PROPOSED COLLGAR WIND FARM

ENVIRONMENTAL ASSESSMENT

Prepared for

Collgar Wind Farm Pty Ltd
Level 31, Chifley Tower
2 Chifley Square
SYDNEY NSW 2000

Report No. J08005
21 August 2008

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

Sundowner Nominees Pty Ltd as trustee for the Bayley Cook Family Trust ABN 20 822 598 897
trading as Bayley Environmental Services

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 The Proposal

Collgar Wind Farm Pty Ltd (CWF) proposes to construct and operate a wind farm on cleared farm land at Collgar, approximately 15km south-east of Merredin. The project will comprise about 127 wind turbines within a 126km^2 project area spread over 16 farms. The wind farm will have a nominal generating capacity in the order of 267MW of electricity, which will be sold into the State grid via an existing 220kV powerline that crosses the project area.

A location plan and overview of the project area are shown on Figure 1.

1.2 The Proponent

The proponent of the Collgar wind farm project is Collgar Wind Farm Pty Ltd, a wholly-owned subsidiary of Investec Bank (Australia) Limited. The address of Collgar Wind Farm Pty Ltd is:

Collgar Wind Farm Pty Ltd
c/- Investec Bank (Australia) Limited
Level 31, Chifley Tower
2 Chifley Square
SYDNEY NSW 2000
Ph 02 9293 2000
Fax 02 9293 2322

Investec, a wholly owned subsidiary of the Investec Group, is an investment bank that offers a diverse range of banking products and services to a niche corporate market. Investec has several wind farm projects under development in Victoria, Queensland, New Zealand and Western Australia, and also has a financial interest in several operating wind farms internationally through its involvement with the Viridis Clean Energy Fund. Investec is responsible for the development, financing and operation of the Collgar wind farm and its other wind farm development projects.

1.3 The Site

The Collgar wind farm site is located on cleared farmland approximately 15km south-east of Merredin. The land is held by sixteen landowners, all of whom are financial beneficiaries of the project.

Because the precise locations of the turbines will continue to be refined based on further wind measurements and modelling up until the point of construction, CWF seeks

approval for a project "envelope" (Figure 1) within which the turbines will be located. It is anticipated that the Shire of Merredin will establish a Special Use (Wind Farm) zone over the project area and a Restricted Use area around the development envelope, with turbines required to be located so as to meet the planning requirements implied by the Restricted Use boundary.

1.4 Sale of Electricity

Electricity produced by the wind farm will be sold into the State interconnected grid under a commercial agreement. The farm will be connected to the grid via a substation that will be constructed adjacent to the existing 220kV power line that runs through the centre of the project area (Figure 1).

1.5 Benefits of the Proposal

The Collgar wind farm will contribute up to 266.7MW of electricity to the State interconnected grid. This will be sufficient to power up to 426,700 typical households and will save up to 2.15 million tonnes per annum of greenhouse gases (CO_2 equivalent) when compared with coal-fired power generation (*Draft Greenhouse Gas Abatement Plan for Bluewaters Power Station*, quoted in WA *Greenhouse Gas Emission Reduction (Power Stations) Bill 2008 Explanatory Memorandum*).

The project will also inject substantial revenue into the local economy, including lease payments to participating land owners, payments to local suppliers for construction materials and labour, and employment of operating personnel.

1.6 Project Schedule

Construction of the wind farm is scheduled to commence in about June 2009 and to run for approximately 18 – 24 months.

The facility may be completed in stages, with a first stage of approximately 75% of turbines being installed by November 2010 and the second stage being installed approximately 18 months later. This will depend upon market conditions at the time of installation.

1.7 Evaluation of Alternative Sites

The site selection for the wind farm has been carried out by Windlab Systems Pty Ltd, a commercial offshoot of the CSIRO, which specialises in identifying suitable sites for wind farms using wind mapping and modelling technology developed by the CSIRO.

Suitable sites for wind farms are dependent on the strength and, perhaps more importantly, the consistency of their winds. Such sites are typically in elevated locations and usually, but not always, near the coast. The suitability of a site is dependent on its elevation, proximity to electricity infrastructure, and the strength and consistency of its wind regime.

Windlab Systems Pty Ltd owns the WindScape atmospheric model, which allows broad regions to be mapped for wind resources. Windlab then employs a rigorous site selection process which involves the study of the wind resource, the electricity infrastructure, the planning environment and the land use. In Western Australia, Approximately 30 sites in Western Australia were examined in detail and the Collgar site was selected as the priority site for further feasibility studies due to the excellent wind resource (now proven with on-site measurements), supportive landholders and strong electricity infrastructure.

As an inland site, the Collgar location is able to mitigate many of the planning issues associated with siting wind farms in more sensitive coastal regions.

1.8 Community and Government Consultation

CWF and its consultant team have consulted with a range of government and private organisations and individuals in the planning of the Collgar wind farm. These include:

Shire of Merredin
Mr John Mitchell, Manager Development Services
Mr Jim Garrett, Manager Engineering Services
Mr Paul Bashall, Shire Planner

Shire of Westonia
Ms Sara Bright, Office Manager

Department of Environment & Conservation
Mr Gary Williams, Manager Planning & Infrastructure
Mr Murray Hogarth, Manager Land Development

Department of Planning & Infrastructure
Mr Phil DeCosta, Manager Aviation Policy

Participating Landowners
Mr George Giraudo
Mr Bryan Davies
Mr Rodney Crees
Mr Peter Crees
John & Peter Lambert
Neil & Marion Edgecombe (N&M Edgecombe Pty Ltd)

Mr Brian Pascoe
John & Rosetta Meharry
Leon & Suzann Franklin (Janmar Holdings Pty Ltd)
Mr Brian Johnston
Mr Graham Johnston
Peter & Jennifer Lynch (Kalinka Holdings Pty Ltd)
Stephen & Tania Higgins
Mr Murray Giles
John & Katherine Ward
Peter & Ian Sutherland

Neighbouring Landowners
Ken and Robyn Liebeck (Auld Nominees Pty Ltd)
Mark and Gavin Auld
Patricia Ward
David White and Caroline Hart
Gavin and Judy Duffy
Brian and Barbara Read
Peter Brown (tenant of Bryan Argyle, located in the US)
Tony and Vanessa Murfit (fixed-wing aircraft operators)
Greg Wahlsten
Brad and Kevin Anderson (helicopter operators)

Civil Aviation Safety Authority
Mr Bill Deuchar, Manager Airports WA

China Southern West Australia Flying College
Mr Frank Duan, CEO
Mr Mark Bucksey, Operations/Safety Manager
Mr Bob Travers, Manager Merredin

Royal Flying Doctor Service
Capt Michael Blues, Chief Pilot

Royal Australian Air Force
Sqn Ldr Murray Sullivan, Operations RAAF Base Pearce

1.9 Relevant Legislation

There is no legislation dealing specifically with wind farm construction or operation in Western Australia, although a number of legislative and policy instruments are relevant.

The wind farm will be constructed under a Planning Approval from the Shire of Merredin. The proposal will be referred to the Environmental Protection Authority and will be subject to the provisions of the *Environmental Protection Act 1986*. Clearing of

native vegetation, if necessary (expected to be less than 1ha), will be the subject of an application to the DEC for a Clearing Permit under the clearing provisions of the *Environmental Protection Act 1986.*

The EPA is familiar with the construction and operation of wind farms. The EPA decided not to formally assess two recent wind farm proposals in rural areas. These were at Emu Downs in 2006 and at Walkaway in 2005. The Collgar Wind Farm proposal is larger in size but similar in construction and operation to those projects.

The project area is currently zoned General Farming under the Shire of Merredin Town Planning Scheme No. 1. Electricity generation is a "PS" use (not permitted unless special approval given by council and conditions complied with) under TPS No. 1. It is expected that the Planning Approval for the project will be issued under the existing Scheme.

