Abour Energy Company Wind Farm
Abour, Governorate of Tafila - Jordan

Environmental and Social Impact Assessment Report

Prepared by:

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and
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With contributions from:
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and
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الروابي لإستشارات البيئة و الطاقة

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السادة/ وزارة البيئة المحترمين

الموضوع / دراسة تقييم الأثر البيئي والاجتماعي

مشروع مزرعة طاقة الرياح (50 ميغا واط)

عابور - محافظة الطفيلة

تحية وبعد،،

مرفق طيه ثلاثة نسخ ورقية وثلاث عشرة نسخة الكترونية من تقرير دراسة تقييم الأثر البيئي والاجتماعي لمشروع مزرعة طاقة الرياح بقدرة 50 ميغاواط التابع لشركة Abour Energy Company في منطقة عابور – محافظة الطفيلة.

يتضمن هذا التقرير نتائج دراسة المسح البيئي، منهجية تقييم الأثر البيئي، الآثار المتوقعة، الإجراءات الوقائية وبرنامج المراقبة البيئية، جميع هذه المراحل تكون الدراسة المقدمة لحضرتكم.

في حال الحاجة إلى أية استفسارات أو معلومات إضافية، لا تترددوا بالاتصال بمكاتبنا.

وتفضلوا بقبول فائق الاحترام،،

بالنيابة عن فريق المشروع

م. حامد العجارمة

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1- وصف المشروع

1-1 مقدمة

يلتزم الأردن بزيادة حصة الطاقة المتجددة في توليد الطاقة الكهربائية لتصبح بنسبة 10% في 2020، سيأتي الحصة الكبرى من هذه الطاقة من طاقة الرياح (1200 ميغاواط) والطاقة الشمسية (600 ميغاواط).

تأسست شركة طاقة عابور عام 2013 من خلال زينيل الدولية ضمن قوانين المملكة الأردنية الهاشمية كشركة مساهمة خاصة. هدف الشركة هو تطوير وامتلاك وتشغيل مشروع مزرعة رياح تتكون من 15 توربيناً من نوع فيستاس (V117 / 3.3 MW) وبقدرة إجمالية تبلغ 49 ميغاواط تقع في قرية عابور ضمن محافظة الطفيلة. تقدر الطاقة الكهربائية السنوية المتولدة من هذه المحطة بـ 152 غيغاواط. سيتم وسيتم ربط مزرعة الرياح إلى نظام شبكة نقل 132 كيلو فولت من شركة الكهرباء الوطنية.

2-1 مكونات المشروع

سيتكون المشروع من التالي:

- 15 مولدات توربينات الرياح من نوع فيستاس وقدرة كل توربين 3,3 ميغا واط.
- أساسات التوربينات.
- طرق الوصول الحالية والجديدة.
- 33 كيلو فولت شبكة داخلية باستخدام كابلات تحت الأرض لربط توربينات الرياح إلى المحطة الفرعية للمشروع.
- المحطة الفرعية للمشروع وتضم: محولات 2*132/33 كيلوفولت، مفاتيح التشغيل، الحماية الكهربائية، والقياس، والاتصالات، والمراقبة، والطقس، وحماية سلامة المعدات.

3-1 موقع المشروع

يقع المشروع على بعد 140كم جنوب العاصمة عمان، ويقع بالقرب من المشروع البلدات والقرى التالية:

- بلدة الطفيلة: تقع على بعد 8,3كم شمال غرب موقع المشروع.
- قرية أم السراب: تقع على بعد 4,2كم جنوب غرب موقع المشروع.
- قرية العين البيضاء: تقع على بعد حوالي 8كم غرب موقع المشروع.

2- الأسس المرجعية لدراسة تقييم الأثر البيئي والاجتماعي

ركزت دراسة تقييم الأثر البيئي والاجتماعي على تعريف وتحليل وتقييم وإدارة الآثار البيئية على المكونات الأساسية التالية:

- الصحة العامة.
- الصحة والسلامة المهنية.
- مصادر المياه.
- الظروف الاقتصادية والاجتماعية.
- الآثار.

- التنوع الحيوي.
- الطرق والمرور.

الظروف الاقتصادية والاجتماعية

القضية	مرحلة الإنشاء	مرحلة التشغيل	مرحلة الانتهاء من المشروع
التوظيف	✓	✓	✓
المنظر الجمالي	✓	✓	✓
استعمالات الأراضي	✓	✓	✓
ازدهار الأعمال	✓	✓	
الضغط على البنية التحتية	✓	✓	✓
استملاك الأراضي	✓		
الأثر على السياحة		✓	

مصادر المياه

القضية	مرحلة الإنشاء	مرحلة التشغيل	مرحلة الانتهاء من المشروع
الآثار طويلة الأمد على التربة السطحية والانجراف	✓	✓	✓
التخلص من المياه العادمة وأثرها على المياه الجوفية	✓	✓	✓
أثر المخلفات الصلبة على المياه الجوفية والسطحية	✓	✓	✓
الاحتياجات المائية	✓	✓	
الفيضانات	✓	✓	

الصحة العامة

القضية	مرحلة الإنشاء	مرحلة التشغيل	مرحلة الانتهاء من المشروع
خطر الحوادث	✓	✓	✓
نوعية الهواء (الغبار)	✓		✓
الضجيج	✓	✓	✓
وميض الظل		✓	
التجمد		✓	
الملاحة الجوية والرادار		✓	
الاتصالات والإشارات الكهرومغناطيسية		✓	

المياه العادمة المنزلية	✓	✓	✓
المخلفات الصلبة المنزلية	✓	✓	✓
السلامة العامة	✓	✓	

الصحة والسلامة المهنية

القضية	**مرحلة الإنشاء**	**مرحلة التشغيل**	**مرحلة الانتهاء من المشروع**
العناية الصحية والتأمين الصحي	✓	✓	✓
المياه العادمة المنزلية	✓	✓	✓
المخلفات الصلبة المنزلية	✓	✓	✓
نوعية الهواء (الغبار)	✓		✓
الضجيج	✓	✓	✓
خطر الحوادث	✓	✓	✓
وميض الظل		✓	
التجمد		✓	
الملاحة الجوية والرادار		✓	
الاتصالات والإشارات الكهرومغناطيسية		✓	
معدات الحماية الشخصية	✓	✓	
توفر خطة للطوارئ	✓	✓	

الآثار

القضية	**مرحلة الإنشاء**
البقايا الأثرية	✓
قائمه بالآثار المسجلة	✓

التنوع الحيوي

القضية	**مرحلة الإنشاء**	**مرحلة التشغيل**	**مرحلة الانتهاء من المشروع**
التأثير على النباتات	✓	✓	✓
التأثير على الحياة البرية	✓	✓	✓
التأثير على الطيور المهاجرة	✓	✓	✓
التأثير على الموائل	✓	✓	✓

النقل والمرور

القضية	مرحلة الإنشاء	مرحلة التشغيل	مرحلة الانتهاء من المشروع
نقل المعدات ومواد الإنشاء	✓		
الحجم المروري	✓	✓	✓
الأثر على الطرق والبنية التحتية	✓	✓	✓

3- الإطار القانوني

3-1 التشريعات الوطنية ذات العلاقة

القوانين

- قانون حماية البيئة (2006/52)
- قانون الكهرباء العام (2002/64)
- قانون الطاقة المتجددة وترشيد الطاقة (2015/2)
- قانون السير (2008/49)
- قانون الصحة العامة (2008/47)
- قانون الآثار (1988/21) وتعديلاته
- قانون النقل (2003/89)
- قانون وزارة الزراعة (2015/13)
- قانون الحرف والصناعات (1953/16)
- قانون العمل رقم (1996/8) وتعديلاته
- قانون الدفاع المدني (1999/18) وتعديلاته
- قانون سلطة المياه (1988/18) وتعديلاته
- قانون تنظيم شؤون المصادر الطبيعية (1968/8)
- قانون الاستملاك (1987/8)
- قانون التعويض (1987)

الأنظمة

- نظام تقييم الأثر البيئي (2005/37)
- نظام تنظيم اجراءات ووسائل ترشيد الطاقة وتحسين كفاءتها (2012/73)
- نظام تنظيم استعمال الاراضي (2007/6)
- نظام المحميات الطبيعية والمتنزهات الوطنية (2005/29)
- نظام حماية التربة (2005/25)
- نظام إدارة النفايات الصلبة (2005/27)

- نظام حماية الهواء (2005/28)
- نظام مراقبة المياه الجوفية (2002/85)

المواصفات القياسية

- المواصفة القياسية الأردنية لمياه الصرف الصحي المنزلية المستصلحة (893/ 2006)
- المواصفة القياسية الأردنية لمياه الشرب (2008/286)
- المواصفة القياسية الأردنية لنوعية الهواء المحيط (2006/1140)

التعليمات

- تعليمات حماية الطيور والحيوانات البرية وتنظيم صيدها والاتجار بها، تعليمات رقم (ز/34) لعام 2003
- تعليمات حماية المصادر المائية (2012)
- تعليمات إدارة الزيوت المستهلكة وتداولها (2014)
- تعليمات الحد والوقاية من الضجيج (2003)
- تعليمات منع حدوث المكاره الصحية الناجمة عن الوحدات السكنية للتجمعات العمالية (2013/1)

المبادئ التوجيهية

- المبادئ التوجيهية للحد من التعرض للكهرباء والحقول المغناطيسية والكهرومغناطيسية الزمنية المتفاوتة، الصادرة وفقا للمادتين (6/ب و 48) من قانون الاتصالات.
- المبادئ التوجيهية لحماية مصادر مياه الشرب، تموز 2006

2-3 المعايير الدولية

- سياسة مؤسسة التمويل الدولية ومعايير الأداء في الاستدامة الاجتماعية والبيئية:
  - المعيار الأدائي 1: تقييم وإدارة الآثار والمخاطر البيئية والاجتماعية
  - المعيار الأدائي 2: ظروف العمل والعمالة
  - المعيار الأدائي 3: كفاءة استخدام الموارد ومنع التلوث
  - المعيار الأدائي 4: المجتمع، الصحة، السلامة والأمن
  - المعيار الأدائي 5: استملاك الأراضي وإعادة التوطين القسرية
  - المعيار الأدائي 6: حفظ التنوع الحيوي والإدارة المستدامة للموارد الطبيعية الحية
  - المعيار الأدائي 7: السكان الأصليين، عام 2012
  - المعيار الأدائي 8: الموروث الثقافي
- الملاحظات الإرشادية لمؤسسة التمويل الدولية:
  - المبادئ التوجيهية لمؤسسة التمويل الدولية للبيئة العامة، الصحة والسلامة لسنة 2007
  - المبادئ التوجيهية لمؤسسة التمويل الدولية للبيئة العامة، الصحة والسلامة للرياح لسنة 2007

- السياسة التشغيلية لمؤسسة التمويل الدولية (OP4.01) للتقييم البيئي، تشرين الأول 1998 (مراجعة نيسان 2013)
- السياسة التشغيلية لمؤسسة التمويل الدولية (OP4.04) للموائل الطبيعية، تشرين الثاني 1998 (مراجعة نيسان 2013)

4- تقييم الظروف الاجتماعية والاقتصادية والإجراءات الوقائية

1-4 المعلومات الأساسية

توفر المعلومات الأساسية للظروف الاجتماعية والاقتصادية ملخصا للبيانات الاجتماعية والاقتصادية ذات الصلة، والمعلومات التي تم جمعها.

- لمحة عامة عن منطقة المشروع: محافظة الطفيلة، الأقضية والنواحي، والهيكل الإداري لمنطقة المشروع.
- التركيبة السكانية: السكان والمساكن في الأردن بشكل عام، ومنطقة الدراسة بصفة خاصة؛
- المستلزمات الطبية: إحصائيات عن المستشفيات ومرافق الرعاية الصحية في المنطقة.
- استخدام الأراضي / خطط وأنماط استخدام الأراضي: بما في ذلك الزراعة (أنواع من المحاصيل والإنتاج السنوي)، والمنشآت الصناعية.
- النشاط الاقتصادي: المؤسسات التعليمية والنقل (الطرق والسكك الحديدية والجوية)، والاتصالات، والاقتصاد الكلي (التوظيف والعائدات الزراعية والصناعية).

2-4 تقييم الآثار

ومن المتوقع أن يكون للمشروع آثار اجتماعية واقتصادية محتملة في المنطقة خلال مرحلة الإنشاء وتشغيل المشروع. ويقدم الجدول التالي ملخصا لتقييم الآثار:

الأثر	المدى الجغرافي	المستوى	التكرار	الفترة الزمنية	مباشر/ غير مباشر	معكوس/ غير معكوس	الاحتمالية	القوة	+/-	ملاحظات
التوظيف	عالي	متوسط	متوسط	متوسط	مباشر	معكوس	عالي	نعم	+	الإجراءات الوقائية مطلوبة
المنظر الجمالي	متوسط	متوسط	متوسط	متوسط	مباشر	غير معكوس	عالي	نعم	-	الإجراءات الوقائية مطلوبة
استخدامات الأراضي	قليل	قليل	قليل	متوسط	غير مباشر	-	متوسط	نعم	+/-	-
ازدهار الأعمال	متوسط	متوسط	متوسط	عالي	غير مباشر	-	متوسط	نعم	+	الإجراءات الوقائية مطلوبة
الضغط على البنية التحتية	متوسط	متوسط	متوسط	متوسط	مباشر	غير معكوس	متوسط	نعم	-	الإجراءات الوقائية مطلوبة
استملاك الأراضي	قليل	قليل	قليل	قليل	غير مباشر	-	غير مباشر	لا	+	-
الأثر على السياحة	قليل	قليل	قليل	عالي	-	-	قليل	لا		-

معايير الأهمية

الامتداد الجغرافي	قليل: محدود في موقع المشروع	متوسط: يمكن أن يصل خارج موقع المشروع	عالي: يصل خارج موقع المشروع
المستوى	قليل: لا يغير من الوضع الحالي	متوسط: يمكن أن يغير الوضع الحالي قليلا	عالي: يغير الوضع الحالي بقوة
التكرارية	قليل: تحدث مرة واحدة أو نادرا	متوسط: يحدث في الظروف الغير العادية	عالي: يحدث باستمرار
الفترة الزمنية	قليل: تحدث في العملية نفسها	متوسط: يحدث في مرحلة الإنشاء	عالي: يحدث خلال مرحلة التشغيل باستمرار
الاحتمالية	قليل: لا يحتمل وقوع الأثر	متوسط: يمكن أن يحدث	عالي: سوف يحدث

3-4 الإجراءات الوقائية

1-3-4 التوظيف

- يوصى بدرجة كبيرة لإعطاء الأولوية للمقاولين المحليين المؤهلين لتنفيذ بعض الأعمال الإنشائية المتعلقة بالمشروع مثل إعداد الموقع.
- يوصى بدرجة كبيرة لإعطاء الأولوية للسكان المحليين المؤهلين في التعيين على الوظائف الفنية وغير الفنية في المشروع.
- يجب أن يخضع العاملون المحليون للتدريب التقني من قبل المطور والمقاول الرئيسي من أجل تحسين القدرة التقنية، وزيادة جاذبيتها للعمال المحتملين في مشاريع أخرى مماثلة في المنطقة.

2-3-4 ازدهار الأعمال

- يوصى أن يتزود عمال وموظفو المشروع بحاجاتهم من المؤن والطعام والمشروبات وقطع الغيار (إلى حد توفرها) من المتاجر المحلية.
- يوصى استخدام ورش صيانة المركبات المحلية خلال جميع مراحل المشروع.
- يوصى بتشجيع رواد الأعمال الشبابية المحلية لإقامة المشاريع الصغيرة التي يمكن أن تمنح عقود الخدمة الصغيرة أثناء عمليات المشروع مثل الأمن والصيانة البسيطة وخدمات الحراسة.

3-3-4 الضغط على البنية التحتية

- التأكيد على السائقين في هذا المشروع الالتزام بقواعد السير على الطرق الداخلية والخارجية.
- عدم تجاوز الحمولات المسموح بها بالنسبة للشاحنات وناقلات المواد الإنشائية ومعدات مزرعة الرياح.

4-4 المراقبة

ستعمل شركة طاقة عابور على مراقبة ومتابعة الآثار على المؤشرات الاجتماعية والاقتصادية الكمية التالية:

- العمالة المحلية (مصنفة حسب ذكور / إناث، والقرية، ونوع الوظيفة)
- مشاركة البدو في المشروع
- الأسر / الأشخاص الذين أعيد توطينهم وتمنت مساعدتهم في إعادة التوطين
- مستويات التدريب والمهارات الجديدة
- حوادث المرور
- مشاريع التنمية المجتمعية الجديدة
- التغيرات في الدخل المحلي
- الأنشطة الجديدة المدرة للدخل والمبادرات المرتبطة بالمشروع

5-4 الآثار المتبقة والاستنتاجات

- تعتبر الآثار المتبقية على الوضع الاجتماعي والاقتصادي للمنطقة المشروع منخفضة ومعظمها إيجابية.

- لا يؤثر المشروع على المجتمعات المحلية، حيث لن يحدث أي نزوح خلال مرحلة البناء. على الرغم من ذلك قد تكون شهدت طريقة الحياة الريفية في منطقة المشروع تأثيرات دنيا كتأثر نشاط رعي الأغنام في عابور.
- هناك عدد من المناطق حيث تقوم شركة طاقة عابور يمكن أن تعالج بعض هذه الاحتياجات خاصة في رفع مستوى المهارات وتدريب المجتمع المحلي للعمل في المشروع الذي سوف يعود بالنفع على المنطقة المحلية.

5- الجيولوجيا والهيدرولوجيا ومصادر المياه

5-1 المعلومات الأساسية

الطبوغرافية: تتميز منطقة الدراسة بتغير التضاريس الوعرة.

المناخ: يقع موقع المشروع في منطقة جبلية من الطفيلة ويتميز بشتاء بارد نسبيا مع المطر بين الحين وسقوط الثلوج، ومعتدل إلى حار صيفا.

الجيولوجيا: البروز الصخورية في منطقة الدراسة من أصل رسوبي من العصر الكريتاسي العلوي. نشاط النارية في المنطقة يظهر الصخور البركانية البازلتية مرتبطة مع الترسيب.

مصادر المياه: تتكون المصادر المائية في منطقة الدراسة من مصدرين هما المياه الجوفية والسطحية. هناك أربعة آبار مياه جوفية في المنطقة القريبة من موقع المشروع.

الزلزالية: لا توجد صدوع نشطة أو أي ميزات مورفولوجية عاملة في منطقة المشروع.

5-2 تقييم الآثار

إن التأثيرات الرئيسية على مصادر المياه ستكون خلال مرحلة الإنشاء للمشروع بدلا من مرحلة التشغيل. ويمكن تلخيص الآثار المتوقعة من المشروع المقترح على مصادر المياه السطحية والجوفية في مرحلة الإنشاء على النحو التالي:

- المياه العادمة المنزلية
- المخلفات الصلبة
- العواصف المطرية
- التعرية والانجراف

خلال مرحلة التشغيل ليس من المتوقع أن تحدث أية آثار المتبقية على مصادر المياه.

5-3 الإجراءات الوقائية

- خلال مرحلة الإنشاء يتعين على المقاول إدارة مياه الصرف الناتجة بطريقة آمنة بيئيا. وهذا قد يشمل استخدام الحجرات المؤقتة منقولة المياه (المراحيض) ونقل هذه المياه إلى أقرب محطة لمعالجة مياه الصرف الصحي.
- جميع المياه العادمة الناتجة عن أنشطة الإنشاء سيتم نقلها خارج الموقع إلى محطة معالجة مياه الصرف الصحي المحلية.
- يجب أن يكون صيانة الآلات والمركبات في أماكن خاصة، ويجب ألا تكون داخل موقع المشروع لتجنب توليد نفايات سائلة إضافية.
- النفايات الصلبة المنزلية التي تنتج من العمال يجب أن تجمع في حاويات خاصة ونقلها بشكل دوري إلى أقرب مكب النفايات الصلبة.

- النفايات الصلبة الناتجة من إعداد الموقع، بناء وإعادة تأهيل يمكن استخدام مواد الردم في الموقع (إذا كان ذلك مناسبا)، في حين سيتم جمع المتبقي في أماكن خاصة بعيدا عن الأودية ونقلها إلى أقرب مكب النفايات الصلبة.
- يجب ان تغطي أكوام مواد البناء (مثل الحصى والرمل) المكشوفة في الموقع بالقماش المشمع خلال العواصف المطرية.
- يجب عرض طرق تنظيف انسكابات المواد الإنشائية بشكل واضح في جميع مناطق تخزين هذه المواد.
- يمكن تقليل مخاطر الانجراف من خلال:
  - التقليل من كمية من التربة أثناء عملية البناء، وبصورة رئيسية خلال إزالة الطرق التي لا لزوم لها.
  - تجنب البناء على المنحدرات الشديدة.
  - السماح مصدات من التربة دون عائق قرب المجاري، أو على حافة الهضاب.
  - ضمان إعادة الغطاء النباتي للتربة المستخدمة.
  - تصميم هياكل السيطرة على انجراف التربة الكافية للقيام بهذه المهمة.

6- الصحة العامة والصحة والسلامة المهنية

6-1 دراسات المسح الميداني

6-1-1 نوعية الهواء المحيط

تمت دراسة مراقبة الأغبرة بشكل مستمر للتراكيز الموجودة لـ (TSP, PM10, PM2.5) لمدة عشرين يوماً خلال الفترة من 2014/4/30-11 في أقرب مبنى مأهول للمشروع وهو مركز البحوث الزراعية. وقد دلت النتائج وبالمقارنة مع المواصفة القياسية الأردنية لنوعية الهواء المحيط (2006/1140) بأنه لم تسجل أية تجاوزات للحدود المسموح بها خلال فترة المراقبة.

6-1-2 الضجيج

تمت دراسة مراقبة مستويات الضجيج بشكل مستمر على مدار الـ24 لمدة أسبوع خلال الفترة من 2014/4/20-13 في أقرب مبنى مأهول للمشروع وهو مركز البحوث الزراعية، وعند مقارنة هذه المستويات مع التعليمات الوطنية وتعليمات مؤسسة التمويل الدولية وجد الآتي:

المستويات النهارية: كل المستويات المقاسة كانت أقل من الحد المسموح به لمؤسسة التمويل الدولية (55 ديسيبل (أ)) وتعليمات الحد والوقاية من الضجيج الأردنية (65 ديسيبل (أ)).

المستويات الليلية: نصف المستويات الليلية المقاسة كانت أقل من الحد المسموح به لمؤسسة التمويل الدولية (45 ديسيبل (أ)). إن نتائج الرصد الليلي تظهر أن مستويات الضجيج المراقبة تأثرت باستمرار بمصادر دخيلة.

6-1-3 وميض الظل

بما أن وميض الظل يحدث في الاتجاه الشرق الغربي فإن مستقبلات الظل المحتملة ستكون المباني الموجودة في الاتجاه الشرق الغربي لموقع المشروع قد تم مسحها. إن هذا المستقبل يقع للشرق من موقع المشروع والذي هو نفسه مستقبل الضجيج الحساس.

2-6 تقييم الآثار

الأثر	الإمتداد الجغرافي	المستوى	التكرارية	الفترة الزمنية	مباشر/ غير مباشر	عكسي/ غير عكسي	الاحتمالية	الأهمية	إيجابي/سلبي	ملاحظات
أثر الحوادث	متوسط	متوسط	قليل	متوسط	غير مباشر	غير عكسي	قليل	نعم	سلبي	الإجراءات الوقائية مطلوبة
النفايات الصلبة المنزلية	قليل	متوسط	عالي	عالي	مباشر	عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
المياه العادمة المنزلية	قليل	قليل	عالي	عالي	مباشر	عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
نوعية الهواء (الغبار)	متوسط	متوسط	متوسط	متوسط	مباشر	عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
الضجيج	متوسط	متوسط	متوسط	متوسط	مباشر	عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
وميض الظل	متوسط	متوسط	متوسط	متوسط	مباشر	عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
الانجماد	قليل	متوسط	قليل	قليل	غير مباشر	غير عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
الملاحة الجوية والرادار	قليل	متوسط	قليل	قليل	غير مباشر	غير عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
الاتصالات و والإشارات الكهرومغناطيسية	متوسط	متوسط	متوسط	متوسط	غير مباشر	غير عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
السلامة العامة	قليل	متوسط	متوسط	متوسط	غير مباشر	غير عكسي	متوسط	نعم	سلبي	الإجراءات الوقائية مطلوبة
العناية الصحية والتأمين الصحي	عالي	عالي	عالي	عالي	مباشر	عكسي	عالي	نعم	إيجابي	الإجراءات الوقائية مطلوبة
توفر معدات السلامة الشخصية	متوسط	عالي	عالي	عالي	مباشر	عكسي	عالي	نعم	إيجابي	الإجراءات الوقائية مطلوبة
توفر خطة للطوارئ	متوسط	عالي	عالي	عالي	مباشر	عكسي	عالي	نعم	إيجابي	-

معايير الاهمية:

الإمتداد الجغرافي
قليل: محدود في موقع المشروع
متوسط: يمكن ان يصل خارج موقع المشروع
عالي: يصل خارج موقع المشروع

المستوى
قليل: لا يغير من الوضع الحالي
متوسط: يمكن ان يغير الوضع الحالي قليلا
عالي: يغير الوضع الحالي يقوة

التكرارية
قليل: تحدث مرة واحدة او نادرا
متوسط: يحدث في الظروف الغير العادية
عالي: يحدث باستمرار

الفترة الزمنية
قليل: تحدث في العملية نفسها
متوسط: يحدث في مرحلة الانشاء
عالي: يحدث خلال مرحلة التشغيل باستمرار

الاحتمالية
قليل: لا يحتمل وقوع الاثر
متوسط: يمكن ان يحدث
عالي: سوف يحدث

3-6 الإجراءات الوقائية

1-3-6 خطر الحوادث

- القيام بأعمال النقل للمعدات في أوقات تتجنب أوقات الذروة والتقليل من حركة الآليات داخل المدن وذلك باتباع قوانين السير.
- على السائقين الالتزام بإرشادات السلامة على الطرق، قانون السير وحدود السرعة المسموح بها للتقليل من أثر الحوادث على الطرق.
- ضرورة توفير الإشارات الارشادية اللازمة للمشروع لتسهيل التقيد بأمور السلامة المرورية.
- يجب أن يكون لدى السائقين المعرفة بالإسعافات الأولية في حال وقوع أي حادث.
- التقيد بتعليمات ومتطلبات الدفاع المدني.

6-3-2 نوعية الهواء (الغبار)

- يوصى بترطيب مناطق الإنشاء وطرق الخدمات بالمياه للحد من إثارة الغبار.
- تغطية جميع المركبات التي تنقل المواد السائبة خلال فترة الإنشاء والتركيب داخل أو خارج الموقع لمنع انبعاث الغبار.
- تغطية أية مخزونات من الحصمة اللازمة في الإنشاء (إن لزم تخزينها في موقع المشروع).
- صيانة المركبات بشكل دوري لتقليل الانبعاثات الغازية منها.
- التقيد بالتدابير اللازمة لنظافة الموقع.
- ينبغي أن يكون هناك تفتيش يومي لمناطق العمل والمناطق المحيطة للتأكد من أن تتم إزالة أي تراكم للغبار.

6-3-3 الضجيج

من أجل الحد من تأثير الضجيج المحتمل في خصائص المنطقة المحيطة، تم تحسين تخطيط مزرعة الرياح المقترح. حيث أن مستويات الضجيج للتوربينات المتوقعة هي دون الحدود النهارية والليلية المسموح بها في التعليمات الأردنية ومؤسسة التمويل الدولية / البنك الدولي ، ولا يقترح أي تخفيف روتيني.

6-3-4 وميض الظل

لم يقترح أي تخفيف روتيني، ولكن أن تبقى هذه قيد الاستعراض خلال تشغيل مزرعة الرياح في أي حالة من الحالات تنشأ والتي تزيد من احتمال الانزعاج من وميض الظل.

في حالة الانزعاج من وميض الظل فإنه يمكن إدراج إجراءات وقائية عند تشغيل المشروع للتقليل من وميض الظل. وتتراوح الإجراءات الوقائية من زراعة حزام من الأشجار ما بين المستقبلات المتأثرة والتوربينات المؤثرة إلى إدخال الستائر المعتمة للمباني المتأثرة. ومن الإجراءات الأكثر شيوعا يستلزم ضمان تزويد التوربينات بأنظمة التحكم بوميض الظل التي تغلق التوربينات الفردية تلقائيا خلال الفترات التي تومض الظل. ويمكن أيضا تزامن الوقت من اليوم والسنة التي يحدث فيها وميض الظل في المبنى المتأثر.

6-3-5 الانجماد

سيتم تجهيز عدد تمثيلي من توربينات الرياح بمجسات الكشف عن الجليد والتي سوف تكون قادرة على الكشف عن وجود تراكم الجليد ووقف توربينات الرياح المجاورة وبالتالي منع رمي الجليد.

6-3-6 الملاحة الجوية

سيتم تجهيز التوربينات بأضواء الطيران.

6-3-7 الإشارات الكهرومغناطيسية

قد تؤدي مولدات توربينات الرياح إلى التداخل الكهرومغناطيسي مع رادارات الطيران وأنظمة الاتصالات السلكية واللاسلكية، شفرات توربينات الرياح مصنعة من المواد الاصطناعية التي لا تنتج أي أثر كهرومغناطيسي. هناك نوعان من أبراج الاتصالات بالقرب من موقع المشروع ومع ذلك فإن هناك مسافة كبيرة عن كل من توربينات الرياح في موقع المشروع، كما أن خط الرؤية

بين البرجين لا يعبر حدود موقع المشروع. كذلك لا توجد رادارات الطيران في المنطقة المجاورة لموقع المشروع، وبالتالي فإن المشروع لا يتعارض مع أنظمة الاتصالات السلكية واللاسلكية في المنطقة.

8-3-6 السلامة العامة

سيتم توظيف أفراد الأمن خلال مرحلتي الإنشاء والتشغيل للمشروع من أجل منع الوصول غير المصرح به لمزرعة الرياح وتوربينات الرياح الفردية من قبل العامة. وبالإضافة إلى ذلك عند الانتهاء من مرحلة البناء، وسيتم تسييج كل توربينات الرياح بسياج بطول 70م مع وبنصف قطر 2.5 م.

9-3-6 معدات الحماية الشخصية

ينبغي على الشركة ان تقدم لجميع العاملين المعدات وأدوات السلامة وتعليمات الوقاية الشخصية اللازمة للعمل وفقا لاحتياجاتها.

10-3-6 العناية الصحية والتأمين الصحي

- يجب أن يوفر المقاولون العاملون في المشروع خلال مرحلة الإنشاء التغطية الطبية لعمالهم.
- توفير التأمين الصحي وفقاً للتعليمات والتشريعات المعمول بها وعمل فحوصات دورية أولية لجميع العاملين في المشروع في مرحلة التشغيل.

7- الآثار والموروث الثقافي

1-7 المسح الأثري

أجري المسح الميداني لمنطقة المشروع من خلال التجوال المنتظم واستخدام نظام تحديد المواقع للتحقق من المكان المحدد حيث سيتم تركيب توربينات الرياح وبمساعدة من قاعدة بيانات ميغا الأردن. تم تحديد أربعة مواقع أثرية مسجلة في منطقة المشروع، وقد تم إعلام الشركة لتجنب هذه المناطق وإعادة النظر في تخطيط مزرعة الرياح واقتراح مواقع جديدة لهذه التوربينات من قبل فريق من علماء الآثار. تمت إعادة النظر في تخطيط مزرعة الرياح وزار فريق الآثار المواقع المنقحة بـ 20 سبتمبر 2014 وكانت النتائج مرضية.

2-7 الاجراءات الوقائية

تم وضع التوربينات وطرق الوصول في مواقع للحد من التأثيرات المباشرة على المواقع الأثرية المسجلة سابقا ضمن موقع المشروع.

وتشير نتائج المسح الأثري أنه لا توجد أي علامات يجب تجنبها في محيط مواقع التوربينات المقترحة. وبالتالي لا يلزم اتخاذ تدابير التخفيف في هذه المجالات.

من الواجب وأثناء تنفيذ مرحلة الإنشاء تزويد المقاول بالتعليمات والقوانين والأنظمة التي تشترط عليه ضرورة التوقف فوراً، في حال ظهور أية مخلفات أثرية أو مواقع تاريخية وإبلاغ دائرة الآثار العامة أو أقرب مركز أمني، وفي مثل هذه الحالة تقوم دائرة الآثار باتخاذ الإجراءات اللازمة لضمان حماية المواقع الأثرية المكتشفة.

8- التنوع الحيوي

ركزت دراسة التنوع الحيوي على بيانات المسح الميداني للنباتات والمجتمعات الحيوانية في موقع المشروع، تم تنفيذ الدراسة خلال الفترات آذار-أيار 2013 وحزيران- تشرين الثاني 2013، لفترة الربيع 40 يوماً ميدانياً و50 يوماً ميدانياً لفترة الخريف.

8-1 النباتات

- تم مسح مواقع محددة للنباتات البرية حيث كان المسح بشكل مربعات وخطي في محطات المراقبة لتحديد المناطق الجغرافية الحيوية في المنطقة.
- منطقة مزرعة رياح المقترحة تلية يخترقها العديد من الأودية (وديان الأنهار الموسمية)، ولوحظ تدهور الغطاء النباتي بسبب الرعي الجائر، الحرث وجمع الخشب من قبل السكان المحليين.
- لا يوجد غابات في أو بالقرب من الموقع، وهناك عدد من المزارعين والبدو المحليين يستخدمون الموقع للرعي الماشية.
- الموئل العام هو نباتات البحر الأبيض المتوسط غير حرجية.
- يتكون الغطاء النباتي من الشجيرات القزمة بارتفاعات تصل الى 30-40 سم.
- يقع المشروع ضمن المنطقة الايرانية الطورانية والبحر الأبيض المتوسط، بارتفاع 1400 متر فوق مستوى سطح البحر.
- كان هناك غطاء نباتي غني نسبيا في وقت المسح الميداني بسبب الفيضانات الموسمية في وديان المنطقة، حيث تم تسجيل أكثر النباتات المزهرة وعلامات للحيوانات.

8-2 المجتمعات الحيوانية

8-2-1 البرمائيات

البرمائيات غير متوقعة في منطقة الدراسة، بالإضافة إلى حقيقة أن البرمائيات لم تكن مسجلة سابقا.

8-2-2 الزواحف

شملت الدراسة الزواحف بالتزامن مع مسح الطيور والثدييات. وسجلت الملاحظات العرضية (مثل الثعابين الحية والميتة على طول طرق الوصول). في المجموع تم تسجيل 19 نوعا من الزواحف خلال فصلي الربيع والخريف 2013 في منطقة المشروع والمناطق المجاورة لها.

8-2-3 الطيور

8-2-3-1 مسح الطيور

تقع منطقة المشروع إلى الشمال الشرقي من المحيط الحيوي لمحمية ضانا ومنطقة ضانا للطيور المهمة. ووفقا للمسح الأدبي فإن منطقة المشروع ليست جزءا من منطقة ضانا للطيور المهمة ولكن مجاورة لها.

أجريت عمليات المسح الميداني لمدة 5 مواسم هجرة في المجموع (ربيع وخريف 2013 وربيع وخريف 2014 وربيع 2015):

- أجري المسح في ربيع 2013 لمدة 8 أيام بين 22/03/2013 و 18/05/2013 في نقطتي مراقبة.
- وأجري المسح في خريف 2013 لمدة 8 أيام بين 28/08/2013 و 01/11/2013 على نفس نقطتي المراقبة.

- وأجري المسح في ربيع 2014 لمدة 13 يوما بين 21/03/2014 و 14/04/2014 في نقطتي مراقبة. بينما ظلت نقطة المراقبة الأولى نفسها من السنة السابقة، وتم تغيير موقع نقطة المراقبة الثانية.
- وأجري المسح في خريف 2014 لمدة 15 يوما بين 05/09/2014 و 01/11/2014 في نفس نقطتي المراقبة من الموسم السابق.
- وأجرى المسح في ربيع 2015 لمدة 58 يوما بين 03/04/2015 و 31/05/2015.

2-3-2-8 نتائج المسح الإجمالي لحركة الطيور لمواسم 2013و2014

Black Stork	مهاجر مرور، تم تسجيل فرد واحد فقط خلال أربعة مسوح
White Stork	مهاجر مرور، تم تسجيل 92 فرداً في 3 أسراب خلال المسوح الأربعة كلها في مسح خريف 2014
Griffon Vulture	طير مفترس متكاثر، تم تسجيل 42 فرداً في 28 سرباً خلال المسوح الأربعة خلال مسوح الخريف
Egyptian Vulture	مهاجر مرور أو متكاثر، تم تسجيل 26 فرداً في 17 سرباً خلال المسوح الأربعة
Lesser Spotted Eagle	مهاجر مرور غير متكاثر، تم تسجيل 20 فرداً في 12 سرباً خلال المسوح الأربعة
Steppe Eagle	مهاجر مرور، تم تسجيل 124 فرداً في 59 سرباً خلال المسوح الأربعة
Short-toed Eagle	طير مفترس متكاثر محلي، تم تسجيل 65 فرداً في 60 سرباً خلال المسوح الأربعة
Booted Eagle	مهاجر مرور ومحلي، تم تسجيل 9 فرداً في 7 سرباً خلال مسوح ربيع وخريف 2014
Black Kite	مهاجر مرور ومحلي، تم تسجيل 354 فرداً في 75 سرباً خلال المسوح الأربعة
Western Marsh Harrier	مهاجر مرور غير متكاثر، تم تسجيل 71 فرداً في 17 سرباً خلال المسوح الأربعة في مواسم الخريف فقط
Montagu's Harrier	مهاجر مرور، تم تسجيل 16 فرداً في 12 سرباً خلال المسوح الأربعة
Pallid Harrier	مهاجر مرور غير متكاثر، تم تسجيل 14 فرداً في 14 سرباً خلال المسوح الأربعة

Long-legged Buzzard	طير مقيم محلي، تم تسجيل 78 فرداً في 70 سرباً خلال المسوح الأربعة
Steppe Buzzard	مهاجر، تم تسجيل 2764 فرداً في 215 سرباً خلال المسوح الأربعة
Honey Buzzard	مهاجر مرور، تم تسجيل 438 فرداً في 53 سرباً خلال المسوح الأربعة
Eurasian Sparrow hawk	مهاجر مرور غير متكاثر، تم تسجيل 22 فرداً في 6 أسراب خلال المسوح الأربعة
Levant Sparrow hawk	مهاجر مرور، تم تسجيل 3 فرداً في سربين خلال مسح الخريف 2014
Common Kestrel	مهاجر مرور ومقيم، تم تسجيل 77 فرداً في 67 سرباً خلال المسوح الأربعة
Lesser Kestrel	مهاجر مرور متكاثر، تم تسجيل 38 فرداً في 27 سرباً خلال 3 أيام في نيسان 2014
Red-footed Falcon	مهاجر مرور، تم تسجيل 2 فرداً في سربين خلال المسوح الأربعة
Unidentified Eagle Species	تم تسجيل 3 أفراد في 3 أسراب خلال 3 أيام مختلفة
Unidentified Buzzard Species	تم تسجيل 7 أفراد في سربين خلال يومين مختلفين
Unidentified Harrier Species	تم تسجيل فرد واحد في سرب واحد فقط
Unidentified Falcon	تم تسجيل 4 أفراد في سربين

3-3-2-8 نتائج المسح لحركة الطيور لموسم الربيع 2015

Honey Buzzard	مهاجر مرور، تم تسجيل 153 فرداً في 26 سرباً
Black Kite	مهاجر مرور، تم تسجيل 7 فرداً في 6 أسراب
Egyptian Vulture	سربان، عرضة لضربة الاصطدام من توربينات الرياح
Griffon Vulture	سربان، عرضة لضربة الاصطدام من توربينات الرياح
Short-toed Eagle	تم تسجيل 26 فرداً في 23 سرباً
Marsh Harrier	لوحظ في مناسبتين
Pallid Harrier	لوحظ في مناسبة واحدة

Montagu's Harrier	فرد واحد فقط تم تسجيله
Eurasian Sparrow hawk	تم تسجيله في 8 مناسبات
Levant Sparrowhawk	تم تسجيل فرد واحد فقط
Steppe Buzzard	تم تسجيله بانتظام
Long-legged Buzzard	تم تسجيل 59 فرداً خلال 53 سرباً
Steppe Eagle	تم ملاحظة 22 فرداً خلال 20 سرباً
Eastern Imperial Eagle	تم تسجيل 4 فرداً خلال 3 أسراب
Booted Eagle	سربان تم تسجيلهما
Osprey	مهاجر خريفي نادر، تم تسجيله في مناسبة واحدة فقط
Lesser Kestrol	تم ملاحظة 3 أسراب
Common Kestrel	أكثر الأنواع المسجلة في معظم الأحيان
Red-footed Falcon	تم ملاحظة سرب واحد
White Stork	تم ملاحظة سرب واحد

4-3-2-8 تقييم مخاطر اصطدام الطيور

خطر اصطدام الطيور مع توربينات الرياح يحصل فقط عندما يطير الطائر على ارتفاع الدوار في التوربين. معظم الطيور تعمل على تجنب هذا التصادم بتغيير خطوط رحلاتهم لتجنب الهياكل. أو أنها قد ترى عن قرب شفرة قادمة، وتأخذ حالة الطوارئ في تجنب التصادم.

5-3-2-8 الاستنتاجات

- نظرا لخمسة مواسم من المسوحات التي أجريت في موقع المشروع، وخلصت إلى أن موقع المشروع ليس مشغولا كممر هجرة.
- النظر في تخطيط التوربينات وحجم مزرعة الرياح التي تتكون من 15 توربينات رياح فقط، لا يعتبر مزرعة رياح أن ينجم عنها عائقا رئيسيا للطيور خلال فترات الهجرة في فصلي الربيع والخريف.
- نزوح الطيور المقيمة ممكن ومع ذلك، منطقة ضانا المهمة للطيور و المحيط الحيوي لمحمية ضانا يمكن أن تكون بمثابة بيئة مناسبة في المنطقة المجاورة.

- من المتوقع التأثير في فقدان الموائل وتأثير الأضرار التي لحقت تكون منخفضة في مزرعة رياح عابور.

8-2-4 الثدييات

تم تسجيل ما مجموعه 15 نوعا من الثدييات من خلال المسوحات أثناء الربيع والخريف 2013.

8-2-5 الخفافيش

شملت مسوحات الخفافيش في موقع المشروع في الفترة من 20 يونيو وحتى سبتمبر 2013 مع ما مجموعه 10 أيام عمل. لم تسجل أية أنشطة للخفافيش في الموقع، ولكن تم تسجيل نوع من الخفافيش على بعد 8 كم إلى الجنوب من موقع المشروع في عين غرندل.

8-3 المناطق المحمية طبيعياً

أقرب المناطق إلى موقع المشروع هي محمية ضانا الطبيعية ومنطقة ضانا المهمة للطيور. المسافة بين محمية ضانا الطبيعية وموقع المشروع حوالي 11 كم في حين تقع منطقة ضانا المهمة للطيور على بعد حوالي 7.5 كم من موقع المشروع في الجنوب الغربي.

8-4 تقييم الآثار

8-4-1 الآثار على النباتات

ويمكن تلخيص هذه الآثار على النحو التالي:

- إزالة التربة السطحية.
- النفايات الصلبة والسائلة.
- تدمير النباتات.

8-4-2 الآثار على الحيوانات

ويمكن تلخيص هذه الآثار على النحو التالي:

- فقدان الموائل.
- تغيير/تعديل الموئل.
- تجزئة الموائل.
- الضجيج.
- الضوء وحركة المرور.
- النفايات الصلبة والسائلة.
- الصيد من قبل العمال.

5-8 الإجراءات الوقائية

1-5-8 الإجراءات الوقائية خلال مرحلة الإنشاء

- الامتثال للمعايير البيئية وفرض رقابة صارمة على العمال ليتصرفوا بمسؤولية فيما يتعلق بالقضايا البيئية.
- تصغير / تحسين كمية وحجم الطرق الجديدة إلى أقصى حد ممكن.
- إعادة زراعة النباتات الطبيعية ونقل التربة الغنية في مواقع البناء الى المناطق المجاورة.
- إعادة تأهيل مناطق التجمع المؤقتة واستعادة الظروف الأصلية.
- الحد من أنشطة التأهيل في مواقع الحفر حيثما كان ذلك ممكنا وزراعة الموقع بالنباتات الأصلية.
- جمع كل النفايات، صلبة وسائلة، في حاويات مغلقة والتخلص منها في مواقع التخلص السليم.
- يجب العمل ضمن الاعتماد ISO14001 للإدارة البيئية التي يجب أيضا أن تفرض على جميع المقاولين الفرعيين.
- تغطية أماكن تخزين نواتج الحفر عندما تتطلب الظروف المناخية للسيطرة على الغبار.
- الحد من أنشطة البناء ليكون في موقع مزرعة الرياح.
- تخزين التربة الطبيعية في مواقع خاصة وإعادة استخدامها عند الحاجة إلى الطمم.
- تحويل النباتات الطبيعية والتربة الغنية بالمغذيات من مواقع البناء إلى المناطق المجاورة.

2-5-8 الإجراءات الوقائية خلال مرحلة التشغيل

- جمع كل النفايات، صلبة وسائلة، في حاويات مغلقة والتخلص منها في مواقع التخلص السليم.
- يحظر ترك الطرق ورافعة المنصات مع المركبات إلا إذا توجب إجراء أعمال الصيانة الرئيسية.
- منع العمال من الصيد وعمل مواد التوعية مثل:
  - الإشارات
  - دليل التدريب
  - ملصقات
  - كتيبات ونشرات إرشادية
- تقليل حركة المركبات إلى أدنى حد ممكن.
- تقليل البصمة قدر الإمكان.
- تقليل التدخل قدر الإمكان.
- إجراء بحوث المتابعة لآثار المشروع على الطيور.
- مزامنة أضواء الطيران (إن كان عملياً).
- القيام بأنشطة مراقبة الطيور في الربيع (أواخر فبراير حتى منتصف مايو) والخريف (أواخر أغسطس إلى منتصف نوفمبر) خلال مواسم الهجرة وتحليل الآثار المترتبة من مزرعة الرياح على الطيور، وبعد البرنامج لمدة 3 سنوات ينبغي أن يتم إجراء تقييم لتحديد المستوى المستمر من الجهد.
- إجراء المراقبة في فترة الصيف (أواخر مايو إلى أوائل شهر أغسطس) للطيور المقيمة في فصل الشتاء، وبعد برنامج لمدة 3 سنوات ينبغي أن يتم إجراء تقييم لتحديد المستوى المستمر من الجهد.

- وضع بروتوكول للإغلاق على الطلب لطيور الأولوية، وبعد برنامج لمدة 3 سنوات ينبغي أن يتم إجراء تقييم لتحديد المستوى المستمر من الجهد.
- إجراء عمليات البحث عن جثث الحيوانات خلال مواسم الهجرة في فصلي الربيع والخريف خلال فترة أسبوع واحد، وخلال الصيف والشتاء لمدة أسبوعين.
- توثيق وتقرير وقائع إيجاد جثث و/ أو بقايا طيور الأولوية وإجراء التحقيقات وتحديد الإجراءات التصحيحية.

9- المرور والنقل

9-1 المسار المخطط

سيتم نقل المعدات اللازمة للمشروع من ميناء العقبة إلى موقع المشروع عبر الطريق الصحراوي.

9-2 تقييم التأثير

من المتوقع أن يكون الأثر الرئيسي للمشروع خلال مرحلة الإنشاء وهي فترة مؤقتة. في حين أن مرحلة التشغيل سيكون لها تأثير أقل بكثير مما كانت عليه خلال مرحلة الإنشاء.

الطريق الرئيسي لنقل المعدات يكون عبر الطريق الصحراوي الذيتم المنشأ بشكل جيد ويتكون من عدة مسارب، لذلك ليس من المتوقع أن تضيف أنشطة المشروع على هذا الطريق أي تأثير إضافي.

9-3 الإجراءات الوقائية

- يجب أن تكون مواد الإنشاء المنقولة في الشاحنات مغطاة بشكل جيد لتجنب أية انسكابات خلال النقل.
- يجب ألا تتجاوز الشاحنات الناقلة للمعدات ومواد الإنشاء الحمولة المحورية المسموح بها.

10- تحليل بدائل المشروع المقترح

ضم تحليل البدائل لهذا المشروع خيارات "لا مشروع" مقابل بديل "المشروع"، وقد تم تحديد موقع المشروع من قبل وزارة الطاقة والثروة المعدنية ومطور المشروع.

يعتبر بديل المشروع المقترح أفضل خيار ممكن بدلا من "لا مشروع" حيث يعتبر المشروع المقترح حلا بيئياً لتوليد الطاقة في الأردن من مصادر متجددة مثل طاقة الرياح، والتي تعتبر تكنولوجيا نظيفة بدون أية انبعاثات، كما أن الاتجاه العالمي والمحلي لتوليد الطاقة يتوجه لتوليدها من المصادر المتجددة.

1. PROJECT DESCRIPTION

1.1 Introduction

Jordan is committed to increasing the share of Renewable Energies (RE) in generation of electricity to 10% by 2020. Major share of RE is to come from Wind Power (1,200 MW) and Solar Power (600 MW).

Abour Energy Company ("AEC") was established in 2013 by Xenel International under the laws of The Hashemite Kingdom of Jordan as a Private Shareholding Company. The purpose of AEC is to develop, own and operate a wind farm project comprising of 15 Vestas V117 / 3.3 MW turbines, having a total installed capacity of 49.5 MW, to be located in the Village of Abour in the Governorate of Tafila. The annual electrical energy to be generated by the wind farm is estimated at 152 GWh. The wind farm will be connected to the 132 kV transmission grid system of National Electric Power Company ("NEPCO").

1.2 Project Components

The Project will comprise:

- 15 x Vestas V117- 3.3 MW wind turbine generators;
- Turbine foundations;
- Existing and new onsite access roads;
- A 33 kV internal grid network using underground cables to connect the 15 wind turbines to the Project substation;
- A Project substation incorporating 2 x 33/132 kV step-up transformers, switchgear, electrical protection, metering, communications and monitoring, and weather and safety protection equipment.

1.3 Project Location

The Project site is located 140 km south of Amman. Communities that are located in the vicinity of the Project site include:

- Town of Tafila: about (8.3) km northwest of the Project site;
- Village of Umm Sarab: about (4.2) km southwest of the Project site; and
- Village of Alayn Al-Byyda: about (8) km west of the Project site.

2. ESIA TERMS OF REFERENCE

The Environmental and Social Impact Assessment ("ESIA") has focused on identifying, analyzing, assessing, and mitigating impacts on the following Valued Environmental Components ("VECs"):

- Public health;
- Occupational health and safety;
- Water resources;
- Socio-economic conditions;
- Archaeology;
- Biodiversity; and
- Traffic.

Socio-economic Conditions

Issue	Construction phase	Operation phase	Decommissioning phase
Employment	√	√	√
Landscape and visual impact and aesthetics	√	√	√
Land use	√	√	√
Business prosperity	√	√	
Stress on infrastructure	√	√	√
Land acquisition and Resettlement	√		
Impact on tourism		√	

Water Resources

Issue	Construction phase	Operation phase	Decommissioning phase
Long term impacts on topsoil and erosion	√	√	√
Wastewater disposal and its impact on groundwater resources	√	√	√

Solid waste and its impact on surface and ground water resources	√	√	√
Water Requirements	√	√	
Floods and rainfall	√	√	

Public Health

Issue	Construction phase	Operation phase	Decommissioning phase
Accidents risks	√	√	√
Ambient air quality (dust)	√		√
Noise	√	√	√
Shadow flickering		√	
Icing/ Ice throw		√	
Aviation & radar		√	
Telecommunication / EMI links		√	
Domestic wastewater	√	√	√
Domestic solid waste	√	√	√
Public Safety	√	√	

Occupational Health and Safety

Issue	Construction phase	Operation phase	Decommissioning phase
Medical care and health Insurance	√	√	√
Domestic wastewater	√	√	√
Domestic solid waste	√	√	√
Ambient air quality (dust)	√		√
Noise	√	√	√
Accidents impact	√	√	√

Shadow flickering		√	
Icing/ Ice throw		√	
Aviation & radar		√	
Telecommunication / EMI links		√	
Personal Protection Equipment (PPE)	√	√	
Availability of Emergency Plan	√	√	

Archaeology

Issues	Construction phase
Remaining archaeology	√
List of monuments / remains recorded	√

Biodiversity

Issue	Construction phase	Operation phase	Decommissioning phase
Impact on flora	√	√	√
Impact on Wildlife	√	√	√
Impact on Migratory Birds	√	√	√
Impact on habitats	√	√	√

Traffic

Issues	Construction phase	Operation phase	Decommissioning phase
Transportation of equipment & construction materials	√		
Traffic volume	√	√	√
Impact on roads and	√	√	√

transportation infrastructure			

3. RELEVANT LEGAL FRAMEWORK

3.1 Relevant National Legislation

Laws

- The Environment Protection Law No. 52 Year 2006.
- Renewable Energy and Energy Efficiency Law No. 2 Year 2015.
- General Electricity Law Temporary Law No. 64 Year 2002.
- Traffic Law No. 49 Year 2008.
- General Health Law No. 47 Year 2008.
- The Antiquities Law No. 21, Year 1988 and its amendments.
- Transportation Law (89/2003)
- Agricultural Law No. 13 Year 2015.
- Trade, Industry and Occupation Safety Law No. 16 Year 1953.
- Civil Defense Law No. 18 Year 1999.
- Labour Law No. 8 Year 1996 and its amendments.
- Water Authority Law and its amendments No. 18 Year 1988.
- The Organization of the Natural Resources Affairs Law No. 12 Year 1968.
- Acquisition Law No. 12 Year 1987.
- Compensation Law Year 1987.

Regulations

- The Environmental Impact Assessment Regulation No. 37 Year 2005.
- The Bylaw on Regulating Procedures and Means of Conserving Energy and Improving its Efficiency No. 73 Year 2012.
- Land use planning Regulation No. 6 Year 2007.
- Natural Reserves and National Parks Regulation No. 29 Year 2005.
- Soil Protection Regulation No. 25 Year 2005.
- Regulation of Solid Waste Management No. 27 Year 2005.
- Air Protection Regulation No. 28 Year 2005.
- Groundwater Control Regulation No. 85 Year 2002

Standards

- Jordanian Standard for reclaimed domestic wastewater (JS 893/2006).
- Jordanian Standard for drinking water (JS 286/2008).
- Jordanian Standard for Ambient Air Quality (JS 1140/2006).

Instructions

- Instructions for Protection of Birds and Wildlife and rules covering their hunting No.34 Year 2003.
- Instructions on the Protection of water Resources Year 2012.
- Instructions for Recycling and Handling of Consumed Oils Year 2014.
- Instructions for the Limitation and Control of Noise Year 2003.
- Instructions No. 1 Year 2013 for the prevention of occupational hazards related to health hazards resulting from labour housing units' onsite.

Guidelines

- Guidelines for limiting exposure to time-varying Electric, Magnetic and Electromagnetic fields, issued in accordance to articles (6/b and 48) of the Telecommunication Law.
- Drinking Water Resources Protection Guideline, July 2006.

3.2 International Standards

- IFC Policy and Performance Standards on Social and Environmental Sustainability:
  - IFC Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts.
  - IFC Performance Standard 2: Labour and Working Conditions.
  - IFC Performance Standard 3: Resource Efficiency and Pollution Prevention.
  - IFC Performance Standard 4: Community, Health, Safety and Security.
  - IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement.
  - IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
  - IFC Performance Standard 7: Indigenous People, Year 2012.
  - IFC Performance Standard 8: Cultural Heritage.
- IFC Guidance Notes:

  - IFC General Environmental, Health and Safety Guidelines, Year 2007.
  - IFC General Environmental, Health and Safety Guidelines for Wind, Year 2007.
- IFC Operational Policy OP 4.01 Environmental Assessment, October 1998 (Revised April 2013).
- IFC Operational Policy OP 4.04 Natural Habitats, November 1998 (Revised April 2013).

4. SOCIOECONOMIC ASSESSMENT AND MITIGATION PLAN

4.1 Baseline

The baseline socio-economic conditions provide a summary of the relevant socio-economic data and information collected.

- Overview of Project Area: Tafila Governorate, districts, sub-districts, and the administrative structure of Project area;
- Demographics: Population and housing for Jordan in general, and the focus area in particular;
- Medical Provisions: Statistics on hospitals and health care facilities in the area;
- Land use/land use plans and patterns: Including agriculture (types of crops and annual productions), and industrial facilities; and
- Economic Activity: Educational institutions, transportation (road, rail, air), communication and overall economy (i.e. employment and revenue for agriculture and industry).

4.2 Evaluation of Impact

The AEC wind farm Project is expected to have potential socio-economic impacts on the area during its construction and operation phase. The table below provides a summary of the impacts assessment:

Impact	Geographical Extent	Level	Frequency	Duration	Direct (D) Indirect (ID)	Reversible (R) Irreversible (IR)	Likelihood	Significant	Positive/ Negative	Remarks
Employment	H	M	M	M	D	R	H	Yes	+	Mitigation measures are required
Landscape and visual impact and aesthetics	M	M	M	M	D	IR	H	Yes	-	Mitigation measures are required
Land Use	L	L	L	M	ID	-	M	Yes	-/+	-
Business prosperity	M	M	M	H	ID	-	M	Yes	+	Mitigation measures are required
Stress on infrastructure	M	M	M	M	D	IR	M	Yes	-	Mitigation measures are required
Land acquisition and Resettlement	L	L	L	L	ID	-	L	No	+	-
Impact on tourism	L	L	L	H	-	-	L	No		-

Significance criteria:

Geographical Extent:	L:	Limited to project site.	M:	May reach outside the project site.	H:	Will reach outside the project site.
Level:	L:	Will not change existing level.	M:	Will change existing level slightly.	H:	Will change existing level severely.
Frequency:	L:	Occurs only once / rarely.	M:	Occurs during abnormal conditions.	H:	Occurs continuously.
Duration:	L:	During specific activity.	M:	During construction phase.	H:	During operational phase continuously.
Likelihood:	L:	Impact is not likely to occur.	M:	May occur.	H:	Will occur.

4.3 Mitigation Measures

4.3.1 Employment

- It is highly recommended to give priority to qualified local contractors to execute some of the construction works related to the Project such as site preparation.
- It is highly recommended to give priority to qualified local people in recruitment for skilled and non-skilled jobs in the Project.
- Local staff should undergo technical training by the developer and the EPC contractor in order to improve their technical capacity, and increase their attractiveness as potential workers on other similar projects in the region.

4.3.2 Business prosperity

- It is recommended that the Project workers and related staff get supplies, food, beverages and spare parts (to the extent available) from local stores.

- It is recommended to use local vehicle maintenance workshops during all phases of the Project.
- It is recommended to encourage local young entrepreneurs to establish small businesses that could be awarded small service contracts during operations such as security, simple maintenance and janitorial services.

4.3.3 Stress on Infrastructure

- Strict instruction shall be given to the drivers in this Project to comply with the rules of road traffic (internal and external).
- To protect the roads, trucks used for construction and transportation of wind farm equipment shall have a gross weight within the axial permissible load.

4.4 Monitoring

AEC will track and monitor the impact on the following quantitative socio-economic indicators:

- Local employment (disaggregated by male/female, village origin, and type of post);
- Bedouin participation in Project;
- Households/persons resettled and assisted in the resettlement;
- New training and skill levels;
- Traffic accidents;
- New community development projects;
- Changes in local incomes; and
- New income generation activities and initiatives associated with the Project.

4.5 Residual Impacts and Conclusions

- The residual impacts on the socio-economic status of the Project area are considered to be low or mostly positive.
- The Project will have no impacts on the local communities as no displacement will occur throughout the construction phase. Nonetheless minimum impacts to the rural way of life in the Project area may be witnessed as sheep herding activity in Abour may be disrupted.

- There are a number of areas where AEC could address some of these needs especially in the upgrade of skills and training of local community to work in the Project which will in return benefit the local area.

5. GEOLOGY, HYDROLOGY & WATER RESOURCES

5.1 Baseline Data

Topography: The study area is characterized by a rough topography variation.

Climate: The Project site is located in a hilly area of Tafila and is characterized by relatively cold winters with occasional rain and snow fall, and mild to hot summers.

Geology: The bed rock outcropping in the investigated area is of sedimentary origin of Upper Cretaceous (Campanian to early Tertiary). An igneous activity in the area is appearing as basaltic volcanic rocks associated with sedimentation.

Water Resources: Water resources in the study area consist of two sources namely, groundwater and surface water resources. There are four groundwater wells in close vicinity of the Project site.

Seismicity: No active faults or any active morphological features were found in the Project area.

5.2 Impact Assessment

The principal impacts to water resources will be during the construction phase rather than the operation phase. The expected impacts of the proposed Project on the surface water and groundwater of the Project in the construction phase can be summarized as following:

- Domestic wastewater;
- Solid wastes;
- Storm water runoff; and
- Erosion.

During the operation phase, no residual water resources and quality impacts are expected to occur.

5.3 Mitigation Measures

- During the construction phase, the contractor shall manage the generated domestic wastewater in an environmentally safe manner. This might include using temporary movable water closets (toilets) and transporting of the resulting domestic wastewater to the nearest wastewater treatment plant.

- All wastewater generated by the construction activities will be trucked off site to the local wastewater treatment plant.
- Maintenance of machinery and vehicles must be in special places and shall not be within the Project site to avoid generating additional liquid waste.
- Domestic solid wastes that result from workers must be collected in special containers and transported periodically to the nearest solid wastes landfill.
- Solid waste resulting from site preparation, construction and rehabilitation can be used as fill material in the site (if appropriate), while the remaining will be collected in special places far from wadis and transported to the nearest solid waste landfill.
- Open stockpiles of construction materials (e.g. aggregates and sand) at the site shall be covered with tarpaulin or similar fabric during rainstorms.
- Spill clean-up procedures must be clearly displayed in all construction materials storage areas.
- The risk of serious erosion can be reduced by:
  - Minimizing the amount of earth disturbed during construction, principally by eliminating unnecessary roads;
  - Avoiding construction on steep slopes;
  - Allowing buffers of undisturbed soil near drainages and at the edge of plateaus;
  - Assuring re-vegetation of disturbed soils; and
  - Designing erosion-control structures adequate for the task.

6. PUBLIC HEALTH AND OCCUPATIONAL HEALTH & SAFETY

6.1 Baseline studies

6.1.1 Ambient Air Quality

Continuous dust monitoring study of the existing ambient air concentrations of TSP, PM10 and PM2.5 for 20 days between 11 April 2014 and 30 April 2014 was conducted at the closest occupied building is the is the office of Agricultural Research Center.

The results were compared to Jordanian ambient air quality standard (JS1140/2006) and no exceedances to JS1140/2006 were observed throughout the monitoring period.

6.1.2 Noise

Background noise monitoring studies were undertaken at the closest occupied building which is the office of Agricultural Research Center in the east of the Project site for a week

between April 13, 2014 and April 20, 2014 continuously measured for 24 hours and the levels were logged for 10-minute sampling intervals.

Daytime: all background noise levels at NSR were below the IFC/WB daytime noise level limit of 55 dBA and Jordanian noise regulation limit of 65 dBA.
Nighttime: half of the measured nighttime background noise levels at the NSR were below the IFC/WB limit value of 45 dB(A). The nighttime baseline noise monitoring results show that the monitored noise levels were influenced constantly by extraneous sources.

6.1.3 Shadow Flickering

Since shadow flickering occurs in east-west direction, potential shadow receptors which are occupied buildings in east-west direction to the Project site were surveyed. The shadow receptor, which is also determined as noise sensitive receptor, is located to the east of the Project site.

