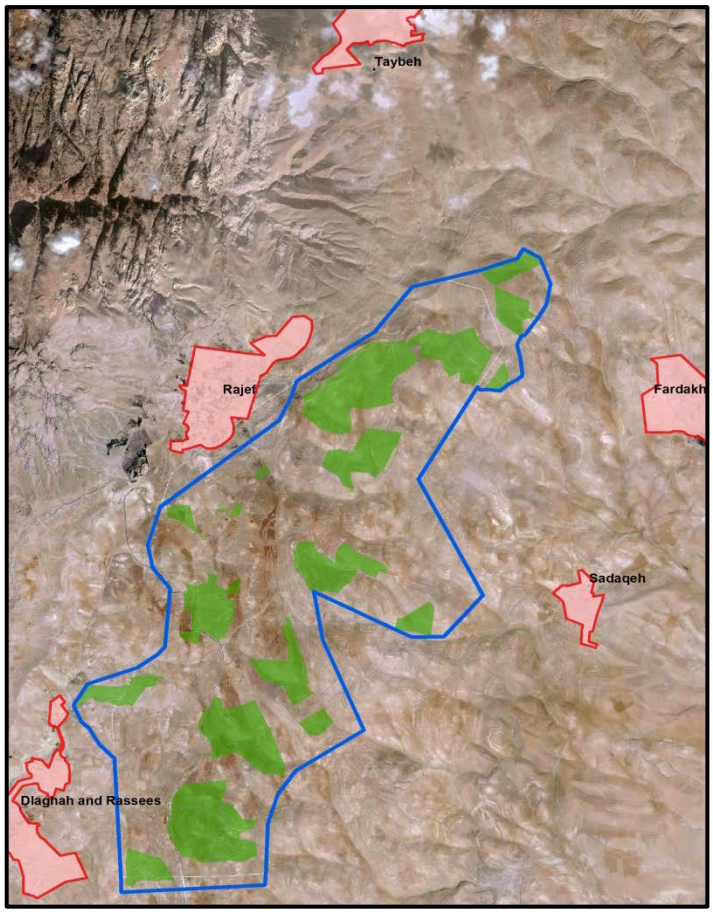

Figure 73: Local Communities Around the Project Site

Table 46: Administrative Setup for the Local Communities of the Project Site

Governorate	District/Sub-District	Local Community
Ma'an	**District of Qasabit Ma'an**	
	Eel Sub-District	Fardakh and Sadaqah
	Al-Jafr Sub-District	
	Mregha Sub-District	
	Athroh Sub-District	
	District of Petra	Al-Rajef, Dlaghah & Rassees and Taybeh
	District of Al-Shobak	
	District of Al-Husseiniyeh	

Socio-economic conditions have been established based on a review of secondary statistical data available mainly from the Department of Statistics (DoS). Available data was collected and reviewed for certain indicators in order to characterize and describe the socio-economic conditions. However, it is important to note that the majority of the socio-economic data from DoS is only available at the Governorate level; no data is available at the District level or specifically for the local communities near the Project area.

Therefore, additional socio-economic studies were collected and reviewed to compliment statistical data and provide additional insights for the socio-economic situation within the Project area in general and that of the nearby local communities to the greatest extent possible. Such data was mainly available for the Petra District only. This mainly includes the following studies: (i) "A Strategic Master Plan for Petra Region: Initial Diagnostic Report" (ATC Consultants, 2012), (ii) "Social and Economic Situation in Ma'an Governorate" (Social Development Unit of Ma'an Governorate, 2013), and (iii) "The Socio-economic Survey for Petra District" (Petra Development and Tourism Region Authority, 2013). It is important to note that very limited information was available on the local communities of Fardakh and Sadaqah.

In addition, as discussed earlier in "Section 6.56.5.2", detailed onsite consultation were undertaken with the local community. One of the objectives of such consultations (amongst others) was to verify (to the greatest extent possible and where relevant) the socio-economic conditions of those local communities based on the secondary data collected above.

19.1.2 Results

This section presents the results of the socio-economic conditions in relation to (i) population and demographics, (ii) livelihood and employment, (iii) income, unemployment, and poverty, and (iv) education and health services.

(i) Population and Demographics

According to DoS the population of Ma'an Governorate in 2014 (latest statistic) was estimated at 126,900 with an annual average population increase of 2.3% over the last decade. The population of the Governorate represents 2% of the total population of the Kingdom. Moreover, the population of Petra District was estimated at around 32,100 with a population of around 1,700, 1,400 and 5,719 of the villages near the Project site; Al-Rajef, Dlaghah & Rassees and Taybeh respectively. Taybeh is the second-largest community in the Petra District after Wadi Mousa. In addition, the population of Eel sub-district was 9,830 with a population of around 1,400 and 700 for Fardakh and Sadaqah respectively.

Generally, the Governorate has a similar gender distribution ratio of approximately 1:1, and an average household size of around 6 members. As expected, the majority of the population of the Governorate lives in the major district (around 55%) where the capital city is located (Ma'an City); whereas Petra District represents the second largest population count constituting approximately 25% of the population of the Governorate as a whole.

The Governorate has a population density less than 4 people/km^2, which is significantly lower than the national average of 75 people/km^2 given the relatively large area of the Governorate and the fact that the majority of the Governorate is unpopulated desert land. A summary of the Governorate and Petra District profile is presented in Table 47 below while the population breakdown is presented in Table 48. No additional details were available for Eel sub-district.

Table 47: Summary of Ma'an Governorate

Statistic	Ma'an Governorate	Petra District	National Average
Population	126,900	32,100	6,675,000
Average Household Size	6	5.6	5.3
Number of households	20,101	5,434	1,134,177
Population Density (people/km^2)	3.9	34.1	75.2
% Living in Major District	55%	N/A	N/A
% of Male /Female	52/48	51/49	52 / 48

Table 48: Population Breakdown of Ma'an Governorate

Governorate	District	Population
Ma'an	***Qasabit Ma'an District***	***68,680***
	Eel Sub-district	*9,830**
	Fardakh	*1,400**
	Sadaqah	*700**
	Petra District	***32,100***
	Al-Rajef	*1,674**
	Dlaghah and Rassees	*1,434**
	Taybeh	*5,719**
	Al-Shobak District	***14,930***
	Husseiniyeh District	***11,190***
Total		**126,900**

**those have been accounted for within the Qasabit Ma'an District or Petra District population count*

In general, Ma'an governorate is characterized by three major social environments; these are the city style, the village style, and nomads. The city style is represented mainly by Ma'an city. In spite of that, the simple village life style is dominant in the villages and small settlements scattered along the Governorate (including the local communities near the Project site), which are still the base that governs all social relations in Ma'an. Nomadic population is decreasing due to several factors, however nomads move on seasonal basis in search of proper range land to feed their livestock.

The communities of Ma'an Governorate in general identify themselves primarily in terms of tribal affiliations, and each village belongs to a distinct tribe or sub-group of a tribe. Within the local communities it is safe to say that the general demographic structure of the community is represented by a single kinship group as discussed in further details below.

Table 49: Tribe/Affiliations of Local Communities in the Area

Community	Tribe/Affiliation
Al-Rajef	The local community of Al-Rajef belong to the Al-Rawajfeh sub-group of the Bani Atiyyah tribe. The Bani Atiyyah tribe has no longer a presence in Jordan, and the Al-Rawajfeh are autonomous socially and politically (ATC Consultants, 2012).
Dlaghah & Rassees	The local community of Dlaghah & Rassees belong to the Saidiyyin tribe whom occupy primarily the southwestern end of the Petra Region. They also have more important settlements in Wadi Araba. They are distinctive within the Petra Region for having the largest proportion of nomadic families (ATC Consultant, 2012).
Taybeh	The local community of Taybeh belong to Al-Layathnah tribe, which is a relatively large group that occupies various other areas in the region besides Taybeh (such as Sadaqah and Wadi Mousa). Therefore, there are sub-groups to this tribe which are relevant to the structure of the region. The Taybeh community belongs to the Shrour sub-group of Al-Layathnah tribe (ATC Consultants, 2012).

Fardakh	The local community of Fardakh belong to the Naimat tribe, which is a large group that occupies many areas in in Ma'an Governorate in general. There are many sub-groups of to this tribe which are relevant to the structure of the region. The Fardakh community mainly belongs to Al-Salalmah sub-group.
Sadaqah	The local community of Sadaqah belong to the Howeitat tribe which is a large group that occupies many areas in Ma'an Governorate in general. There are many sub-groups of to this tribe which are relevant to the structure of the region. The Sadaqah community mainly belongs to the Thyabat sub-group of the Howeitat Tribe. In addition, the village is also occupied by Al-Layathnah tribe and specifically by Al-Rawadyah sub-group.

(ii) Livelihood and Employment

The section below discusses the main employment sectors in Ma'an Governorate, Petra District and the local communities to the greatest extent possible. This mainly includes: public services, industry and commerce, as well as other important sectors which do not employ a high percentage of the population - agriculture and tourism.

a. Public Services

According to DoS, the public service constitutes the highest percentage of the working population, accounting for 43% of the population in Ma'an Governorate. This sector mainly entails working for armed forces, police, and public administration offices and civilian central government. On the other hand, the education sector accounts for 19% of the working force (mostly in schools operated and managed by the Ministry of Education). The staff mainly includes teachers and administrative personnel, whom are mostly females. Together these two sectors constitute around two thirds of the working population in Ma'an Governorate, indicating that the majority of the workforce work for the government and in the public sector.

With regards to Petra District including its villages, a similar trend to the Governorate as a whole is true; where the majority of the working population is in the public services – accounting to around 69% (PDTRA, 2013). In fact, the economic base of Al-Rajef and Dlaghah & Rassees is primarily military service (in addition to livestock and agriculture as discussed in detail below). The economic base of Taybeh is also primary based on public services in general and not just military service, to include public administration offices and civilian central government (however they are less involved in livestock and agriculture).

Finally, based on discussions, it was understood that the economic base of the local communities of Fardakh and Sadaqah is similar to that of Al-Rajef and Dlaghah And Rassees – military service (in addition to livestock and agriculture as discussed in detail below).

b. Industry and Commerce

Industry and commerce forms an important part of the employment sector in Ma'an Governorate that accounts for 20% of the workforce respectively. According to DoS, in 2006 (latest statistic) there were approximately 2,260 active economic establishments in Ma'an. The breakdown for the active economic establishments that represent 90% of the total active establishments is presented in Table 50 below.

Table 50: Major Economic Establishments in Ma'an

Economic Establishment	Number of Establishments	Comment
Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods.	1,274	Represents 60% of the total active establishments. Mainly includes retail in food and beverages , and some in clothing and household appliances

Sale, maintenance and repair of motor vehicles	199	Mainly includes maintenance and repair of motor vehicles and sales of parts
Hotels and restaurants	149	Mainly restaurants
Other service activities	127	Mainly includes hairdressing and other beauty treatment
Other business activities	73	Mainly includes law firms.
Manufacture of fabricated metal products	60	Mainly manufacture of structural metal products and treated and coating of metals
Manufacture of fabricated metal products, except machinery and equipment.	57	Mainly includes manufacture of structural metal products
Manufacture of other non-metallic mineral products	47	Engaged in manufacture of articles of concrete, cement and plaster as well as cutting, shaping and finishing of stone
Manufacture of food products and beverages	34	Mainly includes bakery products and grain mill products
Mining and quarrying	22	Quarrying of stone, sand, and clay
Construction	8	Engaged in civil engineering and building construction
Total	**2,050**	**Represent 90% of the total active economic establishments**

It can be concluded that the majority of economic establishments in the Governorate are those that engage in retail trade of commodities (food, beverage, clothing, and household appliances) all of which are considered to be small establishments.

In fact, according to discussions with Ma'an Chamber of Commerce it was confirmed that the majority of economic establishments engage in retail trade, and most economic establishments are of small size. There are a limited number of economic establishments which have a registered capital greater than 1 million JD in Ma'an Governorate (none of which are located within the Project area) and which include: (i) Jordan Phosphate Mining Company – engaged in mining of phosphate, (ii) Indo-Jordan Chemicals Company - engaged in production of Phosphoric Acid and Sulphuric Acid, and (iii) a newly established plant - Al Awsat for chemical production.

Within the Petra District, this sector employs around 24% of the working population – 17% within the tourism services, 5% within the retail trade and 2% within the industrial sector (outside of the Petra Region) (PDTRA,2013). Similarly to the Governorate, the majority of economic establishments in Petra include rather small size economic establishments which engage in retail trade of commodities as well as hotels and restaurants given the touristic characteristic of the Petra region.

However, job opportunities in this sector for the nearby communities is rather limited (and even well below the percentages for the Petra District) and mainly include limited opportunities within retail trade establishments generally for food and beverage. The local communities of the Project have been largely uninvolved within the tourism sector as discussed in further details below.

c. Agriculture

The DoS statistics indicate that a very low percentage of the working population in this sector in Ma'an Governorate (approximately 1%). Within the Petra region this is true as well - around 5% (PDTRA, 2013), although agriculture could constitute an important pillar to the regional economy due to great potential it holds.

The economic base of the nearby villages is primarily livestock and agriculture (in addition to military service as mentioned earlier). However, the local communities engage in such activities mainly for self-sufficiency purposes and less so for a source of income. In addition, it is important to note that the local community of Taybeh are less involved in such activities when compared to the other communities.

d. Tourism

A limited percentage of the working population in Ma'an Governorate (excluding Petra region) work in this sector despite the presence of several unique archaeological sites which holds great potential for the area. On the contrary, within the Petra region, since the 1970's tourism has become an increasingly important income source for all communities, with the exception of the local communities in the Project site whom have been largely uninvolved within the tourism sector.