The Shire of Merredin is currently preparing a new Local Planning Scheme, under which the properties involved in the wind farm project will be rezoned to Special Use (Wind Farm). Within this zone, permitted ("P") uses will be wind farm and those uses permitted in the General Farming zone. The new Scheme will also include a Restricted Use area extending about 1.5km from the wind turbines in accordance with the final noise modelling of the wind farm, within which no new noise-sensitive land uses such as dwellings will be permitted.

The new Scheme has not yet been formally initiated by Council. When the Scheme is initiated it will be referred to the EPA for possible assessment under Division 3 of Part IV of the *Environmental Protection Act 1986.* The new Scheme is not expected to be implemented until after construction of the wind farm has commenced. In the meantime, it is understood that Council has applied to the WAPC for an Interim Development Order, giving it power to assess development applications independently of the Scheme.

This report and associated applications have been prepared in line with guidelines contained in WAPC Planning Bulletin 67: *Guidelines for Wind Farm Development*. The visual impact assessment has been undertaken with reference to *Auswind Best Practice Guidelines: Interim Landscape Assessment.*

2.0 PROJECT DESCRIPTION

2.1 Turbine Configuration

The turbine generators used for the wind farm are expected to be the Suzlon S88 2.1 MW model that will employ a three-blade, horizontal axis design. The turbine has a tower height of approximately 80m with a rotor blade radius of not greater than 50m. The final choice of turbine will be made on the basis of commercial factors including price, power output and availability. Noise emissions have been assessed based on the S88 turbine.

Each turbine comprises three carbon fibre composite rotor blades, a nacelle, tower and concrete footing. The tower will be constituted of tubular steel segments and will be approximately 4 m wide at the base and 3 m wide at the top. The tower colour is expected to be a non-reflective off-white. Figure 2 shows an generic elevation view of the turbine and tower.

Two types of footing will be used for the turbines:

- Gravity - Where the sediments are unconsolidated and of adequate depth, a 3m thick concrete slab 17 metres in diameter is installed in an excavation so that the upper surface is 1m below ground surface and then backfilled with local soil.

- Pile-anchored - Where hard rock is close to the surface, eight holes are drilled to a depth of 15 metres and become rock anchors for a 2m thick and 7m diameter slab. The surface of the slab must remain exposed for routine inspection.

A reconnaissance of geology and bore holes in the area suggests that there is sufficient depth of sediment for most of the turbines to be installed on gravity footings. Precise ground conditions for each turbine location will be confirmed by further geotechnical work during the detailed design phase.

A crane hardstand area will be required at the base of each turbine. The approximate dimensions of the hardstand are 20m by 35m, with the exact dimensions depending on the construction requirements of the turbine model. Hard standing areas need to be relatively level for the assembly and erection of the turbine elements. They will be retained after construction to facilitate future maintenance, repair or replacement of the turbine parts. A transformer will be located within or immediately adjacent to each turbine and will convert the electricity generated to the site reticulation voltage.

2.2 Turbine Placement

Figure 1 shows the current conceptual layout of the turbines, based on existing wind data. In general, the turbines are placed on the highest points where winds are most

reliable. The turbines are spaced to minimise aerodynamic interference and maximise the power output from each turbine.

As more data are collected and the wind regime at the site is refined, the locations of the turbines are likely to undergo minor modification. Figure 1 shows the Development Envelope, within which modification to turbine locations may occur.

2.3 Access Roads

The wind farm will be accessed from outside by means of the existing local road network. Where necessary, these roads will be upgraded to cope with the demands of heavy trucks carrying the turbines and other equipment. Any such upgrading will be consistent with the Main Roads WA *Handbook of Environmental Practice for Road Construction and Maintenance*. CWF will discuss the requirements for road upgrading with the Shire of Merredin.

Within the wind farm, a dedicated network of approximately 60km of gravel roads will be constructed to provide access to the turbines for construction, operation and maintenance. Wherever possible, the access roads will intersect the public road network via existing farm gates and access tracks, in order to avoid as much as possible the need to clear roadside vegetation. Figure 1 shows the conceptual locations of access points from the public road network. This may alter somewhat with minor variations in the locations of turbines.

Within farms, the access roads will be sited in cleared paddocks, in consultation with land owners to minimise interference with normal farming operations. The layout of the internal road network has not yet been determined.

Any vegetation clearance required for access road entries from the public road system will only be undertaken after a Clearing Permit has been obtained from the DEC.

2.4 Power Reticulation

The turbines will be connected by a combination of underground and overhead 33kV power lines. In general, groups of turbines will be linked by underground cables and overhead lines will be used to connect the groups of turbines to the substation. The reticulation network will generally follow the shortest route between turbines and groups of turbines.

Both underground and overhead powerlines will be routed predominantly through cleared paddocks. Overhead powerlines will be strung on new poles similar to those used by Western Power in reticulating its 33kV network in the area. Where it is necessary for reticulation to cross vegetation on farms (e.g. fencelines) or road verges, it will preferentially be installed underground by horizontal drilling to remove the need for

clearing. Where reticulation must cross roads, CWF will consult with council regarding the timing of road closures to minimise disruption of traffic. The reticulation will also need to cross the railway reserve that runs through the project area. It is expected that this crossing will be underground. CWF will consult with the owner of the railway reserve regarding access for the underground cable.

An electrical substation will be constructed located close to the 220kV power line to house transformers required to feed the wind farm's output into the grid, as well as metering, control and circuit protection equipment. The substation will be securely fenced and monitored to prevent unauthorised access. Transformers that use oil for cooling will be bunded to capture spills and leaks. A possible location for the substation is shown on Figure 1.

In general, the works on the low voltage side of the on-site 33kV to 220kV transformer, together with the transformer within the substation, will be owned by CWF. Those on the high voltage side will be owned by Western Power. Western Power has indicated it may wish to own the land on which its works reside. If this is necessary, then a separate application for subdivision will be made on the basis that the subdivision can only be used for construction of utility works.

2.5 Ancillaries

A temporary construction compound with site offices, vehicle and machinery parking, laydown area and concrete batching plant will be required during the construction phase. The size of the construction compound is estimated to be approximately 4ha. The location of the compound has not been finalised, although a possible location adjacent to Bulls Head Road is identified on Figure 1. The compound will be securely fenced.

Fuel and oil for cranes and earthmoving equipment may be stored on site. Any on-site storage will be in accordance with the Department of Water's *Water Quality Protection Note 58: Tanks for Temporary Elevated Fuel and Chemical Storage (2006)*.

The majority of the construction compound will be removed and rehabilitated following construction, although a sub-area may be retained for the operational facilities.

An operations and maintenance building will be required to accommodate the equipment associated with the substation and wind turbine operation and for the supervision and data acquisition of the wind farm as a whole. The building will provide amenity facilities such as toilet (septic or dry composting type), kitchenette and storage for tools and spare parts. This will be suitably located in close proximity to the substation along with an employee car park.

2.6 Project Construction

2.6.1 Construction Schedule

Construction of the wind farm is expected to start in June 2009 and to continue for approximately 18 to 24 months. Construction will begin with the establishment of access roads. Installation of the towers and turbines is expected to commence in about October 2009 and to continue for about twelve months.

The facility may be completed in stages, with a first stage of approximately 75% of turbines being installed by November 2010 and the second stage being installed approximately 18 months later. This will depend upon market conditions at the time of installation.

2.6.2 Sources of Materials

The wind turbines will be imported from the manufacturers. The turbine towers and ancillary materials and equipment such as power lines, buildings and control equipment will be sourced from within Australia where commercially feasible and advantageous to do so.

Road base (gravel) for the access roads will be obtained either from excavations made for the turbine footings, from other sources identified within the development envelope or from existing licensed borrow pits in the Shire of Merredin. If private sources are to be used, applications for extraction licences will be made to the Shire of Merredin as required.

A mobile concrete batching plant is likely to be located on the site to produce concrete for tower footings. Basic construction materials such as cement, aggregate and sand will be obtained locally wherever possible, both to minimise transport costs and to maximise the benefits to the local economy.

