PacificHydro

Taralga Wind Farm

Decommissioning and Rehabilitation Plan

24 September 2020

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Revision Control

Issue	Date	Comments	Author	Reviewer	Approver
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B	24 July 2020	Five yearly review	M Baines	C Salvatierra	K Derriman
C	24 September 2020	Amendments based on the DPIE review	M Baines	C O'Riordan	K Derriman

Document Control

The document control of this document is maintained by the Environment and Development Manager or their delegate.

Access to this document shall be maintained for the duration of Wind Farm operations and until completion of decommissioning and may be accessed by employees, sub-contractors, Health and Safety Representatives, the Environmental Representative and operational personnel.

An electronic version will be maintained on the Pacific Hydro document management system.

Distribution List

Version	Copy#	Date	Issued to	Organisation
C	1		Operations & Environment and Development Team	Pacific Hydro (Management System)
C	2		Shireen Baguley	Environmental Representative, Molino Stewart
C	3		Department of Planning, Industry and Environment	Department of Premier and Cabinet
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1. Introduction

1.1 Wind Farm Ownership

Taralga wind farm (the Wind Farm) is owned by Pacific Hydro Pty Ltd under the following subsidiaries:

- Energy Pacific (Vic) Pty Ltd;
- Taralga Wind Farm Nominees No 1 Pty Ltd;
- Taralga Wind Farm Nominees No 2 Pty Ltd; and
- Taralga Wind Farm Pty Ltd.

1.2 Wind Farm Description

Taralga Wind Farm is located near the town of Taralga, in the southern tablelands of New South Wales (NSW). The Wind Farm generates up to 106.8 MW of electricity and consists of the following components:

- 51 Wind Turbine Generators (WTGs) with hub heights of 80 m above ground level and consisting of three types of WTG:
  - 21 V100 1.8 MW WTGs (100 metre rotor diameter);
  - 21 V90 2.0 MW WTGs (90 metre rotor diameter); and
  - 9 V90 3.0 MW WTGs (90 metre rotor diameter).
- A Substation to transform the electricity produced by the Wind Farm from 33 kV to 132 kV;
- A Service Compound located adjacent to the Substation and consisting of the Site Office and workshop;
- Site access roads;
- WTG hardstands for WTG assembly and maintenance;
- Underground electrical and fibre optic cabling;
- 33 kV overhead power line and optical ground wire;
- Eight wind monitoring masts, each 80 m in height; and
- One digital television re-transmitter.

The Wind Farm is divided into five collector groups (electrical circuits) and 12 rows of WTGs.

The Wind Farm is connected to the electricity network near Marulan, approximately 30 km to the south east; via a dedicated 132 kV single circuit transmission line. This transmission line is owned and operated by Essential Energy (EE) and is, therefore, not addressed by this Decommissioning and Rehabilitation Plan (DRP).

1.3 Background to this Document

Condition of Consent 116 (refer Appendix C) requires that a DRP is prepared and reviewed every five years from the date of preparation until decommissioning and rehabilitation is completed. The previous DRP prepared by CBD Energy Limited was submitted 6 July 2014.

The purpose of this DRP is to address the Conditions of Consent and to identify the methodology that Pacific Hydro currently propose use to mitigate potential impacts resulting from the cessation of operation of individual turbines and the wind farm facility at the end of the project's useful economic life.

This plan provides an outline of:

- The stakeholder and landowner consultation;
- Expected operational life;

- Dismantling, disposal / recycling;
- Land rehabilitation;
- Funding arrangements;
- Timeframe;
- Responsibility; and
- Review of the plan associated with the decommissioning of the Taralga Wind Farm.

The proposed resource recovery / recycle / reuse strategy to minimise disposal of material will be guided by the NSW EPA Resource Recovery Framework. The method for disposing or recycling of the wind turbines' blades is addressed in this plan based on current technology. These methods will be reviewed during 5 yearly DRP reviews and prior to decommissioning, to ensure the appropriate technology is utilised.

1.4 State Approvals

State approval for the Wind Farm was first granted on 17th January 2006. This approval was appealed in 2006 and subsequently determined by the Land and Environment Court of NSW on 23rd February 2007 (Court Order 11216), subject to a number of Conditions of Consent. Conditions of Consent relevant to the decommissioning and rehabilitation phase of the Wind Farm can be found in Appendix C with reference given to where each item has been addressed in the DRP.

Since the original court decision, seven modifications to the Wind Farm have been granted by the NSW Department of Planning, Industry and Environment (DPIE) under the Environmental Planning and Assessment Act 1979**.**

The Conditions of Consent contains several conditions which must be addressed prior to the commencement of decommissioning of the Wind Farm.

2. Consultation

2.1 Consultation undertaken to date

2.1.1 Consultation with Landowners

When first proposed the land within which the project site is located was owned by 9 private landowners including a parcel of vacant Crown land, totalling an area of around 3,830 hectares. All landowners were initially contacted and consulted about the project and issues of decommissioning and rehabilitation were discussed at the early stages of the project.

A lease agreement was later presented to each landowner, which reflects that the decommissioning of the wind farm is the sole responsibility of the Owner. Provisions in the various land lease agreements relating to decommissioning and rehabilitation are summarised in Appendix A. Conditions of Consent relating to decommissioning and rehabilitation are summarised in Appendix C The entered lease agreements provide TWF with leases of the site for a term of 30 years, with an option to extend for another 30 years, all-in five-year increments. The leases commit to undertake the decommissioning in all manners mandated by the consent, including but not limited to the timing and the extent.

Prior to each lease being executed with the landowners, the conditions for this DRP were discussed and agreed with all landowners. During these discussions the Owner affirmed their commitment to this Plan.

2.1.2 Other Consultation

The previous owner of the Wind Farm maintained consultation with the Upper Lachlan Shire Council (ULSC) during construction. Since Pacific Hydro acquired principle control of the wind farm it has and will maintain a line of communication, relating to, operation and decommissioning of the project.