However, the local community of Taybeh has been involved to some extent in the tourism sector when the five-star hotel Taybeh Zaman was constructed there in the 1999's. Nevertheless, within the Petra region, tourism is especially critical for Wadi Musa which has developed local service industries and now rivals Ma'an city as a commercial hub for the region; where the other villages depend on it for most needs, e.g. mechanics, bakeries, supermarkets, construction material and services, etc.

(iii) Income, Unemployment, and Poverty

The section below discusses the income, unemployment, and poverty in Ma'an Governorate and Petra District and the nearby communities to the greatest extent possible.

According to DoS, the average annual income per household in 2010 (latest statistic) in Ma'an Governorate was around 7,500 JD , lower than the national average of 8,800 JD. This translates into 625 JD per month for the entire household (which averages around 6 members). In addition, around 60% of the income is generated from employment, 20% from transfers (which in general are in the form of pensions, subsidy transfers from the Government and transfers from expatriates), 5% from own business, and 13% from rent. Similarly, the average annual income per household member in Ma'an Governorate is 1,300 JD which is lower than the national average of 1,660, which translates into less than 110 JD per month.

Within the Petra District, the average annual income per household is 7,212JD, which translates into around 600 JD per month for the entire household (which averages around 5.6 members). In addition, the average annual income per household member in Petra District is 1,275JD. Those statistics are even lower than the average for the entire Governorate.

Taking all of the above into account and comparing those figures to the national averages clearly reveals that households in Ma'an Governorate and Petra District in general are poorer and are at a lower standard of living when compared to the average Jordanian households.

Finally, within Al-Rajef and Dlaghah & Rassees the average annual income per household is 6,564JD and 4,812JD respectively, while the average annual income per household member is 1,185JD and 747JD respectively; lower than the average of the entire District. The highest income statistics were for Wadi Mousa, which is expected given that it is considered the commercial hub for the Petra region and as it largely benefits from tourism services in the area. No statistical data was available for Fardakh and Sadaqah.

Similarly, taking all of the above into account and comparing those figures to the Petra District clearly reveals that households of the local communities in general are poorer and are at a lower standard of living when compared to the average households within the Petra Region.

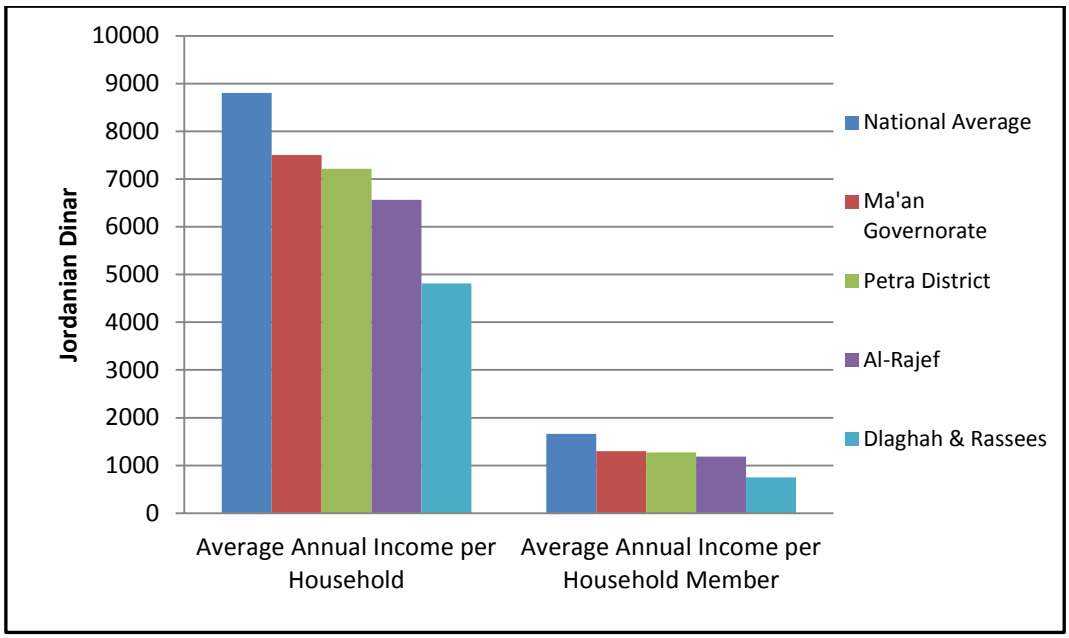

Figure 74: Income Statistics for Ma'an, Petra and the Nearby Communities

With regards to employment, in 2012 (latest statistic) in Ma'an Governorate 40% of the population of age 15 and above were economically active, of which 32% are working and 8% are seeking a job, whereas 60% are economically inactive. The high rate for the inactive population is due to the fact that they are mostly students (30% of the inactive) and housewives (50% of the inactive). It is worth mentioning that the majority of the economically inactive that can work but do not, believe that there are no job opportunities in the market for them and/or are tired of searching for a job.

Taking into account 2012 statistics for population, labor, and age breakdown gives insights about the human resources that are capable of being producers, of age 15 – 60+, in the community (economically active but cannot find a job); estimated at 6,000. The majority of the workforce, more than 50%, is between the age of 25 years old and 39, and around 19% are between 20-24 and 40-49. A very low percentage of the workforce is between the age of 15 -19 and 60+ (around 1%). Assuming a similar distribution among the unemployed, then projects targeting men and women in their twenties and thirties would have the highest impact on employment.

Figure 75 below presents the unemployment rate of Ma'an Governorate during the last 10 years compared to the national average. All statistics were based on DoS figures. The trend indicates a decreasing unemployment rate from around 24% to around 19% during the last 10 years; although from year to year it varies and most notable it increases from 2011 till 2012 from 15% to 19%. Nevertheless, the gap between the national figure and that of Ma'an Governorate clearly decreases throughout the last decade as presented in the figure below. However, although unemployment rate has improved throughout the last 10 years, it still remains higher than the national average, estimated at 12% in 2012, compared to 19% in Ma'an.

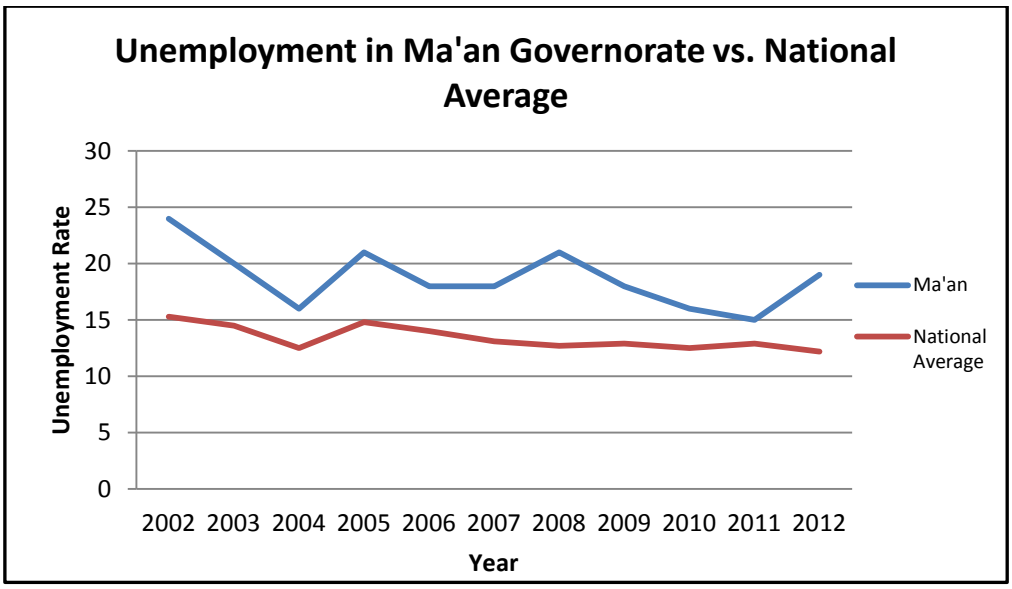

Figure 75: Unemployment in Ma'an vs. National Average from 2002-2012

According to the "Strategic Master Plan for Petra Region: Initial Diagnostic Report" (ATC Consultants, 2012), as of 2009 the unemployment rate in the Petra Region (9%) is lower on average than the Kingdom as a whole (14%). Table 51 below illustrates that, in 2009, the total number of unemployed amounted to 980, 59% of which were women, and 46% of all unemployed are aged between 21 and 25. Therefore, unemployment in the Petra Region mostly affects women as well as the population group aged between 21-25.

Although the exact share of this age group of the overall labor force is not known, it is still evident that the proportionate unemployment rate must be higher. Hence young people apparently encounter significant difficulties in entering the labor market. In addition, in this age group, approximately two thirds of all the unemployed are female: women thus face even higher obstacles to entering the labor market. The higher age groups account for a lower number of the unemployed. This might either be due to better job opportunities or quite conversely due to limited prospects.

The female share in unemployment also varies significantly depending on the age group. It is low for the age groups 36-40 and above 40, as well as below 20 years of age. Furthermore, the females' unemployment rate drops for the age group between 26 and 30. Most likely these fluctuations relate to women entering and dropping out of the labor market due to cycles related to family and social norms as well as limited social services such as childcare.

Table 51: Unemployment Rate per Age Group and Gender in Petra Region 2009

Age	Total	Male	Female
15-20	136	71	65
21-25	447	151	296
26-30	215	95	120
30-35	89	27	62
36-40	60	33	27
40 and above	33	25	8
Total	**980**	**402**	**578**

According to the "The Socio-economic Survey for Petra District" (PDTRA, 2013) unemployment rates in 2012 are significantly higher than those recorded within the "Strategic Master Plan for Petra Region: Initial Diagnostic Report" (ATC Consultants, 2012) – which were based on 2009 data. Table 52 below presents the unemployment rates within the Petra District and for each of those local communities in 2012 (PDTRA, 2013). No statistical information was available for Fardakh and Sadaqah.

Table 52: Unemployment Rate by Community in Petra District

Community	Unemployment Rate
Wadi Mousa	30.3%
Taybeh	19.9%
Al-Rajef	23.6%
Dlaghah & Rassees	41.5%
Um Sayhoun	18.7%
Al-Bayda	37.3%
District	**28.6**

As noted within the table above, unemployment rates are significantly higher (around 3 fold) compared to 2009 statistics; but similarly, the study concludes that unemployment in the Petra Region mostly affects women as well as the population group aged between 21-25.

According to discussions with the Social Development Unit of the PDTRA, the increase in unemployment rates since 2009 is generally due to the following: (i) the economic recession has significantly affected tourism within the Petra Region (which is an important employment sector), and thus many jobs have been lost. This has significantly affected Wadi Mousa in specific and the Petra Region in general, and (ii) since 2009 employment opportunities within the public services (which constitute the highest percentage of employment for the Petra Region) are limited or stopped entirely.

Figure 76 below presents the poverty rates for the Governorate for 2008 and 2010 compared to the national average. Similarly, all statistics were based on DoS figures. Poverty rate accounts for the percentage of residents who spend less than the national absolute poverty line. The absolute poverty line, also known as the general poverty line, is the required level of income or expenditure for an individual to secure the basic nutritional needs along with other basic non-nutritional needs related to housing, clothing, education, health, and transportation. In 2008, the absolute national average poverty line for the Kingdom was estimated at 680 JD and increased to 814JD in 2010.

The numbers in the figure below indicate that poverty rates in Ma'an are significantly higher than that of the national average in 2008 and 2010; around 24% compared to 13% and around 27% compared to 14% respectively. Ma'an ranked second (after Mafraq) in 2008 and was ranked first in 2010 for the Governorates with the highest poverty rates in the Kingdom.

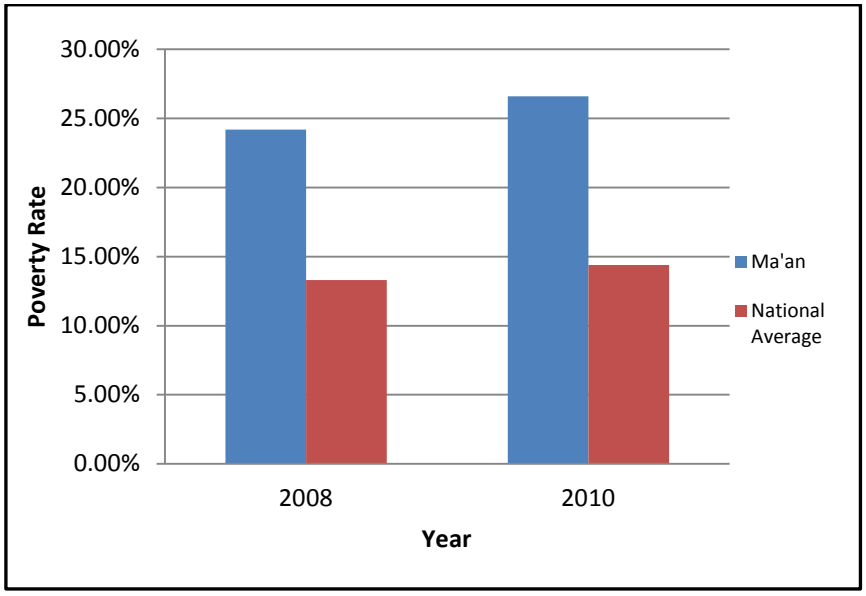

Figure 76: Poverty Rate in Ma'an vs. National Average for 2008 and 2010

According to the report 'Poverty Situation in Jordan' (DoS, 2010 and 2012) (which was based on 2008 and 2010 data respectively), the increase in poverty is likely attributed to the reduction in the purchasing

power due to inflation throughout the years which has reflected on the actual expenditure of individuals in those areas. However, generally poverty rates can be considered rather constant in Jordan as it is constant in those Governorates with the highest population numbers where more than two-thirds of the population of the Kingdom is concentrated.

