

BOARD OF INQUIRY

EAST WEST LINK PROPOSAL

IN THE MATTER

of the Resource Management Act 1991

AND

IN THE MATTER

of a Board of Inquiry appointed under s149J of the Resource Management Act 1991 to consider notices of requirement and applications for resource consent made by the New Zealand Transport Agency in relation to the East West Link roading proposal in Auckland

**Evidence of Roy John Clement Noble on behalf of
Transpower New Zealand Limited: lines and substations**

10 May 2017

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STATEMENT OF EVIDENCE OF ROY CLEMENT NOBLE

EXECUTIVE SUMMARY

- 1 Transpower owns and operates the National Grid, which transmits electricity throughout New Zealand. This infrastructure plays a strategic role in New Zealand's electricity transmission network. As a region, Auckland is dependent on the National Grid to provide about 95% of its electricity from power stations in the Central North Island the South Island.
- 2 Four of Transpower's assets are affected by the East West Link:
 - 2.1 Henderson-Otahuhu A 220kV overhead line on towers;
 - 2.2 Penrose-Mt Roskill A 110kV overhead line on towers;
 - 2.3 Mangere-Mt Roskill A 110kV overhead line on towers; and
 - 2.4 Southdown Substation, and in particular the KiwiRail transformer and associated switchgear (**KiwiRail substation**).
- 3 The vast majority of Transpower's overhead line infrastructure is on private land. These assets were established in Auckland between the 1920s - 1960s under the relevant Public Works legislation of the time. Development has occurred incrementally around the assets. Most of Transpower's overhead infrastructure is not designated, nor is it protected by easement. Instead, Transpower relies on rights to lawfully occupy and, subject to certain processes, access and operate its infrastructure, under the Electricity Act 1992 (**Electricity Act**). Where permanent line relocations and new structures are proposed Transpower may need to obtain easements. For temporary deviations, appropriate landowner agreements may be required. Resource consents and property rights will need to be obtained for some tower works. This presents some risk to the EWL Project from delay, or if, for some reason, they are not secured. Transpower will work closely with the Transport Agency to minimise those risks as much as possible.
- 4 Transpower has had detailed discussions with the Transport Agency about the East West Link Project and the potential impacts on Transpower's assets, and on third parties. We have made considerable progress on resolving these issues since we lodged our submission. I am confident that all remaining matters can be addressed through the conditions **Mr Horne** has proposed in his planning evidence for Transpower.

QUALIFICATIONS AND EXPERIENCE

- 5 My full name is Roy John Clement Noble.
- 6 I am the General Manager Transformation and acting General Manager Grid Performance with Transpower New Zealand Limited ("**Transpower**"). I have held these roles since April 2015 and February 2017, respectively. My role as General Manager Transformation ends on 30 June 2017. I anticipate that the role of acting General Manager Grid Performance will end on 15 June 2017. From 1 July 2017, I will return to my substantive position of Tactical Engineering Manager, in Transpower's Grid Development Division.

- 7 I have over 32 years' experience in the design, construction and maintenance of high voltage transmission lines. I hold a New Zealand Certificate of Engineering (Civil).
- 8 My experience includes five years as a South Island Transmission Line Maintenance Manager for a contractor for Transpower, followed by three years working in a transmission line design and project management consultancy.
- 9 I have worked for Transpower directly for 19 years, initially in a national engineering support role for maintenance works. I then transitioned into engineering design, construction and asset management roles for transmission line development and enhancement projects.
- 10 Between 2009 and 2012, I worked on the construction of Brownhill-Whakamaru A (NIGUP) transmission line from Whakamaru to Auckland, firstly in the role of Programme and Property Manager, and then Operations Manager during the build phase.
- 11 Between November 2012 and April 2015, I was Asset Engineering (Lines) Manager. In this role, I led an Engineering team which developed long term maintenance and capital plans for lines throughout New Zealand, provided engineering support to maintenance works, compiled design and maintenance standards, and led the design and engineering support for capital transmission line projects. This role worked closely with the Asset Engineering (Substations) team to ensure a co-ordinated approach to the management of the National Grid. As Tactical Engineering Manager, my role leads the lines, substations and secondary systems engineering teams.
- 12 I am also a member of Transpower's Auckland Strategy Governance Group, which has been formed to manage issues and risks, and make key decisions, following recommendations from staff. The East West Link project has been discussed at this Group.
- 13 I am familiar with the National Grid assets within the Auckland Region generally and in particular those affected or likely to be affected by the New Zealand Transport Agency's (**the Transport Agency's**) East West Link proposal.
- 14 I am authorised to give this evidence on Transpower's behalf.
- 15 In preparing this brief I have read the following statements or draft statements of evidence:

15.1 NZTA briefs and reports (addressing specific Transpower issues) of:

- (a) Mr Nancekivell;
- (b) Mr Hopkins;
- (c) Mr Lister;
- (d) Mr Wickman;

15.2 Evidence of Christopher Horne, for Transpower.

CODE OF CONDUCT

- 16 I can confirm that I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Practice Note 2014. As I am employed by Transpower, I acknowledge I am not independent. However, I have sought to comply with the Code of Conduct. My experience is described above. I confirm that, subject to the exceptions below, the issues addressed in this statement are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.
- 17 I note that I am not a property expert. To the extent that my evidence addresses property matters, it is not expert evidence, but conveys my understanding of Transpower's approach to obtaining property rights.

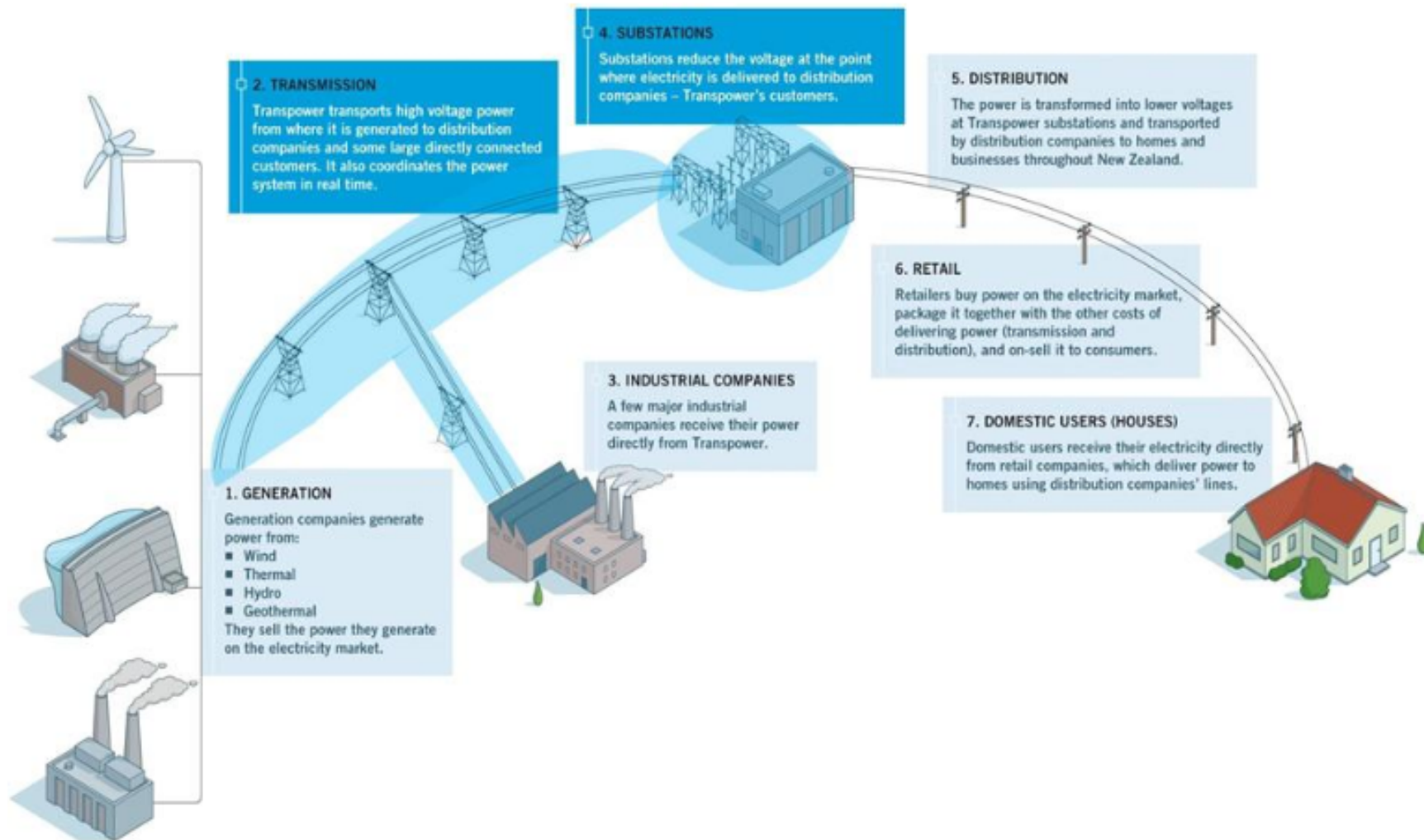
SCOPE OF EVIDENCE

- 18 My evidence will address the following:
- 18.1 A description of Transpower and its role;
 - 18.2 An overview of New Zealand's Electricity System;
 - 18.3 The role of the National Grid in the Auckland (and Northland) context;
 - 18.4 National Grid infrastructure in the Auckland Region;
 - 18.5 Assets affected by the East West Link project (**EWL Project**);
 - 18.6 A summary of the engagement by the Transport Agency with Transpower to date;
 - 18.7 Effects of the EWL Project on Transpower's assets;
 - 18.8 Anticipated process to resolve uncertainty going forward (from a technical perspective);
 - 18.9 Conclusions.

