Western Renewables Link

FACT SHEET

Transmission towers and conductors

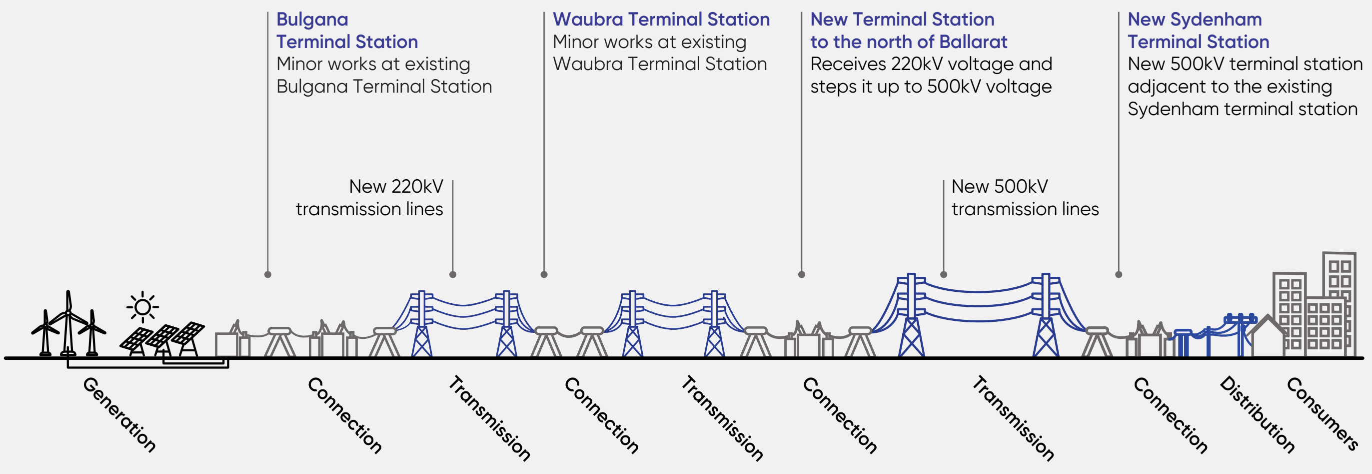
Please note that this document has been superseded and therefore may contain outdated information. To access current information on Western Renewables Link, please visit our website's Resources page or contact our project team.

Purpose

This fact sheet provides general information about the proposed Western Renewables Link overhead transmission towers and conductors (wires).

Information about underground construction of the Western Renewables Link is available in the Underground Construction Summary on the project website, Resources page.

Western Renewables Link



New overhead double circuit 220kV transmission line between the existing Bulgana Terminal Station, connecting to the existing Waubra Terminal Station and a new terminal station to the north of Ballarat.

From there, a new overhead double circuit 500kV transmission line connecting to a new terminal station at Sydenham.

For illustrative purposes only

Suspension towers

What are transmission towers?

Transmission towers are used to support the overhead conductors (wires) at the required height above the ground to meet regulations and safety requirements.

What are conductors?

Transmission conductors, commonly referred to as 'power lines' or 'wires', are the metal cables that carry high voltage electricity over long distances.

What will the Western Renewables Link towers look like?

The towers proposed for the project are **double circuit steel lattice towers**. They are called 'double circuit' towers because each tower supports two independent electrical circuits, one on each side of the tower.

The galvanised steel lattice structure is a common tower type used elsewhere in Victoria and the national network. This type of structure is proposed due to the large power transfer and redundancy requirements of the project. The proposed transmission line will have both suspension and strain towers.

What are suspension towers?

