Chapter 5

Project description

5.1 Overview

This chapter describes the infrastructure and associated construction works proposed for the project. It also describes how the project would operate during its life and what would be required to decommission it.

The project would harness strong and reliable winds to generate renewable energy through the construction and operation of up to 59 wind turbines. Electricity produced by the project would be fed through underground cables to the on-site substation and battery energy storage system, from where it would be exported to the Tarrone Terminal Station and the national electricity transmission network via the existing Moorabool to Heywood 500 kilovolt transmission line.

The project would generate more than 1,300 gigawatt hours of electricity each year, which is, on average, as much electricity as is used by more than 200,000 homes in Victoria each year. A detailed rationale for the project is presented in Chapter 2 – *Project rationale and benefits*.

The EES impact assessments have been based on conservative estimates for the total development footprint. The total construction footprint for the project is estimated to be up to 222.3 hectares (or 5.4% of the site). This includes an area of up to 99.5 hectares (or 2.4% of the site) that would be used for the life of the project and 122.8 hectares that would be rehabilitated once construction is complete.

Table 5.1 provides a summary of the main features of the project.

Table 5.1 Summary of the main project features

Project's main features	Details
Location	The project is located about 3 kilometres north-east of Orford and 10 kilometres south-west of Hawkesdale. The wind farm site is entirely within the Moyne Shire. Intersections on the Princes Highway and the intersection of Tyrendarra-Ettrick Road and Woolsthorpe-Heywood Road will require minor works to allow wind turbine blade transport from Portland through the Glenelg Shire. The project site is situated immediately south of the Woolsthorpe-Heywood Road and lies between the Hamilton-Port Fairy Road to the west and the Penhurst-Warrnambool Road to the east.
Setting	The main land use within the project site is agricultural (predominantly sheep and cattle grazing). Native vegetation is largely restricted to roadside reserves and highly modified isolated occurrences along waterways, roadsides, and stony knolls, which would largely be avoided.
Landowners	There are 16 landowners with project infrastructure proposed to be built on their land.
Wind turbines	Up to 59 with a maximum tip height of 250 metres, maximum rotor diameter up to 190 metres, minimum tip height of 40 metres and blade length of up to 93 metres.
Wind farm capacity	Around 354 megawatts.
Annual generation	Over 1,300 gigawatt hours per year.
Construction period	About 24 months.

Project's main features	Details
Electrical reticulation	Around 112.6 kilometres of 33 kilovolt electricity cable would be laid in 62.1 kilometres of trenches, about one metre below the surface to connect wind turbines to the on-site substation. An overhead transmission line of up to about 300 metres would be needed to connect the on-site substation to the Tarrone Terminal Station.
On-site substation	The underground cabling would terminate at the on-site substation to the north of the Tarrone Terminal Station, which would connect to the 500 kilovolt Moorabool to Heywood transmission line via the Tarrone Terminal Station. The on-site substation area may also host a synchronous condenser. The substation would be in a single yard with footprint of up to 70 metres by 220 metres.
Operations and maintenance facility	An operations and maintenance facility would be built next to the on-site substation and provide office, storage and maintenance facilities. The facility would be approximately 70 metres by 220 metres.
Wind turbine hardstand areas	Each wind turbine hardstand covers an area of 6,500 square metres, which equates to 38.3 hectares for all project wind turbines.
Meteorological masts	Up to three meteorological masts are proposed to be in place for the life of the project. A single-lane access track roughly 3 metres wide will be constructed to provide access to these masts.
Battery Energy Storage System	An on-site battery energy storage facility with a nominal capacity of 200 megawatts/ 400 megawatt hours is proposed to be built next to the on-site substation. The battery would consist of a series of modular batteries with transformers and other electrical plant. The battery would be sited on a hardstand area of up to 5.5 hectares (around 320 metres x 220 metres).
Synchronous condenser	The synchronous condenser, if built, would have a nameplate capacity of about 30 megavolt amperes and a footprint of about 15 metres by 20 metres, although the actual capacity and footprint would be determined at a later date when the grid connection requirements are better known.
Transport	Transport of wind turbines and ancillary components (e.g., battery and substation infrastructure) would mostly be from Portland and via the regional road network.
Site access and access tracks	Twelve site access points are proposed from one arterial and three local council roads; the Woolsthorpe-Heywood Road, Tarrone North Road, Riordan's Road and Old Dunmore Road. These access points would connect to about 60 kilometres of internal access tracks. Access tracks would have a final width of six metres and a minimum 30 metre turning radius. The construction footprint of access tracks would be 12 metres wide, within a 40-metre-wide corridor that has been surveyed by ecologists and heritage specialists.
External road upgrades	Duplicating a section of Woolsthorpe-Heywood Road (from single lane to dual lane) and maintenance of several sections of local roads to Department of Transport and Moyne Shire Council standards would occur to facilitate the project.
Raw materials / quarry	The project is estimated to require approximately 450,000 cubic metres of crushed rock. This would be sourced from an on-site quarry (subject to approval of the Quarry Work Plan) or existing commercial quarries. The closest commercial quarry is the Tarrone Quarry, about 3.5 kilometres to the south-east of the project site. The temporary on-site quarry (if approved) would be established to provide crushed rock for the construction of the project including tracks, hardstands, the temporary construction compound, and may also be used in the wind turbine foundations if the material is of suitable quality. The quarry would be in the western part of the site, east of the Old Dunmore Road and about 4 kilometres to the north-east of Orford. The proposed quarry work authority area is about 30 hectares, with the extraction area being 10.5 hectares with a maximum depth of 14 metres. The total disturbance area of the quarry is estimated to be 24.7 hectares, including 10 hectares of hardstand areas. Water used during construction would be sourced from the on-site quarry and local standpipes, if needed, subject to approval.

Project's main features	Details
Temporary components	Three temporary construction compounds would be developed and include office facilities, amenities, car parking, chemical and hazardous material storage, waste collection, and additional laydown areas. Three concrete batching plants (50 metres by 100 metres) would be established to supply concrete for the wind turbine foundations, the on-site substation, and the battery. Four laydown hardstand areas would also be established at strategic locations for the storage of wind turbine components and other equipment.
Life	A minimum 25-year operating life is expected after a period of up to 3 years of pre-development and construction activities. Pre-development would include detailed design and early works, where permitted.
Decommissioning	Within 12 months of wind turbines permanently ceasing to generate electricity (assuming the turbines are not repowered), the wind farm would be decommissioned. This would include removing all above ground equipment, restoration of all areas associated with the project, unless otherwise useful to the ongoing management of the land, and post-decommissioning revegetation with pasture or crop (in consultation with and as agreed with the landowner).

The proposed locations of the main project features are shown in Figure 5.1 and in greater detail in the project map book (Attachment III).

The project has been investigated during the past decade and the current design has considered a range of engineering, environmental and social aspects, including feedback from the local community and other stakeholders. An iterative design process has been followed to make sure that any design changes resulting from one specialist's advice were assessed by the other relevant specialists. These changes have resulted in the project design described in this chapter. The design process, and alternatives considered, are described in detail in Chapter 4 – *Project alternatives and design development*.

A detailed design would be prepared after receiving a planning permit and achieving financial close, incorporating the results of future geotechnical investigations and information from the selected wind turbine manufacturer, civil and electrical contractors. A 100-metre micro-siting radius is proposed around each current wind turbine location to facilitate refinements to the detailed design. This micro-siting area has been assessed by specialist consultants (as part of this EES) so the detailed designer team can be confident about where wind turbines can be moved later (e.g., to improve wind farm efficiency or due to geotechnical factors). Micro-siting would not occur within areas of known constraints or where sensitive areas are known to occur. The micro-siting of any wind turbines would require that the routes of access tracks and underground cables are also adjusted, while ensuring that there are no greater impacts than those assessed during this assessment process. Sensitive ecological and heritage areas would be demarcated and protected during construction to prevent damage, including where infrastructure micro-siting is required.

Power units and terminology

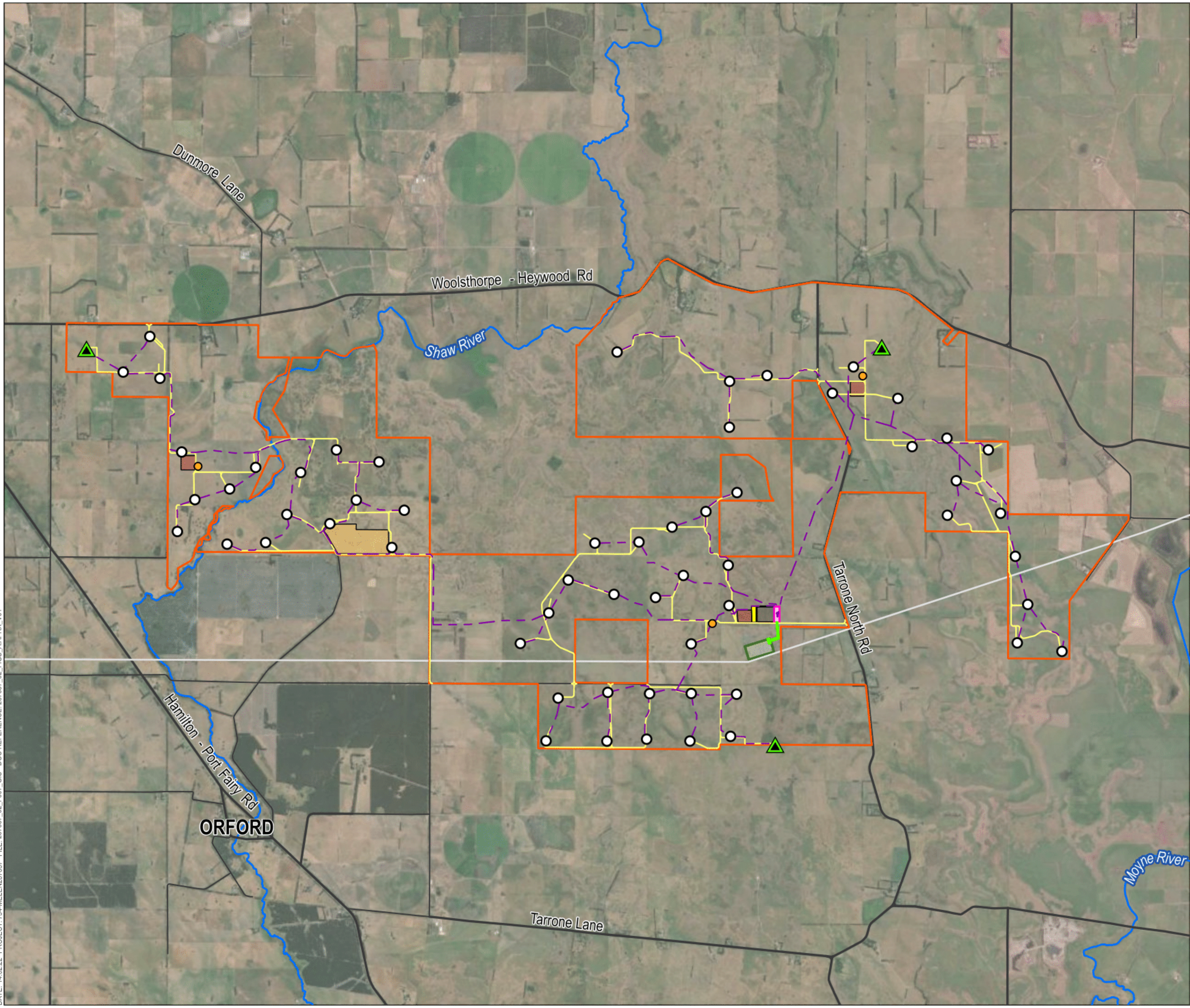
Kilovolts (kV): refers to 1,000 volts. Kilovolts are commonly used to describe transmission line voltages.

Megawatts (MW) and megawatt hour (MWh): One megawatt is one million watts and is a measure of power generation or consumption. A megawatt hour refers to the generation or usage of one million watts for one hour.

Gigawatt (GW): One billion watts or 1,000 megawatts.

Nameplate capacity: Maximum rated output generation capacity of a generator, determined by the manufacturer.

Capacity factor: The average power output divided by its maximum power capability. If a 6 MW wind turbine produced on average 3 MWh in one hour, then its capacity factor would be 0.5.



LEGEND

- Turbine location
- Permanent met mast
- Concrete batch plant
- Underground cable
- Access track
- Substation
- Battery energy storage system
- Construction compound
- Quarry area
- Operations and maintenance facility
- Transmission line and grid connection infrastructure
- Willatook Wind Farm boundary

Other

- 500kV Moorabool-Heywood transmission line
- Major road
- Local road
- Watercourse
- Tarrone Terminal Station

SOURCE:
Willatook Wind Farm boundary, turbine locations and site infrastructure from Wind Prospect.
Roads and watercourses from Vicmap.
Imagery from ArcGIS Online (various capture dates).

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WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 5.1

Project overview

DATE: 14.02.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F007_GIS DOC REFERENCE: 287657_02_FIGS_A.APRX_V01

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5.2 Project components and layout

5.2.1 Wind turbine generators

The global wind turbine market is rapidly advancing to develop higher capacity wind turbines with longer blades. Market trends and forecasts from manufacturers indicate that wind turbines entering the Australian market will be up to 250 metres from the ground to upper blade tip. The project has therefore been designed to enable a maximum wind turbine tip height of 250 metres and have an associated maximum rotor diameter of 190 metres. The minimum blade clearance from ground level would be 40 metres. A range of current and future wind turbine models would be considered that fit within those parameters.

Each wind turbine would have foundations, tower, nacelle, rotor, and transformer (Figure 5.2) and is expected to have a generating capacity of 6 megawatts or more.

The maximum and minimum parameters described above have been adopted for this EES, allowing a 'worst case' assessment of environmental and social impacts. Note that if the minimum blade clearance of 40 metres is adopted, the maximum tip height would be 230 metres. If the maximum tip height of 250 metres is adopted, the ground clearance would be 60 metres or higher.

How wind power works

Wind turbines work by converting the kinetic energy of the wind into electrical energy. A wind turbine is made up of five main parts: the foundations, tower, rotor, nacelle and transformer.

