Auckland

Spare Capacity and Load Characteristics Report

EECA

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Document History & Status

Revision	Date	Author	Reviewed by	Approved by	Status
A	2-04-2025	Caitlin Bergervoet, Ellie Wright, Nathan Miller	Willem Rawlins	Kane Morison	Draft
B	14-05-2025	Caitlin Bergervoet, Ellie Wright	Kane Morison	Kane Morison	Revised
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Revision	Details
A	Stage 2 Draft for client review/comment
B	Updated for comments from Transpower, EECA, Vector, Counties Energy, and Sapere
C	Updated following discussion with Vector

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1. Executive Summary

Transpower maintains/manages the transmission network in New Zealand and supplies the Auckland region (as described in this report) via twenty-three GXP's (supplying Vector and Counties Energy, along with some directly connected industrial customers). Ergo notes that Auckland is unique in that some GXPs are linked within the connected distribution networks, resulting in multiple GXPs being grouped together in analysis (for example, Auckland CBD, which is supplied by Penrose 110 kV and Hobson St 110 kV GXPs).

The two Electrical Distribution Businesses (EDBs), Counties Energy and Vector, then take supply from Transpower and distribute the electricity to end customers in the various regions.

The Energy Efficiency & Conservation Authority (EECA) is running a flagship programme that is called Regional Energy Transition Accelerator (RETA)[1]. The programme is targeted at large energy-using businesses and public sector organisations that are seeking to identify barriers involved and opportunities available to replace fossil fuels with renewable energy sources.

As part of the RETA programme, EECA has developed a set of Load Sites for the Auckland region. The Load Sites involve existing consumers/plant that use fossil fuels for space and process heating, and which could potentially be converted to using electricity, resulting in an overall lower carbon footprint.

EECA contracted Ergo to determine the following for the Auckland region:

- The current supply demand characteristics (peak & average supply and seasonality information) at the major electrical substations.
- The (N) and (N-1) capacity available for each grid exit point and substations.
- An indicative capital cost to supply electricity to each of the Load Sites.

The purpose of the Load Site cost analysis is to provide information that can be used for planning and investment decisions.

1.1 Network Spare Capacity

The following Figure 1 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Auckland region. This figure is based on historical maximum loadings and Transpower's *Transmission Planning Report 2023* and does not incorporate any future load growth. It is important to note that these spare capacities do not include any voltage constraints or upstream transmission constraints (which would have to be confirmed by Transpower or the relevant EDB). As such, it is highly likely that those constraints would prevent all the spare capacity shown below being utilised.

[1] https://www.eeca.govt.nz/co-funding-and-support/products/about-reta/

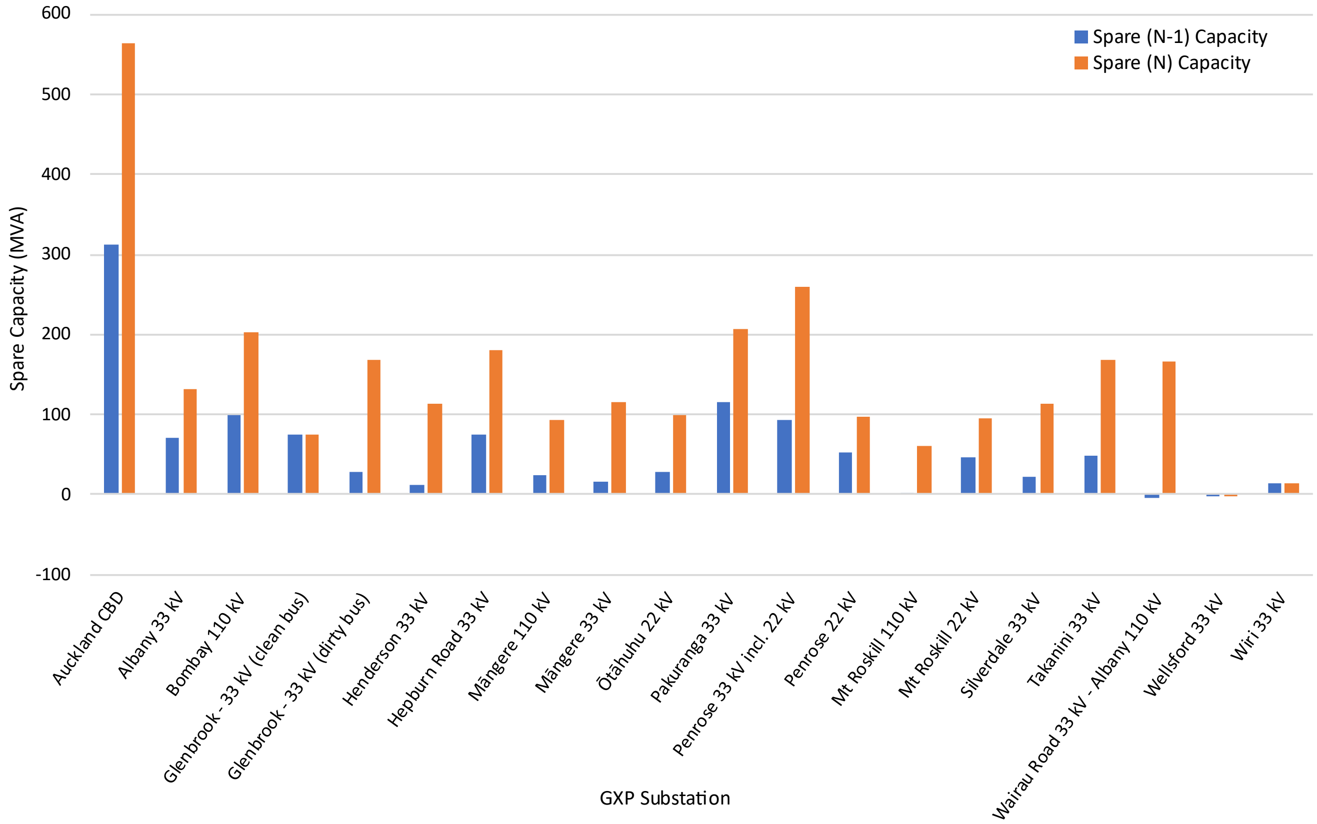

Figure 1. Summary: Approximate (N) and (N-1) spare capacity at GXP substations (not including the two Kiwirail supply GXPs, Penrose and Southdown 25 kV GXPs)

The following Figure 2 and Figure 3 illustrate the (N) and (N-1) spare capacity at the two EDB's (Counties Energy and Vector) zone substations in the Auckland region. These figures are based on the maximum loadings and the EDB 2023-2024 disclosures. Negative numbers for (N-1) capacity indicate zone substations where the load has exceeded the (N-1) capacity in the past.

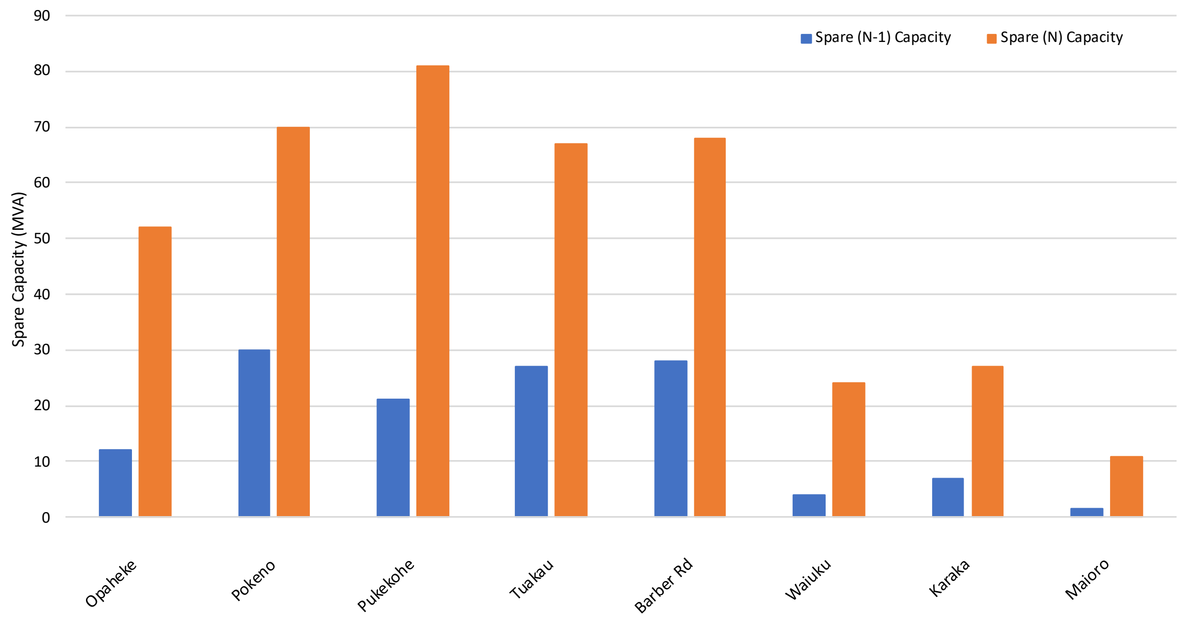

Figure 2. Summary: Approximate (N) and (N-1) spare capacity at Counties Energy's zone substations.

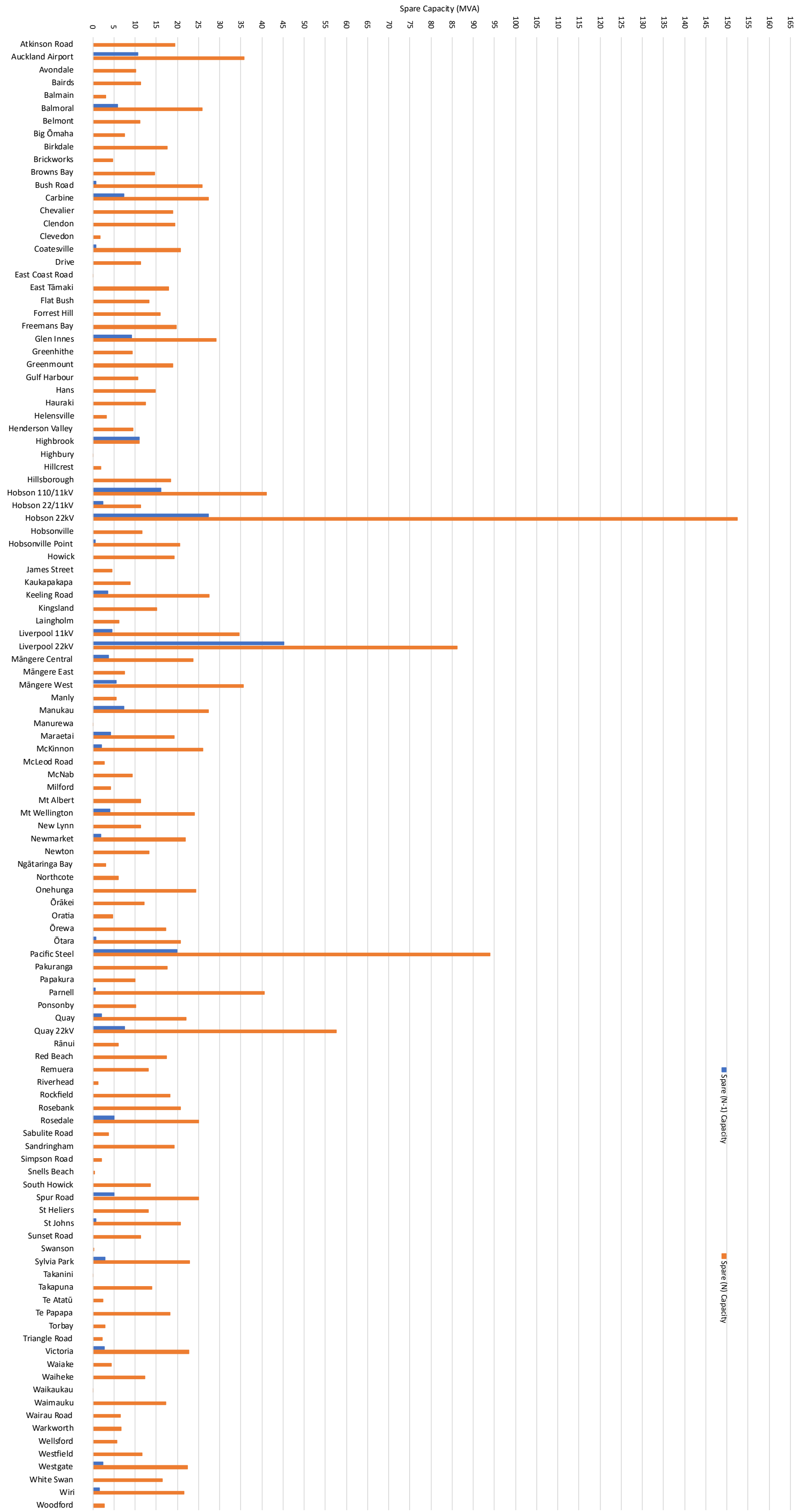

Figure 3. Summary: Approximate (N) and (N-1) spare capacity at Vector's zone substations.

1.2 Load Characteristics

The substation load characteristics are documented in detail in the main body of the report (and the supplementary document 24136-RPT-004) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Auckland CDB (Penrose 110 kV GXP and Hobson St 110 kV GXP)* – Supplies Auckland's CBD area. Load is predominantly commercial, with some residential. Load is reasonably flat throughout the year, with a slight winter peak, with typical daily morning and evening peaks, with load significantly dropping during weekends.
- *Albany 33 kV GXP* – Supplies a portion of Auckland's North Shore, including Albany North Harbour, Rosedale, Forrest Hill, Browns Bay, Torbay, and Greenhithe. Load is predominantly residential and commercial, with extensive growth occurring in both groups. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Bombay 110 kV GXP* – Supplies the eastern area of Counties' network, including Mangatāwhiri, Bombay, Pukekohe, and Tuakau. Load is predominantly residential with some industrial (dairy plants). Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Glenbrook 33 kV GXP (clean bus)* – Supplies the western area of Counties' network, including Glenbrook, Karaka, and Waiuku; as well as supplying a portion of the Glenbrook Steel Mill's load. Load is a mixture of residential, commercial, and industrial, with some agricultural. Load is peaky and relatively even through the year, appearing to be largely dominated by the Steel Mill load.
- *Glenbrook 33 kV GXP (dirty bus)* – Supplies the portion of the Glenbrook Steel Mill's load which has a lower power quality (this bus is kept separate from the clean bus to avoid exposing other loads to this power quality). Load is entirely industrial and is peaky and relatively even throughout the year.
- *Henderson 33 kV GXP* – Supplies a section of West Auckland, including Rānui, Swanson, Woodford, Hobsonville, Westgate, Te Atatu, Riverhead, and Simpson Rd. Load is predominantly residential and commercial, with extensive growth occurring in both groups. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Hepburn Rd 33 kV GXP* – Supplies a section of West Auckland, including Rosebank, Green Bay, Rānui, Oratia, Glendene, New Lynn, Titirangi, and Laingholm. Load is predominantly residential, with some commercial and industrial. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Māngere 110 kV GXP* – Supplies the PAC Steel industrial area, including some other industrial customers. Load is entirely industrial. Load is peaky throughout the year.
- *Māngere 33 kV GXP* – Supplies Māngere township and the surrounding areas, including the area around the Auckland Airport. Load is a mixture of residential and commercial with some industrial. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Ōtāhuhu 22 kV GXP* – Supplies Ōtāhuhu and surrounding areas such as the Highbrook commercial and industrial areas, as well as Ōtara and Bairds. Load is predominantly industrial with some residential. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.

- *Pakuranga 33 kV GXP* – Supplies East Tāmaki, Pakuranga, Howick, and Flat Bush. Load is predominantly residential, with some industrial customers. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Penrose 33 kV and 22 kV GXPs* –Supply areas in central Auckland, including Onehunga, Westfield, Glen Innes, Mt Wellington, Newmarket, Ōrākei, Remuera, and Sylvia Park. Load is a mixture of residential, commercial, and industrial (including some of Vector's largest industrial customers). Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Mt Roskill 110 kV and 22 kV GXPs* – Supply the areas around Mt Roskill including Chevalier, Kingsland, Ponsonby, Avondale, Hillsborough, Mt Albert, Sandringham, Balmoral, and White Swan. Load is predominantly residential, with some industrial and commercial loads. Residential demand is rapidly increasing. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Mt Roskill 22 kV GXP –Silverdale 33 kV GXP* – Supplies some of the northern area of Vector's network, including Ōrewa, Silverdale, Millwater, Whangaparāoa, Stillwater, Red Beach, Manly, and Tindalls Beach. Load is predominantly residential, with an increasing commercial demand. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Takanini 33 kV GXP* [2]– Supplies areas of Manurewa, Takanini, and Papakura, as well as some smaller townships and rural areas such as Clevedon, Maraetai, Beachlands, and Waiheke Island. Load is predominantly residential, with some commercial and industrial. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Wairau Rd 33 kV/Albany 110 kV GXP* – Supplies a portion of Auckland's North Shore, including the Wairau Valley, Glenfield, Devonport, Bayswater, Takapuna, Northcote, Birkenhead, and Beach Haven. Load is predominantly residential and commercial, with extensive growth occurring in both of these groups. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Wellsford 33 kV GXP* – Supplies the northernmost area of Vector's network, including Wellsford, Warkworth, Matakana, Sandspit, Ōmaha, Snells Beach, Leigh, and Tapora. Load is predominantly residential, with some commercial and agricultural demand. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Wiri 33 kV GXP* – supplies Manukau and the surrounding areas such as the Wiri commercial area and residential Clendon. Load is a mixture of residential, commercial, and industrial. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.

Zone Substations:

- The load characteristics of the zone substations vary widely depending on the connected consumers/generators.

[2] Ergo wishes to acknowledge, and respects, the local Iwi's preference to use the spelling Takaanini in reference to the Auckland suburb, per a proposal put forward to LINZ in 2024. However, for the purposes of this report, the official names of the suburb and substations are used, in accordance with the eventual decision of LINZ.

1.3 EECA Load Sites

The following table shows EECA's Load Sites together with:

- The peak electrical power requirements of the Load Site.
- The distribution zone substation to which the Load Site would connect.
- The transmission substation/GXP which supplies the relevant zone substation.
- Ergo's estimate of the capital cost to increase the capacity of the relevant transmission assets (lines and substations).
- Ergo's estimate of the capital cost to install the necessary distribution assets to supply the Load Site.
- The cost efficiency associated with the Load Site in terms of $M/MW.
- The 'complexity of connection' based on the level of upgrades required.

The costs are preliminary and Ergo is of the view that they have an accuracy of Class 5[3], which is only suitable for concept screening (refer to the assumptions outlined in Appendix 3 for more details).

Ergo notes that, additional to any costs outlined in this report, Vector requires a development contribution cost to be paid by connecting Load Sites. This development contribution varies depending on the complexity of installing and connecting the new load, and would be determined by Vector when a connection application request is made by the customer. More information on this contribution is available on the Vector website.

[3] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

Table 1. Summary of Load Sites and indicative high-level capital costs

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
AKL71	Health New Zealand Auckland City Hospital	5.81	ACBD	$0.00	Liverpool 22kV	$6.19	$6.19	$1.07	Moderate	1, 2
AKL162	University of Auckland City	4.69	ACBD	$0.00	Liverpool 22kV	$1.50	$1.50	$0.32	Minor	1, 2
AKL163	University of Auckland Grafton	1.59	ACBD	$0.00	Liverpool 11kV	$0.00	$0.00	$0.00	Minor	1
AKL149	Sky City Auckland	0.98	ACBD	$0.00	Victoria	$0.00	$0.00	$0.00	Minor	1
AKL30	Auckland University of Technology City Campus	0.93	ACBD	$0.00	Liverpool 11kV	$0.00	$0.00	$0.00	Minor	1
AKL46	Department of Corrections Mt. Eden Prison & Aucklanc	0.52	ACBD	$0.00	Newton	$0.00	$0.00	$0.00	Minor	1
AKL184	Grand Millennium Hotel	0.41	ACBD	$0.00	Liverpool 22kV	$0.00	$0.00	$0.00	Minor	1
AKL19	Auckland Council Tepid Baths	0.26	ACBD	$0.00	Hobson 22/11kV	$0.00	$0.00	$0.00	Minor	1
AKL13	Auckland Council Parnell Baths	0.18	ACBD	$0.00	Quay	$0.00	$0.00	$0.00	Minor	1
AKL160	The Olympic Pools & Fitness Centre Newmarket	0.17	ACBD	$0.00	Parnell	$0.00	$0.00	$0.00	Minor	1
AKL6	Amcor Cartons Albany	5.94	ALB33	$0.00	Bush Road	$11.06	$11.06	$1.86	Moderate	1, 2
AKL48	Department of Corrections Auckland Prison	0.84	ALB33	$0.00	Coatesville	$0.00	$0.00	$0.00	Minor	1
AKL102	Ministry of Education Long Bay College	0.42	ALB33	$0.00	Torbay	$0.00	$0.00	$0.00	Minor	1
AKL14	Auckland Council Albany Stadium Pool	0.40	ALB33	$0.00	McKinnon	$0.00	$0.00	$0.00	Minor	1
AKL98	Massey University Auckland	0.36	ALB33	$0.00	McKinnon	$0.00	$0.00	$0.00	Minor	1
AKL18	Auckland Council Glenfield Pool and Leisure Centre	0.18	ALB33	$0.00	James Street	$0.00	$0.00	$0.00	Minor	1
AKL177	Boundary Road Brewery	5.18	BOB110	$0.00	Ōpaheke	$1.50	$1.50	$0.29	Minor	1, 2
AKL190	NIG Nutritionals Pukekohe	4.76	BOB110	$0.00	Pukekohe	$0.00	$0.00	$0.00	Minor	1
AKL126	NZ Hothouse Karaka	2.37	BOB110	$0.00	Ōpaheke	$0.05	$0.05	$0.02	Minor	1
AKL127	NZ Hothouse Bombay	1.98	BOB110	$0.00	Pukekohe	$1.19	$1.19	$0.60	Minor	1
AKL180	Gellerts Auckland	1.56	BOB110	$0.00	Pukekohe	$0.00	$0.00	$0.00	Minor	1
AKL188	KJ Flowers Drury	0.51	BOB110	$0.00	Ōpaheke	$0.00	$0.00	$0.00	Minor	1
AKL183	Rainbow Park Nurseries Ltd Drury	0.50	BOB110	$0.00	Pukekohe	$0.00	$0.00	$0.00	Minor	1
AKL192	Bokay Flower Farms	0.37	BOB110	$0.00	Barber Rd	$0.00	$0.00	$0.00	Minor	1
AKL167	Van den Brink Poultry Limited (Brinks Chicken) Karaka	0.29	BOB110	$0.00	Ōpaheke	$0.00	$0.00	$0.00	Minor	1
AKL189	Ministry of Education Pukekohe High School	0.22	BOB110	$0.00	Pukekohe	$0.00	$0.00	$0.00	Minor	1
AKL91	Karaka Park Produce Ltd Pukekohe	0.14	BOB110	$0.00	Ōpaheke	$0.00	$0.00	$0.00	Minor	1
AKL130	NZ Steel Glenbrook Steel Mill - Stage 1	26.20	GLN33-clean	$0.00	N/A	$7.00	$7.00	$0.27	Moderate	1, 2
AKL130	NZ Steel Glenbrook Steel Mill - Stage 2	25.67	GLN33-clean	$0.00	N/A	$3.70	$3.70	$0.14	Moderate	1, 2
AKL191	NZ Gourmet Waiuku	1.44	GLN33-clean	$0.00	Waiuku	$2.71	$2.71	$1.89	Minor	1, 2
AKL185	Dhindsa Farm Limited	0.39	GLN33-clean	$0.00	Waiuku	$0.00	$0.00	$0.00	Minor	1
AKL33	Ayyildiz Ltd Rose's Halloumi Cheese	0.25	GLN33-clean	$0.00	Karaka	$0.00	$0.00	$0.00	Minor	1
AKL194	Wing Shing Farms Karaka	0.15	GLN33-clean	$0.00	Karaka	$0.00	$0.00	$0.00	Minor	1
AKL138	PALM McCallum Industries	4.49	HEN33	$0.00	Rānui	$20.48	$20.48	$4.57	Moderate	1, 2
AKL88	Industrial Processors Limited	1.98	HEN33	$0.00	Swanson	$10.80	$10.80	$5.46	Moderate	1, 2
AKL175	William Morrison Funeral Directors Auckland	1.91	HEN33	$0.00	Te Atatū	$6.60	$6.60	$3.45	Moderate	1, 2
AKL181	Tasti Auckland	0.76	HEN33	$0.00	Te Atatū	$0.00	$0.00	$0.00	Minor	1
AKL84	Homestead Produce Ltd	0.62	HEN33	$0.00	Riverhead	$0.00	$0.00	$0.00	Minor	1
AKL74	Health New Zealand Waitākere Hospital	0.47	HEN33	$0.00	Woodford	$0.00	$0.00	$0.00	Minor	1
AKL131	Sunrise Healthcare West Harbour	0.27	HEN33	$0.00	Hobsonville Point	$0.00	$0.00	$0.00	Minor	1
AKL168	Van Lier Riverhead	0.25	HEN33	$0.00	Riverhead	$0.00	$0.00	$0.00	Minor	1
AKL108	Ministry of Education Waitākere College	0.21	HEN33	$0.00	Woodford	$0.00	$0.00	$0.00	Minor	1
AKL187	Heirloomacy Waimauku	0.21	HEN33	$0.00	Waimauku	$0.00	$0.00	$0.00	Minor	1
AKL117	Ministry of Education Edmonton Primary School	0.11	HEN33	$0.00	Te Atatū	$0.00	$0.00	$0.00	Minor	1
AKL145	Riverland Roses Riverland Nursery	0.09	HEN33	$0.00	Hobsonville Point	$0.00	$0.00	$0.00	Minor	1
AKL158	Tegel Henderson	5.28	HEP33	$0.00	Henderson Valley	$31.86	$31.86	$6.03	Moderate	1, 2
AKL63	Glucina Alloys Avondale	4.19	HEP33	$0.00	Rosebank	$17.20	$17.20	$4.11	Moderate	1, 2
AKL32	Autex Industries Ltd	3.15	HEP33	$0.00	Rosebank	$17.20	$17.20	$5.46	Moderate	1, 2
AKL37	Blue Star Group (New Zealand) Ltd Webstar Auckland	1.88	HEP33	$0.00	Keeling Road	$22.86	$22.86	$12.15	Moderate	1, 2
AKL10	Pact Reuse Avondale	1.78	HEP33	$0.00	Rosebank	$17.20	$17.20	$9.65	Moderate	1, 2
AKL169	VIP Steel Packaging NZ Limited	1.68	HEP33	$0.00	Rosebank	$17.20	$17.20	$10.22	Moderate	1, 2
AKL148	Sealed Air	1.09	HEP33	$0.00	McLeod Road	$9.00	$9.00	$8.27	Moderate	1, 2
AKL140	Perry Metal Protection Auckland	0.89	HEP33	$0.00	Rosebank	$0.00	$0.00	$0.00	Minor	1
AKL12	Auckland Council West Wave Pool and Leisure Centre	0.59	HEP33	$0.00	McLeod Road	$0.00	$0.00	$0.00	Minor	1
AKL26	Auckland Council Waikumete Cemetery	0.56	HEP33	$0.00	Sabulite Road	$0.00	$0.00	$0.00	Minor	1
AKL144	Rheem New Zealand Ltd Auckland	0.32	HEP33	$0.00	Rosebank	$0.00	$0.00	$0.00	Minor	1
AKL109	Ministry of Education Prospect School	0.18	HEP33	$0.00	Waikaukau	$0.00	$0.00	$0.00	Minor	1
AKL113	Ministry of Education Greenbay High School	0.17	HEP33	$0.00	Atkinson Road	$0.00	$0.00	$0.00	Minor	1
AKL93	Ko Taku Reo Deaf Education, Auckland	0.13	HEP33	$0.00	Sabulite Road	$0.00	$0.00	$0.00	Minor	1
AKL186	Wicked Hot Waitākere	0.13	HEP33	$0.00	Henderson Valley	$0.00	$0.00	$0.00	Minor	1
AKL101	Methven Auckland	0.01	HEP33	$0.00	Rosebank	$0.00	$0.00	$0.00	Minor	1
AKL36	Blue Scope Pacific Steel	9.90	MNG110	$0.00	Pacific Steel	$1.50	$1.50	$0.15	Minor	1, 2

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary, based on data gathered at one point in time, and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes. For the larger Load Sites Ergo recommend proceeding with a Concept Design Report (CDR) to improve the accuracy of the respective cost estimate. It is additionally encouraged that Load Sites engage with their respective EDB at the earliest opportunity during upgrade planning in order to confirm the most up-to-date information.

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
AKL195	Coca Cola Amatil Keri Juice	3.05	MNG33	$0.00	Māngere Central	$23.62	$23.62	$7.75	Moderate	1, 2
AKL85	Hubbards Foods	2.77	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL75	Health New Zealand Middlemore Hospital	2.76	MNG33	$0.00	Hans	$9.26	$9.26	$3.35	Moderate	1, 2
AKL136	Oji Fibre Solutions Packaging Northern	1.98	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL59	George Weston Foods Ōtāhuhu	1.72	MNG33	$0.00	Hans	$9.26	$9.26	$5.39	Moderate	1, 2
AKL11	Auckland Airport	1.63	MNG33	$0.00	Airport	$1.32	$1.32	$0.81	Minor	1, 2
AKL154	Supreme Steel Products Ltd	1.48	MNG33	$0.00	Hans	$9.26	$9.26	$6.24	Moderate	1, 2
AKL2	Air New Zealand Manukau	1.15	MNG33	$0.00	Airport	$1.40	$1.40	$1.21	Minor	1, 2
AKL90	Jack Link's Māngere	0.69	MNG33	$0.00	Māngere West	$0.00	$0.00	$0.00	Minor	1
AKL89	International Waste Ltd	0.59	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL23	Auckland Council Manukau Memorial Gardens	0.56	MNG33	$0.00	Māngere East	$0.00	$0.00	$0.00	Minor	1
AKL83	Holiday Inn Auckland Airport Hotel	0.31	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL8	Arxada (Arch Wood Protection)	0.18	MNG33	$0.00	Hans	$0.00	$0.00	$0.00	Minor	1
AKL67	Green Harvest Pacific Ltd.	0.18	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL20	Auckland Council Moana Nui A kiwa - Māngere Pool	0.18	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL114	Ministry of Education Aorere College	0.14	MNG33	$0.00	Māngere East	$0.00	$0.00	$0.00	Minor	1
AKL96	LSG Sky Chefs Auckland Airport	0.12	MNG33	$0.00	Airport	$0.00	$0.00	$0.00	Minor	1
AKL5	Altus NZ Ltd Auckland	5.48	OTA22	$0.00	Highbrook	$1.50	$1.50	$0.27	Minor	1, 2
AKL45	DB Breweries Limited Waitematā	5.23	OTA22	$0.00	Bairds	$5.60	$5.60	$1.07	Moderate	1, 2
AKL65	Goodman Fielder Quality Bakers Auckland	5.05	OTA22	$0.00	Ōtara	$7.32	$7.32	$1.45	Moderate	1, 2
AKL95	Lion The Pride	3.81	OTA22	$0.00	Ōtara	$6.30	$6.30	$1.65	Moderate	1, 2
AKL86	Huhtamaki NZ Ltd Moulder Fibre	3.27	OTA22	$0.00	Bairds	$4.60	$4.60	$1.41	Moderate	1, 2
AKL129	NZ Panels East Tāmaki	1.15	OTA22	$0.00	Ōtara	$6.30	$6.30	$5.49	Moderate	1, 2
AKL50	East Tāmaki Galvanising	0.54	OTA22	$0.00	Ōtara	$0.00	$0.00	$0.00	Minor	1
AKL35	Bell Tea & Coffee Company Ltd Auckland	0.49	OTA22	$0.00	Ōtara	$0.00	$0.00	$0.00	Minor	1
AKL78	Heinz Watties Limited La Bonne Cuisine	0.35	OTA22	$0.00	Ōtara	$0.00	$0.00	$0.00	Minor	1
AKL106	Ministry of Education Sir Edmund Hillary Collegiate	0.22	OTA22	$0.00	Bairds	$0.00	$0.00	$0.00	Minor	1
AKL24	Auckland Council Ōtara Pool & Leisure Centre	0.17	OTA22	$0.00	Bairds	$0.00	$0.00	$0.00	Minor	1
AKL27	Auckland Council Papatoetoe Centennial Pool & Leisu	0.11	OTA22	$0.00	Bairds	$0.00	$0.00	$0.00	Minor	1
AKL115	Ministry of Education Fairburn School	0.07	OTA22	$0.00	Bairds	$0.00	$0.00	$0.00	Minor	1
AKL66	Grain Corp NZ Ltd MeadowLea Foods	10.89	PAK33	$0.00	Greenmount	$12.16	$12.16	$1.12	Moderate	1, 2
AKL81	Higgins East Tāmaki	9.60	PAK33	$0.00	Greenmount	$14.56	$14.56	$1.52	Moderate	1, 2
AKL118	Mr Chips Ltd	5.38	PAK33	$0.00	East Tāmaki	$6.40	$6.40	$1.19	Moderate	1, 2
AKL173	Waste Management Technical Services East Tāmaki	0.42	PAK33	$0.00	Greenmount	$0.00	$0.00	$0.00	Minor	1
AKL15	Auckland Council Lloyd Elsmore Park Pool & Leisure C	0.33	PAK33	$0.00	Howick	$0.00	$0.00	$0.00	Minor	1
AKL112	Ministry of Education Botany Downs Secondary Colleg	0.21	PAK33	$0.00	Greenmount	$0.00	$0.00	$0.00	Minor	1
AKL119	Much Moore Icecream East Tāmaki	0.17	PAK33	$0.00	Greenmount	$0.00	$0.00	$0.00	Minor	1
AKL80	Henkel NZ Ltd. East Tāmaki	0.17	PAK33	$0.00	Greenmount	$0.00	$0.00	$0.00	Minor	1
AKL170	Visy Glass Auckland	30.31	PEN33	$0.00	N/A	$15.40	$15.40	$0.51	Moderate	1, 2
AKL57	Fulton Hogan Limited Reliable Way	21.37	PEN33	$0.00	N/A	$11.50	$11.50	$0.54	Moderate	1, 2
AKL49	Downer New Zealand Limited Auckland Asphalt	11.47	PEN33	$0.00	N/A	$15.70	$15.70	$1.37	Moderate	1, 2
AKL70	Hayes Metal Refinery	5.44	PEN33	$0.00	Te Papapa	$20.42	$20.42	$3.75	Moderate	1, 2
AKL121	New Zealand Starch Auckland	4.73	PEN33	$0.00	Te Papapa	$20.10	$20.10	$4.25	Moderate	1, 2
AKL62	Gerard Roofs Auckland	4.06	PEN33	$0.00	St Johns	$17.80	$17.80	$4.39	Moderate	1, 2
AKL178	Expol Ltd Auckland	2.77	PEN33	$0.00	Te Papapa	$19.50	$19.50	$7.04	Moderate	1, 2
AKL143	Purewa Cemetery Auckland	1.92	PEN33	$0.00	St Johns	$17.80	$17.80	$9.27	Moderate	1, 2
AKL42	Coca Cola Amatil The Oasis	1.83	PEN33	$0.00	Sylvia Park	$0.00	$0.00	$0.00	Minor	1
AKL73	Health New Zealand Greenlane Clinical Centre	1.81	PEN33	$0.00	Drive	$17.00	$17.00	$9.37	Moderate	1, 2
AKL51	Environwaste ltd Chemwaste	1.68	PEN33	$0.00	Te Papapa	$19.50	$19.50	$11.59	Moderate	1, 2
AKL100	Mercy Hospital	1.07	PEN33	$0.00	Newmarket	$0.00	$0.00	$0.00	Minor	1
AKL40	Cemix Ltd	0.99	PEN33	$0.00	Te Papapa	$0.00	$0.00	$0.00	Minor	1
AKL165	Valmont Coatings Auckland FKA CSP Galvanizing	0.99	PEN33	$0.00	McNab	$0.00	$0.00	$0.00	Minor	1
AKL141	Pets @ Rest	0.92	PEN33	$0.00	Te Papapa	$0.00	$0.00	$0.00	Minor	1
AKL193	Delmaine Fine Foods Auckland	0.57	PEN33	$0.00	McNab	$0.00	$0.00	$0.00	Minor	1
AKL164	University of Auckland Newmarket	0.35	PEN33	$0.00	Newmarket	$0.00	$0.00	$0.00	Minor	1
AKL156	Mt. Smart Stadium	0.35	PEN33	$0.00	Te Papapa	$0.00	$0.00	$0.00	Minor	1
AKL150	Smart Foods Ltd.	0.30	PEN33	$0.00	Sylvia Park	$0.00	$0.00	$0.00	Minor	1
AKL161	Tip Top Auckland	0.25	PEN33	$0.00	Carbine	$0.00	$0.00	$0.00	Minor	1
AKL43	Auckland Showgrounds	0.22	PEN33	$0.00	Drive	$0.00	$0.00	$0.00	Minor	1
AKL107	Ministry of Education Epsom Girls Grammar School	0.21	PEN33	$0.00	Newmarket	$0.00	$0.00	$0.00	Minor	1
AKL111	Ministry of Education Stanhope Road School	0.19	PEN33	$0.00	McNab	$0.00	$0.00	$0.00	Minor	1
AKL28	Auckland Council Lagoon Pools	0.18	PEN33	$0.00	Mt Wellington	$0.00	$0.00	$0.00	Minor	1
AKL151	Southern Cross Healthcare Gillies Hospital	0.16	PEN33	$0.00	Drive	$0.00	$0.00	$0.00	Minor	1
AKL22	Auckland Council Glen Innes Pool and Leisure Centre	0.17	PEN33	$0.00	Mt Wellington	$0.00	$0.00	$0.00	Minor	1
AKL166	Van den Brink Poultry Limited (Brinks Chicken) St John	0.09	PEN33	$0.00	Glen Innes	$0.00	$0.00	$0.00	Minor	1
AKL132	Oceania Healthcare Meadowbank	0.06	PEN33	$0.00	Ōrākei	$0.00	$0.00	$0.00	Minor	1

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			Transmission Details		Distribution		TOTAL			
No.	Load Site Name	Load (MW)	GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
AKL53	Fletcher Steel Ltd Pacific Coil Coaters	2.97	PEN22	$0.00	Westfield	$3.00	$3.00	$1.01	Moderate	1, 2
AKL87	Huntsman Chemical Company Ltd Barnes Plastics	1.88	PEN22	$0.00	Westfield	$3.00	$3.00	$1.60	Moderate	1, 2
AKL123	NZ Comfort Group	1.78	PEN22	$0.00	Westfield	$3.00	$3.00	$1.68	Moderate	1, 2
AKL29	Auckland Meat Processors Auckland	1.48	PEN22	$0.00	Westfield	$3.00	$3.00	$2.03	Moderate	1, 2
AKL182	Mauri NZ Auckland	1.33	PEN22	$0.00	Westfield	$3.00	$3.00	$2.25	Moderate	1, 2
AKL92	Kerry Group Kerry Ingredients	1.19	PEN22	$0.00	Westfield	$3.00	$3.00	$2.53	Moderate	1, 2
AKL128	NZ Nail Industries	0.69	PEN22	$0.00	Westfield	$0.00	$0.00	$0.00	Minor	1
AKL153	Steel Masters Auckland Ltd	0.49	PEN22	$0.00	Westfield	$0.00	$0.00	$0.00	Minor	1
AKL4	Alsco NZ Auckland	2.20	ROS110	$0.00	Kingsland	$20.90	$20.90	$9.50	Moderate	1, 2
AKL76	Health New Zealand Mason Clinic	0.24	ROS110	$0.00	Chevalier	$0.00	$0.00	$0.00	Minor	1
AKL116	Ministry of Education Western Springs College	0.13	ROS110	$0.00	Chevalier	$0.00	$0.00	$0.00	Minor	1
AKL147	Sanitarium Auckland	1.63	ROS22	$0.00	Hillsborough	$5.92	$5.92	$3.63	Moderate	1, 2
AKL44	Davis Funeral Services Limited Auckland	0.96	ROS22	$0.00	Balmoral	$0.00	$0.00	$0.00	Minor	1
AKL103	Ministry of Education Lynfield College	0.37	ROS22	$0.00	White Swan	$0.00	$0.00	$0.00	Minor	1
AKL133	Lexham Gardens Rest Home	0.27	ROS22	$0.00	Balmoral	$0.00	$0.00	$0.00	Minor	1
AKL134	Everil Orr Care Centre	0.27	ROS22	$0.00	Avondale	$0.00	$0.00	$0.00	Minor	1
AKL34	Mount Albert Aquatic Centre	0.26	ROS22	$0.00	Sandringham	$0.00	$0.00	$0.00	Minor	1
AKL142	Plant & Food Research Mt Albert	0.25	ROS22	$0.00	Sandringham	$0.00	$0.00	$0.00	Minor	1
AKL155	Tai Poutini Polytechnic Auckland Campus	0.22	ROS22	$0.00	Mt Albert	$0.00	$0.00	$0.00	Minor	1
AKL196	Epicurean Dairy Co Auckland	0.18	ROS22	$0.00	Avondale	$0.00	$0.00	$0.00	Minor	1
AKL52	ESR (Institute of Environmental Science and Research)	0.14	ROS22	$0.00	Sandringham	$0.00	$0.00	$0.00	Minor	1
AKL58	Fulton Hogan Limited North Harbour	7.71	SVL33	$0.00	Spur Road	$13.44	$13.44	$1.74	Moderate	1, 2
AKL82	Higgins Silverdale	7.27	SVL33	$0.00	Spur Road	$12.90	$12.90	$1.77	Moderate	1, 2
AKL125	NZ Gourmet Gourmet Paprika	2.55	SVL33	$0.00	Helensville	$9.42	$9.42	$3.69	Moderate	1, 2
AKL61	George Weston Foods Silverdale	0.59	SVL33	$0.00	Spur Road	$0.00	$0.00	$0.00	Minor	1
AKL99	Massimo's Italian Cheeses	0.49	SVL33	$0.00	Spur Road	$0.00	$0.00	$0.00	Minor	1
AKL179	Superb Herb Helenville	0.21	SVL33	$0.00	Helensville	$0.00	$0.00	$0.00	Minor	1
AKL110	Ministry of Education Ōrewa College	0.10	SVL33	$0.00	Ōrewa	$0.00	$0.00	$0.00	Minor	1
AKL54	Fonterra Brands Limited Takanini	7.05	TAK33	$0.00	Papakura	$21.40	$21.40	$3.04	Moderate	1, 2
AKL69	Griffins Papakura	3.28	TAK33	$0.00	Papakura	$14.84	$14.84	$4.53	Moderate	1, 2
AKL97	Mainfeeds Ltd Manurewa	1.98	TAK33	$0.00	Manurewa	$26.10	$26.10	$13.18	Moderate	1, 2
AKL137	Ottogi NZ Ltd Takanini	1.83	TAK33	$0.00	Takanini	$18.42	$18.42	$10.06	Moderate	1, 2
AKL139	CORE Timber Services Papakura	1.21	TAK33	$0.00	Papakura	$13.76	$13.76	$11.35	Moderate	1, 2
AKL157	Tegel Takanini Feedmill	0.93	TAK33	$0.00	Takanini	$0.00	$0.00	$0.00	Minor	1
AKL77	Health New Zealand Manukau Super Clinic	0.42	TAK33	$0.00	Manurewa	$0.00	$0.00	$0.00	Minor	1
AKL17	Auckland Council Manurewa Pool and Leisure Centre	0.26	TAK33	$0.00	Manurewa	$0.00	$0.00	$0.00	Minor	1
AKL41	Clevedon Valley Buffalo Company	0.25	TAK33	$0.00	Maraetai	$0.00	$0.00	$0.00	Minor	1
AKL122	New Zealand Sugar Company Limited Auckland - Stage	6.00	WRD33	$7.50	Highbury	$7.20	$14.70	$2.45	Major	1, 2
AKL122	New Zealand Sugar Company Limited Auckland - Stage	6.49	WRD33	$0.00	Highbury	$4.60	$4.60	$0.71	Moderate	1, 2
AKL72	Health New Zealand North Shore Hospital	1.30	WRD33	$7.50	Wairau Road	$7.60	$15.10	$11.61	Major	1, 2
AKL124	NZ Defence Force Devonport	0.85	WRD33	$0.00	Ngātaringa Bay	$0.00	$0.00	$0.00	Minor	1
AKL31	Auckland University of Technology North Campus	0.39	WRD33	$0.00	Hillcrest	$0.00	$0.00	$0.00	Minor	1
AKL104	Ministry of Education Northcote College	0.38	WRD33	$0.00	Highbury	$0.00	$0.00	$0.00	Minor	1
AKL105	Ministry of Education Birkenhead College	0.28	WRD33	$0.00	Birkdale	$0.00	$0.00	$0.00	Minor	1
AKL25	Auckland Council Birkenhead Pool and Leisure Centre	0.22	WRD33	$0.00	Highbury	$0.00	$0.00	$0.00	Minor	1
AKL21	Auckland Council Takapuna Pool and Leisure Centre	0.11	WRD33	$0.00	Hillcrest	$0.00	$0.00	$0.00	Minor	1
AKL152	Southern Paprika Limited Warkworth	4.30	WEL33	$14.00	Warkworth	$36.21	$50.21	$11.68	Major	1, 2
AKL68	Griffins Wiri	13.12	WIR33	$7.50	Wiri	$7.50	$15.00	$1.14	Major	1, 2
AKL38	Bluebird Foods	10.10	WIR33	$7.50	Wiri	$5.90	$13.40	$1.33	Major	1, 2
AKL9	COLAS Limited (ASCO Asphalt)	7.52	WIR33	$7.50	West Wiri	$1.70	$9.20	$1.22	Major	1, 2
AKL55	Frucor Suntory New Zealand Limited Plunket Avenue	5.00	WIR33	$7.50	Wiri	$7.90	$15.40	$3.08	Major	1, 2
AKL171	Visy Board	2.76	WIR33	$7.50	West Wiri	$1.64	$9.14	$3.31	Major	1, 2
AKL56	Frucor Suntory New Zealand Limited Orb Avenue	2.44	WIR33	$7.50	Wiri	$6.90	$14.40	$5.91	Major	1, 2
AKL39	Bremworth Auckland	1.90	WIR33	$7.50	Manukau	$0.56	$8.06	$4.24	Major	1, 2
AKL172	Visy Beverage Can	1.73	WIR33	$7.50	Wiri	$6.90	$14.40	$8.33	Major	1, 2
AKL146	Salters Cartage Ltd	1.68	WIR33	$7.50	West Wiri	$1.80	$9.30	$5.53	Major	1, 2
AKL120	Nestle Cambria Park	1.63	WIR33	$7.50	West Wiri	$0.00	$7.50	$4.59	Major	1, 2
AKL64	Godfrey Hirst NZ Limited Auckland	1.48	WIR33	$7.50	Wiri	$0.00	$7.50	$5.08	Major	1, 2
AKL7	Ann Funeral Home & Onsite Cremations Auckland	1.15	WIR33	$7.50	Wiri	$0.00	$7.50	$6.51	Major	1, 2
AKL60	George Weston Foods Wiri	1.09	WIR33	$7.50	Wiri	$0.00	$7.50	$6.89	Major	1, 2
AKL94	Koppers Performance Chemicals NZ Wiri	0.84	WIR33	$0.00	Wiri	$0.00	$0.00	$0.00	Minor	1
AKL47	Department of Corrections Auckland Regional Women	0.69	WIR33	$0.00	Clendon	$0.00	$0.00	$0.00	Minor	1
AKL79	Hellers Ltd Auckland	0.54	WIR33	$0.00	Wiri	$0.00	$0.00	$0.00	Minor	1
AKL174	Westfield Manukau City	0.33	WIR33	$0.00	Manukau	$0.00	$0.00	$0.00	Minor	1
AKL1	AFFCO New Zealand Limited Wiri	0.16	WIR33	$0.00	Wiri	$0.00	$0.00	$0.00	Minor	1
	TOTAL =>	435.57	TOTAL =>	$126.50	TOTAL =>	$771.89	$898.39			

Notes

1 Doesn't include distribution transformer or switchgear costs for Load Sites (details provided in body of report). Estimated between $50k - $350k depending on size.

2 (N-1) scenario cost shown

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2. Introduction

The consumers in the Auckland region are supplied with electricity via electrical networks that are owned by the following EDBs:

- Counties Energy – 8 zone substations
- Vector – 115 zone substations

The regional areas of the EDBs are shown in Figure 4 for the two EDBs respectively.

The Energy Efficiency & Conservation Authority (EECA) is running a flagship programme that is called Regional Energy Transition Accelerator (RETA)[4]. The programme is targeted at large energy-using businesses and public sector organisations and seeks to identify the barriers involved and opportunities available to replace fossil fuels with renewable energy sources.