Water will be required throughout the construction phase for concrete mixing, road construction and dust suppression. The quantity required throughout the construction phase is estimated at between 10 and 12 megalitres, with a peak demand of about 60 kilolitres per day. The quality of water required will vary with the purpose, with concrete mixing requiring the highest quality and dust suppression having the least stringent quality requirements. Dust suppression water will in any case be of a quality sufficient not to harm remnant or roadside vegetation. This will form a requirement of the site Environmental Management Plan.

The water requirements are expected to be met from a variety of sources, possibly including the goldfields pipeline (for concrete mixing) and groundwater (dust suppression and road construction). The feasibility of using groundwater will depend on finding an economical source with suitable salinity. Alternatively, desalination of groundwater using a mobile reverse osmosis plant may be feasible. If groundwater is to

be used, CWF will apply to the Department of Water for the necessary licences. CWF may need to construct connected water infrastructure such as pumping stations, pipelines and connected electricity generation and supply.

If water from the goldfields pipeline is to be used, on-site storage may be employed to provide for peak demand while evening out the draw on the pipeline.

2.6.3 Transport of Materials and Equipment

The wind turbines, towers, concrete and other materials will be transported to site by means of trucks using the existing public roads. The primary access to the site will be via Great Eastern Highway, Merredin-Narembeen Road, Bulls Head Road, Springwell Valley Road, Scott Road, Koonadgin South Road, Old Muntadgin Road, Giraudo Road, Bassula Road and Norpa Siding Road. With the exception of the highway and Bulls Head Road, all of these roads are unsealed.

The heaviest vehicles using the roads will be the once-only delivery and later removal of a 600 tonne crawler crane and a 70 tonne crane. Other over-dimensional loads will include tower sections, turbine blades and nacelles, which will be delivered by large or extended articulated trucks, while other construction materials will be delivered by single-body trucks, truck and trailer or semi-trailers. The traffic volumes likely to be generated by the project over the 18-month construction phase are summarised as follows:

Material	*Vehicle Type*	*Round Trips*
Road base	10m^3 truck and trailer	7,050
Aggregate and sand	10m^3 truck and trailer	3,500
Cement	Semi trailer	900
Reinforcing steel	Semi trailer	129
Tower sections	Extended articulated truck	387
Turbine blades	Extended articulated truck	387
Nacelles	Heavy duty semi trailer	129
Employees and contractors	Car	47,500

Assuming a construction period of 18 months working five days per week, the average number of vehicle movements into and out of the site per day is estimated as:

Vehicle Type	*Trips Per Day*
Trucks for access road construction	43
Trucks for foundation construction	28
Trucks for turbine delivery and erection	14
Cars for employees and contractors	200

Traffic management measures will be implemented throughout construction to ensure that the impact of this traffic on the public road network and other road users is minimised. Details of this management are provided in Section 4.7.4.

Once the wind farm is operational, the turbines are designed to operate with minimal maintenance and therefore traffic to and from the wind farm will be minimal. The only time heavy equipment is likely to be required on site will be for un-expected and rare events such as repair or replacement of major components of the turbines or substation during the 25 year life. Such activity may generate increased traffic (including heavy vehicles) for short periods. Scheduled maintenance is undertaken primarily inside the turbine and only requires a 4WD or van similar to a typical farm vehicle. The wind farm may also encourage tourism to the area, which may cause a slight increase in regular traffic.

2.7 Construction and Operation Workforce

The site workforce may exceed 200 people during the construction of the wind farm, depending on the staging of construction. Typical project phases and their associated work groups may be:

- site study and feasibility involving such teams as geotechnical, environmental, electrical and civil conducting investigative works;
- early construction including civil works such as roads and compounds involving such teams as civil construction;
- late construction including foundations, electrical cabling and turbine erection involving such teams as electrical, civil, and turbine specialists; and
- monitoring teams such as environmental and management teams will likely have a presence throughout all construction phases.

The operational workforce will consist of management, support and maintenance staff, possibly numbering 5 to 15 people. Scheduled turbine maintenance may be approximated at twelve man-days per turbine per year totalling about 1548 man-days per year, in addition to any unscheduled maintenance and repair.

The construction and operation workforce will abide by all occupational health and safety regulations, environment management plans, cultural and heritage management plan and any other laws, regulations and approvals that are applicable to this development.

2.8 Drainage

Given the porous soils and low slopes over most of the project area, drainage requirements for the wind farm will be minimal. Access roads will be graded so that rain water runs off to the side of the track. Where the tracks cross sloping ground, bunds and drainage swales will be installed as necessary to trap and infiltrate runoff. Where the roads cross drainage lines, culverts or floodways will be provided to maintain the existing drainage regime.

2.9 Project Lifetime

The Collgar wind farm is designed for a 25 year life span, although the turbines and towers have a nominal service life of 30 years. The overall project lifetime may be extended as considered appropriate by CWR. It is likely that, as the turbines near the end of their serviceable life, they will be replaced with updated and/or upgraded equipment and the wind farm will be recommissioned. The agreements held with landholders involved in the project provide for leases to be entered into for an initial 30 year term with an option to extend for a further 20 years.

2.10 Decommissioning

If and when the wind farm ceases operation, it will be decommissioned and the site will be rehabilitated. All above ground non-operational equipment will be removed, which will necessitate the use of heavy cranes and trucks similar to those used for construction. Footings and underground reticulation will remain in place, but underground footings will be covered with at least 1000mm of soil. All access tracks (except those the landowners choose to keep) will be rehabilitated to the use considered appropriate at the time of decommissioning, for example cropping/grazing or native vegetation.

3.0 EXISTING ENVIRONMENT

3.1 Climate

Merredin has a warm Mediterranean climate with short, cool winters and long, dry, warm to hot summers. Average maximum temperatures range from 33.7°C in January to 16.3°C in July, while minima range from 17.9°C in February to 5.4°C in August (Bureau of Meteorology).

Merredin's average annual rainfall is 326.4 mm, of which more than 60% falls between the months of May and September.

The winds in Merredin are dominated by north-easterlies to south-easterlies in the mornings and by south-westerlies and south-easterlies in the afternoon. The prevailing winds vary somewhat throughout the year, particularly in the afternoons, with south-easterlies dominating in late summer/autumn, north-westerlies in winter and south-westerlies in spring/early summer.

Windlab Systems Pty Ltd has carried out detailed computer-aided mapping of wind speeds in the vicinity of the project area as part of the planning of the wind farm project. This mapping has been and is being augmented by on-site data from wind measurement towers collecting detailed real-time data on wind speeds at the height of the turbines, which are generally significantly greater than the wind speed at ground-based meteorological stations. Wind monitoring to establish the viability of this resource has been undertaken at the site since April 2007.

3.2 Topography

The landscape of the project area is very gently undulating, with elevations ranging from about 360m to 440m AHD. The slopes are low, rarely exceeding 5%. The wind farm is located on a NNW – SSE trending ridge line, with all turbines located above the 390m AHD contour. Figure 3 shows the topography of the project area.

3.3 Hydrology

There are no permanent watercourses in the project area, although there are a number of defined ephemeral drainage lines and gullies that would carry surface flow for short periods after heavy rain. Many of these drainage lines terminate in or are intercepted by farm dams. The porous soils and low slopes of the project area mean that runoff would occur only during and shortly after intense rainfall.

The project is located within the Avon River catchment system. The project occurs in the catchments of three small unnamed subcatchments, with the ridge line forming the

watershed boundary between the three catchments (Figure 3). The south-western and southern catchments drain to an unnamed chain of swamps and salt lakes about 30km to the west, while the north-eastern catchment drains generally towards the Lake Campion-Lake Brown system about 35km to the north. Neither of these systems has a defined outflow.

There are some minor areas of salt scalding and saline seepage within the project area but the area is largely free of salinity, probably due in part to its elevation. The nearest substantial salt lakes are about 30km west of the project area.