Kinetic energy from the wind forces the wind turbine's blades to turn. The blades and the central hub are collectively called the rotor. The turning rotor turns a shaft within the nacelle which is connected to the generator via a gearbox. The generator then converts the wind's energy into electricity via the wind turbine's transformer, which regulates the output voltage.

More specifically, a wind turbine converts the wind into electricity using the aerodynamics of the blade which create lift. Lift occurs because of the air pressure differences on each side of the blade due to the design of the blade. This lift enables the rotor (connected to the generator) to turn, which then generates electricity.

The wind turbine ultimately chosen for the project would comply with relevant international standards, such as IEC 61400-1 Wind energy generation systems – Part 1: Design requirements and IEC 61400-24 Lightning protection standard. Each wind turbine would have a matte white, non-reflective, finish to achieve visual consistency throughout the landscape. No unnecessary lighting, signage or logos are proposed.

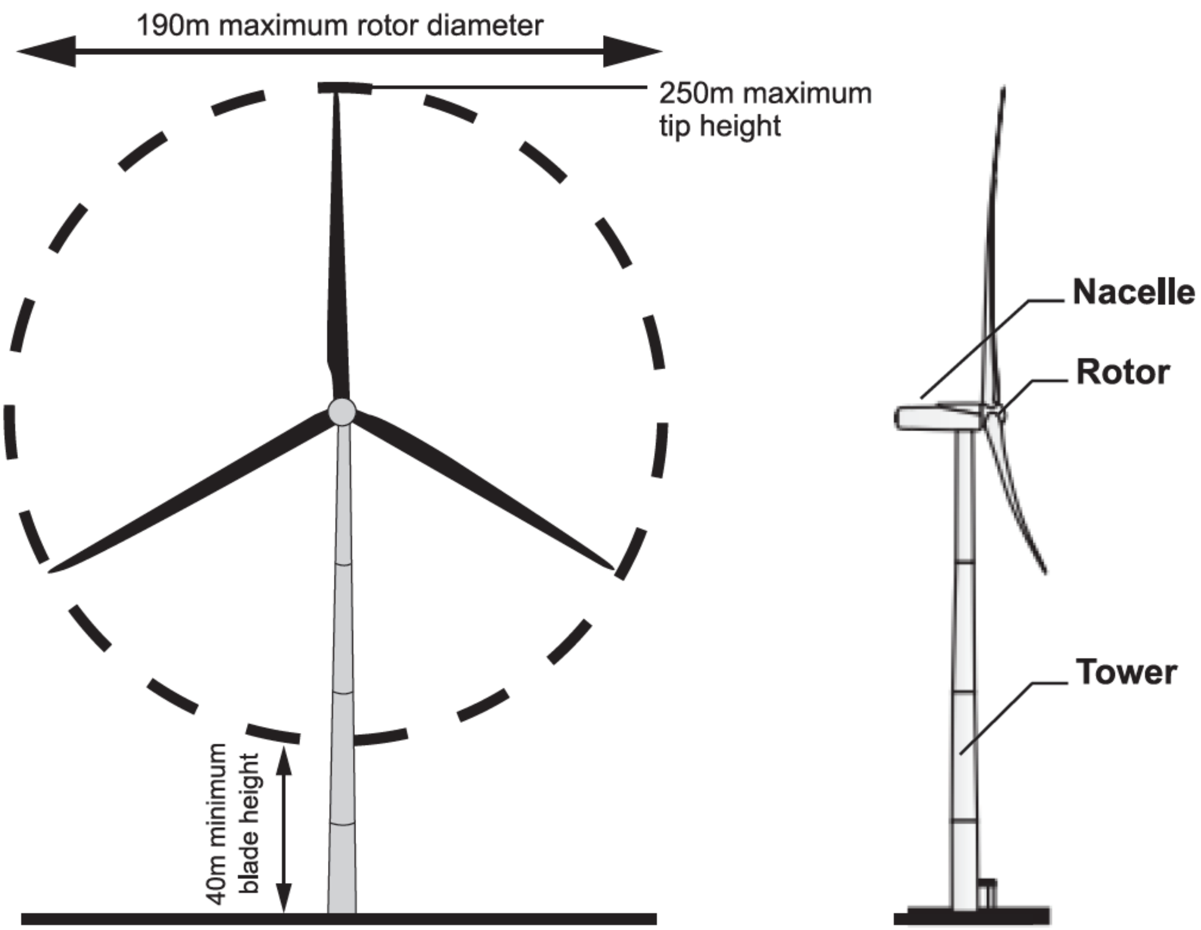

Figure 5.2 Wind turbine components

Wind turbine foundations

The wind turbine foundations would be either a gravity foundation or rock anchor foundation (discussed further in Section 5.4.2). The final designs of individual foundations for each wind turbine would be determined by detailed geological and geotechnical investigations. It is possible that more than one type of wind turbine foundation will be needed across the wind farm (see Section 5.4.2 for details about foundation construction).

Figure 5.3 shows a typical wind turbine excavation and hardstand area.

Figure 5.3
Aerial view of typical wind turbine hardstand during construction
(*source: Wind Prospect*)

Hardstands

Hardstands are needed next to each wind turbine for the assembly, erection, maintenance, repowering and decommissioning of a wind turbine. Each hardstand area would be about 0.65 hectares, which includes the foundation, laydown areas, and crane pads. Hardstands would be surfaced with material to the required load-bearing specifications for the selected crane. This would consist of crushed rock. After construction, the hardstand would be retained and used for periodic maintenance of the wind turbines throughout the life of the project. Rehabilitation would occur around the margins of the hardstand areas as needed. The exact hardstand arrangement would be designed for the specific requirements of the wind turbine, the crane and local topography.

Tower

Each wind turbine tower sits on a foundation and comprises several bolted steel sections. Typically, towers that could accommodate the proposed maximum blade tip height of 250 metres would have base diameter of between 5 and 6 metres, tapering to 3 metres at the top. Towers would be transported in sections for on-site assembly.

Nacelle

On the top of each tower sits the nacelle onto which the wind turbine hub is mounted, with the three blades attached to the hub. The wind turbine tower, nacelle and rotor would all have the same matte white colour.

The nacelle houses the generator and gearbox (if there is a gearbox) and shafts to convert mechanical energy to electrical energy. The nacelle is the housing constructed of steel and fibreglass and is typically around 15 to 18 metres long, 4.5 metres high and 4.5 metres wide (depending on the wind turbine model). As well as the gearbox and generator, it also houses a transformer (model dependant), motor, brake, electronic components, wiring and hydraulic and lubricating oil systems and sound insulation. The nacelle also includes the control systems and yaw mechanism. The yaw mechanism enables the rotor and nacelle to rotate so the plane of the wind turbine blades is always facing the direction of the wind.

An example of a nacelle is shown in Figure 5.4.

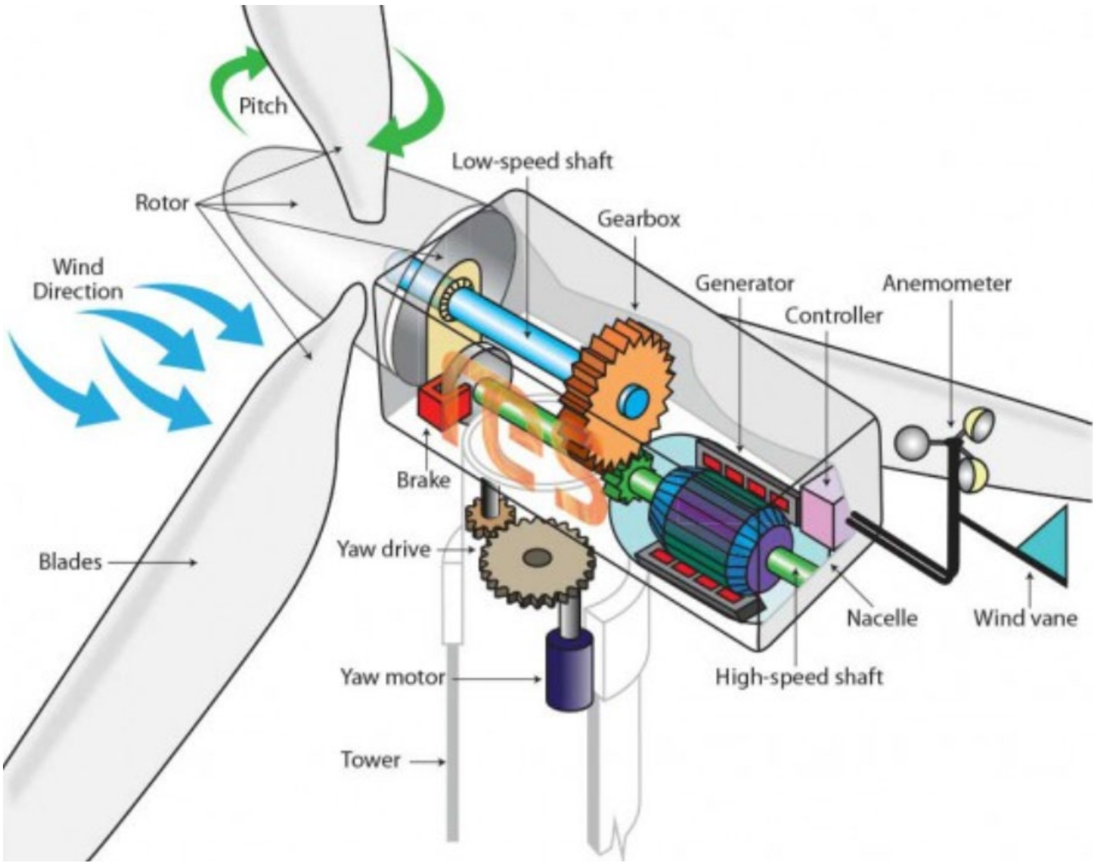

Figure 5.4 Simplified diagram of nacelle (*source: Vestas*)

Rotor

The rotor consists of a hub and three blades that are typically made of fibreglass and reinforced with an epoxy resin and carbon fibre (Figure 5.5). A control unit controls the speed of the rotor and the pitch of the blades (the angle of the blade to the wind), which is monitored remotely to ensure the safe and reliable operation of the wind turbine. Should the wind speed exceed the normal operating range of the wind turbine, the blades would ‘feather’ and adjust their pitch to stop the wind turbine rotating. Feathering is where the blades are stopped, with one blade positioned in line with the tower and the other two blades forming a ‘Y’ shape from the tower. This reduces wear on the wind turbine components.

The wind turbine rotor drives the generator within the nacelle, producing electrical output. In general, the larger the rotor, the greater the generation capacity.

The blades typically rotate about 4 revolutions per minute at low wind speeds and up to 12 revolutions per minute at higher wind speeds.

The project is designed to include wind turbine rotors of up to 190 metres in diameter with an individual swept area of 28,353 square metres. However, it is possible that smaller rotors would be used depending on the specifications of wind turbines on the market at the time of construction and their suitability to the project.

The project has conservatively assessed blade lengths of 93 metres in a single piece. This is about 10 metres longer than blades currently in production, however, longer blades can be expected in the future as wind turbine technology develops further.

An example of a blade, like what is proposed, being transported on a wind farm site is shown in Figure 5.6.

Figure 5.5
A blade being lifted onto a wind turbine

Figure 5.6
Example wind turbine blade being transported

Transformer

The transformer may be in either the nacelle, within the base of the tower, or next to the base of the tower on a concrete pad.

Provision would be made in the design for containment of any oil that may leak or spill from the transformers. If placed on the hardstand area this would typically be achieved via a concrete bund.

5.2.2 Access tracks and site access from public roads

A total of twelve site access points from public roads would be established to bring project components onto site (Figure 5.7), all of which would remain in place for the life of the project. One of these access points would be from the Woolsthorpe-Heywood Road, three from the Tarrone North Road, three from Riordans Road, one from Macgraths Road and one from Old Dunmore Road. There are also three crossing points of Landers Lane. Designated access points would be confirmed in the Traffic Management Plan and would be designed and constructed in accordance with VicRoads *Type B – 'Truck Access to Rural Property'* as shown in the project map book (Attachment III).

The Woolsthorpe-Heywood Road is managed by Regional Roads Victoria (as a Class C arterial road), while the others are local roads managed by the Moyne Shire Council. Access points would be established at various times during construction to allow the wind turbine components to be brought onto the site. All site access points would be gated and have wash down facilities or rumble grids in some instances.

Details of when and how access points and associated public roads would be used during construction, operation and decommissioning phases would be included in the project's Traffic Management Plan, which would form part of the Environmental Management Plan. Further detail on the proposed Traffic Management Plan is provided in Chapter 15 – *Traffic and transport*.

Around 60 kilometres of internal access tracks would be needed to provide access to each individual wind turbine and other infrastructure associated with the project. Access tracks would connect all the project infrastructure and provide access for construction and maintenance vehicles, as well as emergency vehicles, and may also be used by landowners for their farm operations.

Access tracks would generally have a final width of six metres, or up to 10 metres at corners. The construction footprint for access tracks would be 12 metres wide. Four staging areas of up to 320 metres in length would be constructed next to the access tracks, thereby doubling the width in those locations. Several passing lanes would also be needed throughout the site. These would have a length of up to 25 metres.

The access tracks would be built to a standard which enables all weather access to the wind turbines and would satisfy the requirements of the CFA Guidelines (*Design Guidelines and Model Requirements for Renewable Energy Installations*, 2022). The CFA Guidelines contain several provisions to enable access for fire vehicles, including minimum width, maximum grade and number of access points.

The indicative layout of the access tracks is shown in Figure 5.7. The access tracks may be subject to micro-siting within the construction footprint that has been assessed as part of the EES. Ecological and cultural heritage surveys assessed a 40-metre-wide corridor for tracks and cables.

