Hexham Wind Farm

Chapter 6

Project description

WIND PROSPECT

6.1 Overview

This chapter responds to the EES scoping requirements by describing the project in sufficient detail both to allow an understanding of all components, processes and development stages, and to enable assessment of their likely potential environmental effects. It describes the infrastructure and associated construction works proposed for the project. It also describes how the project is proposed to operate during its life and what would be required to decommission it.

The language used in this chapter and throughout the EES assumes that if the project is approved and proceeds to construction, it will be built, operated and decommissioned as described here, subject to outcomes of the approvals process.

The project will harness strong and reliable winds to generate renewable energy through the construction and operation of up to 106 wind turbines. Electricity produced by the project would be distributed by underground and overhead cables to the new on-site terminal station and battery energy storage system, from where it would be exported to the national electricity transmission network via the existing Moorabool to Heywood 500-kilovolt transmission line.

The project would generate more than 2,559 gigawatt-hours of electricity each year, which is, on average, as much electricity as is used by up to 570,000 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 construction disturbance area and operational footprint. The total construction disturbance area for the project is estimated to be up to around 603.1 hectares (or around 3.75% of the project site). This includes an area of around 150.3 hectares (or 0.9% of the site) that would be used for the life of the project.

Table 6.1 provides a summary of the main features of the project.

Table 6.1 Summary of the main project features

Project's main features	Details
Location	The project is located about 3 kilometres south-west of Hexham, 3 kilometres north-west of Ellerslie and 4 kilometres south-east of Caramut. The project site is entirely within the Moyne Shire. The project site is situated immediately south of Hamilton Highway and lies between Woolsthorpe-Hexham Road and Hexham-Ballangeich Road to the east, Warrnambool-Caramut Road to the west and Gordons Lane to the south.
Setting	The main land use within the project site is agricultural (predominantly sheep and cattle grazing as well as some cropping). Native vegetation is largely restricted to roadside reserves and along watercourses, with small, isolated areas on private land.
Landowners	There are 14 landowner families with project infrastructure proposed to be built on their land.
Wind turbines and hardstand areas	Up to 106 with a maximum tip height of 260 metres, maximum rotor diameter up to 190 metres, minimum tip height of 40 metres and blade length of up to 93 metres. Each wind turbine is proposed to have an adjacent hardstand area of around 6,500 square metres, which equates to 70 hectares for all project wind turbines.
Wind farm capacity	Around 721 megawatts.
Annual generation	Around 2,559 gigawatt-hours per year.
Construction period	About 24 months.

Project's main features	Details
Electrical reticulation	Around 139 kilometres of 33-kilovolt electricity cable would be laid in approximately 86 kilometres of trenches about one metre below the surface. The work area width for the excavator to operate and for stockpiling of soil would be about eight metres wide for all trenches assuming up to four cables are housed in each trench. Around 42 kilometres of overhead cables (i.e., powerlines) would be needed to connect wind turbines to the new on-site terminal station. The linear length of overhead cabling would be around 18 kilometres as a portion of cabling would be strung on parallel lines of poles. All overhead cabling would be contained within the project site.
On-site terminal station	Electricity generated by the project would be distributed by underground and overhead cables to the proposed new onsite terminal station facilitating connection to the existing Moorabool to Heywood 500-kilovolt transmission line located in the southern portion of the project site The on-site terminal station area would be approximately 7.3 hectares in size.
Battery Energy Storage System	An on-site battery energy storage system with a rated storage capacity of 200 megawatts / 800 megawatt-hours is proposed to be built next to the on-site terminal station. The battery energy storage system would consist of a series of containerised batteries with transformers, coolers and other electrical plant. It would be sited on a hardstand area of up to three hectares (around 413 metres by 67 metres).
Operations and maintenance facility	An operations and maintenance facility would be constructed adjacent to the on-site terminal station and battery energy storage system providing office, storage and maintenance facilities. The facility would be approximately 90 metres by 200 metres.
Meteorological masts	Up to five meteorological masts are proposed to be in place for the life of the project. A single-lane access track roughly four metres wide would be constructed to provide access to these masts.
Transport	Transport of wind turbines and ancillary components (e.g., battery energy storage system and terminal station infrastructure) would be from Portland or Geelong and via the regional road network. The most suitable over-dimensional haulage routes will be identified and consider previously developed routes for other wind farms.
Site access and access tracks	Approximately 147.5 kilometres of internal access tracks, including upgrades to around 16.5 kilometres of existing access tracks within the project site, would provide for construction and maintenance access to each wind turbine. Access tracks would have a final width of 9 metres (inclusive of drainage, where required) and a maximum 120 metre turning radius. The construction footprint of access tracks would be around 20 metres wide. Ten site access points are proposed from two arterial and four local council roads, being: • one access point from the Hamilton Highway • one access point from Warrnambool-Caramut Road and Hamilton Lane • four access points from Woolsthorpe-Hexham Road • one access gate on immigrants lane • one access point from Keillors Road • two access point from Hexham-Ballangeich Road.

Project's main features	Details
External road upgrades	Road upgrades will be required to sections of local roads relied on by project traffic. These roads are: • Hexham-Ballangeich Road • Woolsthorpe-Hexham Road • Immigrants Lane • Keillors Road • Hamiltons Lane Three intersections along Warrnambool-Caramut Road and three project gates will also require right and/or left turn lane improvements.
Raw materials	A temporary on-site quarry is being investigated for the purposes of providing aggregate materials for access tracks and hardstand areas, and to minimise traffic movements on local roads during construction. The on-site quarry is proposed to be located in the western portion of the project site. The work authority area is 52.3 hectares with an approximate extraction area of 21.5 hectares, a material stockpile area of approximately 8.6 hectares and an area of approximately 0.5 hectares for amenities and light vehicle parking. The remaining area will be used for stockpiling overburden and for groundwater management infrastructure. Should an on-site quarry be deemed viable, a work authority would be sought, and a work plan prepared under section 77G of the *Mineral Resources (Sustainable Development) Act 1990*. If an on-site quarry is not deemed viable, aggregate material would be supplied from one or more nearby quarries. Potential quarries that have been investigated to supply the necessary raw materials required include Mt Shadwell Quarry, Mt Napier Quarry, Tarrone Quarry, Gillear Sand and Limestone Quarry and/or Camperdown quarries). All quarries have good access to the project site via major arterial roads.
Temporary components	A main temporary construction compound would be developed and include office facilities, amenities and car parking. Four additional temporary construction compounds are also planned. Seven concrete batching plants (each around 50 metres by 100 metres) would be established to supply concrete for the wind turbine foundations, the on-site terminal station, and the battery energy storage system. Temporary laydown 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 three 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 participating landowner).

The proposed locations of the main project features are shown in Figure 6.1 and Figure 6.2, and in greater detail in Attachment III – ***Project map book***.

The project has been in planning and development since 2011. 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 5 – ***Project alternatives and design development***.

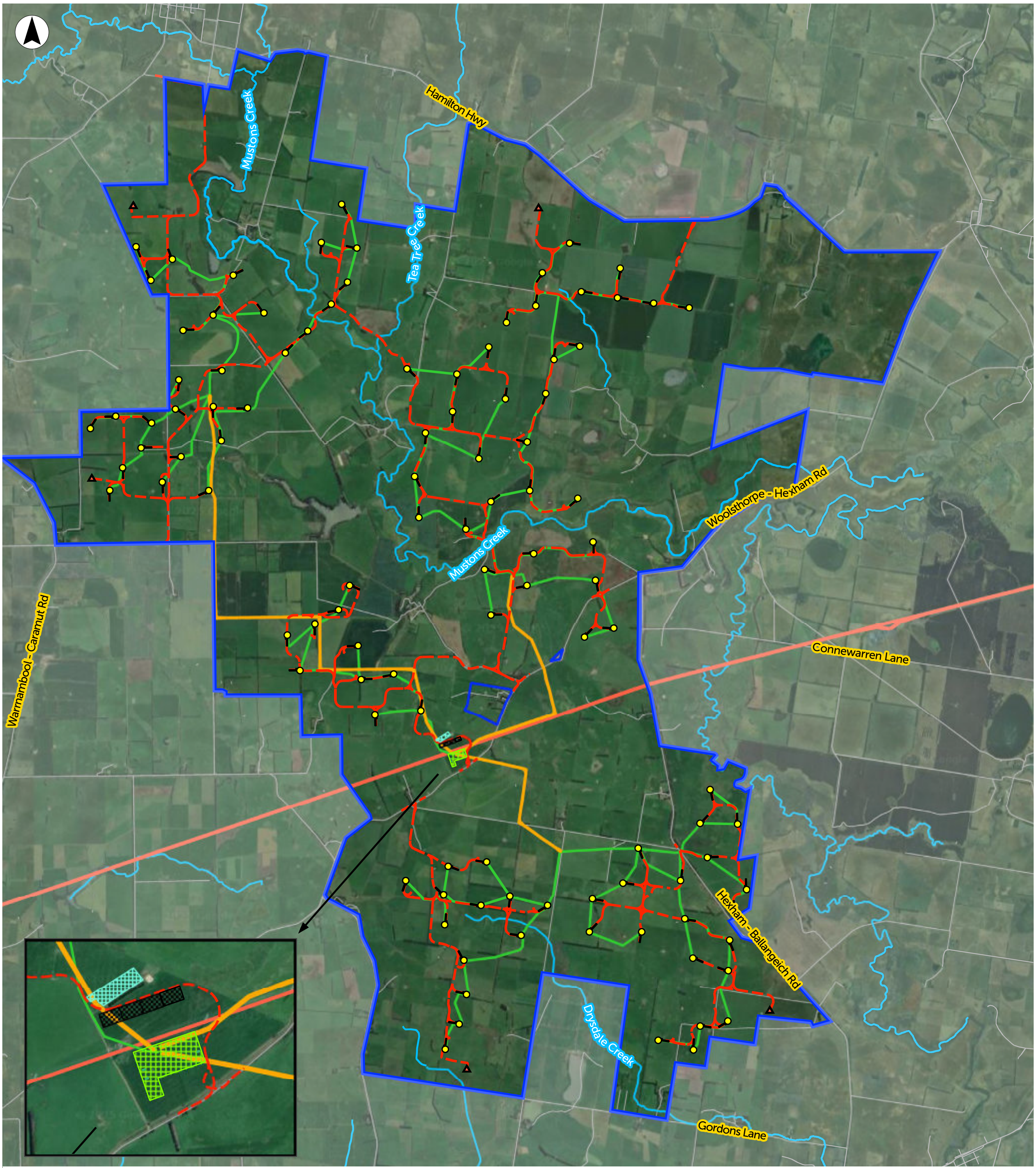
A detailed design would be prepared after receiving a planning permit and achieving financial close, incorporating the results of future geotechnical investigations and information from the selected wind turbine manufacturer, civil and electrical contractors. A 100-metre micro-siting radius is proposed 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 and overhead 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.



