ElectraNet

Land use guidelines
for electricity
transmission corridors

We welcome and encourage early engagement to achieve the best and safest outcomes for land use planning within and around transmission corridors. For further information, or to start a conversation, please contact ElectraNet's Land Development team:

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1. Introduction

1.1 SAFETY FIRST

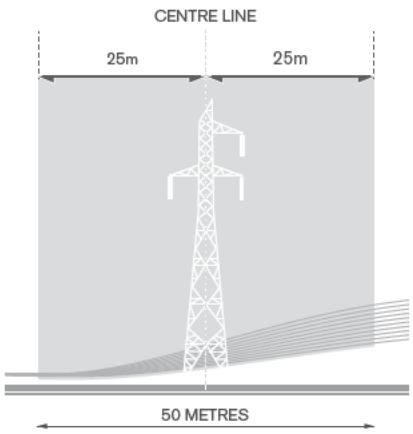
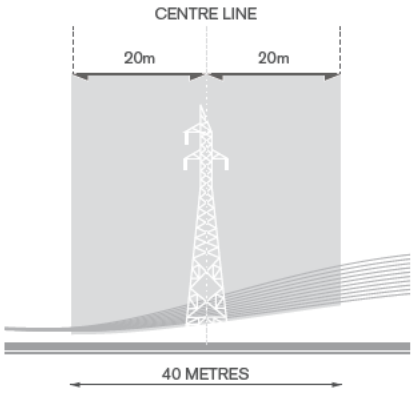
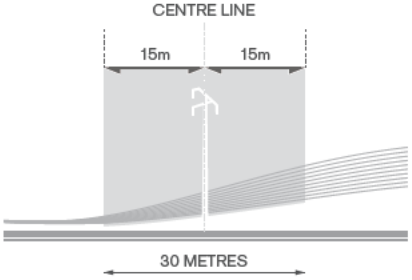
Electricity and the benefits it provides us have become part of our everyday lives. For the most part, we co-exist with the infrastructure that moves electricity around the state to our homes and businesses, without a second thought.

However, electricity has the potential to be dangerous and safety considerations must always be top of mind when planning future developments or carrying out any work near powerlines.

These guidelines describe safety clearance distances around electricity transmission lines, which are prescribed by legislation, and are summarised in the tables below. *(See Table 1).*

These safety clearances take into account the potential sag and swing of transmission lines and must be maintained to prevent structures from either coming into contact with transmission lines or being close enough for the electricity to

Table 1: Prescribed clearance distances for building structures near electricity transmission lines

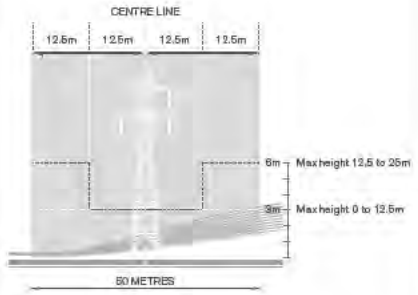
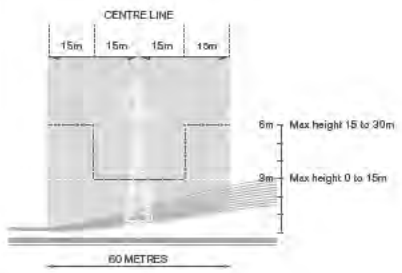
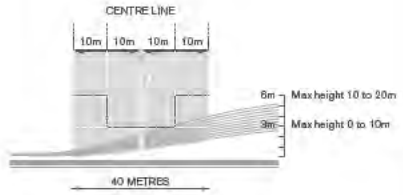
Building clearance distances		
The minimum safe building clearance distances between buildings or structures and powerlines are set out in the Electricity (General) Regulations 1997. These distances are a legal requirement and must be maintained at all times. The clearance distance, and how it is measured, depends on the voltage and type of power line. When building near high voltage transmission lines, (132 kV or higher), the safe clearance distance is measured horizontally from the centreline of the transmission tower		
Transmission line voltage 275,000V (275 kV)	Transmission line voltage 132,000V (132 kV) excluding single pole lines	Transmission line voltage 132,000V (132 kV) single pole lines
		
Minimum horizontal clearance distance 25 metres either side of centreline	Minimum horizontal clearance distance 20 metres either side of centreline	Minimum horizontal clearance distance 15 metres either side of centreline

arc from the transmission line to the structure. *(See Table 2).*

These safety clearances also take into account the potential sag and swing of transmission lines and must be maintained to prevent vegetation falling onto or growing into reach of transmission lines and potentially bringing the transmission lines down, conducting electricity or sparking and leading to fire-start.

In addition, any building or construction work proposed within the clearance distances of a transmission line must be approved by ElectraNet and the South Australian Government's Office of the Technical Regulator.

Table 2: Prescribed clearance distances for planting trees near electricity transmission lines

Vegetation clearance distances								
Limitations on the type and location of vegetation that can be planted near transmission lines are detailed in the Electricity (Principles of Vegetation Clearance) Regulations 2010. Planting limits only apply within a certain distance from the powerlines and depend on the voltage and insulation of the line and whether the powerlines are located in a bushfire risk area.								
Transmission line voltage 275,000V (275 kV)			Transmission line voltage 132,000V (132 kV) excluding single pole lines			Transmission line voltage 132,000V (132 kV) single pole lines		
								
Prescribed planting distance from centreline	0 - 12.5 metres	12.5 – 25 metres	Prescribed planting distance from centreline	0 - 15 metres	15 – 30 metres	Prescribed planting distance from centreline	0 - 10 metres	10 – 20 metres
Maximum vegetation height	3 metres	6 metres	Maximum vegetation height	3 metres	6 metres	Maximum vegetation height	3 metres	6 metres

1.2 HOW TO USE THESE GUIDELINES

These land use guidelines present a number of ways to minimise the impacts of transmission lines and optimise the opportunities for wider community benefit through the productive use of land within electricity transmission corridors.

They have been prepared specifically for townships, urban and peri-urban areas. They are important in the assessment of appropriate developments and land uses alongside and within electricity transmission corridors and are centred upon three primary objectives:

- **Safety**

  To avoid land use planning and design outcomes that could have the potential to endanger life or property.

- **Security**

  To provide for the security of essential state infrastructure by preventing land uses which are incompatible with the long term (50 year +) functional requirements to operate, maintain and replace electricity transmission infrastructure.

- **Community Benefit**

  To support and align with the amenity of neighbourhoods and optimise opportunities to yield wider community benefits by planning for the efficient and meaningful use of the land around the corridors of land within which transmission lines are located.

These guidelines can be used to inform Development Plan policy and structure planning for new growth areas with electricity transmission corridors running through, or adjacent to them, or to inform the assessment of applications adjacent to, or within, electricity transmission corridors.

They should not be seen to be 'one solution to fit all scenarios'. Consideration needs to be given to local characteristics of the electricity transmission corridor and the surrounding areas and context.

These guidelines look at a range of potential uses for:

- land already occupied by transmission lines
- interim uses of the land reserved for new or replacement transmission lines.

Chapter One explains how to use these guidelines; who and what is involved in the design and planning process; describes the elements of a transmission line and outlines the requirements of existing and future use electricity transmission corridors.

Chapter Two outlines the safety requirements relating to transmission lines contained in the *Electricity Act 1996* (SA) and *Electricity (General) Regulations 2012* (SA) and explains the safety principles behind these legal requirements.

Chapter Three describes the key principles behind the guidelines.

Chapter Four examines ways in which the land within and around the electricity transmission corridors can be used safely and efficiently to improve the visual amenity of the spaces within and surrounding electricity transmission corridors.

Chapter Five explains the importance of considering the design guidelines as part of the structure planning process.

The guidelines examine ways in which the land within and around the electricity transmission corridors can be used safely and efficiently to improve the visual amenity of the spaces within and surrounding electricity transmission corridors. As such, these guidelines are appropriate for:

- State Government Strategic and Policy Planners
- Local Government Policy Planners and Development Assessment Planners
- Local Government, Open Space, Recreation and Asset Management staff
- Developers
- Surveyors
- Planners and Urban Designers
- Engineers
- Landscape Architects
- Landowners.

1.3 WHO IS ELECTRANET?

ElectraNet is the principal electricity Transmission Network Service Provider (TNSP) in South Australia, operating as part of the National Electricity Market under the National Electricity Rules.

ElectraNet owns and manages the electricity transmission network throughout South Australia, transporting high-voltage energy over long distances and to remote areas between ElectraNet's direct-connect customers which include the state's electricity generators, large industry and the state's electricity distributor, SA Power Networks' (formerly ETSA Utilities).

ElectraNet's electricity transmission network is one of the most extensive regional transmission systems in Australia, extending across some 200,000 square kilometres of the state. This network consists of high-voltage substations, and transmission lines operating at 275,000, 132,000 and 66,000 Volts (275, 132 and 66 kV), which are supported by lattice towers, and large steel and concrete poles.

1.4 WHY THE NEED FOR GUIDELINES?

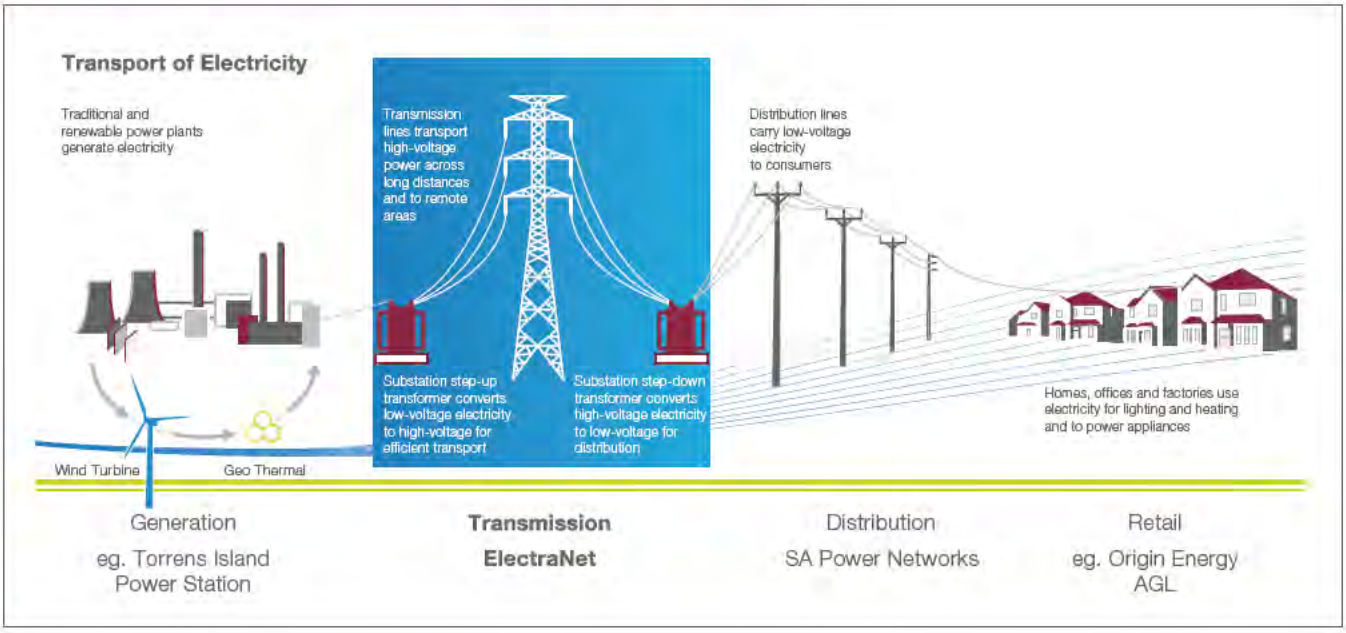
These guidelines have been prepared as a tool to assist planning authorities, developers and landowners understand the short and long-term requirements of the electricity transmission network in South Australia.