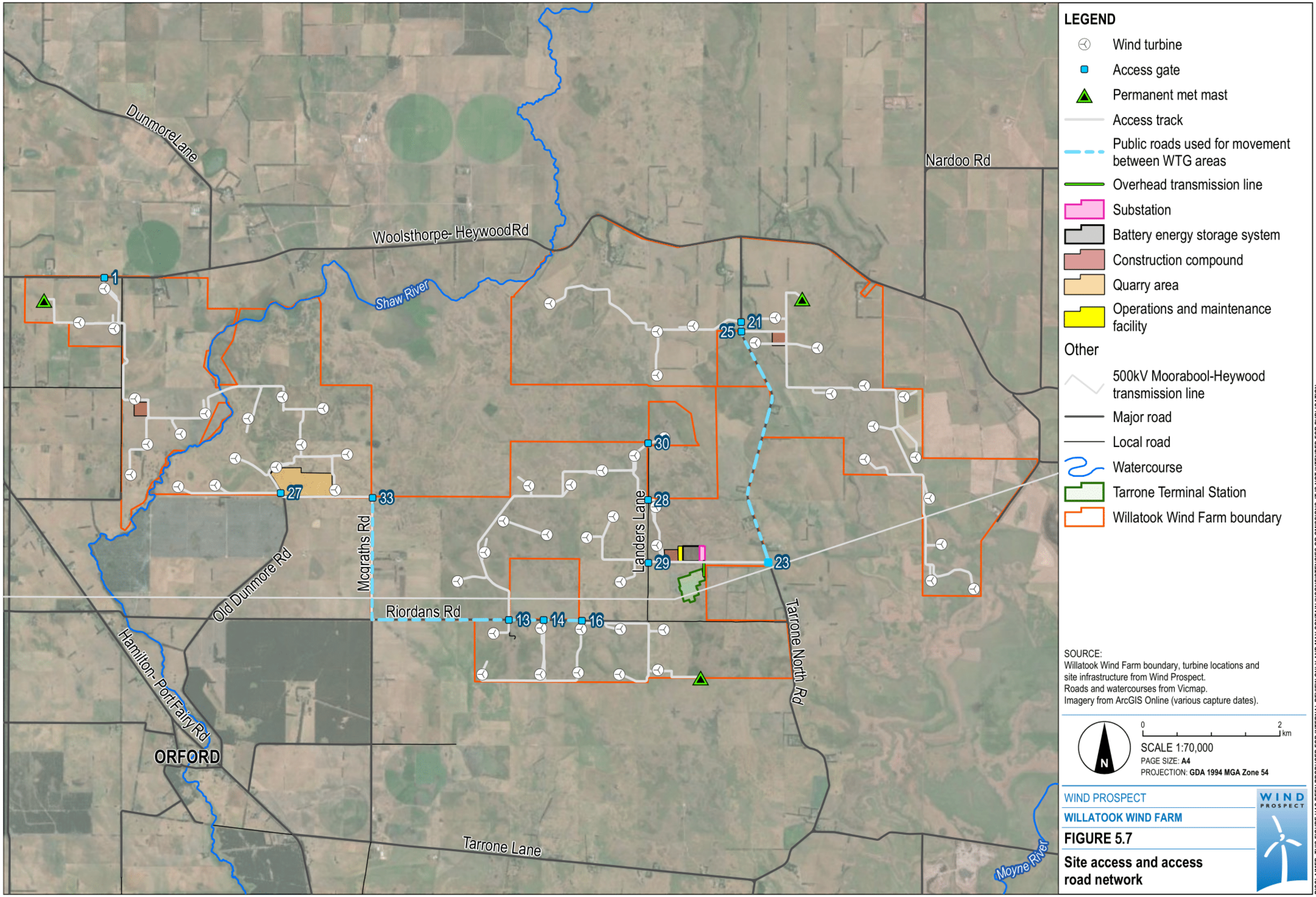

FIGURE 5.7
Site access and access road network

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5.2.3 Electrical reticulation and distribution

Underground 33 kilovolt cable and fibre optic network

Electricity produced by each wind turbine would be transformed from low voltage to medium voltage (nominally 33 kilovolts) by a transformer within or next to each wind turbine. The electrical network would comprise 33 kilovolt circuits (called strings) between the wind turbines and the on-site substation.

It is proposed that the internal electrical network between the wind turbines and the substation would be an underground distribution network (i.e., buried cables). It is estimated that this would entail 62 kilometres of trenches with insulated copper or aluminium electrical cables installed. The cable trenches would have a width of up to one metre within a work area width of about seven metres for the excavator to operate and for stockpiling of soil. The trenches would either be next to the access tracks or directly across open paddocks, with a depth of about one metre, unless this is not practical due to the presence of rock, in which case the cables would be installed in cable ducts. There are two locations where cables are proposed to be attached to newly constructed bridges over the Shaw River and Back Creek to avoid additional ground disturbance at these locations. Fibre optic cable would be laid alongside the power cable, with a bare copper earth cable being laid at the bottom of the trench.

Trenches would be covered with the removed soil and rehabilitated shortly after the cable laying is completed.

The proposed design of the internal electrical network is shown above in Figure 5.1 and Attachment III – *Project map book*.

Overhead cable

An overhead transmission line of up to 300 metres would be needed to connect the on-site substation to the Tarrone Terminal Station. The project will include works on the Tarrone Terminal Station land associated with the connection. The transmission voltage is expected to be 132 kilovolts (although 220 kilovolts is an alternative option) with the overhead dual circuit transmission line consisting of a single pole line (i.e., single poles up to 26 metres high, with conductor circuits on each side).

On-site substation

A single on-site substation would be needed for the project to receive electricity generated by the wind turbines and to increase the voltage to 132 kilovolts to enable connection to the grid. The on-site substation would be on a parcel of land north of the existing Tarrone Terminal Station, which would enable a simple integration into the terminal station and then the electricity network via the short span of overhead transmission line.

The on-site substation would be a single yard with a footprint of up to 70 metres by 220 metres and include infrastructure with a height of up to eight metres (excluding the poles for the overhead transmission line). The on-site substation would consist of a series of electrical transformers, switchgear, circuit breakers, a control room and switch room, amenity facilities, including a toilet, and fire services. A security fence of up to 2.4 metres high would be installed around the perimeter of the on-site substation, battery system (Section 5.2.4) and operations and maintenance facility (Section 5.2.5). The whole area would be accessed via locked gates. The exact fence and gate specifications and their location would be agreed with Energy Safe Victoria during the pre-construction stage and be compliant with relevant legislation. A typical substation with control room and amenities is shown in Figure 5.8 with concept designs for the project shown in the project map book (Attachment III).

Reduced sound power levels would be adopted for the substation transformer where required to achieve the relevant noise criteria and the general environmental duty. Refer to Chapter 13 – *Noise and vibration* for information regarding ancillary equipment noise.

Areas within the on-site substation would be covered partly with a layer of crushed rock and partly by concrete slabs. The transformers within the on-site substation would be bunded to contain any spills, and fire barrier walls would be installed to protect workers and the community from any incidents. These measures are standard for all transformers within electrical substations in Australia and are governed by strict standards.

Figure 5.8
Example of wind farm substation and operations and maintenance facility

Synchronous condenser

A synchronous condenser, which is a machine that can help stabilise the electricity grid during imbalances in supply and demand, is provided for in the design to provide grid strengthening capabilities. Synchronous condensers regulate voltage by either generating or absorbing reactive power as needed to adjust the grid's voltage, or to improve the reliability of electricity supplied to network customers.

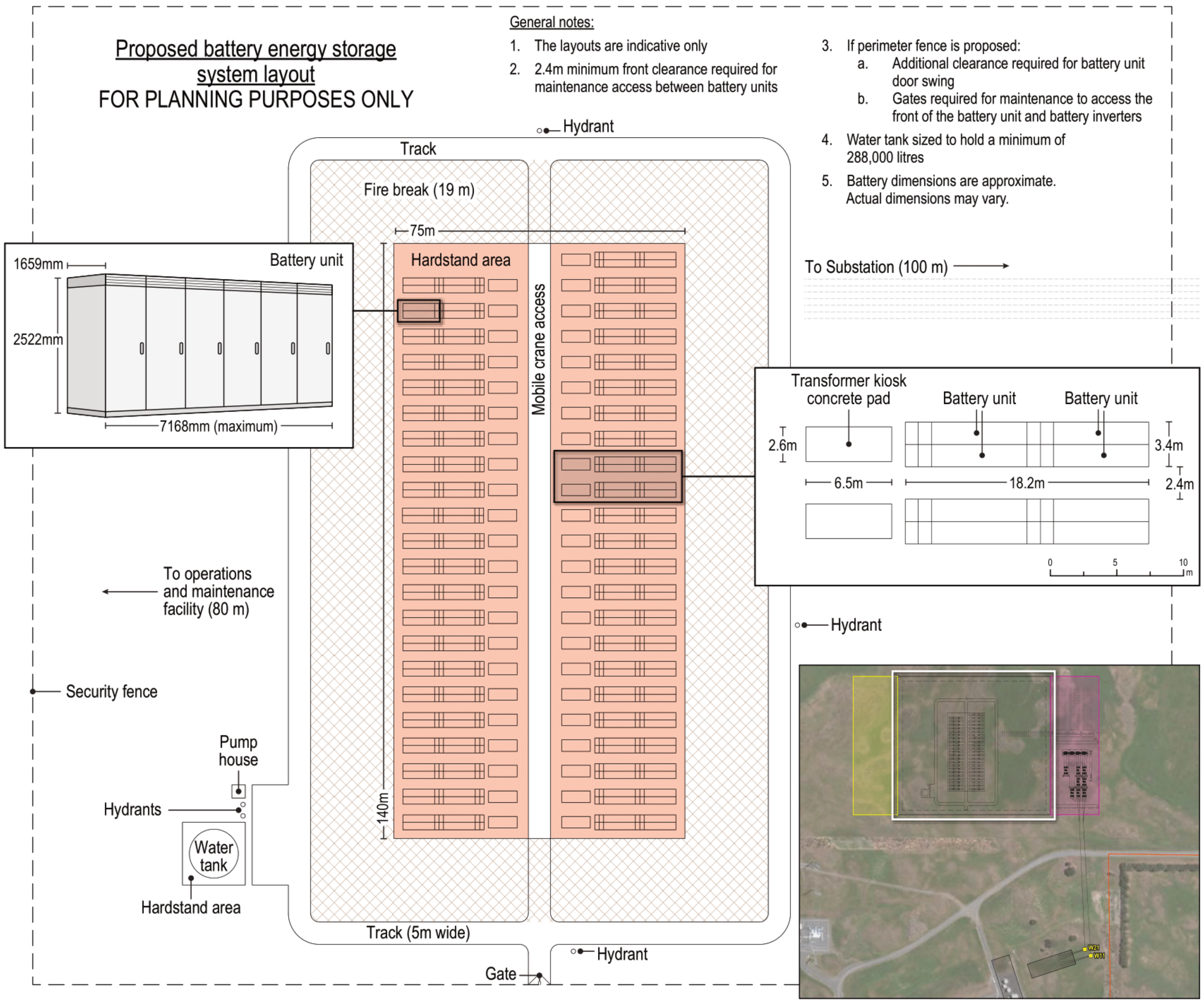
A synchronous condenser may or may not be required and therefore would need further investigation before construction. A synchronous condenser could be expected to have a nameplate capacity of around 30 megavolt amperes and a footprint of about 15 metres by 20 metres, although the actual capacity and footprint would be determined later in consultation with the Australian Energy Market Operator and AusNet Services, when grid connection requirements are more certain. The synchronous condenser would be located next to the battery and on-site substation, if required. A typical synchronous condenser is shown in Figure 5.9.

Figure 5.9
Example synchronous condenser
(*source: ABB*)

5.2.4 Battery energy storage system

A battery energy storage system would be built immediately to the west of the on-site substation. The battery system would have a nominal capacity of up to 200 megawatts/400 megawatt hours and would include the battery units, inverters, transformers, ventilation/cooling systems, and fire protection system. Further information about fire management is included in Chapter 16 – *Land use and planning*.

The battery system would consist of a series of modular batteries with transformers, inverter, high voltage alternating current (heating, ventilation and air conditioning) coolers and other electrical plant. The battery system would be built within an area of 5.5 hectares (nominally 320 metres by 220 metres), as indicatively shown on Figure 5.1 with a concept design shown in Figure 5.10.



LEGEND

- Battery layout design
- Battery area
- Fire break (19 m)

SOURCE:
Willatook Wind Farm boundary and battery infrastructure from Wind Prospect.
Imagery from ArcGIS Online (various capture dates).

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PROJECTION: **GDA 1994 MGA Zone 54**

WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 5.10

Battery energy storage system

WIND PROSPECT

DATE: 21.04.22 PROJECT: 754-MELEN287657 FILE: 287657_01_FXXX_GIS DOC REFERENCE: 287657_01_FIGS_E.APRX_V02 AI FILE: 287657_02_GRA006_V02

How do large-scale batteries work?

Batteries store electrical energy in chemical form. There are a range of battery technologies that enable large-scale energy storage such as lithium-ion and zinc-hybrid.

Large-scale batteries typically consist of several components: a battery unit or module, an inverter (to convert electricity from direct current to alternating current and vice versa), and a transformer (to transform the electricity to a different voltage). Each battery module is usually individually controlled with its own monitoring and fire suppression system.

Large-scale batteries can store electricity when there is an over-supply or during periods of low demand within the National Electricity Market so that the electricity is available when demand is higher and/or supply decreases. They also stabilise the grid during frequency disruptions.

Large-scale batteries can immediately dispatch stored electricity when energy demand exceeds generation supply or when there is a temporary loss of supply. This can reduce the frequency of blackouts and the need for load shedding when there is a supply imbalance.

The proposed battery is located with suitable fire breaks, and static water supplies will be installed in strategic locations through the project area. Access tracks and project infrastructure are sited so emergency vehicles can easily enter and manoeuvre around the site. Further detailed plans will be prepared in collaboration with the Country Fire Authority (CFA) before construction and commissioning of the project and will be influenced by the outcomes of a detailed risk assessment that aligns with the CFA Guidelines.

An example energy storage system, albeit significantly smaller than proposed for the project, is shown in Figure 5.11.

Figure 5.11
Example 30-megawatt battery system at Ballarat, Victoria (*source: https://www.energy.vic.gov.au/batteries-and-energy-storage*)

5.2.5 Operations and maintenance facility

An operations and maintenance facility would be built next to the battery energy storage system. It would require an area of about 1.3 hectares (nominally 70 metres by 220 metres), and include an office, storage and maintenance facility housed on a concrete base, with adjoining car parking. The facility would be occupied during normal office hours and potentially outside these hours at times, while the wind farm and battery energy storage system would be monitored remotely 24 hours per day, 7 days per week. An example operations and maintenance facility is shown in Figure 5.12 and in the project map book (Attachment III).