DESCRIPTION OF TRANSPOWER: TRANSPOWER'S ROLE

- 19 Transpower is the State-Owned Enterprise (**SOE**) that plans, builds, maintains, owns and operates New Zealand's electricity transmission network – the National Grid. The Grid, which extends from Kaikohe in the North Island down to Tiwai Point Smelter in the South Island, is the physical infrastructure that transports bulk electricity throughout New Zealand.
- 20 Transpower, whose main role is to ensure the delivery of a reliable and secure supply of electricity to New Zealand, has a fundamental role in the industry and in New Zealand's economy. Transpower's role in the Electricity Industry is illustrated in **Figure 1** on the following page.

Figure 1: Electricity Industry in New Zealand



- 21 Transpower is not a generator of electricity and has no retail sales of electricity. It can be considered the “freight company” for electricity, in that it transports bulk electricity from where it is generated by companies such as Contact Energy, Mercury and Genesis to the local lines distribution companies (Counties Power and Vector) which supply electricity to our homes, farms, communities and businesses. The Grid also supplies some major users of electricity (eg. New Zealand Steel at Glenbrook, KiwiRail at Southdown and Penrose, and Marsden Point oil refinery further to the north of Auckland).
- 22 Transpower also manages New Zealand’s power system in real time. In its role as System Operator, Transpower operates the electricity market to ensure electricity transmitted through the Grid is delivered whenever and wherever it is needed, 24 hours a day, seven days a week.
- 23 As an SOE, Transpower’s principal objective is to operate as a successful business.¹ It must operate within certain legislative constraints and report regularly to its shareholding Ministers. The transmission network is a natural monopoly. Transpower’s investments in the Grid and transmission charges are regulated by the Commerce Commission and Electricity Authority respectively. Any major capital expenditure proposal to the Commerce Commission must satisfy a ‘net benefits to electricity consumers’ test. Capital expenditure is ultimately paid for by New Zealand consumers.
- 24 Transpower is required to deliver and operate a National Grid that meets the needs of users now and into the future.² Prudent investment in the Grid, long term transmission planning strategies, and developing technologies are crucial to ensure the most can be made out of the existing infrastructure.

Safety – Transpower’s key operational concern

- 25 Transmission infrastructure like that operated by Transpower is used throughout the world and is generally considered a safe and efficient way to transmit electricity. Transpower operates its assets as safely as possible and seeks to protect, to the greatest extent practicable, its staff, the public, consumers and property from exposure to injury or harm, damage, economic losses and nuisance.

OVERVIEW OF NEW ZEALAND’S ELECTRICITY SYSTEM

- 26 The National Grid consists of approximately 12,000km of overhead lines and underground cables and 167 substations across the country. It is controlled by a telecommunications network of 300 sites, which help to link together the components that make up the National Grid.

¹ Transpower New Zealand Limited *Statement of Corporate Intent* 2016/2017, 1 July 2016, Section 1.2 Transpower’s Objectives, <https://www.transpower.co.nz/sites/default/files/publications/resources/TP%20SCI%202016-17%20final.pdf>.

² Transpower New Zealand Limited *Statement of Corporate Intent* 2016/2017, 1 July 2016, Section 1.2 Transpower’s Objectives, <https://www.transpower.co.nz/sites/default/files/publications/resources/TP%20SCI%202016-17%20final.pdf>.

- 27 The Grid comprises of a high voltage backbone which runs the length of the country and links major generation (such as geothermal power stations in Taupo) to major loads in large cities. The bulk of the backbone Grid was built around 60 years ago and comprises most of the 220kV lines through New Zealand, along with the High Voltage Direct Current (**HVDC**) link between the North and South Islands.
- 28 Connected to this Grid backbone are regional lines (also owned and operated by Transpower) which connect smaller generation stations and supply regional communities. The Grid is an interlinked network. Electricity flows along transmission lines and varies in any instant, depending on actual generation at power stations and the demand for electricity across New Zealand. As System Operator, in operating the electricity market, Transpower uses real-time information about electricity use by consumers and electricity generation available from generators to balance electricity demand and supply, ensuring optimum performance of the network.
- 29 Generally, renewable sources of generation are remote from the area of demand (ie from the electricity consumers). The National Grid provides connectivity between all sources of generation and consumers. Without the National Grid, consumers across New Zealand would be dependent on locally generated electricity which would be more expensive and less reliable. As such, the National Grid plays an important role in the sustainable management of natural and physical resources.
- 30 Transpower's 2016 publication "*Transmission Tomorrow*" sets out Transpower's strategy for the future development of the Grid for the next 30 years and beyond.³ *Transmission Tomorrow* confirms Transpower's view that there is an enduring role for the National Grid. Transpower's lines and substations will be required for many years into the future to power the economy while enabling New Zealand's continued reliance on renewable forms of electricity generation, including from the power stations along the Waikato River, and the new geothermal stations commissioned near Taupo.
- 31 It is through *Transmission Tomorrow* that we have identified the importance of our Auckland work in the context of rapid technological changes and uncertainty of demand amid Auckland's intensified urban setting.
- 32 Our existing network in Auckland has remained largely unchanged for 60 years. Over the next decade or two, significant maintenance work will be needed to replace the overhead conductor on many of the National Grid lines in Auckland. **Photos 1** and **2** below show reconductoring and other maintenance work being carried out in an urban environment in Auckland.

³ A copy of *Transmission Tomorrow* is available at <https://www.transpower.co.nz/resources/transmission-tomorrow>



Photos 1 and 2 – Reconductoring in urban Auckland

- 33 Rather than approaching the replacement of conductor in the Auckland region as separate projects over a number of years, we are looking at the full programme of work required for Auckland. We have started an Auckland Strategy Project that looks at the importance of electricity transmission into and across Auckland today. It will explore the question: *based on what we know of our future and what Auckland sees in its future, how can we best manage our Auckland network into that future?* This is an opportunity to look at the connected nature of our upcoming projects, and decide overall what is the best solution/strategy for our largest commercial and population centre into the future.
- 34 In summary, the National Grid:
- 34.1 transports electricity across the country (connecting generation to consumers);
 - 34.2 supports New Zealand's national and regional economic growth;
 - 34.3 plays an essential role in maintaining reliability and security of supply of energy;
 - 34.4 provides a basis for investment decisions to be made by both suppliers and consumers of electricity;
 - 34.5 enables competition among suppliers and retailers of electricity, thereby providing the basis for reduction in electricity prices; and
 - 34.6 assists the development of new electricity generation technologies, including renewable energy, by providing access to markets.
- 35 The National Grid has operational requirements and engineering constraints that both dictate and constrain the way it is managed. The operational requirements relating to the Grid are set out in various legislation, rules and regulations governing the National Grid, including the Electricity Act 1992 and the Electricity Industry Participation Code. I understand that the National Policy Statement on Electricity Transmission (**NPSET**) recognises the technical, operational and security requirements associated with the transmission network, and that these requirements can limit the extent to which it is feasible to avoid or mitigate all adverse environmental effects of the National Grid.⁴

THE NATIONAL GRID IN A WIDER AUCKLAND AND NORTHLAND CONTEXT

- 36 Auckland is New Zealand's main centre of electricity demand, and Transpower's assets in Auckland are significant.
- 37 Approximately 95% of the Auckland (and Northland) peak electricity demand comes from generation sources which are located south of Auckland in the central and lower North Island and South Island (predominantly renewable hydro, geothermal and wind generation). For this reason, strong National Grid connections are important - as electricity from large renewable sources distant

⁴ Refer, eg the Preamble, 4th bullet point; and Policy 3.

from Auckland can produce more cost-effective electricity to power the region, and beyond.

- 38 Auckland's peak load (its electricity consumption) is about 1850 MW. Auckland's local generation can produce up to 150 MW of electricity, although not all generation is "on" at any one time. Typically, local generation contributes about 5% of Auckland's power supply. With the closure of Otahuhu (Contact) and Southdown (Mercury), generation in the Auckland area now only includes one large gas-fired plant at Glenbrook Steel Mill (Alinta - 112 MW), and a number of very small distributed generators throughout Auckland.
- 39 Northland, including the nationally significant Marsden Point refinery is supplied via National Grid transmission lines that pass through Auckland. Northland has a peak load of about 250 MW. There is one significant generator, the Ngawha geothermal plant at Kaikohe (27 MW). The remaining Northland load is supplied from the south via the National Grid network across Auckland.
- 40 Auckland's load is expected to grow at a rate of 1% per annum, or about 18 MW a year, over the long term. This growth is similar to the national average demand growth of 1.1%.

NATIONAL GRID INFRASTRUCTURE IN THE AUCKLAND REGION

- 41 Transpower has a significant number of assets in the Auckland region - 300 km of overhead transmission lines, 60km of underground cables, and 19 substations. **Appendix A** contains an overview map of the National Grid assets in the region. **Appendix B** is a map showing the Transpower assets affected by the EWL Project. These assets are all part of an interconnected network and all have a critical role in the supply of electricity to the Auckland region, and Northland beyond.
- 42 While these assets are interconnected, they each form a distinct role in ensuring electricity supply to and through Auckland.
- 43 The assets can be grouped into two broad categories – those that transport bulk energy into and through Auckland (the 220kV lines and 220kV cables), and those that distribute the energy to individual supply points (substations) within Auckland (the 15 regional Grid 110kV lines and 2 cables).
- 44 In the Auckland Region, the 220 kV Grid forms 3 broad functions (which I expand on below):
- 44.1 supply into Auckland, from the South: five 220kV lines supply Auckland and Northland's electricity needs from the South⁵. These lines terminate at Otahuhu and Pakuranga Substations (these are not affected by the proposed East West link);
- 44.2 core Grid supply through Auckland: five transmission lines and four cables between the main substations to ensure a reliable and resilient supply⁶.

⁵ These lines are: the Brownhill-Whakamaru North 400kV capable line, which currently operates at 220kV, with the final 11 kilometres being underground cable; the Huntly-Otahuhu line, and the Otahuhu-Whakamaru A, B and C lines.