Electricity is so important to our way of life that our modern cities, towns and neighbourhoods cease to function safely without a robust and reliable electricity supply.

The delivery of this essential service to households, governments and industry relies on the state's electricity transmission network (ElectraNet) and electricity distribution network (SA Power Networks) of powerlines and substations that transport the energy to where it is needed. Understanding the needs and constraints of these energy networks is an important consideration in planning our cities and neighbourhoods.

Like road and rail networks, the overhead powerline networks are strong landscape elements that can shape the layout and function of our urban environment.

Figure 1(a): The role of ElectraNet in the electricity supply chain



Though the infrastructure can appear similar, electricity networks are built on a hierarchy based on safe voltage management, specific engineering requirements and supporting design.

Transmission lines are the electricity network equivalent of highways and freeways. These transmission lines with voltage support from transmission substations provide the efficient and safe transport of electricity, between states as part of the National Electricity Market and to ElectraNet's direct-connect customers.

Distribution lines (poles and wires) are the network equivalent of arterial roads and local streets bringing electricity directly to the meter boxes of consumers and re-distributing the surplus energy generated by domestic solar panels. These are the powerlines and underground cables found in most residential streets. In South Australia the distribution network is owned and operated by SA Power Networks.

The engineering and safety requirements of the transmission and distribution networks are very different. As line voltages increase, so do the safety and reliability requirements which affect the scale and cost of the infrastructure.

While both networks are important to South Australians, the scale and spatial requirements of the electricity transmission network have the greatest impact on the urban form.

These guidelines specifically cover South Australia's electricity transmission network and therefore it is important to recognise and understand the differences between the structures associated with each network.

ElectraNet's electricity transmission infrastructure is designed for a long service life often spanning up to 50 years. During this time the land uses around electricity transmission infrastructure can change as urban areas grow, mature and renew.

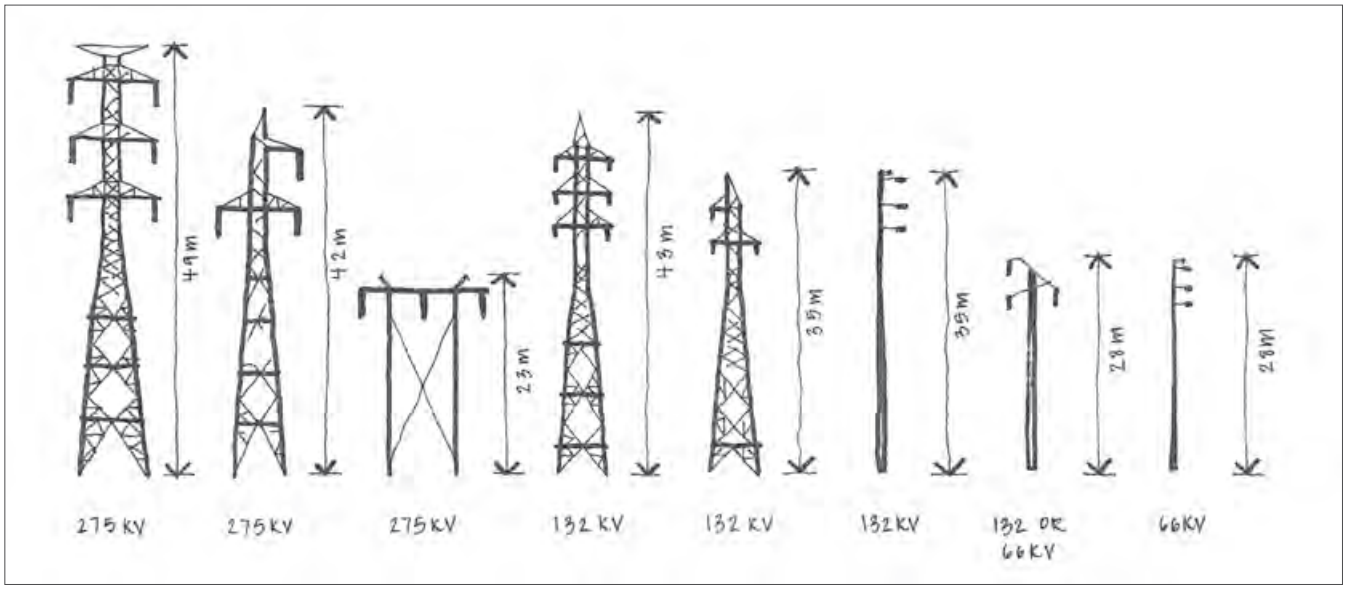
In some circumstances it can result in unsuitable land use that creates an unintended risk to public safety or an unforeseen threat to the reliability and continued operation of the infrastructure.

These land use conflicts can be avoided by understanding the long-term requirements of electricity transmission infrastructure and ensuring that land use planning considers their enduring nature.

Issues affecting safety must not be compromised.

Achieving a balance between security and community benefit objectives requires guidance and cooperation from all stakeholders, including ElectraNet, state and local governments, together with the landowners and developers impacted by current and future corridors.

Figure 1(b): The different types of electricity infrastructure found in South Australia. ElectraNet's electricity transmission lines range from 66 kV to 275 kV while SA Power Networks' distribution lines operate at a maximum 66 kV.



1.5 WHAT MAKES UP A TRANSMISSION LINE AND CORRIDOR?

It is important to understand how electricity transmission lines operate to gain an understanding of the risk and design considerations needed to protect the infrastructure, natural environment and community safety.

An electricity transmission line and its corridor is made up of a number of components, which include:

- **Conductors (also known as wires)**

  Conductors carry the power along the corridor and are attached to the towers or poles by insulators. Electricity transmission lines are usually configured to carry either three conductors (single circuit) or six conductors (double circuit) and also carry an earth wire mounted at the very top of the poles or towers. The number of conductors is not an indication of line voltage.

- **Towers and Poles**

  These are the supporting structures that hold the conductors above the ground, and generally the most visible element of a transmission corridor. There are a range of tower and pole structures, depending on the voltage of the line and the function of the tower (some assist in changing directions while others terminate the line). Sometimes towers and poles are supported by guy wires to reinforce the integrity of the structure.

- **Insulators**

  These are attached to the tower or pole structures and connect the conductors to the structure while preventing the transfer of electricity to the tower under normal conditions (refer page 14).

- **Easements**

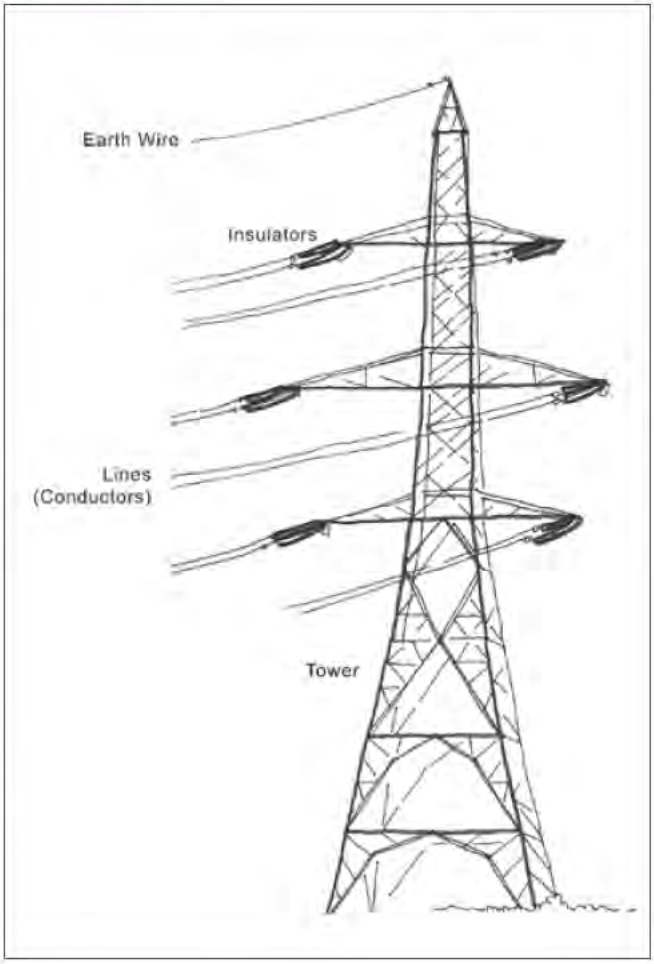
  As an electricity transmission line traverses the landscape it passes through both publicly and privately owned land. Although the land underneath the line is not owned by ElectraNet, the legal authority for the transmission line to exist and ElectraNet's right to operate the transmission line and access the land to maintain, repair and replace it, is provided by a property right known as an easement.

  Easements can take the form of a registered agreement (grant) which will appear on a landowner's certificate of title, or alternatively they may be authorised by an act of parliament. Easements do not grant title over the land, but allow ElectraNet certain rights of access and will often restrict the activities a landowner or occupier is permitted to conduct within the easement area.

When electricity passes through a conductor some of the energy is lost due to the electrical friction (resistance) of the material. It generates heat as the electricity flows through it.