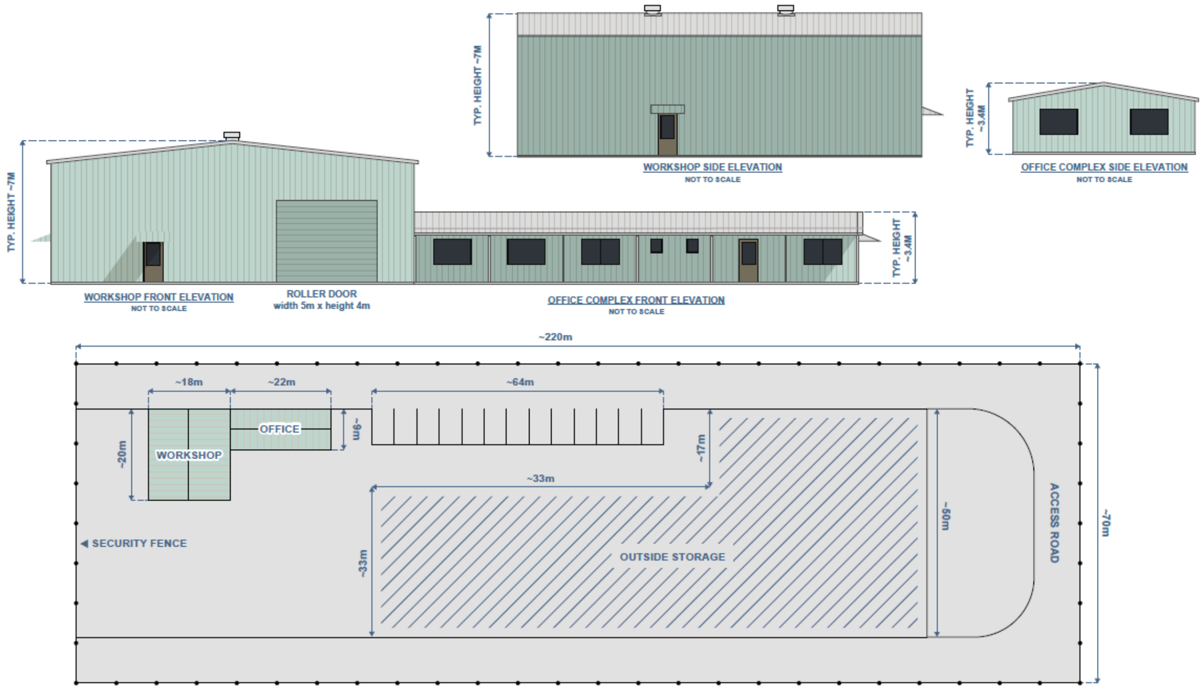

Figure 5.12 **Conceptual operations and maintenance site plan**

5.2.6 Meteorological monitoring masts

Up to three meteorological monitoring masts ('met masts') would be constructed around the edges of the project site and remain in operation for the life of the project. Each met mast would be a lattice tower, with a height equal to the wind turbine hub height (maximum height of 150 metres). Equipment installed on the met mast would include anemometers and wind vanes at various heights to record wind speed and direction, temperature and atmospheric pressure, and have prominent aviation markers to ensure visibility for any low flying aircraft, such as those used for crop spraying or firefighting. A single-lane access track roughly 3 metres wide would be constructed to provide access to each met mast. Figure 5.13 shows an example met mast and an associated equipment. A concept design is shown in the project map book (Attachment III).

Figure 5.13
Meteorological monitoring mast
(*source: ART Group*)

5.3 Temporary infrastructure components and layout

Several features of the project would be temporary, needed only during construction, and in some cases, during decommissioning. The on-site quarry and concrete batching plants would only be needed during the construction phase. The specific infrastructure requirements for the decommissioning phase (after 25 or more years post-construction) would be determined in the future but could include a new site compound and staging areas. Washdown facilities would be in use during construction and decommissioning phases.

The proposed locations of temporary infrastructure outlined below are shown in

Figure 5.14 and are shown in greater detail in the project map book (Attachment III).

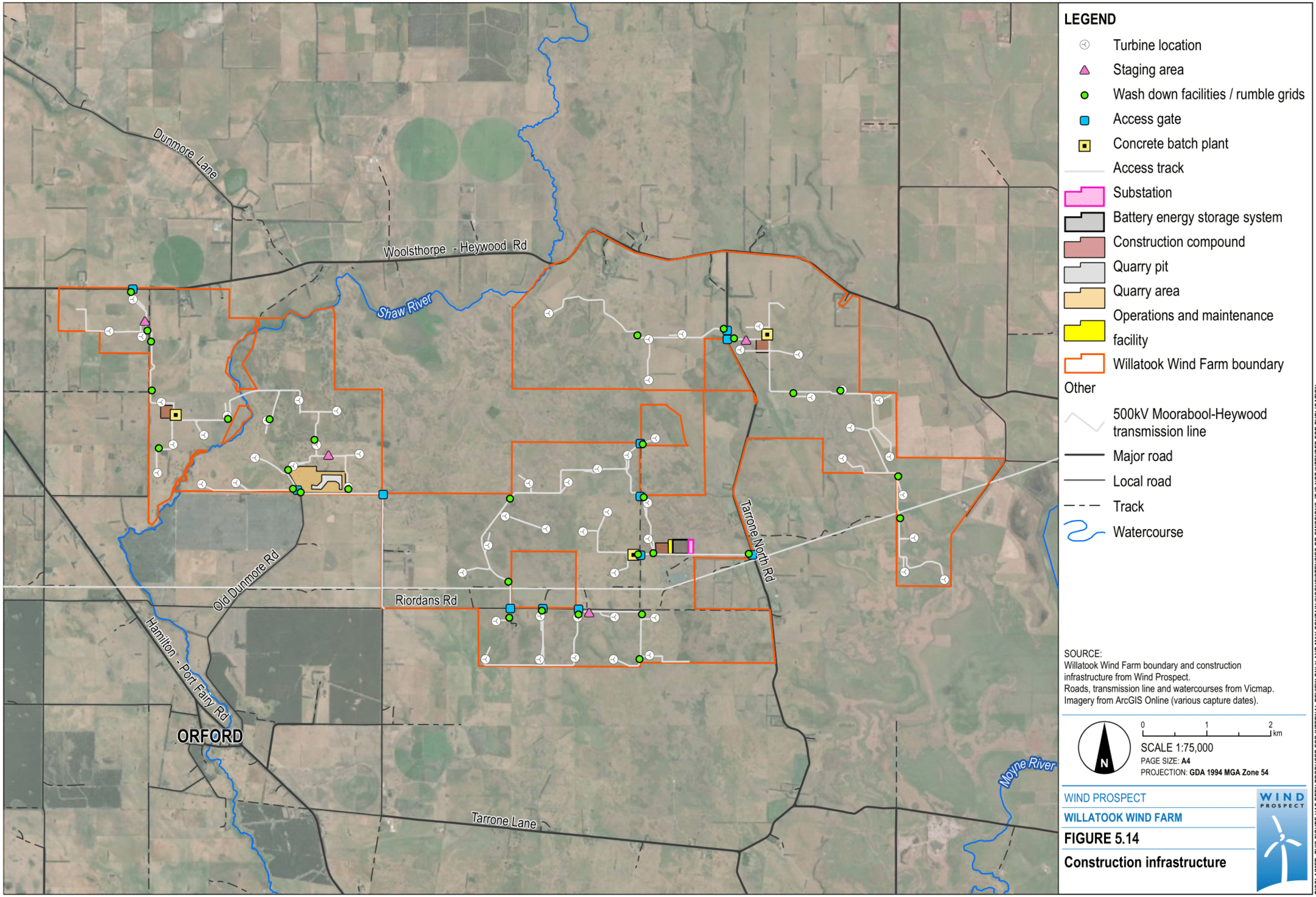

FIGURE 5.14

Construction infrastructure

DATE: 15.02.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F023_GIS DOC REFERENCE: 287657_02_FIGS_B.APRX_V01

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5.3.1 Quarry

The project includes the preferred option for a temporary on-site quarry. This would require a work authority (i.e., approval) from Earth Resources Regulation, a part of the Victorian Department of Jobs, Precincts and Regions. The quarry's environmental impact has been assessed in this EES.

The on-site quarry would provide basaltic rock for construction, including tracks, hardstands, and the temporary construction compound. Aggregate may also be used for wind turbine foundations if the rock is of suitable quality. The quarry would be located in the western part of the project site, east of Old Dunmore Road and about 4 kilometres to the north-east of Orford (refer to Figure 5.1). The proposed quarry location and design avoids community, environmental, hydrological, cultural, biodiversity and geo-morphological constraints, and has gone through several iterations after feedback from stakeholders.

The alternate option to supply aggregate material for the project is to source material from nearby commercial quarries including the Tarrone Quarry, if the temporary on-site quarry is not approved or the cost of developing it proves to be prohibitive. The Tarrone Quarry is around 3.5 kilometres south-east of the project site.

Quarry material

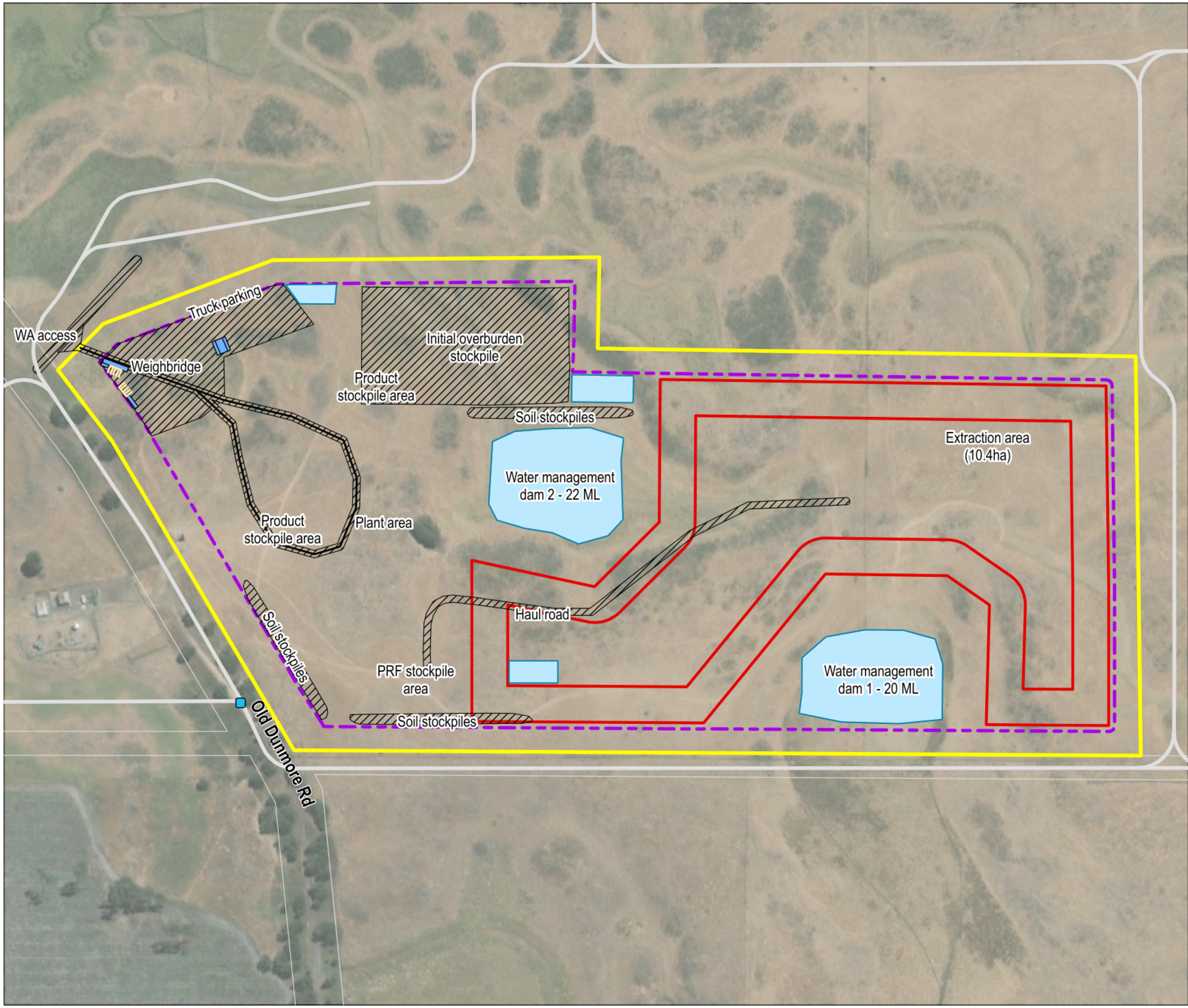
The project is estimated to need around 450,000 cubic metres of quarried aggregate. Around 185,000 cubic metres of aggregate would be needed for the access tracks (including access points, laydown areas and construction pads at each wind turbine), with a smaller quantity (about 50,000 cubic metres) needed for use in concrete. The material suitable for manufacturing concrete aggregates would need to be a higher quality and would be produced to a much tighter specification than used for the access tracks.

Work authority area

The proposed quarry work authority area is about 30 hectares, with the extraction area being 10.5 hectares with a maximum excavation depth of 14 metres below the current surface (see Figure 5.15). The total disturbance area for the quarry is estimated to be 24.7 hectares including 10 hectares of hardstand areas.

The quarry site was selected based on the quality and availability of the rock resource, ability to provide good access across the site, the limited environmental and cultural values, and minimal impacts to neighbouring dwellings due to their distance from the quarry site. Investigations indicate the site should yield sufficient quantity of suitable quality material to meet the needs of the project.

Once identified as the preferred location for the quarry, a geophysical survey was carried out followed by a program of targeted percussion drill holes to a depth of about 16 metres (Figure 5.16). Drill cuttings (chip samples) were collected at 1.8-metre intervals, then washed and logged to assess the quality of the resource. This program confirmed the site's suitability for the quarry.



