

Electric and magnetic field (EMF) assessment

Transgrid transmission lines 1,7 relocation



Ginninderry, ACT

January 2024

Front Picture – Existing lines 1,7 looking north-west away from Canberra substation across Ginninderry.

Executive Summary

The Upper and Lower Tumut 330kV Transmission Line Realignment project consists of moving two overhead Transgrid transmission lines, numbered 1 and 7 from the Ginninderry development and rerouting them to the new Stockdill substation.

This report has been prepared to evaluate potential safety impacts from electromagnetic field (EMF) and electromagnetic induced (EMI) or related risks. It also addresses the Australian Capital Territory (ACT) Utility Technical Regulator (UTR) requirements for the project to address in the project Environmental Impact Statement (EIS).

This report has found no adverse impacts from the proposed Transgrid transmission lines concept design and route.

The EMF levels are below the maximum public reference levels and well below the maximum magnetic field reference levels that are deemed safe for people and livestock within the easements.

Within the newly created easements and identified hatched areas, Transgrid and their nominated contractor for the transmission line design, construction, commissioning and testing shall comply with the following in addition to standard Transgrid, Evoenergy and Federal, NSW, and ACT government standards and requirements:

- A. All fences shall have isolation panels installed and be earthed as per Transgrid fencing guidelines
- B. All metallic infrastructure crossing, running parallel and within the easement shall be tested and ensure that required earthing and isolation is in place to prevent the risks covered in section 1.2.
- C. Hatched locations where existing or old fencing and metallic infrastructure has been identified for further identification, will require earthing and isolation testing as a minimum, noting the standards and procedures outlined in this report.

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1 Introduction

1.1 Electric and Magnetic fields (EMF)

What are electric and magnetic fields (EMF)? EMF are both naturally occurring and found wherever there is electricity. Natural occurrences include from lightning, solar activity and the earth itself. All living organisms produce EMF. Wherever electricity is flowing or there is an electrical force, EMF are produced.

The presence of EMF is an essential part of the electricity process. EMF are not the same as the electromagnetic radiation (EMR) associated with radio waves, microwaves and x-rays. EMF cause energy to be transferred along electric wires whereas EMR causes energy to be radiated away from the source and can be detected at a great distance.

Internationally, there have been almost 3,000 studies carried out in relation to EMF. Leading health bodies such as the World Health Organisation (WHO), the US National Institute of Environmental and Health Sciences and the UK National Radiological Protection Board have evaluated the research to assess the likelihood of health effects associated with exposure to EMF.

Transgrid is guided by the advice from the WHO and Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the responsible agency in Australia for advising on exposure limits to EMF.

The equipment used for the transmission of electricity will operate at a frequency of 50 Hertz (Hz), which falls into a range referred to as extremely low frequency (ELF) EMF. While there is currently no scientific evidence or research that confirms exposure to ELF EMF causes any health effects, Transgrid takes a precautionary approach of 'prudent avoidance'. More information on EMF is provided on the Transgrid website¹.

Electric fields: An electric field occurs around any area where electric charges experience a force. The strength of this force is related to the voltage: the higher the force/voltage, the stronger the electric field. The level of electric fields is measured in thousands of volts per metre (kV/m). Electric fields are strongest closest to the source but reduce quickly with distance. In addition, most materials act as a barrier to electric fields.

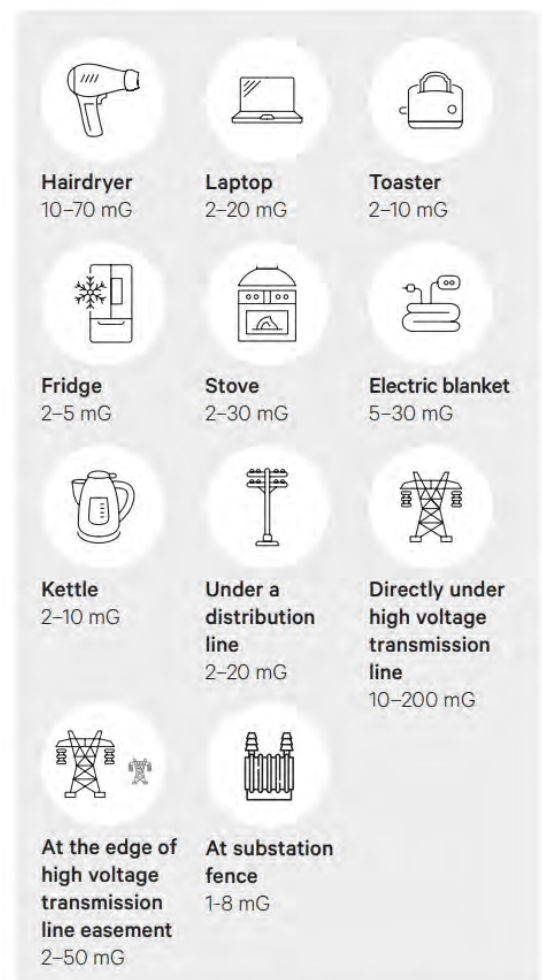


Figure 1 Typical values of magnetic fields measured near various appliances and powerlines

International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guideline Reference Level for Human public exposure is 2,000 mG.

Source: ARPANSA, Measuring magnetic fields,
<http://www.arpansa.gov.au/>

¹ [Precaution - Managing Electric & Magnetic Fields | Transgrid](#)

Magnetic fields: A magnetic field occurs around any area where magnetic materials experience a force. Magnetic fields are produced by the flow of an electric current: the higher the current (measured in amps), the greater the magnetic field. The strength of magnetic fields is measured in milliGauss (mG). Like electric fields, magnetic fields are highest closest to the source but also reduce quickly with distance. Unlike electric fields, magnetic fields are only present when an electric current is flowing. As most materials will not act as a shield or barrier to magnetic fields, this is a reason why research into EMF and health generally focuses on magnetic fields.

1.2 Introduction – Electric and Magnetic Induced current (EMI)²

Electromagnetic fields can create (or induce) currents in metallic objects that can carry electricity. This is influenced by:

- The voltage on the energized line. The higher the voltage on the energized line, the higher the induced voltage on the parallel line.
- The current flowing through the energized line. The more current in the energized line, the higher the induced voltage on the parallel line.
- The distance between the energized line and the parallel line. The closer they are together, the higher the induced voltage and current.
- The length (distance) that the lines parallel each other. The longer the distance, the higher the induced voltage and current.

An ungrounded conductor that parallels an energized line is in an electric field induction (*capacitive coupling*) situation, caused by the electric field around the energized line. This can cause in extreme cases electrocution so it is important that testing is undertaken to ensure no induced currents remain.

There may be as many circulating current paths as there are grounded locations. This circulating current at each grounded location sets up voltage gradients in the earth around the place where the conductor is grounded. The voltage gradients consist of step potentials, touch potentials, and transferred touch potentials as defined below:

STEP POTENTIAL: The voltage between the feet of a person standing near an energized grounded object. It is equal to the difference in voltage between two points at different distances from the grounded object (the ground electrode). For worker protection this distance is usually assumed to be about three feet, or the distance between a worker's feet while in a walking configuration. A person could be at risk of injury during a fault simply by standing near the grounding point.

TOUCH POTENTIAL: The voltage between the energized object and the feet of a person in contact with the object. It is equal to the difference in voltage between the object (which is at a distance of 0 feet) and a point some distance

² [Powerlineman Magazine - PROTECT YOURSELF FROM INDUCED CURRENT](#)

away, usually assumed to be about three feet, or the distance a worker could touch an object while standing on the ground.

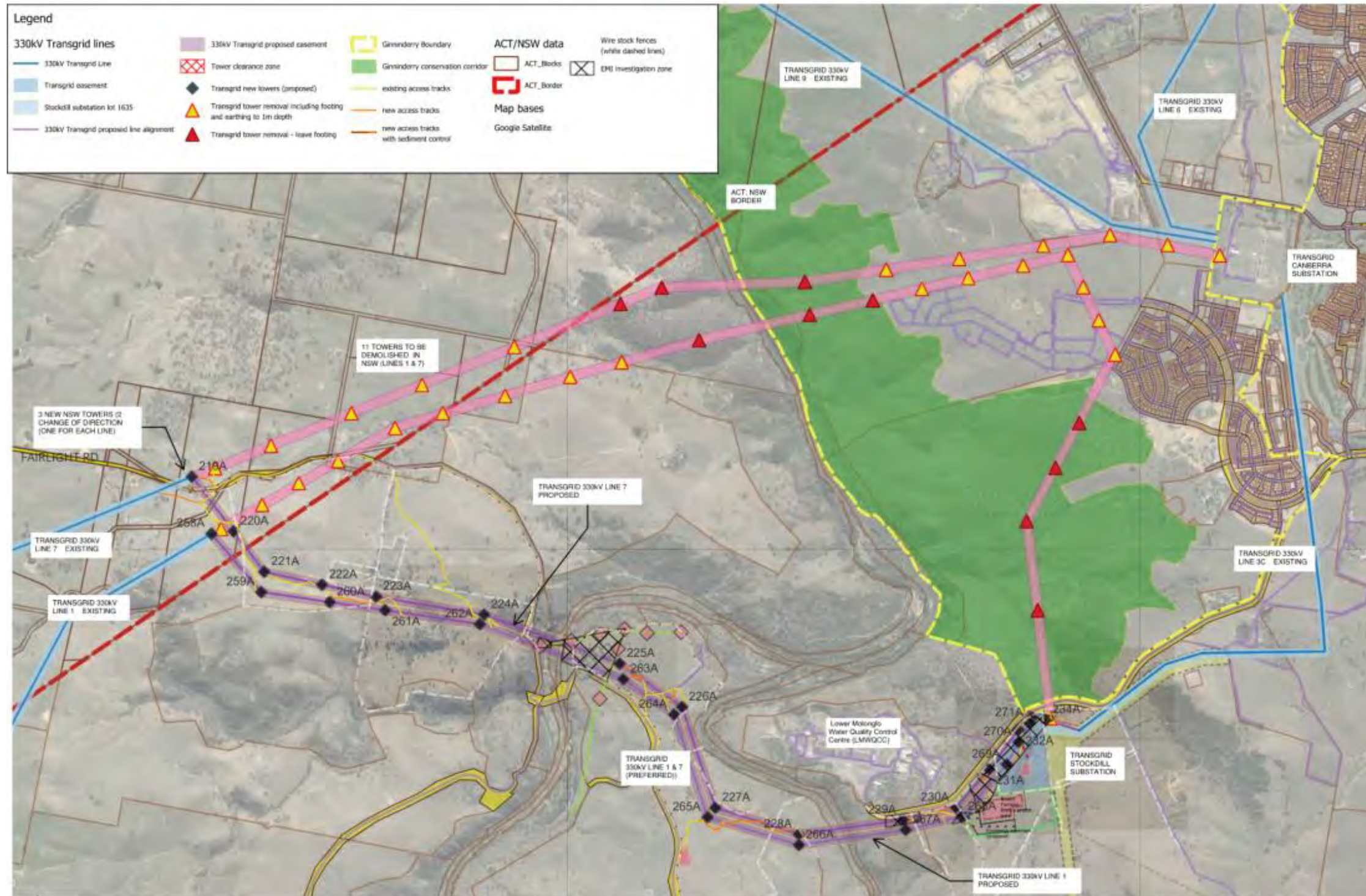
TRANSFERRED TOUCH POTENTIAL: The voltage between the energized object and the feet of a person standing on the ground while making contact with the energized object (the ground electrode) through a conductive medium such as the frame or winch line of a vehicle that has been bonded to the grounding electrode with a length of grounding cable. The same applies to a worker with no worksite protection who is contacting a conductor that is grounded at some remote distance. This voltage may be much higher than the “touch potential” due to the greater distance between the worker and the grounding electrode. These differences of potential in the earth pose an electrical hazard to the workers on the ground who are in the voltage gradient zone. The hazard ranges from mild electric shock to fatal electrocution. This is why line crews measure the differences in potential in the earth at the worksite with a voltage meter referred to as a “step and touch kit.”

It is therefore important to ensure that fences, pipes etc are isolated as per the relevant guidelines.

1.3 Project outline

The Upper and Lower Tumut 330kV Transmission Line Realignment project consists of moving two overhead Transgrid transmission lines, numbered 1 and 7, from the Ginninderry development and rerouting them to the new Stockdill substation as shown in Drawing 23-002 in Appendix C and in Figure 2 below. The drawing in Appendix C also shows access tracks for transmission line construction and proposed routes for construction routes and vehicles.

Figure 2 - Lines 1 & 7 relocation drawing, showing Canberra Substation to the North East. Pink shows easements to be removed, with red triangles showing towers to be removed with footings retained, Red triangles with yellow centre show towers to be removed along with footings and earth straps (down to a depth of 1m). New alignments are shown in purple, with new towers shown as black diamonds. The new alignments pass around the south of the Lower Molonglo Water Quality Control Centre (LMWQCC)



The project removes the existing lines from within the Ginninderry conservation corridor and places them in farmland near the LMWQCC.