⁶ These lines are: Henderson-Otahuhu, Otahuhu-Pakuranga, Otahuhu-Penrose, the part of the Henderson-Marsden line between Henderson and Huapai, Albany-Huapai, and four cables from

With the completion of Transpower's NAaN (North Auckland and Northland) project, the Grid now encircles Auckland, however the capacity of this cable is not sufficient to serve the load to the north of Auckland on its own;

44.3 core Grid supply to Northland via Marsden Point: 1 transmission line⁷.

- 45 The 110kV regional Grid supply through Auckland includes three overhead lines from Otahuhu which supply the bulk of Auckland's suburban load. These lines connect to Vector's supply points at Penrose, Mangere, Mount Roskill, Hepburn Road, Henderson and Albany.

ASSETS AFFECTED BY THE EAST-WEST LINK PROJECT

- 46 Transpower has 4 assets that are affected by the East-West Link project. These are:

46.1 Henderson-Otahuhu A (HEN-OTA A) 220kV overhead line on towers. This line supplies 70% of the transmission capacity across Auckland. Without this line, the existing peak load in Northland and North Auckland could not be supplied. This line is most significantly affected by the proposed EWL Project.

46.2 Penrose-Mt Roskill A (PEN-ROS A) 110kV overhead line on towers. This line supplies the Mount Roskill substation, one of three substations supplying central Auckland via Vector's cable network.

46.3 Mangere-Mt Roskill A (MNG-ROS A) 110kV overhead line on towers. This line also supplies the Mount Roskill substation. In conjunction with the Penrose-Mount Roskill a line, it supplies part of the central Auckland suburban load as well as a back-up supply to the Auckland CBD via Vector's cable network.

46.4 Southdown Substation. This substation, in conjunction with Penrose, supplies Auckland's electric rail network. It is also the location of the Southdown power station, a 175 MW gas-fired powered station that closed at the end of 2015.

Outage constraints

- 47 The assets in the National Grid are an extensive, linear, and connected system of lines and substations. Therefore, activities or changes on one part of the system can affect other parts. For this reason, any work on the National Grid assets, particularly the HEN-OTA A line and KiwiRail Substation, needs to be carefully planned to ensure security of supply to Auckland, and Northland (in the case of the HEN-OTA A line) and the rail network (in the case of the KiwiRail Substation).
- 48 As noted earlier in my evidence, the HEN-OTA A line carries approximately 70% of the electricity required by consumers in north Auckland and Northland. This line carries two circuits. However, due to the lack of redundancy in the

Pakuranga to Penrose, Penrose to Hobson Street, Hobson Street to Wairau Road and Wairau Road to Albany (together referred to as the NAaN cables).

⁷ This line is the Henderson-Marsden line.

transmission system across the Auckland Isthmus, only one circuit can be removed from service at any one time without placing a major electricity supply risk on consumers. Any work on this line, including deviating or replacing structures, as required by the proposed East West project requires work to be undertaken with one circuit live at all times. While achievable, it does require larger work sites and detailed procedural development to ensure workers are safe and security of electricity supply is maintained.

- 49 In addition, Transpower cannot have outages of the HEN-OTA A line at the same time as other 220kV assets are having outages (e.g. the NAaN cables). Accordingly, any Transpower project work needs to be tightly co-ordinated with other work on the Grid. These outages will also likely be impacted by requirements from major customers such as the refinery who contract for shut-downs at specific times of the year.

Southdown Substation

- 50 The Southdown Substation is a 220kV substation. A KiwiRail transformer and switchgear at the Substation supply KiwiRail's electrical rail network in Auckland. The Substation is one of 2 supply points for KiwiRail's Auckland network (the other is at Penrose). KiwiRail requires both supply points for its network to operate.
- 51 I understand that any outage of the KiwiRail Substation could put the rail network at risk and create security issues. I also understand that given the importance of the Substation to the rail network, the timing of any work would need to be carefully planned (and potentially limited to periods when the network is not required to operate at full capacity). I understand that Transpower has discussed some of these issues and risks with KiwiRail, and discussion is ongoing.

Separation Distances

- 52 To ensure the safe and reliable operation of the Grid, specific separation distances are required between National Grid assets and other infrastructure. These separation distances assist in addressing the safety risks and hazards associated with high voltage electricity equipment. These separation distances are prescribed by national regulation (Electricity (Safety) Regulations 2010)⁸ and industry standards.⁹
- 53 Risks to transmission lines, substations and substation equipment include the following:

53.1 Electrocution;

53.2 Fire;

⁸ Including codes of practice issued under these Regulations such as NZECP34 (discussed later in my evidence) and the New Zealand Electrical Code of Practice for Power Systems Earthing (NZECP35:1993), the Health and Safety at Work Act 2015. Some submitters refer to the New Zealand Electrical Code of Practice for Harmonic Levels (NZECP36:1993). I understand that this code is not relevant to the works that would be required in response to the East West Link project.

⁹ For instance the Safety Manual – Electricity Industry (SM-EI), published by the Electricity Engineers' Association (EEA).

- 53.3 Chemical or gas exposure;
- 53.4 Collapse due to seismic events;
- 53.5 Electric and magnetic field exposure;
- 53.6 Earth potential rise;
- 53.7 Induced electrical currents;
- 53.8 Inadvertent or unauthorised entry; and
- 53.9 Accidental or malicious damage.

- 54 In addition, the separation distances preserve an area for Transpower's staff and contractors to safely operate, maintain and replace equipment.

A SUMMARY OF THE ENGAGEMENT BY THE TRANSPORT AGENCY WITH TRANSPOWER TO DATE

- 55 I have read the evidence of Mr Nancekivell in relation to engagement with Transpower and agree that it reflects the engagement undertaken by the Transport Agency with Transpower to date. I am aware that the Transport Agency has been in discussions with various staff at Transpower from as early as 2013. In that time, the Transport Agency has shared several iterations of preliminary designs for the road, including responding to feedback from Transpower.
- 56 Transpower staff continue to engage with Transport Agency and East West Alliance staff, in various fields, including our investigations project manager, engineers, environmental and property staff.
- 57 While I have not been involved in most of this engagement, I attended a meeting with the Transport Agency/East West Alliance in Auckland on 28 April 2017, to discuss the most recent plans showing the impact of the proposed road alignment on Transpower's assets and potential solutions/next steps to resolving those impacts.
- 58 As I will explain further in my evidence, a number of Transpower's assets are 'in the way' of the proposed alignment of the EWL Project. Since lodgement of the Notices of Requirement (**NORs**) for the EWL Project, Transpower has been in discussions with the Transport Agency to understand the extent of the impact on its assets, and to discuss possible mitigation options.
- 59 I am also aware that the Transport Agency has surveyed the footprint location of the National Grid towers in the project area. These locations are identified in Annexure F to the evidence of Noel Nancekivell.
- 60 Further, the Transport Agency has provided cross-sections of its proposed works in proximity to the National Grid infrastructure. These cross-sections and other information provided give sufficient information to agree that the effects on the National Grid infrastructure can be managed at the detailed design and construction stages of the EWL Project on the proviso that there are not ongoing

major changes from the information provided. The conditions set out in **Mr Horne's** evidence will enable this to occur.

EFFECTS OF THE EWL PROJECT ON TRANSPOWER'S ASSETS

- 61 As discussed earlier, there are three National Grid lines and one substation within the proposed alignment of the EWL Project. These assets cannot all remain in their current location as they conflict with the proposed EWL alignment.
- 62 As I describe below, it is not a simple matter for Transpower to move the assets 'out of the way' of the proposed East West Link alignment. Towers are carefully located and designed to ensure conductor clearances under all electrical loading conditions, while being of sufficient strength to withstand environmental conditions such as wind and conductor tensions. Foundations are designed and installed to sustain specific structural loads. Minimum electrical safety clearances must be maintained at all times between towers and other buildings and structures and between conductors, buildings and the ground. Transpower may need to build temporary line deviations (to ensure supply continues during construction) and outages may also be required to ensure worker safety. Consents and property rights may also need to be obtained to allow Transpower to undertake this mitigation works.
- 63 I discuss the impacts on each of the National Grid assets affected by the EWL Project below. The impacts on the 3 lines affected, and potential solutions, at an individual structure level are discussed in **Appendix C**.

Effects on the HEN-OTA A line

- 64 A number of towers on the HEN-OTA A line are affected by the EWL project. In summary, these impacts fall into 3 categories:
- 64.1 Assets with impacts so great that relocation is required;
 - 64.2 Additional assets that may be required, either as part of the line relocation or to ensure conductors (wires) are appropriately elevated over proposed roads; and
 - 64.3 Assets that, subject to detailed design, can remain in situ, but with work on the structure to ensure they remain structurally sound and/or ground to conductor clearances are at safe levels.
- 65 Towers with the greatest impacts are as follows:
- 65.1 Tower 9, which will require a replacement monopole and temporary line diversion. While final design and construction methodology have yet to be confirmed, it is likely that any temporary diversion would involve construction of a temporary monopole (with foundations of around 15m deep) in the local road/footpath, or in an adjacent property opposite the existing tower.
 - 65.2 The replacement monopole would look similar to the structure in **photo 3** below. It could be around 45 metres in height. I note that Mr Lister,

landscape architect for the Transport Agency, has considered the visual impacts of a monopole in this location and others.



Photo 3 – National Grid monopole in Auckland

65.3 Towers 14 and 15 will need to be replaced with 3 monopoles and tower 16 will require foundation strengthening and conversion to a strain tower (see **photos 4** and **5** below).



Photo 4 – HEN-OTA A Tower 16 (existing configuration)



Photo 5 – Typical strain tower configuration

- 65.4 A temporary line diversion will also be required over the Turners & Growers property. The general layout of the permanent line relocation and temporary diversion are shown on the plans in **Appendix D**.
- 65.5 Wherever possible, Transpower will minimise effects of any relocated or replaced assets on third parties, for example impacts due to conductor swing. Transpower will also endeavour to stay on its current conductor alignment where it can reasonably do so. Other minimisations are possible such as the use of an intermediate tower, such as proposed tower 15B to reduce the height of the replacement tower 15A while ensuring statutory clearances are maintained.
- 65.6 Towers 18 and 19 are to be replaced by monopoles which could be around 8m higher than the existing towers to provide clearance to the proposed

road overpass. To reduce the impact of this increase in height Transpower plans to share the increase in height over the two new poles. An additional monopole is also required between existing towers 19 and 20 to gain clearance to the proposed road. These new structures are identified as towers 18A, 19A and 19B on the plans attached as **Appendix D**.