As part of the RETA programme, EECA contracted Ergo to determine the existing spare supply capacity and the load characteristics at the major electrical substations within the Auckland region.

Ergo previously developed similar reports for Southland, South Canterbury, Waikato, Manawatū-Whanganui, and more regions.

[4] https://www.eeca.govt.nz/co-funding-and-support/products/about-reta/

Figure 4 EDB regional areas[5]

[5] ENA Lines Company Map: https://www.ena.org.nz/lines-company-map/

3. Scope of Work

The scope requested of Ergo was to assess the existing capacity (both (N) and (N-1) security) and supply characteristics (peak and average supply and seasonality information) for the major electrical infrastructure in the Auckland region. This included reviewing both the GXP's and local distribution zone substations along with their associated lines/cables within the Auckland region.

Ergo's assessments and analysis were based on the following information sources:

- Transpower's Transmission Planning Report 2023.
- Counties Energy's 2023 regulatory information disclosures and 2023 AMP, 2024 AMP update, and 2025 AMP[6].
- Vector's 2023 regulatory information disclosures and 2023 AMP and 2024 AMP update[7].
- SCADA substation loading data provided by Counties and Vector.
- GXP metering data extracted from the Electricity Authority's website[8].
- Network diagrams provided by Counties and Vector.
- Geographic Information System (GIS) asset and location data provided by Counties and Vector.
- Vector's network loading and planned upgrades online map.
- Ergo notes that as loading data provided by EDBs were for the 2023 year, the same period has been used when assessing GXPs, for consistency, although 2024 data is now available.

[6] https://countiesenergy.co.nz/about-us/regulatory-disclosures/#asset-management-plans
[7] https://www.vector.co.nz/about-us/regulatory/disclosures-electricity/asset-management-plan
[8] https://www.emi.ea.govt.nz/Wholesale/Datasets

4. Auckland Network

The following sections describe (at a high level), the locations of the relevant substations and lines. For the purposes of this document the EDB regional areas defined above and supplied by Counties and Vector, are referred to as the Auckland region.

4.1 Transmission/GXP Substations

The following Figure 5 and Figure 6 illustrate the relevant transmission substations (GXPs) within the Auckland region, which include the following (linked here to the EDB they supply and the name of the EDB network area if applicable):

- Counties:
  - Bombay 110 kV GXP (Eastern network).
  - Glenbrook 33 kV GXP – clean bus (Western network).
- Vector:
  - Albany 33 kV GXP (Northern network)
  - Albany 110 kV and Wairau Rd 33 kV GXPs (Northern network).
  - Henderson 33 kV GXP (Northern network).
  - Hepburn 33 kV GXP (Northern network).
  - Hobson 110 kV and Penrose 110 kV GXP (Auckland CBD) (Central network).
  - Māngere 110 kV GXP (Southern network).
  - Māngere 33 kV GXP (Southern network).
  - Ōtāhuhu 22 kV GXP (Southern network).
  - Pakuranga 33 kV GXP (Southern network).
  - Penrose 22 kV GXP (Central network).
  - Penrose 33 kV GXP (Central network).
  - Mt Roskill 110 kV GXP (Central network).
  - Mt Roskill 22 kV GXP (Central network).
  - Silverdale 33 kV GXP (Northern network).
  - Takanini 33 kV GXP (Southern network)[9].
  - Wellsford 33 kV GXP (Northern network).
  - Wiri 33 kV GXP (Southern network).
- Glenbrook Steel Mill (direct connect customer):
  - Glenbrook 33 kV GXP – clean bus.
  - Glenbrook 33 kV GXP – dirty bus.
- Kiwirail (direct connect customer):
  - Penrose 25 kV GXP.
  - Southdown 25 kV GXP.

[9] Ergo wishes to acknowledge, and respects, the local Iwi's preference to use the spelling Takaanini in reference to the Auckland suburb, per a proposal put forward to LINZ in 2024. However, for the purposes of this report, the official names of the suburb and substations are used, in accordance with the eventual decision of LINZ.

The Auckland region includes a portion of the North Island generation capacity, with generators connected at dedicated GIPs (Grid Injection Points), or at the GXPs listed above. Generation in the region includes cogeneration and landfill generators. The generation plants in the region include:

- Hampton Downs Landfill (Landfill/Biogas generation) (7 MW) and Papakura (thermal generation) (5 MW) – connects at Bombay GXP.
- Glenbrook (cogeneration) (112 MW) – connects at Glenbrook GXP.
- Watercare Māngere (landfill/biogas generation) (7 MW) – connects at Māngere GXP.
- Greenmount (landfill/biogas generation) (1 MW) – connects at Ōtāhuhu GXP.
- Auckland Hospital (cogeneration) (4 MW) – connects at Penrose GXP.
- Redvale (landfill/biogas generation) (12 MW) – connects at Silverdale GXP.
- Whitford Landfill (landfill/biogas generation) (3 MW) – connects at Takanini GXP.

The transmission network in the Auckland region is also shown schematically in Figure 7. The Auckland region forms a crucial part of Transpower's grid backbone, and is well-interconnected with the neighbouring Waikato and Northland regions.
Generally, generation capacity in the Auckland region is lower than its maximum demand, with the deficit imported from the National Grid, mostly via the circuits which connect the region to the Waikato (two 220 kV circuits to Huntly, one 110 kV circuit to Arapuni, one 110 kV circuit to Hamilton, two 220 kV circuits to Ōhinewai, and four 220 kV circuits to Whakamaru). Historically, the circuits through the Auckland region also supplied most of Northland's load, however with increasing generation in Northland, the amount of load transferred north is expected to drop, with Northland potentially exporting power into the Auckland region at times in the future. Two 110 kV circuits connect Wellsford to Northland's Maungatūroto and Maungatapere Transpower substations, and a further two 220 kV circuits connect Auckland's Huapai to Northland's Marsden and Bream Bay Transpower substations.

Figure 5. Transpower Auckland Region Transmission/GXP substations[10]

[10] *Transmission Planning Report 2023*.

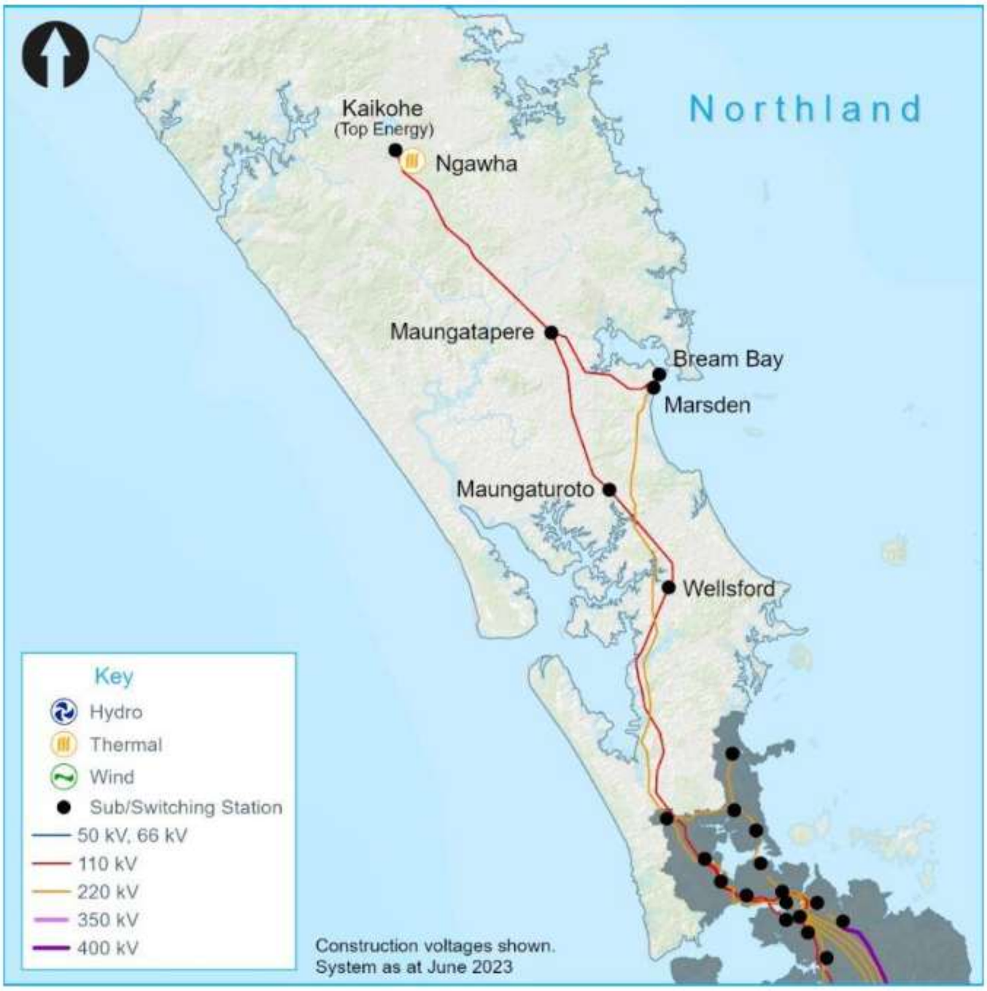


Figure 6. Transpower Northland Region Transmission/GXP substations[10] (note only Wellsford in this Transpower region is included in the EECA Auckland Region)[10]

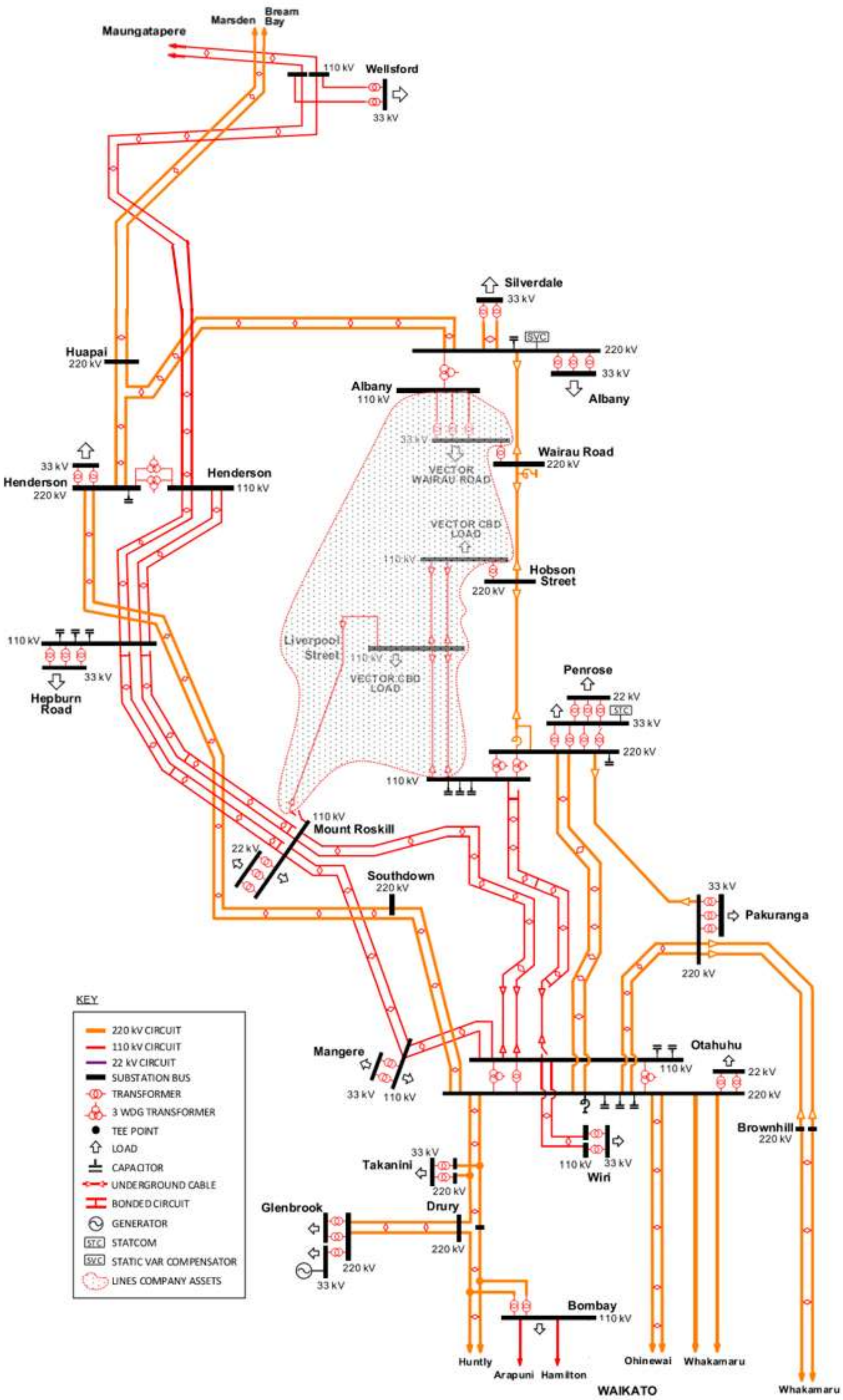


Figure 7. Existing transmission/GXP substations[10]

4.2 Zone Substations

Zone substations are categorised by the EDB that owns and operates the network. As mentioned earlier, in the Auckland area, there are two relevant EDBs – Counties and Vector. Table 2 below gives an overview of the number of zone substations managed by each EDB, and the number of Transpower GXPs they take power from.

Table 2 Overview of substation numbers for each EDB under review.

EDB Name	Number of zone substations	Number of GXPs
Counties Energy	8	2
Vector	115	17

4.2.1 Counties Energy

Figure 8 shows the subtransmission network, zone substations, and GXPs for Counties Energy's region. The substations include:

- Bombay GXP (Eastern region):
  - Ōpaheke 110/22 kV zone substation
  - Barber Road 110/22 kV zone substation[11]
  - Pukekohe 110/22 kV zone substation
  - Pōkeno 110/22 kV zone substation
  - Tuakau 110/22 kV zone substation
- Glenbrook GXP (Western region):
  - Karaka 33/11 kV zone substation
  - Waiuku 33/11 kV zone substation
  - Maioro 33/11 kV zone substation

[11] Ergo notes that Counties Energy previously owned/operated substations at Ramarama and Mangatāwhiri, which have now been decommissioned, replaced by the Barber Rd substation.

Figure 8. Counties Energy zone substations and interconnecting subtransmission circuits [12]

4.2.2 Vector

Figure 9 shows the Vector network split into the three regions and the areas supplied by each GXP. Readers are encouraged to consult Vector's AMP for maps of each individual GXP. Vector's substations include:

- Auckland Network:
    - CBD Network (Hobson 110 kV and Penrose 110 kV GXPs, can be fed by Mt Roskill 110 kV GXP):
        - Freeman's Bay 22/11 kV zone substation
        - Hobson 110/22/11 kV zone substation
        - Liverpool 110/22/11 kV zone substation
        - Newton 22/11 kV zone substation
        - Victoria 22/11 kV zone substation
        - Parnell 22/11 kV zone substation
        - Quay 110/22/11 kV zone substation
    - Penrose 22 kV and 33 kV GXPs:
        - Onehunga 22/11 kV zone substation
        - Westfield 22/11 kV zone substation
        - Carbine 33/11 kV zone substation
        - Drive 33/11 kV zone substation
        - Glen Innes 33/11 kV zone substation
        - McNab 33/11 kV zone substation

[12] Counties Energy's 2024 Asset Management Plan found here: https://countiesenergy.co.nz/about-us/regulatory-disclosures/

        - Mt Wellington 33/11 kV zone substation
        - Newmarket 33/11 kV zone substation
        - Ōrākei 33/11 kV zone substation
        - Remuera 33/11 kV zone substation
        - Rockfield 33/11 kV zone substation
        - St Heliers 33/11 kV zone substation
        - St Johns 33/11 kV zone substation
        - Sylvia Park 33/11 kV zone substation
        - Te Papapa 33/11 kV zone substation
    - Mt Roskill 110 kV and 22 kV GXPs:
        - Chevalier 22/11 kV zone substation
        - Kingsland 110/22/11 kV zone substation
        - Ponsonby 22/11 kV zone substation
        - Avondale 22/11 kV zone substation
        - Balmoral 22/11 kV zone substation
        - Hillsborough 22/11 kV zone substation
        - Mt Albert 22/11 kV zone substation
        - Sandringham 22/11 kV zone substation
        - White Swan 22/11 kV zone substation
- Northern network:
    - Albany 33 kV GXP:
        - Browns Bay 33/11 kV zone substation
        - Bush Rd 33/11 kV zone substation
        - Coatesville 33/11 kV zone substation
        - East Coast Rd 33/11 kV zone substation
        - Forrest Hill 33/11 kV zone substation
        - Greenhithe 33/11 kV zone substation
        - Horseshoe Bush 33/11 kV zone substation
        - James St T1 (11 kV feeders K01, K02, K04, K05) 33/11 kV zone substation
        - McKinnon 33/11 kV zone substation
        - Rosedale 33/11 kV zone substation
        - Sunset Rd 33/11 kV zone substation
        - Torbay 33/11 kV zone substation
        - Waiake 33/11 kV zone substation
        - Waimauku 33/11 kV zone substation
    - Henderson 33 kV GXP:
        - Hobsonville 33/11 kV zone substation
        - Hobsonville Point 33/11 kV zone substation
        - Rānui 33/11 kV zone substation
        - Riverhead 33/11 kV zone substation
        - Simpson Rd 33/11 kV zone substation
        - Swanson 33/11 kV zone substation
        - Te Atatū 33/11 kV zone substation
        - Triangle Rd 33/11 kV zone substation
        - Westgate 33/11 kV zone substation
        - Woodford Ave 33/11 kV zone substation

- Hepburn Road 33 kV GXP:
  - Atkinson Road 33/11 kV zone substation
  - Brickworks 33/11 kV zone substation
  - Henderson Valley 33/11 kV zone substation
  - Keeling Rd 33/11 kV zone substation
  - Laingholm 33/11 kV zone substation
  - McLeod Rd 33/11 kV zone substation
  - New Lynn 33/11 kV zone substation
  - Oratia 33/11 kV zone substation
  - Rosebank 33/11 kV zone substation
  - Sabulite Rd 33/11 kV zone substation
  - Waikaukau 33/11 kV zone substation
- Silverdale 33 kV GXP:
  - Gulf Harbour 33/11 kV zone substation
  - Helensville 33/11 kV zone substation
  - Kaukapakapa 33/11 kV zone substation
  - Manly 33/11 kV zone substation
  - Ōrewa 33/11 kV zone substation
  - Red Beach 33/11 kV zone substation
  - Spur Rd 33/11 kV zone substation
- Wellsford 33 kV GXP:
  - Big Ōmaha
  - Snells Beach
  - Warkworth
  - Wellsford
- Wairau-Albany area (Wairau Rd 33 kV and Albany 110 kV GXPs):
  - Balmain 33/11 kV zone substation
  - Belmont 33/11 kV zone substation
  - Birkdale 33/11 kV zone substation
  - Hauraki 33/11 kV zone substation
  - Highbury 33/11 kV zone substation
  - Hillcrest 33/11 kV zone substation
  - James St T2 (11 kV feeders K07, K08, K10, K11, K12) 33/11 kV zone substation
  - Milford 33/11 kV zone substation
  - Ngātaringa Bay 33/11 kV zone substation
  - Northcote 33/11 kV zone substation
  - Takapuna 33/11 kV zone substation
  - Wairau Road 33/11 kV zone substation

- Southern Network:
  - Māngere 110 kV GXP:
    - PAC Steel
  - Māngere 33 kV GXP:
    - Airport 33/11 kV zone substation
    - Hans 33/11 kV zone substation
    - Māngere Central 33/11 kV zone substation
    - Māngere East 33/11 kV zone substation

    - Māngere West 33/11 kV zone substation
  - Ōtāhuhu 22 kV GXP:
    - Bairds 22/11 kV zone substation
    - Highbrook 22 kV switching station (Ergo notes that this switching station does supply some 22 kV distribution feeders as well as providing subtransmission-type connections to Bairds and Ōtara substations at 22 kV).
    - Ōtara 22/11 kV zone substation
  - Pakuranga 33 kV GXP:
    - East Tāmaki 33/11 kV zone substation
    - Flat Bush 33/11 kV zone substation
    - Greenmount 33/11 kV zone substation
    - Howick 33/11 kV zone substation
    - Pakuranga 33/11 kV zone substation
    - South Howick 33/11 kV zone substation
  - Takanini 33 kV GXP:
    - Clevedon 33/11 kV zone substation
    - Manurewa 33/11 kV zone substation
    - Maraetai 33/11 kV zone substation
    - Papakura 33/11 kV zone substation
    - Takanini 33/11 kV zone substation
    - Waiheke 33/11 kV zone substation
  - Wiri 33 kV GXP:
    - Clendon 33/11 kV zone substation
    - Manukau 33/11 kV zone substation
    - Wiri 33/11 kV zone substation

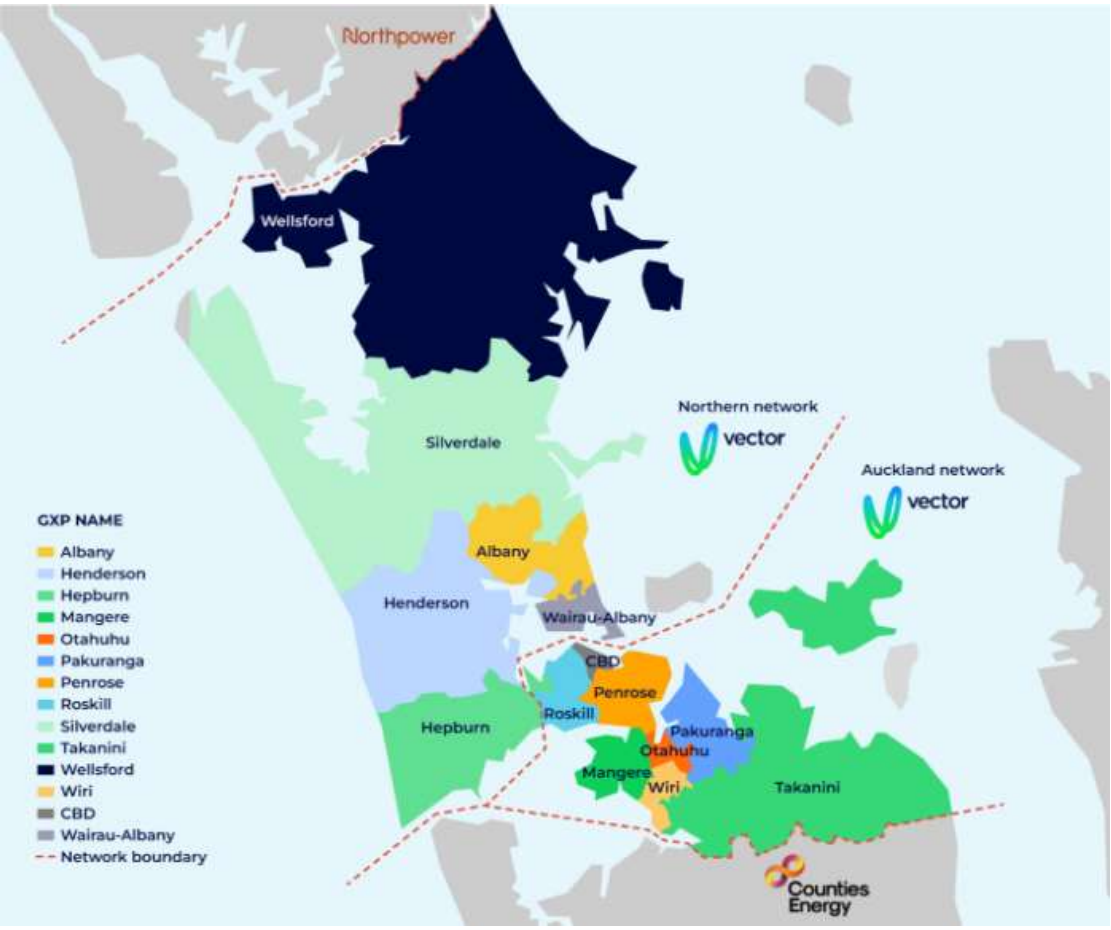


Figure 9. Vector network by GXP and region[13]

[13] Vector's 2024 Asset Management Plan found here: https://electra.co.nz/our-company/disclosures/

5. (N) and (N-1) Security Classifications

Both Transpower and the EDBs develop and operate their networks in accordance with a set of reliability standards. In the context of Transpower it is required to meet the grid reliability standards that are outlined in the *Electricity Industry Participation Code* (EIPC)[14]. In contrast, EDBs are required to publish an annual AMP which often details a network specific security standard, which is used to plan/develop its network.

In both cases, these standards are usually quantified in terms of the following terminology:

- **(N) security:** The network is designed and operates such that it will be unable to supply load in the event of a single asset failure (i.e., a line, transformer or other primary asset). This is equivalent to a single-engine airplane, which in the event of engine failure will result in the aircraft crashing.
- **(N-1) security:** The network is designed and operates such that it can continue to supply load uninterrupted in the event of a single asset failure. This scenario can be compared with to an aircraft, but in this case with two engines, which in the event of single engine failure will not crash.

The decision around whether to develop/operate a network supply with (N) or (N-1) security is typically driven by the size and criticality of the load versus the investment costs.

Typically, in New Zealand, this results in the following:

- Transmission GXP substations and lines being designed and operated with (N-1) security of supply.
- Distribution zone substations are designed and operated as follows:
- Loads ≥ 12 MW designed and operated with (N-1) security of supply.
- Loads < 12 MW designed and operate with (N) security of supply.

Transpower is required to provide (N-1) for "core grid" (typically, 220 kV and >150 MVA loads) interconnected assets (i.e. transmission lines that supply multiple GXP substations). For "non-core grid" assets (typically, <220 kV and <150 MVA loads), the decision to supply (N-1) is still made by Transpower but must be economically justified.

For connection assets that are dedicated to a single consumer the decision regarding security is made by the consumer/customer. The customer can be an industrial consumer, but in most cases is an EDB and usually (N-1) security of supply is specified. However, for GXPs that supply small consumer load or where a large industrial customer does not want to pay for (N-1) security, an (N) security connection is not uncommon.

The Transpower GXPs discussed in this report are considered connection assets and therefore decisions around their security classifications lie with their end customers (i.e., Counties or Vector). For those substations that are supplied via dedicated incoming lines, the lines are also considered to be connection assets. The remaining lines that are not dedicated to a single substation are interconnection assets.

[14] https://www.ea.govt.nz/code-and-compliance/the-code/

The distribution networks owned/operated by EDBs generally supply multiple consumers and thus, in most cases, EDBs have to make security of supply decisions on behalf of their consumers. These decisions are based on the EDB's disclosed network security criteria, that have been ratified by their respective boards of directors.

Both Transpower and EDBs have taken advantage of technology to make the above-mentioned standards more flexible, by managing consumer demand where possible. Initially this involved the use of mains borne ripple injection equipment to manage the load drawn by consumer's hot water cylinders. But more recently this has involved, for example, special protection systems (SPS) that, in the event of the loss of specific network equipment will shed specific consumer loads. More recently, the development of a market for interruptible load[15] has been initiated. There are examples of this at both transmission and distribution levels. This has allowed Transpower and EDB's to operate some sections of their networks well beyond their (N-1) limits, whilst still maintaining sufficient security of supply to the majority of their consumers.

There is potential to significantly reduce the costs associated with electrical network upgrades if load sites can be designed to:

- Operate during times of minimum network loading (typically late in the evening and early in the morning) such that they do not significantly increase existing peak network loading.
- Swiftly and safely disconnect from the relevant electrical network during periods of peak loading.

Vector has introduced an option for flexible connections, which builds upon the learnings from electrifying bus depots for Auckland Transport and enables savings for customers that are able to connect to Vector's DERMS. Flexible electricity connections save customers money and speed up connections, especially when upgrades to the network are needed. They also let customers start electrification projects without knowing their exact future energy needs. Since network constraints are often short-term, Vector's DERMS provides near real-time data, helping customers manage their usage and enabling a more adaptable approach to electrification efforts in Auckland.

From 1 April 2025, approved commercial DER ICPs can benefit from a reduced capacity charge by effectively deferring load when required by Vector. Customers will need to apply for and enter into a DER connection agreement with Vector for each site. The ICP needs to be connected to or respond to Vector's DERMS (distributed energy resource management system). Please refer to Vector's pricing schedule effective from 1 April 2025 for further explanation on the initial application process.

[15] Demand side participation | Transpower

6. Spare Capacity – Transmission Substations (GXPs)

The following sections document the spare capacity that is available at the GXPs that supply the Auckland region.

Transpower has identified "*grid issues*" that result from increasing electrical demand and generation in the Auckland region, including:

- Decommissioning of thermal generation in the Auckland and Waikato regions has created a need to invest in voltage support.
- An outage of the 220 kV Pakuranga-Penrose cable circuit during peak load periods is forecast to overload the Ōtāhuhu-Penrose circuits from the winter of 2025. Options to mitigate this include:
    - Switching in the presently bypassed series reactor at Penrose (on the Penrose-Hobson St circuit). This solution results in a drop of the Auckland CBD (N-1) capacity, due to impedance and the resulting share of the load at Auckland CBD between Penrose and Hobson St 110 kV GXPs.
    - Splitting the Penrose 110 kV bus.
    - Installing a second 220/110 kV interconnecting transformer at Hobson St and splitting Vector's 110 kV network at Liverpool St.
    - Installing series reactors on the Liverpool-Penrose circuits (indicative cost $16M).
    - Ergo notes that load shifts planned by Vector may delay this issue.
- An outage of the Henderson T5 220/110 kV interconnecting transformer may cause the remaining Henderson T1 220/110 kV interconnecting transformer to overload from 2030. Other projects which are in planning would mitigate this issue for the planning period, i.e.:
    - The Penrose series reactor being put into service.
    - Installation of a 220/110 kV interconnecting transformer at Huapai to supply the 110 kV circuits to Wellsford. This would mean that the Henderson interconnecting transformers no longer need to supply the load to the north of Henderson.
- The Hobson St-Wairau Rd circuit (part of the Pakuranga-Penrose-Hobson St-Wairau Rd-Albany NAaN[16] cable circuits) is expected to overload for an outage of one of the 220 kV circuits between Ōtāhuhu, Southdown, and Henderson during peak load periods towards the end of the planning period. Putting the Penrose series reactor into service is also expected to mitigate this issue.

Figure 10 below illustrates Transpower's view of a possible 2038 configuration for the Auckland region's transmission network. It includes:

- Scheduled replacement of:
    - One Hepburn Rd 110/33 kV transformer.
    - The Static VAr Compensator (SVC) at Albany.
    - The Henderson 220/110 kV interconnecting transformers.

[16] "NAaN" refers to the North Auckland and Northland grid upgrade project, which installed the 220 kV cable circuits between the Pakuranga, Penrose, Hobson St, Wairau Rd, and Albany GXPs.

  - One of the Henderson-Hepburn Rd 110 kV double circuits.
  - The capacitor bank at Henderson 220 kV bus.
  - The SVC on the Penrose 33 kV bus and capacitor bank on the Penrose 220 kV bus.
  - Two capacitor banks on the Ōtāhuhu 110 kV bus.
  - One of the 110/33 kV transformers at Wiri.
  - The two Ōtāhuhu-Whakamaru 220 kV circuits.
  - The Ōtāhuhu-Bombay 220 kV double circuit.
  - A portion of the 22 kV bus at Mt Roskill.
- Installation of:
  - A new 33 kV GXP (including 220/33 kV transformers) at Huapai.
  - A third 220/33 kV transformer at Henderson.
  - A second 220/33 kV transformer at Wairau Rd.
  - Series reactors on the Penrose-Liverpool 110 kV circuits.
  - A new 33 kV GXP (including 220/33 kV transformers) at Southdown.
  - Reactors on the Pakuranga 220 kV bus.
  - A 110 kV bus and third 110/33 kV transformer at Wiri.
  - An STC (at 220 kV) and third capacitor bank (at 110 kV) at Ōtāhuhu.
  - A third Point of Supply at the Glenbrook GXP (including a new 220/33 kV transformer and 33 kV bus).
  - A third 110/33 kV transformer at Māngere.
  - Series capacitors on the Brownhill-Whakamaru 220 kV circuits.
  - A 220 kV circuit between Ōtāhuhu and Brownhill and a new 220 kV bus at Brownhill.
- Additional to the above, minor upgrades to two of the 110/22 kV transformers at Mt Roskill, and of the two 220/33 kV transformers at Takanini.

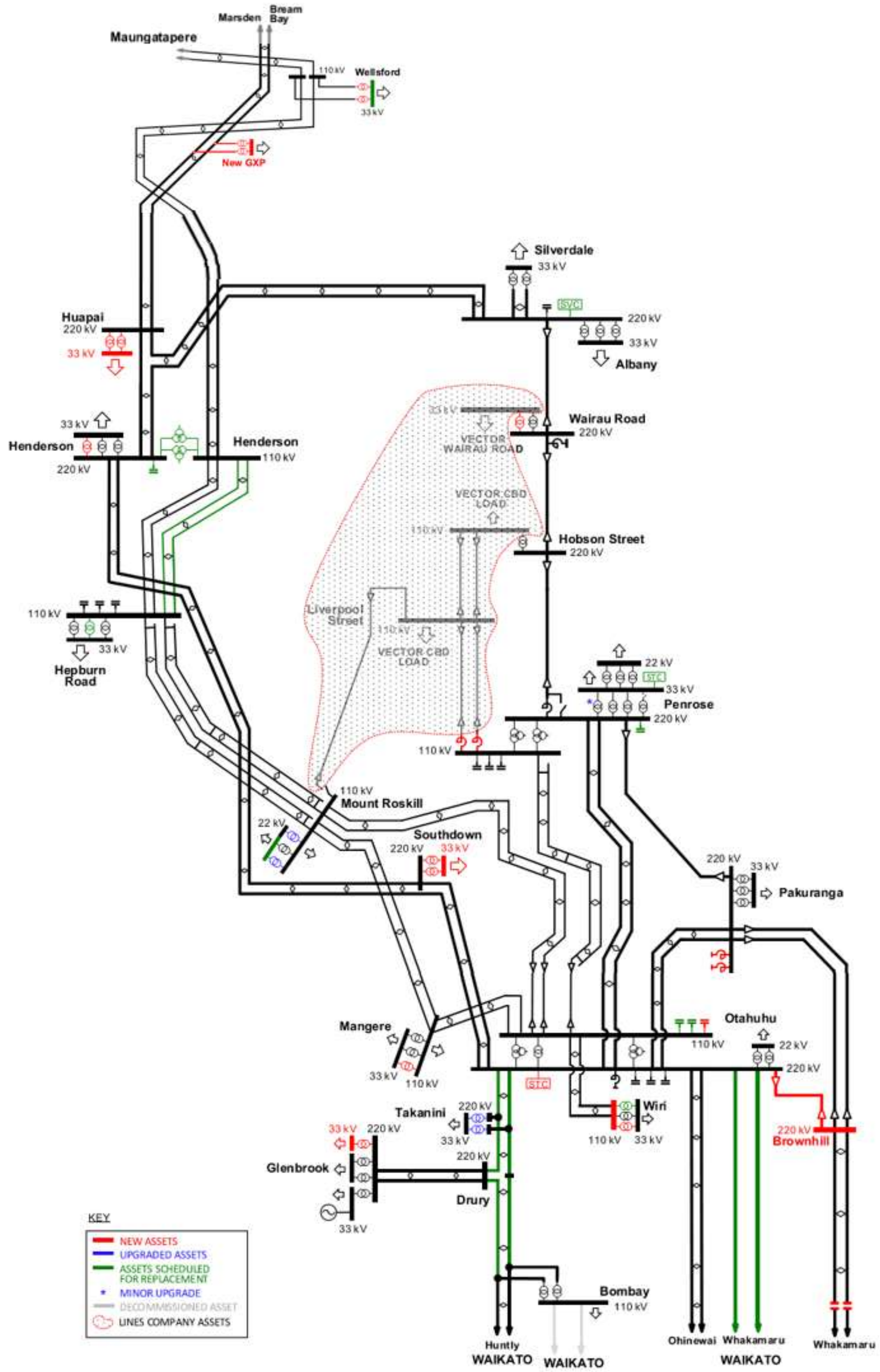


Figure 10. Existing transmission/GXP substations together with future possible upgraded/new assets[17]

[17] Transmission Planning Report 2023

6.1 Demand Forecast

Table 3 illustrates Transpower's forecast demand at the transmission substations in the Auckland region from its annual *Transmission Planning Report 2023*[18]. The forecast predicts the demand growing at an average of 2.6% per annum over the ten forecasted years (to 2033), which is higher than the national average of 2.0%.

Table 3 Forecast prudent annual peak demand (MW) at Auckland grid exit points to 2038.

GXP	Power factor	Peak demand (MW)											
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2038
Albany 33 kV	1.00	186	205	218	227	241	248	255	262	268	275	280	292
Bombay 110 kV[1]	1.00	106	116	122	128	132	136	140	143	146	149	151	156
Glenbrook - 33 kV (clean bus)[2]	0.96	80	82	83	85	86	87	88	88	89	90	90	90
Glenbrook - 33 kV (dirty bus)	0.96	112	112	112	112	112	112	112	112	112	112	112	112
Henderson 33 kV[3]	1.00	136	157	171	194	207	216	225	232	241	251	258	277
Hepburn Road 33 kV	1.00	141	146	169	172	175	179	185	188	191	194	195	195
Hobson St 110 kV[3, 4, 5]	-0.98	110	130	137	143	154	164	169	176	179	183	185	193
Māngere 110 kV	1.00	19	19	19	19	19	19	19	19	19	19	19	19
Māngere 33 kV	0.99	117	120	127	130	136	140	144	147	150	153	155	155
Ōtāhuhu 22 kV	0.99	64	65	66	67	70	72	73	75	76	77	78	80
Pakuranga 33 kV	1.00	163	176	179	181	183	195	199	202	204	206	207	203
Penrose 110 kV[3, 4, 5]	-0.96	110	130	137	143	154	164	169	176	179	183	185	193
Penrose 33 kV	0.99	292	310	318	324	333	344	354	362	371	377	381	385
Penrose 25 kV	0.98	15	15	15	15	15	15	15	15	15	16	18	27
Penrose 22 kV	0.98	47	50	51	52	53	54	55	59	60	60	61	61
Mt Roskill 110 kV[4, 6]	-0.98	78	80	82	84	87	91	94	97	101	104	105	107
Mt Roskill 22 kV	1.00	125	130	129	140	144	147	153	162	167	172	174	177
Silverdale 33 kV[3]	1.00	99	102	107	112	117	123	128	131	135	137	140	143
Southdown 25 kV	0.98	15	15	15	15	15	15	15	15	15	16	18	27
Takanini 33 kV	1.00	150	165	174	177	123	128	131	135	137	140	143	207
Wairau Road 33 kV - Albany 110 kV	1.00	176	180	188	192	196	203	210	215	219	223	224	225
Wellsford 33 kV	1.00	43	46	47	48	50	51	53	55	57	58	59	62
Wiri 33 kV	0.98	114	123	126	129	133	137	138	139	141	141	142	142

Notes:

1. The majority of the Bombay 33 kV load was shifted to the Bombay 110 kV bus in late 2022. At the time of writing the transfer of the remaining load is delayed awaiting completion of Counties Energy's Barber Road zone substation..
2. This is the Glenbrook 33 kV load on the clean bus with no contribution from the generation connected directly onto the 33 kV bus at Glenbrook.
3. There are significant new load increases forecast across the Auckland grid exit points of Henderson and Silverdale and the Auckland CBD grid exit points of Hobson St and Penrose 110 kV (to Liverpool St).
4. Leading power factor.
5. The load split between Hobson St and Liverpool St-Penrose is an estimate only. The Vector and Transpower networks between these grid exit points are operated in parallel.
6. This includes the Kingsland feeders only.

[18] Transmission Planning Report 2023

6.1.1 Auckland CBD GXPs (Penrose and Hobson 110 kV)

Vector takes supply from Transpower at 110 kV at both the Penrose GXP and the Hobson St GXP. The two GXPs are interconnected within Vector's network, via a set of 110 kV lines, to Vector's 110/22 kV substations Hobson, Quay, and Liverpool. These operate like a single GXP, referred to as the Auckland CBD network.

While, generally, Transpower reports on the Auckland CBD rather than Hobson St or Penrose 110 kV individually, the demand forecast separates these two GXPs:

- Transpower's demand forecast indicates that the Hobson St 110 kV GXP was expected to have a 2023 peak demand of 110 MW at 0.98 leading power factor (~112 MVA). This contrasts with the historical SCADA data that indicates that, during 2023, the Hobson St 110 kV GXP experienced a peak load of 65.9 MVA (41% lower than forecasted).
- Transpower's demand forecast indicates that the Penrose 110 kV GXP was expected to have a 2023 peak demand of 110 MW at 0.96 leading power factor (~115 MVA). This contrasts with the historical SCADA data that indicates that, during 2023, the Penrose 110 kV GXP experienced a peak load of 161 MVA (40% higher lower than forecasted).
- It seems to Ergo that the Transpower forecast assumed a different load share of the Auckland CBD load through each of the two GXPs than actually occurred.

The Auckland CBD is supplied by the following transformers:

- 2x 220/110 kV transformers at Penrose each rated to 250 MVA (the capacity of these transformers is limited by the Vector-owned 110 kV cables which connect to them).
- 1x 220/110 kV transformer at Hobson St rated to 250 MVA.

The result are the following capacities:

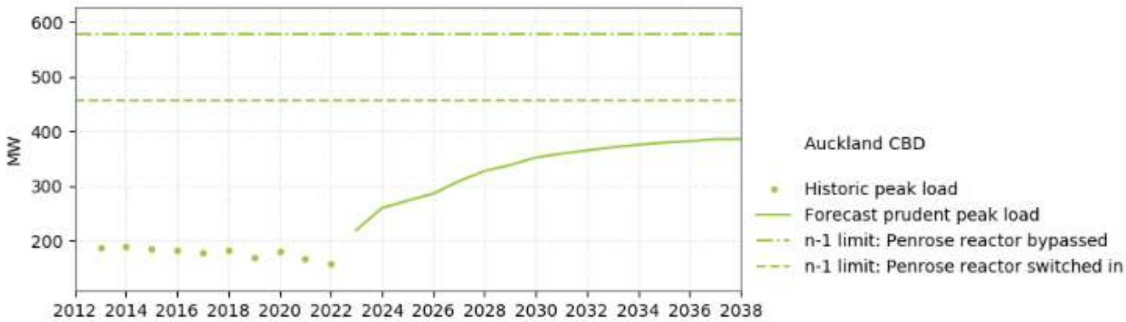
- (N) capacity of 750 MVA and
- (N-1) capacity of 500 MVA.

The combined GXP is supplied by:

- 1x 220 kV circuit between Penrose and Hobson St, rated to 899/914 MVA (summer/winter).
- 1x 220 kV circuit between Wairau Rd and Hobson St, rated to 735/788 MVA (summer/winter).
- 2x 220 kV circuits between Penrose and Ōtāhuhu, each rated to 469/492 MVA (summer/winter).
- 1x 110 kV circuit between Penrose and Ōtāhuhu, rated to 149/158 MVA (summer/winter). **Note this circuit is normally open.**
- 1x 220 kV circuit between Penrose and Pakuranga, rated to 874/933 MVA (summer/winter).

Ergo notes that there is an existing 220 kV Ōtāhuhu-Penrose issue, which may be resolved by inserting the currently bypassed 220 kV Penrose series reactor. This fix would lower the Auckland CBD (N-1) capacity, as the impedance of the reactor means that Penrose would supply a larger portion of the CBD load than it currently supplies.

The following graph[19] compares Auckland CBD's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 11 illustrates Auckland CBD's 2023 loading in comparison to its substation capacity.

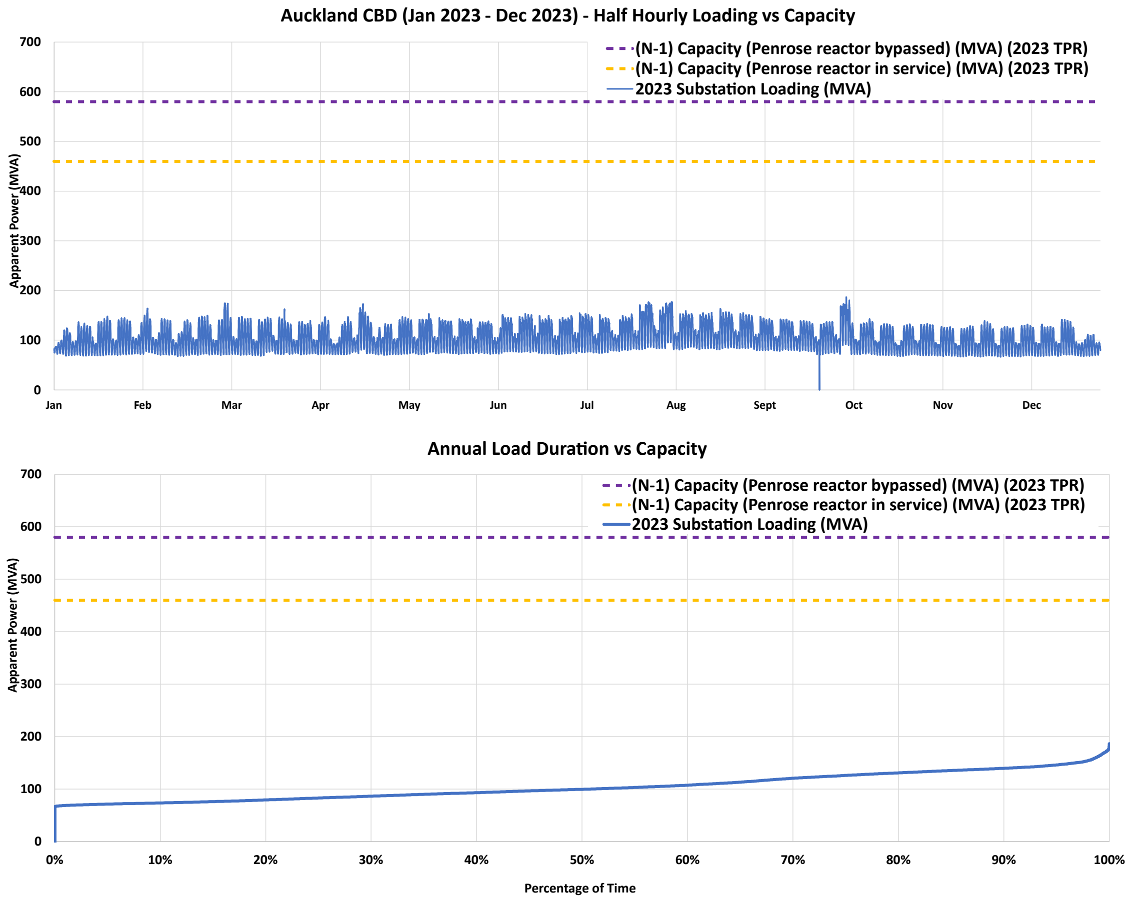


Figure 11. Auckland CBD: 2023 Loading: Substation capacity

[19] Sourced from Transpower's *Transmission Planning Report 2023*.

6.1.2 Albany 33 kV GXP

Transpower's demand forecast indicates that the Albany 33 kV GXP was expected to have a 2023 peak demand of 186 MW at 1.00 power factor (186 MVA). This contrasts with the historical SCADA data that indicates that during 2023 the Albany 33 kV GXP experienced a peak load of 129 MVA (~30% difference to forecast). Ergo understands that there are numerous projects listed in the Vector AMP which would increase load at Albany 33 kV GXP, such as load shifts from Henderson GXP, and installation of some large commercial facilities – it is possible that these were initially planned for 2023 (therefore were included in Transpower's demand forecast), and did not happen, resulting in the large difference between forecast and actual load.

The Albany 33 kV GXP is equipped with three 220/33 kV transformers providing:

- (N) capacity of 260 MVA (estimated from the graph below) and
- (N-1) capacity of 200 MVA.

Ergo notes that the ratings above consider the summer ratings of the transformers. Additionally, the T8 transformer at Albany 33 kV GXP has a lower impedance and higher capacity than the other two, which means that the (N) capacity of the three transformers together is lower than the sum of the capacity of each transformer.

Albany GXP is supplied by:

- 2x 220 kV circuits to Henderson (one of these tees to Huapai), rated to 561/617 MVA (summer/winter).
- 1x 220 kV circuit to Wairau Rd, rated to 733/788 MVA (summer/winter).

Albany also directly supplies Silverdale GXP via 2x 220 kV circuits, each rated at 304 MVA.

Peak load at Albany 33 kV GXP is forecast to exceed the (N-1) capacity of the transformers from winter of 2026. Ergo understands that Transpower is discussing options with Vector to improve the security of supply, including load transfers to neighbouring GXPs, transformer replacements at Albany 33 kV GXP, or building a new GXP between Albany and Wairau Rd.