In addition, three new conductors would be strung along Line 3C, between the Canberra and Stockdill Substations.

The final configuration and line numbers is shown in Table 1 below.

Table 1 - Line parameters. Current capacity is based on current line capacity for lines 1,7 (constraints of existing cables) and Line 3C has existing capacity plus line 7 capacity added. Note that Canberra has a winter peak usage.

	<i>Line 1</i>	<i>Line 7</i>	<i>Line 3C</i>
Voltage (kV)	330	330	330
Number of circuits	1	1	2 (one existing)
Number of new poles	4	5	0
Number of new Towers	10	11	0
Maximum current capacity, winter (Amps)	1,226	1,143	2,572
Maximum current capacity, summer (Amps)	915	972	2,252
Winter line capacity (MVA)	405	377	849
Summer line capacity (MVA)	302	321	743

1.4 Scoping document requirements

This report has been prepared to satisfy the requirements of the Environmental Impact Statement (EIS) Scoping Document, which outlines the matters to be addressed in the EIS for understanding potential environmental impacts of the project.

Section A8 of the scoping document contains comments from the ACT Utilities Technical Regulation (UTR) to be addressed in the EIS. These have been reproduced in Table 1 below. Table 1 also specifies the sections of this report in which each comment has been addressed.

Table 1 – UTR entity comments in the EIS Scoping Document

UTR entity comment	Relevant section of report
A. <i>If a change of network configuration occurs additional electrical modelling is required</i> [abbreviated from full text]	The project does not involve a change to the transmission network configuration. Further discussion contained in Section 4.1.
B. <i>Provide the electrical rating for each of the two relocated lines.</i>	Section 4.2
C. <i>The Umwelt project outline [the EIS Scoping Document Application] report does not include the removal of existing buried earth conductors associated with Towers that will be removed.</i>	Section 4.3
D. <i>EMF assessment to be undertaken for Normal & Maximum load conditions, and for Maximum Line rating, for compliance with ARPANSA limits.</i>	Section 4.4 (summary) and Section 2 (detail)
E. <i>Sound level and electrical interference assessment to be undertaken for Corona discharge, and the line designed so that ACT noise level requirements and electrical interference limits are met at edge of easement</i> [this has been addressed in the Noise and Vibration Impact Assessment prepared by Umwelt and is attached to the EIS. It is not considered further in this EMF report].	N/A
F. <i>Detailed assessment to be undertaken for possible excessive voltages due to Electromagnetic Induction/Low Frequency Induction (EMI/LFI) and Earth Potential Rise (EPR) and associated Step & Touch voltages, on nearby metallic infrastructure such as fences, telecommunication infrastructure, pipelines, streetlight poles due to transferred voltages from the MEN earthing system, etc. Some relevant standards would include AS/NZS 4853, AS EGO and AS EG1. Mitigation measures to be identified if allowable limits are exceeded.</i> <i>Upon completion of the construction phase, the line commissioning phase should include overall verification of design hazard mitigation for EMI and EPR of nearby metallic infrastructure through low voltage current injection testing as undertaken on other similar projects as this has revealed hazard locations not identified during the design phase.</i>	Section 4.5 (summary) and Section 3 (detail)

2 EMF Modelling

2.1 Transmission line background

All types of electrical equipment, including those associated with electrical substations and transmission lines, produce EMF. For a transmission line, the strength of the electric field varies generally with the operating voltage of the line (measured in volts), while the magnetic field strength is related to the current flowing in the line (measured in amps). The current flowing in the line is dependent upon the load or power flow, and would vary with consumer demand (which varies on a daily and seasonal basis). The EMF strengths at ground level below the conductors, are also dependent on the height of the wires above the ground and their geometric arrangements as supported by the transmission structures.

The Project study area and surrounding environment currently contains a series of EMF generating electrical equipment including the existing Transgrid Stockdill and Canberra substations and existing Transgrid transmission lines, located towards the eastern end of the Project study area. Evoenergy lines also run parallel to Transgrid line 3C.

2.2 Reference levels of EMF

The scientific literature on EMF exposure is extensive, complex and generally inconclusive. There are no confirmed health risks but some studies have shown higher exposure could increase childhood leukaemia risk. In addressing the question of adverse health effects, Transgrid relies on expert advice on EMF from competent health authorities in Australia and from around the world. This includes ARPANSA, which is the Federal Government agency responsible for providing health assessments and recommendations to the government on matters relating to EMF.

ARPANSA has adopted the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines for limiting exposure to EMF, published in 2010. The ICNIRP Guidelines express limits in terms of 'Reference Levels' and 'Basic Restrictions' under general public and occupational exposure conditions. The Basic Restriction values are expressed as the internal electric fields which can be induced in the body without adverse health outcomes, which must be met. As the Basic Restriction values apply within body tissue, it is difficult and impractical to measure them. For that reason, Reference Levels, which are simpler to measure, are provided as an alternative means of showing compliance with the Basic Restrictions. If desktop study and/or direct field measurements show that the EMF is below the Reference Levels, the EMF is well within the Basic Restrictions. The reference levels may be exceeded if it can be demonstrated that the basic restrictions are still met.

The reference levels contained in the ICNIRP Guidelines are listed in Table 2 below. Occupational exposure limits are set higher than public exposure limits and apply to individuals who are exposed to elevated levels of Radio Frequency (RF) Electromagnetic Exposure (EME) in the course of their work and are either trained to manage the exposure or are aware of the exposure. Specific criteria for occupational exposure are outlined in Section 5 of the ARPANSA RF Standard³. There is no substantiated scientific evidence of adverse health effects from exposure to RF EME below the occupational limits.⁴

³ [Radiation Protection Series F-1 | ARPANSA](#)

⁴ [Radiofrequency Electromagnetic Energy and the new ARPANSA safety Standard | ARPANSA](#)

Table 2 - ICNIRP EMF Reference levels (Reference level limits are taken as instantaneous root mean squared values)

Exposure characteristic	Electric Field	Magnetic field
Public Exposure	5 kV/m	2,000mG or 160 A/m
Occupational exposure	10 kV/m	10,000 mG or 796 A/m

2.3 Transmission line location and impact

The addition of the new transmission equipment as part of the project would result in a localised alteration to EMF contours in the immediate vicinity of the transmission lines. However, localised field levels would decrease very quickly (halving in 10-20 meters) from the cables and are not anticipated to result in impacts to adjacent properties or people or livestock utilising the easements for recreational/rural land uses.

The transmission lines have been designed consistent with the concept of prudent avoidance. Prudent avoidance is generally defined as what can be done at modest cost and without undue inconvenience to avoid a possible risk. With regard to the installation of new transmission lines, it can be demonstrated that Transgrid have undertaken the following steps consistent with prudent avoidance:

- designing structures with appropriate clearance (height above ground) to ensure EMF exposure levels are below the relevant guidelines, noting that in this case that at ground level the exposure levels are below public exposure levels even directly under the cables. Structures must not be within a 17 meters ground exclusion zone either side of the cables.
- siting and selecting the location of the new alignments using objectives that included avoidance of residential dwellings and commercial or industrial buildings such as Lower Malonglo Water Quality Control Centre (LMWQCC), thereby maximising the distance from public exposure.

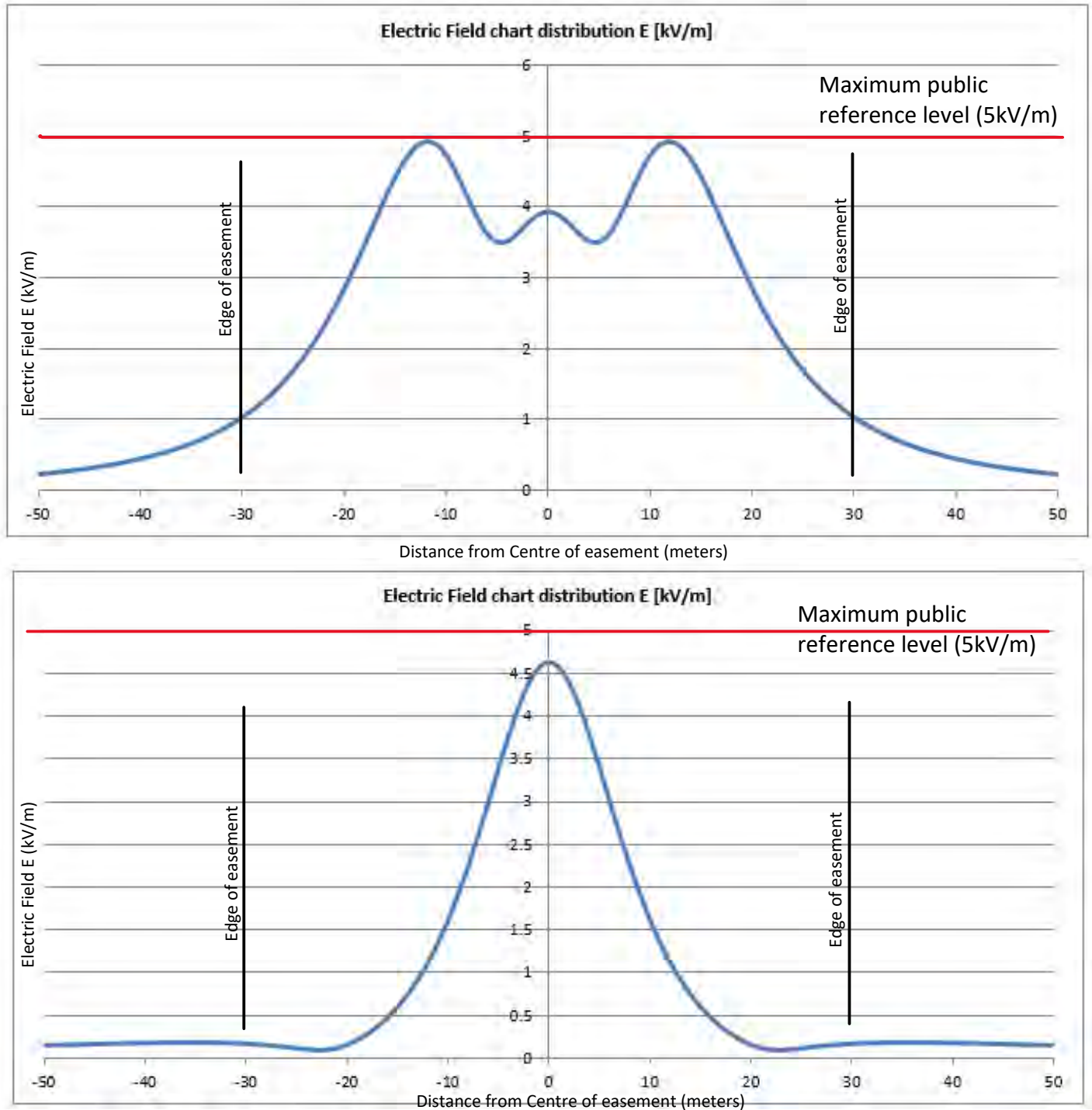
2.4 EMF modelling

Preliminary modelling of EMF has been undertaken to assess the project's risk against the reference values of 5kV/m for public and 10kV/m for occupational exposure. As shown in Figure 3 below, for a fully loaded line 1 or 7 at maximum rating (at 11m level above ground level which is the closest the conductors get to ground level), the exposure levels would be below public reference levels within the new easement. At the edge of the easement this drops down to below 1kV/m. The new easements would be 60m wide, with the edges at 30m and -30m as shown on Figure 3.

The electric field impacts shown in Figure 2 and 3 are worst-case, as they are at locations where the conductors would be closest to the ground during a fully loaded event (eg a peak summer or winter day) where they pose a greater risk to people. The electric field levels at other locations along the new alignments, where the conductors would be higher above the ground, would therefore be lower than those shown in Figure 2 or 3.

The horizontal alignment of conductors held by towers provides 3 peaks and the poles with vertical alignment only have a single peak when below all 3 conductors at once.

Figure 3 – Maximum electric field impact for transmission towers (top) and poles (bottom) along the new easements for locations with lines closest to the ground.. The majority of the transmission corridor will be lower than shown in the graphs.