Management of roads and infrastructure has been addressed in Sections 4.1.4 and 5.2 and is to be included in the Transport Management Plan (TMP) of the Operational Environmental Management Plan.

2.2 Consultation Prior to Decommissioning Works

The Owner will undertake further consultation with stakeholders prior to and during the decommissioning process. Stakeholders to be consulted will include (but not necessarily limited to) the Roads and Maritime Services, Upper Lachlan Shire Council, landowners and the local community. Other relevant stakeholders will be identified and consulted as required, including regulatory authorities, industry neighbours and other community groups, if required.

The consultation process will be open and transparent, and its objectives will be to (as a minimum):

- Provide the timing of the proposed decommissioning works;
- Present the nature of the proposed decommissioning works, including the turbine dismantling procedure and the proposed land rehabilitation works and objectives;
- Obtain all stakeholder comments on the decommissioning works and address any concerns (including providing timely and responsive feedback and conflict resolution); and
- Seek ideas to maximise the net benefit to the community during the decommissioning process.

The consultation activities to be undertaken will include:

- Discussion with the Department of Planning, Industry and Environment and Environmental Protection Authority as necessary;
- Meetings with the Upper Lachlan Shire Council;
- Information session or ‘Open House’ forum to introduce the decommissioning activities to the local community;

- One-on-one consultation and discussion with individual landowners; and
- A newsletter mail-out to all residents within 5km of the project site providing information on the decommissioning activities.

The consultation activities undertaken to meet Conditions of Consent (COC) will include:

- Prior to decommissioning works, commission an independent qualified person or team to undertake and complete a review the proposed route and existing access provisions to the Wind Farm to the ensure COC 118 is satisfied;

2.3 Assessment / Report to be Prepared

Table 1 lists the required assessments and reports to be prepared for the Decommissioning and Rehabilitation Process.

Table 1 – Required Assessment / Report

Assessment / Report	Relevant Condition of Consent	Due By	Review / Approval
Decommissioning and Rehabilitation Plan (this Plan)	116	Reviewed every 5 years until decommissioning and rehabilitation is completed	Secretary
Commission an independent, qualified person or team to consult with the relevant road authority to review the proposed route and existing access provisions	118 (a)	Prior to the commencement of decommissioning	-
Commission an independent, qualified person or team to consult with the relevant road authority to assess all roads proposed to be used for over mass and/or over-dimensional transport	118 (b)	Prior to the commencement of decommissioning	-
An independent and qualified person or team shall undertake a **Road Dilapidation Report.**	118 (b)	Prior to the commencement of decommissioning	Report shall be submitted to the R**elevant Road Authority** for review prior to the commencement of haulage
A subsequent **Road Dilapidation Report.**	118 (b)	Within three months of completion of decommissioning	Report shall be submitted to the **Relevant Road Authority** for review
Decommissioning Environmental Management Plan	119	No later than 1 month prior to the commencement of decommissioning activities Decommissioning works shall not commence until written approval has been received from the Secretary	Secretary

3. Operational Life of the Wind Farm

As noted above, the lease agreements held by the Owner are for a period of 30 years with an option to extend. The operational life of the Taralga Wind Farm is therefore expected to be of at a minimum 30 years.

Megawatt-scale wind turbine generators available on the market today have a nominal design life expectancy of 20 to 25 years depending on site conditions after which a capex refurbishment program or repowering would be expected. The tubular steel towers supporting the generators are of simple design and with basic routine maintenance could serve significant years beyond the life expectancy of the generators.

During the design life period or as the turbine generators approach the end of their expected life, the nacelle components and the blades of the turbines may be replaced or renewed, or the turbine may be repowered to utilise newer and more efficient technology available at that time.

This will economically drive the replacement of the existing generators and thus prolong the economic life of the project until at least the end of the lease agreement period.

Any continuation of the project may take the form of one of the following:

- Extended operation of the original turbines;
- Repowering - Turbine replacement with the similar model that has newer and more efficient technology; or
- Repowering - Turbine replacement with a different model that would be subject to the requisite approvals being obtained at that time.

During the operational life of the wind farm the Owner will keep independently verified annual records of each wind turbine electricity generation production. These records will be made available to the relevant government departments on request.

Once the wind farm reaches the end of its useful economic life, the project would be decommissioned, as agreed with landowners and regulatory authorities.

4. Dismantling Process Description

The wind farm equipment and infrastructure will be removed, and the land restored to its previous condition in accordance with the Development Approval (DA) and Leaseholder Agreements, with the following qualifications:

- Essential Energy has ownership of the 37km 132kV transmission line from the Taralga Wind Farm Substation to Transgrid's Marulan Substation and this section of the project will be retained as Essential Energy would likely use this asset to improve the local access to the electricity network;
- The wind farm access road infrastructure, will be retained for on-going use by the landowners, as agreed in lease consultations, in consultation with each landholder; and
- The crane hardstand areas at each turbine site, which will be partially removed after wind farm commissioning, will be fully removed and rehabilitated after turbine dismantling.

The following sections summarise how the remainder of the wind farm equipment and infrastructure is proposed to be dismantled and decommissioned, restoring the land, as far as practicable, to its previous condition.

4.1 Dismantling

4.1.1 Dismantling Turbines and Foundation Removal

Should the wind turbines be sold for re-use, they will be dismantled in the reverse of the erection sequence. A large crane will be brought to the site and assembled on re-established crane operation areas, along with support cranes and equipment. The turbines will be dismantled using standard good management practices of the day.

Critical lift plans will be developed specifically for the turbine dismantling and for handling of each major turbine component. As the majority of each hardstand area will be restored to pre-construction state after construction, a safe hardstand area will need to be established for safe operation of cranes and vehicles before decommissioning commences.