The following graph[20] compares Albany 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.

[20] Sourced from Transpower's *Transmission Planning Report 2023*.

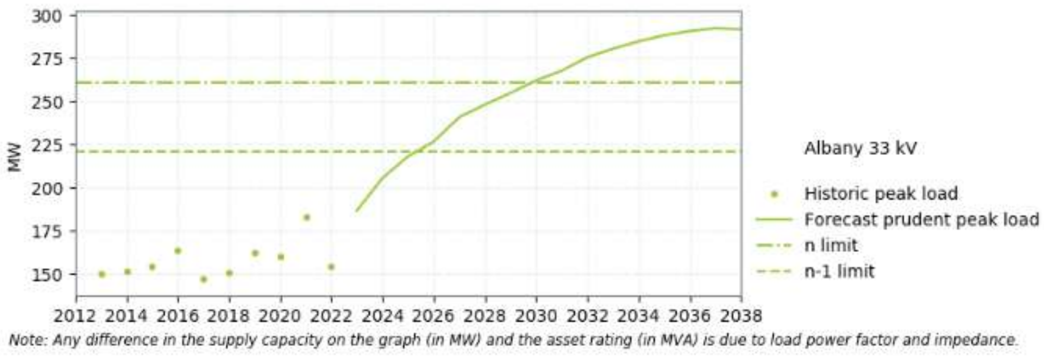


Figure 12 illustrates Albany 33 kV GXP's 2023 loading in comparison to its substation capacity.

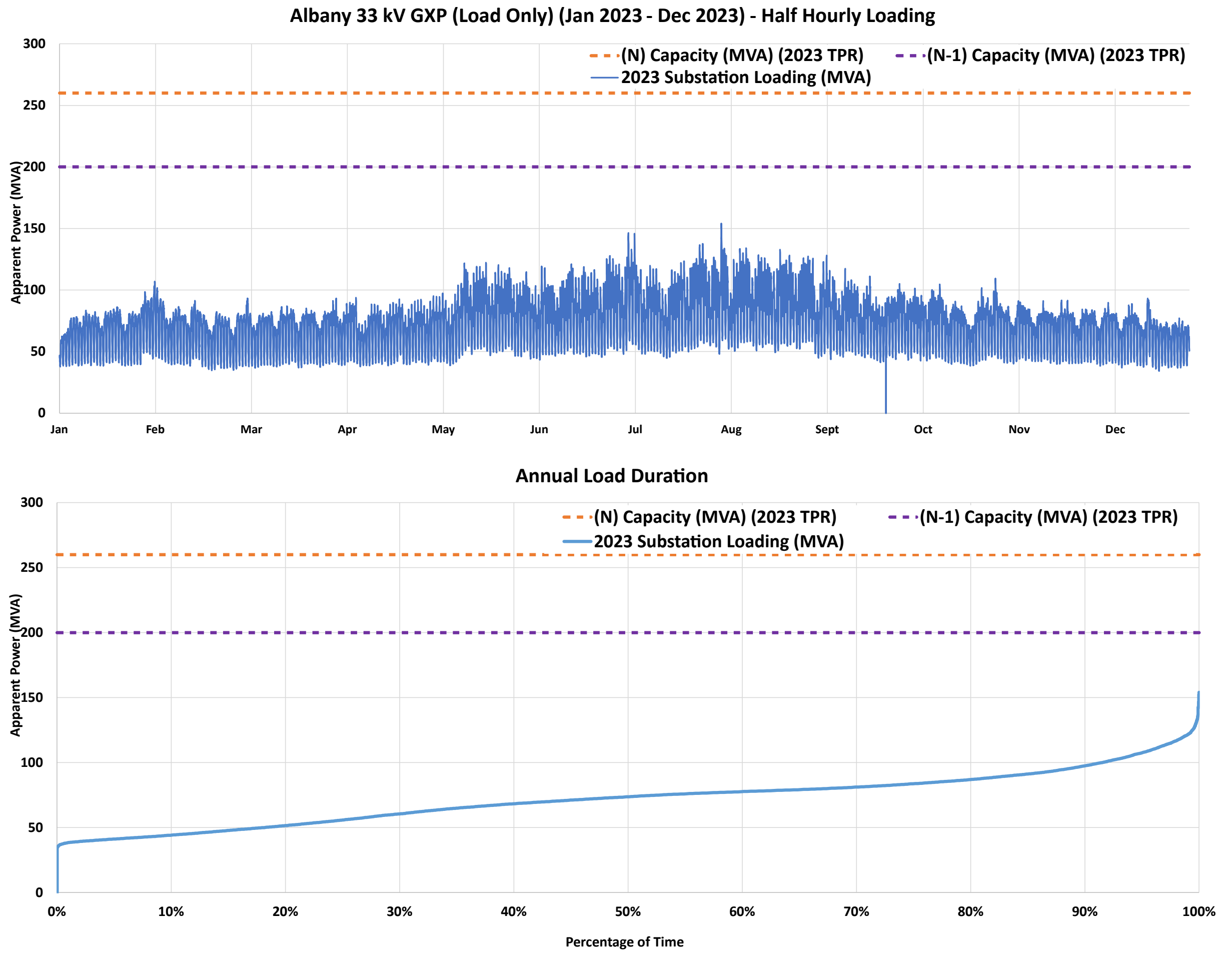


Figure 12. Albany 33 kV GXP: 2023 Loading: Substation capacity

6.1.3 Bombay 110 kV GXP

Previously, Bombay GXP supplied Counties Energy's load at both 33 kV and 110 kV. However, following the installation of Counties' Barber Road substation adjacent to the GXP, Counties Energy now takes supply at 110 kV only.

Transpower's demand forecast indicates that the Bombay 110 kV GXP was expected to have a 2023 peak demand of 106 MW at 1.00 power factor (106 MVA). This value compares to the historical SCADA data that indicates the Bombay GXP recorded a peak load of 97 MVA during the 2023 year. The difference between forecast and actual load may be because Transpower's forecast is prudent.

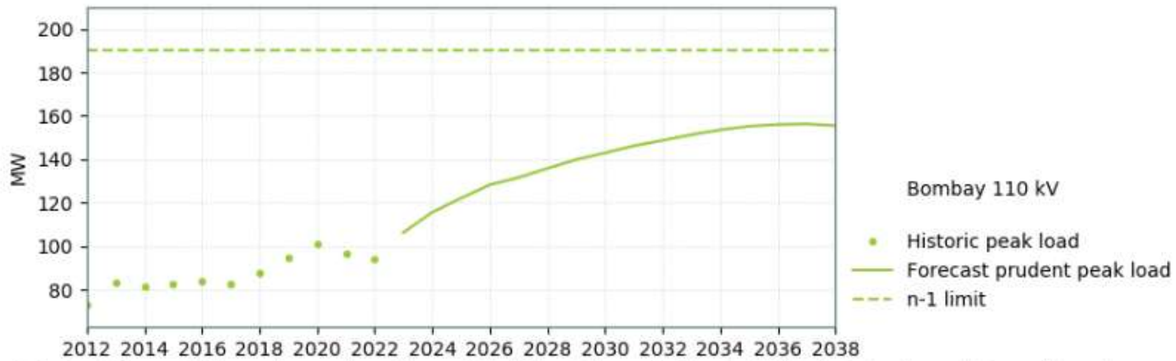
The Bombay GXP is equipped with two 220/110 kV interconnecting transformers providing:

- (N) capacity of 300 MVA and
- (N-1) capacity of 190 MVA (196 MVA 24-hour rating).

Ergo notes that the (N-1) capacity at the GXP may be limited by the ICTs, which are rated to only 150 MVA continuously, and so may require upgrades if the full transformer (N-1) capacity of 190 MVA was to be utilised.

At present, two 110 kV circuits connect Bombay to Hamilton and Arapuni GXPs respectively, however Transpower is planning to disconnect these, resulting in the sole supply to Bombay being via the two 220/110 kV transformers.

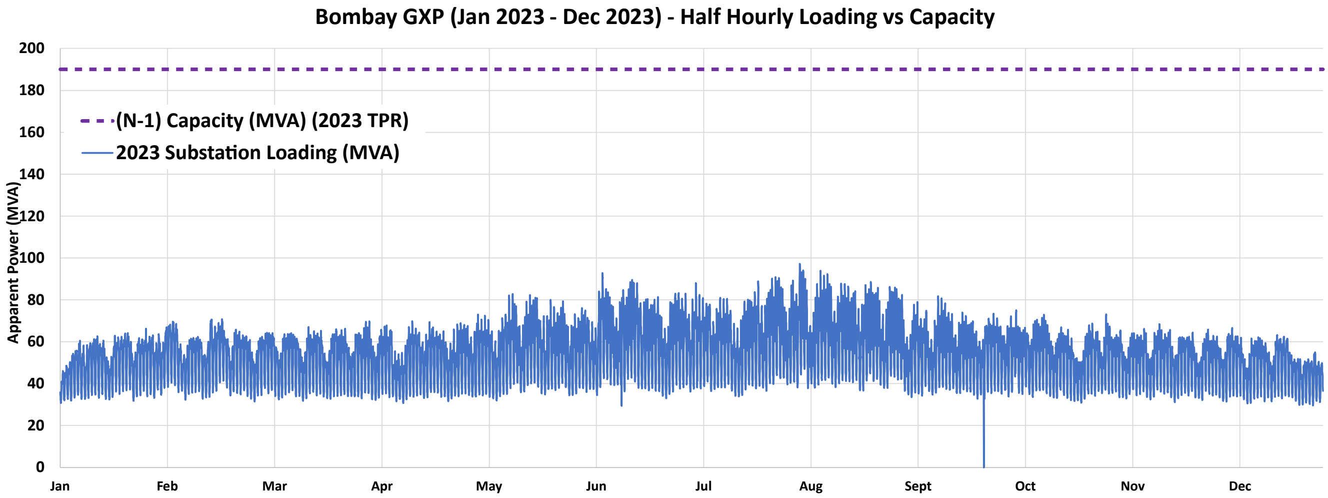
The peak load is not forecast to exceed the (N-1) capacity of the transformers within the planning period. The following graph[21] compares Bombay GXP's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 13 illustrates Bombay's 2023 loading in comparison to its substation capacity. Ergo notes that the substation capacity shown below assumes the disconnection of the two 110 kV Arapuni-Bombay and Bombay-Hamilton circuits.

[21] Sourced from Transpower's *Transmission Planning Report 2023*.



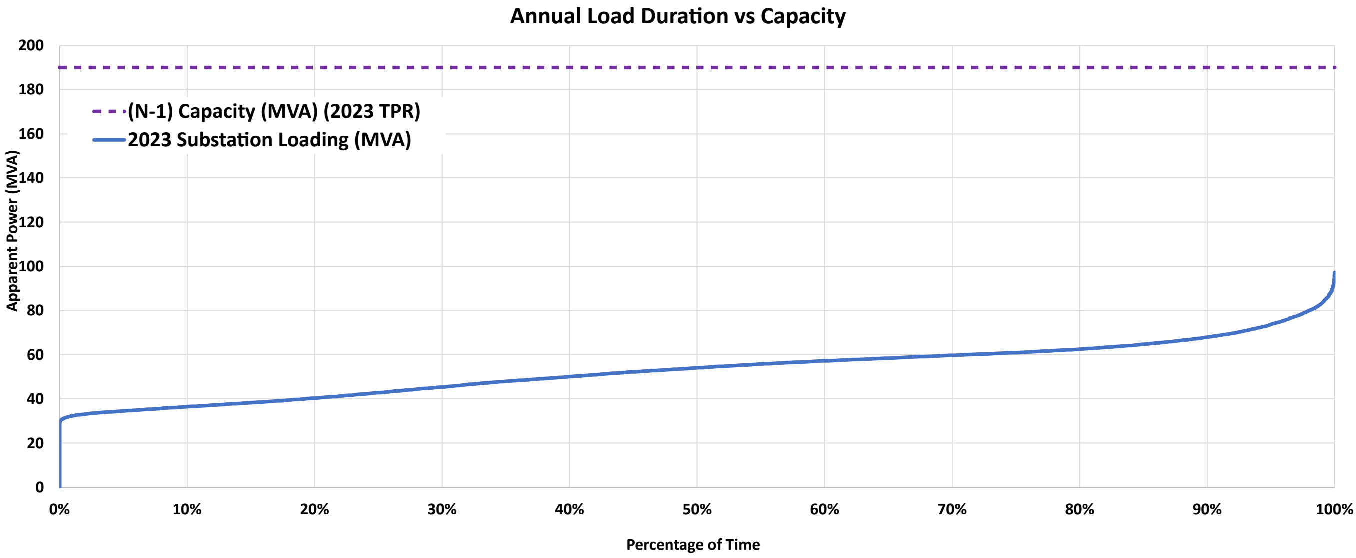


Figure 13. Bombay GXP: 2023 Loading: Substation capacity.

6.1.4 Glenbrook 33 kV GXP (clean and dirty buses)

Glenbrook GXP has two 33 kV buses, one "dirty bus" (which supplies the portion of the Glenbrook Steel Mill's load which creates significant and regular voltage disturbances) and one "clean bus" (which connects the remaining Steel Mill load and cogeneration and supplies the Counties Energy network).

Transpower's demand forecast predicts that the Glenbrook GXP dirty bus was expected to have a peak load of 112 MW at 0.96 power factor (~116.7 MVA) through to the end of the forecast period, which aligns with the historical SCADA data which indicates that, during 2023, the Glenbrook GXP dirty bus experienced a peak load of 112 MVA.

The dirty bus is supplied by two 220/33 kV transformers which provide the Steel Mill load with an (N) capacity of 280 MVA and (N-1) capacity of 140 MVA. The transformer capacity is limited by 33 kV switchgear and incomer cables.

Transpower's demand forecast indicates that the Glenbrook GXP clean bus was expected to have a 2023 peak demand of 80 MW at 0.96 power factor (~83.3 MVA). This differs from the historical SCADA data that indicates that, during 2023, the Glenbrook GXP clean bus experienced a peak load of 64.8 MVA (22% lower than forecast). The difference between forecast and actual load may be because Transpower's forecast is prudent.

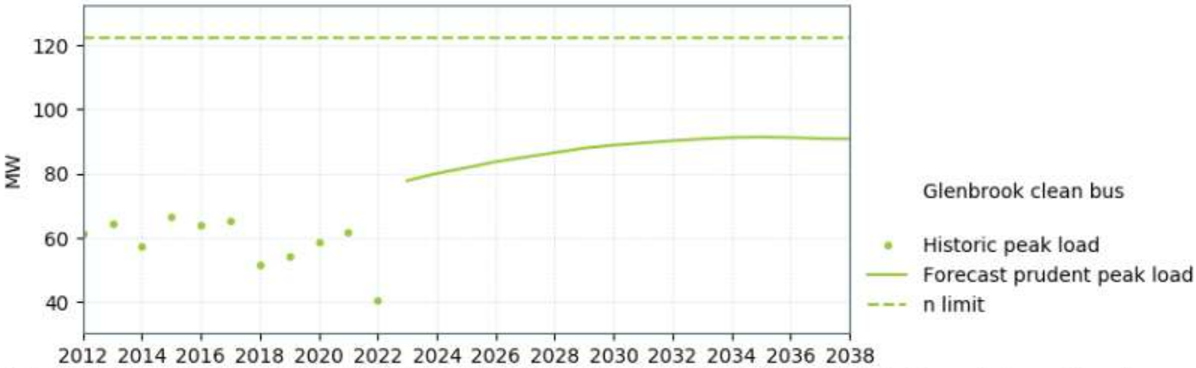
The Glenbrook GXP clean bus is equipped with one 220/33 kV transformer which is rated at 140 MVA. Additionally, one of the dirty bus transformers can be switched to supply the clean bus when required, resulting in:

- (N) capacity of 140 MVA and
- (N-1-switched) capacity of 140 MVA.

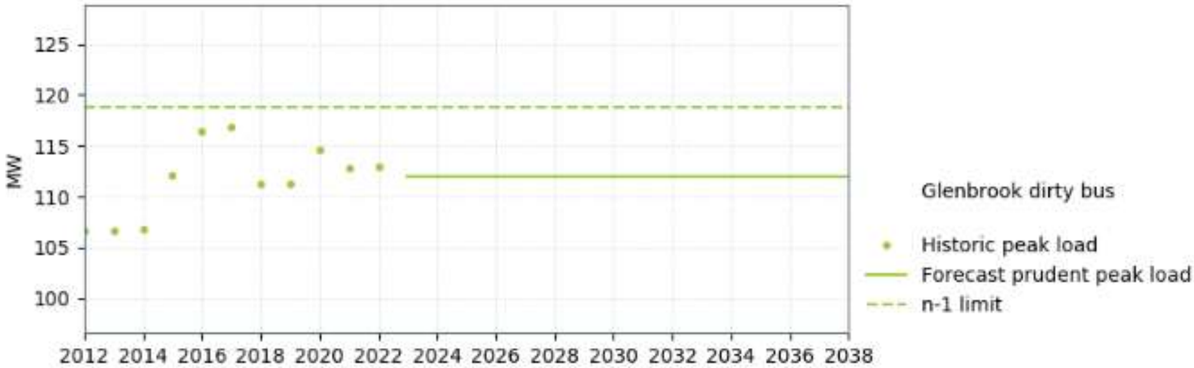
Glenbrook is supplied from Drury via a double circuit 220kV spur line. Each of the circuits are rated to approximately 694/762 MVA (summer/winter), which well exceeds the installed transformer capacity at the Glenbrook GXP.

Peak load at Glenbrook GXP is well within the continuous rating of the single supply transformer of the clean bus, and of the two transformers of the dirty bus, even without the generation contribution at the Steel Mill (on the clean bus). The following graphs[22] compare Glenbrook GXP's supply capacity with the historical loading and Transpower's demand forecast.

[22] Sourced from Transpower's *Transmission Planning Report 2023*.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 14 and Figure 15 illustrates Glenbrook GXP's 2023 loading in comparison to its substation capacity.

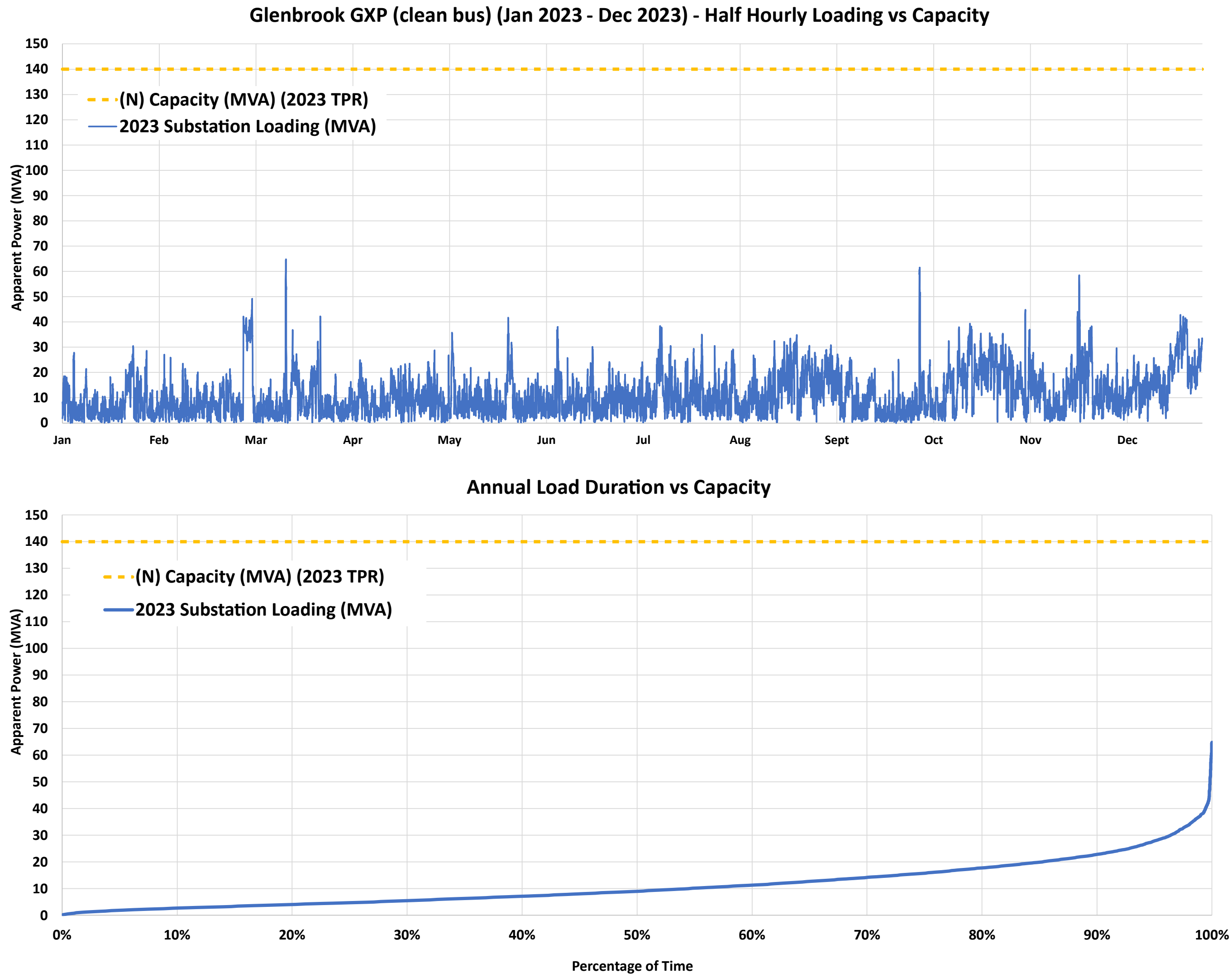
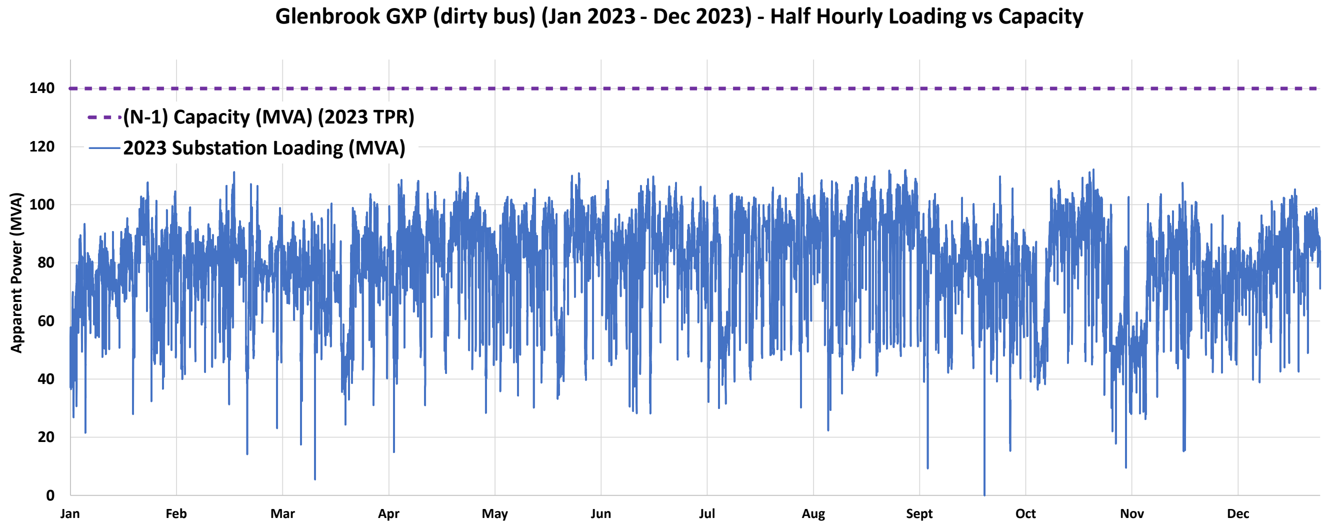


Figure 14. Glenbrook GXP clean bus: 2023 Loading: Substation capacity.



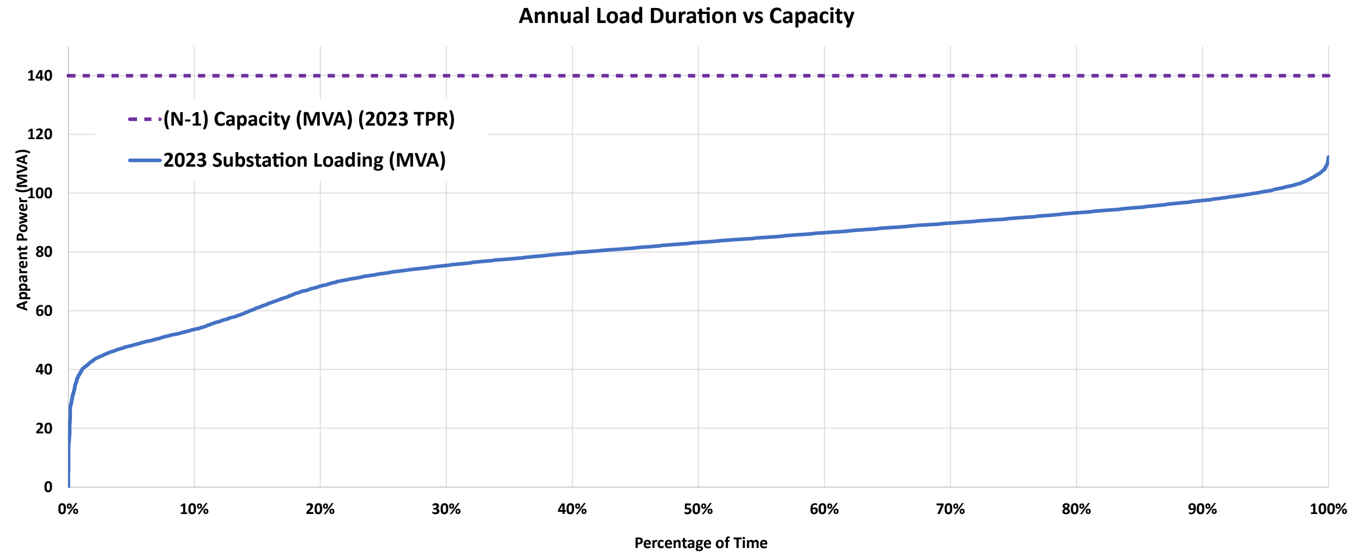


Figure 15. Glenbrook GXP dirty bus: 2023 Loading: Substation capacity.

6.1.5 Henderson 33 kV GXP

Transpower's demand forecast indicates that the Henderson 33 kV GXP was expected to have a 2023 peak demand of 136 MW at 1.00 power factor (136 MVA). This aligns with the historical SCADA data that indicates that during 2023 the Henderson 33 kV GXP experienced a peak load of 126 MVA (~7% difference to forecast).

The Henderson 33 kV GXP is equipped with two 220/33 kV transformers providing:

- (N) capacity of 240 MVA and
- (N-1) capacity of 138 MVA.

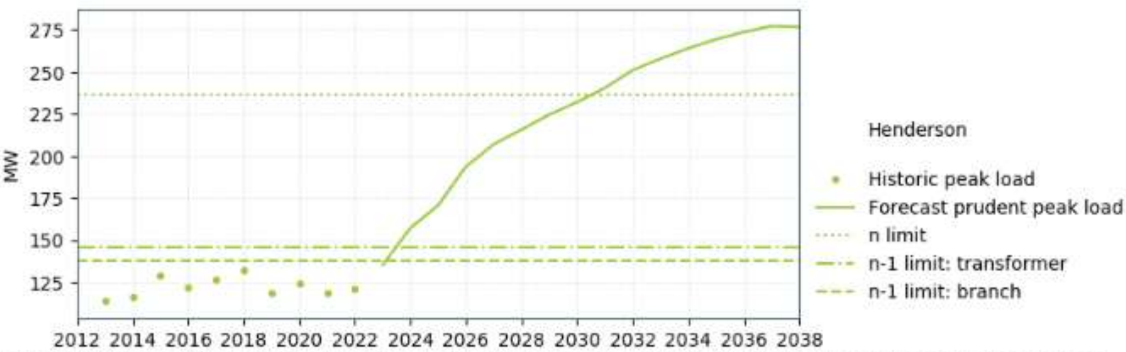
The transformers' capacity at Henderson is limited by the connected 33 kV cables and circuit breakers (branch).

Henderson 33 kV GXP is supplied by the GXP's 220 kV bus, which is supplied by:

- 2x 220 kV circuits which connect to Ōtāhuhu GXP, each rated at 914 MVA.
- 2x 220 kV circuits which connect to Albany (and tee to Huapai), each rated at 561/617 MVA (summer/winter).
- 2x 220/110 kV interconnecting transformers at Henderson GXP, rated at 200 MVA. The Henderson 110 kV bus is connected to:
    - 4x 110 kV circuits to Hepburn Road, each rated at 95/105 MVA (summer/winter).
    - 2x 110 kV circuits to Wellsford, each rated at 55/68 MVA (summer/winter).

Peak load at Henderson 33 kV GXP is forecast to exceed the (N-1) capacity of the transformers from winter of 2024. In the short-term, this will be managed by transferring load from Henderson 33 kV GXP to Albany 33 kV GXP. In the medium-term, Transpower is considering installation of a third transformer at Henderson or building a new GXP north of Henderson. Ergo understands that, long-term, Vector plans to establish a new GXP at Huapai, to manage loading at Henderson.

The following graph[23] compares Henderson 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[23] Sourced from Transpower's *Transmission Planning Report 2023*.

Figure 16 illustrates Henderson 33 kV GXP's 2023 loading in comparison to its substation capacity.

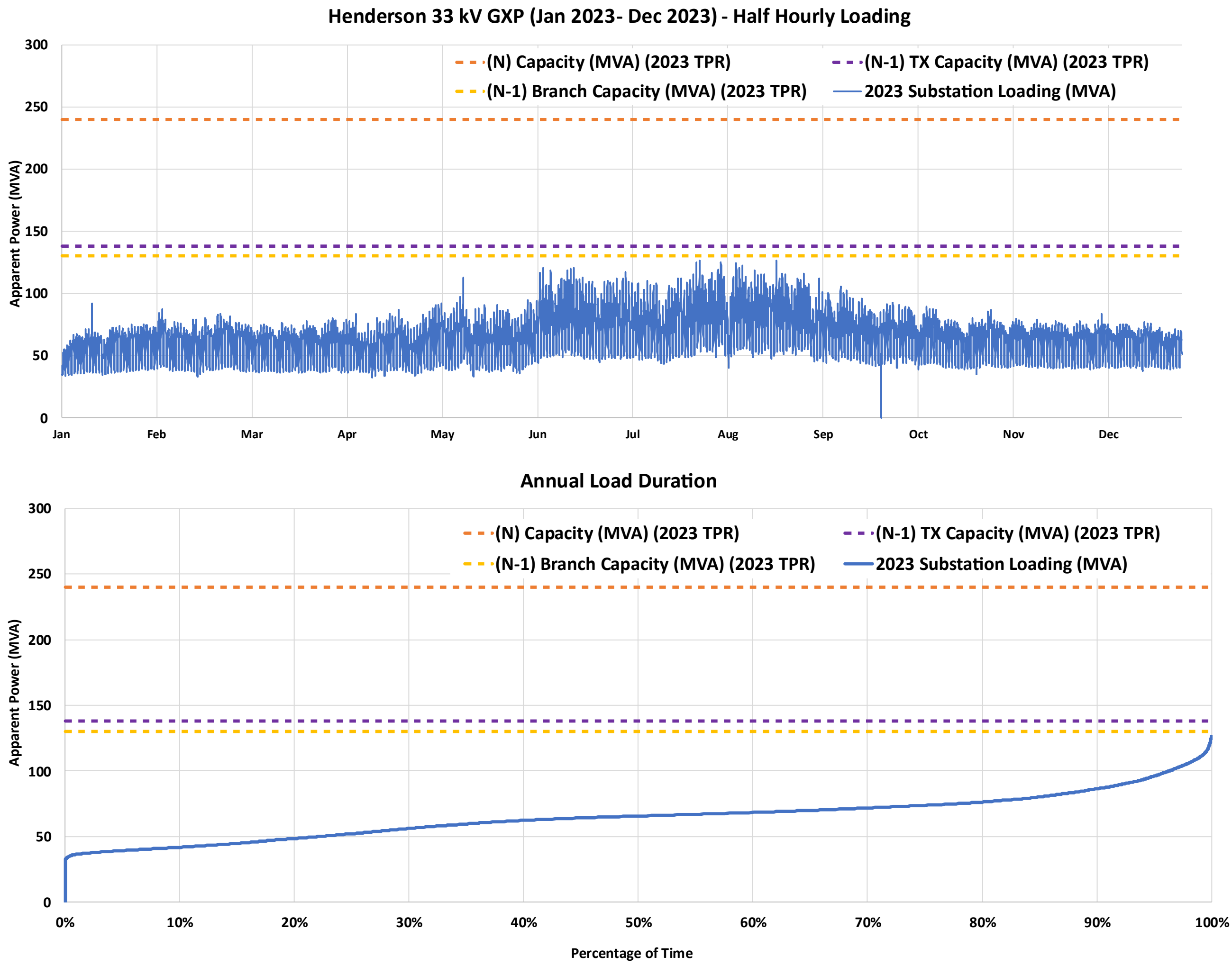


Figure 16. Henderson 33 kV GXP: 2023 Loading: Substation capacity.

6.1.6 Hepburn Road 33 kV GXP

Transpower's demand forecast indicates that the Hepburn Road 33 kV GXP was expected to have a 2023 peak demand of 141 MW at 1.00 power factor (141 MVA). This compares with the historical SCADA data that indicates that during 2023 the Hepburn Road 33 kV GXP experienced a peak load 145 MVA (~2% difference to forecast).

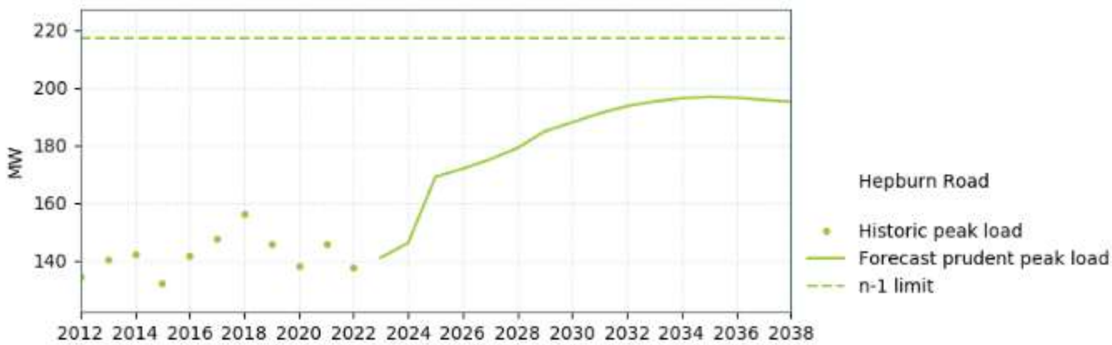
The Hepburn Road 33 kV GXP is equipped with three 110/33 kV transformers providing:

- (N) capacity of 325 MVA (Ergo estimate) and
- (N-1) capacity of 219 MVA.

Hepburn Road GXP is supplied by:

- 4x 110 kV circuits from Henderson GXP, each rated at 95/105 MVA (summer/winter).
- 2x double 110 kV circuits from Mt Roskill GXP, each rated at 152 MVA.

The following graph[24] compares Hepburn Road 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 17 illustrates Hepburn Road 33 kV's 2023 loading in comparison to its substation capacity.

[24] Sourced from Transpower's *Transmission Planning Report 2023*.

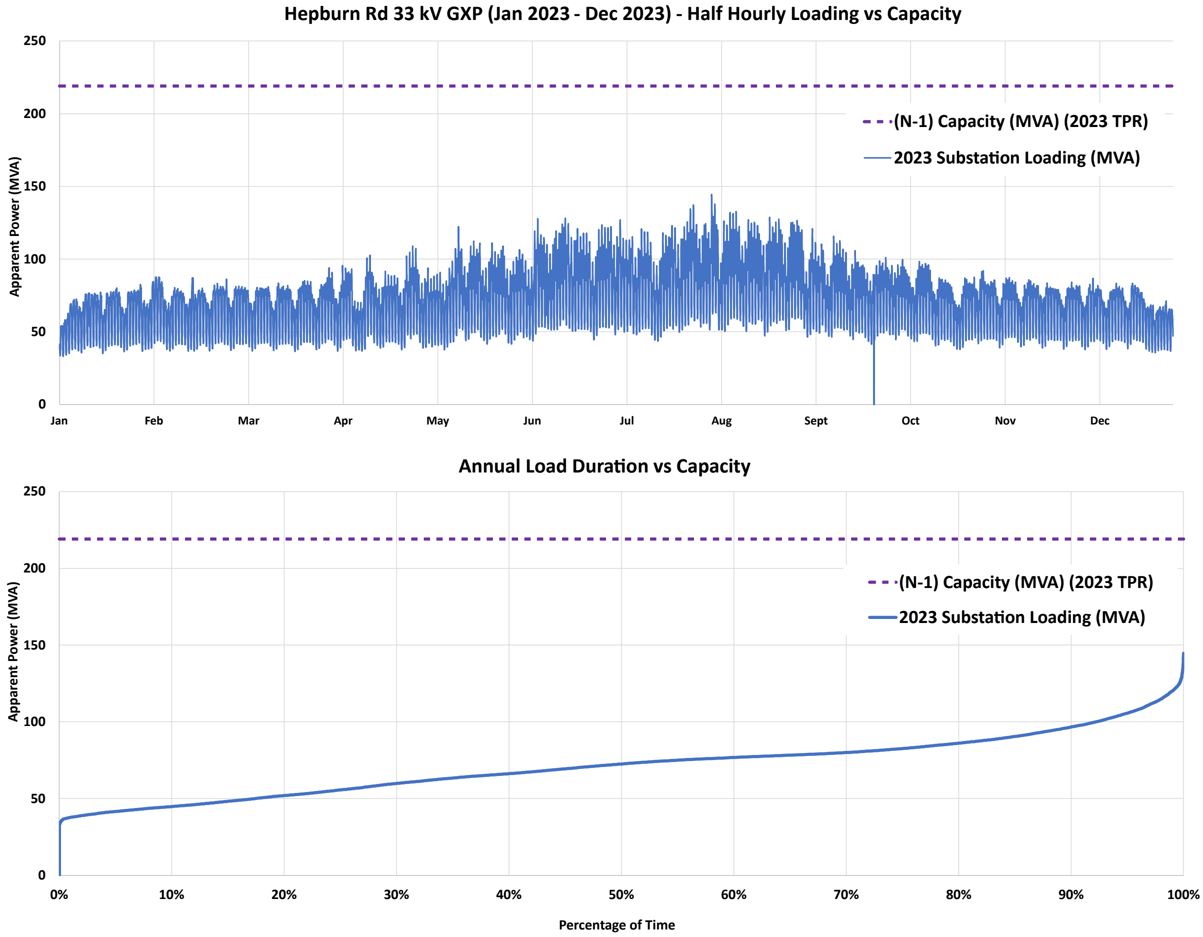


Figure 17. Hepburn Road 33 kV GXP: 2023 Loading: Substation capacity

6.1.7 Māngere 110 kV GXP

Transpower's demand forecast indicates that the Māngere 110 kV GXP was expected to have a 2023 peak demand of 19 MW at 1.00 power factor (19 MVA). This compares with the historical SCADA data that indicates that during 2023 the Māngere 110 kV GXP experienced a peak load of 16.1 MVA (a difference of 15%). Ergo understands that load at Vector's PAC Steel substation, the sole substation connected to this GXP, has been decreasing due to decreased operations of a connected industrial customer, which aligns with the actual load being lower than Transpower's forecast.

The Māngere 110 kV GXP provides a direct supply to Vector, who operate two 110 kV lines from the GXP to their PAC Steel substation (which has 2x transformers installed, one 40 MVA, and one 70 MVA). These transformers and lines are not reported in the TPR and therefore are not reported in the graphs in this section.

Māngere GXP is supplied by:

- 2x 110 kV circuits to Ōtāhuhu, rated at 304 MVA, and
- 2x 110 kV circuits to Mt Roskill, rated at 95/105 MVA (summer/winter).

The following graph[25] shows Māngere 110 kV GXP's historical loading and Transpower's demand forecast.

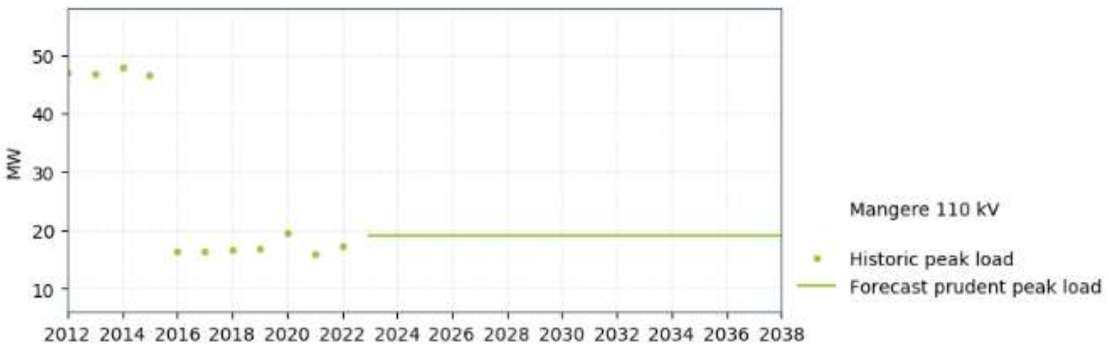


Figure 18 illustrates Māngere 110 kV GXP's 2023 loading.

[25] Sourced from Transpower's *Transmission Planning Report 2023*.

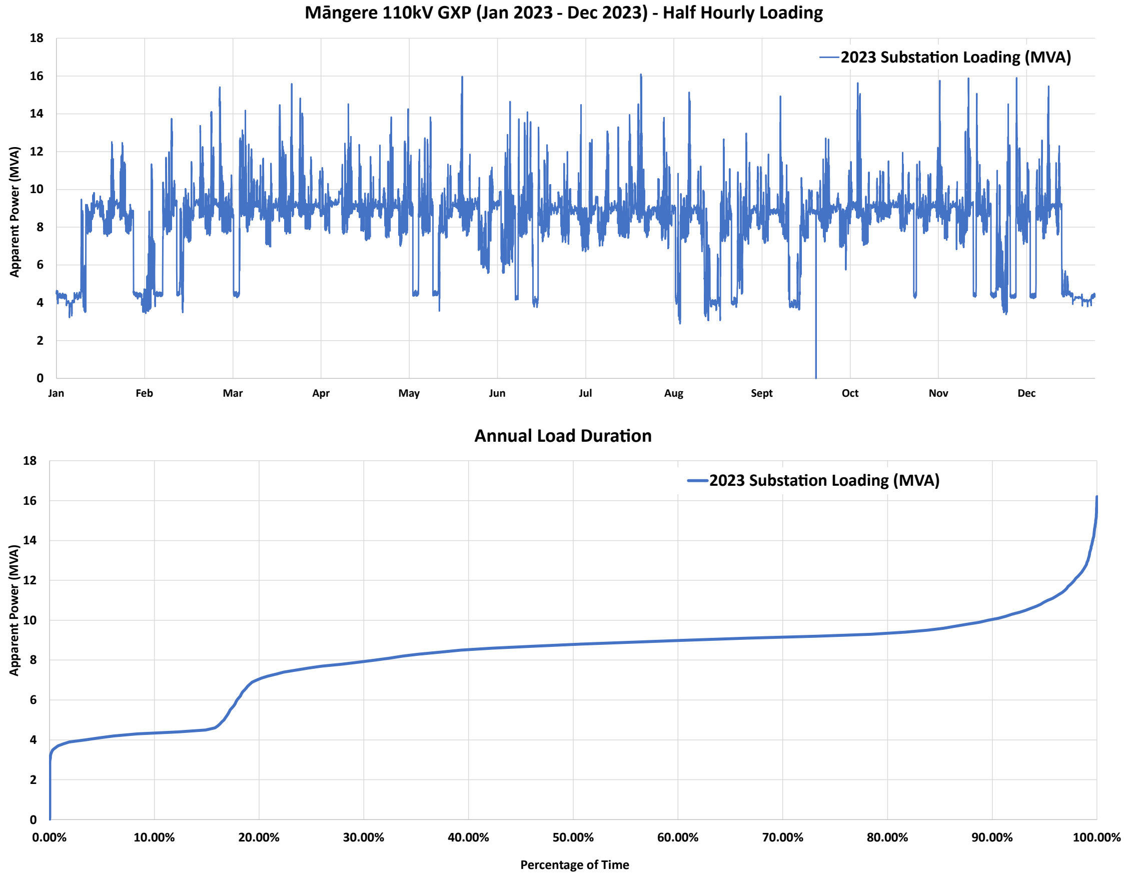


Figure 18. Māngere 110 kV GXP: 2023 Loading

6.1.8 Māngere 33 kV GXP

Transpower's demand forecast indicates that the Māngere 33 kV GXP was expected to have a 2023 peak demand of 117 MW at 0.99 power factor (~118.2 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Māngere 33 kV GXP experienced a peak load of 114.5 MVA.

The Māngere 33 kV GXP is equipped with two 110/33 kV transformers providing:

- (N) capacity of 229 MVA and
- (N-1) capacity of 131 MVA.

The capacity of the transformers at Māngere 33 kV GXP is limited by their associated HV disconnectors.

Māngere GXP is supplied by:

- 2x 110 kV circuits to Ōtāhuhu, rated at 304 MVA, and
- 2x 110 kV circuits to Mt Roskill, rated at 95/105 MVA (summer/winter).

The Māngere 33 kV GXP peak load is forecast to exceed the (N-1) capacity of the transformers from winter of 2027. Transpower plans to discuss longer term options with Vector to resolve this issue, with some options being to upgrade the existing transformers or install a third 110/33 kV supply transformer at the GXP.

The following graph[26] compares Māngere 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.

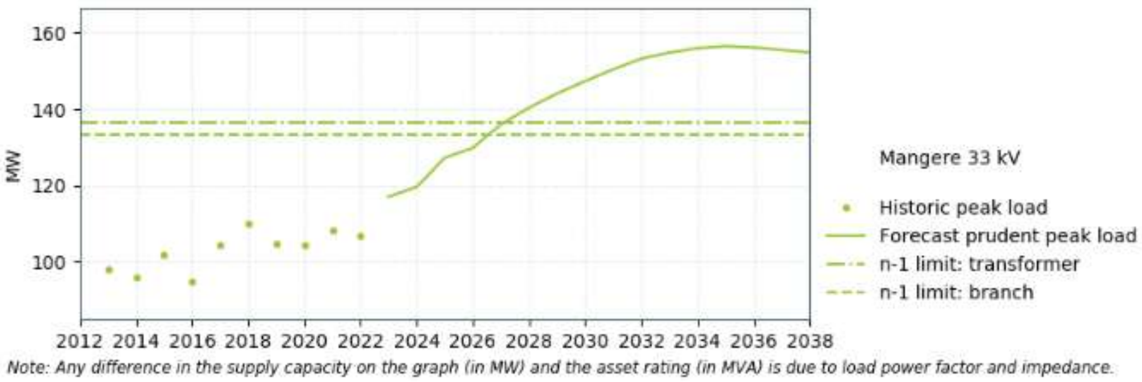


Figure 19 illustrates Māngere 33 kV GXP's 2023 loading in comparison to its substation capacity.

[26] Sourced from Transpower's *Transmission Planning Report 2023*.