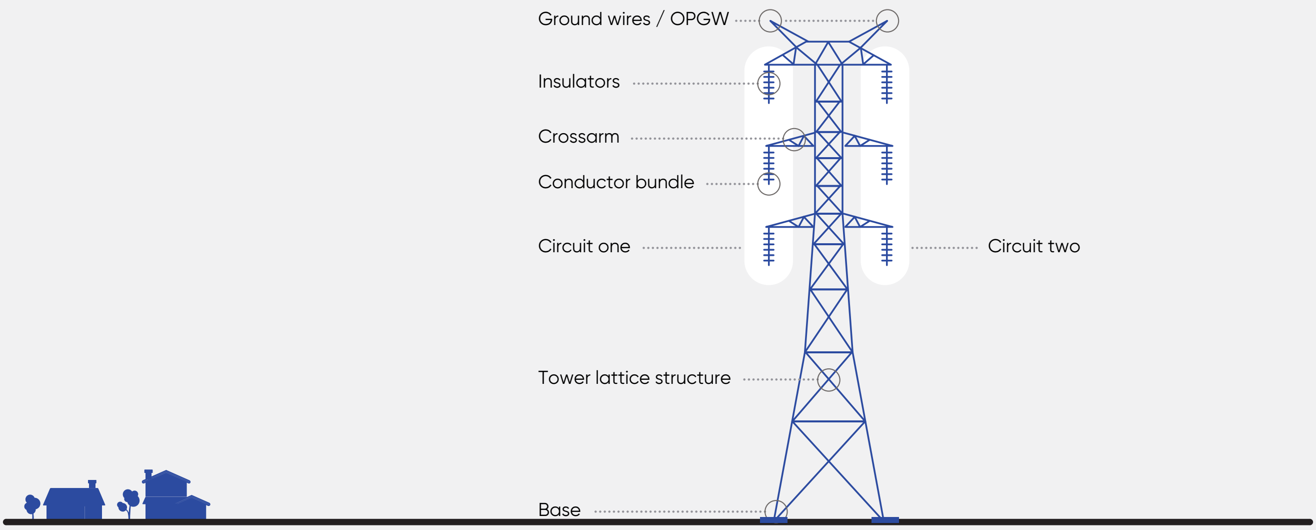
Suspension towers are used where the transmission towers are in a straight line or have a very small deviation angle (up to 10 degrees). The insulators and wires are strung vertically from the crossarms. Although designed to withstand high wind speeds, suspension towers hold up the wires but don't pull them to change the transmission line direction, therefore these towers have a smaller base and are lighter in weight and appearance relative to strain towers.

What are strain towers?

Strain towers are generally used where the transmission line changes direction beyond 10 degrees. These towers need to pull on the wires and are designed to take the tension load (or strain) of the wires. Generally, strain towers are larger at the base and heavier compared to suspension towers. The insulators and wires are strung horizontally on the crossarms on strain towers with some hanging insulators to help hold the conductors in place.

Strain tower

Double circuit steel lattice transmission tower features



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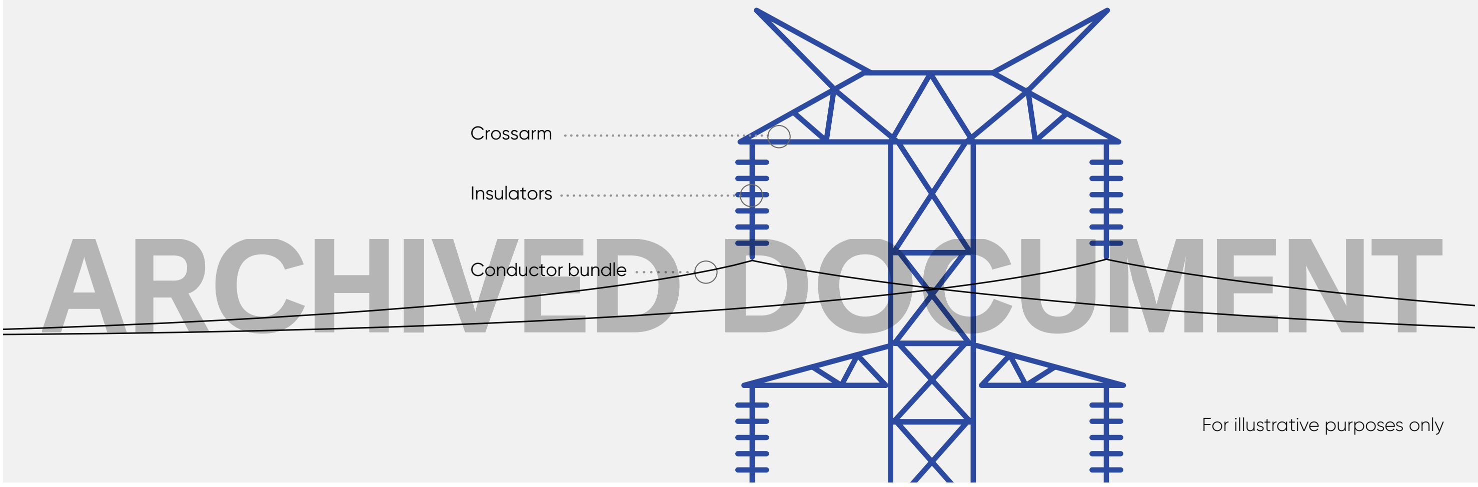
The conductor bundles (wires) are hung on each side of the crossarms. Insulators are used to attach the wires to the towers. These provide insulation between the high voltage electricity flowing through the wires and the (earthed) metal towers.