Legend

Proposed wind farm infrastructure

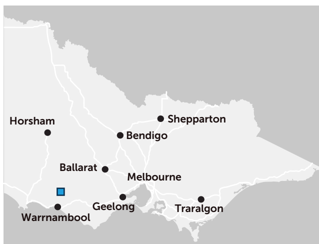
- Wind farm boundary
- Internal overhead powerline
- Wind turbine generator and hardstand area
- Site accessway
- Underground powerlines
- Permanent wind monitoring mast
- Site O&M facility and carpark
- Electrical terminal station
- Battery energy storage system

Existing infrastructure

- 500kV powerline

Scale

5.00 km



Data: State of Victoria (DECCA/Land Use Victoria), Commonwealth of Australia, Wind Prospect, and specialist studies/reports. Data is indicative only; accuracy and completeness are not guaranteed.
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Figure 6.1 Proposed operational project infrastructure layout

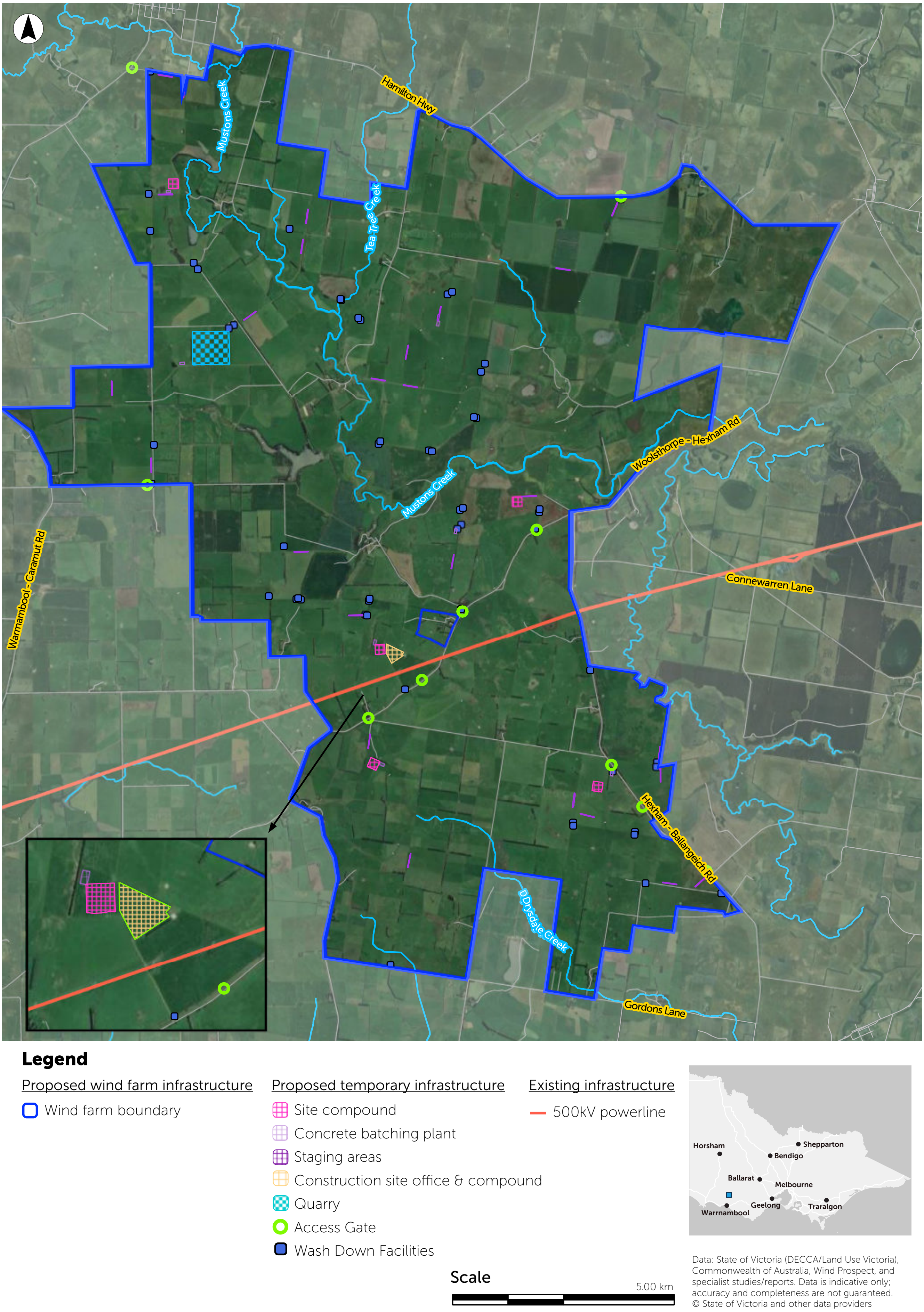

Figure 6.2 Proposed temporary project infrastructure layout

6.2 Project components and layout

6.2.1 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 260 metres from the ground to upper blade tip. The project has therefore been designed to enable a maximum wind turbine tip height of 260 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 6.3) and is expected to have a generating capacity of 6.8 megawatts or more.

The maximum and minimum parameters described above have been adopted for this EES, allowing a 'conservative assessment of environmental and social impacts. Note that if the minimum blade clearance of 40 metres is adopted for the turbine ultimately chosen to be installed as an outcome of the detailed design, the maximum tip height would be 230 metres. If the maximum tip height of 260 metres is adopted, the ground clearance would be 70 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.

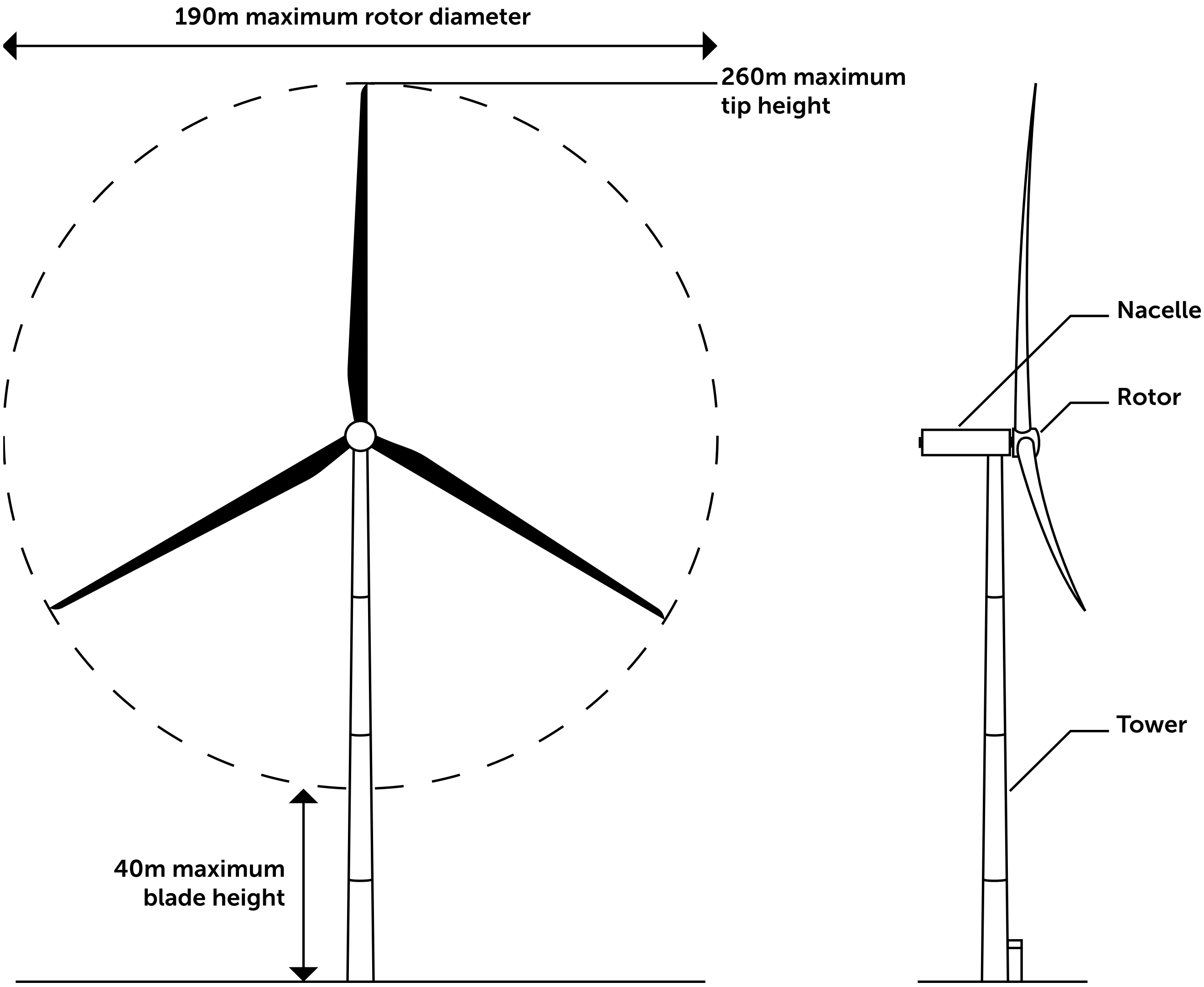

Figure 6.3 Wind turbine components

Wind turbine foundations

The wind turbine foundations would be either a gravity foundation or rock anchor foundation (discussed further in Section 6.4.2). 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 6.4.2 for details about foundation construction).