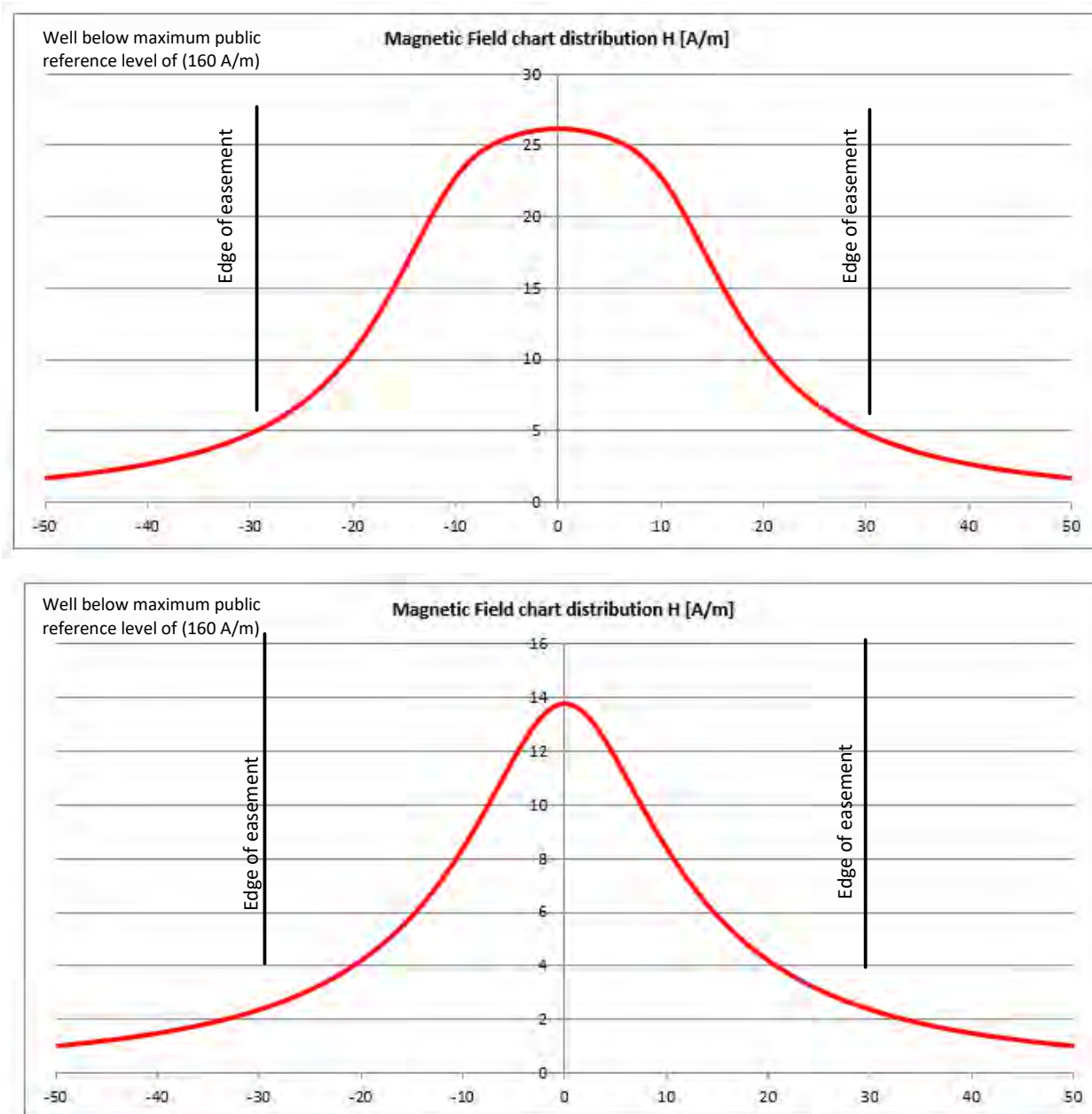


Preliminary modelling of magnetic fields associated with the project has been undertaken to assess the risk against the reference value of 2,000mG for public and 10,000mG for occupational exposure (see Table 2).

As shown in Figure 4 below, for a fully loaded line 1 or 7 at maximum rating (at 11m above ground level) then the magnetic field exposure levels would be significantly below public reference levels within the new easement. At the edge of the easement this drops down to below 5mG well below the 2,000mG public exposure reference level.

The electric field impacts shown in Figure 2 and 3 are worst-case, as they are at locations where the conductors would be closest to the ground during a fully loaded event (eg a peak summer or winter day) where they pose a greater risk to people. The electric field levels at other locations along the new alignments, where the conductors would be higher above the ground, would therefore be lower than those shown in Figure 2 or 3.

Figure 4 – Maximum magnetic field impact for transmission towers (top) and poles (b) along the new easements for locations with lines closest to the ground.



2.5 Design and construction requirements

2.5.1 Detailed design and construction phases

During detailed design of the project, additional modelling shall be undertaken in accordance with the ICNIRP Guidelines for limiting exposure to EMF (ARPANSA 2010) to confirm the final design continues to meet these guidelines.

Transgrid easement requirements shall be enforced such as, development of homes or workplaces within high voltage easements is prohibited. Any developments and activities within easements shall be in accordance with the easement safety requirements established by Transgrid.

[2.5.2 Interference with Electricity Supply to Other Customers](#)

The ACT *Utilities (Electricity Service and Installation Rules Code) Determination 2013* (ES&I Rules) may set requirements for the connection and operation of electric motor installations and control of starting current or any other electrical articles which may affect the quality of supply.

Any requirements of ES&I Rules in relation to limits on harmonic voltage distortion or voltage fluctuations in the electricity network caused by a customer's electrical Installation must be consistent with AS/NZS 61000 Electromagnetic compatibility.

[2.6 Expected conditions](#)

Figures 2 and 3 show safe levels within and on the edges of the easement for EMF. Levels outside the easement are within typical safe house EMF emission levels as discussed in section 1. Therefore the operation of the project is not expected to impact surrounding properties which are outside the easements and will not pose a significant risk to community.

3 Existing Infrastructure and electromagnetic induced currents mitigation

3.1 Mitigation risks

As discussed in section 1.2, electric and magnetic Induced currents can provide risks to people and livestock on the routes. Metallic infrastructure crossing or running parallel to the power lines shall be isolated to avoid any electrocution risk from touching the metallic surfaces. The voltage of metallic infrastructure, most commonly metal fencing must be measured to ensure that any induced currents are within safe limits. Metal elements should be isolated and earthed, and further testing then undertaken to ensure that the system is safe.

3.2 Route locations for EMI investigation and testing

The routes for the new lines 1 and 7 are predominately across farmland and river corridors where there is little existing infrastructure. Figures 4, 5, 6 and 7 show the identified metal fences and infrastructure along the new lines that require EMI and EPR investigation and measurement during design, construction, and commissioning phases of the project. Line 3C is not shown given that earthing is in place for the existing towers which will be sufficient for the new conductors being installed as part of the project.

Towers and lines being removed do not require testing as no electricity will be flowing to cause EMF or EMI risks.

A registered infrastructure search, ground image desktop review and a site walk through has been undertaken to identify metallic infrastructure and fences that could potentially pose an EMI risk. Drawings from the infrastructure search are included in Appendix C.

While the easements are located mostly in farm areas, existing identified infrastructure will need to be further inspected to ensure above ground and underground metallic objects are isolated and electrocution risks due to these minimised.

Within the newly created easements and identified hatched areas:

- D. All fences shall have isolation panels installed and be earthed as per Transgrid fencing guidelines
- E. All metallic infrastructure shall be tested and ensure that required earthing and isolation is in place to prevent the risks covered in section 1.2.
- F. The drawings on the following pages show hatched locations where existing or old fencing and metallic infrastructure has been identified for further identification, and will require earthing and isolation testing as a minimum, noting the standards and procedures outlined in this report and required by Transgrid, Evoenergy and Federal, NSW, and ACT government standards and requirements.

Figure 5 - NSW and western ACT section of the project showing fences (white dashed lines) to be isolated within the new transmission easements. No other underground or overhead infrastructure identified.

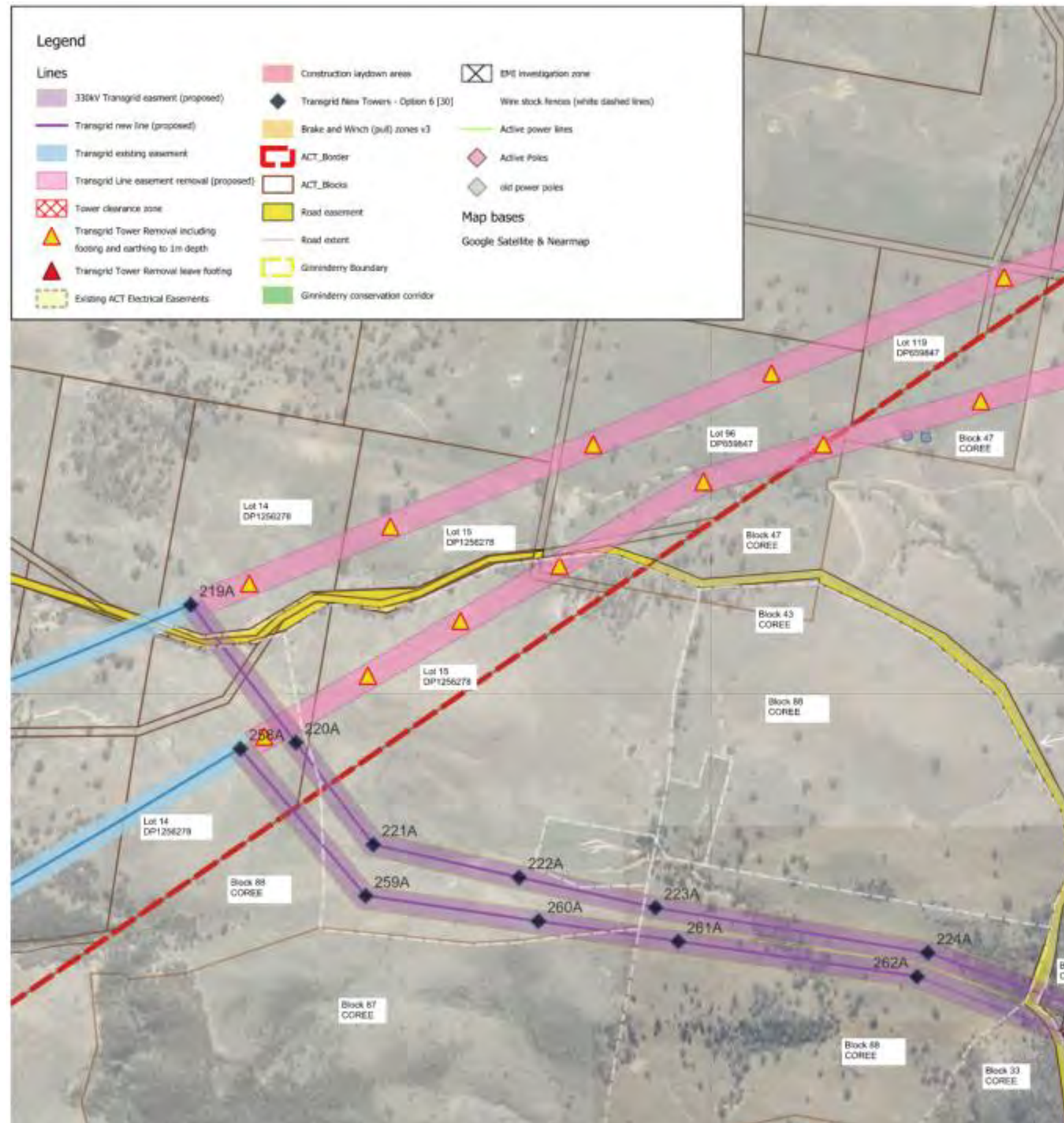


Figure 6 – Central (Huntly) section showing fences (white dashed lines) to be isolated within the new transmission easements. Note black hatched areas to be investigated for earthing, EMI and EPR. This includes electricity supply to a decommissioned ranger hut and water supply. It also includes previous buildings (now removed, likely connected to the YMCA camp Sturt) and electricity distribution poles (with previous electricity distribution removed).