6.2 Impacts Evaluation

Impact	Geographical extent	Level	Frequency	Duration	Direct (D) / Indirect (ID)	Reversible(R) / Irreversible(IR)	Likelihood	Significant	Positive/Negative	Remarks
Accidents risks	M	M	L	M	ID	IR	L	Yes	-	Mitigation measures are required
Domestic Solid wastes	L	M	H	H	D	R	M	Yes	-	Mitigation measures are required
Domestic Wastewater	L	L	H	H	D	R	M	Yes	-	Mitigation measures are required
Air quality (dust)	M	M	M	M	D	R	M	Yes	-	Mitigation measures are required
Noise	M	M	M	M	D	R	M	Yes	-	Mitigation measures are required
Shadow flickering	M	M	M	M	D	R	M	Yes	-	Mitigation measures are required
Icing/ Ice throw	L	M	L	L	ID	IR	M	Yes	-	Mitigation measures are required
Aviation & radar	L	M	L	L	ID	IR	M	Yes	-	Mitigation measures are required
Telecommunication/EMI links	M	M	M	M	ID	IR	M	Yes	-	Mitigation measures are required
Public safety and access	L	M	M	M	ID	IR	M	Yes	-	Mitigation measures are required
Medical care	H	H	H	H	D	R	H	Yes	+	Mitigation measures are required
Personal Protection Equipment	M	H	H	H	D	R	H	Yes	+	Mitigation measures are required

Availability of Emergency Plan	M	H	H	H	D	R	H	Yes	+	-

Significance criteria:

Geographical Extent:	L:	Limited to project site.	M:	May reach outside the project site.	H:	Will reach outside the project site.
Level:	L:	Will not change existing level.	M:	Will change existing level slightly.	H:	Will change existing level severely.
Frequency:	L:	Occurs only once / rarely.	M:	Occurs during abnormal conditions.	H:	Occurs continuously.
Duration:	L:	During specific activity.	M:	During construction phase.	H:	During operational phase continuously.
Likelihood:	L:	Impact is not likely to occur.	M:	May occur.	H:	Will occur.

6.3 Mitigation Measures

6.3.1 Accidents Risk

- Transportation of equipment shall be carried out during such periods as to avoid peak times, and to minimize the movement of machinery within the cities and obeying traffic laws.
- Drivers should be instructed to follow safety instructions, the traffic law and to abide with the road speed limits.
- The need for traffic signs for the Project to facilitate compliance with traffic safety matters.
- Drivers must have knowledge of first aid in the event of any accident.
- Compliance with instructions and the requirements of civil defence.

6.3.2 Air Quality (Dust)

The construction contractors shall take sufficient precautionary measures to limit dust generation. Such measures are outlined below:

- Water trucks should be employed periodically to douse the construction areas and site roads to minimize dust emissions;
- All vehicles carrying bulk materials into or out of the site shall be covered to prevent dust emission;
- Any storage on site of aggregate or fine materials shall be properly enclosed and screened so that dust cannot escape from the site;
- All vehicles shall be properly maintained to reduce air emissions;
- Good housekeeping arrangements shall be employed so that the site is kept as clean as possible; and
- There should be daily inspections of the working areas and immediate surrounding areas to ensure that any dust accumulation or spillages are removed / cleaned up as soon as possible.

6.3.3 Noise

In order to minimize the potential noise impact at the surrounding properties, the layout of the proposed wind farm was optimized. As the predicted turbine noise levels at the NSR are below the local Jordanian noise regulation and IFC/WB Guideline daytime and nighttime noise limits, no routine mitigation is proposed.

6.3.4 Shadow Flickering

No routine mitigation is proposed; this will however be kept under review during the operation of the wind farm in case particular combinations of circumstances arise that increase the potential for nuisance.

Where nuisance arises, mitigation measures can be incorporated into the operation of the wind farm to reduce the instance of shadow flicker. Mitigation measures range from planting tree belts between the affected receptors and the responsible turbine(s) and/or installing blinds at the affected buildings. A more common measure entails ensuring the turbines are fitted with shadow flicker control systems that automatically shut down individual turbines during periods when shadow flicker could theoretically occur, i.e., when the wind speed and direction coincides with sufficient sun for shadows to form. It can also coincide the time of day and year that shadow flicker occurs at a particular property.

6.3.5 Ice Throw

A representative number of wind turbines will be equipped with Ice Detection sensors which will be capable of detecting the presence of ice build-up and stop the neighbouring wind turbines thus preventing ice throw.

6.3.6 Aviation

The turbines will be equipped with aviation lights.

6.3.7 Electromagnetic Interference Problems

Wind turbine generators could lead to electromagnetic interference with aviation radars and telecommunication systems. The blades of the proposed wind turbines are made of synthetic material which produces no electromagnetic impact. There are two telecommunication towers near the Project site, however, (i) they are at considerable

distance from all of the wind turbines at the Project site; and (ii) the line of sight between the towers does not cross the overall boundary of the Project. There are no aviation radars in the vicinity of the Project site and consequently the Project will not interfere with the telecommunication systems in the area.

6.3.8 Public Safety and Access

Security personnel will be employed during the construction and operations phases of the Project in order to prevent unauthorized access by the public to the wind farm and individual wind turbines. In addition at the completion of the construction phase, each wind turbine will be fenced off with a 70m radius and 2.5-m high metal fencing.

6.3.9 Personal Protection Equipment

The company should provide all workers with the personal protective equipment and safety tools and instructions required for the work and according to their needs.

6.3.10 Medical Care and Health Insurance

- Contractors working on the construction of the Project should provide their workers with the necessary medical coverage.
- Employees and personnel in operation phase will be provided with medical insurance according to the laws and regulations of Jordan and will be also subject to primary and periodical medical check-ups.

7. ARCHAEOLOGY & CULTURAL HERITAGE

7.1 Archaeological Survey

A systematic walkthrough survey of the Project area was carried out. GPS was used to verify the exact location where the 15 wind turbines will be installed. With the aid of Mega Jordan database3, four registered archaeological sites were identified in the Project area. Abour Energy Company was notified to avoid these areas and to revise the wind farm layout. New locations for these wind turbines were suggested by the archaeological team. Abour Energy proceeded to revise the wind farm layout and the archaeology team visited the revised site layout on 20 September 2014 with satisfactory results.

7.2 Mitigation Measures

The turbines and access roads have been positioned in locations to minimize direct impacts on previously recorded archaeological sites within the Project site.

The results of the archaeological survey suggest that there are no features in the vicinity of the proposed turbine locations that must be avoided. Mitigation measures in these areas are therefore not required.

It is essential during the construction phase to provide strict instructions to the contractors to suspend construction activity upon discovery of any antiquities or archaeological items. Such discoveries should be reported to the Director of Department of Antiquities or to the nearest Public Security Center. The Department of Antiquities may recommend certain measures to protect the found items.

8. BIODIVERSITY

The biodiversity study focused on the baseline data of flora and fauna (reptilia, mamalia, aves, amphibia) at the Project site in Abour area in Tafila. The study was conducted during March – May 2013 and June - November 2013. For the spring period, a total of 40 field days and for the fall period 50 field days were spent at the Project site.

8.1 Flora

- Quadrates and linear specific sites were surveyed for terrestrial flora at the observation stations to define the bio-geographical zones of the area.
- The area of the proposed wind farm is hilly with several wadis (seasonal river valleys) crossing the site. The vegetation is degraded due to overgrazing, plowing and wood collection by local people.
- There is no forest at or near the site. A number of farmers and local nomads use the site for livestock grazing.
- The general habitat structure is typical of Mediterranean non-forest vegetation.
- The vegetation is composed of dwarf shrubs like cushions and the vegetation heights are up to 30-40 cm.
- The Project site lies within the Irano-Turanian eco-zone and Mediterranean, at an attitude of about 1,400 m above sea level.

- There was relatively rich vegetation cover at the time of field survey due to seasonal floods in the wadis of the area, where more flowering plants and animal signs were recorded.

8.2 Fauna

8.2.1 Amphibians

No amphibians were expected in the study area in addition to the fact that amphibians have never been recorded previously.

8.2.2 Reptiles

Reptiles were surveyed in conjunction with bird and mammal surveys. Incidental observations were recorded (e.g. live and dead snakes along access roads). In total 19 species of reptilians were recorded during spring and fall 2013 in the Project area and its vicinity.

8.2.3 Birds

8.2.3.1 Birds Surveys

The Project area is located to the northeast of the Dana Biosphere Reserve and Dana Important Bird Area. According to the literature survey, the Project area is not a part of the IBA, but is adjacent to the IBA.

Field surveys were conducted for 5 migration seasons in total (spring and autumn 2013, spring and autumn 2014, and spring 2015):

- The spring 2013 survey was conducted for total of 8 days between 22.03.2013 and 18.05.2013 on two vantage points.
- The autumn 2013 survey was conducted for 8 days between 28.08.2013 and 01.11.2013 on the same two vantage points.
- The spring 2014 survey was conducted for 13 days between 21.03.2014 and 14.04.2014 on two vantage points. While one vantage point remained the same as the previous year, location of the second vantage point was changed.
- The autumn 2014 survey was conducted for 15 days between 05.09.2014 and 01.11.2014 on the same two vantage points of the previous season.
- The spring migration 2015 was undertaken by Natural Research Projects for 58 days between 03.04.2015 and 31.05.2015.

Survey Season	Survey Period	Days of Survey
Spring 2013	22.03.2013 - 18.05.2013	8
Autumn 2013	28.08.2013 - 01.11.2013	8
Spring 2014	21.03.2014 - 14.04.2014	13
Autumn 2014	05.09.2014 - 01.11.2014	15
Spring 2015	03.04.2015 - 31.05.2015	58

8.2.3.2 Overall Results of the Bird Movements in the Project Area for 5 Seasons

Scientific Name of the Species	Common Name of the Species	Number of Flights	Number of Birds Recorded
Ciconia nigra	Black Stork	1	1
Ciconia ciconia	White Stork	4	93
*Gyps fulvus***	Griffon Vulture	30	44
*Neophron percnopterus**	Egyptian Vulture	19	28
*Aquila heliacal**	Eastern Imperial Eagle	3	4
Clanga pomarina	Lesser Spotted Eagle	12	20
*Aquila nipalensis**	Steppe Eagle	79	146
Circaetus gallicus/***	Short-toed Snake Eagle	78	91
*Hieraaetus pennatus**	Booted Eagle	9	11
Pandion heliaetus	Osprey	1	1
Milvus migrans	Black Kite	56	238
Circus aeruginosus	Western Marsh Harrier	19	73
Circus pygargus	Montagu's Harrier	13	17
Circus macrourus	Pallid Harrier	15	15
*Buteo rufinus***	Long-legged Buzzard	123	167
Buteo buteo vulpinus	Steppe Buzzard	215	2847
Pernis apivorus	Honey Buzzard	66	484
Accipiter nisus	Eurasian Sparrowhawk	24	30
Accipiter brevipes	Levant Sparrowhawk	3	4
Falco tinnunculus	Common Kestrel	178	188
Falco naumanni/***	Lesser Kestrel	30	41
Falco vespertinus	Red-footed Falcon	3	3
Aquila spp.	Eagle Species	3	3
-	Buzzard Species	2	7
Circus spp.	Harrier Species	1	1
Falco spp.	Falcon Species	2	4
All the species recorded		989	4561

The highlighted species are amongst the Priority raptors identified by the TRWPP CEA.
*shows the Migratory Soaring Birds
** shows the Resident/Summer breeding

8.2.3.3 Bird Collision Risk Assessment

The risk of collision of birds with the wind turbines exists only when a bird is flying at rotor swept height. Most birds do take avoiding action: they may detect either an entire wind farm array, or an entire wind turbine, and alter their flight lines such as to avoid the structures; or they may at close quarters see an oncoming blade and take emergency avoiding action.

The Band collision risk model (Band et al., 2007) (CRM) was used during pre-construction surveys to predict the number of bird collisions that might be caused by the Project. The CRM requires input parameters describing species-specific information on biometrics, flight characteristics and the expected amount of flight activity; and turbine-specific information on blade size, blade pitch, rotor rotation period and the anticipated proportion of time that turbines will be operational.

The CRM is used to estimate the the number of bird transits (per annum) through the rotors of the windfarm for the Migratory Soaring Birds (MSBs) and breeding raptors.

Collision risk estimates results for migratory soaring birds and other collision vulnerable species are reported as low across each of the individual surveys. With the exception of Steppe Buzzard all results suggest a species-specific fatality rate of below 1 individual per year. It is likely that this is a reasonable estimate for migratory species passing through the site during spring and autumn migration as the surveys were targeted for these migratory periods. However, for summer breeding and resident species, surveys would have needed to have been conducted for the whole period when birds were present to provide reasonable collision risk estimates. Assuming these species use the site during the period they are present in the area, then collision risk estimates presented in the report are likely to be underestimates. Therefore, for Griffon Vulture, Short-toed Eagle, Long-legged Buzzard, Lesser Kestrel and Common Kestrel a higher annual collision rate than those given would be expected. Given the high regional conservation status of some of these species populations, a comprehensive monitoring and mitigation strategy is required to reduce collision likelihood and minimize any adverse effects of the development on these populations.

8.2.3.4 Conclusions

- 8 of 11 of the Priority raptors identified by the TRWPP CEA were recorded during the 3 years' pre-construction survey at the Project site. These species (see table)are Egyptian Vulture, Eastern Imperial Eagle, Booted Eagle, Steppe Eagle (belonging to

CEA Priority Bird VECs: Migratory Soaring Birds)and. Short-toed Snake-eagle, Griffon Vulture, Golden Eagle, Long-legged Buzzard, Lesser Kestrel (belonging to Resident/Summer breeding raptors).

- Considering the five seasons of VP surveys have been conducted at the Project site, it is concluded that the Project site is **not a busy migration corridor**. According to BirdLife International, at least 2 million migratory soaring birds pass along the Rift Valley-Red Sea flyway twice a year. However, during the 5 seasons of surveys in the Project area before construction, 4561 MSBs from 22 target species were recorded as also some of the records belong to the resident / breeding birds.
- Considering the size of the Abour wind farm consisting of only 15 wind turbines and the layout of the turbines as the pre-construction survey data showing that the majority of the flight action occurs within the valleys in between and surrounding the hills that the turbines are located on especially for the autumn surveys (see Annex III a), the micro-siting and layout of wind farm is considered to be **suitable**. Moreover, the wind farm is not considered to cause a major barrier effect for birds during spring and autumn migration periods. However, these conclusions should be reviewed following the results of post-construction bird monitoring and carcass search surveys.
- Displacement of resident birds is possible. However, Dana Important Bird Area and Biosphere Reserve within it can serve as the suitable habitat in the vicinity.
- The impact in terms of habitat loss and damage impact is anticipated to be low in the AEC wind Farm.

8.2.4 Mammals

A total of 15 mammalian species were recorded through observations during spring and fall 2013.

8.2.5 Bats

The bat surveys covered the Project site from the period of 20th of June and until September 2013 with a total of 10 field working days. No bat activities were recorded at the site; however, a species of bat was recorded 8 km south of the Project location in Ein Garandal.

8.3 Naturally Protected Areas

The closest areas to the Project site are Dana Biosphere Reserve and Dana Important Bird Area (IBA). The distance between Dana Biosphere Reserve and the Project site is about 11 km whereas Dana IBA is situated around 7.5 km away from the Project site in southwest.

8.4 Impact Assessment

8.4.1 Impacts on Flora

These impacts can be summarized as following:

- Removal of topsoil;
- Solid and liquid waste; and
- Destruction of flora.

8.4.2 Impacts on Fauna

These impacts can be summarized as following:

- Habitat loss;
- Habitat Alteration;
- Habitat Fragmentation
- Noise;
- Light and Traffic;
- Solid and liquid wastes;
- Hunting by workers.

8.5 Mitigation Measures

8.5.1 Mitigation Measures during Construction Phase

- Comply with environmental standards and strictly control workers to behave responsibly with respect to environmental issues;
- Reduce / optimize amount and size of new roads as much as possible;
- Replant natural vegetation and transfer rich soil of the construction sites to nearby areas;
- Decommission temporary assembly areas and restore to the original conditions;
- Limit decommissioning activities to the excavation site where possible and replant site with native plants;

- Collect all wastes, solid and liquid, in sealed containers to be disposed in proper disposal sites;
- Work shall be under ISO14001 accreditation for environmental management which shall also be imposed on all the subcontractors;
- Cover each spot where excavated material is stored when climate conditions requires to effect dust control by usage of dust suppression substances;
- Limit construction activities within the wind farm site;
- Store the natural soil at special sites and reuse it when back-fill activities are needed; and
- Shift natural vegetation and nutrient rich soil of the construction sites to nearby areas.

As displacement is one of the most possible and important impacts towards fauna during the construction periods, it is found to be more important for the birds using the site to breed or forage. Displacement of resident birds such as larks, wheatears, warblers, serins, bulbuls, Palestine sunbirds and other passerines is possible. However, Dana Important Bird Area and Biosphere Reserve within it can serve as the suitable habitat in the vicinity. Therefore, displacement due to the construction period of the Project is not considered as a major impact also for the Priority Bird VECs including non-raptors (Syrian Serin and European Goldfinch).

Finally, the impact in terms of habitat loss and damage impact is anticipated to be low in the Project area as the habitat is already fragmented and is not representing a vital and very special habitat that cannot be replaced since the area is heavily disturbed by local resident people and roads.

8.5.2 Mitigation Measures for the Operation Phase

- Collect all wastes in sealed containers to be disposed in proper disposal sites;
- Prohibit leaving the roads and crane pads with vehicles unless major maintenance works will have to be performed;
- Prohibit workers from hunting and produce awareness materials such as:
  - Signs
  - Training manuals and material.
  - Posters.
  - Brochures.

- Reduce vehicle movements to a minimum;
- Reduce footprint as much as possible;
- Minimize intervention as much as possible;
- Conduct follow-up researches on the effects of the Project on the avifauna;
- Synchronize aviation lights (if practical);
- Post construction bird mortality monitoring should be undertaken in order to identify short-term and long-term impacts of the wind farm and appropriate mitigations which satisfactorily address these impacts. Recommended minimum requirements for during and post construction monitoring effort and timing are as follows:
    - Flight-activity monitoring conducted throughout the year with an increased level of monitoring effort during the spring and autumn migration periods.
    - Implementation of an observer-led shutdown on demand system to mitigate for collision between turbine rotors and high conservation status/collision vulnerable bird species.
    - Conducting of 'carcass search surveys' to assess bird collision fatalities
    - Conducting of 'bias correction trials' to calibrate carcass search surveys for searcher efficiency and carcasses removal rates.
    - Monitoring of livestock movements within the site to help identify elevated risks to Griffon Vulture and other scavenging bird species that may be attracted to the site by the periodic presence of livestock on site.
- All mitigation activities listed above about the birds should be conducted initially for the first 3-years of operation. These mitigation measures then should be reviewed and subsequent mitigation measures should be confirmed.
- All mitigation measures described above should follow protocols detailed ESMMP and developed before the start of post-construction monitoring.
- A reporting schedule described in detail in ESMMP will be followed. This should include:
    - Immediate reporting of fatalities.
    - Monthly review of carcass search results and
    - 6 monthly review of all mitigation measures as part of adaptive management process.

9. TRAFFIC AND TRANSPORT

9.1 Planned route

Transportation of the equipment required for the Project from Port of Aqaba to the Project site will be via the Desert Highway.

9.2 Impact Assessment

The main impact of the Project is expected to be during construction phase (temporary period). While the operation phase will have much smaller impact than during construction phase.

The main route for equipment transportation will be via Desert Highway which is well-developed and consists of several lanes. Therefore, no additional impact is expected to affect this route.

9.3 Mitigation Measures

- Construction materials should be well-sealed in the trucks to prevent spill during transportation.
- Trucks delivering construction materials should have a gross weight that is within the axial permissible load.

10. ANALYSIS OF PROPOSED PROJECT ALTERNATIVES

The analysis for this Project contains options/alternatives which are the “No Project” versus “Project” alternative; however, the Project location is selected by MEMR and the Project developer.

Going forward with the proposed Project alternative is considered the best possible option as opposed to “No Project” since the proposed Project is considered a green and environmental solution for energy generation in Jordan as the wind energy considered as renewable clean technology with no emissions as well as the global and local trend for energy generation.

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Abbreviations

AEC	Abour Energy Company
BoP	Balance of Plant
CITES	Convention of International Trade in Endangered Species
CO_2	Carbon Dioxide
dB	Decibels
DOS	Department of Statistics
DTM	Digital Terrain Model
EC	European Commission
EDCO	Electricity Distribution Company
EE	Energy Efficiency
EHS	Environmental Health and Safety
ESIA	Environmental and Social Impact Assessment
EMP	Environmental Management Plan
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Green House Gas
GPS	Global Positioning System
GWh	Giga Watt hour
HASP	Health and Safety Plan
HGVs	Heavy Goods Vehicles
IBA	Important Bird Area
ICAO	International Civil Aviation Organization
ICT	Information and Communication Technology
IEA	Institute of Environmental Assessment
IRPPS	Instruction and Requirements for Proposal Preparation and Submission
IFC/WB	International Finance Corporation / World Bank
IUCN	International Union for the Conservation of Nature
JD	Jordanian Dinar
JREEF	Jordan Renewable Energy and Energy Efficiency Fund
kWh	Kilo Watt hour
MEMR	Ministry of Energy and Mineral Resources
MENA	Middle East and North Africa
MoEnv	Ministry of Environment
MOH	Ministry of Health
MW	Mega Watt
NEPCO	National Electric Power Company
NOx	Oxides of Nitrogen

NSR	Noise Sensitive Receptor
RE	Renewable Energy
RPF	Resettlement Policy Framework
RAP	Resettlement Action Plan
SNH	Scottish Natural Heritage
SO_2	Sulphur Dioxide
TORs	Terms of Reference
TSP	Total Suspended Particulate
TTU	Tafila Technical University
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNRWA	United Nations Relief and Works Agency
UTM	Universal Transverse Mercator
VECs	Valued Environmental Components
VP	Vantage Point
WT	Wind Turbine
WTG	Wind Turbine Generator
ZTV	Zone of Theoretical Visual

1. PROJECT DESCRIPTION

1.1 Introduction

Global energy supply is dominated by fossil fuels, natural gas and oil products. Lacking its own fossil fuel resources, Jordan is highly dependent on imports, costing the country the equivalent of 19.5% of GDP. At the same time, demand for energy in general, and electricity in particular, is growing at an average rate of 7.4% annually since 2004[1].

Jordan is committed to increasing the share of Renewable Energies (RE) to 10% by 2020. The major share of RE is to come from Wind Power (1,200 MW) and Solar Power (600 MW). At the same time, Jordan is committed to adapting the electricity network to address the challenge of increasing electricity demand and fluctuating input from RE. Jordan's Energy Strategy for 2020 is given below in Figure 1-1.

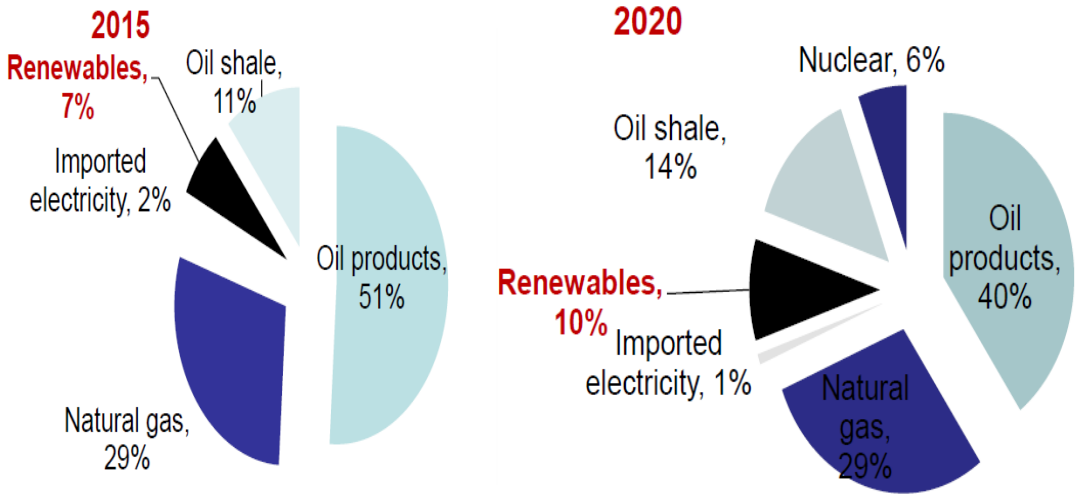

Figure 1-1 Jordan's Energy Strategy for 2020

1.2 Proposed Project

Abour Energy Company ("AEC") was established in 2013 by Xenel International under the laws of The Hashemite Kingdom of Jordan as a Private Shareholding Company ("PSC"). The purpose of AEC is to develop, own and operate a wind farm project comprising of 15 Vestas V117 / 3.3 MW turbines, having a total installed capacity of 49.5 MW, to be located in the region of Abour in the Governorate of Tafila (the "Project"). The annual electrical energy to be generated by the wind farm is estimated at 152 million kWh. The wind farm will be connected to the 132 kV transmission grid system of National Electric Power

[1] National Centre for Research & Development/Energy Research Program (NERC)

Company (“NEPCO”). The proposed Project is being developed in accordance with the national energy strategy of Jordan, within the framework of the Renewable Energy and Energy Efficiency Law of 2012, which was enacted for the purpose of diversifying sources for electricity generation and promoting use of renewable energy.

1.3 Electricity Generation in Jordan

In 2012 total electricity generation in Jordan was 16,595 GWh and was made available to 99% percent of a population of 6.4 million. Natural gas was the primary fuel used for the generation of 90% of generated electricity in 2009. However, due to disruptions to the natural gas supply from Egypt in recent years, natural gas accounted for only 20% of electricity generation in Jordan in 2012; the balance of electricity generation requirements was shifted to costly liquid fuels, such as heavy fuel and distillate oil. It is estimated that relying on heavy and distillate oils as primary energy sources raised the cost of electricity generation alone (excluding transmission and distribution) to as high as 18 US cents/kWh. It is important to note that with the completion of the receiving LNG terminal at the Port of Aqaba in 2015, imports of natural gas to Jordan was resumed and substantial savings are being made in the cost of electricity generation. Peak historical and forecasted (MW) electricity demand in Jordan (according to the 2012 NEPCO Annual Report) is shown in below in Figure 1-2 .

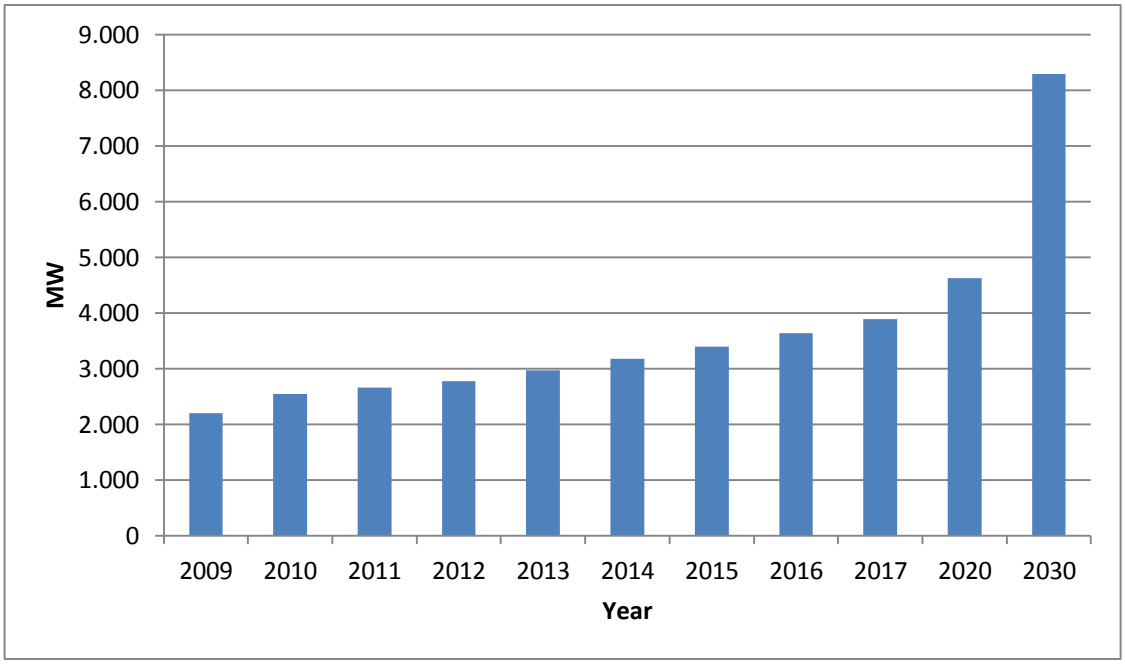

Figure 1-2 Electricity Peak Demand in Jordan

1.4 Project Background

To address its dependence on foreign supply of fossil fuels, Jordan's Ministry of Energy and Mineral Resources ("MEMR") embarked on an aggressive program to increase the country's use of domestic renewable energy sources with the enactment of the Renewable Energy and Energy Efficiency Law of 2012.

Jordan has the 8th largest oil shale reserves in the world. Currently, the government has started to implement a comprehensive strategy for oil shale development. This is due to many factors such as the dramatic rise of the global oil prices in recent past (notwithstanding the sharp decreases in oil prices at the time of writing of this report) which has directly affected the government's budget and Jordan's GNP and the willingness of interested investors and companies that have approached MEMR to exploit oil shale for producing crude oil and for power generation (*MEMR, 2015*).

In addition to developing locally available oil shale as a primary energy source for electricity generation, another objective of the program is to increase contributions from renewable energy sources, such as wind and solar, from 1% in 2012, to 7% by 2015, and 10% by 2020. The driving force behind the development of renewable energy projects is MEMR's "Investment Opportunity in Renewable Energy Projects in Jordan" initiative.

In November 2013, Jordan Wind Power Company ("JWPC"), the first major wind farm project in Jordan with a capacity of 117 MW achieved financial close. This project deploys 39 Vestas wind turbines, each with a capacity of 3.0 MW, and was commissioned in the fourth quarter of 2015.

The 50 MW wind farm of Abour Energy Company ("AEC") is another example of the drive by MEMR to capture domestically available sources of energy. When completed in 2019, this Project will contribute approximately 152 GWh of electrical energy to the interconnected system of NEPCO.

There is currently one meteorological mast at the proposed Project site to evaluate the wind energy potential of the Project. This mast was installed on 21 August 2013 at the northern part of the Project site. The wind is measured at three different heights: 100 m, 75 m, and 50m. The schematic of the wind mast is shown in Figure 1-3. The coordinates of the mast (UTM Datum WGS84 Zone 36) are also indicated in Table 1-1. The data acquired from the measurement mast was used to perform energy yield assessment and modelling and to determine the locations of the 15 wind turbines generators (micro siting studies) as well as the feasibility of the Project. Views of the wind measurement mast and wind turbine locations are presented in Figure 1-4 and Figure 1-5 respectively.

Table 1-1 Wind Measurement Mast Coordinates (WGS84)

LAT	LONG
30.780217	35.675250

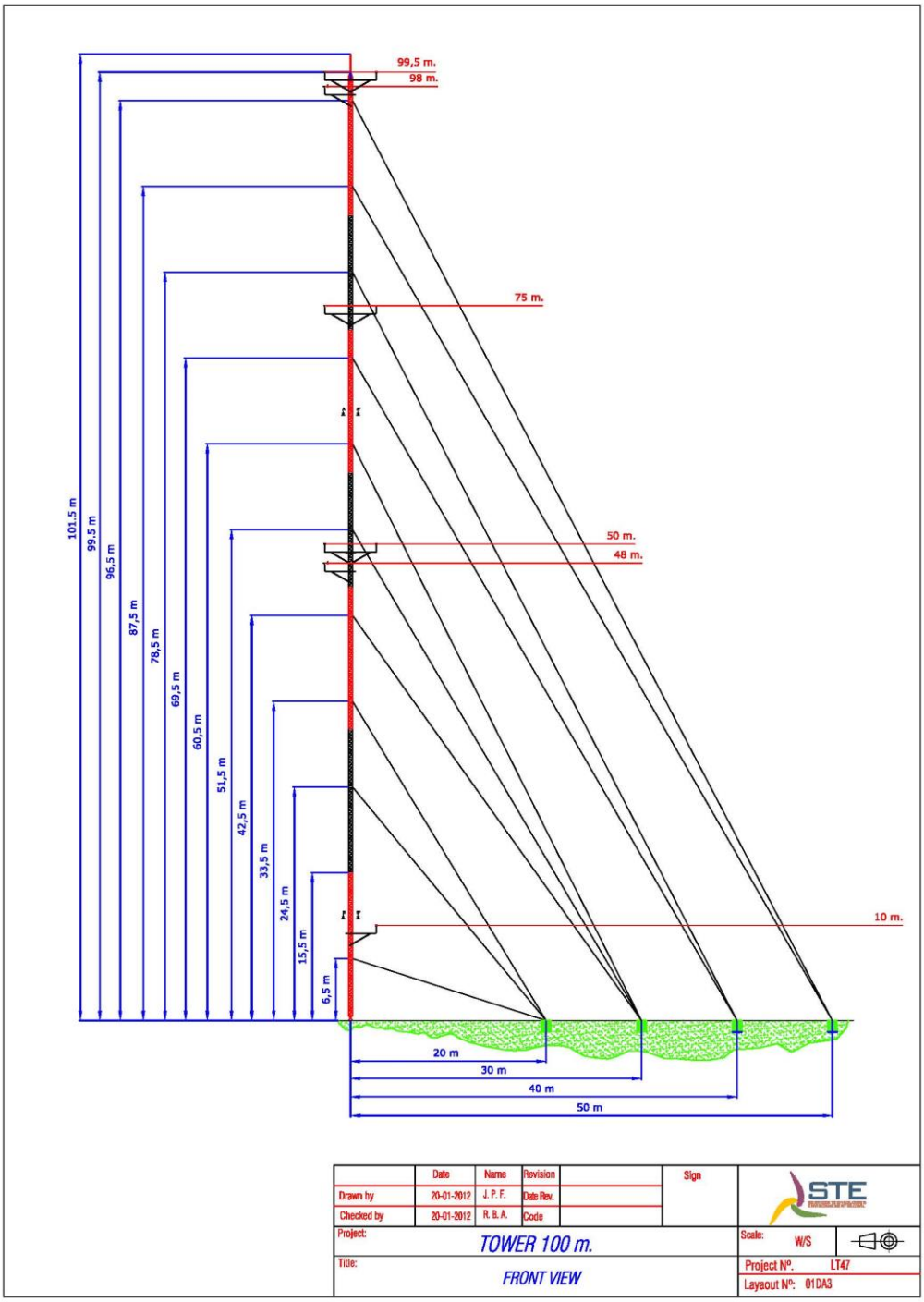

Figure 1-3 Schematic of Wind Measurement Mast Installed at the Project Site

Figure 1-4 Views of the Wind Measurement Mast

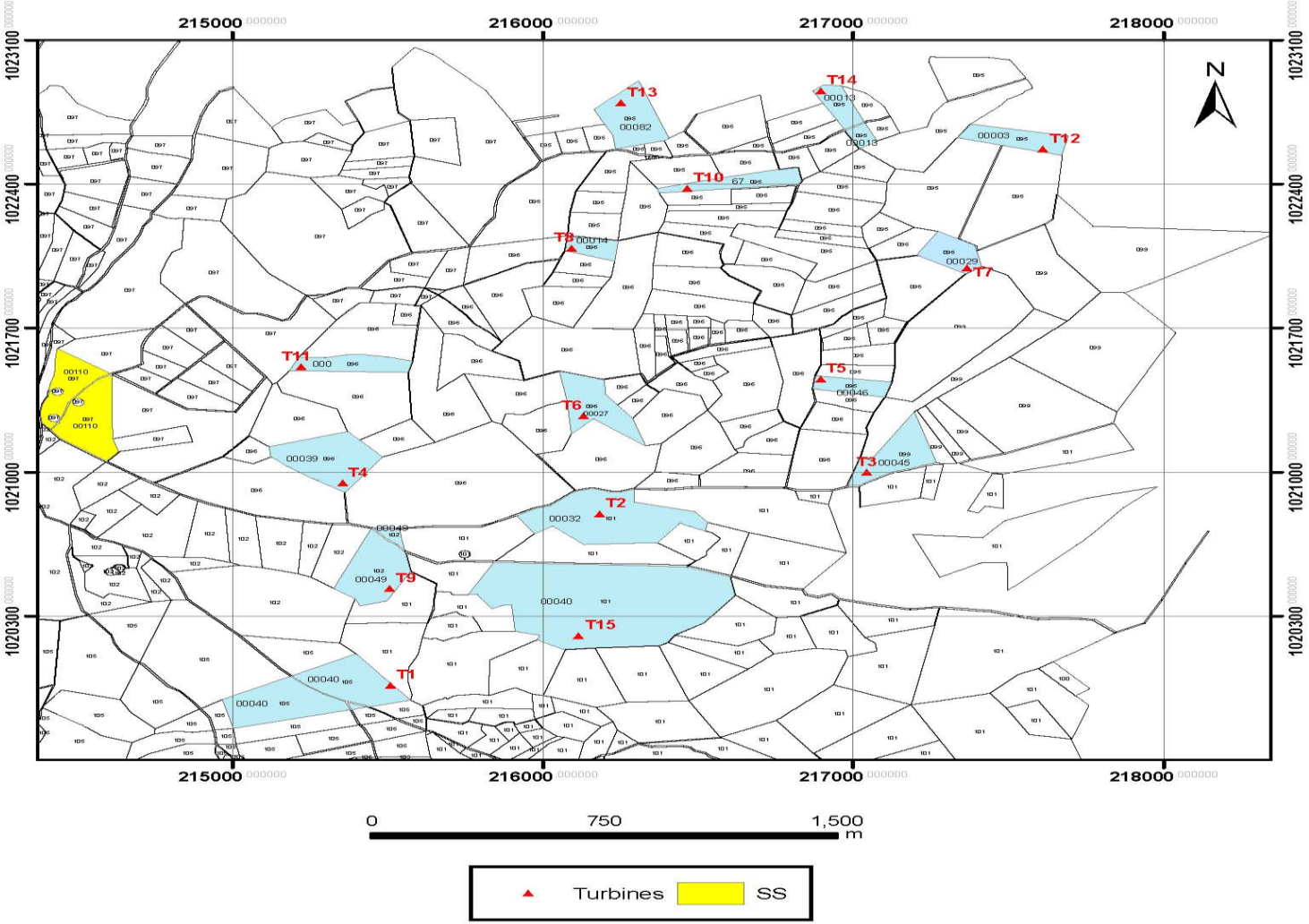

Figure 1-5 Wind Turbine Locations

1.5 Project Components

The Project will comprise:

- 15 x Vestas V117- 3.3 MW wind turbine generators;
- Turbine foundations;
- Existing and new onsite access roads;
- A 33 kV internal grid network using underground cables to connect turbines to the Project substation;
- A Project substation incorporating 2 x 33/132 kV step-up transformers, switchgear, electrical protection, metering, communications and monitoring, and weather and safety protection equipment.

1.5.1 Wind Turbine Generator

1.5.1.1 Overview

The Vestas V117 is a 3.3 MW three-bladed upwind pitch-regulated variable speed-wind turbine designed for medium wind speed sites. It combines a gearbox with an asynchronous generator and full power conversion to aid grid compliance. It has a 117 m rotor and will be supplied with a tower allowing a 91.5 m AGL hub height, certified to withstand IEC Class 1B/2A site conditions. The turbine design life is 20 years. As of 31/Dec/2015 152 x V117s have been delivered globally to various clients. Figure 1-6 below identifies its various external (dark blue) and internal (light blue) components.

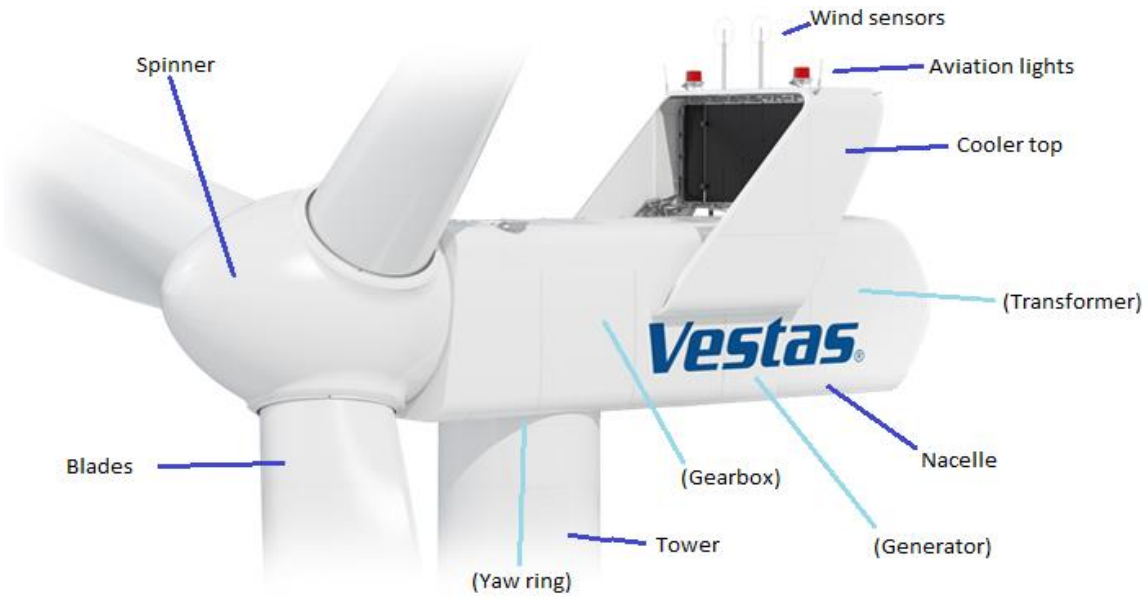

Figure 1-6 Vestas V117 Wind Turbine

The V117 is based on a popular platform launched in 2010 that uses a modular design to aid reliability and maintenance. More than 12 GW of this platform had been ordered, and more than 8 GW installed, as of 31 December 2015.

Vestas is a leading wind turbine manufacturer. Based in Denmark, it has more than 35 years of wind power experience: It has installed more than 70 GW in 75 countries, accounting for 15% of the global total and 15 GW more than its nearest rival. It currently monitors over 28,000 wind turbines worldwide.

The following subsections describe the V117 in more detail.

1.5.1.2 Operational Envelope

AEC's V117s will be rated at 3.3 MW. Under standard conditions they begin generating when the hub height wind speed is 3 m/s and continue to produce rated power until 25 m/s after which they switch off to guard against damage.

These IEC Class IB turbines are suitable for sites with mean annual wind speeds of circa up to 10.0 m/s [2] provided other parameters including turbulence and wind shear are within acceptable limits. The V117 is derated when ambient temperatures exceed 30 °C but at Abour this tends to happen when wind speeds are lower so the expected yield impact is minimal. The turbine can also operate in low noise modes but this reduces energy capture.

1.5.1.3 Turbine Foundation

The turbine foundations are typically designed by the balance of plant contractor to the developer's and Vestas' specifications. Foundations comprise steel reinforced concrete incorporating a Vestas supplied insert onto which the turbine tower is bolted. They also include ducting and earthing equipment, and support stairs for turbine access.

Individual turbine foundations will vary in size and construction depending on the site and ground conditions. For AEC all will have a minimum design life of ≥ 25 years (see Section 1.5.2) and be able to withstand site climatic and seismic conditions while staying within Vestas specifications for movement and settlement.

1.5.1.4 Tower

The V117 has a tubular steel tower made from four (4) sections with flange connections that bolt together on site. At AEC the towers give a 91.5 m AGL hub height. Magnets help

[2] Strictly speaking the latest IEC standard no longer uses site mean speed to define site classification but the two parameters are linked via an assumed wind speed distribution.

support internal ladders, reducing welding which permits thinner, lighter towers that are easier to transport and install.

1.5.1.5 Nacelle

The nacelle sits atop the tower and contains the gearbox, generator, power electronics, and turbine transformer. The same basic nacelle design is used across the platform range.

The front of the nacelle bedplate is made of cast iron, supports the drive train, and transmits rotor forces to the tower via the yaw system. The rear bedplate uses a girder structure and supports the controller, convertors, transformer, and cooling system. The nacelle cover is made from fibre glass.

1.5.1.6 Rotor and Blades

Like most modern-day turbines the V117 employs a three-bladed upwind design. This offers a good compromise between cost, weight, noise, rotational speed, energy capture, aesthetics, torque, and rotational speed.

Blades are made from carbon fibre and fibre glass and bolt onto the cast iron hub via individual blade pitch bearings. These bearings allow blade pitch to be adjusted to control power and speed, and to aerodynamically brake the rotor to a halt via full blade feathering.

1.5.1.7 Drive Train

The hub and rotor assembly are connected to the gearbox via a cast iron low speed shaft. The gearbox steps the rotor speed up for export to the generator via a high speed shaft. The high speed shaft has a disc brake that can be used to park the rotor and/or brake it in emergency conditions, and there is a rotor lock to facilitate servicing. This is a standard design concept widely used in the industry.

1.5.1.8 LV Generator and Convertor

The V117 uses a doubly-fed asynchronous (aka induction) generator equipped with full power conversion. This permits variable speed operation for optimum energy capture, and active and reactive power control to improve grid compliance. The turbine can still operate if one to three of its four convertors are offline, albeit with derating.

1.5.1.9 HV Transformer, Cabling, and Switchgear

The turbine has an appropriate step-up transformer in a separate locked room in the back of the nacelle. High voltage cables run down the tower to switchgear in the base of the tower; this switchgear connects the turbine to the wind farm internal grid system

emanating from the Project substation. The nacelle also has a separate auxiliary transformer used to power pumps, fans and heaters.

1.5.1.10 Yaw

The turbine has an active yaw system driven by motors which rotate the nacelle via a yaw bearing connected to a toothed yaw gear inside the top of the tower.

1.5.1.11 Access

Access is via a lockable door in the lower tower which leads via hatches, ladders, internal platforms, and/or an optional service to the nacelle. More hatches in the nacelle provide access to the hub and to the instrumentation etc. atop the nacelle. The nacelle also has an 800 kg internal crane with an access hatch in the floor to facilitate routine servicing. These hatches and ladders also provide emergency escape routes.

1.5.1.12 Transportation and Installation

The table below sets out key dimensions and masses for installation and transport.

Component	Dimensions (m)	Mass (t)
Blade	57.2 L x 4.0 C (max)	
Nacelle	3.4 H x 12.8 L x 4.2 W	≤ 70 per unit
Hub	3.8 H x 5.5 L x 3.8 W	

The size and weight of the turbine components typically restrict permissible road gradients and changes thereof, width, camber, bearing capacity, and curvature. There are also minimum requirements for crane pads in terms of area, arrangement, gradient, and bearing capacity.

1.5.1.13 Miscellaneous

The turbine is equipped with a supervisory control and data acquisition (SCADA) system which allows remote control, data logging and monitoring.

It also has two sets of wind sensors atop the nacelle to measure wind conditions and aid control of the turbine. Control comes from a Vestas system comprising four processors to direct yawing, pitching, grid synchronisation, and active and reactive power.

The turbine has inductive sensors used to facilitate overspeed protection; it has arc protection; and it has smoke detection but the fire suppression system is an optional extra.

The turbine can be equipped to mitigate shadow flicker and with aviation lights. There is an uninterruptable power supply (UPS) to support the control system and internal lighting.

The lightning protection system combines receptors with shielding, earthing, and a downcurrent system to protect the turbine from lightning strikes. The earthing system varies depending on the design of the turbine foundation.

External and internal areas are protected against corrosion.

1.5.2 Balance of Plant

The balance of plant (BoP) comprises the wind farm on- and offsite civil, electrical, and communications infrastructure. It includes turbine foundations (see 1.5.1.3 above), onsite access roads, highway improvements, crane pads, appropriate fencing, drainage and ducting; the onsite electrical and communications networks, earthing, and substation compound; and the offsite grid connection.

The actual design will reflect the relevant standards; site conditions including ground conditions and topography; logistics; planning consent requirements; and turbine supplier requirements for delivery, installation, operation, and maintenance. The materials, handling, and workmanship used in construction will also comply with the relevant specifications and standards.

The BoP is normally installed before the wind turbines and is removed after the turbines therefore it needs a longer design life. AEC's BoP will have a design life of at least 25 years.

Additional temporary works will be in place during construction to provide a site office, parking, and welfare facilities for construction staff.

The following subsections briefly describe key aspects of the AEC's BoP infrastructure.

1.5.2.1 Civil Works

Access to the site will be from Highway 60 (Tafila Highway), with the existing junction being upgraded as necessary.

Onsite roads will comprise upgraded, existing, and new infrastructure. They will provide access to each turbine and will be designed to meet turbine supplier requirements for delivery, installation, and maintenance. These requirements affect the maximum permissible slope, curvature, camber and the minimum width (≥ 5 m) and bearing capacity

of the roads. The roads will be designed to minimise erosion and standing water. Turning areas and passing places will be provided to avoid long-distance reversing of the vehicles.

Each turbine needs a crane pad and hardstanding area so components can be safely laid down for assembly and craned into position. These will measure approx. 50 m x 50 m each.

The wind farm will have separate drainage systems for rain, foul, and oily water. The rain water drains will protect onsite works from erosion and will be designed for a ≥ two-year return period and a ≥ 50-year storm event to mitigate flood risk. The oily water drains will discharge through an interceptor to guard against pollution.

As far as possible excavated materials will remain onsite during and after construction.

1.5.2.2 Onsite Electrical and Communications

The onsite electrical grid connects the turbines to the substation and will operate at 33 kV. There will be three strings serving five turbines each. Buried cables will be in sand-lined trenches or ducts as appropriate at a depth that protects them from traffic and avoids interference with agricultural processes.

The onsite communications network will serve the wind farm SCADA system and will use fibre optic cables to connect the turbines back to the control building.

The control building and substation compound will be located adjacent to the wind farm will incorporate a mix of civil and electrical elements required for the safe operation of the wind farm. It will include 33 kV switchgear, 2 x 33/132 kV step-up transformers, 132 kV disconnectors, gantries for 132 kV lines of NEPCO, and metering equipment. It will also provide parking and welfare facilities and store ancillary equipment.

An onsite earthing system will be installed for safety reasons.

1.5.2.3 Offsite Electrical & Communications

The wind farm will link to the grid at 132 kV via two parallel gantries form the high voltage bushings of the transformers to the NEPCO's switchgear. The connections will be protected to facilitate safe operation during normal and fault conditions.

1.6 Project Location

The Project site is located in the Village of Abour in Tafila Governorate, 140 km south of Amman. Communities that are located in the vicinity of the Project site include:

- Town of Tafila: about (8.3) km northwest of the Project site;
- Village of Umm Sarab: about (4.2) km southwest of the Project site; and
- Village of Alayn Al-Byyda: about (8) km west of the Project site.

The coordinates of the proposed Project area boundary and the coordinates of the proposed wind turbine locations (UTM Datum WGS84 Zone 36) are presented in Table 1-2 and Table 1-3, respectively. The Project site location and general layout of the wind farm is shown in Figure 1-7 and Figure 1-8 below respectively.

Table 1-2 Overall Boundary Coordinates of the Project Area

Point	X	Y
1	756914	3410154
2	759303	3410157
3	759488	3408527
4	757947	3407005
5	756889	3407047
6	756374	3407485
7	756251	3408091

Table 1-3 Wind Turbine Coordinates

No	X	Y
T1	756967	3407083
T2	757625	3407929
T3	758480	3408149
T4	756791	3408063
T5	758323	3408599
T6	757563	3408405
T7	758785	3409148
T8	757509	3409220
T9	756953	3407552
T10	757875	3409518
T11	756648	3408626
T12	759020	3409732
T13	757652	3409930
T14	758297	3410001
T15	757568	3407335

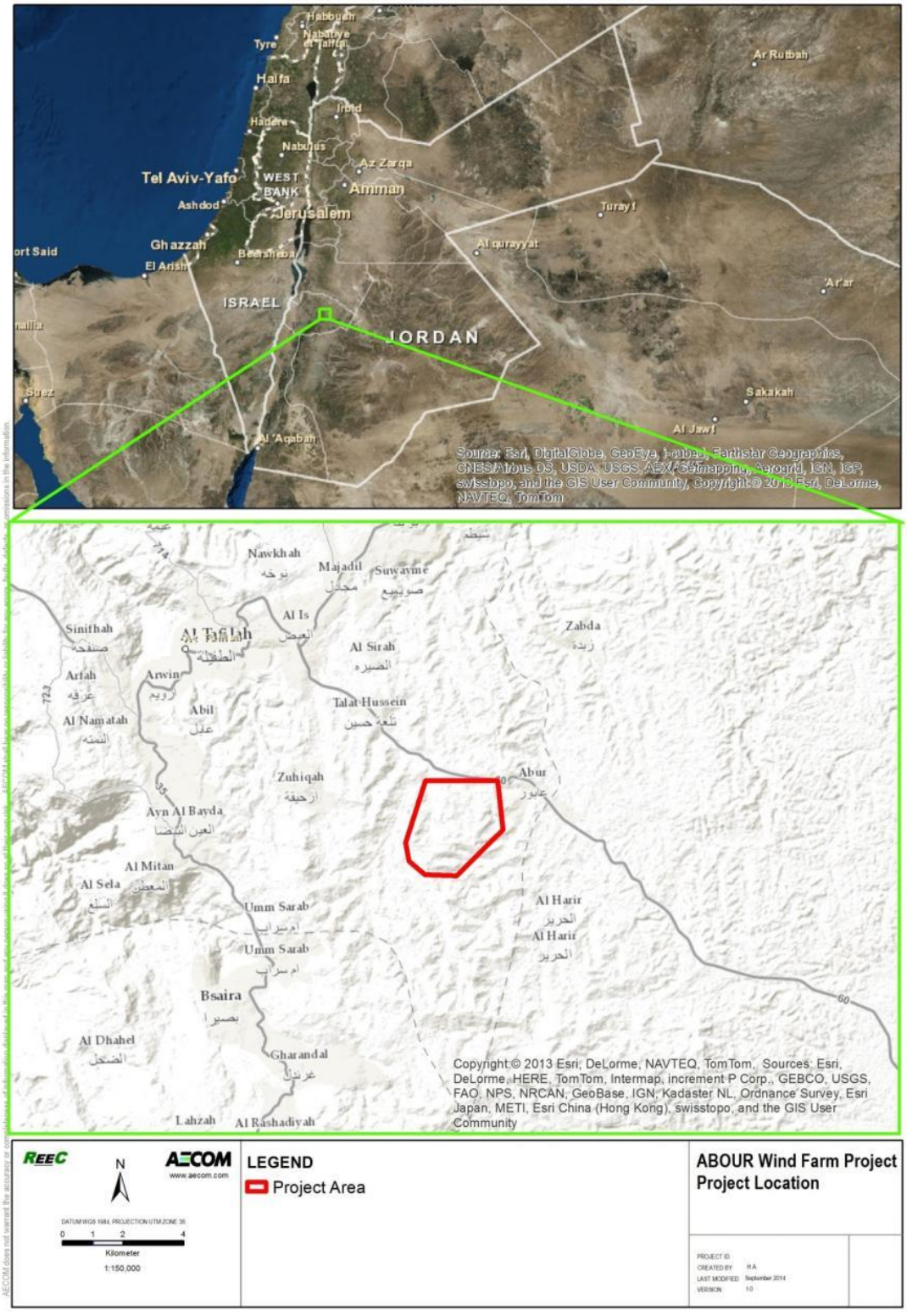

Figure 1-7 Location of AEC Project Area

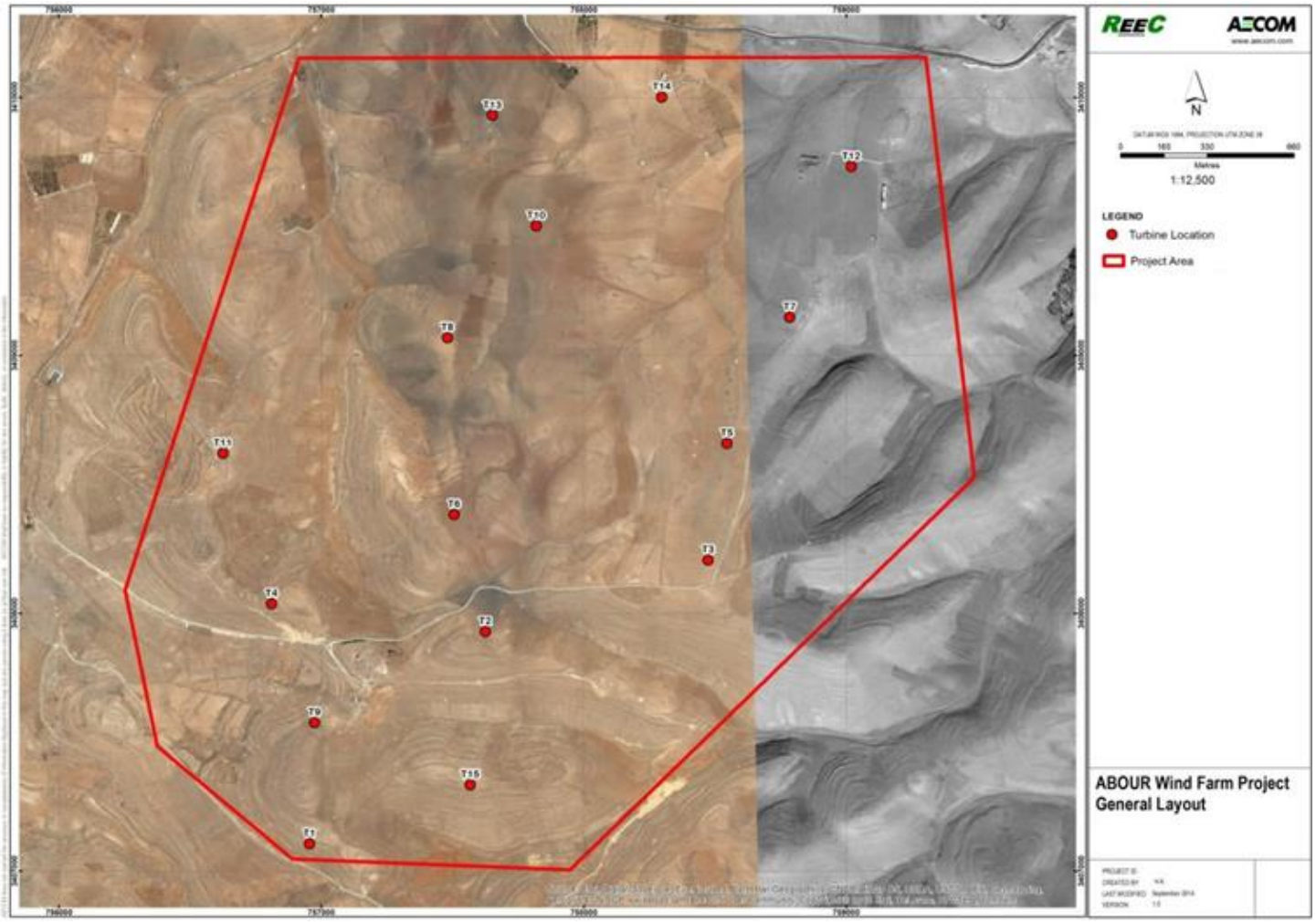

Figure 1-8 General Layout of the AEC Wind Farm

2. SCOPING AND ESIA TERMS OF REFERENCE

2.1 Introduction

The Environmental and Social Impact Assessment is an assessment of the possible impact – positive or negative – that a proposed project may have on the natural, social and economic environments.

The legal system in Jordan includes the requirements and instructions for protecting the environment, so that the project owner takes the responsibility for any project impact that is likely to affect the environment. These requirements fall within the framework of the legal system. These include requirements to conduct environmental assessment procedures which are necessary to prevent the negative effects on the environment and improve the economic efficiency of the project.

The Scoping Stage is the first stage of the ESIA conducted by the consultant and it marks the start of the ESIA study. In this stage stakeholders have the opportunity to participate in the ESIA process and to be introduced to the Project. One of the main purposes of the Scoping Stage is to get the public and the regulatory authorities involved in the course of the ESIA and to denote their concerns about the Project in a formal manner.

2.2 Scoping

2.2.1 Objectives

The following are some of the main objectives of the scoping stage:

- Identify key environmental issues to be included in the assessment.
- Identify legal requirements and framework for the Project through its life.
- Identify relevant component studies to establish the appropriate baseline for the area of the Project.
- Finalize the proposed Terms of References (TORs).

2.2.2 Methodology

The following methodology was used to fulfil the above-mentioned objectives:

- Decision was made by the Ministry of Environment (MoEnv) to conduct a Scoping Session for the purpose of the ESIA in accordance with MoEnv / ESIA regulations for the Project.
- A list of potential and relevant stakeholders was prepared by MoEnv.

- Invitation letters were issued by MoEnv. The letters included the date and place of the Scoping Session (December 28th, 2015 at the Holiday Inn Hotel - Amman).

2.2.3 Scoping Session

The Scoping Session was held in Amman at the Holiday Inn hotel on December 28th, 2015. Invited stakeholders including organizations from the public and private sectors in addition to NGOs attended this session. A list of the scoping session attendees is provided in Annex I.

The session consisted of the following activities:

- Presentation about the Project activities, components and locations, was given by the ESIA team leader Eng. Hamed Ajarmeh (Al-Rawabi Company). The presentation highlighted details of the Project and the need for identifying potential interactions between the Project activities and the Valued Environmental Components ("VECs").

- The participants were then asked to review the legal requirements and the proposed TORs (which were shown in the second part of the presentation) and provide any necessary legal requirements and suggest TORs changes or additions.

- The participants were provided with a special form to write down their concerns about the Project as a function of the following VECs and they were given the right amount of time needed to do so:

  - ✓ Public health;
  - ✓ Occupational health and safety;
  - ✓ Water resources;
  - ✓ Socio-economic conditions;
  - ✓ Archaeology; and
  - ✓ Biodiversity.

- All forms were collected from the participants by the MoEnv representative and a copy of the forms was provided to the ESIA consultant to prepare the Scoping Report and to carry out the ESIA.
- Photos from the scoping session is presented below in Figure 2-1, Figure 2-2 and Figure 2-3.

Figure 2-1 Scoping Session

Figure 2-2 Scoping Session

Figure 2-3 MoEnv Representatives

2.3 ESIA Scope of Work

The ESIA will include the following stages:

- Relevant Baseline: Component studies will be launched to enable describing the relevant existing environmental conditions.
- Assessing: This will include evaluation of interactions between the Project activities and all related environmental components.
- Impact Management: An environmental management plan (EMP) including mitigation measures and monitoring programs will be produced.
- Reporting: ESIA main and EMP draft reports will be provided for the purpose of review by MoEnv.
- Reviewing: Reviewing the reports is the responsibility of MoEnv.
- Finalizing the report and submitting the final version to MoEnv after incorporating required remarks to the draft reports.

2.4 ESIA Valued Environmental Components

The ESIA will be focused on identifying, analyzing, assessing, and mitigating impacts on the following VECs:

- Public health;
- Occupational health and safety;
- Water resources;
- Socio-economic conditions;
- Archaeology;
- Biodiversity; and
- Traffic.

The following tables present the issues resulting from the proposed TORs and Scoping Session. The tables are presented as a function of VECs. Each VEC will be titled in a separate chapter, where issues related to it will be assessed.