The poverty statistics above are consistent with the listings of poverty pockets within Ma'an Governorate. Poverty pockets are the sub-districts in Jordan where poverty rate equals or exceeds 25%. According to DoS, in 2008 Ma'an Governorate had 4 poverty pockets (Mregha, Al-Jafr, Husseiniyeh, and Athroh) in all of which poverty increased in 2010 along with the introduction of a new sub-district (Eel Sub-district which includes the communities of Fardakh and Sadaqah). Petra District was not listed as a poverty pocket in 2008 or in 2010.

Although, Petra District has not been listed as a poverty pocket, yet poverty rates within the District are still considered high – amounting to 23% (PDTRA, 2013). Table 53 below provides the poverty rate within each of the local communities of the Petra District. Detailed poverty statistics for Fardakh and Sadaqah are not available.

The Poverty rate of Al-Rajef is around 23% and in Taybeh is 16% while within Dlaghah & Rassees it reaches extremely high levels – at 56%. The reason for such high poverty rates again is attributed to economic base of such local communities; which is mainly primarily military service and the fact that they have not benefited from the growth in tourism similar to other communities within the Petra Region (such as Wadi Mousa and to a much lesser extent Taybeh). In addition, such local communities generally lack governmental and private sector investment projects that can employ labor and thus positively impact poverty levels as well as unemployment levels.

Table 53: Poverty Rates within Petra District

Community	Poverty Rate
Wadi Mousa	16.6%
Taybeh	***16%***
Al-Rajef	***22.5%***
Dlaghah & Rassees	***55.6%***
Um Sayhoun	50%
Al-Bayda	58%
District	23.2%

(iv) Education and Health Services

a. Education

Ma'an Governorate has 201 schools (59 secondary schools, 135 primary schools, and 7 military education schools) with a total of 3,000 teachers whom educate a total of 29,000 students. The schools are distributed within most of the communities' in Ma'an Governorate. Specifically within the Petra District, there are 45 schools (11 secondary schools, 33 primary schools, and a military education school) with a total of 679 teachers whom educate a total of 7,406 students.

With Al-Rajef there are 5 schools (which includes primary schools and secondary schools for males and females) while within Dlaghah & Rassees there are 3 schools (secondary schools and a military education school for boys). No additional data was available for Fardakh and Sadaqah.

No data was available on students that continue to higher education. Nevertheless, with regards to higher education, within Ma'an Governorate are 4 universities/colleges and which include Al-Hussein Bin Talal University and Ma'an College (near Ma'an city), Al-Shobak College (in Al-Shobak), and the Petra College for Tourism and Archaeology (which is under the umbrella of Al-Hussein Bin Talal University and is located in Petra).

Illiteracy rate within the Petra District is around 10%; higher than the national average of 7% but yet lower than the Governorate average of 13%. However, throughout the last decade illiteracy has generally been improving due to vast improvements in education awareness and education services within those local communities. Table 54 below presents the education level of the local communities within the Petra District. No data was available for Fardakh and Sadaqah.

Table 54: Education Level of Local Communities within Petra District

Education level	Community					
	Wadi Mousa	Taybeh	Al-Rajef	Dlaghah & Rassees	Um Sayhoun	Al-Bayda
Illiterate	7.1%	9%	11. 9%	21.8%	12.1%	17.0%
Reads and Writes	3.6%	2.1%	2%	3.5%	8.4%	8.8%
Primary School	23.3%	31.3%	36.5%	39.5%	38.8%	44.8%
Secondary School	40%	35.5%	34.1%	31.0%	30.8%	25.8%
Diploma	7.9%	8.8%	4.1%	1.6%	1.8%	0.1%
Bachelors	15.4%	11.8%	10.6%	2.5%	7.7%	3.4%
Higher education	2.6%	1.5%	0.7%	0.1%	0.4%	0.1%

As noted in the table above, the highest illiteracy rate is in Dlaghah & Rassees. In addition, for the local communities of the Project area (Al-Rajef, Dlaghah and Taybeh), the majority of the population (around 70%) are at a school level of education, while a very low percentage are at an advanced educational level (beyond school education).

b. Health Services

Within the Ma'an Governorate there are two (2) public hospitals, the Ma'an Public Hospital located within Ma'an city and the Queen Rania Hospital located within Petra District (in Wadi Moussa). The following table summarizes the profile of each hospital.

Table 55: Summary of the Hospitals within Ma'an Governorate

Name	Bed Capacity	Number of Staff	Services Provided (Medical Specialties)
Ma'an Public Hospital	132	45 doctors, 35 administrative staff, 132 nurses, and 40 technicians	Surgery, internal medicine, orthopedics, urology, gynecology, pediatrics, ophthalmology, dermatology, physiotherapy, and otolaryngology.
Queen Rania Hospital	75	37 doctors, 99 nurses, and 28 technicians	Surgery, internal medicine, orthopedics, urology, gynecology, pediatrics, ophthalmology, dermatology, and otolaryngology.

The local communities within the Governorate are also served with five (5) comprehensive health centers of which one is located within Ma'an city while the others are located in Al-Shobak, Wadi Mousa, Al-Husseiniyeh, and Al-Jafr. In addition, spread throughout the Governorate are 38 primary health centers , 22 dentistry centers, 22 maternity and child care centers, 30 pharmacies, 16 laboratories, and 5 radiology laboratories.

19.2 Assessment of Potential Impacts

Given the generic nature of the impacts on socio-economic development for both phases of the Project (construction and operation) those have been identified collectively throughout this section.

From the onset of the Project, the Developer has shown commitment and responsibility towards local community development and engagement. To date, the Developer has been successful in building trust with the local community members through providing job opportunities (employment of 14 residents of Al-Rajef, Dlaghah and Taybeh village in various functions) as well as other social development plans and programs. Such trust from the local community members was felt throughout several interactions by the

'ESIA Team' with the local communities throughout the Project duration, whom in general were very supportive of the Project and grateful for the development plans implemented by the Developer thus far. Since the inception of the Project, the following social development measures were undertaken by the Developer:

- Raised awareness about Al-Rajef through radio talk show;
- Raised funds for the heating of the Special Needs School in Al-Rajef in 2012 and 2013;
- Raised funds for opening of a small road in Al-Rajef;
- Held Ramadan Iftar banquet for widows and orphans;
- Raised funds for the distribution of Ramadan food packages for widows and orphans;
- Funded the purchase of a new water pump for Al Rajef water well used for agricultural purposes; and
- Buying of Al-Rajef Special Needs School's products as gifts for Developer's banks, stakeholders and other partners.

In addition to the above, during the construction and operation phases, the Project is expected to provide job opportunities for local communities of the area. It is expected that the Project will create the following job opportunities:

- Around 200 job opportunities during the construction phase for a duration of approximately 22 months. This will mainly include around 40 skilled job opportunities (to include engineers, technicians, consultants, surveyors, etc.) and 160 unskilled job opportunities (mainly laborers but will also include a number of security personnel).
- Around 30 job opportunities during the operation phase for a duration of 20 years. This will include around 15 skilled job opportunities (such as engineers, technicians, administrative employees, etc.) and 15 unskilled job opportunities (such as security personnel, drivers, etc.).

The Developer will continue his commitment to social responsibly and local community engagement and development. Taking the above into account, the Developer is aiming to hire local community members to the greatest extent possible throughout the construction and operation phase for skilled and unskilled jobs. Based on preliminary information provided by the Developer, this will include around 15 job opportunities during the construction phase (for security and administrative assistance) in addition to unskilled construction workers (however the exact numbers have not been determined at this stage).

During the operation phase, this will include around 15 job opportunities for the local communities (to include security, drivers, and administrative assistance), and the Developer will be providing a capacity building and training programs (in cooperation with the Project Operator) for around 10 selected local community members to ensure they are equipped with the skills and qualifications required for the O&M of the Project. It is important to note that the information discussed above is based on preliminary information – the final numbers and details on such job opportunities and their nature will be finalized at a later stage.

The Developer is also considering other social responsibility programs and plans to the local community. The Developer is aware that such engagement and developments plans must not only serve Al-Rajef village but also the other nearby communities to the greatest extent possible (such as Dlaghah & Rassees, Fardakh, Sadaqah). The other programs and plans being considered include the following:

- Coordinate with local communities to arrange for daily meals to any workers onsite required;
- Installation of a mammogram/ultrasound machines;
- Maintenance of water wells;
- Maintenance of water distribution network;
- Possible University scholarships;

- Possible apple farming scheme;
- Possible cattle raising scheme; and
- Financing of solar power for existing schools.

Taking all of the above into account, such measures that are currently being implemented as well as those planned, could to some extent contribute to enhancing the living environment of the local communities, elevate their standards of living, and bring social and economic prosperity. In specific, the creation of job opportunities is of crucial importance especially because, as stated in "Section 19.1", the local community in general suffers from high unemployment rates and lacks governmental and private sector investment projects which can employ labor and thus positively impact unemployment levels.

The above could also entail other indirect positive benefits to the local community from increase in demand for local services, supplies, and businesses. This could include for example possible engagements from local contractors, as well as other supplies and services (accommodation services, food, household products, etc.). Such demands could improve the existing local economic activities and impact certain sectors, such as construction, wholesale/retail trade, hotels and accommodations, etc.

However, it is understood that the socio-economic development of the area is not hinged on a single project but rather on implementing collective and coordinated actions, including other development projects and investment within the area.

Nevertheless, proper planning and local community engagement from the start is crucial to understand issues and opportunities which in turn would enable the Project build true sustainable links which will bring maximum benefits to the local communities. Given the above, such impacts are anticipated to be ***positive***.

Recommendations

As the impacts discussed are mainly positive, no mitigation measures have been identified. This section provides recommendations which aim to enhance such positive impacts anticipated from the Project throughout the construction and operation phases to the greatest extent possible.

It is understood that Developer is committed to social responsibly and local community engagement and development. However, it is crucial that such development plans are structured as this would bring greater and more sustainable benefit to the local community.

Therefore, it is recommended that the Developer adopt and implement an Action Plan for working with the local community members. The Plan must aim to support the local economy stating its aims and objectives and should acknowledge the importance of building a strong socio-economic relationship with the local community through a participatory planning program (in which the local community can express their concerns, strengths and limitations) even before the development is in place. The Plan must take into account the following:

- The Plan must be fair and inclusive to all local communities affected by the Project and not just Al-Rajef village (to include Dlaghah & Rassees, Fardakh and Sadaqah) – it is understood that the degree of engagement and development would vary depending but on the proximity of the village to the Project and the degree to which it is affected, but nevertheless it is important that the other communities feel they are engaged and involved throughout the various phase of the Project;
- Manage expectations so that local communities are realistic about opportunities from the Project and clearly identify commitments by developers related to social development;
- Identify the number of skilled and unskilled job opportunities targeted to the local community throughout the construction and operation phases. The developers are expected to provide in details the qualifications and skills required for each job opportunities as well as the limitations and

constraints of local community members and how and to which extent those could be addressed through training and capacity building;

- Present transparent recruitment procedures for the local community, to be adopted and implemented in the various construction and operation contracting arrangements. Such procedures must provide equal opportunities for all, including females;
- Detail additional areas where local community members can benefit or be involved besides job opportunities provided they have the required skills and expertise needed to meet the development standards. For example, during construction the Project shall consider the appointment of local contractors, local sourcing of materials and supplies, etc.; and
- Ensure timely and continuous communication and dissemination of information between the developers and the local community members to alleviate potential sense of social marginalization and improve their understanding and perception of the benefits associated with development. Communication should also include information and updates on the projects development, number of employment opportunities, the bidding process for project components, construction plans, etc.

Finally, the Developer is expected to implement a structured approach for social responsibly programs. This involves developing a Corporate Social Responsibility (CSR) Program. The CSR program must include a needs assessment to identify priority development projects which benefit all local communities. Based on the outcomes of the needs assessment the CSR program will be developed along with an action plan which identifies the priority projects to be developed, allocated budget, timeline for implementation, etc. A summary of the CSR program then needs to be communicated to the local community and stakeholders through appropriate platforms (such as the local community offices in which the grievance mechanism is advertised).

20. SUMMARY OF ANTICIPATED IMPACTS

Table 56, Table 57 and Table 58 below present a summary of the anticipated impacts during the planning and construction, operation, and decommissioning phase of the Project. The information in the tables includes:

- Key and generic environmental attributes (e.g. air quality, noise);
- Impact (textual description);
- Nature of impact (negative or positive);
- Duration (long-term or short-term);
- Reversibility (reversible or irreversible);
- Magnitude (high, medium, or low);
- Sensitivity (high, medium, or low);
- Significance (major, moderate, minor, or not significant);
- Management action – generally management actions describe whether an impact can be mitigated or not. Management actions include: (i) mitigation measures; (ii) compensation measures; (iii) additional requirements which must be implemented at a later stage and which could be required by a governmental entity; (iv) for positive impacts recommendations have been provided which aim to enhance the impact; and
- Residual significance after management actions are implemented (major, moderate, minor, or not significant).