LEGEND

- Access gate
- Access track
- Amenities
- Plant stockpile
- Amenities
- Dams
- Stockpile
- Extraction limit
- Disturbance area
- Work authority boundary
- Property

SOURCE:
Willatook Wind Farm boundary and quarry layout from Wind Prospect.
Property from Vicmap.
Imagery from ArcGIS Online (various capture dates).

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PROJECTION: **GDA 1994 MGA Zone 54**

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WIND PROSPECT
WILLATOOK WIND FARM
FIGURE 5.15
Quarry layout

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Figure 5.16
Photograph of the percussion drilling at the proposed quarry site

The quarry would consist of the following:

- access track
- extraction zone where blasting would occur
- office facility with toilets
- rock crushing facility
- stockpiling areas for topsoil, overburden and crushed rock
- car parking area
- water storage dams
- wheel washing area
- potable water storage.

Overburden refers to the earth (rock, soil, vegetation) that needs to be removed to access the materials to be mined.

The quarry site contains a viable resource in the order of two million tonnes of fresh to moderately weathered basalt. The quarry would be excavated across several low, elongate basalt rises and associated depressions.

The quarry would be established, and excavation would start, during the enabling works. It is expected the quarry would be in use for up to 24 months. After completion of the civil works, the quarry site would be rehabilitated according to the on-site quarry rehabilitation plan and in consultation with the landowner, Earth Resources Regulation and Moyne Shire Council.

Development and operation of the quarry is described further in Section 5.4.2 and in Attachment II – *Preliminary draft quarry work plan*.

5.3.2 Construction site office and compounds

A main temporary construction compound and site office would be established during the enabling works and would be located in the central part of the project site (see Figure 5.1). The compound would be a fenced area of about four hectares. The temporary construction compound would consist of:

- cleared construction lay down areas
- temporary site buildings (site offices)
- ablution facilities
- site parking for vehicles and mobile plant
- storage of machinery and construction materials.

The construction site office would be staffed during normal office hours and would include a sign-in/sign-out area for visitors to the project.

Two additional temporary construction compounds, nominally 200 metres by 200 metres, are planned on the east and western sides of the project site. These hardstand areas would be established for the storage of wind turbine components and other equipment.

5.3.3 Staging areas

Temporary staging areas are areas where components are placed on the ground in preparation for moving around the project site during construction. Their locations will depend on the detailed design and construction programming but would be selected to minimise the project footprint and to avoid environmental constraints and impacts.

Staging areas would be needed next to each wind turbine, construction compounds and access tracks for the storage and assembly of wind turbine components and equipment. The area allocated for hardstands and crane assembly areas would be used wherever possible to minimise the footprint and impacts, however in some instances dedicated staging areas would be needed.

5.3.4 Concrete batching plants

Three temporary concrete batching plants are proposed for the construction of the project and would be positioned to provide convenient access to all wind turbine locations. These plants are needed for the construction of wind turbine foundations and would also supply concrete for the construction of building foundations, the pad for the on-site substation and other project infrastructure. Each concrete batching plant would have a footprint of about 50 metres by 100 metres and would contain the concrete batching equipment, stockpiled materials, a cement silo, water tanks, a slump stand, washout facility and bunding for the containment of water runoff.

5.3.5 Washdown facilities

Washdown facilities or in some instances rumble grids would be installed at all access points from public roads and at crossing points between neighbouring properties. Each washdown facility would consist of a bunded area capable of retaining all excess water runoff as a result of any wash down activity.

5.4 Project phases

Subject to receiving all planning and environmental approvals, permits and consents, the construction of the project is estimated to take around two years. Assuming approvals are obtained in early 2023, grid connection agreements would be secured, and detailed design and pre-construction activities would start in early 2023, along with financing and other commercial activities. The earliest construction is likely to start is about mid-2024, with commissioning of the project in mid-2026. To provide for potential delays that could feasibly be caused by grid connection and market-related issues, a planning permit is sought for five years from the time of issue of a planning permit to the time of substantial start of construction.

The project consists of four discrete phases: pre-construction, construction, operation and decommissioning. These phases and associated activities are outlined in Table 5.2, and further discussed in the following sections.

Table 5.2 Overview of project phases

Project phase (and timeframe)	Project activities
Pre-construction (12–18 months)	• Grid connection application made, and approval received • Geotechnical assessment • Tendering for wind turbine supply and construction, and balance of plant civil works • Discharge of planning conditions, including preparation of the Environmental Management Plan, Construction Method Statement and Traffic Management Plan, with production of other mitigation plans, as required • Financing and other commercial activities.

Project phase (and timeframe)	Project activities
Construction (2 years)	• Enabling works, including project-specific local road upgrades, construction of site access points, temporary construction compounds and on-site quarry • Construction of access tracks and wind turbine hardstands • Construction of wind turbine foundations • Installation of underground cabling, on-site substation and battery • Testing and commissioning of the wind farm • Maintenance of local road network in consultation with Regional Roads Victoria and Moyne Shire Council in accordance with the Traffic Management Plan • Removal of all temporary infrastructure from the project site, including the on-site quarry infrastructure and construction compound • Rehabilitation of the on-site quarry area and the wider project site.
Operations (25–30 years)	• Commencement of electricity export • Operation and maintenance of the project.
Decommissioning and rehabilitation (6-12 months)	• Removal of wind turbines and all other above ground equipment and infrastructure • Restoration of the project site in accordance with the Decommissioning Plan and in consultation with the relevant landowners, Earth Resources Regulation and Moyne Shire.

5.4.1 Pre-construction

Before project construction starts, a range of pre-construction activities would be completed as detailed in the following section.

Geotechnical investigations

During the pre-construction phase, a geophysical investigation would be conducted to determine ground conditions at each wind turbine location, along access tracks, at the construction compounds, on-site substation and battery facility locations. This work would inform the detailed wind turbine foundation design, as well as identify any micro-siting requirements for all project infrastructure. Geotechnical surveys may consist of:

- visual inspections
- machine and hand excavated trial pits
- sample boreholes
- rotary core boreholes
- thermal and earth resistivity tests
- sampling and laboratory based geotechnical and geochemical testing.

Construction Method Statement

The Construction Method Statement would outline construction principles, construction program, and health and safety requirements for the project, and contain several specific procedures according to the activity being carried out.

Parts of the Construction Method Statement that relate to specific construction activities would identify reference documentation for that activity, including the Environmental Management Plan and any relevant individual management plans, legislation and construction drawings and documents. For each construction activity, the Construction Method Statement would detail the environmental sensitivities relating to the activity and the control and mitigation measures established. Any additional approvals or consents required to complete the activity would also be described. The Construction Method Statement would be prepared in consultation with stakeholders relevant to the works covered in the statement, including the relevant landowner or manager, responsible authorities where required in relation to issues within their jurisdiction, emergency services, and as required by any relevant environmental management measure.

Management plans

Detailed management plans would be prepared before construction commences in consultation with the Responsible Authority and relevant environmental regulators. Some plans would require approval and endorsement by the Responsible Authority under the planning permit. The following plans would be prepared during the pre-construction phase.

Environmental Management Plan

An Environmental Management Plan would be prepared to reflect conditions of the planning permit and the Environmental Management Framework, as endorsed by the Minister, before construction starts (see Chapter 26 – *Environmental management framework*). The Environmental Management Plan would consolidate all environmental management measures that relate to the project and provides details of how they should be performed. The plan would include the measures set out in this EES (see Chapter 26 – *Environmental management framework*), and relevant planning permit conditions (should the project be approved). It would also include measures derived from recommendations set out in the EES Inquiry and Panel Report and the EES Minister's Assessment. The Environmental Management Plan (including sub-plans) would be a key document when preparing detailed designs, and is the main document used when undertaking planning and environmental compliance audits.

The Environmental Management Plan would remain a live document throughout the project pre-construction and construction phases. Some provisions may also apply during the operational phase. The Environmental Management Plan would be updated after the detailed design and pre-construction ecological surveys, and to reflect any changes in legislation, where relevant. All appropriate mitigation and management strategies would be consolidated in the Environmental Management Plan, which would clearly outline what should be done and who has the responsibility for doing it.

The Environmental Management Plan would also apply to the decommissioning phase, acknowledging that decommissioning would occur at least 25 years later and may need significant amendments by that time due to changes in legislation and exiting social and environmental conditions.

As part of the Environmental Management Plan, a Construction Environmental Management Plan would be developed and cover a range of aspects relating to construction including (but not limited to):

- construction noise and vibration
- blasting
- sediment and erosion control
- air quality
- native vegetation, flora and fauna (including bats and avifauna)
- hazardous substances.

Other management plans

A range of other management plans would be prepared in accordance with a planning permit (should one be granted). These would include:

- noise and vibration management plan
- cultural heritage management plan
- traffic management plan
- water management plan
- bushfire management plan
- emergency management plan.

These and a range of other proposed management plans are detailed relevant assessment chapters (Chapters 8–23) and Chapter 26 – *Environmental management framework*. Further information about bushfire management is included in Chapter 16 – *Land use and planning*.

5.4.2 Construction

Construction of the project is anticipated to take around two years. The anticipated timing of the key project construction milestones in presented in Figure 5.17.

Public road upgrades would start after completion of the detailed engineering design. Key site establishment activities would include:

- establishing the on-site quarry to supply crushed rock
- delivery of key plant and construction vehicles
- construction of the initial access tracks needed for the delivery of materials and goods for construction
- establishment of temporary concrete batching plants and temporary construction offices.

The next phase of work would be civil construction works, which would include the construction of:

- the balance of internal access tracks
- wind turbine hardstand areas and footings
- underground cables
- on-site substation and battery facilities.

The final construction activities would involve wind turbine delivery, installation, demobilisation of key plant and rehabilitation of temporary construction areas and commissioning. Significant overlap between activities would occur, with site preparation and civil works, and wind turbine delivery and installation being completed on a rolling basis.

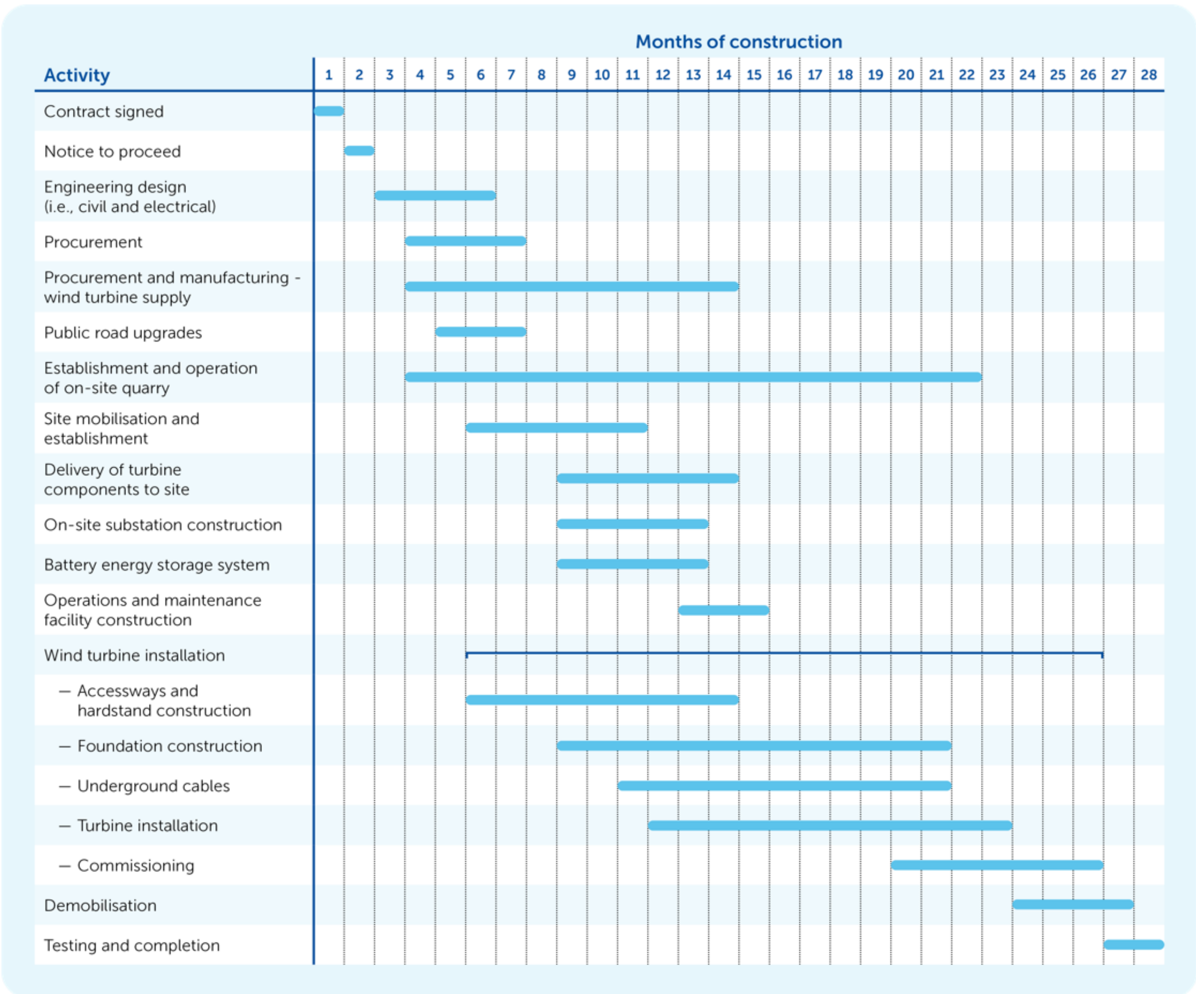


Figure 5.17 Approximate construction timeline

Construction hours of operation

EPA Victoria Publication 1834: *Civil construction, building and demolition guide* supports the civil construction, building and demolition industries to eliminate or reduce the risk of harm to human health and the environment through good environmental practice. The guideline includes the working hours that should be applied to various activities. The project would be constructed in accordance with this guideline, with construction generally being carried out during the specified normal working hours:

- Monday to Friday, 7 am to 6 pm
- Saturday, 7 am to 1 pm.

Work outside these normal hours may be required for some activities including:

- wind turbine installation, which is weather dependent
- concrete pouring, which may need to be completed during a fixed period and/or within specific temperature conditions
- transport of over-sized equipment, such as the wind turbine tower sections and blades, which is sometimes performed during lighter traffic periods (e.g., at night).