Figure 6.4 shows a typical wind turbine excavation and hardstand area.

Figure 6.4
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. Truck turning circles would be included as an extension to turbine hardstands at the end of access tracks. In this situation, an individual hardstand area would be 0.95 hectares. 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 if, for example, revegetation is required for managing weeds and pest animals. Measures would be outlined in the Construction Environmental Management Plan [EMM01](detailed in Chapter 28 – ***Environmental management framework***). 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 260 metres would have base diameter of between five and six metres, tapering to three 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 6.5.

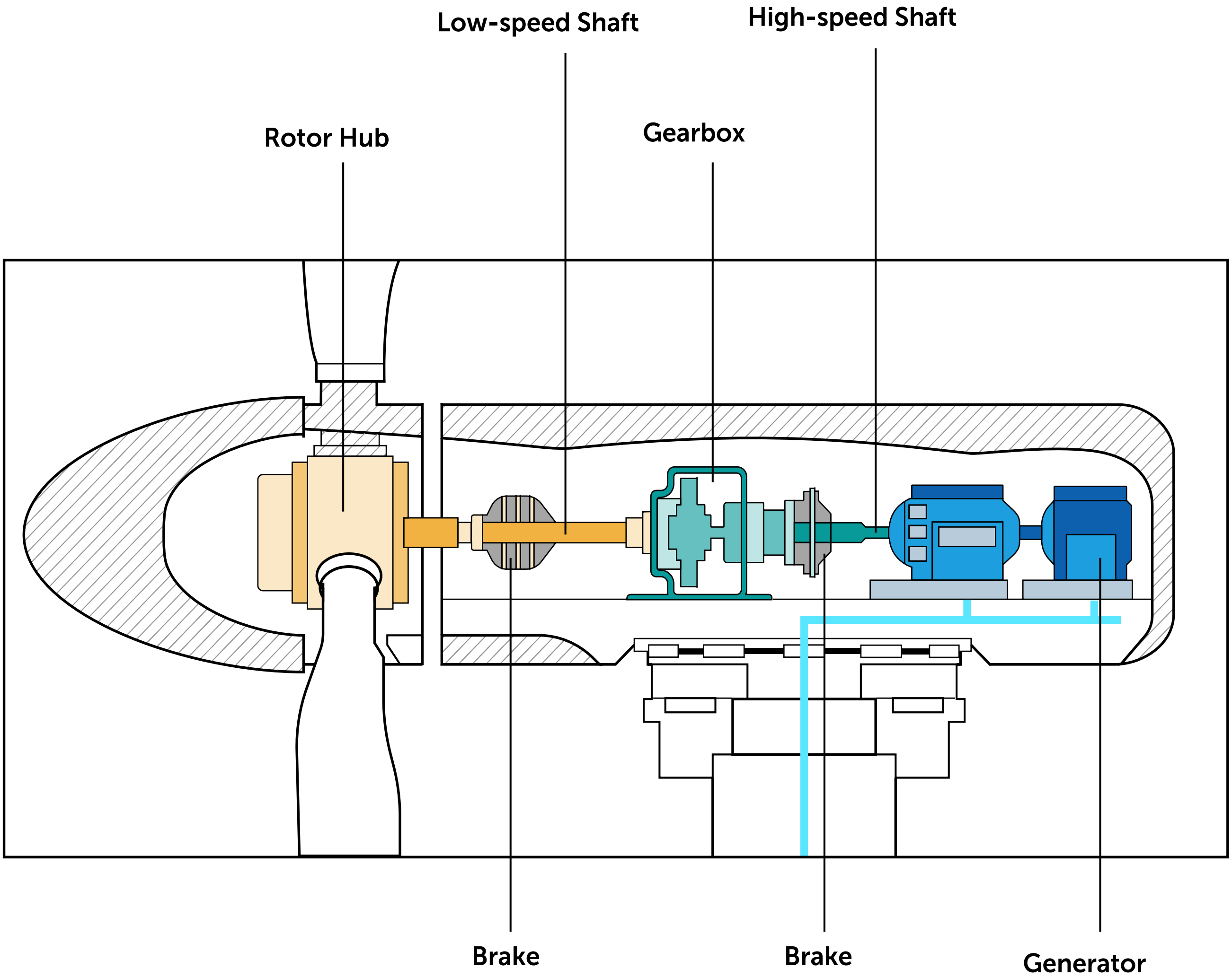

Figure 6.5 Simplified diagram of nacelle

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 6.6). 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 four 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 a 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 for 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.

A visual example of a blade, similar to what is proposed, being transported to a wind farm site is shown in Figure 6.7.

Figure 6.6
A blade being lifted onto a wind turbine

Figure 6.7
Example wind turbine blade being transported *(Source: ABC News, 2020)*

Transformer

The transformer, which transfers electrical energy from one electrical circuit to another circuit, 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.

6.2.2 Access tracks and site access from public roads

A total of ten site access points from public roads would be established to bring project components onto site (Figure 6.1 and Figure 6.2), all of which would remain in place for the life of the project. Four of these access points would be from Woolsthorpe-Hexham Road, two from the Hexham-Ballangeich Road, one from the Hamilton Highway, one access point from the Warrnambool-Caramut Road and Hamilton lane, and one from Keillors Road. 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 Attachment III – ***Project map book***.

Hamilton Highway (Class B arterial road) and Warrnambool-Caramut Road (Class C arterial road) are managed by Regional Roads Victoria, while the others are local roads managed by 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 Construction Environmental Management Plan. Further detail on the proposed Traffic Management Plan is provided in Chapter 25 – ***Traffic and transport***.

Around 131 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 9 metres, inclusive of drainage (where required). The construction footprint for access tracks would be around 20 metres wide. Twenty-four staging areas of up to 300 metres in length and 15 metres in width would be constructed next to the access tracks, thereby more than doubling the width in those locations. Several passing lanes of 25 metres in length would also be needed throughout the site.

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 Country Fire Authority (CFA) Guidelines and Model Requirements for Renewable Energy Facilities (The CFA, 2025) (CFA Guidelines). 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 6.1. The access tracks may be subject to micro-siting within the construction disturbance area that has been assessed as part of the EES. Ecological and cultural heritage surveys assessed a 20-metre-wide corridor for tracks and cables.

6.2.3 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.

It is proposed that the internal electrical network between the wind turbines and the terminal station would comprise of both an underground distribution network (i.e., buried cables) and overhead cables. It is estimated to include around 86 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 eight 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. 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 6.1 and Attachment III – ***Project map book***.

Overhead cable

Around 42 kilometres of overhead powerlines are proposed to connect wind turbines to the new on-site terminal station. The distribution voltage is expected to be 33 kilovolts (although 132 kilovolts and 220 kilovolts are alternative options), with the overhead dual circuit distribution line consisting of either single or parallel pole line (i.e., single poles up to 26 metres high, with conductor circuits on each side). The linear length of overhead cabling would be around 18 kilometres as a portion of cabling would be strung on parallel lines of poles.

On-site terminal station

A single on-site terminal station would be needed to enable the transfer of electricity generated by the wind turbines to the existing Moorabool to Heywood 500-kilovolt transmission line, located in the southern portion of the project site (owned and operated by AusNet Services). The on-site terminal station would be located adjacent to the existing transmission line.

The on-site terminal station would have a footprint of around 7.3 hectares. The on-site terminal station 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 terminal station, battery energy storage system (Section 6.2.4) and operations and maintenance facility (Section 6.2.5). 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 terminal station with control room and amenities is shown in Figure 6.8, with concept designs for the project shown in Attachment III – ***Project map book***.

Sound power levels of the transformers will be assessed and measures applied to achieve the relevant noise criteria and the general environmental duty. Refer to Chapter 17 – ***Noise and vibration*** for information regarding ancillary equipment noise.

Areas within the on-site terminal station would be covered partly with a layer of crushed rock and partly by concrete slabs. The transformers within the on-site terminal station 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 terminal stations in Australia and are governed by strict standards.

Figure 6.8
Example of a terminal station and control room with amenities *(Source: AusNet Services)*

6.2.4 Battery energy storage system

A battery energy storage system would be built adjacent to the on-site terminal station. The battery energy storage system would have a nominal capacity of up to 200 megawatts / 800 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 20 – ***Land use and planning***.

The battery energy storage system would consist of a series of containerised batteries with transformers, inverter, high-voltage alternating current (heating, ventilation and air conditioning) coolers and other electrical plant. The battery energy storage system would be built within an area of up to three hectares (nominally 413 metres by 67 metres), as indicatively shown on Figure 6.1 with a concept design shown in Figure 6.9.