Table 56: Summary of Anticipated Impacts during the Planning and Construction Phase

Environmental Attribute	Likely Impact – Planning and Construction Phase	Impact Assessment							
		Nature	Duration	Reversibility	Magnitude	Sensitivity	Significance	Management Action	Residual Significance
Landscape and Visual	Visual and landscape impacts due to presence of elements typical of a construction site such as equipment and machinery.	Negative	Short – Term	Reversible	Medium	Low	Minor	Mitigation Available	Not Significant
Land Use	Project could conflict the formal assigned land sues set by the various governmental entities.	There are no anticipated impacts.						Additional Requirements	Not relevant
	Construction activities could disturb and affect the actual land use of the site as it is used by the local community for agriculture and grazing. In addition, nomads settle in the area and undertaken agricultural and grazing activities.	Negative	Short – Term	Reversible	Low	Medium	Minor	Mitigation Available	Not Significant
Geology and Hydrology	Risk of soil and groundwater contamination during the various construction activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater.	Negative	Long – Term	Could be irreversible	Low	Medium	Minor	Mitigation available	Not Significant
Biodiversity	Construction activities would disturb existing habitats (flora and fauna). In addition, other impacts could be from improper management of the site (e.g. improper conduct and housekeeping practices).	Negative	Long – Term	Could be irreversible	Medium	Low	Minor	Mitigation Available/ Additional Studies	Not Significant
Avi-Fauna (Birds)	Construction activities could disturb existing habitats of birds breeding and/or nesting within the Project site.	Negative	Short – Term	Could be irreversible	Low	Medium	Minor	Mitigation Available/ Additional Studies	Not Significant
Bats	Construction activities would alter the site's habitat and potentially affects bats particularly through loss of hunting habitats as well as removal of roosting sites.	Negative	Long – Term	Could be irreversible	Low	Low	Not Significant	No Mitigation Required	Not Significant
Archeology	Improper management of construction activities could disturb/damage the archaeological locations recorded within the area as well as potential archaeological remains which could be buried in the ground (if any).	Negative	Short – Term	Could be irreversible	Medium	Medium	Moderate	Mitigation Available	Not Significant
Air Quality and Noise	Construction activities will likely result in an increased level of dust, particulate matter and pollutant emissions which in turn will directly impact ambient air quality.	Negative	Short - Term	Reversible	Medium	Low	Minor	Mitigation Available	Not Significant
	Possible noise emissions to the environment from the construction activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities	Negative	Short - Term	Reversible	Medium	Low	Minor	Mitigation Available	Not Significant
Infrastructure and Utilities	Water Resources – water requirements of the Project could entail constraints on the existing resources users such as the local communities.	Negative	Short - Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Wastewater Utilities – it is important to ensure that existing utilities would be able to handle the amount of wastewater generated from the Project during the construction phase.	Negative	Short - Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Solid Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project during the construction phase.	Negative	Short - Term	Reversible	Low	Low	Not Significant	Additional Requirements	Not Significant
	Hazardous Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of hazardous waste generated from the Project during the construction phase.	Negative	Short - Term	Reversible	Low	Low	Not Significant	Additional Requirements	Not Significant
	Road Networks – if transportation activities of the various project components to the site are not properly managed beforehand, they could entail risk of damage to the existing roads and could be of public safety concerns to other users on the road.	Negative	Short - Term	Could be Irreversible	High	Medium	Moderate	Mitigation Available	Not Significant
	Aviation, Telecommunication, and TV & Radio Links – Improper planning and site selection of the Project could impact aircraft safety and/or could potentially interfere with certain electromagnetic transmissions associated with air transport, telecommunications, and radio/television systems in the area.	There are no anticipated impacts.						Additional Requirements	Not relevant
Occupational Health and Safety	There will be some generic risks to workers health and safety from working on construction sites, as it increases the risk of injury or death due to accidents.	Negative	Short – Term	Could be Irreversible	Medium	High	Moderate	Mitigation Available	Not Significant
Socio-economic Development	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity to local communities.	Positive	Not applicable.						

Table 57: Summary of Anticipated Impacts during the Operation Phase

Environmental Attribute / Issue	Likely Impact – Operation Phase	Impact Assessment							
		Nature	Duration	Reversibility	Magnitude	Sensitivity	Significance	Management Action	Residual Significance
Landscape and Visual	Visual impacts concern the turbines themselves (e.g. color, height, and number of turbines) and impacts relating to their interaction with the character of the surrounding landscape. There were various impacts assessed on various landscape types. The assessment outcome to the right presents the worst case scenario – although for most of the landscape types the assessment was considered of minor significance.	Could be Negative or Positive	Long – Term	Reversible	High	Medium	Moderate	Mitigation Available	Minor
Land Use	Operational activities could disturb and affect the actual land use of the site as it is used by the local community for agriculture and grazing. In addition, nomads settle in the area and undertaken agricultural and grazing activities.	Negative	Long – Term	Reversible	Low	Medium	Minor	Mitigation Available	Not Significant
Geology and Hydrology	Risk of soil and groundwater contamination during the various operational activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater.	Negative	Long – Term	Could be irreversible	Low	Medium	Minor	Mitigation available	Not significant
Biodiversity	Improper management of the site could disturb existing habitats (e.g. improper conduct and housekeeping practices).	Negative	Long – Term	Could be irreversible	Medium	Low	Minor	Mitigation Available	Not Significant
Avi-Fauna (Birds)	Wind turbines are associated with impacts on birds from risks of strikes and collision on both migratory and resident soaring birds. Such impacts depend on several factors but could affect the population levels of certain species especially those with international/national critical conservation status.	Negative	Long – Term	Could be irreversible	Low – High	Medium	Moderate	Mitigation Available	Not Significant
Bats	The potential impacts from the Project during operation are mainly related to risk of bat strikes and collisions with rotors of the operating wind turbines.	Negative	Long – Term	Could be irreversible	Low	Low	Not Significant	Mitigation Available / Additional Studies	Not Significant
Archeology	Improper management of operational activities could disturb/damage the archaeological locations recorded within the Project area.	Negative	Long - Term	Could be irreversible	Medium	Low	Minor	Mitigation available	Not Significant
Infrastructure and Utilities	Water Resources – water requirements of the Project could entail constraints on the existing resources users such as the local communities.	Negative	Short - Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Wastewater Utilities – it is important to ensure that existing utilities would be able to handle the amount of wastewater generated from the Project during the operation phase.	Negative	Long – Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Solid Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project during the operation phase	Negative	Long – Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Hazardous Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of hazardous waste generated from the Project during the operation phase.	Negative	Long – Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Electricity network - Project is expected to contribute to supplying electricity to the National Grid for end users and help meet the increasing electricity demands throughout the Kingdom	Positive	Not applicable.						
Occupational Health and Safety	There will be some risks to workers health and safety during the operation and maintenance activities of the Project.	Negative	Long – Term	Could be irreversible	Medium	High	Moderate	Mitigation Available	Not Significant
Community Health , Safety and Security	Operating wind turbines will produce noise from mechanical and aerodynamic effects. This could be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment.	Negative	Long – Term	Reversible	Medium	High	Moderate	Mitigation and Compensation Available	Not Significant
	Operating wind turbines could produce low frequency noise, infrasound and vibration which could be a source of nuisance to the receptors and residents of the nearby villages.	Negative	Long – Term	Reversible	Low	Low	Not Significant	No additional requirements	Not Significant
	Shadow flicker from the rotating turbines could potentially be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment.	Negative	Long – Term	Reversible	Low	High	Minor	Mitigation and Compensation Available	Not Significant
	Blade or tower glint can impact a community, as the reflection of sunlight off the rotor blade may be angled toward nearby residences.	Negative	Short – Term	Reversible	Low	Low	Minor	No additional requirements	Not Significant
	Failure in rotor blade or ice accretion can result in the 'throwing' of the blade. Although overall risk of such events is extremely low, it could affect the public safety of the residents of nearby villages.	Negative	Long – term	Could be Irreversible	Low	High	Minor	Mitigation Available	Not Significant
	Public access of unauthorized personnel to the various Project components (turbines, substation) could results in various public safety hazards to local communities.	Negative	Long – term	Could be Irreversible	Medium	High	Moderate	Mitigation Available	Not Significant
Socio-economic Development	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity to local communities.	Positive	Not applicable						

Table 58: Summary of Anticipated Impacts during the Decommissioning Phase

Environmental Attribute / Issue	Likely Impact – Operation Phase	Impact Assessment							
		Nature	Duration	Reversibility	Magnitude	Sensitivity	Significance	Management Action	Residual Significance
Geology and Hydrology	Risk of soil and groundwater contamination during the various decommissioning activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater	Negative	Long – Term	Could be irreversible	Medium	Low	Minor	Mitigation available	Not significant
Air Quality and Noise	Decommissioning activities will likely result in an increased level of dust and particulate matter emissions which in turn will directly impact ambient air quality.	Negative	Short term	Reversible	Medium	Low	Minor	Mitigation available	Not significant
	Possible noise emissions to the environment from the decommissioning activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities	Negative	Short term	Reversible	Medium	Low	Minor	Mitigation available	Not significant
Occupational Health and Safety	There will be some generic risks to workers health and safety from working on decommissioning sites, as it increases the risk of injury or death due to accidents.	Negative	Short Term	Could be irreversible	Medium	High	Moderate	Mitigation Available	Not significant

21. ASSESSMENT OF CUMULATIVE IMPACTS

This section investigates the cumulative impacts which could results from incremental impacts from other known existing and/or planned developments in the area based on currently available information.

Within the Project area and its surrounding there are no existing and/or planned developments which would result in cumulative impacts on any of the environmental/social receptors investigated as part of the ESIA. Investigating existing and planned developments in a broader area reveals that there are other projects which could result in cumulative impacts. Those mainly include other existing and planned wind farm developments which are located at a distance from the Project site. Those include the following and which are presented in Figure 77 below.

1. Tafileh Wind Farm Project: a 117MW project that is located around 55km north of the Project site. Project is owned by Jordan Wind Power Company (JWPC) and started commercial operation in September 2015;
2. Fujeij Wind Farm Project: a 90MW project that is located around 40km north of the Project site. Project is owned by MEMR. Project is expected to commence with construction activities in first quarter of 2016 and operation is expected in 2017;
3. Ma'an Wind Farm Project: a 75MW project that is located around 20km to the northeast of the Project site. Project is owned by MEMR. Construction activities are currently being undertaken and operation is anticipated in the first quarter of 2017;
4. Kospo Wind Farm Project: a 50MW project that is located around 60km north of the Project site. Project is owned by Korea Southern Power Company. This Project is part of the Direct Proposal Projects that have been shortlisted by MEMR, but it is unclear at this stage whether this Project would move forward or not due to capacity constraints on the national grid; and
5. Xenel Wind Farm Project: a 50MW project that is located around 65km north of the Project site. Project is owned by Xenel. This Project is part of the Direct Proposal Projects that have been shortlisted by MEMR, but it is unclear at this stage whether this Project would move forward or not due to capacity constraints on the national grid.

Investigating the potential cumulative impacts from these Projects reveals that for most environmental/social receptors there aren't any foreseen impacts. This is mainly due to the following;

- Long distance between the Rajef Project and the other wind farm development. Such a geographical distance would not result in any key cumulative impacts on relevant receptors. This includes impacts on visual and landscape and impacts from shadow flicker and noise; and
- The nature of the other impacts is site-specific and assessment of cumulative impacts in that sense is not relevant. This includes impacts such as land use, geology and hydrology, biodiversity, bats, archeology and cultural heritage, air quality, infrastructure and utilities, and occupational health and safety.

However, of particular importance would be the potential cumulative impacts on avi-fauna during the operation phase. In such a geographical distance, cumulative impacts could occur mainly from strikes and collision of birds with operating wind farms. For example, given the migration route of birds during spring there could be impacts on migratory birds from the Rajef Project which could result in fatalities on certain species considered of key importance. As birds continue with their migration route towards the north there could be other impacts from other project (such as the existing Tafileh Project). A qualitative or quantitative assessment of such cumulative impacts could not be undertaken at this stage due to unavailable public data of bird surveys undertaken for most of these projects, unavailable detailed designs and turbine layouts, etc.

Nevertheless, the only operational project at this stage from those projects listed above is the Tafileh Wind Farm. The Project is currently implementing a bird monitoring plan for observer-led turbine(s) shutdown

on both migratory and resident birds. As noted throughout this ESIA (refer to "Section 12.3.2"), a similar monitoring plan has been developed for this Project. It is also assumed that should other wind farm developments take place a similar monitoring plan is implemented during the operation phase. With the implementation of such measures, the cumulative impacts on avi-fauna are anticipated to be not significant.