Table 2-1 Socio-economic Conditions

Issue	Construction phase	Operation phase	Decommissioning phase
Employment	√	√	√
Landscape and visual impact and aesthetics	√	√	√
Land use	√	√	√
Business prosperity	√	√	
Stress on infrastructure	√	√	√

Land acquisition and Resettlement	√		
Impact on tourism		√	

Table 2-2 Water Resources

Issue	Construction phase	Operation phase	Decommissioning phase
Long term impacts on topsoil and erosion	√	√	√
Wastewater disposal and its impact on groundwater resources	√	√	√
Solid waste and its impact on surface and ground water resources	√	√	√
Water Requirements	√	√	
Floods and rainfall	√	√	

Table 2-3 Public Health

Issue	Construction phase	Operation phase	Decommissioning phase
Accidents risks	√	√	√
Ambient air quality (dust)	√		√
Noise	√	√	√
Shadow flickering		√	
Icing/ Ice throw		√	
Aviation & radar		√	
Telecommunication/EMI links		√	
Domestic wastewater	√	√	√
Domestic solid waste	√	√	√
Public Safety	√	√	

Table 2-4 Occupational Health and Safety

Issue	Construction phase	Operation phase	Decommissioning phase
Medical care and health Insurance	√	√	√

Domestic wastewater	√	√	√
Domestic solid waste	√	√	√
Ambient air quality (dust)	√		√
Noise	√	√	√
Accidents impact	√	√	√
Shadow flickering		√	
Icing/ Ice throw		√	
Aviation & radar		√	
Telecommunication/EMI links		√	
Personal Protection Equipment (PPE)	√	√	
Availability of Emergency Plan	√	√	

Table 2-5 Archaeology

Issues	Construction phase
Remaining archaeology	√
List of monuments / remains recorded	√

Table 2-6 Biodiversity

Issue	Construction phase	Operation phase	Decommissioning phase
Impact on flora	√	√	√
Impact on Wildlife	√	√	√
Impact on Migratory Birds	√	√	√
Impact on habitats	√	√	√

Table 2-7 Traffic

Issues	Construction phase	Operation phase	Decommissioning phase
Transportation of equipment & construction materials	√		
Traffic volume	√	√	√
Impact on roads and transportation infrastructure	√	√	√

2.5 Scope of Work of the Components Studies

2.5.1 Water Resources

Objectives

- To determine information regarding water resources, hydrology, geology, topography and soil in relation to the Project;
- To assess impacts of Project activities on water resources; and
- To propose mitigation measures and prepare mitigation plan.

Methodology

- Collecting the available data about geological, topographic, soil characteristics of the Project area;
- Collecting the available data about the meteorology and climate of the Project area such as: daily rainfall from the rainfall stations distributed within the Project area;
- Description of the water resources in the Project area and groundwater flow regimes;
- Determination of water availability, quality and Project water requirements;
- Assessing the potential impacts of the Project activities on water resources (i.e. potential impacts on groundwater quality and quantity); and
- Proposing proper mitigation measures to minimize/avoid the negative impacts and necessary monitoring program as part of the Environmental Management Plan to protect valleys and water resources.

2.5.2 Socio-Economic Conditions

Objectives

- To assess the impact of Project activities on the socio-economic conditions; and
- To propose proper mitigation measures to enhance positive impacts of the Project and to reduce the negative ones.

Methodology

- Collecting data through literature survey and field surveys and visits to local municipalities and governmental organizations and members of the public in the study area. The data will cover primarily the issues relevant to the Project;
- Based on the above findings and using the information about the Project assess potential impacts of Project activities on the socio-economic conditions (e.g. land use, visual impacts); and
- Propose mitigation measures to reduce the negative impacts and to enhance the positive impacts.

2.5.3 Resettlement Policy Framework and Plan

As a safeguard, the Resettlement Policy Framework ("RPF") sets the basis for a subsequent Resettlement Action Plan ("RAP"). It will be prepared according to NEPCO's resettlement policies. It is noted that due to the remote location of Project site (being away from any farm land or commercial activity) it is not anticipated that there will be any resettlement for the implementation of the Project; however, for the record and for the sake of completeness of the ESIA, the overall procedure and requirements are outlined below. The objective of a resettlement study is to prepare a RPF for a project, in accordance with NEPCO's resettlement policies. These are:

- Involuntary resettlement should be avoided, or minimized where unavoidable;
- Where resettlement is unavoidable, resettlement plans and activities should be seen and executed as development programs;
- Resettled persons should be provided with sufficient investment resources and opportunities to share in project benefits;
- Displaced persons should be meaningfully consulted and allowed to participate in planning and implementation of resettlement programs;
- Displaced persons should be compensated for their losses at full replacement cost, within three months of confiscation date, according to the Compensation Law of 1987 and its Amendments;
- The resettled persons should be assisted with the move and provided with support during the transition period; and
- Resettled persons should be assisted with their efforts to improve, or at least restore, their former living standards and income earning capacities.

Depending on the location of the project, as well as its components or routes, the project may require resettlement of a number of households that would be directly or indirectly affected by the project. These households would be affected through potential loss of resources, as land would be confiscated for the purposes of this project or any of its components requiring clearance of land. All people affected in this manner may be defined as potentially displaced and will have to be identified and accounted for.

According to the Compensation Law of 1987, valuation methods include the following steps:

- Provision of public benefit from such a project;
- Assessment of replacement values of confiscated land and any attachments; and
- Establishment of compensation rates for all assets to be confiscated.

Compensation requires negotiation and communication with affected stakeholders. Consultation with affected communities will be necessary. Such consultation will explain the nature of the project and its expected effects and benefits on the surrounding environment and residents. A brief leaflet about the project may be distributed to the villagers in Arabic explaining the project and describing of the project's safety factors. In addition, a survey questionnaire in Arabic language may be distributed to allow locals to voice their opinions and concerns regarding the project.

The RAP will include the following:

- Eligibility Criteria for Displaced Persons;
- Legal Framework;
- Entitlement Delivery;
- Implementation Process;
- Funding Arrangements;
- Consultation and Participation;
- Grievance Redress and Dispute Resolution Procedures;
- Monitoring of Confiscation and Compensation; and
- Budget.

2.5.4 Archaeology

Objectives

- To identify and assess potential impacts on archaeology and cultural heritage - upon available information- resulting from the construction and operation of the Project; and
- To define the necessary mitigation measures to minimize potential impacts on archaeological sites and cultural heritage within the Project area.

Methodology

- A review of the available data will be conducted;
- An archaeologist will investigate the Project area and the survey will be conducted on foot for the parts where no previous information is available; and
- A mitigation plan will be proposed to avoid and/ or reduce negative impacts of the project on the historic sites.

2.5.5 Biodiversity

Objectives

This is to satisfy the interest of basic planning for the area and to highlight any environmental concern that may arise upon the implementation of the proposed Project on the existing biological conditions. Specifically, the study aims to:

- Conduct the baseline field surveys of flora, fauna and avifauna in the Project area;
- Identify and list all flora, fauna and avifauna species, and related habitats;
- Identify and locate all protected, endangered or rare plants, animals and avifaunal species and habitats;
- Recommend appropriate mitigation measures to reduce (and monitor, if appropriate) such impacts to flora, fauna, avifauna, bats and habitats; and
- Ensure compliance with existing national and/or international protection requirements.

Methodology

In order to meet the objectives and scope of this study, different methods will be used to assess the existing biological environment aspects along the Project area and to evaluate the expected impacts on these aspects. These methods will include the following:

- Literature Survey: In this part, the survey team will collect and review the available data about the biological environment in the Project area. Data collection will be achieved through library search for the available references on the biodiversity or any related biological aspects. References from institutions that are working in this field will be used.

- Field Work Survey: This survey is to complete and update the literary collected data. Different techniques will be used in the field to assess the biological environment:
  - ✓ Conducting field survey of flora of the proposed Project area;
  - ✓ Conducting an avifauna survey in the proposed Project area;
  - ✓ Conducting a mammal and bats survey in the proposed Project area; and
  - ✓ Conducting a reptile survey in the proposed Project area.

The study will correlate the target biological environment aspects with their physical environment units. The effects of the predicted impacts that would occur for these physical environment units according to the Project activities on the biological environment aspects in the Project area will be examined.

2.5.6 Traffic Study

Objectives

- To identify the alternative access routes to the proposed Project area; and
- To assess impacts of Project activities on traffic.

Methodology

- Describe the roads network in the Project area;
- Determine expected transportation movements to and from the wind farm and each individual wind turbine sites during all phases of the Project;
- Assess potential impacts of the Project activities on the used roads network; and
- Propose mitigation measures to reduce negative impacts and discuss possible alternatives.

2.5.7 Noise

Objectives

- To establish baseline noise levels;
- To identify potential noise sources and impacted areas relevant to Project activities;
- To assess and understand the causes of such impacts; and
- To propose proper mitigation measures to protect the public and employees from such impacts.

Methodology

- Monarch 322 Data logging Sound Level Meter, intended for general-purpose measurements of sound pressure levels in industrial and environmental applications, was used. The standard compliance of the instrument is IEC651 Type 2, ANSI S1.4 Type 2;
- Noise level meter was used for one week (continuous monitoring) around the Project site to identify baseline levels;
- A numerical model was used to predict noise levels as function of distance from defined sources; and
- Based on that affected zones, impacts were identified and type of mitigation measures will be proposed.

2.5.8 Air Quality (dust)

Objectives

- To establish the baseline data for dust emissions (TSP, PM10 and PM2.5). Such values will be compared to local air quality standards and specifications;
- To identify potential dust sources and impacted areas relevant to Project activities;
- To assess and understand the causes of such impacts; and
- To propose proper mitigation measures to protect the public and personnel from such impacts.

Methodology

- Establish the baseline data for (TSP, PM10 and PM2.5). Such values will be compared to local air quality standards and specifications;
- Air quality analyzers were used for 20 days around the Project site to monitor (TSP, PM10 and PM2.5) to identify baseline levels; and
- Impacts were identified and type of mitigation measures will be proposed.

2.5.9 Landscape and Visual Impact

Objectives

- To identify landscape designations and visual receptors within the study area;
- To assess and understand potential impacts; and
- To propose proper mitigation measures to minimize any impacts.

The above objectives can be achieved according to the following guidance:

- Guidelines for Landscape and Visual Impact Assessment: Third Edition (*The Landscape Institute with the Institute of Environmental Assessment, 2013*); and
- Visual Representation of Wind farms Good Practice Guidance (*Scottish Natural Heritage, 2007*).

2.5.10 Shadow Flickering

The effect of shadow flickering will be assessed by studying the distances of nearest residential areas or economic activities from the proposed locations of the wind turbines. The direction and extent of shadow will be estimated for different seasons of the year; where possible, modelling software will be used. However, the final aim is not to force unacceptable shadow effect with flickers on people and economic activities.

2.6 Study Team

The following professional staff has been engaged in this Project in various capacities:

Name	Qualification	Experience (years)
Eng. Hamed Ajarmeh	Team Leader / Environmental Engineer, Environmental Impact Assessment Specialist	30
Adnan Budieri	M.Sc. /Ecologist	26
Eng. Tayseer Jwaiad	Traffic Engineering	26
Ramia Ajarmeh	Ph.D. / Environmental Engineering / Socio-Economy Specialist	12
Eng. Shorouq Al-Wekhyan	B.Sc. Water Resources and Environmental Management /Water Resources Specialist	13
Omar Al-Sawa'eer	B.A. / Archaeology	7
Anas Hamed	Air quality and Noise equipment technician	7
Ahmet Korkmaz (AECOM)	Environmental Modelling and GIS Specialist	7
Basak Senturk (AECOM)	B.Sc. Biology /Ornithology	3
Evren Ari (AECOM)	B.Sc. Chemistry	15
Jamal Othman (IDRC)	M.Sc. & Ph.D., Environmental Sciences / Socio-Economy	30
Tareq Tarawneh (IDRC)	M.Sc. Water and Env. Management; Ph.D. Civil Engineering / Socio-Economy	25

Study Team CVs are provided in Annex II.

2.7 Relevant National Legislation

2.7.1 Laws

- The Environment Protection Law No. 52 Year 2006.
- Renewable Energy and Energy Efficiency Law No. 2 Year 2015.
- General Electricity Law Temporary Law No. 64 Year 2002.
- Traffic Law No. 49 Year 2008.
- General Health Law No. 47 Year 2008.
- The Antiquities Law No. 21, Year 1988 and its amendments.
- Transportation Law (89/2003)
- Agricultural Law No. 13 Year 2015.
- Trade, Industry and Occupation Safety Law No. 16 Year 1953.

- Civil Defense Law No. 18 Year 1999.
- Labour Law No. 8 Year 1996 and its amendments.
- Water Authority Law and its amendments No. 18 Year 1988.
- The Organization of the Natural Resources Affairs Law No. 12 Year 1968.
- Acquisition Law No. 12 Year 1987.
- Compensation Law Year 1987.

2.7.2 Regulations

- The Environmental Impact Assessment Regulation No. 37 Year 2005.
- The Bylaw on Regulating Procedures and Means of Conserving Energy and Improving its Efficiency No. 73 Year 2012.
- Land use planning Regulation No. 6 Year 2007.
- Natural Reserves and National Parks Regulation No. 29 Year 2005.
- Soil Protection Regulation No. 25 Year 2005.
- Regulation of Solid Waste Management No. 27 Year 2005.
- Air Protection Regulation No. 28 Year 2005.
- Groundwater Control Regulation No. 85 Year 2002

2.7.3 Standards

- Jordanian Standard for reclaimed domestic wastewater (JS 893/2006).
- Jordanian Standard for drinking water (JS 286/2008).
- Jordanian Standard for Ambient Air Quality (JS 1140/2006).

2.7.4 Instructions

- Instructions for Protection of Birds and Wildlife and rules covering their hunting No.34 Year 2003.
- Instructions on the Protection of water Resources Year 2012.
- Instructions for Recycling and Handling of Consumed Oils Year 2014.
- Instructions for the Limitation and Control of Noise Year 2003.
- Instructions No. 1 Year 2013 for the prevention of occupational hazards related to health hazards resulting from labour housing units' onsite.

2.7.5 Guidelines

- Guidelines for limiting exposure to time-varying Electric, Magnetic and Electromagnetic fields, issued in accordance to articles (6/b and 48) of the Telecommunication Law.
- Drinking Water Resources Protection Guideline, July 2006.

2.8 International Standards

- IFC Policy and Performance Standards on Social and Environmental Sustainability:
  - ✓ IFC Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
  - ✓ IFC Performance Standard 2: Labour and Working Conditions
  - ✓ IFC Performance Standard 3: Resource Efficiency and Pollution Prevention
  - ✓ IFC Performance Standard 4: Community, Health, Safety and Security
  - ✓ IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement
  - ✓ IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
  - ✓ IFC Performance Standard 7: Indigenous People, Year 2012
  - ✓ IFC Performance Standard 8: Cultural Heritage
- IFC Guidance Notes
- IFC General Environmental, Health and Safety Guidelines, Year 2007
- IFC General Environmental, Health and Safety Guidelines for Wind, Year 2007
- IFC Operational Policy OP 4.01 Environmental Assessment, October 1998 (Revised April 2013)
- IFC Operational Policy OP 4.04 Natural Habitats, November 1998 (Revised April 2013)

3 RELEVANT LEGAL FRAMEWORK

3.1 Renewable Energy and Energy Efficiency

3.1.1 Policies and Regulations

Jordan has adopted a number of innovative policies and regulations in certain areas, which is proving that putting in place sound regulatory frameworks can play a transformative role in key economic sectors. For example, the Renewable Energy Law contains provisions for a Renewable Energy and Energy Efficiency Fund, for the creation and maintenance of renewable energy infrastructure. As a final inducement, the law aims to minimize barriers to efficient energy used in the Jordanian market. Such policies could be expanded to other sectors of particular importance, along with greater government spending that target the most prominent environmental challenges.

Jordan ratified the United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol in 1993, and the Ministry of Environment became the national focal point for climate change issues. In 1996, Jordan started its climate change mitigation efforts with a UNDP-GEF supported program for capacity building in documenting national emissions of greenhouse gas (GHG) and preparing the country's national communication to the UNFCCC.

3.1.2 National Energy Efficiency Strategy

The Government of Jordan adopted a National Energy Efficiency Strategy in 2004 that calls for the promotion of energy efficiency measures in all sectors, development of domestic energy resources, including renewable energy, and adoption of a rational pricing policy for meeting high energy demand.

<u>Jordan Renewable Energy (RE) Policy</u>

- Promoting RE to contribute 7% in the primary energy mix by 2015 and 10% by 2020.
- Main Projects to be developed, either through Competitive Bidding or Direct Proposal Submissions, to reach these targets include:
  - 1,200 MW Wind Energy
  - 600 MW Solar Energy
  - 50 MW Waste-to-Energy

- Establishing the Jordan Renewable Energy and Energy Efficiency Fund (JREEF). This Fund was established as a legally independent entity with financial and administrative autonomy in accordance with the Articles of the Renewable Energy and Energy Efficiency Law, and aims to:

- Provide incentives and financial support for RE and EE measures, studies and projects.
- Promote the use of RE and EE in Jordan.
- Encourage private-sector investment in RE and EE projects and activities.
- It also allows for financial assistance and grants from donors.

In response to its many energy challenges, the energy strategy of Jordan emphasizes:

- Significant progress in and expansion of all types of clean energy technologies;
- Encouraging prudence in energy usage and cost effective demand management;
- Sustainable economic growth and ecological preservation; and
- Creation of an energy grid utilizing renewable resources to be supplied to rural areas.

The objectives of Renewable Energy and Energy Efficiency Law No. 13, 2012 are the following:

- Exploiting renewable energy sources for increasing the percentage of their contribution to the total energy mix;
- Contributing to environmental protection and achieving sustainable development by promoting the exploitation of Renewable Energy;
- Rationalizing the exploitation of energy and improving its efficiency in various sectors; and
- Creating the Jordan RE and EE Fund JREEF as a financial incentive to further investments and development of RE and EE.

The law permits local and international companies wishing to establish renewable energy projects to bypass the competitive bidding process and negotiate directly with the Ministry of Energy and Mineral Resources. Additionally, the law establishes fixed feed–in electricity tariffs. Other incentives include a complete income tax exemption within its first decade of operation for any industrial investment in renewable energies. The law also specifies metering policies for residential and small RE producers, in order to encourage low-scale renewable energy supply, via residents selling electricity to their local area at market prices. It makes the purchasing of renewable energy by NEPCO compulsory. NEPCO also have to pay for connecting these renewable energy supplies to the nation's electrical infrastructure.

In Jordan's second National Communication to the UNFCCC (2009), 38 GHG mitigation projects were proposed in the areas of primary energy, renewable energy, energy efficiency, waste, and agriculture. The cost, benefits and CO_2 emission reduction for each proposed project were analyzed and the areas that offer the biggest

potential are fuel switch to promote natural gas usage, renewable energy (especially wind energy) and energy efficiency. If executed, these projects would have led to annual reductions of 2,761 thousand tons of CO_2 eq. in 2009; and expected to increase to 12,345 thousand tons of CO_2 eq. in 2033, representing 9.7 percent and 17.5 percent from baseline emissions, respectively (*Jordan's Second National Communication to the UNFCCC report, 2009*).

3.2 Relevant National Legislation

3.2.1 Laws

- The Environment Protection Law No. 52 Year 2006.
- Renewable Energy and Energy Efficiency Law No. 2 Year 2015.
- General Electricity Law Temporary Law No. 64 Year 2002.
- Traffic Law No. 49 Year 2008.
- General Health Law No. 47 Year 2008.
- The Antiquities Law No. 21, Year 1988 and its amendments.
- Transportation Law (89/2003).
- Agricultural Law No. 13 Year 2015.
- Trade, Industry and Occupation Safety Law No. 16 Year 1953.
- Civil Defense Law No. 18 Year 1999.
- Labour Law No. 8 Year 1996 and its amendments.
- Water Authority Law and its amendments No. 18 Year 1988.
- The Organization of the Natural Resources Affairs Law No. 12 Year 1968.
- Acquisition Law No. 12 Year 1987.
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- The Environmental Impact Assessment Regulation No. 37 Year 2005.
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- Land use planning Regulation No. 6 Year 2007.
- Natural Reserves and National Parks Regulation No. 29 Year 2005.
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- Air Protection Regulation No. 28 Year 2005.
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3.2.3 Standards

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- Jordanian Standard for drinking water (JS 286/2008).
- Jordanian Standard for Ambient Air Quality (JS 1140/2006).

3.2.4 Instructions

- Instructions for Protection of Birds and Wildlife and rules covering their hunting No.34 Year 2003.
- Instructions on the Protection of Water Resources Year 2012.
- Instructions for Recycling and Handling of Consumed Oils Year 2014.
- Instructions for the Limitation and Control of Noise Year 2003.
- Instructions No. 1 Year 2013 for the prevention of occupational hazards related to health hazards resulting from labour housing units' onsite.

3.2.5 Guidelines

- Guidelines for limiting exposure to time-varying Electric, Magnetic and Electromagnetic fields, issued in accordance to articles (6/b and 48) of the Telecommunication Law.
- Drinking Water Resources Protection Guideline, July 2006.

3.3 Regional and International Agreements and Protocols

The Kingdom of Jordan has signed into law the following international protocols and agreements relevant to this Project (effective dates noted in parentheses):

- International Plant Protection Convention (24/4/1970).
- Convention Concerning the Protection of the World Cultural and Natural Heritage (17/12/1975).
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR Convention) (10/5/1971).
- Protocol to amend the Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR Convention) (Paris Protocol) (1982).
- Amendments to Articles 6 and 7 of the 1971 Convention on Wetlands of International Importance especially as Waterfowl Habitat (Regina Amendments) (1987).
- Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) (14/3/1979).
- Amendment to the Convention of International Trade in Endangered Species of Wild Fauna and Flora (art. XI) (13/4/1987).
- Protocol on Substances that Deplete the Ozone Layer (30/8/1989).
- Convention for the Protection of the Ozone Layer (31/8/1989).

- Basel Convention on the Control of Trans-boundary Movements of hazardous Wastes and their Disposal (5/5/1992).
- Convention on Biological Diversity (10/2/1994).
- Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer (10/2/1994).
- Framework Convention on Climate Change (21/3/1994).
- Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer (28/9/1995).
- International Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (26/12/1996).
- Constitution of the Food and Agriculture Organization of the United Nations (23/1/1951).
- The Equator Principles: defined as “a benchmark for the financial industry to manage social and environmental issues in project financing.” These principles have been adopted by global financial institutions.

3.4 International Standards

The International Finance Corporation (IFC), a member of the World Bank Group, established a firm-wide set of guidelines related to sustainable development and risk mitigation in 2006 (updated 2012), known as the Sustainability Framework. Contained within the Sustainability Framework are the IFC Policy and Performance Standards on Social and Environmental Sustainability. The Performance Standards are eight points which were designed to help clients to avoid, mitigate and manage risks and impacts of project activities as a way of doing business in a sustainable way:

- IFC Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts.
- IFC Performance Standard 2: Labour and Working Conditions.
- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention.
- IFC Performance Standard 4: Community, Health, Safety and Security.
- IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement.
- IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- IFC Performance Standard 7: Indigenous People, Year 2012.
- IFC Performance Standard 8: Cultural Heritage.

Corresponding to the eight different IFC Performance Standards, IFC has prepared Guidance Notes. These Guidance Notes explain the requirements that are set in each Performance Standard. The Guidance Notes are not intended to establish policies.

They offer helpful materials and good sustainable practices to improve the project performances.

IFC General Environmental, Health and Safety (EHS) Guidelines, Year 2007: This guideline contains information on cross-cutting environmental, health and safety issues applicable to all industry sectors. It defines performance levels and measures to decrease impacts.

IFC General Environmental, Health and Safety (EHS) Guidelines for Wind, Year 2007: This guideline deals with environmental, health and safety issues especially designed for the wind power industry. Different problems that are going along with wind power are listed and mitigation measures are suggested. This EHS Guideline should be used together with the General EHS Guidelines mentioned above.

IFC Operational Policy OP 4.01 Environmental Assessment, October 1998 (Revised April 2013): This policy highlights the need of environmental assessment, which considers the natural environment (air, water and land), human health and safety, social, trans boundary and global environmental aspects. Preventive measures are favoured over mitigatory or compensatory measures.

IFC Operational Policy OP 4.04 Natural Habitats, November 1998 (Revised April 2013): This policy ensures environmentally sustainable development. Natural habitat conservation, improved land use and the maintenance of ecological functions are supported. Projects that involve significant conversion or degradation of natural habitats are not supported.

4 SOCIOECONOMIC ASSESSMENT AND MITIGATION PLAN

4.1 Methodology

- The required data was identified in the ESIA Terms of Reference.
- Available data were collected from documents, statistics reports, national reports and studies collected from the Department of Statistics (DoS), the Ministry of Municipal Affairs (MoMA), Ministry of Health (MoH), Ministry of Education and Ministry of Higher Education and Scientific Research (MoHESR). In addition to relevant institutions annual reports and previous studies.
- Collected data and results were analyzed to describe the socio-economic context of the Project area, and how the Project may affect the socio-economic context of the area during the construction of 15 Vestas wind turbines and during operation. Lastly, recommendations were made to mitigate any adverse impact, and enhance the benefits of the Project. For that, this section is presented in the following sequence:
  - *Socio-economic Conditions Baseline:* provides a summary of the relevant socioeconomic data and information collected;
  - *Impact Assessment and Significance:* summarizes the findings of the socio-economic assessment;
  - *Mitigation Measures:* provides recommendations to be undertaken to reduce or eliminate potential impacts.
  - *Monitoring:* Sets the indicators that would enable the tracking and monitoring of expected socio-economic impacts.
  - *Residual Impacts and Conclusion*

4.2 Socio-Economic Conditions Baseline

- The baseline socio-economic conditions provide a summary of the relevant socio-economic data and information collected. This is to enable the identification of the socio-economic impacts, if any, and summarize the findings of the socio-economic assessment. Accordingly, this section provides detailed information on the following socio-economic aspects:
  - Overview of Project Area: Tafila Governorate, districts, sub-districts, and the administrative structure of Project area;
  - Demographics: Population and housing for Jordan in general, and the focus area in particular;
  - Medical Provisions: Statistics on hospitals and health care facilities in the area;
  - Land use/land use plans and patterns: Including agriculture (types of crops and annual productions), and industrial facilities; and

- Economic Activity: Educational institutions, transportation (road, rail, air), communication and overall economy (i.e. employment and revenue for agriculture and industry).

4.2.1 Overview of Project Area

The Tafila Governorate is bordered by the Karak Governorate to the north, the Ma'an Governorate to the east and south, and the Aqaba Governorate to the south. The governorate constitutes 2.5% of the area of Jordan with a population of 96,291 inhabitants as per the general census of population and housing results for 2015. In other words, 1.01% of Jordan's population lived in the 37 towns and villages across the governorate of Tafila in 2015, making it the least populated governorate in Jordan.

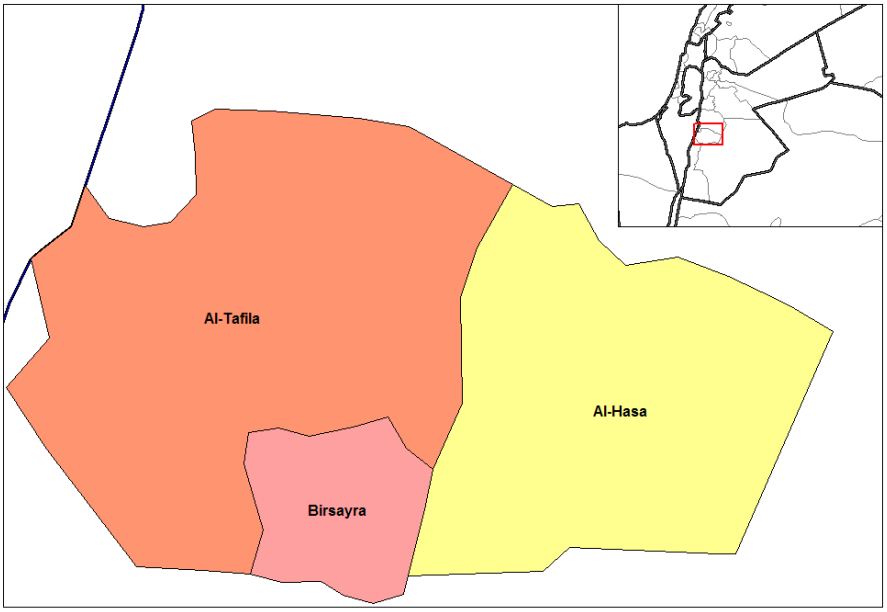

Figure 4-1 Tafila Governorate Districts

The governorate lies on an area of 2,209 km^2, and is divided into three main districts. Those are Qasabet Al Tafila, Bussaira and Al Hasa districts, as illustrated in Figure 4-1. The total number of communities within the three districts is 37, out of which 27 communities are located within Qasabet Al Tafila district, eight communities within Bussaira district and two within Al Hasa district.

The Project site lies within Al Abour community, which is located within Qasabet Al Tafila district. Other communities that lie in the vicinity of the Project site as shown in Figure 1-7 earlier, and include the following:

Table 4-1 Communities Adjacent to the Project Site

Community	District	Estimated Distance from AEC Project Site
Tafila town	Qasabet Al Tafila	8.3 km northwest of the Project site
Umm Sarab	Bussaira	4.2 km southwest of the Project site
Alayn Al-Byyda	Qasabet Al Tafila	8 km west of the Project site

Tafila governorate is also divided into four administered municipal boundaries. These include Greater Tafila Municipality, Al Hareth Ibn Al Omair Municipality, Al Qadessiah Municipality, and Al Hasa Municipality. Figure 4.2 below illustrates the municipal boundaries of Tafila governorate, the district boundaries, and indicates the location of the Project area.

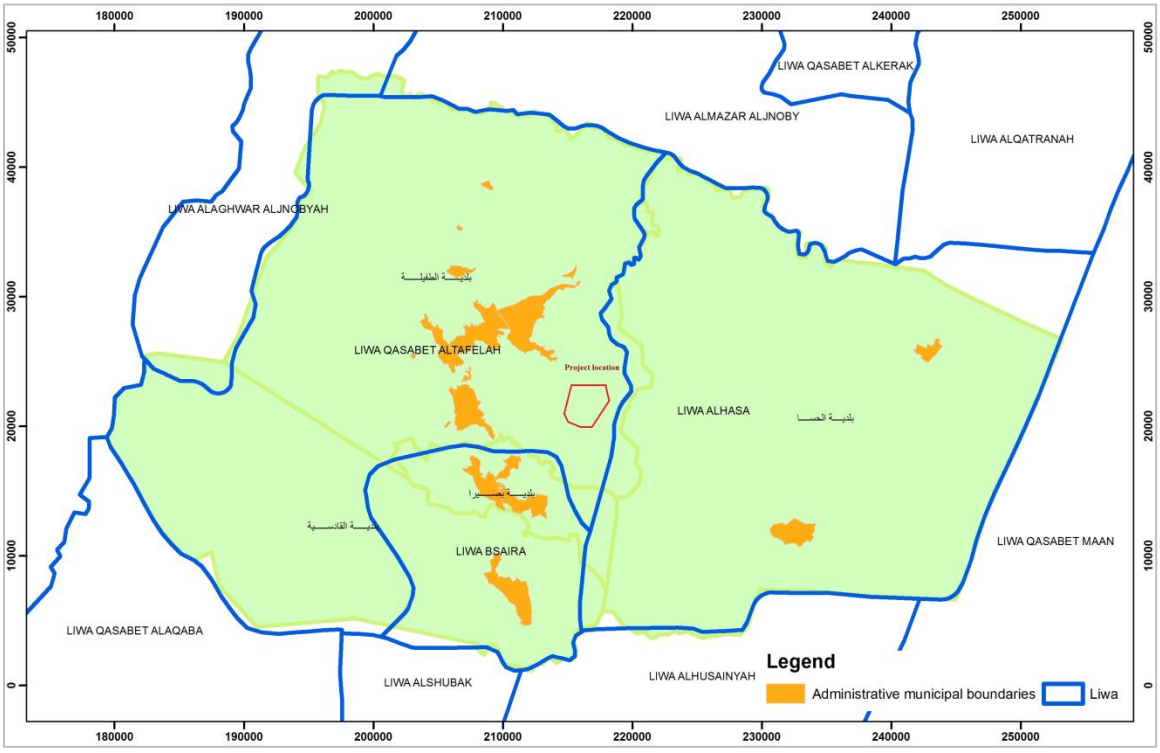

Figure 4-2 Tafila District, Municipality and AEC's Project Area Boundaries

As shown in Figure 4.2 above the AEC's Project area lies in the Abour community within the boundaries of Qasabet Al Tafila district. The area of the Project is considered relatively distant from any community clusters within either Qasabet Al Tafila District or Bussaira District.

4.2.2 Demographics of the Area

Population

According to the results of the general census of population and housing for 2015, the population of Jordan was 9,531,712 in 2015. The governorate of Tafila is considered the least populated of the 12 Jordanian governorates with a population of 96,291 in 2015. Table 4.2 below illustrates the relative size of Tafila governorate within Jordan. Around 1.01% of the national population lives within Tafila. The population density of the area as per 2015 results is 43.5 persons/km^2, illustrating the sparse nature of the area.

Table 4-2 Population, Area and Population Density in Tafila and Jordan

Governorate	Population	%	Area (km^2)	Population density (capita/km^2)
Tafila	96,291	1.01	2,209	43.5
Jordan	9,531,712	100	88,794	107.3

Source: Department Of Statistics (2015)

The Tafila Governorate as mentioned earlier is subdivided into three districts. The number of families recorded in all three districts is 19,296 which is considerably low in comparison to the number of families within the remaining 11 governorates of Jordan ranging between 865,339 families in Amman and 28,641 in Ma'an. Based on the population statistics of 2015, the average family size is nearly 5 persons. It is important to mention here that there are approximately 6,183 non-Jordanians living in Tafila, forming about 0.21% of all foreigners staying in the country.

Table 4-3 below provides key demographic indicators for the three districts of Tafila Governorate based on data from the Department of Statistics for the year of 2015.

Table 4-3 Population of Tafila's 3 Districts in 2015

Indicator	Qasabet Al Tafila	Bussaira	Al Hasa
Population	60,803	25,245	10,243
Males	32, 023	13,013	5,355
Females	28,780	12,232	4,888
Households	12,481	4,972	1,843

In general, the gender breakdown for all three districts shows a slightly higher ratio of males to females. Abour community in particular has a 1:3 ratio of females to males, with the male rate being dominant. The population of Abour is 69, consisting of only 19 families (i.e., an average family size of 3.6 people) which is lower than the Governorate's family size average. Table 4.4 below presents the population of all 37 communities found in the Tafila Governorate illustrating those within each district.

Table 4-4 Population of Tafila Governorate by Locality, (DoS, 2015)

District	Sub-district	Community	Population	Community	Population
Tafila	Tafila	**Alayn Al-Byyda***	**10,448**	Barbietah	175
		Ies	9,787	Liban	43
		Aimeh	2,582	Harier	42
		Sanfahah	454	Ezhaigah	15
		Namteh	62	Zabdah	65
		Abu Banna	1,247	Sirah	255
		Shaidham	946	Jeser El-Shohada'	161
		Erhab	708	Nokhah	292
		IDhba'ah	49	Arafah	1,098
		Majadel	885	Abel	747
		Swaimie'	771	Al Ma'atan	15
		Afra	39	Erwayyem	1,866
		Abour	**69**	**Tafila***	**27,559**
		Tal'et Hussain	453		
Bussaira	Bussaira	Bussaira	10,587	**Umm Sarab***	**744**
		Al Qadessiah	8,604	Dana	31
		Ghranadal	4,680	Lahtha	10
		Al Rashadeiyah	516	Qarqour	73
Hasa	Al Hasa	Al Hasa	8,084	Al Jarf	2,159

**** communities adjacent to the Project area***

Source: Department of Statistics

Employment

Workforce in Jordan includes all economic active citizens above the age of 15 years old. Such force has reached about 32.2% of all Jordanians above the age of 15. Since Jordan has a young population, it is also expected that this work force will increase rapidly in the future. The distribution of the labor force for Jordan during the period from 2012 and 2014 was divided between nine different occupations as shown in Table 4.5 below.

However, due to the nature of the Tafila Governorate, the majority of work is distributed between phosphate mining industries, agriculture and tourism sector activities.

Table 4-5 Relative Distribution of Employed Jordanians

Occupation	2014		2013		2012	
	Female	Male	Female	Male	Female	Male
Legislators, Senior Officials & Managers	1.8	0.4	1.6	0.5	1.8	0.4
Professionals	60.0	17.2	57.4	17.5	55.9	18.3
Technicians & Associate Professionals	13.5	6.0	14.1	6.3	14.2	6.6
Clerks	6.7	4.5	8.4	4.9	8.3	5.8
Service Workers, shop & Market Sales Workers	7.9	34.4	8.9	34.5	8.8	33.0
Skilled agriculture, forestry & fishery workers	0.2	1.7	0.4	1.8	0.4	1.7
Craft & Related Trades Workers	3.2	16.8	3.3	16.3	2.9	15.9
Plant Machine Operators & Assemblers	0.0	13.5	0.1	13.1	0.0	12.4
Elementary Occupations	6.6	5.4	5.9	5.1	7.8	6.0
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Department Of Statistics

On the other hand, unemployment rate in Jordan was 12.9% in 2014 and was reported by the Department of Statistics to have reached 13.6% in the fourth quarter of 2015. For males it reached 11%, and for females 22.1% demonstrating that unemployment among females is much higher than for males. This is usually attributed to social status, cultural habits, as well as education levels. The estimated unemployment rate of Tafila Governorate was 21.1% in total, 13.4% for males and 28.9% for females. Table 4.6 below illustrates the unemployment rate by governorates in Jordan for the year 2013/2014.

Table 4-6 Unemployment Rates Among Jordan's Workforce 2013/2014

GOV.	AMM	BAL	ZAR	MAD	IRB	MAF	JER	AJL	KAR	TAF	MAN	AQA
Male	8.7	12.9	12	14.2	10.4	12.3	20.4	9.7	12.5	**13**	14.1	14.1
Female	19	20.4	21.9	23.2	26.5	24.9	22.3	27.2	25	**28.9**	19.1	21.3

In late 2005, the Royal Decree was issued to establish the Tafila Technical University in Alees, on the road connecting Tafila with high desert way. The location of this university is not far from the Abour site: only about 5 km, and the number of enrolled students exceeded 6,000 in 2016. The university consists of five schools as follows:

-College of Engineering

-College of Arts

-College of Business

-College of Educational Sciences

-College of Science

In addition, there are research and service centers, such as the Languages Center, Community Services, Training and Consultancy and Energy and Oil Shale. The latter is the most important since it is related to this Project; this College was established in 2009 due to the fact that the southern region is rich with renewable energy, such as wind, and oil shale resources. It may be worth investigating the possibilities of cooperation between this center and the AEC's wind Project in order to benefit from the laboratories and workshops at the university for testing and maintaining certain parts or components. On the other hand, senior engineering students may have short training during their study in the Project and/or nearby renewable energy projects.

Housing and Utilities

Housing in Jordan varies from small apartments to large villas. The total number of housing units in Jordan was estimated to be 1,221,055 in 2004 and approximately 1,900,000 in 2015, including marginal houses used to accommodate refugees in the country. Whereas, in Tafila governorate alone, the total number of housing units was 16,785 in 2004 and increased to approximately 20,000 in 2015. Further details on housing types within Tafila are provided in Table 4-7 below.

Table 4-7 Distribution of Housing Units in Tafila Governorate in 2004 and 2015

Type of Housing	2004	2015
Conventional (House, Apartment, Villa)	16,209	19,420
Mobile (Tent)	236	283
Marginal (Barracks)	2	8
Business Establishment	12	19
Under Construction	326	365
Total	16,785	20,095

Source: Department Of Statistics

The cost of living in Jordan is increasing rapidly, but is still lower than industrially developed nations in the MENA area. Living in Tafila or its suburb is not very costly due to the fact the rents are much less than in the central and northern regions, although electricity and water retail prices as well as petroleum products are the same everywhere in Jordan.

The inflation rate in 2016 was 5.6%. According to the Government of Jordan, the retail prices of petroleum products as of February 2016 are as follows: unleaded gasoline (90) 0.580 JD per liter, super unleaded gasoline (95) 0.745 JD per liter, diesel 0.440 JD per liter, kerosene 0.440 JD per liter, and LPG 7.00 JD per cylinder (*Source: MEMR, 1-7-2016*).

4.2.3 Medical Provision

The standard of health care centers in Jordan is among the best in the region. Tafila is served by one governmental hospital with a capacity of over 100 beds, and over 20 health centers as shown in Table 4.8.

There is one central hospital which is administered by the Medical Services of Jordan Armed Forces. But there is a plan to construct a new hospital by the Ministry of Health in the near future. It is worth noting that according to the recent census in 2015 more than 90% of the citizens in Tafila are having full health insurance.

In terms of employment in the health sector as of 2014, there were 600 employees at health centers in the Tafila Governorate, with an average of 27.3 employees for each health care center. Table 4-8 below illustrates Tafila Governorate medical facilities.

Table 4-8 Distribution of Medical Facilities in Jordan and Tafila

Indicator	Tafila	Jordan
Total Hospital Number	1	104
Total Hospital Beds	106	12,497
MOH Comprehensive Health Centers	6	98
MOH Primary Health Centers	11	377
MOH Peripheral Health Centers	6	202
MOH MCH Centers	17	677
MOH Dental Clinic	15	397
Pharmacy	14	2,298

Source: Ministry of Health - Annual Statistical Report 2014

The classification of medical human resources within the Tafila Governorate compared to that of Jordan is presented in Table 4-9 below.

Table 4-9 Medical Human Resources at MOH in Jordan and Tafila

Personnel	Tafila	Jordan
Doctors	91	19,655
Dentists	20	6,881
Pharmacists	17	12,215
Nurses	50	18,454
Legal midwives	40	2,762
Others	182	3,179

Source: Ministry of Health - Annual Statistical Report 2014

4.2.4 Land Use

Large areas of the Tafila Governorate are identified as agricultural or rural land and classified as first, second and/or third degree. Other land use patterns within Tafila Governorate is a mixture of protected areas, nature reserves, existing mining areas, and proposed areas for phosphate mining, copper and manganese The AEC's wind

farm Project area is located in an area classified as an agricultural area as per MoMA's classification.

4.2.4.1 Agriculture

The total area of suitable land for agriculture in Jordan is about 10% of the total area of Jordan. Only 31% of suitable land (3% of all land) is used for agriculture due to the scarcity of water resources. Jordan is considered as one of the three poorest countries in water resources in the world. A comparison of green land use in the Tafila Governorate to that of Jordan in 2014 is shown in Table 4-10.

Table 4-10 Comparison of Green Land Use in Tafila and Jordan in 2014

Governorate	Total area	Irrigated planted land area	Non-irrigated planted land area	Designated as forest land area	Grazing land reserves
Tafila	2,253,500	20,409	27,018	114,570	20,000
Jordan	88,747,500	1,021,863.5	2,266,857	1,305,490	741,700

Source: Ministry of Agriculture

It should be noted that land designated as forest land is not necessarily covered with forests. Table 4-11 below shows the distribution of planted areas in dunums (thousands of square meters) in Tafila Governorate and in Jordan in 2014. Planted areas in Tafila Governorate are compared to Jordan, highlighting irrigated land as compared to non-irrigated land.

Table 4-11 Distribution of Planted Areas in Jordan and Tafila in 2014

Crop	Tafila (dunums)		Jordan (dunums)	
	Irrigated	Non-irrigated	Irrigated	Non-irrigated
Fruit Trees	2,690	1,590	157,632	170,998
Grain Crops	0	15,130	56,902	702,330
Vegetables	185	0	520,760	32,883
Olive Trees	1,230	9,550	284,299	584,411

Source: Ministry of Agriculture

It is also worth noting that the total area of fruit and olive farms in Tafila was 42,210 km^2 in 2011, out of which more than 31 km^2 were olive farms.

The agricultural sector contributed 3% to 4% to Jordan's GDP in 2013 and used about 60% of the water resources in Jordan in the same year, as per the National Water Strategy. Such contribution can be boosted by irrigation and technological advancement in farming methods and the use of other water resources such as treated wastewater in irrigation.

According to the National Water Strategy, wastewater collection and treatment services were provided to about 63% of the population in 2014, producing about 137 MCM of treated wastewater annually of which 125 MCM is being reused primarily in agriculture. However, reused wastewater for agricultural purposes is currently not used in Tafila Governorate.

In Jordan, natural grazing lands, as well as barley and hay production from grains and legumes, comprise the main forage production which maintains livestock during winter. In Tafila Governorate, livestock included 111,219 heads of sheep, 36,270 heads of goats, and 108 cows at the end of 2014, according to the Department of Statistics agricultural surveys.

4.2.4.2 Industry

According to the Ministry of Industry and Trade, industry in Jordan is divided into two main types:

- The Manufacturing (converting) Sector: includes leather and footwear manufacturing, chemical industry, plastic industry, IT industry, furniture industry, food industry, packaging industry, engineering products, etc. This Sector contributes about 18% of Jordanian GDP.
- The Mining Sector: contributes about 2% of Jordanian GDP.

Data obtained from the Ministry of Industry and Trade (*Report of industrial Statistics for the first three quarters of 2010*) shows that the value of national exports for the first nine months of 2010 was 3,100 million dinars, while the value of industrial exports was 2,752 million dinars. Thus, the industrial exports constituted approximately 890% of the total national exports for the first nine months of 2010. The latest official document published by the Ministry of Industry and Trade covers the first half of 2014, and shows the above two figures to be 2,540 million dinars for all exports, and 2,178 million dinars for industrial exports, respectively.

The number of workers in the industrial sector, according to DoS, in 2008 was 193,708. Out of which, 8,090 were working in the extractive industries sector and 171,776 workers in the manufacturing sector while 13,842 workers in the sector of electricity and water supplies. According to the latest figures from DoS in 2014, those numbers

were 8,369 employees in the extractive industries, 201,075 in the manufacturing sector, and 7,786 in the electricity and water supply sectors.

The number of workers in both industrial and artisan enterprises registered in the chambers of industry in the Kingdom for the three first quarters of 2010 was 137,778. Those classified to work in craft and installations were 26,647 while the remaining 111,131 workers were working in industrial plants. In the latest report issued for the first half of 2014, those numbers were 162,582 in total, with 32,140 in crafts and installations, and 130,442 in industrial establishments.

Table 4-12 Industrial Activities in Tafila Governorate

Type	Number
Mining and Cement	6
Food & Beverage	34
Textiles & Clothing	22
Wood Industry for Construction	14
Copying and Printing	1
Non-metal & Glass Products	18
Metal & Metal Electroplating Products	30
Furniture Manufacturing and Assembly	15
Construction & Building Assembly	6
Automotive Mechanics, Location and Trade	91

Source: Ministry of Industry and Trade

A new industrial zone is under construction in Tafila, on the way to the Desert Highway, close to Jurf Al-Darawish. This project is supported under the arrangement of the Gulf Grant, and financed by the Saudi Development Fund. It is expected that the required infrastructure (water pipelines, main sub-station and buildings) to be completed before the end of 2018. This new industrial city will mainly host small and medium industries.

4.2.4.3 Tourism

In recent years, the Jordanian tourism business development has been the focus of study and research. In the analysis of tourism, economists emphasize economic effects of tourism on the economy. The speedy growth of tourism causes an increase

of household incomes and government revenues through multiplier effects, improvements in the balance of payments, and growth of the tourism industry. This industry makes a substantial contribution to the Jordanian economy. Employment in the tourism cluster, including direct and indirect employment, was estimated at approximately 49,096 in 2015. This was also witnessed in Tafila Governorate as it depends on domestic tourists who visit the hot water springs and the natural reserves in the Governorate

Tourism development in Jordan is aided by the existence of many internationally well-known landmarks, including Petra and the Dead Sea, among others. In Tafila Governorate, there are only a few sites popular among tourists. One of these is the Afra Mineral Spa. In addition to its therapeutic value, the Spa is situated next an old Byzantine Church dating back to the sixth century. A total of 28,794 visitors were registered during the first nine months of 2015, with 1,861 non Jordanians. In comparison, for the same period during 2014, 32,633 visitors were registered, of which about 1,001 were non Jordanians. This indicates an average decrease of approximately 11.8% for the total number of visitors, but an increase of 18% in non Jordanian visitors.

Another historical site is the Sala'a Castle which is located about 15 km southwest of Afra Spa and about 1 km west of Ain Al Baidaa. The castle overseas Sala'a traditional village and is built using mud and stone and surrounded by fruit and olive trees.

One area in Tafila region reflecting a special kind of tourism, namely "ecotourism", is the Dana Reserve. It was established in 1989 as the largest and first natural reserve in Jordan. Its total area is about 300 square kilometers and is located near the Al-Qadesiya area. It constitutes the only reserve containing all four biodiversity geographical regions, namely the Mediterranean, Irani-Torani, Arab desert, and Sudanese regions. It is considered home to about 800 plant species, three of which exist only in Dana Reserve. The Reserve contains lodging locations within its Guest House, Al-Rummana Camp and Finan Lodge. In 2010 the number of visitors to each lodging location reached 3,273, 4,097 and 6,500, respectively.

4.2.5 Economic Activity

The following section presents some key indicators on services and utilities within Tafila Governorate. Where possible, the indicators are compared to their conditions in Jordan and other governorates.

4.2.5.1 Education

The main general educational providers in Jordan are the Ministry of Education (MoE), the private sector, in addition to the Armed Forces, which in its turn provides remote

areas in the country with educational services. The United Nations Relief Agency (UNRWA), on the other hand, provides educational services to Palestinian Refugees in Jordan.

In Jordan, there are four educational levels:

I. Kindergarten (2 years);
II. Basic education (10 years);
III. Secondary education (2 years); and
IV University education (as per requirements of the degree).

The Ministry of Education (MoE), which administers vocational and academic education from kindergarten through secondary education, is the primary source of baseline data for those demographics. The Ministry of Higher Education and Scientific Research (MoHESR) supervises education in Jordanian universities and community colleges, and is the main source of statistics for this sector. Figure 4-3 below illustrates the percentages of schools as per their supervising authority.

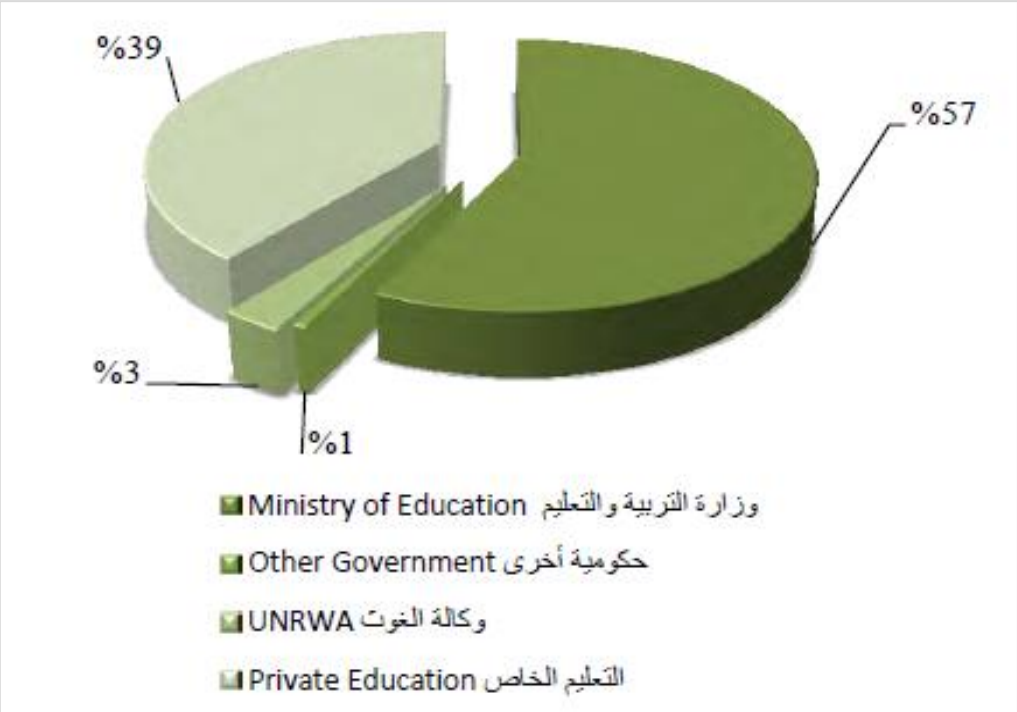

Figure 4-3 Schools According to Supervising Authority

The following table includes various statistics on students in educational institutions, whether governmental or private, according to several characteristics, as well as statistics on Jordanian students abroad. This is based on the latest publication for the Ministry of Education, which covers the years 2012/2013.

Table 4-13 Education Indicators in Jordan for the Years 2012-2013

Average No. of Students per Class Unit	**25.12**
Average No. of Students per Teacher 2010-2011	15.7
Percentage of Females among Students 2010-2011	49.2%
Percentage of Female School Teachers to Total Teachers 2010-2011	67.28%
Percentage of Students in Basic and Secondary Stages of Total Population 2010-2011	25.2%
Percentage of Rented School Buildings of Total School Buildings 2010-2011	36.5 %

Whereas the classification of Jordanian teachers according to the education level provided is presented in Figure 4.4 below.

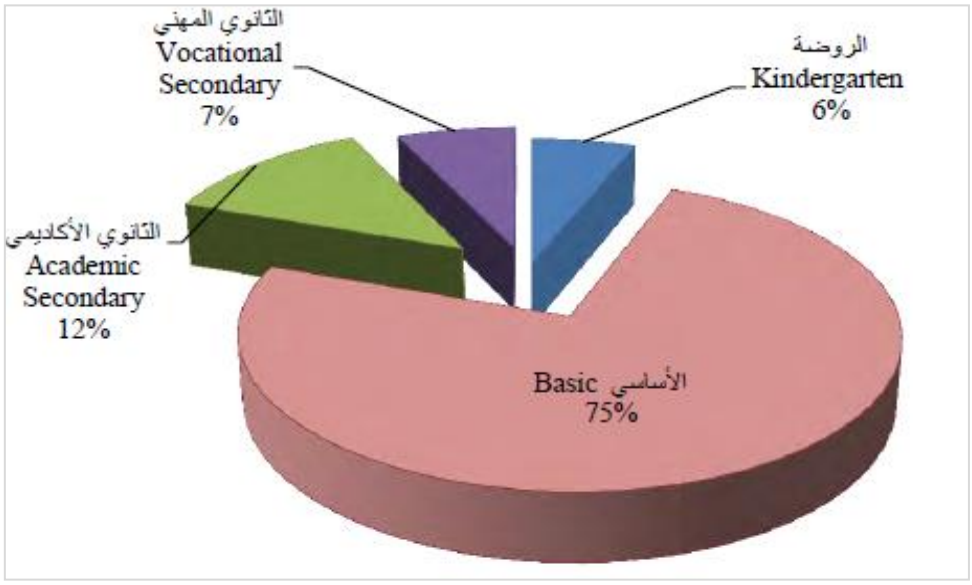

Figure 4-4 Teachers According to Education Level

As for the Tafila Governorate, the distribution of schools, teachers and students, in Tafila in 2011-2012 are shown in Table 4-14, Table 4-15, Table 4-16 and Table 4-17.

Table 4-14 Schools in Tafila Governorate According to Gender

	Total
Male	41
Female	7
Co-ed	100

Table 4-15 Schools in Tafila Governorate by District, Level and Gender

Directorates	Kindergarten			Basic.			Secondary		
	Male	Female	Co-ed	Male	Female	Co-ed	Male	Female	Co-ed
Tafila	0	0	14	16	1	48	13	5	11
Bussaira	0	0	4	7	1	20	5	0	3

Table 4-16 Teachers in Tafila Governorate by District, Level and Gender

Directorates	Kindergarten		Basic		Secondary	
	Male	Female	Male	Female	Male	Female
Tafila	0	82	405	894	217	231
Bussaira	0	19	146	297	71	59

Table 4-17 Students in Tafila Governorate by District, Level and Gender

Directorates	Kindergarten		Basic		Secondary	
	Male	Female	Male	Female	Male	Female
Tafila	912	831	7825	7519	1376	1358
Bussaira	291	258	2759	2620	442	447

Furthermore, a Royal Decree was issued to establish Tafila Technical University (TTU) on the 17th of January 2005. The TTU, which currently contributes to the development of higher education in Jordan includes seven colleges. These are: Engineering, Science, Business, Education, Arts, Student Affairs, and Scientific Research and Graduate Studies.

The number of TTU students at the beginning of 2016 was approximately 6,000 students, spread over different programs: Bachelor's Program; Two-Year Intermediate Diploma Program; Higher Diploma Program; and Master's Degree Program.

The number of faculty members has recently reached 237, while the number of the administrative staff was 631. At present the TTU campus is witnessing a construction boom in the area in buildings, facilities and infrastructure, where a number of laboratories, centers, halls, classrooms, restaurants and administrative departments are going to be relocated.

Engineering workshops with the latest machinery and equipment will be also relocated to the new buildings. Moreover, an integrated sport complex is being constructed; it is the largest and first of its kind in all Jordanian universities. Another building is being constructed for the Computer Center, the Department of Admission and Registration and the library. A new complex of halls and classrooms is being constructed as well.

4.2.5.2 Transportation

The transport sector is a very important sector of the economy in Jordan. It serves the national economy essentially along the Aqaba-Amman corridor; it also plays an important role on a regional level in transport goods and passengers to and from the neighboring countries (Syria, Iraq, Saudi Arabia, Egypt and, potentially, Israel and Palestine). The transport infrastructure in Jordan can be summarized as follows:

- One sea port (Aqaba) located on the Red Sea;
- Two railway corporations, the Aqaba Railway Corporation (ARC) which transports phosphate and other mining product from the mines to the port of Aqaba and the Jordan Hijaz Railway Corporation (JHRC) which is not in operation for the time being;
- A road network totaling 7,200 km in 2012; and
- Three international airports (Queen Alia international, Amman International, and King Hussein International).

Air Transportation

Jordan has three airports; two of them are in Amman (Queen Alia International Airport and Amman Civil Airport); the third is King Hussein International Airport in Aqaba. Table 4-18 shows air traffic levels in 2014 for all the three airports.

Table 4-18 Airport Traffic During 2014

Queen Alia International Airport movement during 2014

Aircraft Movement			Passenger Volume			Air Cargo Movement (Ton)			Mail Movement (Ton)		
Arrival	Departure	Total	Arrival	Departure	Total	In- bound	Out-bound	Total	In- bound	Out-bound	Total
36578	36547	73125	3489902	3599200	7089102	57699	36184	93883	1350	1196	2546

Amman / Marka Civil Airport during 2014

Aircraft Movement			Passenger Volume			Air Cargo Movement (Ton)		
Arrival	Departure	Total	Arrival	Departure	Total	In-bound	Out-bound	Total
3147	3129	6276	20793	20746	41539	0	0	0

King Hussein International Airport/ Aqaba during 2014

Aircraft Movement			Passenger Volume			Air Cargo Movement (Ton)		
Arrival	Departure	Total	Arrival	Departure	Total	In-bound	Out-bound	Total
2150	2152	4302	77918	85457	163375	1625	732	2357

Source: Civil Aviation Regulatory Commission

Maritime Transportation

Aqaba city has the only port in Jordan. Most of the imported and exported cargo is transported through this port. In addition, this port is used for passengers traveling by ship in and out of the country. Table 4-19 represents handling of Jordanian goods and transit movement via Port of Aqaba during 2014.

Table 4-19 Jordanian Goods and Transit Movement via Port of Aqaba

Number of Vessels	Jordanian Goods			Transit Goods			Total of Handling
	Imported	Exported	Total	Imported	Exported	Total	
1664	8667282	3195704	11862986	450059	107508	557567	12420553

Source: Statistics, Ministry of Transport, 2014

Land Transportation

The road network in Jordan has progressed in terms of design, construction and maintenance. In 2013, the total length of the network in Jordan was about 7,299 km, including the three types of roads which are highways, secondary and village roads. Table 4-20 illustrates the length of roads for Tafila and Jordan as per their type. These are the latest official numbers posted by the Ministry of Public Works and Housing.

Table 4-20 Length of Roads in Jordan and Tafila

Particulars	Tafila	Jordan
Highway (km)	161	2,651
Secondary (km)	31	1,894
Village (km)	44	2,754
Total (km)	**220**	**7,299**

There are two main highways connecting north and south of Jordan. These are the Dead Sea Highway (Highway 65) and the Desert Highway (Highway 15). In order to go to Tafila from the Desert Highway, Highway 60 west at Jurf Al Darawish route should be taken. The Desert Highway also serves as the main route through Jordan to the Sea and it used to transport good.

In 2013, 1,263,754 vehicles were operating in Jordan. The number and type of vehicles operating in Tafila is presented below.

Table 4-21 Number and Type of Vehicles in Tafila

Type of vehicle	Tafila
Total no. of passenger cars Private Public	2,260 1,921 339
Buses Private companies Public companies	23 2 21
Total no. of trucks No. of privately-owned trucks	5,660 5,243
Oil tankers companies Private companies Public companies	9 5 4
Total no. of trucks & trailers Private Public	911 436 475
Other vehicles	790

The railway system in Jordan runs approximately 452 km. Railway transport is not currently an effective mode of transportation in Jordan but the country aims to expand the system by integrating it with neighboring countries. A planned light railway system is under consideration, and would connect the capital Amman to Zarqa, the second largest city in Jordan. It will be designed mainly for passenger transportation.

Railway transport in Jordan is managed by Jordan Hejaz Railway Corporation and the Aqaba Railway Corporation. Jordan will be developing a modern, reliable freight railway network, linking the nation's key cities (the national capital, Amman, and major industrial cities such as Mafraq and Zarqa) to the country's gateway port, the Port of Aqaba, and the largest phosphate mine, Shidiya Mine. The network will also connect with the railways of Saudi Arabia and Syria (and onward to Turkey and Europe in the future) as well as important markets in Iraq. (*Source: Ministry of Transport, Future Projects, Jordan National Railway Project*)

4.2.5.3 Telecommunications

Jordan has a highly developed communications infrastructure. Jordan's telecom infrastructure is growing at a very rapid pace and continually being updated and expanded. Jordan's telecom industry remains the most competitive in the Middle East. Communications in Jordan occur across many media, including telephone, radio, television, and internet.

According to statistics issued by the Telecommunications Regulatory Commission in late 2014, the following are main characteristics of the sector:

- 377,208 land line subscriptions, which is declining due to the higher penetration and cheaper rates of mobile telephones.
- Mobile penetration in Jordan reached 146% at the end of the first half of 2014, with 10.691 million subscriptions, compared with 78% (4.343 million subscriptions) in 2006.
- Internet users reached 5.4 million users by the end of 2014, with penetration exceeding 70% - a high figure for the region. Internet usage more than doubled from 2007 to 2013, with the rapid growth expected to continue. Jordan has more internet start-up companies than any other country in the Middle East. The Jordanian government has recently announced that the sales tax on computers and internet connection would be removed in order to further stimulate the Information and Communication Technology (ICT) industry in Jordan.

4.2.5.4 Economy

Jordan is considered as an upper middle-income country with a population of 6.5 million, without accounting for refugees and foreign residents (estimated to be less than 3 million), and a per capita GDP of approximately US$4,800 in 2014. Approximately 60% of the population is young and under 20 years of age, being mostly students or trainees.

The country has limited natural resources. Potash and phosphate are its main export commodities. Agricultural land is limited due to the scarcity of water. Jordan is among the world’s five poorest countries in terms of available water resources. Services account for more than 70% of the gross domestic product and absorb more than 75% of the workforce. As one of the most open economies of the region, Jordan is well integrated with its neighbors through trade, remittances, foreign direct investment, and tourism, and especially has strong links to the Arab Gulf states.

As a result of its open economy and high degree of regional integration, Jordan is vulnerable to the political, economic and social volatility of the region. The political upheaval that swept the Arab region has had a significant impact on Jordan, taking the form of economic shocks as well as inspiring domestic demands for stronger citizen voice, greater accountability and improvements in living conditions.

The regional political upheaval impacted Jordan economically through two factors:

(i) the sharp drop in natural gas supplies from Egypt led to a surge in Jordan's current account and fiscal deficits; and

(ii) the Syrian conflict which led to a large influx of refugees is further straining Jordan's difficult fiscal position. Equally important is the instability in the region as a whole.

Recent reports confirmed that Jordan's economy has been on a path of recovery for the last 5 years. In 2015, the growth ratio was about 2.4% and according to the IMF forecasts, economic growth may touch 3% in 2016. But still there are worrying negative trends, such as increasing public debt and significant decrease of money transfer from Jordanians working in the Gulf States.

Unfortunately, unemployment rate is also rising. Foreign employment is estimated over 800,000 working in the construction, agriculture and services sectors. Moreover, annual foreign direct investment (FDI) inflows fell 36.6% in 2015. Lower investments, which are attributed to external factors mainly the armed conflicts in the neighbouring Arab countries, contributed to the reduced growth rate. The main economic indicators in Jordan for 2014 are shown in Table 4-22 and Table 4-23.