At lower voltages this 'transmission loss' can consume a significant amount of the energy being supplied. Conversely by transmitting electricity at higher voltages, these energy losses are significantly reduced.

Figure 1(c): The components of an electricity transmission line



The increase in efficiency and subsequent energy savings at transmission voltages enables the efficient delivery of electricity over long distances and to remote areas.

Transmission lines are exposed to the elements. Wind, rain and temperature variations can affect their behaviour and even their form within the corridor.

This variability is important to consider as it guides the extent of clearances required around transmission lines.

Typically, the characteristics of transmission lines include:

- **Sag**

  The conductors expand and contract with variations in temperature, which is more pronounced in hot weather and under high electrical loads.

- **Swing**

  The extent to which the lines will move horizontally between the connecting transmission line structures as a result of wind.

The Electricity (General) Regulations 2012 (SA) prescribe the safe clearance distances between transmission lines and any nearby structures or vegetation (see pages 4 and 5 for details). These Regulations take into account the maximum likely effects of sag and swing on the conductors at any given location and are directly related to voltage.

Although they can often appear similar in width, registered easements are not reliable indicators of the prescribed safe clearance distances from a transmission line.

The restrictions on land use and development contained in registered easements apply in addition to the safe clearance distances prescribed by regulation.

Planning of electricity transmission corridor routes is typically in straight lines, with deviations minimised as much as possible. This minimises the length of the transmission line and the end cost impact on electricity consumers. It also improves the visual impact of electricity transmission corridors as deviations typically involve a greater number of towers.

The most visible elements of transmission lines understate the underlying complexity of the civil and electrical engineering design work inherent in their design and construction. Electricity transmission infrastructure is very expensive to design and construct and is not readily relocated, nor technically suitable for replacement with underground cable.

As such, the ability to relocate transmission lines is typically not financially sustainable (the cost of relocating transmission lines is ultimately borne by electricity consumers) and is generally avoided. It is therefore far more appropriate for development of areas around the corridors to cater for both the infrastructure already in place and future planned infrastructure within the corridor.

Figure 1(d): The 'swing' characteristics of an electricity transmission line

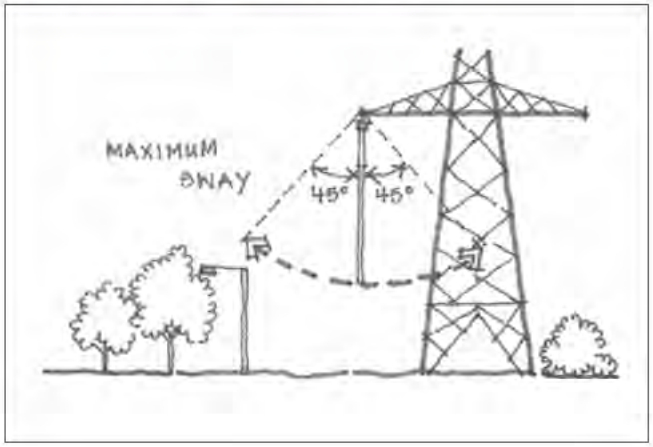
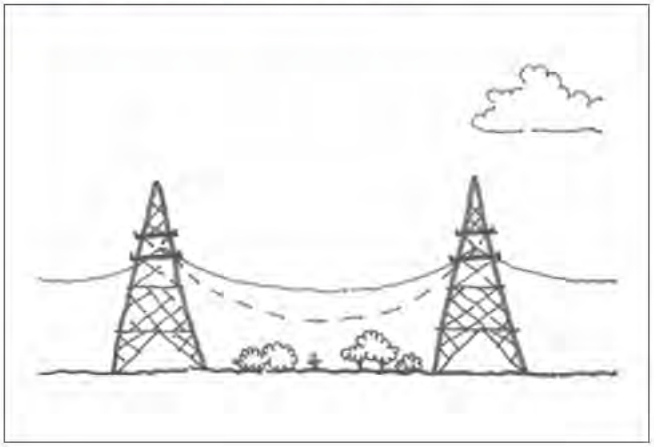


Figure 1(e): The 'sag' characteristics of an electricity transmission line



1.6 THE LIFE CYCLE OF A TRANSMISSION LINE

Electricity transmission lines have a functional life of around 50 years after which they usually need to be replaced to ensure the continuity of a safe and reliable supply.

The energy delivered by a transmission line is essential to the communities and customers it serves. This creates a dilemma; de-energising and dismantling an existing transmission line to rebuild it in-situ would leave the communities it serves disconnected over the many weeks and months it takes to build a replacement transmission line.

The most practical, efficient and socially palatable solution is to build the replacement transmission line alongside the existing transmission line, connect it and then dismantle the old transmission line.

If unsuitable forms of development are permitted to occur alongside or on both sides of a transmission line it can 'crowd in' the transmission line and complicate the rebuilding process. Rectifying the consequences of unsuitable development can impose a considerable social and economic burden on affected communities and electricity consumers.

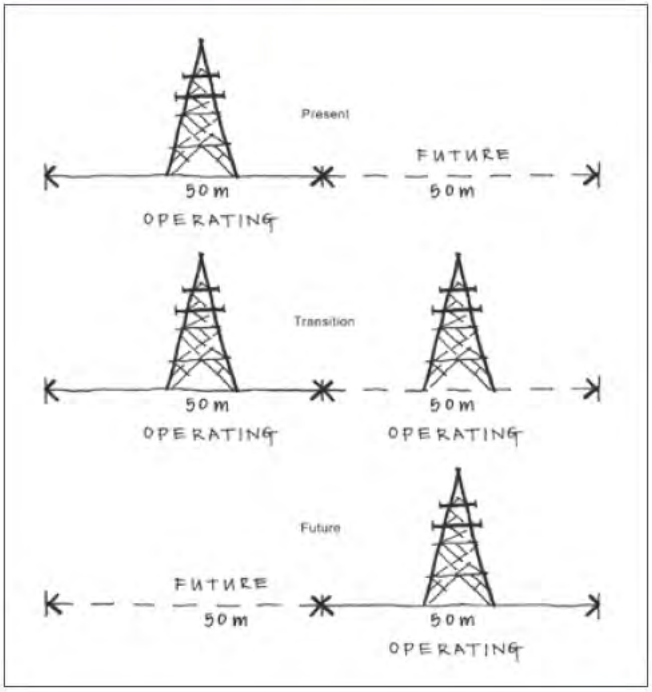
These guidelines note the need to include a whole-of-life transmission corridor within planning instruments.

The whole-of-life corridor has two parts defined by the 'operating corridor' in which the existing transmission line operates together with the 'future corridor' which provides space for its eventual replacement.

Once a transmission line has been replaced, the operating and future corridors switch. The area with the new transmission line becomes the 'operating corridor' and the area vacated by the dismantled transmission line then becomes the 'future corridor' for the next rebuild in up to 50 years' time.

In the past, infrastructure planning has not identified nor secured corridors for future or replacement transmission lines, but ElectraNet works closely with the state and local governments and developers to identify, preserve and in some cases acquire, future corridors.

Figure 1(f): Operating and future electricity transmission corridors



2. Electricity Rules

2.1 LAWS GOVERNING DEVELOPMENT WITHIN TRANSMISSION CORRIDORS

The regulations that affect development around and under electricity transmission lines are:

- *Electricity Act 1996 (SA) and Electricity (General) Regulations 2012 (SA)*
- *Electricity (Principles of Vegetation Clearance) Regulations 2010 (SA)*
- *Development Act 1993 (SA) and Development Regulations 2008 (SA)*
- *Environment Protection Act 1993 (SA) and Environment Protection Regulations 2009*
- *National Parks and Wildlife Act 1972 (SA) and Regulations (2001)*
- *Native Vegetation Act 1991 (SA) and Regulations (2001)*
- *Water Resources Act and Regulations 1997*
- *Natural Resources Management Act 2004 (SA) and Regulations (2001)*
- *Aboriginal Heritage Act 1998 (SA)*
- *Native Title Act 1993 (Commonwealth)*
- *Heritage Places Act 1993 (SA)*
- *Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*
- *Occupational Health and Safety Welfare Act 1986 (SA) and Occupational Health Safety Welfare Regulations 2010* (operative until 1 January 2013 until repealed and replaced by *Work Health Safety Act 2012 and Work Health Safety Regulations 2012*)
- local and regional planning requirements and development plans
- any registered easements over the land.

Specifically, these regulations:

- promote the establishment and maintenance of safe and efficient systems for generating, transporting and distributing electricity
- establish and enforce appropriate standards of safety, reliability and quality in the South Australian electricity supply industry
- establish and enforce appropriate safety, environmental and technical standards for electrical installations and electricity infrastructure
- define the legal requirements for vegetation clearance around transmission lines, including requirements for clearing vegetation around electricity transmission lines and lower voltage distribution lines as well as legal safety limitations for planting trees near transmission lines
- define safety and technical requirements for electrical installations, electricity infrastructure, work on electrical installations, working near transmission lines, clearance from transmission lines for buildings and other structures
- aim to minimise the risk of bushfires, damage to transmission lines and electrical shocks without imposing excessive vegetation clearance
- protect the interests and safety of the South Australian community.

These laws and regulations contain information on mandatory requirements relating to development and vegetation clearance near existing electricity transmission assets. Failure to comply with them can endanger lives.

The safety rules prescribed by law are the minimum safety requirements at the foundation of these guidelines.

Remember, transmission lines carry electricity at extremely high voltages. Electricity at these voltages can arc through the air even without direct contact.

To protect human safety the law prohibits certain activities and types of developments from being undertaken near electricity transmission lines.

Safe separation distances are outlined within the *Electricity (General) Regulations 2012.* These regulations set out minimum separation distances for excavation and construction work and the operation of mobile works near conductors and their support structures (towers and poles). The primary purpose of these distances is to protect people and property from harm caused by electrical hazards, such as flashovers (see page 14).

Any suitable buildings, structures or ancillary services and uses (and their associated construction) proposed within the minimum safety clearance distances of transmission lines must be approved by ElectraNet and the South Australian Government's Office of the Technical Regulator.

3. Policy Principles

The following principles underpin the guidelines for land uses and design of buildings and spaces in and adjacent to electricity transmission corridors.

They drive the thinking about appropriate land use and design solutions when considering the guidelines for specific development sites or structure plan areas.

3.1 SAFETY

Safety is the primary driver behind the design of all electricity transmission infrastructure.