Effects on the PEN-ROS A line

- 66 Three towers on the PEN-ROS A line are affected by the EWL Project (towers 20, 21 and 22). These three towers do not require relocation. The Transport Agency will need to obtain dispensations under NZECP34 to carry out any works within the minimum approach distances to these towers. I discuss this further below. Access will also need to be retained to each tower.

Effects on the MNG-ROS A line

- 67 Four towers on the MNG-ROS A line are affected by the EWL Project (towers 31, 32, 33 and 34). Impacts on these structures primarily related to ensuring that access to them was maintained, which has now been confirmed by the Transport Agency.
- 68 Changes will likely be required to the arms of tower 33, to ensure that the ground to conductor clearances are maintained. This structure may also require foundation strengthening, due to the fill proposed to be placed in close proximity to/over its foundations.
- 69 Stormwater infrastructure was shown in proximity to tower 34. I understand the Transport Agency has now relocated this proposed infrastructure away from tower 34.

Dispensations under NZECP34

- 70 As discussed above, given the proximity of the EWL Project to a number of towers, the Transport Agency will need to obtain dispensations under the New Zealand Electricity Code of Practice for Electrical Safe Distances: 2001 (**NZECP34**) in many instances prior to work commencing.
- 71 NZECP34 is a mandatory code of practice issued under the Electricity (Safety) Regulations 2010. It is enforced by WorkSafe NZ.
- 72 NZECP34 sets safe separation distances between:
- 72.1 the conductors (wires) and the ground/other structures, mobile plant and people;
 - 72.2 towers and "buildings and other structures"; and
 - 72.3 towers and earthworks.
- 73 In my experience, many people are unaware of NZECP34's requirements. I understand Transpower often seeks specific conditions on resource consents based on NZECP34's requirements to ensure the relevant people are aware of the code's obligations.

- 74 NZECP34 enables Transpower to grant dispensations to other parties where they propose work that would not meet the minimum separation distances between towers and buildings or other structures and between towers and earthworks. NZECP34 does not allow Transpower to grant any dispensations that would reduce the minimum separation distance between the conductors and the ground. Specific clauses of NZECP 34 state:
- 2.1.2 *Excavations and other works near overhead electric line supports can compromise the structural integrity of the overhead electric line.*
- 2.1.4 *Any consent and associated conditions given under this section shall be reasonable, and shall not be unreasonably withheld.*
- 2.2.3 *Prior written consent of the tower owner shall be obtained for any excavation or other interference with the land near any tower supporting an overhead electric line where the work:*
- (a) *is at a greater depth than 300 mm within 6 m of the outer edge of the visible foundation of the tower; or*
- (b) *is at a greater depth than 3 m between 6 m and 12 m of the outer edge of the visible foundation of the tower; or*
- (c) *creates an unstable batter.*
- 71 When a party requests that Transpower grant a dispensation, there is a cascade of solutions preferable to Transpower. These are:
- a. Where possible, the proposed works are moved away from the National Grid assets, so as not to breach the separation distances in NZECP34;
 - b. If the proposed works cannot be moved away, where reasonable the third party pays to move Transpower's assets away;
 - c. If Transpower's assets cannot be moved away, or where it is not considered reasonable to move Transpower's assets away, the effects of the encroachment are considered and mitigated to an acceptable level; and
 - d. If the effects cannot be mitigated to an acceptable level, Transpower refuses to grant the dispensation.
- 72 Transpower considers each request to grant a dispensation on a case by case basis – considering the proposed works and the Grid assets. Risks are considered, based on the context of the surrounding land use and probable future uses. Safety, both public and that of Transpower's maintenance and contracting staff is considered. Transpower also considers the ability to operate, maintain and upgrade the Grid now and in the future.
- 73 Transpower very infrequently grants dispensations in relation to buildings, or similar structures (although one was granted for a building in Onehunga in 2015 after a detailed risk assessment, and a number of mitigations were put in place by the owner).
- 74 Most dispensations granted by Transpower are for earthworks – where the structural integrity of our assets could be impacted. These impacts can often be

addressed by work being carried out on towers, including through foundation strengthening, as is proposed.

- 75 Most of the dispensations that would need to be granted to the Transport Agency would fall into this category.

Southdown Substation

- 76 The proposed road alignment (shown on Sheet 7 Drawing Set AEE-AL-107, attached to the Annexure F of the evidence of **Mr Nancekivell**) runs directly through part of the outdoor switchyard at Southdown Substation. In particular, the East West Link affects the following assets that exclusively serve KiwiRail's electrical traction system:

- a. A 220/25kV traction transformer;
- b. 66kV air insulated switchgear (operating at 25kV); and
- c. Cable and ancillary support structures.

- 77 The location of this equipment at Southdown Substation is shown on the plan contained in **Appendix E**. This indicates the conflict between the KiwiRail Substation and the proposed EWL Project.

- 78 As can be seen from this plan, the East West Link cannot be located as proposed while the KiwiRail Substation remains in its current location – there is a direct conflict between the infrastructure. As a result, the KiwiRail Substation will need to be relocated – either to another location on the Mercury-owned land at Southdown or to another site (either greenfields or to an existing Transpower Substation). Alternatively, the East West Link would need to be relocated further south (although I understand that this may not be feasible, given environmental and other issues).

- 79 There will be other impacts on the remainder of the Southdown Substation (for example the control building and relay room). The proposed road alignment would restrict Transpower's ability to safely maintain and replace equipment. Transpower's restricted area would be violated by the Transport Agency maintenance envelope, a structural collapse hazard during a seismic event has been introduced, and a risk of falling or wind-blown debris is also introduced due to the location of the traffic on the proposed elevated adjacent road. There could also be vibration impacts on the Substation during construction of the EWL Project. However, I am confident that these impacts can be appropriately managed through the conditions **Mr Horne** has proposed.

THE AREAS OF MAJOR CONCERN / MOST CURRENT UNCERTAINTY

Towers

- 80 The main area of uncertainty in relation to other structures (if not generally) is that Transpower has not been able to undertake detailed design yet, because it is not possible to do so until a sufficient level of detail and certainty of the final road position has been provided. In some instances, that may not occur until the Board has made its decision and, if it is to approve the EWL Project, the conditions

are clear. Transpower has not applied for any necessary consent applications, or obtained necessary property rights, that would be required for it to accommodate the EWL Project. **Mr Horne** explains these issues further in his evidence. Nor is Transpower able to grant dispensations under NZECP34 to the Transport Agency until the Transport Agency has more detailed design available to it, and agreement of mitigations have been reached, and in some cases where mitigations have been installed at Transpower's towers.

- 81 While these uncertainties remain, it is not unusual that they exist at this stage of a Transport Agency project. The conditions attached to **Mr Horne's** evidence enable the National Grid assets to be protected in the short and long-term.
- 82 I am only aware of one project where the Transport Agency's proposal was advanced to a sufficient level of detail and included sufficient flexibility for Transpower to apply for resource consents at the same time as the Transport Agency (Transmission Gully). For all other projects, Transpower has protected its assets via conditions, and applied for consents subsequently to enable the other projects to proceed.

Southdown Substation

- 83 As discussed earlier in my evidence, the KiwiRail transformer and switchgear at the Southdown Substation supply KiwiRail's network. Any outage of the Substation could put the rail network at risk and this could create network stability issues. A flyover over the Substation could create adverse impacts on the Substation such as construction vibration effects (which may affect sensitive electronic equipment). There could be debris hazards both during construction and from the on-going operation of the road. At a minimum, a barrier would need to be erected to mitigate falling debris. In my view, it is far from ideal to have a road built over a substation.
- 84 As I discussed above, the best way to manage these risks is to either move the road alignment or move the Substation. The largest area of uncertainty from Transpower's perspective is where the KiwiRail Substation would be relocated to, and the timing of any construction work required for the relocation.
- 85 Options of where to relocate the KiwiRail Substation are not at an advanced level. One option considered in a preliminary manner would be to relocate the KiwiRail Substation onto vacant land on the Mercury-owned Southdown site. Transpower has had very preliminary discussions with Mercury and KiwiRail about this option. In addition, Transpower has given some preliminary consideration to other locations. The issues and risks (including RMA approvals, property rights, and construction timelines) associated with a relocation to another site would depend on what site or sites were pursued further. Transpower has been discussing these issues and risks with KiwiRail. An engineering investigation into the options is about to commence. This investigation is expected to take 3-6 months.
- 86 A further risk in relation to Transpower's Southdown Substation is that the road realignment is moved further into the substation site, and impacts on the Control Building and Relay Room and the 220kV Substation. The Control Building and Relay Room and Substation are identified in the Plan in **Appendix E**. The issues and risks associated with relocating a 220kV substation in Auckland would be different, but equally as complex – due to the size and scale of the 220kV

infrastructure, and impacts on the HEN-OTA line which connects to the substation. For this reason, Transpower could not support any changes to the road alignment that impacted on the 220kV Substation.