A suitably qualified and independent Health, Safety, and Environment (HSE) professional would be appointed to pre-approve unavoidable night work activities (occurring between 10:00 pm and 7:00 am). The project's Construction Noise Management Plan would outline how activities are controlled and managed outside normal hours (see Chapter 13 – *Noise and vibration*).

Construction workforce

It is anticipated up to 180 direct and 290 indirect full time equivalent jobs would be created during construction, based on estimates in Appendix I – *Economic and social*. It is predicted that most of the construction workforce would be accommodated in the surrounding towns of Warrnambool, Port Fairy and Koroit.

Transport route

The wind turbine towers would be manufactured in sections and transported to the project site for installation. The tower sections, along with the wind turbine blades and other large project infrastructure, require specially planned transport routes.

The proposed over-dimensional route starts at Portland and ends at the various project site access gates after travelling along the Woolsthorpe-Heywood Road from the west, as described in Chapter 15 – *Traffic and transport* and detailed in Appendix G – *Traffic and transport*.

Five intersections along this route would need some roadside infill works, potential roadside furniture removal and traffic management works. These intersections are:

- Henty Highway/New Street, Portland
- Princes Highway/Henty Highway, Portland
- Princes Highway/Tyrendarra-Ettrick Road, Tyrendarra
- Tyrendarra-Ettrick Road/Woolsthorpe-Heywood Road, Homerton
- Woolsthorpe-Heywood Road/Hamilton-Port Fairy Road, Broadwater.

A swept path assessment was completed as part of the traffic and transport assessment and potential for native vegetation clearance associated with intersection works was assessed as part of the flora and fauna impact assessment (Appendix D). The proposed works would be finalised in consultation with the haulage contractor, Regional Roads Victoria and Moyne Shire Council. A Traffic Management Plan would be developed before the start of construction to document the detailed requirements for safe transport of equipment and materials for the project with minimal disruption.

Other material that would be brought to the project site and the associated traffic impacts are described in Chapter 15 – *Traffic and transport*.

Public road upgrades and site access

To facilitate the mobilisation of construction teams, equipment and project infrastructure to site, site access works would be needed at intersections along the over-dimensional access route and at project site access gates. Local road upgrades would also be needed in some locations. Improvements to local roads would be completed as required in consultation with Regional Roads Victoria and Moyne Shire Council to ensure safe and efficient traffic movements (including that of the public).

Site access works required for the project would include:

- trimming some trees and shrubs at intersection upgrade locations and along some road sections to allow transport of over-dimensional project components
- intersection upgrades along the over-dimensional route and the local road network to enable safe access to the project site
- upgrades of local roads to accommodate over-dimensional vehicles and heavy vehicles and to allow safe turning into the project site by all vehicles, as needed
- construction of access gates from local roads onto private property.

Upgrades have been identified based on a theoretical maximum wind turbine blade length of 93 metres and a maximum tower base width of between 5 and 6 metres.

Internal access tracks

Around 60 kilometres of internal access tracks would be needed for construction and would be left in place and maintained during project operation. Access tracks would be developed on private property, maximising the use of existing farm tracks, or positioned next to existing fence lines where this is preferred by the relevant landowner. A number of access tracks would cross unnamed government roads known as 'paper roads', which are Crown land.

Internal access tracks would be established using heavy earthwork machinery to excavate these areas to a depth determined under the relevant standards, before laying a compacted gravel. Sediment and erosion control measures would be established during civil construction works.

Internal access tracks would have a pavement width of about 6 metres, in addition to an adjacent shoulder drain (see Figure 5.18). The road base would be crushed rock aggregate sourced from the project's on-site quarry or an existing commercial quarry. Rock excavated from wind turbine foundations and other infrastructure areas would also be used for the subgrade road base subject to meeting the relevant functional specification. Access tracks would be constructed to enable water to shed directly to table drains to avoid scouring, with drainage culverts built at determined flow paths informed by hydrological modelling.

Based on observations of construction of the Macarthur and Dundonnell wind farms, it is predicted there would be areas of similar stony rise geology with shallow soils interspersed with depressions with deeper soils. There are likely to be areas where excavated areas would need to be plugged with boulders and rock excavated from turbine foundations. The thickness of pavement and the degree to which 'plugging' is needed would depend on the condition of the subgrade; the surface upon which the access tracks would be laid. It has been assumed there is an average track pavement of 300 millimetres across the project. In shallow rock areas a thinner pavement (~150 millimetres) is expected, however, thicker pavements would be expected where subgrade replacement is needed or where subgrade is less competent.

The access tracks would be built to a standard that enables all weather access to the wind turbines and would satisfy the requirements of the Country Fire Authority (2022) *Design Guidelines and Model Requirements for Renewable Energy Installations*. The Country Fire Authority guidelines contain several provisions to enable access for fire vehicles, including minimum width, maximum grade and number of access points.

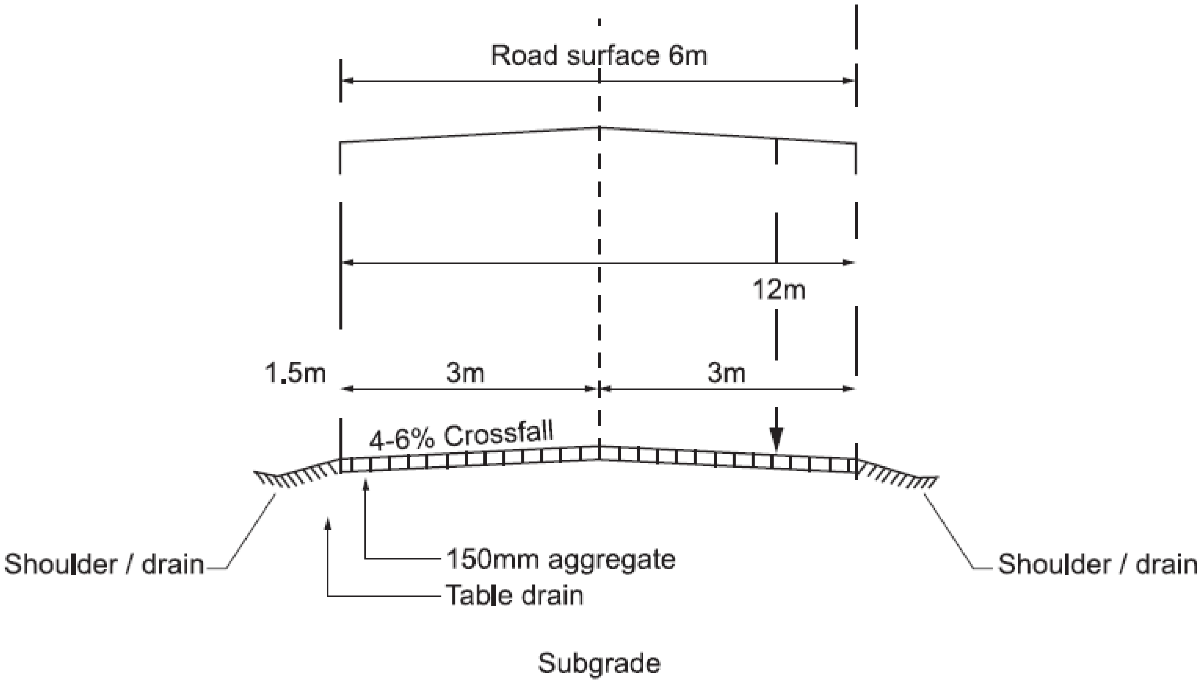


Figure 5.18 Internal access track cross section

Detailed civil engineering designs for the internal access tracks network would be prepared after the awarding of a contract to balance of plant contractor. The design would include:

- cut and fill batters and embankments to stabilise the roads
- drainage structures
- erosion and sediment control structures.

Access tracks cross the Shaw River, Back Creek and several tributary creeks or drainage lines. Although these have been minimised by appropriate siting of the access tracks, the proposed crossings are necessary to provide access to infrastructure and would prevent vehicles, including trucks from the quarry, being diverted onto public roads.

Culverts would be installed for crossing minor drains, with the access tracks being constructed over the culvert. Structures would be sized to accommodate the required design capacity, based on peak water velocity and depth estimates predicted by hydrological modelling (Appendix B – *Hydrology and hydrogeology*). The exact design specifications to maintain water flow at each drainage line would be determined as part of the detailed design during the pre-construction phase.

A typical culvert design is shown for illustrative purposes in Figure 5.20. A typical internal access track is shown in Figure 5.19.

Figure 5.19
Typical internal access track

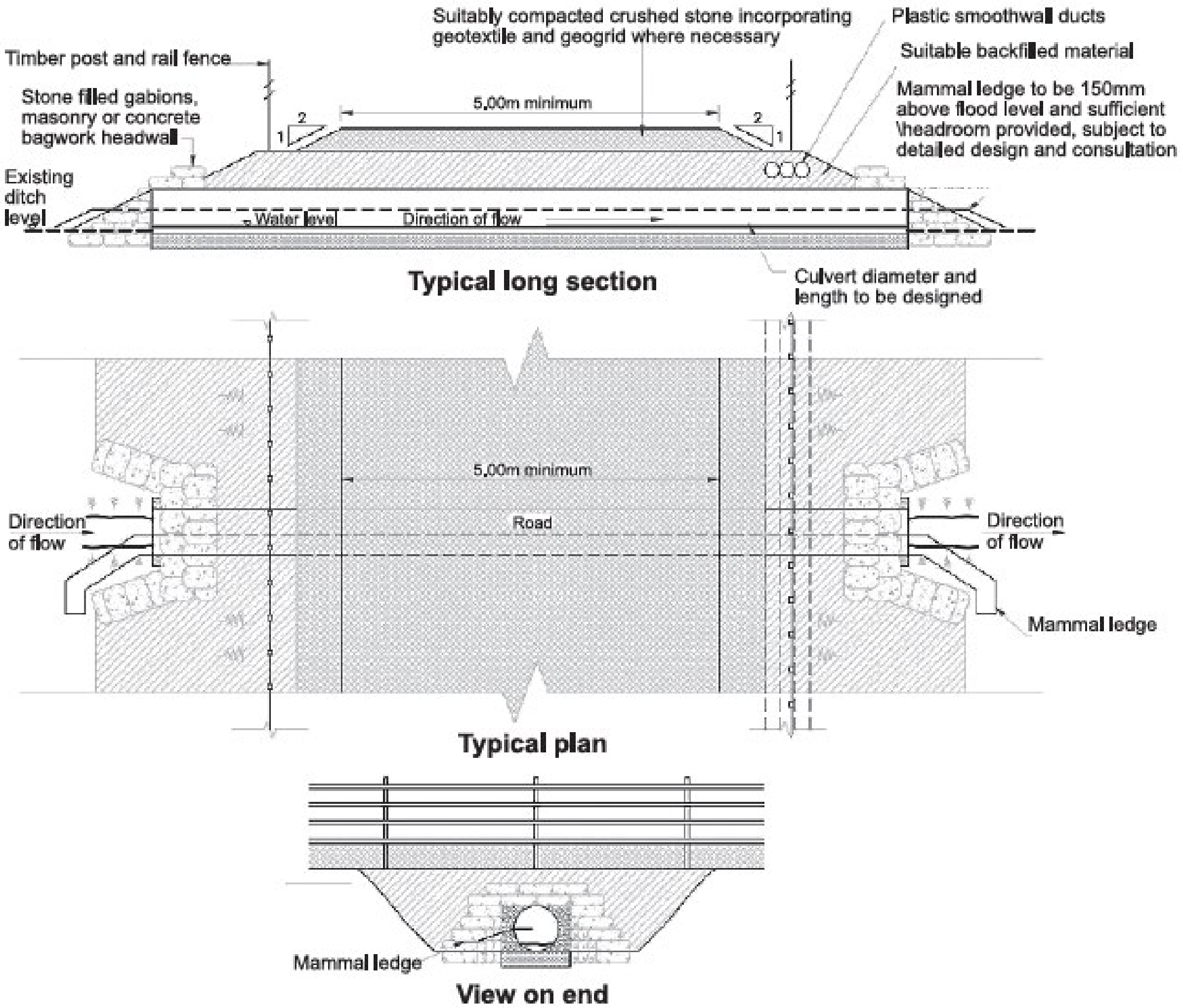


Figure 5.20 Typical culvert design

Conceptual designs have been developed by YYTTRUP Associates for the two main watercourse crossings one on Shaw River and the other on Back Creek (see Attachment III – *Project map book*). The construction footprint of the water crossings has been designed to avoid impacts to waterway flows and to protect the integrity of the waterway banks as much as possible. All waterway crossings designs would conform to relevant guidelines and be approved by Glenelg Hopkins Catchment Management Authority before the start of construction. Potential impacts to waterways and associated potential impacts to ecology are described in Chapter 10 – *Surface water* and Chapter 12 – *Biodiversity and habitat*.

The construction of water crossings would adhere to a project erosion and sediment control management plan, as well as the measures outlined in Chapter 26 – *Environmental management framework*, to enable the project to develop the necessary infrastructure in line with legislation, approval requirements and industry best practice.

Any works to cross waterways would be discussed with the landowners and relevant authorities. Permissions for waterway crossings, including permits for works on waterways from Glenelg Hopkins Catchment Management Authority, would be obtained before crossing works commence.

The location and design of waterway crossings may be influenced by the micro-siting of wind turbines post-EES lodgement. Final designs of waterway crossings would be refined during the detailed design when the balance of plant contractor is engaged, and the requirements of the crossing are better defined.

Wind turbine generator installation

As noted in Section 5.2.1, the wind turbine foundation type would be determined after detailed geotechnical surveys are completed. The foundation type would be either be gravity or rock anchor foundations. The excavated area needed for both types of foundation would be about 27 metres by 27 metres, potentially requiring low-level blasting where firm rock is encountered. Blasting would be carried out by qualified specialists subject to relevant statutory requirements being met.

Gravity foundations would involve the excavation of ground material to a depth of 3.5 metres or more. Steel reinforcement is installed, before concrete is poured into the excavated area in-situ and allowed to cure. See Figure 5.21 for construction methods of a typical gravity foundation for a wind turbine.