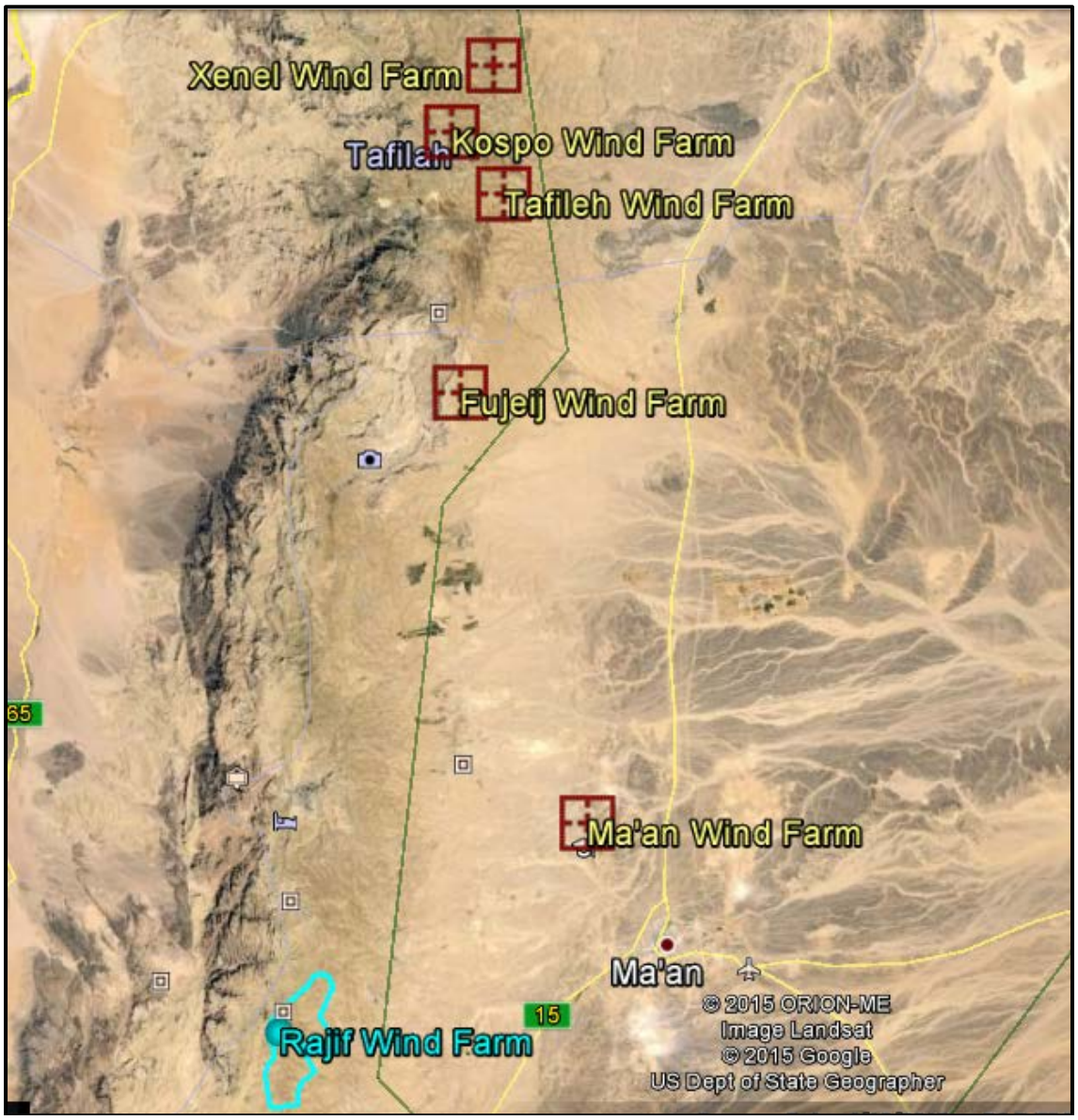

Figure 77: Location of Wind Farm Projects in the Area

22. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

22.1 Institutional Framework and Procedural Arrangement for ESMP Implementation

Generally, two main pillars govern the successful implementation of any Environmental and Social Management Plan (ESMP):

1. Proper identification of roles and responsibilities for the entities involved; and
2. Effective control of the process.

All management practices are interlinked, and this section describes how these two pillar criteria could be fulfilled, which in turn helps ensure that the overall objectives of the ESMP are met.

Defining roles and responsibilities of the involved entities in any ESMP identifies where and when each entity should be engaged, their degree of involvement, and the tasks expected of the entity. This in turn eliminates any overlap of jurisdiction or authority and ensures proper communication and effective management of ESMP components. Control processes mainly include training and awareness for entities involved and control of non-conformances that might occur throughout the process.

The objective is to ensure that the ESMP recommendations are implemented in practice, during construction and operation, and assess how environmental resources are affected. Table 59 below summarizes the overall proposed institutional and procedural arrangement for the implementation of the ESMP, while Table 60 discussed in details the roles and responsibilities of each of the entities involved in implementation of the ESMP.

Generally, a self-compliance approach is advocated, whereby the body responsible for the causative action should ensure that the objectives and requirements stipulated within the ESMP are met – this mainly includes the appointment of a competent HSE Officer by the EPC Contractor during the Construction Phase, while during the Operation Phase this is to be undertaken through the appointment of a competent staff member of the Project Operator Team – there is no need to appoint a separate HSE Officer during operation due to the limited and simple mitigation/monitoring measures detailed within the ESMP (with the exception of the avi-fauna and bat management and monitoring measures which must be undertaken by an expert in this field).

In addition, the Developer is required to review the reporting requirements as per the ESMP and undertake auditing exercises to ensure that the EPC Contractor and Project Operator meets the requirements stipulated within the ESMP. This could be undertaken through the appointment of a competent HSE Officer as part of the Developer Team or through a third party Employer Representative. It is recommended to undertake the auditing exercises on a monthly basis during the construction phase and on a quarterly basis during the operation phase.

Finally, in accordance with the "EIA Regulation No. (37) of 2005", the Regulator (being MoEnv), will be responsible for undertaking compliance monitoring to ensure that the responsible entity is adhering to the ESMP requirements.

Table 59: Overall proposed institutional and procedural arrangement for ESMP Implementation

Issue	Self-Compliance	Review/Checks	Compliance Monitoring/ Inspection
Construction Phase			
Compliance with ESMP Requirements	EPC Contractor – HSE Officer	Project Developer – HSE Officer or third party Employer Representative (monthly basis)	MoEnv
Compliance with environmental legislations	EPC Contractor – HSE Officer	Project Developer – HSE Officer or third party Employer Representative (monthly basis)	MoEnv
Operation Phase			
Compliance with ESMP	Project Operator – Project	Project Developer – HSE Officer or	MoEnv

Requirements	Staff Member	third party Employer Representative (on a quarterly basis)	
Compliance with environmental legislations	Project Operator - Project Staff Member	Project Developer – HSE Officer or third party Employer Representative (on a quarterly basis)	MoEnv

Table 60: Roles and Responsibilities of Entities Involved in ESMP

Designation	Entity	Project Role	Environmental and Social Responsibilities
Project Developer	Green Watts Renewable Energy	Project Owner and Developer	▪ Selection of EPC Contractor and Project Operator; ▪ Implement mitigation and monitoring requirements as detailed in the ESMP; and ▪ Appoint a competent HSE Officer or Third Party Employer representative to review the reporting requirements as per the ESMP and undertake auditing exercises to ensure that the EPC Contractor and Project Operator conform to the requirements of the ESMP. Auditing is to be undertaken on a monthly basis during the construction phase and on a quarterly basis during the operation phase.
Engineering, Procurement, and Construction (EPC) Contractor	Gamesa	Undertake detailed design and construction of the project	▪ Appoint a competent HSE officer responsible for implementing the ESMP. ▪ Implement mitigation and monitoring requirements as detailed in the ESMP; ▪ Prepare and submit reporting requirements to Project Developer as detailed in the ESMP; ▪ Implement corrective action measures in case of non-compliance incidents and submit non-conformance report to Project Developer whom in turn will submit to MoEnv.
National Electric Power Company (NEPCO)	National Electric Power Company (NEPCO)	Build substation with overhead lines to the existing grid	▪ Refer to “Chapter 23”.
Project Operator	Gamesa	Operation and maintenance of the Project	▪ Due to the limited and simple mitigation/monitoring measures detailed within the ESMP for the Operation Phase, a staff member of the Project Operator Team must be appointed to implement the requirements detailed within the ESMP; ▪ Appoint avi-fauna and bat expert to implement the management and monitoring measures required as per the ESMP. ▪ Prepare and submit reporting requirements to Project Developer as detailed in the ESMP; and ▪ Implement corrective action measures in case of non-compliance incidents and submit non-conformance report to Project Developer whom in turn will submit to MoEnv.
Environmental Regulator	Ministry of Environment	Granting environmental clearance to the Project	▪ Undertake compliance monitoring

22.2 Training and Awareness Raising

Effective and efficient implementation of any ESMP requires that all personnel involved in the Project (construction/operation staff across all levels) understand its objectives and requirements. A proper training and awareness program ensures that applying mitigation measures is more of a sense of responsibility rather than an enforcing protocol.

Training and awareness is an ongoing process, but most importantly must take place before the commencement of any activity in any phase of the Project. The EPC Contractor and Project Operator are responsible, each for his own staff, for conducting inductions, training requirements and awareness raising which should include at a minimum the following:

- Ensure that staff understand all requirements, measures, and protocols stipulated within the ESMP;
- Ensuring that all personnel engaged in activities that may have an impact on the environment are competent to carry out their duties, or, where necessary, arrange for suitable training to be undertaken;
- Cultural change towards environmental perception;
- Waste, wastewater, and hazardous waste management practices as identified throughout the ESMP;
- Occupational health and safety; and
- Emergency response procedures.

22.3 Control of Non-Compliances

In case any incidents of non-compliance with the ESMP or relevant environmental legislations were noted by MoEnv, as part of their compliance monitoring, then the responsible entity (EPC Contractor or Project Operator) is responsible for issuing a Non-Compliance Report to be submitted to the MoEnv. The report would identify the nature of the problem, the proposed corrective action, action taken to prevent recurrence of the problem and verification that the agreed actions have been carried out. Normally, a Non-Compliance Report should be submitted within 24 hours of the identification of the non-compliance. However, in cases that demand an immediate response to address the non-compliance incident, the MoEnv should verbally notify the Contractor of the non-compliance. The Contractor should then take all necessary measures to address the non-compliance.

22.4 Compilation of Environmental and Social Management Plan

Table 61, Table 62 and Table 63 below present the ESMP for the planning and construction, operation, and decommissioning phase respectively and which include the following:

- The environmental attribute (e.g. air quality) that is likely to be impacted;
- A summary of the potential impact and/or likely issue;
- The identified management measures that aim to eliminate and/or reduce the potential impact to acceptable levels. Management measures include mitigation actions, further requirements, additional studies, and compensation measures;
- Monitoring actions to ensure that the identified mitigation measures are implemented. Monitoring actions include: inspections, review of reports/plans, reporting, etc.;
- The frequency for implementing the monitoring actions, which include: once , continuously throughout the construction/operation period (depending on the mitigation measure identified this could include daily, weekly, or monthly), or upon occurrence of a certain issue;
- The responsible entity for implementing the mitigation measures and monitoring actions identified; and
- The relevant legislation that must be adhered to and which govern the environmental attribute or likely issue identified.

Table 61: ESMP for the Planning and Construction Phase

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
Landscape and Visual	Visual and landscape impacts due to presence of elements typical of a construction site such as equipment and machinery.	Ensure proper general housekeeping and personnel management measures are implemented which could include: (i) ensure the construction site is left in an orderly state at the end of each work day, (ii) to the greatest extent possible construction machinery, equipment, and vehicles not in use should be removed in a timely manner, (iii) proper handling of waste streams, etc.	Mitigation	Inspection	Continuous	EPC Contractor	- Environmental Protection Law No. 52 of 2006
Land Use	Project could conflict with formal land use set at the planning level for the area. In addition	Once a final detailed design has been prepared for the Project components, and only if construction activities require any forest trees in the Project site be removed, then the EPC Contractor must submit an application to the Sherah Agricultural Development Directorate in order to obtain their approval	Additional Requirement	Submit official letter of approval from Sherah Agricultural Directorate	Once; before construction commences	EPC Contractor	- Agriculture Law No. 44 for the year 2002
	Construction activities could disturb and conflict with actual land use as it could provide value to locals.	Allow all local community members to continue with their grazing and agricultural activities in the Project area as normal, as well as nomadic settlers (that is besides those areas of the actual footprint of the Project site).	Mitigation	Inspection	Continuous	EPC Contractor	- Environmental Protection Law No. 52 of 2006
		A detailed grievance mechanism must be developed for the local community as well as nomads. The local community and nomads must be made aware of the grievance mechanism to submit complaints against any potential prohibition of access to the Projects area with no legitimate reason (e.g. safety and security reasons).	Mitigation	Submit report which details grievance nature, how it was handled, and follow-up measures implemented	Continuous	EPC Contractor	
Soil and Groundwater	Improper management of solid waste	Coordinate with PDTRA or hire a competent private contractor for the collection of solid waste from the site to Al-Basta Landfill (for municipal waste) and Shabit Al Dabe Landfill (for construction waste).	Mitigation	Review contract with contractor	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Solid Waste Management Regulation No. (27) of 2005
		Prohibit fly-dumping of any solid waste to the land.	Mitigation	Inspection	Continuous	EPC Contractor	
		Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste".	Mitigation	Inspection	Continuous	EPC Contractor	
		Distribute a sufficient number of properly contained containers clearly marked as "Construction Waste" for the dumping and disposal of construction waste. Where possible, the EPC Contractor must seek ways to reduce construction waste by reusing materials (for example through recycling of concrete for road base coarse).	Mitigation	Inspection	Continuous	EPC Contractor	
		Implement proper housekeeping practices on the construction site at all times.	Mitigation	Inspection	Continuous	EPC Contractor	
		Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. The numbers within the records are to be consistent to ensure no illegal dumping at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	EPC Contractor	
	Improper management of wastewater	Coordinate with Petra wand Wadi Mousa Water Directorate to hire a private contractor for the collection of wastewater from the site to Wadi Mousa WWTP or Ma'an WWTP.	Mitigation	Review contract with contractor	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Public Health Law No. 47 for 2008
		Prohibit illegal disposal of wastewater to the land	Mitigation	Inspection	Continuous	EPC Contractor	
		Ensure that constructed septic tanks during construction and those to be used during operation are well contained and impermeable to prevent leakage of wastewater into soil.	Mitigation	Inspection	Once	EPC Contractor	
		Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing.	Mitigation	Inspection	Continuous	EPC Contractor	
		Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas.	Mitigation	Review manifests to ensure consistency	Continuous	EPC Contractor	
	Improper management of hazardous waste	Coordinate with the MoEnv and hire a private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility.	Mitigation	Review contract with contractor	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Management, Transportation, & Handling of Harmful & Hazardous Substances Regulation No. (24) of 2005, - Instruction for Management and Handling of Consumed
		Follow the requirements for management and storage as per the 'Instructions for Hazardous Waste Management and Handling of the Year 2003' of the MoEnv.	Mitigation	Inspection	Continuous	EPC Contractor	
		Prohibit illegal disposal of hazardous waste to the land.	Mitigation	Inspection	Continuous	EPC Contractor	
		Ensure that containers are emptied and collected by the contractor at appropriate	Mitigation	Inspection	Continuous	EPC	