The project will not have any significant effect on drainage or groundwater recharge.

3.4 Environmentally Sensitive Areas

Several nature reserves exist close to the project area. These are shown on Figure 1 and include:

- Tank Hill Nature Reserve: C Class, area 592ha, located 3.5km north-west of nearest turbine.
- Booraan Nature Reserve: C Class, area 480ha, located 360m north-west of nearest turbine.
- Norpa Nature Reserve: C Class, area 203ha, located 195m west of nearest turbine.
- Maughan Nature Reserve: C Class, area 816ha, located 5.6km south-west of nearest turbine.
- Unnamed nature reserve: C Class, area 121ha, located 620m west of nearest turbine.
- Unnamed nature reserve: A Class, area 106ha, located 560m south of nearest turbine.
- Unnamed nature reserve: A Class, area 144ha, located 280m east of nearest turbine.

These nature reserves are all vested in the Conservation Commission for the purpose of protection of flora and fauna. They will not be affected by the construction or operation of the wind farm.

There are no other known environmentally sensitive areas in the vicinity of the project area.

3.5 Vegetation and Flora

The Merredin area, including the project area, is heavily cleared, with native vegetation confined mostly to small nature reserves, small remnants on farms and narrow strips along roadsides and some fencelines.

A vegetation and flora survey of the project area was undertaken in July 2008 by Mattiske Consulting, concentrating on areas where disturbance of native vegetation was likely to occur due to construction of access roads. The findings of the survey are detailed in Appendix A and summarised below.

3.5.1 Vegetation Type and Condition

Four plant communities were defined within the survey area. These were:

- Low Open Woodland of *Eucalyptus capillosa*, *Eucalyptus pluricaulis* over *Allocasuarina acutivalvis, Allocasuarina corniculata, Acacia neurophylla*, *Gastrolobium spinosum* and low subshrubs and grasses on sandy loams.

- Low Open Woodland of *Eucalyptus loxophleba* subsp. *loxophleba* over *Acacia acuaria, Allocasuarina acutivalvis, Exocarpos aphyllus* and *Senna artemisioides* subsp. *filifolia* on sandy loams.

- Tall Shrubland of *Allocasuarina acutivalvis, Allocasuarina campestris, Allocasuarina corniculata, Isopogon gardneri, Melaleuca cordata* and *Thryptomene kochii* with patchy emergent *Eucalyptus burracoppinensis* and *Eucalyptus obtusiflora* over low subshrubs and herbs on sandy soils.

- Tall Shrubland of *Allocasuarina acutivalvis, Allocasuarina corniculata, Hakea francisiana, Hakea scoparia, Acacia resinosa* and *Melaleuca cordata* with patchy emergent *Eucalyptus burracoppinensis* and *Eucalyptus leptopoda* subsp. *leptopoda* over low subshrubs and herbs on sandy soils.

All communities were slightly degraded as a result of the degree of fragmentation within the survey area. The majority of the sites occurred in narrow strips along road verges or in localised remnant areas within the farming properties.

3.5.2 Flora

A total of 77 taxa (including subspecies and varieties) from 42 genera and 21 families were recorded within the survey area during the July 2008 survey. Most of the survey area has been cleared for agricultural activities and consequently the number of species is relatively low.

One introduced species, *Briza maxima* (blowfly grass), was recorded within the remnant areas. The number of introduced species is much higher in cleared areas, however

these areas were not assessed. None of the introduced species recorded are listed as Declared Plants by the Department of Agriculture and Food (2008).

3.5.3 Rare and Significant Flora

Two Priority Flora species were recorded in the survey area: *Banksia shanklandiorum* (Priority 4) and *Synaphea ?constricta* (Priority 3). The latter species could not be confirmed as the specimen was lacking flowering material.

Banksia shanklandiorum was recorded at GDA94 - 640932mE: 6504210mN on the edges of a roadside and *Synaphea ?constricta* was recorded at GDA 94 - 639293mE: 6504444mN and 640690mE: 6503450mN on the edges of roadsides and tracks. Another species of interest, *Melaleuca* sp., was recorded in remnant areas of native vegetation near GDA94 - 639292mE: 6512381mN and 636300mE: 6507100mN.

These significant flora were recorded close to the locations of proposed access points from public roads. This is not considered to indicate that these locations are particularly rich in significant flora; rather, it reflects the focus of vegetation survey effort in these locations and the significance of the road verges and remnant vegetation in the survey area in general. Nevertheless, it is clear that CWF's strategy of minimising clearance of access roads is appropriate. Further detailed botanical survey will be carried during the detailed design phase to ensure that access points do not affect significant flora. This is discussed further in Section 4.2.

None of the plant communities described in the project area are considered Threatened Ecological Communities pursuant to Schedule 2 of the *Environmental Protection Biodiversity and Conservation Act 1999* or the Western Australian DEC Threatened Ecological Communities database.

No plant taxa located in the survey area are gazetted as Declared Rare Flora pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950.*

No plant taxa listed as Threatened pursuant to Schedule 1 of the *Environmental Protection and Biodiversity Conservation Act 1999* were located in the survey area.

3.6 Fauna

The fauna of the project area is depauperate due to the heavy clearing and fragmentation of the native vegetation. Nevertheless, a number of native species do persist, including some rare and endangered species.

A fauna survey of the project area was undertaken in July 2008 by Ninox Wildlife Consulting. The findings of the survey are detailed in Appendix B and summarised below.

3.6.1 Overview

Twenty-five bird species and two native mammal species were identified from either direct observation or indirect signs (scats and diggings) during the fauna field survey. A further 121 native bird species, 25 native mammal species, 11 frog species, 61 reptile species and six introduced mammal species have previously been recorded in the general vicinity of the project area.

Some of the bird species and several of the frogs and reptiles may occur in road verges, on-farm remnants and even open paddocks, but other bird species and most of the native mammals (with the exception of kangaroos and possibly bats) will only occur in the larger nature reserves. Several of the mammal species previously recorded, such as the Numbat and the Bilby, are highly unlikely to persist in the area.

3.6.2 Rare and Significant Fauna

Fifteen bird species of conservation significance are known to occur in the general vicinity of the project. Two of these, the Malleefowl and the White-browed Babbler, were observed during the field survey.

Carnaby's Black-cockatoo is listed in the DEC and/or DEWHA databases as likely to occur in the project area. However, more detailed mapping by these departments suggests that the wind farm site is outside of the range of this species.

The conservation status and distribution of Carnaby's Black-cockatoo is outlined in the DEC *Fauna Note No. 5: Carnaby's Cockatoo,* last updated on 24th July 2007. This shows a distribution map for the Cockatoo that indicates that its eastern distribution is limited to Kellerberrin, which is about 70 kilometres west of the Collgar site. The *Carnaby's Black Cockatoo Recovery Project* sponsored by the Australian Government Natural Heritage Trust also adopts the same distribution map

The DEWHA *Threatened Species Fact Sheet* also notes that the eastern limit of the distribution of Carnaby's Black-cockatoo is Kellerberrin. Thus it is understood that this project will not affect Carnaby's Black-cockatoo.

Seven mammals of conservation significance may occur in the general area although, given the lack of large areas of undisturbed natural vegetation, only one, the Red-tailed Phascogale (*Phascogale calura*), is likely to be present. This small marsupial could occur in areas of Wandoo and/or Rock Sheoak within the survey area. The majority of the native mammals listed are very unlikely to be present, even within larger areas of vegetation such as the Norpa Nature Reserve immediately west of the Survey Area. They are even less likely to be found in the very small patches of unfenced remnant vegetation within farmland.

No frogs but two reptiles of conservation significance could occur within the survey area. The Western Spiny-tailed Skink (*Egernia stokesii badia*) could occur in a small rocky

breakaway near the southern end of the project area. The Carpet Python (*Morelia spilota imbricata*) could occur within any of the remnant vegetation patches, road verges and also in farm buildings, where the introduced House Mouse (*Mus musculus*) is prey for this harmless snake.