3.1.1 ELECTROCUTION

Even at the 240 Volts supplied to domestic households, electricity presents a danger of electrocution or electric shock.

In South Australia the electricity transmission network, which operates at 66 000, 132 000 and 275 000 Volts, is designed, maintained and operated to meet the highest standards of safety and reliability.

Although safety is inherent in the design of the infrastructure changes in surrounding land use, over time can increase the risk of an accident occurring.

Best practice urban design has an important role in negating these risks.

In urban settlements the safety of those taking part in activities within electricity transmission corridors, of those passing through them and of those living near them must be fundamental to the development of land use policies and planning decisions.

The safe clearance distances prescribed by the *Electricity (General) Regulations 2012* must not be compromised.

Planning authorities must assess the potential for hazards created by a development application in light of the risks associated with direct and indirect contact with a transmission line, including:

- **Flashovers**

  These are major electrical discharges, usually in the form of an electric arc, that jump from the conductor across the insulator to the supporting structure (or from the conductor to another object), resulting in a short circuit. Flashovers may be caused by a lightning strike, switching surge, contamination of the insulator or when a person or object breaches safety clearances. The safety measures ElectraNet employs and observing the safe clearance distances prescribed in the *Electricity (General) Regulations 2012* during planning can help minimise this risk.

- **Step and Touch Potential**

  'Step potential' is the voltage between the feet of a person standing near an energised grounded object. If a fault occurs in a powerline, the current will enter the ground to 'earth'. The strength of this current will decrease as distance from the current's grounding point increases. However, if a person is standing close to the grounding point when a fault occurs they could be at risk of injury. The safety measures ElectraNet employs and observing the safe clearance distances prescribed in the *Electricity (General) Regulations 2012* during planning can help minimise this risk.

  'Touch potential' is the voltage between the energised object and the feet of a person in contact with the object. If a person were to touch a powerline structure or a nearby conductive object when a fault occurs, they would become a conductor and would be seriously harmed as the current passed through their body and into the ground. The safety measures ElectraNet employs are in accordance with the *Electricity (General) Regulations 2012* and minimise this risk.

While the built form and vegetation plantings must comply with safe clearance distances prescribed by legislation, authorities must also be cognisant of not encouraging or permitting land use activities which could increase the risk of accidental contact with the conductors or flashovers.

Landowners and local authorities should also note the special requirements prescribed by regulation that apply to the operation of mobile plant and equipment (eg. excavators, cranes, elevated work platforms) within electricity transmission corridors.

3.1.2 ELECTRIC AND MAGNETIC FIELDS (EMFs)

As well as being naturally occurring phenomena, EMFs are also produced by human activity.

These invisible fields are present whenever and wherever electricity is used. They are associated with wiring in homes and offices, solar panels, electric clocks, computers, hair-dryers, electric blankets and other electrical devices, as well as all powerlines.

As the issue of EMFs sometimes attracts media attention, it is natural for individuals to express concern about any potential health effects that could be associated with them.

Many reviews have been published world-wide, but none have concluded that electric and magnetic fields cause or contribute to, adverse health effects.

A factual summary of current research findings is available from the Australian Government's Australian Radiation Protection and Nuclear Safety Authority (ARPANSA).

In the management of this issue, ElectraNet is guided by the findings of independent authoritative scientific and medical reviews, which evaluate research.

In its planning and development of South Australia's electricity transmission network, ElectraNet continues to adopt industry best-practice by acting prudently in the planning and siting of new electrical assets near communities across South Australia.

The clearance distances for safety purposes around transmission lines incorporate suitable buffers to limit exposures. Within the 'operating corridor' land use plans should discourage long, repetitive stays and, as an alternative, promote movement through the corridor or along it for short or infrequent times. These guidelines have been written with these objectives in mind.

3.1.3 COMMUNITY SAFETY AND CRIME PREVENTION

Electricity transmission corridors create large areas of open space through neighbourhoods. This land is often accessible to the public and it can be a valuable community resource if well planned.

The principles of crime prevention through environmental design should be included in land use and design considerations for development within, or adjacent to, electricity transmission corridors.

These principles assist in reducing opportunities for criminal activity and incivility to occur in areas accessed by the public by creating environments designed to lessen or prevent the incidence of crime.

3.1.4 BUSHFIRES

Essential to bushfire prevention and the safe operation of the South Australian electricity transmission network is the ongoing management of trees and vegetation to ensure that safe clearance distances are maintained at all times.

These critical safety standards for both bushfire and non-bushfire risk areas are prescribed by the *Electricity (Principles of Vegetation Clearance) Regulations 2010*.

It should be noted that the maintenance of existing vegetation is only one element of the regulatory requirements. ElectraNet deploys a range of risk reduction measures throughout the design, maintenance and operation of the electricity transmission network.

Automatic protection systems are inherent in the design and operation of South Australian electricity transmission lines. These, together with ElectraNet's rigorous system controls and operating procedures, minimise the risk of a bushfire being ignited by a transmission line even under extreme conditions.

As severe weather conditions may increase the risk of fire start to unacceptable levels, or where bushfires are already burning, ElectraNet's operating procedures include the de-energisation of line segments.

By ensuring that any new plantings within electricity transmission corridors are designed and located to ensure compliance with regulatory requirements, the safety risks created by inappropriate species and plantings together with the significant cost, disturbance and community angst that tree trimming programs can create, can also be avoided.

3.2 SECURITY OF SUPPLY

Electricity transmission corridors contain the critical infrastructure that provides the efficient transport of electricity from traditional and renewable energy generators to electricity distributors and subsequently the homes and businesses of almost every South Australian.

The reliability of electricity transmission supply is a foundation of our modern economy, and ensuring that supply continues without interruption must be central to development considerations which could impact on the ability to operate and maintain South Australia's electricity transmission network.

Developers and planners must ensure that proposals to alter land use within or near electricity transmission corridors do not give rise to circumstances which could result in damage to the existing infrastructure.

This risk could arise either through increasing the risk of direct accidental contact with transmission lines by vehicles and equipment or through the effects of pollutants which could increase corrosion or increase the risk of flashovers through the deposit of dirt and other chemicals and materials on insulating equipment.

Security of access to the infrastructure within electricity transmission corridors is necessary for the inspection and maintenance of elements of transmission lines.

This is critical in keeping the transmission lines in the safest and most efficient condition and relates directly to minimising power outages and securing supply.

Cranes and heavy vehicles require safe and ready access to transmission lines, poles and towers for both routine and emergency maintenance works. If development which restricts the ability of maintenance crews to access the infrastructure is permitted to occur it can delay the ability to repair the infrastructure and quickly restore power at a critical time. In addition the high cost of any extended power outages and remedial work is borne by the community.

The safe separation distances outlined within the *Electricity (General) Regulations 2012* set out minimum separation distances for excavation and construction work and the operation of mobile plant and equipment on easements near conductors and their support structures.

The importance in establishing and adhering to these distances is to protect maintenance crews and the general public from harm caused by electrical hazards, in particular flashovers.

Linked to the issue of security of supply is the need to secure space for the replacement and upgrading of the infrastructure for the future. The functional life of a transmission line is around 50 years after which a full rebuild is usually needed to ensure its continued safe operation and maintain an uninterrupted supply to consumers.

Over these long life cycles the land uses around transmission lines are prone to change.

Consequently the development of areas adjacent to electricity transmission corridors needs to take into account the potential future needs within the electricity transmission corridor, and be adaptable to accommodating the infrastructure and additional limitations on this land associated with this function. The identification of additional corridor areas needs to be undertaken early, prior to the identification and development of growth areas.

3.3 COMMUNITY BENEFITS

The land set aside to accommodate both the 'operating' and 'future' elements of an electricity transmission corridor is a valuable resource.

With the restrictions on development and activities within electricity transmission corridors, it is likely that many areas within corridors will vest in public ownership through land division processes and form part of a community's public open space.

Although the land may be encumbered in part by the presence and functional requirements of the electricity transmission corridor, the large tracts of open space and the linear connections it provides through the communities it traverses presents opportunities for innovation in land use design and the development of sustainable neighbourhoods.

Planning should therefore aim to:

- achieve a land use and design outcome that maximises efficiency in the use of land
- seek the best possible use of the land for community benefit, taking into account the policy drivers
- contribute to the 'healthy environments' function for new urban growth areas
- consider future requirements to rebuild and switch active lines within a corridor.

3.3.1 VISUAL AMENITY

The form and scale of transmission lines and the elements that comprise the transmission network are, through necessity, robust and can dominate the landscapes through which they pass.

It is not always possible to eliminate the visual impact of this infrastructure at a broad landscape scale. However, in urban settings and at street level, the principles of landscape design can be used with good effect to reduce the prominence of transmission lines and improve the environment and spaces in and around electricity transmission corridors in general.

4. Design Guidelines

Many recreational activities can safely take place under and around transmission lines, but their presence places some necessary restrictions on how the land can be developed and used.

These guidelines apply to three different scenarios:

- development within electricity transmission corridors
- switching active lines within an electricity transmission corridor
- development adjacent to electricity transmission corridors.

4.1 DEVELOPMENT WITHIN TRANSMISSION LINE CORRIDORS

While there are limitations to the number of land uses that can be established within the electricity transmission corridors themselves, the aim should be to maximise the diversity of land uses and activities (even if they are ancillary to adjacent land uses) within the corridor, to add interest and assist in breaking up the linear characteristic of the corridor.

The following land uses are appropriate within the electricity transmission corridor (subject to achieving adequate separation distances from transmission lines).

4.1.1 PASSIVE OPEN SPACE

Subject to meeting the prescribed safe clearance distances passive open space can be supported by amenities, including toilets, playgrounds, barbecue facilities, seating, shelters, drinking fountains and informal gathering spaces.

Permitted

Passive open space should add visual interest and structure to electricity transmission corridors as well as provide for passive recreational activities by:

- encouraging visitors to pass through the area via delineated recreational trails
- including small public spaces suitable for picnic areas, barbecuing and informal gatherings
- incorporating banks of indigenous plantings which can enhance the amenity of the area.