- **Circuit** – the unbroken conductive path for the flow of electricity between substations. Transmission line circuits in Australia have 3 phases per circuit.
- **Conductor** – the metal wires that are suspended from the towers along which electricity travels.
- **Conductor bundle (Phase)** – two or more conductors grouped together to efficiently increase power transmission for high voltage transmission lines.
- **Double circuit** – arrangement in which the conductors (wires) make two different circuits.
- **Ground (or earth) wire** – safety control that directs electricity to the earth by creating the shortest and easiest path in the event of a fault or lightning strike. Ground wires may incorporate a fiber optic core to provide communication between substations. These modified ground wires are commonly known as optical ground wires (OPGW).
- **Insulator** – a block of ceramic, glass or polymer that does not conduct electricity.

How many wires will there be on each tower?

	220kV	500kV
Number of circuits	2	2
Number of phases/conductor bundles per circuit	3	3
Number of wires per phase/conductor bundle	2	4
Number of ground wires	2	2
Total number of wires	14 (2 circuits of 3 phases each, with 2 wires per phase, plus 2 ground wires / OPGW)	26 (2 circuits of 3 phases each, with 4 wires per phase, plus 2 ground wires / OPGW)

Cross arm and insulator arrangement



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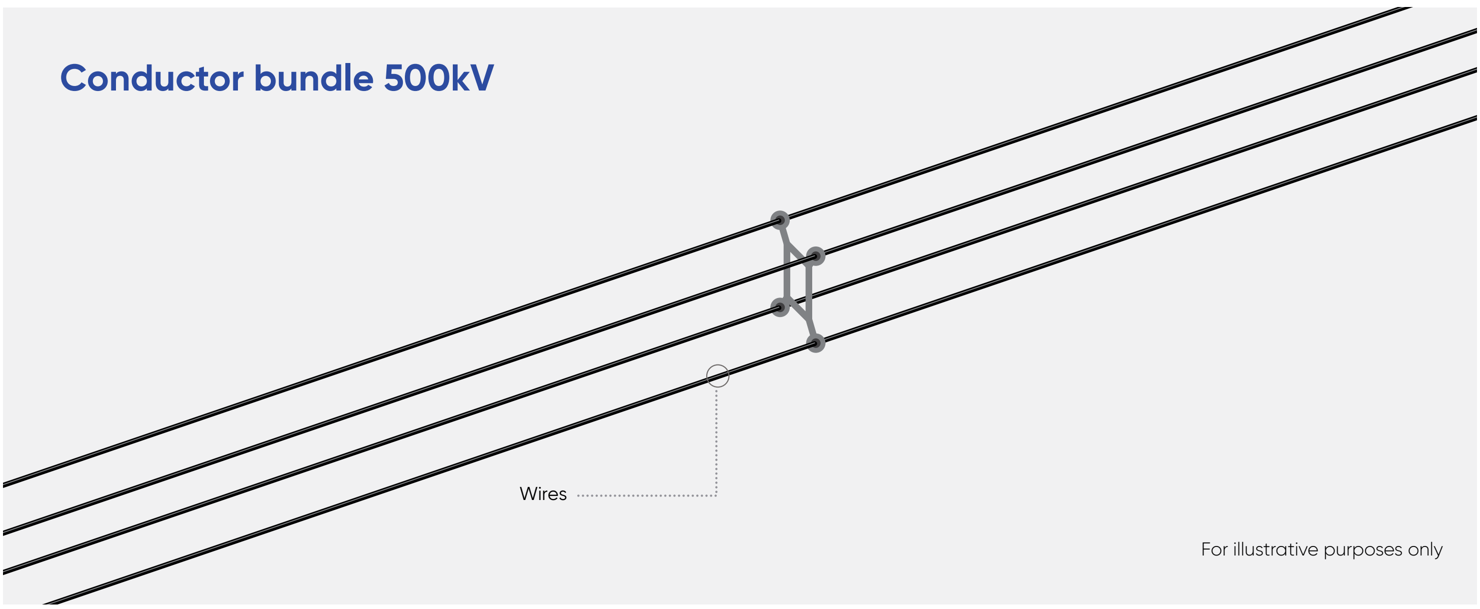
Conductor bundle 500kV