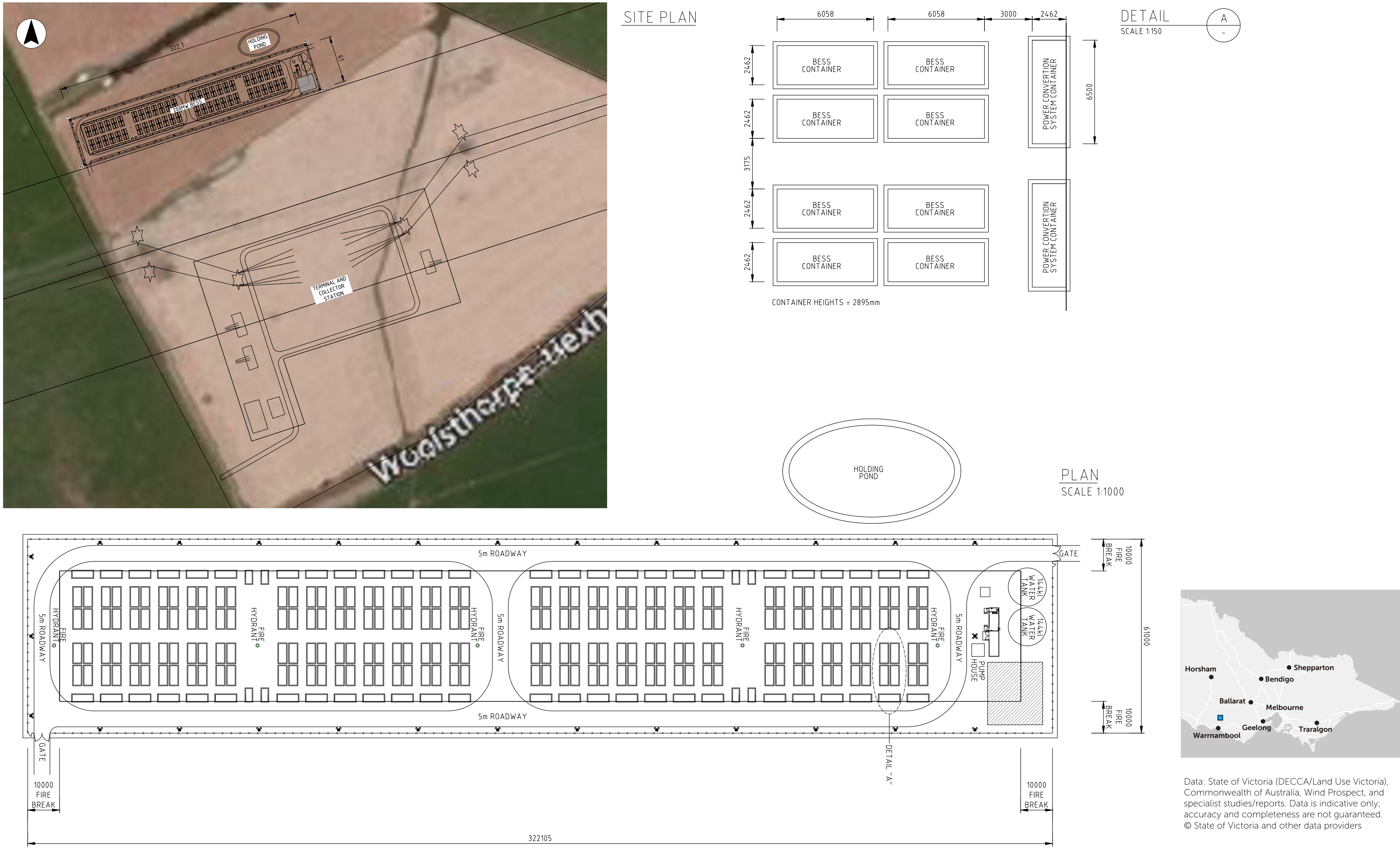

Figure 6.9 Battery energy storage system

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 energy storage system is located with suitable fire breaks, and static water supplies would be installed in strategic locations through the project site. Access tracks and project infrastructure are sited so emergency vehicles can easily enter and manoeuvre around the site. Further detailed plans would be prepared in collaboration with the CFA before construction and commissioning of the project and would 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 6.10.

Figure 6.10
Example 30-megawatt battery energy storage system at Ballarat, Victoria
(Source: DEECA, 2025c)

6.2.5 Operations and maintenance facility

An operations and maintenance facility would be built in an area near the on-site terminal station and battery energy storage system. It would require an area of about 1.8 hectares (nominally 90 metres by 200 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 6.11 and in Attachment III – ***Project map book***.

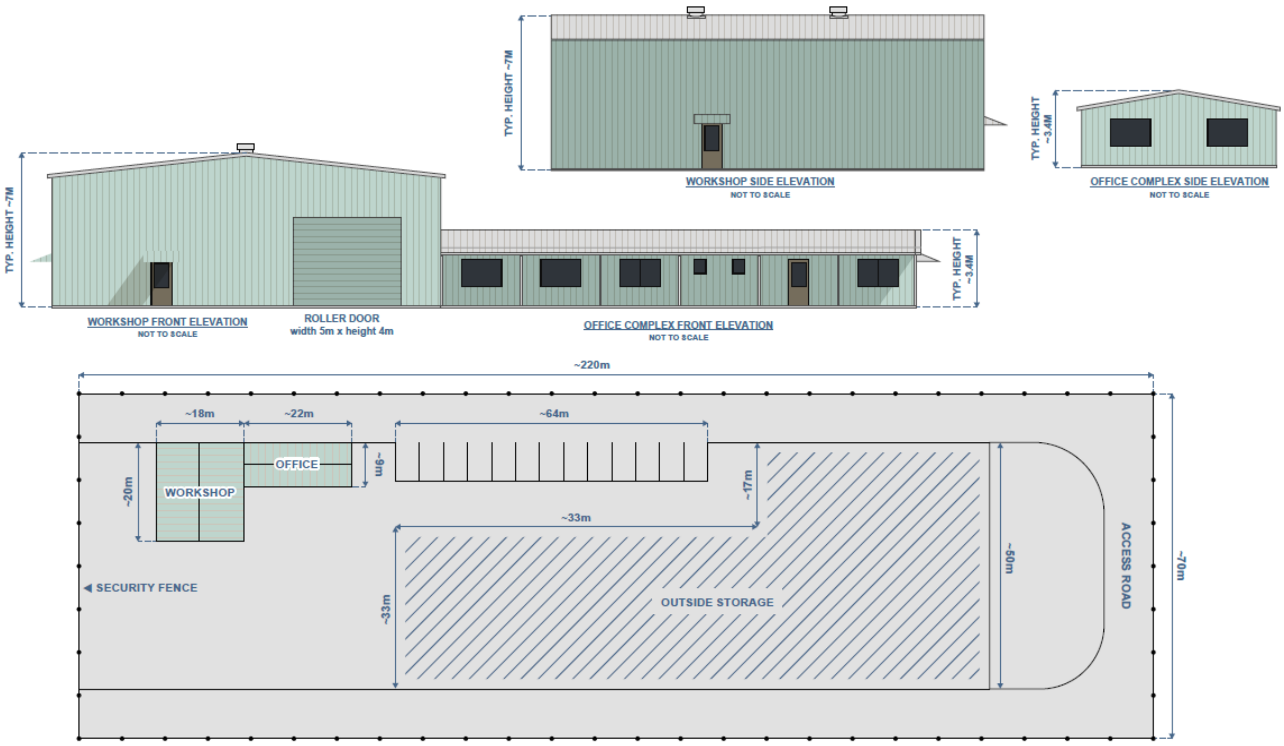

Figure 6.11 Conceptual operations and maintenance facility site plan

6.2.6 Meteorological monitoring masts

Up to five 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. Permanent meteorological masts are important tools in monitoring the power performance of operating wind turbines and ensure they are operating efficiently and safely whilst maximising energy production. Each met mast would be a lattice tower, with a height equal to the wind turbine hub height (proposed 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 four metres wide, would be constructed to provide access to each met mast. Figure 6.12 shows an example met mast and associated equipment. A concept design is shown in Attachment III – ***Project map book***.

Figure 6.12
Meteorological monitoring mast
(Source: ART Group)

6.3 Temporary infrastructure components and layout

Several features of the project would be temporary, needed only during construction, and in some cases, during decommissioning. The proposed 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 6.13 and in greater detail in Attachment III – ***Project map book***.

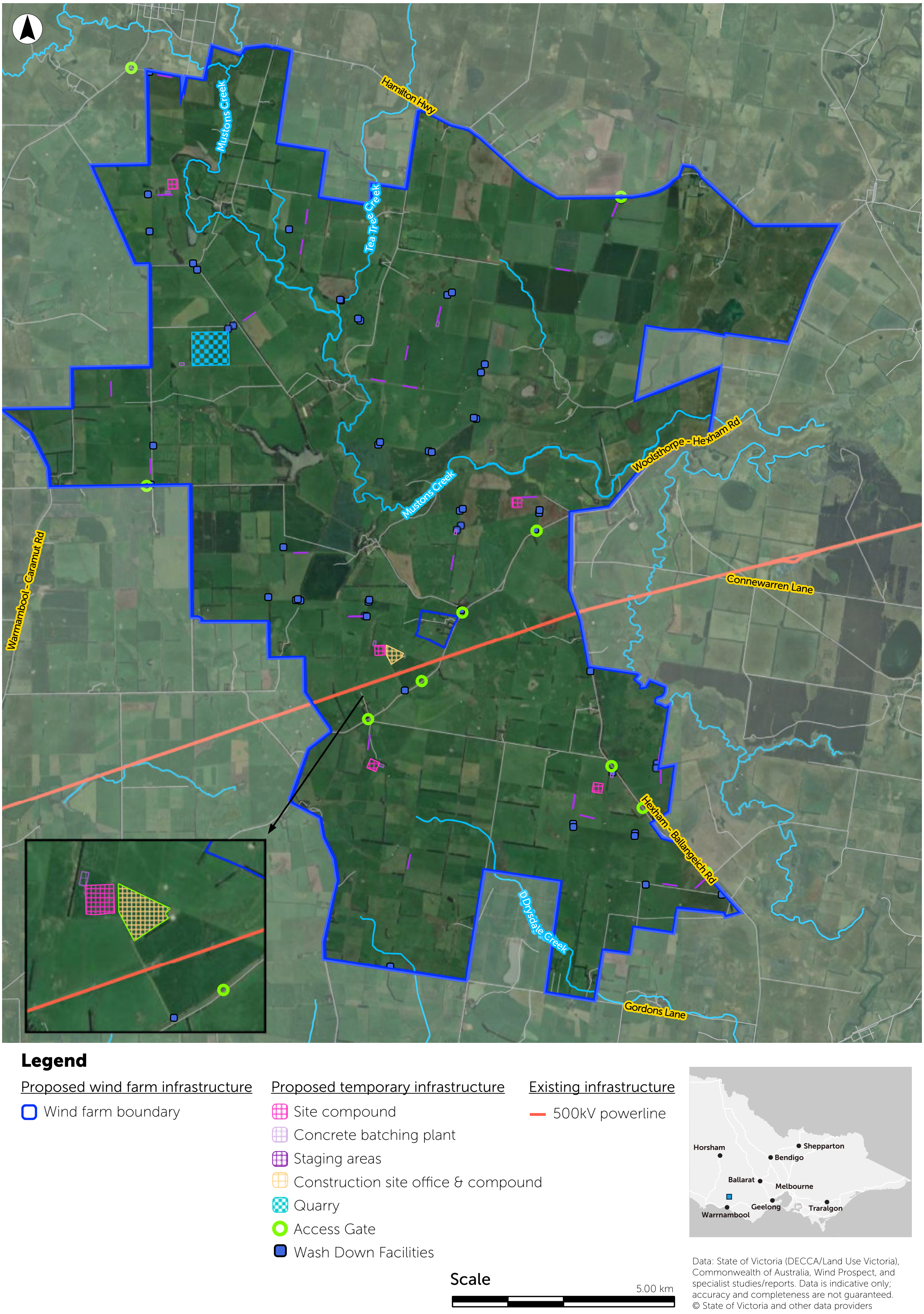

Figure 6.13 Construction infrastructure

6.3.1 Quarry

A temporary on-site quarry is proposed (as the preferred option) for the purposes of providing 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 on-site quarry would require a work authority (i.e., approval) from Resources Victoria, a part of DEECA.