The work sequence for dismantling and decommissioning a particular wind turbine site will most likely proceed as follows:

- Install modified erosion and sediment controls as required. As access roads are to be retained the changes would be minimal and most likely constrained to the crane hardstand areas;
- Disconnect electrical connections;
- Assemble and stage crane/s on re-established hardstand at turbine;
- Remove rotor and hub and set on ground;
- Remove nacelle and set on ground;
- Remove turbine tower sections and stage on ground;
- Haul off turbine components either off-site or to marshalling compound for salvage operations;
- Removal of Fixtures and Fittings:
  - Remove the turbines and any other apparatus equipment or works of any nature erected or installed upon the Premises or Development Area to a depth of 1 metre below the level surface of the soil. This will likely include the foundation pedestal and possibly foundation footing);
- Backfill the resulting 1 metre deep void following removal of fixtures and fittings associated with each turbine;
- Rehabilitate the disturbed areas; and
- Monitor the site in context of sediment control and weed management as agreed with landowners in the Lease Agreement.

Should the wind turbines be sold for scrap, the dismantling will not warrant careful dismantling using costly crane operations but can be felled by a “controlled collapse / pull-over” process and cut into manageable pieces for transport to scrap recycling facilities.

Where areas of the Wind Farm do not support the cut and drop demolition method other methods will be considered to avoid steep terrain, vegetation and protected habitat.

Refer to Appendix B for an estimate of costs.

4.1.2 Other Ancillary Facilities

All ancillary facilities related to the wind farm and located on the landowners’ property would be removed. Sheds and any portable buildings will be transported off site for sale, recycling or disposal. Alternatively, if any of the buildings are required by the landowner, the buildings may be retained for farm use.

A demolition contractor will remove decommissioning debris to a licensed disposal facility permitted to operate under the current and applicable regulations at the time decommissioning occur.

4.1.3 Electrical Infrastructure

All underground and overhead power line poles and conductors connecting the wind farm to the Taralga Wind Farm substation at the Taralga site will be removed (unless land owners decide to accept cable buried to 950mm depth to avoid significant disruption to their land, as established through consultation prior to decommissioning).

The transmission line from the Taralga Wind Farm Substation to Transgrid’s Marulan Substation is owned by Essential Energy and this section of the project will be retained as Essential Energy would likely use this asset to improve the local access to the electricity network.

The O&M Building, control room and substation facilities and equipment will be terminated from the 132kV transmission line and will be dismantled and removed, including the 33kV / 132kV transformer and switchgear.

As far as possible, all materials and components (e.g. steel, conductors, switches, transformers, etc.) will be reused, sold as scrap, recycled, or re-purposed to the maximum amount economically practical. Any other components will be hauled to approved disposal facilities. Any ground disturbed as a result of these activities will be rehabilitated.

4.1.4 Access Roads

Where improvements or changes to the proposed route are identified in the consultation process prior to commencement of decommissioning and rehabilitation, the Owner will implement these in consultation with Roads and Maritime Services and Upper Lachlan Shire Council, prior to the commencement of decommissioning and at the full expense of the Owner;

Consultations with the host landowners during construction of the Wind Farm have determined that access tracks and access roads would be retained as they were considered to be conducive to farming activities. They were to be left in place and will remain part of the on-farm infrastructure. During decommissioning the same access tracks and roads will be utilised to facilitate transport of vehicles, machinery and equipment. The hardstand areas will be utilised with the access tracks and access roads and will removed and with the ground rehabilitated.

4.2 Transportation

All of the turbines will be dismantled at the WTG sites into smaller components to allow for easier transportation, either for resale/reuse, or for recycling/disposal. If the pieces cannot be transported off site immediately, they will be stored on site on a lay down area until they can be removed.

Central lay down areas servicing each collector groups may therefore be required to be created, including topsoil removal, levelling and compacting if new lay down areas are required. Any ground disturbed by the creation of the lay down area would later be rehabilitated. However, new laydown areas and resulting impact could be avoided if the previous temporary construction

compound and/or O&M areas for example could be re-purposed. Current turbine hardstands could also be re-purposed and expanded if more space is required where the previous temporary construction compound and/or O&M areas are not suitable such as for Turbines 20-31 and 49-56.

Off-site transport of pieces and components would be undertaken in accordance with a Transport Management Plan (TMP). A new TMP will be prepared for decommissioning traffic movements. This plan will be drafted in consultation with the Upper Lachlan Shire Council, Goulburn Council, the RMS and the local Police.

The location of scrap metal merchants and other recycling and disposal facilities to be used will be determined closer to the time of decommissioning.

Current local options identified in the vicinity of the project area who may be likely candidates are:

- Southern District Metal Recyclers – 57 Wayo Street, Goulburn;
- Goulburn Sand & Soil – 282 Carrick Road, Goulburn; and
- Woodland Bioreactor – 619 Collector Road, Tarago.

This list will be subject to review every five years in order to stay current.

4.3 Waste Minimisation Strategy

4.3.1 Waste Management

All waste management will be undertaken in accordance with the NSW EPA's Waste Classification Guidelines, or any other guidelines relevant at the time of decommissioning.

As an overarching principle, the waste minimisation hierarchy of avoid / reduce / reuse / recycle / dispose will be applied wherever possible to all decommissioning wastes. Any waste that is unable to be reused, reprocessed or recycled will be disposed of at a facility approved to receive that type of waste.

4.4 Recovery of Wind Turbines

After removal the wind turbines will be either scrapped or transported to another site for resale or reuse. There is an emerging 3rd party global WTG refurbishment industry. Any component that can neither be reused nor salvaged will be recycled or disposed of:

- Sold for reuse;
  - If the turbines are sold for reuse, the rotor, nacelle and tower sections will be dismantled and transported from the site in a manner similar to that used to deliver the turbines to the site;
- Sold for scrap;
  - If the turbines are not sold for reuse, they will be disassembled into smaller components and sold for scrap to a scrap metal recycling company. The turbine hardstand areas will be used as laydown area at each turbine site, unless a consolidated holding area is preferred at the time of decommissioning (refer 4.2);
- The hub, blades and nacelle will be broken down and stripped of high value components, including gear-boxes, generators the composite materials of the blades and nacelles will be recycled in accordance with EPA guidelines effective at the time of decommissioning. Refer to current methods in Table 4-1 below;
- Cabling internals in the towers will be removed and scrapped to recover the high value copper conductor materials;
- Transformers and Control Panels at the base of the towers will be removed and stripped of high value components;
- Tower sections may be cut into transportable sections for delivery to a scrap metal recycling company;

- The concrete used for the turbine's foundations will be excavated to a depth of 1000mm and rubble sent to a concrete recycling facility; and
- Foundation reinforcing steel will be recycled as scrap steel.