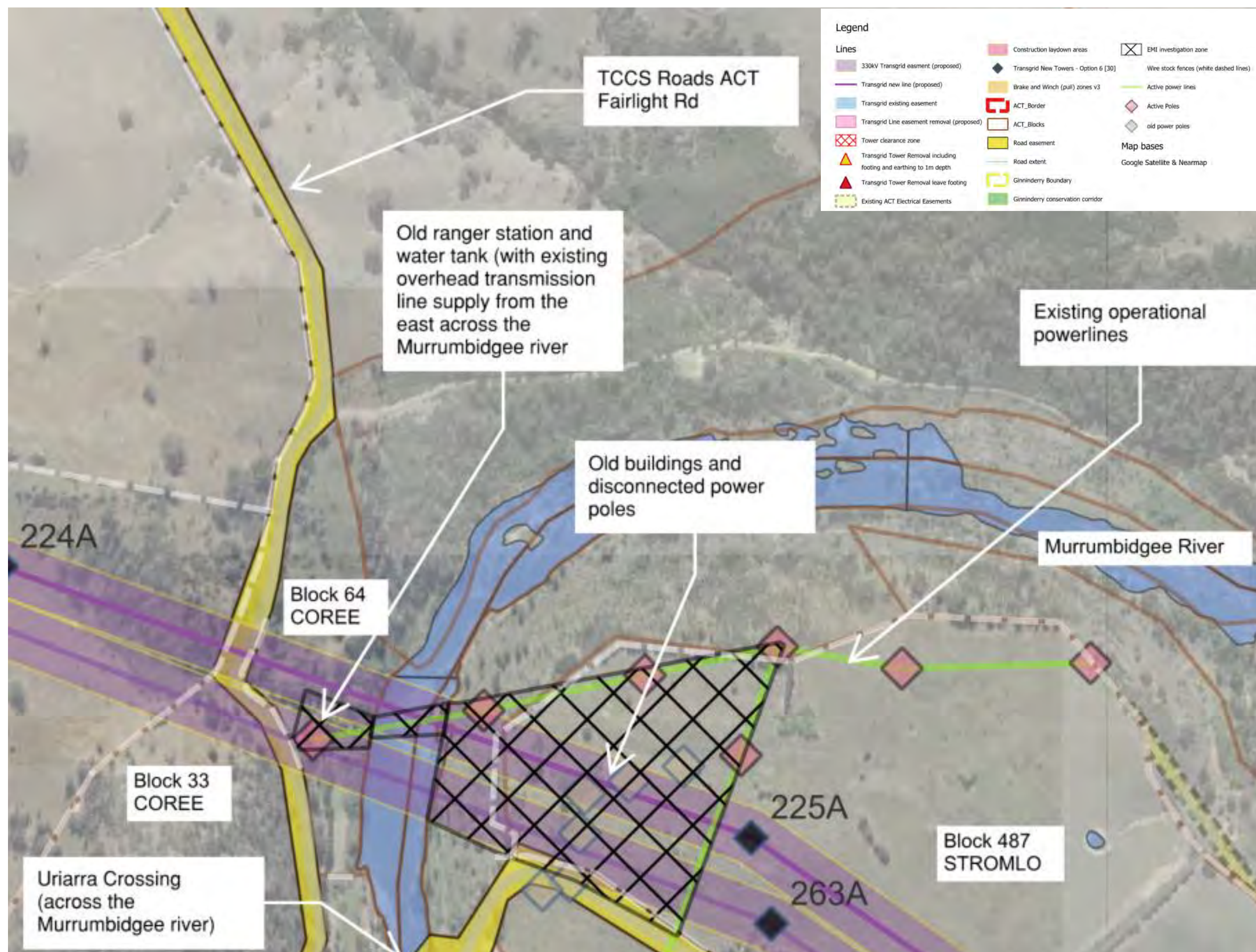


Figure 7 – Central (Huntly) section showing fences (white dashed lines) to be isolated within the new transmission easements. . Note black hatched areas to be investigated for earthing, EMI and EPR

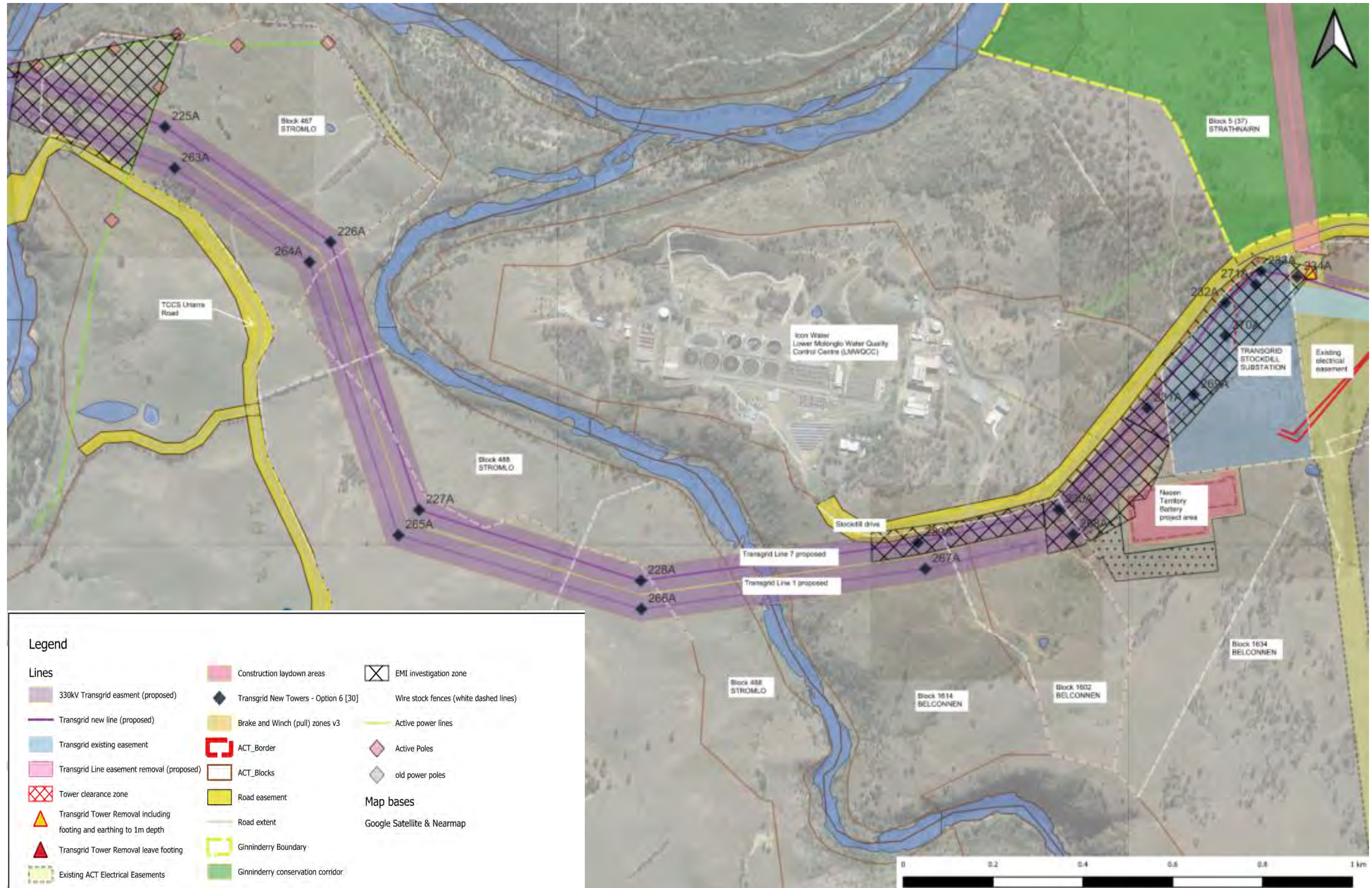


Figure 8 – Area close to Lower Molonglo Water Quality Control Centre (LMWQCC) and Stockdill substation showing fences (white dashed lines) to be isolated within the new transmission easements. Coordination and fencing isolation is required for the proposed Neoen Territory battery project (for both the operational and construction zones) as well as within and approaching the Stockdill Substation site (black hatching).

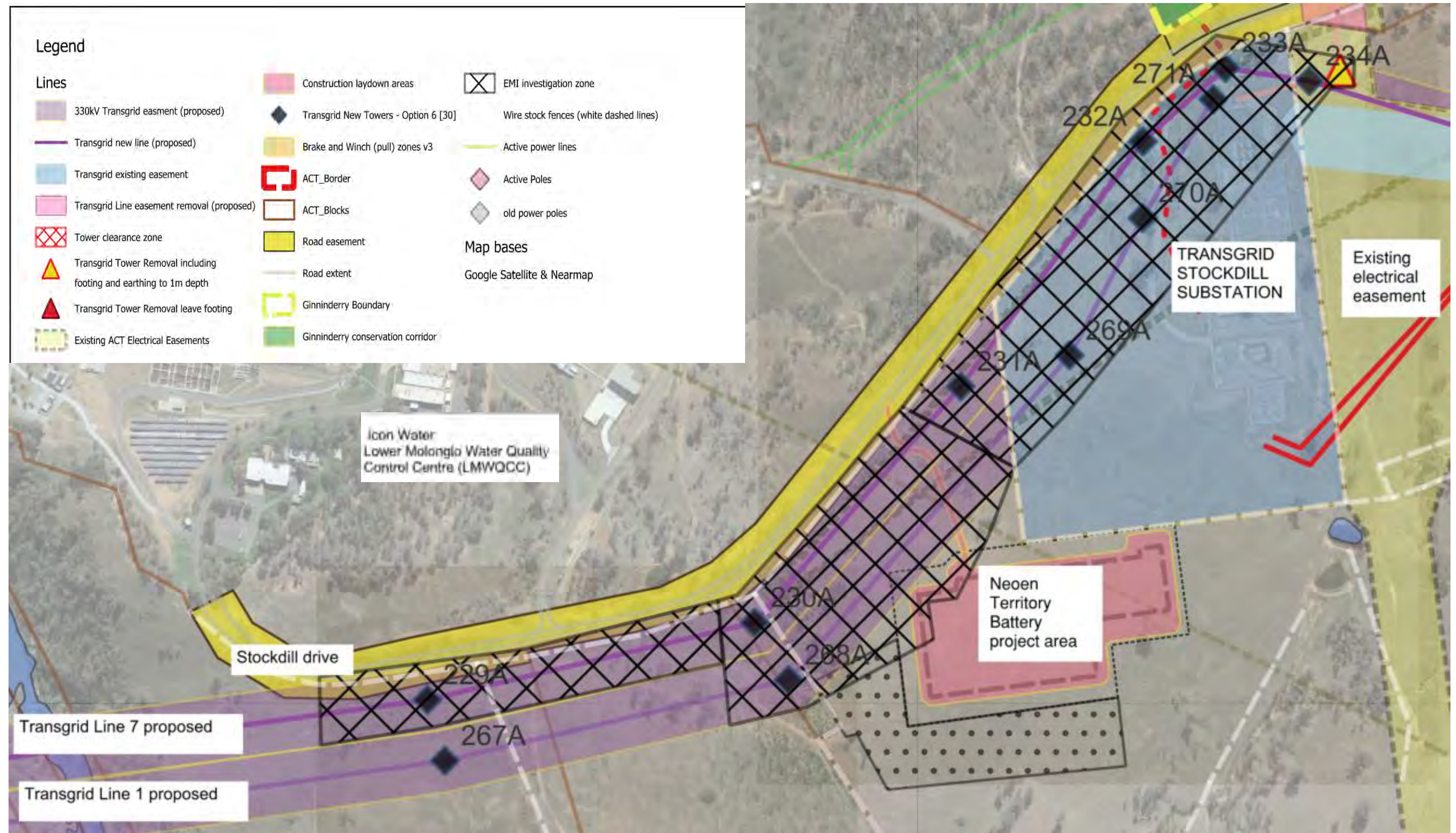
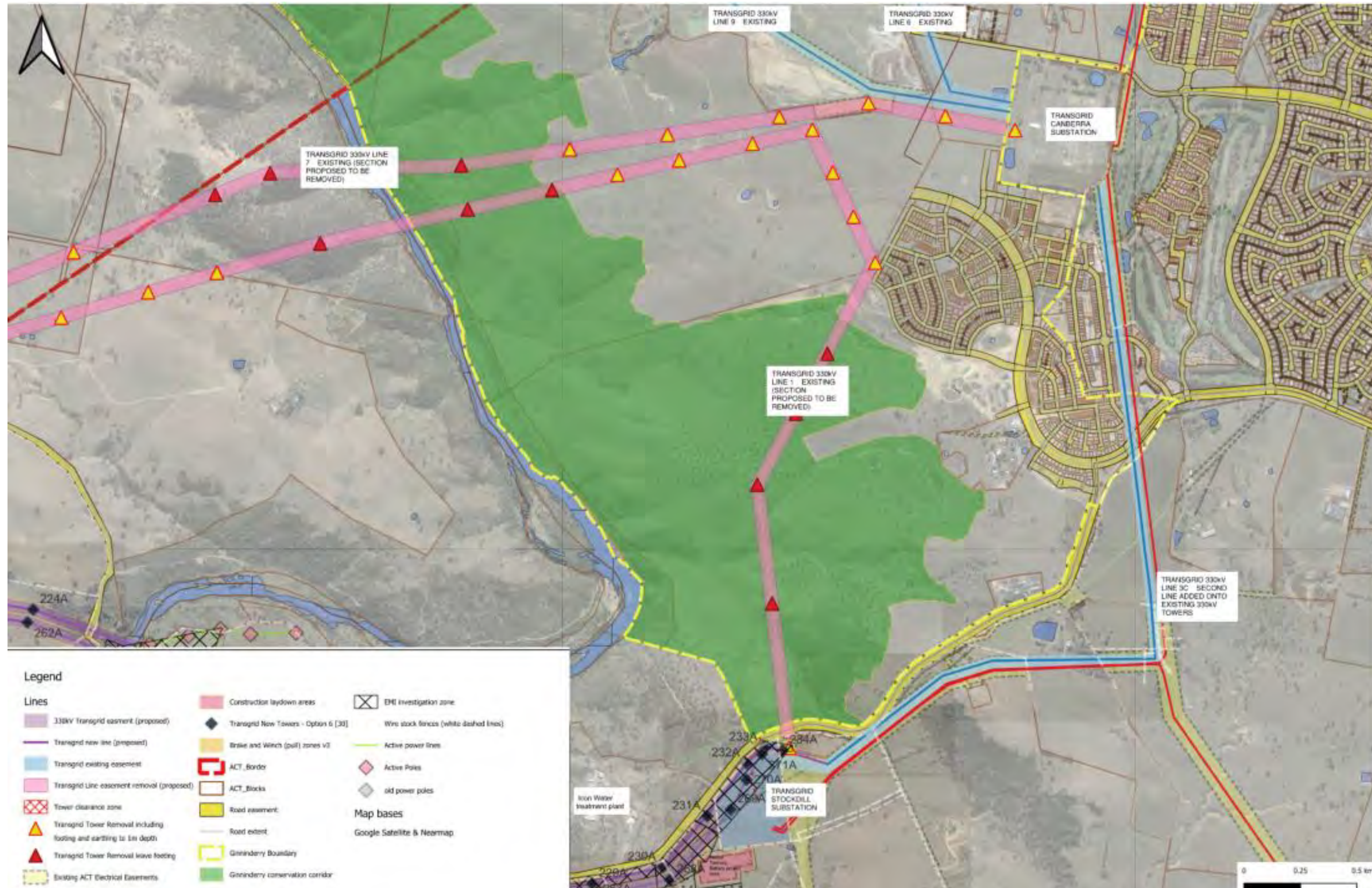


Figure 9 Existing Transgrid easement Line 3C duplication. The existing line 3C duplication occurs in an existing transgrid easement with existing fencing isolation through the route. Testing shall be undertaken along the route as shown in drawing xx below.