Undergrounding of transmission lines

- 87 I am aware that Auckland Council's submission has sought the undergrounding of National Grid lines particularly the MNG-ROS A line.
- 88 Electricity can be transmitted through overhead lines or underground cables. Each option has its advantages and disadvantages. Transpower actively considers both when developing its transmission system and currently uses both options in its network.
- 89 Undergrounding is approximately 7-10 times more expensive per circuit km (12-18 times per route km) to construct and maintain than overhead transmission lines. The approximate cost of undergrounding around 1km of two of the 110 kV lines in the Onehunga area would be approximately \$23 million, where as undergrounding the high capacity HEN-OTA A 220 kV line between Towers 12 and 30 (6.3km) would be approximately \$230 million.
- 90 Although Transpower attempts to co-locate its transmission lines with other service providers in common corridors (e.g. roadways), it is not always feasible to do so, as some services are not compatible with underground transmission solutions. For example, it is important to maximise the separation between various types of infrastructure, including gas lines, high pressure water mains and high voltage transmission cables to minimise common mode failures and electrical interactions. Further, due to the mutual heating effects of power cables, minimum distances are required between all power cables to prevent a loss of the designed capacity, thermal run away and failure.
- 91 From time to time, developers, councils, other infrastructure providers (such as NZTA) and road controlling authorities (for example) request the relocation or undergrounding of transmission assets to enable development. Transpower tries to accommodate these requests wherever possible and provides technical, property and other support for options assessments provided any investigation, engineering and other work is funded by the developers or those seeking the relocation or undergrounding. Recent examples of undergrounding projects include:
- a. Highbrook – this involved the movement and undergrounding of high voltage infrastructure within the Highbrook industrial Development to the north-east of Otahuhu. Pragmatic early communication with the developer lead to the successful integration of the transmission lines into the development plans;
 - b. Massey North town centre development – this involved the undergrounding of 2km of the Albany to Henderson 110kV line to facilitate safe and cost effective development of land
- 92 The financial and physical challenges of undergrounding existing National Grid lines are significant and often misunderstood. Cost is just one factor. Other considerations include: avoiding or minimising route environmental impacts as

far as reasonably practicable, technical constraints and system security and operational impacts.

- 93 Underground cables require transition stations at each end. For large capacity lines like the 220kV network, the transition station at each end of an underground cable would need to be very large (see **photos** below).
- 94 Examples of cable transition structures are shown in **photos 6, 7, and 8** below.



Photo 6: 220kV Cable transition structure at Transpower's Brownhill Road Substation



Photo 7: 220kV Cable transition structure at Transpower's Brownhill Road Substation



Photo 8 – Cable transition structure for the 110kV ALB-HEN A line at Massey

- 95 In addition, underground joint bays are required approximately every 800m. Although these bays are buried, they place restrictions on above ground developments for property owners as they require access for maintenance, inspections, and fault repairs.
- 96 Underground cables for a typical double circuit 110kV line require a clear corridor of around 14 metres wide (including being clear of vegetation) above them or to be placed in a tunnel so that the cables and joints are able to be accessed for routine maintenance or to be able to repair a fault. For a 220kV line similar to that of the HEN-OTA A line, this corridor would be more likely to be around 25m. They would require corridors larger than this again during the construction phase.
- 97 Underground cable projects have long lead times. The coastal location of the MNG-ROS A line would require careful consideration of routes, including the location of the cable termination structures at each end of the cable (which would

also need to be located in the coastal area, or the length of the cable increased significantly).

- 98 Underground cables are vulnerable to earthworks activity (i.e. being dug up) and natural events such as earthquakes. Once damaged, the time to locate and repair an underground fault is much longer than for overhead lines, with repairs on average taking between 6-12 weeks.
- 99 System security is a critical consideration with undergrounding. Undergrounding small sections of a transmission line has the potential to constrain the network.
- 100 Two years ago a Parliamentary Select Committee investigated petitions seeking the progressive undergrounding of Transpower's overhead lines in urban Auckland. The Committee heard submissions from various organisations including the Commerce Commission and Electricity Authority who both explained the regulatory limitations on funding undergrounding. Transpower would seek to recover all costs relating to an undergrounding project from developers and others seeking to underground line, where those costs were not approved by the Commerce Commission. The Select Committee discusses in its report the prohibitive costs of undergrounding.
- 101 Accordingly, while there is no obvious single technical reason that would prevent undergrounding of the MNG-ROS A line, the HEN-OTA line or any other National Grid overhead line, no detailed engineering assessments have been undertaken in relation to these technical matters. Further, the adverse effects and consentability of any underground cable project has not been considered.
- 102 Further, Transpower has recently commenced work on a long-term strategy for the National Grid into, within and across the Auckland region. This strategy will determine the long-term transmission requirements for Auckland to meet forecast electricity supply and demand for the next 40 years. It will also look at opportunities to rationalise the Grid footprint.
- 103 Developing this strategy could take 18-24 months. Following the strategy being complete, detailed engineering, consenting/property rights acquisition of the options would still be required. Until this work is complete, Transpower will not know the long-term role of the MNG-ROS A line or whether the line could or should be undergrounded.

ANTICIPATED PROCESS GOING FORWARD

- 104 Transpower has previous experience relocating, strengthening and protecting its assets to enable Transport Agency roading projects. I anticipate that the process for this project, while on a greater scale, would be no different from Transpower's usual process.
- 105 Firstly, Transpower would work to resolve engineering, safety, constructability and other technical issues relating to any assets that require relocation and any assets that are to remain in situ, but which are affected by the East West Link project.
- 106 To date, Transpower has relied on preliminary designs of the EWL Project to determine impacts on National Grid assets. Transpower engaged an engineering

consultancy (Aecom New Zealand Limited) to consider these preliminary designs, and identify a high-level response in relation to the impacts on the National Grid assets. This response is generally desk-top only. Some site visits would have occurred to consider safety and constructability issues at an early stage.

107 The impacts on Transpower's assets that have been identified to date were discussed earlier in my evidence. These impacts will become more certain over time. Once a definitive East West Link detailed road design is available, Transpower would engage a consultant to carry out a detailed investigation into the impacts on our assets. This work would involve:

- a. An assessment of the effect of road civil works on the foundations of our structures remaining in situ, and the subsequent design of any mitigations required;
- b. An assessment of new structures and conductor required including size, type, constructability, foundation requirements;
- c. An assessment of any modifications required to existing assets.

The total time to undertake this level of design is expected to take 6-9 months.

108 Once detailed design of the Transpower project work is complete – either in stages, or as a whole – Transpower would start procurement. The longest lead time would be 6 months to procure the required poles. If a new transformer was required, it could take up to 13 months to obtain. Usually, procurement would occur after any RMA approvals had been obtained and project certainty is gained. Once necessary approvals have been obtained, Transpower would package its project work and tender for contractors. There is some consenting risk and this is discussed further in **Mr Horne's** evidence.

109 Transpower is currently in initial discussions with the Transport Agency regarding programming of any Transpower project works. Our programme would respond to that of the Transport Agency. We would endeavour to have our project works completed prior to the Transport Agency commencing work as working clearances are required from our structures and conductors at an early stage of the roading works.

110 At this stage, and subject to necessary RMA approvals and property rights being obtained, we anticipate Transpower project works to commence as follows:

- a. Works in the Princes Street area commencing first, in early 2018 through to mid 2019;
- b. Minor works in the Onehunga area beginning in 2018;
- c. Works on the Great South Road area beginning in 2019;
- d. Works near State highway 1 / Sylvia Park area in 2020/21.

111 From a property perspective, the bulk of Transpower's lines assets in the area of the EWL Project have statutory occupation and use rights under the Electricity Act 1992. Where the Transpower project works will result in a loss of those

statutory rights (such as for the proposed relocation/replacement of HEN-OTA towers 14, 15, 18 and 19), or the statutory rights do not authorise certain works (such as for 14A, 15A, 15B, and 18A, 19A and 19B), Transpower will require easements from the relevant landowners. Where landowner agreement is required for any temporary works, licences from the affected landowners will be obtained.

- 112 Discussions about the property rights required for the Transpower project works cannot commence beyond preliminary discussions until the detailed design is complete and the short and long-term footprint of the Transpower project works are known.
- 113 Discussions with landowners to obtain property rights will be led by the Transport Agency, or its representatives, on a willing buyer/willing seller basis.
- 114 Property rights may also be required for the relocation of the KiwiRail substation. The property rights required will depend on the project option chosen, and could range from the acquisition of a new site through to purchase of appropriate easements.