Not Permitted

Any recreational activities which create a risk of flashovers or contact with a conductor, compromise safe clearance distances, create an electrical hazard or could result in damage to the infrastructure, including:

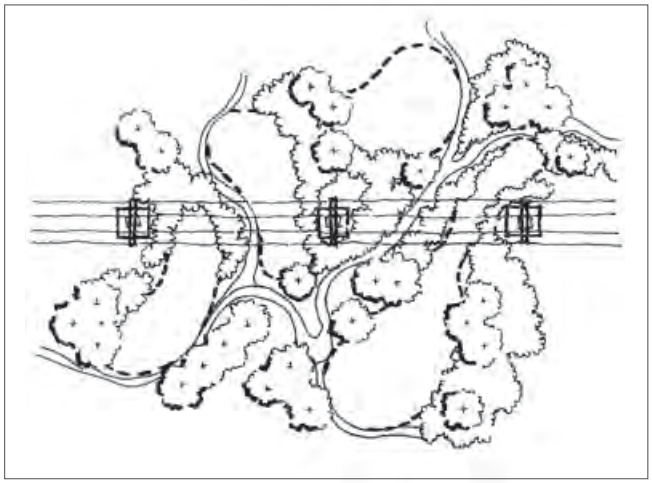
- kite flying
- model airplane flying
- fishing
- insulated containments (eg. swimming pools).

Siting and Design

Environmental design should ensure adequate natural surveillance and connectivity for permitted uses while intuitively inhibiting non-permitted uses through:

- providing small passive open spaces which restrict active uses
- undertaking mass planting within specific locations
- incorporating a shallow body of water.

Figure 4(a): Passive open space with delineated recreation trails and small pockets of open space.



4.1.2 ACTIVE OPEN SPACE

Active open spaces may be appropriate within the electricity transmission corridor provided they do not increase the risk of contact with the lines (eg. by kicking or hitting a ball into transmission lines).

This requires consideration of the use of the spaces and playing fields (particularly if they are shared with various sports) and the extent to which they are located directly under transmission lines. It is recommended that these recreational developments are established at the edge (or outside) of corridors.

Permitted

Playing fields and courts where balls and objects are not likely to come into contact with lines such as:

- hockey
- athletics
- tennis courts
- netball or basketball courts.

Active play spaces such as an off-leash dog park may also be appropriate for this area.

Limitations on structures needs to be considered when planning the location of a facility for organised sporting clubs within the electricity transmission corridor (such as ovals and pitches) to take into account the future needs of the sporting club, such as lighting or stands and shelters, which may be prevented from being developed due to the need to adhere to safe clearance distances.

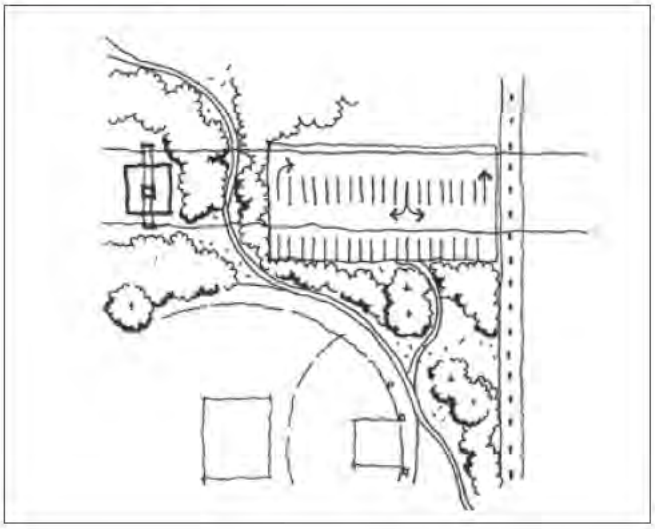
Not Permitted

Active areas where contact with transmission lines may be possible include activities likely to increase the risk of ball contact with transmission lines such as:

- Australian rules football, rugby or soccer
- cricket
- softball or baseball
- kite flying
- model airplane flying
- fishing.

These activities are more appropriately located outside of the electricity transmission corridor. If these uses are located adjacent to the electricity transmission corridor, the corridor can then be used for more appropriate land uses which are ancillary to active recreation uses such as car parking, training areas and landscaping.

Figure 4(b): Active open space with activities and ancillary uses.



4.1.3 FOOD PRODUCTION

Spaces within the corridors provide an opportunity to create a range of food production areas to service the local community.

Permitted

A number of food production activities may be possible, from community to commercial production, including:

- a local community garden serving nearby residents
- larger scale community commercial enterprises incorporating orchards, vegetables and viticulture
- private commercial farming, similarly incorporating orchards, vegetables and viticulture
- food gardens and training 'patches' related/linked to education facilities.

These activities are appropriate within electricity transmission corridors, provided they do not result in structures and vegetation above the desired minimum safety clearances.

Small structures (eg. storage sheds, toilets etc.) are also appropriate outside of prescribed safe clearance distances, but should be located on the periphery of the corridor to maximise distances from electricity transmission lines.

Safety clearances also need to be considered for making these spaces accessible at night, through the careful design and placement of lighting so that it achieves separation distances for safety.

Care also needs to be taken to ensure any farm machinery or equipment moved around or under a transmission line is not at risk of coming into contact with transmission lines.

Not Permitted

Some activities relating to food production are not suitable within electricity transmission corridors, including:

- planting of orchard trees which exceed the maximum height restriction for plantings within electricity transmission corridors
- implementing unregulated irrigation and the spraying of chemicals on crops and vegetables in locations under transmission lines, which can lead to exposure of transmission lines. This can be appropriately avoided through management guidelines for such ventures (eg. covered by leases or management agreements over public land).

4.1.4 CONNECTIONS - ROADS, CYCLEWAYS, PATHS AND TRAILS

Roads, cycleways, paths and trails are appropriate within electricity transmission corridors as they can help break up the linear characteristics of the electricity transmission corridor, as well as provide access along the corridor and between the two sides of the corridor to key nodes.

Attention should be paid to the orientation and alignment of roads, cycleways and pedestrian paths and horse trails throughout electricity transmission corridors, so that they help improve the amenity of the corridor space, rather than emphasise the negative aspects of corridors and infrastructure. Similarly, attention should be paid to potential conflicts between user preferences for trails (eg. separating horse trail and pedestrian paths).

It is also important to site new roads in ways which reduce the potential for vehicle collisions with transmission lines.

'Designing in' the electricity transmission corridor as part of the land division layout and structure planning of an area can help achieve a more seamless connection between development on both sides of the electricity transmission corridor, as well as create a number of different spaces, uses and functions within the corridor to provide interest and break up the linear element of space.

Permitted

Roads within the electricity transmission corridor should be positioned to allow for connectivity with surrounding areas and minimise views to transmission lines. The following roads, cycleways and paths are permitted:

- roads to provide access to infrastructure, such as transmission lines
- roads/cycleways/paths to break up large expanses of linear open space
- roads which connect to nodes in adjacent areas
- paths/trails with adequately spaced amenities (eg. seating)
- separate paths/trails for horses
- shared pedestrian and cyclist path.

Not Permitted

The layout and positioning of roads, cycleways and paths within and surrounding the electricity transmission corridor should not compromise the amenity of the area. As such, the following should be avoided:

- roads/cycleways/paths which create a terminating vista at transmission lines
- roads which facilitate orientation of allotments towards transmission lines.

Figure 4(c): Paths should meander through the electricity transmission corridor to prevent emphasising the linearity of corridors.

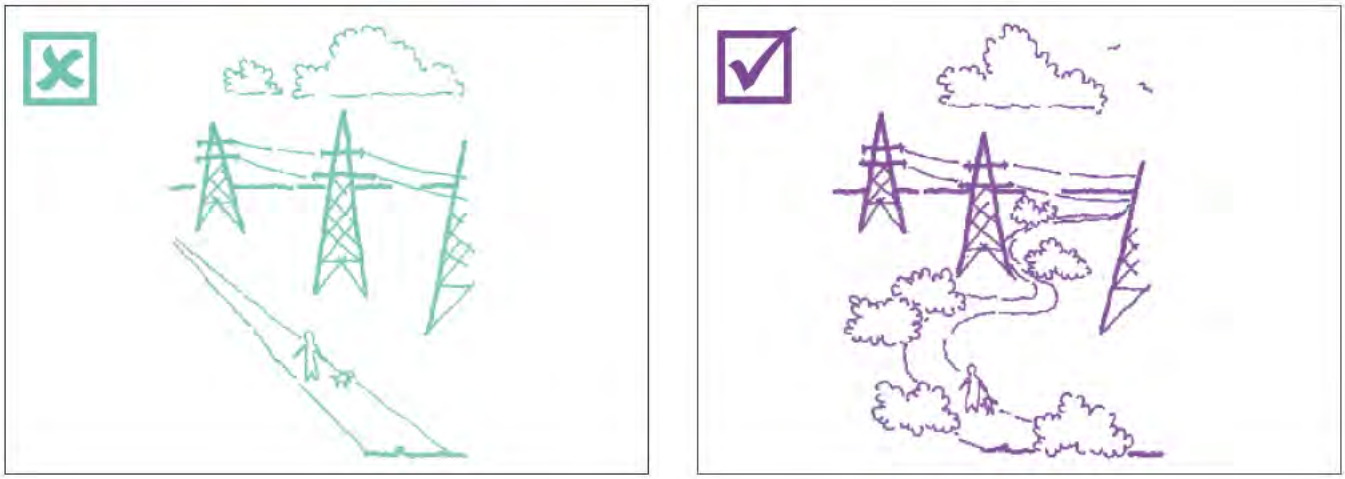
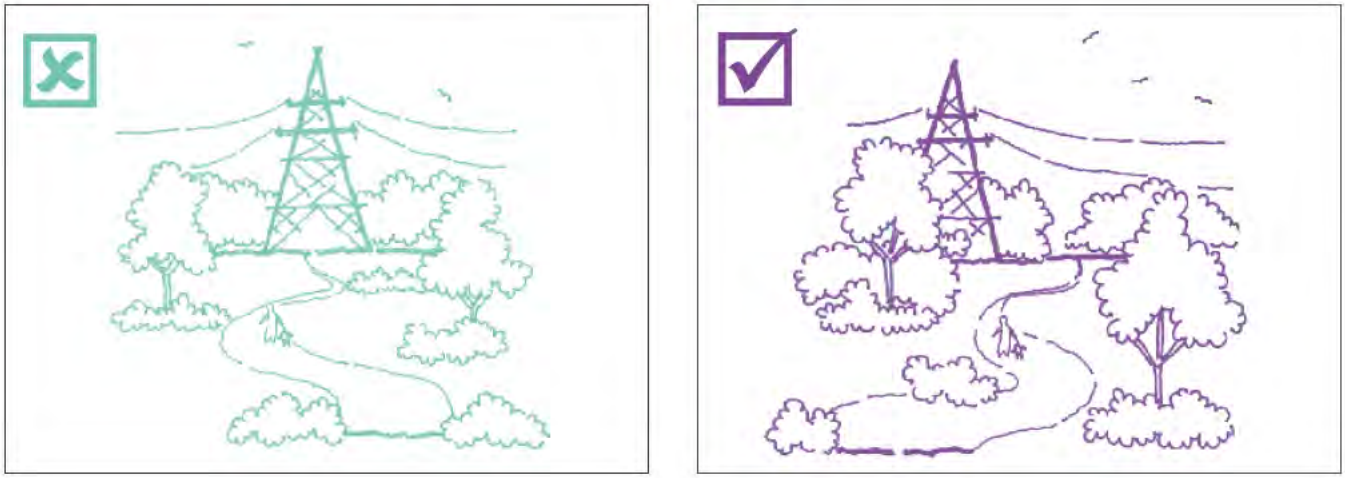


Figure 4(d): Path locations should not enhance vistas to electricity transmission lines, rather screen or offset views to help break up their prominence.