Four species of trapdoor spider, one crustacean and one cricket are listed in the DEC's rare fauna database as potentially occurring in the vicinity of the project area. As little is known about these species, it is not possible to state with any certainty whether any of these animals could be present within the habitats of the Survey Area. One possible Tree-stem Trapdoor Spider burrow was located during the site visit.

3.6.3 Habitat Connectivity

The habitats of the project area, like those of the majority of the wheatbelt in general, are highly fragmented and poorly connected. Large patches of remnant vegetation in nature reserves and, in a few cases, on farms are separated, often by several kilometres of open farmland from other large remnants. In many cases where habitat connections exist they consist of road verges and wind breaks only a few metres wide.

In this environment, the protection of the large vegetation remnants and of the habitat linkages that remain is important. It is for this reason that CWF has adopted the strategy of minimising vegetation clearance for the wind farm.

3.7 Social Environment

3.7.1 Existing Land Uses

The project is situated within a broadacre farming area, with individual landholdings ranging in size from a few hundred to several thousand hectares. The predominant land uses are wheat cropping and sheep grazing. The construction and operation of the wind farm will not interfere significantly with the existing land use once the project is operational. All land owners on whose properties turbines will be located are financial participants in the project.

3.7.2 Nearby Residences

There are a number of farm homesteads located in and around the project area, as shown on Figure 4. Most of those in close proximity to the wind farm, including all of those within the predicted 35dB(A) noise contour (see Section 4.4), are owned and occupied by financial participants in the project.

3.8 Aboriginal Heritage

An ethnographic survey of the project area was undertaken in July 2008 by R. & E. O'Connor Pty Ltd. An archaeological survey was undertaken in August 2008 by Quartermaine Consultants. The surveys have included searches of the Department of Indigenous Affairs' online Aboriginal Sites Database, consultation and site visits in conjunction with representatives of the local indigenous community, and detailed searches of the project area. The findings of the ethnographic and archaeological surveys are detailed in Appendix C and summarised below.

3.8.1 Ethnography

The DIA Online Aboriginal Sites Database shows no Aboriginal ethnographic sites listed in the survey area.

The Project area is covered by one registered Native Title claim, namely the Ballardong claim, number WC00/7. The claimant group has recently combined with certain other south-western claimant groups to form a large composite claim over the entire south-west corner of the State. In the survey area, land and heritage matters of interest to local Aboriginal organisations are dealt with exclusively by the native title claimant group.

Site inspections of the project area were carried out by R. & E. O'Connor Pty Ltd on 15 and 16 July 2008 in company with six representatives of the native title claimant group: Ms Chantelle Yarran, Ms Beatrice Yarran, Mr Reginald Yarran, Ms Lesley Nelson, Ms Coreena Abraham and Mr Peter Henry. The general inspection was carried out by car, with detailed inspections of areas requested by the consultants carried out on foot. As a result of the field survey, the representatives were satisfied that the project will not disturb any known Aboriginal sites and therefore signed an approval for it to proceed.

The ethnographic report recommends that Aboriginal heritage considerations should not be deemed an impediment to the establishment of the wind farm.

3.8.2 Archaeology

The DIA Online Aboriginal Sites Database shows no known archaeological sites in or near the project area.

A site survey consisting of walked and vehicular traverses of the project area found no signs on any archaeological sites or material. The archaeological report recommends that there is no impediment on archaeological grounds to the project proceeding.

In the unlikely event that any archaeological material is discovered during project construction or operation, CWF will comply with the requirements of the *Aboriginal Heritage Act 1972.*

4.0 ENVIRONMENTAL IMPACTS AND MANAGEMENT

4.1 Identification of Key Environmental Factors

A scoping exercise has been carried out to identify the significant environmental and social factors applying to the project. This exercise has included:

- consideration of the location, design, construction and operation of the project;
- review of policies, previous studies relevant to the Merredin area and experience of previous wind farm projects in Western Australia and elsewhere;
- consultation with relevant government agencies and local stakeholders including landowners, neighbours and the traditional Aboriginal owners of the Merredin area; and
- environmental field surveys of the project area.

As a result of the scoping exercise, the following have been identified as the key environmental and social issues to be addressed in the design, construction and operation of the project:

- Minimising vegetation clearance and protection of rare or otherwise significant vegetation communities and species during project construction and operation.
- Protection of significant fauna and fauna habitats during project construction and operation.
- Alteration of the visual landscape of the site and surroundings.
- Potential noise impacts on neighbouring residents during construction and operation.
- Impact of construction and operation of the project on local traffic and the safety of other road users.

4.2 Vegetation and Flora

Impact

The project is located almost entirely within cleared farmland and as such will have an extremely low impact on native vegetation. The current layout plan indicates that the total clearing required for the project is expected to be less than 1ha, consisting of unavoidable clearing for new access points from public roads. Considerable effort has

been made in the project design to minimise clearing by routing access points through existing farm gates and gaps in vegetation.

The vegetation to be cleared consists of narrow strips of shrubs and occasional small trees along road verges. The clearings will be approximately 12m wide and between 3m and 25m long.

The clearing will not affect any significant vegetation types, flora species or connecting corridors. Further botanical surveys will be undertaken during the detailed design of the project to ensure that any clearing does not affect any rare or significant flora.

Management

Measures will be taken in the establishment and use of the access roads to ensure that weeds and plant diseases are not introduced to or spread within the project area. These measures are summarised in Section 4.7.3.

4.3 Fauna and Habitats

4.3.1 Loss of Habitat

Impact

The construction of the wind farm will have negligible impact on fauna habitats due to the extremely low level of clearing. The total loss of habitat is expected to be less than 1ha.

Ninox Wildlife Consulting examined all of the proposed access road crossings through vegetation in July 2008 and concluded that these crossings would have no significant impact on fauna or habitats provided that mature eucalypt trees (which may provide nesting habitat) were avoided.

Management

CWF will endeavour at all times to minimise the requirement for access tracks to cross vegetated road verges. Where such crossings are unavoidable, they will be sited to avoid impacting mature trees.

The wind farm will be constructed near areas of vegetation where Malleefowl or their nests have been found. The risk of construction impacts on Malleefowl can be minimised by minimising construction activity in these areas when Malleefowl breeding is in progress (generally between August and December).

CWF will arrange monitoring, by an expert fauna consultant, of Malleefowl nesting activity in the early breeding season months of August and September. If nesting

activity is detected, all site works (including construction, earthworks and vehicle traffic) within 250m of the nesting site will be carefully managed according to a plan that will be established with the fauna consultant in consultation with the DEC.

4.3.2 Operational Hazards to Fauna

Impact

The following description of wind farm hazards to fauna is drawn from a number of sources including AWEA (2002), Kevin Mills & Associates (2005), Smales (2005), Smales *et al.* (2005) and Brett Lane & Associates (2008).

Wind farms may affect birds and bats by:

- direct mortality due to collision with the towers or rotor blades; and
- disturbance to habitats and flight paths due to birds or bats having to make wide detours to avoid clusters of wind turbines.

Investigations in Australia and overseas have shown that the types of birds at most risk from collisions with wind turbine blades are:

- wetland birds that form large flocks;
- migratory birds that follow defined flight paths;
- night-flying birds;
- birds of prey; and
- species that flock and fly above the tree canopy (AWEA, 2002).

The likelihood of collision mortality is highly dependent on the siting of wind farms and the characteristics of the relevant bird and bat species. The greatest impacts appear to occur near large wetlands and on important migration routes, where large flocks of birds congregate. Particular risk areas are those where flight paths are concentrated or channelled, such as coastlines or gaps in mountain ranges. Bird species that fly at the rotor height, particularly those that tend to hover or circle, are at greater risk than those that tend to fly below or above rotor height (Smales, 2006).