If they are recycled, the following materials separation requirements will apply. The objective of the recovery strategy will be to maximise the salvage potential of each turbine and extract value through recycling and reusing its components.

The entire turbine is not recycled homogeneously; as shown below:

All large metal components that are primarily mono-material (e.g. tower sections, cast iron frame in nacelle, etc.) are assumed to be 98% recycled, + 2% landfilled.

Other major components, such as generator, gearbox, cables and yaw system parts are 95% recycled + 5% landfilled;

All other parts of the turbine are treated as shown below:

- Steel 92% recycled + 8% landfilled
- Aluminium 92% recycled + 8% landfilled
- Copper 92% recycled + 8% recycled
- Polymers 50% incinerated + 50% landfilled
- Lubricants 100% incinerated
- All other materials (including concrete) 100% landfilled

Waste management options include: recycling; incineration with energy recovery; component reuse; and deposition to landfill. The Life Cycle Assessment (LCA) model for disposal of the turbine accounts for specific recycling rates of different components, depending on their material purity and ease of disassembly, based upon industry data.

Vestas has calculated the average recyclability across the components of a V90-3.0MW wind turbine to be approximately 82%. For estimation purposes this breakdown is representative of all 3 Vestas turbine models installed in the Taralga Wind Farm.

Material Breakdown of V90-3.0MW turbine only (%mass)

- Steel and iron materials (88%)
- Aluminium and alloys (1%)
- Copper and alloys (1%)
- Polymer materials (3%)
- Process polymers (<1%)
- Carbon / glass composites (5%)
- Concrete (0%)
- Electronics / electrics (<1%)
- Fuels and fluids (<1%)
- Not specified (<1%)

4.4.1 Metallic components

As described above, the tower, nacelle and hub components of the turbines primarily consist of metals including steel, aluminium and copper. Refer to Life Cycle Assessment (LCA) report (*Peter Garrett & Klaus Ronde*; 2013). The turbines will be disassembled on site and all metal components will be transported and sold to a local scrap metal recycling facility.

4.4.2 Turbine blades

Unlike the rest of the turbine, the blades are constructed from composite materials including glass fibre, carbon fibre, polyester and epoxy resins.

There are currently no plans for regulating composite turbine blade disposal, however in the future as disposal laws become more stringent this situation may change. A review of the current laws will be made every five years and this section updated to remain relevant.

Current technologies for wind turbine blades require a complex recycling process for recovery due to their inherent heterogeneous nature. The aim of the recycling process of composite materials is to separate the polymer (resin) and fibre composites. Once separated, the resins are usually used for energy production while the fibre recyclates can be reused or recycled.

There currently exist five main methods for recycling composite materials, including mechanical, thermal, oxidation, chemical and cement kiln route processes. These processes are described in Table 4-1 below.

Table 4-1 - Composite Materials Recycling Processes (Source: *Job* 2010; *Cherrington et al* 2011)

Process	Description
Mechanical	Blades materials are crushed to reduce the size of the pieces to 50 micrometres in size (Pickering, 2006). This process 'pounds' the resins out of the fibres. A grading process is then used to separate the finer (resin) and coarser (fibre) materials.
Thermal Pyrolysis	Blades materials are heated to 450°C to 700°C without oxygen, which converts the resins into gas while the fibres remain inert. The energy generated (gas) can be used in electricity production. Fibres can be later recovered and reused or recycled.
Oxidation in fluidised bed	The fluidised bed process is the most well-known implementation. It consists of combusting the polymeric matrix in a hot and oxygen-rich air flow of 450°C to 550°C. The polymer breaks down and vaporises, releasing the fibres which are carried out into the gas stream. The fibres are separated out and the resin products are fully oxidised in a combustion chamber, where the heat energy can be recovered.
Chemical – Solvolysis	Alcohols (propanol for carbon fibre, methanol for glass fibre) in a supercritical state are used to dissolve the resin from the fibre composites. The polymeric resin is decomposed into oils which free the fibres for collection. This process allows the chemicals in the resin to be reclaimed.
Cement kiln route	Composite materials are fed into a cement kiln. Approximately two-thirds of the material is transferred into raw materials for cement and one third, the organic part (resin) is burnt, generating energy.

The optimal solution for the recycling of the turbine blades will be determined and selected closer to the decommissioning time. It is noted that the technology in wind turbine manufacture as well as in recycling processes evolves quickly.

Currently, Germany has the world's only industrial-scale factory for reprocessing wind turbine blades. The blades are sawn and chopped into chunks then shredded and hammered into 5cm long fragments. These are mixed with other wet waste material and used as fuel in a cement kiln. The reprocessing firm deals with up to 500 tonnes of blades per month.

Owner is committed to staying well-informed of new research and to embracing new technologies as they become available. In this light, if technology advances at the time of decommissioning allow for more efficient and cost-effective resource recovery, they will be given preference.

5. Land Rehabilitation

5.1 Rehabilitation Objectives

The general objective of the rehabilitation activities is to return the site to pre-construction conditions and contours; however specific rehabilitation outcomes will be developed in consultation with each landowner prior to decommissioning.

5.2 Areas to be rehabilitated

Any land disturbed during the construction, operation or decommissioning of the Wind Farm will be rehabilitated, except for parts to remain as agreed with the landowners and electricity companies.

As discussed in Section 4, the turbines and any other apparatus equipment or works of any nature erected or installed upon the Premises or Development Area to a depth of 1 metre below the level surface of the soil will be removed. All remaining sections of foundation below 1000 mm below ground level will not be removed including sections of the foundation footing.