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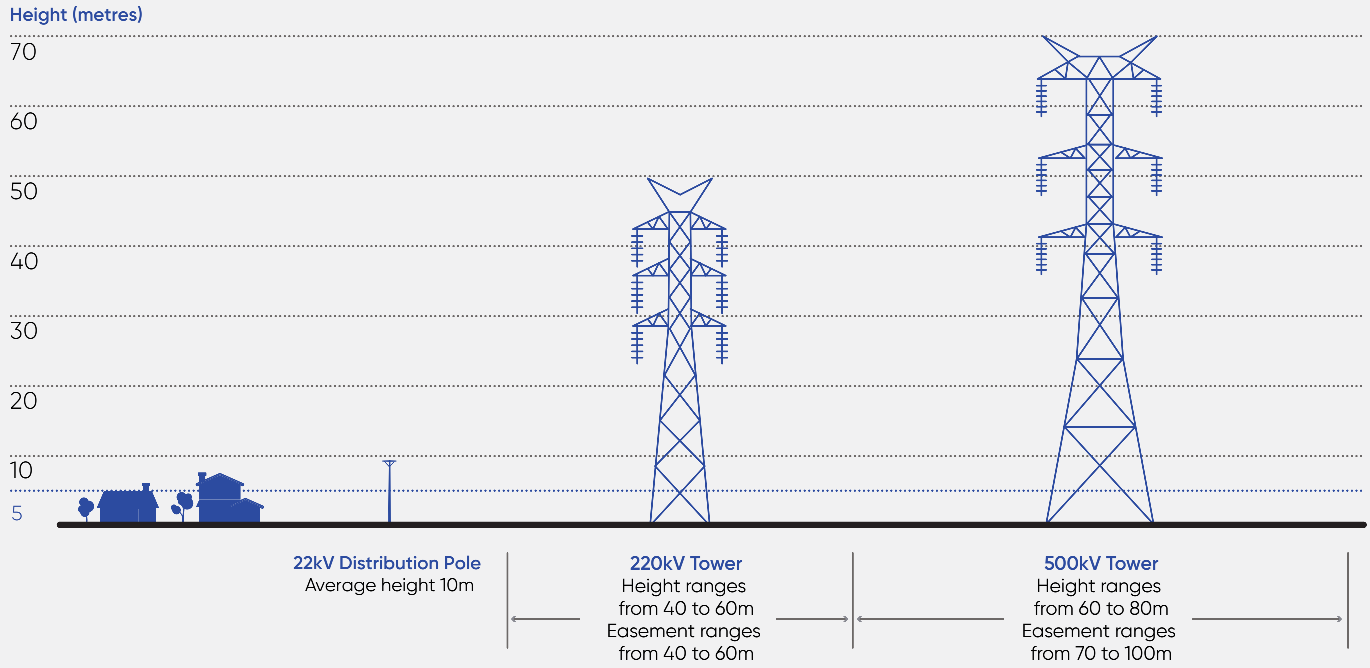
Transmission tower height and easement



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How high will the towers be?

The height of the towers will vary based on engineering and other requirements. The proposed 220kV towers between Bulgana and the new terminal station to the north of Ballarat will be between 40 and 60m high and the 500kV towers between the new terminal station to the north of Ballarat and the expanded terminal station at Sydenham will be between 60 and 80m high.

The height of transmission towers is governed by the Electricity Safety (General) Regulations 2019. Regulations for transmission tower design and maintenance requirements have improved since the initial construction of transmission towers in Victoria to respond to learnings from natural disasters, fire and other unplanned events.

Transmission towers and their associated footings and wires are designed to meet the requirements of AS/NZS 7000:2016 Overhead Line Design, which outlines the engineering requirements for the structural integrity of the towers. The height of each tower is designed to ensure that minimum electrical safety distances are achieved between each wire, each wire and the ground, and each wire and any objects that may traverse the ground underneath. Further factors including agricultural land use and equipment heights, visual and landscape considerations, or native vegetation can also influence tower heights provided all minimum safety clearances are maintained.

Transmission towers are fitted with an approved anti-climbing device at approximately 3m above the ground, and safety signage is placed on all towers.

How far above the ground will the conductors (wires) be?

The height of the conductors above the ground will vary depending on a number of factors including the height of the towers, how far apart the towers are, terrain and where in the span between towers the measurement is taken. In each span between towers, the conductors will typically be closest to the ground in the middle of the span due to the sag in conductors between the towers and will be highest above the ground closest to the towers which support the conductors.