The alternate option to supply aggregate material for the project is to source material from nearby commercial quarries, including the Mt Shadwell Quarry, Mt Napier Quarry, Tarrone Quarry, Gillear Sand and Limestone Quarry and/or Camperdown quarries, if the temporary on-site quarry is not approved or the cost of developing it proves to be prohibitive. All quarries have good access to the project site via major arterial roads. The closest quarry to the project site is Mt Shadwell Quarry, located around 20 kilometres north-east of the project site.

Quarry material

The project is estimated to need around one million cubic metres of quarried aggregate for the construction of the project (including access tracks, laydown areas and construction pads at each wind turbine), A small quantity of these materials may also be used in concrete mix subject to further quality testing.

Work authority area

The proposed quarry work authority area is around 52.3 hectares, with an approximate extraction area of 21.5 hectares, a material stockpile area of approximately 8.6 hectares and an area for amenities and light vehicle parking of approximately 0.5 hectares (Figure 6.14). The remaining area will be used for stockpiling overburden and for groundwater management infrastructure.

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

Conductivity surveys were undertaken to determine the suitability of the resources, followed by a drilling program at a target depth of 18 metres to gain an accurate understanding of subsurface conditions and extent of resources present.

Typical quarry requirements include:

- 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.

The proposed on-site quarry would be established, and excavation would start, during the enabling works. It is expected the on-site quarry would be in use for up to 24 months. In accordance with management measures nominated for the project (described further in Chapter 28 – ***Environmental management framework***):

- construction and operation of the on-site quarry will be undertaken in accordance with a Work Authority, [EMM06] and Quarry Work Plan [EMM07]
- the Quarry Work Plan will require the proposed on-site quarry to be remediated following the completion of materials extraction [EMM LUP02].

Rehabilitation will be undertaken in consultation with the participating landowner, Resources Victoria and Moyne Shire Council. The landowner has agreed to the rehabilitated land remaining as a void, with a small farm dam at the low point.

Development and operation of the quarry is described further in Section 6.4.2 and in Attachment II – ***Preliminary draft Quarry Work Plan***.

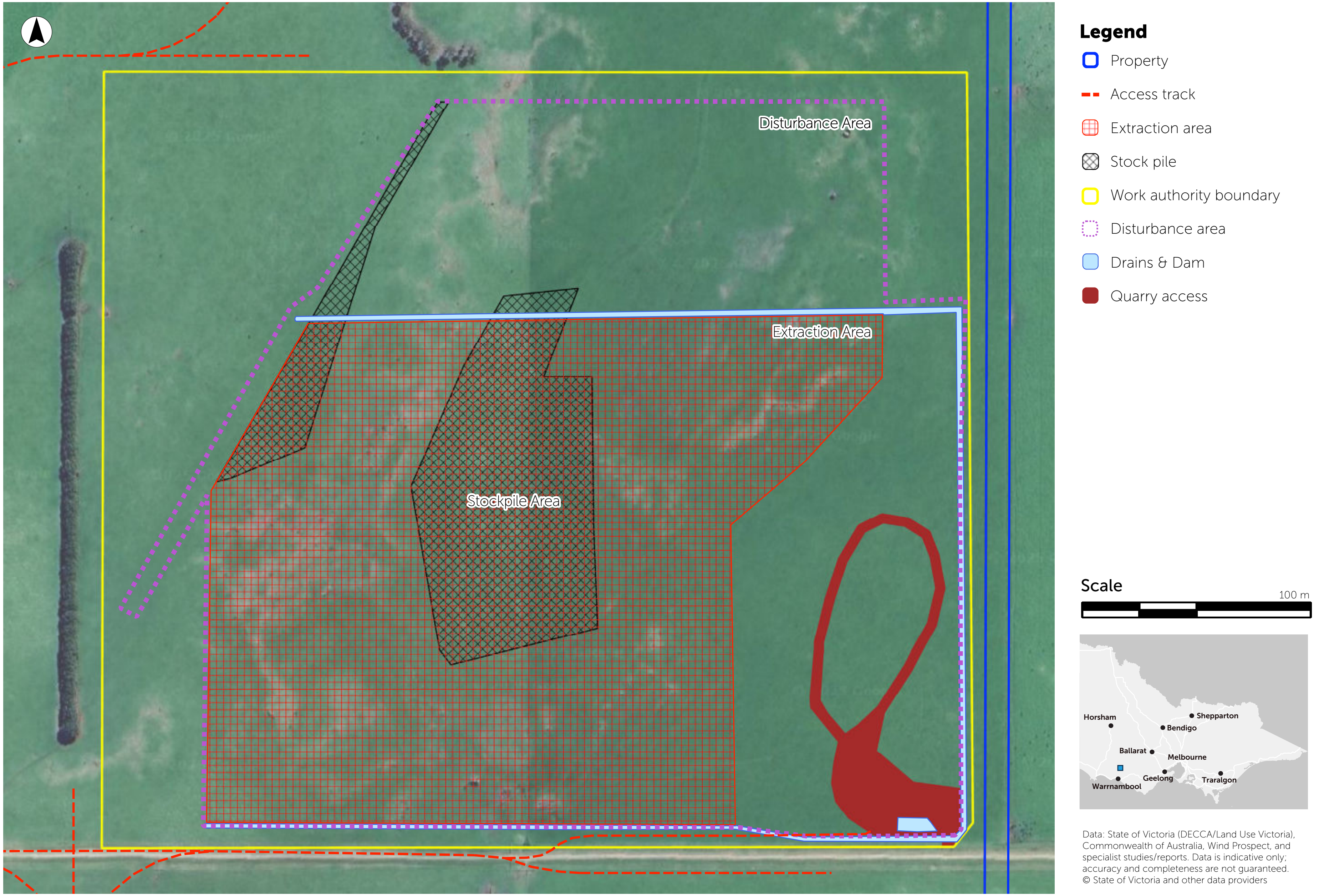

Figure 6.14 Proposed On-Site Quarry layout

6.3.2 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 6.2). The compound would be a fenced area of about eight hectares and 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.

Four additional temporary construction compounds, nominally 200 metres by 200 metres, are planned to the north, centre and south of the project site. These hardstand areas would be established for the storage of wind turbine components, and other equipment.

6.3.3 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 construction disturbance area and to avoid environmental constraints and impacts.

Staging areas would be required adjacent to each wind turbine, and a temporary construction compound 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 construction disturbance area and impacts, however in some instances, dedicated staging areas would be needed. Twenty-six staging areas of up to 300 metres in length and 15 metres in width are proposed to be constructed next to access tracks.

6.3.4 Concrete batching plants

Seven 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 terminal station 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.

6.3.5 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.

6.4 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 2026, grid connection agreements would be secured, and detailed design and pre-construction activities would start in 2027, along with financing and other commercial activities. The earliest that construction is likely to start is in the final months of 2027, with commissioning of the project in 2029. 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 6.2, and further discussed in the following sections.

Table 6.2 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 Construction Environmental Management Plan, Construction Method Statement and Traffic Management Plan, with production of other mitigation plans, as required • Financing and other commercial activities.
Construction (2 years)	• Enabling works, including project-specific local road upgrades as required, construction of site access points, temporary construction compounds and on-site quarry • Site establishment activities, including establishment of the on-site quarry, delivery of key plant and construction vehicles, construction of initial access tracks to facilitate deliveries, and establishment of temporary concrete batching plants and construction offices • Construction of access tracks and wind turbine hardstands • Construction of wind turbine footings • Installation of underground and overhead cabling, on-site terminal station and battery energy storage system • Delivery and installation of wind turbines • 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, Resources Victoria and Moyne Shire Council.

6.4.1 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, and at the construction compounds, on-site terminal station and battery energy storage system 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 Construction 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 necessitated 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.

Construction Environmental Management Plan

A Construction Environmental Management Plan would be prepared to reflect conditions of the planning permit and the Environmental Management Framework, as endorsed by the Minister for Planning, before construction starts (see Chapter 28 – ***Environmental management framework***). The Construction Environmental Management Plan would consolidate all construction-phase environmental management measures that relate to the project and provide details of how they should be performed. The plan would include the measures set out in this EES (see Chapter 28 – ***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 Construction 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 Construction Environmental Management Plan would remain a live document throughout the project pre-construction and construction phases. The Construction 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 Construction Environmental Management Plan, which would clearly outline what should be done and who has the responsibility for doing it.

The 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, including the management of potential acid sulfate soil and potentially contaminated soils.

Other management plans

A range of other management plans would be prepared in accordance with a planning permit (should one be granted) and the findings of the Minister's Assessment. These would include:

- Water Management Plan
- Sediment, Erosion and Water Quality Management Plan
- Acid Sulfate Soil Management Plan
- Spoil Management Plan
- Air Quality Management Plan
- Noise and Vibration Management Plan
- Heritage Management Plan
- Traffic Management Plan
- Risk Management Plan
- Fire Management Plan
- Emergency Management Plan.

These and a range of other proposed management plans are detailed in the relevant discipline-specific chapters (Chapters 8–25) and presented in Chapter 28 – ***Environmental management framework***. An Operations Environmental Management Plan [EMM09] and Decommissioning Plan [EMM10] will also be developed prior to the commencement of the relevant project phases (see Chapter 28 – ***Environmental management framework***).