It is expected that the following areas will be restored and rehabilitated:

- Following removal of fixtures and fittings to one metre below ground level the resulting void will be backfilled, and the disturbed area of each turbine will be rehabilitated according to Landowner agreements.

  Note: The actual surface area to be rehabilitated will not be determined until the removal of fixtures and fittings to 1 metre below ground level has been completed and all materials, equipment, machinery, vehicles and anything else associated with the decommissioning process;
- The hardstand areas at each turbine site (approx. 50mx20m);
- The sub-station, Control Room and O&M compound area;
- The holes left in the ground following the removal of overhead power-line poles; and
- Underground cable trenches after cable removal (unless the option of leaving the cable and land undisturbed be agreed by landowners);

The following areas will be retained as agreed with the landowners, council and electricity companies:

- Access roads and access tracks, and
- The 132kV Transmission lines from the Wind Farm substation to Marulan Substation.

5.3 Rehabilitation Process Description

All excavated areas will be filled with certified clean compatible sub-grade material compacted to match density to the surrounding area and contoured to match the surrounding landform. Topsoil would then be replaced and compacted to match the density and consistency of the immediate surrounding area.

Unexcavated areas compacted by equipment used in the decommissioning process will be tilled in a manner adequate to restore the topsoil and sub-grade material to the density consistent with the surrounding area.

Areas to be returned to pasture will be seeded with a seed mix agreed upon with the landowners in order to maintain consistency with the surrounding agricultural uses and to mitigate colonisation of these areas by weed species. Typical species mix will promote species diversity and include legumes species.

Areas to be returned to trees and shrubs will be seeded with a native species mix promoting species diversity and containing fast germinating species. Where possible, the seeds will be sourced locally. The vegetation to be re- established will be aligned to an endemic ecosystem or local plant communities.

In order to promote plant establishment, all revegetation areas will be treated with fertiliser at the time of sowing.

In all area's rehabilitation will include, as reasonably required, levelling, terracing, mulching and other necessary steps to prevent soil erosion, to ensure establishment of desirable vegetation, and to control weeds and vertebrate pests.

6. Funding Arrangements

Financial assurance for the decommissioning costs will be fully established for the entire useful economic life of the project. The decommissioning funding plan for the project is summarised below.

6.1 Decommissioning Costs

The net cost to decommission the Taralga Wind Farm is equal to the cost to perform the decommissioning tasks described in Section 4, less the resale value of the turbines (either for reuse or for scrap). Costs estimates were originally developed for the first iteration of this DRP for the dismantling, rehabilitation and resale of the wind turbines and have been provided in Appendix B. The costs estimate in Appendix B were last reviewed in 2014 and are still considered to be reasonable. Cost estimates will change over time and could be higher or lower depending on a variety of factors such as market volatility, the general cost of labour and materials and market trends in decommissioning.

Estimates were based on industry examples and using available information from a variety of credible industry sources and are considered to be the current dollar value (at the time of approval) of salvage value and removal costs.

Several assumptions have been made and foreseeable risks identified during the cost estimation process (refer to Appendix B). It is noted that the level of confidence in these estimates are only as good as the reliability of the information on which they are based.

There are currently no examples of previous wind farm decommissioning in Australia to rely on historical data; and therefore, there is a level of uncertainty surrounding these estimates.

6.1.1 Decommissioning costs with turbine salvage

The estimated value of the turbines was based solely on its value as scrap steel and nacelle copper, which by far represents the greatest value of all metal components of the turbines. Based on the current values for recycled steel and copper, the net surplus to decommission the wind farm was estimated to be approximately $1,500 per wind turbine (refer to Appendix B2).

The salvage price of other individual components such as blades, gearbox, transformer, switchgear (etc.), was excluded.

6.1.2 Decommissioning cost with turbine resale

From the estimates (Appendix B1), it is evident that the greatest value of the decommissioned wind turbines would be realised by selling the turbines for reuse. The estimated turbine resale value ($100,000 per turbine) would exceed the estimated decommissioning and rehabilitation costs ($90,000 per turbine -refer to Appendix B1), and thus, under the assumption that wind turbines are resold, there would be no net cost to decommissioning the wind farm.

At the time of writing this plan, it is therefore expected that decommissioning funds will be provided using either recycle or resale option noting that the conservative scrap options will in fact cover decommissioning costs.

6.2 Ensuring Decommissioning Funds

Decommissioning funds will be ensured through either the resale (for reuse) of the wind turbines to other providers or recycling as scrap. No bond is therefore required at this time.

7. Timing

TWF P/L commits to undertaking all decommissioning and rehabilitation works outlined in this plan within the 18 months after the end of Taralga Wind Farm's operational life assuming no repowering.

During the operational life of the project, it is possible that individual turbines will cease operating for extended periods of time if they are malfunctioning and need to be repaired. Depending on the market availability of specific wind turbine parts, which regularly have to be sourced overseas, some turbines may be inactive for periods longer than twelve months before they can be repaired. Any turbine that cannot be repaired within this twelve-month period and is deemed permanently unworkable (due to environmental, social, economic or other unforeseen issues) will be decommissioned and dismantled, and the site rehabilitated within 18 months of the last electricity generation, in accordance with Consent Condition 117.

8. Responsibility

Current Owner (or any future Owner) will be fully responsible for the decommissioning of the project. This is supported by the provisions in the lease agreements which will be executed between Owner and the landowners prior to the commencement of decommissioning. (refer to Appendix A).

9. Review of this Plan

This DRP will be reviewed, and revised as required, every 5 years for the duration of the project until decommissioning and rehabilitation is completed. During each review, the effectiveness of the plan will be re-assessed against its objectives.

Examples of why the plan may need to be revised include:

- A modification to the condition of the Approval;
- Deficiencies being identified;
- Changing environmental requirements;
- Instructions of the Secretary;
- Change in legislation; and
- Improvements in knowledge or technology become available.

Any major changes to this plan will be undertaken in consultation with the appropriate regulatory authorities and stakeholders.