4 Conclusion and Recommendations

Each of the below sections respond directly to the UTR's comments in the EIS Scoping Document (see Section 1.4).

4.1 Network configuration

Given that line 1 and 7 would be relocated and connections to the Stockdill and Canberra substations would remain the same, the project would not result in a change to the network configuration and a network capacity study / model is not required as requested by the UTR in the Scoping Document.

The project would not change the current network configuration for the following reasons:

- The new line 1 would replace the existing Line 1 connection at the Stockdill Substation. The existing line 1 was previously disconnected from the Canberra Substation and would not be reconnected to the Canberra Substation.
- The existing line 7 connects to the Canberra Substation. The new line 7 would not connect to the Stockdill Substation, and would replace the existing line 7 connection at the Canberra substation. The line 7 conductors would be installed along spare arms on line 3C to become a second circuit on line 3C.

4.2 Transmission line ratings

The electrical rating of the two relocated lines will be maintained. This is summarised in Table 4.1 below.

Table 4.1 - Line parameters. Current capacity is based on current line capacity for lines 1,7 (constraints of existing cables) and line 3C has existing capacity plus line 7 capacity added. Note that Canberra has a winter peak usage.

	<i>Line 1</i>	<i>Line 7</i>	<i>Line 3C</i>
Voltage (kV)	330	330	330
Number of circuits	1	1	2 (one existing)
Maximum Current capacity, winter (Amps)	1,226	1,143	2,572
Maximum current capacity, summer (Amps)	915	972	2,252
Maximum 2023 operational level (Amps)	613	778	721
Winter line capacity (MVA)	405	377	849
Summer line capacity (MVA)	302	321	743

4.3 Removal of existing towers and earthing conductors

The project involves the removal of existing towers. In ecologically sensitive areas such as the river corridors and Ginninderry Conservation Corridor, the tower footings would be left in place to reduce ecological impacts. At all other locations (e.g. in farmland and within the Ginninderry urban development area), tower removal would include the removal of footings and buried earth conductors down to approximately 1m in depth (currently buried approximately 0.5m under the surface).

The remaining earth straps will be disconnected and tested and will not have any risks associated with them as the transmission lines and towers will have been removed.

4.4 EMF modelling

An EMF assessment has been undertaken in Section 2 for maximum load conditions and maximum line ratings to demonstrate project compliance with ARPANSA limits, which align to limits recommended by the ICNIRP Guidelines (2010). The project complies with regulated, recommended ARPANSA limits and no impacts are predicted from the project.

Additional EMF assessments will also to be undertaken for normal and maximum load conditions, and for maximum line ratings, to ensure the detailed design is compliant with ARPANSA limits, once the detailed design has been finalised.

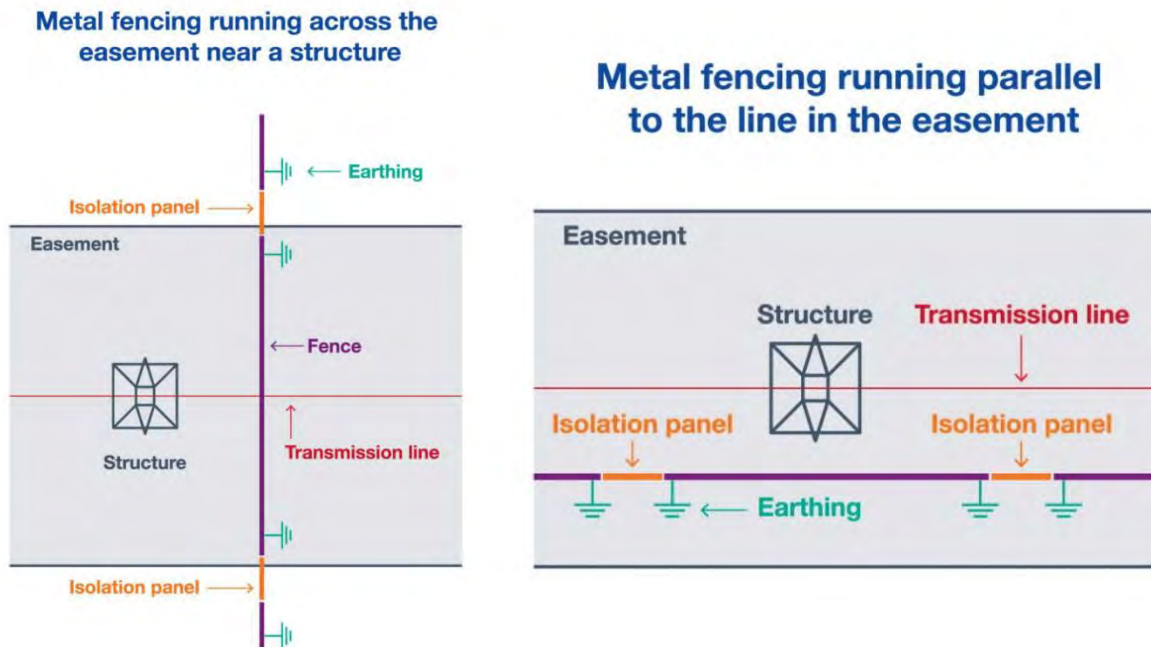
Utilising the above principles, it is not expected that the project would result in any potential health risks to future adjacent residents with respect to EMF associated with the new transmission lines.

4.5 EMI / Low frequency induction and EPR

A review of fences and other metallic infrastructure located near the new alignments has been undertaken (see Section 3 and the drawings in Appendix B). The design and construct contractor shall undertake a detailed assessment for possible excessive voltages for this infrastructure, due to EMI/low frequency induction and EPR and associated step and touch voltages arising from transferred voltages from the transmission lines' earthing system, etc. The assessment shall be undertaken in accordance with relevant standards including *AS/NZS 4853:2021 Electrical hazards on metallic pipelines*, *ENA Doc 025-2022 Power System Earthing Guide (EG-0)* and *ENA EG1-2006 Substation Earthing Guide*. Mitigation measures shall be identified if allowable limits are exceeded.

All fences within the new easements are to be isolated as per the Transgrid fencing guidelines⁵, as illustrated in Figure 10 below.

Figure 10 - Transgrid fencing guideline isolation and earthing diagram



During commissioning of the new lines once construction has been completed, low voltage current injection testing shall be undertaken to verify the EMI and EPR design hazard mitigations. This has been demonstrated to reveal hazard locations not previously identified during the design phase.

⁵ Transgrid Fencing Guidelines [getContent \(nsw.gov.au\)](https://www.getcontent.nsw.gov.au)

5 References

Reference Document	Details
ARPANSA Radiation protection series	Radiation Protection Series F-1 ARPANSA
AS/NZS 4853:2021 Electrical hazards on metallic pipelines	826164500397.pdf (saiglobal.com)
ENA Doc 025-2022 Power System Earthing Guide (EG-0)	ENA DOC 025-2022 Power System Earthing Guide (EG-0) Part 1: Manag (saiglobal.com)
ENA EG1-2006 Substation Earthing Guide	ENA EG1-2006 SUBSTATION EARTHING GUIDE (saiglobal.com)
Line operating levels	Transgrid Transmission Annual Planning Report 2023
Measuring Magnetic fields	ARPANSA, Measuring magnetic fields, www.arpansa.gov.au
Protect yourself from Induced current	Powerlineman Magazine - PROTECT YOURSELF FROM INDUCED CURRENT
Radiofrequency electromagnetic energy and the new ARPANSA safety standard	Radiofrequency Electromagnetic Energy and the new ARPANSA safety Standard ARPANSA
Transmission line rating	AEMO Transmission Equipment Ratings
Transgrid - Managing Magnetic fields	Precaution - Managing Electric & Magnetic Fields Transgrid
Transgrid Easement guidelines and documentation	Easement Guidelines - Protecting Your Safety Transgrid
Transgrid Fencing guidelines	Transgrid Fencing Guidelines getContent (nsw.gov.au)

Transmission Lines Safe Work Handbook Power System Safety Rules [Transmission Lines \(transgrid.com.au\)](#)

6 Appendices

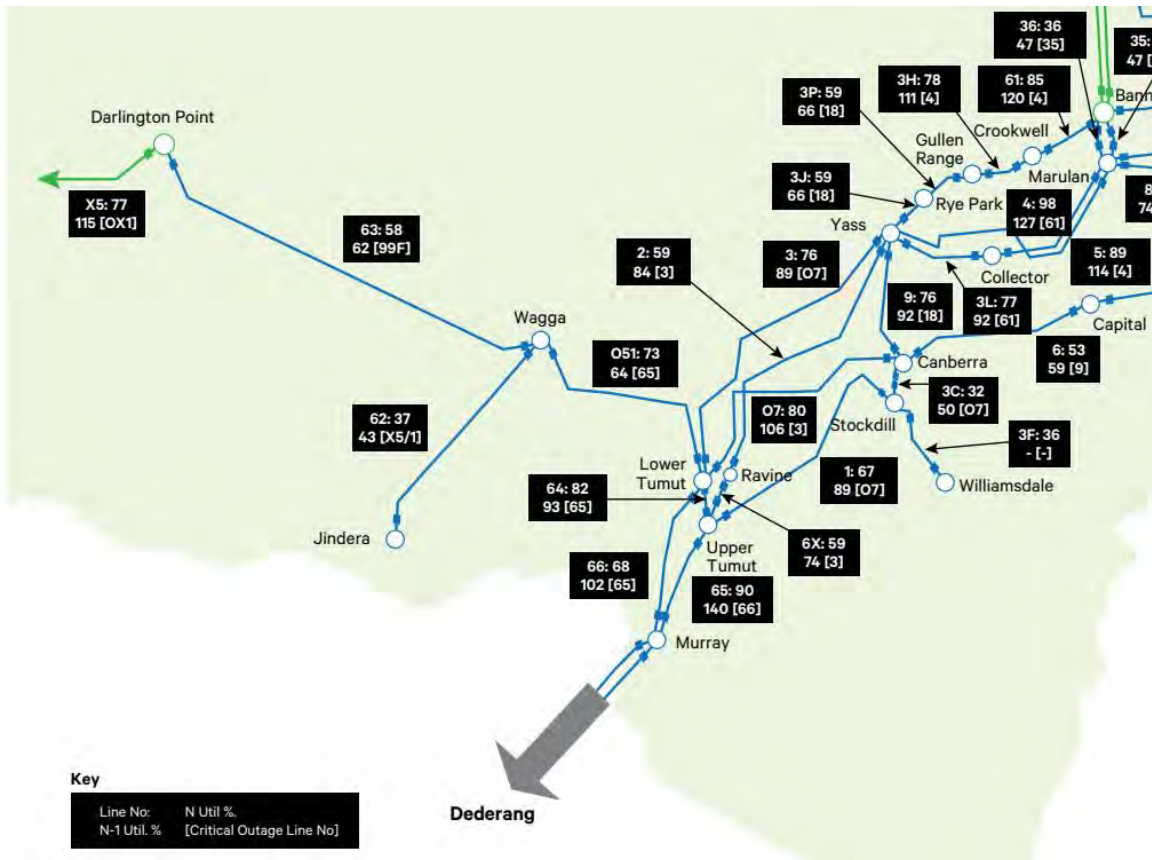
Appendix A – Glossary

<i>Abbreviation</i>	<i>Full name</i>
AS	Australian Standard
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
EG	Earthing Guide
EIS	Environmental Impact Statement
ELF	Extra low frequency
EPR	Earth Potential Rise
EMF	Electromagnetic Field
EMI	Electromagnetic Induced current
EME	Electromagnetic exposure
EMR	Electromagnetic Radiation
Hz	Hertz (measure of frequency)
ICNIRP	International Commission on Non-Ionizing Radiation Protection
LFI	Low Frequency Induction
LMWQCC	Lower Molonglo Water Quality Control Centre (Canberra's main water treatment plant)
m	Meter
MEN	Multiple Earthed Neutral (referring to earthing of electrical cables or lines)
NZS	New Zealand Standard
TAPR	Transmission Annual Planning Report
RF	Radio Frequency
UK	United Kingdom
US	United States
UTR	Utilities Technical Regulator of the ACT
WHO	World Health Organisation