CONCLUSIONS

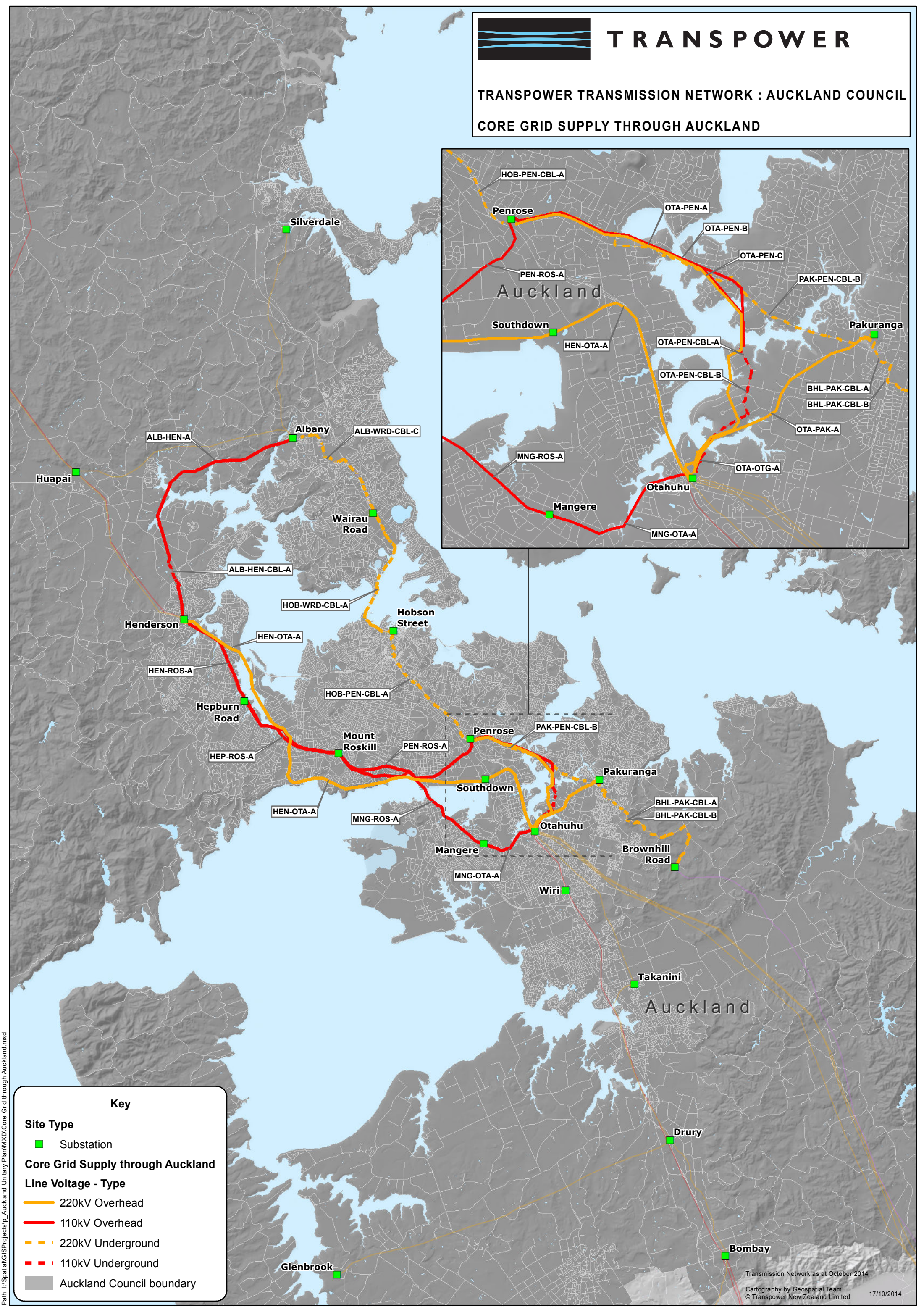
- 115 Transpower is committed to working with the Transport Agency to enable the EWL Project to proceed with the minimum impact on Transpower's assets, third parties, and the wider environment. We have made significant and positive progress since lodging our submission. We are confident that all remaining issues will be able to be resolved.
- 116 I support the conditions **Mr Horne** has put forward – they will ensure important National Grid infrastructure is protected and security of supply is not compromised.
- 117 There will be some 'flow-on' effects on third parties, for example on those whose land will be required to accommodate Transpower assets that need to be moved to enable the EWL Project. Resource consents and property rights will need to be obtained for some tower works. This presents some risk to the EWL Project from delay, or if, for some reason, they are not secured. Transpower will work closely with the Transport Agency to minimise those risks as much as possible.

Appendix A: National Grid assets in Auckland Region



TRANSPower

TRANSPower TRANSMISSION NETWORK : AUCKLAND COUNCIL
CORE GRID SUPPLY THROUGH AUCKLAND



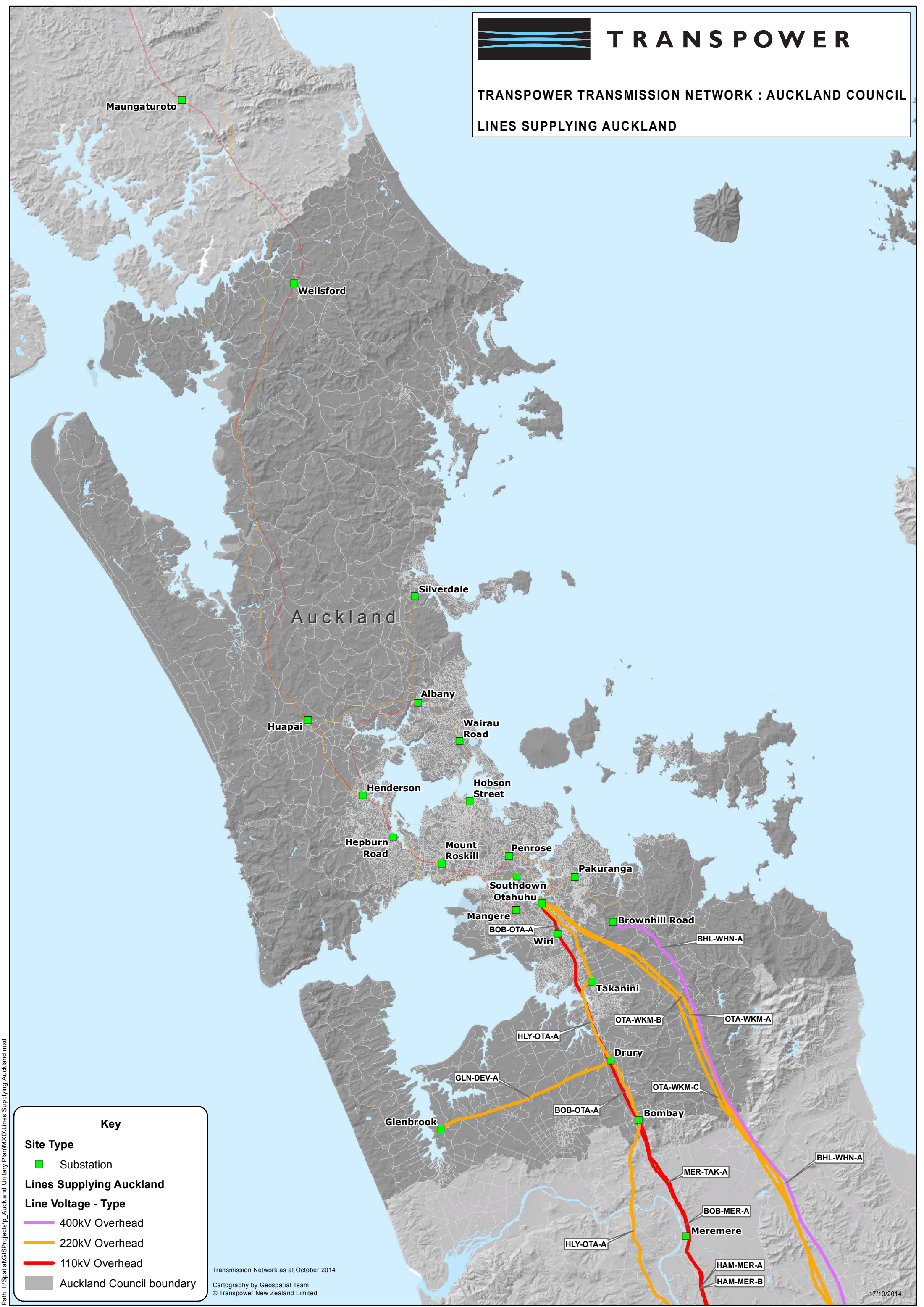
Key

- Site Type**
- Substation
- Core Grid Supply through Auckland**
- Line Voltage - Type**
- 220kV Overhead
 - 110kV Overhead
 - - - 220kV Underground
 - - - 110kV Underground
 - Auckland Council boundary



TRANSPower

TRANSPower TRANSMISSION NETWORK : AUCKLAND COUNCIL
LINES SUPPLYING AUCKLAND



Key

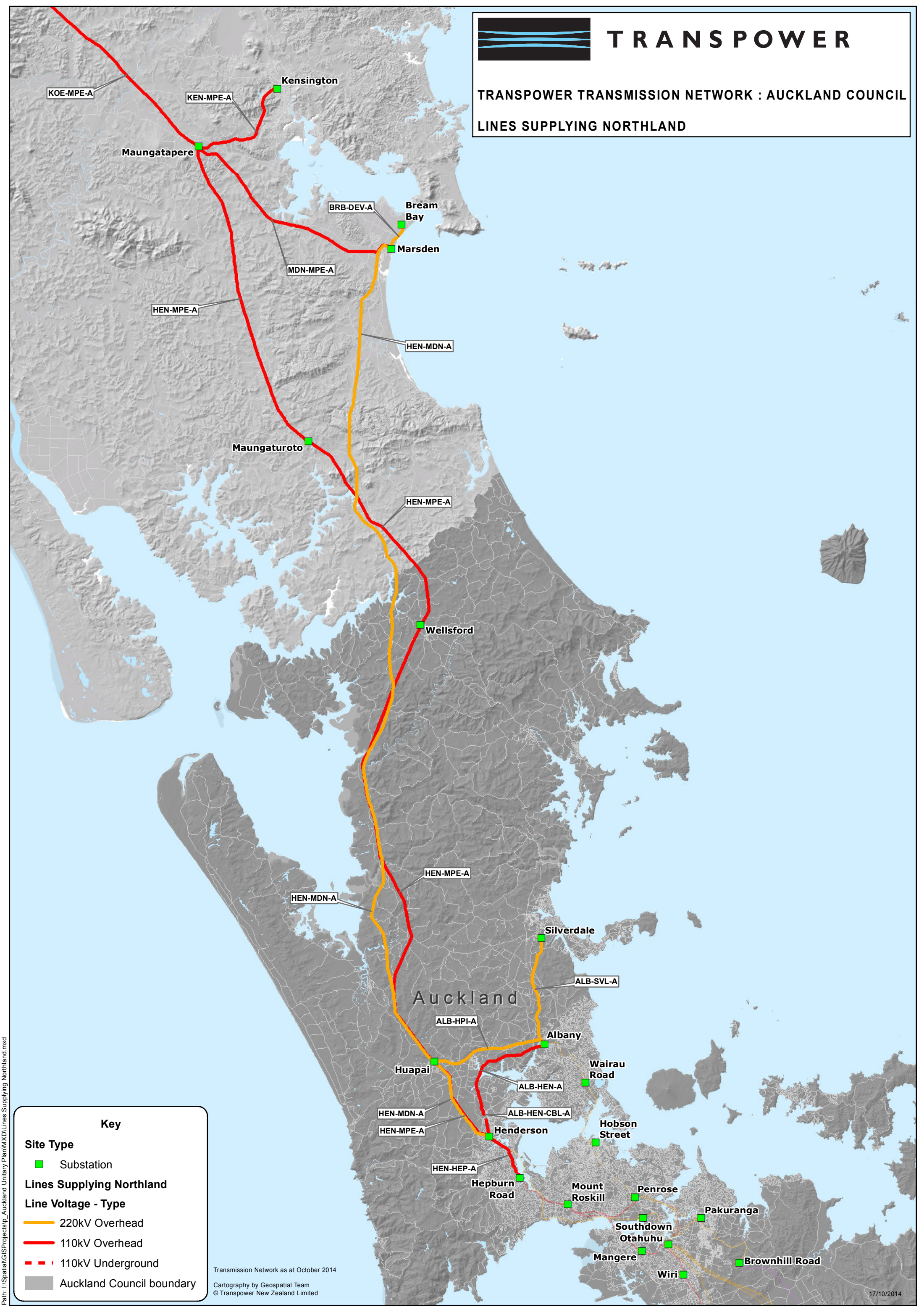
- Site Type**
- Substation
- Lines Supplying Auckland**
- Line Voltage - Type**
- 400kV Overhead
 - 220kV Overhead
 - 110kV Overhead
- Auckland Council boundary