Table 4-22 Main Economic Indicators

Indicator	Value
Growth rate of GDP at fixed producer prices	3.1%
Growth rate of GDP at current producer prices	6.6%
Total production at fixed prices	11,147.6 Million JDs
Total production at current prices	25,194.5 Million JDs
Inflation rate	5.0%
GDP per Capita (JD)	3,876.00
Trade balance (Goods Only)	-3,000 Million JDs

Table 4-23 Average Growth Rates in Fixed Prices

Sector	Rate
Agriculture	7.6%
Industry	
- Mining Industry	27.6%
- Other Industry	1.5%
- Energy (water & electricity)	3.3%

Construction	6.8%
Trade, Restaurants, and Hotels	3.7%
Transportation and Communications	1.6%

Public debt (91.7% of GDP at the beginning of 2016) is continuing to rise due to an increase in the debt being accumulated by the electricity and water entities, while the debt of the central government declined. There is a targeted program to correct the situation with the IMF and the Ministry of Finance will strictly follow agreed action plan. This new program is necessary to anchor government commitments to reforms, and increase confidence in the economy as well as to bridge the gap in the balance of payments. But still more effort should be focused on improving:

(i) Investment climate;

(ii) Labour market reforms; and

(iii) Governance which is currently under discussion to be targeted in the near future with the help from IMF.

In this regard and during the past few years, the GoJ made some progress in addressing the aforementioned challenges, these include:

(i) Reducing fuel subsidies by eliminating government subsidies on fuel for cars; and

(ii) Gradually increasing retail prices of electricity and water for almost all categories of consumers except the 1st two segments of residential consumers.

After serious disruptions of natural gas supply from Egypt, the cost-recovery strategy for NEPCO has been successful and this was achieved by increasing electricity tariffs since 2013 by 15% on yearly basis. LNG imports started in 2015 to substitute for liquid fuels used in power generation plants. At present about 85% of the generated electricity is by firing LNG in thermal power plants.

The costs and impacts of Syrian refugees are very high and caused serious difficulties for concerned authorities and hosting communities. The GoJ is suffering from lack of available resources and international aid. Hosting increasing number of Syrian refugees are being mitigated by the National Resilience Plan 2014-2016 and Jordan Response Plan 2016-2018 which includes priority responses to mitigate the impact of the Syrian crisis on Jordan and on host communities.

We can conclude that GoJ policies are in the right direction to support macroeconomic stability. The 2016 budget targets are appropriate, with a forecasted deficit reduction by 1% from 2015, in addition to efforts to reduce the growth rate of debt. The monetary stance remains a strong point and has been stable in recent

years, with a rebound in foreign currency reserves. Fixing and pegging the local currency (Jordanian dinar) to the US dollar has helped in controlled inflation expectations and provided a measure of fiscal stability.

4.3 Evaluation of Impact

The AEC Wind Farm Project is expected to have potential socio-economic impacts on the area during its construction and operation phase. Table 4-24 below provides a summary of the impacts assessment in terms of several factors such as its level, frequency, duration, likelihood and significance.

Table 4-24 Impact Assessment and Significance During Construction and Operation

Impact	Geographical Extent	Level	Frequency	Duration	Direct (D) Indirect (ID)	Reversible (R) Irreversible (IR)	Likelihood	Significance	Positive/ Negative	Remarks
Employment	H	M	M	M	D	R	H	Yes	+	Mitigation measures are required
Landscape and visual impact and aesthetics	M	M	M	M	D	IR	H	Yes	-	Mitigation measures are required
Land Use	L	L	L	M	ID	-	M	Yes	-/+	-
Business prosperity	M	M	M	H	ID	-	M	Yes	+	Mitigation measures are required
Stress on infrastructure	M	M	M	M	D	IR	M	Yes	-	Mitigation measures are required
Land acquisition and Resettlement	L	L	L	L	ID	-	L	No		-
Impact on tourism	L	L	L	H	-	-	L	No		-

Significance criteria:

Geographical Extent:	L:	Limited to Project site.	M:	May reach outside the Project site.	H:	Will reach outside the Project site.
Level:	L:	Will not change existing level.	M:	Will change existing level slightly.	H:	Will change existing level severely.
Frequency:	L:	Occurs only once / rarely.	M:	Occurs during abnormal conditions.	H:	Occurs continuously.
Duration:	L:	During specific activity.	M:	During construction phase.	H:	During operational phase continuously.
Likelihood:	L:	Impact is not likely to occur.	M:	May occur.	H:	Will occur.

4.3.1 Employment

The Project can be expected to have positive impacts in terms of employment. Given its remote location, and its distance from Amman, it is expected to recruit local labor

and local contractors from the area of Tafila during the construction activities and site preparation. When the Project goes into operation phase, AEC's Project is expected to use local technicians as much as possible in the operation and maintenance of the Project.

Based on experience from similar projects in the region, and discussions with the manufacturer of the turbine technology to be used in the Project, the estimated number of workforce during the construction phase is expected to range from 80 to 85. This will mainly include managers, engineers, technicians, skilled and unskilled labor, and security staff, and will most probably be males. Work opportunities and recruitments for local men to work as unskilled labor, drivers, security guards, and other support positions from the surrounding area will highly increase.

Given the specialized nature of the Project, it is still expected to have a foreign work force comprising almost 35% of the total work force during construction. Those will be in the top level managerial and technical positions, however, one can expect significant knowledge transfer and capacity building to local technicians. Even for the unskilled labor category, good construction practices, especially as it relates to occupational safety and construction methods, one could expect significant knowledge transfer.

Given the nature of the Project (i.e., mostly self-operational), the expected number of employment opportunities during the operation phase is average. Discussions with the developers of other similar projects, and the developer of the current Project revealed that a total of 11 to 15 employment opportunities will be created in a number of categories.

As can be seen, the Project will create opportunities for employment, a good part of which can be filled from local residents. The EPC contractor will be encouraged to give priority to local residents in filling those positions. Furthermore, local service providers (e.g., small contractors, small suppliers, etc.) can be used for the provision of support services and materials to the site during the construction phase of the Project.

4.3.2 Land use

The land use and future expansion in housing will not be an issue for the Project area as it is designated as an agricultural land. Currently, there are no housing structures in the area and dense housing is not expected to occur in the area. However, the municipality should account for the location of the wind turbines in any future changes in the land designations and permits for buildings, even within the agricultural area. No impact is expected in this regard.

Figure 4-5 Photographs of Project Surroundings

4.3.3 Business Prosperity and New Business

It is expected that construction contracts related to the Project site preparation, installation of infrastructure, construction of internal roads will be awarded to local contractors. Therefore, good opportunities for local employment from the local people during the construction phase are expected.

Project workers represent a new purchasing power to be injected into the local market, and the workers will add to the demand for several goods and services in nearby villages. Small shops, food and beverages stores, spare part suppliers, vehicle maintenance workshops and other local businesses will be positively affected.

A model that has successfully worked elsewhere in the MENA region is for such projects to encourage groups of workers to establish small businesses that would be awarded small contracts such as cleaning and janitorial services for the management building, small maintenance works, and so on. This has additional socio economic positive impacts on the local community if followed for this Project.

4.3.4 Stress on infrastructure

Since the Project site is largely undeveloped, the impact on existing infrastructure will be minimal. Transportation of materials by construction vehicles during the construction phase will, however, add to the traffic loads on surrounding roads. This impact, however, is temporary, and does not have any long term impacts. The transporters of materials will be strongly monitored for observing good transportation practices such as:

- Covering their trucks to prevent any debris and dust (especially trucks transporting aggregate and other similar materials);
- Abiding by safety traffic regulations;
- Observing speed limits; and
- Having truck wash stations at Project exits to prevent transfer of debris and other forms of waste to public roads.

4.3.5 Visual Impacts

A wind farm development introduces a number of elements into the landscape which are likely to be visible from outside the development site, including turbines, access roads, masts and control buildings. The introduction of these elements into the landscape can alter the landscape character of the area and can result in visual effects which may be experienced by a variety of different receptors.

4.3.5.1 Methodology

The visual impact assessment of the proposed AEC wind farm was carried out with the determination of the visual impacts on the representative viewpoints that are the major receptors situated in the vicinity of the wind farm. In the assessment of the significance of the visual impacts, a significance rating matrix is used. The impact significance assessment methodology is explained in detail below.

Impact Assessment Methodology

To identify and evaluate the potential impacts (positive or negative) of the wind farms on identified receptors, an impact assessment is carried out. The study also assesses the significance of the impacts.

Impact Types and Definitions

An impact can be defined as the change in any manner to source or receptor caused by a facility or facility related activities. The assessment study is carried out to evaluate and describe how the physical and visual environment can be affected by the facilities. Impacts of the facilities may be categorized as Positive, Negative, Direct, Indirect and Cumulative. To define them briefly:

Positive Impact: Improvement occurs on the baseline conditions, or cause improvement;

Negative Impact: Adverse change from the baseline, or cause a new undesirable condition;

Direct Impact: Direct interaction between a facility/activity and the receiving environment/receptors;

Indirect Impact: Result from other activities that occur as a consequence of the facility;

Cumulative Impact: Consider and include other facility impacts to affect the same resources and/or receptors as the facility.

4.3.5.2 Significance

"Significance" is used to describe the impact which is a function of the magnitude of the impact and the probability of the impact occurring (i.e. likelihood). Impact magnitude, or severity, is a function of the extent, duration and intensity of the impact.

The impact significance and its components are presented in a matrix structure as shown in Table 4-25.

Table 4-25 Significance Rating Matrix with Significance Colour Scale for Negative Ratings

SIGNIFICANCE				
		SENSITIVITY		
		Low	Medium	High
MAGNITUDE	Negligible	Negligible	Negligible	Minor
	Negligible – Low	Negligible	Minor – Negligible	Minor – Moderate
	Low	Negligible	Minor	Moderate
	Low – Medium	Minor – Negligible	Minor – Moderate	Moderate
	Medium	Minor	Moderate	Moderate
	Medium – High	Minor – Moderate	Moderate	Moderate – Major
	High	Moderate	Moderate – Major	Major

SENSITIVITY

Low: People engaged in work activities indoors, with limited opportunity for views of the development, road users on minor access roads travelling for other purposes than just the view.

Medium: Users of primary transport road network, orientated towards the development, likely to be travelling for other purposes than just the view, dwellings with oblique views of the proposed development.

High: Users of outdoor recreational facilities, on recognized national cycling or walking routes or in nationally designated landscapes, dwellings with views oriented towards the proposed development.

MAGNITUDE

Negligible: No real change to perception of the view. Weak, not legible, hardly discernible.

Low: The development would cause very minor changes to the existing view over a wide area or minor changes over a limited area.

Medium: The development would cause minor changes to the existing view over a wide area or noticeable change over a limited area.

High: The development would cause a considerable change to the existing view over a wide area or an intensive change over a limited area.

Very High: The development would dominate the existing view.

SIGNIFICANCE

Negligible:
- No discernible improvement or deterioration in the existing view.

Minor:
- A minor shift away from baseline conditions.
- This would typically occur where change arising from the alteration would be discernible but the underlying character / composition / attributes of the baseline condition will be similar to the pre-development.
- It would also occur where the proposed development newly appears in the view but not as a point of principal focus or where the proposed development is closely located to the viewpoint but seen at an acute angle and at the extremity of the overall view.

Moderate:
- Alteration to one or more elements/features of the baseline conditions such that post development character/attributes of the baseline will be materially changed.
- This would typically occur where the proposed development closes an existing view of a local landscape and the proposed development would be prominent in the future view.

Major:
- Major/substantial alteration to elements/features of the baseline (pre-development) conditions.
- Where the proposed development would cause a very noticeable alteration in the existing view.
- This would typically occur where the proposed development closes an existing view of a landscape of regional or national importance and the proposed development would dominate the future view.

4.3.5.3 Impact Assessment

The visual impact assessment of AEC wind farm turbines and the turbines of other wind farms located in the vicinity of AEC wind farm is carried out according to the visibility of the AEC wind farm turbines, together with the visibility of the turbines of other wind farms in the same viewshed from the settlements which are the major principle visual receptors.

Settlements

The settlements including villages and neighborhoods that lie within the study area were identified in the process of visual assessment. There are not many villages in the study area where the turbines AEC wind farm will be observed from.

Roads

The Project area has an undeveloped nature and hence there are not many roads running through the Project area. Mostly, the roads are the connection tracks between agricultural sites and small villages.

4.3.5.4 Zone on Theoretical Visibility Diagrams (ZTV)

The term 'Zone of Theoretical Visibility' (ZTV) is used to describe the area over which a development can theoretically be seen, and is based on a Digital Terrain Model (DTM) and overlaid on a map base. This is also known as a Zone of Visual Influence (ZVI), Visual Envelope Map (VEM) and Viewshed. However, the term ZTV is preferred for its emphasis of two key factors that are often misunderstood:

- visibility maps represent where a development may be seen theoretically – that is, it may not actually be visible in reality, for example due to localized screening which is not represented by the DTM; and
- the maps indicate potential visibility only, i.e. the areas within which there may be a line of sight. They do not convey the nature or magnitude of visual impacts, for example whether visibility will result in positive or negative effects and whether these will be significant or not.

ZTV diagrams for each wind farm have been generated using ArcGIS, Geographic Information System (GIS) software, to demonstrate the number of turbines that may theoretically be seen from any point in the study area. In the preparation of the ZTV diagrams, as the DTM, 30 m resolution DTM generated from ASTER GDEM elevation data was used. The height of the observer points were assumed as 1.5 m as the recommended value. The ZTVs indicate the number of hubs that are theoretically visible. In the preparation of hub height ZTV, the hub height values for each turbine model in the wind farms were taken as the height that will be visible from any point in the study area.

There are some limitations in the generation and use of the ZTVs. These limitations mean that while the ZTVs are used as a starting point in the assessment, providing an indication of where the wind farms will theoretically be visible, the information drawn from the ZTVs is always checked on the ground to ensure that the assessment accurately represents the visibility of the wind farm. The hub height ZTV diagrams of each wind farm are shown in the same map in order to understand on which settlements visual impact will occur.

The assessment of visual impacts is determined by a series of representative viewpoints which are selected to cover points of specific importance such as recognized settlements, minor and major routes.

The type of locations used for viewpoints in visual impact assessments tends to vary from site to site, depending on the nature of the study area and the land uses that surround the site. The study area is not developed with settlements and transport corridors. There are no remote upland areas that are designated for landscape qualities or notable hilltops that provide recognized viewpoints. This means that the majority of viewpoints used in the assessment is located within or on the edges of settlements and have been included to represent the views that will be observed by the residents, who are considered to have increased sensitivity. These viewpoints generally provide a clearer and more open view than is available from public areas within settlements and the viewpoints therefore represent views that may be observed by the residents of nearby houses.

There are five representative viewpoints selected in the study area. The map showing the locations of the viewpoints is given in Figure 4-6 and Figure 4-7.

In addition, the coordinates of the viewpoints, reasons for selection and distance to the nearest turbine are listed in Table 4-26.

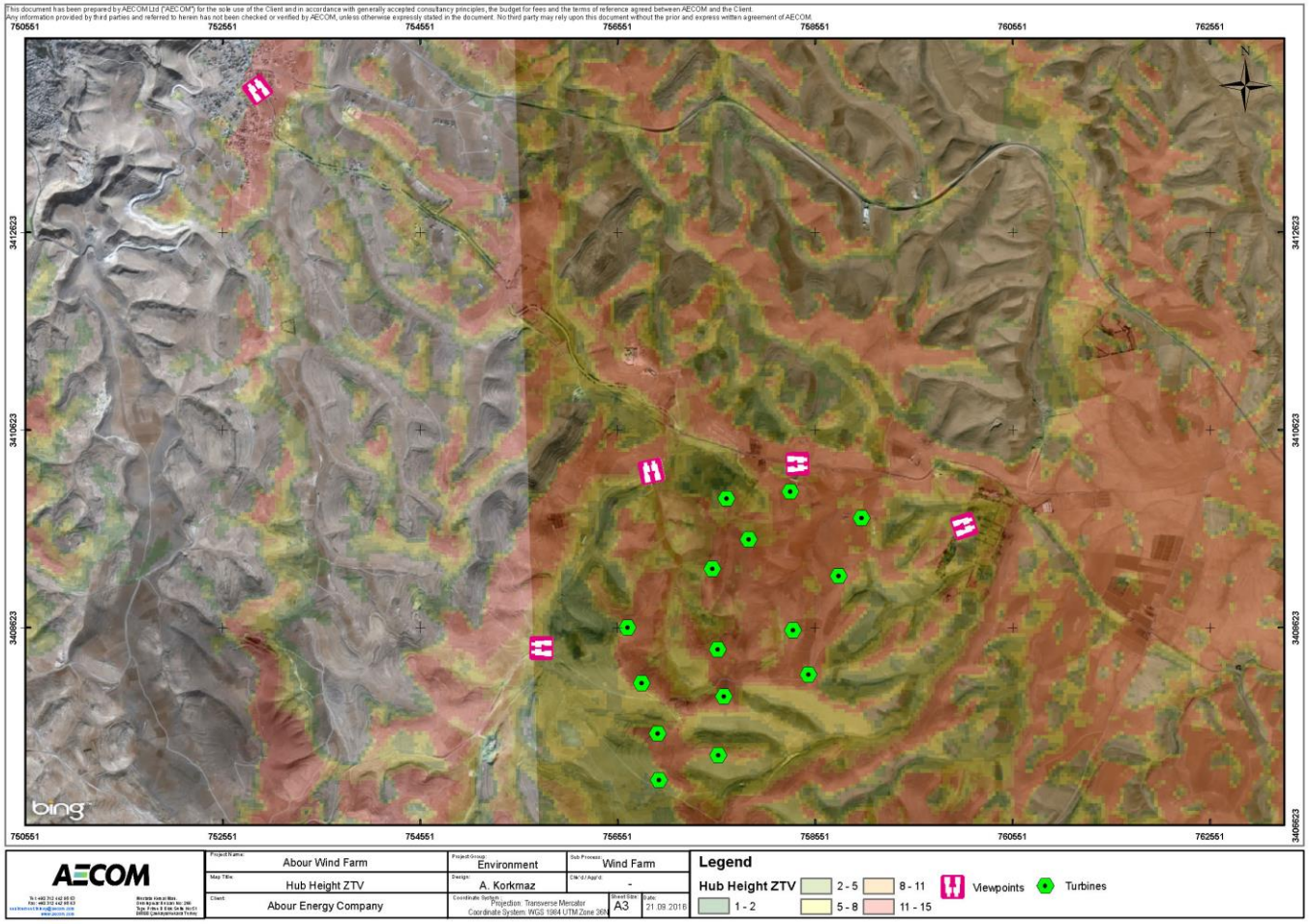

Figure 4-6 Hub Height ZTV Diagrams and Representative Viewpoints

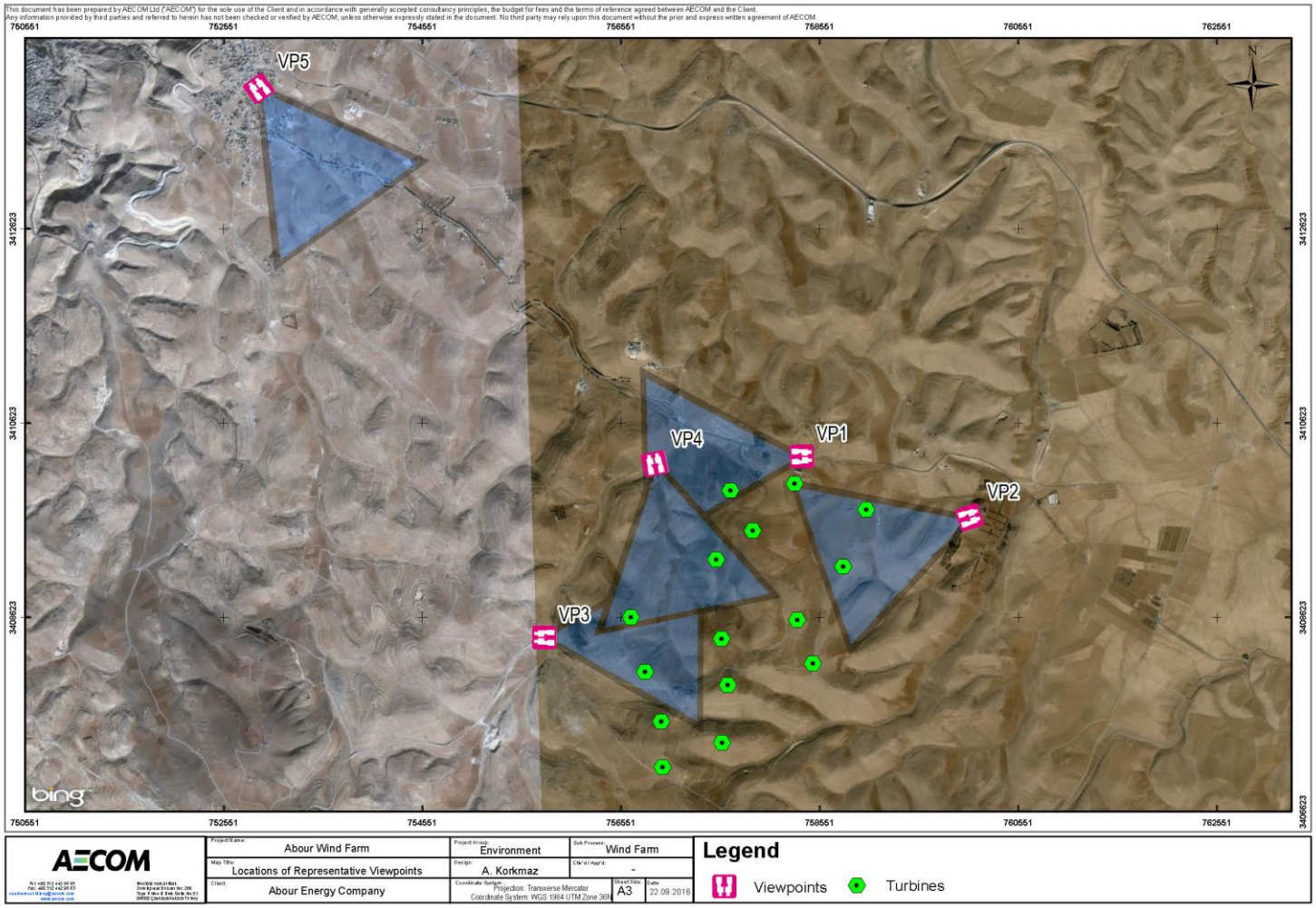

Figure 4-7 Locations of Representative Viewpoints

Table 4-26 Representative Viewpoint Information

Viewpoint no	Coordinates (Lat / Long)
1	30.797500N 35.700250E
2	30.791465N 35.717725E
3	30.781269N 35.672693E
4	30.797145N 35.684761E
5	30.832783N 35.644098E

4.3.5.5 Preparation of Photomontages

Photomontages are illustrations that aim to represent an observer's view of a proposed development. For the purposes of this assessment, photomontages have been compiled to appreciate the potential visual impact of the presence of the AEC wind farm from a selection of the representative viewpoints, which are illustrated in A3 format (see Annex VI).

The methodology for the visualisation production has been based on the Guidelines for Landscape and Visual Impact Assessment 3rd edition (Landscape Institute, 2013) and the Visual Representation of Wind Farms (December 2014).

Five of the ten photographed viewpoints have been selected for preparation of photomontages. The selection was based on the viewpoints which represent a range of viewer types (e.g. residents living on rural properties, recreational visitors, tourist travelling along designated routes) and cumulative affects with the greatest visual exposure to the wind farms (i.e. the greatest numbers of turbines or part thereof, visible from the public realm). The photomontages, therefore, seek to represent the “worst case scenario”.

The photomontages have been generated using digital photographs taken by AEC, ESRI ArcGIS software, 3D modeling software (Autodesk 3ds Max) to generate the wireline diagrams or “wireframes”, and rendering software (Adobe Photoshop).

4.3.5.6 Assessment of Effects on Representative Viewpoints

The visual baseline has been assessed and described in terms of views from selected representative viewpoints within the study area. It is considered that likely viewers (visual receptors) who would experience views of the AEC wind farm would include:

- Residents living on rural properties (including homesteads and cottages) in proximity to the Project;
- People working in the countryside; and
- Recreational users of the landscape on foot or vehicle.

In order to demonstrate the views from the representative viewpoints, photographs were taken by AEC personnel. The views from each representative viewpoint are given in Table 4-27 below and in Annex VI. The assessment of potential effects on each representative viewpoint is given below.

Viewpoint 1: Tafila Highway	
 **Figure A-1 Existing view from Viewpoint 1 (180^{O} field of view): The Agriculture building is located in the north of AEC wind farm. The selected viewpoint is a Highway**	
Visual Baseline Assessment	
Viewpoint Information	Coordinates : 30.797500N 35.700250E Elevation : 1291 m View : WSW
Description	• Nearest turbine is approximately 280 m (T14) to the south of this viewpoint; • Represents typical and accessible views of highway users. The view of AEC wind farm from the viewpoint is given in the Figure A-1 above. As it is shown in the figure, the observers at the viewpoint which is on SW of the wind farm will be able to observe the turbines of wind farm. The closest turbine of AEC wind farm is turbine T14 at a distance of 280m. The movement and form of the turbines will not create contrast with the baseline characteristics of the view.
Key visual sensitivities	• Strong rural character, with agricultural land; • The concentration of native vegetation on small areas.
Overall inherent sensitivity	The overall sensitivity of receptors from this point is considered to be medium, due to on the primary transport road.

Viewpoint 2: Hussein Agricultural Station	
 **Figure A-2 Existing view from Viewpoint 2 (180^{O} field of view): Hussein Agricultural Station is located on north east of AEC wind farm.**	
Visual Baseline Assessment	
Viewpoint Information	Coordinates : 30.791465N 35.717725E Elevation : 1217 m View : SW
Description	• Nearest turbine is approximately 1030m (T12) to the W of this viewpoint; • Represents typical and accessible views of personnel and visitors. The view of AEC wind farm from the viewpoint is given in the Figure A-2 above. As it is shown in the figure the observers at the viewpoint which is on NE of the wind farm will be able to observe the turbines of wind farm. The closest turbine of Abour WF is T12 at a distance of 1,217m to the viewpoint.
Key visual sensitivities	• Strong rural character; • An “un-built” skyline.
Overall inherent sensitivity	The overall sensitivity of receptors from this point is considered to be low.

Viewpoint 3	
 **Figure A-3 Existing view from Viewpoint 3 (180^{O} field of view)**	
Visual Baseline Assessment	
Viewpoint Information	Coordinates : 30.781269N 35.672693E Elevation : 1271 m View : E
Description	• Nearest turbine is approximately 900m (T11) to the NE of this viewpoint; • Represents typical and accessible views of minor access road users. The view of AEC wind farm from the viewpoint with a view direction of E is given in the Figure A-3 above. T11 is closest turbine of Abour WF to the viewpoint at a distance of 1,271 m respectively.
Key visual sensitivities	• Strong rural character; • An 'un-built' skyline.
Overall inherent sensitivity	The overall sensitivity of receptors from this point is considered to be low.

Viewpoint 4	
 **Figure A-4 Existing view from Viewpoint 4 (180^{O} field of view**	
Visual Baseline Assessment	
Viewpoint Information	Coordinates : 30.797145N 35.684761E Elevation : 1237 m View : NE
Description	• Nearest turbine is approximately 810m (T13) to the E of this viewpoint; • Represents typical and accessible views of road users. The view of AEC wind farm from the viewpoint with a view direction of NE is given in the Figure A-4 above. T10 is the closest turbine to the viewpoint at a distance of 810 m.
Key visual sensitivities	• Strong rural character; • An 'un-built' skyline.
Overall inherent sensitivity	The overall sensitivity of receptors from this point is considered to be low.

Viewpoint 5 : Tafila Town	
 **Figure A-5 Existing view from Viewpoint 5 (180^{O} field of view): At-Tafilah is located on north of AEC wind farm.**	
Visual Baseline Assessment	
Viewpoint Information	Coordinates : 37.197612E 36.961210N Elevation : 1237m View : SE
Description	• Nearest turbine is approximately 6,300m (T3) to the SSW of this viewpoint; • Represents typical and accessible views of residents and visitors; • The bases of four of the turbines will be screened by foreground vegetation and changes in landform. The observers at the viewpoint are able to view AEC wind farm as can be seen in Figure A-5 above. The closest turbine of Abour WF to the viewpoint is T13at a distance of 6,300m.
Key visual sensitivities	• Minaret of mosque • Strong rural character • An “un-built” skyline
Overall inherent sensitivity	The overall sensitivity of receptors from this point is considered to be low, due to distance.

Table 4-27 Visual Impact Assessment

Viewpoint name	Distance to nearest turbine	Key visual receptors	Viewpoint Sensitivity	Magnitude	Overall Visual Impact
1- At-Tafilah Highway	280 m (T14)	Road Users	Low	Medium	Minor
2 - Hussein Agricultural Station	1030m (T12)	Personnel and Visitors	Low	Medium	Minor
3 – Viewpoint 3	900m (T11)	Road Users	Low	Medium	Minor
4 – Viewpoint 4	810m (T13)	Road Users	Low	Medium	Minor
5 - At-Tafilah Town	6300m (T3)	Residents and visitors	Low	Low	Negligible

4.3.5.7 Mitigation Measures

Regarding the visual impacts and necessary mitigation measures, visual impacts of minor and below are considered as not significant, as this is the level at which changes would be clearly perceived. Since the visual impacts at the viewpoints in this study are classified negligible to minor, no mitigation measures are proposed.

4.3.6 Impact on Tourism

Due to its remote location, the proposed AEC wind farm will not affect the tourism in the area. However, it will be a destination for some categories of the community: students from different stages will visit the site to understand how wind energy converted to clean electricity with zero emissions. It could become a destination for students from educational facilities throughout Jordan, which should help contribute to domestic tourism, and making the area more known throughout Jordan.

4.3.7 Land Acquisition and Resettlement

It is not anticipated there will be any resettlement necessary for the implementation of Abour Energy wind farm; all needed parcels of lands for the Project have already been leased from the private owners under 22-year land lease agreements. Some additional parcels of land will be leased in the near future for construction of some of the access roads within the existing overall coordinates of the Project site. However, for the sake of completeness of the ESIA, if there were to be any resettlement, the procedure and requirements were previously outlined (see section 2.5.3), for the record.

4.4 Mitigation Measures

Following the assessment of the socio-economic aspects and impacts throughout the Project phases (i.e. construction, operation and decommissioning), mitigation measures for certain socio-economic aspects were recommended in order to reduce or eliminate their potential impacts. These include the following aspects.

4.4.1 Employment

- It is highly recommended to give priority to qualified local contractors to execute some of the construction works related to the Project such as site preparation.
- It is highly recommended to give priority to qualified local people in recruitment for skilled and non-skilled jobs in the Project.
- Local staff should undergo technical training by the developer and the EPC contractor in order to improve their technical capacity, and increase their attractiveness as potential workers on other similar projects in the region.

4.4.2 Business prosperity

- It is recommended that the Project workers and related staff get supplies, food and beverages, and spare parts (to the extent available) from local stores.
- It is recommended to use local vehicle maintenance workshops during all phases of the Project.
- It is recommended to encourage local young entrepreneurs to establish small businesses that could be awarded small service contracts during operations such as security, simple maintenance, and janitorial services.

4.4.3 Stress on Infrastructure

- Strict instruction shall be given to the drivers in this Project to comply with the rules of road traffic (internal and external).
- To protect the roads, the trucks that will be used for construction and equipment transporting should have a gross weight within the axial permissible load.

4.5 Monitoring

AEC will track and monitor the impact on the following quantitative socio-economic indicators:

- Local employment (disaggregated by male/female, village origin, and type of post);

- Bedouin participation in Project;
- Households/persons resettled and assisted in the resettlement;
- New training and skill levels;
- Traffic accidents;
- New community development projects;
- Changes in local incomes;
- New income generation activities and initiatives associated with the Project.

4.6 Residual Impacts and Conclusions

4.6.1 Residual Impacts

The residual impacts on the socio-economic status of the Project area are considered to be low and mostly positive. These impacts relate to the development of economic activity in the area and possible upgrading of local infrastructure and facilities as the Project may attract other businesses into the area.

4.6.2 Conclusions

The Project is located in the Tafila Governorate, the towns, villages of which are populated by mostly Jordanian families from settled tribes and a few shepherds many of whom continue to move seasonally. The area is considered to be fairly conservative in its traditions and cultural values. The nearest community to the Project area is umm Sarab which lies 4.2 km southwest of the Project site. The area is also adjacent to Tafila Technical University (TTU). Moreover, the Abour area is surrounded by four groundwater wells, those most adjacent to the Project site are Al Tawabieh groundwater well and Al Harrer Well.

Around 69 people live within Al Abour community. However, it was noted that none of those families live near a 10 km radius from the Project site. Some of the families are semi-permanently settled there, and other families work as shepherds. The area is considered to be an open grazing land with a very low percentage of cultivated land mainly located near the wind mast and includes 4-5 cypress trees.

Accordingly, the Project will have no impacts on the local communities as no displacement will occur throughout the construction phase. Nonetheless minimum impacts to the rural way of life in the Project area may be witnessed as sheep herding activity in Abour may be disrupted.

Finally, there are a number of areas where AEC could address some of these needs especially in the upgrade of skills and training of local community to work in the Project which will in return benefit the local area.

5 GEOLOGY, HYDROLOGY & WATER RESOURCES

5.1 Methodology

- Collecting the available data about geological, topographic, soil characteristics of the Project area;
- Collecting the available data about the meteorology and climate of the Project area such as: daily rainfall from the rainfall stations distributed within the Project area;
- Description of the water resources in the Project area and groundwater flow regimes;
- Determination of water availability, quality and Project water requirements;
- Assessing the potential impacts of the Project activities on water resources (i.e. potential impacts on groundwater quality and quantity); and
- Proposing proper mitigation measures to minimize/avoid the negative impacts and necessary monitoring program as part of the Environmental Management Plan to protect valleys and water resources.

5.2 Baseline Data

5.2.1 Topography

The study area is characterized by a rough topography variation. Terrain can be described as an extent of east Jordan desert; landforms are mainly composed of wadis and small hills. Drainage in the mapped area has been directly affected by faulting which has caused linear valleys to develop along sections of wadis. The linear valleys are especially common within Wadi Umm Ghudran Formation.

The Project site varies in elevation from 1,210 m above sea level (asl) in the eastern part of the area, to a maximum altitude of 1,415 m (asl) in the southwest. Generally, the altitude falls gently to the east and steeply to the west of the area. Figure 5-1 shows the topographic map of the Project site.

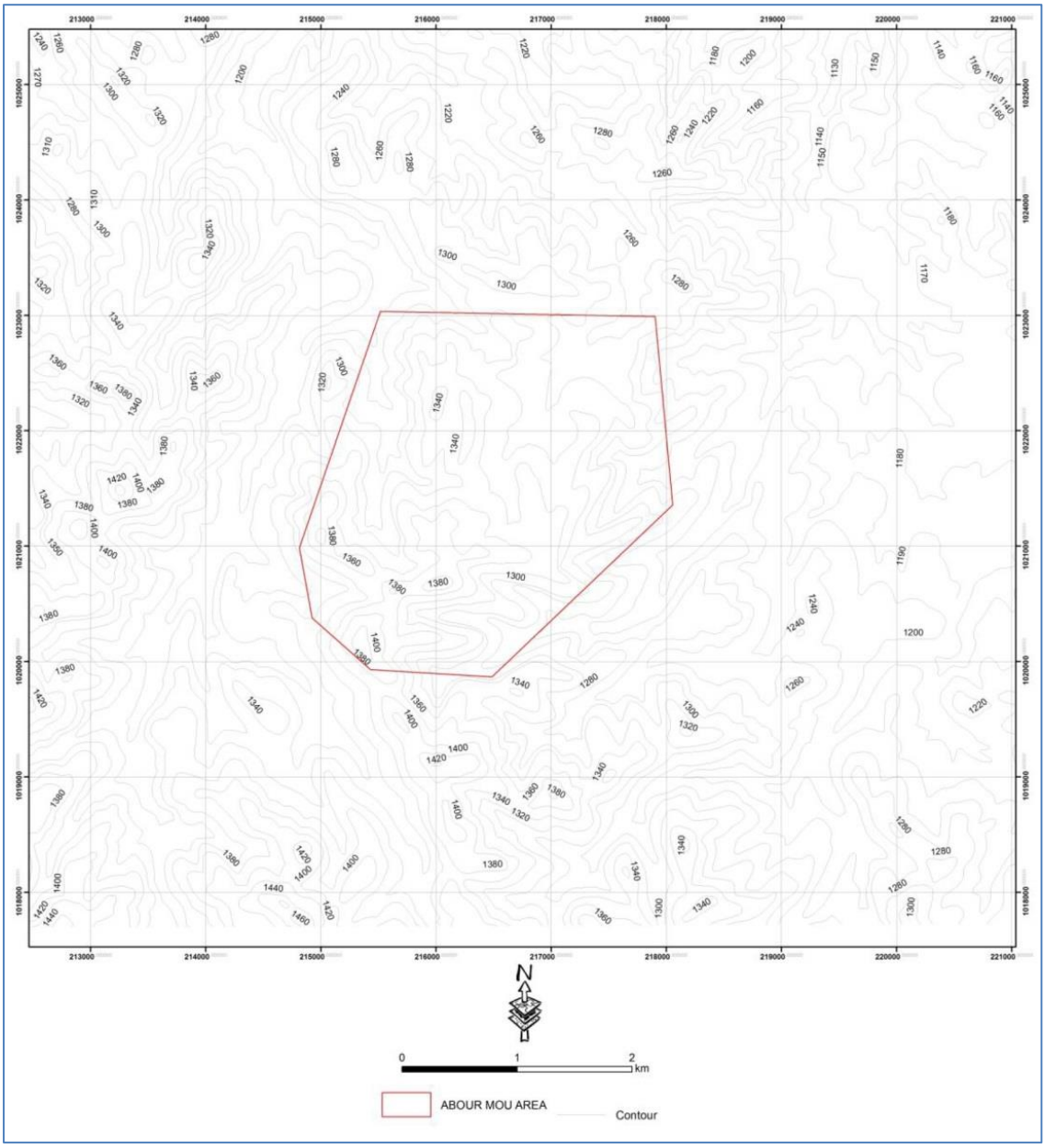

Figure 5-1 Topographic Map of the Project Site

5.2.2 Climate

The Project site is located in a hilly area of Tafila and is characterized by relatively cold winters, with occasional rain and snow fall, and mild to hot summers.

The main climatology stations near the Project site are listed in Table 5-1 below and shown in Figure 5-2. Continuous recording data was available only in three of these stations: Shabuk Agr. station, Tafila station and Rashadiya P. Post station.

Table 5-1 Coordinates of Meteorological Station

Station name	X	Y	Altitude (m)
Shabuk Agr.	742523	3378368	1418
Tafila	749315	3414470	1019
Rashadiya P. Post	751612	3399508	1428
Buseira	749523	3403969	1121
Dana	749971	3396473	1221
Prince Hasan Agr. Station	759600	3410472	1272

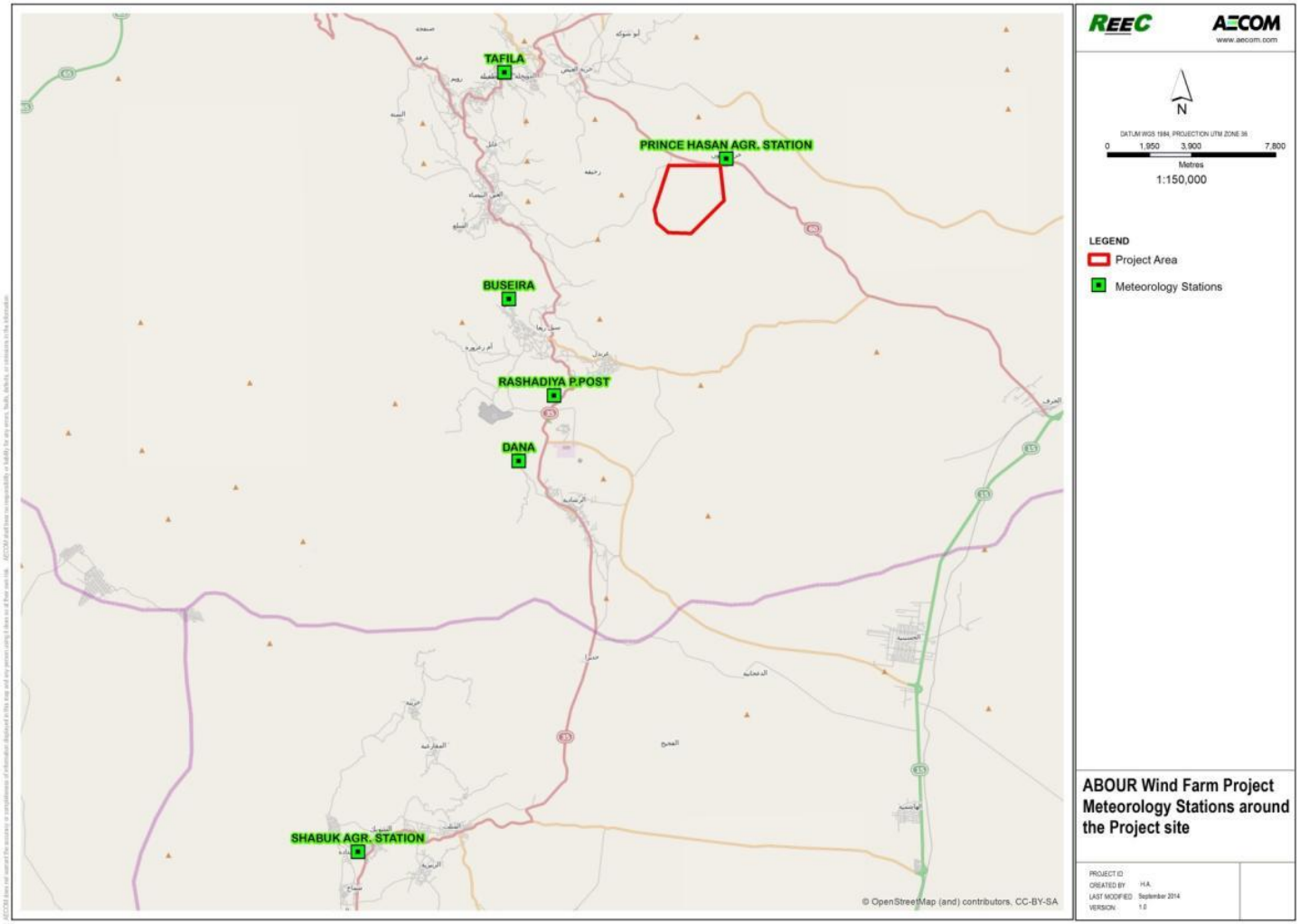

Figure 5-2 Meteorology Stations around the Project site

Tafila station is the nearest climatic station to the Project site that provided continuous recording data. As depicted in the figure above, it is located about 8.8 km northwest of the Project site. This station is considered as a representative climatic station of the Project.

According to recorded data at Tafila station, the rate of annual rainfall in the winter is about 238.5 mm. Because the surface runoff in the basin is limited, there is no flood station to measure flooding in the area. The runoff process which occurs only in the event of a rainstorm is often short.

Table 5-2 below represents the long-term average monthly climatological parameters (1985-2011) for Tafila station.

Table 5-2 Long Term Monthly Averages for Tafila Station (1985-2011)

Parameter	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Maximum Temperature (C)	10.3	11.2	13.7	18	21.9	24.9	25.7	25.4	24	21.4	16.6	11.6
Minimum Temperature (C)	3.2	3.6	5.2	7.5	10.2	12.9	14.6	14.5	13.7	11.2	7.7	4.5
Mean Temperature (C)	6.8	7.5	9.4	12.7	16.1	18.9	19.7	20	18.9	16.3	12.2	8.1
Wind Speed (km/hr)	3.9	3.8	3.9	3.6	3.2	3.4	3.4	3.4	3	2.9	3.2	3.6
Prevailing Wind Direction	W	W	W	W	W	W	W	W	W	W	W	W
Sunshine Duration (hr/day)	5.1	5.3	6.1	7.4	8.7	10.3	10.3	9.6	8.6	7.5	6.4	5
Relative Humidity (%)	59.2	56.6	51.4	42.9	36	35.2	36.9	39.4	42.9	42	49.7	57.4
Average Monthly Rainfall (mm)	66.9	60	52.3	19.7	0.3	0	0	0	0	1.4	28.5	47
Class A Pan Evap. (mm/day)	3.4	4.4	5.5	6.9	9.2	10.3	11.2	10.1	9.4	7.3	4.5	3.5
Potential Evapotranspiration (mm/day)	1.3	1.8	2.7	3.9	4.8	5.7	5.4	5.3	4.2	3.2	1.9	1.4

- *Temperature:* the minimum average temperature was 3.2 °C during the month of January, while the highest average temperature was 25.7 °C during the month of July.

- *Rainfall:* Tafila Governorate is characterized by low amounts of annual rainfall which is about 276.1 mm.

- *Relative Humidity*: relative humidity ranges between 59.2% during the month of January to about 35.2% during the month of May, while the average relative humidity is about 45.8%.

- *Evaporation*: the maximum daily rate of evaporation was observed as 5.7 mm in June, whereas the minimum rate was 1.3 mm in January.

5.2.3 Geology

The geology of the study area was investigated by Tarawneh, 1988, as sheet No. 3151IV. The bed rock outcropping in the investigated area is of sedimentary origin of Upper Cretaceous (Campanian to early Tertiary) as shown in Figure 5-3. In some places, the bed rock is covered by superficial deposits and soils of Pleistocene to Recent age. However, an igneous activity in the area is appearing as basaltic volcanic rocks associated with sedimentation.

Wadi As-Sir Limestone Formation (WSL)

This formation is exposed in the northwest and west of the Project site. The Wadi As-Sir Limestone formation was first defined by Masri (1963), and was later adopted by NRA Sandstone Aquifer Project (1965-1968). Subsequently, Parker (1970) used the term Wadi As-Sir limestone Unit. This formation is equivalent to the top part of Ajlun Series, first described by Quennell (1951) and MacDonald (1965) used “A7” as an equivalent term to Wadi As-Sir Formation.

The formation is characterized by predominant hard buff dolomitic limestone which passes upwards to various carbonate lithofacies including oolitic wackestone-packstone and dolomite with subordinate beds of grey chert nodules. The upper third is marked by a distinctive massive bedded dolomitic limestone which locally contains quartz- sand and chert nodules and is overlain by thin medium bedded micrite and dolomite wackestone.

The maximum thickness of this formation in the study area is about 40m, and increases towards Wadi Al Hisa in the north direction of the area. The age of Wadi As-Sir Limestone formation is Toronian-Santonian according to Bender (1974). The Wadi As-Sir Formation is overlain by the Wadi Um Ghudran Formation which is Santonian.

The presence of rudistid bivalves, gastropoda and echinoids as macro fauna and the presence of wackestone-packstone and the presence of dolomite with subordinate beds of grey chert nodules suggest a marine, subtidal depositional environment.

Wadi Umm Ghudran Formation (WG)

The formation is exposed over the most part of the Project site. The Wadi Umm Ghudran Formation was included by Masri (1963) in the lower part of the Amman Formation. It comprises the lower part of Belqa series of Quennell (1951). MacDonald (1965) used “B1”

as equivalent to Wadi Umm Ghudran Formation. Bender (1974) included it in the upper part of the massive limestone unit. The base of this formation consists of white to buff chalk with broken bivalve fragments. Above the chalk there is a bed of swelling grey chert and chalky limestone. Above this phosphatic siltstone and phosphatic sandstone with fish fragments including abundant teeth occur. The sandstone within this formation is extensively bioturbated (Thalassinoides).

In the middle of the formation, there are alternating beds of chalk and thin beds of chert which are dolomitic, and break down into Tripoli, the chalk contains fish fragments including abundant teeth. The upper part of the formation is again largely chalk with abundant fish fragments and with chert beds near the top of the unit. The thickness of Wadi Umm Ghudran Formation ranges between 30-40m within the mapped area. The thickness decreases towards the south.

The lower boundary of this formation is marked by non-sequence comprising white to buff chalk with broken bivalve fragments which rests the Wadi As Sir Formation. The upper boundary of this formation is marked above the chalk at the base of the overlaying lowermost brecciated chert of the prominent Amman Silicified Limestone.

The presence of extensive bioturbation within the sandstone beds indicates a shallow environment, whereas chalk deposits are pelagic so a variable fluctuating water depth is indicated. Wetzel and Morton (1959) considered Lapha sollirei Species and Globotuncana concavata Species from this formation to be an index of Santonian. Parker (1970) assigned a Coniacian- Santonian age for this formation.

Amman Silicified Limestone Formation (ASL)

This formation is exposed on the north eastern part of the Project site and it is equivalent to the lower part of the Belqa Series that was first described by Quennell (1951). MacDonald (1965) established the term “B2” for this formation and the overlaying of Al Hisa Phosphorite Formation.

The Amman Silicified Limestone Formation consists of dark grey, thick bedded, auto brecciated chert interbedded micro crystalline variably phosphatic limestone, oyster rich coquinal limestone and phosphatic chert. The proportion of phosphate increases upward and is usually restricted to granules at the top of the chert beds. In some areas a grey, thick bedded oyster rich coquina grain stone is present, up to 6m thick.

The thickness of this formation within the Project site is ranging from 12m to 27m. The lower boundary of this formation is marked by dark grey, thick-bedded, autobrecciated

chert overlaying the Wadi Umm Ghudran chalk. The top does not outcrop in the Project site.

The presence of a diverse benthonic fauna and the oyster-rich limestone suggests a shallow to deep water sub tidal marine environment of fluctuating depth. Futyan (1968) suggests that the formation was deposited in a transgressive sea with the deposition of chert and lime stone taking place towards the shore.

On the basis of macro fauna and micro fauna Wetzel and Modton (1959) assigned a Campanian age to the formation.

Basalt (B)

Basalt occurrences have been observed in the northern part of the Project site. The basalts are prophyritic, fine grained, melanocratic rocks. The flow is mostly blocky and massive in the lower part and vesicular and amygdaloidal towards the top. At outcrop the basalts often show spheroidal weathering and exfoliation. The basalt flow is usually separated vertically by zones of pyroclastic deposits composed of tuff, tuffaceous ash and scoriaceous materials.

The essential minerals common in the exposed basalts are pyroxene, plagioclase and olivine. The age of the volcanism was determined relatively using stratigraphical and structural evidence (*Bender 1974*) is of Miocene to Pliocene age.

Soil (S)

Soil has been observed in the Project site mostly on the flat highlands and is used for agriculture. The soil is mainly consisting of yellow–brown loess like silt, residual calcareous bed rocks and clay (*Barjous, 1992*). It was probably deposits by a combination of mechanical and chemical weathering followed by colluvial and Aeolian processes. In some places the soil is red to brown in colour indicating that the soil contains iron oxides. The soil thickness ranges from 0.5m to 1.0m.

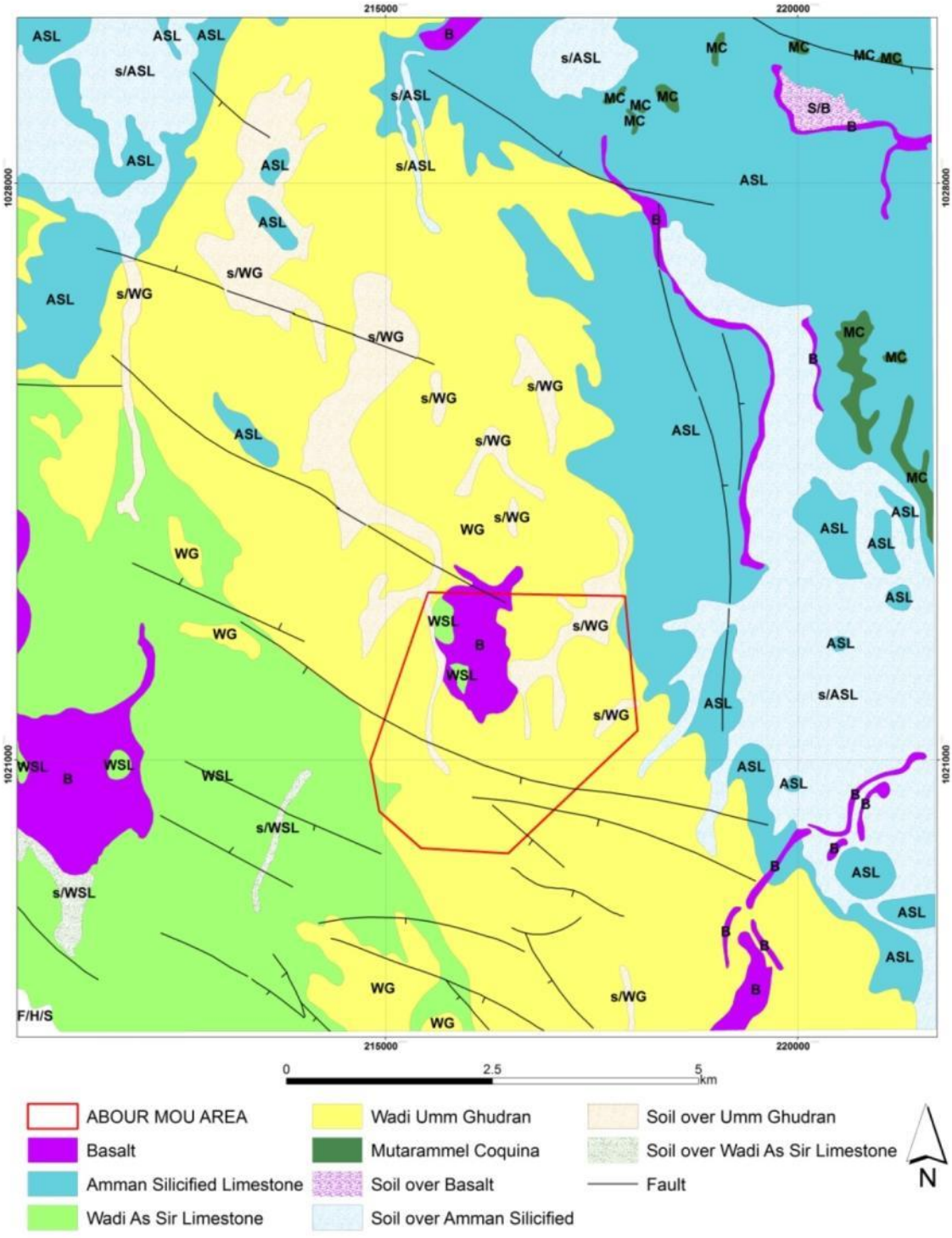

Figure 5-3 Geological Map of the Project Site

5.2.4 Tectonic Setups

The study area is located on the eastern side of the Gulf of Aqaba Dead Sea transform fault system on the north-western boundary of the Arabian Plate; the fault system is part of the East African Dead Sea rift zone, which extends for about 6,000km (Bender, 1974; Powell, 1989; Quenell, 1956, 1958, 1983). Faulting of different types, trends extend and ages are shown on the geological map given in Figure 5.3 above.

The structure is dominated by high angle normal faults. Many faults are trending WNW-ESE cut across the eastern and central parts of the area. Down thrown within the WNW-ESE central fault set is mostly to the south-southwest, but some faults have an opposing throw displacement along these faults as few meters only. Throughout the whole region, there are numerous minor faults without particular orientation.

The Wadi Al Hisa fault in north of the study area is the major E-W faults in the region. In the west, it trends ENE and curves eastwards to E-W and ESE direction. At its western end, it branches into two faults where it has the largest discernible effect, down throwing the Wadi Umm Ghudran Formation about 500m to the south against Wadi Umm Ishrin Sandstone Formation.

The drag folding in the upper cretaceous sediments which can be seen at the southern side of the fault implies a dextral strike slip sense of movement. Lateral displacement along the fault plane is also suggested by the presence of horizontal slickensides.

The minor faults at the eastern end of Wadi Al Hisa fault are considered to be dextral strike slip faults as indicated by the peripheral small scale folding.

Along the Wadi Al Hisa fault, a volcanic plug has erupted. A system of SE trending faults is encountered on the southern side of the Wadi Al Hisa fault, which makes an acute angle with the major faults. Vertical movements along these faults are small.

5.2.5 Water Resources

The water resources in the study area consist of two sources namely, groundwater and surface water resources. Groundwater resources near the study area are presented by the pumped wells and the springs encountered in the catchment areas, while surface water includes spring flow and flood flow.

The Project site is located within the upper part of Al-Hasa basin and groundwater is the main source of water in Al-Hasa basin. The main aquifer in Al-Hasa basin is Amman-Wadi –Sir (B2/A7) aquifer, this aquifer is considered the main supplier of water in the basin.

Amman-Wadi–Sir (B2/A7) recharge is directly through the rainfall on the basin from different regions, especially from areas where the layers of the western parts of the basin are outcropping.

Surface Water

Total average area of Al-Hasa basin is 2,500 square kilometres. The Project site is located in the southern part of the basin. There is no discharge from springs that can form surface runoff in and around the Project site, but could get runoff in the event of the heavy rain during limited periods.

At Al-Hasa basin, runoff only occurs when rainfall is more than 8 mm per day; coefficient of runoff in the study area could be about 6.8 mm. Thus, the amount of runoff in Al-Hasa basin is estimated about 13.8 million cubic meters.

Within Al-Hasa basin, rainfall ranges between 300 mm in the higher parts of the basin to about 100 mm in the low-laying area near the southern area of the Jordan Valley, while the rainfall in the eastern parts of the basin is only about 50 mm.

Depending on the natural water drainage system in the basin, the runoff occur in the valleys which are moving to east and northeast of high land towards the area of Al-Fageij and Husseiniya. These valleys transfer the water that fall on the high land in the wet to the eastern area.

Valleys of Al-Hasa basin are characterized by non-permanently continuing water flow. The runoff is decreasing when the rainfall stops. The flow velocity decreases towards the east, where some of this water may enter to the groundwater and recharging it. Figure 5-4 below shows the hydrological map of the Project site. As it can be seen from the figure, there are no rivers or creeks in the Project site, only some minor wadis around the Project site.

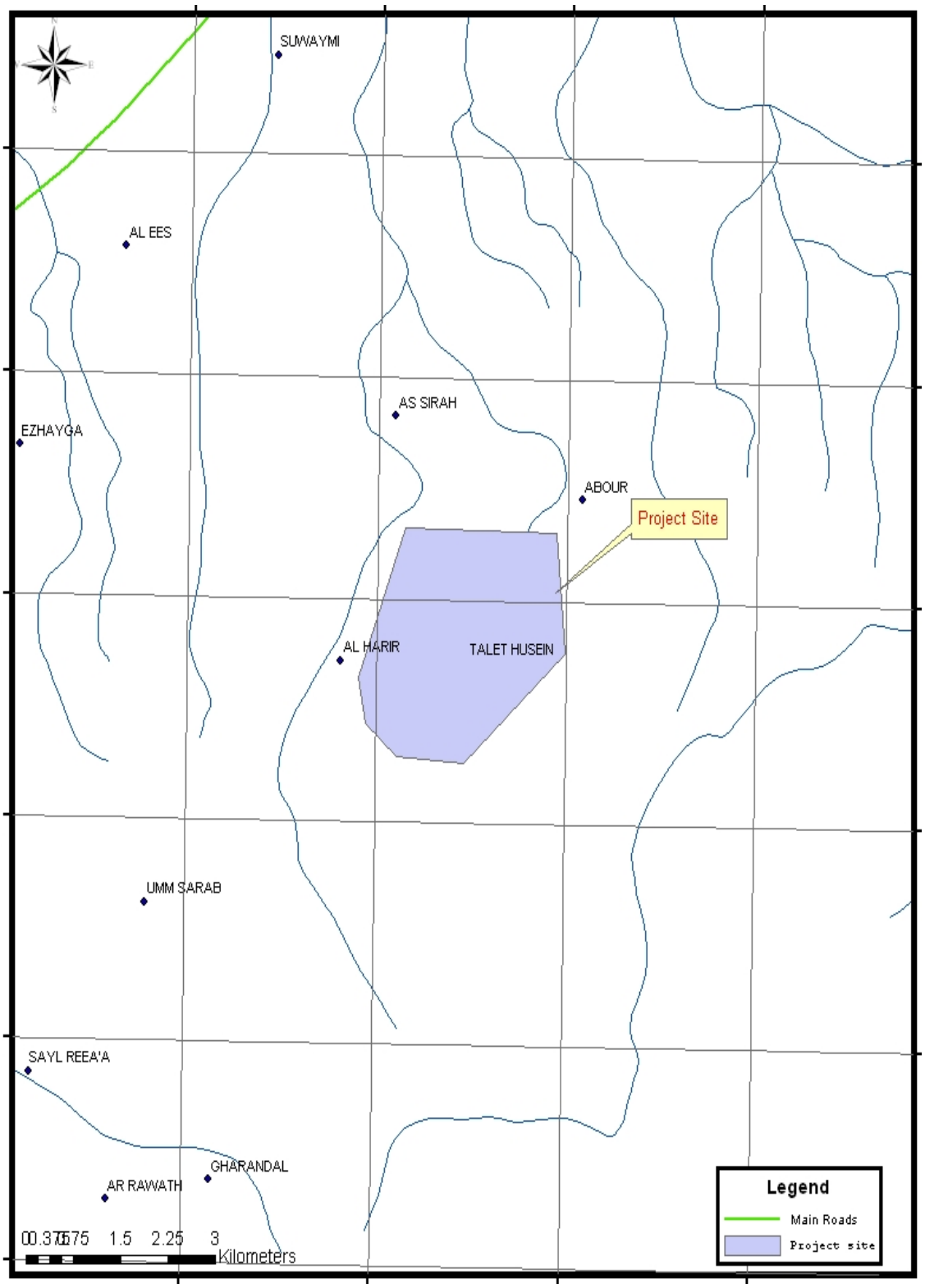

Figure 5-4 Hydrological Map of the Project Site

Groundwater

As mentioned earlier, Amman–Wadi-Sir Formation (B2/A7) is the most important formation containing groundwater in the basin; Ajlun formation (A1/6) is also very important in the basin.

These two formations can be divided into:

- Ajlun, Fhais and Hummer Unit (A1/6): These three units can be considered as one unit composed of limestone and layers of mud stone. These units are characterized by low permeability and therefore do not contain water.

- Naur Unit (A1/2): consists of limestone which contains many of the cracks as well as it contains some of the fossils.

- Wadi – Sir Unit: consists of dolomitic limestone, limestone. The total thickness of this unit is about 140 m.

- Amman Unit (B2): Most of the groundwater wells in the Project site penetrate the layers of this formation. Because there is a connection between Amman unit (B2) and Wadi-Sir unit (A7), these two units can be considered one unit called Amman – Wadi-Sir formation (B2/A7).

Groundwater movement is from the west to northwest. The thickness of this formation is about 200 m, with the permeability changing with the direction of groundwater movement, ranging from 50-140 square meters per day (*Source: Water Authority documents).*

At western highlands of the basin, the rate of rainfall at these highlands is about 300 mm, so these highlands are considered an area for recharge of this basin. Groundwater moves from the western highlands towards the eastern areas and also towards northwest area.

Groundwater Resources in the Project Site

There are four groundwater wells in close vicinity of the Project site. The details of these wells are presented in Table 5-3 below. Figure 5-5 shows the locations of these wells.

Table 5-3 Details of Wells around the Project site

Well ID	X	Y	Aquifer Code	Aquifer Top	Aquifer Bottom	Water Level
CF1027	760202	3409423	B2/A7	54	152	54
CF1031	756728	3410014	B2/A7	59	162	59
CF1035	755707	3408296	B2/A7	-	-	19.35
CF1037	759708	3410073	B2/A7	54	168	53.9

5.2.6 Seismicity

The rate of seismic activity in Jordan is moderate, however many of the strong seismic events are located along the axis of Dead Sea Rift, which is formed in the north-western boundary of the Arabian plate. Matching magnetic anomalies across the rift have indicated a total strike-slip movement of approximately 107km.