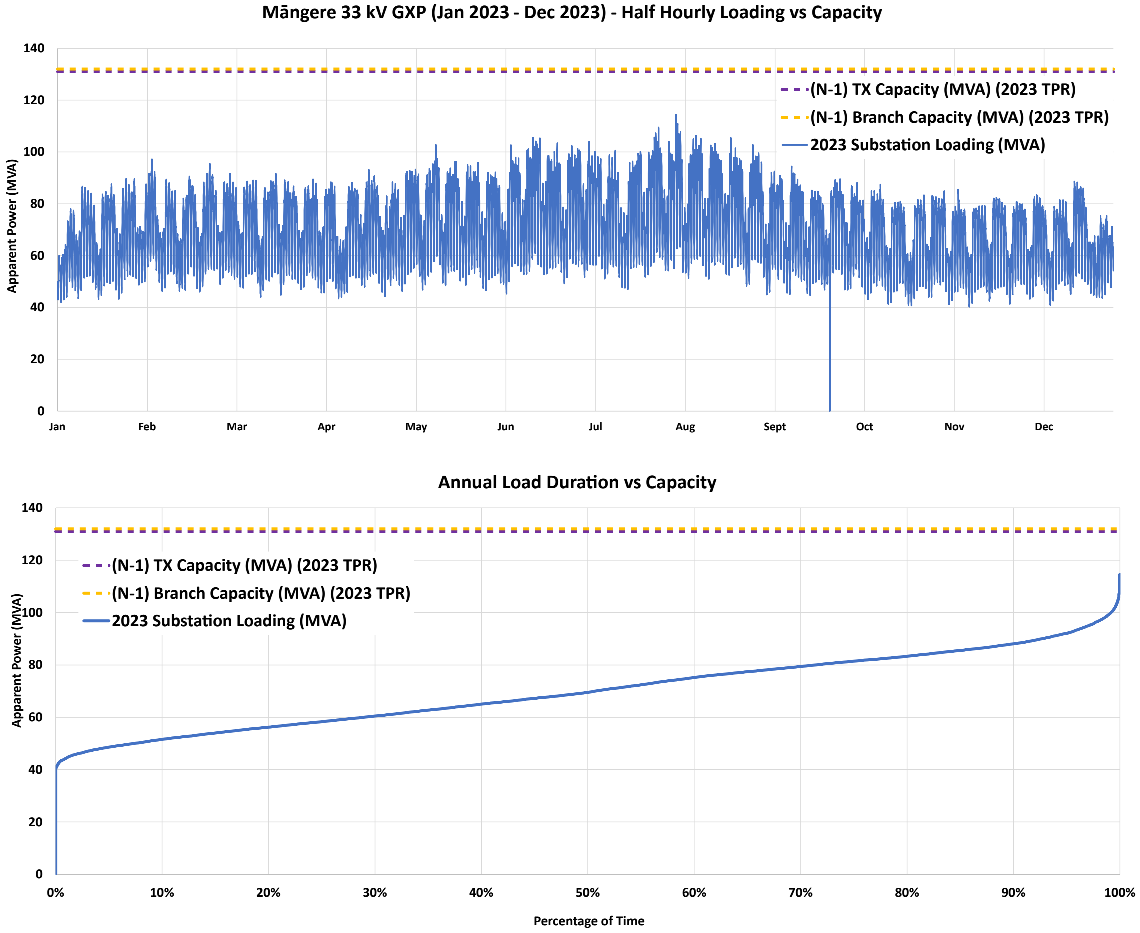


Figure 19. Māngere 33 kV GXP: 2023 Loading: Substation capacity

6.1.9 Ōtāhuhu 22 kV GXP

Transpower's demand forecast indicates that the Ōtāhuhu 22 kV GXP was expected to have a 2023 peak demand of 64 MW at 0.99 power factor (~64.7 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Ōtāhuhu 22 kV GXP experienced a peak load of 60.2 MVA.

The Ōtāhuhu 22 kV GXP is equipped with two 220/22 kV transformers providing:

- (N) capacity of 160 MVA and
- (N-1) capacity of 89 MVA.

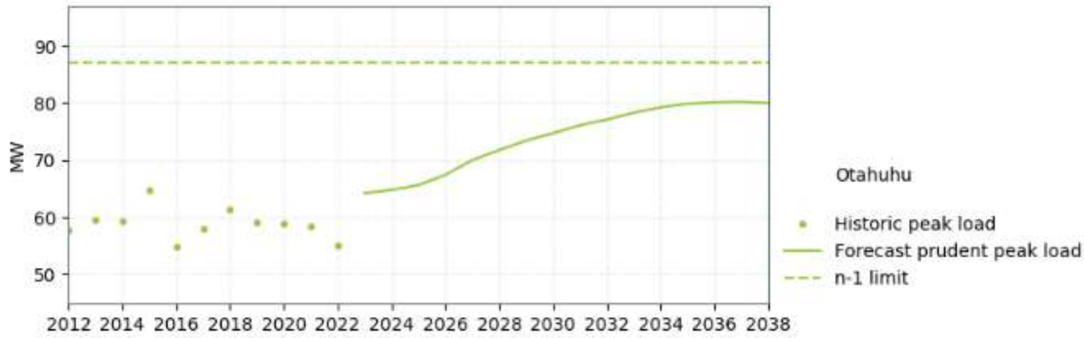
The capacity of the transformers at Ōtāhuhu 22 kV GXP is limited by their associated 22 kV circuit breakers.

Ōtāhuhu GXP is well interconnected, with the following connections:

- At 220 kV:
    - 2x circuits to Henderson (one of which tees into Southdown GXP), each rated to 914 MVA.
    - 2x circuits to Whakamaru, each rated to 285/320 MVA (summer/winter).
    - 2x circuits to Ōhinewai, each rated to 615/671 MVA (summer/winter).
    - 2x circuits to Pakuranga, with one rated to 609 MVA and the other to 1139/1200 MVA (summer/winter).
    - 2x circuits to Penrose, each rated to 469/492 MVA (summer/winter).
    - 2x circuits to Takanini/Drury/Bombay/Huntly (circuits with multiple tees), one rated to 677/724 MVA (summer/winter), and the other to 1139/1200 MVA (summer/winter).
- At 110 kV:
    - 2x circuits from Māngere, rated at 304 MVA.
    - 1x circuit to Penrose, rated to 149/158 MVA (summer/winter).
    - 2x circuits to Mt Roskill, rated to 79/87 MVA (summer/winter).
    - 2x circuits to Wiri, rated to 91/101 MVA (summer/winter).
- Three 220/110 kV interconnecting transformers are located at Ōtāhuhu, each rated at 250 MVA.

The following graph[27] compares Ōtāhuhu 22 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.

[27] Sourced from Transpower's *Transmission Planning Report 2023*.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 20 illustrates Ōtāhuhu 22 kV GXP's 2023 loading in comparison to its substation capacity.

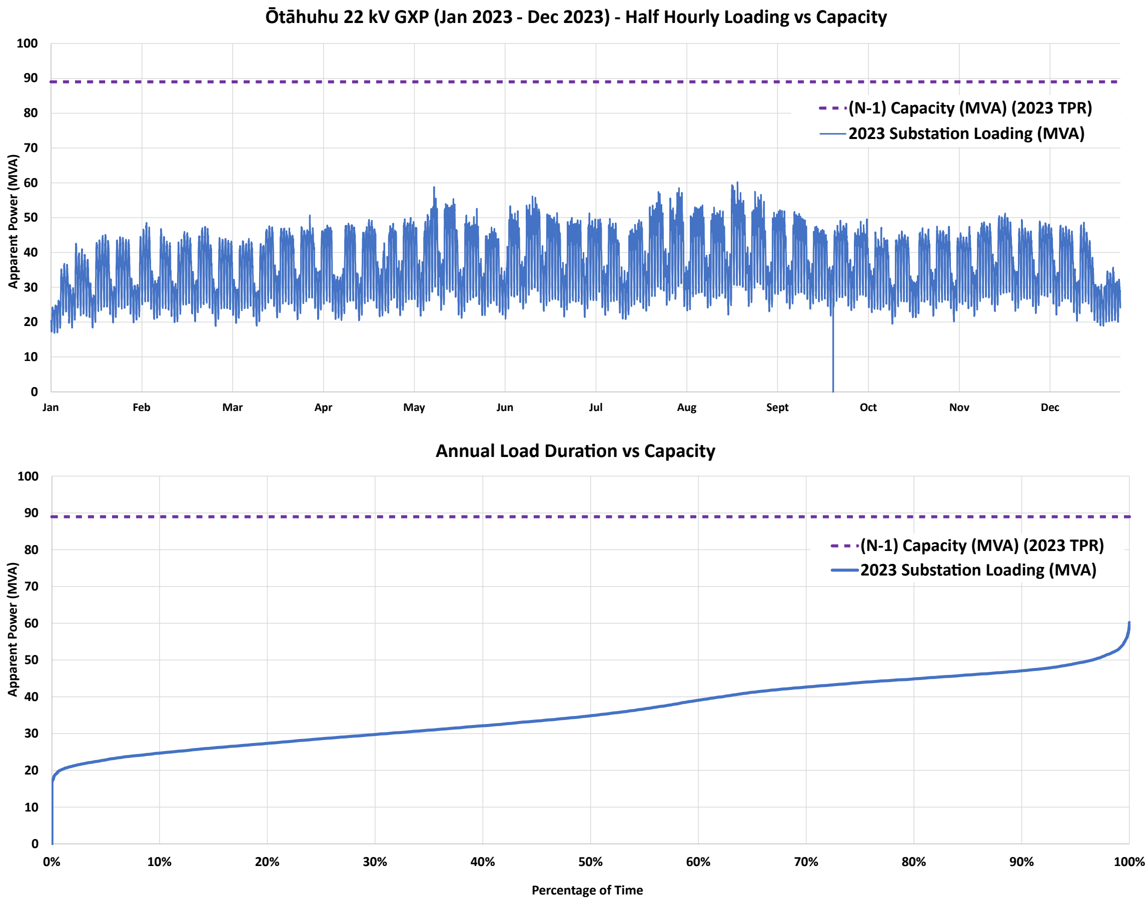


Figure 20. Ōtāhuhu 22 kV GXP: 2023 Loading: Substation capacity

6.1.10 Pakuranga 33 kV GXP

Transpower's demand forecast indicates that the Pakuranga 33 kV GXP was expected to have a 2023 peak demand of 163 MW at 1.00 power factor (163 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Pakuranga 33 kV GXP experienced a peak load of 154 MVA.

The Pakuranga 33 kV GXP is equipped with three 220/33 kV transformers providing:

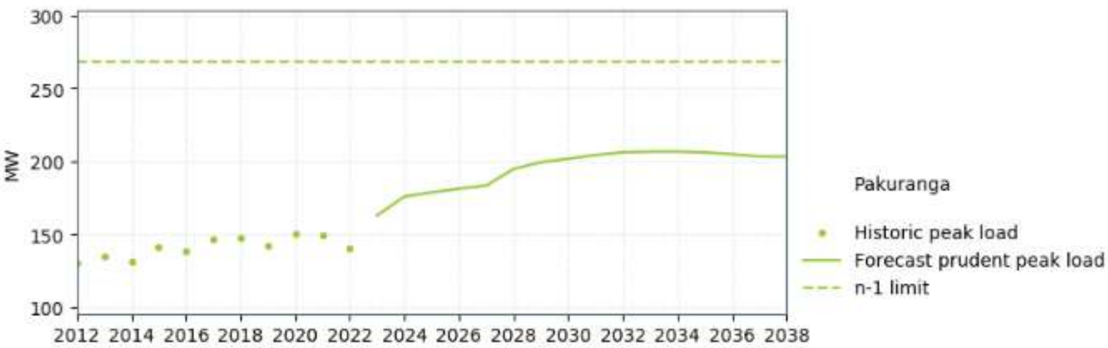
- (N) capacity of 360 MVA and
- (N-1) capacity of 270 MVA.

The capacity of the transformers at Pakuranga 33 kV GXP is limited by their associated 33 kV incomers.

Pakuranga GXP is supplied by:

- 2x 220 kV circuits to Ōtāhuhu, with one rated to 609 MVA and the other to 1139/1200 MVA (summer/winter).
- 1x 220 kV circuit to Penrose, rated to 874/933 MVA (summer/winter).
- 2x 220 kV circuits to Brownhill, rated at 632/676 MVA (summer/winter).

The following graph[28] compares Pakuranga 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 21 illustrates Pakuranga 33 kV GXP's 2023 loading in comparison to its substation capacity.

[28] Sourced from Transpower's *Transmission Planning Report 2023*.

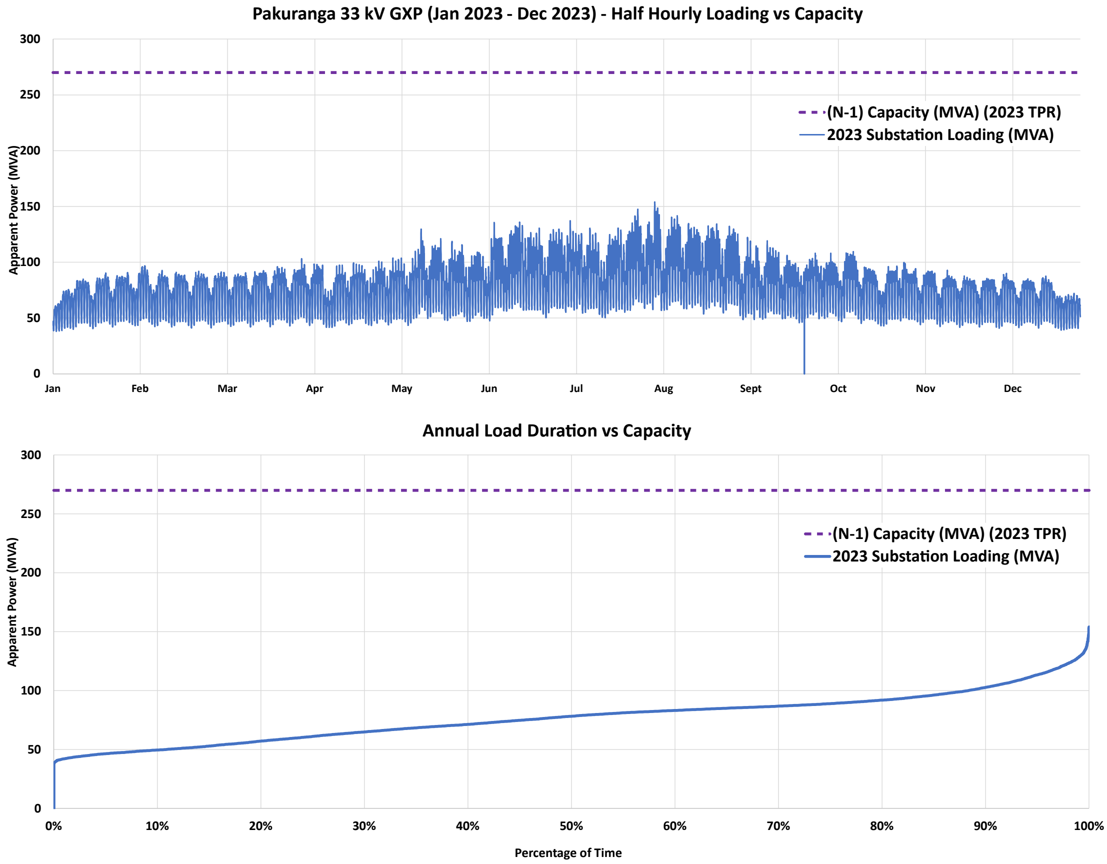


Figure 21. Pakuranga 33 kV GXP: 2023 Loading: Substation capacity

6.1.11 Penrose 22 kV and 33 kV GXPs

Transpower's demand forecast indicates that the Penrose 33 kV GXP was expected to have a 2023 peak demand of 292 MW at 0.99 power factor (~295 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Penrose 33 kV GXP experienced a peak load of 267 MVA (10% lower than forecast).

Transpower's demand forecast indicates that the Penrose 22 kV GXP was expected to have a 2023 peak demand of 47 MW at 0.98 power factor (~48 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Penrose 22 kV GXP experienced a peak load of 37.9 MVA (21% lower than forecast).

The Penrose 33 kV GXP is equipped with three 220/33 kV transformers (which also provide supply to the 22 kV GXP via the 33/22 kV transformers) providing:

- (N) capacity of 560 MVA and
- (N-1) capacity of 393 MVA.
- Switched (N-1) capacity of 470 MW.

Ergo notes that there is a fourth transformer at Penrose, which is a standby unit (which is not normally used due to the resulting high fault levels), which can be switched in quickly to restore supply during outages.

The Penrose 33 kV GXP is equipped with three 33/22 kV transformers providing:

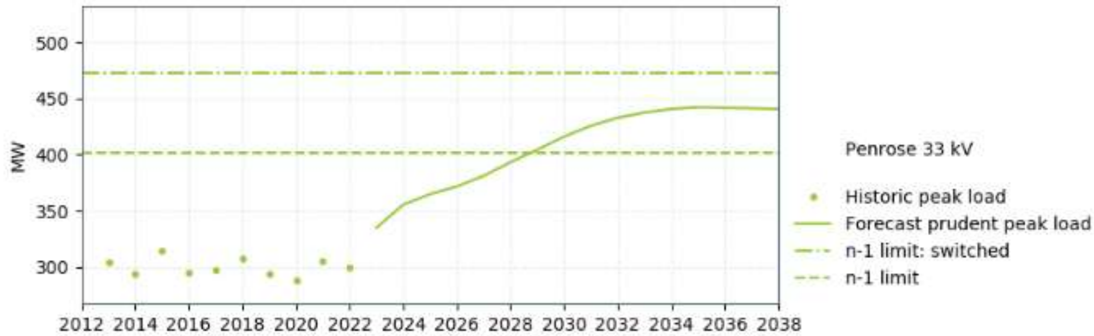
- (N) capacity of 135 MVA and
- (N-1) capacity of 90 MVA.

Penrose GXP is supplied by:

- 2x 220 kV circuits to Ōtāhuhu, each rated to 469/492 MVA (summer/winter).
- 1x 220 kV circuit to Hobson St, rated to 899/914 MVA (summer/winter).
- 1x 110 kV circuit to Ōtāhuhu, rated to 149/158 MVA (summer/winter). Note this circuit is normally open.
- 1x 220 kV circuit to Pakuranga, rated to 874/933 MVA (summer/winter).
- 2x 220/110 kV interconnecting transformers, each rated at 250 MVA.

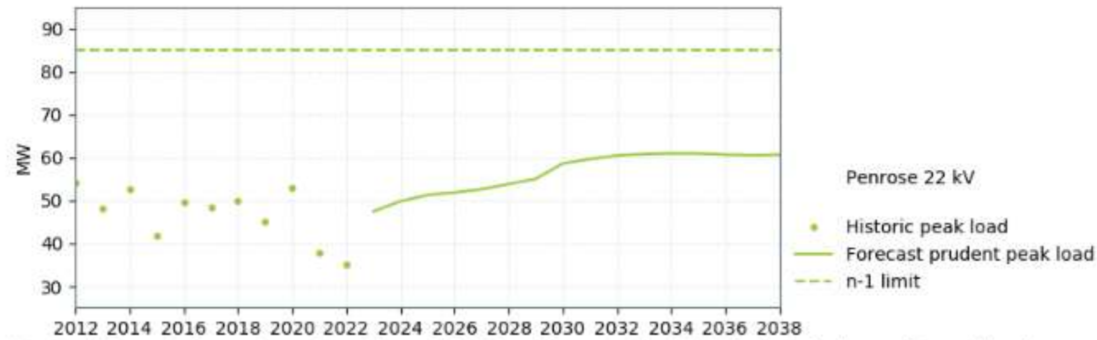
The Penrose 33 kV & 22 kV GXP peak load is forecast to exceed the (N-1) capacity of the 220/33 kV transformers from winter of 2029. For the short-term, having the fourth 220/33 kV transformer on standby is seen as adequate to manage risk at the GXP. Vector has been investigating the possibility of shifting some Penrose load to a new GXP at Southdown (which is an existing GXP, however it presently only supplies Kiwirail at 25 kV). Ergo understands that discussions are ongoing between Transpower and Vector.

The following graph[29] compares Penrose 33 kV GXP's supply capacity (including Penrose 22 kV GXP's load) with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The following graph[30] compares Penrose 22 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 22 illustrates Penrose 33 kV GXP's 2023 loading (including the loading of the 22 kV GXP) in comparison to its substation capacity. Figure 23 illustrates Penrose 22 kV GXP's 2023 loading in comparison to its substation capacity.

[29] Sourced from Transpower's *Transmission Planning Report 2023*.
[30] Sourced from Transpower's *Transmission Planning Report 2023*.

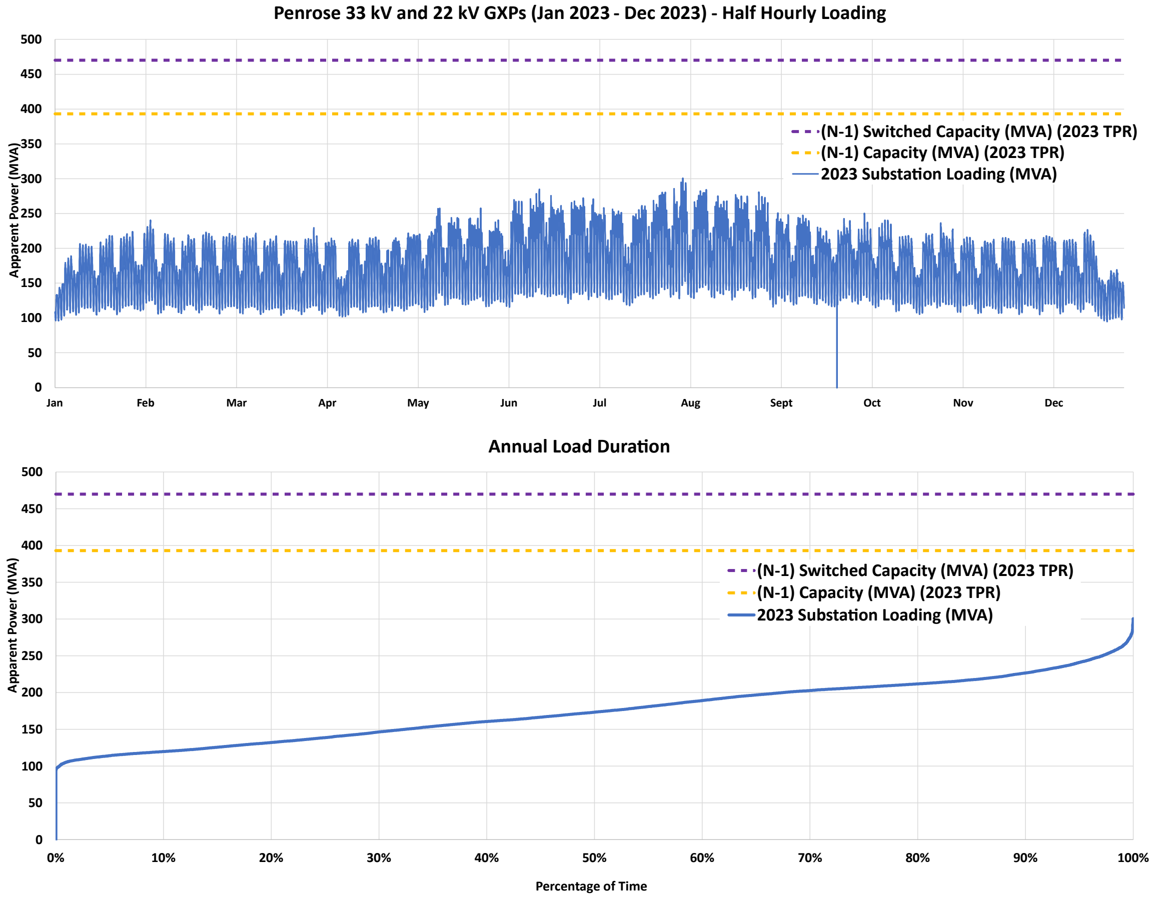


Figure 22. Penrose 33 kV GXP: 2023 Loading: Substation capacity

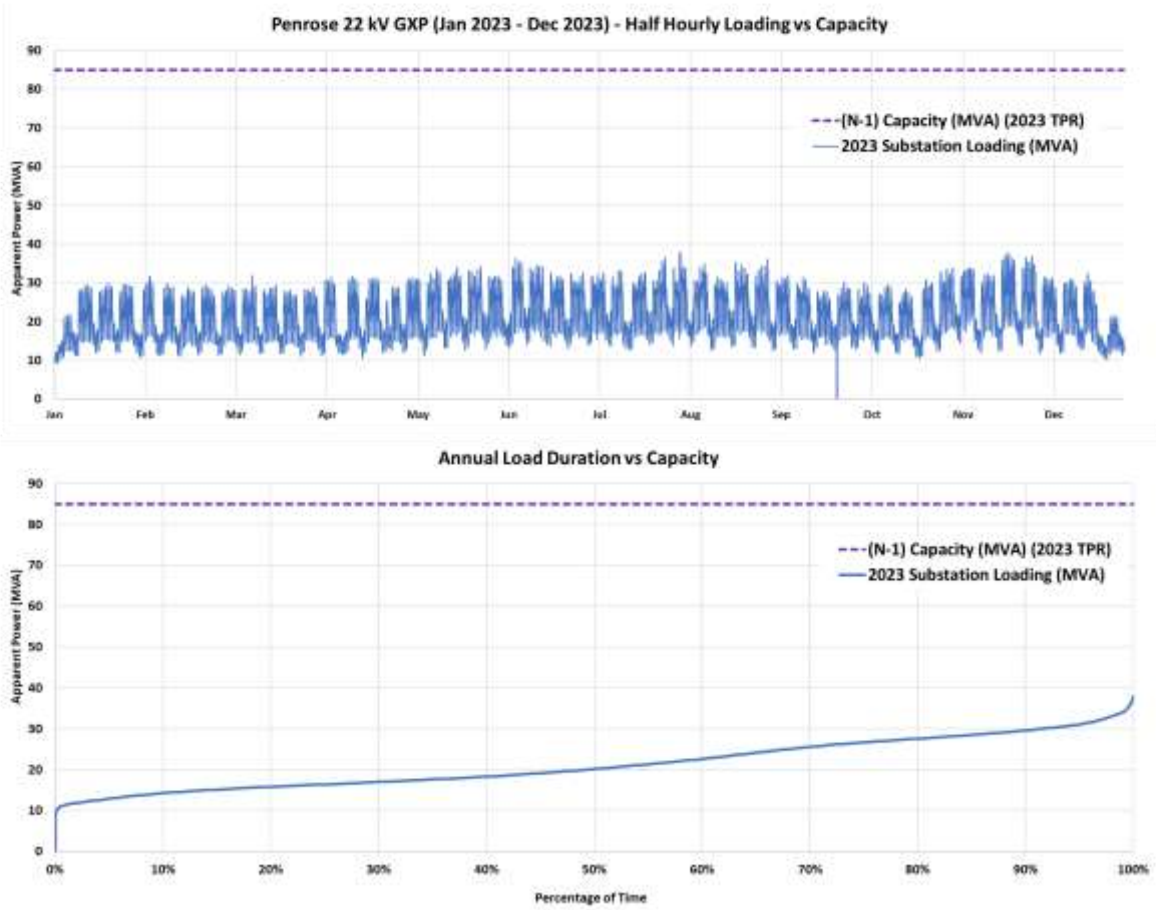


Figure 23. Penrose 22 kV GXP: 2023 Loading: Substation capacity

6.1.12 Mt Roskill 110 kV GXP

Transpower's demand forecast indicates that the Mt Roskill 110 kV GXP was expected to have a 2023 peak demand of 78 MW at 0.98 leading power factor (~79.6 MVA). This contrasts with the historical SCADA data that indicates that, during 2023, the Mt Roskill 110 kV GXP experienced a peak load of 59.4 MVA (25% lower than forecast).

Vector takes direct supply from the Mt Roskill 110 kV GXP, operating 2x 110 kV lines to Vector's Kingsland substation, which has 2x 110/22 kV transformers, each rated to 60 MVA. These transformers and lines are not reported in the TPR and therefore are not reported in the graphs in this section.

Mt Roskill GXP is supplied by:

- 2x 110 kV circuits to Ōtāhuhu, rated to 79/87 MVA (summer/winter).
- 2x double 110 kV circuits to Hepburn Road GXP, each rated at 152 MVA.

The following graph[31] compares Mt Roskill 110 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.

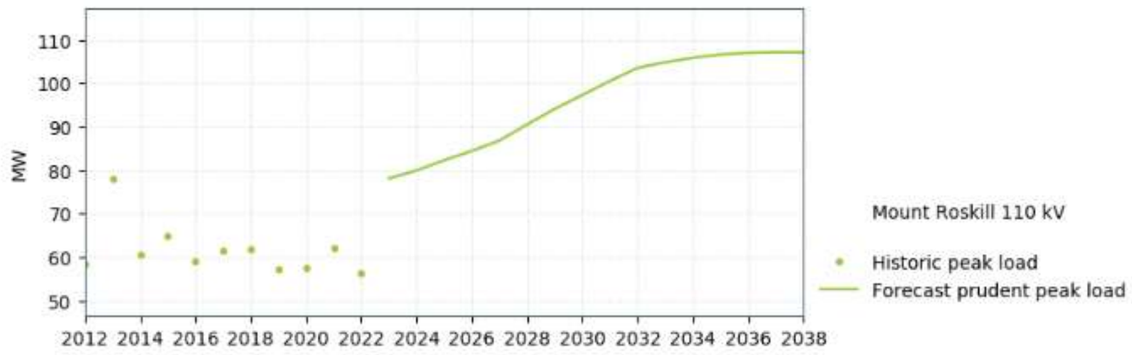


Figure 24 illustrates Mt Roskill 110 kV GXP's 2023 loading.

[31] Sourced from Transpower's *Transmission Planning Report 2023*.

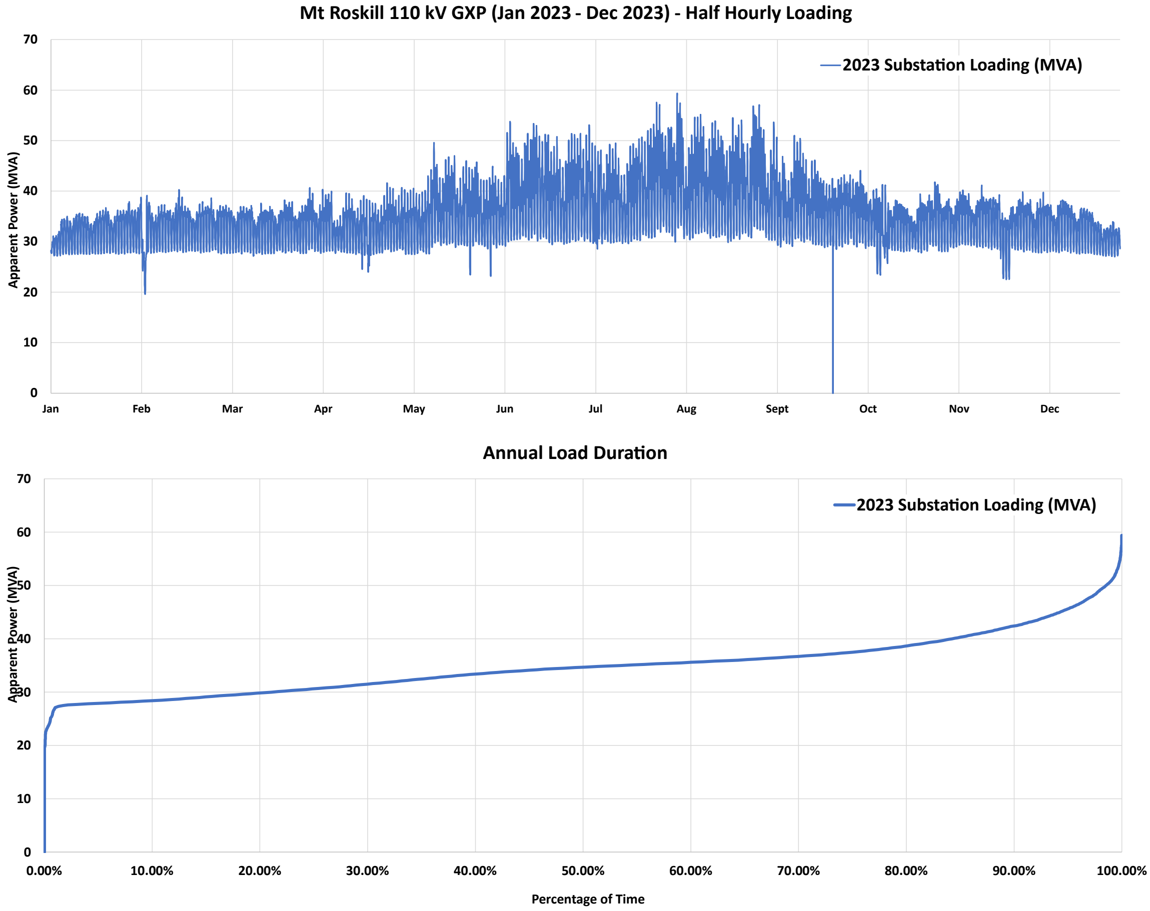


Figure 24. Mt Roskill 110 kV GXP: 2023 Loading: Substation capacity

6.1.13 Mt Roskill 22 kV GXP

Transpower's demand forecast indicates that the Mt Roskill 22 kV GXP was expected to have a 2023 peak demand of 125 MW at 1.00 power factor (125 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Mt Roskill 22 kV GXP experienced a peak load of 116.6 MVA.

The Mt Roskill 22 kV GXP is equipped with three 110/22 kV transformers providing:

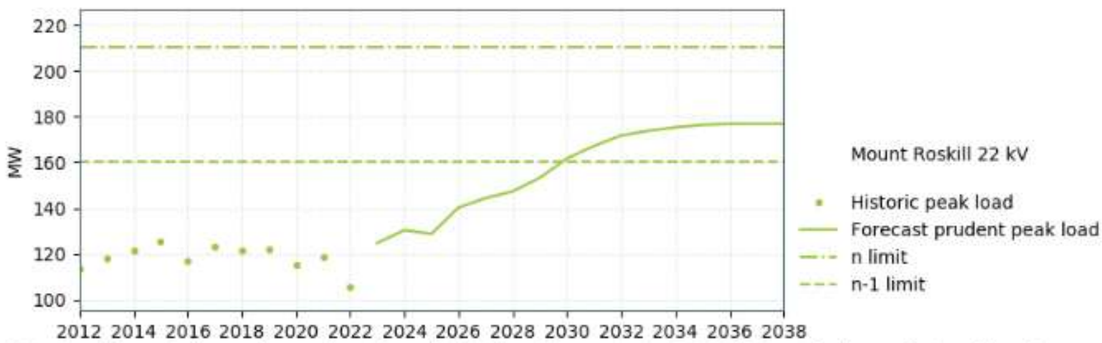
- (N) capacity of 212 MVA and
- (N-1) capacity of 162 MVA.

Mt Roskill GXP is supplied by:

- 2x 110 kV circuits to Ōtāhuhu, rated to 79/87 MVA (summer/winter).
- 2x double 110 kV circuits to Hepburn Road GXP, each rated at 152 MVA.

The Mt Roskill 22 kV GXP peak load is forecast to exceed the (N-1) capacity of the transformers from winter of 2030. Transpower plans to discuss options with Vector to resolve this issue, with one option being to replace the two older transformers with higher capacity units.

The following graph[32] compares Mt Roskill 22 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 25 illustrates Mt Roskill 22 kV GXP's 2023 loading in comparison to its substation capacity.

[32] Sourced from Transpower's *Transmission Planning Report 2023*.

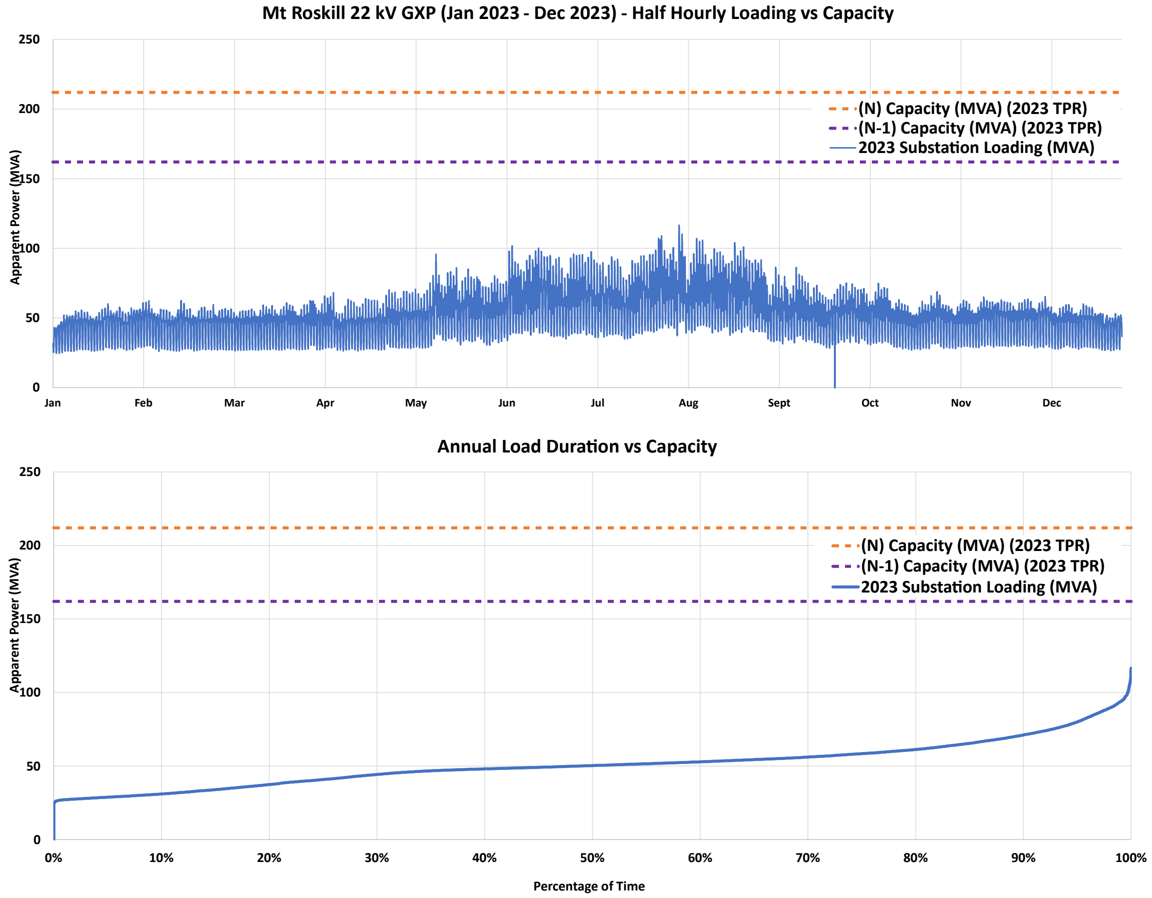


Figure 25. Mt Roskill 22 kV GXP: 2023 Loading: Substation capacity

6.1.14 Silverdale 33 kV GXP

Transpower's demand forecast indicates that the Silverdale 33 kV GXP was expected to have a 2023 peak demand of 99 MW at 1.00 power factor (99 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Silverdale 33 kV GXP experienced a peak load of 107 MVA (8% higher than forecast).

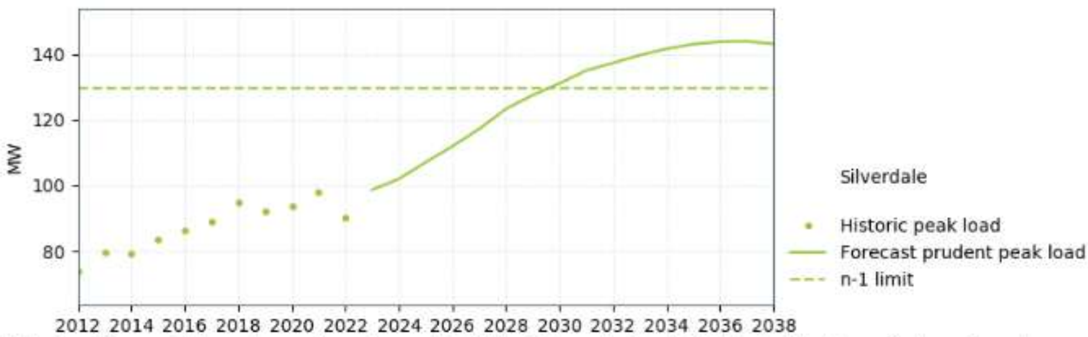
The Silverdale 33 kV GXP is equipped with two 220/33 kV transformers providing:

- (N) capacity of 220 MVA and
- (N-1) capacity of 130 MVA.

Silverdale is supplied via 2x 220 kV circuits from Albany, each rated at 304 MVA.

The Silverdale 33 kV GXP peak load is forecast to exceed the (N-1) capacity of the transformers from winter of 2030. Ergo understands that Transpower is discussing options with Vector to resolve this issue.

The following graph[33] compares Silverdale 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 26 illustrates Silverdale 33 kV GXP's 2023 loading in comparison to its substation capacity.

[33] Sourced from Transpower's *Transmission Planning Report 2023*.

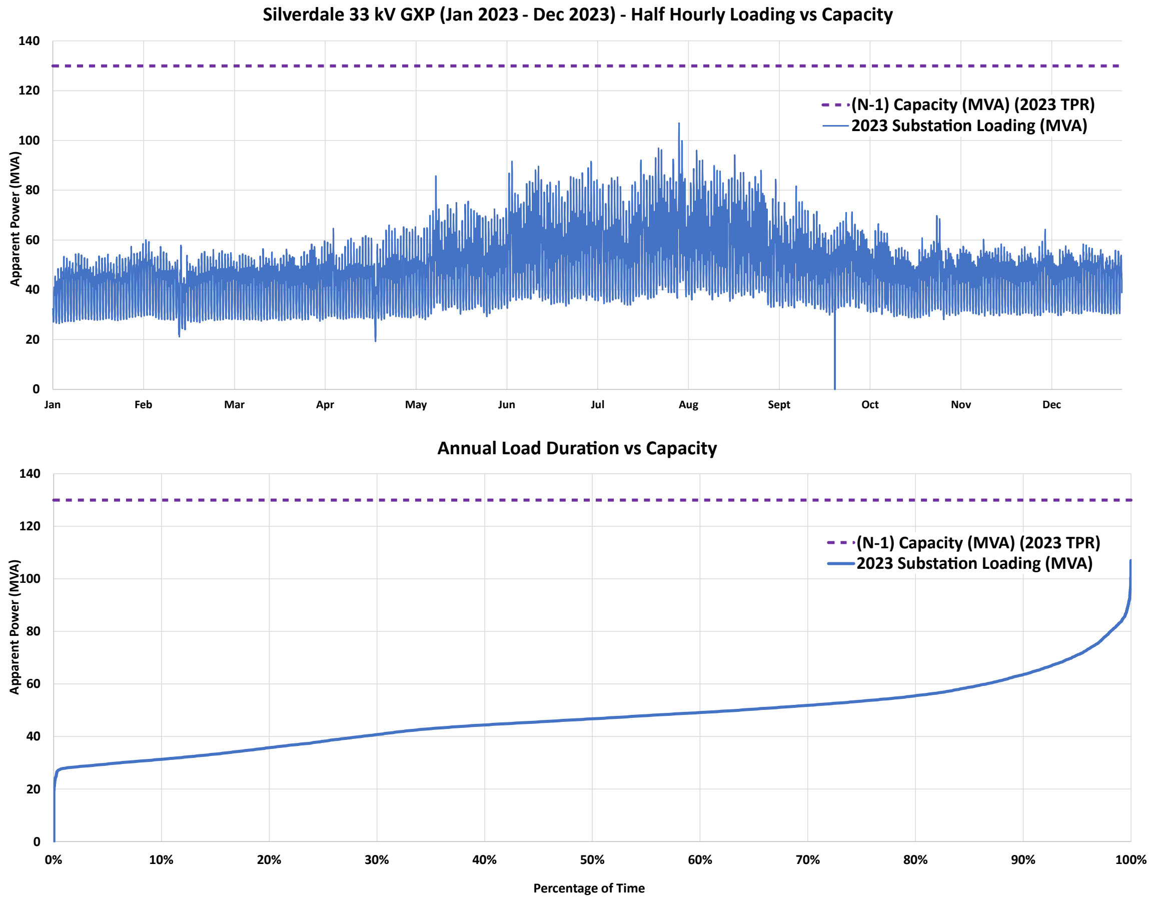


Figure 26. Silverdale 33 kV GXP: 2023 Loading: Substation capacity

6.1.15 Takanini 33 kV GXP

Transpower's demand forecast indicates that the Takanini 33 kV GXP was expected to have a 2023 peak demand of 150 MW at 1.00 power factor (150 MVA). This contrasts with the historical SCADA data that indicates that, during 2023, the Takanini kV GXP experienced a peak load of 132 MVA (12% lower than forecast).

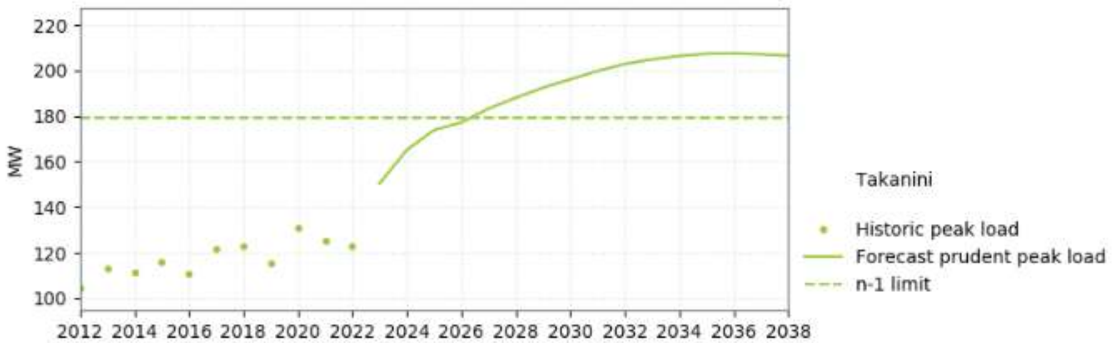
The Takanini 33 kV GXP is equipped with two 220/33 kV transformers providing:

- (N) capacity of 300 MVA and
- (N-1) capacity of 180 MVA.

Takanini GXP is supplied by a tee off the 2x 220 kV circuits from Ōtāhuhu to Huntly. The main branches of these circuits are rated to 677/724 MVA (summer/winter), and 1139/1200 MVA (summer/winter). The tee from the main branch to Takanini is rated to 569/626 MVA (summer/winter).

The Takanini 33 kV GXP peak load is forecast to exceed the (N-1) capacity of the transformers from winter of 2027. Additionally, a loss of one of the Takanini supply transformers during high load periods could cause voltage steps on the Takanini 33 kV bus of greater than 5%. Ergo understands that Transpower plans to discuss options with Vector to resolve one or both of these issues.

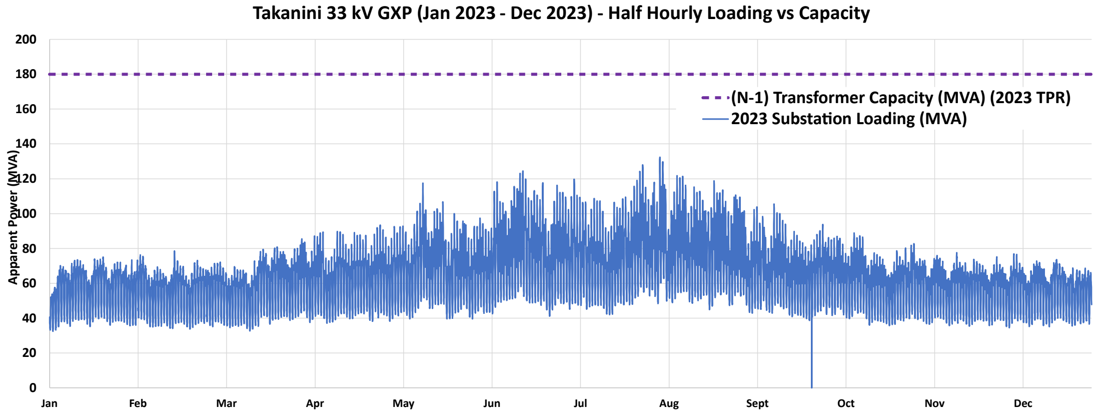
The following graph[34] compares Takanini 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Figure 27 illustrates Takanini 33 kV GXP's 2023 loading in comparison to its substation capacity.

[34] Sourced from Transpower's *Transmission Planning Report 2023*.



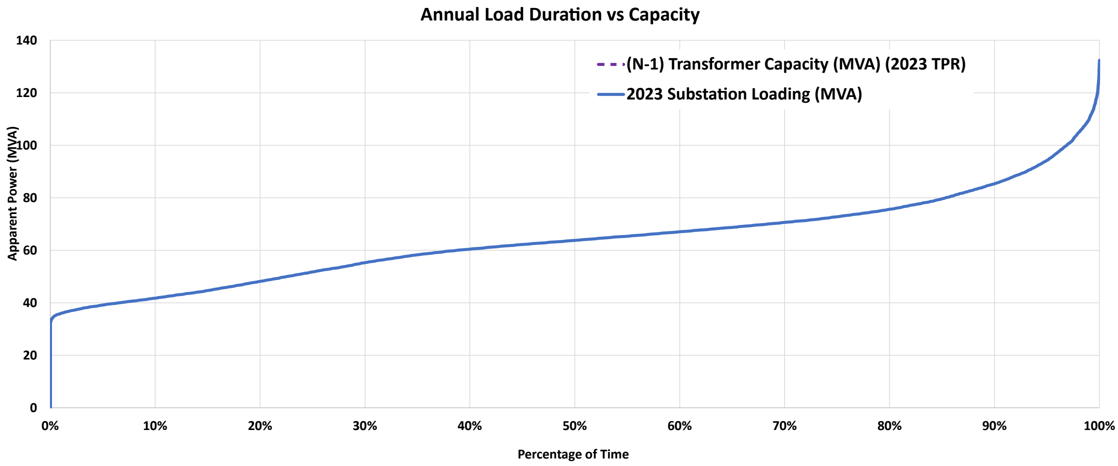


Figure 27. Takanini 33 kV GXP: 2023 Loading: Substation capacity

6.1.16 Wairau Rd 33 kV/Albany 110 kV GXP

Vector takes supply from Transpower at 33 kV at Wairau Road, and at 110 kV at Albany. Vector then owns/operates 3x lines and 110/33 kV transformers which connect Albany 110 kV to Wairau Road 33 kV. These operate like a single GXP, referred to as Wairau-Albany or Wairau Rd GXP.