The Electricity Safety (General) Regulations 2019 govern the minimum distances above the ground (clearance) the conductors must be. These clearances allow for thermal expansion, the required electrical safety separation and sufficient height for vehicles and equipment to work beneath the transmission line. Electric and magnetic field levels are also considered when designing the tower and conductor heights.

The typical minimum distances from the conductors to the ground proposed for the project are:

- For the 220kV section - 9.2m to ground traversable by vehicles, such as an access track or through a farm paddock.
- For the 500kV section - 15m to ground traversable by vehicles, such as an access track or through a farm paddock.

Closer to the towers, the distance from the conductors to the ground will be higher, ranging between approximately 29 to 37m in both the 220kV and 500kV sections.

The minimum clearances proposed for the project are greater than the minimum distances required by the regulations in some areas to improve land use and farming opportunities within the easement. Any increase in tower heights is however being balanced against other impacts, such as visual and landscape impacts.

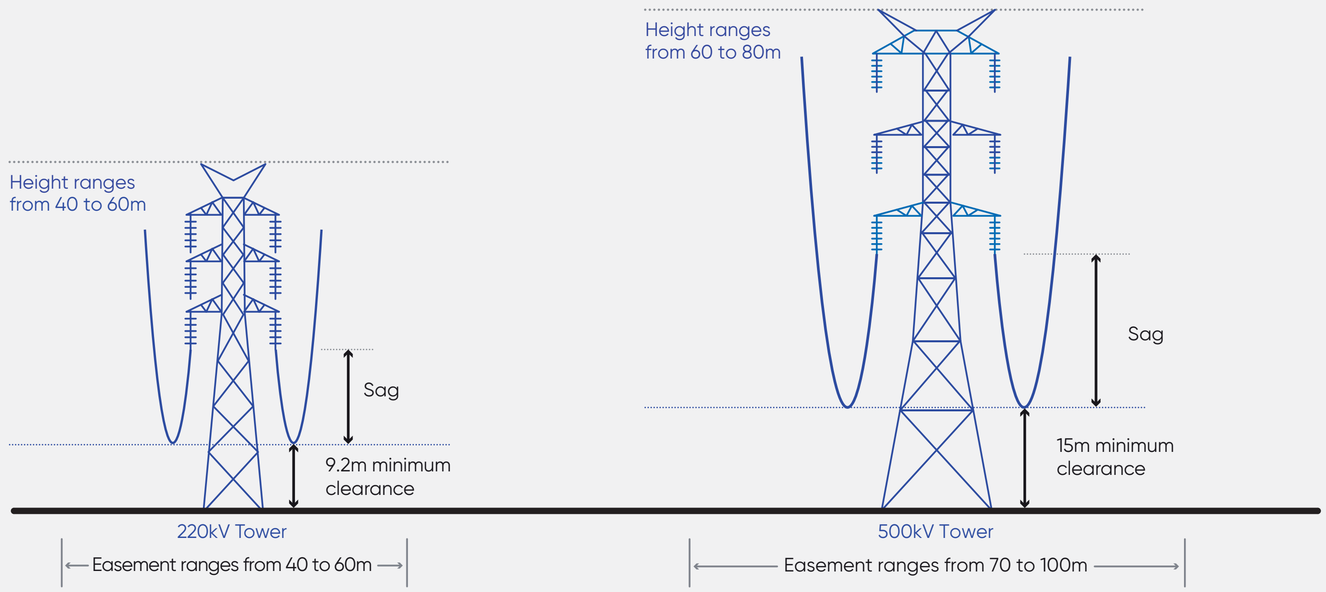
Minimum height clearances are typically used as the basis for activities permitted in the easement, however easement terms will be discussed with each landholder individually.

Information about activities permitted within the easement is available in the Landholder Guide on the project website, Resources page.

What are ground wires?