The Dead Sea rift is a transform boundary between the Arabian and African plates, connecting the Red Sea spreading center in the south to the Taurus-Zagros collision zone in the north. The Dead Sea transform is about 1100 km. long, and separates the Sinai sub plate from the Arabian plate. A geological offset is of about 105-110 km. Seismicity map of the Dead Sea rift region during the period 1983-2008 is shown in Figure 5-6 and Seismic Hazard Distribution Map of Jordan is presented in Figure 5-7.

No active faults or any active morphological features were found within the Project area due to the location of the major plate boundary (Dead Sea Transform Fault System – DSTFS) at a distance of approximately between 30-40 km to the west of the Project site and it is not expected to affect the Project site.

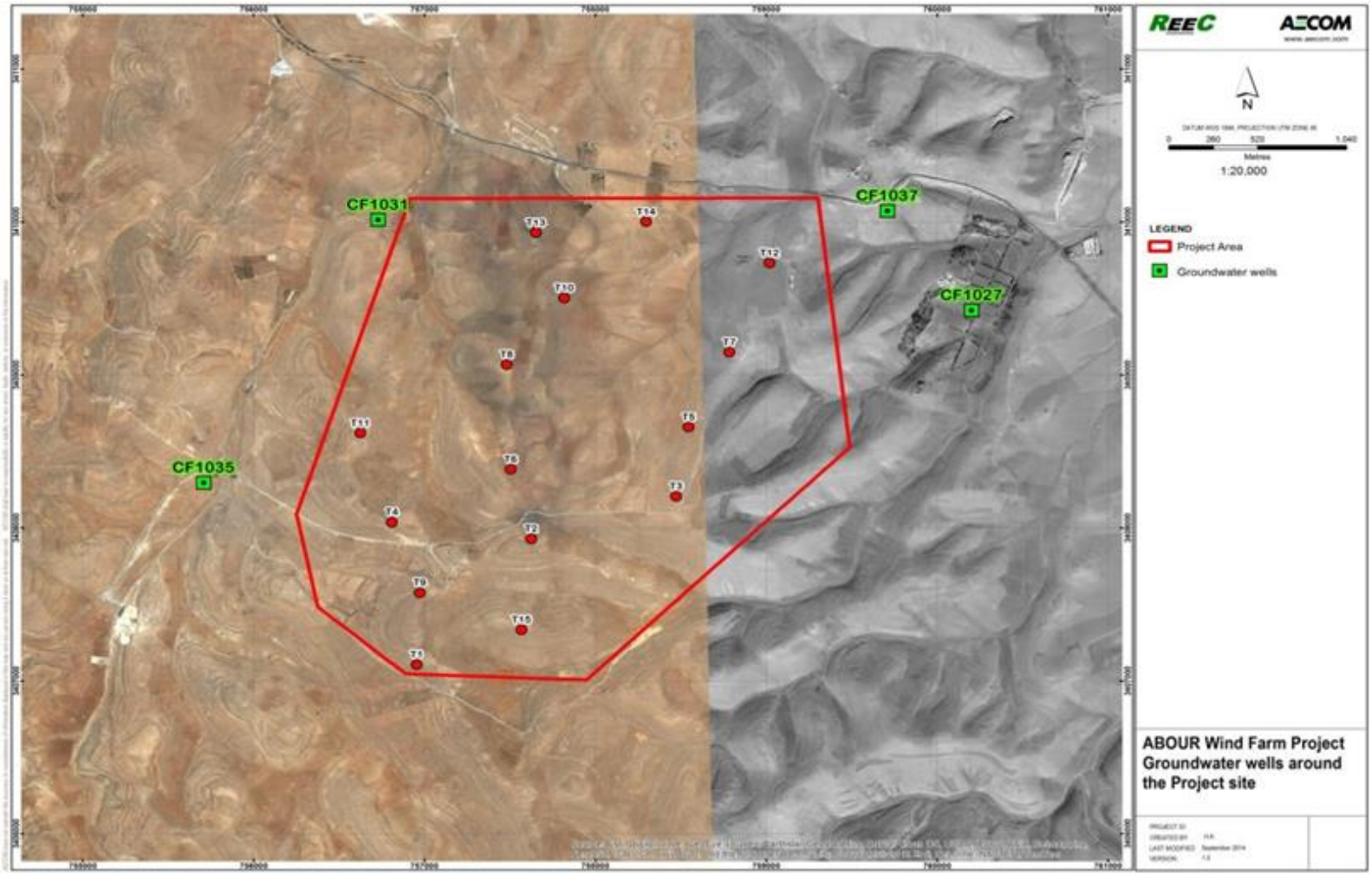

Figure 5-5 Groundwater wells around the Project Site

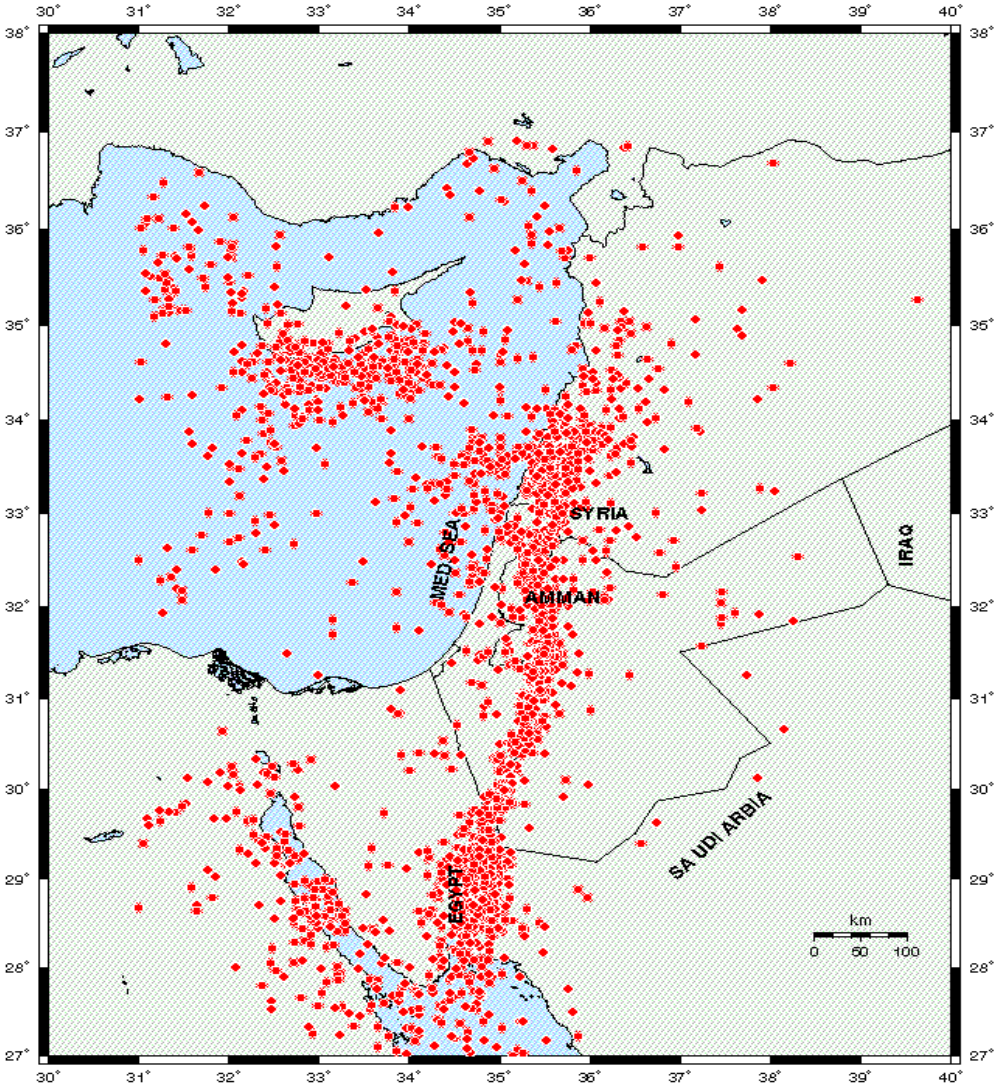

Figure 5-6 Seismicity map of the Dead Sea rift region during the period 1983-2008

(*source: Jordan Seismological Observatory*)

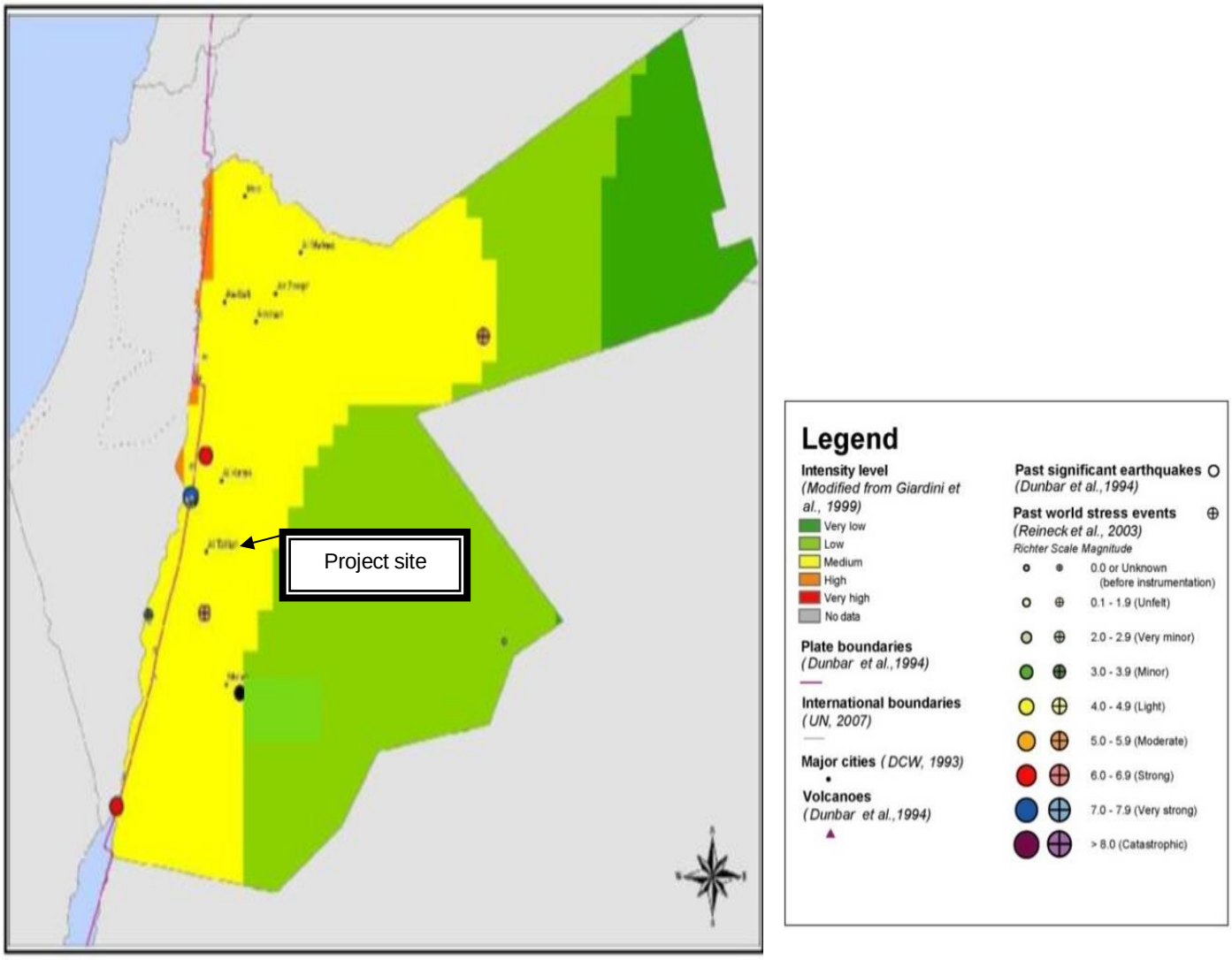

Figure 5-7 Seismic Hazard Distribution Map of Jordan

(Source: World Health Organization (WHO), 2007)

5.3 Impact Assessment

The principal impacts to water resources would be those during the construction phase rather than the operational phase. The Project should seek to minimize the potential for soil and water contamination by ensuring that all wastes are properly handled, managed, and disposed of in an appropriate manner by a licensed contractor.

The expected impacts of the proposed Project on the surface water and groundwater of the Project area in the construction phase can be summarized as follows:

Domestic wastewater: wastewater resulting from uses of workers may affect the water resources in the region in case of its access to these sources, if not handled properly.

Solid wastes (solid wastes that result from the workforce in the Project and construction debris): The quality of rain water, which is a source to groundwater recharge, may be affected by these wastes if not handled properly. The collection of the solid waste should be within the prepared area at the Project. Therefore, it must provide an integrated system for the management of solid waste. It should be noted that it is not allowed to change the oils of the vehicles used within the Project site and it should be done in specific places which is dedicated for this purpose.

Storm water runoff is considered to be the sole cause of impact to water quality through washing off sand/suspended solids during excavation, backfilling and underground cable laying into any of the identified existing water bodies.

Erosion is another potential environmental problem that can stem from construction activities of the Project. Erosion impacts can include increased siltation of streambeds, alteration of stream courses, and increased flooding, leaving scars on the land.

During the operational phase, no residual water resources and quality impacts are expected to occur and the operational phase causes insignificant impact.

5.4 Mitigation Measures

- During the construction phase, the contractor should manage the generated domestic wastewater in an environmentally safe manner. This might include using temporary movable water closets (toilets) and transporting the resulting domestic wastewater to the nearest wastewater treatment plant.
- All wastewater generated by the construction activities will be trucked off site to the local wastewater disposal station.

- For the liquid waste that can result from machinery and vehicles as a result of maintenance work, the maintenance of these machines and vehicles must be in special places and it should not be within the Project site.
- Domestic solid wastes that result from workers must be collected in special containers and transported periodically to the nearest solid wastes landfill.
- Solid waste resulting from site preparation, construction and rehabilitation will be used as fill material in the site (if appropriate), while the remaining will be collected in special places far from wadis and transported to the nearest solid waste landfill.
- Open stockpiles of construction materials (e.g. aggregates and sand) on site should be covered with tarpaulin or similar fabric during rainstorms.
- Spill clean-up procedures must be clearly displayed in all construction materials storage areas.
- The risk of serious erosion can be reduced by:
  - Minimizing the amount of earth disturbed during construction, principally by eliminating unnecessary roads;
  - Avoiding construction on steep slopes;
  - Allowing buffers of undisturbed soil near drainages and at the edge of plateaus;
  - Assuring re-vegetation of disturbed soils; and
  - Designing erosion-control structures adequate to the task.

6 PUBLIC HEALTH AND OCCUPATIONAL HEALTH & SAFETY

6.1 Methodology

- Defining the issues may affect either public or occupational health during the Project phases;
- Assessing the potential impacts of the Project activities on public health and occupational health and safety; and
- Proposing proper mitigation measures to reduce/avoid the negative impacts.

The key issues are:

Public Health

Issue	Construction phase	Operation phase	Decommissioning phase
Accidents risks	√	√	√
Ambient air quality (dust)	√		√
Noise	√	√	√
Shadow flickering		√	
Icing/ Ice throw		√	
Aviation & radar		√	
Telecommunication/EMI links		√	
Domestic wastewater	√	√	√
Domestic solid waste	√	√	√
Public Safety	√	√	

Occupational Health and Safety

Issue	Construction phase	Operation phase	Decommissioning phase
Medical care and health Insurance	√	√	√
Domestic wastewater	√	√	√
Domestic solid waste	√	√	√
Ambient air quality (dust)	√		√
Noise	√	√	√

Accidents impact	√	√	√
Shadow flickering		√	
Icing/ Ice throw		√	
Aviation & radar		√	
Telecommunication/EMI links		√	
Personal Protection Equipment (PPE)	√	√	
Availability of Emergency Plan	√	√	

6.2 Baseline studies and Impacts Evaluation

Impact	Geographical extent	Level	Frequency	Duration	Direct (D) Indirect (ID)	Reversible(R) Irreversible(IR)	Likelihood	Significant	Positive/Negative	Remarks
Accidents risks	M	M	L	M	ID	IR	L	Yes	-	Mitigation measures are required
Domestic Solid wastes	L	M	H	H	D	R	M	Yes	-	Mitigation measures are required
Domestic Wastewater	L	L	H	H	D	R	M	Yes	-	Mitigation measures are required
Air quality (dust)	M	M	M	M	D	R	M	Yes	-	Mitigation measures are required
Noise	M	M	M	M	D	R	M	Yes	-	Mitigation measures are required
Shadow flickering	M	M	M	M	D	R	M	Yes	-	Mitigation measures are required
Icing/ Ice throw	L	M	L	L	ID	IR	M	Yes	-	Mitigation measures are required
Aviation & radar	L	M	L	L	ID	IR	M	Yes	-	Mitigation measures are required
Telecommunication/EMI links	M	M	M	M	ID	IR	M	Yes	-	Mitigation measures are required
Public safety and access	L	M	M	M	ID	IR	M	Yes	-	Mitigation measures are required
Medical care	H	H	H	H	D	R	H	Yes	+	Mitigation measures are required
Personal Protection Equipment	M	H	H	H	D	R	H	Yes	+	Mitigation measures are required
Availability of Emergency Plan	M	H	H	H	D	R	H	Yes	+	-

Significance criteria:

Geographical Extent:	L:	Limited to Project site.	M:	May reach outside the Project site.	H:	Will reach outside the Project site.
Level:	L:	Will not change existing level.	M:	Will change existing level slightly.	H:	Will change existing level severely.
Frequency:	L:	Occurs only once / rarely.	M:	Occurs during abnormal conditions.	H:	Occurs continuously.
Duration:	L:	During specific activity.	M:	During construction phase.	H:	During operational phase continuously.
Likelihood:	L:	Impact is not likely to occur.	M:	May occur.	H:	Will occur.

6.2.1 Domestic Solid Waste and Wastewater

These issues were previously discussed in Sections 5.3 and 5.4.

6.2.2 Accidents Risk

The main concern is the transportation movement on external roads and the use of machinery and vehicles during the different phases of the Project. The second concern would be related to safety of workers. Therefore, clear instruction and mitigation measures are required.

One of the major occupational health and safety issues is working at heights, especially during assembly of the turbine tower, nacelle, generator, etc. and maintenance of these components. A detailed Health and Safety Plan (HASP) including this issue will be developed before the construction activities start and it will be implemented later. The safety harness will be used to secure persons during ascent to and descent from the nacelle of the wind turbine generator system and when carrying out work in areas where there is a falling hazard. Furthermore, a training program including climbing techniques, fall protection measures and use of fall protection equipment will be conducted for employees. In addition, during adverse weather conditions, tower installation and maintenance work will not be performed.

During the construction and operational phases of this proposed Project, all necessary precautions related to working at heights will be taken. This Project will comply with national legislation and IFC/WB Guidelines. With proper implementation of the HASP and taking the necessary precautions given in the regulations, potential accidents associated with working height would be eliminated.

6.2.3 Ambient Air Quality

Although air quality is not expected to be an important issue in wind farm projects, brief background information about air quality of the Project area is provided in this section.

6.2.3.1 Guidance

The Jordanian ambient air quality standard (JS1140/2006) is accepted as guidance in the assessment of ambient air quality of the area. This standard sets limits to daily total suspended particulate (TSP), PM_{10} and $PM_{2.5}$ concentrations as shown in Table 1-1 below.

Table 6-1 Limit Concentrations for TSP, PM_{10} and $PM_{2.5}$

Standard	PM2.5(μg/m^3)	PM10(μg/m^3)	TSP(μg/m^3)
JS1140/2006	65	120	260

6.2.3.2 Existing Baseline

Dust Monitoring Study

The Project site is situated in an undeveloped rural area and there is no dust receptor close to turbine locations in the Project site. In order to understand and identify the existing ambient air concentrations of TSP, PM_{10} and $PM_{2.5}$, a continuous dust monitoring study for 20 days between 11 April 2014 and 30 April 2014 was conducted at the closest occupied building which is the building of Agricultural Research Center situated approximately 1,030m away from the closest turbine T12 in the east. The map showing the dust monitoring location and the view of the monitoring point are presented in Figure 6-1 and Figure 6-2 respectively.

Dust and Noise measurements instruments details are provided in Annex III.

Dust Monitoring Results

The hourly monitoring results for TSP, PM_{10} and $PM_{2.5}$ are presented in Figure 6-3, Figure 6-4 and Figure 6-5 respectively.

The hourly TSP monitoring results show that the TSP concentrations do not show major variations except few outliners which are likely to be measurement errors. The hourly PM_{10} and $PM_{2.5}$ measurement results however show higher variations than TSP measurement. All the measurement results show that the concentrations recorded on 25th of April 2014 are higher than the concentrations measured in other days which can be explained by the possible dust emitting operation near the agricultural research center.

In addition to hourly measurement results, the daily average of TSP, PM_{10} and $PM_{2.5}$ measurement results are presented in Table 6-2. The maximum daily average concentration of TSP was recorded on the first measurement day as 60.13 $\mu g/m^3$. The PM_{10} and $PM_{2.5}$ maximum daily average concentrations were recorded on the same day, 25th of April 2014 as 108.88 $\mu g/m^3$ and 193.71 $\mu g/m^3$, respectively. The results are compared to Jordanian ambient air quality standard (JS1140/2006) and no exceedances to JS1140/2006 were observed throughout the monitoring period.

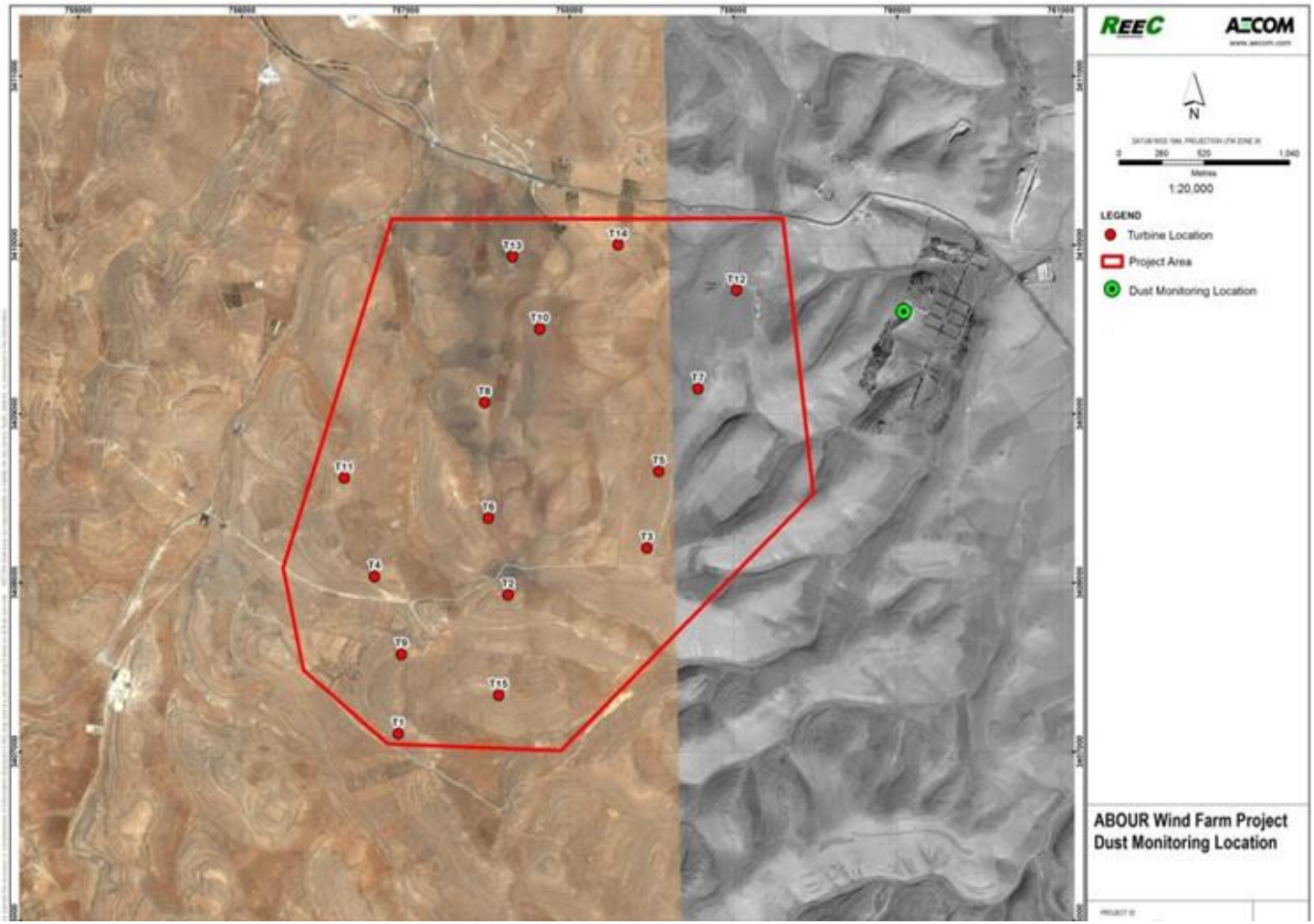

Figure 6-1 Dust Monitoring Location

Figure 6-2 View of the Monitoring Point

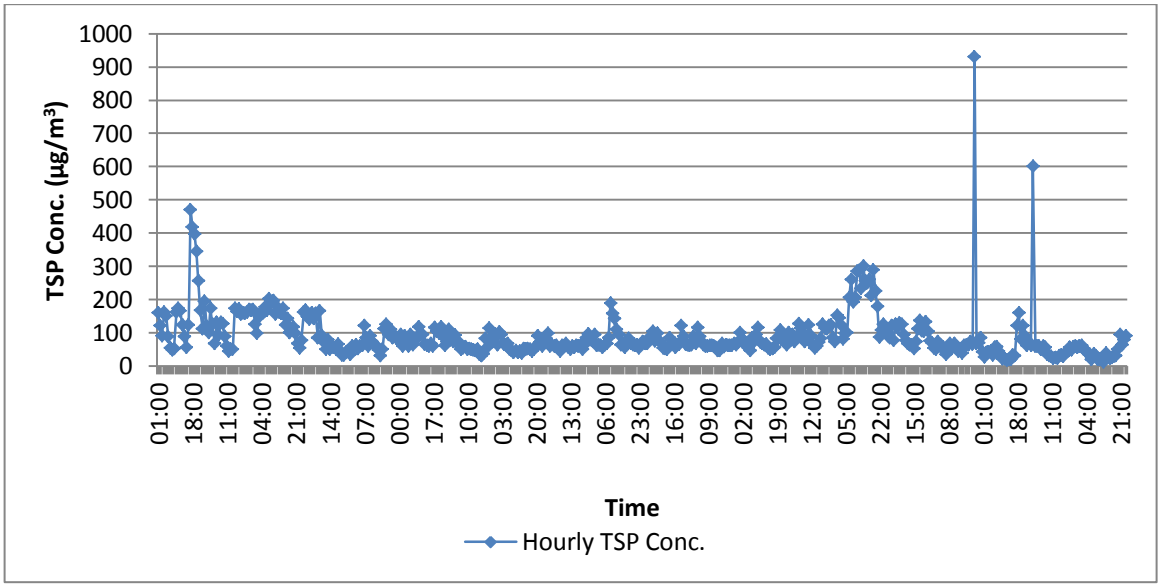

Figure 6-3 Hourly TSP Concentrations

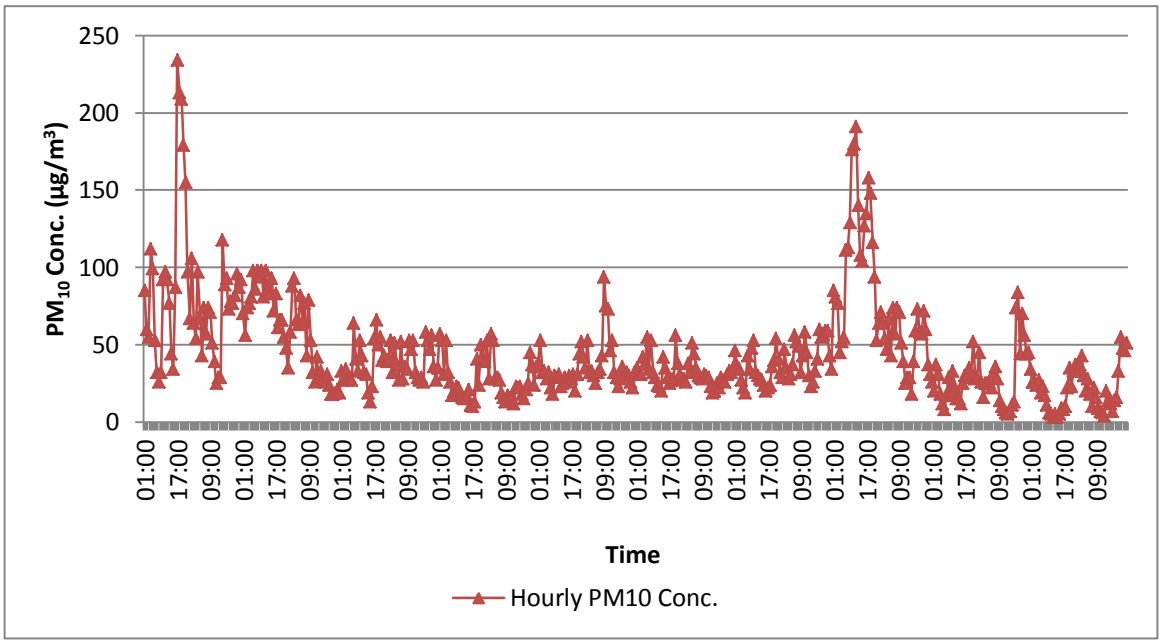

Figure 6-4 Hourly PM_{10} Concentrations

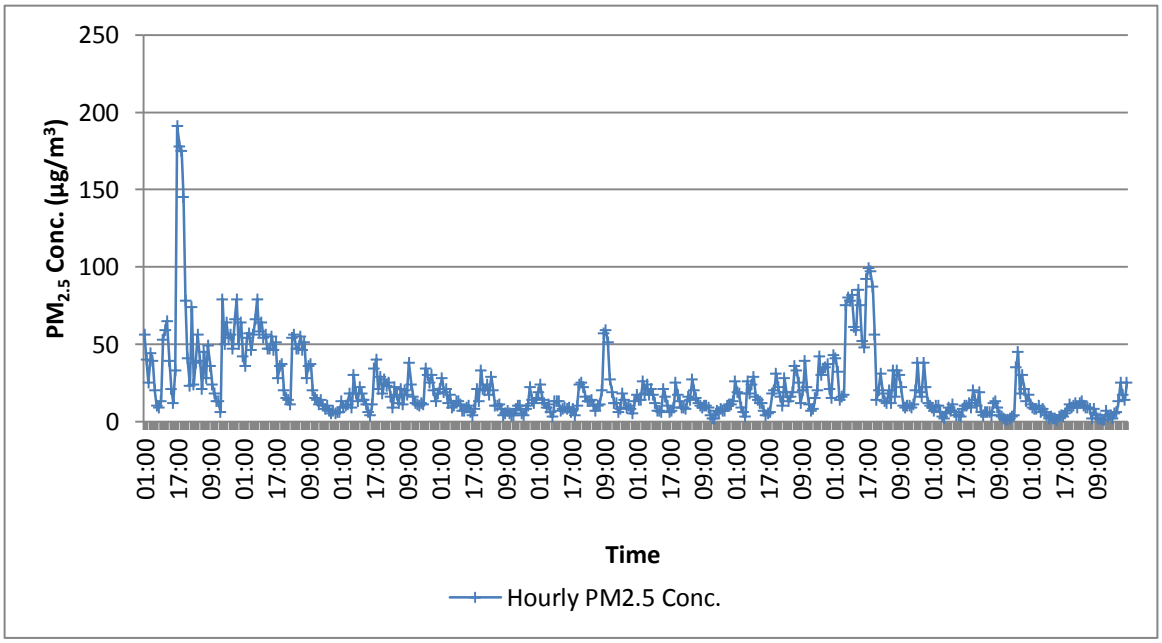

Figure 6-5 Hourly $PM_{2.5}$ Concentrations

Table 6-2 Daily Average of TSP, PM_{10} and $PM_{2.5}$

Date	PM2.5(μg/m^3)	PM10(μg/m^3)	TSP(μg/m^3)
11/04/2014	60.13	97.38	173.67
12/04/2014	42.46	69.13	124.96
13/04/2014	44.79	75.71	139.13
14/04/2014	24.79	44.79	88.38
15/04/2014	18.08	38.25	75.46
16/04/2014	18.71	39.92	82.58
17/04/2014	14.88	29.38	65.50
18/04/2014	10.50	25.75	58.50
19/04/2014	12.21	31.75	65.17
20/04/2014	17.75	39.29	80.88
21/04/2014	14.25	33.83	73.33
22/04/2014	10.33	30.21	65.75
23/04/2014	15.70	33.57	73.35
24/04/2014	23.21	43.04	92.21
25/04/2014	56.42	108.88	193.71
26/04/2014	18.46	51.17	95.33
27/04/2014	8.67	25.75	94.50
28/04/2014	11.04	30.25	53.21
29/04/2014	6.38	18.50	67.46
30/04/2014	8.42	23.58	41.17
Max. Daily Average Value	**60.13**	**108.88**	**193.71**
JS1140/2006 Limit Value	**65**	**120**	**260**

6.2.3.3 Impact Assessment

Compared to the environmental impact of traditional energy sources, the impact of the power produced by the wind turbines is relatively minor. They consume no fuel, and emit no air pollution, unlike fossil fuel power sources.

Wind farm reduces greenhouse gas emissions (GHGs) and other emissions, which can cause regional and local air pollution mainly carbon dioxide (CO_2), sulphur dioxide (SO_2) and oxides of nitrogen (NOx). Furthermore, during operation the wind farm will not emit any pollutants into atmosphere.

Dust may be generated as a result of construction activities. Dust could arise from: earth moving operations for site levelling, backfilling and foundations; removal of soil, site

stripping, blow-off and spillage from vehicles, concreting operations, site reinstatement and road construction. The extent of such emissions of dust is dependent on wind speed, ground conditions and the prevalence of hot dry conditions.

During most weather conditions, using the proposed dust mitigation measures, will suppress generation of dust at the site during construction phase and will not cause nuisance at the receptors in the area and will not impact local air quality.

Air quality effects arising from vehicles exhaust emissions will also be insignificant. Emissions from the maintenance procedures like oil changes, lubrication, etc., are low since most of the materials could be recycled.

6.2.4 Noise

The Project site is situated in a rural area and there is no permanent noise-emitting activity in or around the Project site. The results of the site survey show that there is no dwelling inside or in the close vicinity of turbine locations. The closest dwelling is an agricultural office situated to the east of the Project site.

The construction and operation of wind farms has the potential to cause annoyance to people residing in the settlements situated in the close vicinity of the wind farm sites. The noise is generated during the construction and decommissioning phase from the construction machines and traffic and also during the operation phase from the operation of wind turbines.

6.2.4.1 Guidance

The noise assessment is performed in accordance with the following legislation and guidance:

- National Jordanian Noise Legislation such as “Instructions for the Limitation and Control of Noise”, 2003
- IFC/World Bank Group Environmental, Health and Safety Guidelines – Wind Energy (April 30, 2007)

Jordanian Noise Legislation

Relevant national noise regulation in Jordan sets the noise limits according to the use of the noise sensitive receptors for day time and night time periods. The limits stated in the regulation for each area usage are given in Table 6-3 below.

Table 6-3 National noise regulation limit values

Area	Highest Permissible limits of equivalent sound level (dB(A))	
	Day	Night
Residential in urban	60	50
Residential in sub-urban	55	45
Residential in rural	50	40
Residential having small industries, offices and public buildings. City centers	65	55
Industrial areas	75	65
Schools, hospitals, mosques and churches	45	35

IFC/World Bank Group Environmental, Health and Safety Guidelines – Wind Energy

Wind turbines produce noise when operating. The noise is generated primarily from mechanical and aerodynamic sources. The noise guideline addresses the impacts of noise beyond the property boundary of the facilities. According to the guideline, noise impacts should not exceed the levels presented in Table 6-4 below, or result in a maximum increase in background levels of 3 dBA at the noise sensitive receptor location off-site.

Table 6-4 IFC/WB Guideline Noise Limits

Receptor	One Hour L_{Aeq} (dBA)	
	Day Time (07:00-22:00)	Night Time (22:00-07:00)
Residential; Institutional; Educational	55	45
Industrial, Commercial	70	70

6.2.4.2 Existing Baseline

In order to determine existing ambient noise levels (background noise) around the Project site, background noise monitoring studies were undertaken at the closest occupied building which is the office of Agricultural Research Center in the east of the Project site.

Noise Sensitive Receptor

The NSR, selected as nearest permanent office used by the staff of Agricultural Research Center, was determined according to its distance to the closest turbines. The coordinates

(UTM Projection WGS84 Datum Zone 36) of the NSR are given in Table 6.5. The closest turbine is Turbine 12 (T12) in west with a distance of about 1,030 m. The location of the receptor is given in Figure 6-6 below.

Table 6-5 Coordinates of Noise Sensitive Receptor

Noise Sensitive Receptor	X	Y
Agricultural office	760043	3409608

Background Noise Monitoring

Background noise level monitoring studies were undertaken for a week between April 13, 2014 and April 20, 2014 at the NSR. Ambient noise levels were continuously measured for 24 hours and the levels were logged for ten minute sampling interval. The noise measurements were undertaken with Monarch 322 data logging sound level meter. The equipment used is in compliance with the standards. Calibration of the equipment was checked before and after each measurement with an acoustic calibrator. All measurement systems were set to log the L_{Amin}, L_{Amax} and L_{Aeq} noise levels over the required ten minute intervals over the deployment period.

The equipment used for the measurements was set to a weighted, fast response, continuously monitoring mode over ten minute sampling period. All noise measurements were performed with the following precautions:

- Field calibration checked before and after measurements;
- Windshield placed over the microphone;
- Microphone was positioned approximately 1.5 m above local ground level;
- Microphone placed away from any significant vertical reflective surfaces; and
- Monitoring equipment was secured so as to avoid extraneous wind noise generated in close proximity to the microphone.

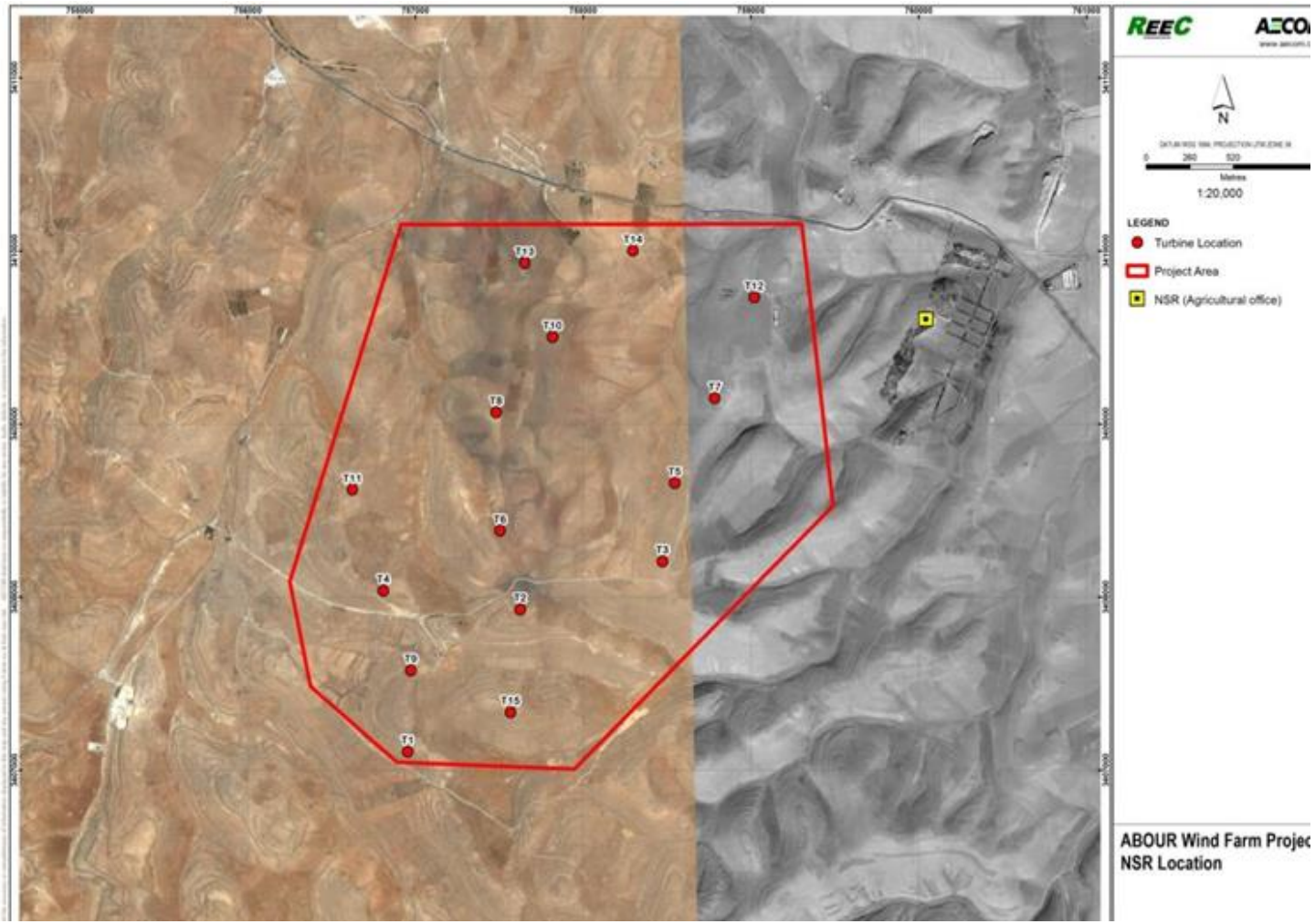

Figure 6-6 Location of Noise Sensitive Receptor

Measured Background Noise Levels

The results of the background noise level measurements are compared with respect to both IFC/World Bank Group Environmental, Health and Safety Guidelines – Wind Energy (April 30, 2007) and Jordanian Noise Regulation. Both IFC/WB and local standards provide noise limits in Equivalent Sound Level (L_{Aeq}) which is the average A-weighted sound pressure level that gives the same total energy as the varying sound level during the measurement period of time. Since both IFC/WB and Jordanian noise regulation give the noise limits in L_{Aeq}, the comparisons are made with the L_{Aeq} values measured during the noise survey.

The IFC/WB noise guideline provides limits for daytime (07:00-22:00) and nighttime (22:00-07:00). Noise level limits of 55 dBA and 45 dBA are considered for daytime and nighttime guideline L_{Aeq} limits, respectively.

Daytime

The results of the daytime background noise levels are compared with the IFC/WB guideline values and Jordanian noise regulation values. In this regard, the day-time noise measurement results, 10 minute noise level logs, (L_{Aeq}), IFC/WB guideline value of 55 dBA and Jordanian noise regulation value 65 dBA are plotted in the graph and given in Figure 6-7 below.

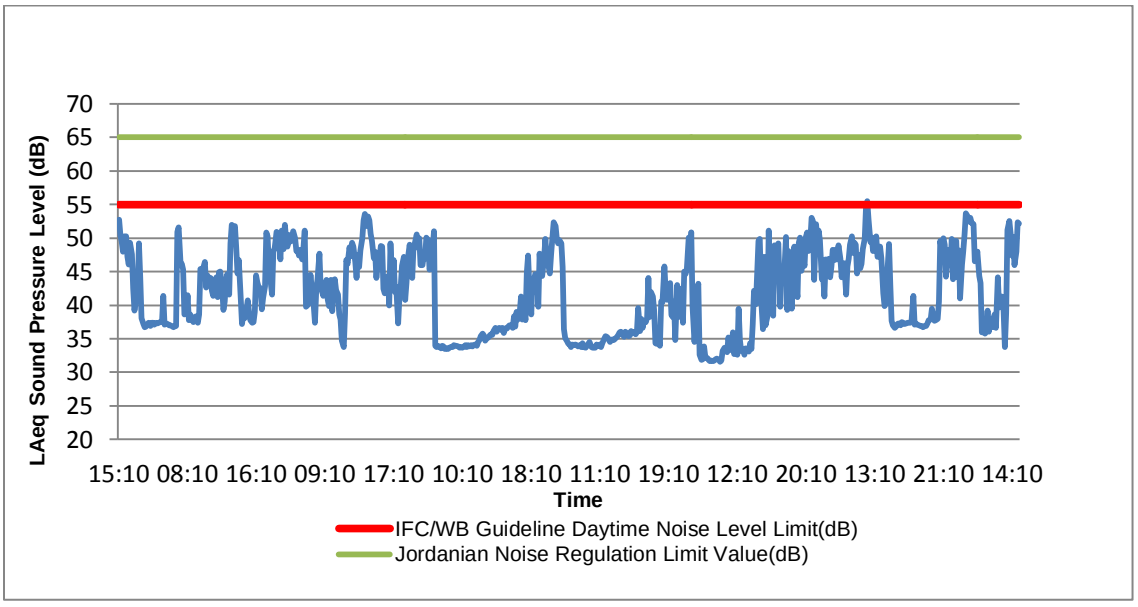

Figure 6-7 Daytime Background Noise Measurement Results

As it can be seen from the graph above, almost all the background noise levels at NSR are below the IFC/WB daytime noise level limit of 55 dBA and Jordanian noise regulation limit of 65 dBA. The reason of some high background noise levels is mainly extraneous noises. Background noise levels range between 32 dBA and 55 dBA.

Nighttime

The results of the night-time background noise levels are compared with the IFC/WB guideline values. The noise measurement results (L_{Aeq}), IFC/WB guideline value of 45 dBA and Jordanian noise regulation value of 55 dBA are plotted and given in Figure 6-8 below.

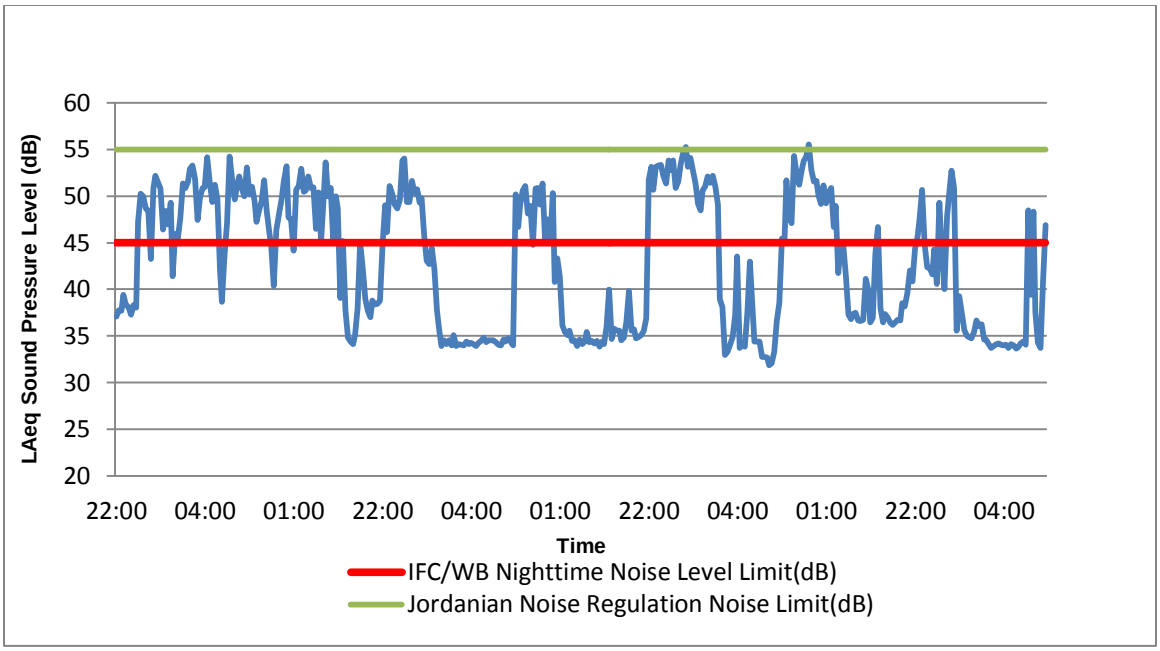

Figure 6-8 Night-time Background Noise Measurement Results

The nighttime measurement results show that background noise levels show rapid changes in the night-time hours of 22:00 – 07:00. As can be seen in Figure 6-8, almost half of the measured nighttime background noise levels at the NSR are below the IFC/WB limit value of 45 dB(A). The nighttime baseline noise monitoring results show that the monitored noise levels were influenced constantly by extraneous sources.

6.2.4.3 Impact Assessment

Construction & Decommissioning Phase

Construction inevitably creates some degree of noise emissions at locations in close proximity. However, construction noise is temporary and transient in nature. The noise levels generated by construction would have the potential to impact noise sensitive

receptors. Noise levels at a receptor during construction depends on several factors, such as the number and type of equipment and machinery used, the distance between the noise sensitive receptor and the construction site and level of attenuation likely due to ground absorption, air absorption and barrier effects.

The noise assessment will consider potential impacts associated with the construction stages of wind farm development. The guidance in BS5228:2009, Code of Practice for Noise and Vibration Control on Construction and Open Sites will be followed to minimize noise emissions.

The noise impact during the decommissioning phase will likely be similar in nature to that experienced during the construction phase.

Operation Phase

Operating wind turbines generate noise varying with wind speed. The sources of sounds emitted from wind turbines consist of 1) mechanical sounds and 2) aerodynamic sounds.

Mechanical sound originates from the rotation of mechanical and electrical equipment. Sources of mechanical sounds include gearbox, generator, yaw drives, cooling fans and auxiliary equipment. Mechanical sounds can be transmitted directly to air (air-borne) or transmitted along structural components before noise is radiated into the air (structure-borne). Aerodynamic sound originates from the flow of air around the blades. Continuous improvements in mechanical design of large wind turbines have resulted in significant reductions in mechanical sounds. Presently, noise emissions from modern wind turbines mostly come from broadband aerodynamic sounds.

Since the operating wind turbines generate noise, there is a potential impact at the neighbouring receptors. Thus, a noise impact assessment is carried out for this Project.

Methodology

Noise assessment study basically consists of the following major steps:

- Noise survey to determine existing ambient background noise levels;
- Noise levels predicted or measured for the turbines;
- Predicting turbine noise levels at noise sensitive receptor; and
- Comparison of estimated sound pressure levels with noise criteria.

Background Noise Survey

As described in the previous section in detail, background noise levels were measured at the NSR. During the survey, L_{Aeq} data was collected for 10-minute averaged periods. The measured L_{Aeq} noise levels were then averaged for daytime and nighttime hours described in IFC/WB Guideline and the average L_{Aeq} values were determined for daytime and nighttime periods of IFC/WB Guideline and given in Table 6-6 below.

Table 6-6 Average Background Noise Levels

	Background Noise Levels, dBA
Daytime Period (07:00 – 22:00)	41.9
Nighttime Period (22:00 – 07:00)	42.9

Turbine Noise Characteristics

Vestas V117-3.3 MW model turbines (91.5 m hub height) will be used in the Project. The noise levels generated by V117-3.3 MW were obtained from the turbine manufacturer. The noise data include sound power levels with wind speed over a range of 3 to 13 m/s (referenced to a 10 m height). Sound power levels at hub height for each wind speed are given in Table 6-7. These are calculated at a reference air density of 1.225 and for the normal operation mode.

Table 6-7 Sound Power Levels at each Wind Speed from 3 to 13 m/s

	Reference Wind Speed (m/s)										
	3	4	5	6	7	8	9	10	11	12	13
V117-3.3MW	92.5	93.0	95.5	99.0	102.4	105.5	107.6	108.3	108.3	108.3	108.3

Noise Modelling

The potential noise impact of the wind turbines on sensitive receptor is determined by noise modelling. Commercially available WindPro version 2.7 noise propagation model which is based on ISO 9613-2 is used in this Project. The model is capable of utilizing different propagation modules, for a variety of wind speed, and it incorporates terrain data into calculations. The model also includes absorbance due to atmosphere and nearby surfaces. Ambient noise levels at the NSR are modelled under worst case conditions.

The model contained within ISO 9613-2 Acoustics – Attenuation of Sound during Propagation Outdoors – Part 2: General method of Calculation (1996) has been used to

calculate the noise emission levels at the nearest sensitive receptor. The ISO 9613-2 algorithm, which is one of the available models presented in WindPro software, has been chosen as being the most robust prediction method based on the findings of a joint European Commission (EC) research project into wind farm noise propagation over large distances.

Although it is not possible to specify exact error bands on noise predictions, the ISO 9613-2 model was found to be the best available, both in flat and hilly, complex terrain. ISO 9613-2, like all the other models, tends to over-estimate the noise at the nearest sensitive receptor, rather than under-estimate it. The study performed as part of the EC research ("Development of a Wind Farm Noise Prediction Model", JOR3-CT95-0051) concluded that the ISO 9613-2 method tended to predict noise levels that would generally occur under downwind propagation conditions. The probability of non-exceedance of the levels predicted by the ISO 9613-2 algorithm was about 85%. The same research also demonstrated that under upwind propagation conditions, between a given receiver and the wind farm, the noise level at that receiver will be as much as 10dB(A) to 15dB(A) lower.

Model Inputs

ISO 9613-2 model uses the following equation in calculating the noise levels at the receptor locations.

$$L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet$$

Where:

$L(DW)$	: Calculated noise level at the receptor, dBA
LWA,ref	: Noise emission of Wind Turbine, dBA
K	: Pure tone, dBA
Dc	: Directivity correction, dB
$Adiv$	: Attenuation due to the geometrical divergence, dB
$Aatm$	: Attenuation due to atmospheric absorption, dB
Agr	: Attenuation due to ground effect, dB
$Abar$	: Attenuation due to a barrier, dB
$Amisc$	: Attenuation due to miscellaneous other effects, dB
$Cmet$	: Meteorological correction, dB

All the input values except LWA,ref are calculated according to coordinates of the wind turbines and noise sensitive receptor. Turbine noise emission levels given in Table 6.7 are

used as LWA, ref values. Other inputs and assumptions used for the noise propagation model are as follows:

- Wind turbine and noise sensitive receptor coordinates;
- Elevation data of the Project site is used to determine ground effect;
- Meteorological coefficient value is assumed as 0 dB to represent worst case conditions; and
- Pure tone value is assumed as 0 dB.

Air absorption value is assumed 1.9 dB/km, default value of ISO 9613-2.

Model Output

Predicted turbine noise levels at the NSR, in terms of L_{Aeq}, over the wind speed range from 3 m/s to 13 m/s are estimated with the model and shown in Table 6-8 below.

Table 6-8 Predicted Wind Farm Noise Levels at the NSR

Predicted Turbine Noise Levels (dBA)	Reference Wind Speed (v_{10}), ms^{-1}										
	3	4	5	6	7	8	9	10	11	12	13
NSR	20.9	24.8	29.0	32.8	34.4	34.7	34.7	34.7	34.7	34.7	34.7

Noise contour map obtained from the results of noise modelling is given in Figure 6-9.

Noise Criteria

In this assessment, two noise criteria are used:

1. A constant regulatory noise limit set for the daytime and night-time by the Jordanian noise regulation. These noise limits are 65 dBA and 55 dBA for the daytime and night-time, respectively, for residential having small industries, offices and public buildings and city centers.

2. The IFC/WB noise guideline limit is given as L_{Aeq} and is set for 55 dBA for daytime (07:00-22:00) and 45 dBA for night-time (22:00-07:00). It should be also noted that the night-time absolute lower limit of 45 dBA is also based on World Health Organization guidelines for the protection of sleep indoors with windows open. In addition, the IFC/WB noise guideline states that if the noise impact is above the

IFC/WB limits then it requires that proposed activities should not result in a maximum increase in background levels of 3 dBA at the nearest receptor.

In addition to the explanation above, the noise limits and guideline values applicable to this Project are summarized in Table 6-9 below.

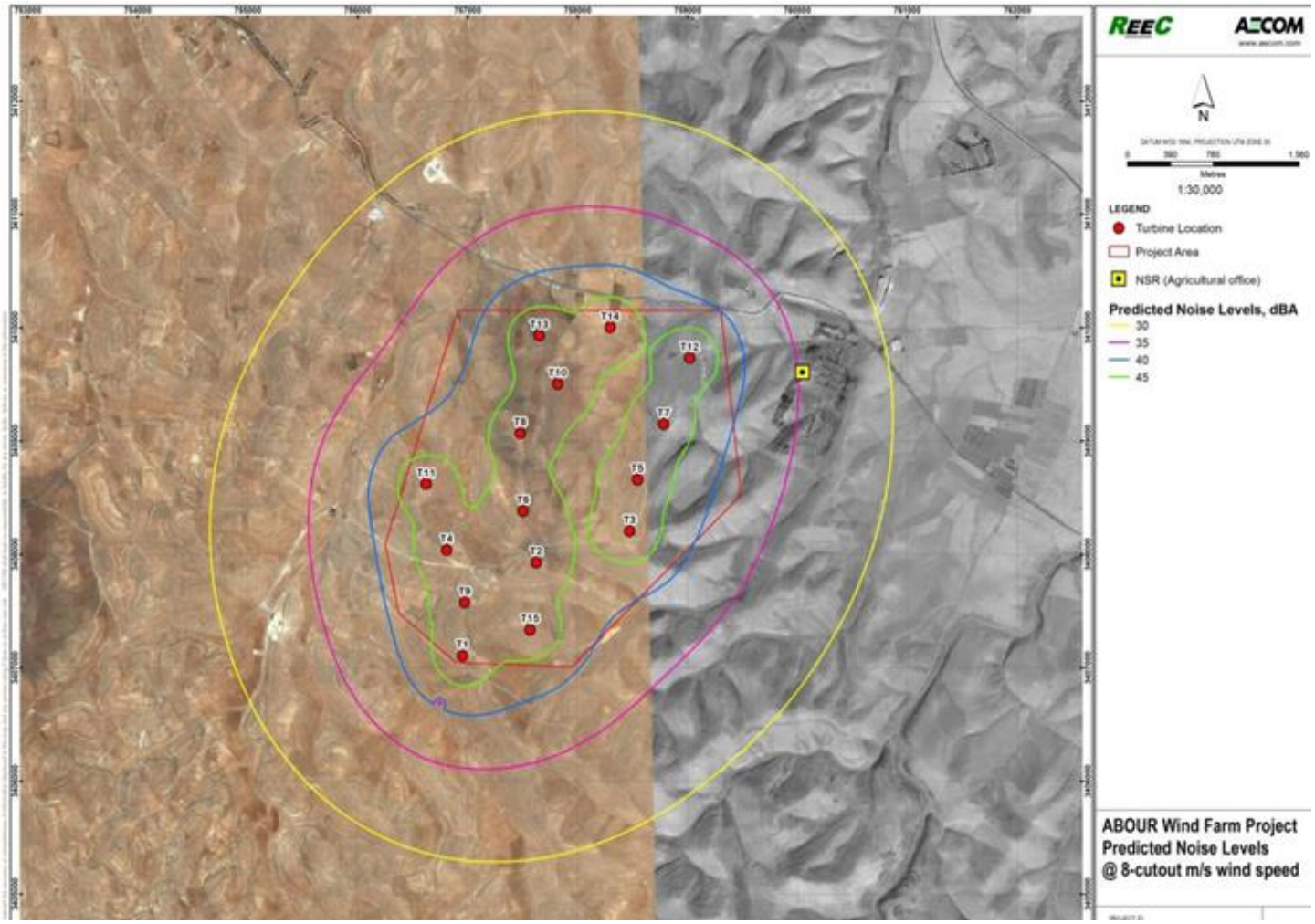

Figure 6-9 Noise Contour Map

Table 6-9 Noise Limits and Guidelines Applicable to the Project

Jordanian noise regulation			
Limit Value	**Definition**	**L_{day} (dBA)**	**L_{night} (dBA)**
	Residential having small industries, offices and public buildings and city centers.	65	55
IFC/WB Guideline			
Guideline value	**Definition**	**L_{day} (dBA) (7:00-22:00)**	**L_{night} (dBA) (22:00-7:00)**
	Residential; Institutional; Educational	55	45
Maximum allowable increase in background	If the limit values are not satisfied, the maximum allowable increase in the background level(at the nearest receptor off-site)	3	3

Comparison of Noise Impact with Noise Criteria

Maximum noise impact level result from turbine operation at the NSR and background noise levels for IFC/WB Guideline and Jordanian noise regulation daytime and night-time periods are given in Table 6-10.

Table 6-10 Daytime and Night-time Predicted Turbine and Background Noise Levels

			Turbine Noise Emission Level (@ 8-cutout m/s wind speed), dBA
Predicted Turbine Noise Levels			34.7
IFC/WB Guideline & Jordanian Noise Regulation	**Daytime Period**	Background Noise Levels, dBA	41.9
	Nighttime Period	Background Noise Levels, dBA	42.9

As can be seen from Table 6-10, the predicted maximum turbine noise level at the NSR is below the absolute noise criteria of Jordanian noise regulation and IFC/WB Guideline for daytime and night-time.

This noise assessment study has demonstrated that the operational noise of the proposed wind farm will not exceed the Jordanian noise regulation and IFC/WB Guideline daytime and night-time noise limits.

6.2.4.4 Cumulative Impacts

The Project site is separated from other proposed or consented wind farms in the area by sufficient distances to ensure cumulative noise impacts will not arise from this development.

6.2.5 Shadow Flickering

Wind turbines, like all other tall structures will cast a shadow on the neighbouring area when the sun is visible. The major difference between a tall structure and a wind turbine regarding their shadow casting potential is the rotating blades of the wind turbine. As the rotor blades rotate, shadows pass over the same point causing an effect termed as shadow flicker. Shadow flicker occurs when the sun passes behind the wind turbine and thus casts a shadow. This phenomenon is regarded as an environmental impact and can create a disturbance/nuisance if the wind farm is not situated and/or planned accordingly.

It is possible to calculate the number of hours per year that shadow flicker may occur at a building from the relative position of turbine to the building, the geometry of the wind turbine, the latitude of the wind farm site and the width of the windows potentially affected.

6.2.5.1 Guidance

Shadow flicker has rarely been a problem with wind farm developments although it is accepted that it can on occasion present a nuisance to amenity when people are within the rooms affected by the phenomenon. There is no specific standard for the assessment of shadow flicker in Jordan and no international guidelines on acceptable levels of shadow flicker. Therefore, relevant German Guideline, “Instructions for identifying and assessing the optical emissions from wind turbines, States Committee for Pollution Control, March 2002”, which includes strict standard for shadow flicker impact was used.

On this basis, in order to define the significance of effects, the German guidelines have been adopted as the reference for this Project. They state that shadow flicker should not exceed:

- 30 hours per year worst case
- 30 minutes per day worst case

The German guidelines also state:

- Shadow flicker is only created when more than 20% of the sun is covered by the turbines blade; and

- Minimum sun height over the horizon for influence in shadow calculations is 3 degrees.

Any predicted shadow flicker effect that is less than the German guideline of 30 minutes per day and 30 hours per year is deemed to be of negligible magnitude and therefore not significant. Where the magnitude is predicted to be greater than negligible, professional judgement is used to describe the effect as large, medium or small, taking into account salient factors such as duration and distance.

6.2.5.2 Existing Baseline

Since shadow flickering occurs in east-west direction, potential shadow receptors which are occupied buildings in east-west direction to the Project site are surveyed. A desktop study followed by the site survey identified only one building susceptible to shadow flicker. The map showing location of the shadow receptor is given in Figure 6-10. As can be seen in Figure 6-10, the shadow receptor, which is also determined as noise sensitive receptor, is located to the east of the Project site.

The coordinates of the shadow receptor (UTM Projection, WGS 84 datum Zone 36) are given in Table 6-11 below.

Table 6-11 Shadow Receptor Coordinates

Shadow Receptor	X	Y
Agriculture office	760043	3409608

The shadow flickering modelling study was performed in order to predict the shadow hours and minutes at the shadow receptor.