4.1.5 RESIDENTIAL LAND DIVISION

It is possible to develop land near electricity transmission line corridors for residential use, provided the necessary safety and security considerations are taken into account, including compliance with regulated separation distances.

If residential development proposals are considered in the early planning stages using sound urban design principles, the impacts of transmission lines can be reduced and the effects of the development on the transmission lines can be effectively managed.

Permitted

Portions of residential allotments which:

- constitute private open space that is in addition to Development Plan requirements
- afford natural surveillance of public open space within the electricity transmission corridor
- are fenced and screened appropriately to meet safety and amenity. (Best practice would ensure that only non-conductive fencing is constructed anywhere within the safe clearance distances of transmission lines).

Not Permitted

Portions of residential allotments which incorporate dwellings, domestic outbuildings and Development Plan private open space requirements.

While the *Electricity (General) Regulations 2012* sets out clearance distances from electricity transmission infrastructure, restrictions on certain developments, such as swimming pools and pergolas, have necessary and ongoing impacts on residential development and must be taken into account. Please contact ElectraNet for further information.

Siting and Design

The land division should include a building envelope of sufficient size and shape to contain all dwellings and domestic outbuildings outside of the electricity transmission corridor.

4.1.6 RURAL LIVING

Like residential development, rural living allotments can be located partly within the electricity transmission corridor.

However, the dwelling and private open space area requirements need to be located on the portion of the allotment outside of the electricity transmission corridor.

Permitted

A number of semi-rural activities are appropriate within electricity transmission corridors provided appropriate clearance distances and maintenance access is maintained to infrastructure, including:

- horse keeping.

Not Permitted

Land management practices must ensure that the following are avoided within electricity transmission corridors:

- structures
- inappropriate planting to the location, in terms of height
- creation of dust
- irrigation methods causing damage to transmission lines
- portions of rural living allotments which incorporate dwellings, domestic outbuildings and Development Plan private open space requirements.

4.1.7 NON-RESIDENTIAL USES

Similar to residential uses, non-residential activities and structures within the electricity transmission corridor are not appropriate, as they can create a safety risk and impinge on access to critical infrastructure, or future transmission lines within the corridor.

However, there may be some components of non-residential development that can safely utilise land within the electricity transmission corridor. This is typically in the form of placement of car parking areas and in some limited circumstances, outdoor display of goods and items.

Permitted

- car parking areas
- outdoor display areas (in limited circumstances).

Any outdoor storage or display of items needs to take into account the clearance distances required from the infrastructure (including for the safe use of machinery used to load and unload goods), as well as access requirements to infrastructure for maintenance.

Not Permitted

- advertising signage
- shipping container and bulk material storage such as timber stacking
- flammable materials
- creation of dust.

The types of goods kept, and activities occurring within the corridor should be non-flammable and non-explosive, and avoid the creation of dust which may impact on transmission lines.

4.1.8 ANIMAL KEEPING

Forms of animal keeping may be appropriate within electricity transmission corridors, subject to the context of the surrounding settlement character (ie. not in context of suburban locations with no connection to rural hinterlands).

However, consideration needs to be provided to the following:

- providing appropriate safety clearances to transmission lines, including tower bases, for both safety of animals, and access for maintenance purposes
- limiting the intensity of animal keeping to be appropriate for the area of the electricity transmission corridor
- managing vegetation and land cover to prevent erosion and creation of dusty conditions
- installation of appropriate fencing, including materials and locations to manage safety clearances and enable access for transmission line maintenance. (Best practice would ensure that only non-conductive fencing is constructed anywhere within 30m of transmission lines).

4.1.9 FLORA AND FAUNA CORRIDORS

Electricity transmission corridors, by virtue of their linearity, can assist in creating flora and fauna corridors through urban settlements.

They can serve an important function in establishing a habitat for wildlife, acting as connection paths for fauna and linking other remaining habitats within the urban fabric, such as along watercourses.

The corridors also provide an opportunity to plant and manage vegetation so that the corridors contribute to increasing biodiversity within urban areas.

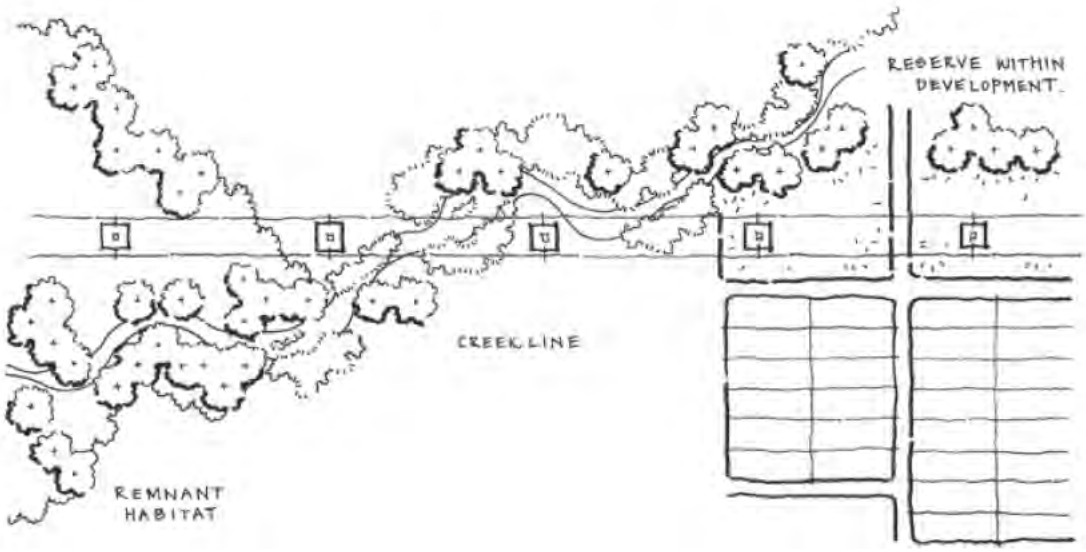
Permitted

- low-intensity animal keeping (appropriate for the area)
- flora/fauna corridors.

Not Permitted

- intensive animal keeping
- animal keeping within the clearance distances of transmission lines.

Figure 4(e): Flora and fauna corridors can establish habitat linkages



4.1.10 BUILDINGS

Buildings should be avoided within the electricity transmission corridor.

Permitted

If required to be located within the electricity transmission corridor, buildings should:

- complement or add to the amenity of the use of the space for community purposes (such as shelters, toilets, community halls / clubs, small storage sheds)
- be located outside of the minimum clearance distances from transmission lines
- not prevent access to infrastructure for maintenance or inspection
- not prevent the placement of additional required transmission infrastructure within the corridor.

Not Permitted

The following buildings are not permitted within electricity transmission corridors:

- buildings that prevent access to transmission lines for maintenance or inspection
- buildings that prevent the placement of additional required infrastructure within the corridor.

4.1.11 FENCING

Fencing may be appropriate within electricity transmission corridors however consideration needs to be given to the materials and form of the fencing.

Please note the fencing heights mentioned below are in accordance with the *Electricity (General) Regulations 2012* and these may differ from fencing allowances or exemptions specified under the *Development Regulations 2008*. For the purposes of fencing in electricity transmission corridors, the *Electricity (General) Regulations 2012* takes precedent.

Permitted

- fencing no more than 2.0m high constructed in sections and earthed where running parallel with transmission lines
- fencing no more than 2.0m high constructed from materials which are non-conductive
- fencing maintaining access to infrastructure for maintenance and inspection (either direct access or through a gate within the fence line).

While the *Electricity (General) Regulations 2012* sets out clearance distances for fencing from electricity transmission infrastructure, best practice would ensure that only non-conductive fencing is constructed anywhere within safe clearance distances of towers.

Not Permitted

- fencing greater than 2.0m high located within the clearance distance from infrastructure (eg. transmission lines)
- fencing which restricts access to the infrastructure or maintenance purposes.

4.1.12 LANDSCAPING

Landscaping within electricity transmission corridors plays a critical role in improving, framing and identifying precincts and breaking up the linear characteristics of the space within the corridor.

Permitted

The following landscaping is envisaged within electricity transmission corridors:

- using diverse plantings in precincts throughout the corridor so that the corridor is experienced differently from various locations, helping to diminish the prominence of the corridor
- strategic planting within layers at varying heights to provide a level of intimacy in confined areas creating a perception that the transmission lines are in the distance through a depth of vision
- planting near the base of towers to screen the view from a pedestrian level.

Not Permitted

- plantings which inhibit access to infrastructure for maintenance purposes
- plantings with a mature height which exceeds the necessary height clearances required.

Consideration needs to be given to the increased limitations to the types of plantings able to be established within electricity transmission corridors due to the necessary height clearances required.

This is essential to prevent damage to transmission lines during storms or the failure of a tree.

As a general rule, the following needs to be considered within the electricity transmission corridor:

- maintaining access to transmission lines for maintenance purposes
- using appropriate trees and vegetation that grow to mature heights that are not more than 1.5 times their distance from the transmission lines to minimise damage potential and prevent the need for frequent inspection and maintenance.

4.1.13 EXCAVATION AND FILLING OF LAND

The excavation and filling of land within the electricity transmission corridor, when used as a design feature, can help break up the linear dimension of the space, and add visual interest to the surrounding areas.

Used together with the natural topography near the towers, and surrounding development, elevating a site can help reduce their visual prominence.