6.4.2 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 6.15.

Public road upgrades (as required) 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 and overhead cables
- on-site terminal station and battery energy storage system.

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.

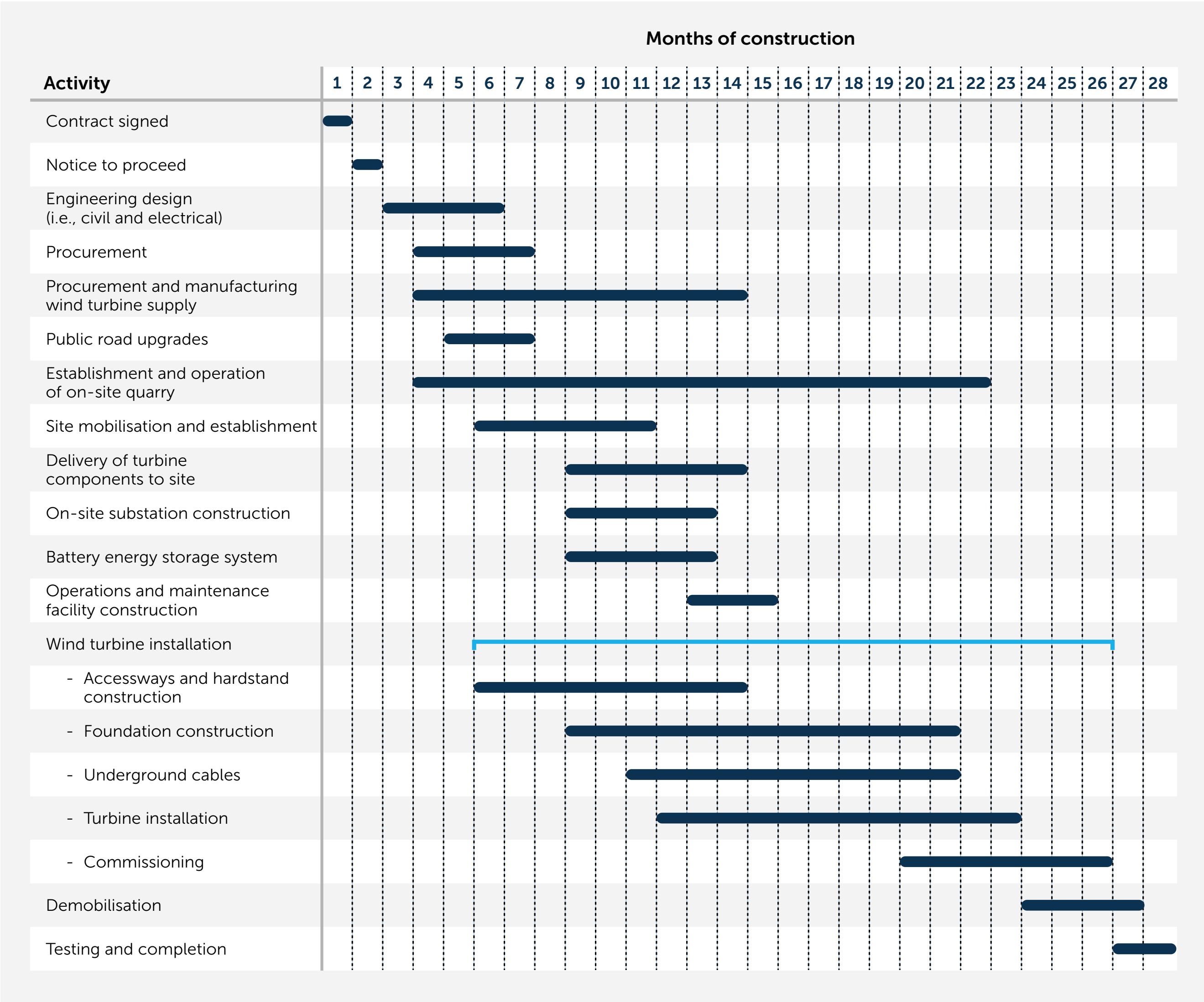

Figure 6.15 Approximate construction timeline

Construction hours of operation

EPA Victoria Publication 1834.2: 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 pm and 7 am). The project's Construction Noise Management Plan would outline how activities are controlled and managed outside normal hours (see Chapter 17 – ***Noise and vibration***).

Construction workforce

It is anticipated up to 350 direct and around 193 indirect full-time equivalent jobs would be created during construction, based on estimates in Appendix I – ***Social and Economic Impact Assessment***. The anticipated housing arrangements and associated strategy are described in Chapter 21 – ***Socio-economic***.

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 preferred over-dimensional route for over size and over mass transport vehicles starts at the Port of Portland and ends at the various project site access gates after travelling along the transport route as described in Chapter 25 – ***Traffic and transport*** and detailed in Appendix G – ***Traffic and Transport Impact Assessment***.

Six intersections along this route would require specific traffic management measures such as the temporary removal of signage, temporary intersection closures and infill within road verges. 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 25 – ***Traffic and transport***.

Public road upgrades and site access

To facilitate the mobilisation of construction teams, equipment and project infrastructure to site, right and/or left turn lane improvements would be needed at three intersections along the over-dimensional access route and at two project site access gates. Local road upgrades would also be needed in some locations, which would be completed as required in consultation with Regional Roads Victoria and Moyne Shire Council to ensure safe and efficient traffic movements.

Trimming of trees or vegetation removal would be required at some intersections to allow transport of over-dimensional project components. Vegetation removal is further discussed in Chapter 8 – ***Biodiversity and habitat***.

Internal access tracks

Around 131 kilometres of new 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.

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 (plus 1.5 metres of drainage either side of the pavement, where required), in addition to an adjacent shoulder drain (see Figure 6.16). The road base would be crushed rock aggregate sourced from the project's proposed 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.

The thickness of pavement 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 (approximately 150 millimetres in depth) 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 CFA Design Guidelines and Model Requirements for Renewable Energy Facilities (The CFA Guidelines, 2025). The CFA Guidelines contain several provisions to enable access for fire vehicles, including minimum width, maximum grade and number of access points.

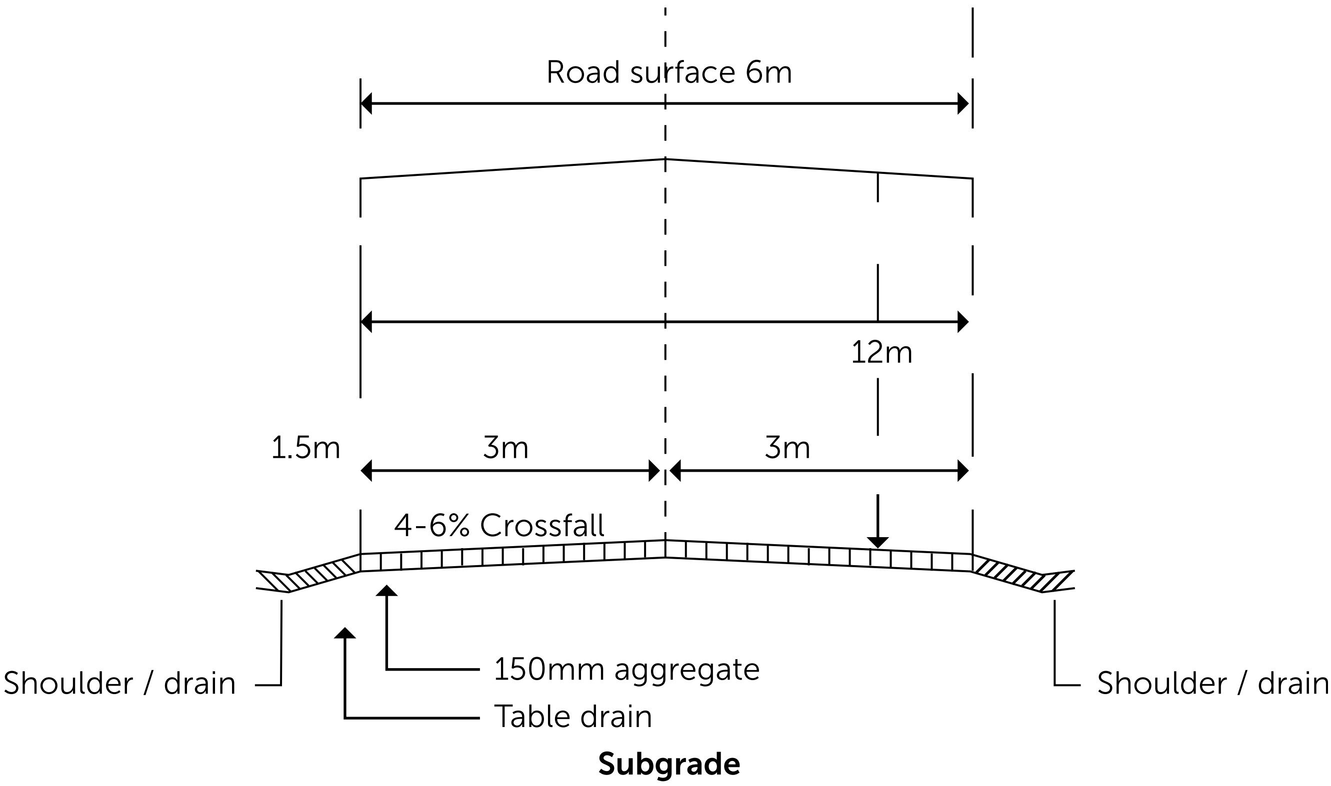

Figure 6.16 **Internal access track cross section**

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 are proposed to cross designated waterways (including Mustons Creek) and 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 on-site quarry, being diverted onto public roads.

Depending on the size of the flow path, a bridge or culvert may be used. The design of these structures would conform to local Council and Glenelg Hopkins CMA guidelines and sized to accommodate the required design capacity, based on peak water velocity and depth estimates predicted by hydrological modelling (Appendix B – ***Surface Water and Groundwater Impact Assessment***). They would allow flow beneath the access tracks along their natural flow paths with the required structural and erosion controls to prevent damage to the structure and ensure sediment is not transported downstream.