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
		intervals to prevent overflowing.				Contractor	Oils for 2003, - Instruction for Hazardous Waste Management for the year 2003
		Maintain records and manifests that indicate volume of hazardous waste generated onsite, collected by contractor, and disposed of at the Swaqa Facility. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas.	Mitigation	Review manifests to ensure consistency	Continuous	EPC Contractor	
	Improper management of hazardous material	Ensure hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of impermeable surface, accessible to authorized personnel only, prevent incompatible materials from coming in contact, etc.	Mitigation	Inspection	Continuous	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Jordanian Standard 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials
		Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. Spilled material should be tracked and accounted for.	Mitigation	Inspection	Continuous	EPC Contractor	
		Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc.).	Mitigation	Inspection	Continuous	EPC Contractor	
		Regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material.	Mitigation	Inspection	Continuous	EPC Contractor	
		Ensure that a minimum of 1,000 liters of general purpose spill absorbent is available at hazardous material storage facility.	Mitigation	Inspection	Continuous	EPC Contractor	
		If spillage occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.	Mitigation	Inspection Reporting of incident and measures taken to minimize impact	Upon Occurrence	EPC Contractor	
Biodiversity	Construction activities would disturb existing habitats (flora and fauna). In addition, other impacts could be from improper management of the site (e.g. improper conduct and housekeeping practices).	Before construction commences, undertake a detailed survey to identify the presence of any active tortoises as well as potential hibernation/aestivation sites (during summer and winter) within all assigned areas to be disturbed by construction. Should any tortoises be located, they should be relocated to distant areas (outside of construction active areas) with similar habitat characteristics to the species to ensure that they would not return to the Project site, taking into account the home range for the species.	Additional Study	Reporting on outcomes of survey	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Agriculture Law No. 44 of 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
		Should as part of the Project any fencing be erected, it must be ensured that it allows for the natural movement of small faunal species within the area. This could include for example a fence with an appropriate gap between the ground level and the first rail or strand (around 30cm).	Mitigation	Inspection	Once	EPC Contractor	
		Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel (e.g. with respect to prohibiting hunting) and good housekeeping (e.g. keeping the site orderly and clean).	Mitigation	Inspection	Continuous	EPC Contractor	
Birds (avi-fauna)	Construction activities could disturb existing habitats of birds breeding and/or nesting within the Project site.	A breeding survey must be undertaken at the Project site during the breeding season (which lasts from March till mid-May). The survey must be undertaken by a qualified ornithologist and must be based on point counts that are spread over the entire Project site. At each point count all breeding activities must be recorded. The survey must aim to identify any breeding areas of importance within the Project site.	Additional Study	Reporting on outcomes of survey	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Agriculture Law No. 44 of 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
		Based on the outcomes of the survey, should any areas of importance be identified then construction activities must be properly planned to avoid any disturbance to such areas during the breeding season. Construction activities may commence in other areas but through the implementation of proper housekeeping measures to reduce such impact such as prohibiting hunting, restricting activities to allocated areas only, avoiding unnecessary elevated noise levels, etc.	Mitigation	Inspection	Continuous	EPC Contractor	
Archeology and Cultural Heritage	Improper management of construction activities could disturb/damage the archaeological locations recorded in the	Ensure that the final prepared detailed design avoids sitting any of the Project components (to include the turbines, roads, transmission lines, warehouses, etc.) within such delineated areas (Figure 53) to avoid damage to those sites.	Mitigation	Inspection on Final Detailed Design	Once; before construction commences	EPC Contractor	- Antiquities Law No. 21 of 1988 and its amendments No. 23 for 2004

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
	Project area as well as potential archaeological remains which could be buried in the ground (if any).	Properly plan construction activities to take into account the identified archeological locations to ensure they are protected from any potential damage. This could include proper movement of vehicles and machinery into/out of the site to avoid such areas, ensure that all vehicles are on established roads and prohibit off-roading, prohibit movement of vehicles near those areas, etc.	Mitigation	Inspection	Continuous	EPC Contractor	
		Ensure that the Code of Conduct, awareness raising, and training developed for construction workers and personnel to emphasize the presence of archeological locations in the area.	Mitigation	Inspection	Continuous	EPC Contractor	
		Implement appropriate measures for chance find procedures which mainly require that construction activities be halted and the area fenced, while immediately notifying the DoA. No additional work will be allowed before the Department assesses the found archaeological site and grants a clearance to resume the work. Construction activities can continue at other parts of the site if no potential archaeological remains were found. If found, same procedures above apply.	Mitigation	Inspection	Upon Occurrence	EPC Contractor	
				Report prepared and submitted to the DoA	Upon occurrence	EPC Contractor	
Air Quality and Noise	Construction activities will likely result in an increased level of dust, particulate matter and pollutant emissions which in turn will directly impact ambient air quality.	If dust or pollutant emissions are found to be excessive due to construction activities, the source of such excessive emissions must be identified and adequate control measures must be implemented.	Mitigation	Inspection and visual monitoring to include periodic inspections at nearby sites (e.g. nearby Highway) to determine whether harmful levels of dust from construction activities exist.	Continuous	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Air Protection Regulation No. 28 for 2005 - Instruction for Reduction and Prevention of Noise for 2003 - JS 1140-2006 Ambient Air Quality
				Reporting of any excessive levels of pollutants and measures taken to minimize impact.	Upon occurrence	EPC Contractor	
		Comply with the OSHA requirements and the Jordanian Codes to ensure that for activities associated with high dust levels, workers are equipped with proper protective equipment (e.g. masks, eye goggles, etc.).	Mitigation	Inspection	Continuous	EPC Contractor	
		Apply basic dust control and suppression measures which could include: regular watering of roads, proper management of stockpiles/excavated material, proper covering of trucks transporting aggregates and fine materials, adhering to a speed limit of 15 km/h for trucks on construction sites, etc.	Mitigation	Inspection	Continuous	EPC Contractor	
		Develop a regular inspection and scheduled maintenance program for vehicles, machinery, and equipment to be used throughout the construction phase for early detection of issue to avoid unnecessary pollutant emissions.	Mitigation	Inspection	Continuous	EPC Contractor	
	Possible noise emissions to the environment from the construction activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities.	If noise levels were found to be excessive due to construction activities, the source of such excessive noise levels must be identified and adequate control measures must be implemented.	Mitigation	Inspection and visual monitoring	Continuous	EPC Contractor	
				Reporting of any excessive levels of noise and measures taken to minimize impact.	Upon occurrence	EPC Contractor	
		Comply with OSHA requirements and the Jordanian Codes to ensure that for activities associated with high noise levels, workers are equipped with proper protective equipment (e.g. earmuffs).	Mitigation	Inspection	Continuous	EPC Contractor	
		Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.	Mitigation	Inspection	Continuous	EPC Contractor	
Infrastructure and Utilities	Water Resources – it is important to ensure that the water requirements of the Predict would not affect the existing users and resources in the area.	Coordinate with the Petra and Wadi Mousa Water Directorate to secure the water requirements for the Project.	Additional requirement	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Instruction for Hazardous Waste Management for the year 2003 - Water Authority Law No. 18

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
	Wastewater Utilities – it is important to ensure that existing utilities would be able to handle the amount of wastewater generated from the Project.	Coordinate with the Petra and Wadi Mousa Water Directorate for disposal of wastewater at Wadi Mousa or Ma'an WWTP.	Additional requirement	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	for 1988 and it's amendments thereof - Groundwater Control Regulation No. 85 for 2002 and its amendments thereof - Municipalities Law No. Law No. 13 of year 2011 - Traffic Law No. 49 for 2008 - Civil Aviation Law No. 41 of the year 2007 - Telecommunications Law No.21 for the year 2011
	Solid Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project.	Coordinate with PDTRA or hire a competent private contractor for the collection of solid waste from the site to the municipal approved landfill	Additional requirements	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	
	Hazardous Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of hazardous waste generated from the Project.	Coordinate with MoEnv to hire a competent private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility.	Additional requirements	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	
	Road Networks – if transportation activities are not properly managed, they could entail risk of damage to the existing roads and could be of public safety concerns to other users on road.	Adopt and implement the recommendations/provisions of the transport plan throughout the transportation activities.	Mitigation	Submission of poof of coordination and permits from the Traffic Department, Ministry of Public Works and Housing, and the relevant electricity company.	Once; before transportation commences	EPC Contractor	
	Aviation, Telecommunication and Television & Radio Links - Improper sitting of the wind farm could impact aircraft safety if located near airports and could potentially interfere with electromagnetic transmissions associated with air transport.	Provide CARC with final detailed design along with the coordinates of the turbines. Design must take into account their requirements for navigational lighting obstacles for wind farm developments. Those requirements must be adhered to and are summarized in their Publication AN-14-I (Chapter 6) (http://carc.gov.jo/images/filemanager/AMM%202%20chapter%206.pdf).	Additional requirement	Submit official approval letter of CARC	Once; before construction commences	EPC Contractor	
	Aviation, Telecommunication and Television & Radio Links - Improper planning and site selection of the Project could impact and interfere with electromagnetic signals of existing telecommunications and radio/television systems in the area.	Coordinate with TRC to obtain the responses from the remaining telecommunication service providers (Orange and Zain).	Additional Requirements	Submit official responses from telecommunication providers	Once; before construction commences	EPC Contractor	
Occupational Health and Safety	There will be some generic risks to workers health and safety from working on construction sites, as it increases the risk of injury or death due to accidents	Implement the provisions of the Occupational Health and Safety Plan throughout the Project construction phase.	Mitigation	Inspections to ensure the implementation of provisions of Plan	Continuous	EPC Contractor	- Labor Law No. 8 for the Year 1996 and its amendments
			Mitigation	Regular reporting in addition to reporting of any incidents and measures undertaken to control the situation and prevent it from occurring again.	Upon occurrence		
Socio-economic	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity	Develop and implemented an Action Plan for working with the local community members during the construction phase. The plan must aim to support the local community stating its aims and objectives and should acknowledge the importance of building a strong socio-economic relationship with the local community through a participatory planning program (in which the local community can express their concerns, strengths and limitations) even before the development is in place.	Recommendation	Regular reporting on outcomes of Action Plan implementation	Continuous	Project Developer	N/A
		Develop and implement a structured approach for social responsibly programs. This involves developing a Corporate Social Responsibility (CSR) Program. The CSR	Recommendation	Regular reporting on outcomes of CSP Program	Continuous	Project Developer	N/A

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
		program must include a needs assessment to identify priority development projects which benefit all local communities. Based on the outcomes of the needs assessment the CSR program will be developed along with an action plan which identifies the priority projects to be developed, allocated budget, timeline for implementation, etc. A summary of the CSR program then needs to be communicated to the local community and stakeholders through appropriate platforms (such as the local community offices in which the grievance mechanism is advertised).		implementation			

Table 62: ESMP for the Operation Phase

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
Landscape and Visual	Visual impacts concern the turbines themselves (e.g. color, height, and number of turbines) and impacts relating to their interaction with the character of the surrounding landscape.	Avoid including lettering, company insignia, advertising or graphics on the turbines.	Mitigation	Inspection	Once; before operation commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006
Land Use	Operational activities could disturb and conflict with actual land use as it could provide value to locals.	Allow all local community members to continue with their grazing and agricultural activities in the Project area as normal, as well as nomadic settlers (that is besides those areas of the actual footprint of the Project site).	Mitigation	Inspection	Continuous	Project Operator	- Environmental Protection Law No. 52 of 2006
		A detailed grievance mechanism must be developed for the local community as well as nomads. The local community and nomads must be made aware of the grievance mechanism to submit complaints against any potential prohibition of access to the Projects area with no legitimate reason (e.g. safety and security reasons.	Mitigation	Inspection	Continuous	Project Operator	
Soil and Groundwater	Improper management of solid waste	Coordinate with PDTRA or hire a competent private contractor for the collection of solid waste from the site to the Al-Basta Landfill.	Mitigation	Review contract with contractor	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - Solid Waste Management Regulation No. (27) of 2005
		Prohibit fly-dumping of any solid waste to the land.	Mitigation	Inspection	Continuous	Project Operator	
		Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste".	Mitigation	Inspection	Continuous	Project Operator	
		Implement proper housekeeping practices on the construction site at all times.	Mitigation	Inspection	Continuous	Project Operator	
		Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. The numbers within the records are to be consistent to ensure no illegal dumping at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	Project Operator	
	Improper management of wastewater	Coordinate with Petra and Wadi Mousa Water Directorate to hire a private contractor for the collection of wastewater from the site to Wadi Mousa WWTP or Ma'an WWTP	Mitigation	Review contract with contractor	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - Public Health Law No. 47 for 2008
		Prohibit illegal disposal of wastewater to the land	Mitigation	Inspection	Continuous	Project Operator	
		Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing	Mitigation	Inspection	Continuous	Project Operator	
		Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the Industrial Park WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	Project Operator	
	Improper management of hazardous waste	Coordinate with the MoEnv and hire a private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility	Mitigation	Review contract with contractor	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - Management, Transportation, & Handling of Harmful &
		Follow the requirements for management and storage as per the 'Instructions for Hazardous Waste Management and Handling of the Year 2003' of the MoEnv	Mitigation	Inspection	Continuous	Project Operator	
		Prohibit illegal disposal of hazardous waste to the land	Mitigation	Inspection	Continuous	Project	