Permitted

- excavation and limited filling which enhances the amenity or visual interest of the electricity transmission corridor and surrounding area may be permitted subject to the prior approval of ElectraNet, the Office of the Technical Regulator and where deemed a development pursuant to the *Development Act 1993*, approval by the relevant assessment authority.

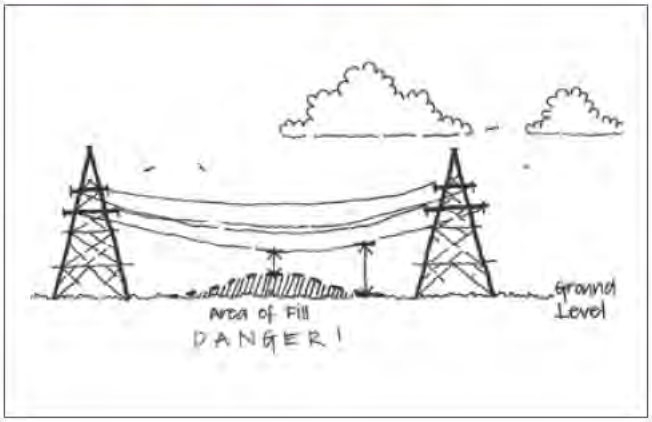
Not Permitted

The changing of land form needs to be considered carefully within electricity transmission corridors to prevent the following:

- excavation/filling which impacts on the footings of transmission lines
- excavation/filling which infringes on the clearance distances to transmission lines with the revised ground levels.

Note that consideration needs to be given to the remaining clearance areas with the new ground levels for potential uses of the land and whether the new ground level will compromise the use of spaces within electricity transmission corridors.

Figure 4(f): Excavation and filling of land can compromise safety clearances



4.2 'SWITCHING' ACTIVE LINES WITHIN CORRIDOR

The need to accommodate the upgrading of a transmission line concurrently with the operation of the active transmission line requires a double width electricity transmission corridor.

Given the timeframes involved in the 'switching' between the two areas of the electricity transmission corridor (which could be up to 50 years), it is appropriate to utilise the 'non-active' corridor for public facilities (as mentioned in section 4.1 above).

However, the placement of any small scale buildings, landscaping and other structures must not compromise the planning and development of the alternative transmission line and uses should:

- be demountable or economically relocated to the new 'non-active' side of the electricity transmission corridor
- remove all trees in excess of the designated height clearances for landscaping
- plant taller trees within the new 'non-active' screen infrastructure, given new height limitations
- have suitable legal agreements that enable cessation of a use or function of land, with the option of relocating to the non-active side of the electricity transmission corridor (within predetermined areas).

4.3 DEVELOPMENT ADJACENT TO CORRIDORS

4.3.1 THE NEED FOR STRUCTURE PLANNING

The early identification of the characteristics of the electricity transmission corridor in the planning of an area provides an ideal opportunity to 'design in' the electricity transmission corridor to the growth area.

This allows for maximising opportunities to address key visual amenity issues to ensure that development not only addresses safety requirements, but improves design outcomes by reducing the prominence of the electricity transmission corridor within the development area as much as possible.

4.3.2 LAND USES AND BUILT FORM

As a general rule, outside of electricity transmission corridors, the restrictions on land uses can be relaxed. Therefore, there is scope to provide a diversity of land uses in accordance with the structure plan and zoning for the area.

Similarly, there is greater flexibility with the intensity of built form and heights of buildings outside of electricity transmission corridors. Indeed, the strategic placement of taller building forms adjacent to transmission lines can help screen electricity infrastructure from development within the wider area.

4.3.3 ALLOTMENT AND ROAD LAYOUT ORIENTATION

The alignment of streets and orientation of allotments plays an important part in reducing the visual prominence of electricity transmission corridors on surrounding development.

The dominant elements of the corridor are the towers and poles and mitigating their prominence should be the focus for land division and road layouts, which can be achieved by:

- orienting streets to avoid framing views directly to transmission lines (ie. terminating vistas) including further away from the corridor, particularly if topography assists in providing views to transmission lines
- designing road grids to minimise the allotments fronting the transmission lines through the use of rectangular development blocks oriented perpendicular to the corridor
- orienting dwellings at the end of development blocks away from the corridor (ie. to side street), preventing them from 'fronting' the corridor and the transmission line. However, some orientation towards the corridor is desirable to provide an appropriate level of passive surveillance for crime prevention purposes
- breaking up the extent of roads running parallel to the edge of the corridor to minimise their linearity
- having roads crossing the corridor at intervals to break up large expanses of uninterrupted spaces within the corridor to help reduce linearity and allow the creation of 'precincts' and ensure adequate connectivity of residential areas either side of the corridor
- orient dwellings and windows away from transmission lines.

Figure 4(g): Using street layout to enhance amenity

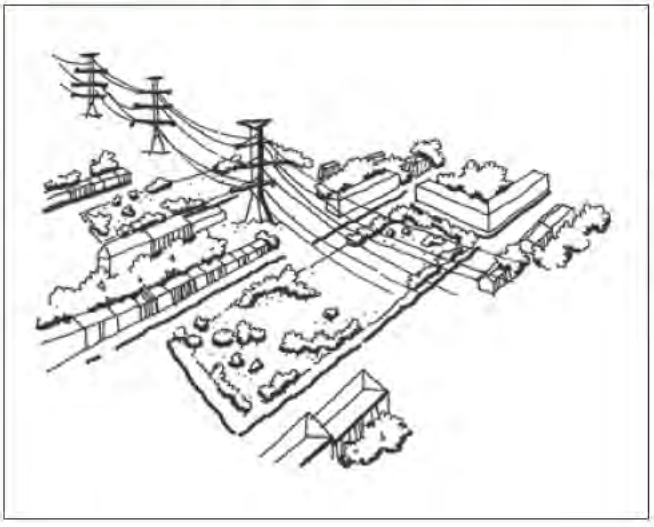


Figure 4(h): Allotment and road layout orientation can break up linearity through a mix of land uses

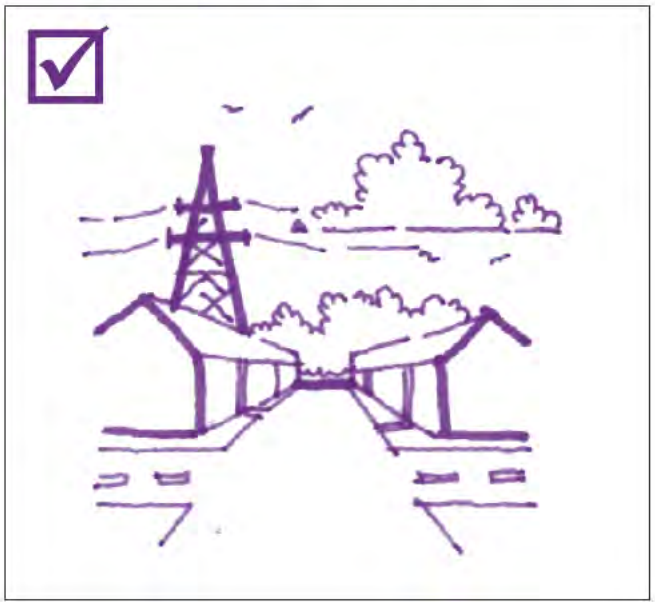


Figure 4(i): Allotment and road layout orientation can reduce the visual prominence of linear electricity transmission corridors