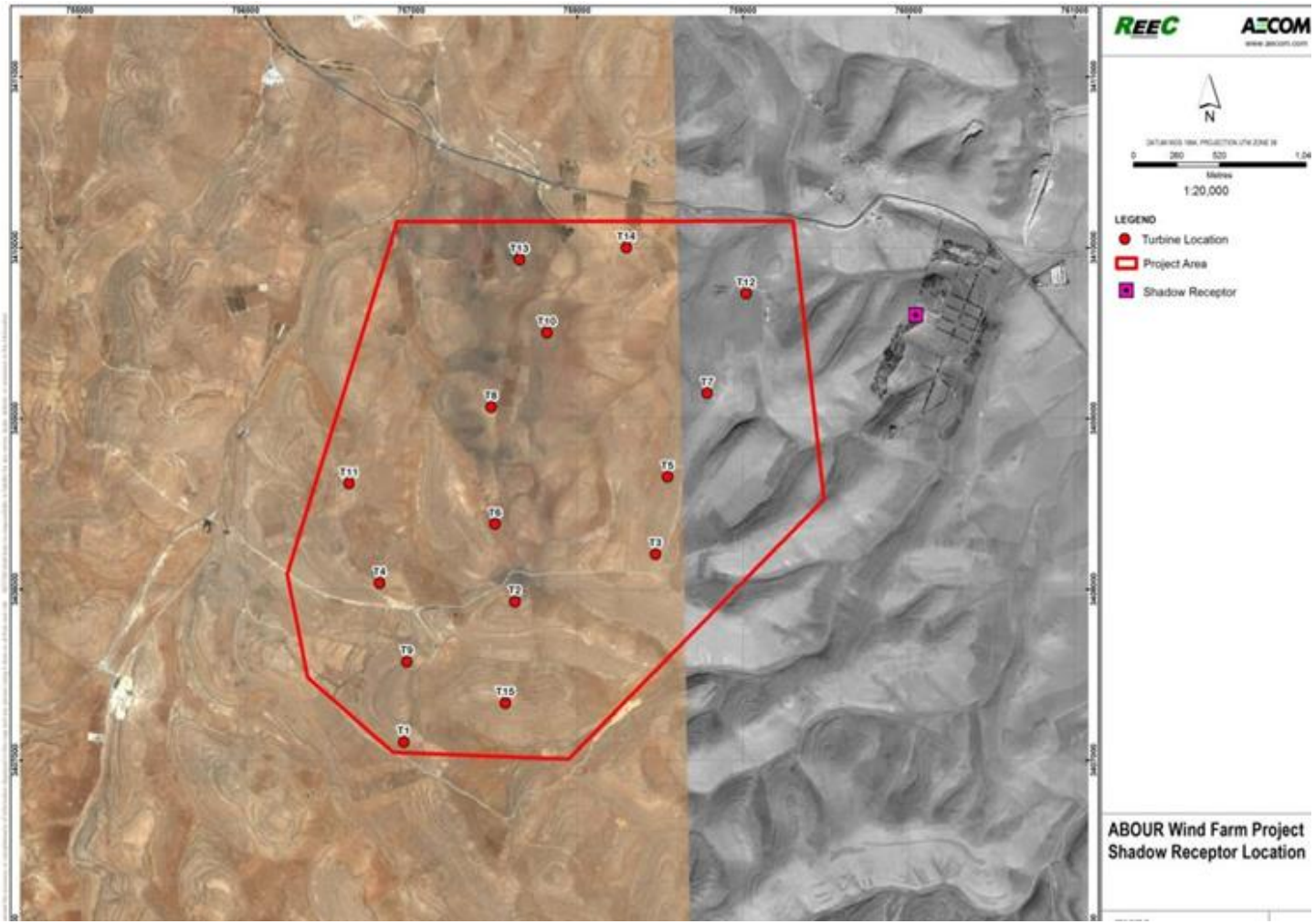

Figure 6-10 Location of the Shadow Receptor

6.2.5.3 Impact Assessment

Shadow flicker is only an issue during operation of wind turbines, and there can be no effect during construction or decommissioning of the proposed turbines. Following the baseline study, further assessment was undertaken in order to determine the duration, dates and times when shadow flicker may occur at the receptor.

EMD's WindPRO software Shadow module was used to create a mathematical model of the proposed development and receptor.

Model Inputs

This model accounts for latitude and longitude of the proposed site and uses a model of the sun's position in the sky throughout the year to calculate shadow lengths, positions and times. A Digital Terrain Model (DTM) was also used in the assessment to take account of the topography between receptor and turbines.

Regarding the maximum distance for influence of shadow flickering, various attempts and experiments have showed that the shadow impact is irrelevant at the areas which are ten times rotor diameter distance away from the wind turbine. Although the influence distance is 1,170 m according to this assumption, the distance calculated by the model, 1,711 m is used as the maximum distance of influence for shadow flickering.

Model Results

Shadow modelling calculates the shadow flickering impact in worst case. The worst case scenario assumes that the sun is shining for all day from dusk to dawn with no cloud cover and the heading of the turbines is following the movement of the sun during the shining hours. The model calculates the shadow flickering for each minute of a day throughout a year. The full results of the modelling study include several reports and graphical demonstrations. These reports are given in Annex V.

The summary of the modelling results are provided in Table 6-12. In this table, shadow hours per year, shadow days per year and maximum shadow minutes per day at the shadow receptor for worst case scenario are provided. The maps showing the contour lines for shadow hours per year and shadow minutes per day for worst case are given in Figure 6-11 and Figure 6-12 respectively.

Table 6-12 Shadow Modelling Results

Shadow Receptor	Shadow Worst Case		
	Shadow hours per year (h/year)	Shadow days per year (days/year)	Max. shadow minutes per day (min/day)
Agricultural office	20:41	67	0:27

Modelling results demonstrate that the shadow flickering that is estimated to be observed at the Shadow Receptor, which is located approximately 1 km away from the closest turbine T12 in the east of the Project site, will be caused by only T7 and T12. Shadow receptor will observe total shadow for 20:41 hours in a year in 67 days. Maximum 27 minutes of shadow in a day will be observed at the shadow receptor.

The theoretical instances of shadow flicker will always be less than that predicted by the model given the use of the worst case assumptions. The occurrence of shadow flicker is only possible during the operation of the wind farm (i.e. when the rotor blades are turning, and when the sky is clear enough to cast shadows). It is important to consider the following facts when making an assessment:

- Climatic conditions dictate that the sun is not always shining. Direct sunlight may account for as little as 25% of daylight hours over a year. Cloud cover during other times may obscure the sun and prevent shadow flicker occurrence. While some shadow may still be cast under slightly overcast conditions, no shadow at all would be cast when heavy cloud cover prevails. It is considered that weather conditions will reduce actual occurrence of shadow flicker by at least half, compared to calculated levels.
- Objects such as trees or walls may obscure the view of the turbines and hence shadow flicker.
- During operation, the turbine rotors automatically orient themselves to face the prevailing wind direction. This means the turbine rotors will not always be facing the affected dwellings, and in fact will sometimes be “side on” to the receptor. Very little area of blade movement would be visible during such occurrences and therefore the potential for shadow flicker is significantly reduced.
- The turbines will not operate for 100% of daylight hours. During periods of very low speed wind or very high speed wind or maintenance shut-downs, the rotors do not turn. During such periods shadow flicker would not occur.

Consideration of these factors leads to the conclusion that the level of shadow flicker will be significantly less than the predicted levels in Table 6-12.

6.2.5.4 Cumulative Impacts

There are no other developments within ten rotor diameters of the receptor identified for this study. Therefore, no cumulative effects have been taken into account.

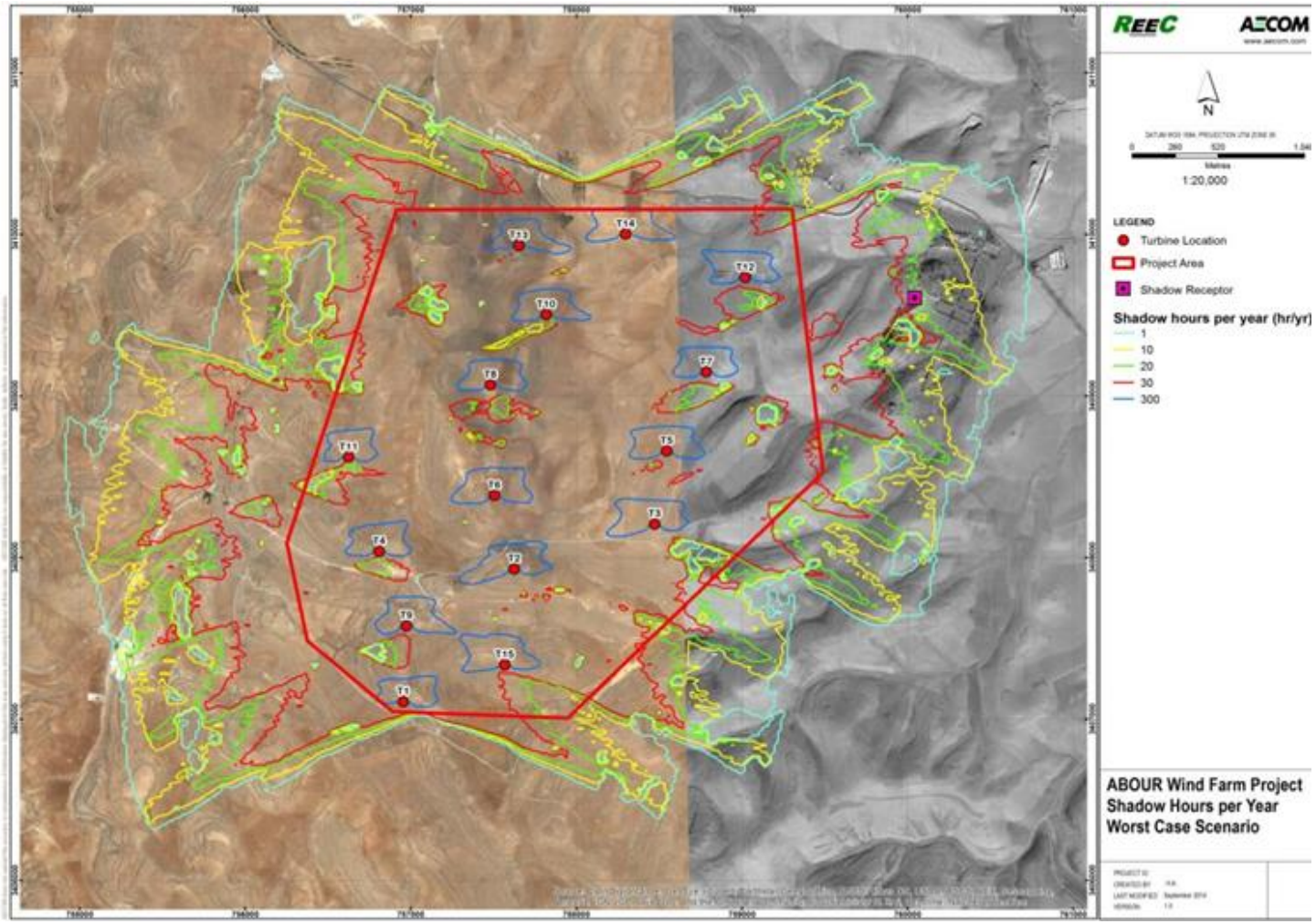

Figure 6-11 Shadow Hours per Year

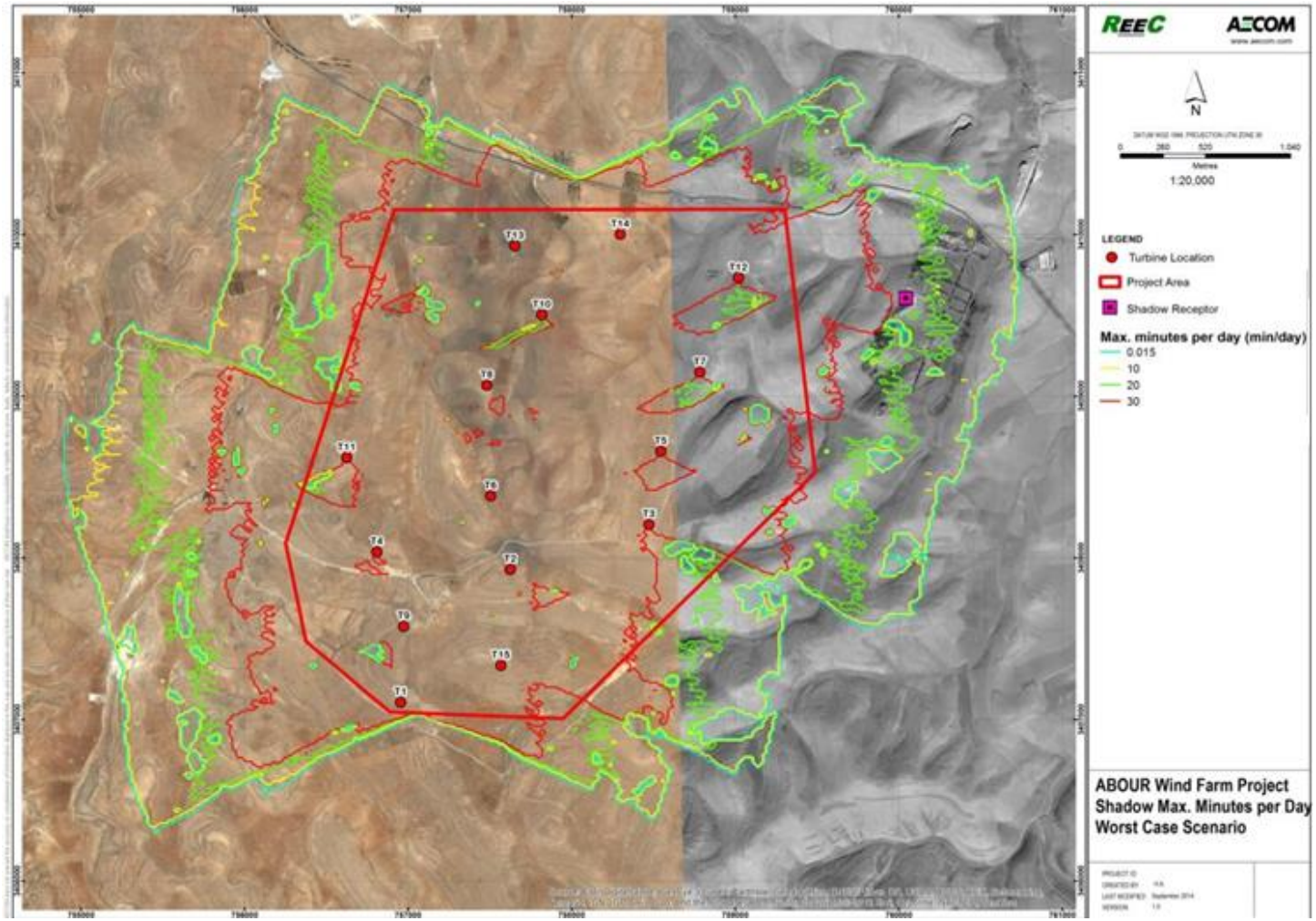

Figure 6-12 Shadow Minutes per Day

6.2.6 Electromagnetic Interference Problems

This concern is usually about problems caused by the location of wind turbines in relation to existing radio or television stations and to possible electromagnetic emissions produced by the wind turbines.

The main problem created by wind turbines is caused by the moving blades which can result in signal variations due to deflection. This effect was more of a problem with first generation wind turbines which had metal blades. The blades of modern wind turbines are made exclusively of synthetic materials which have a minimal impact on the transmission of electromagnetic radiation. Any possible interference problems can be prevented by proper design and location.

As for radiation emitted, the parts of a wind turbine which could possibly emit low level electromagnetic radiation are the electrical generator and the transformer. The electromagnetic field of a wind turbine is extremely weak and is confined to a very short distance from the exterior turbine housing which is more than 50m above the ground. Hence, there is no exposure to electromagnetic radiation, and especially not at the base of the wind turbine. The transformer is always surrounded by a security barrier or is enclosed by a metal shed. The barrier is placed at a distance where the level of electromagnetic radiation is negligible.

6.2.7 Ice Throw

As stated in Section 4.3.2, the coldest month is January and average temperature is 3.7°C for January. Therefore, it is foreseen that blade/ice throw will not be a potential risk to threat public safety. However, the turbines will be maintained regularly in case of a blade/ice throw risk.

Ice detection system is used for protection against the risk of ice throw from the blades. The system is directly connected to the top controller and stops the turbine(s) operation when ice is detected.

The ice detection sensor is located on the nacelle of Vestas V117-3.3 MW wind turbine. One WTG (wind turbine generator) is equipped with the ice detection sensor in a region covering 3 or 4 WTGs.

The ice detection sensor utilizes an ultrasonic axially vibrating nickel alloy tube to detect the presence of icing conditions. The nickel alloy tube expands and contracts under the influence of variable magnetic field.

As the ice detection sensor faces an icing environment, ice accumulates on the nickel alloy probe. The additional mass from ice causes the frequency of the sensing probe to decrease, which is detected by an electronic frequency comparator circuit. Once the ice accumulation on the probe is detected, all the WTGs in the same region are shut down.

6.2.8 Aviation

There are three airports in Jordan: Queen Alia International Airport is located approximately 110 km north of the Project site; Amman Civil Airport is located approximately 134 km north of the Project site; and King Hussein International Airport is located approximately 147 km southwest of the Project site. The wind turbines are not expected to adversely impact aviation given the distances between the site and the airports.

International Standards and Recommended Practices published by the International Civil Aviation Organization (ICAO) recommend that the obstacles or fixed objects listed below should be marked or lightened according to the defined methods:

- A fixed obstacles that extend above a takeoff climb surface within 3,000 m of the inner edge of the take-off climb surface;
- A fixed object, other than a obstacles adjacent to the take-off climb surface;
- A fixed obstacles that extends above an approach or transition surface within 3,000 of the inner edge of the approach surface;
- A fixed obstacle above a horizontal surface; and
- A fixed object that extends above an obstacle protection surface.

All of the 15 wind turbines will be equipped with aviation lights.

6.2.9 Public Safety and Access

The proposed Project will not cause any risk in terms of public access. All the necessary precautions will be taken in order to prevent unauthorized access to the Project site. In order to prevent unauthorized access to the wind turbine area, security personnel will be employed during the operation period. Moreover, if needed, selected areas will be cordoned off by a fence. Access to wind turbine towers will be prevented by installing a 70m radius and 2.5m high metal fence around each tower and bilingual warning signs to warn the public will be posted.

6.2.10 Medical Care and Health Insurance

Contractors working on the construction of the Project should provide their workers with the necessary medical coverage.

Employees and personnel in operation phase will be provided with medical insurance according to the laws and regulations and will be also subjected to primary and periodical medical check-ups.

6.2.11 Personal Protection Equipment

Using personal protective equipment and safety tools are required in this Project especially during construction and during assembly of wind tower component and general maintenance activities.

6.2.12 Availability of Emergency Plan

This plan identifies actions to be taken by management and workers at the site if an accident may result in serious injury or loss of life or property.

The most important goals of the emergency plan is to avoid situations of confusion and disorder, reduce the time needed for reflection, ensure the protection of individuals and property and the environment in the event of emergency situations, as well as to facilitate a return to normal operating conditions and reduce the impact of the emergency to the minimum.

6.3 Mitigation Measures

6.3.1 Accidents Risk

- Transportation of equipment should be carried out in the times to avoid peak times, and minimize the movement of machinery within the cities and following the traffic laws.
- Drivers should be instructed to follow safety instructions, the traffic law and to abide with the road speed limits.
- The need for traffic signs for the Project to facilitate compliance with traffic safety matters.
- Drivers must have knowledge of first aid in the event of any accident.
- Compliance with instructions and the requirements of civil defence.

6.3.2 Air Quality (Dust)

The proponent will require its construction contractors to take sufficient precautionary measures to limit dust generation. Such measures are outlined below:

- Water trucks should be employed to periodically wet the construction areas and location roads to minimize dust emissions;
- All vehicles carrying bulk materials into or out of the site will be covered to prevent dust emission;

- Any storage on site of aggregate or fine materials will be properly enclosed and screened so that dust escape from the site is avoided;
- All vehicles will be properly maintained to reduce air emissions;
- Good housekeeping arrangements should be employed so that the site is kept as clean as possible; and
- There should be daily inspections of the working areas and immediate surrounding areas to ensure that any dust accumulation or spillages are removed/cleaned up as soon as possible.

6.3.3 Noise

In order to minimize the potential noise impact at the surrounding properties, the layout of the proposed wind farm was optimized. As the predicted turbine noise levels at the NSR are below the local Jordanian noise regulation and IFC/WB Guideline daytime and nighttime noise limits, no routine mitigation is proposed.

6.3.4 Shadow Flickering

No routine mitigation is proposed, this will however be kept under review during the operation of the scheme in case particular combinations of circumstances arise that increase the potential for nuisance (particularly where rooms affected are in regular occupancy and the effect proves to be a frequent occurrence in reality).

Where nuisance arises, mitigation measures can be incorporated into the operation of the wind farm to reduce the instance of shadow flicker. Mitigation measures range from planting tree belts between the affected receptor and the responsible turbine(s) and/or installing blinds at the affected buildings. A more common measure entails ensuring the turbines are fitted with shadow flicker control systems that automatically shut down individual turbines during periods when shadow flicker could theoretically occur, i.e. when the wind speed and direction coincides with sufficient sun for shadows to form. It can also coincide the time of day and year that shadow flicker occurs at a particular property.

6.3.5 Ice Throw

A representative number of wind turbines will be equipped with Ice Detection sensors which will are capable of detecting the presence of ice build-up and stop the neighbouring wind turbines thus preventing ice throw.

6.3.6 Aviation

The turbines will be equipped with aviation lights.

6.3.7 Electromagnetic Interference Problems

Wind turbine generators could lead to electromagnetic interference with aviation radars and telecommunication systems. The blades of the proposed wind turbines are made of synthetic material which produces no electromagnetic impact. There are two telecommunication towers near the Project site, however, (i) they are at considerable distance from all of the wind turbines to be installed at the Project site; and (ii) the line of sight between the towers does not cross the overall boundary of the Project. There is no aviation radar in the vicinity of the Project site. Consequently the Project will not interfere with the telecommunication systems in the area.

6.3.8 Public Safety and Access

Security personnel will be employed during the construction and operations phases of the Project in order to prevent unauthorised access by the public to the wind farm and individual wind turbines. In addition at the completion of the construction phase, each wind turbine will be fenced off with a 70m radius and 2.5-m high metal fencing.

6.3.9 Personal Protection Equipment

The company should provide all workers with the personal protective equipment and safety tools and instructions required for the work and according to their needs.

6.3.10 Medical Care and Health Insurance

- Contractors working on the construction of the Project should provide their workers with the necessary medical coverage.
- Employees and personnel in operation phase will be provided with medical insurance according to the laws and regulations and will be also subjected to primary and periodical medical check-ups.

7 ARCHAEOLOGY & CULTURAL HERITAGE

7.1 Methodology

The study team investigated the Project site in order to establish the baseline comparison required to assess any impact on this Valued Environmental Component, and also to provide relevant authorities with information about the archaeological and heritage sites.

7.2 Archaeological Background

The rich culture of Tafila Governorate is attributable to the diversity of sites, the landscape and the strategic location of this area on the Old Kings Highway which connects the southern part of Jordan with the north. The archaeological surveys indicated the presence of hundreds of sites related to many historical periods starting from the prehistorical periods in Kh. Hemma at wadi Hassa to the Iron age city state of the Adomite within Bousiera, its capital. One of the flourished periods in the Tafila region was under the Nabeaten civilization such as Dharieh and Kh.Tannuer.

The Byzantine period started in the 4th century in the Rashadieh area, and the Islamic period is manifested through different sites starting from the 8th century up to the early 20th century. Major sites in Tafila are Tafila Castle, As-Sila‘ Castle, As-Sila‘ Village, Al-Ma‘tan Village, Senefheh, Majadel, Sayir, Freij, Zubre, Naqd, Ayn Al-Beida, An-Namata, Busiera, Dharieh, Kh.Tannur, Kh. Hemma, Dana and Rashadieh. These sites are located to the west of the Project site; the closest site is more than one km from the western border of the Project site.

Figure 7-1 Dana Site

Figure 7-2 As-Sila

7.3 Archaeological Survey

A systematic walkthrough survey of the Project area was carried out. GPS was used to verify the exact location where the 15 wind turbines will be installed. Annex VII shows

photographs of the locations of each of the 15 wind turbines of the Project. The survey started from the top of the each location to the distances of 20 meters apart through the rest of each turbine site.

With the aid of Mega Jordan database[3], four registered archaeological sites were identified in the Project area. The coordinates of these sites (UTM Datum WGS84 Zone 36) are shown in Table 7-1 below and the locations of these sites and the wind turbines are shown in Figure 7-3 below.

Table 7-1 Mega Jordan Database Sites at the Project Area

Site	X	Y	Altitude (m)
Site 174	756954	3408952	1300.01
Site 175	757134	3407611	1375.11
Site 172	756402	3407810	1320.57
Thalithumat	757899	3407940	1339.43

[3] Mega site is a project at the Jordanian Department of Antiquities for registering the archaeological remains.

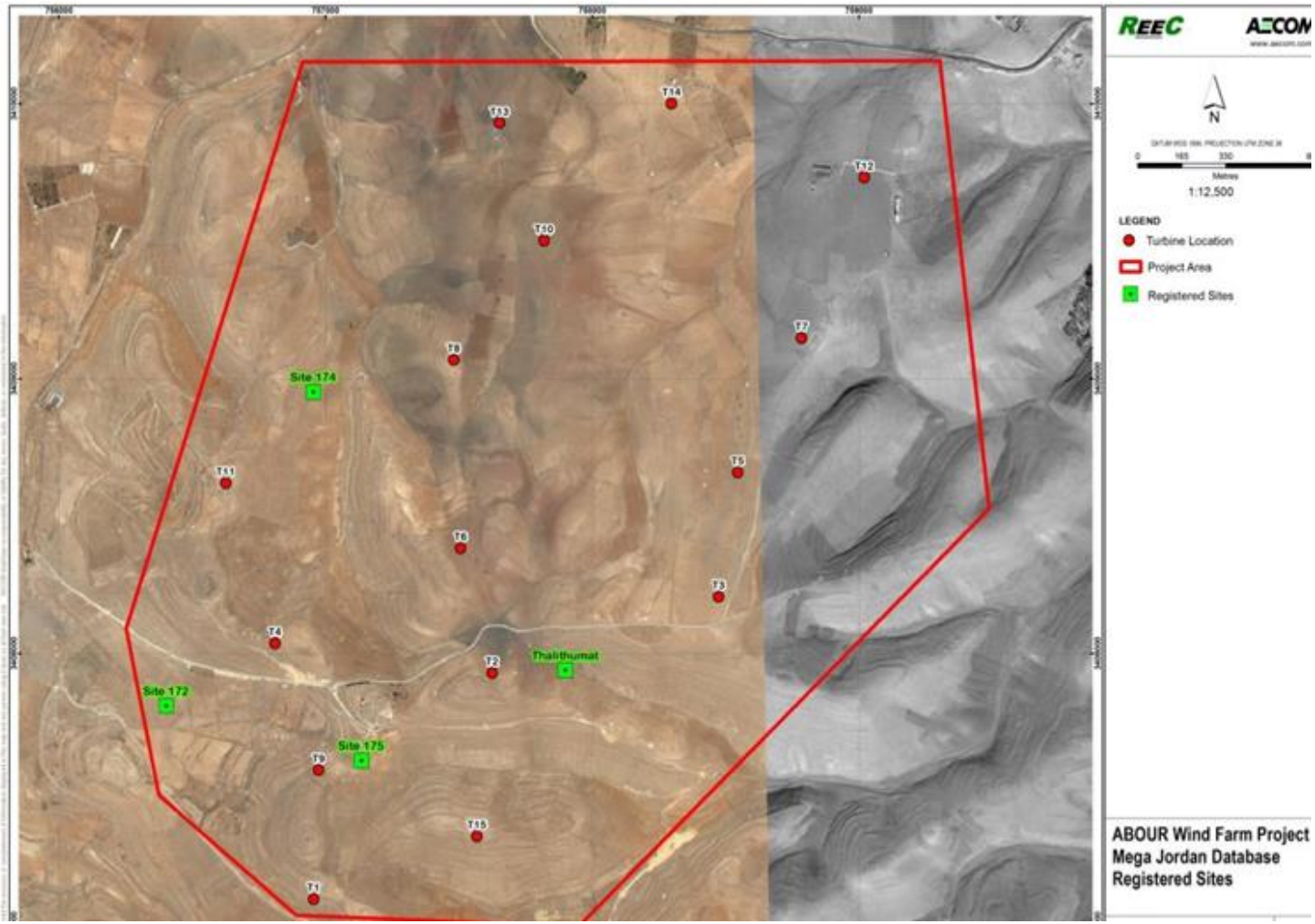

Figure 7-3 Wind Turbines and Registered Site Locations

The details of each registered archaeological site, including site elements, are given in Table 7-2 below.

Table 7-2 Details of Registered Archaeological Sites

Registered site	Details	
Site 172	Other Site Name	JADIS: 2102038
	MEGA Number	9868
	Total Area (m²)	198.8
	Perimeter (m)	56.4
	Buffer Zone (m)	0
	The following site related data have been recorded at this site:	
	Date Entered	July 1, 2010
	Element Type	Rock-cut with Simple Entrance or Dromos
	Periods	Unspecified Period
Site 174	Other Site Name	JADIS: 2102033
	MEGA Number	9866
	Total Area (m²)	198.8
	Perimeter (m)	56.4
	Buffer Zone (m)	0
	The following site related data have been recorded at this site	
	Date Entered	July 1, 2010
	Element Type	Cave/
	Periods	Unspecified Period
	Date Entered	July 1, 2010
	Element Type	Water Structure, Cistern
	Periods	Unspecified Period
Site 175	Other Site Name	JADIS: 2102034
	MEGA Number	9867
	Total Area (m²)	198.8
	Perimeter (m)	56.4
	Buffer Zone (m)	0
	The following site related data have been recorded at this site	
	Date Entered	July 1, 2010
	Element Type	Cave/Shelter
	Periods	Unspecified Period
	Date Entered	July 1, 2010
	Element Type	Water Structure, Cistern
	Periods	Unspecified Period
	Date Entered	July 1, 2010
	Element Type	Sherd/Flint Surface Scatter
	Periods	Iron Age IIa-b
	Date Entered	July 1, 2010
	Element Type	Sherd/Flint Surface Scatter
	Periods	Roman, Early
Thalithumat	Other Site Name	JADIS: 2102035
	MEGA Number	4821

	Total Area (m²) Perimeter (m) Buffer Zone (m)	198.8 56.4 0
	<u>The following site related data have been recorded at this site</u> Date Entered July 1, 2010 Element Type Tall/Tell Periods Unspecified Period	
	Date Entered July 1, 2010 Element Type Grave Periods Unspecified Period	
	Date Entered July 1, 2010 Element Type Tower Periods Unspecified Period	
	Date Entered July 1, 2010 Element Type Sherd/Flint Surface Scatter Periods Byzantine, Unspecified	
	Date Entered July 1, 2010 Element Type Sherd/Flint Surface Scatter Periods Unspecified Period	
	Date Entered July 1, 2010 Element Type Sherd/Flint Surface Scatter Periods Iron Age IIa-b	
	Date Entered July 1, 2010 Element Type Sherd/Flint Surface Scatter Periods Unspecified Period	
	Date Entered July 1, 2010 Element Type Sherd/Flint Surface Scatter Periods Ottoman, Unspecified	

7.4 Impact Assessment

Potential types of impact of the Project to the archaeological sites, built heritage and historic landscape include:

- Physical impacts upon archaeological features;
- Visual impacts upon archaeological features;
- Physical impacts upon built heritage features;
- Visual impacts upon built heritage features;
- Visual impacts on the historic landscape; and
- Physical impacts upon deposits with palaeoecological potential.

On the basis of the initial archaeological survey, 4 of the proposed turbine locations were identified as archeologically sensitive. Abour Energy Company was notified to avoid these areas and to revise the wind farm layout. New locations for these wind turbines were

suggested by the archaeological team. Abour Energy proceeded to revise the wind farm layout and the archaeology team visited the revised site layout on 20 September 2014 with satisfactory results. The details of this survey are presented in Table 7-3 below.

Table 7-3 Archaeological Survey Results of Turbine Locations

Turbine Location	Description	Remarks
T1 X – 756955 Y – 3407106	A hilly site with steep slope at 80m to the north of the road.	No archaeological signs of any kind
T2 X – 757625 Y – 3407929	Agricultural land, plowed and planted, with modern walls within the land.	No archaeological signs of any kind
T3 X – 758474 Y – 3408206	Well plowed flat agricultural land, 60m from dirt road to the north, surrounded by barbed wire fence from east and west.	No archaeological signs of any kind
T4 X – 756810 Y – 3408037	Semi flat land covered with flint stones, with sharp drop to the east.	No archaeological signs of any kind
T5 X – 758546 Y – 3408659	Well plowed agricultural land with a slope to the east, surrounded by modern stone walls and barbed wire fence, with water well.	No archaeological signs of any kind
T6 X – 757506 Y – 3408383	A flat agricultural land, part of it randomly covered with medium size flint stones and other parts planted; small hill surrounds the location of the turbine from the north.	No archaeological signs of any kind
T7 X – 758785 Y – 3409148	Flat agricultural land with slope to the north.	No archaeological signs of any kind
T8 X – 757481 Y – 3409068	An agricultural plateau.	No archaeological signs of any kind
T9 X – 756974 Y - 3407576	A hilly site with steep slope, traversed by modern walls; bedrock can be seen on many spots.	No archaeological signs of any kind
T10 X – 757819 Y – 3409502	A flat plowed agricultural plateau surrounded by stone walls with a water well.	No archaeological signs of any kind
T11 X – 756625 Y – 3408620	A sloped plateau surrounded by agricultural land.	No archaeological signs of any kind
T12 X – 759020 Y – 3409732	Flat agricultural land with slope to the north and northeast.	No archaeological signs of any kind
T13 X – 757652 Y – 3409930	Base of the turbine near a sheep barn and surrounded with barbed wire fence; bedrock can easily be seen all around.	No archaeological signs of any kind
T14 X – 758297 Y – 3410001	Base of turbine located at the slope of a plateau, surrounded by agricultural land.	No archaeological signs of any kind
T15 X – 757568 Y – 3407335	A semi flat land covered with flint bedrock.	No archaeological signs of any kind

7.5 Mitigation Measures

The turbines and access roads have been positioned in locations to minimize direct impacts on previously recorded archaeological sites within the Project site.

The results of the archaeological survey suggest that there are no features in the vicinity of the proposed turbine locations that must be avoided. Mitigation measures in these areas are therefore not required.

Further evaluation will likely be needed during the initial construction stages. This evaluation may include excavation of the turbine base areas under the supervision of a suitably qualified archaeologist, monitoring of the topsoil strip of the access roads. The exact nature of this work will need to be defined in consultation with an archaeologist. The impact assessment will be updated following results from the required evaluation.

It is essential during the construction phase to provide strict instructions to the contractor to suspend construction upon discovery of any antiquities or archaeological items. Such discoveries should be reported to the Director of Department of Antiquities or to the nearest Public Security Center. The Department of Antiquities may recommend certain measures to protect the found items.

There are no mitigation measures that can be recommended to reduce the visual impacts to archaeological sites, due to the nature of the proposed development.

8 BIODIVERSITY

8.1 Introduction

The biodiversity study focused on the baseline data of flora and fauna (reptilia, mamalia, aves, amphibia) at the Project site in Abour area in Tafila. The following methodology was applied:

- Conducting field survey of flora of the proposed Project area;
- Conducting an avifauna survey in the proposed Project area;
- Conducting a mammal survey in the proposed Project area (Bat surveys were conducted in May-August 2013); and
- Conducting a reptile survey in the proposed Project area.

The study was conducted during March – May 2013 and June - November 2013. For the spring period, a total of 40 field days and for the fall period 50 field days were spent at the Project site. The study comprises of two methodology components in compliance with the Jordan Ministry of Environment, the ESIA committee standards in Jordan and the international standards for wind farms. The ecological baseline research includes data from the following primary and secondary sources:

- Desktop data from secondary sources; and
- On-site monitoring of the wind farm area and the surrounding as primary source.

Information on the flora and fauna of the area was derived from studies published by universities, the Royal Society for the Conservation of Nature (RSCN), the Ministry of Agriculture as well as from field information collected during the monitoring surveys. The investigation was carried out in linear transects of 500 meters and 20m x 20m of quadratic transects. Two fixed observation stations and two random observation areas were chosen.

During the first migration season, researchers observed that the Project area is disturbed by farmers, constant movements of the local residents and road traffic; the core of the Project site is away from the edges of the Rift Valley and it is sparsely covered with desert vegetation.

8.2 Objectives

This is to satisfy the interest of basic planning for the area and to highlight any environmental concern that may arise upon the implementation of the proposed Project on the existing biological conditions. Specifically, the study aimed to:

- Conduct the baseline field surveys of flora, fauna and avifauna in the Project area;

- Identify and list all flora, fauna and avifauna species, and related habitats;
- Identify and locate all protected, endangered or rare plants, animals and avifaunal species and habitats;
- Recommend appropriate mitigation measures to reduce (and monitor, if appropriate) such impacts to flora, fauna, avifauna, bats and habitats; and
- Ensure compliance with existing national and/or international protection requirements.

8.3 Guidance

The following national and international laws and regulations were considered:

- Jordan Environmental Law No. 52 Year 2006;
- Jordan Environmental Impact Assessment Regulation No. 37 Year 2005;
- Convention on the Conservation of European Wildlife and Natural Habitats Standing Committee 23rd meeting Strasbourg, 1-4 December 2003;
- Wind Farms and Birds: An analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues report written by BirdLife International on behalf of the Bern Convention;
- IFC Guidance note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources; and
- IFC/WBG Environmental, Health and Safety Guidelines for Wind, Year 2007.

8.4 Study Team

The team was composed of 3 lead surveyors as follows:

-Adnan Budieri	Team Leader, Mammals and Reptiles Surveys
-Banan Sheikh	Flora Surveys
-Laith Moghrabi	Birds and Bats Surveys

8.5 Flora

In order to determine the flora species within the Project site and its vicinity, Banan Al Sheikh and his team conducted the ecological surveys (see Figure 8-1). Together with their evaluation on the proposed Project area, detailed literature surveys were conducted for the area.

Figure 8-1 Flora Surveys during Spring and Fall 2013

8.5.1 Flora Literature Review

The flora literature review is based on records in available publications, such as (Zohary, 1968-1972; Feinbrun, 1978; Al-Eisawi, 1998). Information on the flora and fauna of the area was also collected from universities, the Royal Society for the Conservation of Nature, the Ministry of Agriculture and published sources. Flora species were determined according to records published by (Al-Eisawi *et al.,* 1998).

It should be noted that no official conservation status exists up to date for the flora and fauna of Jordan. Jordan committees are currently setting the status of Jordanian plants. Several studies have been conducted to identify the flora of southern Jordan (Boulos, 1977; Boulos *et al.,* 1977; Al-Eisawi, 1980*,* 1982, 1983; Al-Oran, 1994, 1995). Moreover, several other works are aimed to identify the bioclimatic subdivisions in Jordan and the corresponding vegetation types (Long, 1957; Poore and Robertson, 1963; Kruchner, 1986; Al-Eisawi, 1985, 1997).

The mountainous parts of the area belong to the Mediterranean bio-climate which occurs at altitudes 1,200 and 1,300 m above sea level. Lower altitudes are considered to be Irano-Turanian bio-climate. The climate of the area is under the influence of Sahro-Arabian desert in the eastwards.

8.5.2 Flora Survey Methodology

For the flora field survey, the Project area was scanned by linear and quadratic transects. The site was divided into 4 blocks. A quantitative approach (species richness = number of species) of recording species was used in addition to the assessment of the species

dominance. The investigation was carried out in linear transects of 100 m and 20m x 20m of quadratic transects for plant biodiversity.

The information about quadratic transects such as elevation, coordinates and vegetation cover are provided in Table 8-1. Quadratic transects were marked with yellow paint in order to be referenced for further data collection and monitoring as shown in Figure 8-2. Flora surveys included up to 4 quadratic transects in the area (Figure 8-3).

Table 8-1 Observation locations for the flora surveys

Info	Q1	Q2	Q3	Q4
Elevation (m)	1282	1310	1320	1333
X Coordinate	758984	758784	757898	757759
Y Coordinate	3409885	3408981	3409721	3408705
Vegetation Cover %	40	50	15	15

Figure 8-2 Quadrants Marked with Yellow Paint for References and Monitoring

The plant species were identified with the help of national and regional field guides and other scientific material published on the internet. Flowers, stands of shrubs and trees were also photographed during the field surveys.

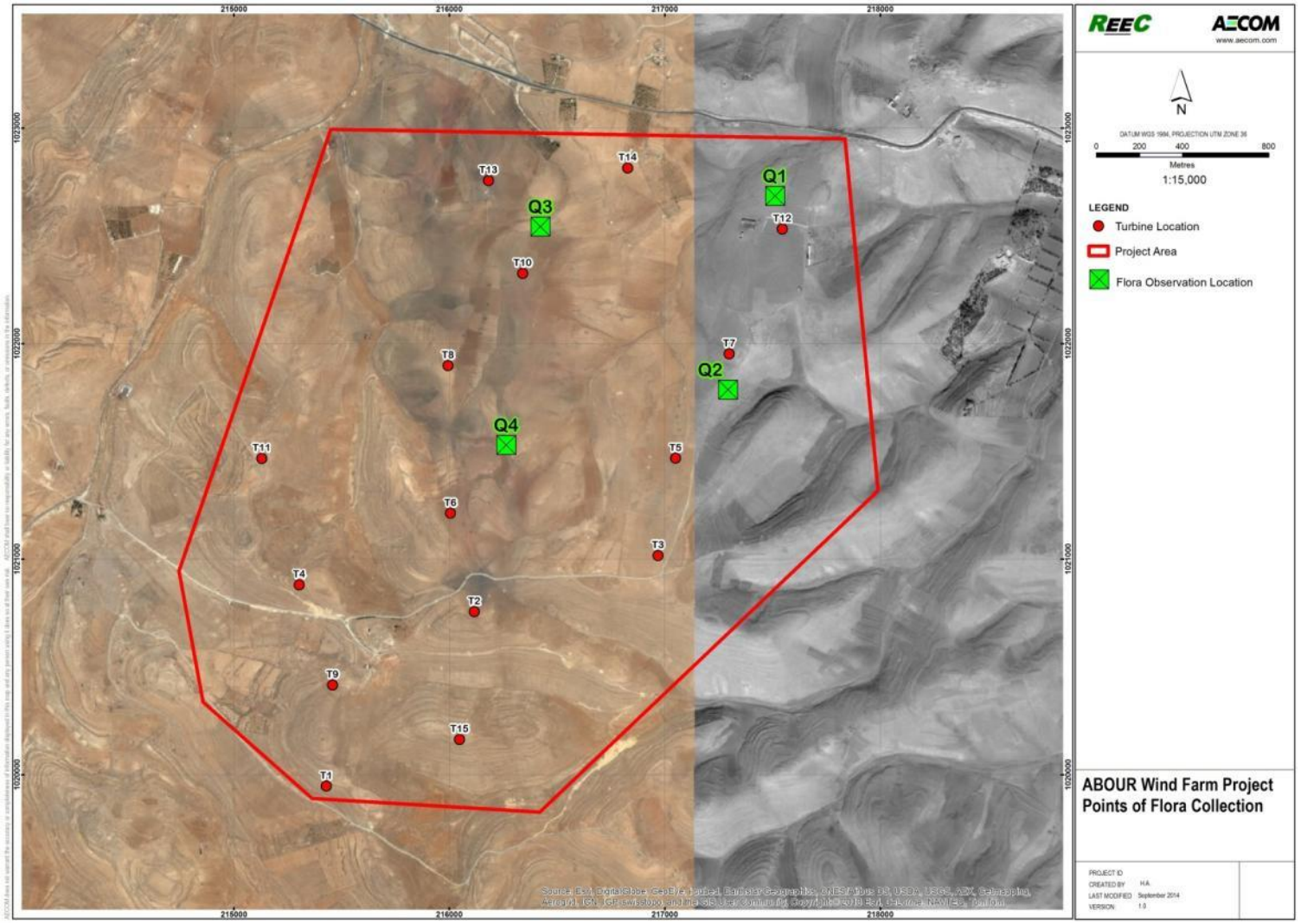

Figure 8-3 Points of Flora and Fauna Collection

The data collected from the field surveys are as follows:

1- Quadrates and linear specific sites were surveyed for terrestrial flora at the observation stations to define the bio-geographical zones of the area;
2- For terrestrial flora the vegetation communities were distinguished based on field observations and analyzed in terms of various parameters such as species dominance, coverage, height, species diversity, etc.;
3- Flora composition was determined, with emphasis on key species, based on documentation of specimens and identification of plant species according to the use of key and manuals of the terrestrial of the region; and
4- Data analysis produced information on standard characteristics including:
    - General habitat structure
    - Dominant species
    - Species composition
    - Vegetation height
    - Plant species richness
    - Degree of existing disturbance

The last of these items is extremely important for evaluating the pre-ecological rehabilitation period. The survey dates are given in Table 8-2 with their locations.

Table 8-2 Surveys in days and locations, 2013

Survey field visit	Date	Location	No of days
Habitat assessment	17-19 March	Q1-3	3 days
Flora survey	17-18 March	Q1	2days
Flora Survey	22 March	Q2	1 day
Flora Survey	9-10 April	Q3	2 days
Flora Survey	20 April	L1	1 day
Flora Surveys	10 May	L2	1 day
Flora surveys	20 May	L3	1 day
Habitat assessment	20 June	Q1-3	1 day
Flora survey	1 July	Q1	1day
Flora Survey	30 July	Q2	1 day
Flora Survey	5 August	Q3	2 days
Flora Survey	20 August	L1	1 day
Flora Survey	7 September	L2	1 day
Flora survey	10 October	L3	1 day
Flora survey	15 November	Q4	1 day

8.5.3 Floristic Analysis

The area of the proposed wind farm is hilly with several wadis (seasonal river valleys) crossing the site. The vegetation is degraded due to overgrazing, plowing and wood collection by local people.

There is no forest at or near the site. A number of farmers and local nomads use the site for livestock grazing (Figure 8-4).

Figure 8-4 Grazing of Livestock at the Project Area by Nomadic Bedouins

The vegetation density was less than 30% due to overgrazing habitat which also causes minimal vegetation diversity in the area. The deterioration in vegetation cover has caused a decrease in the number of mammals, reptiles and some resident bird species.

The general habitat structure is typical of Mediterranean non-forest vegetation (Al Eisawi, 1986).

The dominant species are *Artemisia sieberi*, *Astragalus spinosus*, *Centaurea pallescebs*, *Colchicum ritchii*, *Launea spinosa*, *Noaea mucronata*, *Poa bulbosa* and *Scorzonera judaica*. The vegetation is composed of dwarf shrubs like cushions and the vegetation heights are up to 30-40 cm. The plant species richness is defined as follows:

Q1= 21 species, Q2= 18 species, Q3= 28 species and Q4= 18 species

8.5.4 Phytogeographical region

The Project site lies within the Irano-Turanian eco-zone and Mediterranean, at an attitude of about 1,400 m above sea level. The main bioclimatic zones in the region are shown in Figure 8-5.

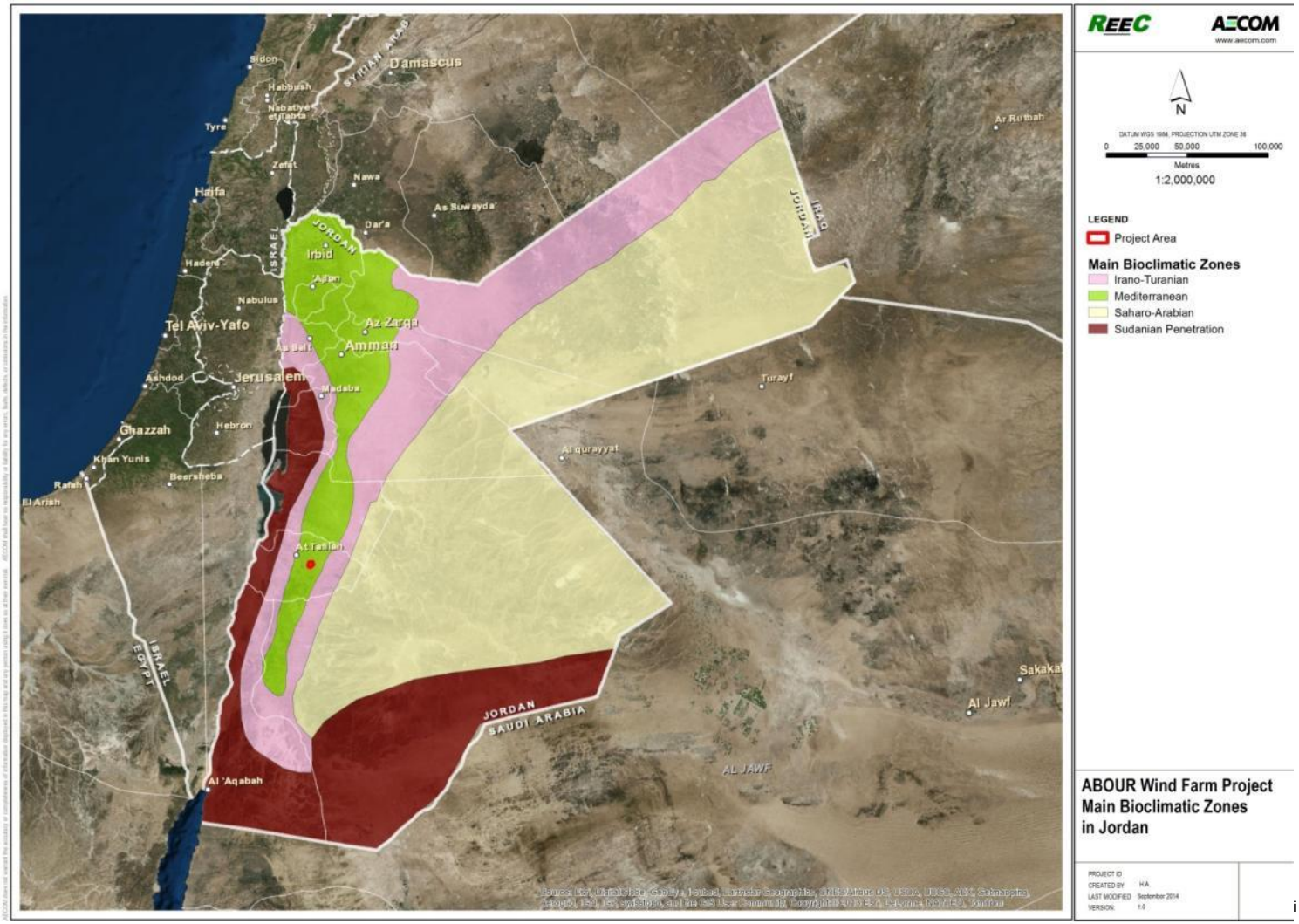

Figure 8-5 Main Bioclimatic Zones in Jordan

On its eastern borders, the Project site is located at approximately 10 km from Dana Biosphere Reserve, a resting and feeding zone for migrating birds and also a habitat for local birds. Figure 8-6 shows the typical habitat of the Project area.

Figure 8-6 Typical Habitats of the Project Area

8.5.5 Flora Survey Results

There was relatively rich vegetation cover at the time of field survey due to seasonal floods in the wadis of the area, where more flowering plants and animal signs were recorded. The Project site exhibits both Irano-Turanian and Mediterranean features in many aspects as shown in Table 8.3.

Table 8-3 shows the different flora species found in the Project site according to the spring 2013 and fall 2013 survey results.

Table 8-3 Flora Species Found in the Project Area in Spring and Fall 2013

Species (+/-)	PHYTO-GEOGRAPHIC REGION	HABITAT	END.	IUCN	CITES	BERN
Asteraceae						
Achillea falcate	M	Light soil		NE	-	-
Achillea santolina	DD	DD	DD	NE	-	-
Artemisia herba-alba	DD	DD	DD	NE	-	-
Tragopogon collinus	DD	DD	DD	NE	-	-
Anthemis melampodina	DD	DD	DD	NE	-	-

Species (+/-)	PHYTO-GEOGRAPHIC REGION	HABITAT	END.	IUCN	CITES	BERN
Carlina hispanica	M	Grazed area		NE	-	
Centaurea pallescens	O	Grazed, fields	R	NE	-	
Centaurea ammocyanus	M		-	NE	-	
Crepis sancta	M	Fields	-	NE	-	-
Brassicaceae						
Eruca sativa	DD	Abandoned field		NE	-	-
Mathiola longipetala	DD	Rocky slopes	DD	NE	-	-
Ranunculaceae						
Adonis cupaniana	M	Light soil abandoned field		NE	-	-
Adonis dentate	M	Light soil		NE	-	-
Anchusa strigosa	M	Fields, grazed area		NE	-	
Papilionaceae						
Astragalus sanctus	M	Fields		NE	-	-
Artemisia sieberi	O	Degraded, grazed		NE	-	-
Astragalus spinosus	T	Grazed area		NE	-	
Berberidaceae						
Bongardia chrysogonum	M	Fields		NE	-	
Leontice leontopetalum	DD	Fields		NE	-	-
Cruciferae						
Cardaria draba	M	Roads, wastes		NE	-	
Causinia moabitica	M	Grazed area	R	NE	-	
Liliaceae						
Colchicum ritchii	O	Grazed area	R	NE	-	
Cruciferae						
Diplotaxis erucoides	M	Fields	-	NE	-	-
Diplotaxis harra	TDX	Grazed area	-	NE	-	-
Umbelliferae						
Eryngium glomeratum	MT	Grazed area	-	NE	-	-
Euphorbiaceae						
Euphorbia spsphierosolymitana	M		-	NE	-	-
Liliaceae						
Gagea commutate	M	Light soil, Grazed area	-	NE	-	-
Geraniaceae						
Geranium tuberosum	M	Fields	F	NE	-	-
Erodium hirtum	DD	DD	DD	NE	-	-
Papaveraceae						

Species (+/-)	PHYTO-GEOGRAPHIC REGION	HABITAT	END.	IUCN	CITES	BERN
Glausium grandiflorum	O	Road sides	R	NE	-	-
Caryophyllaceae						
Gypsophila Arabica	T	Grazed area	-	NE	-	-
Silene conoidea	DD	Fields	DD	NE	-	-
Solanaceae						
Hayoscyamus spreticulatush hhreticulates	T	Fields	-	NE	-	-
Cistaceae						
Helianthemum vesicarium	T	Fields	-	NE	-	-
Amaryllidaceae						
Ixiolirion tataricum	M	Fields	R	NE	-	-
Compositae (Asteraceae)						
Lactuca undulate	M	Grazed area	-	NE	-	-
Launea spinosa	T	Grazed area	-	NE	-	-
Launea undulate	M	Grazed area	-	NE	-	-
Fumariaceae						
Hypecoum procumbens	M	Abandoned field		NE	-	-
Iridaceae						
Gynandriris sisyrinchium	M	Maquis and calcareous hills		NE	-	-
Lamiaceae						
Ajuca chia	DD	DD	DD	NE	-	-
Salvia palaeastina	DD	DD	DD	NE	-	-
Salvia lanigera	DD	DD	DD	NE	-	-
Fabaceae	DD	DD	DD			
Astragalus cretaceous	DD	DD	DD	NE	-	-
Gramineae (Poaceae)						
Lolium rigidum	MT	Grazed, fields	-	NE	-	-
Poa bulbosa	MTD	Grazed area	-	NE	-	-
Aegilops crassa	DD	DD	DD	NE	-	-
Avena sterillis	DD	DD	DD	NE	-	-
Hordeum glaucum	DD	DD	DD	NE	-	-
Hordeum spontaneum	DD	DD	DD	NE	-	-
Piptatherum holciforme	DD	DD	DD	NE	-	-
Schismus barbatus	DD	DD	DD	NE	-	-
Malvaceae						
Malva neglecta	MT	Road sides	-	NE	-	-
Labiatae						

Species (+/-)	PHYTO-GEOGRAPHIC REGION	HABITAT	END.	IUCN	CITES	BERN
Marrubium cuneatum	M	Grazed area	R	NE	-	-
Marrubium vulgare	M	Grazed area	-	NE	-	-
Cruciferae						
Matthiola longipetala	M	Grazed area	-	NE	-	-
Chenopodiaceae						
Noaea mucronata	MT	Grazed area	-	NE	-	-
Labiatae (Lamiaceae)						
Nepeta involucrate	O	Grazed, rocky	R	NE	-	-
Boraginaceae						
Alkanna tinctoria	DD	DD	DD	NE	-	-
Salsoleae						
Anabasis syriaca	DD	DD	DD	NE	-	-
Papilionaceae						
Onobrychis montanum	O	Grazed, fields	R	NE	-	-
Ononis natrix	MT	Chalky	-	NE	-	-
Liliaceae						
Ornithogalum montanum	MT	Grazed, fields	-	NE	-	-
Papaveraceae						
Papaver syriacum	M	Grazed area	-	NE	-	-
Compositae						
Picnomon acarna	MT	Grazed, fields	-	NE	-	-
Papaveraceae						
Roemeria hybrid	MT	Fields	F	NE	-	-
Ranunculaceae						
Runanculus damascenum	M	Fields, grazed	-	NE	-	-
Labiatae						
Salvia ceratophylla	O	Fields, grazed	R	NE	-	-
Umbelliferae (Apiaceae)						
Scandix stellata	O	Fields	R	NE	-	-
Cruciferae						
Schimpera Arabica	O	Fields	-	NE	-	-
Scrophulariaceae						
Schropholaria xanthoglossum	T	Fields, grazed	-	NE	-	-
Compositae						
Scorzonera judiaca	MT	Grazed area	-	NE	-	-
Scorzonera papposa	M	Grazed area	-	NE	-	-
Scrophulariaceae						
Schropholaria xanthoglossum	T	Fields, grazed	-	NE	-	-

Species (+/-)	PHYTO-GEOGRAPHIC REGION	HABITAT	END.	IUCN	CITES	BERN
Caryophyllaceae						
Silene sp.	T	Fields, grazed	-	-	-	-
Scrophulariaceae						
Verbascum fruticulosum	MT	Grazed	F	NE	-	-

ABREVIATIONS		
M; Mediterranean	DX: extreme desert	O: Montana=Mediterranean
T: Transition	R: Rare	F: frequent
EX: Extinct	NT: Near Threatened	NE: Not Evaluated
EW: Extinct In The Wild	LC: Least Concern	EN: Endangered
CR: Critically Endangered	DD: Data Deficient	VU: Vulnerable

8.6 Fauna

8.6.1 Field surveys

Fauna surveys were designed to collect information on the presence, distribution and habitat use of important functional terrestrial fauna elements and species of special interest. Linear transects of 500 m length and quadratic transects with 400 m squares for reptiles and mammals. The surveys focused on vertebrates because of their importance in ecosystem function and status.

Table 8-4 shows field visits of a total of 19 days and these included:

- Mammals
- Reptiles
- Soaring Birds

Table 8-4 Field Visits in Spring and Fall 2013 for Fauna Surveys

Survey field visit	Date	No of Days
Habitat Assessment	17-19 March	3 days
Fauna Mammals	20-21 April	2 day
Fauna Mammals	10-12 May	2 days
Fauna Reptiles	20 April	1 day
Fauna Reptiles	10 May	1 day
Fauna Mammals	20 June	3 days
Fauna Mammals	1 July	2 day
Fauna Mammals	30 July	2 days
Fauna Reptiles	5 August	2 day
Fauna Reptiles	20 September	1 day

Line-transects were conducted at the site. Each transact was examined carefully for the presence of living animals, animal signs and tracks, active burrows, remains or any other vital signs that indicate the activity of animals.

In addition to the field observations, local farmers and labourers were queried if they had noticed the presence of certain species. Their observations were interpreted based on precise descriptions of some key species or commonly-known species which are difficult to be mistaken.

8.6.2 Fauna Literature Review

The review relied on previous studies and surveys conducted in the area, specially the national IBA inventory. Literature review was conducted for reptiles, birds and mammals. The records are available in hard copies or published electronically. Currently Jordan has no official conservation status for the fauna. However, the conservation status of birds was defined according to International Union for the Conservation of Nature (IUCN) Red List.

As for reptiles and mammals, the conservation status was determined according to published data by (Z. Amr, 2012*)*. Some scattered information on the natural history of the area is published along with other studies on fauna. A study on the reptiles of southern Jordan, (El -Oran *et al.,* 1994) collected several snake species in the vicinity.

Disi *et al., (*2000) included records of various lizards from Shobak area close to the Project area, covering both the Irano-Turanian and the Mediterranean bio climates. Additionally, Disi & Hatough-Bouran, (1999) reported one species of amphibians and 42 species and subspecies of reptiles belonging to two orders and twelve families; they indicated that two reptilian species--European Chameleon and Roth's Dwarf Snake and eleven species of mammals were found in the area as well as one rare and endangered species, *Hyaena hyaena.*

There are several studies available on the mammals of southern Jordan, particularly at Dana Biosphere Reserve. Amr *et al.,* (1995) studied the carnivores of the reserve, where they reported on the occurrence of seven species. Some of these species (i.e. the Red Fox, *Vulpes vulpes*) have a wide home range that may extend several kilometers.

Furthermore, Catullo *et al.,* (1996) investigated the status of the Nubian Ibex, *Capra nubiana*, in Dana Biosphere Reserve with notes on its distribution within the area. Disi & Hatough- Bouran, (1999) reported on the occurrence of 29 species of mammals belonging to six orders and 14 families that were found in the area of Petra.

8.6.3 Amphibians

No amphibians were expected in the study area in addition to the fact that amphibians have never been recorded previously.

8.6.4 Reptilians

Reptilian Survey Method

Fauna surveys were designed to collect information on the presence, distribution and habitat use of important functional terrestrials and species of special interest. Linear transects of 500 m length and quadratic transects with 400 m squares for reptiles and mammals. The surveys focused on vertebrates (reptiles) because of their importance in ecosystem function and status.

Reptiles were surveyed in conjunction with bird and mammal surveys. Incidental observations were recorded (e.g. live and dead snakes along access roads). Searches were conducted in selected microhabitats (e.g. beneath rocks, along wadi systems and at crossings and convergences), night-lighting for nocturnal animals and information from local residents.

Reptiles were surveyed by walking transects in each of the flora sampling locations (see above) so that much of the data for plants and animals is co-located. Additional habitats (vegetation edge, man-made features) were surveyed for wildlife.

Line-transects were conducted at the site. Each transect was scanned to search alive animals or their signs such as foot prints, scat or nesting / burrowing areas. In addition to the field observations, local farmers and labourers were asked if they have noticed the presence of certain species. Their observations were interpreted based on precise descriptions of some key species or commonly-known species which are difficult to mistake.

Reptilian Survey Results

The area is impacted somewhat by agriculture and heavily by grazing activities. Only general fauna species were observed on the site. The following reptiles were recorded through observation at daytime especially in the morning. Formal consultation with local farmers and Semi-Nomadic herders living in the area indicated presence of reptile species.

In total 19 species of reptilians were recorded during spring and fall 2013 in the Project area and its vicinity. Table 8-5 shows the species and their conservation status.