Transpower's demand forecast indicates that the Wairau-Albany GXP was expected to have a 2023 peak demand of 176 MW at 1.00 power factor (176 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Wairau-Albany GXP experienced a peak load of 153.1 MVA (13% lower than forecasted).

The Wairau-Albany GXP is supplied by the following transformers:

- Transpower-owned:
  - 1x 220/33 kV transformer at Wairau Road rated to 120 MVA (this transformer's capacity is limited by the associated 33 kV Vector-owned switchgear).
  - 1x 220/110 kV transformer at Albany rated to 200 MVA
- Vector-owned:
  - 3x 110/33 kV transformers at one end of the Albany-Wairau Rd circuits, each rated to 80 MVA.

The result are the following capacities:

- (N) capacity of 320 MVA and
- (N-1) capacity of 149 MVA.

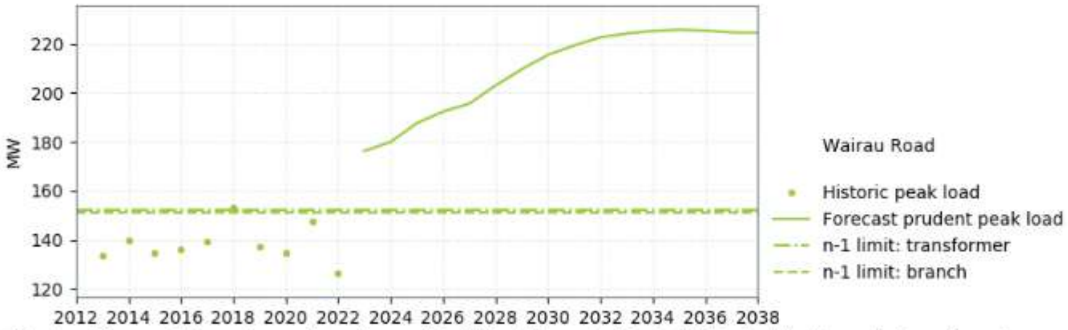
The combined GXP is supplied by:

- 1x 220 kV circuit between Wairau Rd and Albany, rated to 733/788 MVA (summer/winter).
- 1x 220 kV circuit between Wairau Rd and Hobson St, rated to 735/788 MVA (summer/winter).
- 2x 220 kV circuits between Albany and Henderson (one of these tees to Huapai), rated to 561/617 MVA (summer/winter).

The Wairau-Albany GXP peak load was forecast to exceed the (N-1) capacity of the transformers from winter of 2023. Transpower plans to discuss options with Vector to resolve this issue, with one option being to install a second 220/33 kV transformer at Wairau Rd.

The following graph[35] compares Wairau-Albany GXP's supply capacity with the historical loading and Transpower's demand forecast.

[35] Sourced from Transpower's *Transmission Planning Report 2023*.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The following Figure 25 illustrates Wairau-Albany GXP's 2023 loading in comparison to its substation capacity.

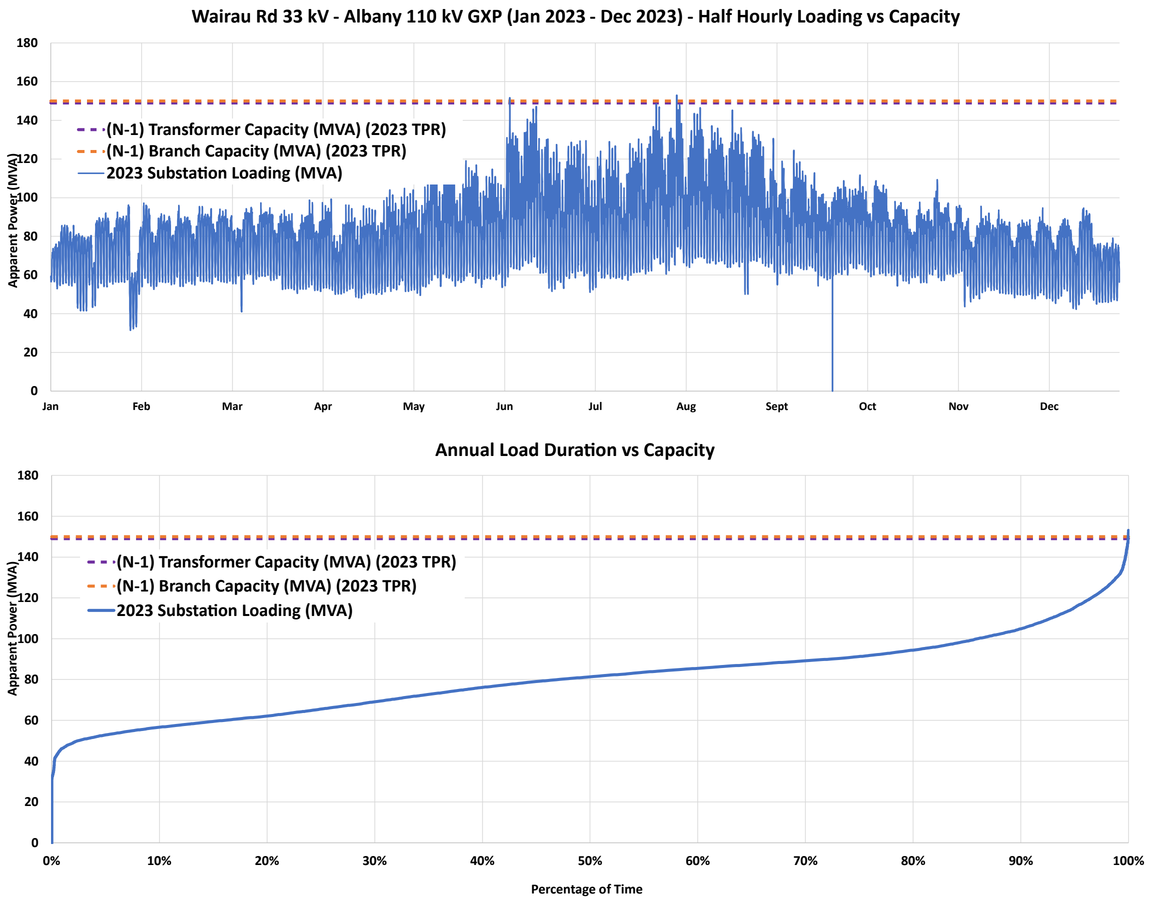


Figure 28. Wairau-Albany GXP: 2023 Loading: Substation capacity

6.1.17 Wellsford 33 kV GXP

Transpower's demand forecast indicates that the Wellsford 33 kV GXP was expected to have a 2023 peak demand of 43 MW at 1.00 power factor (43 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Mt Wellsford 33 kV GXP experienced a peak load of 39.2 MVA (9% lower than forecast).

The Wellsford 33 kV GXP is equipped with two 110/33 kV transformers providing:

- (N) capacity of 38 MVA and
- (N-1) capacity of 38 MVA.
- The (N) and (N-1) capacities are the same as there is no 110 kV bus at Wellsford.

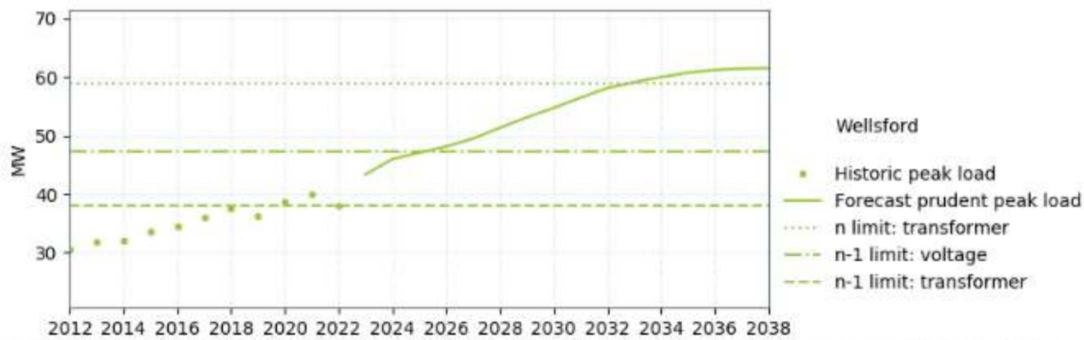
Wellsford GXP is supplied by:

- 2x 110 kV circuits to Maungatūroto, rated to 55/68 MVA (summer/winter).
- 2x 110 kV circuits to Henderson, each rated at 55/68 MVA (summer/winter).

The Wellsford 33 kV GXP peak already exceeds its (N-1) capacity. Additionally, loss of one of the Henderson-Wellsford-Maungatūroto circuits during high loading can cause voltage changes on the Wellsford bus of more than 5% and also risks voltage dropping below 0.95 p.u. Part of this issue is that the two existing supply transformers do not have on-load tap changers. In the short-term, this issue is managed operationally within Vector's network. Other options include:

- Installing a special protection system (SPS) at the GXP (indicative cost $0.5 M),
- Replacing the existing transformers with larger units (indicative cost $14 M), or
- Building a new GXP.

The following graph[36] compares Wellsford 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast. Ergo notes that although the graph below notes a higher (N) capacity, the 38 MVA (N) capacity has been confirmed by Transpower.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[36] Sourced from Transpower's *Transmission Planning Report 2023*.

The following Figure 29 illustrates Wellsford 33 kV GXP's 2023 loading in comparison to its substation capacity.

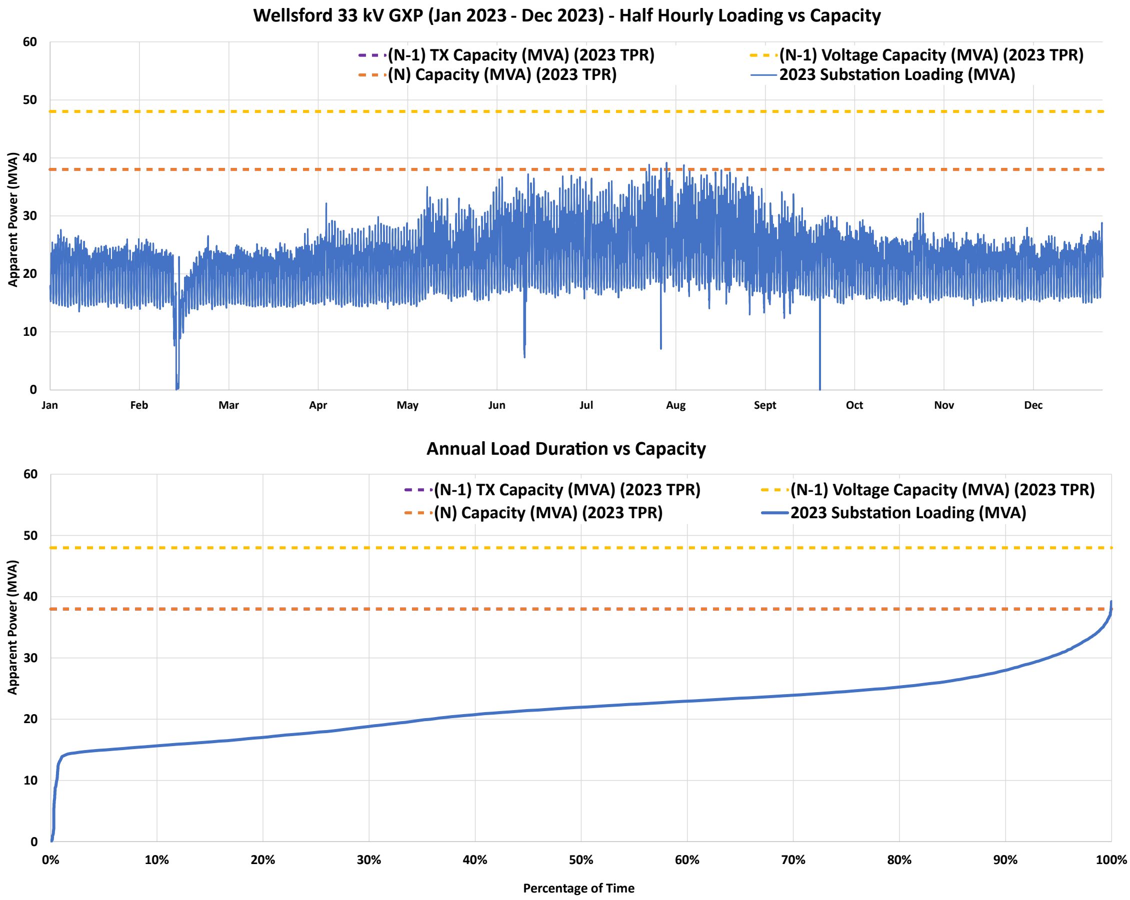


Figure 29. Wellsford 33 kV GXP: 2023 Loading: Substation capacity

6.1.18 Wiri 33 kV GXP

Transpower's demand forecast indicates that the Wiri 33 kV GXP was expected to have a 2023 peak demand of 114 MW at 0.98 power factor (~116 MVA). This contrasts with the historical SCADA data that indicates that, during 2023, the Wiri 33 kV GXP experienced a peak load of 93 MVA.

The Wiri 33 kV GXP is equipped with two 110/33 kV transformers providing:

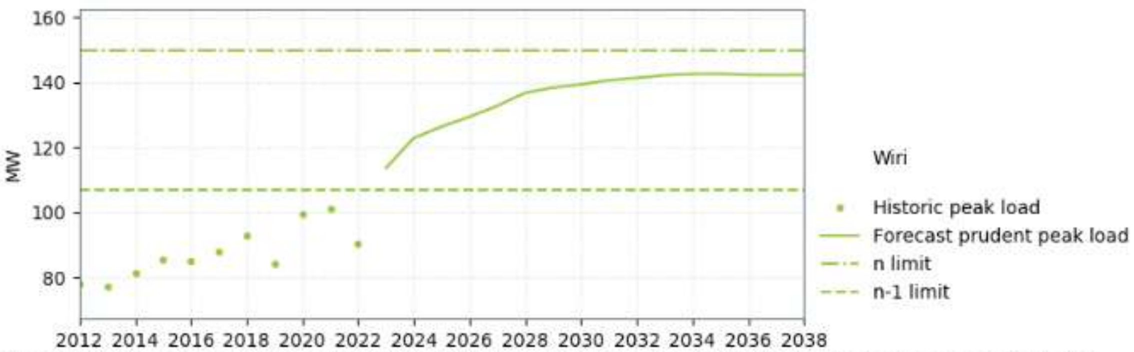
- (N) capacity of 108 MVA and
- (N-1) capacity of 108 MVA.

Wiri GXP is supplied by:

- 2x 110 kV circuits to Ōtāhuhu, rated to 152/168 MVA (summer/winter).

The Wiri 33 kV GXP peak load was forecast to exceed the (N-1) capacity of the transformers from winter of 2023. In the short-term, this issue is managed operationally or by utilising a special protection scheme or similar. In the longer-term, one option being investigated is building a 110 kV bus at Wiri and installing a third transformer (indicative cost $11M-$16M).

The following graph[37] compares Wiri 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast. Ergo notes that although the graph below notes a higher (N) capacity, the 108 MVA (N) capacity has been confirmed by Transpower.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The following Figure 30 illustrates Wiri 33 kV GXP's 2023 loading in comparison to its substation capacity.

[37] Sourced from Transpower's *Transmission Planning Report 2023*.

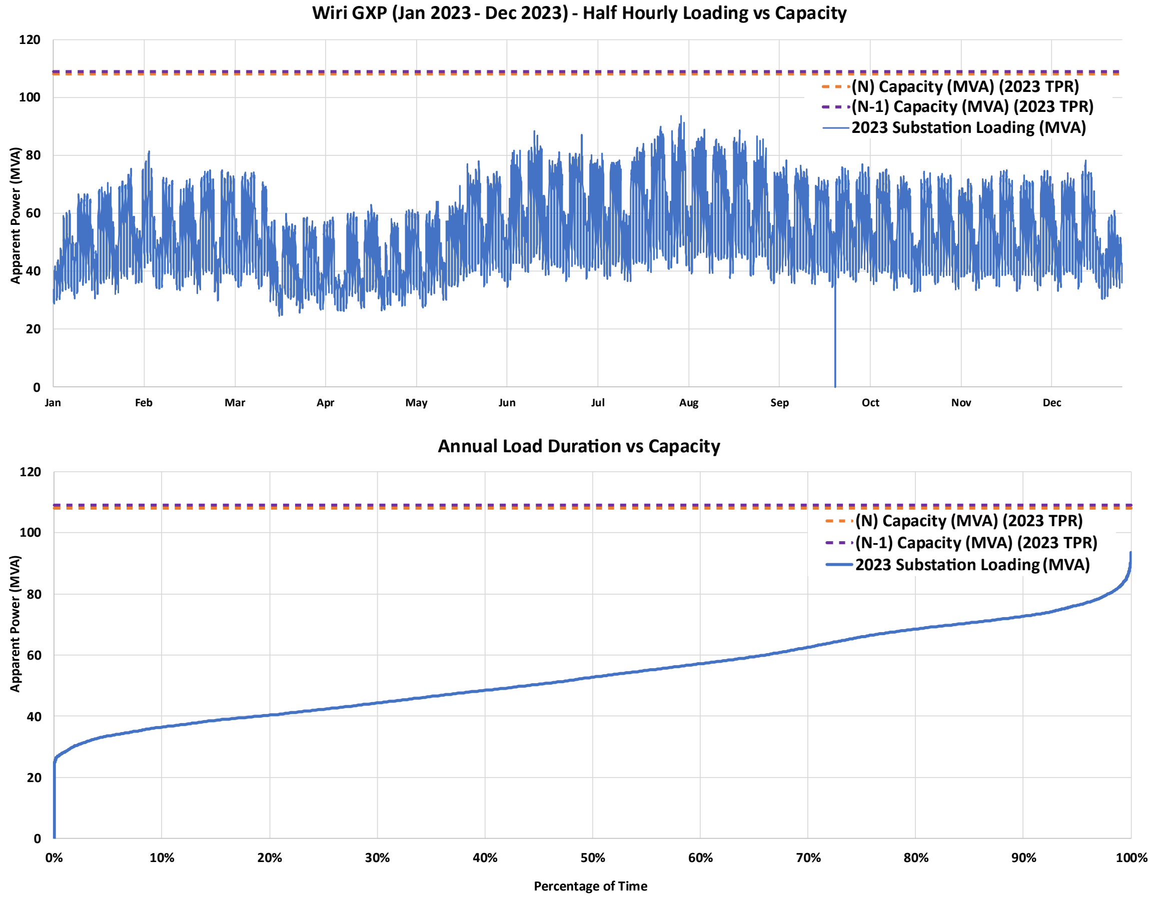


Figure 30. Wiri 33 kV GXP: 2023 Loading: Substation capacity

6.2 Spare Capacity based on Transpower's 2023 Forecast

Figure 31 summarises the approximate, all year, (N-1) and (N) spare capacities at each GXP based on:

- The substation capacity disclosed in Transpower's *Transmission Planning Report 2023*
- The 2023 forecast load provided in Transpower's *Transmission Planning Report 2023* (refer to Table 3).
- Half hourly load data from Electricity Market Information website.
- The 2023 and 2024 Vector and Counties Energy *Asset Management Plans.*

Negative values are only possible for (N-1) capacities and indicate that there is no spare (N-1) capacity, and that consumer load cannot be supplied for (N-1) conditions. The negative amount indicates the capacity increase that is required to achieve a secure firm capacity at the substation.

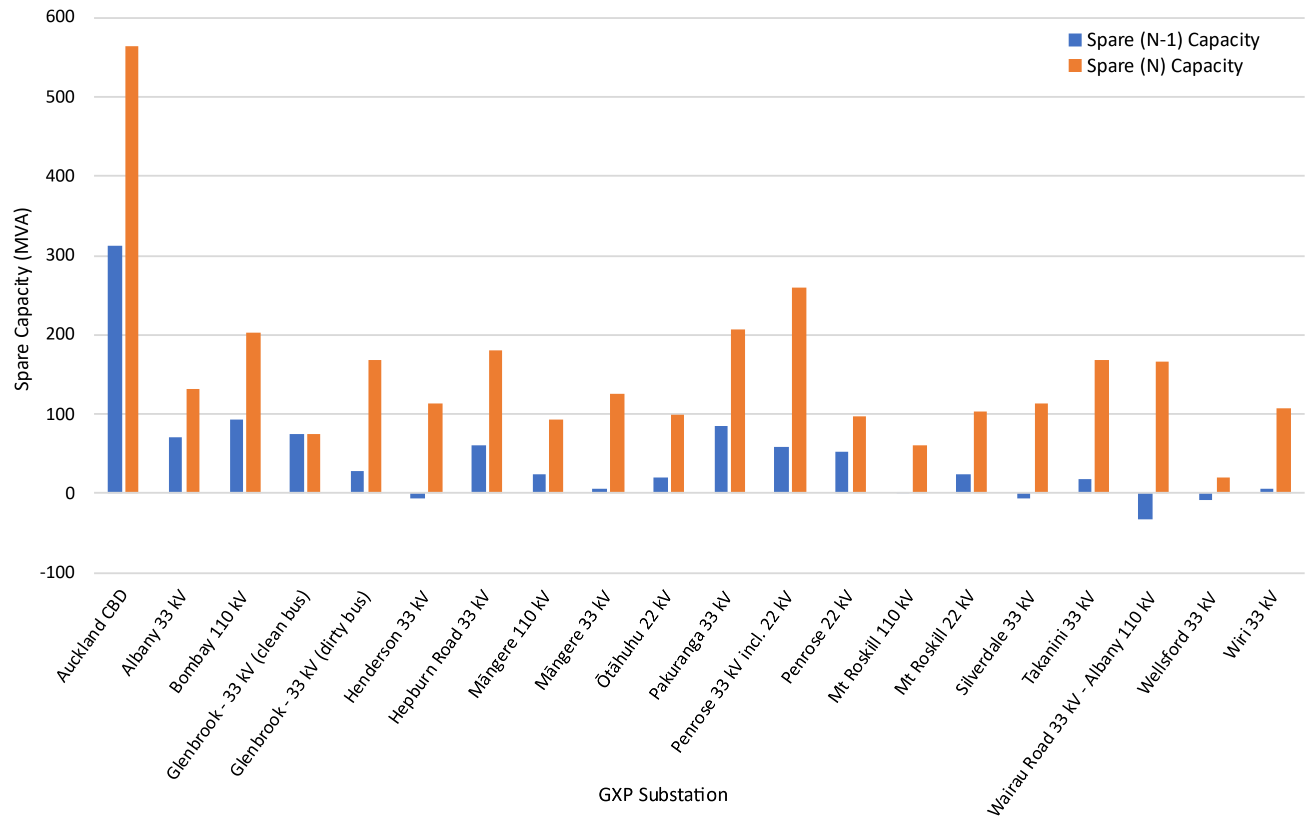


Figure 31. Summary: GXP Spare Capacity based on GXP 2023 EMI loading data.

It should be noted that the spare capacities are based on the asset rating values disclosed by Transpower, and the actual 2023 load data as recorded and presented on The Electricity Market Information website. Also, the spare (N) capacities do not include any voltage constraints or upstream transmission constraints, other than those mentioned in the *Transmission Planning Report 2023*, which would need to be confirmed by Transpower or the relevant EDB.

7. Spare Capacity – Zone Substations

In determining the (N) and (N-1) spare capacities for each zone substation, Ergo reviewed the EDB 2023 and 2024 disclosure data and the historical substation loading data for 2023. Actual historical loading data was provided by Counties Energy and Vector, and all data is shown in Table 4 and Table 5, respectively. As requested by Counties Energy, Ergo has updated the Counties Energy information in this section for the *2025 Asset Management Plan* disclosure data.

7.1 Counties Energy

Table 4 Counties Energy: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity		Spare (N-1) Capacity	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
1	Ōpaheke	49.0	39.8	9.0	-0.2
2	Pōkeno	68.0	67.0	28.0	27.0
3	Pukekohe	82.0	75.3	22.0	15.3
4	Tuakau	67.0	66.8	27.0	26.8
5	Barber Rd	68.0	68.3	28.0	28.3
6	Waiuku	23.0	22.0	3.0	2.0
7	Karaka	28.0	23.8	8.0	3.8
8	Maioro	10.0	5.7	1.0	-3.3

Note: The negative (N-1) values represent a zone substation where the (N-1) rating is already exceeded for periods during the year.

7.2 Vector

Ergo has assumed, in line with Vector comments, that where Vector zone substations do not have (N-1) capacity, that a value of 0 MVA is used for the spare (N-1) capacity (rather than showing negative (N-1) capacities).

Table 5 Vector: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity (MVA)		Spare (N-1) Capacity (MVA)	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
1	Atkinson Road	19.50	19.2	0.0	0.0
2	Auckland Airport	35.70	33.2	10.7	8.2
3	Avondale	10.20	12.0	0.0	0.0
4	Bairds	11.40	15.7	0.0	0.0
5	Balmain	3.00	3.3	0.0	0.0
6	Balmoral	25.90	27.1	5.9	7.1
7	Belmont	11.10	11.9	0.0	0.0
8	Big Ōmaha	7.50	Unknown	0.0	Unknown
9	Birkdale	17.60	18.3	0.0	0.0
10	Brickworks	4.70	7.6	0.0	0.0

No.	Substation Name	Spare (N) Capacity (MVA)		Spare (N-1) Capacity (MVA)	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
11	Brownsbay	14.70	14.3	0.0	0.0
12	Bush Road	25.80	28.6	0.8	3.6
13	Carbine	27.40	26.6	7.4	6.6
14	Chevalier	19.00	20.2	0.0	0.0
15	Clendon	19.40	21.0	0.0	1.0
16	Clevedon	1.80	-0.1	N/A	N/A
17	Coatesville	20.80	21.0	0.8	1.0
18	Drive	11.30	13.8	0.0	0.0
19	East Coast Road	-3.60	-4.1	0.0	0.0
20	East Tāmaki	17.90	26.7	0.0	6.7
21	Flatbush	13.30	15.3	0.0	0.0
22	Forrest Hill	16.00	15.2	0.0	0.0
23	Freemans Bay	19.70	19.4	0.0	0.0
24	Glen Innes	29.10	29.5	9.1	9.5
25	Greenhithe	9.30	12.8	0.0	0.0
26	Greenmount	19.00	23.1	0.0	3.1
27	Gulf Harbour	10.70	11.1	0.0	0.0
28	Hans	14.80	18.8	0.0	0.0
29	Hauraki	12.40	13.1	0.0	0.0
30	Helensville	3.20	3.4	0.0	0.0
31	Henderson Valley	9.50	8.0	0.0	0.0
32	Highbrook	11.00	11.5	11.0	11.5
33	Highbury	-0.20	0.7	0.0	0.0
34	Hillcrest	1.90	1.5	0.0	0.0
35	Hillsborough	18.40	18.1	0.0	0.0
36	Hobson 110/11kV	41.10	44.5	16.1	19.5
37	Hobson 22/11kV	11.40	13.0	2.4	4.0
38	Hobson 22kV	152.40	173.4	27.4	48.4
39	Hobsonville	11.60	12.7	0.0	0.2
40	Hobsonville Point	20.60	23.7	0.6	3.7
41	Howick	19.20	23.2	0.0	2.2
42	James Street	4.60	4.8	0.0	0.0
43	Kaukapakapa	8.80	8.6	0.0	0.0
44	Keeling Road	27.50	28.3	3.5	4.3
45	Kingsland	15.20	21.4	0.0	1.4
46	Laingholm	6.20	6.7	0.0	0.0
47	Liverpool 11kV	34.60	47.5	4.6	17.5
48	Liverpool 22kV	86.20	149.3	45.2	108.3
50	Māngere Central	23.70	27.1	3.7	7.1
51	Māngere East	7.50	11.3	0.0	0.0
52	Māngere West	35.60	34.8	5.6	4.8

No.	Substation Name	Spare (N) Capacity (MVA)		Spare (N-1) Capacity (MVA)	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
53	Manly	5.50	6.2	0.0	0.0
54	Manukau	27.30	28.0	7.3	8.0
55	Manurewa	-0.80	7.7	0.0	0.0
56	Maraetai	19.20	18.7	4.2	3.7
57	McKinnon	26.10	27.6	2.1	3.6
58	McLeod Road	2.70	3.2	0.0	0.0
59	McNab	9.30	26.3	0.0	6.3
60	Milford	4.20	0.9	0.0	0.0
61	Mt Albert	11.30	12.5	N/A	N/A
62	Mt Wellington	24.00	25.4	4.0	5.4
63	New Lynn	11.30	11.2	0.0	0.0
64	Newmarket	21.90	24.4	1.9	4.4
65	Newton	13.30	14.5	0.0	0.0
66	Ngātaringa Bay	3.10	4.4	N/A	N/A
67	Northcote	6.10	5.9	0.0	0.0
68	Onehunga	24.30	22.5	0.0	0.0
69	Ōrākei	12.10	11.4	0.0	0.0
70	Oratia	4.70	3.8	0.0	0.0
71	Ōrewa	17.30	17.6	0.0	0.0
72	Ōtara	20.80	23.9	0.8	3.9
73	Pacific Steel	93.90	89.8	19.9	15.8
74	Pakuranga	17.60	18.8	0.0	0.0
75	Papakura	10.00	11.7	0.0	0.0
76	Parnell	40.50	40.5	0.5	0.5
77	Ponsonby	10.20	11.1	0.0	0.0
78	Quay	22.10	21.3	2.1	1.3
79	Quay 22kV	57.60	65.2	7.6	15.2
80	Rānui	6.00	6.9	0.0	0.0
81	Red Beach	17.40	17.0	0.0	0.0
82	Remuera	13.20	13.0	0.0	0.0
83	Riverhead	1.20	-0.1	0.0	0.0
84	Rockfield	18.30	17.9	0.0	0.0
85	Rosebank	20.70	21.5	0.0	0.0
86	Rosedale	25.00	25.6	5.0	5.6
87	Sabulite Road	3.70	3.4	0.0	0.0
88	Sandringham	19.30	21.3	0.0	0.3
89	Simpson Road	2.10	2.3	0.0	0.0
90	Snells Beach	0.40	-0.3	0.0	0.0
91	South Howick	13.70	13.3	0.0	0.0
92	Spur Road	25.00	26.4	5.0	6.4
93	St Heliers	13.10	13.1	0.0	0.0

No.	Substation Name	Spare (N) Capacity (MVA)		Spare (N-1) Capacity (MVA)	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
94	St Johns	20.70	21.9	0.7	1.9
95	Sunset Road	11.40	12.4	0.0	0.0
96	Swanson	0.10	1.3	0.0	0.0
97	Sylvia Park	22.90	23.2	2.9	3.2
98	Takanini	-1.50	2.4	0.0	0.0
99	Takapuna	13.90	16.0	0.0	0.0
100	Te Atatū	2.40	4.1	0.0	0.0
101	Te Papapa	18.30	18.8	0.0	0.0
102	Torbay	2.90	3.1	0.0	0.0
103	Triangle Road	2.30	1.4	0.0	0.0
104	Victoria	22.70	22.8	2.7	2.8
105	Waiake	4.30	2.6	0.0	0.0
106	Waiheke	12.30	13.5	N/A	N/A
107	Waikaukau	-1.00	-2.1	0.0	0.0
108	Waimauku	17.20	18.0	0.0	0.0
109	Wairau Road	6.50	6.9	0.0	0.0
110	Warkworth	6.70	3.6	0.0	0.0
112	Wellsford	5.70	5.3	0.0	0.0
113	Westfield	11.60	16.0	0.0	0.0
114	Westgate	22.40	27.7	2.4	7.7
115	White Swan	16.50	22.8	0.0	1.8
116	Wiri	21.50	19.5	1.5	0.0
117	Woodford	2.80	1.0	0.0	0.0

Note: The negative (N-1) ratings represent a zone substation where the (N-1) rating is already exceeded at times throughout the year.

7.3 Summary

7.3.1 Counties Energy

(N-1) Capacity Summary

The following Figure 32 illustrates the approximate (N-1) spare capacities at Counties' zone substations, for the disclosed peak demand estimates. It should be noted that these have been calculated based on the transformer ratings disclosed by Counties.

The spare capacities shown do not include any upstream or downstream lines, cables or other equipment thermal constraints, which may be discussed for the selected zone substations in Section 8.

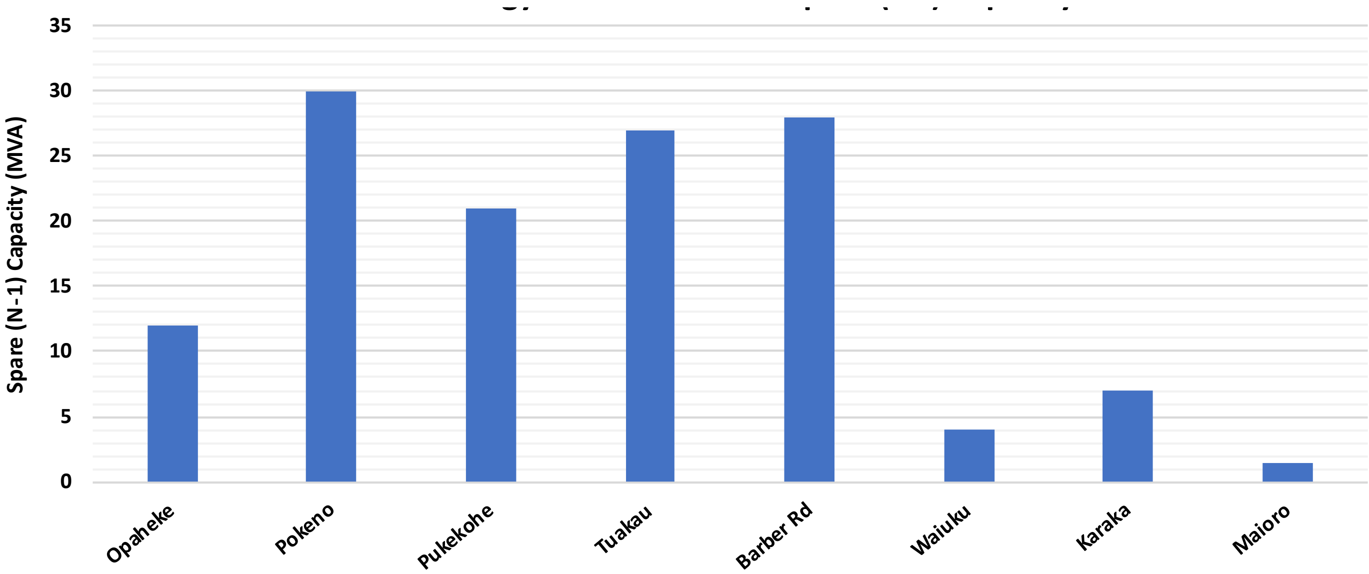


Figure 32. Summary: Approximate (N-1) spare capacity at Counties' zone substations

The zone substations with spare (N-1) capacity available vary from 15% (for Maioro) to 75% (for Pōkeno).

(N) Capacity Summary

The following Figure 33 illustrates the approximate (N) spare capacities at Counties' zone substations, for the disclosed peak demand estimates[38]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Counties.

The spare capacities shown do not include any upstream or downstream lines, cables or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8. Figure 33 indicates that there is a moderate volume of spare (N) capacity at Counties' substations, with spare capacity ranging from 15% to 88%, although we note that these may be in locations where (N-1) security of supply would be a standard requirement.

[38] Counties' 2023 AMP available here: https://countiesenergy.co.nz/about-us/regulatory-disclosures/

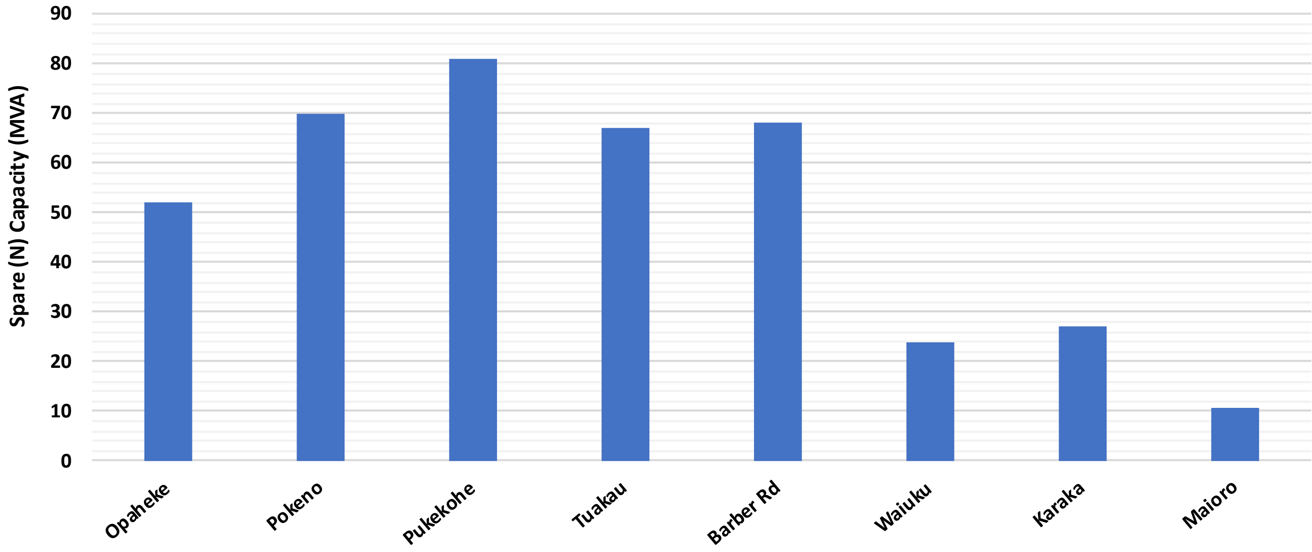


Figure 33. Summary: Approximate (N) spare capacity at Counties' zone substations

7.3.2 Vector

(N-1) Capacity Summary

The following Figure 34 illustrates the approximate (N-1) spare capacities at Vector's zone substations, for the disclosed peak demand estimates. It should be noted that these have been calculated based on the transformer ratings disclosed by Vector.

The spare capacities shown do not include any upstream or downstream conductor or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

Ergo has assumed, in line with Vector comments, that where Vector zone substations do not have (N-1) capacity, that a value of 0 MVA is used for the spare (N-1) capacity (rather than showing negative (N-1) capacities). Four of the one-hundred-and-seventeen zone substations (Clevedon, Mt Albert, Ngātaringa Bay, and Waiheke) do not have (N-1) security with respect to the supply transformers. At many of the zone substations, the (N-1) supply capacity was met or exceeded in 2023.

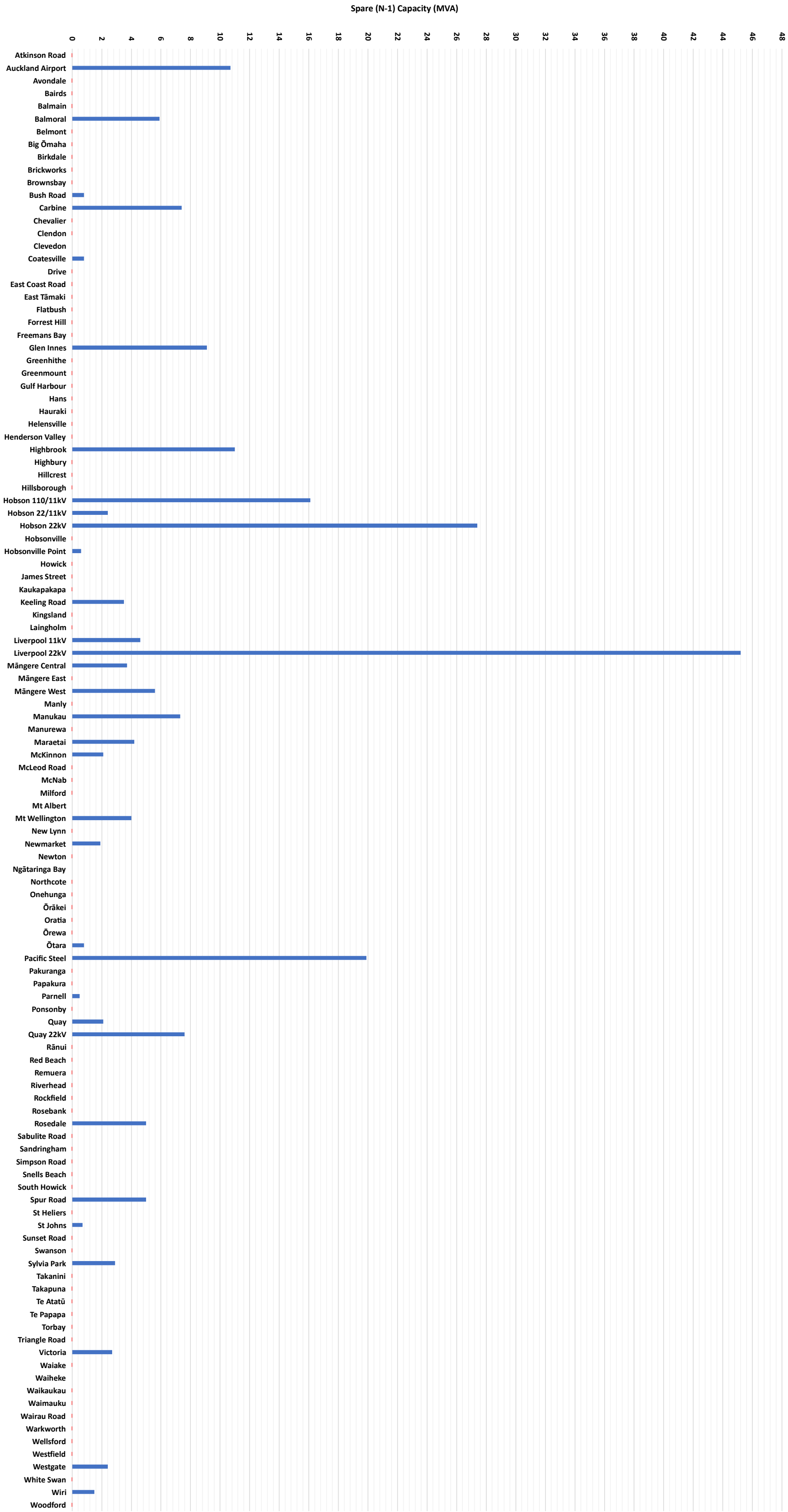


Figure 34. Summary: Approximate (N-1) spare capacity at Vector's zone substations

The zone substations with spare (N-1) capacity left vary from 3% to 64% available capacity.

(N) Capacity Summary

The following Figure 35 illustrates the approximate (N) spare capacities at Vector's zone substations, for the disclosed peak demand estimates[39]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Vector.

The spare capacities shown do not include any upstream or downstream lines, cables or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

Figure 35 indicates that there is a wide range of spare (N) capacity, with spare (N) capacity ranging from 5% to 85%. We note that where substations have spare (N) capacity may be in locations where (N-1) security of supply would be a standard requirement.

[39] Powerco's 2023 AMP available here: https://www.Powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures

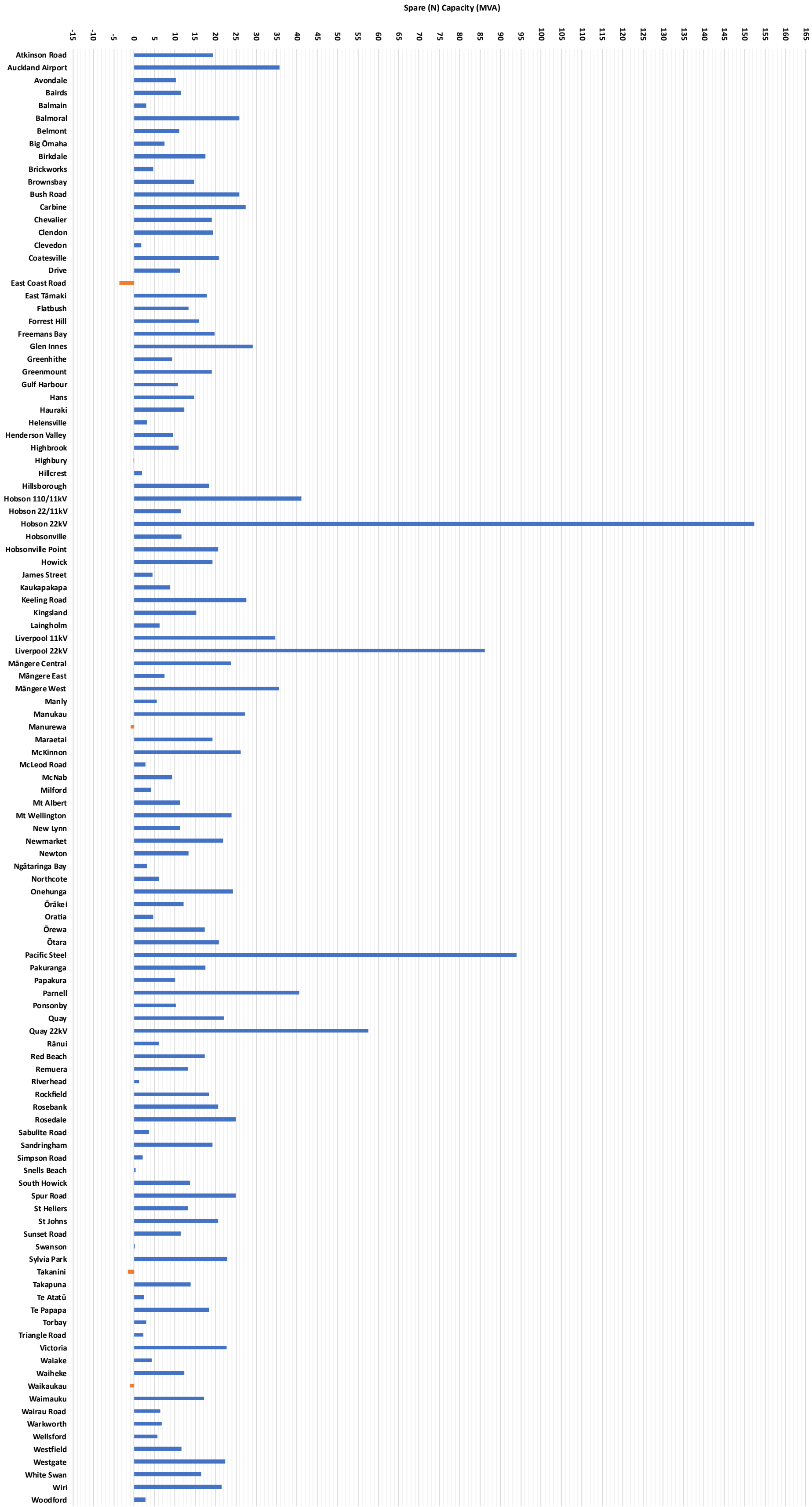


Figure 35. Summary: Approximate (N) spare capacity at Vector's zone substations

8. Connection Options

The following sections describe the potential connection options for EECA's Load Sites. For simplicity Ergo has categorised (and discusses) the connection options for each Load Site in terms of the local substations, as follows:

- Transpower GXP substations (shaded blue colour in diagrams).
- The EDB zone substations (shaded yellow in diagrams).

The purpose of this section is to provide a high-level assessment regarding the feasibility of connecting the Load Sites to the existing electrical infrastructure (both transmission and distribution) and where upgrades would be needed, provide an indication of potential scope, capital costs and timeframes.

The assessments made have involved a desk-based assessment using the various information provided to Ergo. Where information was not available, we have used engineering judgement. If the Load Sites are progressed further, Ergo recommends more detailed engineering assessments are undertaken in consultation with Transpower and the relevant EDB. This would likely entail powerflow modelling, optioneering and concept designs to provide more refined cost estimates.

8.1 Assessment Methodology

The assessment of each individual Load Site uses a top-down approach where the Load Site peak load is used to determine whether there appears to be spare capacity at:

- The incoming transmission lines.
- The GXP substation.
- The sub-transmission lines feeding the nearby zone substation.
- The nearby zone substation.
- The adjacent 11 kV or 22 kV feeder.

The spare capacity across each asset type has been determined using the information provided by Transpower and the relevant EDB or in the absence of information, assumptions made based on the asset type/voltage and typical capacity expectations.

Once the load implications across the supply network are understood, Ergo has been able to determine the implications of connecting that load (i.e. the necessary infrastructure upgrades). Ergo has used a building block approach to the costing of the necessary upgrades where typical assets have a unit rate associated with them.