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 – ***Surface Water and Groundwater Impact Assessment***). 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 internal access track is shown in Figure 6.17. A typical culvert design is shown for illustrative purposes in Figure 6.18.

Figure 6.17
Typical internal access track
(Source: Wind Prospect)

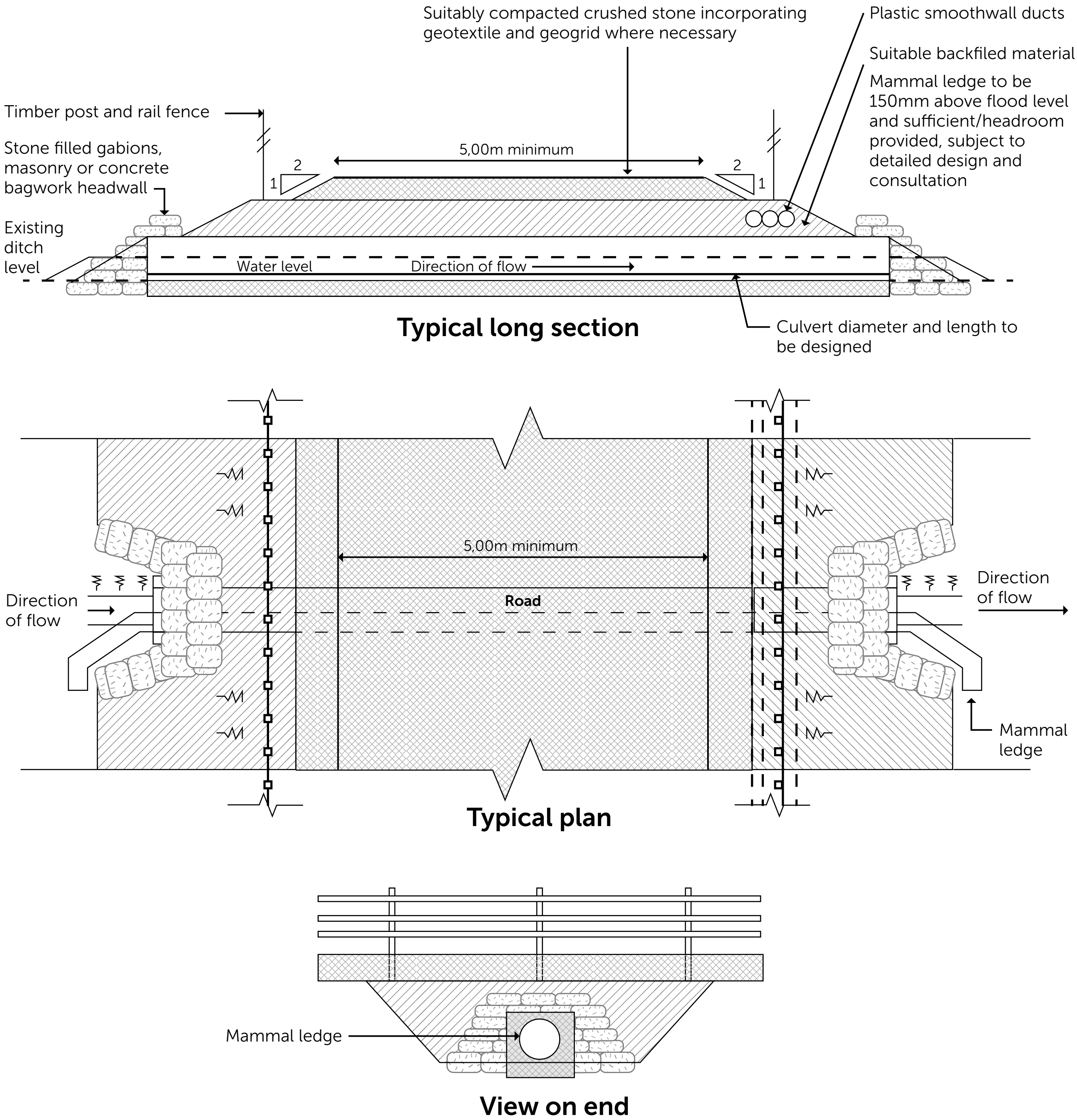

Figure 6.18 Typical culvert design

The construction footprint of the water crossings would be designed to avoid impacts to waterway flows and to protect the integrity of the waterway banks as much as possible. All waterway crossing 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 12 – ***Surface water*** and Chapter 8 – ***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 28 – ***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 6.2.1, the wind turbine foundation type would be determined after detailed geotechnical surveys are completed. The foundation type would 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 6.19 for a typical wind turbine gravity foundation.

Figure 6.19

'Typical' gravity foundation for a wind turbine *(Source: Wind Systems Magazine, 2023)*

Flood modelling has informed the siting of wind turbine locations. 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 and overmass 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 6.20). 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 6.21). This can take three days to complete depending on the weather conditions.

Figure 6.20

Wind turbine installation

Figure 6.21

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 6.22.

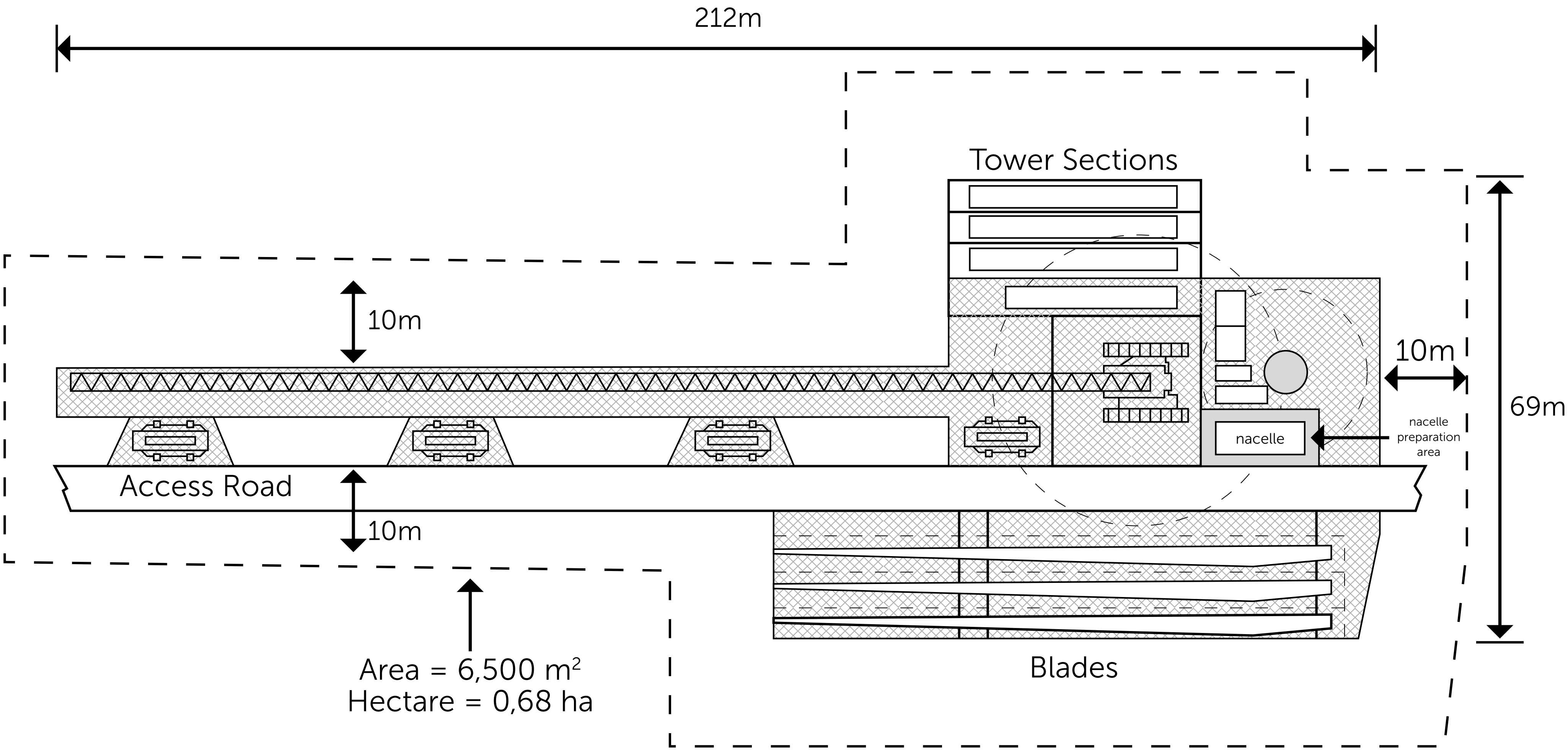

Figure 6.22 Wind turbine conceptual construction layout

Electrical cable reticulation

Underground cabling

The project design provides for the undergrounding of electrical cabling connecting clusters of wind turbines.

Around 85 kilometres of trenches up to one metre below the surface would be dug to lay cables.

Several parallel cables would be required 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, subsequently creating 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 6.23.