Appendix B – Additional EMF modelling data - current operational levels

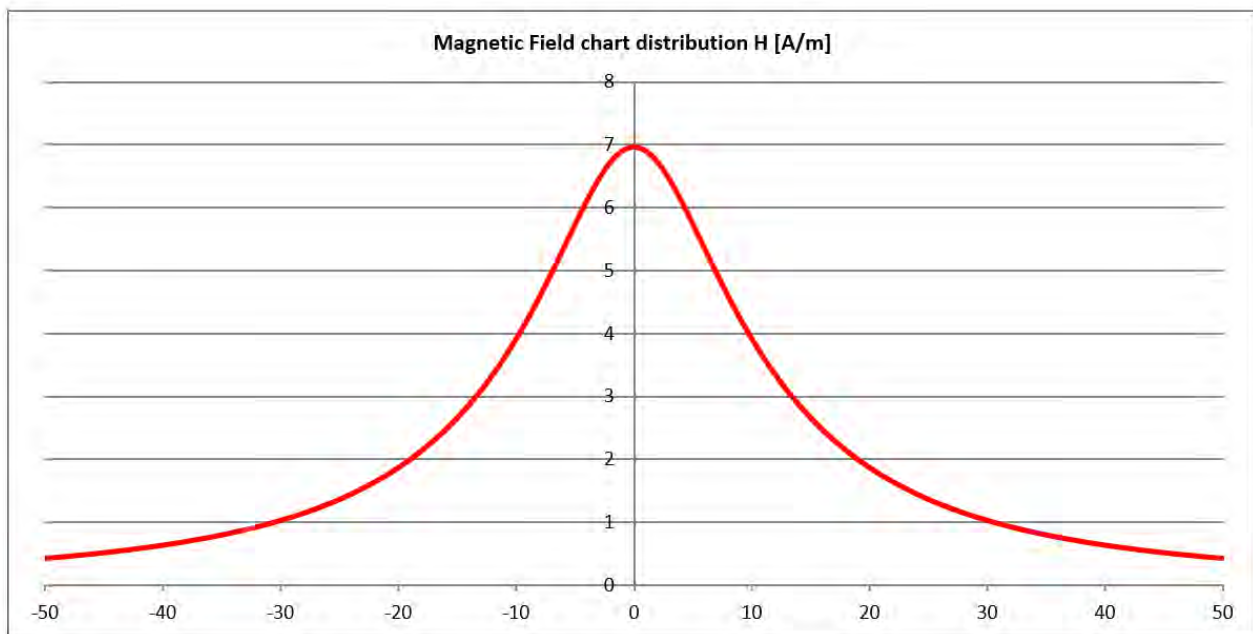
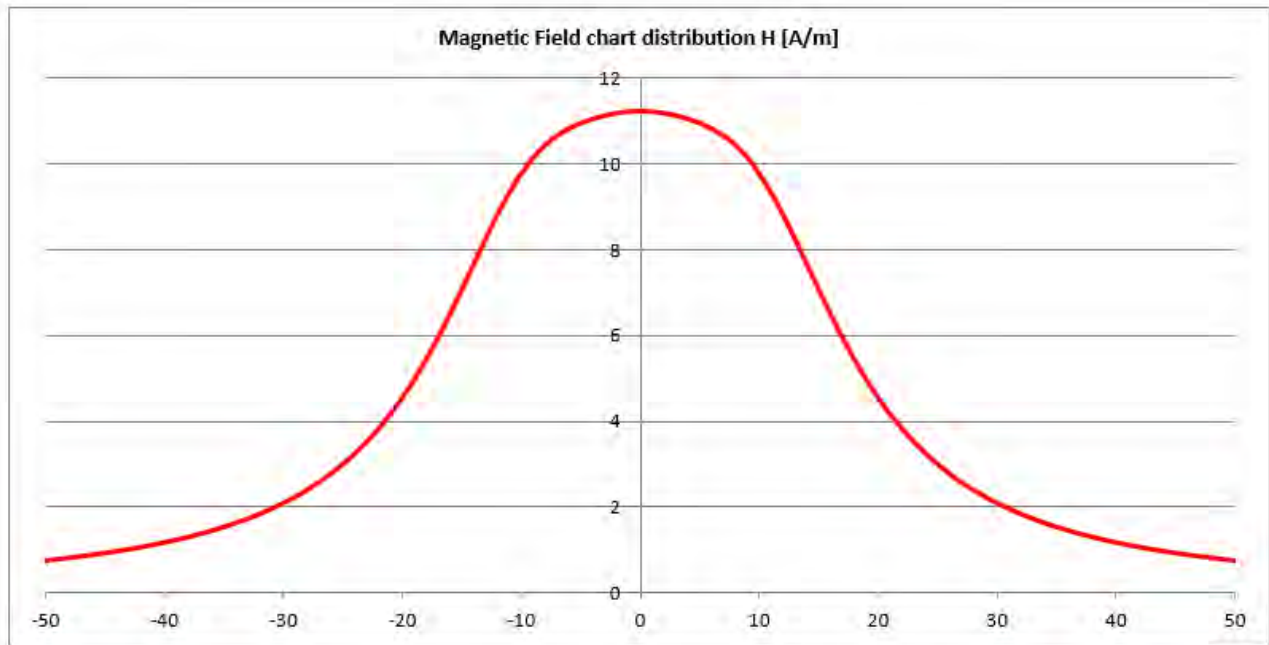
In addition to the maximum levels of potential EMF, the current operational levels of EMF have been modelled. This is shown in Figure 11 below from the Transgrid transmission annual planning report (TAPR) 2023.

Figure 11 – Transgrid transmission highest line utilization levels for 2023. Noting that Line 1 runs at 67% of rated capacity, Line 7 runs at 80% of rated capacity and Line 3C runs at 32% of rated capacity.

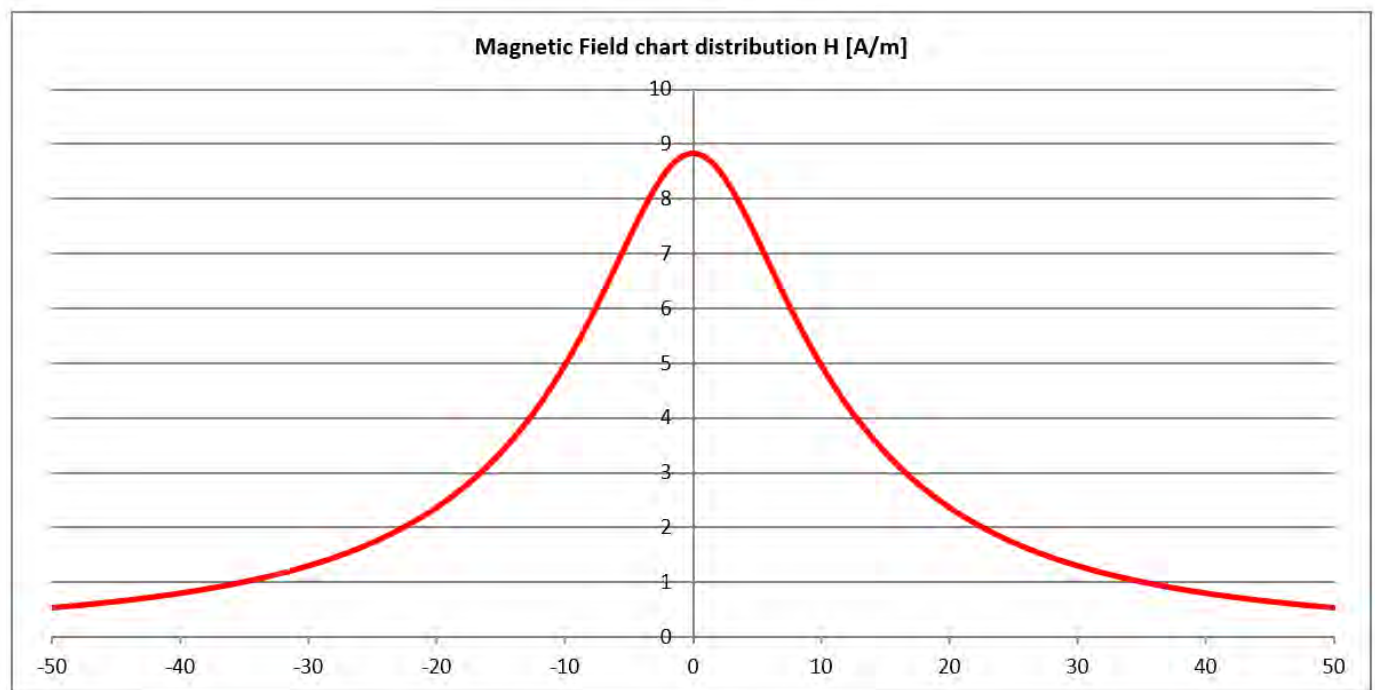
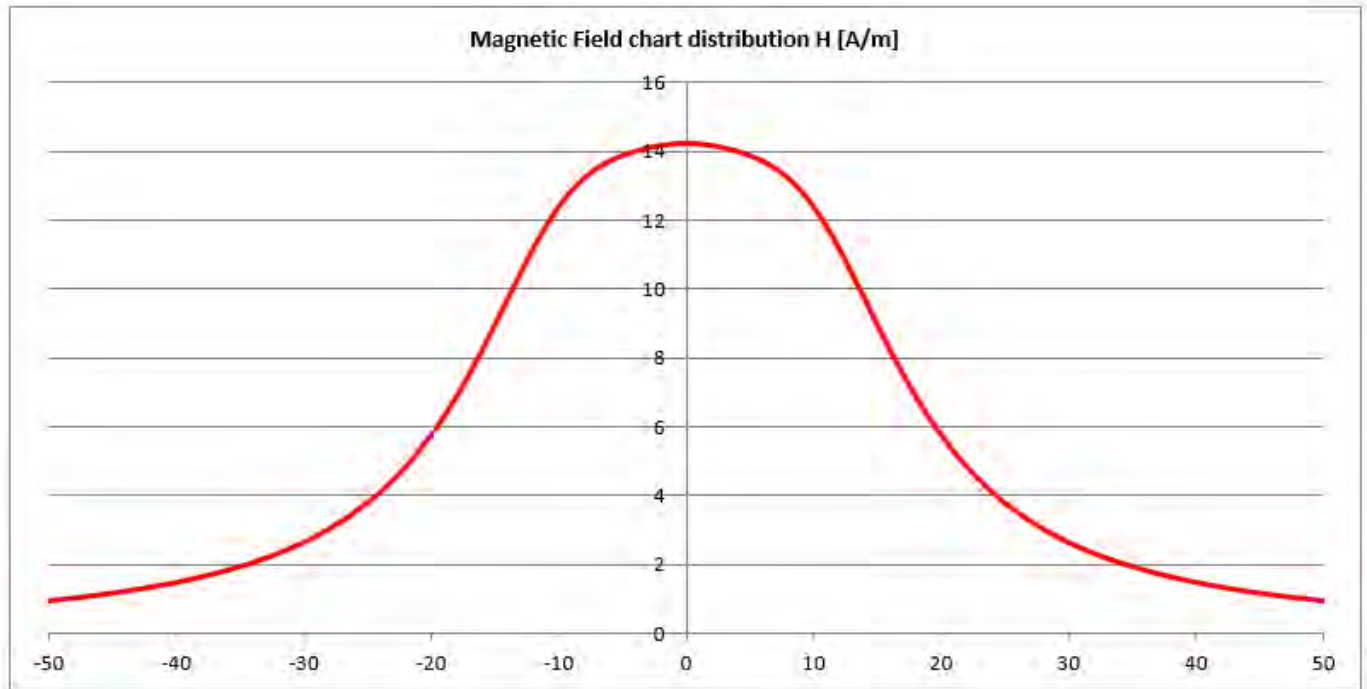


[Transgrid Transmission Annual Planning Report 2023](#)