Figure 8-7 Spur-Thighed Tortoise at the Project site

Table 8-5 Reptile Species List of the Project Area

Species	Common Name	IUCN Red List Status	CITES	Bern
Family Gekkonidae				
Ptyodactylus hasselquistii	Fan-footed Gecko	Not Evaluated	-	App-3
Ptyodactylus guttattus	Spoted Fan-footed Gecko	Least Concern	-	App-3
Family Chamaeleonidae				
Chamaeleo chamaeleon	Mediterranean Chameleon	Least Concern	-	App-2
Family Agamidae				
Stellagma stellio	Starred Agama	Least Concern	-	App-3
Family Lacertidae				
Acanthodactylus boskianus	Bosk's Fringe-toad Lizzard	Not Evaluated	-	App-3
Ophisops elegans	Sanke-eyed Lizard	Not Evaluated	-	App-2
Family Scincidae				
Chalcides ocellatus	Ocellated Skink	Not Evaluated	-	App-2
Family Colubridae				
Dolichophis jugularis	Large whip Snake	Least Concern	-	App-3
Platyceps collaris	Red whip Snake	Least Concern	-	App-3
Coluber nummifer	Coin Snake	Not Evaluated	-	App-3
Eirenis rothi	Collared Dwarf Snake	Least Concern	-	App-3
Eirenis coronella	Crowned dwarf Snake	Least Concern	-	App-3
Malpolon monspessulanus	Montpellier Snake	Least Concern	-	App-3
Telescopus nigriceps	Black-headed Snake	Least Concern	-	App-3
Lytorhynchus diadema	Diademed Sand Snake	Least Concern	-	App-3

Species	Common Name	IUCN Red List Status	CITES	Bern
Platyceps rhodorachis	Jan's Whip Snake	Not Evaluated	-	App-3
Psammophis schokari	Forskål's Sand Snake	Not Evaluated (common)	-	App-3
Telescopus hoogstraali	The Black Cat Snake	Endangered	-	App-3
Family Testudinidae				
Testuedo graeca	Spur-thighed tortoise	Vulnerable	-	App-3

8.6.5 Birds

Jordan is located along one of the most important migration flyways in the world, namely the Great Rift Valley / Red Sea Flyway. Millions of birds fly along this flyway biannually from north to south in autumn and in the opposite direction the spring season when the birds will be heading to their breeding grounds. The Great Rift Valley passes by the western side of the country and constitutes a critical flyway passing through the country as shown in Figure 8-8 below.

Figure 8-8 Migration routes through Jordan and the region

(Source: http://migratorysoaringbirds.undo.birdlife.org/en/flyway)

Spring migration in Jordan starts approximately in late February and continues until early May, depending on the species that pass through. During the spring migration, birds migrate from the south in Africa to the north in Europe and Russia in order to go back to their breeding grounds. In autumn, birds migrate in the opposite direction from Europe south to Africa in order to avoid the cold weather in the northern parts of the northern hemisphere and they spend winter in Africa; although some other species have shorter journeys and they spend winter in the Middle East, including Jordan.

8.6.5.1 Importance of Jordan for Migration

The Rift Valley in general is part of the major routes for annual bird migrations between Asia, Europe and Africa (Figure 8-9). The area of Dana Biosphere Reserve is a huge resting habitat for migratory birds. It serves as a stopover site during their fall migration to Africa and their spring migration to Europe and Asia. Being at the crossroads of Europe, Africa and Asia, Jordan serves as a natural bridge for birds migrating between their breeding areas in Europe and Asia, and their winter quarters in Africa.

Although many bird species migrate across broad fronts, several congregate along established corridors while migrating. As a result, enormous concentrations of tens of thousands of birds regularly and predictably occur at specific geographical features, especially along mountain ridges and passes, narrow coastal plains, isthmuses and peninsulas. Migration corridors usually occur along what are known as “leading lines”, which are geographic or topographic features such as mountain ranges and coastlines that are oriented along or near the preferred direction of travel.

The Great Rift Valley in Jordan forms such an important corridor for migration, where the adjacent mountain ridges are important and crucial leading lines for soaring migratory birds. The Sharah Mountains are an excellent example for a migration corridor.

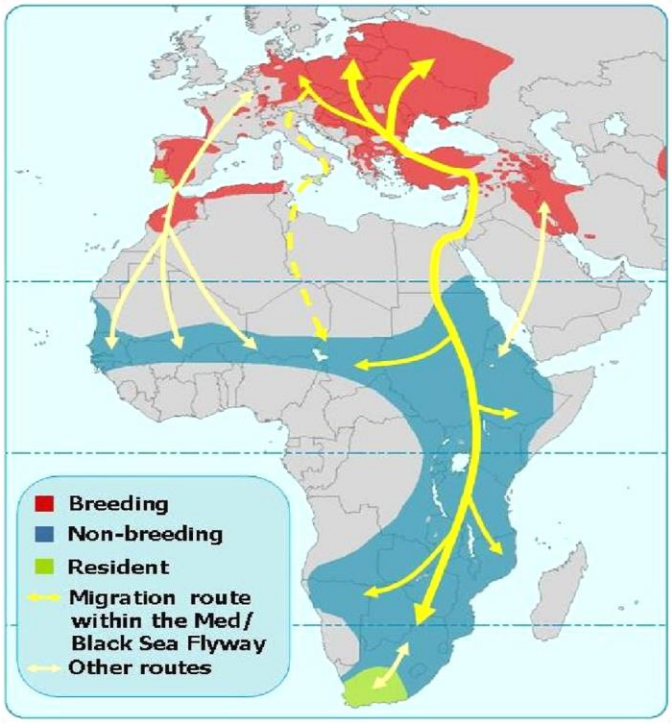

Figure 8-9 Global Migration Pathways through Great Rift Valley

(Source: http://www.birdlife.org/datazone/userfiles/file)

According to BirdLife International, at least 2 million migratory soaring birds pass along the Rift Valley-Red Sea flyway. Many of these species breed in mid and Eastern Europe and a significant portion of their entire population pass through the region. Indeed, the entire population of species such as the Lesser Spotted Eagle and White Stork passes through the area twice a year. Moreover, dozens of these species are listed as globally threatened by (IUCN).

8.6.5.2 Importance of Project Area for Migration

The Project area is located to the northeast of the Dana Biosphere Reserve and Dana Important Bird Area, which engulfs the reserve as a whole. According to the literature survey, the Project area is not a part of the IBA, but is adjacent to the IBA. The distance between Dana Reserve and the Project area is approximately 8 km. It is assumed that the IBA boundary cannot be regarded to be strict and sharp drawn but rather as a sketch of a zone deserving protection.

Aim of the Study

An aim of the field surveys was to identify patterns of visible bird migration within and adjacent to the Project site, with a particular focus on the migration of raptors and storks, which are known to be sensitive to wind farm development.

A further aim of the survey was to record flight activity of target species that might occur within or close to the Project site. All soaring migrants on passage or resident were recorded throughout the observation time. Recorded data includes the species, number of individuals on passage (if in flock), height of bird from substrate, direction, duration spent on site (in a radius of 2 km) and behavior.

The avifauna research focused on the transit and resident soaring birds. The soaring birds are large bodied birds that use the raising thermals and updraft air while they migrate. This compels them to avoid the crossing of large water bodies. The navigation around the Black Sea, Caspian Sea, Mediterranean and Red Sea brings most of the soaring birds into the Middle East.

Methodology

Field surveys were conducted for 5 migration seasons in total in order to make an assessment of the ornithological value of the Project site and identify potential ornithological constraints.

In order to achieve a suitable level of survey both across the spring and autumn, survey periods were timed and stratified to coincide with the peak migration periods for a number of species that are known to migrate through Jordan. Target species for the purposes of this study included all herons, ducks, waders, cranes, bustards and especially storks and raptors, while the majority of the recorded species during the surveys have been consisted of raptors.

8.6.5.3 Survey Area and Vantage Point Surveys

The survey is based on a methodology for counting migrating raptors, storks and some passerines from vantage points (on high ground) as described in Sutherland (2006). The survey method was also consistent with the vantage point survey guidance published by Scottish Natural Heritage (SNH, 2005) which has been used in ornithological wind farm assessments throughout the United Kingdom and is broadly applicable to the assessment of wind farm proposals in Jordan.

Vantage Point (VP) watches are a means of quantifying flight activity of bird species of conservation importance that take place within the wind farm envelope, with the principal aim of determining the likely collision risk. Activity patterns and time spent flying within the turbine envelope may also allow an assessment of the consequences of displacement assuming that the turbines are built.

Two different vantage points have been used during the observations in the Project area. While the VP1 remains stable, there has been a change in VP2 after the surveys in 2013 in order to have a broader idea of the migration both in and the vicinity of the Project area and compare the area with adjacent area having same type of habitat.

-VP1 is on the north part of the Project area.

- While the VP2 in 2013 is on the outside of the Project area on north-west, the VP2 in 2014 and 2015 is inside of the Project area on the south of VP1.

-The map of the area showing the vantage points is given below (Figure 8-10). The coordinates and elevations of the VPs are given below (Table 8-6).

Table 8-6 Vantage Points Coordinates and Elevations

Vantage Point	Coordinates		Elevation
VP1	30°47'27.40"N	35°41'30.30"E	1338 m
VP2 (2013)	30°48'30.51"N	35°38'33.64"E	1311 m
VP2 (2014)	30°46'33.76"N	35°41'28.70"E	1381 m

The vantage point surveys were performed under the supervision of AECOM Turkey for the four seasons of spring and autumn 2013 and spring and autumn 2014.

The surveys for the spring migration period of 2015 were undertaken by Natural Research Projects on and around the site of the proposed Abour Wind Farm and referred to as “the Development”, and was jointly commissioned by the International Finance Corporation (IFC) and Abour Energy Company (AEC).

The spring 2013 survey was conducted for total of 8 days between 22.03.2013 and 18.05.2013 on two vantage points by Laith El-Moghrabi and his team on VP1 and VP2 (2013).

The autumn 2013 survey was conducted for 8 days between 28.08.2013 and 01.11.2013 on the same two vantage points by Laith El-Moghrabi and his team.

The spring 2014 survey was conducted for 13 days between 21.03.2014 and 14.04.2014 on two vantage points. While one vantage point remained the same as the previous year, location of the second vantage point was changed. The survey was conducted by Anton Issa Khalilieh and Talal Bani Oudeh.

The autumn 2014 survey was conducted for 15 days between 05.09.2014 and 01.11.2014 on the same two vantage points of the previous season. The surveys were conducted by Ibrahim K. Al-Hasani and Anwar Fahd Elhalah.

The spring migration 2015 was undertaken by Natural Research Projects for 58 days between 03.04.2015 and 31.05.2015.

Each observation day on each survey season during 2013 and 2014 in a vantage point lasted for at least seven-and-half hours. The start and end of each observation day ranged between 07:15 and 10:00 and the end time between 16:00 and 18:00. Two expert bird watchers counted and recorded bird movements simultaneously in two vantage points (a single expert bird watcher in each vantage point).

Observation effort on 2015 spring migration was stratified across four daylight periods (termed “Early Morning”, “Late Morning”, “Early Afternoon” and “Late Afternoon”) to allow for bimodal variation in diurnal flight activity. “Early morning”/”Late Morning” watches were conducted between dawn-10:00 hrs/10:00-13:00 hrs and “Early Afternoon”/”Late afternoon” watches were conducted between 13:00-16:00 hrs/16:00 hrs-dusk, with a break of a minimum of 30 minutes between consecutive watches by the same observer to prevent fatigue.

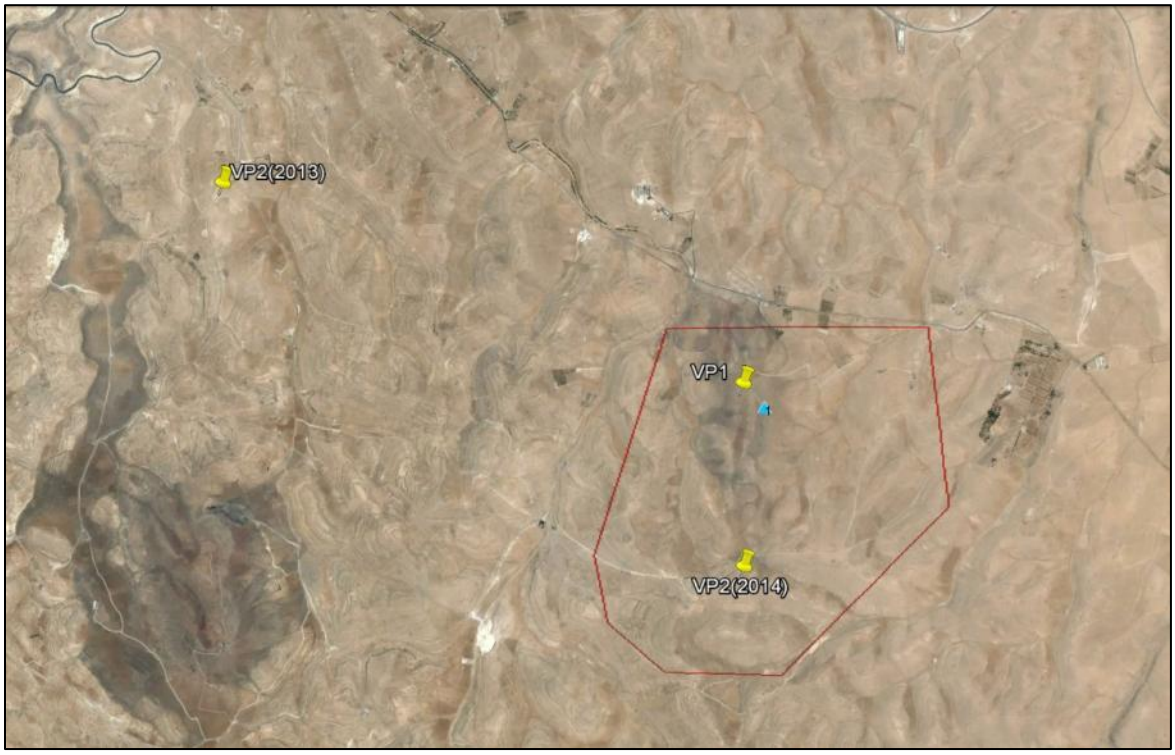

Figure 8-10 Locations of Vantage Points

8.6.5.4 Recording Effort

The vantage point surveys were performed under the supervision of AECOM Turkey for the four seasons of 2013 and 2014 spring and autumn.

The surveys for the spring migration period of 2015 were undertaken by Natural Research Projects (NRP) on and vicinity of the site of the proposed Abour Wind Farm and was jointly commissioned by the International Finance Corporation (IFC) and Abour Energy Company (AEC).

It should be noted that the differences between the methodologies conducted by AECOM and NRP especially in terms of data collection cause some results not to be comparible although the difference is not so critical.

The spring 2013 survey was conducted for total of 8 days between 22.03.2013 and 18.05.2013 on two vantage points by Laith El-Moghrabi and his team on VP1 and VP2 (2013).

The autumn 2013 survey was conducted for 8 days between 28.08.2013 and 01.11.2013 on the same two vantage points by Laith El-Moghrabi and his team.

The spring 2014 survey was conducted for 13 days between 21.03.2014 and 14.04.2014 on two vantage points. While one vantage point remained the same as the previous year, location of the second vantage point was changed. The survey was conducted by Anton Issa Khalilieh and Talal Bani Oudeh.

The autumn 2014 survey was conducted for 15 days between 05.09.2014 and 01.11.2014 on the same two vantage points of the previous season. The surveys were conducted by Ibrahim K. Al-Hasani and Anwar Fahd Elhalah.

The spring migration 2015 was undertaken by Natural Research Projects for 58 days between 03.04.2015 and 31.05.2015. The surveys were conducted by Laith El-Mogrhabi (LEM), Abdullah Rumman (ABD), Ashraf Elhalah (AE), Osama Smadi (OS) and Ibrahim Hasani (IH).

Each observation day on each survey season on 2013 and 2014 in a vantage point lasted for at least seven-and-half hours. The start and end of each observation day ranged between 07:15 and 10:00 and the end time between 16:00 and 18:00. Two expert bird watchers counted and recorded bird movements simultaneously in two vantage points (a single expert bird watcher in each vantage point).

Observation effort on 2015 spring migration was stratified across four daylight periods (termed “Early Morning”, “Late Morning”, “Early Afternoon” and “Late Afternoon”) to allow for variation in diurnal flight activity. “Early morning”/”Late Morning” watches were conducted between dawn-10:00 hrs/10:00-13:00 hrs and “Early Afternoon”/”Late afternoon” watches were conducted between 13:00-16:00 hrs/16:00 hrs-dusk, with a break of a minimum of 30 minutes between consecutive watches by the same observer to prevent fatigue.

The recording effort during 5 seasons of surveys is given in the table below (Table 8-7).

Table 8-7 Recording Effort during 5 Seasons of Surveys

Survey Season	Date	Surveyor	Starting Time	Ending Time	Duration of Survey (hour-minute)	Wind Direction and Speed	Temperature (^{0}C)	Cloud Cover (*)	VP No
Spring 2013	22.03.2013		08:00	16:00	8 hours	No weather parameters were collected for this season and mat mast was installed during this season			VP1
	29.03.2013		08:00	16:00	8 hours				VP1
	05.04.2013		08:00	16:00	8 hours				VP1
	12.04.2013		08:00	16:00	8 hours				VP1
	26.04.2013		08:00	16:00	8 hours				VP1
	02.05.2013		08:00	16:00	8 hours				VP1
	09.05.2013		08:00	16:00	8 hours				VP1
	17.05.2013		08:00	16:00	8 hours				VP1
Autumn 2013	28.08.2013		08:00	16:00	8 hours	NE-NW / 25	26		VP1
	28.08.2013		08:00	16:00	8 hours	NE-NW / 25	26		VP2
	05.09.2013		08:00	16:00	8 hours	NW / 22	22		VP1
	05.09.2013		08:00	16:00	8 hours	NW / 22	22		VP2
	15.09.2013		08:00	16:00	8 hours	W–NW / 25	24		VP1
	15.09.2013		08:00	16:00	8 hours	W-NW / 25	24		VP2
	24.09.2013		08:00	16:00	8 hours	W-NW / 37	17		VP1
	24.09.2013		08:00	16:00	8 hours	W-NW / 37	17		VP2
	04.10.2013		08:00	16:00	8 hours	W-NW / 37	15		VP1
	04.10.2013		08:00	16:00	8 hours	W-NW / 37	15		VP2
	16.10.2013		08:00	16:00	8 hours	SE-SW / 17	21		VP1
	16.10.2013		08:00	16:00	8 hours	SE-SW /17	21		VP2
	25.10.2013		08:00	16:00	8 hours	W-NW / 21	16		VP1
	25.10.2013		08:00	16:00	8 hours	W-NW / 21	16		VP2
	01.11.2013		08:00	16:00	8 hours	NE-NW /13	13		VP1
	01.11.2013		08:00	16:00	8 hours	NE-NW / 13	13		VP2
Spring 2014	21.03.2014	A.K.	07:30	18:10	10 hours 40 minutes	SW / 13-17	07 - 13	25%	VP1
	21.03.2014	T.O.	07:30	18:10	10 hours 40 minutes	SW / 13-17	07 - 13	25%	VP2
	22.03.2014	A.K.	07:20	18:00	10 hours 40 minutes	SW / 8-14	10 - 17	7%	VP1
	22.03.2014	T.O.	07:20	18:00	10 hours 40 minutes	SW / 8-14	10 - 17	7%	VP2
	23.03.2014	T.O.	07:30	18:00	10 hours 30 minutes	WN-W / 10-30	10 - 17	10-60%	VP1
	23.03.2014	A.K.	07:30	18:00	10 hours 30 minutes	WN-W / 10-30	10 - 17	10-60%	VP2
	29.03.2014	T.O.	08:00	18:00	10 hours	E / 15-30	13-22	8%	VP1
	29.03.2014	A.K.	08:00	18:00	10 hours	E / 15-30	13-22	8%	VP2
	07.04.2014	T.O.	08:00	17:00	9 hours	NN-E / 19-23	24	5%	VP1
	07.04.2014	A.K.	08:00	17:00	9 hours	N-NE / 19-23	24	5%	VP2
	08.04.2014	T.O.	08:00	17:00	9 hours	E-NE / 19-23	24	5%	VP1

Survey Season	Date	Surveyor	Starting Time	Ending Time	Duration of Survey (hour-minute)	Wind Direction and Speed	Temperature (^{0}C)	Cloud Cover (*)	VP No
	08.04.2014	A.K.	08:00	17:00	9 hours	E-NE / 19-23	24	10-15%	VP2
	12.04.2014	A.K.	08:00	18:00	10 hours	SW / 20-30	13	15%	VP1
	12.04.2014	T.O.	08:00	18:00	10 hours	SW / 20-30	13	15%	VP2
	13.04.2014	T.O.	08:00	18:00	10 hours	W-NW / 25-30	25	30%	VP1
	13.04.2014	A.K.	08:00	18:00	10 hours	W-NW / 25-30	25	30%	VP2
	26.04.2014	T.O.	07:30	18:00	10 hours 30 minutes	NW / 10-15	13-27	5%	VP1
	26.04.2014	A.K.	07:30	18:00	10 hours 30 minutes	NW / 10-15	13-27	5%	VP2
	27.04.2014	T.O.	07:30	18:00	10 hours 30 minutes	W-NW / 10	16-27	5%	VP1
	27.04.2014	A.K.	07:30	18:00	10 hours 30 minutes	W-NW / 10	16-27	5%	VP2
	09.05.2014	T.O.	07:30	17:00	9 hours 30 minutes	W-NW / 20-30	13-27	20%	VP1
	09.05.2014	A.K.	07:30	17:00	9 hours 30 minutes	W- NW / 20-30	13-27	20%	VP2
	10.05.2014	T.O.	07:30	17:00	9 hours 30 minutes	W-NW / 20-30	13-27	20%	VP1
	10.05.2014	A.K.	07:30	17:00	9 hours 30 minutes	W-NW / 20-30	13-27	20%	VP2
	14.05.2014	T.O.	07:30	17:00	9 hours 30 minutes	W-NW / 20-30	13-27	20%	VP1
	14.05.2014	A.K.	07:30	17:00	9 hours 30 minutes	W-NW / 20-30	13-27	20%	VP2
Autumn 2014	05.09.2014	İ.A.	08:00	17:00	9 hours	W / 5-8	23	0	VP1
	05.09.2014	A.E.	08:35	17:00	8 hours 25 minutes	W / 5-8	23 - 30	0	VP 2
	12.09.2014	A.E.	08:20	17:00	8 hours 40 minutes	W-NW / 8-26	18 - 27	0	VP 1
	12.09.2014	İ.A.	08:15	17:00	8 hours 45 minutes	W-NW / 8-26	18 - 27	0	VP 2
	13.09.2014	İ.A.	08:30	16:30	8 hours	NW / 10-26	18 - 27	0	VP 1
	13.09.2014	A.E.	08:30	16:30	8 hours	NW / 10-26	18 - 27	0	VP 2
	19.09.2014	A.E.	07:30	17:00	9 hours 30 minutes	NW / 3-27	17 - 26	0	VP 1
	19.09.2014	İ.A.	07:45	17:00	9 hours 15 minutes	NW / 3-27	17 - 26	0	VP 2
	20.09.2014	İ.A.	07:45	16:00	8 hours 15 minutes	NW / 16-31	16 – 31	1	VP 1
	20.09.2014	A.E.	07:40	16:00	8 hours 20 minutes	NW / 16-31	16 - 31	1	VP 2
	26.09.2014	A.E.	07:40	16:00	8 hours 20 minutes	NW / 8-21	17 - 26	2	VP 1
	26.09.2014	İ.A.	07:45	16:00	8 hours 15 minutes	NW / 8-21	17 - 26	2	VP 2
	27.09.2014	İ.A.	08:00	16:00	8 hours	SW / 2-16	19 - 29	2	VP 1
	27.09.2014	A.E.	08:00	16:00	8 hours	SW / 2-16	19 - 29	2	VP 2
	02.10.2014	İ.A.	07:30	16:00	7 hours 30 minutes	NW / 10-26	16 - 24	4	VP 1
	02.10.2014	A.E.	07:30	16:00	7 hours 30 minutes	NW / 10-26	16 - 24	4	VP 2
	08.10.2014	İ.A.	08:00	16:30	8 hours 30 minutes	W / 5-7	24 - 27	3	VP 1

Survey Season	Date	Surveyor	Starting Time	Ending Time	Duration of Survey (hour-minute)	Wind Direction and Speed	Temperature (^{0}C)	Cloud Cover (*)	VP No
	08.10.2014	A.E.	08:00	16:30	8 hours 30 minutes	W / 5-7	24 - 27	3	VP 2
	09.10.2014	A.E.	08:00	16:30	8 hours 30 minutes	SE-NW / 3-16	20 - 26	5	VP 1
	09.10.2014	İ.A.	08:00	16:30	8 hours 30 minutes	SE-NW / 3-16	20 - 26	5	VP2
	17.10.2014	A.E.	08:00	16:30	8 hours 30 minutes	W-NW / 11-13	14 - 22	0	VP1
	17.10.2014	İ.A.	08:00	16:30	8 hours 30 minutes	W-NW / 11-13	14 - 22	0	VP2
	18.10.2014	A.E.	08:00	16:30	8 hours 30 minutes	W / 4-6	14 - 23	0	VP1
	18.10.2014	İ.A.	08:00	16:30	8 hours 30 minutes	W / 4-6	14 - 23	0	VP2
	24.10.2014	A.E.	08:00	16:30	8 hours 30 minutes	S-W / 11-13	12 - 21	0	VP1
	24.10.2014	İ.A.	08:00	16:30	8 hours 30 minutes	S-W / 11-13	12 - 21	0	VP2
	25.10.2014	A.E.	08:00	16:30	8 hours 30 minutes	W-NW / 13	13 - 24	0	VP1
	25.10.2014	İ.A.	08:00	16:30	8 hours 30 minutes	W-NW / 13	13 - 24	0	VP2
	01.11.2014	A.E.	07:00	15:30	8 hours 30 minutes	W / 24	13 - 17	5	VP1
	01.11.2014	İ.A.	07:00	15:30	8 hours 30 minutes	W / 24	13 - 17	5	VP2
Spring 2015	03.04.2015	AE	7:30	1730	10 hours	SW /3	14	10	VP1
	04.04.2015	IH	7:30	1800	10 hours	W / 4	15	10	VP2
	06.04.2015	AE	7:30	1730	10 hours	E / 2	?	0	VP1
	07.04.2015	IH	7:30	1730	10 hours	NW /3	23	0	VP2
	10.04.2015	AE	7:30	1730	10 hours	NW / 3	10	7	VP1
	11.04.2015	IH	7:30	1730	10 hours	W-SW /4	6	9	VP2
	14.04.2015	OS	7:30	1730	10 hours	W-SW / 2	15	1	VP2
	15.04.2015	AE	7:30	1730	10 hours	E / 3	15	0	VP1
	16.04.2015	ABD	1200	1730	10 hours	W / 4	10	6	VP2
	17.04.2015	IH	730	1730	10 hours	NW / 2	14	2	VP1
	18.04.2015	IH	730	1730	10 hours	SW / 4	18	0	VP2
	22.04.2015	IH	730	1730	10 hours	W / 4	18	1	VP2
	23.04.2015	AE	730	1730	10 hours	W / 5	13	6	VP1
	24.04.2015	AE	730	1730	10 hours	W / 2	14	4	VP1
	25.04.2015	OS	730	1730	10 hours	SE / 3	17	0	VP2

Survey Season	Date	Surveyor	Starting Time	Ending Time	Duration of Survey (hour-minute)	Wind Direction and Speed	Temperature (^{0}C)	Cloud Cover (*)	VP No
	28.04.2015	Abd	730	1730	10 hours	SW / 1	0	25	VP1
	29.04.2015	IH	730	1730	10 hours	S / 4	0	26	VP2
	01.05.2015	AE	730	1730	10 hours	W / 3	23	0	VP1
	02.05.2015	OS	730	1730	10 hours	W / 2	20	0	VP2
	05.05.2015	AE	730	1730	10 hours	NW / 2	20	0	VP1
	06.05.2015	ABD	730	1730	10 hours	E / 2	20	0	VP2
	08.05.2015	OS	730	1730	10 hours	W / 3	25	3	VP1
	09.05.2015	OS	730	1730	10 hours	W / 3	23	1	VP2
	11.05.2015	LEM	730	1730	10 hours	SW / 2	25	3	VP1
	12.05.2015	IH	730	1730	10 hours	W / 2	20	2	VP2
	15.05.2015	AE	730	1730	10 hours	NW / 4	20	0	VP1
	16.05.2015	IH	730	1730	10 hours	SE-E / 3	21	0	VP2
	21.05.2015	AE	730	1730	10 hours	NW / 3	24	0	VP1
	23.05.2015	AE	730	1730	10 hours	W / 4	23	3	VP2
	28.05.2015	AE	730	1730	10 hours	W / 3	31	1	VP1
	30.05.2015	IH	730	1730	10 hours	W / 3	20	0	VP2

***The cloud cover data was collected as percentages in spring 2014 survey while it was collected as okta scales in autumn 2014 and spring 2015 surveys.**

8.6.5.5 Results and Discussions

The species observed and the number of individuals of these species for five seasons are given in Figure 8-11 below.

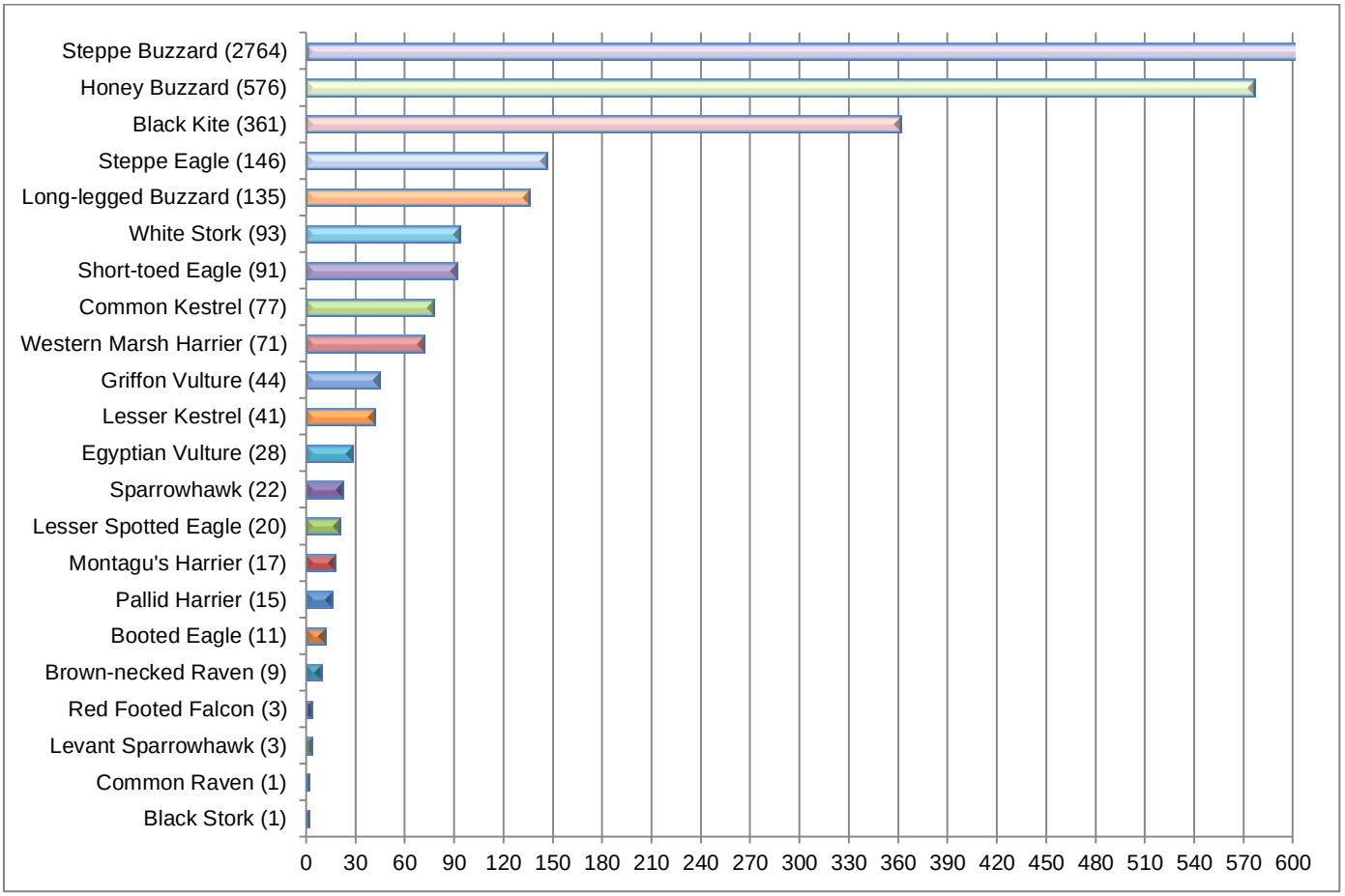

Figure 8-11 Number of Each Species Recorded along 5 Seasons of Surveys

Target species recorded in the Project area are given in Table 8-8.

As well as soaring birds, all recorded bird species in the region are listed in Table 8-9.

Table 8-8 Target Bird Species in the Study Area

Scientific Name	Common Name	Status in and the Vicinity of the Project Area	Number of Records	IUCN Status	CITES Status	Bern Status
Ciconia nigra	Black Stork	MSB	1	LC	App II	App II
Ciconia ciconia	White Stork	MSB	93	LC	-	App II
Gyps fulvus	Griffon Vulture	Resident and summer breeding populations	44	LC	App II	App II
Neophron percnopterus	Egyptian Vulture	MSB/ Occasionaly foraging	28	EN	App II	App II
Clanga pomarina	Lesser Spotted Eagle	MSB	20	LC	App II	App II
Aquila nipalensis	Steppe Eagle	MSB	146	LC	App II	App II
Circaetus gallicus	Short-toed Snake Eagle	MSB/ Resident and summer breeding populations	91	LC	App II	App II
Hieraaetus pennatus	Booted Eagle	MSB	11	LC	App II	App II
Milvus migrans	Black Kite	MSB	361	LC	App II	App II
Circus aeruginosus	Western Marsh Harrier	MSB	71	LC	App II	App II
Circus pygargus	Montagu's Harrier	MSB	17	LC	App II	App II
Circus macrourus	Pallid Harrier	MSB	15	NT	App II	App II
Buteo rufinus	Long-legged Buzzard	Resident and summer breeding populations	135	LC	App II	App II
Buteo buteo vulpinus	Steppe Buzzard	MSB	2764	LC	App II	App II
Pernis apivorus	Honey Buzzard	MSB	576	LC	App II	App II
Accipiter nisus	Eurasian Sparrowhawk	MSB	22	LC	App II	App II
Accipiter brevipes	Levant Sparrowhawk	MSB	3	LC	App II	App II
Falco tinnunculus	Common Kestrel	Both resident and MSB individuals	77	LC	App II	App II
Falco naumanni	Lesser Kestrel	Both resident and MSB individuals	41	LC	App II	App II
Falco vespertinus	Red-footed Falcon	MSB	3	NT	App II	App II
Corvus ruficollis	Brown-necked Raven	Residents and summer breeding populations	9	LC	-	App-III
Corvus corax	Common Raven	Residents and summer breeding populations	1	LC	-	App-III

Table 8-9 Non-target Species in and the Vicinity of the Project Area

Species Population Category	Common Name	Species Scientific Name	Reason included	In the Project Area
Category 3: Other migrants and wintering populations	Common Quail	*Coturnix coturnix*	Recorded at TRWPP during bird surveys	-
	European Nightjar	*Caprimulgus europaeus*	Recorded at TRWPP during bird surveys	-
	Alpine Swift	*Tachymarptis melba*	Recorded at TRWPP during bird surveys	+
	Little Swift	*Apus affinis*	Recorded at TRWPP during bird surveys	+
	Pallid Swift	*Apus pallidus*	Recorded at TRWPP during bird surveys	+
	Common Swift	*Apus apus*	Recorded at TRWPP during bird surveys	+
	Common Cuckoo	*Cuculus canorus*	Recorded at TRWPP during bird surveys	+
	Corncrake	*Crex crex*	Recorded at TRWPP during bird surveys	-
	Glossy Ibis	*Plegadis falcinellus*	Recorded at TRWPP during bird surveys	-
	Eurasian Bittern	*Botaurus stellaris*	Recorded at TRWPP during bird surveys	-
	Common Hoopoe	*Upupa epops*	Recorded at TRWPP during bird surveys	-
	European Bee-eater	*Merops apiaster*	Recorded at TRWPP during bird surveys	+
	European Roller	*Coracias garrulus*	Recorded at TRWPP during bird surveys	+
	Eurasian Wryneck	*Jynx torquilla*	Recorded at TRWPP during bird surveys	-
	Merlin	*Falco columbarius*	Recorded at TRWPP during bird surveys	?
	Red-backed Shrike	*Lanius collurio*	Recorded at TRWPP during bird surveys	+
	Woodchat Shrike	*Lanius senator*	Recorded at TRWPP during bird surveys	+
	Masked Shrike	*Lanius nubicus*	Recorded at TRWPP during bird surveys	+
	Eurasian Golden Oriole	*Oriolus oriolus*	Recorded at TRWPP during bird surveys	+
	Sand Martin	*Riparia riparia*	Recorded at TRWPP during bird surveys	+
	Eurasian Crag-martin	*Hirundo rupestris*	Recorded at TRWPP during bird surveys	+
	Barn Swallow	*Hirundo rustica*	Recorded at TRWPP during bird surveys	+
	Red-rumped Swallow	*Hirundo daurica*	Recorded at TRWPP during bird surveys	+
	Northern House-martin	*Delichon urbicum*	Recorded at TRWPP during bird surveys	+

Species Population Category	Common Name	Species Scientific Name	Reason included	In the Project Area
	Calandra Lark	*Melanocorypha calandra*	Recorded at TRWPP during bird surveys	+
	Bimaculated Lark	*Melanocorypha bimaculata*	Recorded at TRWPP during bird surveys	+
	Greater Short-toed Lark	*Calandrella brachydactyla*	Recorded at TRWPP during bird surveys	+
	Wood Lark	*Lullula arborea*	Abour WF report. Listed as occurring in project area	+
	Eurasian Skylark	*Alauda arvensis*	Recorded at TRWPP during bird surveys	+
	Upcher's Warbler	*Hippolais languida*	Listed as population occurring at Dana IBA	+
	Willow Warbler	*Phylloscopus trochilus*	Recorded at TRWPP during bird surveys	+
	Common Chiffchaff	*Phylloscopus collybita*	Recorded at TRWPP during bird surveys	+
	Common Chiffchaff (Wintering)	*Phylloscopus collybita*	Recorded at TRWPP during bird surveys	+
	Wood Warbler	*Phylloscopus sibilatrix*	Recorded at TRWPP during bird surveys	-
	Blackcap	*Sylvia atricapilla*	Recorded at TRWPP during bird surveys	+
	Garden Warbler	*Sylvia borin*	Abour WF report. Listed as occurring in project area	+
	Common Whitethroat	*Sylvia communis*	Recorded at TRWPP during bird surveys	+
	Lesser Whitethroat	*Sylvia curruca*	Recorded at TRWPP during bird surveys	+
	Common Starling	*Sturnus vulgaris*	Recorded at TRWPP during bird surveys	+
	Eurasian Blackbird	*Turdus merula*	Recorded at TRWPP during bird surveys	+
	Song Thrush	*Turdus philomelos*	Recorded at TRWPP during bird surveys	+
	European Robin	*Erithacus rubecula*	Abour WF report. Listed as occurring in project area	+
	Bluethroat	*Luscinia svecica*	Abour WF report. Listed as occurring in project area	+
	Bluethroat (Wintering)	*Luscinia svecica*	Abour WF report. Listed as occurring in project area	+
	Black Redstart	*Phoenicurus ochruros*	Recorded at TRWPP during bird surveys	+
	Common Redstart	*Phoenicurus phoenicurus*	Recorded at TRWPP during bird surveys	+
	Whinchat	*Saxicola rubetra*	Recorded at TRWPP during bird surveys	+
	Common Stonechat	*Saxicola torquatus*	Recorded at TRWPP during bird surveys	+
	Northern Wheatear	*Oenanthe oenanthe*	Recorded at TRWPP during bird surveys	+

Species Population Category	Common Name	Species Scientific Name	Reason included	In the Project Area
	Finsch's Wheatear	*Oenanthe finschii*	Recorded at TRWPP during bird surveys	+
	Black-eared Wheatear	*Oenanthe hispanica*	Recorded at TRWPP during bird surveys	+
	Pied Wheatear	*Oenanthe pleschanka*	Recorded at TRWPP during bird surveys	-
	Isabelline Wheatear	*Oenanthe isabellina*	Recorded at TRWPP during bird surveys	+
	Rufous-tailed Rock-thrush	*Monticola saxatilis*	Recorded at TRWPP during bird surveys	-
	Blue Rock-thrush	*Monticola solitarius*	Recorded at TRWPP during bird surveys	+
	Spotted Flycatcher	*Muscicapa striata*	Abour WF report. Listed as occurring in project area	+
	Spanish Sparrow	*Passer hispaniolensis*	Recorded at TRWPP during bird surveys	+
	Dead Sea Sparrow	*Passer moabiticus*	Listed as population occurring at Dana IBA	-
	Pale Rock Sparrow	*Petronia brachydactyla*	Recorded at TRWPP during bird surveys	+
	White Wagtail	*Motacilla alba*	Recorded at TRWPP during bird surveys	+
	Yellow Wagtail	*Motacilla flava*	Recorded at TRWPP during bird surveys	+
	Tawny Pipit	*Anthus campestris*	Recorded at TRWPP during bird surveys	+
	Tree Pipit	*Anthus trivialis*	Recorded at TRWPP during bird surveys	-
	Red-Throated Pipit	*Anthus cervinus*	Recorded at TRWPP during bird surveys	-
	Eurasian Chaffinch	*Fringilla coelebs*	Recorded at TRWPP during bird surveys	+
	European Serin	*Serinus serinus*	Recorded at TRWPP during bird surveys	+
	European Greenfinch	*Carduelis chloris*	Abour WF report. Listed as occurring in project area	+
	European Goldfinch	*Carduelis carduelis*	Recorded at TRWPP during bird surveys	+
	Eurasian Linnet	*Carduelis cannabina*	Recorded at TRWPP during bird surveys	+
	Corn Bunting	*Miliaria calandra*	Recorded at TRWPP during bird surveys	+
	Ortolan Bunting	*Emberiza hortulana*	Recorded at TRWPP during bird surveys	+
Category 4: Other residents and summer	Chukar	*Alectoris chukar*	Recorded at TRWPP during bird surveys	+
	Sand Partridge	*Ammoperdix heyi*	Recorded at TRWPP during bird surveys	+
	Rock Dove	*Columba livia*	Recorded at TRWPP during bird surveys	+

Species Population Category	Common Name	Species Scientific Name	Reason included	In the Project Area
breeding populations	Feral Pigeon	*Columba livia domestica*	Recorded at TRWPP during bird surveys	-
	Eurasian Collared-dove	*Streptopelia decaocto*	Recorded at TRWPP during bird surveys	+
	Laughing Dove	*Spilopelia senegalensis*	Recorded at TRWPP during bird surveys	+
	Spotted Sandgrouse	*Pterocles senegallus*	Listed as population occurring at Dana IBA	-
	Crowned Sandgrouse	*Pterocles coronatus*	Listed as population occurring at Dana IBA	-
	Alpine Swift	*Tachymarptis melba*	Recorded at TRWPP during bird surveys	+
	Eurasian Thick-knee	*Burhinus oedicnemus*	Recorded at TRWPP during bird surveys	-
	Cream-coloured Courser	*Cursorius cursor*	Recorded at TRWPP during bird surveys	-
	Little Owl	*Athene noctua*	Recorded at TRWPP during bird surveys	+
	Hume's Owl	*Strix butleri*	Listed as population occurring at Dana IBA	-
	Pharaoh Eagle-owl	*Bubo ascalaphus*	Listed as population occurring at Dana IBA	-
	Woodchat Shrike	*Lanius senator*	Recorded at TRWPP during bird surveys	+
	Masked Shrike	*Lanius nubicus*	Recorded at TRWPP during bird surveys	+
	Brown-necked Raven	*Corvus ruficollis*	Recorded at TRWPP during bird surveys	+
	Common Raven	*Corvus corax*	Recorded at TRWPP during bird surveys	+
	Pale Crag-martin	*Hirundo obsoleta*	Recorded at TRWPP during bird surveys	-
	Greater Hoopoe-lark	*Alaemon alaudipes*	Listed as population occurring at Dana IBA	-
	Bar-tailed Lark	*Ammomanes cinctura*	Listed as population occurring at Dana IBA	
	Desert Lark	*Ammomanes deserti*	Recorded at TRWPP during bird surveys	+
	Dunn's Lark	*Eremalauda dunni*	Listed as population occurring at Dana IBA	-
	Crested Lark	*Galerida cristata*	Recorded at TRWPP during bird surveys	+
	Wood Lark	*Lullula arborea*	Recorded breeding in Dana IBA (expert review)	+
	Temminck's Lark	*Eremophila bilopha*	Recorded at TRWPP during bird surveys	+
	Streaked Scrub-warbler	*Scotocerca inquieta*	Recorded at TRWPP during bird surveys	+
	Graceful Prinia	*Prinia gracilis*	Abour WF report. Listed as occurring in project area	+

Species Population Category	Common Name	Species Scientific Name	Reason included	In the Project Area
	White-spectacled Bulbul	*Pycnonotus xanthopygos*	Abour WF report. Listed as occurring in project area	+
	Orphean Warbler	*Sylvia hortensis*	Abour WF report. Listed as occurring in project area	+
	Arabian Warbler	*Sylvia leucomelaena*	Listed as population occurring at Dana IBA	+
	Sardinian Warbler	*Sylvia melanocephala*	Listed as population occurring at Dana IBA	+
	Spectacled Warbler	*Sylvia conspicillata*	Recorded at TRWPP during bird surveys	+
	Arabian Babbler	*Turdoides squamiceps*	Listed as population occurring at Dana IBA	-
	Tristram's Starling	*Onychognathus tristramii*	Listed as population occurring at Dana IBA	+
	Eurasian Blackbird	*Turdus merula*	Recorded breeding in Dana IBA (expert review)	+
	White-tailed Wheatear	*Oenanthe leucopyga*	Listed as population occurring at Dana IBA	+
	Hooded Wheatear	*Oenanthe monacha*	Listed as population occurring at Dana IBA	-
	Mourning Wheatear	*Oenanthe lugens*	Recorded at TRWPP during bird surveys	+
	Black-eared Wheatear	*Oenanthe hispanica*	Recorded at TRWPP during bird surveys	+
	Desert Wheatear	*Oenanthe deserti*	Recorded at TRWPP during bird surveys	-
	Isabelline Wheatear	*Oenanthe isabellina*	Recorded at TRWPP during bird surveys	+
	Blue Rock-thrush	*Monticola solitarius*	Recorded at TRWPP during bird surveys	+
	Blackstart	*Cercomela melanura*	Recorded at TRWPP during bird surveys	+
	Palestine Sunbird	*Nectarinia osea*	Recorded at TRWPP during bird surveys	-
	House Sparrow	*Passer domesticus*	Recorded at TRWPP during bird surveys	+
	Spanish Sparrow	*Passer hispaniolensis*	Recorded at TRWPP during bird surveys	+
	Dead Sea Sparrow	*Passer moabiticus*	Recommended for inclusion by expert review	-
	Rock Sparrow	*Petronia petronia*	Recorded at TRWPP during bird surveys	+
	Pale Rock Sparrow	*Petronia brachydactyla*	Recorded at TRWPP during bird surveys	+
	Tawny Pipit	*Anthus campestris*	Recorded at TRWPP during bird surveys	+
	Long-Billed Pipit	*Anthus similis*	Recorded at TRWPP during bird surveys	-
	Syrian Serin	*Serinus syriacus*	Listed as population occurring at Dana IBA	+

Species Population Category	Common Name	Species Scientific Name	Reason included	In the Project Area
	European Greenfinch	*Carduelis chloris*		+
	European Goldfinch	*Carduelis carduelis*	Recorded at TRWPP during bird surveys	+
	Eurasian Linnet	*Carduelis cannabina*	Recorded at TRWPP during bird surveys	+
	Desert Finch	*Rhodopechys obsoletus*	Recorded at TRWPP during bird surveys	+
	Trumpeter Finch	*Bucanetes githagineus*	Recorded at TRWPP during bird surveys	-
	Pale Rosefinch	*Carpodacus synoicus*	Listed as population occurring at Dana IBA	-
	Corn Bunting	*Miliaria calandra*	Recorded at TRWPP during bird surveys	+
	Ortolan Bunting	*Emberiza hortulana*	Recorded at TRWPP during bird surveys	+
	Cretzschmar's Bunting	*Emberiza caesia*	Listed as population occurring at Dana IBA	+
	Striolated Bunting	*Emberiza striolata*	Listed as population occurring at Dana IBA	-

The flight activity of the target species are analysed for each vantage point for five seasons in the Project area. The tables below (see Table 8-10 and Table 8-11) give an overview of the bird activity in terms of number of flights, number of individuals and total flight times for each species in the Project area. The detailed information on each survey is given in the Annexes (see Annex III and Annex IV). The number of flights shows that how many times the species were observed during the whole season. The total number of birds recorded is the total number of birds during the whole season. The total time recorded shows how many seconds the species use the survey area.

Table 8-10 Number of Flights and Number of Individuals of Target Species for 5 Seasons

(Total survey effort for each survey season in brackets)

Scientific Name of the Species	Common Name of the Species	Spring 2013 (64hrs)		Autumn 2013 (128hrs)		Spring 2014 (259hrs)		Autumn 2014 (255hrs)		Spring 2015 (306hrs)	
		Number of Flights	Number of Birds Recorded	Number of Flights	Number of Birds Recorded	Number of Flights	Number of Birds Recorded	Number of Flights	Number of Birds Recorded	Number of Flights	Number of Birds Recorded
Ciconia nigra	Black Stork	-	-	-	-	-	-	1	1	-	-
Ciconia ciconia	White Stork	-	-	-	-	-	-	3	92	1	1
Gyps fulvus	Griffon Vulture	-	-	5	8	-	-	23	34	2	2
Neophron percnopterus	Egyptian Vulture	2	6	12	12	-	-	3	8	2	2
Aquila heliaca	Eastern Imperial Eagle	-	-	-	-	-	-	-	-	3	4
Clanga pomarina	Lesser Spotted Eagle	3	4	7	8	1	3	1	5	-	-
Aquila nipalensis	Steppe Eagle	5	7	38	88	9	20	7	9	20	22
Circaetus gallicus	Short-toed Snake Eagle	4	7	12	15	17	20	22	23	23	26
Hieraaetus pennatus	Booted Eagle	-	-	-	-	4	6	3	3	2	2
Pandion heliaetus	Osprey	-	-	-	-	-	-	-	-	1	1
Milvus migrans	Black Kite	10	28	-	-	22	175	18	28	6	7
Circus aeruginosus	Western Marsh Harrier	-	-	14	67	-	-	3	4	2	2
Circus pygargus	Montagu's Harrier	-	-	5	9	4	4	3	3	1	1
Circus macrourus	Pallid Harrier	2	2	6	6	1	1	5	5	1	1
Buteo rufinus	Long-legged Buzzard	2	2	13	45	20	20	35	41	53	59
Buteo buteo vulpinus	Steppe Buzzard	50	402	37	1201	69	954	59	207		83
Pernis apivorus	Honey Buzzard	-	-	3	63	33	264	4	4	26	153
Accipiter nisus	Eurasian Sparrowhawk	-	-	6	8	-	-	10	14	8	8
Accipiter brevipes	Levant Sparrowhawk	-	-	-	-	-	-	2	3	1	1
Falco tinnunculus	Common Kestrel	-	-	-	-	3	3	64	74	111	111
Falco naumanni	Lesser Kestrel	-	-	-	-	27	38	-	-	3	3

Scientific Name of the Species	Common Name of the Species	Spring 2013 (64hrs)		Autumn 2013 (128hrs)		Spring 2014 (259hrs)		Autumn 2014 (255hrs)		Spring 2015 (306hrs)	
		Number of Flights	Number of Birds Recorded	Number of Flights	Number of Birds Recorded	Number of Flights	Number of Birds Recorded	Number of Flights	Number of Birds Recorded	Number of Flights	Number of Birds Recorded
Falco vespertinus	Red-footed Falcon	-	-	-	-	-	-	2	2	1	1
Aquila spp.	Eagle Species	-	-	-	-	-	-	3	3		
	Buzzard Species	-	-	-	-	-	-	2	7		
Circus spp.	Harrier Species	-	-	-	-	-	-	1	1		
Falco spp.	Falcon Species	-	-	-	-	**2**	**4**	-	-	-	-
All the species recorded		**91**	**555**	**176**	**1599**	**207**	**1496**	**274**	**571**	**267**	**490**

Table 8-11 Total Flight Times Recorded and at RSH of Target Species for 5 Seasons

(Total survey effort for each survey season in brackets)

Scientific Name of the Species	Common Name of the Species	Spring 2013 (64hrs)		Autumn 2013 (128hrs)		Spring 2014 (259hrs)		Autumn 2014 (255hrs)		Spring 2015 (306hrs)	
		Total Flight Time	Flight Time Spent at RSH	Total Flight Time	Flight Time Spent at RSH	Total Flight Time	Flight Time Spent at RSH	Total Flight Time	Flight Time Spent at RSH	Total Flight Time	Flight Time Spent at RSH
Ciconia nigra	Black Stork	-	-	-	-	-	-	60	0	-	-
Ciconia ciconia	White Stork	-	-	-	-	-	-	420	285	17	0
Gyps fulvus	Griffon Vulture	-	-	300	210	-	-	1980	780	211	98
Neophron percnopterus	Egyptian Vulture	120	90	600	600	-	-	210	150	122	78
Aquila heliaca	Eastern Imperial Eagle	-	-	-	-	-	-	-	-	1638	406
Clanga pomarina	Lesser Spotted Eagle	150	105	375	330	57	0	75	75	-	-
Aquila nipalensis	Steppe Eagle	390	345	2085	1560	406	248	615	285	2416	1188
Circaetus gallicus	Short-toed Snake	255	105	1000	850	1691	512	2145	930	3317	2504

Scientific Name of the Species	Common Name of the Species	Spring 2013 (64hrs)		Autumn 2013 (128hrs)		Spring 2014 (259hrs)		Autumn 2014 (255hrs)		Spring 2015 (306hrs)	
	Eagle										
Hieraaetus pennatus	Booted Eagle	-	-	-	-	160	30	345	45	276	276
Pandion heliaetus	Osprey	-	-	-	-	-	-	-	-	86	86
Milvus migrans	Black Kite	690	510	-	-	1239	90	1590	525	662	162
Circus aeruginosus	Western Marsh Harrier	-	-	870	795	-	-	120	45	NA	NA
Circus pygargus	Montagu's Harrier	-	-	315	315	455	260	300	60	91	61
Circus macrourus	Pallid Harrier	75	45	405	405	39	15	405	60	41	15
Buteo rufinus	Long-legged Buzzard	75	60	1170	1170	2507	683	3345	1965	4390	2994
Buteo buteo vulpinus	Steppe Buzzard	2685	1905	2295	1455	3564	225	4575	1575	NA	NA
Pernis apivorus	Honey Buzzard	975	720	150	90	1414	75	435	225	18180	13091
Accipiter nisus	Eurasian Sparrowhawk	-	-	285	285	-	-	480	240	NA	NA
Accipiter brevipes	Levant Sparrowhawk	-	-	-	-	-	-	75	0	NA	NA
Falco tinnunculus	Common Kestrel	-	-	-	-	303	135	5895	3090	NA	NA
Falco naumanni	Lesser Kestrel	-	-	-	-	9617	1530	-	-	212	183
Falco vespertinus	Red-footed Falcon	-	-	-	-	-	-	135	45	30	30
Aquila spp.	Eagle Species	-	-	-	-	-	-	240	0	-	-
	Buzzard Species	-	-	-	-	-	-	75	0	-	-
Circus spp.	Harrier Species	-	-	-	-	323	218	-	-	-	-
Falco spp.	Falco species	-	-	-	-	-	-	60	60	-	-
All the species recorded		**5415**	**3885**	**10975**	**8725**	**21577**	**3803**	**23580**	**10440**	**31689**	**21172**

Bird Movements in the Project Area

This section provides an overall view of the 5 seasons (2013 and 2014 Spring and Autumn and Spring 2015 seasons) of bird surveys in the Project area.

Twenty two target species (not including unidentified species) were recorded during the five seasons of surveys (refer to Table 8-10). Accounts for target species are given in paragraphs below. For the detailed information for each season see the annexes (Annex III and Annex IV)

- Black Stork

The species is a passage migrant for Jordan, consequently for the project area, too. Only 1 individual is recorded during four surveys; on 19.09.2014 in autumn 2014 survey.

- White Stork

The species is a passage migrant for the project area and its vicinity. 4 flights of 93 individuals are recorded during the five surveys. The data indicates that when this species occurs it may do so in moderate or possibly large flocks. (see Table 8-10).

- Griffon Vulture

Griffon Vulture is one of the most iconic breeding raptors in Jordan. It used to breed along the Rift Margin. Some colonies reached more than 100 nests according to Andrew (1995). Although this species is considered as 'Least Concern' on the IUCN Red List, numbers have declined in Jordan. Recent records include a few pairs in the Dana Biosphere Reserve where, in 1997 and 1999, there were a total of six pairs. In 2006 and 2010, 17 and 9 active nests were located respectively. In 2008, a new colony was spotted by Mr. Yaman Al-Safadi in Wadi Namaleh close to Petra (where is approximately 50 km southwest of the project site), estimated to be 7 to 10 pairs. In 2012, the colony was double checked and birds were noticed at the site.

30 flights of 44 individuals for this species are recorded in total of five surveys. The species is recorded during the autumn 2013 and 2014 surveys and the spring 2015 survey. Since the species is considered to be using the area for foraging, the percentage of time observed at rotor swept height suggests that individuals of this species may be repeatedly at risk from colliding with turbines. Special attention should be paid for during and post construction period surveys due to the numbers have declined recently in Jordan.

- Egyptian Vulture

The species occurs in two different ways in Jordan. While there are breeding populations, there are also passage migrants for the country over the Rift Valley. The studies conducted in Shaumari Nature Reserve show that the species is present in the reserve.

Although the nature reserve is approximately 140 km away from the project area, it is likely that the individuals present in the reserve might fly into the project area with foraging purposes considering the behaviours of the species. Egyptian Vultures are non-flocking species, migrating along a broad front. This is probably the reason why only small numbers of these species were seen in the autumn and even smaller numbers were seen in the spring. We assume that these species also fly, at least partially, along the Negev and Jordan Valley axis, a route which has not been studied in detail.

19 flights of 28 individuals for this species are recorded in total of four surveys. The only period that the species was not recorded is spring 2014 survey. Although the numbers recorded are not high, special attention should be paid for the during and post construction period surveys due to the species has the conservation status of EN (Endangered) according to IUCN Red List and the species is vulnerable towards both the wind turbines and powerlines. Both the Middle Eastern and European population of Egyptian Vultures has declined by over 50 percent in recent times. Hunting, habitat destruction, and power lines, such as the one that injured this particular Egyptian vulture, are viewed to be the main reasons why the Egyptian Vultures are an endangered species today.

- Eastern Imperial Eagle

3 flights of Eastern Imperial Eagle were observed only during the 2015 spring survey period, involving 4 individuals. This species is globally categorised as Vulnerable on the IUCN Red List on account of its small global population size and continuing long-term decline in numbers (Birdlife International 2013c).

- Lesser Spotted Eagle

The species is a non-breeding passage migrant for the Project area. The majority of the migration of this species is considered to occur along the western side of the project area towards Israel. The species is recorded on four survey surveys although in low numbers. 12 flights of 20 individuals for this species are recorded in total of four surveys. 74.74% of the total flight time of 582 seconds occurred at rotor swept height. It is not recorded in spring 2015 season.

- Steppe Eagle

Steppe Eagle is a common passage migrant for the project area and it is one of the raptor species that migrates as big numbers over Jordan both during spring and autumn. Some studies (Leshem Y. and Yom-Tov Y., 1998) indicate that about an eighth (13.5%) of the Steppe Eagles fly along the Negev-Jordan Valley axis from Elat Mountains on the north-west towards their breeding sites in spring. Hence, the species is observed in each survey period as it is expected.

79 flights of 146 individuals are recorded for this species in total of five surveys. While the number of the individuals is not high for total of four surveys, the percentage of flight time at risk height raises the concern.

- Short-toed Snake Eagle

Short-toed Eagle is a native breeding raptor in Jordan and regularly uses the Rift Margin in both summer and winter. It typically nests on trees, but is also found on cliffs, such as in the Mujib Biosphere Reserve and its surroundings. In Dana, a total of two to three pairs breed every year, while in Muijb a total of five breeding pairs were recorded in 2006. The species also occurs on migration through the survey area.

83 flights of 91 individuals are recorded for this species in total of five surveys. It is observed in every survey season.

Considering the information that the species is native and the observations on site, the species is thought to be using the area for foraging.

- Booted Eagle

Booted Eagle occurs in Jordan both natively and on passage migration.

9 flights of 11 individuals are observed during 5 seasons, in 2014 spring and autumn and 2015 spring. As the species is observed mostly flying high, it is thought to be using the area only for passage on migration. Moreover, the reason why the species was not recorded during the surveys in 2013 might be due to the low survey effort, or the species does not prefer using the project area for migration as it prefers the more western part of the Project area.

- Osprey

Osprey was recorded on one occasion during the spring 2015 survey period with 1 flight of 1 individual. In Jordan osprey are considered a scarce autumn migrant.

- Black Kite

Black Kite is a both native and a passage migrant species for the country. Although no breeding activity is recorded during the surveys, it is known to be breeding in the close vicinity of the project area (BirdLife Fact Sheet 2014). Black Kites are known to fly along the Negev-Jordan Valley axis starting from Elat Mountains during migration.

87 flights of 361 individuals are observed during the five surveys. And it is recorded during all five surveys.

The species uses the area only for passage during migration.

- Western Marsh Harrier

The species occurs in Jordan both as non-breeding and passage migrant. The species is known to be a broad front migrant. It was recorded in low numbers within the survey area with a total of 19 flights of 73 individuals during the five surveys.

- Montagu's Harrier

Jordan is on the migration route between the breeding areas on north and wintering areas on south for Montagu's Harriers. The species is a passage migrant for Jordan and the project area while it also uses the area for foraging during migration according to the observations on surveys. 13 flights of 17 individuals are observed during the five surveys. The species was recorded on all but the spring 2013 survey. Total number of records for each survey was low. The 4 observations in spring 2014 surveys are thought to belong to the same individuals that spent some days in the area for resting and foraging purposes during its migration.

- Pallid Harrier

The species occurs in Jordan both as non-breeding and passage migrant. However, it is thought to be seen in the project area only on migration considering the field observations although a few individuals were recorded landing on the ground. 15 flights of 15 individuals were observed during the four surveys. It was observed during all five surveys. Majority of the total flight time of 935 seconds occurred at rotor swept height. The flight time spent below RSH (almost the rest of the activity) is mainly due to the records of landing on the ground.

- Long-legged Buzzard

Long-legged Buzzard is a resident species in Jordan and results indicate that it is likely also to breed in the vicinity of the Project area. 123 flights of 137 individuals were observed during the four surveys. 60% of the total flight time of 11406 seconds occurred at rotor swept height. Many individuals recorded in the survey area were observed flying low, foraging and landing. This behaviour suggests that turbines are a collision risk to this species.

- Steppe Buzzard

Steppe Buzzard is an eastern subspecies of *Buteo buteo* (Common Buzzard). It is a long distance migrant that migrates as huge flocks over Jordan while western subspecies are either resident or short distance migrants. Steppe Buzzard passes through Israel along the Mediterranean coast only in the autumn. Only small proportions of the numbers of the Steppe Buzzard pass over Israel in the spring following Mediterranean coast in the autumn. Much larger proportions of both species migrate over the Elat Mountains in the spring, turning northeast from there towards breeding grounds in Russia. A small proportion of

these two species fly along the Negev-Jordan Valley eastern axis and another proportion of the species migrate along the western axis. Steppe Buzzard was recorded on all five surveys with a total of 215 flights comprising 2764 individuals.

Due to the methodology difference in spring 2015, the species is recorded as a secondary target species and only the number of individuals per 5-minute period was recorded. The number of five- minute recording periods in which steppe buzzard was encountered was 83 during the spring 2015 survey.