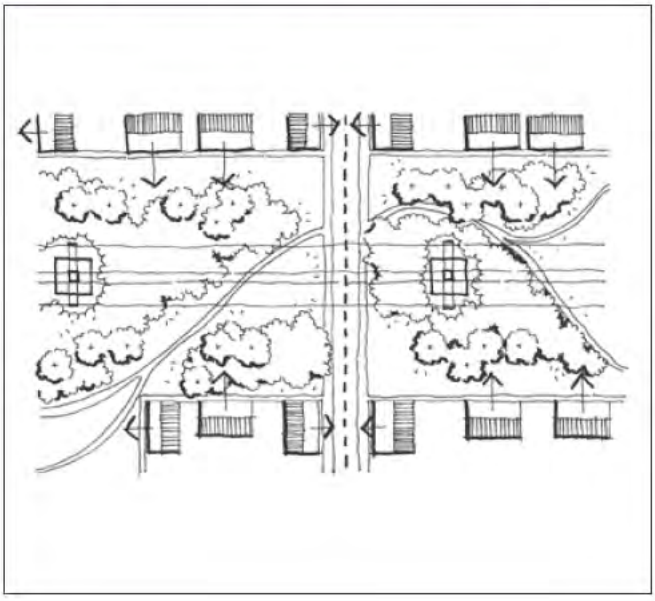


Figure 4(j): Road grids to minimise visual aspects

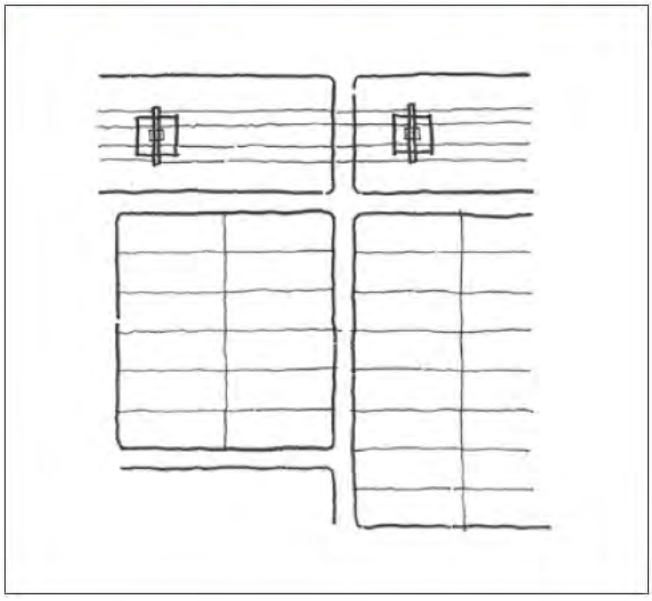


Figure 4(k): Dwelling orientation to minimise visual aspects

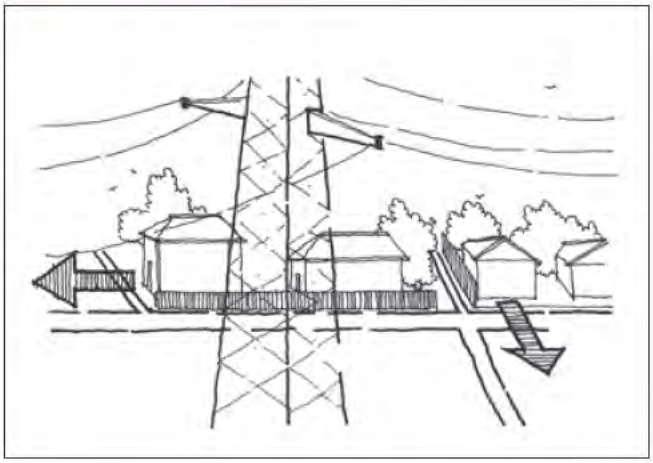


Figure 4(l): Minimising parallel road alignments

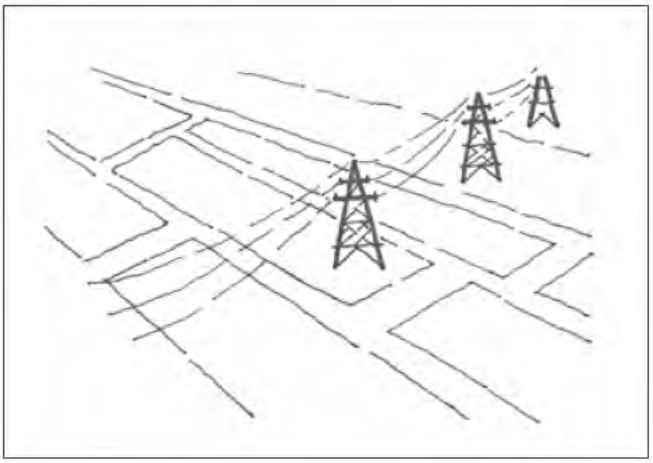
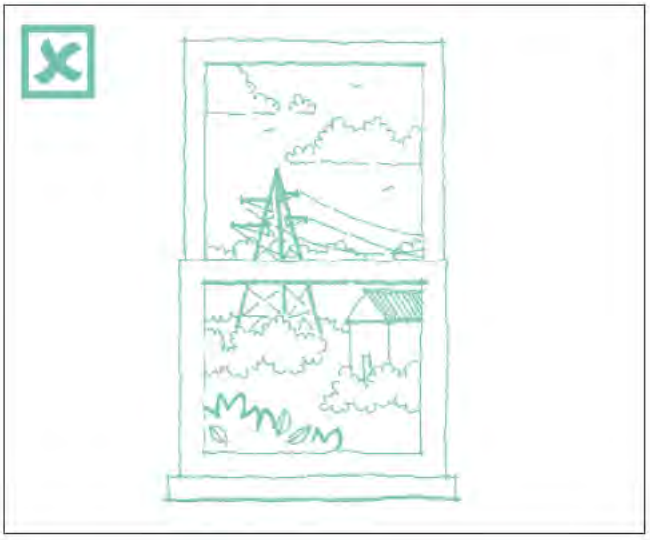
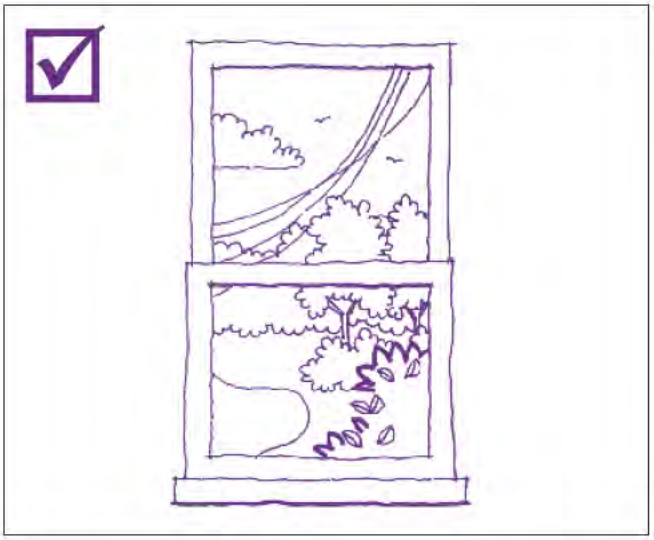


Figure 4(m): Dwelling and window orientation





4.3.4 PROVIDING HIGH LEVELS OF VISUAL INTEREST

Adding visual interest within streetscapes and public spaces will increase the quality of the environment, and help reduce the prominence of transmission lines. This diversity of visual experiences relates to the detail provided in:

- the number of vistas and views available (short and long distance)
- the variety of land uses and experiences at ground level to draw attention within the public realm
- the quality and location of planting in front and to the sides of buildings, car parks and other areas to help screen views and provide for an attractive setting
- the variety in details and materials within the built form in the streetscape, street furniture and pavements in the public realm
- the presence of water bodies that provide interest and reflections.

4.3.5 LANDSCAPING

Landscaping of areas adjacent to and further away from the electricity transmission corridor plays a critical role in minimising the visual prominence of the structures located within the corridor.

As there is greater scope to plant taller trees in these locations, they have the ability to screen the structure from certain vantage points.

However, important landscaping principles include:

- planting of mature street trees within streets with vistas to transmission lines. Street trees have the ability to enclose the street space, screening views to the towers in the distance
- planting of narrow avenues of trees parallel to the road along enclosed streets and paths in close proximity to the electricity transmission corridor
- strategically planting trees and other vegetation outside of the electricity transmission corridor and layering with plantings within the corridor to screen views and add depth to views, providing a perception of distance to transmission lines.

Figure 4(n): Planting of mature street trees.

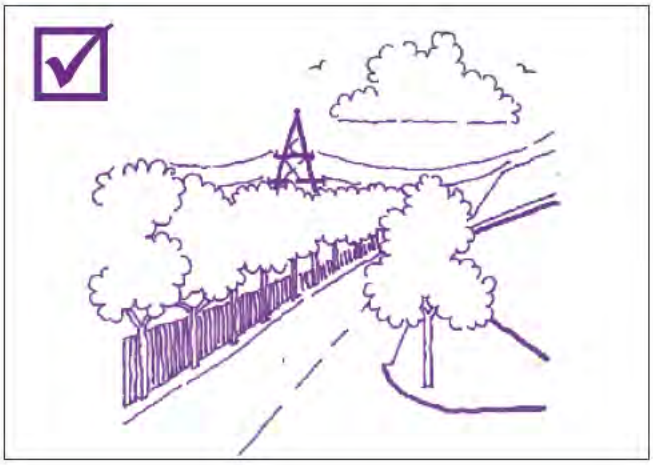


Figure 4(o): Planting of narrow avenues of trees.

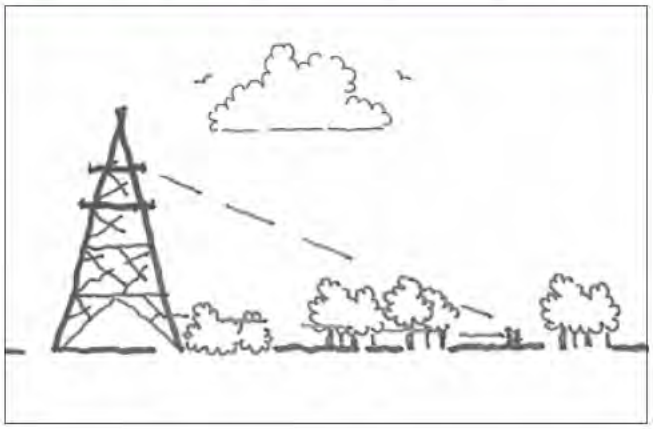
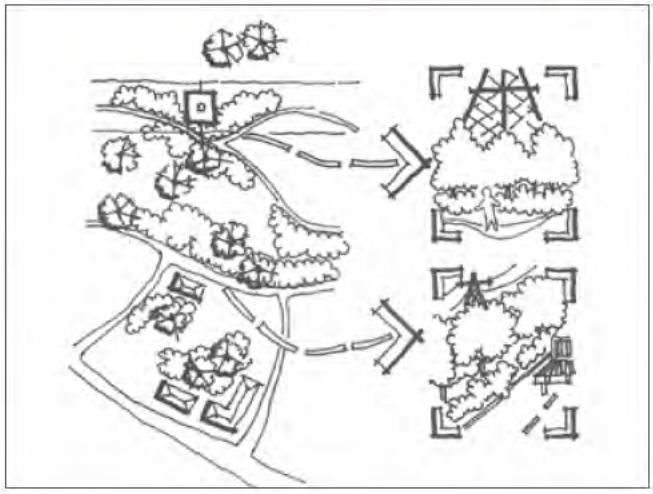


Figure 4(p): Planting near the base of the tower screens views from pedestrian level, while planting at the edge of the adjacent dwellings provides additional screening.



5. Land Use Plans

Development can have unintended effects on existing transmission lines and equally, the transmission lines can adversely affect development. Information contained within these guidelines highlight three key issues to consider when developing land under and around transmission lines:

- mitigating public safety risks by setting development back from existing transmission infrastructure
- allowing for the ongoing operation, maintenance and replacement of existing assets by preserving suitable access
- promoting optimal development outcomes through early design and planning for best possible land use under transmission lines.

The design guidelines outlined in Chapter Four can assist in determining the most appropriate land uses to be incorporated within an electricity transmission corridor, as well as guiding their layout and design overall (with the view to producing a land use plan for the electricity transmission corridor).

However, in order to successfully integrate these uses within the surrounding existing and future urban areas, an analysis of any existing structure plan and the current (or proposed) zoning is required.

Importantly, where such structure planning and rezoning has yet to be completed, integration of land use planning within and surrounding an electricity transmission corridor can best be achieved by full consideration of these guidelines as part of the structure planning process.

When a land use plan for a corridor has been approved by all parties (including ElectraNet and the Office of the Technical Regulator), it can form part of an agreed land management agreement or other legally binding document to help guide the ongoing use and management of land within a corridor in the long term.

5.1 LAND USE GUIDE CHECKLIST

When planning the development of land within or around an electricity transmission line corridor, consider the following:

- ☑ **discuss development plans with ElectraNet and the Office of the Technical Regulator**
- ☑ **check the legislative and relevant regional and local plan guidelines for specific provisions relating to electricity transmission line clearance distances**
- ☑ **understand the implications of any land use constraints imposed by existing transmission infrastructure**
- ☑ **ensure the preservation of vehicle access to existing transmission structures**
- ☑ **ensure that any nearby excavation and construction works will not generate dust emissions that may adversely affect existing electricity transmission lines.**

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