In terms of upgrades, these can typically be classified as:

- **Minor** – The "as designed" electrical system can likely connect the Load Site with minor distribution level changes and without the need for substantial infrastructure upgrades costs.
- **Moderate** – The "as designed" electrical system requires some infrastructure upgrades including new connections into the local zone substation and/or upgrades at the local zone substation or sub-transmission network.

- **Major** – The "as designed" electrical system requires substantial upgrades at both the transmission and distribution level, likely requiring significant investment.

Ergo notes that, additional to any costs outlined in this report, Vector requires a development contribution cost to be paid by connecting Load Sites. This development contribution varies depending on the complexity of installing and connecting the new load, and would be determined by Vector when a connection application request is made by the customer. More information on this contribution is available on the Vector website.

8.2 Engineering Assumptions

Specific engineering assumptions in this section include:

- We have used the spare capacities of both the GXP, and zone substations based on the publicly disclosed loading and capacity data (and have subsequently updated these estimates based on comments from Transpower, Vector, and Counties Energy). Ergo's view is that these are typically more conservative than the actual loading and are therefore appropriate for this sort of high-level assessment.
- We have assumed the existing site security should be maintained (unless otherwise stated). For example, if the site currently presently has (N-1) security, we have recommended infrastructure upgrades to maintain this.
  For larger loads, where appropriate, both an (N) supply option and an (N-1) supply option have been investigated.
- The upgrades and costs of individual Load Sites are considered in isolation of the adjacent Load Sites. We have not considered, in-depth, the scope and costs associated with connecting multiple Load Sites at this stage.
- The Load Site loads will have unity power factor which is reasonable considering the preliminary nature of the assessment.
- Unless otherwise stated, we have assumed the existing incoming sub-transmission line/cable capacities exceed the capacity of the existing zone substation(s) they supply.
- Unless capacity information is available, we assumed existing 33 kV, 22 kV, and 11 kV feeders are capable of supplying up to 12 MVA, 9 MVA, and 4.5 MVA respectively which is generally accepted as a conservative capacity limit in the absence of detailed information.
- Cost estimates have a Class 5[40] accuracy - suitable for concept screening. Appendix 3 outlines accuracy of the cost estimates and the general assumptions.
- Cost estimates exclude land purchase, easements and consenting. These costs are difficult to estimate without undertaking a detailed review of the available land (including a site visit) and the local council rules in relation to electrical infrastructure. For example, the upgrade of existing overhead lines or new lines/cables across private land does require utilities to secure easements to protect their assets. Securing easements can be a very time consuming and costly process. For this reason, Ergo's estimates for new electrical circuits are generally based on assuming they are installed in road reserve and involve underground cables in urban locations and overhead lines in rural locations. We note that, generally, 110 kV and 220 kV lines cannot be installed in road reserve

40 Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

due to wide corridor requirements. In some locations the width of the road reserve is such that 66 kV and 33 kV lines cannot be installed. This issue only becomes transparent after a preliminary line design has been undertaken.

- Cost estimates only include the incumbent network operator's distribution/transmission equipment and do not include onsite equipment that may be required to supply the Load Sites (for example, MV switchboards/cabling and LV switchboards/cables within the respective Load Site sites are not included).
- There is space available in zone substation and GXP buildings to accommodate new circuit breakers to supply medium size loads. For example, a single 11 kV breaker can be accommodated without having to extend the relevant zone substation switchroom, or a new 33 kV circuit breaker can be accommodated at a GXP for a new feeder to a zone substation.
- The time estimates provided are based on Ergo's experience. These can vary significantly depending on the scope of the project and the appetite for expediting. These should be used as a guide only.
- Where projects are assessed in stages, the analysis undertaken assumes that upgrades continue down either the (N) or (N-1) security path, and the two options are not mixed between stages. Costs are cumulative as the Load Site growth progresses.
- Some Load Sites have staged analysis. For these Sites, EECA provided Ergo with preferred staging MW levels, however, at EECA's request, some of these sites staging MW levels have been adjusted by Ergo to better align with electrical system constraints.

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary, based on data gathered at one point in time, and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes. For the larger Load Sites Ergo recommend proceeding with a Concept Design Report (CDR) to improve the accuracy of the respective cost estimate. It is additionally encouraged that Load Sites engage with their respective EDB at the earliest opportunity during upgrade planning in order to confirm the most up-to-date information. Vector does not endorse the cost estimates in this report and recommends any customer wanting to find out about the cost of connecting to contact Vector directly.

8.3 Auckland CBD GXPs (Penrose and Hobson 110 kV)

The "Large" EECA load sites connecting to the Auckland CBD GXPs include:

- Health New Zealand Auckland City Hospital (5.81 MW)
- University of Auckland City (4.69 MW)
- University of Auckland Grafton (1.60 MW)

The "Small" EECA load sites connecting to the Auckland CBD GXPs include (refer to Sections 8.3.5 and 8.3.7):

- Sky City Auckland (0.98 MW)
- Auckland University of Technology City Campus (0.93 MW)
- Department of Corrections Mt. Eden Prison & Auckland Central Remand Prison (0.52 MW)
- Grand Millennium Hotel (0.41 MW)
- Auckland Council Tepid Baths (0.26 MW)
- Auckland Council Parnell Baths (0.18 MW)
- The Olympic Pools & Fitness Centre Newmarket (0.17 MW)

The geographic locations of the Load Sites are shown on the following map, in relation to the local transmission and distribution substations.

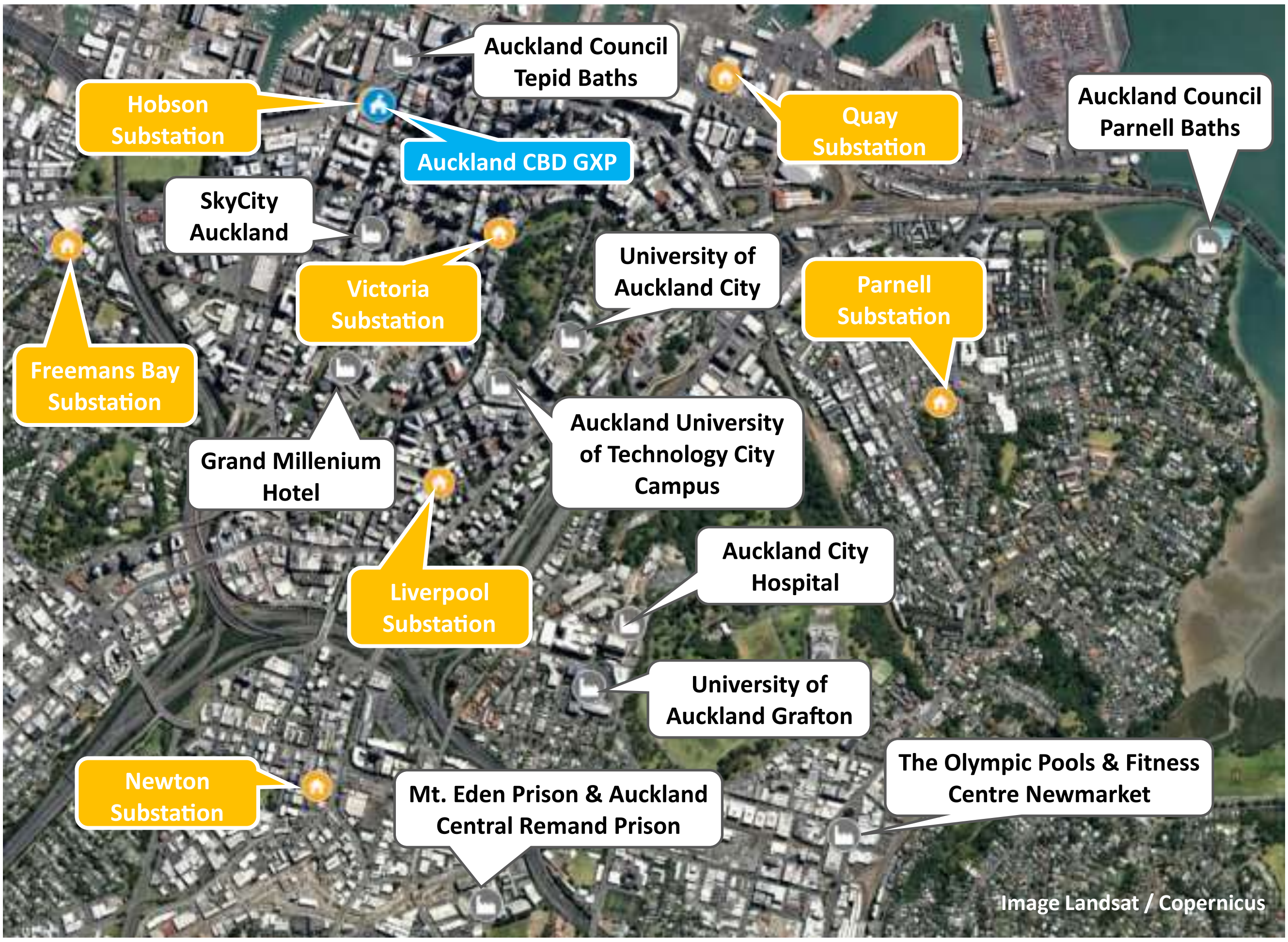


Figure 36. Auckland CBD GXPs: EECA Load Sites vs local substations

8.3.1 Auckland CBD GXPs upgrade

The Auckland CBD 33 kV GXP presently has 313 MVA of spare (N-1) capacity and 563 MVA of spare (N) capacity, based on the transformer ratings. The spare (N-1) capacity of the GXPs is not expected to be exceeded by the connecting Load Sites (see section 8.3.8). Therefore, further upgrades of the Auckland CBD GXPs are not considered.

8.3.2 Health New Zealand Auckland City Hospital

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	5.81	Auckland CBD

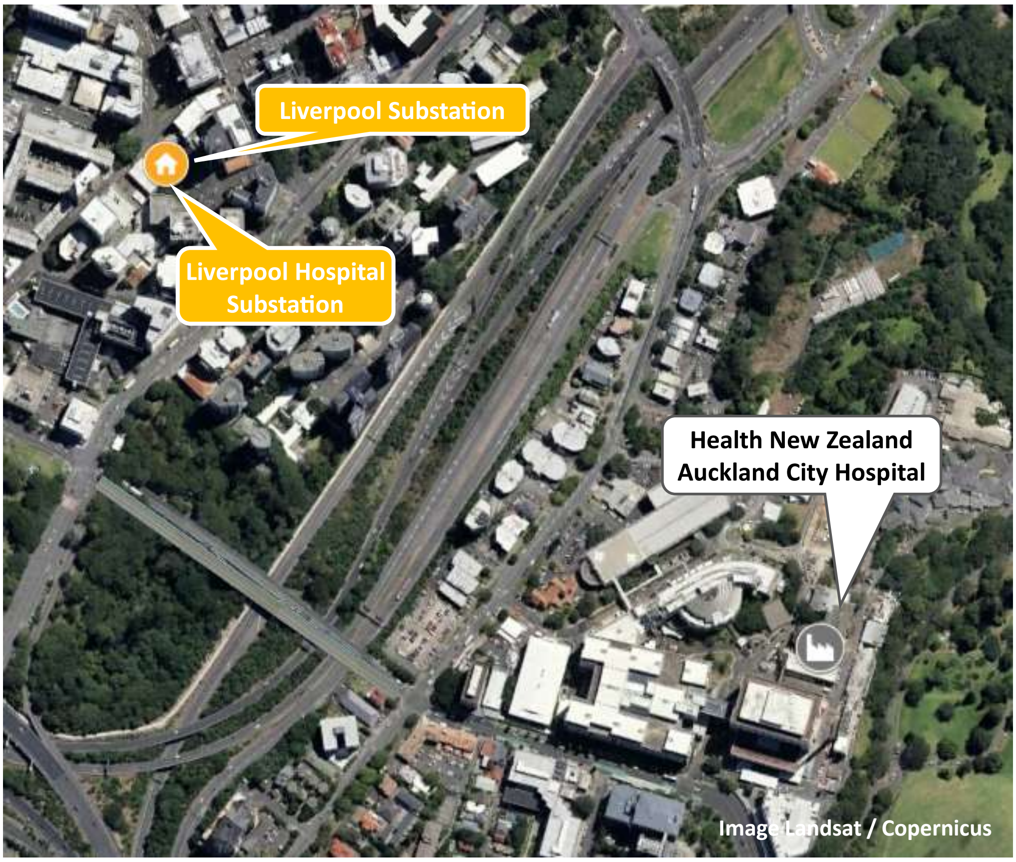


Figure 37. Health New Zealand Auckland City Hospital geographic location in relation to the surrounding zone substations

8.3.2.1 Existing electrical supply to the Plant

Auckland City Hospital is presently supplied by Vector's Liverpool Hospital zone substation, which is adjacent to, and supplied by, the Liverpool 22 kV substation. One 22/11 kV transformer (rated to 10 MVA) is located at the hospital substation. The load site is currently supplied by two 11 kV feeders with unique LHOS feeder codes which are fully underground. The Liverpool substation 11 kV feeder LIVE K28 also runs adjacent to the site. There is a single 22 kV subtransmission cable rated at approximately 13.9 MVA connecting the Liverpool substation to the hospital substation next door. Liverpool connects to the Kingsland, Victoria, and Newton zone substations through underground cables at 22 kV, while additionally functioning as a Vector-owned 110 kV/22 kV substation.

The site is located approximately 0.8 km away from Liverpool Hospital zone substation/Liverpool Substation. The zone substation is located in turn approximately 1.2 km from Hobson St GXP.

There is currently a maximum loading of 93.8 MVA on Liverpool 22 kV zone substation, with 86.2 MVA of spare (N) capacity and 45.2 MVA of spare (N-1) capacity. Ergo does not have visibility on the existing load of the Liverpool Hospital site, however it is assumed that the existing supply would not have capacity to supply the proposed additional load (as the existing 11 kV feeders to the site do not have spare capacity). The Auckland CBD GXP presently has 313 MVA of spare (N-1) capacity and 563 MVA of spare (N) capacity, based on the transformer ratings.

8.3.2.2 Supply Option(s) for New Load

Ergo has assumed that the existing supply arrangement via the Liverpool Hospital substation would be maintained for future upgrades. Liverpool 22 kV substation and the associated GXPs do have adequate (N) and (N-1) capacity for this load. As mentioned above, it is assumed that the existing Liverpool Hospital substation does not have (N) or (N-1) capacity for this load.

For either an (N) or an (N-1) security supply, it is assumed that an additional 11 kV feeder would be required to supply this site. This new feeder would be underground, matching the existing supply, and be approximately 1.22 km long. Included in this route would be a crossing under a series of motorway-type roads, for which Ergo has allowed an additional 1 km worth of cabling in the pricing. Additionally, an upgrade of the 22 kV supply from the Liverpool 22 kV substation to the Liverpool Hospital substation would be required, and a replacement of the existing 22/11 kV transformer at the Liverpool Hospital substation.

For an (N-1) supply, it is assumed that a second 22 kV supply between Liverpool 22 kV substation and Liverpool substation would be required. A second 22/11 kV transformer would also be required at the Liverpool Hospital substation.

8.3.2.3 Capital Cost Estimate

Table 6. Auckland City Hospital: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Single underground 22kV cable	0.02	$0.01
Subtransmission	Medium supply transformer (ZSS)	1.00	$1.90
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	2.22	$1.78
		TOTAL	**$3.89**

Table 7. Auckland City Hospital: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Double underground 22kV cable	0.02	$0.02
Subtransmission	22kV circuit breaker (ZSS)	2.00	$0.40
Distribution	Medium supply transformer (ZSS)	2.00	$3.80
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	2.22	$1.78
		TOTAL	**$6.19**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.3.2.4 Expected Timeframe

It is estimated to take 24-36 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.3 University of Auckland City

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	4.69	Auckland CBD

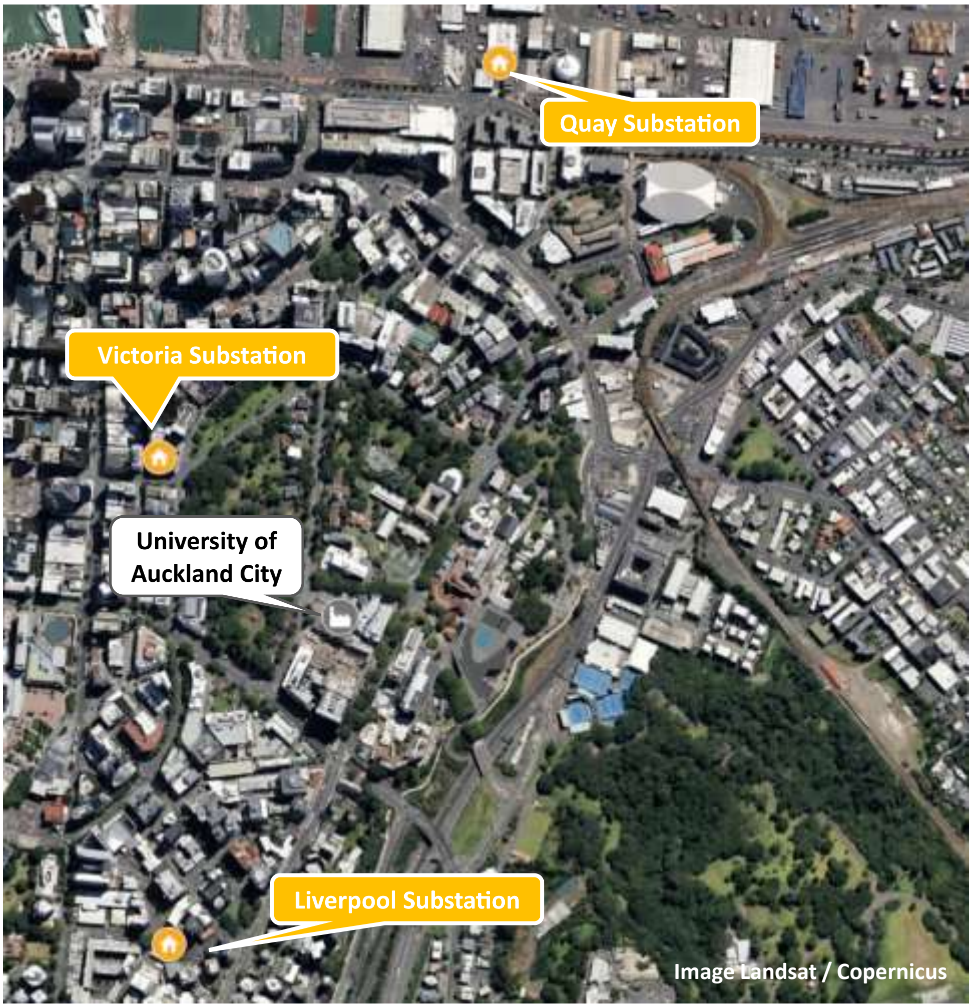


Figure 38. University of Auckland City geographic location in relation to the surrounding zone substations

8.3.3.1 Existing electrical supply to the Plant

University of Auckland City campus is presently supplied by Vector's Quay and Liverpool zone substations. The north side of the site is currently supplied with a 11 kV feeder from Quay which is fully underground. The south side is supplied from the Liverpool zone substation with an underground 11 kV feeder. There is additionally a feed into the university from the Liverpool J04 (22 kV) feeder.

The site is located approximately 0.6 km away from Liverpool zone substation. The Liverpool zone substation is located in turn approximately 1.2 km from Hobson St GXP. The site is located approximately 0.9 km away from Quay zone substation. The Quay zone substation is located in turn approximately 1.1 km from Hobson St GXP.

There is currently a maximum loading of 35.4 MVA on Liverpool 11 kV zone substation, with 34.6 MVA of spare (N) capacity and 4.6 MVA of spare (N-1) capacity. There is currently a maximum loading of

93.8 MVA on Liverpool 22 kV zone substation, with 86.2 MVA of spare (N) capacity and 45.2 MVA of spare (N-1) capacity. There is currently a maximum loading of 17.9 MVA on the Quay 11 kV substation, with 22.1 MVA of spare (N) capacity, and 2.1 MVA of spare (N-1) capacity. The Auckland CBD GXP presently has 313 MVA of spare (N-1) capacity and 563 MVA of spare (N) capacity, based on the transformer ratings.

8.3.3.2 Supply Option(s) for New Load

The Liverpool 22 kV substation and GXP both have adequate (N) and (N-1) spare capacity for this load. The Liverpool and Quay 11 kV substations have adequate (N) spare capacity but not (N-1). As such, it is assumed that the new supply to the site would be connected to the Liverpool 22 kV substation.

The LIVE J04 feeder is presently loaded at a maximum of 6.28 MVA. Vector's capacity map indicates that this feeder is operating below 60% of its capacity, so it is assumed that the load site would be able to connect to the feeder without upgrades (other than upgrades required within the load site such as RMUs and distribution transformers). For costing purposes, Ergo has included the cost of a 22/11 kV transformer appropriate for this load, which may be required at the Load Site.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.3.3.3 Capital Cost Estimate

Table 8. University of Auckland City: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Small supply transformer (ZSS)	1.00	$1.50
		TOTAL	**$1.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.3.3.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.4 University of Auckland Grafton

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	1.60	Auckland CBD

Figure 39. University of Auckland Grafton geographic location in relation to the surrounding zone substations

8.3.4.1 Existing electrical supply to the Plant

University of Auckland Grafton campus is presently supplied by Vector's Liverpool zone substation. The site is currently supplied with a 11 kV feeder which is fully underground. Liverpool substation connects to the Kingsland, Victoria, and Newton zone substations through underground cables.

The site is located approximately 0.8 km away from Liverpool 110/22/11 kV zone substation. The zone substation is located approximately 1.2 km from Hobson St GXP.

There is currently a maximum loading of 35.4 MVA on Liverpool 11 kV zone substation, with 34.6 MVA of spare (N) capacity and 4.6 MVA of spare (N-1) capacity. There is currently a maximum loading of 93.8 MVA on Liverpool 22 kV zone substation, with 86.2 MVA of spare (N) capacity and 45.2 MVA of spare (N-1) capacity. The Auckland CBD GXP presently has 313 MVA of spare (N-1) capacity and 563 MVA of spare (N) capacity, based on the transformer ratings.

8.3.4.2 Supply Option(s) for New Load

Both the GXP and the zone substation have spare (N) and (N-1) capacity. Therefore, no further upgrades are expected at the zone substation or GXP.

Vector's capacity map indicates that the 11 kV feeder supplying the site is operating below 60% of its capacity, so it is assumed that the load site would be able to connect to the feeder without upgrades (other than upgrades required within the load site such as RMUs and distribution transformers).

8.3.4.3 Capital Cost Estimate

Indicatively, it is expected that a distribution transformer to supply this load would cost approximately $350k.
Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.3.4.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.5 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 9. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Estimated Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Sky City Auckland	Victoria	2.7	22.7	5.2	0.98	260
Auckland University of Technology City Campus	Liverpool 11 kV	4.6	34.6	6.7	0.93	260
Department of Corrections Mt. Eden Prison & Auckland Central Remand Prison*	Newton	0.0	13.3	-1.9	0.52	200
Grand Millennium Hotel	Liverpool 22 kV	45.2	86.2	11.9	0.41	130
Auckland Council Tepid Baths	Hobson 22/11 kV	2.4	11.4	3.9	0.26	130
Auckland Council Parnell Baths*	Quay	2.1	22.1	-0.7	0.18	80
The Olympic Pools & Fitness Centre Newmarket	Parnell	0.5	40.5	2.5	0.17	80

*Ergo has checked the existing feeders of these sites against the Vector capacity map, which indicated that the feeders have sufficient capacity for the additional load, contrary to the data shown above. Ergo has assumed that the data in the map is accurate.

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.3.6 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.3.6.1 Liverpool 11 kV

Two of the loads on the Auckland CBD GXPs are expected to connect to Liverpool 11 kV zone substation. These loads are University of Auckland Grafton, and Auckland University of Technology City Campus. The sum of peaks of these loads is 2.53 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades of the Liverpool 11 kV substation are expected.

8.3.6.2 Liverpool 22 kV

Three of the loads on the Auckland CBD GXPs are expected to connect to Liverpool 22 kV zone substation. These loads are Health New Zealand Auckland City Hospital, University of Auckland City, and Grand Millenium Hotel. The sum of peaks of these loads is 11.97 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades of the Liverpool 22 kV substation are expected.

8.3.7 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Auckland CBD GXPs gives a combined load of 3.45 MW. When the load shapes are combined, they result in the following load shape (Figure 40), with a maximum load of 2.55 MW, with a diversity factor of 0.90.

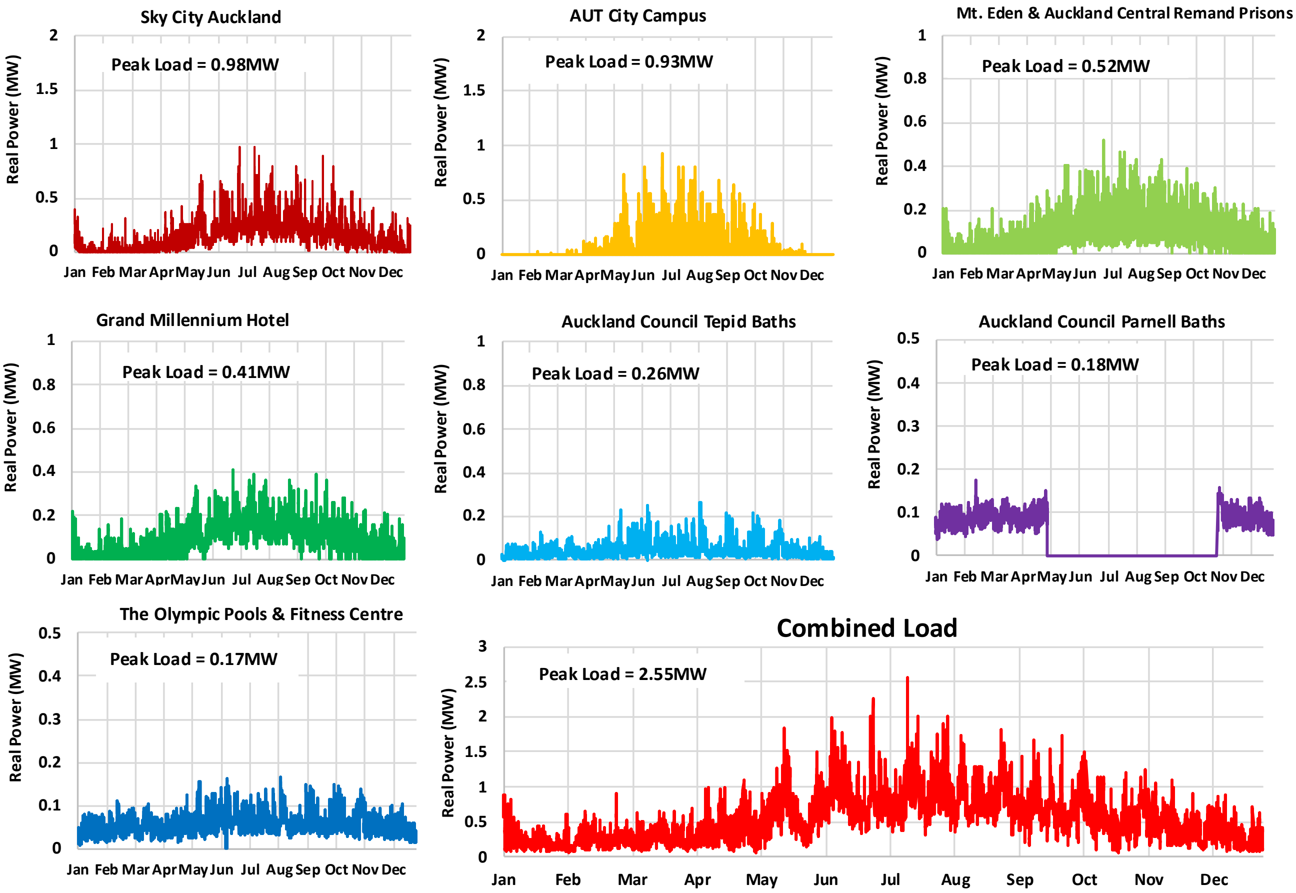


Figure 40. Loading Profiles: Auckland CBD GXPs "small" Load Site Profiles: Combined Load (sum of all profiles)

8.3.8 Effect of all Load Sites Connecting to Auckland CBD GXPs

Figure 41 illustrates the Auckland CBD load profile together with the load profiles of all the Load Sites within the Auckland CBD region. Also shown in Figure 41 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Auckland CBD GXPs would increase to 171 MW, an increase of 7.5 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 178 MW there is a diversity factor of 0.96 between the loads.
- Based on Ergo's analysis, the Auckland CBD GXPs' (N-1) limit is not expected to be exceeded.

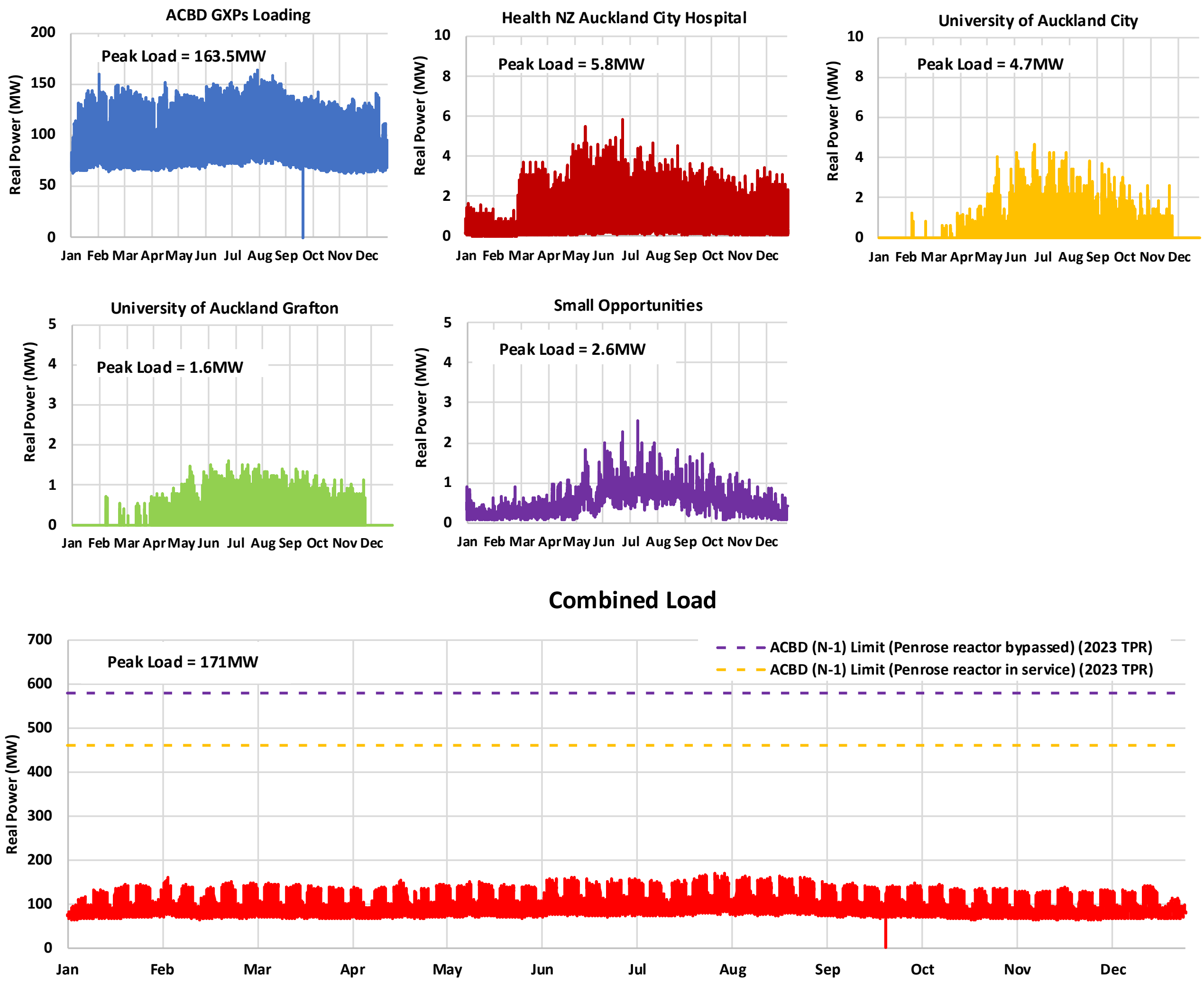


Figure 41. Loading Profiles: Auckland CBD GXPs 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.4 Albany 33 kV GXP

The "Large" EECA load site connecting to the Albany 33 kV GXP is:

- Amcor Cartons Albany (5.94 MW)

The "Small" EECA load sites connecting to the Albany 33 kV GXP include (refer to Sections 8.4.3 and 8.4.5):

- Department of Corrections Auckland Prison (0.84 MW)
- Ministry of Education Long Bay College (0.42 MW)
- Auckland Council Albany Stadium Pool (0.40 MW)
- Massey University Auckland (0.36 MW)
- Auckland Council Glenfield Pool and Leisure Centre (0.18 MW)

The geographic locations of the Load Sites are shown on the following maps, in relation to the local transmission and distribution substations.

Figure 42. Albany 33 kV GXP: EECA Load Sites vs local substations

8.4.1 Albany 33 kV GXP upgrade

The Albany 33 kV GXP presently has 71 MVA of spare (N-1) capacity and 131 MVA of spare (N) capacity, based on the transformer ratings. The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.4.6). Therefore, no further upgrades are expected at Albany 33 kV GXP.

8.4.2 Amcor Cartons Albany

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	5.94	Albany 33 kV

Figure 43. Amcor Cartons Albany geographic location in relation to the surrounding zone substations

8.4.2.1 Existing Electrical Supply to the Plant

Amcor Cartons Albany is presently supplied by Vector's Bush Road zone substation. The site is currently supplied with an 11 kV feeder which is fully underground. Bush Road connects directly to the Albany GXP through three circuits at 33 kV (two of which are rated to 25 MVA, and the other to 53 MVA). Two 33 kV circuits supply the downstream Sunset Road and Forrest Hill substations from the Bush Road 33 kV bus.

The site is located approximately 0.67 km away from Bush Road zone substation. The zone substation is located in turn approximately 1.8 km from Albany GXP.

There is currently a maximum loading of 22.2 MVA on Bush Road zone substation, with 25.8 MVA of spare (N) capacity and 0.8 MVA of spare (N-1) capacity. The Albany 33 kV GXP presently has 70 MVA of spare (N-1) capacity and 130 MVA of spare (N) capacity, based on the transformer ratings.

The sum of the peak loads at Bush Road (22.2 MVA), Sunset Road (13.6 MVA), and Forrest Hill (16.5 MVA), is 52.3 MVA. Therefore, the subtransmission circuits supplying Bush Road have ~50.7 MVA of spare (N) capacity, and ~-2.3 MVA of spare (N-1) capacity.

8.4.2.2 Supply Option(s) for New Load

Both the zone substation and the GXP have sufficient spare (N) capacity for this load. However, both the zone substation and the subtransmission circuits supplying it lack (N-1) capacity.

For either an (N) or an (N-1) security supply, it is expected that a new 11 kV feeder from the Bush Road substation to the site would be required. This new feeder would be expected to be underground cabling due to the urban topography, and would be ~1.1 km long.

Additionally, for an (N) security solution, Ergo has assumed that a special protection scheme would be required for the Bush Road substation transformers, to prevent an overload of one when the other is offline.

For an (N-1) solution, transformer replacements would be required at Bush Road substation, along with upgrade/replacement of one of the lower capacity 33 kV circuits presently supplying Bush Road. It has been assumed that this circuit upgrade would consist of 2.8 km (the length of the existing circuit) of underground cabling, due to the urban topography.

8.4.2.3 Capital cost estimate

Table 10. Amcor Cartons Albany: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Special protection system (ZSS)	1.00	$0.25
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable	1.10	$0.66
		TOTAL	**$1.11**

Table 11. Amcor Cartons Albany: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N-1)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Single underground 33kV cable	2.80	$5.60
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable	1.10	$0.66
		TOTAL	**$11.06**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.4.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.4.3 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 12. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Estimated Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Department of Corrections Auckland Prison	Coatesville	0.8	20.8	1.2	0.84	260
Ministry of Education Long Bay College	Torbay	0.0	2.9	4.2	0.42	130
Auckland Council Albany Stadium Pool	McKinnon	2.1	26.1	3.6	0.40	130
Massey University Auckland	McKinnon	2.1	26.1	3.6	0.36	130
Auckland Council Glenfield Pool and Leisure Centre*	James Street	0.0	4.6	-1	0.18	80

*Ergo has checked the existing feeder of this site against the Vector capacity map, which indicated that the feeder has sufficient capacity for the additional load, contrary to the data shown above. Ergo has assumed that the data in the map is accurate.

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.4.4 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.4.4.1 McKinnon

Two of the loads on Albany GXP are expected to connect to McKinnon zone substation. These loads are Auckland Council Albany Stadium Pool, and Massey University Auckland. The sum of peaks of these loads is 0.76 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at McKinnon zone substation.

8.4.5 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on the Albany 33 kV GXP gives a combined load of 2.19 MW. When the load shapes are combined, they result in the following load shape (Figure 44), with a maximum load of 1.67 MW, with a diversity factor of 0.76.

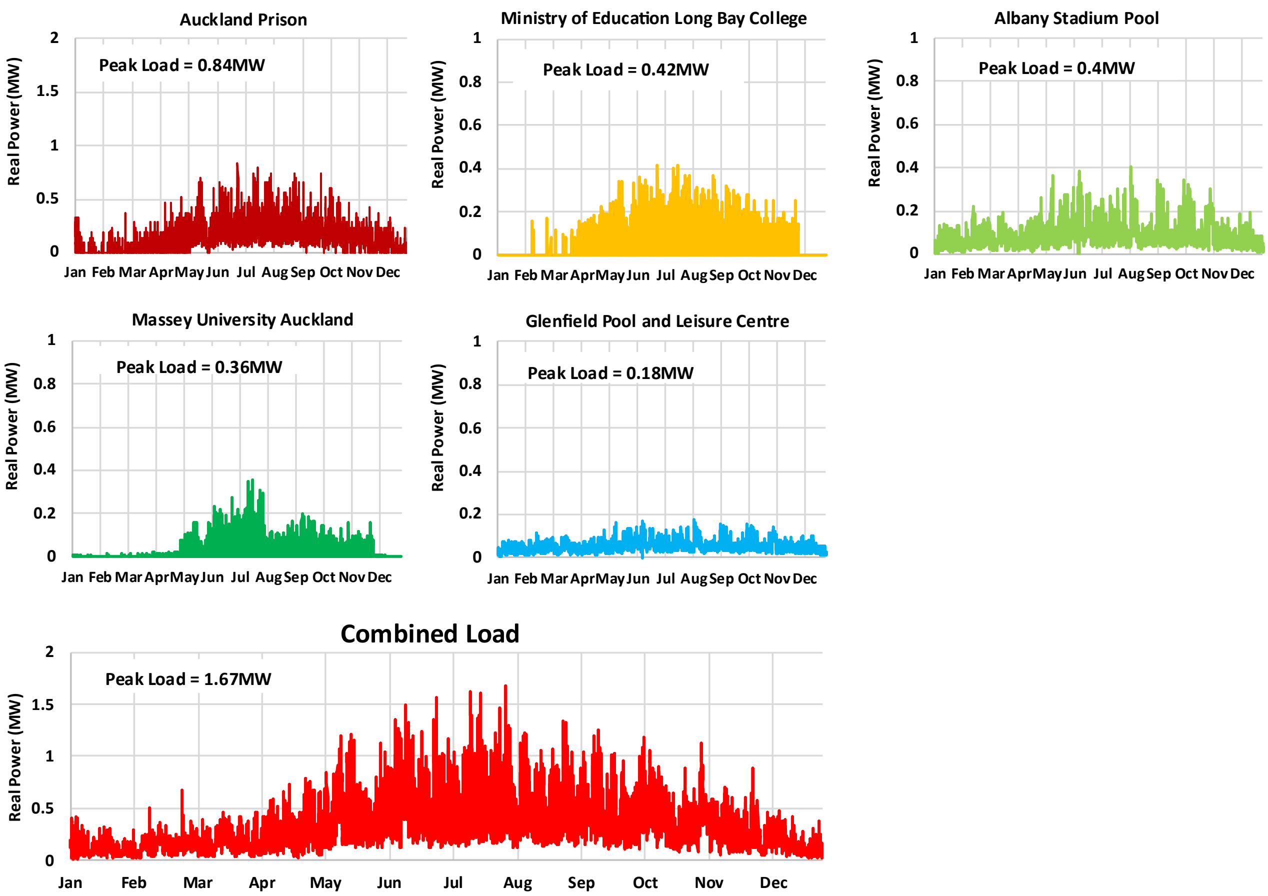


Figure 44. Loading Profiles: Albany 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.4.6 Effect of all Load Sites Connecting to Albany 33 kV GXP

Figure 45 illustrates the Albany 33 kV GXP load profile together with the load profiles of all the Load Sites within the Albany 33 kV GXP region. Also shown in Figure 45 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Albany 33 kV GXP would increase to 171 MW, an increase of 7.5 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 178 MW there is a diversity factor of 0.96 between the loads.
- Based on Ergo's analysis, the Albany 33 kV GXP's (N-1) limit is not expected to be exceeded.

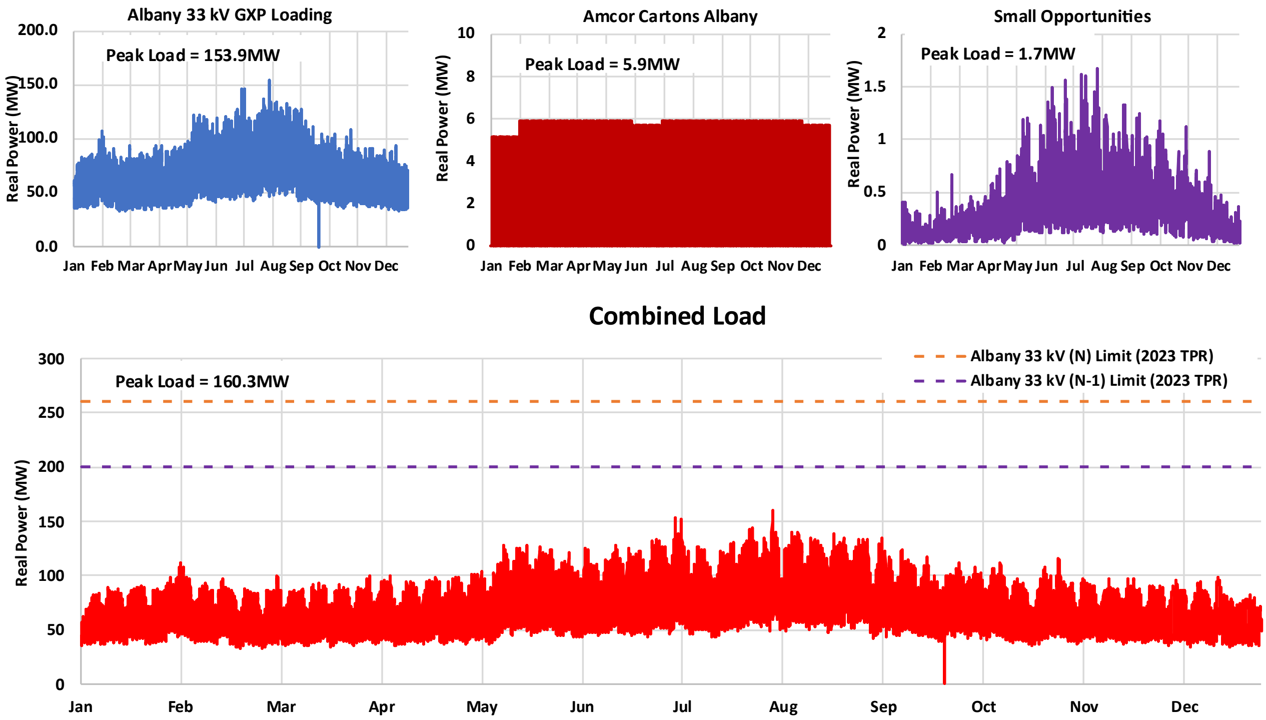


Figure 45. Loading Profiles: Albany 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.5 Bombay 110 kV GXP

Ergo notes that Bombay 110 kV GXP was previously included in the Waikato EECA region. Due to mismatches between the regions used by EECA and Transpower/EDBs, more load sites for the Bombay 110 kV GXP are added as part of this Auckland regional EECA study. Where possible/relevant, Ergo has given consideration to the effect of the Load Sites identified in the previous Waikato study, though the working for those Load Sites is not replicated here.

The “Large” EECA load sites connecting to the Bombay 110 kV GXP include:

- Boundary Road Brewery (5.18 MW)
- NIG Nutritionals Pukekohe (4.76 MW)
- NZ Hothouse Karaka (2.37 MW)
- NZ Hothouse Bombay (1.98 MW)
- Gellerts Auckland (1.56 MW)

The “Small” EECA load sites connecting to the Bombay 110 kV GXP include (refer to Sections 8.5.7 and 8.5.9):

- KJ Flowers Drury (0.51 MW)
- Rainbow Park Nurseries Ltd Drury (0.50 MW)
- Bokay Flower Farms (0.37 MW)
- Van den Brink Poultry Limited (Brinks Chicken) Karaka (0.29 MW)
- Ministry of Education Pukekohe High School (0.22 MW)
- Karaka Park Produce Ltd Pukekohe (0.14 MW)

The geographic locations of the Load Sites are shown on the following maps, in relation to the local transmission and distribution substations.

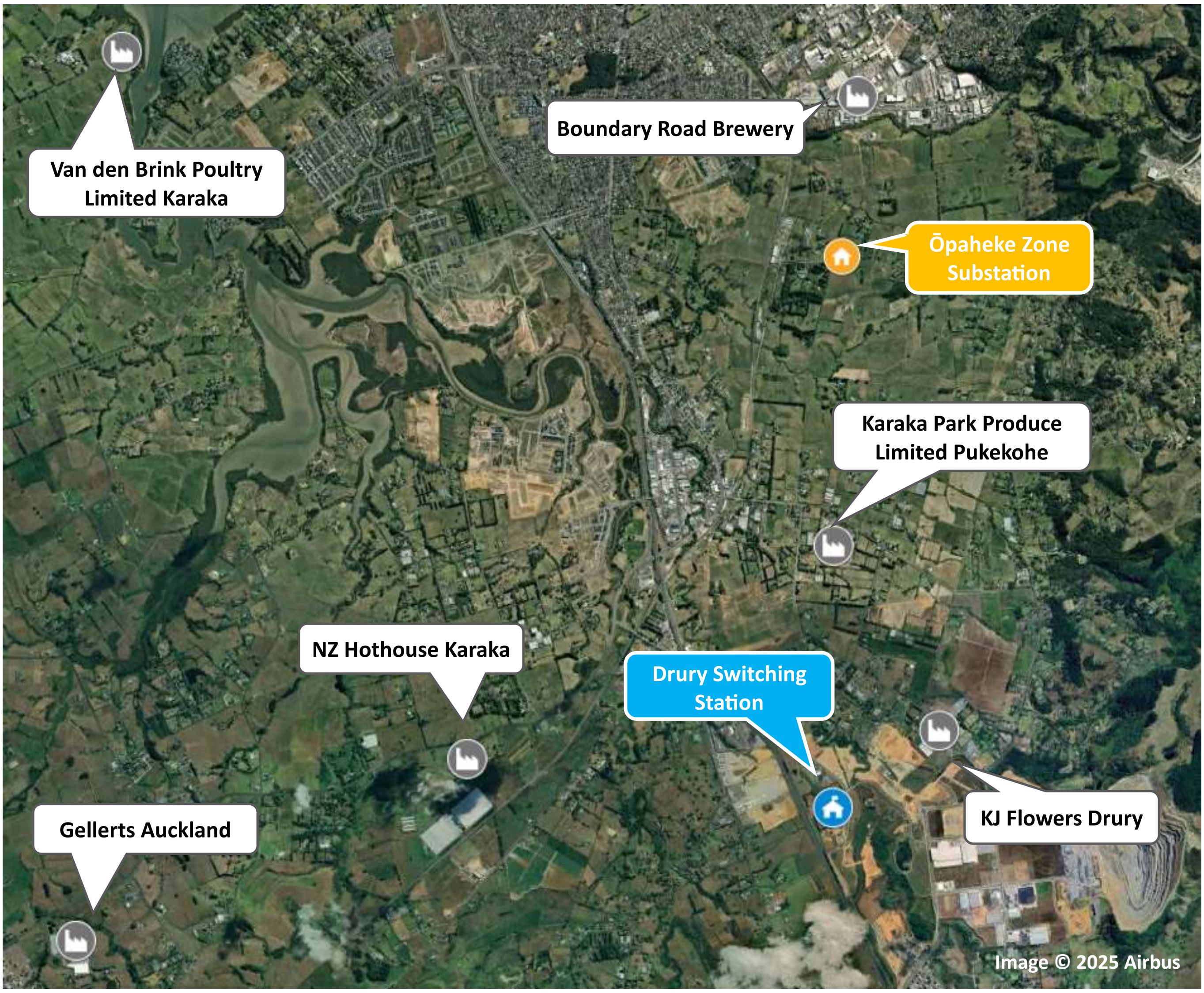


Figure 46. Bombay 110 kV GXP: EECA Load Sites vs local substations (northern snippet)

Figure 47. Bombay 110 kV GXP: EECA Load Sites vs local substations (southern snippet)

8.5.1 Bombay 110 kV GXP upgrade

The Bombay 110 kV GXP presently has 99 MVA of spare (N-1) capacity and 203 MVA of spare (N) capacity, based on the transformer ratings. The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.5.10). Therefore, no further upgrades are expected at Bombay 110 kV GXP.