Figure 5.21 'Typical' gravity foundation for a wind turbine. Top left – excavated foundation area with base reinforcing steel; Top right – wind turbine plinth added with electrical cabling laid; Bottom left – foundation ready for concrete pour; Bottom right – foundation ready for first tower segment attachment

Rock anchor foundations involve drilling several holes deep into the rock at the base of the wind turbine. Steel rods are inserted and tensioned then connected to the base of the wind turbine.

Flood modelling has informed the siting of wind turbine locations. Inundation across the site is generally less than 300 millimetres in a 1% AEP event (i.e., about a 1 in 100-year event), with some localised areas exceeding one metre due to ponding and them being within the major flow paths. In areas where inundation is predicted, hardstands would be designed to ensure water flows away from wind turbine location. Hardstands would be slightly raised above surrounding ground level and, in several instances, foundations would be raised further to ensure floodwaters do not reach the base of the wind turbine.

The wind turbine components would be delivered to the project site progressively using oversize/over-mass truck and trailer combinations. Erection of wind turbines is generally a two-stage process, with the base and first two tower sections lifted into place (see Figure 5.22). This generally takes one day to complete.

Once this has been completed various minor works are carried out before the remaining tower sections, nacelle, generator, hub and blades are lifted into place (see Figure 5.23). This can take three days to complete depending on the weather conditions.

Figure 5.22
Wind turbine installation

Figure 5.23
Rotor and blades being installed on a wind turbine

Construction typically involves the use of a small auxiliary 200 tonne crane for vehicle offloading and preliminary assembly. A larger main-lift crane, with about 1,000 tonnes of lifting capacity, and a 100-tonne trailing crane would be used to erect the wind turbines once preliminary assembly has been completed.

Hardstands would be surfaced with pavement material to the required load-bearing specifications. A typical layout of a wind turbine hardstand area is shown in Figure 5.24.

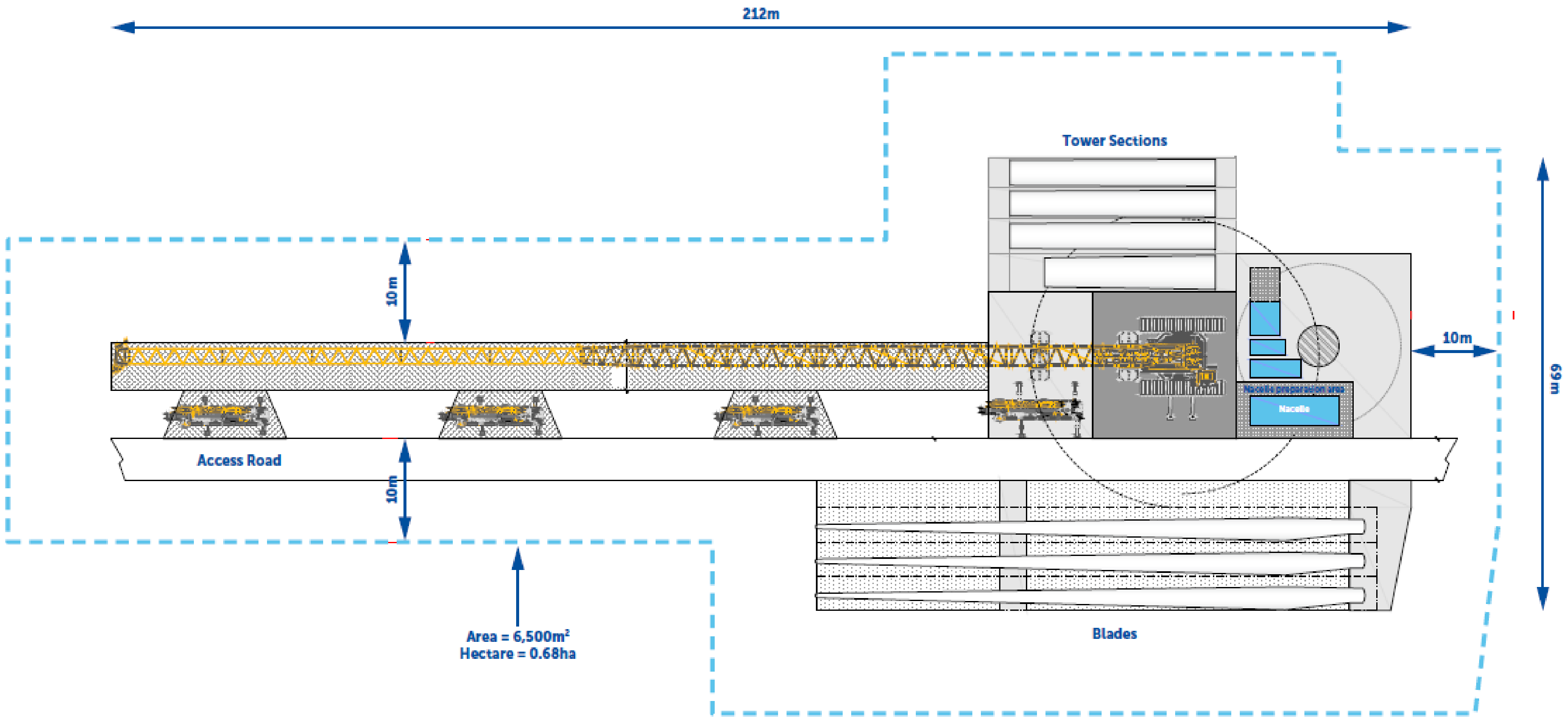


Figure 5.24 Wind turbine conceptual construction layout

Electrical cable reticulation

The project design provides for the undergrounding of electrical cabling wherever possible in response to feedback from stakeholders to minimise the visual impact, provide an important bushfire safety mitigation, and protect birds from accidental collisions.

Around 62 kilometres of trenches up to one metre below the surface would be dug to lay cables. The only exception for underground cables is at two watercourse crossings (Shaw River and Back Creek) where it is proposed that cables would be run along-side the bridge structures.

Several parallel cables would be needed in each trench, the number of which would be confirmed during detailed design. It is possible that some of the strings (i.e., groups of wind turbines connected via a single cable route) can be merged to result in fewer, larger cables, resulting in a smaller total cabling trench length. The proposed underground cable design can be found in Attachment III – *Project map book*.

A conceptual design of the underground cable reticulation is shown in Figure 5.25.

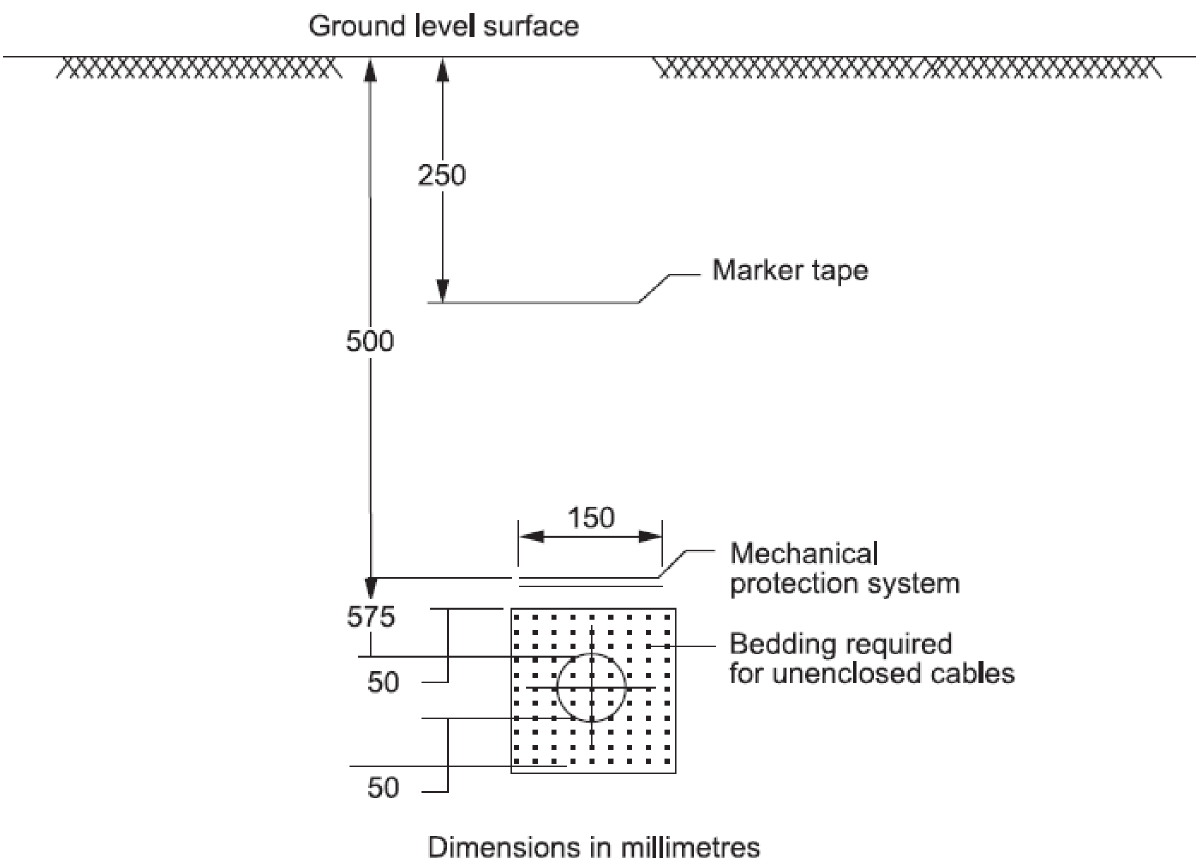


Figure 5.25 Indicative underground electrical cable layout

The process for the laying of underground cables involves creating a trench with excavated material stored next to the trench for subsequent backfilling. Trenching methods would depend on geotechnical conditions and would include either a trenching machine, using rocksaws or excavators, or in rare circumstances drill and blast techniques.

In soil areas, excavation would be via a trenching machine, which is a small vehicle on crawler tracks with a cutting or trenching boom (Figure 5.26). An excavator would be used to excavate a trench where soil and geotechnical conditions vary across short distances or where it is inappropriate to use a trenching machine. Drill and blast techniques may be used where high-strength rock (e.g., basalt) is encountered and where micro-siting of trenches around the high-strength rock is not possible. For this method, a series of holes is drilled along the cable route and small charges are exploded to break up the rock, which is then excavated using an excavator. Only qualified and authorised personnel would undertake blasting. No blasting would start without a permit from the site manager, and before all potentially affected parties have been notified.

Once a trench has been excavated, bundled cables would then be laid within a bed of protective sand and warning tape added to alert the presence of electrical cables at the required depth (see Figure 5.26). Trenches would then be backfilled and compacted with previously excavated material using a vibration plate compactor. On completion, the underground transmission lines may be marked with small marker posts.

It is estimated this trenching would cause a seven-metre-wide surface disturbance area during construction, which would be rehabilitated to be consistent with the surround landscape. In certain locations, to avoid disturbance to infrastructure and environmental values on the surface, horizontal directional drilling or directional boring may be used.

Figure 5.26
Example of wind farm cable trench laying (*source: Nexans Olex*)

Underground cables would cross several designated waterways, drainage lines, and public roads. There are a range of methods that would be used for these crossings. Proposed crossing methods for watercourses have been based on an assessment of the environmental, cultural heritage and technical constraints. Geotechnical conditions would influence the design of an appropriate crossing method, and these future investigations at specific sites would inform the final crossing method of each watercourse. All crossings of designated waterways would require a waterways licence from the Glenelg Hopkins Catchment Management Authority.

The three options for crossing watercourses, drainage lines and roads are:

- Open cut excavation: For this method, the trench is excavated through the feature, which involves excavating soil to form a trench, enabling new infrastructure to be laid, and then backfilled. This method is typically employed on minor watercourses and local roads. Where this method is used to cross a local road, one lane or a deviation is always kept open for emergency vehicle access. Where this method is used to cross watercourses, the water (when flowing) is diverted around the excavation to ensure stream flows are maintained.
- Directional boring: This method involves a small tunnel being drilled through soil enabling new infrastructure to be laid. Provided there are suitable geotechnical conditions, this method can limit disruption to the watercourse bed and banks. To enable a directional boring to occur, sumps are excavated either side of the feature. The boring machine is placed in one sump and then drills under the feature to the other sump.
- Aboveground conduits: It is proposed that cables would be run along-side the proposed bridges/culverts on Shaw River and Back Creek. These would be designed in accordance with electrical standards to ensure protection from debris and flooding.

Final designs of waterway crossings would be refined during detailed design when the balance of plant contractor is engaged, and the requirements of the crossing are better defined. Further detail about watercourse crossings is provided in Chapter 10 – *Surface water*.

On-site substation and battery energy storage system

The on-site substation and battery areas would be cleared and then excavated to the depth required. Reinforced concrete foundations would then be constructed to support electrical infrastructure and buildings. Infrastructure required within these yards would include transformers, switchgear, power conditioning equipment, energy storage technology, switch room, cabling and backup generators.

The on-site substation would be designed and constructed in accordance with relevant technical, electrical, and planning standards and in consultation with relevant stakeholders. On-site trafficked areas would be limited to the site entrance and surrounding the switch room and control building. The electrical compound areas would be finished with coarse gravel.

Temporary facilities

Temporary buildings and facilities would be needed for construction personnel and equipment. Within each temporary construction compound (three in total), a portable site office, amenities, general waste storage and parking bays would be established. Rock crushing and batching plant facilities and staging and storage areas for plant, equipment and wind turbine components would also be established. Arrangements would be made for power, potable water, and communications at the site office during the construction period.

Concrete batching plants would be developed and operated in accordance with EPA Victoria Publication 1806: *Reducing risk in the premixed concrete industry*. Figure 5.27 shows a typical batching plant. The concrete batching plants would be decommissioned and removed at the end of the construction phase, and the land would be rehabilitated and returned to the landowners.

Figure 5.27
Example concrete batching plant

On-site quarry

The quarry concept plan (Figure 5.15) shows the proposed extraction area, stockpiling areas, crushing plant location, access tracks, sedimentation basins, storage dams and tanks, and other elements. The following sections provide more detail on the quarry site establishment process, extraction and processing methods, stockpiling, water management, related infrastructure, and closure and rehabilitation process.