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
						Operator	Hazardous Substances Regulation No. (24) of 2005, - Instruction for Management and Handling of Consumed Oils of 2003, - Instruction for Hazardous Waste Management of2003
		Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing	Mitigation	Inspection	Continuous	Project Operator	
		Maintain records and manifests that indicate volume of hazardous waste generated onsite, collected by contractor, and disposed of at the Swaqa Facility. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	Project Operator	
	Improper management of hazardous material	Ensure hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of impermeable surface, accessible to authorized personnel only, prevent incompatible materials from coming in contact, etc.	Mitigation	Inspection	Continuous	Project Operator	- Environmental Protection Law No. 52 of 2006 - JS 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials
		Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. Spilled material should be tracked and accounted for.	Mitigation	Inspection	Continuous	Project Operator	
		Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc.).	Mitigation	Inspection	Continuous	Project Operator	
		Regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material.	Mitigation	Inspection	Continuous	Project Operator	
		Ensure that a minimum of 1,000 liters of general purpose spill absorbent is available at hazardous material storage facility.	Mitigation	Inspection	Continuous	Project Operator	
		If spillage occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.	Mitigation	Inspection Reporting of incident and measures taken to minimize impact	Upon occurrence	Project Operator	
Biodiversity	Improper management of the site could disturb existing habitats (e.g. improper conduct and housekeeping practices).	Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel (e.g. with respect to prohibiting hunting) and good housekeeping (e.g. keeping the site orderly and clean).	Mitigation	Inspection	Continuous	Project Operator	- Environmental Protection Law No. 52 of 2006 - Agriculture Law No. 44 of 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
Birds (avi-fauna)	Wind turbines are associated with impacts on birds from risks of strikes and collision on both migratory soaring birds and resident soaring birds in the area. Generally, such impacts depend on several factors but could affect the population levels of certain species especially those with international/national critical conservation status.	The ESIA requires that the Project Operator implement an avi-fauna monitoring and turbine shutdown plan, avi-fauna carcass search plan ,and onsite carcass search plan (other than birds). Additional details are provided at the end of the ESMP.					- Environmental Protection Law No. 52 of 2006 - Agriculture Law No. 44 of 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
Bats	The potential impacts from the Project during operation are mainly related to risk of bat strikes and collisions with rotors of the operating wind turbines.	The ESIA requires that the Project Operator implement a bat mortality monitoring plan. Additional details are provided at the end of the ESMP.					- Environmental Protection Law No. 52 of 2006

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
Archeology	Improper management of operational activities could disturb/damage archaeological locations recorded in the Project area	Properly plan operation and maintenance activities to take into account the identified archeological locations to ensure they are protected from any potential damage. This could include for example proper movement of vehicles and machinery into/out of the site to avoid those areas, ensure that all vehicles are on established roads and prohibit off-roading, prohibit movement of vehicles near those areas during the various operation and maintenance activities, etc.	Mitigation	Inspection	Continuous	Project Operator	- Antiquities Law No. 21 of 1988 and its amendments No. 23 for 2004
		Ensure that the Code of Conduct, awareness raising, and training developed for operation workers and personnel to emphasize the presence of archeological locations in the area.	Mitigation	Inspection	Continuous	Project Operator	
Infrastructure and Utilities	Water Resources – it is important to ensure that the water requirements of the Predict would not affect the existing users and resources in the area.	Coordinate with the Petra and Wadi Mousa Water Directorate to secure the water requirements for the Project.	Additional requirement	Submit report with proof of coordination	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - Instruction for Hazardous Waste Management of2003 - Water Authority Law No. 18 for 1988 and it's amendments Groundwater Control Regulation No. 85 for 2002 and its amendments - Municipalities Law No. Law No. 13 of year 2011
	Wastewater Utilities – it is important to ensure that existing utilities would be able to handle the amount of wastewater generated from the Project.	Coordinate with the Petra Water Administration for disposal of wastewater at Wadi Mousa or Ma'an WWTP.	Additional requirements	Submit report with proof of coordination	Once; before operation commences	Project Operator	
	Solid Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project.	Coordinate with PDTRA or hire a competent private contractor for the collection of solid waste from the site to the municipal approved landfill.	Additional requirements	Submit report with proof of coordination	Once; before operation commences	Project Operator	
	Hazardous Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of hazardous waste generated from the Project.	Coordinate with MoEnv to hire a competent private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility.	Additional requirements	Submit report with proof of coordination	Once; before operation commences	Project Operator	
Occupational Health and Safety	There will be some generic risks to workers health and safety from operational and maintenance activities.	Implement the provisions of the Occupational Health and Safety Plan throughout the Project operation phase.	Mitigation	Inspections to ensure the implementation of provisions of the Plan	Continuous	Project Operator	- Labor Law No. 8 for the Year 1996 and its amendments
			Mitigation	Regular reporting in addition to reporting of accidents, incidents and/or emergencies and measures undertaken in such cases to control the situation and prevent reoccurrence.	Upon occurrence		
Community Health, Safety and Security	Noise from operating wind turbines could be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment	Develop a reduced power operation strategy for the wind turbines causing the exceedance of the noise limits at Al-Rajef village to ensure compliance with Jordanian and IFC requirements. Based on the monitoring measures undertaken (discussed to the right), reduced power measures can be identified (operation in a noise-reduce mode or shut-off of the turbine) in addition to the situations in which they are required (in which applicable standards are exceeded)	Mitigation Measure	Comprehensive noise baseline measurements shall be performed without any construction noise. The measurements shall cover the range of wind speeds (4 - 10 m/s) for all wind directions (45° sectors) at day and night time.	Once; before operation of turbines	Project Operator	- Environmental Protection Law No. 52 of 2006 - Instruction for Reduction and Prevention of Noise for 2003 - Public Health Law No. 47 for 2008
				Actual monitoring during wind farm operation at locations near receptor points Q, J, K, and L. The measurements shall cover the range of wind speeds (4 - 10 m/s) for all wind directions (45° sectors) at day and night time	Once; during operation of turbines	Project Operator	
				Successful implementation of the reduced power measures shall be demonstrated during operation by additional monitoring at the	Continuous	Project Operator	

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
				receptor locations for those wind situations identified as potentially exceeding the Jordanian limit values. The measurements should be accompanied by an investigation on perception of the wind turbine noise by the residents.			
		Discuss the effects of noise from turbines to the local community and nomads and present the results of the worst-case scenario analysis undertaken and identify the areas where exceedances are expected and the outcomes of the reduced power strategy developed.	Mitigation	Inspection	Once	Project Operator / Developer	
		A detailed grievance mechanism must be developed for the local community. The local community must be made aware of the grievance mechanism to submit complaints against any nuisance from noise from turbines. If such a situation occurs, such nuisances must be verified on the ground and if true appropriate compensation measures must be implemented (e.g. provision of noise shielding at receptor locations such as sound reducing windows (double glazed) and planting of trees and shrubs.	Mitigation/ Compensation	Submit report which details grievance nature, how it was handled, and follow-up measures implemented	Upon Occurrence	Project Operator / Developer	
		For the nomads in specific, develop informative maps in Arabic of noise propagations from the turbines in accordance with results of the ESIA. Such maps must be published on information boards within the wind farm to allow nomads to build up their tents in less affected areas.	Mitigation	Inspection	Continuous	Project Operator	
	Shadow flicker could be a source of disturbance and nuisance to the receptors and residents of the nearby villages.	Introduce the effects of shadow flicker to the local community and nomads and present the results of the worst-case scenario analysis, and identify the areas where shadow flicker is expected.	Mitigation	Inspection	Once	Project Operator / Developer	- Environmental Protection Law No. 52 of 2006 - Public Health Law No. 47 for 2008
		A detailed grievance mechanism must be developed for the local community. The local community must be made aware of the grievance mechanism available to submit complaints regarding shadow flicker nuisances. If such a situation occurs, such nuisances and conditions are verified on the ground and if true appropriate compensation measures must be implemented to limit such impacts. This could include the introduction of vegetative buffers as a barrier for shadow flicker and/or providing window blinds.	Mitigation/ Compensation	Submit report which details grievance nature, how it was handled, and follow-up measures implemented	Upon Occurrence	Project Operator / Developer	
		For the nomads in specific, develop informative maps in Arabic of shadow flicker propagations from the turbines in accordance with results of the ESIA. Such maps must be published on information boards within the wind farm to allow nomads to build up their tents in less affected areas.	Mitigation	Inspection	Continuous	Project Operator	
	Blade or tower glint can impact a community, as the reflection of sunlight off the rotor blade may be angled toward nearby residences.	Consideration should be given to the use of non-reflective finishes to ensure potential impacts are not significant.	Mitigation	Inspection	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - Public Health Law No. 47 for 2008
	Failure in rotor blade or ice accretion can result in the 'throwing' of the blade. Although overall risk of such events is extremely low, it could affect the public safety of the residents of nearby villages.	Present to the local communities the risks related to blade/ice throws and the likelihood of occurrence of such events (highly unlikely events). In addition, inform the local communities of the safety distance that must be kept from the turbines to ensure their public safety from events related to blade and ice throws.	Mitigation	Inspection	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - Public Health Law No. 47 for 2008
		Ensure that regular maintenance of the wind turbines takes place according to set schedule to prevent any unforeseen events from occurring such as blade throws.	Mitigation	Inspection	Continuous	Project Operator	
		Install warning signs and post signs at least 200 meters from the wind turbine in all directions which provide informative information in English and Arabic language about risks from such events.	Mitigation	Inspection	Once; before operation commences	Project Operator	
	Public access of unauthorized personnel to the various Project components (turbines, substation) could results in various public safety hazards to local	Develop a Security Risk Assessment for the Project and which takes into account the following: (i) each turbine to be fitted with locked doors to prevent unauthorized access to the turbines; (ii) substation area to be completely fenced with concrete walls to prevent unauthorized access; (iii) onsite guards within the entire Project site at all	Mitigation	Inspection	Continuous	Project Operator	- Environmental Protection Law No. 52 of 2006 - Instruction for Reduction

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
	communities	times to ensure the safety and security of the Project as well a preventing unauthorized access to any of the Project components. However, it must be ensured that all onsite guards are adequately trained to deal with unauthorized trespassing incidents. In addition, guards must refrain from using excessive force, unless situation extremely requires so.; (iv) present to the local communities the public safety hazards of the turbines and the various other Project components; and (v) post informative signs on the turbines and other Project components (substation) about public safety hazards and emergency contact information.		Reporting of trespassing incidents and measures to control situation	Upon Occurrence	Project Operator	and Prevention of Noise for 2003 - Public Health Law No. 47 for 2008
Socio-economic	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity	Develop and implemented an Action Plan for working with the local community members during the construction phase. The plan must aim to support the local community stating its aims and objectives and should acknowledge the importance of building a strong socio-economic relationship with the local community through a participatory planning program (in which the local community can express their concerns, strengths and limitations) even before the development is in place.	Recommendation	Regular reporting on outcomes of Action Plan implementation	Continuous	Project Developer	N/A
		Develop and implement a structured approach for social responsibly programs. This involves developing a Corporate Social Responsibility (CSR) Program. The CSR program must include a needs assessment to identify priority development projects which benefit all local communities. Based on the outcomes of the needs assessment the CSR program will be developed along with an action plan which identifies the priority projects to be developed, allocated budget, timeline for implementation, etc. A summary of the CSR program then needs to be communicated to the local community and stakeholders through appropriate platforms (such as the local community offices in which the grievance mechanism is advertised).	Recommendation	Regular reporting on outcomes of CSR Program implementation	Continuous	Project Developer	N/A

Table 63: ESMP for the Decommissioning Phase

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
Soil and Groundwater	Risk of soil and groundwater contamination during the various decommissioning activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater	Refer to mitigation and monitoring actions for improper management of waste streams within Table 61.				Developer or MEMR	Refer to legal requirements within Table 61.
Air quality and noise	Decommissioning activities will likely result in an increased level of dust and particulate matter emissions which in turn will directly impact ambient air quality.	Refer to mitigation and monitoring actions for air quality within Table 61.				Developer or MEMR	Refer to legal requirements within Table 61.
	Possible noise emissions to the environment from the decommissioning activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities	Refer to mitigation and monitoring actions for noise within Table 61.				Developer or MEMR	
Occupational health and safety	There will be some generic risks to workers health and safety from working on decommissioning sites, as it increases the risk of injury or death due to accidents.	Refer to mitigation and monitoring actions for occupational health and safety within Table 61.				Developer or MEMR	Refer to legal requirements within Table 61.