Line 1 – 2023 Operational level for Towers (top diagram) and Poles



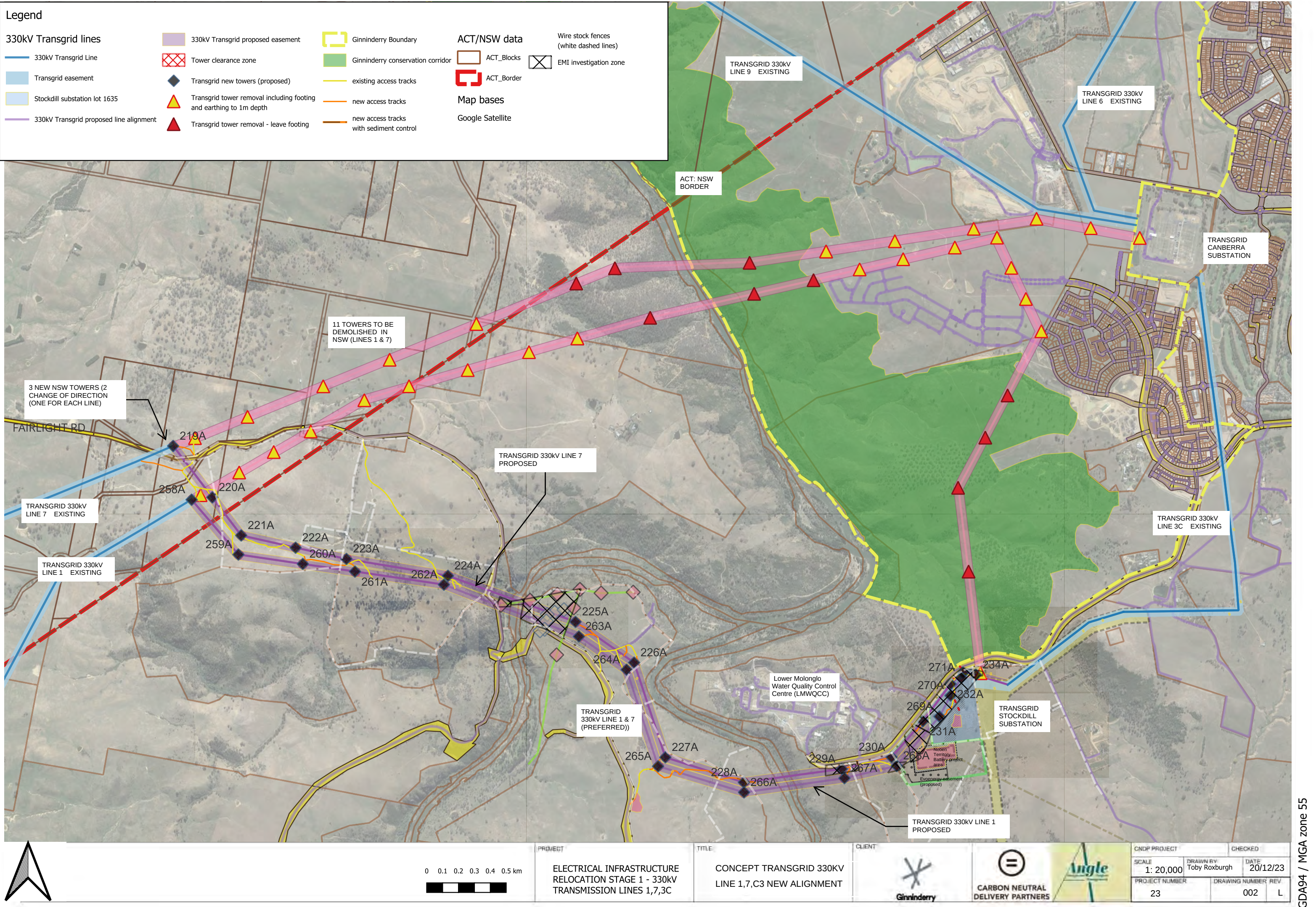
Line 7 operational level 2023 for Towers (top diagram) and Poles





CARBON NEUTRAL
DELIVERY PARTNERS

Appendix C – Project Drawings

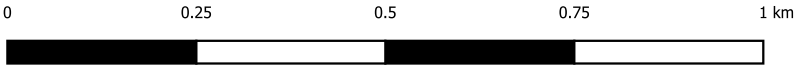
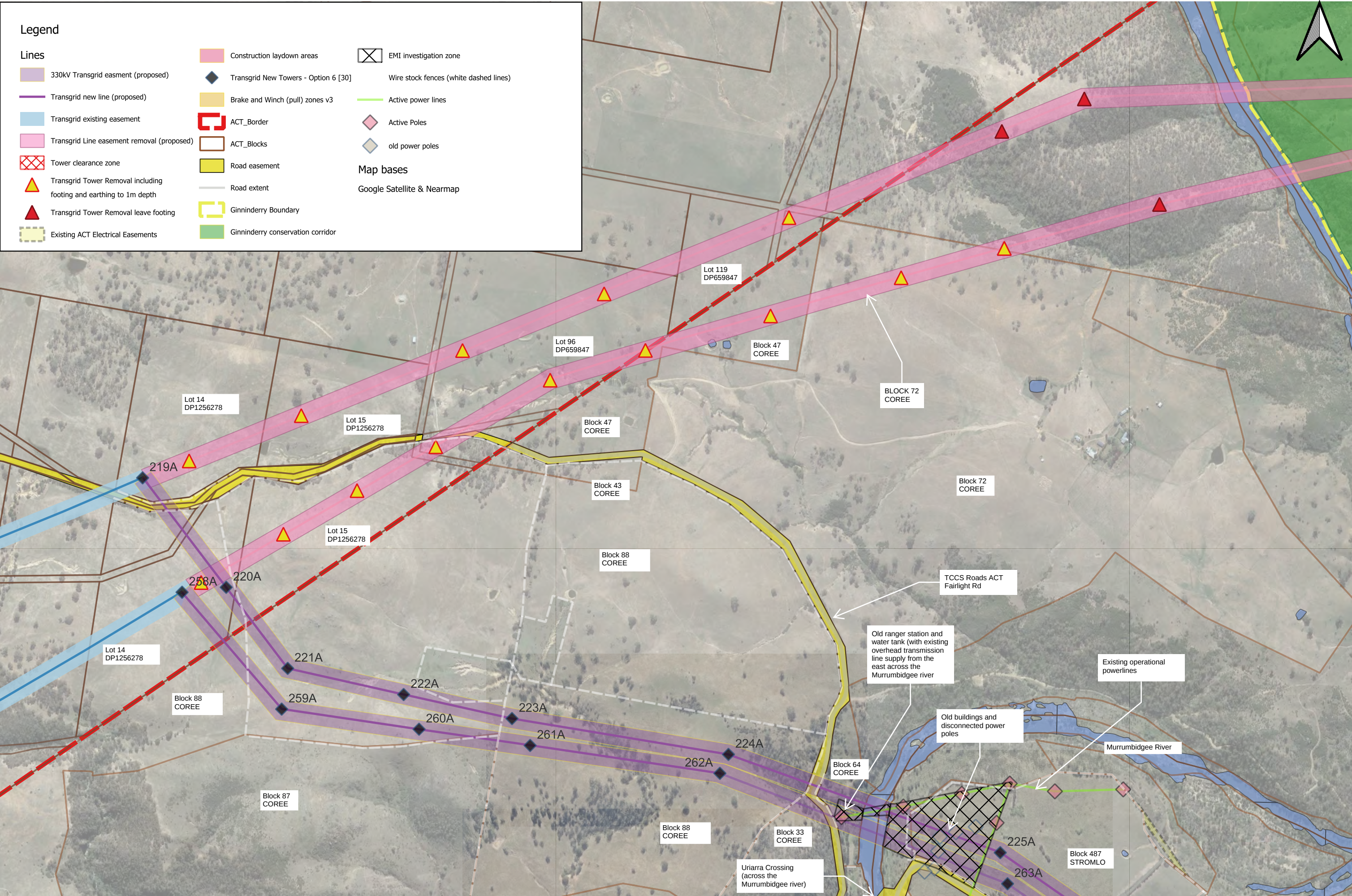


Legend

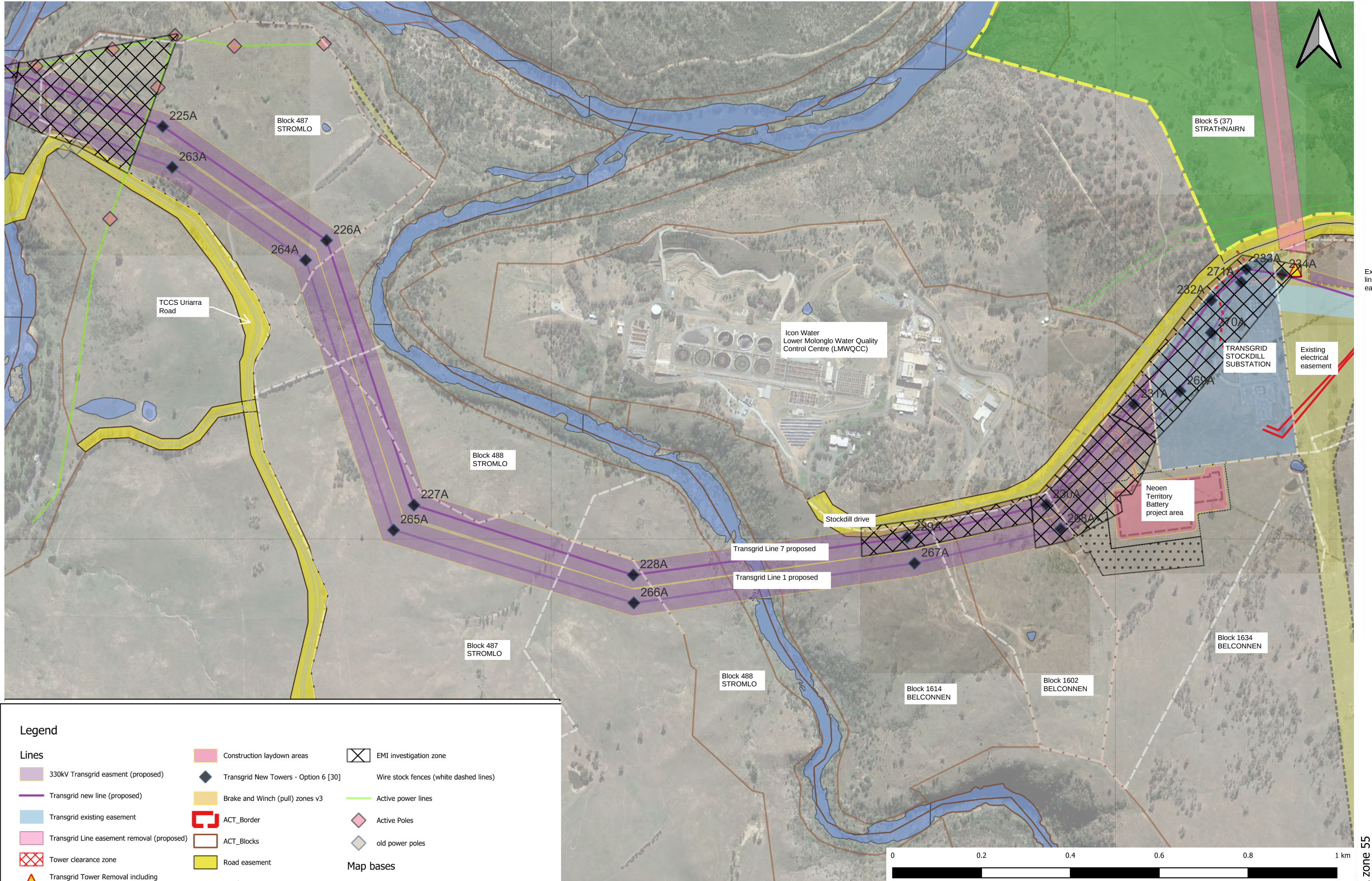
- Lines

 - 330kV Transgrid easment (proposed)
 - Transgrid new line (proposed)
 - Transgrid existing easement
 - Transgrid Line easement removal (proposed)
 - Tower clearance zone
 - Transgrid Tower Removal including footing and earthing to 1m depth
 - Transgrid Tower Removal leave footing
 - Existing ACT Electrical Easements
- Construction laydown areas
 - Brake and Winch (pull) zones v3
 - ACT_Border
 - ACT_Blocks
 - Road easement
 - Road extent
 - Ginninderry Boundary
 - Ginninderry conservation corridor
- EMI investigation zone
 - Wire stock fences (white dashed lines)
 - Active power lines
 - Active Poles
 - old power poles
- Map bases

Google Satellite & Nearmap



PROJECT	TITLE	CLIENT	CNDP PROJECT			CHECKED		
ELECTRICAL INFRASTRUCTURE RELOCATION STAGE 1 - 330kV TRANSMISSION LINES 1,7,3C	CONCEPT - TRANSGRID 330kV LINE 1, 7 NEW ALIGNMENT – NSW / WESTERN PORTION - EMF / EMI INVESTIGATION							
								
			SCALE 1: 10,000	DRAWN BY Toby Roxburgh		DATE 20/12/23		
			PROJECT NUMBER 23		DRAWING NUMBER 050		REV A	



Legend

Lines

330kV Transgrid easment (proposed)

Transgrid new line (proposed)

Transgrid existing easement

Transgrid Line easement removal (proposed)

Tower clearance zone

Transgrid Tower Removal including footing and earthing to 1m depth

Transgrid Tower Removal leave footing

Existing ACT Electrical Easements

Construction laydown areas

Transgrid New Towers - Option 6 [30]

Brake and Winch (pull) zones v3

ACT_Border

ACT_Blocks

Road easement

Road extent

Ginninderry Boundary

Ginninderry conservation corridor

EMI investigation zone

Wire stock fences (white dashed lines)