Site establishment

Site establishment is the first phase of quarry development and would involve the following steps:

1. Establish a basic site access track from Old Dunmore Road to the works area.
2. Install any infrastructure in the form of gates, additional fencing and signage as required by the Work Authority or permit conditions.
3. Mark out and fence any no-go areas and mark out infrastructure areas including extraction area, stockpiles and processing areas, as per the site layout plan.
4. Bring in basic equipment to establish site amenities, light and heavy vehicle parking areas.
5. Prepare a small hardstand area for heavy vehicle use, initial crushing plant location and refuelling.
6. Bring in the remaining heavy equipment, dozer, excavator, haul truck, drill rig and processing infrastructure (crusher, screens etc.).
7. Strip the initial blast area of topsoil and stockpiling in mounds, as per the site layout plan.
8. Strip the initial blast area of overburden and use this to construct any screening mounds and recharge dams, then stockpile excess overburden.
9. Establish the crushing plant configuration (and potentially start processing any rock collected from the initial earthworks).
10. Mark out, drill, load and fire the first shot.
11. Start feeding the processing plant, producing material for establishing the all-weather hardstand areas, then upgrading the site access track to an all-weather standard road.

Extraction and processing

The quarry would use traditional drill and blast practices, loading haul trucks with shot rock (i.e., rock produced from quarry blasting) using an excavator or front-end loader, and hauling to a mobile crusher.

Blasting would involve drilling into the rock in a specified pattern and placing explosives in the holes (see Figure 5.28). The explosives would then be detonated in a precise sequence, designed to maximise the efficiency of rock breakage while minimising noise, vibration and dust. An approved Blasting Management Plan that details all aspects of the design, initiation, type and quantity of explosive, exclusion zones and community notification would be carried out to ensure compliance with Dangerous Goods (Explosives) Regulations 2011 and Appendix 2 of *AS 2187.2-2006 Explosives – Storage and Use – Use of Explosives*.

A front-end loader or excavator would then be used to load haul trucks (nominally 35 tonne capacity) where the rock would be transported to the processing plant, which would consist of a mobile crusher with a capacity of about 150 tonnes per hour. Processing would include primary crushing (the first stage to break the rock into pieces) and secondary crushing (reduces the rock size even further) to produce the various products needed. Given the short life span of this quarry, it is expected the processing plant would consist of two mobile crushing and screening trains, which typically consist of a primary crushing unit, a secondary crushing unit and a control screen with stacking conveyor unit. Tertiary crushing and product blending may also be carried out to meet the more stringent specifications for concrete aggregate or road bases.

A front-end loader or excavator would be used to stockpile product (see Figure 5.29) from under the stacking conveyors, load delivery trucks for haulage to construction work sites, and for general house-keeping duties on the hardstand area.

All rock processing would take place within the quarry footprint.

Figure 5.28
Example drilling in preparation for blasting (*source: BCA*)

Figure 5.29
Example stockpiles of road base aggregate (*source: BCA*)

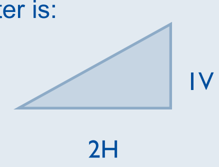
Quarry stockpiles

The location and layout of overburden and soil stockpiles within the quarry work authority area may change periodically, as this material would be used for rehabilitation as much as possible, however, there are some fundamental concepts adopted.

Around 40,000 cubic metres of topsoil would be stripped and stored on the site. The top 200 millimetres would be stored separately for later reuse during rehabilitation. Poor quality or clayey soils would be stockpiled separately. The maximum height of soil stockpiles would be limited to two metres. Soil stockpiles would be pushed up with a dozer, with the outer face profiled to a smooth 1V:2H batter (see info box). Appropriate erosion control measures would be carried out including revegetating with suitable fast-growing grasses. Soil stockpiles would be placed at the outer edge of the disturbance area, where they would be available for top dressing the area being rehabilitated.

Batter refers to the slope of a wall, earthwork or structure. Batter slopes are described in terms of ‘V’ (unit of vertical rise) and ‘H’ (unit of horizontal run).

A representation of a 1V:2H batter is:



Around 220,000 cubic metres of overburdened would be extracted from within the work authority area. Of this, about 100,000 cubic metres would initially be stockpiled before it can be used for rehabilitation carried out progressively throughout quarry operation and then post-operation. Overburden stockpiles would be a maximum of 8 metres in height. Overburden would be placed in worked-out areas of the excavation as much as possible. Overburden stockpiles would have 1V:2H side slopes with a contour drain at the base of the dump to direct any runoff into the site drainage control system and be contoured and vegetated with fast growing grasses.

Water management

Surface water management would include the use of swale drains, bunding, sediment traps and sumps. This would ensure surface water that comes into contact with disturbed areas is captured within water retention basins, and finally the quarry sump, within the work authority area.

Process water for use in dust suppression would be obtained from incident rainfall collection within the work authority area and would be supplemented by the groundwater extracted from the excavated quarry. Quarry water usage is anticipated to be around 15 megalitres per annum for dust suppression and for use in the processing plant.

Water collecting at the quarry sump (i.e., low point) would be pumped to a storage dam or tanks close to the processing plant. Estimates from hydrogeological modelling (see Appendix B – *Hydrology and hydrogeology*) indicate groundwater inflows are predicted to be around 77 cubic metres per day (under the base case scenario) once the quarry has reached its maximum size. It is proposed that two water dams would be established to capture water run-off from the quarry site and to contain water from quarry dewatering. Dam 1 on the southern boundary would be developed as part of the initial site development and be available for dewatering at the outset. Dam 2 would not be constructed until a substantial excavation has occurred and more reliable inflows can be assessed. Other contingencies for groundwater management on site include portioning a part of the excavation area for water retention once rehabilitation batters have been developed.

Dewatering refers to the removal of groundwater or surface water from an excavated area.

Work to date indicates the groundwater quality is ‘good’ and could be used for construction purposes (subject to approval from Southern Rural Water via an extraction licence) (Appendix B – *Hydrology and hydrogeology*).

Surface water management measures would be consistent with those developed for the project as a whole. Chapter 26 – *Environmental management framework* contains details about these measures and specific requirements for the quarry.

Other infrastructure

Portable site offices and amenities (lunchroom, toilets etc.) would be installed within the quarry work authority area. Designated parking spaces for employees and visitors would also be provided within this area. Due to the temporary nature of the quarry, no permanent structures are proposed to be constructed.

Fuel, oils and lubricants would be used and stored on-site. Diesel fuel would be stored in a self-bunded, above ground storage tank. Oils and lubricants would be stored appropriately in a suitable covered area in accordance with legislative requirements. All refuelling and minor servicing would be conducted on the hard stand area or the processing plant/stockpile area.

Closure and rehabilitation

At the completion of extractive operations all buildings, sheds, mobile equipment would be removed from the site.

After the extraction of all stone needed for the project, the quarry pit would be allowed to flood and level out with groundwater. The extraction crest would be fenced with a 1.2-metre-high stock fence to protect livestock entering the pit dam. This has been agreed with the landowner.

The excavation area would be backfilled to a 1V:4H slope to below the final water line. The land surrounding the quarry pit would be rehabilitated consistent with the surrounding landscape and able to be used by the landowner for their farming operations.

Further details of the quarry operations and design can be found in Attachment II – *Preliminary draft quarry work plan*.

Project resource requirements

Aggregate, sand and cement

Aggregate and sand would be needed to prepare the high-strength concrete to pour the wind turbine foundations. Aggregate would also be needed to dress the wind turbine sites, on-site substation and battery facilities, and to construct the base for access tracks and other hardstand areas. It has been assumed this would be to an average depth of 300 millimetres for access tracks and 400 millimetres for hardstands.

As noted in Section 5.3.1, the on-site quarry is the preferred option for the supply of aggregate to construct the access tracks. The use of an on-site quarry would reduce the number of truck movements on local roads. There is the opportunity to also source some or all the aggregate for wind turbine foundations, and substation, battery and site office concrete slabs from the on-site quarry. Further feasibility investigations are required to assess the properties of the basalt from the on-site quarry for its suitability for various uses.

If an on-site quarry is not possible, the project would need to use local quarries to supply the material. The closest commercial quarry is Tarrone Quarry. Use of the Tarrone Quarry (or other off-site quarries) would result in additional truck movements on public roads and require additional road upgrades to accommodate the weight of the stone laden trucks (refer to Chapter 15 – *Traffic and transport* for further discussion).

Procurement requirements for cement, sand and other resources would be determined during detailed design and procurement phases of the project.

Topsoil cleared during construction would be used for rehabilitation, and rock excavated when preparing wind turbine foundations would be used for road base, back fill for foundations and/or erosion control purposes, as far as practicable.

Water supply

Water for the concrete batching plants and dust suppression of the access tracks and hardstand areas is intended to be sourced from dewatering of the quarry, subject to the water quality and quantity being suitable. The project would require a licence from Southern Rural Water to take and use the water.

It is estimated up to 5 megalitres of water would be needed to produce the quantity of concrete required for gravity foundations. It is estimated up to 80 megalitres would be needed for all the construction activities. This estimated volume would service all new and upgraded access track construction and dust suppression activities, including those associated with the unsealed public roads. Weather conditions during the period of construction, in particular temperature, would affect the volume of water needed.

Should the water available from the on-site quarry not be sufficient or appropriate for use, water would be obtained from other local sources, subject to relevant approvals.

Biosecurity

It is recognised construction works have the potential to spread weeds and pathogens and to encourage pest animals. Weeds and pathogens may be lodged and transported in construction plant and equipment and then driven through the project site.

The key design measure to minimise this risk has been including washdown stations at all entry points and gates (see Section 5.2.2). Construction works would also be subject to management requirements for weeds and pathogens such as vehicle hygiene protocols and a spoil management plan, which would be incorporated into the project Environmental Management Plan. The Environmental Management Plan would need to be prepared to the satisfaction of the Minister for Planning, in consultation with DELWP, Moyne Shire and any other relevant agency.

The balance of plant contractor would have or be able to source information (e.g., from the Civil Contractors Federation, Victoria) about machinery hygiene that would comply with the relevant biosecurity plan.

Other measures that would be carried out to manage biosecurity risks are outlined in Chapter 12 – *Biodiversity and habitat*.

Post-construction site rehabilitation

The project site would be progressively rehabilitated during construction. When construction is completed for an area, all temporary plant and equipment would be removed, and disturbed areas no longer needed would be rehabilitated. This may require revegetation with native species or making the land suitable to grazing or cropping once more. Post-construction rehabilitation would be completed in accordance with the Environmental Management Framework (contained within Chapter 26) commitments and project permit conditions, and in consultation with involved landholders hosting infrastructure.

5.4.3 Operation

Wind turbines start to generate energy at wind speeds of around 3 metres per second (or 11 kilometres per hour). This is known as the cut-in wind speed. The output increases in a linear trend with increasing wind speed until the wind reaches 13 to 14 metres per second (or 47 to 50 kilometres per hour). At that point, the power is regulated at rated power (i.e., 6 megawatts if using the nominal rated capacity of a 6-megawatt wind turbine). If the average wind speed exceeds the maximum operational limit (about 25 metres per second, or 90 kilometres per hour), the wind turbine is shut down and the blades are feathered (i.e., locked in a set position).

During periods of operation, wind turbines generate noise and shadow flicker. The project is required to operate within regulated limits and to demonstrate compliance via predictive modelling and on-ground monitoring see Chapter 13 – *Noise and vibration* and Chapter 21 – *Shadow flicker and blade glint* for further details on these aspects.

Once the wind turbines are in operation, the project would be monitored by both on-site staff and remote monitoring. Around nine staff, mostly involved in technical maintenance, would be located on-site. These on-site staff and specialised contractors would carry out routine and responsive operation, maintenance and repair activities.

The site office would be occupied during normal office hours, except when required to respond to unplanned equipment failures that may occur outside these hours. Remote monitoring would occur via control systems to monitor the performance and control the operation of the wind turbines. Major planned servicing of the wind turbines would be carried out about twice per year. This would involve additional on-site staff to undertake these works.

Light vehicles and small trucks would travel from the site office and maintenance yard to individual wind turbines and substation, mostly via internal access tracks. Large vehicles may occasionally deliver replacement wind turbine components to the project site and a crane may be needed to install them. Refer to Chapter 15 – *Traffic and transport* for further details about vehicle use during operation.

5.4.4 Decommissioning and rehabilitation

The wind turbines would have an operating life of around 25 years, at which stage there are three main options for consideration:

1. continue to use the project site as a wind farm using the existing wind turbines, potentially with some refurbishment and subject to their condition at that time
2. replace the existing wind turbines with more modern wind turbines and continue to operate the wind farm
3. decommission the project by removing all above ground infrastructure and rehabilitating hardstand areas and access tracks (except where landowners want them retained for their farm operations) so the land can be returned to agricultural use.

The decision on whether to refurbish or replace the wind turbines would be subject to an assessment of the economic viability closer to the time, and in consultation with the landowners and approval authorities. Long-term leases have been entered into with landowners with stringent decommissioning obligations. Ongoing fees are payable to landowners until decommissioning is properly completed, providing a strong incentive for this to occur once the wind farm ceases operation.

Decommissioning activities would result in similar potential impacts to construction activities and is expected occur over a period of 6 to 12 months. Decommissioning activities would involve large equipment (e.g., cranes, excavators and graders) and the transport of large project components from the site (e.g., wind turbine towers and blades). Chapter 26 – *Environmental management framework* includes requirements to manage the decommissioning of the project in a way that mitigates and manages any associated impacts.

Most above ground components of the project can be recycled at the end of their life, including the steel towers and copper contained within each wind turbine. The ability to recycle some wind turbine components, including blades, is expected to be significantly improved (technologically and economically) by the time decommissioning of wind turbines is required.

Upon decommissioning, below ground infrastructure, including wind turbine foundations and underground cables, may be left in situ and covered with at least 500 millimetres of clean fill material. The ground surface would be rehabilitated to reflect the natural surface that existed pre-development and to avoid soil erosion. A map of below ground infrastructure would be provided to each landowner hosting wind farm infrastructure.

Neighbouring landowners and the local community would be engaged when considering options available for the project’s future, seeking to address any issues, minimise potential impacts and maximise benefits.