From the above it can be concluded that the lowest risk sites for wind farms in terms of bird and bat strikes are those which are located on open ground (e.g. farm paddocks) well removed from wetlands, forest and other important feeding and roosting habitats, and away from migratory routes and other flight paths. The Collgar wind farm site fits this description, and consequently is expected to have a relatively low incidence of bird and bat mortality.

Relatively little research has been done on the risk of bird and bat collisions with wind turbines in Australia. What local research exists suggests that collision rates are generally between one and four birds per turbine per year (Brett Lane & Associates, 2008).

Smales (2006) undertook a study of bird deaths at the Codrington wind farm in Victoria. The results suggested a rate of 1.2 to 2.7 bird deaths per turbine per year. All observed fatalities were of common and widespread species.

Research in Australia suggests that the mortality rates at Australian wind farms are lower than in the northern hemisphere. This may be due to the absence from Australia of large populations of night-migrating songbirds, which make up about half of the birds that collide with wind turbines in the northern hemisphere (AWEA, 2002).

In addition to the hazard posed to birds and bats by the turbines, fauna such as kangaroos and Malleefowl may also be at risk from traffic using internal access roads. The risk in this case is similar to that posed to fauna by normal traffic on public roads in the area. Post-construction traffic movements will be very low; a maximum of only 15 people will be required as wind farm maintenance servicing crew.

Management

CWF will take steps to ensure that the potential for bird and bat deaths is kept to a minimum. These will include the following:

- The turbine towers will be fully enclosed, with no sites for perching or nesting.
- The turbines will be unlit (except possibly for LED safety lights for aircraft, depending upon CASA recommendations), to avoid attracting owls and bats.
- The wind farm operator will consult with farmers to discourage the holding of lambing sheep in paddocks within 200m of the turbines, so as not to attract birds or prey or scavengers.
- No tall buildings, poles or other structures that could provide perching sites for birds of prey will be constructed within 200m of the turbines.
- Vehicles travelling on internal access roads will be limited to a maximum speed of 40km/h at all times in order to minimise the risk of collisions with fauna.

4.4 Noise

Impact

Advances in the technology of wind turbine rotor blades and generators in recent years have significantly reduced their noise emissions and hence the level of public nuisance caused by wind farms. The sound emitted by wind turbines is mainly of an aerodynamic nature due to the rotor blades moving through the air. As each blade passes the tower it generates a slight local pressure change that may cause a sound. The sound output of wind turbines is dependent on the actual wind speed; in general, the higher the wind

speed the higher the sound output of the turbine. However, higher wind speeds also create higher levels of background noise (both aerodynamic and from other sources such as vegetation), so wind turbine noise tends to be less intrusive at these higher speeds.

A noise modelling study of the Collgar wind farm has been carried out by Herring Storer Acoustics. The findings of the noise study are attached in Appendix D and summarised below.

Noise levels at 25 identified receiver points near the wind farm were modelled using the computer program "SoundPlan" version 6.5. The noise impact assessment was carried out in accordance with the EPA of South Australia "*Wind Farms – Environmental Noise Guidelines (interim) – December 2007*" (EPASA Guidelines), which is the guideline recognised by the WA Planning Commission and the WA EPA for the assessment of wind farms. Weather conditions indicative of "worst case noise levels" were attained from the WA EPA's *Draft Guidance for Assessment of Environmental Factors No. 8 - Environmental Noise.*

The EPASA Guidelines state that the predicted equivalent noise level (LAeq ,10 minutes), adjusted for tonality, should not exceed :

- 35 dB(A) in a residential area;
- 40 dB(A) in a primary production / rural industry zone;
- the "Alternative Minimum Criteria" (Varying With Wind Speed); or
- the background noise (LA90,10 minutes) by more than 5 dB(A).

At high wind speeds, the EPASA noise criteria are measured relative to background noise (the Alternative Minimum Criteria) and not the 35 dB(A) minimum. This is because as wind speed increases background noise will rise at a faster rate than turbine noise.

The noise study found that, under the most adverse wind conditions:

- Noise levels from the wind farm met the 35 dB(A) residential minimum criterion at 10 out of 14 occupied residences under all wind speeds, and at 12 of 14 residences under all but high wind speeds. The exceedences were all at residences belonging to participating landholders.

- Noise levels from the wind farm met the 40 dB(A) primary production/rural industry criterion at all but one or two occupied residences under high wind speed, and at all residences under low wind speeds.

- Noise levels from the wind farm met the Alternative Minimum Criteria under all but three occupied residences under most wind speeds. The largest exceedence of the alternative criteria was 4 dB(A).

- All residences that recorded exceedences of the residential, primary production/rural industry or alternative criteria are owned and occupied by participating landholders.

This development application contemplates a development envelope within which the final detailed design and turbine siting will be undertaken. The final siting will only allow turbines to be sited such that the EPASA noise guidelines will be complied with. The Shire's proposed Restricted Use boundary will ensure no new non-compliant dwellings can be built within the area affected by noise in excess of the guidelines. In any case the EPASA guidelines will be complied with at all existing non-stakeholder dwellings.

The worst-case noise contours produced by the noise study are shown on Figure 4.

Based on the noise modelling carried out to date, it is concluded that the wind farm will meet the noise standards set out in the EPASA guidelines at all properties owned by persons who are not participants in the wind farm project.

The noise modelling carried out so far is conservative in that it assumes that the wind direction is blowing towards each receptor from all turbines, where in reality a wind of any direction would be likely to blow the noise from at least some turbines away from the receptor.

Background noise monitoring is currently underway at the proposed wind farm site, so that an assessment of noise levels against actual background noise level can be conducted. It is envisaged that this will enable an assessment of predicted noise levels against a higher minimum criterion than has been carried out thus far. It is anticipated that the maximum exceedence of 4 dB(A) can be discounted once the results of background noise monitoring are included within the assessment. As such, it is expected all currently occupiable residential houses will comply with the criteria set out in the SA Guidelines.

Management

CWF has modified the wind farm layout in the light of the preliminary noise modelling results to ensure that residences owned by non-participants in the project are not affected by noise levels above the EPASA guidelines. CWF has also deleted and relocated proposed turbines in the north-west of the project area after the owners of a neighbouring property advised that they were planning a future rural-residential subdivision.

CWF has consulted and met with all adjoining land owners to discuss aspects of the wind farm including noise.

CWF will record and respond to any public complaints received about noise throughout the lifetime of the wind farm.

4.5 Landscape and Visual Impacts

4.5.1 Visibility

Impact

Due to the generally flat topography around the project area and the need to site turbines on high ground to obtain the most favourable wind regime, the wind farm will be potentially visible from a considerable distance. However, the actual visibility will be limited to within a few kilometres by intervening vegetation and the effects of skyline haze.

Parsons Brinckerhoff has carried out a visual impact analysis including a seen area analysis and preparation of photo montages at varying distances from the turbines. The findings of the visual impact study are detailed in Appendix E and summarised below.

Figure 5 shows the mapped zone of visual influence of the wind farm. The figure shows that the zone of visibility extends beyond the limits of the available topographic data. However, the available data reaches from 6km to over 10km from the wind farm, at which distance the turbines will be barely discernible due to size, vegetation screening and haze.

Figure 6 shows simulated views of the wind farm from viewpoints located approximately 0.9km, 1.4km, 2.3km, 3.8km, 4.1km and 7km from the nearest visible turbine. The simulations show that the visibility of the turbines decreases rapidly with distance. The view from 7km shows the effect of intervening vegetation in that, although the seen area analysis suggests that 32 turbines should be visible at this point, in fact none can be seen.

The landscape of the project area is generally flat and monotonous, with few notable features to interrupt the skyline. There are no scenic vistas or lookouts in the vicinity that might be disturbed by the presence of the wind farm. It is therefore concluded that, although the wind farm will be visible for some distance, this is unlikely to be perceived as degrading the view. Indeed, the experience of other Western Australian wind farms such as those at Esperance and Albany suggests that the Collgar wind farm is likely to be seen by both locals and visitors as a scenic attraction in its own right.