This DRP, as well as all subsequent reviews, will be made public and placed on Owner's website. Owner will also provide a copy of the revised DRPs to the relevant consent authority at the time.

10. References

- Peter Garrett & Klaus Ronde; 2013 Life Cycle Assessment of Electricity Production from and Onshore V90-3.0MW Wind Plant- 30 October 2013, Version 1.1. Vestas Wind Systems A/S, hedeager 44, Aarhus N, 8200, Denmark.
- R. Cherrington, V. Goodship, J. Meredith, B.M. Wood, S.R. Coles, A. Vuillaume, A. Feito-Boirac, F. Spee, K. Kirwan. Article Title: Producer Responsibility: Defining the Incentive for Recycling Composite Wind Turbine Blades in Europe. 2012
- *DP&I (2011) Draft NSW Planning Guidelines: Wind Farms,* NSW Department of Planning and Infrastructure, December 2011.
- Job, S. (2010) Composite Recycling – Summary of recent research and development, Materials Knowledge Transfer Network Report, September 2010.
- NSW EPA (2014) Waste Classification Guidelines: Part 1: Classifying Waste, NSW Environmental Protection Agency, Chatswood, NSW.
- Pickering, S.J. (2006) 'Recycling technologies for thermoset composite materials – current status', Composites Part A 37, pp. 1206-1215.

Appendix A – Land Lease Agreement

Lease Extract

2.15 Removal of Fixtures and Fittings

a. Upon the expiration or sooner determination of the Term hereby granted to remove the Turbines and any other apparatus equipment or works of any nature erected or installed upon the Premises or the Development Area to a depth of at least 1 metre below the level surface of the soil at the cost of the Lessee and to make good any damage thereby caused to the reasonable satisfaction of the Lessor and leave the Premises in accordance with all statutory and other rules and regulations applicable to the Premises and in force at the expiration of the Term. For the avoidance of doubt the Lessee shall not be required to remove the Access Roads; and

b. Without limiting clause 2.15(a) or clause 2.8, the Lessee will comply with the decommissioning requirements, including as to timeframes, of the Planning Consent.

Appendix B – Decommissioning Cost Estimates

Wind Turbine Decommissioning and Rehabilitation Costs

APPENDIX B1: TURBINE SALE OPTION: Taralga Wind Farm					
B1.1: DISASSEMBLY COST ESTIMATE:					
Turbines dismantled per week	4				
Total Turbines	51				
Dismantling Duration: weeks	13				
Labour Rate / week	$4,200				
Resource	**Weekly Cost $**	**No Weeks**	**Total Cost for Farm**	**$/WTG**	**Notes**
Main Crane	50,000.00	13	650,000.00	12,745	
Tower Crane	35,000.00	13	455,000.00	8,922	
Other gear eg Tailing/loading crane	20,000.00	13	260,000.00	5,098	
Telehandler	5,000.00	13	65,000.00	1,275	
Trucks	5,000.00	13	65,000.00	1,275	
5 man crew main crane	21,000.00	13	273,000.00	5,353	
5 man crew small cranes	21,000.00	13	273,000.00	5,353	
4 man Internal de-commissioning crew	16,800.00	13	218,400.00	4,282	
Management, Clean Up, Misc, - 4 men	16,800.00	1	16,800.00	329	Can make use of existing O&M facility so cost reduced
Mob/De-Mob	150,000.00	1	150,000.00	2,941	
Site Amentities	30,000.00	1	30,000.00	588	
B1.1 : TURBINE DISASSEMBLY AND REMOVAL COST			**2,456,200.00**	**48,161**	

B1.2: WIND FARM REHABILITATION			**Total for Farm**	**$/WTG**	**Notes**
B1.2.1: Removal of Maintenance Facility					
Disconnect Services, remove buildings and tanks etc			**30,000**	**588**	
B1.2.2: Land Reinstatement					
grading, re-seeding, etc			**40,000**	**784**	
B1.2.3: Logistics					
	Trips per WTG	**$/trip**			
20t Truck Load	**20**	**2,000**	**2,040,000**	**40,000**	
B1.2: WIND FARM REHABILITATION COST			**2,110,000**	**41,373**	

B1.3: SALE OF WTG'S AND COMPONENTS			
B1.3.1: Wind Turbine Transformers			
690/33kV transformer residual value (on-site)	-$102,000	-$2,000	Low allowance as low market in Australia.
B1.3.2: Wind Turbines, including towers			
Based on research of advertised used turbines	**- 5,100,000**	**- 100,000**	See notes below
B1.3: SALE OF WTG'S AND COMPONENTS - TOTAL COST	**- 5,202,000**		

B1: NET DECOMMISSIONING & REHABILITATION COSTS - SALE OPTION	**Total for Wind Farm**	**Total $/WTG**	**Notes**
	- 635,800.00	**- 12,467**	

1. Rotors are dismantled by the small crane prior to arrival of the base tower crew

For simplicity it is assumed that dismantling crews work at the rate of 4 WTGs per week Towers are in 3 sections

2. Labour rates include vehicles, LAFHA, etc

3. Labour is assumed to be 10 hours per day at $70/h, 6 days per week the site is 45km north of Goulburn, and 135km from Canberra.

4. The method of dismantling for resale is assumed to be the reverse of installation.

Turbine Value Data Analysis:Review 1.8MW to 3MW sizes

Wind Turbine Re-Sale Value Data				
Manufacturer	**Size (kW)**	**Age**	**Price (E) per k**	**Price (US$) per kW**
Fuhrländer 1 MW	1000	12	155	175
ENERCON 600 kW	600	12	292	329
VESTAS 1.65 MW	1650	12	203	229
NORDEX 1 MW	1000	17	52	59
Windmaster 750 kW	750	14	87	98
VESTAS 600 kW	600	13	178	201
GE 1.5 MW	1500	9	233	263

References:

http://www.repoweringsolutions.com/english/download_list_wind_turbine/list_wind_turbines.pdf

Notes

The WTGs' value after 30 years of life will possibl;y be significantly less than suggested in the above $/kW data (for <20year old WTG's), so a conservative estimate of $100k per WTG has been included in the estimate. Some factors taken into account are::

1. Used turbines trade in Australia may be more difficult that in Europe or the US, due to the smaller market for renewable energy.