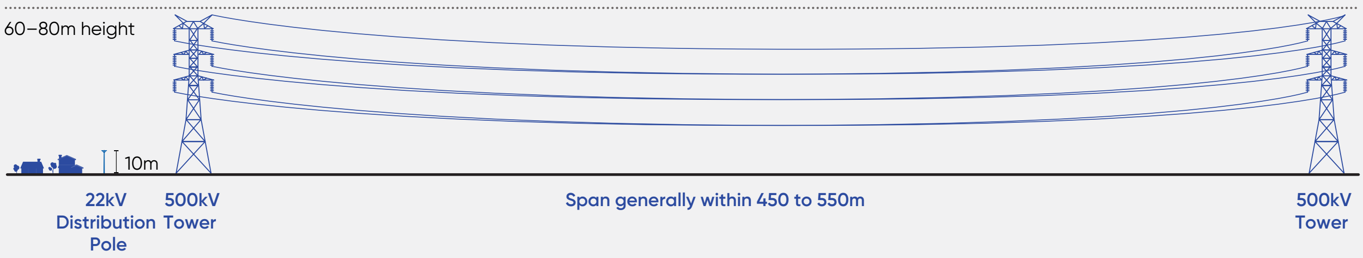
Ground wires are installed above the conductors (wires) to provide protection from faults and lightning. When lightning strikes the ground wire, the power in the strike is directed safely into the ground through the ground wire and towers. One or more of the ground wires may have a fiber optic core within the cable to provide communications between substations.

Minimum conductor height clearances



For illustrative purposes only

Typical transmission tower span



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How far apart will the towers be?

The spacing or span length between each transmission tower is determined by the height from the ground that the transmission conductors (wires) need to be in the middle of the span. The typical span between towers is generally within 450 to 550m for both 220kV and 500kV transmission lines. This may vary where the transmission line changes direction beyond 10 degrees. Shorter or longer span distances are possible over sensitive areas or to avoid impacts. Longer spans require taller towers to provide safe ground clearances and wider easements to allow for sway of the transmission lines.

How are tower locations determined?

The tower locations are selected by adopting the same criteria used for route selection, considering tower design spacing requirements, avoiding and minimising impacts to land use, avoiding culturally sensitive locations and habitat for threatened species, visual impact and considering terrain and geotechnical conditions.

Micro-siting, the process of determining an exact location for each transmission tower, is being undertaken in consultation with landholders, engineers and technical specialists.

What size will the tower base and footings be?

220kV

The width of the base of the 220kV lattice towers proposed for the project will range from approximately 8 to 14m (9m typical).

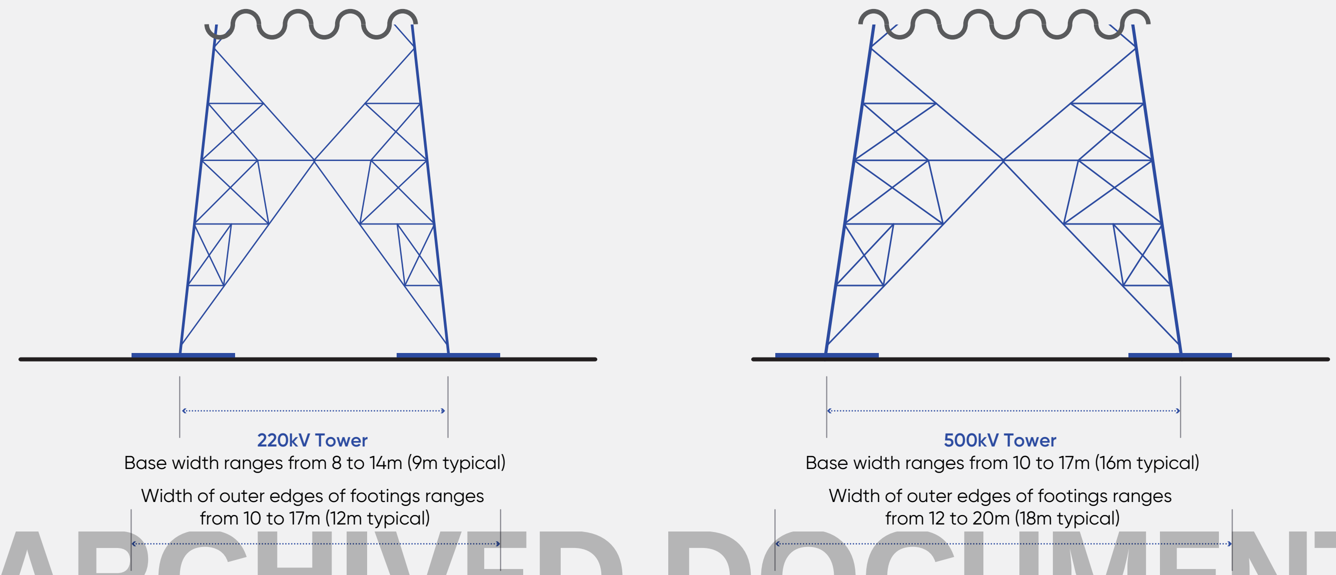
500kV

The width of the base of the 500kV lattice towers proposed for the project will range from approximately 10 to 17m (16m typical).