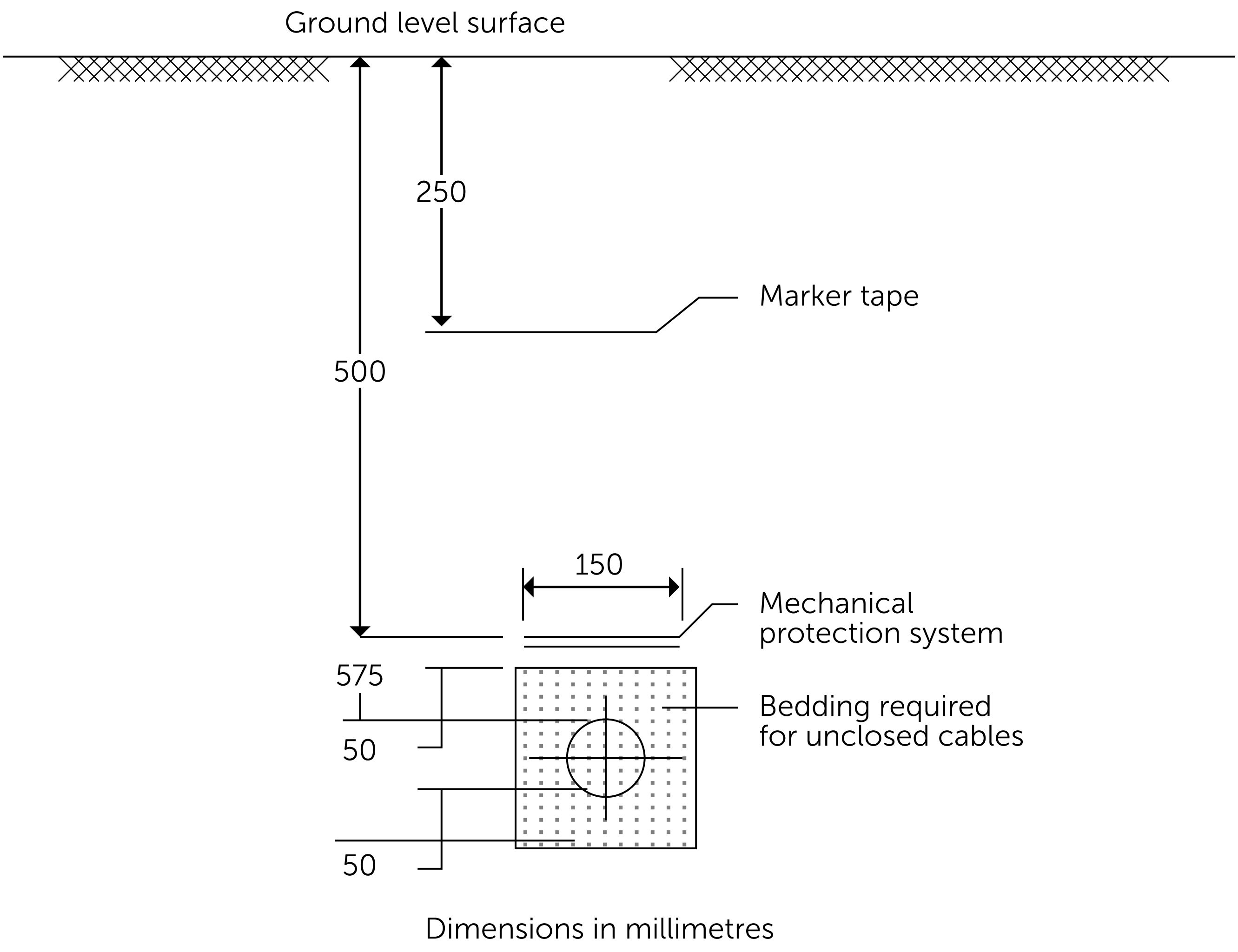

Figure 6.23 **Indicative underground electrical cable layout**

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 6.24). 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 6.24). 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.

The work area for the excavator to operate and for stockpiling of soil would be about eight metres wide, assuming up to four cables are housed in each trench. The surface would be rehabilitated to be consistent with the surrounding landscape. In certain locations, directional boring may be used to avoid disturbance to infrastructure and environmental values on the surface.

Figure 6.24
Example of wind farm cable trench laying
(Source: TESMEC, 2019)

Underground cables would cross 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 Works on a Waterway licence from the Glenelg Hopkins Catchment Management Authority.

The three options for crossing watercourses and drainage lines are:

- Trenching: 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 generally used for ephemeral overland flow paths (due to its invasive nature). 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 to allow new infrastructure to be laid. Provided there are suitable geotechnical conditions, this method can be less invasive than trenching as it can limit disruption to the watercourse bed and banks. It is typically used for major waterways that are flowing. 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.
- Designing structures to accommodate cables: If a waterway crossing is large enough, it is possible for the cables to be attached to the structure. This removes the need for additional crossing construction.

Final designs of waterway crossings would be refined during detailed design when the balance of plant contractor is engaged, and the requirements of the crossings are better defined. Further detail about watercourse crossings is provided in Chapter 12 – ***Surface water***.

Overhead cabling

Around 42 kilometres of 33-kilovolt overhead cabling is proposed to connect wind turbines to the new on-site terminal station. The overhead dual-circuit distribution line would consist of single or dual pole lines, with poles up to 26 metres high.

On-site terminal station and battery energy storage system

The on-site terminal station and battery energy storage system 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 turn in towers transitioning the existing 500 kilovolt to and from the terminal station, transformers, switchgear, power conditioning equipment, energy storage technology, switch room and control building, cabling and backup generators From the terminal station, electricity produced by the project would be exported to the national electricity network via the existing Moorabool to Heywood 500-kilovolt transmission line.

The on-site terminal station 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 (four 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 6.25 shows a typical concrete 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 relevant landowners.

Figure 6.25
Example concrete batching plant
(Source: University of Melbourne, 2019)

On-site quarry

The quarry concept plan (Figure 6.14) 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.

Further details of the quarry operations and design can be found in Attachment II – ***Preliminary draft Quarry Work Plan***.

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 Keillors 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 on-site quarry is proposed to be excavated in stages to limit groundwater and surface water inflows to the quarry pit. As the quarry progresses, the stages will be backfilled to at least one metre above the water table.

The quarrying processes 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. 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 from under the stacking conveyors, load delivery trucks for haulage to construction work sites, and for general housekeeping duties on the hardstand area.

All rock processing would take place within the quarry work authority area.

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. 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 construction disturbance area, where they would be available for top dressing the area being rehabilitated.

Around 220,000 cubic metres of overburden 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 eight 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 which will 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 (i.e., low point), within the work authority area.

The proposed on-site quarry is intended to be a 'zero discharge' site, with all surface water and groundwater to be managed within the work authority area using retention basins. Stored water will be used for dust suppression and other processing activities, with an estimated water usage of up to 15 megalitres per year. Based on modelling undertaken by Water Technology (Appendix B – ***Surface Water and Groundwater Impact Assessment***) surface water and groundwater inflows can be managed through in-pit sump pumping (i.e., in-pit dewatering).

Surface water management measures would be consistent with those developed for the project as a whole. Chapter 28 – ***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 suitably covered area in accordance with legislative requirements. All refuelling and minor servicing would be conducted on the hardstand area or the processing plant/stockpile area.

Closure and rehabilitation

As the quarrying progresses, each stage will be backfilled to at least one metre above the water table, which will prevent the ongoing loss of groundwater from the quarry pit that would occur if it remained open and below the water table. A retention basin is proposed to capture any surface water inflow. Any water captured in this basin will be lost through evaporation and seepage.

Once the proposed on-site quarry is decommissioned, it will no longer be actively managed for surface water inflow. The proposed retention dams will be rehabilitated, and the quarry pit will remain with a permanent dam located at the bottom. Rehabilitation batters will be at least 1V:4H to quarry floor level, which will be backfilled to above the recovered groundwater level.

The time for the quarry pit lake to reach equilibrium after quarrying has finished will depend on several factors including the final rehabilitated quarry pit surface, the surface water inflow rate, and losses through evaporation and seepage.

At the completion of extractive operations all buildings, sheds and mobile equipment would be removed from the site. Quarry rehabilitation is described further 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 terminal station and battery energy storage system, 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.

The proposed 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 energy storage system and site office concrete slabs from the on-site quarry.

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 Mt Shadwell quarry. Use of the Mt Shadwell 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 25 – ***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. If acid sulfate soil or contaminated soil is encountered during construction, it would be managed as a priority waste in accordance with EPA Victoria Publication 1968.1: Guide to classifying industrial waste. An Acid Sulfate Soil Management Plan [EMM LS02] and Spoil Management Plan [EMM LS03] would also be developed for the project (see Chapter 28 – ***Environmental management framework***).

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 used external to the to the quarry work authority area.

It is estimated that up to 300 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, and to make concrete for wind turbine foundations and concrete slabs (at terminal station). Weather conditions during the period of construction, in particular temperature, would affect the volume of water required.

Should the water available from the proposed 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 6.2.2). 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 DEECA, 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 8 – ***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 commitments and project permit conditions (contained within Chapter 28 – ***Environmental management framework***), and in consultation with participating landowners hosting infrastructure.

6.4.3 Operation

Wind turbines start to generate energy at wind speeds of around three 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., 6.8 megawatts if using the nominal rated capacity of a 6.8-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 17 – ***Noise and vibration*** and Chapter 15 – ***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 24 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 as required over the lifetime of the project. 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 on-site terminal station, 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 25 – ***Traffic and transport*** for further details about vehicle use during operation.

6.4.4 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 participating 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 six to twelve 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 28 – ***Environmental management framework*** includes requirements to manage the decommissioning of the project in a way that mitigates and manages any associated impacts. These requirements would be captured in a Decommissioning Plan for the project.

Wind turbines and battery energy storage systems are decommissioned in accordance with environmental regulations, planning permits, and industry best practices. Most above ground components of the project can be recycled at the end of their life, including wind turbine components such as steel towers, copper wiring, and concrete foundations which are commonly recycled where feasible. Blades, which are often made of composite materials, may be repurposed, landfilled, or sent to specialised recycling facilities if available. Battery systems, including those used for energy storage, are removed and either refurbished, recycled through licensed e-waste facilities, or disposed of in compliance with hazardous waste regulations. 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. Waste and materials management would be outlined in the Decommissioning Plan.

Upon decommissioning, below-ground infrastructure, including wind turbine foundations and underground cables, may be left in situ to minimise further ground disturbance and covered with at least 500 millimetres of clean fill material. Wind turbine cables commonly use XLPE polymer insulation, which is inert and resistant to degradation. Due to the stable nature of modern cable materials, it is generally accepted under industry standards and asset management practices that underground cables can be left in situ without posing environment and health risks. 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 participating landowner hosting wind farm infrastructure. The land affected by the proposed on-site quarry would be managed and progressively rehabilitated throughout the quarry life to minimise the impact to the environment, as far as reasonably practicable, in accordance with the Rehabilitation Plan contained in Attachment II – ***Preliminary draft Quarry Work Plan***.

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.