Active power lines

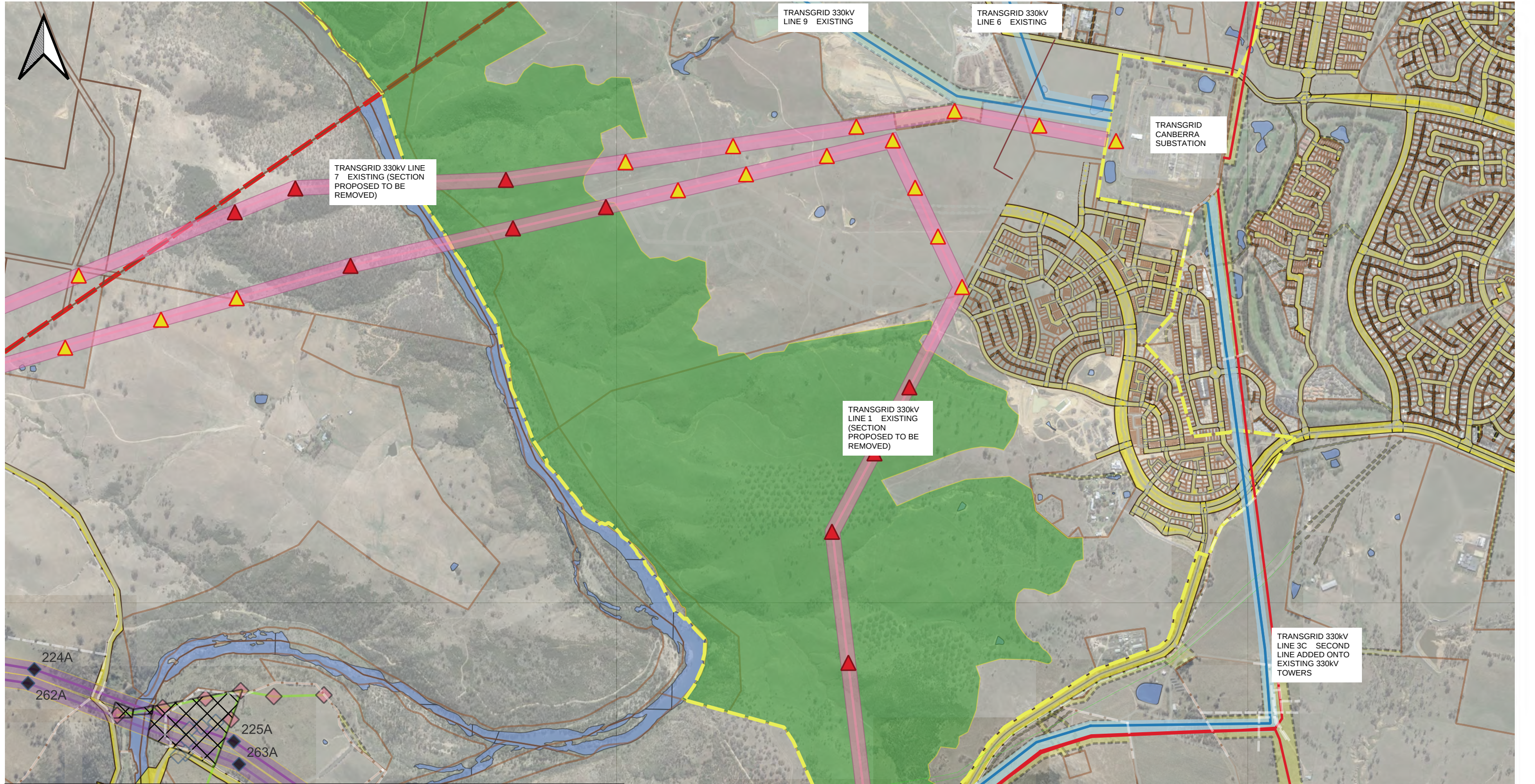
Active Poles

old power poles

Map bases

Google Satellite & Nearmap

PROJECT	TITLE	CLIENT	CNDP PROJECT		CHECKED	T.R.
ELECTRICAL INFRASTRUCTURE RELOCATION STAGE 1 - 330kV TRANSMISSION LINES 1,7,3C	CONCEPT - TRANSGRID 330kV LINE 1,7 NEW ALIGNMENT - CENTRAL PORTION		SCALE	1:7,500	DRAWN BY	Toby Roxburgh
			PROJECT NUMBER	23	DRAWING NUMBER	051
			DATE	21/12/2023	REV	A



Legend

Lines

330kV Transgrid easment (proposed)

Transgrid new line (proposed)

Transgrid existing easement

Transgrid Line easement removal (proposed)

Tower clearance zone

Transgrid Tower Removal including footing and earthing to 1m depth

Transgrid Tower Removal leave footing

Existing ACT Electrical Easements

Construction laydown areas

Transgrid New Towers - Option 6 [30]

Brake and Winch (pull) zones v3

ACT_Border

ACT_Blocks

Road easement

Road extent

Ginninderry Boundary

Ginninderry conservation corridor

EMI investigation zone

Wire stock fences (white dashed lines)

Active power lines

Active Poles

old power poles

Map bases

Google Satellite & Nearmap

PROJECT

ELECTRICAL INFRASTRUCTURE
RELOCATION STAGE 1 - 330KV
TRANSMISSION LINES 1,7,3C

TITLE

CONCEPT TRANSGRID 330KV
LINE 3C1 NEW STRING –
STOCKDILL TO CANBERRA
SUBSTATION

CLIENT

CNDP PROJECT

SCALE
1: 15000

PROJECT NUMBER
23

CHECKED

DRAWN BY
Toby Roxburgh

DRAWING NUMBER
052

DATE
21/12/23

REV
A

0 0.25 0.5 km



CARBON NEUTRAL
DELIVERY PARTNERS

Appendix D – DBYD Drawings



Job No 35487043

Phone: 1100
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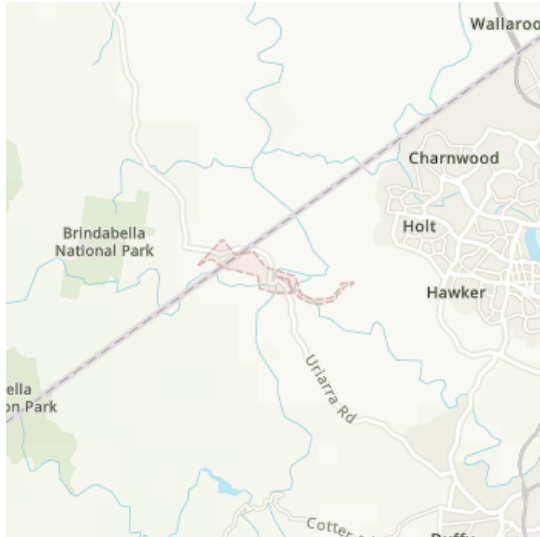
Caller Details

Contact: Toby Roxburgh
Company: Carbon Neutral Delivery Partners
Address: 14 Wormald Street
Symonston ACT 2609

Caller Id: 3477019
Phone: 0402 488 505
Email: toby@cndp.com.au

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.



User Reference: Transgrid Transmission Lines 1,7,3C relocation
Working on Behalf of: Private
Enquiry Date: 16/11/2023
Start Date: 22/11/2023
End Date: 24/12/2026

Address:
20 Fairlight Road
Coree ACT 2611

Job Purpose:
Design

Location of Workplace:
Private

Onsite Activities:
Planning & Design, Tendering

Location in Road:

- Check that the location of the dig site is correct. If not you must submit a new enquiry.
- Should the scope of works change, or plan validity dates expire, you must submit a new enquiry.
- Do NOT dig without plans. Safe excavation is your responsibility. If you do not understand the plans or how to proceed safely, please contact the relevant asset owners.

Notes/Description of Works:

GJV is undertaking EIS and DA works for Transgrid relocation of Lines 1,7 into Stockdill Substation and Canberra Substation

Your Responsibilities and Duty of Care

- The lodgement of an enquiry does not authorise the project to commence. You must obtain all necessary information from any and all likely impacted asset owners prior to excavation.
- If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.
- ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using this service, you agree to Privacy Policy and the terms and disclaimers set out at www.byda.com.au
- For more information on safe excavation practices, visit www.byda.com.au

Asset Owner Details

The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days. Additional time should be allowed for information issued by post. It is **your responsibility** to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Before You Dig service, so it is **your responsibility** to identify and contact any asset owners not listed here directly.

** Asset owners highlighted by asterisks ** require that you visit their offices to collect plans.

Asset owners highlighted with a hash # require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
232230796	Essential Energy	13 23 91	NOTIFIED
232230797	Evoenergy Icon Water	(02) 6293 5770	NOTIFIED
232230795	NBN Co NswAct	1800 687 626	NOTIFIED
232230798	Telstra NSW South	1800 653 935	NOTIFIED

END OF UTILITIES LIST

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Job No 35487567

Phone: 1100
www.byda.com.au

Caller Details

Contact: Toby Roxburgh
Company: Carbon Neutral Delivery Partners
Address: 14 Wormald Street
Symonston ACT 2609

Caller Id: 3477019
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Email: toby@cndp.com.au

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Working on Behalf of: Private
Enquiry Date: 16/11/2023
Start Date: 22/11/2023
End Date: 24/12/2026

Address:
174 Fairlight Road
Coree ACT 2611

Job Purpose:
Design

Location of Workplace:
Private

Onsite Activities:
Planning & Design, Tendering

Location in Road:

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Seq. No.	Authority Name	Phone	Status
232234030	Essential Energy	13 23 91	NOTIFIED
232234031	Evoenergy Icon Water	(02) 6293 5770	NOTIFIED
232234032	Telstra NSW South	1800 653 935	NOTIFIED

END OF UTILITIES LIST

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Job No 35487589

Phone: 1100
www.byda.com.au

Caller Details

Contact: Toby Roxburgh
Company: Carbon Neutral Delivery Partners
Address: 14 Wormald Street
Symonston ACT 2609

Caller Id: 3477019
Phone: 0402 488 505
Email: toby@cndp.com.au

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User Reference: Transgrid Transmission Lines 1,7,3C relocation
Working on Behalf of: Private
Enquiry Date: 16/11/2023
Start Date: 22/11/2023
End Date: 24/12/2026

Address:
1320 Uriarra Road
Stromlo ACT 2611

Job Purpose:
Design

Location of Workplace:
Private

Onsite Activities:
Planning & Design, Tendering
Location in Road:

- Check that the location of the dig site is correct. If not you must submit a new enquiry.
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Asset owners highlighted with a hash # require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
232234153	Evoenergy Icon Water	(02) 6293 5770	NOTIFIED
232234154	Telstra NSW South	1800 653 935	NOTIFIED

END OF UTILITIES LIST

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Job No 35487596

Phone: 1100
www.byda.com.au

Caller Details

Contact: Toby Roxburgh
Company: Carbon Neutral Delivery Partners
Address: 14 Wormald Street
Symonston ACT 2609

Caller Id: 3477019
Phone: 0402 488 505
Email: toby@cndp.com.au

Dig Site and Enquiry Details

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User Reference: Transgrid Transmission Lines 1,7,3C relocation
Working on Behalf of: Private
Enquiry Date: 16/11/2023
Start Date: 22/11/2023
End Date: 24/12/2026

Address:
446 Stockdill Drive
Belconnen ACT 2615

Job Purpose:

Design

Onsite Activities:

Planning & Design, Tendering

Location of Workplace:

Private

Location in Road:

- Check that the location of the dig site is correct. If not you must submit a new enquiry.
- Should the scope of works change, or plan validity dates expire, you must submit a new enquiry.
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Asset owners highlighted with a hash # require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
232234200	Evoenergy Icon Water	(02) 6293 5770	NOTIFIED
232234201	Telstra NSW South	1800 653 935	NOTIFIED

END OF UTILITIES LIST

Lodge Your Free Enquiry Online - 24 Hours a Day, Seven Days a Week



Job No 35487605

Phone: 1100
www.byda.com.au

Caller Details

Contact: Toby Roxburgh
Company: Carbon Neutral Delivery Partners
Address: 14 Wormald Street
Symonston ACT 2609

Caller Id: 3477019
Phone: 0402 488 505
Email: toby@cndp.com.au

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.



User Reference: Transgrid Transmission
Lines 1,7,3C relocation

Working on Behalf of: Private

Enquiry Date: 16/11/2023
Start Date: 22/11/2023
End Date: 24/12/2026

Address:
315 Stockdill Drive
Belconnen ACT 2615

Job Purpose:
Design

Location of Workplace:
Private

Onsite Activities:
Planning & Design, Tendering

Location in Road:

- Check that the location of the dig site is correct. If not you must submit a new enquiry.
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Asset owners highlighted with a hash # require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
232234256	Evoenergy Icon Water	(02) 6293 5770	NOTIFIED
232234257	Telstra NSW South	1800 653 935	NOTIFIED

END OF UTILITIES LIST

Lodge Your Free Enquiry Online - 24 Hours a Day, Seven Days a Week