Transmission Network as at October 2014
Cartography by Geospatial Team
© Transpower New Zealand Limited



TRANSPower

TRANSPower TRANSMISSION NETWORK : AUCKLAND COUNCIL
LINES SUPPLYING NORTHLAND



Key

Site Type

■ Substation

Lines Supplying Northland

Line Voltage - Type

— 220kV Overhead

— 110kV Overhead

- - - 110kV Underground

■ Auckland Council boundary

Transmission Network as at October 2014
Cartography by Geospatial Team
© Transpower New Zealand Limited

Appendix B: Overview map of National Grid assets affected by the East West Link Project

Legend

■

Substation

●

Affected Structure

●

Replacement or New Structure

✕

Existing Structure

Existing Transmission Lines
by Voltage

—

110 kV

—

220 kV

- - -

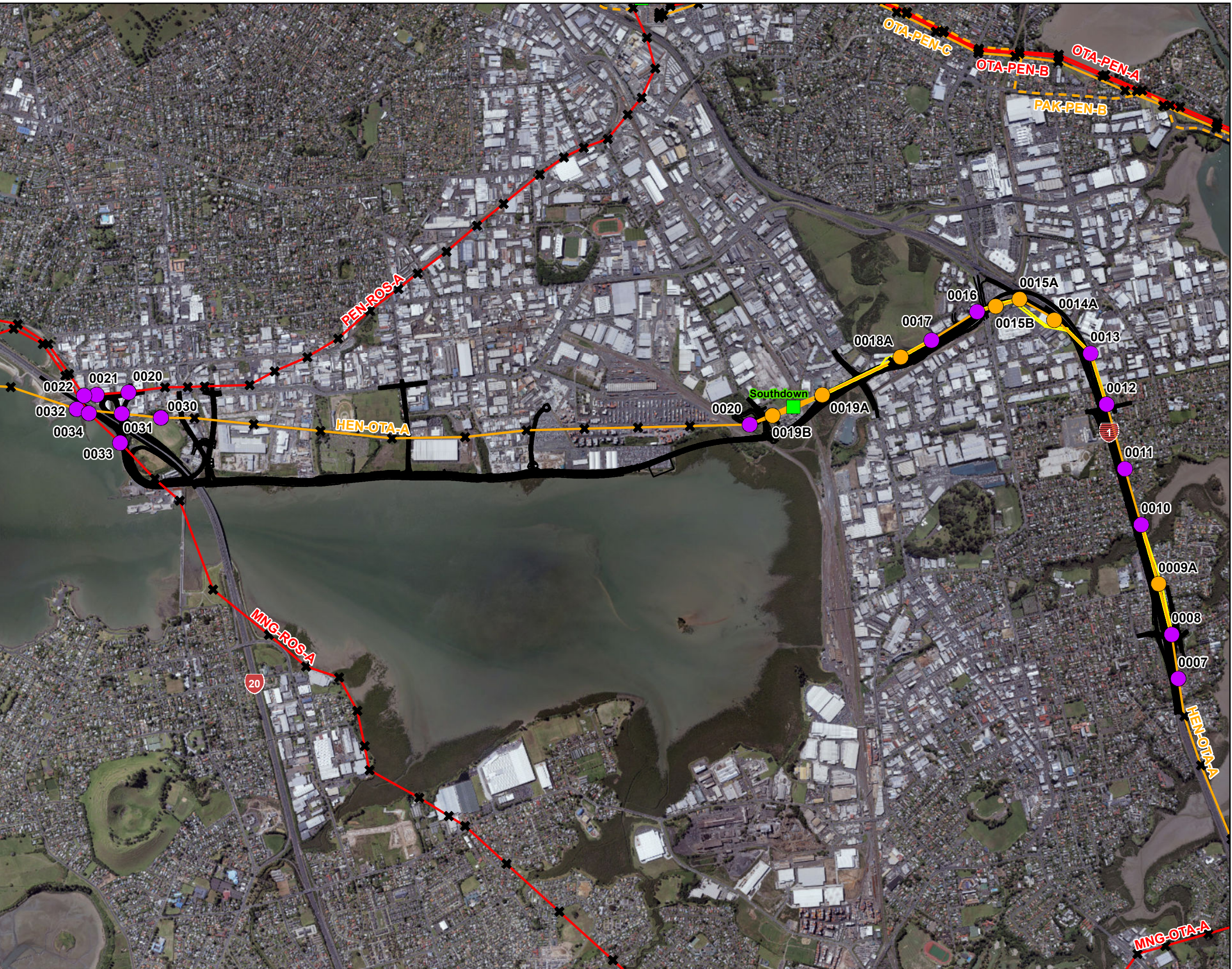
220 kV (underground)

—

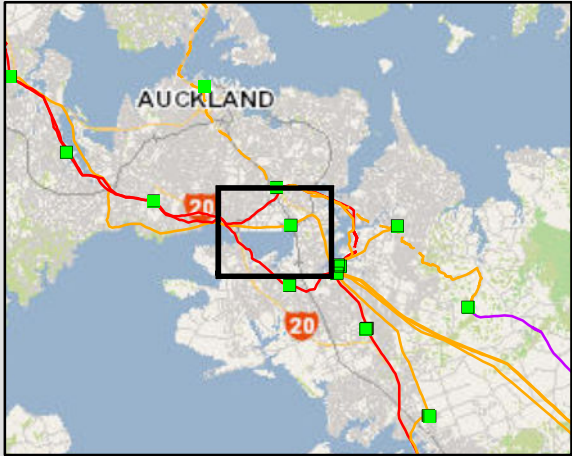
Bypass line

—

East-West Connection alignment

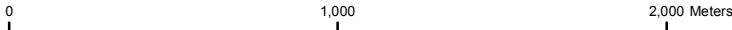


Sheet 1 of 1 - Overview



External Disclaimer
This document is produced for external release. Its conclusions are based on the information currently available to Transpower and may change as further information becomes available either internally or externally.
East-West Connection Alignment as per NZTA (des_all_final.dwg)
Final alignment and Bypass lines as per Aecom.
Imagery sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence.
Cadastral Data as per CoreLogic.

Transpower New Zealand - East-West Connection Overview



Appendix C: Summary of Issues and Provisional Design Responses for affected Transpower Assets¹⁰

Structure or Asset	Comments made in Transpower's submission (note unless otherwise specified, all Sheet numbers refer to the Utilities Relocation Drawing Set provided with the Transport Agency's application)	Revised impacts following discussion with the Transport Agency ¹¹
HEN-OTA Tower 7	Sheet 13 shows a retaining wall running through the tower. This will need to be moved.	<p>The wall shown on the plans is a noise wall, not a retaining wall. It is approximately 2.4-3.0m high. Transpower has now been advised that the noise wall will be positioned on the existing carriageway. The carriageway extent will not change.</p> <p>Foundation assessment of the tower will be undertaken at detailed design stage. Foundation strengthening will occur if necessary.</p>
HEN-OTA Tower 8	<p>Sheet 13 shows a retaining wall blocking the current maintenance access to the tower. Road and off-ramp shown very close to tower.</p> <p>A note on the drawing also states the Tower will be replaced with a new double circuit monopole. Replacement may not be required.</p>	<p>An acceptable plan has been provided to Transpower showing access to the tower from the southbound on-ramp.</p> <p>Despite the indication on the plan, the tower is not likely to need to be replaced.</p>

¹⁰ All issues and provisional Transpower designs are subject to final design and further detailed information from the Transport Agency.

¹¹ Where the minimum requirements in NZECP34 are not complied with, a dispensation will be required in accordance with the process in NZECP34.

	<p>This Tower is also shown within a construction yard. Access will need to be retained to this structure during project construction and establishment and operation of the yard will need to be managed to protect the Transpower tower.</p>	<p>Foundation assessment of the tower will be undertaken at detailed design stage. Foundation strengthening will occur if necessary.</p> <p>Conditions agreed will address impacts during construction.</p>
HEN-OTA Tower 9	<p>Sheet 12 shows the motorway ramp and a retaining wall running through tower. This tower will need to move to accommodate the off ramps and will require replacement with a new double circuit monopole (9A) immediately to north of current tower footprint, within the area where the retaining wall is shown.</p> <p>The retaining wall as drawn may need to move to accommodate the new monopole structure.</p>	<p>Replacement monopole and temporary diversions required – detailed to be confirmed at detailed design stage.</p> <p>Any property requirements to accommodate the line diversion will be confirmed once detailed design complete.</p> <p>Conditions agreed to avoid line clearance issues during construction.</p>
HEN-OTA Tower 10	<p>Sheet 12 shows a retaining wall running through tower. This will need to be moved. Road is also very close to the tower.</p> <p>Suitability of shared cycle and pedestrian footpath near tower base to be confirmed.</p> <p>This Tower is also shown within a construction yard. Access will need to be retained to this structure during project construction and establishment</p>	<p>Transpower understands that what is shown as a “retaining wall” is in fact a noise wall, and so can be moved more readily to reduce the conflict with the tower.</p> <p>Foundation assessment of the tower will be undertaken at detailed design stage. Foundation strengthening will occur if necessary.</p>

	and operation of the yard will need to be managed to protect the Transpower tower.	Conditions agreed to address impacts during construction.
HEN-OTA Tower 11	<p>Sheet 12 shows a retaining wall running immediately adjacent to tower. This will need to be moved.</p> <p>Road is currently shown very close to the tower. Given the height difference between the road and tower, major foundation engineering would be required if tower is to remain in its current location.</p> <p>Demolition of the existing retaining wall would need to be carefully managed.</p> <p>Impacts on practical access need to be confirmed.</p>	<p>Transpower understands that what is shown as a “retaining wall” is in fact a noise wall.</p> <p>The Transport Agency has clarified that the noise wall will be located adjacent to the retaining wall rather than immediately adjacent to the tower.</p> <p>Foundation assessment of the tower will be undertaken at detailed design stage. Foundation strengthening will occur if necessary.</p> <p>Access will be maintained as at present.</p>
HEN-OTA Tower 12	<p>Sheet 11 shows upgrading works to the Panama Road overbridge.</p> <p>Retaining walls are shown close to the tower foundations. They retaining walls would need to move or foundation strengthening would need to be considered.</p> <p>Construction water drainage (Figure 11 – Drawing Set 10 – Sheet 11 provided with the Transport Agency’s application) needs to be relocated away from the tower.</p>	<p>Foundation assessment of the tower will be undertaken at detailed design stage. Foundation strengthening will occur if necessary.</p> <p>Access will be maintained through the existing eastern abutment approach of Panama Road.</p> <p>The sediment control pond has been relocated away from the tower.</p>