For the first 4 seasons of surveys, the species was calculated to have the highest predicted collision risk in the Project area.

- Honey Buzzard

European Honey Buzzard is a passage migrant for that migrates as huge flocks over Jordan and especially over Yarmouk Protected Area. The species is among the species that constitutes the huge flocks of spring migration over Jordan, recorded mainly between late April and early June. 90 % of the season total of Honey Buzzards usually migrates within a period of two weeks from August 31 to September 13 in autumn in Israel. The number of Honey Buzzards counted in Israel is relatively stable over the entire period. As the fluctuations do not necessarily reflect a change in population size and the migration corridor of the Honey Buzzard also reaches east into Jordanian territory but is not as much as Israelian numbers, the number of individuals recorded during the surveys indicates that the species doesn't prefer the project area as a main migratory route.

Sixty six flights comprising 484 individual were observed in total.

This species is considered vulnerable to the effects of potential wind energy development (Strix 2012).

- Eurasian Sparrowhawk

Eurasian Sparrowhawk is a non-breeding passage migrant for Jordan. 24 flights of 30 individuals were observed in total of five seasons. 68.63% of the total flight time of 765 seconds occurred at rotor swept height during the total of first four seasons.

Although most of the individuals recorded were observed transiting through the site, 3 individuals were recorded landing on the ground and foraging in the project area on 02.10.2014. Since the small raptor species are known to stop at some places for foraging during migration, it is considered that some individuals of the species are likely to use the area for feeding purposes.

Due to the methodology difference in spring 2015, the species is recorded as a secondary target species and only the number of individuals per 5-minute period was recorded. The number of five- minute recording periods in which Eurasian Sparrowhawk was encountered was 8 during the spring 2015 survey. However no flight duration is possible to evaluate together with the previous four seasons of surveys.

- Levant Sparrowhawk

Levant Sparrowhawk is also another species that is among the species that occurs in large flocks during the spring migration over Jordan. The species is a passage migrant for Jordan. However, only 3 flights of 4 individuals were observed in total. These individuals were recorded during autumn 2014 and spring 2015 surveys. 100% of the total flight time of 75 seconds occurred at rotor swept height during the autumn 2014.

Only the number of individuals per 5-minute period was recorded during the spring 2015 surveys.

While, Levant Sparrowhawks are also known to migrate during the night or late after sunset which constitutes a source of inaccuracy with the recorded numbers, it is likely that greater numbers would have been recorded during survey periods – daylight – if the project area were an important migration route for the species. The low numbers recorded in the project area during surveys suggests that collision risk to the species is likely to be low.

- Common Kestrel

Both passage migrant and resident populations of Common Kestrel occur in Jordan. 178 flights of 188 individuals were observed in total. The species is seen in 2 days in total during the spring 2014 survey and in 14 days during the autumn 2014 survey then was also observed in spring 2015. Some of the individuals recorded had no specific flight direction and were typically recorded hovering and hunting at low height indicating that a proportion of the birds recorded were resident/locally breeding individuals.

52.03% of the total flight time of 6198 seconds occurred at rotor swept height during the first four survey seasons. Although the number of individuals recorded is not particularly high, the proportion of time at risk height combined with the likely presence resident individuals present throughout the year indicates an annual risk of collision fatalities.

As a secondary target species, only the number of individuals per 5-minute period was recorded during the spring 2015 survey season.

- Lesser Kestrel

There are both breeding and passage migrant populations of Lesser Kestrel in Jordan. Although the vicinity of the project area has potential as a breeding and feeding area since some areas near the escarpments surrounding Dana were shown to be productive habitats with a high density of prey for raptors; these were thus visited more often by the resident and summer visiting raptors including Lesser Kestrels.

27 flights of 38 individuals were observed in 3 days in total all in April 2014. Approximately 15% of total flight time of 9829 seconds occurred at rotor swept height while the majority of the flight (approximately 80%) occurred below rotor swept height during this season.

A total of three flights of lesser kestrel were observed during the spring 2015 survey period. A total of flight duration of 212 seconds was recorded. Of this time 28 seconds was estimated to be below 30 m in height and not at risk of collision. The remaining 183 seconds was estimated to have occurred at heights between 30-150 m and therefore at risk of potential collision. Overall, collision risk for this species is likely to be low.

- Red-footed Falcon

Red-footed Falcon is a rare but a regular passage migrant for Jordan. Falcons (Falconidae) do not migrate by soaring and are generally broad-front migrants (i.e. they do not do follow particular migration routes) and therefore do not usually concentrate in large numbers. However, they will occasionally soar with migrating raptors and often occur at bottleneck sites.

2 flights of 2 individuals were observed in total during the first four surveys. Depending on the general characteristics of the species' flight, these two individuals can be considered as occasional. 33.33% of the total flight time of 135 seconds occurred at rotor swept height. The rest of the flight occurred below the rotor swept height. Although the height of the flights are prone to risk for this near threatened species due to proposed wind turbines, it is very hard to assess it via only two flights of two individuals.

And a single observation of a red-footed falcon, 30 seconds of flight in total, was recorded during the spring 2015 surveys. The entire duration of this flight was estimated to have been at risk of collision, flying between 30- 50 m in height. Based on survey results the collision risk to Red-footed Falcon at this site is likely to be very low.

- Common Raven

A single flight of the species was observed for a total of 110 seconds. Of this time 47 seconds was spent between 30-50 m in height. The remaining 63 seconds was spent below 30 m.

Bird Collision Risk Assessment

The principal risk to birds at the project site is collision with turbine rotors. Collision risk principally occurs when a bird is flying at rotor swept height. Flying height varies both within and between species. Some species may typically fly at rotor swept height while others tend to fly above the rotor swept area. The type of flight such as gliding or hovering, which is characteristic for certain species of birds, may cause different risks of collision. Changes in visibility during day and at night, or different weather conditions, are also likely to influence the risk of bird collision with the turbines.

The 'Band' collision risk model used in this project to predict annual collision rates first calculates a 'no-avoidance risk', i.e. the rate of collision assuming that birds fly as if the wind turbine structures and rotors were not there and take no avoiding action whatsoever. It is assumed that if a bird is hit it is killed, whether immediately or through injury.

In practice, most birds do take avoiding action: they may detect either an entire wind farm array, or a particular wind turbine, and alter their flight lines such as to avoid the structures; or they may at close quarters see an oncoming blade and take emergency avoiding action. To account for this an 'avoidance rate' is applied to the initial 'no avoidance' collision estimate.

Data available on avoidance factors is limited, and often relates to topographic and climatic conditions and to species. The difficulties of collecting such data are also considerable. It can rarely be assumed that all collisions have been detected, because of scavenging losses, injured birds escaping from the search area, or because of rough ground or tall vegetation. A precautionary approach is recommended when basing an avoidance factor on available data.

Collision risk modelling

Differences in data collection methods between the first four seasons of surveys and the spring 2015 survey mean that collision risk estimates are not directly comparable between 2013/4 and spring 2015.

The Band collision risk model (Band *et al*., 2007) was used to assess collision risk using flight activity recorded during the 5 surveys at the site. The Band Model requires input parameters describing species-specific information on biometrics, flight characteristics and the expected amount of flight activity; and turbine-specific information on blade size, blade pitch, rotor rotation period and the anticipated proportion of time that turbines will be operational.

A. Calculating a theoretical collision risk (*Based on Scottish Natural Heritage's Collision Risk Model*)

This approach is especially appropriate for birds such as raptors which occupy a recognized territory, and where observations have led to some understanding of the likely distribution of flights within this territory except for the bird populations making regular flights through the windfarm, possibly in a reasonably defined direction. As a result, the approach yields the number of bird transits (per annum) through the rotors of the windfarm. The approach is followed through the steps below:

1. Identify a 'flight risk volume' (Vw) which is the area of the windfarm multiplied by the height of the turbines.

2. Calculate the combined volume swept out by the WF rotors: $Vr = N \times \pi R2 \times (D + L)$

3. Estimate the bird occupancy (n) within the flight risk volume. This is the number of birds present multiplied by the time spent flying in the flight risk volume, within the period (usually one year) for which the collision estimate is being made

4. Calculate the time (t) taken for a bird to make a transit through the rotor and completely clear the rotors: $t = (d + l) / v$

5. The bird occupancy of the volume swept by the rotors is then $n \times (Vr/Vw)$ bird-seconds.

6. To calculate the number of bird transits through the rotors, divide the total occupancy of the volume swept by the rotors in bird-seconds by the transit time (t): Number of birds passing through rotors = $n \times (Vr/Vw) / t$

Vw: the area of the windfarm multiplied by the height of the turbines.

Vr: the volume swept out by the windfarm rotors

N: the number of wind turbines

R: the rotor radius

d: the depth of the rotor back to front

l: the length of the bird

n: bird occupancy

v: the speed of the bird through the rotor (m/sec)

t: the transit time

Predicted Collision Risk

The number of windfarm (N) is 15 for Abour WF 500 m buffer zone with the area of 7,953,570 m^2. The windfarm area is assumed that the total of the buffer zones with the radius of 1 km in each turbines.

1. The height is assumed as 150 m (max turbine height) for calculation of "the flight risk volume" Vw = 7,953,570 m^2 x 150 m = 1,193,035,500 m^3

(500m = 7,953,570 m^2 1000 m = 14,935,500 m^2)

2. The combined volume swept out by the rotors calculated as $Vr = N \times \pi r^2 \times (d + l)$ where r is the radius of rotor, d is depth of rotor (assumed 2 m) and l is the length of bird.

3. The estimated bird occupancy is calculated and listed for each target species and each survey season (see Annex III for the details)

4. The number of birds passing through rotors for each target species is calculated.

Probability of One Bird Being Hit When Flying Through Rotor Swept Zone

The probabilities of one bird being hit when flying through rotor swept zone for each target species, which were calculated by the help of an Excel spreadsheet available from the renewable energy pages of the SNH web site: http://www.snh.gov.uk/docs/C234672.xls (SNH 2000). The rotor speed is assumed as 17.6 rpm which is technically the maximum speed of this turbine model (V117-3.3 MW 50/60 Hz)

B. The Band Model is a two stage process

Stage 1. An estimation of the number of bird transits per unit time through the rotor swept areas of the turbine blades using data from flight activity surveys.

Stage 2. An estimation of the probability of collision strike for a bird of a given species flying through the rotor swept area of an operational turbine.

1. Multiplying together the outputs of stages 1 and 2 provides an estimate of collision risk, assuming no avoidance behavior.

2. It is widely accepted that flying birds, including raptors, are able to avoid turbine blades in a number of ways. Birds may exercise avoidance by detecting the wind farm or turbine at relatively large distances (tens to hundreds of meters) and modify their flight path to avoid the structures (commonly referred to as far field or macro avoidance). At closer proximity to turbines (approximately <10m), birds may see an oncoming rotor blade and undertake evasion action (commonly referred to as near field or micro avoidance) (SNH, 2000).

3. To provide a credible prediction of the actual number of collisions that might occur, the product from stages 1 and 2 of the Band Model is adjusted downwards by an avoidance rate to take account of the assumed level of behavioral avoidance shown by the species under consideration. Typically, avoidance rates are assumed to lie in the range 95% to 99%, depending on species (SNH, 2010); the actual avoidance rate for some species could potentially be higher or lower than this range.

4. After adjusting for avoidance rate, CRM results provide an estimate of the number of collisions that will occur over the time frame examined, typically a season, or year or for the intended lifetime of the wind farm. The analyses presented here is for an estimate of the number collisions for a single spring migration season.

Model assumptions

5. Band *et al.* (2007) notes a number of approximations are made when undertaking CRM, for example birds are modelled as simple cruciform shape and turbine blades have width and pitch but no thickness.

6. Further assumptions made in the CRM undertaken for the Development are as follows:

- During VP watches all flight activity by primary target species within the study area (a 180 degree arc out to 2 km from the VP) is detected and recorded;
- All air space 30 m above ground level in the study area for a VP is visible;
- Flight height band has been accurately determined;
- Flight lines have been accurately plotted on field maps;
- Species are correctly identified;
- Watch effort is sufficient to overcome stochastic effects of the natural variability in flight activity; and
- Watch effort within each stratum is temporally representative of that stratum.

Wind farm characteristics

The Development has fifteen turbines. The turbine specifications used in CRM were a blade length of 58.5 m and a hub height of 91.5 m, giving a maximum blade tip height of 150 m. The Rotor Swept Height (RSH) of the proposed turbines is 33-150 m. The flight risk volume (Vw) used in the CRM is based on a 500 m buffer around the turbine locations (total area = 833.8 ha) and a height equal to the rotor diameter (117 m).

1. Blade pitch is variable, dependent on wind speed, to create optimum power generation. Modern turbines have an operational range between -5° to 90°. Pitch changes

as wind speed increases and for most ambient wind speeds blade pitch does not increase above c.30°. When blade pitch increases to around 30° wind speeds are generally too high (around 25 m/s or 55 mph) and turbines are shutdown to prevent damage, typically with blades being moved to 90° ("feathered"). It is considered that a blade pitch of 15° is appropriate for use within the Stage 2 calculation as this value represents the approximate average wind speed at which blades will be operating.

Viewsheds and watch effort

2. Viewshed analyses were not undertaken as Digital Elevation Model (DEM) data were not available. Nevertheless the VPs were carefully selected to give optimal views across the areas of interest. For the purpose of the CRM it is assumed that all the air space greater than 30 m above ground level was visible from all VPs. This assumption is likely to overestimate the actual visible area from each VP as there was some 'dead' ground caused by topography. As a consequence the resulting CRM estimates are likely to be slightly biased low.

The below tables (Table 8-12 and Table 8-13) show the results of the CRM for each season. Due to the subtle differences in the data collection between the 2013/14 spring and autumn seasons and spring 2015, a total collision risk is not modelled within this ESIA but the comparisons are shown. Also note that during 2013/14 field surveys flying heights at RSH were categorized as between 30-130m, 20m below the actual maximum turbine blade height of 150m. In theory this will result in a slight underestimation of risk across all estimates for the 2013/14 seasons.

Table 8-12 Expected Number of Birds Colliding per Survey Season

(with Avoidance (98%) in Descending Order)

No	Spring 2013		Autumn 2013		Spring 2014		Autumn 2014	
	Species	**Expected Number of Birds Colliding**	**Species**	**Expected Number of Birds Colliding**	**Species**	**Expected Number of Birds Colliding**	**Species**	**Expected Number of Birds Colliding**
1	Steppe Buzzard	2.89985408	Steppe Buzzard	6.75343265	Steppe Buzzard	0.81195233	Steppe Buzzard	1.234542415
2	European Honey Buzzard	0.27266200	Steppe Eagle	0.81418695	Lesser Kestrel	0.15062298	Common Kestrel	0.786175349
3	Black Kite	0.05455253	Black Kite	0.47928297	European Honey Buzzard	0.07730108	Griffon Vulture	0.607100976
4	Steppe Eagle	0.01446206	Western Marsh Harrier	0.21406987	Black Kite	0.06016823	Long-legged Buzzard	0.311933967
5	Short-toed Snake Eagle	0.00301654	Long-legged Buzzard	0.06795061	Long-legged Buzzard	0.05288919	White Stork	0.149822297
6	Lesser Spotted Eagle	0.00189882	Short-toed Snake Eagle	0.05448245	Short-toed Snake Eagle	0.04202639	Short-toed Snake Eagle	0.087787546
7	Egyptian Vulture	0.00164712	European Honey Buzzard	0.02213622	Steppe Eagle	0.00538959	Black Kite	0.055398141
8	Long-legged Buzzard	0.00046462	Egyptian Vulture	0.01555616	Montagu's Harrier	0.00358726	Steppe Eagle	0.015360323
9	Pallid Harrier	0.00027320	Griffon Vulture	0.01538355	Common Kestrel	0.00107885	Eurasian Sparrow hawk	0.01180555
10			Lesser Spotted Eagle	0.01193546	Booted Eagle	0.00065651	Egyptian Vulture	0.003660273
11			Montagu's Harrier	0.00977872	Pallid Harrier	0.00004553	European Honey Buzzard	0.003513686
12			Eurasian Sparrow hawk	0.00801091			Lesser Spotted Eagle	0.001695377
13			Pallid Harrier	0.00737630			Pallid Harrier	0.000910654
14							Western Marsh Harrier	0.000723413
15							Montagu's Harrier	0.000620871
16							Booted Eagle	0.000492381

Table 8-13 Expected Number of Birds Colliding for Spring 2015

(with Avoidance (98%) in Descending Order)

No	Species	Expected Number of Birds Colliding
1	Pallid Harrier	0.000
2	Montagu's Harrier	0.001
3	Red-footed Falcon	0.001
4	Egyptian Vulture	0.002
5	Osprey	0.002
6	Black Kite	0.003
7	Griffon Vulture	0.004
8	Lesser Kestrel	0.004
9	Eastern Imperial Eagle	0.012
10	Booted Eagle	0.015
11	Steppe Eagle	0.029
12	Short-toed Eagle	0.057
13	Long-legged Buzzard	0.065
14	Honey Buzzard	0.259

8.6.5.6 Conclusions

Migration Paths in the Project Site and Comparison to the Main Migration Routes

- Based on both the literature surveys and the satellite tagged birds' tracks on BirdLife's Soaring Bird Sensitivity Map application, the Project area has relatively low migration rates compared to the migration occurring directly to the west of the project site (Dana Biosphere Reserve and Rift Valley)
- Generally, the results of the five seasons of VP surveys conducted for the ESIA corroborate the Birdlife Sensitivity Map information and indicate that the Project site is **not a busy migration corridor**.
- Flight lines mapped during surveys suggest that within the Project site the main migration routes are orientated north/east and north-east/south-west and tend to be more direct flights during the spring migration and dispersed flights in autumn.
- The micro-migration paths of soaring migrants observed and recorded in the Project area show flight paths aggregating along two valleys in the area. One of these is in the western part of the Project area. The other is in the southeastern part of the Project area.

The wind farm site is away from the edge of the Rift Valley and it is not heavily covered with vegetation. However, both the resident and migrant birds mentioned in the report would still use the Project area occasionally and its vicinity for foraging, breeding, passing and resting.

Collision Risk

Collision risk estimates results for migratory soaring birds and other collision vulnerable species are reported as low across each of the individual surveys. With the exception of Steppe Buzzard all results suggest a species-specific fatality rate of below 1 individual per year. It is likely that this is a reasonable estimate for migratory species passing through the site during spring and autumn migration as the surveys were targeted for these migratory periods. However, for summer breeding and resident species, surveys would have needed to have been conducted for the whole period when birds were present to provide reasonable collision risk estimates. Assuming these species use the site during the period they are present in the area, then collision risk estimates presented in the report are likely to be underestimates. Therefore, for Griffon Vulture, Short-toed Eagle, Long-legged Buzzard, Lesser Kestrel and Common Kestrel a higher annual collision rate than those given would be expected. Given the high regional conservation status of some of these species populations, a comprehensive monitoring and mitigation strategy is required to reduce collision likelihood and minimize any adverse effects of the development on these populations.

Displacement

It is possible that resident birds such as larks, wheatears and other passerines will be displaced from parts of the Project site as a result of changes in habitat brought about by the development. Resident birds may leave the feeding and breeding habitats in the Project site due to disturbance caused by wind farm. Displacement may be temporary or permanent. The Dana Important Bird Area and Biosphere Reserve provides additional and alternative suitable habitat in the vicinity of the Project site.

Habitat Loss and Damage

Since the area is heavily disturbed by local resident people and roads, the impact in terms of habitat loss and damage impact is anticipated to be low in the Abour WF as the habitat is already fragmented and is not representing a vital and very special habitat that cannot be replaced.

Relationship with the Waterfowl

The impact on waterfowl is not a consideration due to the fact that there are no wetlands in the vicinity of the Project area, excluding the coincidental waterfowl migration over the Project area.

Considering the five seasons of VP surveys have been conducted at the Project site, it is concluded that the Project site is not a busy migration corridor. Regarding the flight maps supplied by the surveyors, the main migration routes within the Project site are north / east and northeast / south-west, mainly composed of direct flights in spring migration whilst the main migration routes are composed of more dispersed flights in autumn.

The micro-migration paths observed and recorded in the Project area show a pattern of aggregating along two valleys in the area. While one valley and hence the path that the soaring migrants follow is on the western part within the Project area, the other valley and hence the path that the soaring migrants follow is on the southeastern part of the Project area.

Considering the layout of the turbines and the size of the wind farm consisting of only 15 wind turbines, AEC's wind farm is not considered to cause a major barrier effect for birds during spring and autumn migration periods. Furthermore, the wind farm site is away from the edges of the Rift Valley and it is not heavily covered with vegetation. However the resident and migrant threatened birds mentioned in the report would occasionally or accidentally use the Project area and its vicinity for foraging, breeding, passing and resting.

Based on both the literature surveys and the satellite tagged birds' tracks on BirdLife's Soaring Bird Sensitivity Map application, the Project area has a relatively low migration comparing to the massive migration occurring mainly on the western side (Dana Biosphere Reserve and Rift Valley).

The impact on waterfowl is not a consideration due to the fact that there are no wetlands in the vicinity of the Project area, excluding the coincidental waterfowl migration over the Project area.

Displacement of resident birds such as larks, wheatears, warblers, serins, bulbuls, Palestine sunbirds and other passerines is possible. However, Dana Important Bird Area and Biosphere Reserve within it can serve as the suitable habitat in the vicinity.

Since the area is heavily disturbed by local residents and roads, the impact in terms of habitat loss and damage impact is anticipated to be low in the AEC Wind Farm as the habitat is already fragmented and is not representing a vital and very special habitat that cannot be replaced.

8.6.6 Mammals

Mammals Survey Method

Fauna surveys were designed to collect information on the presence, distribution and habitat use of important functional terrestrial fauna elements and species of special interest. Linear transects of 500 m length and quadratic transects with 400 m^2 for mammals. The surveys focused on vertebrates, particularly on mammal because of their importance in ecosystem function and status.

Incidental observations were also recorded (e.g. live and dead rodents, porcupines and hedgehogs). Searches were conducted in selected microhabitats (e.g. beneath rocks, along wadi systems and at crossings and convergences), night-lighting for nocturnal animals and information from local residents.

Mammals were surveyed by walking transects in each of the flora sampling locations (see above) so that much of the data for plants and animals is co-located. Additional habitats (vegetation edge, man-made features) were surveyed for wildlife. Line-transects was conducted at the site. Each transect was scanned to search alive animals or their signs such as foot prints, scat or nesting / burrowing areas.

In addition to the field observations, local farmers and labourers were asked if they have noticed the presence of certain species. Their observations were interpreted based on precise descriptions of some key species or commonly-known species which are difficult to mistake. Mammals and bat studies were conducted from 15th of May and till 30th of August 2013, using bat detectors.

Mammals Survey Results

A total of 15 mammalian species were recorded through observations during spring and fall 2013. Table 8-14 shows the species and their conservation status:

Table 8-14 Mammalian species of the Project Area

Species	Common name	IUCN Cons. Status	CITES	Bern
Family Erinaceidae				
Erinaceus concolor	European Hedgehog	Least Concern	-	-
Family Rhinolophidae				
Rhinolophus ferrumequinum	Greater Horse Shoe Bat	Least Concern	-	-
Family Leporidae				
Lepus capensis syriacus	Arabian Hare	Least Concern	-	-

Species	Common name	IUCN Cons. Status	CITES	Bern
Family Cricetidae				
Gerbillus dasyurus	Wagner's Gerbil	Least Concern	-	-
Meriones tristrami	Tristram's Jird	Least Concern	-	-
Meriones libycus	Libyan Jird	Least Concern	-	-
Family Spalacidae				
Spalax leucodon	Palestine Mole	Data Deficient	-	-
Family Hystricidae				
Hystrix indica	Indian crested Porcupine	Least Concern	-	-
Family Canidae				
Vulpes vulpes	Red Fox	Least Concern	App-3	-
Canis lupus	Wolf	Least Concern	App-1 and 2	App-2
Family Hyaenidae				
Hyaena hyaena	Striped Hyena	Near Threatened	App-3	-
Family Felidae				
Felis silvestris	Wild Cat	Least Concern	App-2	App-2
Family Muridae				
Acomys dimidiatus	Eastern Spiny Mouse	Least Concern	-	-
Meriones tristrami	Tristrams's Jird	Least Concern	-	-
Family Gerbillinae				
Dipodillus dasyurus	Wagner's Gerbil	Least Concern	-	-

Bats Literature Review

Jordan is a relatively small country, but its bat faunal diversity is high, with 26 species represented by 9 families recorded so far. This diversity is mainly due to Jordan's location at the crossroad between three major continents which enhances the creation of four bio-geographical zones with different climatic conditions; these are the Mediterranean, Irano-Turanian, Saharo-Arabian, and Afro-tropical. This allows the presence of several species from different bio-geographical affinities.

Adjacent areas to the Project site have been studied and notes on their bat diversity were provided. A survey on bats was accomplished in 1995 in the Dana Biosphere Reserve and showed the presence of seven bat species including Botta's Serotine Bat *Eptesicus bottae* and Bodenheimer's Pipistrelle *Pipistrellus bodenheimeri* (RSCN, 1995). The survey results were updated in 2012 which revealed the presence of ten bat species in Dana Reserve (RSCN, 2012).

Harrison and Bates, (1991) published the most comprehensive review on the Mammals of Arabia including Jordan. The book contains a list of all mammalian species from the Arabian Peninsula, including bats with a detailed description of all species' external characteristics, cranial measurements, dentition, variation, distribution in the range countries and some useful remarks on the biology of the species.

In 1996, Qumsiyeh published the second and most comprehensive review of the Mammals of the Holy Land, with more emphasis on the conservation status and biology of the species. Qumsiyeh review stated the presence of bat species with details on their distribution, status and human interaction. This review was followed by a detailed description provided by (Qumsiyeh *et al.,* 1998) on bats' faunal diversity with illustration of their bio-geographical affinities.

In 2000, Amr produced one of the most useful guides to Jordan's mammalian species including their bio-geographical affinity. His guide included comprehensive species list of bats' faunal diversity, with detailed description of each species localities. Amr updated his book in 2012 where further notes on bat species were included and he provided the most recent and updated distribution maps.

Benda *et al.,* (2010) published the most comprehensive and up to date manuscript on the bats of Jordan, including distributional data, ecology, echolocation, ecto-parasites and zoogeographical analysis.

Since 1990s, it has been assumed that bat species foraging in the open air could be affected by wind turbines as birds. Bach *et al.,* (1999); Rahmel *et al.,* (1999) discussed for the first time the problems associated between wind farms and bat species.

Johnson *et al.,* (2000) published his work on bird's strikes findings where he showed that the number of dead bats found under wind turbines was sometimes higher than the number of dead birds. This study was followed by several reports which included notes of bats collision with wind turbines (Durr, 2001; Trapp *et al.,* 2002; Durr & Bach, 2004; Ahlen*, 2002; Alcalide, 2003*). *Robert et al.,* (2007) published their work on the variation in bat fatalities at wind energy facilities where they stated that bat fatalities increased exponentially with tower height; they suggested that migrating bats fly at lower altitudes than nocturnally migrating birds and those newer, larger turbines are reaching that airspace. Therefore, they suggested that minimizing tower height may help minimize bats' fatalities, however, fatalities in birds will be increased.

Rodrigues *et al.,* (2008) developed a publication titled as "Guidelines for Consideration of Bats in Wind Farm Projects". This publication is considered important as it shows the

impact of wind farms on bats and it was adopted by all the European Union countries. Evidences of turbines killing bats from local populations and even from populations at far distance were provided by (Voigt *et al.,* 2012).

Bats Field Survey

The bat surveys covered the Project site from the period of 20th of June and until September 2013. A total of 10 field work days were carried out in June, July, August and September 2013. During the surveys a hand-held Global Positioning Device (GPS) type Garmin Etryx was used and two methods were applied in field days shown in Table 8-15.

Table 8-15 Bat Surveys Date and Field Days

Survey field visit	Date	No of days
Bat survey	20 June	1 days
Bat survey	1 July	2days
Bat survey	30 July	2 day
Bat survey	5 August	2 days
Bat survey	20 August	2 day
Bat survey	7 September	1 day

Habitat Description for Bats

Generally, the Project site is composed of infertile barren lands with some rocky outcrops and a few vegetation land cover. In addition, bands of the White Wormwood (*Artemisia herba-alba)* is found at the site but the majority is degraded and lands were altered to cultivated areas for wheat or barely (Figure 8-12).

Figure 8-12 General Habitat of the Project site in Summer and Fall Seasons

Detection of Bats

Bat box III bat detector with acceptable length range 19-125 KHz and a bandwidth of more than 16 KHz were used. This method included two sub-methodologies and these are:

Route Transect Method

This method started at 09:30 p.m. until 12:00 a.m. Method implies selecting the start point randomly and the team walked for unspecified length depending mainly on the topography of the land. While walking, the team was searching for any evidence of bat presence using the bat detector and when positive calls heard, the team stopped and location was recorded using the GPS. A total route length of three kilometres was covered in the study area (Figure 8.14).

Points for Bat Detection

Four points were selected randomly in the study area with a total of one hour monitoring period. This method started at 08:00 a.m. until 09:00 p.m. where the team positioned in the selected point and searched for bat calls using the bat detector. When positive detection happened, the team recorded the frequency and the location. Activity index was determined in means of number of bats calls detected per hour (Figure 8-13).

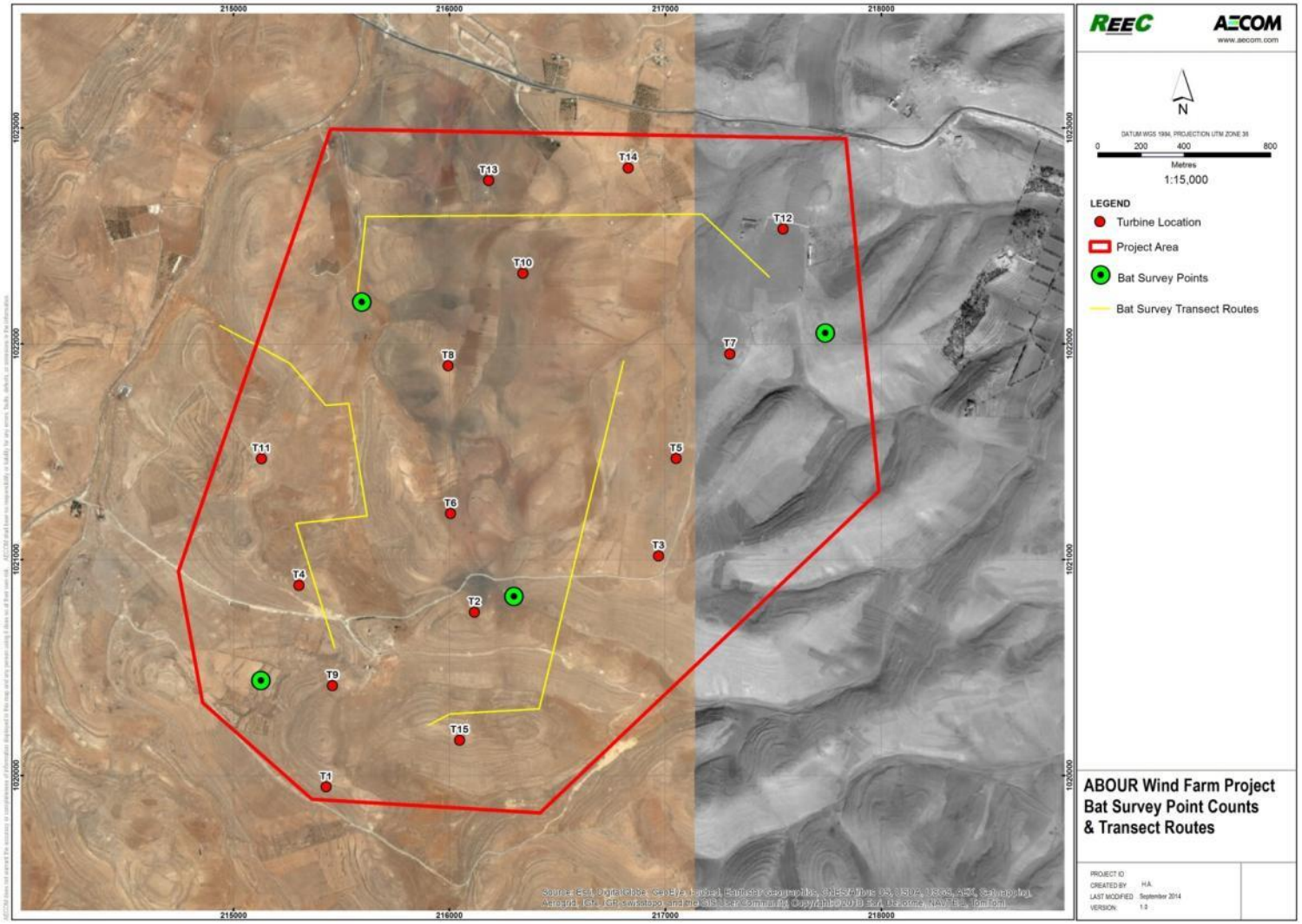

Figure 8-13 Bat Survey Point Counts & Transect Routes

Bat Survey Results

No bat activities were recorded at the site, however, a species of bat was recorded 8 km south of the Project location in Ein Garandal. The signals recorded were found at around 38 KHz and they were belonging to Kuhl's Pipistrelle, *Pipistrellus kuhlii* (LC).

8.7 Naturally Protected Areas

There are couple of designated and proposed protected areas in the region. The map showing the protected areas and important bird areas in the region is given in Figure 8-14. The closest areas to the Project site are Dana Biosphere Reserve and Dana Important Bird Area (IBA). The distance between Dana Biosphere Reserve and the Project site is about 11 km whereas Dana IBA is situated around 7.5 km away from the Project site in southwest.

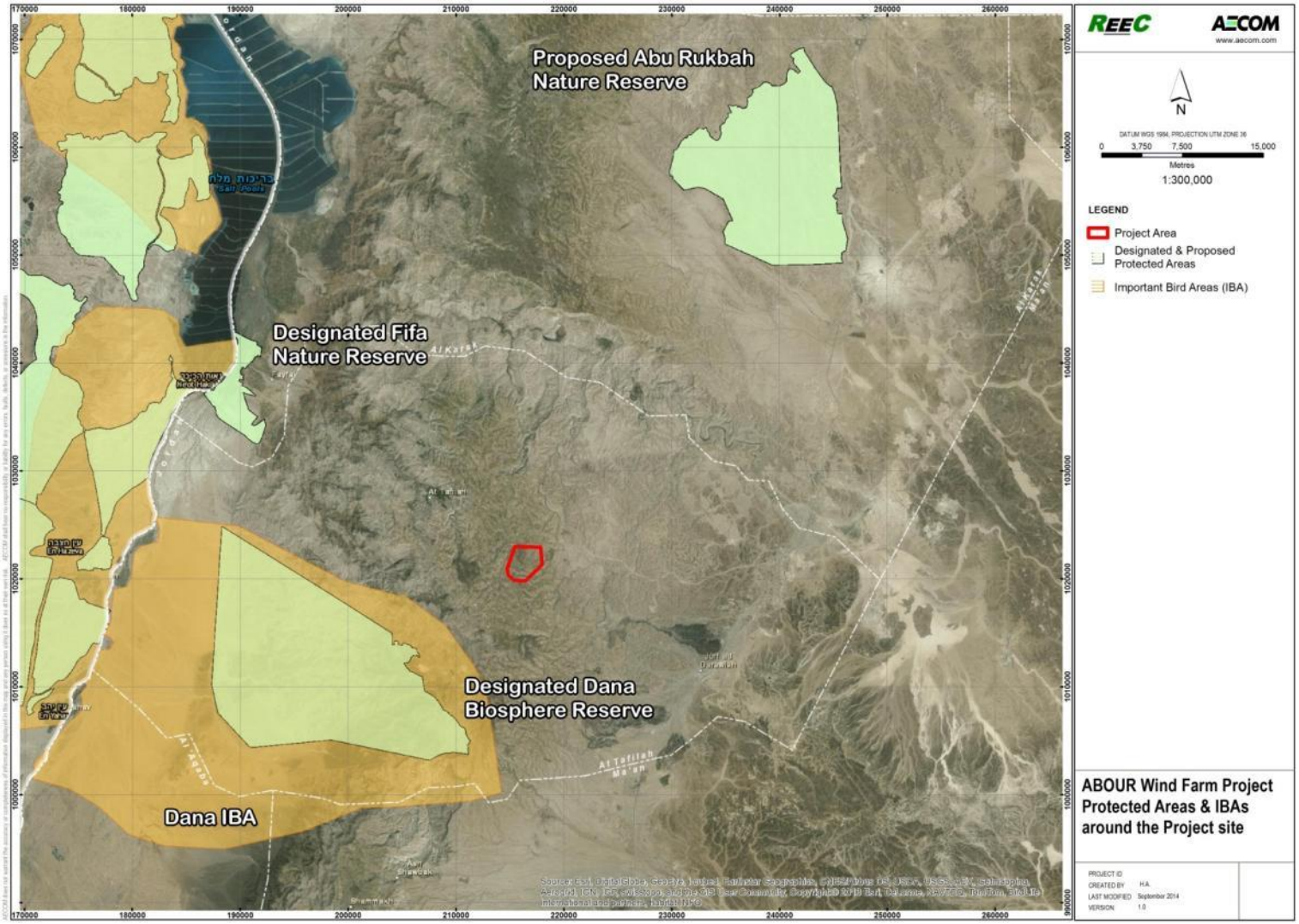

Figure 8-14 Different Conservation Zones in the Area

8.7.1 Dana Biosphere Reserve

According to official website of The Royal Society of Conservation Nature, Dana Biosphere Reserve was established in 1989 and it is the largest nature reserve in Jordan, with 320 km^2 of area along the face of Wadi Araba. It sweeps along mountain ridges starting from high plateau near Quadesiyya (which is 1,500m asl) to the desert plains in Wadi Araba. A number of steep-sided wadis which are often lined with a lush growth of trees and shrubs cut mountains.

Dana Biosphere Reserve includes the four different bio-geographical zones, which are Mediterranean, Irano-Turanian, Saharo Arabian and Sudanian penetration. Moreover, it has a great habitat and species diversity in the region. Dana Biosphere Reserve hosts several vegetation types, including the Phoenician Juniper, evergreen oak, sand dunes, acacia, and rocky sudanian. In addition, it covers the southernmost remaining forest community of Cypress *Cupressus simpervirens*.

Dana holds a wide variety of wildlife, including numerous rare species of plants and animals. It contains several globally threatened species of birds and mammals, such as Syrian Serin (*Serinus syriacus*), Lesser Kestrel (*Falco naumanni*), Blanford's Fox (*Vulpes cana*) and Nubian Ibex (*Capra nubiana*). Dana holds the largest breeding colony for Syrian Serin in the world. Moreover, the Lesser Kestrel is known to breed in the area.

The habitats are diverse ranging from highland plateaus with steppe vegetation and modified by traditional cereal farming, juniper and oak open woodland amongst rounded sandstone hills, rugged rocky slopes and gorges to sand dunes and perennial streams lined with trees and oleander bushes.

Overgrazing, woodcutting, and hunting, mainly of Ibex and Chukar are the major threats to the natural environment of the area. The main use of the Dana Biosphere Reserve is grazing which is causing local habitat degradation and soil erosion, while agriculture is practiced at higher elevations in Wadi Araba. There is a cement factory at Rashadiya and mining area at Jebel Sarab which are causing destruction of local habitat.

8.7.2 Dana Important Bird Area

Figure 8.13 above shows the boundaries of the IBA at Dana Biosphere Reserve. At least 80 bird species breed representing four different biogeographic origins are in the IBA. These include Lesser Kestrel, Bonelli’s Eagle, Short-toed Eagle and Verraux’s Eagle, Griffon Vulture, Hume’s Tawny Owl and Eagle Owl, Hooded and Isabelline Wheatears, Dunn’s, Bar-tailed and Short-toed Larks, Woodlark, Tawny and Long-billed Pipit, Arabian,

Upcher's and Orphean Warblers, Palestine Sunbird, Arabian Babbler, Tristram's Grackle, House and Cretzchmar's Bunting, Sinai Rosefinch and Fan-tailed Raven.

The Dana Biosphere Reserve holds the only breeding population of Syrian Serin in Jordan, and probably up to 50% of the world population of this species, which is endemic to the Near East. There is huge raptor migration in spring, which may total up to 100,000 birds per season including Egyptian Vulture, Imperial, Steppe and Lesser Spotted Eagles, but most numerous are Levant Sparrow Hawk, Honey and Steppe Buzzards. Other migrants or winter visitors include Wryneck, Cyprus and Menetries Warblers, Rock Bunting, Hawfinch and Red fronted Serin.

8.8 Impact Assessment

8.8.1 Impacts on Flora

There will be a significant impact on the existing vegetation during site preparation and excavation activities. There will be limited impact on the flora during the operation phase.

Removal of topsoil

During the construction activities, the topsoil will be removed where the wind turbines, crane pads and access roads will be built. The topsoil has a high nutrient content, thus removal of it will cause direct loss of micro-habitats for common vegetation. Moreover, removal of top soil will have an indirect impact on reptiles, small mammals and local birds which use ground for nesting purposes, such as larks and other passerines.

In order to construct the Project units and access roads, the vegetation will be removed. The majority of the habitat destruction occurs during the road constructions. However, vegetation loss will be limited and moreover, topsoil should be removed and stored on site for future landscaping purposes.

Since the Project site already has many existing dirt roads, the significance of the impact is expected to be low.

Solid and liquid waste

Solid and liquid wastes will be either domestically generated or result from construction activities. The wastes are needed to be handled properly so that the wadi beds not contaminated during water runoffs. These runoffs would also affect directly the flora in the area. Such wastes may also indirectly attract animals to the area.

Destruction of flora

In the first phase of the Project, the vegetation will be stripped for the construction in the Project site. Thus, the natural vegetation will be destroyed by the cuttings, removal of the

vegetation and excavation processes. The construction activities will cause most of the fauna species that depend on this flora and vegetation structure to lose their habitat.

There will be biomass loss due to plant species loss during stripping but the site works will not affect their populations only temporarily and the proposed Project will not disturb the overall vegetation structure permanently.

8.8.2 Impacts on Fauna

In the first phase of the Project activities, the vegetation from areas to be developed within the Project site, e.g. turbine bases, access road routes and substation footprints will be stripped. During this phase, there is a risk of disturbance to birds and other animals that make use of this vegetation for breeding, foraging etc.

After stripping, the Project site will be levelled or excavated. If there are animals just below the soil surface, they may come out to the surface because of excavation disturbance. These should be relocated to an undisturbed area similar to the undisturbed area from which they were originally displaced.

It is not possible for the animals nesting on the plants or soil in the Project site to inhabit these areas again after the stripping. This is the case especially for the wind farm project units and access roads. The individuals leaving their habitats will have to find similar habitats around. During this period, since these animals will be under stress and in an adaptation process, no one should approach or try to capture or any other attempt, which increases their stress.

The degree of effects of these activities on the fauna elements not only depends on the type of the activity, but also the mobility of the animal. If the mobility of the animal is high enough, its reaction to the threats will also be quick. Birds have the highest ability to move away from disturbance, provided they are not breeding in a disturbed area. Minimal adverse effects are expected for the suite of non-breeding birds likely to occur at the site as a consequence of stripping or excavation activities. Compared with any stripped areas there is an abundance of similar quality habitat for foraging and other activities in undisturbed areas within, and adjacent to the site.

If breeding locations of priority bird species are identified in the vicinity of areas to be stripped, removal of vegetation and soil should take place during the non-breeding season.

Habitat loss

Excavation work for the turbine locations, substation building and access roads could result in habitat loss. This could result in direct small decreases in populations of some reptilian (i.e. agama, Tortoise) and mammalian species (i.e. Libyan Jird, foxes). In extreme cases, if an essential habitat area or feature is lost, it is possible to lose species from the area permanently.

The road construction in wind farm projects constitutes the majority of the destruction. For this reason, existing access roads should be used in the area for the construction activities and construction of additional roads should be avoided as much as possible. The time period of the removal of vegetation could be carefully arranged so that the species inhabiting these areas will be protected. These species will migrate to other similar habitats for nesting and nourishment in their breeding periods.

Habitat Alteration

Invasion by weeds, habitat conversion, increased human disturbance due to changes in access, noise and light disturbance at night causes direct changes in plant communities may directly affect resident birds.

Habitat Fragmentation

Fragmentation is resulted from conversion of large, continuous blocks of habitats into smaller patches by Project roads. The severity of this direct effect is determined by the scale of the fragmentation and the tolerance of the species. The impact is anticipated to be low in the AEC wind farm as the habitat is already fragmented.

Noise

Many fauna species are adversely affected by lower noise levels compared to humans. As a result, animals may have a break or quit some of their daily activities such as nutrition, and seasonal activities, particularly breeding. During construction and operation phases, the noise level resulting from various sources might be higher than the background noise levels near the turbines. It is expected that the wild animals will move to calmer and more comfortable environments in the region due to the noise and mobility throughout the construction process. However the construction activities are for a limited period of time and the related activities will not lead to any long term negative biological and physical pressure on the populations of the species classified in IUCN risk categories.

Light and Traffic

The wind turbine components may be brought to the site by large vehicles during night-time. During the construction phase of the Project, the vehicles carrying construction material and personnel to the Project site will also cause a traffic load in the close vicinity

of the Project site. After the installation of the facility, the fauna elements inhabiting near the access roads may face to various risks resulting from these vehicles.

The light and noise will most probably cause animals to leave the Project site. Moreover, these night activities may also lead to accidental killing of animals by transport equipment at the construction site.

The disturbance caused by the construction work may lead to major changes in the use of area for some of the wildlife components such as porcupines. Shifting of the normal feeding time to daytime may be a possible indirect change.

Solid and liquid wastes

Some wildlife species may be attracted by the domestic wastes. Of particular relevance is the possibility that Griffon Vultures and other scavenging raptors will be attracted to the site by domestic waste resulting in an elevated collision risk to these species. There will be a risk of contamination with hazardous wastes for both humans and fauna in the region. All wastes must be collected during construction and disposed properly to decrease the impact on fauna.

Hunting by workers

Since hunting is very common in the area, it is required to give information to the workers about illegal hunting.

Additional impacts related to birds are reviewed in the Birds section (see: Section 8.6.5)

8.9 Mitigation Measures

For detailed discussion on mitigation measures please refer to Annex IX of this report.

8.9.1 Mitigation Measures during Construction Phase

- Comply with environmental standards and strictly control workers to behave responsibly with respect to environmental issues;
- Reduce/ optimize amount and size of new roads as much as possible;
- Replant natural vegetation and transfer rich soil of the construction sites to nearby areas;
- Decommission temporary assembly areas and restore to the original conditions;
- Limit decommissioning activities to the excavation site where possible and replant site with native plants;
- Collect all wastes, solid and liquid, in sealed containers to be disposed in proper disposal sites;

- Work should be under ISO14001 accreditation for environmental management which also be imposed on all the subcontractors; and
- Cover each spot where excavated material is stored when climate conditions requires to effect dust control by usage of dust suppression substances.

Stripping and Excavation Activities

- Limit construction activities within the wind farm site;
- Reduce / optimize amount and size of new roads as much as possible;
- Store the natural soil at special sites and reuse it when back-fill activities are needed; and
- Shift natural vegetation and nutrient rich soil of the construction sites to nearby areas.
- The on-site transmission lines within the wind farm area of the Project are planned to be buried. Moreover, NEPCO should be encouraged that any transmissions lines between the wind farm and the (offsite) substation to be designed in line with Avian and Bat Collision and Electrocution protection measures presented in World Bank Group Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution (2007).
- The bird flight route maps, especially for the autumn surveys (see Annex III a), indicate that the majority of the flight activity occurs within the valleys in between and surrounding the hills that the turbines are located on. Therefore, the pre-construction survey data suggests that current turbine micro-siting and layout of wind farm are suitable considering the observed flight behaviours of the target species and especially the migrants.
- An annual breeding bird survey, to characterize bird populations using the site and evaluate the effect of the development on these populations is suggested as part of the ESMMP, with the first survey to take place before the start of construction activities.

8.9.2 Mitigation Measures for the Operation Phase

- Collect all wastes in sealed containers to be disposed in proper disposal sites;
- Prohibit leaving the roads and crane pads with vehicles unless major maintenance works will have to be performed;
- Prohibit workers from hunting and produce awareness materials such as:
    - Signs
    - Training manuals and material.
    - Posters.
    - Brochures.

- Reduce vehicle movements to a minimum;
- Reduce footprint as much as possible;
- Minimize intervention as much as possible;
- Conduct follow-up researches on the effects of the Project on the avifauna;
- Synchronize aviation lights (if practical);
- Post construction bird mortality monitoring should be undertaken in order to identify short-term and long-term impacts of the wind farm and appropriate mitigations which satisfactorily address these impacts. Recommended minimum requirements for during and post construction monitoring effort and timing are as follows:

    - Flight-activity monitoring conducted throughout the year with an increased level of monitoring effort during the spring and autumn migration periods.

    - Implementation of an observer-led shutdown on demand system to mitigate for collision between turbine rotors and high conservation status/collision vulnerable bird species.

    - Conducting of 'carcass search surveys' to assess bird collision fatalities

    - Conducting of 'bias correction trials' to calibrate carcass search surveys for searcher efficiency and carcasses removal rates.

    - Monitoring of livestock movements within the site to help identify elevated risks to Griffon Vulture and other scavenging bird species that may be attracted to the site by the periodic presence of livestock on site.

- Activities listed above should be conducted initially for the first 3-years of operation. These mitigation measures then should be reviewed and subsequent mitigation measures should be confirmed.
- The mitigation measures described above should follow protocols detailed ESMMP and developed before the start of post-construction monitoring.
- A reporting schedule described in detail in ESMMP will be followed. This should include:

    - Immediate reporting of fatalities.

    - Monthly review of carcass search results and
    - 6 monthly review of all mitigation measures as part of adaptive management process.

9 TRAFFIC AND TRANSPORT

The main transportation impacts from the development will be associated with the movements of commercial heavy goods vehicles (HGVs) travelling to and from the site during the construction phase. HGV vehicles will be associated with the transport of plant and materials to the site.

9.1 Guidance

The assessment will be based on guidance given in the Institute of Environmental Assessment's (IEA) Guidelines for the Environmental Assessment of Road Traffic (1993) used in the assessment of the impacts generated by traffic and transportation associated with a development in UK during ESIA studies.

9.2 Planned Routes

The Project site is located in an area within Tafila Governorate which is served by the Desert Highway running in a north-south direction. It goes south to Aqaba area and Port of Aqaba and north to the capital city Amman.

Transportation of the equipment required for the Project from Port of Aqaba to the Project site will be via the Desert Highway. The planned transportation route of the turbine equipment from Port of Aqaba to the Project site in the Village of Abour is shown in Figure 9-1. Figure 9-2 presents the available tracks within the Project area.

The number of fatalities on the Desert Highway during the 2015 totalled 20 people, in addition to tens of injuries. But no data could be obtained for the planned route.

9.3 Impact Assessment

The main concern is the transportation movement on external roads and the use of machinery and vehicles during the different phases of the Project. The traffic related environmental impacts will be established by comparing predicted development traffic demand levels to key environmental impact thresholds as set out in the (IEA) Guidelines for the Environmental Assessment of Road Traffic. The assessment of traffic related impacts will be undertaken in relation to:

- Severance
- Accident potential
- Conflict with vulnerable road users
- Delay incurred by all modes

Severance is defined by the IEA guidelines as the perceived division that can occur within a community when it becomes separated by a major traffic artery. Severance can result from the difficulty of crossing a road with high traffic or by a physical barrier created by the road itself. Severance effects can impact residents, motorists or pedestrians.

Accident potential may occur because of the transportation movement on external roads and the use of machinery and vehicles during the different phases of the Project. Changes in traffic flow and composition may have implications on the local road network and may increase the risk of accidents.

Conflict with vulnerable road users: Mobility is part of daily life. Anyone using the roads is at risk of injury or death in the event of a road accident. Some people are more at risk than others and are commonly referred to as Vulnerable Road Users (VRU). The term has been defined in different ways:

- World Health Organization in 2013 considered VRUs to be “pedestrians, cyclists, and motorcyclists”;
- US DOT’s National Strategy on Highway Safety has a more complex definition: “road users who are most at risk for serious injury or fatality when they are involved in a motor-vehicle-related collision. These include pedestrians of all ages, types and abilities, particularly older pedestrians and people with disabilities. VRU‘s also include bicyclists and motorcyclists. Older drivers may also be considered to fit into this same user group”;
- European Union’s ITS Directive refers to “non-motorized road users, such as pedestrians and cyclists as well as motor-cyclists and persons with disabilities or reduced mobility and orientation”.

Vulnerable Road Users can be summarized as following:

- Pedestrians;
- Cyclists;
- Children, elderly and disabled persons; and
- Road workers.

Vehicle speed is a key factor in fatalities.

Delay incurred by all modes: additional or changes in traffic volume by a development may cause delays to non-development traffic or may affect the ability of pedestrian to cross roads.

The main impact of the Project is expected to be during construction phase (temporary period). While the operation phase will have much smaller impact than during construction phase. The main traffic activity during operation phase will be the maintenance vehicles which can access the site easily and will not represent a noticeable impact on the total number of vehicles.

The main route for equipment transportation will be via Desert Highway which is well-developed and consists of several lanes. Therefore, no additional impact is expected to affect this route.

9.4 Mitigation Measures

- Construction materials should be well-sealed in the trucks to prevent spill during transportation.
- Trucks delivering construction materials should have a gross weight that is within the axial permissible load.

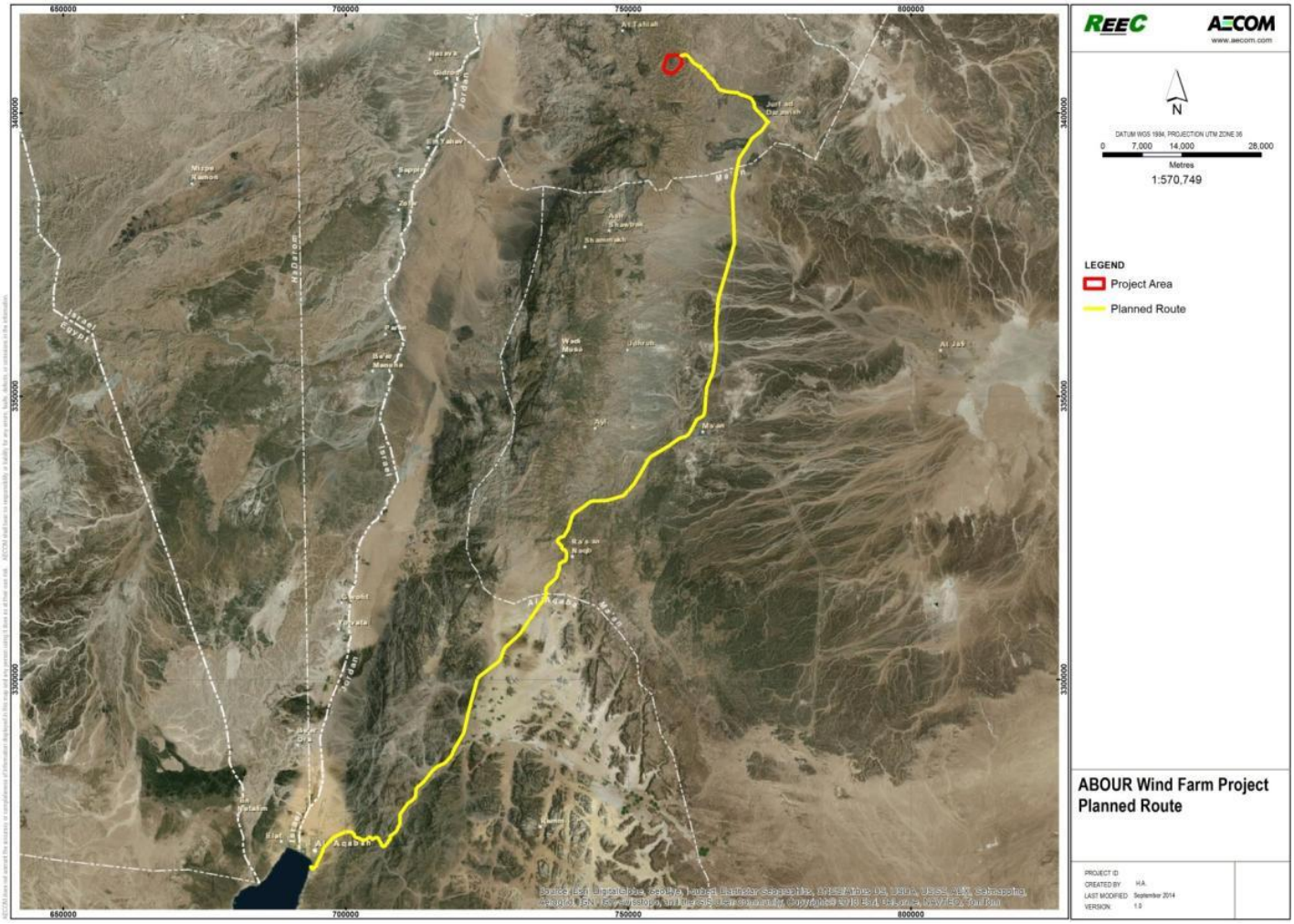

Figure 9-1 Planned Transportation Route

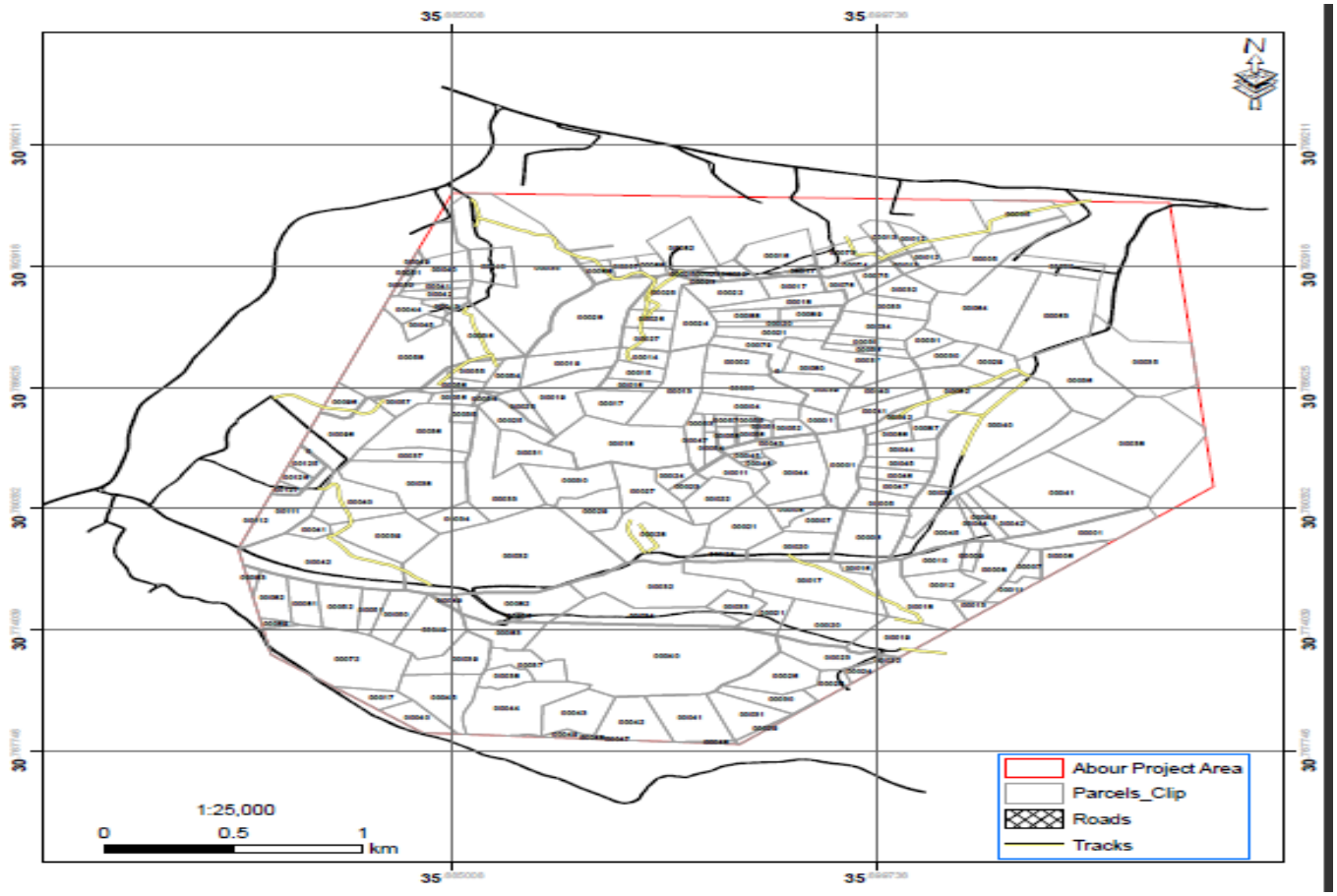

Figure 9-2 Available tracks within the Project area

10 ANALYSIS OF PROPOSED PROJECT ALTERNATIVES

The analysis of Project alternatives is one of the main tenets of environmental impact policy and procedures world-wide. A thorough, unbiased and transparent assessment of alternatives from an environmental, social, technical and economic standpoint is one of the most important contributions an ESIA can make to improve decision making.

The analysis for this Project contains options/alternatives which are the “No Project” versus “Project” alternative; however, the Project location is selected by MEMR and the Project developer.

By considering these alternatives prior to the commencement of Project activities, environmental and social benefits can be maximized and potential challenges can be identified and addressed.

Table 10.1 below presents the symbols that denote the various levels of environmental impact to aid in the comparison of alternatives. Each symbol indicates an overall evaluation of the specified environmental component and social aspect.

Table 10. 1 Evaluation Symbols for Levels of Environmental and Social Impact

Symbol	Description
X	Denotes no change to the existing situation
P	Denotes potential for impact, which is not considered significant
-	Denotes Potential Significant Adverse Impact
+	Denotes Potential Significant Beneficial Impact

10.1 The “Project” vs. the “No Project” Alternative

The “No Project” option considers the alternative of not carrying out the Project at all. It is normally evaluated to assess the impacts if the Project does not go ahead. This alternative is evaluated against the implementation of wind energy project as one of the renewable energy resources in Jordan.

Table 10.2 presents the methodology of evaluation the overall impacts and takes into consideration that a degree of mitigation is applied.

Going forward with the proposed Project alternative is considered the best possible option as opposed to “No Project” since the proposed Project is considered a green and

environmental solution for energy generation in Jordan as the wind energy considered as renewable clean technology with no emissions as well as the global and local trend for energy generation.

Table 10.2 Comparison of overall environmental impacts as a result of the Proposed Project against the "No-Project" Alternative

Environmental Components	Proposed Project	No-Project Alternative
Terrestrial Ecology	-	X
Air Quality	X	X
Noise Generation	X	X
Wastewater Generation	-	X
Waste Generation / Disposal	-	X
Soil & Groundwater	X	X
Health & Safety	-	X
Socio-economic Impacts	+	X
Traffic Disturbance	P	X
Land Use	+	-
Archaeology / Cultural Property	P	X
Energy Production	+	-
Employment and Job Opportunity	+	-

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ZUHAIR S. AMR 1 & AHMAD M. DISI 2 Systematics, distribution and ecology of the snakes of Jordan

ANNEXES

Annex I: List of attendees at the Scoping Session

Annex II: Project Team CVs

Annex III: AECOM Ornithology Report for Abour Wind Farm Based on Field Studies Conducted During Spring and Autumn 2013 and 2014 Migration Periods

Annex IIIa: Appendices to AECOM's Ornithology Report

Annex IV: NRP's Report on Bird Flight Activity Survey in Abour Wind Farm during spring 2015 Migration Period

Annex IVa: Figures of NRP's Report

Annex V: Shadow Flicker Modelling Results

Annex VI: Visual Impact Assessment

Annex VII: Measurements Instruments Details

Annex VIII: Archaeological Survey Photographic Documentation

Annex IX: Environmental and Social Management Mitigation Plans