Management

The visibility of wind turbines is strongly influenced by the colour and shade of the turbine towers and blades. Since the turbines are generally viewed against a background of blue sky or clouds, the least visible colours are generally pale grey or white. Most wind turbines are produced in these colours for this reason.

CWF has consulted and met with all adjoining land owners to discuss aspects of the wind farm including visual impact.

4.5.2 Shadow Flicker

Impact

Shadow flicker occurs when the sun is low on the horizon and the blades cast intermittent shadows on nearby observers. This is more usually a problem in steep terrain when the turbines are located on ground that is significantly higher than the observer, when the sun is high enough in the sky to cast strong shadows.

In the case of the Collgar wind farm, the low topography and the separation of neighbouring residences from the turbines mean that, by the time the sun is low enough to fall behind the turbines, it will be too weak to cast significant shadows.

Planning advice from the South Australian government suggests that the maximum distance from turbines at which shadow flicker is discernible is 500 metres (Planning SA, 2002). The nearest non-participating residence to the Collgar wind farm is 2,183m from the nearest turbine, while the nearest participating residence is 786m distant. It is concluded on this basis that shadow flicker will not be an issue for the Collgar wind farm.

Management

Encroachment of new residences into the zone within which shadow flicker might occur will be prevented by the establishment of a Restricted Use area around the wind farm in the Shire of Merredin Local Planning Scheme (see Section 1.9). Although the Restricted Use area will be based primarily on noise contours, its boundary is expected to be between 1km and 2km from the nearest turbine.

4.5.3 Blade Glint

Impact

Blade glint is caused by sunlight reflecting off the turbine blades towards an observer. Blade glint may occur at any sun angle or time of day, although its occurrence is sporadic and generally short-lived due to changes in sun angle and wind direction. The majority of blade glint occurs where the viewer is located above the altitude of the turbine hub.

Blade glint occurs most often in wind farms with large numbers of turbines. It can be perceived over considerable distances. Blade glint is dependent on the reflectivity of the blades, which is influenced by the colour, finish and age of the blade. It is most notable with new turbines, and typically diminishes after a few months when the blades have become dulled by weathering.

Blade glint can be distracting to drivers if roads are aligned towards turbines, particularly where the road is at a higher altitude than the turbine hub.

Management

The turbines installed at the Collgar wind farm will have blades of a low gloss (~30%) off-white or pale grey colour that will reduce the potential for glint to occur. This, and the absence of viewpoints higher than the turbine hubs, will minimise the potential for blade glint to occur.

4.6 Construction Impacts

4.6.1 Construction Noise and Dust

Impact

The wind farm is sufficiently remote from houses and other sensitive receptors that noise and dust impacts during construction will not be significant. Wheat farming areas are normally subject to periodic high noise levels due to operation of farm machinery and trucks. The noise levels generated by the construction activities will be comparable to those generated by farming activities.
The most significant source of construction phase noise will be the movement of heavy trucks transporting the turbine components. This noise will be short-term and intermittent.

Dust could be generated by the movement of traffic along the unsealed public roads and internal access roads.

Management

Construction activities will generally be confined to daylight hours on weekdays, although some weekend work might occur during critical periods. CWF will comply with the *Environmental Protection (Noise) Regulations 1997* at all times.

Dust suppression watering will be carried out on the internal access roads and possibly unsealed public roads during construction in dry conditions to control the generation of dust. CWF will consult with the Shire on management of the impacts of dust during construction.

4.6.2 Erosion

Impact

Water or wind erosion could occur on access tracks, construction sites and other disturbed areas. Given the generally low gradients and sandy soils of the project area,

the potential for water erosion is low. There is very little evidence of gullying or other significant erosion on existing tracks and other disturbed areas in the project area.

Management

All access roads within the project area will be appropriately constructed, graded and drained to minimise erosion. Access roads will be designed so that runoff is shed to the sides of the road, where it will infiltrate or dissipate. Where necessary, roadside bunds and swales will be provided to intercept and infiltrate runoff.

CWF will carry out a pre-construction survey of the public roads within the project area and will maintain and, if necessary, repair or upgrade the roads throughout the construction program to ensure that they remain at least in the condition they were prior to construction. CWF will discuss requirements for road upgrading and repair with the Shire of Merredin.

4.6.3 Weeds

Impact

Weeds could be introduced to or spread within the project area through the importation of fill (e.g. road base) or the movement of vehicles. Weeds such as doublegee, which infests some parts of the project area, may be carried on vehicle tyres, while plant material and seeds may be carried in fill.

Management

CWF will ensure, through appropriate supply contract conditions, that all fill imported into the project area is obtained from weed-free sources.

CWF will consult with landowners before the commencement of site works on the location of known weed infestations and will implement measures, including inspection and/or under-vehicle cleaning by water or compressed air, of vehicles leaving infested areas, to ensure that weeds are not spread within the project area.

If new weed infestations are discovered in the project that are attributable to construction activities, CWF will arrange treatment using accepted methods.

4.6.4 Traffic

Impact

The construction program will generate significant traffic by light and heavy vehicles on public roads within and around the project area for a period of approximately 18 to 24 months. This traffic will range from light utility and passenger vehicles up to multiple-axle extended articulated vehicles carrying turbine components.

As the construction program is expected to continue through all seasons, this traffic has potential to interfere with the movement of wheat trucks and farm machinery during the harvest and seeding seasons.

Management

The most suitable access routes will be selected in order to reduce the effect of the construction and operational traffic upon the locality. Access requirements for oversize loads will be discussed with the relevant authorities in order that all requirements can be put into place prior to construction.

CWF will consult with the Shire Council, local farmers and local police to agree ways to minimise conflict between construction and farm traffic. Measures might include:

- Scheduling of heavy deliveries for early and late in the day, when harvesting is generally not occurring (due to moisture levels and grain receival point operating hours).

- Provision of police or other escorts for oversize loads.

- Establishment of a designated CB radio channel and/or mobile telephone number that farmers can call to check on heavy vehicle movements on particular roads.

CWF will prepare and implement a Traffic Management Plan for the construction phase in consultation with the local landowners, Shire Council and Police. The Traffic Management Plan will address haulage routes to the wind farm, scheduling of heavy vehicle movements, speed limits, provision of escorts and other relevant matters.

4.7 Aircraft Safety

The Merredin Aerodrome is located approximately 10km west of the wind farm. The aerodrome is privately owned by the China Southern West Australian Flying College (CSWAFC) and is used for intensive training of Chinese pilots. It is also used from time to time, by permission of the CSWAFC, by visiting aircraft.

In addition to the aerodrome, two private flying operations are located in the area:

- Kevin Anderson - a commercial helicopter operator with two aircraft based approximately 7.5km north of the Merredin Aerodrome; and

- Tony Murfit - a private fixed-wing operator who operates from his own airstrip located about 23km east of the Merredin Aerodrome and 3.6km east of the boundary of the wind farm development envelope.

At certain times of the year, aerial agriculture (e.g. crop dusting) is carried out on some farms in the Merredin area.

An airspace study has been carried out for the wind farm by Airport Assist Pty Ltd. The study included review of aeronautical charts and other relevant documents, and consultation with the Civil Aviation Safety Authority (CASA), Airservices Australia, the Royal Flying Doctor Service, the CSWAFC, officers of the Shire of Merredin and neighbouring shires, local aircraft operators, the aviation policy branch of the Department of Planning & Infrastructure and the RAAF.

The report of the study is attached in Appendix F and summarised below.

The airspace study concluded that the presence of the wind farm will have no significant effect on civil aircraft operations. In particular, the project will have no significant effect on the flying training being conducted at Merredin Aerodrome, although some adjustments may be required to areas in which some flying training exercises are conducted.

The study also concluded that the project will have no significant impact on flights by other operators in the vicinity or on overflights.