HEN-OTA Tower 13	<p>Sheet 11 shows the road and a retaining wall running immediately adjacent to the tower. Implications for foundations if not moved.</p> <p>Impacts on practical access to be confirmed.</p>	<p>Access will be maintained via the adjacent private property as at present.</p> <p>The Transport Agency is considering relocating the road away from the tower.</p> <p>Foundation assessment of the tower will be undertaken at detailed design stage. Foundation strengthening will occur if necessary.</p>
HEN-OTA Tower 14	<p>Sheet 10. Tower 14 will be removed and provisionally replaced to a new double circuit monopole. A temporary bypass will need to be constructed while this and other new structures are constructed.</p> <p>Retaining wall currently shown too close to replacement structure.</p> <p>Sheet 10 of Drawing Set 9 (provided with the Transport Agency's application) shows a stormwater system in the vicinity of the existing and likely replacement pole location, so will need to be moved.</p>	<p>A new monopole (14A) will need to be installed / together with a temporary bypass.</p> <p>Building removal will also need to be completed prior to works.</p> <p>The Transport Agency has confirmed that the stormwater infrastructure will be relocated away from National Grid assets.</p>
HEN-OTA Tower 15	<p>Sheet 10. Tower 15 will provisionally be replaced with a new double circuit monopole (15A), and an additional new double circuit monopole (15B) is likely to be required between the motorway ramps to provide sufficient clearance for conductors over these ramps.</p>	<p>A new monopole (15A) will need to be installed / together with a temporary bypass.</p> <p>There is an existing open stormwater channel adjacent to the tower which will remain in its current location.</p>

	<p>This provisional new structure location is also shown within a construction yard. Access to these new structures will need to be provided. A temporary bypass will need to be constructed.</p> <p>Sheet 10 of Drawing Set 9 (provided with the Transport Agency's application) shows a stormwater system in the vicinity of the Transpower tower. This will need to be moved.</p>	<p>During detailed design, consideration will be given to providing any necessary protection that is required to the tower foundation to maintain this stormwater infrastructure.</p>
HEN-OTA, new Monopole 15B	<p>Sheet 9. New structure likely to address ground to conductor clearance. Unlikely to be located where shown.</p> <p>Access to the new structure would need to be provided.</p> <p>Construction yard shown where new structure could be located.</p>	<p>A new monopole (15B) will need to be installed / together with a temporary bypass.</p> <p>Access will be defined at detailed design stage.</p> <p>Conditions agreed to address impacts during construction.</p>
HEN-OTA Tower 16	<p>Sheet 9. Tower 16 does not need to be moved, but may require structural strengthening to convert it from a suspension tower to a strain.</p> <p>Drains are shown close to the tower foundation that may need to be moved.</p>	<p>Foundation assessment of the tower will be undertaken at detailed design stage. Foundation strengthening will occur if necessary.</p> <p>Transpower understands that the drain proposed in this area will be a pipe and relocated away from the tower.</p>
HEN-OTA Tower 17	<p>Sheet 9. NZTA drawings show road affecting edge of tower structure. Road needs to be moved and suitable mitigations to protect tower foundations</p>	<p>Transpower understands that there is now proposed to be no change to location of existing carriageway, kerblines</p>

	<p>put in place, or tower will need to move.</p> <p>Sheet 9 of Drawing Set 9 (provided with the Transport Agency's application) shows drainage near the structure which will need to move.</p> <p>A pedestrian walkway is shown over the tower footprint which will need to move.</p>	<p>or footpath, and the existing cribwall will remain.</p> <p>Transpower understands that the drain proposed in this area will be an underground stormwater pipe and will be relocated further away from the tower.</p>
HEN-OTA Tower 18	<p>Sheet 8. Tower 18 provisionally to be replaced with a new double circuit monopole (18A) in a new location clear of the alignment. Likely to be in the order of 8m higher to enable required clearances over Great South Road overpass. A temporary bypass will be required during these works.</p>	<p>Replacement structure 18A is unlikely to be in the location indicated in sheet 8. This will be clarified at detailed design.</p>
HEN-OTA Tower 19	<p>Sheet 8. Tower 19 provisionally to be replaced with a new double circuit monopole (19A) in the order of 8m higher to enable required clearances over Great South Road overpass.</p>	<p>Replacement structure 19A may not be located as shown on sheet 8. This will be clarified at detailed design.</p>
HEN-OTA, new monopole 19B (referred to as 20A in submission)	<p>Sheet 7. A new double circuit monopole (Tower 19B) provisionally identified as being required adjacent to eastern side of Southdown substation to enable required clearances over Hugo Johnson Drive extension.</p>	<p>Transport Agency is considering alternative vertical and horizontal alignments of Hugo Johnston Drive to satisfy the ground to conductor clearances in NZECP34.</p> <p>If clearances cannot be achieved, then new structure 19B will be required.</p>
HEN-OTA Tower 20	<p>Sheet 7. Tower 20 is shown within a construction yard.</p>	<p>The wetland has been removed.</p>

	<p>Access will need to be retained to this structure during project construction and establishment and operation of the yard will need to be managed to protect the Transpower tower.</p> <p>Stormwater pond is shown too close to Tower 20 (see Sheet 7 Drawing Set 11 provided with the Transport Agency's application). Tower stability risks. Pond likely to need to be moved away from tower.</p>	Access and construction impacts addressed through conditions.
Tower 31	<p>Sheet 1. Tower 31 is shown located immediately between two new ramps. As drawn the ramps would need to move or the tower be relocated.</p> <p>Practical access and any changes to height to achieve electrical clearances to be confirmed.</p> <p>Tower 31 is shown within a construction yard.</p> <p>Access will need to be retained to this structure during project construction and establishment.</p> <p>Operation of the yard will need to be managed to protect the Transpower tower.</p>	<p>Additional drawing (AEE-AL-101 attached to the evidence of Noel Nancekivell) shows ramps realigned to avoid tower.</p> <p>Transpower needs additional assessment and confirmation of crash barrier type, but understands that work is being undertaken.</p> <p>Transpower has been provided information indicating suitable access.</p> <p>Access for construction will be addressed through conditions.</p>
Tower 32	Sheet 1: Final road design must ensure access to the tower is retained.	Existing access from Orpheus Drive will be maintained.
PEN-ROS A Tower 20	Sheet 1: Imagery on drawing shows the road over the tower footprint whilst notes state a	Foundation assessment of the tower will be undertaken at detailed design stage.

	2m distance form kerb to structure.	<p>Foundation strengthening will occur if necessary.</p> <p>Additional consideration of, crash barrier, and assessment of remediation will be required at detailed design.</p>
PEN-ROS A Tower 21	Sheet 1: Imagery on drawing shows embankment over tower footprint whilst commentary indicates 7m form curb to structure.	<p>The proposed carriageway will be located further from the tower than the current carriageway.</p> <p>Access is to be provided from local road or shoulder.</p>
PEN-ROS A Tower 22	Sheet 1: Imagery on drawing shows the road over the tower.	<p>Existing edge barrier and level of carriageway will remain unchanged.</p> <p>Access is to be provided.</p>
MNG-ROS A Tower 31	Sheet 2: Final road design must ensure access to the tower is retained.	Existing access will be maintained.
MNG-ROS A Tower 32	Sheet 2: Final road design must ensure access to the tower is retained.	<p>Existing access will be maintained.</p> <p>Potentially no dispensation under NZECP34 will be required.</p>
MNG-ROS A Tower 33	Sheet 2: Based on the current NZTA design the tower will need to be replaced with a higher structure. However, Transpower understands that there are alternative NZTA alignment options that could avoid any change to the height of this structure (not reflected in current drawings).	<p>The new road alignment likely avoids the need for structure replacement.</p> <p>Some works will, however, be required to lift the conductor height.</p> <p>The structure may need a non-conductive fence, due to the vicinity of the shared path.</p>

	<p>Current NZTA plans shown fill placed over tower foundations which is not acceptable.</p> <p>A shared cycle and pedestrian path is shown passing under the tower which would not be acceptable to Transpower.</p>	
MNG-ROS A Tower 34	<p>Sheet 2: Final road design must ensure access to the tower is provided.</p> <p>Sheet 1, Drawing Set 9, new outfall structure appears to discharge to Transpower structure. Mitigation required.</p>	<p>Transpower understands the outfall is to be moved clear of the tower, but is uncertain of the location.</p>

Appendix D: Plans showing National Grid assets affected by the East West Link Project and proposed layout of the permanent line relocation and temporary diversion

Appendix E: Transpower's Southdown Substation and the East West Link Project