Four concrete pile footings (or foundations) are required for each transmission tower, which will range from approximately 1.5 to 3m in diameter (1.8m typical) and will range from 4.5 to 25m deep (9m typical depth).

The tower base and footing size will vary for different tower locations and soil conditions.

Transmission tower base and footings



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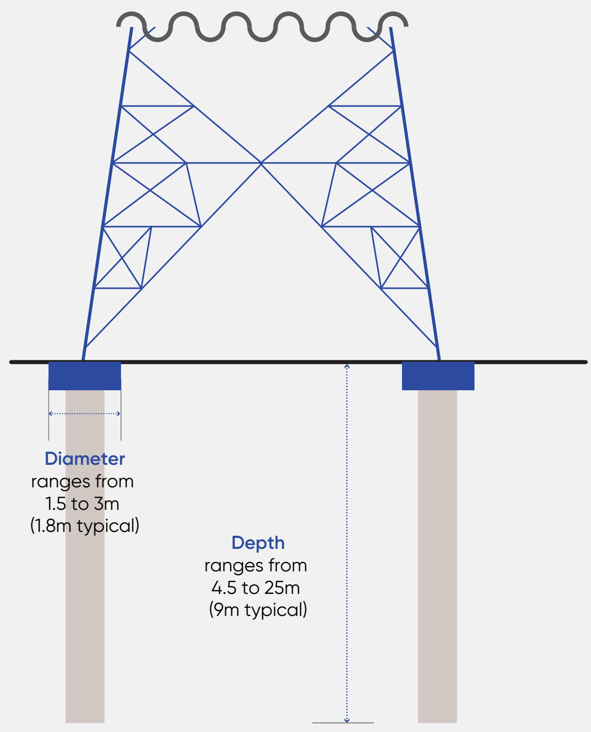
Transmission tower footings



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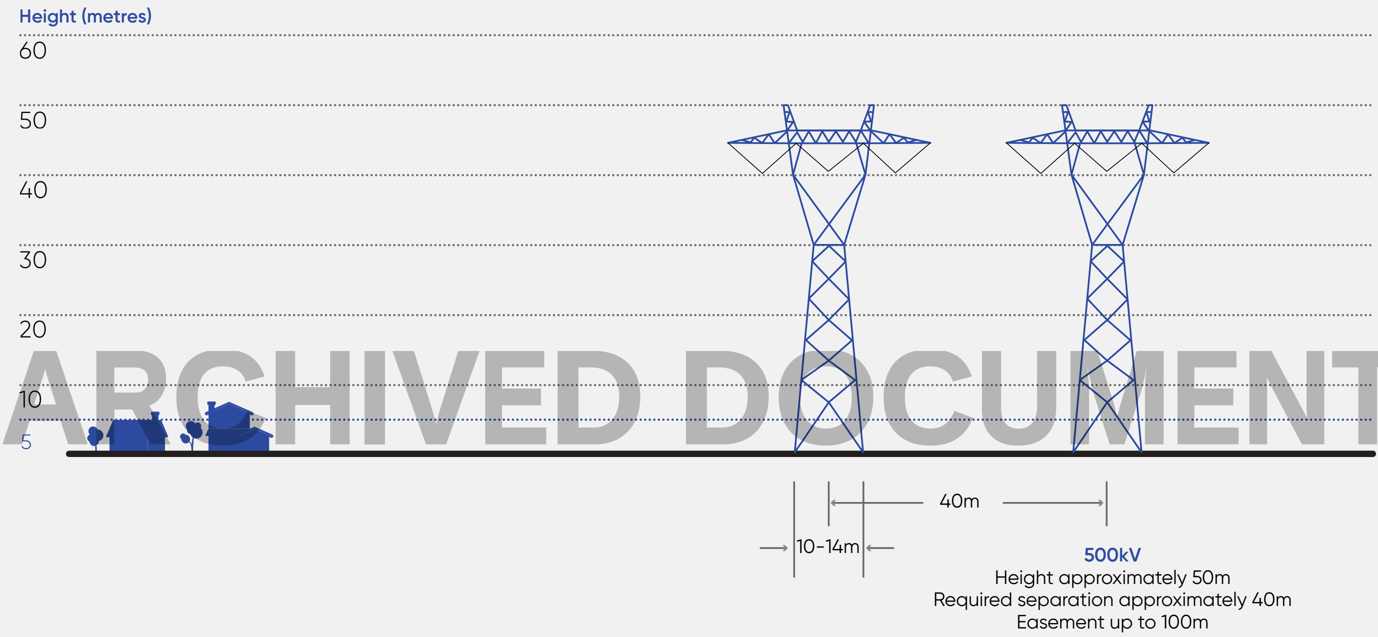
Other tower types

Alternative overhead structures are being considered in response to the Environment Effects Statement scoping requirements.