2. There may be many other wind farms being decommissioned in Australia at the same time, and a possible glut in the used WTG market.

4. As turbines go past their design life, the costs of installing them on a new site could reduce their effective value significantly.

There are no multi MW turbines on the used WTG market to gauge the value of the larger and more efficient models being installed now. Resale values will need to be assessed during the life of the wind farm and 5 yearly re-assessment of the DRP.

APPENDIX B2: TURBINE RECYCLE OPTION: DEMOLITION COST ESTIMATE: Taralga Wind Farm

B2.1 TURBINE FELLING (Avoiding use of large cranes to dismantle as for Resale Option)

Turbines felled per week	6
Total Turbines	51
Turbine Felling Duration: weeks	8
Labour Rate / week	$4,200

Resource	Weekly Cost $	No Weeks	Total Cost for Farm	$/WTG	Notes
Telehandler	8,000.00	8	64,000.00	1,255	
Block Trucks - for felling towers	10,000.00	8	80,000.00	1,569	
4 man Internal de-commissioning crew	16,800.00	8	134,400.00	2,635	
Management, Clean Up, Misc, - 4 men	16,800.00	1	16,800.00	329	
Mob/De-Mob	20,000.00	1	20,000.00	392	
B2.1:TURBINE FELLING COST			**315,200.00**	**6,180**	

B2.2: ON-SITE DEMOLITION OF COMPONENTS					
Resource	**Weekly Costs $**	**No Weeks**	**Total for Farm**	**$/WTG**	**Notes**
Remove tower internals and cable (2 men)	8,400	10	84,000	1,647	
Dissassemble Nacelle (2 men)	8,400	10	84,000	1,647	
Chop up and squash tower sections (2 men)	8,400	10	84,000	1,647	Such as cutting and squashing equipment for towers and blades
Rent Demolition equipment	10,000	10	100,000	1,961	
Rent small crane	8,000	10	80,000	1,569	
Site Amenities	5,000.00	10	50,000	980	
B2.2 ON-SITE DEMOLITION COSTS			**482,000**	**9,451**	

B2.3: WIND FARM REHABILITATION (same as for Resale option)			Total for Farm	$/WTG	Notes
B2.3.1: Removal of Maintenance Facility					
Disconnect Services, remove buildings and tanks etc			**30,000**	**588**	
B2.3.2: Land Reinstatement					
grading, re-seeding, etc			**40,000**	**784**	
B2.3.3: Logistics					
	Trips per WTG	**$/trip**			
20t Truck Load	**20**	**2,000**	**2,040,000**	**40,000**	
B2.3: WIND FARM REHABILITATION COST			**2,110,000**	**41,373**	

B2.4 RESALE OF TRANSFORMERS			
B2.4.1: Wind Turbine Transformer value	**Total for Farm**	**$/WTG**	**Notes**
690/33kV transformer residual value (on-site)	-$102,000	-$2,000	Low - not generally traded in Australia.

B2.4 RESALE OF TRANSFORMERS VALUE	-$102,000	-$2,000	

B2.5 SCRAP METAL VALUE					
Scrap Metal Value	Weight in tonne	$ / tonne	Total for Farm	$/WTG	Notes
Tower and Nacelle (88% WTG Weight)	198	-200	-2,019,600	-39,600	
Copper - Tower and Nacelle (1% WTG Weight)	2.42	-7,000	-863,940	-16,940	
B2.5 SCRAP METAL VALUE			-2,883,540		

B2: TOTAL DECOMMISSIONING COSTS - RECYCLE OPTION	Total for Wind Farm	Total $/WTG	Notes
	- 78,340.00	- 1,536.08	

1. Turbines / towers decommissioned prior to felling, including removal of control panel and SU transformers from base of towers.

2. Cable is attached to top of tower internally and rigged to heavy vehicle (eg block truck, dozer or grader).

3. Utilising strict safety protocols, the tower bolts are loosened at base and the heavy vehicle is used to pull the tower over.

4. Risk Assessments are conducted for each WTG felling, and strict adherence to SWMS is observed.

5. Scrap materials are separated and cut into easily manageable pieces for transport to scrap merchants for recycling.

6. Labour is assumed to be 10 hours per day at $70/h, 6 days per week the site is 45km north of Goulburn, and 135km from Canberra where the scrap steel would be delivered.

7.Steel and copper weights are approximate but based on average actual weights of the three types of Vestas WTG's installed on the Taralga Wind Farm. Potential scrap value of underground 33kV cabling and other miscellaneous equipment has not been considered in the cost estimates. If all underground cabling is to be removed for scrap, this may amount to considerable scrap value.

8. The value of scrap metal has a very large impact and is very variable, linked largely to global metal prices. The scrap price used in the estimate is based on current rates.

9. The method of dismantling as for resale is not warranted due to the high cost of craneage and has not been considered for this option.

Summary of Decommissioning Options

B1: NET DECOMMISSIONING & REHABILITATION COSTS - SALE OPTION	Total for Wind Farm	Total $/WTG	Notes
	- 635,800.00	- 12,467	

B2: TOTAL DECOMMISSIONING COSTS - RECYCLE OPTION	Total for Wind Farm	Total $/WTG	Notes
	- 78,340.00	- 1,536.08	

Both recycling and WTG resale options indicate a nett profit to achieve decommissioning and rehabilitation of the Taralga Wind Farm at the end of its life span, based on current knowledge and techniques. Decommissioning and Rehabilitation funding allowance is not considered necessary at this stage of the project but will be re-evaluated every five years when DRP is due for review.

Appendix C – Conditions of Consent

The following table list the NSW State Approval Conditions of Consent relating to the decommissioning and rehabilitation phase of the Wind Farm.