8.5.2 Boundary Road Brewery

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	5.18	Bombay 110 kV

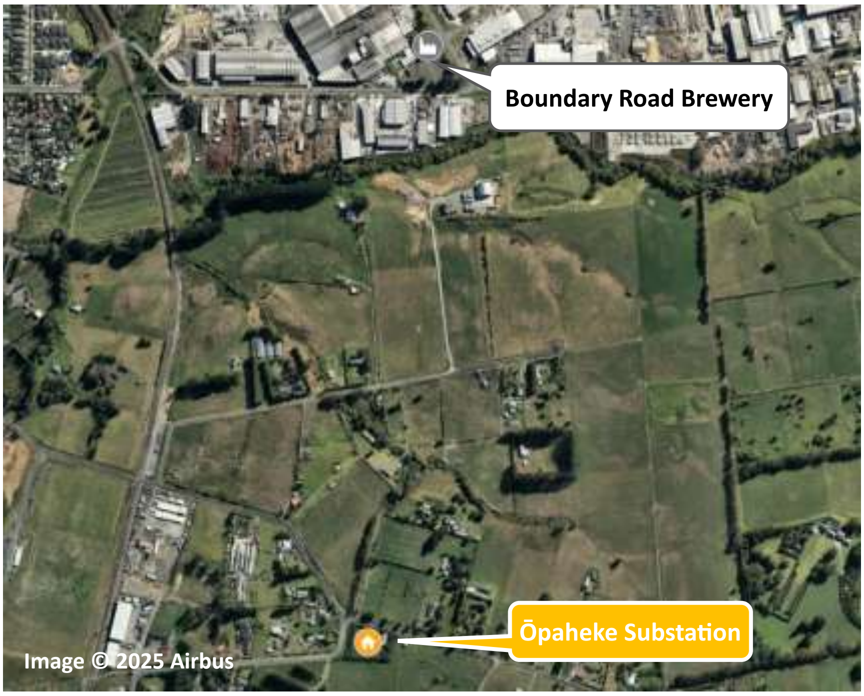


Figure 48. Boundary Road Brewery geographic location in relation to the surrounding zone substations

8.5.2.1 Existing electrical supply to the Plant

Boundary Road Brewery is presently supplied by Counties Energy's Ōpaheke zone substation. The site is currently supplied by an 11 kV feeder which is a mixture of underground cables and overhead lines. Ōpaheke connects directly to the Bombay GXP through two overhead 110 kV circuits, which are rated to 80 MVA and 64.7 MVA (the second circuit is limited by a section of smaller conductors).

The site is located approximately 1.3 km away from Ōpaheke zone substation. The zone substation is located in turn approximately 11.8 km from Bombay 110 kV GXP.

There is currently a maximum loading of 28 MVA on Ōpaheke zone substation, with 49 MVA of spare (N) capacity and 9 MVA of spare (N-1) capacity. The Bombay 110 kV GXP presently has 99 MVA of spare (N-1) capacity and 203 MVA of spare (N) capacity, based on the transformer ratings.

8.5.2.2 Supply Option(s) for New Load

The GXP, zone substation, and circuits supplying the zone substation have adequate spare (N) and (N-1) capacity for this load.

The existing 22 kV feeder to the site is presently loaded to a maximum of 2.54 MVA, with an estimated maximum capacity to the Load Site of 8.7 MVA (limited by a short length of underground cabling). Therefore, the existing feeder is expected to have sufficient capacity to supply this load site.

For costing purposes, Ergo has included the cost of a 22/11 kV transformer appropriate for this load, which may be required at the Load Site.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.5.2.3 Capital Cost Estimate

Table 13. Boundary Road Brewery: Indicative capital cost to supply the Load Site with (N) or (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Small supply transformer (ZSS)	1.00	$1.50
		TOTAL	**$1.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.5.2.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.5.3 NIG Nutritionals Pukekohe

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	4.76	Bombay 110 kV

Figure 49. NIG Nutritionals Pukekohe geographic location in relation to the surrounding zone substations

8.5.3.1 Existing electrical supply to the Plant

NIG Nutritionals Pukekohe is presently supplied by Counties Energy's Pukekohe zone substation. The site is supplied by a 22 kV feeder which is a mixture of overhead lines and cables, as well as some customer-owned 11 kV cables. Pukekohe is part of the Pukekohe-Pōkeno-Tuakau 110 kV subtransmission ring operated by Counties Energy: two circuits (rated to 80 MVA) connect Pukekohe to Bombay, one circuit (rated to 106.7 MVA) connects Pukekohe to Tuakau, one circuit (rated to 80 MVA) connects Tuakau to Pōkeno, and one circuit (rated at 106.7 MVA) connects Pōkeno to Bombay.

The site is located approximately 4.4 km away from Pukekohe zone substation. The zone substation is in turn located approximately 8.1 km from Bombay 110 kV GXP.

There is currently a maximum loading of 38 MVA on Pukekohe zone substation, with 82 MVA of spare (N) capacity and 22 MVA of spare (N-1) capacity. The Bombay 110 kV GXP presently has 99 MVA of spare (N-1) capacity and 203 MVA of spare (N) capacity, based on the transformer ratings.

8.5.3.2 Supply Option(s) for New Load

Both the GXP and the zone substation have adequate spare (N) and (N-1) capacity for this load. Counties Energy indicated to Ergo that the existing 22 kV feeder to the site is expected to have sufficient spare capacity for this proposed additional load. Therefore, no upgrades are expected to supply this load.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.5.3.3 Capital Cost Estimate

Indicatively, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.5.3.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.5.4 NZ Hothouse Karaka

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	2.37	Bombay 110 kV

Figure 50. NZ Hothouse Karaka geographic location in relation to the surrounding zone substations

8.5.4.1 Existing electrical supply to the Plant

NZ Hothouse Karaka is presently supplied by Counties Energy's Ōpaheke zone substation. The site is currently supplied with a 22 kV feeder into the site, connecting with overhead lines on the adjacent road. Ōpaheke connects directly to the Bombay GXP through two overhead 110 kV circuits, which are rated to 80 MVA and 64.7 MVA (the second circuit is limited by a section of smaller conductors).

The site is located approximately 4.9 km away from Ōpaheke zone substation. The zone substation is located in turn approximately 11.8 km from Bombay 110 kV GXP.

There is currently a maximum loading of 28 MVA on Ōpaheke zone substation, with 49 MVA of spare (N) capacity and 9 MVA of spare (N-1) capacity. The Bombay 110 kV GXP presently has 99 MVA of spare (N-1) capacity and 203 MVA of spare (N) capacity, based on the transformer ratings.

8.5.4.2 Supply Option(s) for New Load

The GXP, zone substation, and circuits supplying the zone substation have adequate spare (N) and (N-1) capacity for this load.

The existing 22 kV feeder to the site is presently loaded to a maximum of 6.10 MVA, with an estimated maximum capacity to the Load Site of 8.0 MVA (limited by a short length of overhead conductor).

Therefore, to supply this load site, replacements of a small section of overhead line (~210 m) would be expected.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.5.4.3 Capital Cost Estimate

Table 14. NZ Hothouse Karaka: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N-1)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Reconductor 22kV line (larger)	0.21	$0.05
		TOTAL	**$0.05**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.5.4.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.5.5 NZ Hothouse Bombay

Load Site Description	Electrical Demand (MW)	Transpower GXP
High temperature heat pumps	1.98	Bombay 110 kV

Figure 51. NZ Hothouse Bombay geographic location in relation to the surrounding zone substations

8.5.5.1 Existing electrical supply to the Plant

NZ Hothouse Bombay is presently supplied by Counties Energy's Pukekohe zone substation. The site is supplied by a 22 kV feeder which is a mixture of overhead lines and cables, as well as some customer-owned 11 kV cables. Pukekohe is part of the Pukekohe-Pōkeno-Tuakau 110 kV subtransmission ring operated by Counties Energy: two circuits (rated to 80 MVA) connect Pukekohe to Bombay, one circuit (rated to 106.7 MVA) connects Pukekohe to Tuakau, one circuit (rated to 80 MVA) connects Tuakau to Pōkeno, and one circuit (rated at 106.7 MVA) connects Pōkeno to Bombay.

The site is located approximately 6.2 km away from Pukekohe zone substation. The zone substation is in turn located approximately 8.1 km from Bombay 110 kV GXP.

There is currently a maximum loading of 38 MVA on Pukekohe zone substation, with 82 MVA of spare (N) capacity and 22 MVA of spare (N-1) capacity. The Bombay 110 kV GXP presently has 99 MVA of spare (N-1) capacity and 203 MVA of spare (N) capacity, based on the transformer ratings.

8.5.5.2 Supply Option(s) for New Load

Both the GXP and the zone substation have adequate spare (N) and (N-1) capacity for this load.

The existing 22 kV feeder to the site is presently loaded to a maximum of 12.2 MVA, with an estimated maximum capacity to the Load Site of 13.3 MVA. To supply this load site, replacements of a section of overhead line (~5.3 km), would be expected.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.5.5.3 Capital Cost Estimate

Table 15. NZ Hothouse Bombay: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N-1)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Reconductor 22kV line (larger)	5.30	$1.19
		TOTAL	**$1.19**

8.5.5.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.5.6 Gellerts Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
High temperature heat pumps	1.56	Bombay 110 kV

Figure 52. Gellerts Auckland geographic location in relation to the surrounding zone substations

8.5.6.1 Existing electrical supply to the Plant

Gellerts Auckland is presently supplied by Counties Energy's Pukekohe zone substation. The site is currently supplied by a 22 kV feeder which is a mixture of overhead lines and underground cables. Pukekohe is part of the Pukekohe-Pōkeno-Tuakau 110 kV subtransmission ring operated by Counties Energy: two circuits (rated to 80 MVA) connect Pukekohe to Bombay, one circuit (rated to 106.7 MVA) connects Pukekohe to Tuakau, one circuit (rated to 80 MVA) connects Tuakau to Pōkeno, and one circuit (rated at 106.7 MVA) connects Pōkeno to Bombay.

The site is located approximately 7.9 km away from Pukekohe zone substation. The zone substation is located in turn approximately 8.1 km from Bombay 110 kV GXP.

There is currently a maximum loading of 38 MVA on Pukekohe zone substation, with 82 MVA of spare (N) capacity and 22 MVA of spare (N-1) capacity. The Bombay 110 kV GXP presently has 99 MVA of spare (N-1) capacity and 203 MVA of spare (N) capacity, based on the transformer ratings.

8.5.6.2 Supply Option(s) for New Load

Both the GXP and the zone substation have adequate spare (N) and (N-1) capacity for this load.

The existing 22 kV feeder to the site is presently loaded to a maximum of 8.9 MVA, with an estimated maximum capacity to the Load Site of 10.7 MVA. Therefore, no upgrades are expected to supply this load.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.5.6.3 Capital Cost Estimate

Indicatively, it is expected that a distribution transformer to supply this load would cost approximately $350k.
Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.5.6.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.5.7 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 16. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Estimated Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
KJ Flowers Drury	Ōpaheke	9	49	17.2	0.51	200
Rainbow Park Nurseries Ltd Drury	Pukekohe	22	82	7.6	0.50	130
Bokay Flower Farms	Barber Rd	28	68	2.6	0.37	130
Van den Brink Poultry Limited (Brinks Chicken) Karaka	Ōpaheke	9	49	10.8	0.29	130
Ministry of Education Pukekohe High School	Pukekohe	22	82	8.9	0.22	130
Karaka Park Produce Ltd Pukekohe	Ōpaheke	9	49	3.1	0.14	80

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.5.8 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.5.8.1 Ōpaheke

Five of the loads on Bombay 110 kV GXP are expected to connect to Ōpaheke zone substation. These loads are Boundary Road Brewery, NZ Hothouse Karaka, KJ Flowers Drury, Van den Brink Poultry Limited Karaka, and Karaka Park Produce Ltd Pukekohe. The sum of peaks of these loads is 8.5 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Ōpaheke zone substation.

None of the loads in the previous Waikato report are expected to connect to the Ōpaheke substation.

8.5.8.2 Pukekohe

Five of the loads on Bombay 110 kV GXP are expected to connect to Pukekohe zone substation. These loads are NIG Nutritionals Pukekohe, NZ Hothouse Bombay, Gellerts Auckland, Rainbow Park Nurseries Ltd Drury, and Pukekohe High School. The sum of peaks of these loads is 9.02 MW, which the zone substation does have (N-1) capacity for.

Five of the loads in the previous Waikato report are expected to connect to the Pukekohe zone substation. The sum of the peaks of the Waikato report loads on Pukekohe substation is 6.38 MW. Combined with the new loads for this Auckland study, the sum of all the expected load peaks is 6.38+9.02 = 15.40 MW, which the Pukekohe zone substation does have (N-1) capacity for.

Therefore, no further upgrades are expected at Pukekohe zone substation.

8.5.9 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Bombay 110 kV GXP gives a combined load of 2.04 MW. When the load shapes are combined, they result in the following load shape (Figure 53), with a maximum load of 1.76 MW, with a diversity factor of 0.86.

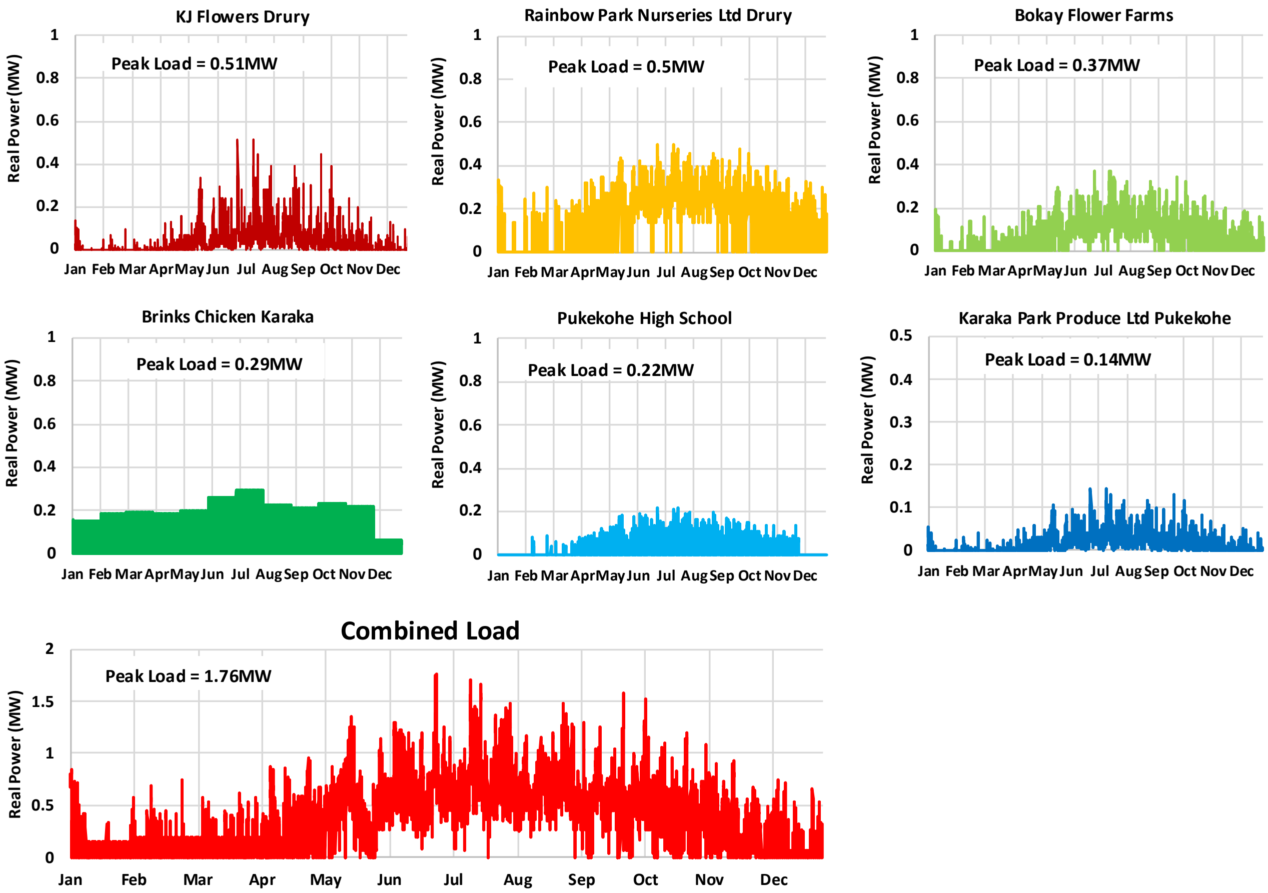


Figure 53. Loading Profiles: Bombay 110 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.5.10 Effect of all Load Sites Connecting to Bombay GXP

The following Figure 54 illustrates the Bombay 110 kV GXP load profile together with the load profiles of all the Load Sites within the Bombay 110 kV GXP region. Also shown in Figure 54 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Bombay 110 kV GXP would increase to 116.8 MW, an increase of 24.4 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 154 MW there is a diversity factor of 0.76 between the loads.
- Based on Ergo's analysis, the Bombay 110 kV GXP's (N-1) limit is not expected to be exceeded.
- It is noted that the loads analysed for the previous Waikato report are included in these calculations.

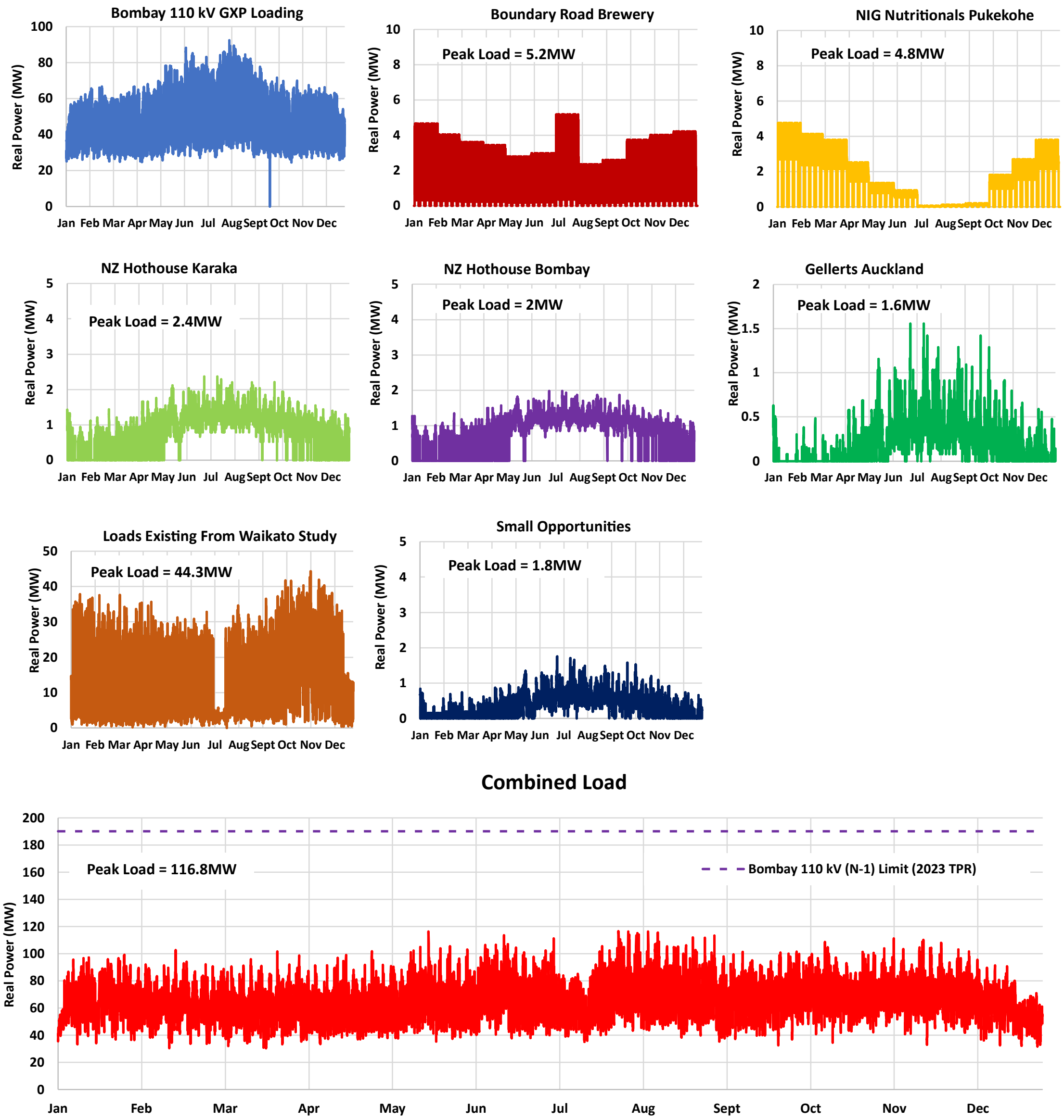


Figure 54. Loading Profiles: Bombay 110 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.6 Glenbrook 33 kV GXP (clean bus)

The "Large" EECA load sites connecting to the Glenbrook 33 kV GXP (clean bus) include:

- NZ Steel Glenbrook Steel Mill (51.87 MW). Ergo notes that while the Steel Mill presently takes supply from both the Glenbrook 33 kV clean and dirty buses, the new load has been assumed to connect to the clean bus.
- NZ Gourmet Waiuku (1.44 MW)

The "Small" EECA load sites connecting to the Glenbrook 33 kV GXP (clean bus) include (refer to Sections 8.6.4 and 8.6.6):

- Dhindsa Farm Limited (0.39 MW)
- Ayyildiz Ltd Rose's Halloumi Cheese (0.25 MW)
- Wing Shing Farms Karaka (0.15 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

Figure 55. Glenbrook 33 kV GXP (clean bus): EECA Load Sites vs local substations

8.6.1 Glenbrook 33 kV GXP (clean bus) upgrade

The Glenbrook 33 kV GXP clean bus presently has 75.2 MVA of both spare switched (N-1) capacity and spare (N) capacity, based on the transformer ratings. Ergo has assumed that (N-1) switched capacity is sufficient for the loads connecting, in this case, and have not allowed for upgrades to full (N-1) security at the GXP.

8.6.2 Glenbrook Steel Mill

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	51.87	Glenbrook 33 kV GXP clean bus

Figure 56. Glenbrook Steel Mill geographic location in relation to the surrounding zone substations

8.6.2.1 Existing electrical supply to the Plant

Glenbrook Steel Mill presently takes supply directly from Transpower from both the Glenbrook 33 kV clean bus and dirty bus. It has been assumed that the proposed new load would connect to the clean bus.

The Glenbrook 33 kV GXP clean bus presently has 75.2 MVA of both spare switched (N-1) capacity and spare (N) capacity, based on the transformer ratings.

8.6.2.2 Supply Option(s) for New Load

EECA requested that Ergo carry out analysis for this load in two stages – the first stage being 26.20 MW, the second being 25.67 MW, for a total of 51.87 MW.

The GXP has adequate spare (N) and (N-1) switched capacity for both stages of the project. Ergo has assumed that (N-1) switched capacity is sufficient, in this case, and have not allowed for upgrades to full (N-1) security at the GXP.

As the GXP has sufficient capacity for both stages, Ergo has considered that a new 33/11 kV substation (which may be owned by the load site) would be required at the load site to supply the new load. This approach matches the existing infrastructure in the plant, which to Ergo's knowledge, includes 33/11 kV substations near loads. As the location of the new load within the site is unknown, and it is assumed that the new substation would be located as close to the new load as practicable, Ergo has allowed for 1 km of cabling to the GXP, where relevant, and have not accounted for any 11 kV reticulation around the site.

Stage 1 - 26.20 MW

For an (N) security solution, the new customer substation would require 1x large transformer, and associated switchgear. Additionally, one 33 kV circuit between the new substation and the GXP would be required.

For an (N-1) security solution, the new customer substation would require 2x large transformers with the associated switchgear. Additionally, two 33 kV circuits between the new substation and the GXP would be required.

Stage 2 - 25.67 MW

The addition of the Stage 2 load brings the total additional load to 51.87 MW.

To supply the additional load, for either an (N) or an (N-1) solution, an additional large transformer (with associated switchgear) would be added to the new customer substation, along with another 33 kV circuit to the GXP.

8.6.2.3 Capital Cost Estimate

Table 17. Glenbrook Steel Mill: Indicative capital cost to supply the Load Site with (N) subtransmission supply security (Stage 1).

Transmission => (N-1)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Single underground 33kV cable	1.00	$0.90
Subtransmission	33kV circuit breaker bay	2.00	$0.50
Subtransmission	Large supply transformer (ZSS)	1.00	$2.30
		TOTAL	**$3.70**

Table 18. Glenbrook Steel Mill: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security (Stage 1).

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Double underground 33kV cable	1.00	$1.40
Subtransmission	33kV circuit breaker bay	4.00	$1.00
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$7.00**

Table 19. Glenbrook Steel Mill: Indicative capital cost to supply the Load Site (Stage 2).

Transmission => Stage 1	Subtransmission => Stage 1		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Single underground 33kV cable	1.00	$0.90
Subtransmission	33kV circuit breaker bay	2.00	$0.50
Subtransmission	Large supply transformer (ZSS)	1.00	$2.30
		TOTAL	**$3.70**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.6.2.4 Expected Timeframe

It is estimated to take 24-36 months (for each stage) for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.6.3 NZ Gourmet Waiuku

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pump	1.44	Glenbrook 33 kV GXP clean bus

Figure 57. NZ Gourmet Waiuku geographic location in relation to the surrounding zone substations

8.6.3.1 Existing electrical supply to the Plant

NZ Gourmet Waiuku is presently supplied by Counties Energy's Waiuku zone substation. The site is supplied by an 11 kV feeder which is a mixture of overhead lines and cables. Waiuku substation is supplied by two 33 kV circuits from the Glenbrook GXP, which are rated to 31.4 MVA and 24 MVA. One 33 kV circuit supplies Maioro substation from Waiuku substation.

The site is located approximately 3.5 km away from Waiuku zone substation. The zone substation is in turn located approximately 5.1 km from Glenbrook 33 kV GXP.

There is currently a maximum loading of 16 MVA on Waiuku zone substation, with 24 MVA of spare (N) capacity and 4 MVA of spare (N-1) capacity. The Glenbrook 33 kV GXP clean bus presently has 75.2 MVA of both spare switched (N-1) capacity and spare (N) capacity, based on the transformer ratings.

With an existing peak load on Maioro substation of 8 MVA, the subtransmission lines supplying Waiuku substation have approximately 31.4 MVA of spare (N) capacity, and no spare (N-1) capacity.

8.6.3.2 Supply Option(s) for New Load

Both the GXP and the zone substation have adequate spare (N) and (N-1) capacity for this load. The subtransmission lines supplying the substation have adequate (N) capacity, but not (N-1).

The existing 11 kV feeder to the site is presently loaded to a maximum of 5.45 MVA, with an estimated maximum capacity to the Load Site of 6.64 MVA. The existing feeder is limited by sections of 95 mm^2 cables. Ergo has determined that the connecting load would have a reduced effect on the existing feeder, as the expected load shape of the Load Site would peak overnight, when the feeder normally is at its minimum loading. However, reconductoring of the feeder cables supplying the site would still be required, for an (N) or an (N-1) security solution. The length of the constraining 95 mm^2 cables is unknown to Ergo, so in lieu of more detailed information, we have conservatively assumed that the full feeder length would be replaced (5.4 km).

For an (N-1) security supply, replacement of the lower capacity of the two 33 kV circuits which supply Waiuku substation would be required. The existing circuit is overhead, and 6.2 km long. It is taken that a reconductoring of this existing circuit would be sufficient.

8.6.3.3 Capital Cost Estimate

Table 20. NZ Gourmet Waiuku: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Reconductor 11kV line (larger)	5.40	$1.08
		TOTAL	**$1.08**

Table 21. NZ Gourmet Waiuku: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Reconductor single overhead 33kV line	6.20	$1.63
Distribution	Reconductor single underground cable	5.40	$1.08
		TOTAL	**$2.71**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.6.3.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.6.4 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 22. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Dhindsa Farm Limited	Waiuku	4	24	-1.2	0.39	130
Ayyildiz Ltd Rose's Halloumi Cheese	Karaka	7	27	2.5	0.25	130
Wing Shing Farms Karaka	Karaka	7	27	8.8	0.15	80

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.6.5 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.6.5.1 Karaka

Two of the loads on Glenbrook 33 kV GXP clean bus are expected to connect to Karaka zone substation. These loads are Ayyildiz Ltd Rose's Halloumi Cheese and Wing Shing Farms Karaka. The sum of peaks of these loads is 0.4 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Karaka zone substation.

8.6.5.2 Waiuku

Two of the loads on Glenbrook 33 kV GXP clean bus are expected to connect to Waiuku zone substation. These loads are NZ Gourmet Waiuku and Dhindsa Farm Limited. The sum of peaks of these loads is 1.83 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Waiuku zone substation.

8.6.6 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Glenbrook 33 kV GXP clean bus gives a combined load of 0.79 MW. When the load shapes are combined, they result in the following load shape (Figure 58), with a maximum load of 0.57 MW, with a diversity factor of 0.72.

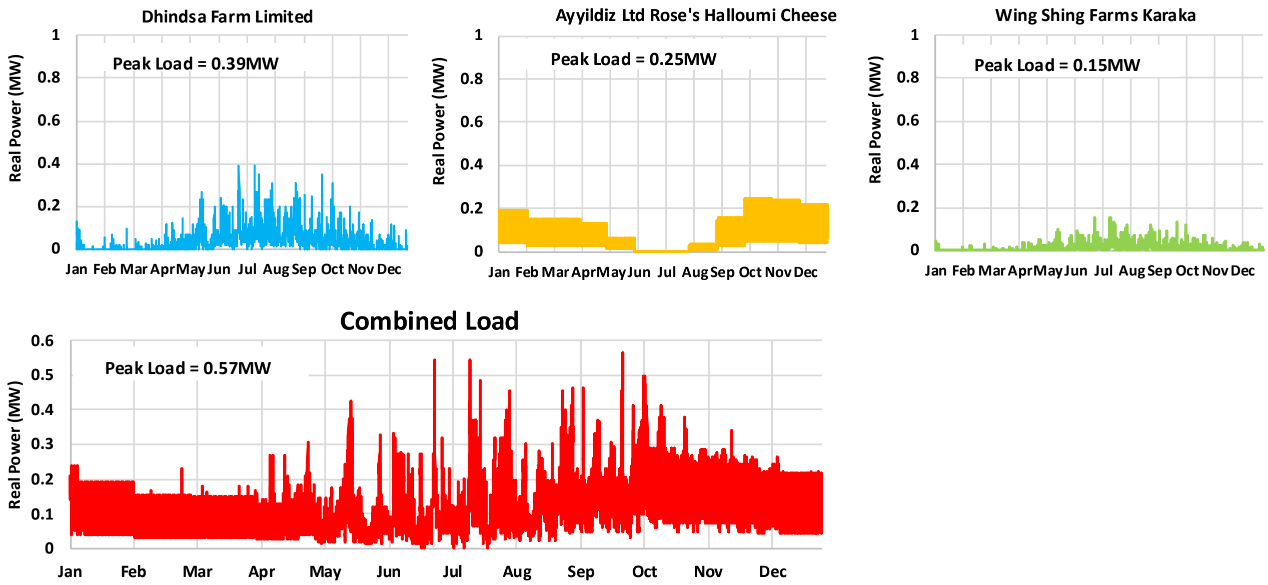


Figure 58. Loading Profiles: Glenbrook 33 kV GXP clean bus "small" Load Site Profiles: Combined Load (sum of all profiles)

8.6.7 Effect of all Load Sites Connecting to Glenbrook 33 kV GXP (clean bus)

The following Figure 59 illustrates the Glenbrook 33 kV GXP clean bus load profile together with the load profiles of all the Load Sites within the Glenbrook 33 kV GXP clean bus region. Also shown in Figure 59 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Glenbrook 33 kV GXP clean bus would increase to 130.9 MW, an increase of 51.4 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 133.4 MW, there is a diversity factor of 0.98 between the loads.
- Based on Ergo's analysis, the Glenbrook 33 kV GXP clean bus' (N) limit and (N-1 switched) limit are not expected to be exceeded.

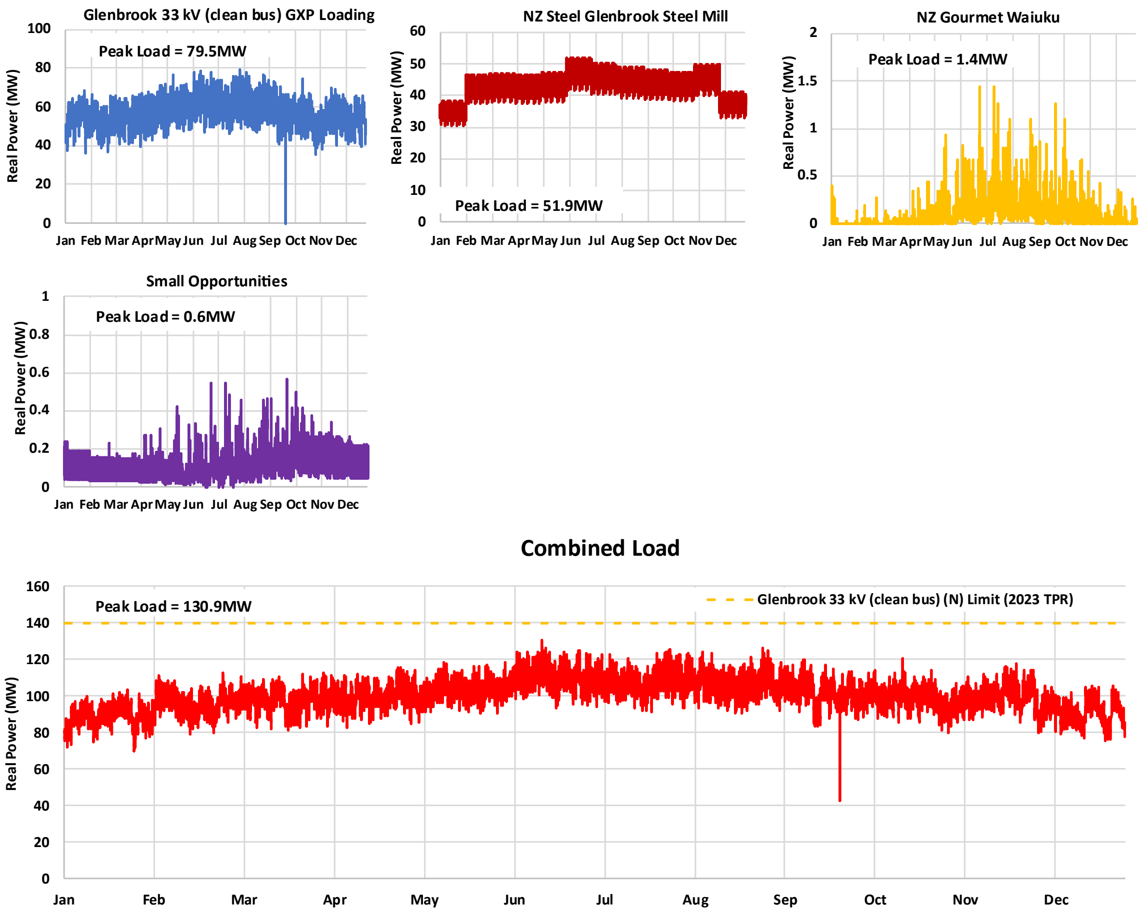


Figure 59. Loading Profiles: Glenbrook 33 kV GXP clean bus 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.7 Glenbrook 33 kV GXP (dirty bus)

No Load Sites are expected to connect to the Glenbrook 33 kV GXP dirty bus, and so upgrades at this GXP are not considered.

8.8 Henderson 33 kV GXP

The "Large" EECA load sites connecting to the Henderson 33 kV GXP include:

- PALM McCallum Industries (4.49 MW)
- Industrial Processors Limited (1.98 MW)
- William Morrison Funeral Directors Auckland (1.91 MW)

The "Small" EECA load sites connecting to the Henderson 33 kV GXP include (refer to Sections 8.8.5 and 8.8.7):

- Tasti Auckland (0.76 MW)
- Homestead Produce Ltd (0.62 MW)
- Health New Zealand Waitākere Hospital (0.47 MW)
- Sunrise Healthcare West Harbour (0.27 MW)
- Van Lier Riverhead (0.25 MW)
- Ministry of Education Waitākere College (0.21 MW)
- Heirloomacy Waimauku (0.21 MW)
- Ministry of Education Edmonton Primary School (0.11 MW)
- Riverland Roses Riverland Nursery (0.09 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

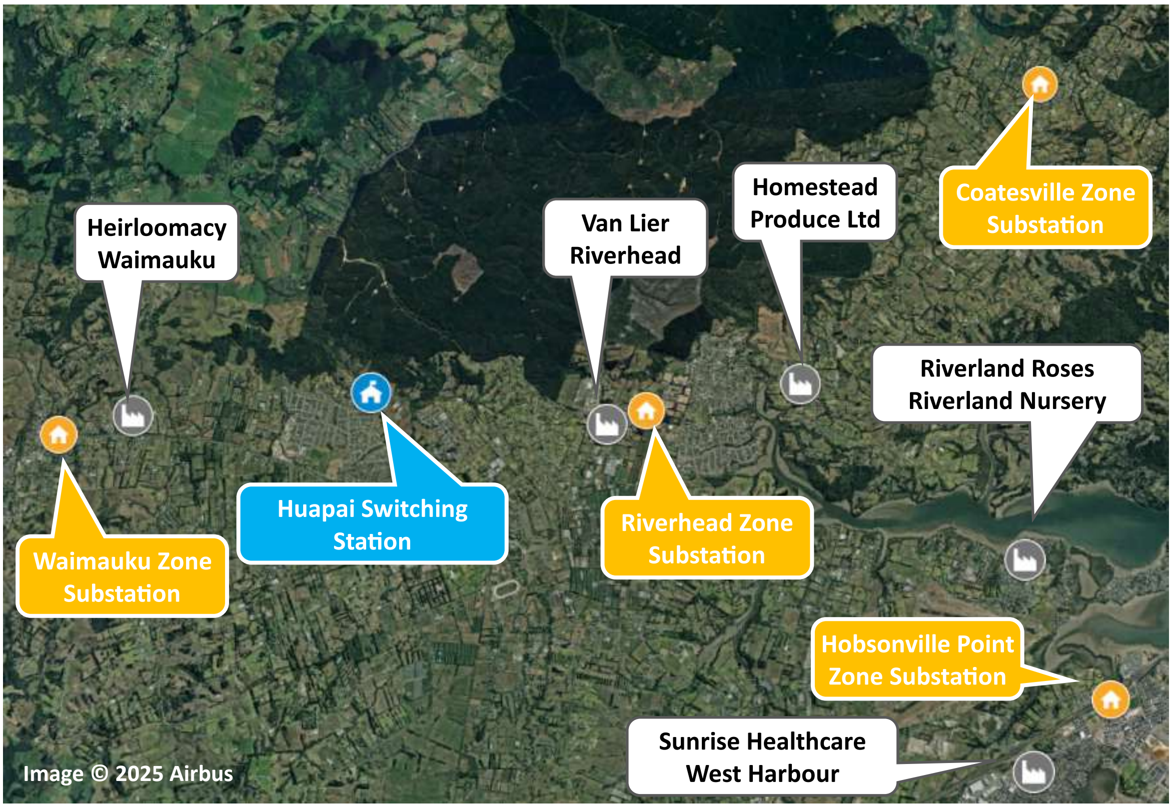


Figure 60. Henderson 33 kV GXP: EECA Load Sites vs local substations (northern snippet)

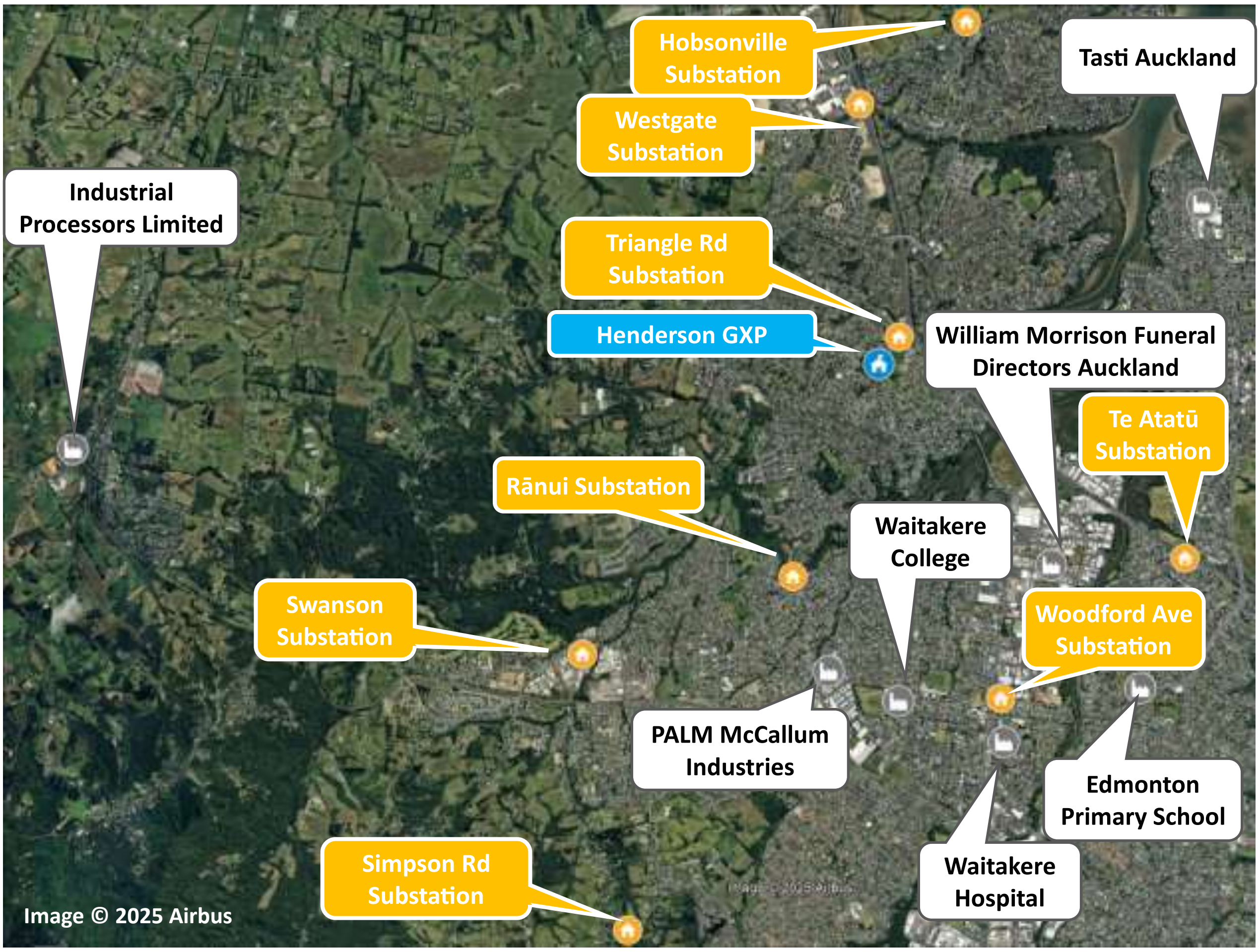


Figure 61. Henderson 33 kV GXP: EECA Load Sites vs local substations (southern snippet)

8.8.1 Henderson 33 kV GXP Upgrade

The Henderson 33 kV GXP presently has 12 MVA of spare (N-1) capacity and 113 MVA of spare (N) capacity, based on the transformer ratings. As discussed in Section 8.8.8, if all Load Sites connect to the GXP, then it is expected that the GXP's branch rating would be exceeded.

Ergo understands that Vector has engaged with Transpower over increasing the capacity of the Henderson GXP and notes that the options being investigated include a possible future GXP in Huapai, or installation of a third transformer at Henderson 33 kV GXP.

Transpower's Transmission Planning Report does not include pricing for the possible solutions, but indicatively, Ergo estimates that a third transformer at Henderson 33 kV would cost ~$4.5M, while establishing a new GXP at Huapai would cost ~$40M.

8.8.2 PALM McCallum Industries

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	4.49	Henderson 33 kV

Figure 62. PALM McCallum Industries geographic location in relation to the surrounding zone substations

8.8.2.1 Existing electrical supply to the Plant

PALM McCallum Industries is presently supplied by Vector's Rānui zone substation. The site is supplied by an 11 kV feeder which is a mixture of overhead lines and underground cables. Rānui zone substation connects directly to the Henderson GXP through two 33 kV circuits each rated to ~33.5 MVA. Rānui substation also supplies Swanson zone substation, and thereby Simpson Rd zone substation, through two 33 kV subtransmission circuits.

The site is located approximately 0.7 km away from Rānui zone substation. The zone substation is in turn located approximately 1.9 km from Henderson GXP.

There is currently a maximum loading of 14 MVA on Rānui zone substation, with 6 MVA of spare (N) capacity and no spare (N-1) capacity (the substation is equipped with only one transformer at present). The Henderson 33 kV GXP presently has 12 MVA of spare (N-1) capacity and 113 MVA of spare (N) capacity, based on the transformer ratings.

With a present maximum loading of 12.4 MVA on Swanson substation, and 5.4 MVA on Simpson Road substation, the 33 kV subtransmission circuits supplying Rānui substation are presently loaded to a maximum of 31.8 MVA. Therefore, the subtransmission circuits have ~2.1 MVA of spare (N-1) capacity, and ~35.2 MVA of spare (N) capacity.

8.8.2.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation and the subtransmission circuits supplying it have adequate (N), but not (N-1) capacity.

Ergo understands that Vector has planned to reconfigure their Rānui-Swanson-Simpson Rd subtransmission network to maintain security of supply. A second transformer at Swanson zone substation will be installed to achieve this. The project is expected to begin in 2027-28 and is projected to cost $5.4M. In the longer term, Vector plans to construct a new zone substation at Redhills to remove the Rānui zone substation capacity constraint. The project is to be commissioned in 2028-29 and is expected to cost $14M. Ergo has assumed that these upgrade projects would be sufficient to provide this Load Site with (N-1) subtransmission security. These costs have been included against this Load Site, for an (N-1) solution as it may impact it.

The existing 11 kV feeder has approximately 2.4 MVA of spare capacity. Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 1.1 km. Ergo notes that this site is nearby the Blue Star Group (New Zealand) Ltd Webstar Auckland site, which also requires a new feeder, though from a different GXP/zone substation. If both sites connect, there may be cost efficiency available if the two were to share a feeder from either substation.

8.8.2.3 Capital Cost Estimate

Table 23. PALM McCallum Industries: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.10	$0.88
		TOTAL	**$1.08**

Table 24. PALM McCallum Industries: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N-1)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	New Redhills ZSS (Rānui constraint)	1.00	$14.00
Subtransmission	Swanson second transformer	1.00	$5.40
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.10	$0.88
		TOTAL	**$20.48**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.8.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.8.3 Industrial Processors Limited

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.98	Henderson 33 kV

Figure 63. Industrial Processors Limited geographic location in relation to the surrounding zone substations

8.8.3.1 Existing electrical supply to the Plant

Industrial Processors Limited is presently supplied by Vector's Swanson zone substation. The site is supplied by an 11 kV feeder which is a mixture of overhead lines and underground cables. Swanson zone substation connects to Rānui substation via two 33 kV subtransmission circuits each rated at ~30.75 MVA, and supplies Simpson Rd zone substation via a single 33 kV subtransmission circuit.

The site is located approximately 4.6 km away from Swanson zone substation. The zone substation is located in turn approximately 3.5 km from Henderson 33 kV GXP.

There is currently a maximum loading of 12.4 MVA on Swanson zone substation, with 0.1 MVA of spare (N) capacity and no spare (N-1) capacity. The Henderson 33 kV GXP presently has 12 MVA of spare (N-1) capacity and 113 MVA of spare (N) capacity, based on the transformer ratings.