Single circuit steel lattice towers are being considered as an option in some areas and may be required near Melton aerodrome for aviation safety because they are shorter. A single circuit steel lattice tower supports one circuit per tower, therefore two single circuit towers would be located side by side, with a required separation distance of approximately 40m (centre to centre), to provide the double circuit transmission line required for the project. A single circuit transmission tower in the 500kV section would be approximately 50m high, with a base footprint ranging from approximately 10 to 14m. The easement for a section of single circuit lattice towers in the project may be up to 100m wide.

Monopoles, tubular steel towers, are also being considered as an option in some areas. A monopole in the double circuit 500kV section of the project would be approximately 70 to 75m high, with a base diameter of 3 to 4m. Two monopoles would be required side by side for heavy strain where the transmission line changes direction significantly.

Single circuit steel lattice tower height and easement



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Single circuit transmission towers

Monopole

Transmission tower information summary

	220kV transmission line	500kV transmission line
Tower type	Double circuit lattice towers, suspension towers and strain towers as required.	Double circuit lattice towers, suspension towers and strain towers as required.
Tower height	40 to 60m	60 to 80m
Minimum clearance from conductors (wires) to ground	9.2m to ground traversable by vehicles, such as an access track or through a farm paddock.	15m to ground traversable by vehicles, such as an access track or through a farm paddock.
Tower spacing	Generally within 450 to 550m	Generally within 450 to 550m
Tower footprint at base	Base width ranges from 8m to 14m (9m typical) Foundation width ranges from 10m to 17m (12m typical)	Base width ranges from 10m to 17m (16m typical) Foundation width ranges from 12m to 20m (18m typical)
Tower footing dimensions	Diameter ranges from 1.5m to 3m (1.8m typical) Depth ranges from 4.5m to 25m (9m typical)	Diameter ranges from 1.5m to 3m (1.8m typical) Depth ranges from 4.5m to 25m (9m typical)
Number of wires per tower	14 wires (2 circuits of 3 phases each, with 2 wires per phase, plus 2 ground wires / OPGW)	26 wires (2 circuits of 3 phases each, with 4 wires per phase, plus 2 ground wires / OPGW)
Easement width	40 to 60m	70 to 100m

Underground construction

Based on preliminary findings, overhead construction is considered most appropriate for the full length of the project. Further work on partial underground construction options is being undertaken to evaluate feasibility and the effectiveness of underground construction to mitigate impacts in areas where the potential for high impact is identified.

Information about underground construction of the Western Renewables Link is available in the Underground Construction Summary on the project website, Resources page.

More information

Further information about the construction process for the project and the proposed terminal stations to the north of Ballarat and in Sydenham will be published separately once available.

Western Renewables Link information

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Information straight to your inbox

Sign up for information straight to your inbox at the project website www.westernrenewableslink.com.au.

Complaints

If you have a query, a compliment or a complaint, you can let us know by using the online enquiry form on www.westernrenewableslink.com.au.
Or you can let us know by:

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Feedback

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Need an interpreter?

If English is not your first language or you need an interpreter, please call 13 14 50.

Other sources of information

Australian Energy Infrastructure Commissioner

(www.aeic.gov.au) including information about how to make a complaint, best industry practice and resources for landholders.

Australian Energy Market Operator

(www.aemo.com.au) including information on the Regulatory Investment Test for Transmission (RIT-T) process for this project.

Energy and Water Ombudsman Victoria

(www.ewov.com.au) including information about complaints and dispute resolution.

Energy Safe Victoria

(www.esv.vic.gov.au) including information about the safe design and operation of high voltage transmission networks in Victoria.

Environment Effects Statement Process in Victoria

(www.planning.vic.gov.au/environment-assessment/what-is-the-ees-process-in-victoria) including information about the environment assessment process managed by DELWP.

Essential Services Commission

(www.esc.vic.gov.au) including information about the regulation of transmission licenses in Victoria and the Electricity Transmission Company Land Access Statement of Expectations.

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