Avi-Fauna Mitigating and Monitoring Measures

As discussed throughout the ESMP, the Project Operator is required to undertake the following during the Project operation phase: (i) avi-fauna monitoring and turbine shutdown; (ii) onsite avi-fauna carcass search; and (iii) onsite carcass search (other than birds).

(i) Avi-Fauna Monitoring and Turbine Shutdown

Monitoring during the operation of the wind farm must be completed in order to inform the actual impact caused by the wind farm on resident and migratory birds. The monitoring must be undertaken with the primary objective of collision avoidance but also secondary for migration monitoring behavior (similar to the methodology undertaken in spring 2015 for this Project).

Monitoring must take place during the spring migration season (from early March till end of May) and autumn migration season (from early September till mid-November). Throughout this period, monitoring must take place continuously on a daily basis.

Monitoring must be undertaken onsite by qualified ornithologist to observe all migrating and resident birds. It is anticipated that a minimum of 3 vantage points will be required to undertake such monitoring (however this can be determined and confirmed at a later stage based on onsite conditions when the turbines are in place). Observers must have the flexibility to move, independently from each other, between the 3 main vantage points and the secondary ones if necessary and when required for better judgement to prevent potential collision of birds with turbines.

Monitoring must take place to prevent potential collision of birds with the wind turbines, through individual shutdown of turbine(s) which pose an imminent collision risk to birds. Imminent risk is identified as (a) bird(s) flying at risk height and within a buffer distance of 500m from the turbine(s). However, this should be verified and confirmed during the actual operation of the Project taking into account the actual turbine shutdown time as well as other onsite conditions.

Individual temporary turbine(s) shut-down will be enacted by the observers calling through to the control room once an imminent risk is identified and until the birds are out of the risk area. This should take place based on two main conditions and which include the following:

c. **Condition 1**: the passage of an individual bird species of global or national significance will require the individual temporary shutdown of the concerned turbine(s). Species under this conditions were previously highlighted in Table 32 and include:

Common name	Scientific name
Globally threatened species	
Egyptian Vulture	*Neophron percnopterus*
Eastern Imperial Eagle	*Aquila heliaca*
Greater Spotted Eagle	*Aquila clanga*
Species of national significance	
Griffon Vulture	*Gyps fulvus*
Other species with high collision risk	
Short-toed Eagle	*Circaetus gallicus*
Long-legged Buzzard	*Buteo rufinus*

d. **Condition 2**: the passage of ten or more individuals of the species provided below will require the individual temporary shutdown of the concerned turbine(s). Species under this conditions were previously highlighted in Table 32 and include:

Common name	Scientific name
Honey Buzzard	*Pernis apivorus*
Steppe Buzzard	*Buteo buteo vulpinus*
Black Kite	*Milvus migrans*
Levant Sparrowhawk	*Accipiter brevipes*
Steppe Eagle	*Aquila nipalensis*
Lesser Spotted Eagle	*Aquila pomarina*

Observers must record in a log sheet in details the following: species involved, number/ID of turbines ordered for shutdown, time of dispatch of shutdown call, time of actual shutdown. After the risk situation is over the observer must also record the following: time of dispatch of operation resumption, time of actual operation resumption, outcome of event (collision or avoidance), and the avoidance behavior of bird(s).

In addition, to the above monitoring must also take place during summer and winter (mainly for resident bird activity) through the same methodology discussed above. However, during this time it is likely that less than 3 vantage points will be required to cover the site – however this can be determined and confirmed at a later stage based on onsite conditions when the turbines are in place.

Taking the above into account, an annual report must be prepared with all the findings and outcomes based on all records for that year and shut-down events and their effectiveness. In addition, the report must also determine whether any changes on the frequency of the monitoring are required – to include effectiveness of the vantage points and observation hours.

In addition, as discussed earlier, the monitoring is also intended for migration monitoring behavior. Therefore, the report must also detail all migratory and resident bird activity and patterns, numbers, etc. (similar to the methodology for the spring 2015 survey of this Project).

The above monitoring plan must be undertaken during the first 3 years of operation. After the third year the monitoring plan will be reviewed and re-evaluated. For example, based on the results it could be decided that summer and winter monitoring should be discontinued or its frequency reduced due to low risk of collisions onsite and good avoidance behavior by bird species.

(ii) Avi-Fauna Carcass Search during Operation

During the operation phase, mortality rate surveys must be undertaken through carcass search surveys covering the entire wind farm. The carcass search will demonstrate the effectiveness of mitigation measures such as turbine shut down and allow an estimation of the annual number of bird deaths caused by the turbine.

a. Carcass Removal and Searcher Efficiency Trials

Before commencement of the avi-fauna carcass search during the operation phase, a carcass removal and searcher efficiency trial test must be undertaken. The objective of this test is to factor and adjust for carcasses that are removed from the Project site from external factors (such as animals that might feed on such carcasses) as well as for searcher efficiency in locating carcasses.

Tests of carcass removal and searcher efficiency must take place during 15 consecutive days. Carcasses will be placed and dispersed over the Project area, avoiding saturation which could attract animals to the site. They should be checked every day over fifteen days or until the entire carcasses have been removed if earlier.

At the same time, searchers should not be familiar with carcass location and will perform the carcass search annotating how many of the placed carcasses they find. After the trial of each person, the carcasses will be checked again to see if they are still there (and were not recorded by the searcher) or have been removed (by animals). Based on the above, the carcass removal and searcher efficiency rates can be calculated.

b. Carcass Search Surveys

Carcass search surveys shall be carried out by the beginning of the operation phase on a weekly basis during the spring and autumn migration season and twice per month during the summer and winter season. A plot area of 100mX100m would be set around each turbine to search for carcasses. The plot will be covered with search transects 10 m apart, with the searcher looking 5 m on either side.

All found carcasses must be recorded in a log sheet with information to include the following: species, sex, age, condition, cause of death (to the greatest extent possible), coordinates, date, and photos as appropriate, condition (intact, scavenged, feather spots, etc.)

An annual report must be prepared with the results and outcomes to complement the report prepared for the migration monitoring as discussed earlier.

The above carcass search surveys must be undertaken during the first 3 years of operation. After the third year, the carcass search survey will be reviewed and re-evaluated. For example, based on the results it could be decided that autumn surveys should be discontinued or its frequency reduced due to absence of carcasses recorded.

(iii) Onsite Carcass Search (other than birds)

The Project Operator must implement a carcass search plan (other than birds) for any carrion which could be present onsite to prevent attraction of birds to the site (such as the Griffon vulture and Egyptian vulture which rely on livestock and medium-large size mammals to feed on). The plan should cover the entire Project site and surrounding areas and must commence with the operation of the Project. This should be undertaken on a monthly basis but particular attention should be paid during the season when nomads are in the area (from April till September). Nomads raise livestock and carcasses could be in the area throughout such times. Such a plan should be implemented throughout the first 2 years of operation of the Project after which it could be reviewed and revaluated (e.g. if not carcasses are recorded during the first 2 years it can be discontinued).

Bats Mitigation and Monitoring Measures

As discussed throughout the ESMP, the Project Operator is required to implement additional mitigation and monitoring measures for bats which are discussed below.

Before commencement of operational activities, Project Operator is required to implement proper and adequate management measures for those sources which could attract bats to the Project site to the greatest extent possible.

This includes coordination with the olive mill owner to properly cover waste streams stored onsite and also with Rajef village to cover and maintain the septic tanks (which act as a source for attracting insects' onsite and in turn bats).

In addition, a bat mortality monitoring program must be established during the initial Project operation phase. The program must be undertaken by an expert and must include the following components:

- An additional two (2) days bat assessment must be undertaken during their active period, before commencement of operational activities and after the above management measures are implemented. The assessment must be undertaken with the use of bat detectors. In addition, the assessment must also include inspections for potential roosting sites within the Project area. The objective of this assessment is to reconfirm that the Project site is an unattractive habitat for bats as it was established throughout the baseline study in this ESIA and also to determine if the implemented management measures were effective in further reducing bat activity onsite;
- Bats mortality monitoring program for a duration of six (6) months during the early operation phase of the wind turbines (this must take into account that the hibernation period for bats lasts from December to March after which they are active from early May till late November). The mortality monitoring program must be undertaken once per month and must include carcass search through visual observations around each wind turbine with a radius of 200-300m around each turbine; and
- Based on the outcomes of the mortality monitoring program, should no issues of concern be identified then the mortality monitoring program can be discontinued (this is the most likely scenario to occur). In the highly unlikely event that any issues of concern are identified (high bats mortality recorded) then additional investigations must take place on the sources of attraction of bats to the site (which will most likely be from external sources) and based on that appropriate mitigation measures must be identified.

23. ENVIRONMENTAL PERFORMANCE REQUIREMENTS FOR NEPCO

As discussed earlier, there are construction activities to be undertaken by NEPCO for building of substation and connection to the national grid through the High Voltage overhead line. This involves onsite construction activities (for the construction of the substation) as well as offsite construction activities (for connection to the national grid through the overhead lines). Details and information are not available or finalized at this stage by NEPCO - which include layout of substation, finalized and detailed grid connections plans and route for the overhead lines, etc.

Therefore, throughout the ESIA such construction activities were not taken into account, due to the fact that details and information are not available. Nevertheless, detailed below are a set of Environmental Performance Requirements which must be implemented by NEPCO once details and plans are finalized, and which aim to ensure that environmental issues are taken into account and adequately considered.

Table 64: Performance Requirements for NEPCO

Component	Performance Requirement
Land Use	With regards to the overhead line it is could require the acquisition of lands for its right of way (ROW) along the route from the Project site till the Mregha area where it will connect with the national grid (Figure 8). Once the detailed design for the overhead line is finalized, the exact lands which need to be acquired must be identified. At that stage, NEPCO is expected to undertake such acquisitions in full accordance with the requirements of the "Land Acquisition Law No. (12) of the year 1987". The Law details a framework for the acquisition process to include advertising requirements, determination of fair compensations, negotiation process with land owners, grievance and dispute procedures, etc.
Biodiversity	Once a final detailed design is available for the substation and the grid connections plans and route for the overhead lines, NEPCO must undertake a biodiversity survey. The survey must cover the substation area as well as the individual areas where the poles are to be erected for installation of the high voltage overhead lines. The survey must aim to determine whether any sensitive or endangered or rare flora/fauna/avi-fauna species exist – although this is unlikely given the low ecological significance of the area due to its natural setting. Nevertheless, should this be the case, then appropriate mitigation measures must be identified and which could include the relocation of species outside of construction active areas.
	During the construction phase NEPCO is expected to implement general proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel (e.g. with respect to prohibiting hunting) and good housekeeping (e.g. keeping the site orderly and clean).
	With regards to the high voltage overhead lines, NEPCO must consider measures which reduce collision risk of birds with the overhead lines. This could include the following: (i) the installation of bird diverters which increase the visibility of the power lines. The installation of dynamic bird diverters in a distance of 15 to 25 m between each other is recommended, and (ii) horizontal arrangement of the phases, reducing the height of the conductors, and, as therefore, minimizing the risks of collision and electrocution of birds
Archeology	The final and detailed design for the substation must take into account the archeological locations noted by the DoA within the Project area – refer to Figure 52.
	Once the final design for grid connections plans and route for the overhead line is available, NEPCO is responsible for undertaking an archeological survey for the individual areas where the poles are to be erected for installation of the high voltage overhead lines. The survey must aim to assess whether any surface archeological remains of significance exist. Should this be the case, appropriate mitigation measures must be identified such as the protection and fencing of the site in coordination with the DoA.
	Implement appropriate chance find procedures. Throughout the construction phase there is a chance that potential archaeological remains in the ground are discovered. It is expected that appropriate measures for such chance find procedures are implemented which are standard requirements by the DoA. Those mainly require that construction activities be halted and the area fenced, while immediately notifying the DoA. No additional work will be allowed before the Department assesses the found potential archaeological site and grants a clearance to resume the work. Construction activities can continue at other parts of the site if no potential archaeological remains were found. If found, same procedures above apply.
Air Quality	During the construction phase, NEPCO is expected to apply adequate dust suppression measures for dust generating

and Noise	activities and avoid unnecessary pollutant emissions from vehicles, machinery, and equipment to be used.
	During the construction phase NEPCO is expected to apply adequate general noise suppressing measures.
Geology and Hydrology	During the construction phase, NEPCO is expected to implement proper waste management practices onsite to include solid waste, wastewater, hazardous waste, and hazardous materials. Refer to "Section 10.2" which identifies in detail the mitigation actions required for proper management of waste streams.
Occupational Health and Safety	NEPCO is expected to develop an Occupational Health and Safety Plan in accordance with the provisions of the Labor Law No. 8 for the Year 1996 and its amendments, including Chapter IX, Occupational Safety & Health before construction activities commence. The Plan must address the likely hazards, emergency response procedures, and provision of protective clothing, adequate safety management.

In addition, ECO Consult undertook a rapid survey and assessment in terms of environmental and social risks associated with the High Voltage overhead line. The rapid survey will assess issues such as archeology and cultural heritage, biodiversity, land use and other. This is included as Annex III to the ESIA.

24. REFERENCES

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25. ANNEXES

1. **Annex I: Project Consent Forms**

2. **Annex II: Detailed Biodiversity Results**

3. **Annex III: Rapid Environmental Assessment for the High Voltage Overhead Line**