Public records of the full conditions are available at *http://majorprojects.planning.nsw.gov.au/*

NSW State Approval Conditions		
	Description	**Reference**
115	Unless otherwise agreed by the Secretary, within 18 months of the cessation of operation of the Development, the site shall be decommissioned and returned by the Applicant, as far as practicable, to its condition prior to the commencement, in consultation with the relevant landowner(s) and to the satisfaction of the Secretary (and in accordance with the Decommissioning and Rehabilitation Plan required by condition 116). All generating facilities and associated infrastructure (including but necessarily limited to the substations and transformers, switchyard, operation and maintenance facility, overhead transmission lines and access roads) shall be removed from the site unless otherwise agreed by the Secretary. Project related infrastructure (including access roads) may only be retained on site, where the Applicant has demonstrated to the satisfaction of the Secretary prior to the commencement of decommissioning, that these components: are permissible under the site's statutory land use provisions in force upon commencement of the decommissioning; would not pose an ongoing impediment to permissible land use at the properties; and their retention has been agreed to in writing (with evidence provided to the Secretary) by the relevant landowners. This condition does not apply to any infrastructure which, as at the relevant date, is owned by a network operator under the Electricity Supply Act 1995 (NSW) (or any equivalent provisions which are in force as at the relevant date).	Section 4
116	The Applicant shall prepare within three months of the determination of modification 3 and 4 and update a Decommissioning and Rehabilitation Plan every five years from the date of preparation, until decommissioning and rehabilitation is completed. A copy of the Plan and updated versions are to be provided to the Secretary and made publicly available. The updated Plan shall be consistent with the requirements of the draft NSW Planning Guidelines – Wind Farms (December 2011), as updated. The updated Plan shall include estimated costs and funding arrangements for decommissioning including provision for a decommissioning bond or other funding mechanisms, where the Plan concludes that estimated costs and funding arrangements are inadequate.	Section 1.3 Section 6 Section 9

NSW State Approval Conditions		
	Description	**Reference**
117	Any individual turbine that ceases operating for a period of more than 12 consecutive months shall be dismantled within 18 months after the 12 month period, unless otherwise agreed by the Secretary. The Applicant shall keep independently-verified annual records of the use of wind turbines for electricity generation. Copies of these records shall be provided to the Secretary upon request. The relevant wind turbine and any associated infrastructure is to be dismantled and removed from the site by the Applicant within 18 months from the date that the wind turbine was last used to generate electricity.	Section 3 Section 7
118	Unless otherwise agreed by the Secretary, the Applicant shall commission an independent, qualified person or team to undertake the following in consultation with the relevant road authority: (a) prior to the commencement of decommissioning, review the proposed route and existing access provisions to the Wind Farm Site to determine whether the route and existing provisions allow for safe access of decommissioning vehicles associated with the Development (including appropriate site distances and provisions for over-mass or over-dimensional transport and safety with other road users). Where improvements or changes to dimensional transport and safety with other road users). Where improvements or changes to the proposed route are required, the Applicant shall implement these in consultation with relevant road authority, prior to the commencement of decommissioning and at the full expense of the Applicant; (b) assess all roads proposed to be used for over-mass and/or over-dimensional transport (including intersections, bridges, culvers and other road features) prior to the commencement of decommissioning to determine whether the existing road condition can accommodate the proposed over-mass and/or over-dimensional haulage. Where improvements are required, the Applicant shall implement these in consultation with the relevant road authority, prior to the commencement of decommissioning and at the full expense of the Applicant. Upon determining the haulage route(s) for decommissioning vehicles associated with the Development, and prior to decommissioning, an independent and qualified person or team shall undertake a Road Dilapidation Report. The report shall assess the current condition of the road(s) and describe mechanisms to restore any damage that may result due to traffic and transport related to the decommissioning of the Development. The Report shall be submitted to the relevant road authority for review prior to the commencement of haulage. Within three months of completion of decommissioning, a subsequent report shall be prepared to assess any damage that may have resulted from the construction of the Development (including mechanisms to restore any damage) and submitted to the relevant road authority for review. Measures undertaken to restore or reinstate roads by the Department shall be undertaken in accordance with the reasonable requirements of the relevant road authority (including timing requirements), and at the full expense of the Applicant.	Section 2.2 Section 4.1.4 Section 4.2

NSW State Approval Conditions		
	Description	**Reference**
119	Prior to the commencement of decommissioning or as otherwise agreed by the Secretary, the Applicant shall prepare and implement (following approval) a Decommissioning Environmental Management Plan for the Development. The Plan shall outline the environmental management practices and procedures that are to be followed during decommissioning and shall be prepared in consultation with the relevant agencies and in accordance with the Guideline for the Preparation of Environmental Management Plans (Department of Infrastructure, Planning and Natural Resources, 2004). The Plan shall include, but not necessarily be limited to: (a) a description of activities to be undertaken during decommissioning of the Development (including staging and scheduling); (b) statutory and other obligations the Applicant is required to fulfil during decommissioning including approval/approvals, consultations and agreements required from authorities and other stakeholders under key legislation and policies; (c) a description of the roles and responsibilities for relevant employees involved in the decommissioning of the Development, including relevant training and induction provisions for ensuring that employees, including contractors and sub-contractors are aware of their environmental and compliance obligations under these conditions of Consent; (d) an environmental risk analysis to identify the key environmental performance issues associated with the decommissioning phase; and (e) details of how environmental performance will be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the decommissioning of the Development). In particular, the following environmental performance issues shall be addressed in the Plan: i. compounds and ancillary facilities management; ii. noise and vibration; iii. traffic and access; iv. soil and water quality and spoil management; v. air quality and dust management; vi. hazardous material and waste management; and vii. hazard and risk management, including bushfire risk. The Plan shall be submitted for the approval of the Secretary no later than on month prior to the commencement of decommissioning, or as otherwise agreed by the Secretary. The Plan may be prepared in stages, however, decommissioning works shall not commence until written approval has been received from the Secretary.	Section 2.31.3