The risk of airborne collision presented by the turbines is considered minimal since, during daylight operations, pilots will be able to see and avoid the large, conspicuous structures provided that the turbines are painted in colours that contrast with the ground (generally white or pale grey). For flights at night or under Instrument Meteorological Conditions, providing that pilots are made aware of the existence and location of the turbines, they will be able to make suitable adjustments to flight paths. There will be a requirement for CWF to notify CASA to enable the regulator to assess obstacle lighting needs and to provide advice to Airservices Australia to enable the amendment of aeronautical charts. If CASA recommends that aircraft lighting is required it may be installed on the turbine nacelle in accordance with CASA specifications. CWF will also need to notify the RAAF to enable its national database of tall structures to be updated.

Consultation has been undertaken with all stakeholders having an interest in aviation in the Merredin area. No stakeholder has raised any objection to the wind farm proposal.

4.8 Electromagnetic Interference

Wind turbines can degrade the performance of fixed radio links through three principal mechanisms for introducing electromagnetic interference (EMI) – near field effects, diffraction and reflection/scattering. Wind farms can also cause interference to television reception at residences within 5km through shadowing, scattering or reflection of the television signal.

CWF commissioned Avail Services Pty Ltd to undertake an assessment of likely electromagnetic interference impacts on fixed radio links (such as Telstra microwave communications links), television reception, aviation communication and navigational aids (e.g. GPS) from the wind farm. The report of the study is attached in Appendix G and summarised below.

The analysis found that no turbines within the proposed wind turbine layout (Rev H) are likely to cause unacceptable interference to fixed radio links operating in the vicinity of the proposed wind farm.

Television reception at approximately eight occupied residences may be affected by the wind farm. This interference may consist of degradation of signal or "ghosting" of the picture. A number of options are available to CWF to remedy any problems caused in this regard, including:

- installing a more directional antenna;
- converting to a digital receiver (although no digital signal is currently available in the area);
- installation of an antenna in an area of good television reception connected to the affected residence by coaxial cable; and
- installation and maintenance of a satellite television system.

CWF will offer nearby residents identified as being potentially affected by electromagnetic interference a pre-wind farm and post-wind farm assessment of television reception, and will remedy any reception problems attributable to the presence of the wind farm.

The EMI analysis found that the wind farm would not have any detrimental impact on aviation communications or navigation aids.

4.9 Rehabilitation

All areas disturbed during construction that are not required for ongoing operations will be rehabilitated following construction. These will include construction stockpile and laydown areas, temporary access tracks and underground cable trenches.

Because the wind farm is predominantly located in cleared farmland, the rehabilitation will mostly consist of reestablishment of topsoil and returning disturbed land to agricultural use. Because native vegetation will only be cleared in very limited areas where essential for access roads, little if any rehabilitation of native vegetation is expected to be necessary.

5.0 SUMMARY OF MANAGEMENT MEASURES

The following summarises the management measures to be implemented to minimise the risk of adverse environmental or social impacts from the construction and operation of the Collgar wind farm.

1. CWF will avoid, as much as practically possible, the clearing of native vegetation in the construction of the wind farm and ancillary facilities.

2. Where vegetation clearance is unavoidable, CWF will minimise the area affected and will position the clearing based on detailed on-site surveys so as to avoid disturbance where possible to mature trees and significant flora.

3. The turbine towers will be fully enclosed, with no sites for perching or nesting.

4. CWF will obtain a Clearing Permit from the DEC prior to commencing any on-site or roadside clearance works.

5. The turbines will be unlit (except perhaps for nacelle-mounted LED safety lights for aircraft, depending on the recommendations of CASA), to avoid attracting owls and bats.

6. The wind farm operator will consult with farmers to discourage the holding of lambing sheep in paddocks within 200m of the turbines, so as not to attract birds of prey and scavengers.

7. No tall buildings, poles or other structures that could provide perching sites for birds of prey will be constructed within 200m of the turbines.

8. Vehicles travelling on internal access roads will be limited to a maximum speed of 40km/h at all times in order to minimise the risk of collisions with fauna.

9. CWF will arrange monitoring, by an expert fauna consultant, of Malleefowl nesting activity in the early breeding season months of August and September. If nesting activity is detected, all site works (including construction, earthworks and vehicle traffic) within 250m of the nesting site will be carefully managed according to a plan that will be established with the consultant in consultation with the DEC.

10. This development application contemplates a development envelope within which the final detailed design and turbine siting will be undertaken. The final siting will only allow turbines to be sited such that relevant noise criteria will be complied with. The Shire's proposed Restricted Use zone will ensure no new non-compliant dwellings can be built within the area where noise levels

exceed the EPASA guidelines. In any case the EPASA guidelines will be complied with at all existing non-participant dwellings.

11. CWF will carry out a pre-construction survey of the public roads to be used by construction traffic and will maintain and, if necessary, repair or upgrade the roads throughout the construction program to ensure that they are left in at least the same condition as they were prior to construction.

12. CWF will ensure, through supply contract conditions, that all fill imported into the project area is obtained from weed-free sources.

13. CWF will consult with landowners before the commencement of site works on the location of known weed infestations and will implement measures, including inspection and/or cleaning by water or compressed air, of vehicles leaving infested areas, to ensure that weeds are not spread within the project area.

14. If new weed infestations are discovered in the project that are attributable to construction activities, CWF will arrange treatment using accepted methods.

15. CWF will prepare and implement a Traffic Management Plan for the construction phase in consultation with the local landowners, Shire Council and Police. The Traffic Management Plan will address haulage routes to the wind farm, scheduling of heavy vehicle movements, speed limits, provision of escorts and other relevant matters.

16. CWF will offer nearby residents that may be affected by electromagnetic interference a pre-wind farm and post-wind farm assessment of television reception and will remedy any reception problems attributable to the presence of the wind farm.

6.0 REFERENCES

AWEA (2002). *Wind Farms and Bird & Bat Impacts: Fact Sheet No. 8*. Australian Wind Energy Association

Beecham, B. (2002a). Avon Wheatbelt 1 (AW1 - Ancient Drainage subregion). In May, J.E. and N.L. McKenzie (2003). *A Biodiversity Audit of Western Australia's Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Perth.

Beecham, B. (2002b). Avon Wheatbelt 2 (AW2 - Rejuvenated Drainage subregion). In May, J.E. and N.L. McKenzie (2003). *A Biodiversity Audit of Western Australia's Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Perth.

Brett Lane & Associates (2008). *Proposed Badgingarra Wind Farm Flora and Fauna Assessment.* Unpublished report prepared for Enthalpy Pty Ltd.

Department of Agriculture and Food (2008). *Declared Plants List.* Publicly available list prepared by the Department of Agriculture and Food, Western Australia.

Kevin Mills & Associates (2005). *Flora and Fauna Assessment: Capital Wind Farm. Southern Tablelands, NSW.* Renewable Power Ventures Pty Ltd.

May, J.E. and N.L. McKenzie (2003). *A Biodiversity Audit of Western Australia's Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Perth.

National Wind Coordinating Committee (NWCC) Resource Document: Avian collisions with wind turbines: A summary of existing studies and comparisons to other sources of avian collision mortality in the United States.

Planning S.A. (2002). *Planning Bulletin: "Wind Farms, Draft for Consultation".* Government of South Australia, Adelaide.

Smales, I. (2005). *Modelled Cumulative Impacts on the White-Bellied Sea Eagle of Wind Farms Across the Species' Australian Range.* Report for the Commonwealth Department of the Environment and Heritage. Biosis Research Pty Ltd, Victoria.

Smales, I. (2006). *Impacts of avian collisions with wind power turbines: an overview of the modelling of cumulative risks posed by multiple wind farms.* Report for the Commonwealth Department of the Environment and Heritage. Biosis Research Pty Ltd, Victoria.

Smales, I. , S. Muir & C. Meredith (2005). *Modelled Cumulative Impacts on the Orange-Bellied Parrot of Wind Farms Across the Species' Range in South-East Australia*. Report for the Commonwealth Department of the Environment and Heritage. Biosis Research Pty Ltd, Victoria.

Figures