With a present maximum loading of 14 MVA on Rānui substation, and 5.4 MVA on Simpson Road substation, the 33 kV subtransmission circuits supplying Rānui substation are presently loaded to a maximum of 31.8 MVA. Therefore, the subtransmission circuits have ~2.1 MVA of spare (N-1) capacity, and ~35.2 MVA of spare (N) capacity.

Combining the maximum loading on the Simpson Road and Swanson zone substations gives a total load of 17.8 MVA. Therefore, the subtransmission circuits between Rānui and Swanson zone substations have ~12.95 MVA of spare (N-1) capacity, and ~43.7 MVA of spare (N) capacity.

8.8.3.2 Supply Option(s) for New Load

The zone substation does not have adequate spare (N) or (N-1) capacity for the new load. The GXP has adequate (N) capacity and (N-1) capacity. The existing subtransmission lines between Rānui substation and Swanson have adequate spare (N) and (N-1) capacity for this load, as do the subtransmission lines between Rānui and the GXP.

Ergo understands that Vector has planned to reconfigure their Rānui-Swanson-Simpson Rd subtransmission network to maintain security of supply. A second transformer at Swanson zone substation will be installed to achieve this. The project is expected to begin in 2027-28 and is projected to cost $5.4M. Ergo has assumed that these upgrade projects would be sufficient to provide this Load Site with (N-1) subtransmission security. These costs have been included against this Load Site, for an (N-1) solution as it may impact it.

The above upgrades at the zone substation would give adequate spare (N) capacity for this load, but not (N-1). To achieve an (N-1) security supply for this site, it is taken that a replacement of the existing Swanson transformer would be required, which is assumed to cost approximately the same amount as the new transformer being installed.

The existing 11 kV feeder has approximately 2.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.8.3.3 Capital Cost Estimate

Table 25. Industrial Processors Limited: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Swanson second transformer	1.00	$5.40
		TOTAL	**$5.40**

Table 26. Industrial Processors Limited: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N-1)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Swanson second transformer	2.00	$10.80
		TOTAL	**$10.80**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.8.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.8.4 William Morrison Funeral Directors Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.91	Henderson 33 kV

Figure 64. Industrial Processors Limited geographic location in relation to the surrounding zone substations

8.8.4.1 Existing electrical supply to the Plant

William Morrison Funeral Directors Auckland is presently supplied by Vector's Te Atatū zone substation. The site is supplied by an 11 kV feeder which is a mixture of overhead lines and underground cables. Te Atatū connects directly to the Henderson 33 kV GXP via two 33 kV subtransmission circuits rated to ~39.55 MVA and ~32.75 MVA.

The site is located approximately 1.1 km away from Te Atatū zone substation. The zone substation is located in turn approximately 3 km from Henderson GXP.

There is currently a maximum loading of 22.6 MVA on Te Atatū zone substation, with 2.4 MVA of spare (N) capacity and no spare (N-1) capacity. The Henderson 33 kV GXP presently has 12 MVA of spare (N-1) capacity and 113 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission circuits supplying Te Atatū have ~10.15 MVA of spare (N-1) capacity, and ~49.7 MVA of spare (N) capacity.

8.8.4.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate spare (N) and (N-1) capacity for this load. The zone substation has adequate (N), but not (N-1) capacity.

Ergo understands that Vector has planned to upgrade both transformers at Te Atatū zone substation. The commissioning date is 2027-28 and is expected to cost $6.6M. Ergo has assumed that these upgrade projects would be sufficient to provide this Load Site with (N-1) subtransmission security. This cost has been included against this Load Site, for an (N-1) solution as it may impact it.

The existing 11 kV feeder has approximately 4 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.8.4.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 27. William Morrison Funeral Directors Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N-1)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Te Atatū transformer capacity upgrade T1 + T2	1.00	$6.60
		TOTAL	$6.60

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.8.4.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.8.5 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 28. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Tasti Auckland*	Te Atatū	0.0	2.4	-4.1	0.76	260
Homestead Produce Ltd	Riverhead	0.0	1.2	18.9	0.62	200
Health New Zealand Waitākere Hospital	Woodford	0.0	2.8	2.8	0.47	130
Sunrise Healthcare West Harbour	Hobsonville Point	0.6	20.6	1.2	0.27	130
Van Lier Riverhead	Riverhead	0.0	1.2	2.8	0.25	130
Ministry of Education Waitākere College*	Woodford	0.0	2.8	-0.9	0.21	130
Heirloomacy Waimauku*	Waimauku	0.0	17.2	-1.4	0.21	130
Ministry of Education Edmonton Primary School*	Te Atatū	0.0	2.4	-3	0.11	80
Riverland Roses Riverland Nursery	Hobsonville Point	0.6	20.6	1	0.09	50

*Ergo has checked the existing feeders of these sites against the Vector capacity map, which indicated that the feeders have sufficient capacity for the additional load, contrary to the data shown above. Ergo has assumed that the data in the map is accurate.

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.8.6 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.8.6.1 Hobsonville Point

Two of the loads on Henderson 33 kV GXP are expected to connect to Hobsonville Point zone substation. These loads are Sunrise Healthcare West Harbour and Riverland Roses Riverland Nursery. The sum of peaks of these loads is 0.36 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Hobsonville Point zone substation.

8.8.6.2 Riverhead

Two of the loads on Henderson 33 kV GXP are expected to connect to Riverhead zone substation. These loads are Homestead Produce Ltd and Van Lier Riverhead. The sum of peaks of these loads is 0.87 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that this substation is already operating under (N) security during peak loading. Vector has an existing upgrade project to increase the capacity of the substation. The upgrade is expected to cost $12.2M, and is forecast to commission in 2027. It is assumed that these upgrades will be sufficient to accommodate the two connecting Load Sites. Therefore, no further upgrades are expected at Riverhead zone substation, beyond those already planned.

8.8.6.3 Te Atatū

Three of the loads on Henderson 33 kV GXP are expected to connect to Te Atatū zone substation. These loads are William Morrison Funeral Directors Auckland, Tasti Auckland, and Ministry of Education Edmonton Primary School. The sum of peaks of these loads is 2.78 MW, which the zone substation does not have (N) or (N-1) capacity for.

Ergo notes that the upgrade project presently planned for Te Atatū (mentioned in individual Load Site discussions earlier) would likely be sufficient for the network to accommodate the connecting loads. Therefore, no further upgrades are expected at Te Atatū zone substation, beyond those already planned.

8.8.6.4 Woodford

Two of the loads on Henderson 33 kV GXP are expected to connect to Woodford zone substation. These loads are Health New Zealand Waitākere Hospital and Ministry of Education Waitākere College. The sum of peaks of these loads is 0.68 MW, which the zone substation does not have (N-1) capacity for. However, both of these loads are "small" and are not expected to have a material impact on the network. Therefore, no further upgrades are expected at Woodford.

8.8.6.5 Rānui-Swanson-Simpson Road subtransmission

Two of the loads on Henderson GXP are expected to connect to the Rānui-Swanson-Simpson Road subtransmission network. These loads are PALM McCallum Industries and Industrial Processors Limited. The sum of peaks of these loads is 6.47 MW, which the subtransmission network does not have (N-1) capacity for. The network is currently constrained at Rānui zone substation.

Ergo notes that the upgrade project presently planned for the subtransmission network (mentioned in individual Load Site discussions earlier) would likely be sufficient for the network to accommodate the connecting loads. Therefore, no further upgrades are expected on the Rānui-Swanson-Simpson Road subtransmission network, beyond those already planned.

8.8.7 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Henderson 33 kV GXP gives a combined load of 2.99 MW. When the load shapes are combined, they result in the following load shape (Figure 65), with a maximum load of 2.58 MW, with a diversity factor of 0.86.

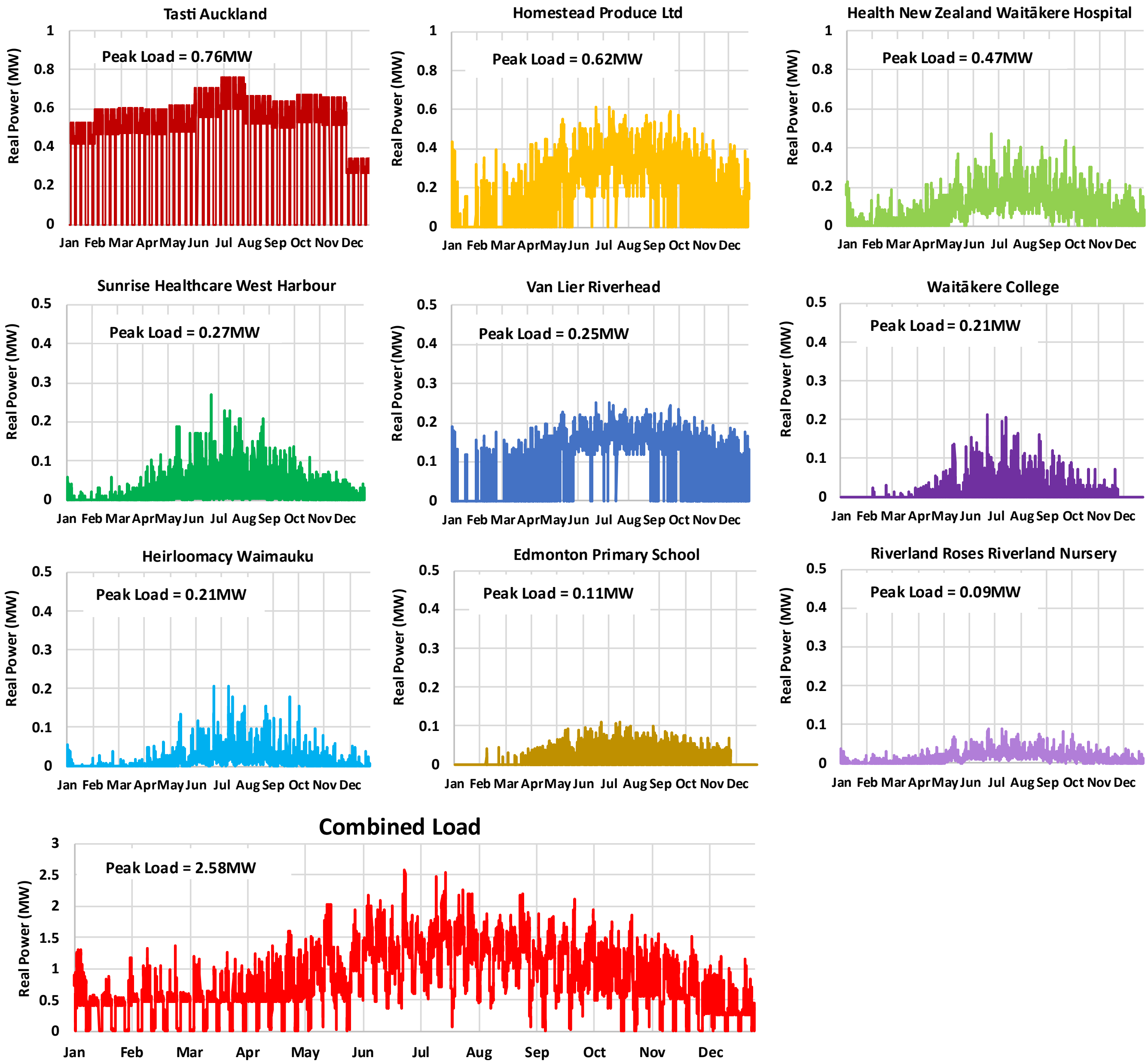


Figure 65. Loading Profiles: Henderson 33 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.8.8 Effect of all Load Sites Connecting to Henderson GXP

The following Figure 66 illustrates the Henderson 33 kV GXP load profile together with the load profiles of all the Load Sites within the Henderson 33 kV GXP region. Also shown in Figure 66 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Henderson 33 kV GXP would increase to 132.8 MW, an increase of 6.5 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 137.3 MW, there is a diversity factor of 0.97 between the loads.
- Based on Ergo's analysis, the Henderson 33 kV GXP's (N-1) branch limit is expected to be exceeded. Mitigations for this are discussed in Section 8.8.1.

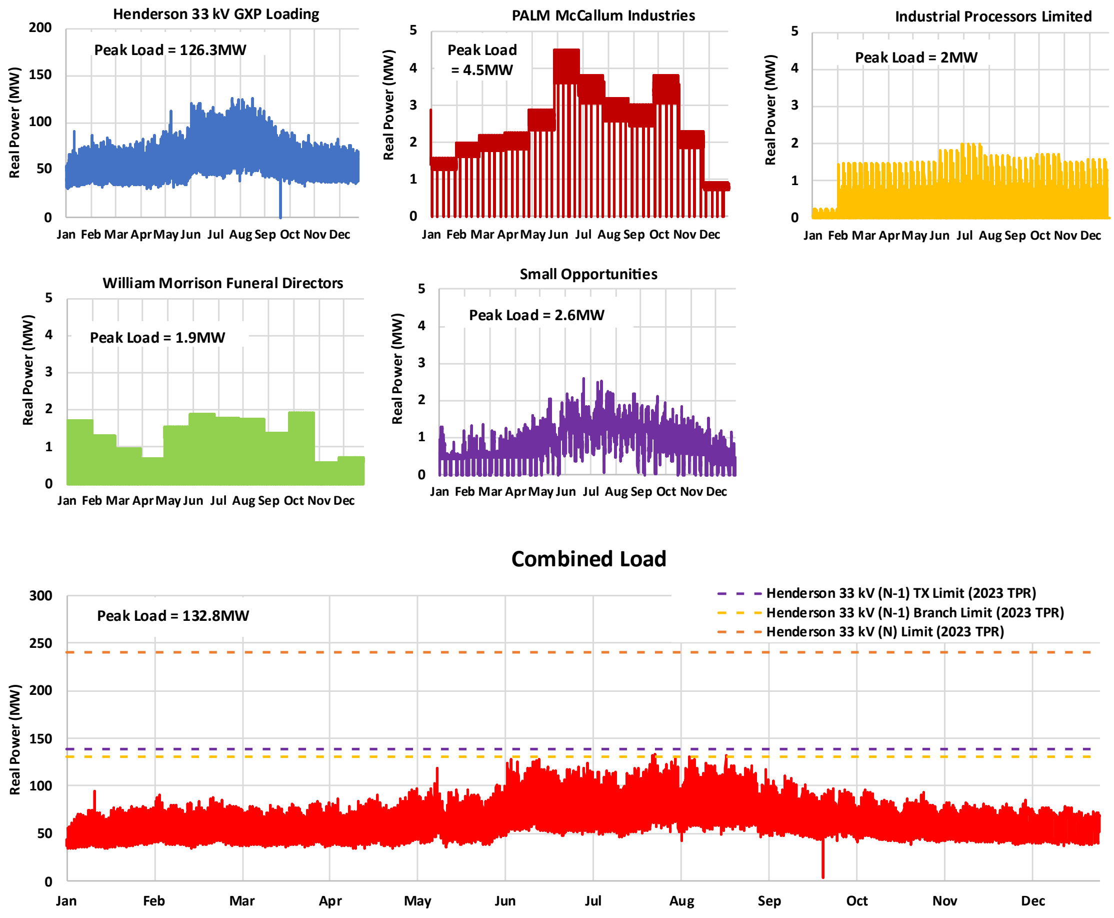


Figure 66. Loading Profiles: Henderson 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.9 Hepburn Road 33 kV GXP

The “Large” EECA load sites connecting to the Hepburn Road 33 kV GXP include:

- Tegel Henderson (5.28 MW)
- Glucina Alloys Avondale (4.19 MW)
- Autex Industries Ltd (3.15 MW)
- Blue Star Group (New Zealand) Ltd Webstar Auckland (1.88 MW)
- Pact Reuse Avondale (1.78 MW)
- VIP Steel Packaging NZ Limited (1.68 MW)
- Sealed Air (1.09 MW)

The “Small” EECA load sites connecting to the Hepburn Road 33 kV GXP include (refer to Sections 8.9.9 and 8.9.11):

- Perry Metal Protection Auckland (0.89 MW)
- Auckland Council West Wave Pool and Leisure Centre (0.59 MW)
- Auckland Council Waikumete Cemetery (0.56 MW)
- Rheem New Zealand Ltd Auckland (0.32 MW)
- Ministry of Education Prospect School (0.18 MW)
- Ministry of Education Greenbay High School (0.17 MW)
- Ko Taku Reo Deaf Education, Auckland (0.13 MW)
- Wicked Hot Waitākere (0.13 MW)
- Methven Auckland (0.01 MW)

The geographic locations of the Load Sites are shown on the following map in relation to the local transmission and distribution substations.

Figure 67. Hepburn Road 33 kV GXP: EECA Load Sites vs local substations

8.9.1 Hepburn Road 33 kV GXP Upgrade

The Hepburn Road 33 kV GXP presently has 74 MVA of spare (N-1) capacity and 180 MVA of spare (N) capacity, based on the transformer ratings. The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.9.12). Therefore, no further upgrades are expected at Hepburn Road 33 kV GXP.

8.9.2 Tegel Henderson

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	5.28	Hepburn Road 33 kV

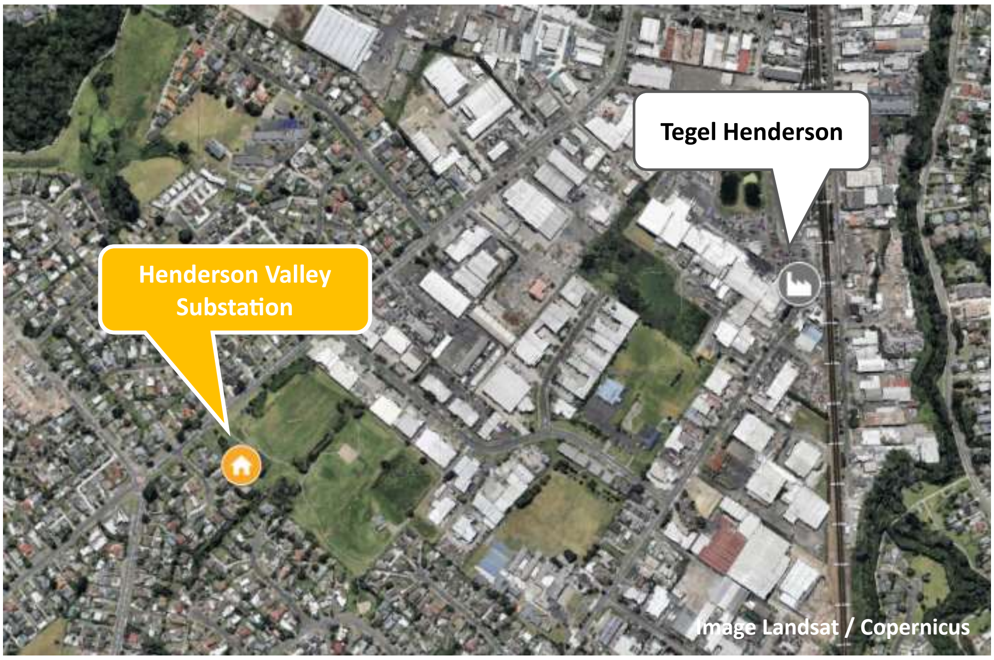


Figure 68. Tegel Henderson geographic location in relation to the surrounding zone substations

8.9.2.1 Existing Electrical Supply to the Plant

Tegel Henderson is presently supplied by Vector's Henderson Valley zone substation. The site is supplied by an 11 kV feeder which consists of a mixture of overhead lines and underground cables. Henderson Valley Zone substation is supplied by the Waikaukau substation via two 33 kV circuits each rated to ~36.35 MVA. Waikaukau is supplied by 4x 33 kV circuits from Hepburn Road GXP, each rated to ~22.69 MVA. Henderson Valley substation supplies Keeling Road substation at 33 kV, via one 33 kV subtransmission circuit. Waikaukau also supplies the Atkinson Road, Laingholm, and Oratia substations via three other 33 kV subtransmission circuits.

The site is located approximately 0.9 km away from Henderson Valley zone substation. The zone substation is located in turn approximately 3.5 km from Hepburn Road GXP.

There is currently a maximum loading of 15.5 MVA on Henderson Valley zone substation, with 9.5 MVA of spare (N) capacity and no spare (N-1) capacity. The Hepburn Road 33 kV GXP presently has 74 MVA of spare (N-1) capacity and 180 MVA of spare (N) capacity, based on the transformer ratings.

Waikaukau, Atkinson Road, Laingholm, Oratia, and Keeling Road substations have maximum present loadings of 8.5 MVA, 20.5 MVA, 8.8 MVA, 5.3 MVA, and 16.5 MVA, respectively. The result is that the four circuits into Waikaukau are presently loaded to a maximum of 75.1 MVA, meaning that the circuits into Waikaukau have ~-7.03 MVA of spare (N-1) capacity, and ~15.66 MVA of spare (N) capacity. Similarly, the two circuits to Henderson Valley substation are presently loaded to a maximum of 32 MVA, meaning that the circuits into Henderson Valley have ~4.35 MVA of spare (N-1) capacity, and ~40.7 MVA of spare (N) capacity.

8.9.2.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) capacity for this load. The zone substation, and the subtransmission lines supplying it and Waikaukau zone substation all have adequate (N) capacity, but not (N-1) capacity for this load.

Vector has a project planned to upgrade the Henderson Valley transformers, which is planned for commissioning in 2031, and expected to cost $6.7M. Ergo expects that these upgrades would be sufficient to give the Henderson Valley substation enough (N-1) capacity to accommodate this Load Site. This cost has been included against this Load Site, for an (N-1) solution as it may impact it.

To provide the site with (N-1) security, additional to the transformer upgrades mentioned above, an additional 33 kV circuit between Henderson Valley and Waikaukau may be required, as well as upgrades to at least two of the circuits which presently supply Waikaukau from Hepburn Road GXP. Ergo has not considered adding another 33 kV circuit between Waikaukau and Hepburn Road as there are already four circuits, whose capacity may be increased without requiring new switchgear, by replacement of lines/cables. Ergo has assumed that the new/replacement subtransmission circuits would be underground, due to the urban/industrial topography, and would follow similar routes to the existing 33 kV circuits in the area. The subtransmission circuits between Waikaukau and Hepburn Road require a crossing of the local rail line, for which Ergo has allowed an extra 1 km of underground cabling.

The existing 11 kV feeder has approximately 3 MVA of spare capacity. Therefore, due to the size of the load, 1x new 11 kV feeder and an associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 1.2 km.

8.9.2.3 Capital Cost Estimate

Table 29. Tegel Henderson: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.20	$0.96
		TOTAL	**$1.16**

Table 30. Tegel Henderson: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Double underground 33kV cable	5.40	$16.20
Subtransmission	33kV circuit breaker (ZSS)	2.00	$0.60
Subtransmission	Single underground 33kV cable	3.60	$7.20
Subtransmission	Henderson Valley T1+T2 upgrade	1.00	$6.70
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.20	$0.96
		TOTAL	**$31.86**

8.9.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.9.3 Glucina Alloys Avondale

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	4.19	Hepburn Road 33 kV

Figure 69. Glucina Alloys Avondale geographic location in relation to the surrounding zone substations

8.9.3.1 Existing Electrical Supply to the Plant

Glucina Alloys Avondale is presently supplied by Vector's Rosebank zone substation. The site is supplied by an 11 kV feeder which is fully underground. Rosebank zone substation connects to the Hepburn Rd GXP directly through two underground 33 kV subtransmission circuits rated to 22.4 MVA each.

The site is located approximately 1 km away from Rosebank zone substation. The zone substation is located in turn approximately 1.9 km from Hepburn Road GXP.

There is currently a maximum loading of 22.3 MVA on Rosebank zone substation, with 20.7 MVA of spare (N) capacity and no spare (N-1) capacity. The Hepburn Road 33 kV GXP presently has 74 MVA of spare (N-1) capacity and 180 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission circuits to Rosebank presently have ~0.1 MVA of spare (N-1) capacity and ~22.5 MVA of spare (N) capacity.

8.9.3.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) capacity for this load. The zone substation, and the subtransmission lines supplying it have adequate (N) capacity, but not (N-1) capacity for this load.

For an (N) security solution, Ergo has assumed that a special protection scheme would be required for the Rosebank transformers, to prevent an overload of one when the other is offline.

For an (N-1) security supply, it is expected that the transformers at Rosebank zone substation may need to be replaced. Additionally, upgrades to the 33 kV subtransmission circuits to Rosebank from the GXP would be required. Ergo has assumed that this would involve installation of a third subtransmission circuit. Due to the urban topography and required river crossing, Ergo has assumed that this circuit would be underground, and would follow a similar route to the existing circuits. Ergo has allowed for an extra 1 km of cabling to account for the required river crossing.

The existing 11 kV feeder has approximately 5.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.9.3.3 Capital Cost Estimate

Table 31. Glucina Alloys Avondale: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Special protection system (ZSS)	1.00	$0.25
		TOTAL	**$0.25**

Table 32. Glucina Alloys Avondale: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	33kV circuit breaker bay	2.00	$1.00
Subtransmission	Single underground 33kV cable	3.90	$7.80
Subtransmission	Medium supply transformer (ZSS)	2.00	$3.80
Distribution	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$17.20**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.9.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.9.4 Autex Industries Ltd

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	3.15	Hepburn Road 33 kV

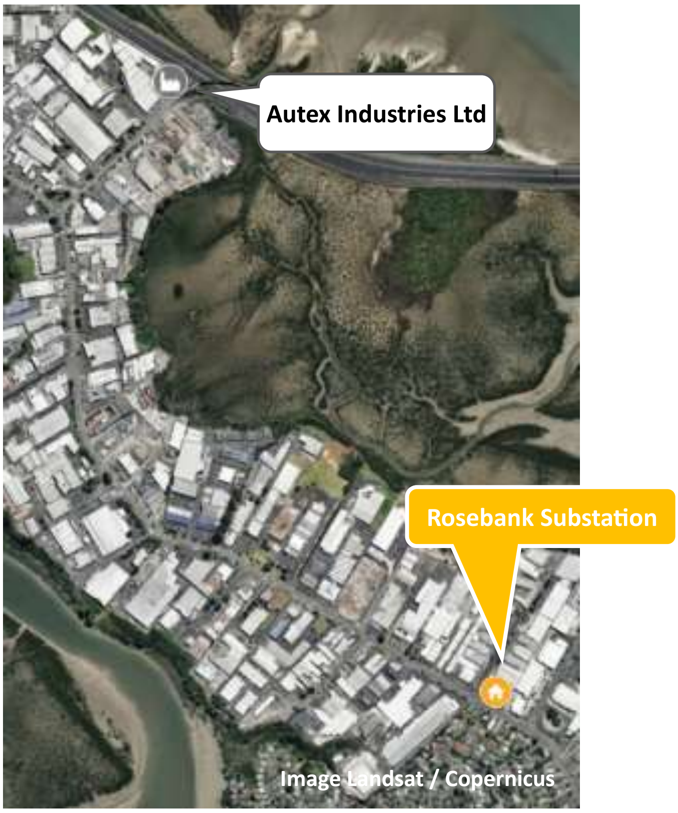


Figure 70. Autex Industries Limited geographic location in relation to the surrounding zone substations

8.9.4.1 Existing Electrical Supply to the Plant

Autex Industries Ltd is presently supplied by Vector's Rosebank zone substation. The site is supplied by an 11 kV feeder which is fully underground. Rosebank zone substation connects to the Hepburn Rd GXP directly through two underground 33 kV subtransmission circuits rated to 22.4 MVA each.

The site is located approximately 1.7 km away from Rosebank zone substation. The zone substation is located in turn approximately 1.9 km from Hepburn Road GXP.

There is currently a maximum loading of 22.3 MVA on Rosebank zone substation, with 20.7 MVA of spare (N) capacity and no spare (N-1) capacity. The Hepburn Road 33 kV GXP presently has 74 MVA of spare (N-1) capacity and 180 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission circuits to Rosebank presently have ~0.1 MVA of spare (N-1) capacity and ~22.5 MVA of spare (N) capacity.

8.9.4.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) capacity for this load. The zone substation, and the subtransmission lines supplying it have adequate (N) capacity, but not (N-1) capacity for this load.

For an (N) security solution, Ergo has assumed that a special protection scheme would be required for the Rosebank transformers, to prevent an overload of one when the other is offline.

For an (N-1) security supply, it is expected that the transformers at Rosebank zone substation may need to be replaced. Additionally, upgrades to the 33 kV subtransmission circuits to Rosebank from the GXP would be required. Ergo has assumed that this would involve installation of a third subtransmission circuit. Due to the urban topography and required river crossing, Ergo has assumed that this circuit would be underground, and would follow a similar route to the existing circuits. Ergo has allowed for an extra 1 km of cabling to account for the required river crossing.

The existing 11 kV feeder has approximately 3.7 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.9.4.3 Capital Cost Estimate

Table 33. Autex Industries Ltd: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Special protection system (ZSS)	1.00	$0.25
		TOTAL	**$0.25**

Table 34. Autex Industries Ltd: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	33kV circuit breaker bay	2.00	$1.00
Subtransmission	Single underground 33kV cable	3.90	$7.80
Subtransmission	Medium supply transformer (ZSS)	2.00	$3.80
Distribution	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$17.20**

8.9.4.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.9.5 Blue Star Group (New Zealand) Ltd Webstar Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.88	Hepburn Road 33 kV

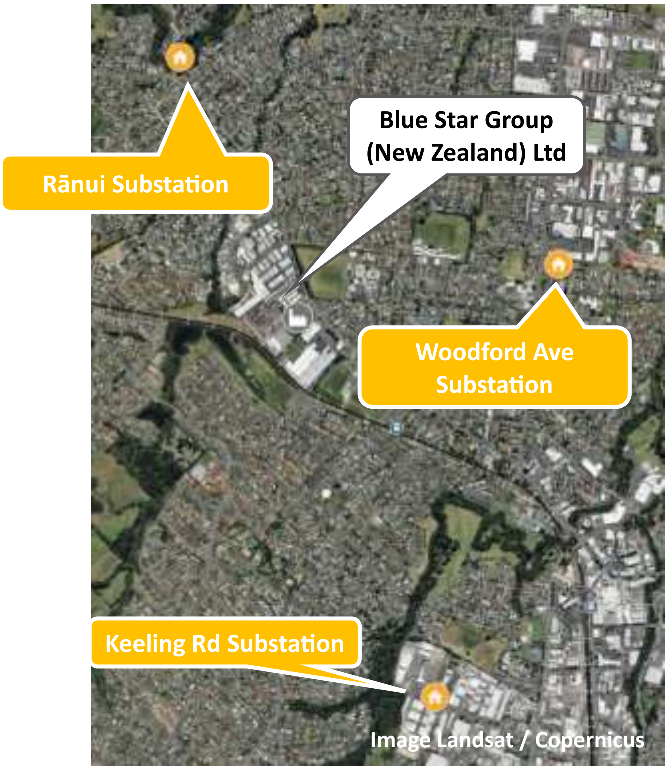


Figure 71. Blue Star Group (New Zealand) Ltd Webstar Auckland geographic location in relation to the surrounding zone substations

8.9.5.1 Existing Electrical Supply to the Plant

Blue Star Group (New Zealand) Ltd Webstar Auckland is presently supplied by Vector's Keeling Road zone substation. The substation is supplied by the nearby Henderson Valley substation through a single underground 33 kV subtransmission circuit rated to ~34.29 MVA. Henderson Valley Zone substation is supplied by the Waikaukau substation via two 33 kV circuits each rated to ~36.35 MVA. Waikaukau is supplied by 4x 33 kV circuits from Hepburn Road GXP, each rated to ~22.69 MVA. Waikaukau also supplies the Atkinson Road, Laingholm, and Oratia substations via three other 33 kV subtransmission circuits.

The site is located approximately 1.9 km away from Keeling Road zone substation. The zone substation is located in turn approximately 3.3 km from Hepburn Road GXP.

There is currently a maximum loading of 16.5 MVA on Keeling Road zone substation, with 27.5 MVA of spare (N) capacity and 3.5 MVA of spare (N-1) capacity. The Hepburn Road 33 kV GXP presently has 74 MVA of spare (N-1) capacity and 180 MVA of spare (N) capacity, based on the transformer ratings.

Waikaukau, Atkinson Road, Laingholm, Oratia, and Keeling Road substations have maximum present loadings of 8.5 MVA, 20.5 MVA, 8.8 MVA, 5.3 MVA, and 16.5 MVA, respectively. The result is that the four circuits into Waikaukau are presently loaded to a maximum of 75.1 MVA, meaning that the circuits into

Waikaukau have ~-7.03 MVA of spare (N-1) capacity, and ~15.66 MVA of spare (N) capacity. Similarly, the two circuits to Henderson Valley substation are presently loaded to a maximum of 32 MVA, meaning that the circuits into Henderson Valley have ~4.35 MVA of spare (N-1) capacity, and ~40.7 MVA of spare (N) capacity.

With only one 33 kV circuit between Henderson Valley and Keeling Road, the single circuit has no (N-1) capacity, and ~17.79 MVA of spare (N) capacity.

8.9.5.2 Supply Option(s) for New Load

The GXP and zone substation have adequate (N) and (N-1) capacity for this load. The subtransmission circuits between Waikaukau zone substation and the GXP, and between Henderson Valley and Keeling Road, all have adequate (N) capacity, but not (N-1) capacity for this load.

An additional 33 kV circuit between Henderson Valley and Keeling Road may be required for an (N-1) security solution, as well as upgrades to at least two of the circuits which presently supply Waikaukau from Hepburn Road GXP. Ergo has not considered adding another 33 kV circuit between Waikaukau and Hepburn Road as there are already four circuits, whose capacity may be increased without requiring new switchgear, by replacement of lines/cables. Ergo has assumed that the new/replacement subtransmission circuits would be underground, due to the urban/industrial topography, and would follow similar routes to the existing 33 kV circuits in the area.

The existing 11 kV feeder has approximately 1.4 MVA of spare capacity. Therefore, due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of ~3.32 km. Ergo notes that this site is nearby the PALM McCallum industries site, which also requires a new feeder, though from a different GXP/zone substation. If both sites connect, there may be cost efficiency available if the two were to share a feeder from either substation.

8.9.5.3 Capital Cost Estimate

Table 35. Blue Star Group (New Zealand) Ltd Webstar Auckland: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	3.32	$2.66
		TOTAL	**$2.86**

Table 36. Blue Star Group (New Zealand) Ltd Webstar Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Double underground 33kV cable	5.40	$16.20
Subtransmission	33kV circuit breaker (ZSS)	2.00	$0.60
Subtransmission	Single underground 33kV cable	1.60	$3.20
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	3.32	$2.66
		TOTAL	**$22.86**

8.9.5.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.9.6 Pact Reuse Avondale

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.78	Hepburn Road 33 kV

Figure 72. Pact Reuse Avondale geographic location in relation to the surrounding zone substations

8.9.6.1 Existing Electrical Supply to the Plant

Pact Reuse Avondale is presently supplied by Vector's Rosebank zone substation. The site is supplied by an 11 kV feeder which is fully underground. Rosebank zone substation connects to the Hepburn Rd GXP directly through two underground 33 kV subtransmission circuits rated to 22.4 MVA each.

The site is located approximately 1.2 km away from Rosebank zone substation. The zone substation is located in turn approximately 1.9 km from Hepburn Road GXP.

There is currently a maximum loading of 22.3 MVA on Rosebank zone substation, with 20.7 MVA of spare (N) capacity and no spare (N-1) capacity. The Hepburn Road 33 kV GXP presently has 74 MVA of spare (N-1) capacity and 180 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission circuits to Rosebank presently have ~0.1 MVA of spare (N-1) capacity and ~22.5 MVA of spare (N) capacity.

8.9.6.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) capacity for this load. The zone substation, and the subtransmission lines supplying it have adequate (N) capacity, but not (N-1) capacity for this load.

For an (N) security solution, Ergo has assumed that a special protection scheme would be required for the Rosebank transformers, to prevent an overload of one when the other is offline.

For an (N-1) security supply, it is expected that the transformers at Rosebank zone substation may need to be replaced. Additionally, upgrades to the 33 kV subtransmission circuits to Rosebank from the GXP would be required. Ergo has assumed that this would involve installation of a third subtransmission circuit. Due to the urban topography and required river crossing, Ergo has assumed that this circuit would be underground, and would follow a similar route to the existing circuits. Ergo has allowed for an extra 1 km of cabling to account for the required river crossing.

The existing 11 kV feeder has approximately 3.7 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.9.6.3 Capital Cost Estimate

Table 37. Pact Reuse Avondale: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Special protection system (ZSS)	1.00	$0.25
		TOTAL	$0.25

Table 38. Pact Reuse Avondale: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	33kV circuit breaker bay	2.00	$1.00
Subtransmission	Single underground 33kV cable	3.90	$7.80
Subtransmission	Medium supply transformer (ZSS)	2.00	$3.80
Distribution	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	$17.20

8.9.6.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.9.7 VIP Steel Packaging NZ Limited

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.68	Hepburn Road 33 kV

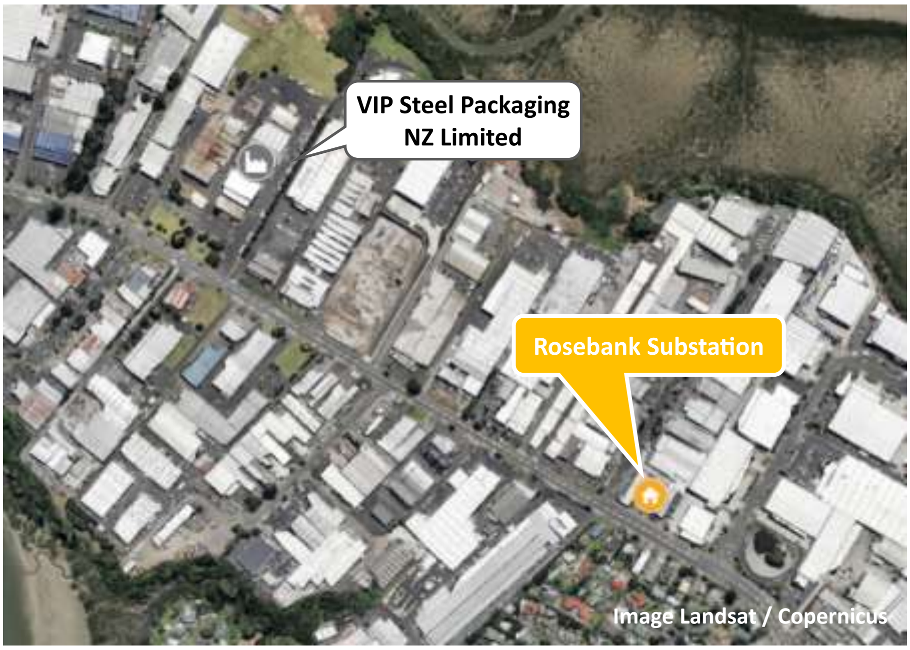


Figure 73. VIP Steel Packaging NZ Limited geographic location in relation to the surrounding zone substations

8.9.7.1 Existing Electrical Supply to the Plant

VIP Steel Packaging NZ Limited is presently supplied by Vector's Rosebank zone substation. The site is supplied by an 11 kV feeder which is fully underground. Rosebank zone substation connects to the Hepburn Rd GXP directly through two underground 33 kV subtransmission circuits rated to 22.4 MVA each.

The site is located approximately 0.6 km away from Rosebank zone substation. The zone substation is located in turn approximately 1.9 km from Hepburn Road GXP.

There is currently a maximum loading of 22.3 MVA on Rosebank zone substation, with 20.7 MVA of spare (N) capacity and no spare (N-1) capacity. The Hepburn Road 33 kV GXP presently has 74 MVA of spare (N-1) capacity and 180 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission circuits to Rosebank presently have ~0.1 MVA of spare (N-1) capacity and ~22.5 MVA of spare (N) capacity.

8.9.7.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) capacity for this load. The zone substation, and the subtransmission lines supplying it have adequate (N) capacity, but not (N-1) capacity for this load.

For an (N) security solution, Ergo has assumed that a special protection scheme would be required for the Rosebank transformers, to prevent an overload of one when the other is offline.

For an (N-1) security supply, it is expected that the transformers at Rosebank zone substation may need to be replaced. Additionally, upgrades to the 33 kV subtransmission circuits to Rosebank from the GXP would be required. Ergo has assumed that this would involve installation of a third subtransmission circuit. Due to the urban topography and required river crossing, Ergo has assumed that this circuit would be underground, and would follow a similar route to the existing circuits. Ergo has allowed for an extra 1 km of cabling to account for the required river crossing.

The existing 11 kV feeder has approximately 5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.9.7.3 Capital Cost Estimate

Table 39. VIP Steel Packaging NZ Limited: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Special protection system (ZSS)	1.00	$0.25
		TOTAL	**$0.25**

Table 40. VIP Steel Packaging NZ Limited: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	33kV circuit breaker bay	2.00	$1.00
Subtransmission	Single underground 33kV cable	3.90	$7.80
Subtransmission	Medium supply transformer (ZSS)	2.00	$3.80
Distribution	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$17.20**

8.9.7.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.9.8 Sealed Air

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.09	Hepburn Road 33 kV

Figure 74. Sealed Air geographic location in relation to the surrounding zone substations

8.9.8.1 Existing Electrical Supply to the Plant

Sealed Air is presently supplied by Vector's McLeod Road zone substation. The site is supplied by an 11 kV feeder which consists of a mixture of overhead lines and underground cables. McLeod Rd zone substation connects to the Hepburn Road GXP directly through a single 33 kV transmission circuit, rated to ~32.97 MVA.

The site is located approximately 1.8 km away from McLeod Road zone substation. The zone substation is located in turn approximately 1.4 km from Hepburn Road GXP.

There is currently a maximum loading of 9.8 MVA on McLeod Road zone substation, with 2.7 MVA of spare (N) capacity and no spare (N-1) capacity (the substation has only one transformer at present). The Hepburn Road 33 kV GXP presently has 74 MVA of spare (N-1) capacity and 180 MVA of spare (N) capacity, based on the transformer ratings.

With only one 33 kV circuit between McLeod Road and Hepburn Road GXP, the single circuit has no (N-1) capacity, and ~23.17 MVA of spare (N) capacity.

8.9.8.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity. However, they both lack adequate spare (N-1) capacity.

The GXP has adequate (N) and (N-1) spare capacity for this load. The zone substation and the subtransmission circuit supplying it both have adequate (N) capacity for this load, but no (N-1) capacity.

To provide the site with an (N-1) security supply, a second transformer (and associated switchgear) would be required at McLeod Rd zone substation, as well as a second 33 kV subtransmission circuit between the GXP and the zone substation. Due to the urban topography, and river crossing required, Ergo has assumed that the new subtransmission circuit would be underground cabling, and would be ~2 km long. Ergo has allowed for an extra 1 km of cabling in the costings to account for the river crossing.

The existing 11 kV feeder has approximately 4.4 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.9.8.3 Capital Cost Estimate

For an (N) security solution, indicatively, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 41. Sealed Air: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	33kV circuit breaker (ZSS)	3.00	$0.90
Subtransmission	Single underground 33kV cable	3.00	$6.00
Subtransmission	Medium supply transformer (ZSS)	1.00	$1.90
Subtransmission	11kV circuit breaker (ZSS)	1.00	$0.20
		TOTAL	**$9.00**

8.9.8.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.9.9 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 42. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Perry Metal Protection Auckland	Rosebank	0.0	20.7	3.7	0.89	260
Auckland Council West Wave Pool and Leisure Centre	McLeod Road	0.0	2.7	1.9	0.59	200
Auckland Council Waikumete Cemetery	Sabulite Road	0.0	3.7	5.3	0.56	200
Rheem New Zealand Ltd Auckland	Rosebank	0.0	20.7	5	0.32	130
Ministry of Education Prospect School	Waikaukau	0.0	-1	4.8	0.18	80
Ministry of Education Greenbay High School	Atkinson Road	0.0	19.5	0.9	0.17	80
Ko Taku Reo Deaf Education, Auckland	Sabulite Road	0.0	3.7	5.3	0.13	80
Wicked Hot Waitākere*	Henderson Valley	0.0	9.5	-2.8	0.13	80
Methven Auckland	Rosebank	0.0	20.7	1.6	0.01	40

*Ergo has checked the existing feeder of this site against the Vector capacity map, which indicated that the feeder has sufficient capacity for the additional load, contrary to the data shown above. Ergo has assumed that the data in the map is accurate.

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.9.10 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.9.10.1 Henderson Valley

Two of the loads on Hepburn Road GXP are expected to connect to Henderson Valley zone substation. These loads are Tegel Henderson and Wicked Hot Waitākere. The sum of peaks of these loads is 4.38 MW, which the zone substation does not have (N-1) capacity for. However, Wicked Hot Waitākere is a small load and expected to have a minimal impact on the network. If Tegel Henderson connects, then the upgrades required for that site would be expected to be sufficient for both sites. Therefore, no further upgrades are expected at Henderson Valley.

8.9.10.2 McLeod Road

Two of the loads on Hepburn Road GXP are expected to connect to McLeod Road zone substation. These loads are Sealed Air and West Wave Pool and Leisure Centre. The sum of peaks of these loads is 1.68 MW, which the zone substation does not have (N-1) capacity for. However, West Wave Pool and Leisure Centre is a small load and expected to have a minimal impact on the network. If Sealed Air connects, then the upgrades required for that site would be expected to be sufficient for both sites. Therefore, no further upgrades are expected at McLeod Road.

8.9.10.3 Rosebank

Seven of the loads on Hepburn Road GXP are expected to connect to Rosebank zone substation. These loads are Glucina Alloys Avondale, Autex Industries Ltd, Pact Reuse Avondale, VIP Steel Packaging NZ Limited, Perry Metal Protection Auckland, Rheem New Zealand Ltd Auckland, and Methven Auckland. The sum of peaks of these loads is 12.02 MW, which the zone substation does not have (N-1) capacity for.

However, several of the connecting sites (Glucina, Autex, Pact Reuse, and VIP Steel Packaging) were previously discussed in their individual assessments, and require the same/similar upgrades to connect. Ergo expects that the upgrades required for one of the larger sites to connect would be sufficient for all of the seven sites to connect, and would present an opportunity for cost sharing. Therefore, no further upgrades are expected at Rosebank.

Pact Reuse and Autex would both connect to the same 11 kV feeder from Rosebank substation. If only one of these loads connects, then it is expected that the existing feeder would be able to support both. If both connect, then upgrades would be required. As an indicative cost, a new 11 kV feeder which would supply both sites is estimated to cost $2.2M.

8.9.10.4 Sabulite Road

Two of the loads on Hepburn Road GXP are expected to connect to Sabulite Road zone substation. These loads are Auckland Council Waikumete Cemetery and Ko Taku Reo Deaf Education Auckland. The sum of peaks of these loads is 0.69 MW, which the zone substation does not have (N-1) capacity for. However, both of these loads are "small" and are not expected to have a material impact on the network. Therefore, no further upgrades are expected at Sabulite Road, however, Ergo notes that Vector has a project planned to replace the transformers at Sabulite Road (commissioning in 2031, no cost given in the AMP), which we expect would mean that the substation will have (N-1) capacity in the future.

8.9.10.5 Waikaukau subtransmission network

Five of the loads on Hepburn Road GXP are expected to connect to the Waikaukau subtransmission network. The loads are Tegel Henderson, Blue Star Group (New Zealand) Ltd Webstar Auckland, Ministry of Education Prospect School, Ministry of Education Greenbay High School, and Wicked Hot Waitākere. The sum of the peaks of these loads is 7.64 MVA, which the four circuits which supply the Waikaukau network do not have (N-1) capacity for. However, only two of these loads are large (Tegel and Blue Star), and both require upgrades of the Waikaukau-Hepburn Road GXP 33 kV circuits. If either of the larger sites connects, it is expected that the upgrades would be sufficient to supply all of the connecting loads with (N-1) security. There is also a cost-sharing opportunity here between the two large loads, if both were to connect.

The other connecting loads are "small" and are not expected to have a material impact on the network.

Therefore, no further upgrades of the Waikaukau subtransmission network are expected.

8.9.10.6 Henderson Valley subtransmission network

Two of the loads on Hepburn Road GXP are expected to connect to the Henderson Valley subtransmission network. The loads are Tegel Henderson and Blue Star Group (New Zealand) Ltd Webstar Auckland. The sum of the peaks of these loads is 7.16 MVA, which the subtransmission circuits supplying Henderson Valley Road do not have (N-1) capacity for. However, both of the loads are large, and require upgrades of the Henderson Valley-Waikaukau 33 kV circuits. If either of the sites connects, it is expected that the upgrades would be sufficient to supply all of the connecting loads with (N-1) security. There is also a cost-sharing opportunity here between the two large loads, if both were to connect.

Therefore, no further upgrades of the Henderson Valley subtransmission network are expected.

8.9.11 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on the Hepburn Road 33 kV GXP gives a combined load of 2.71 MW. When the load shapes are combined, they result in the following load shape (Figure 75), with a maximum load of 2.34 MW, with a diversity factor of 0.87.

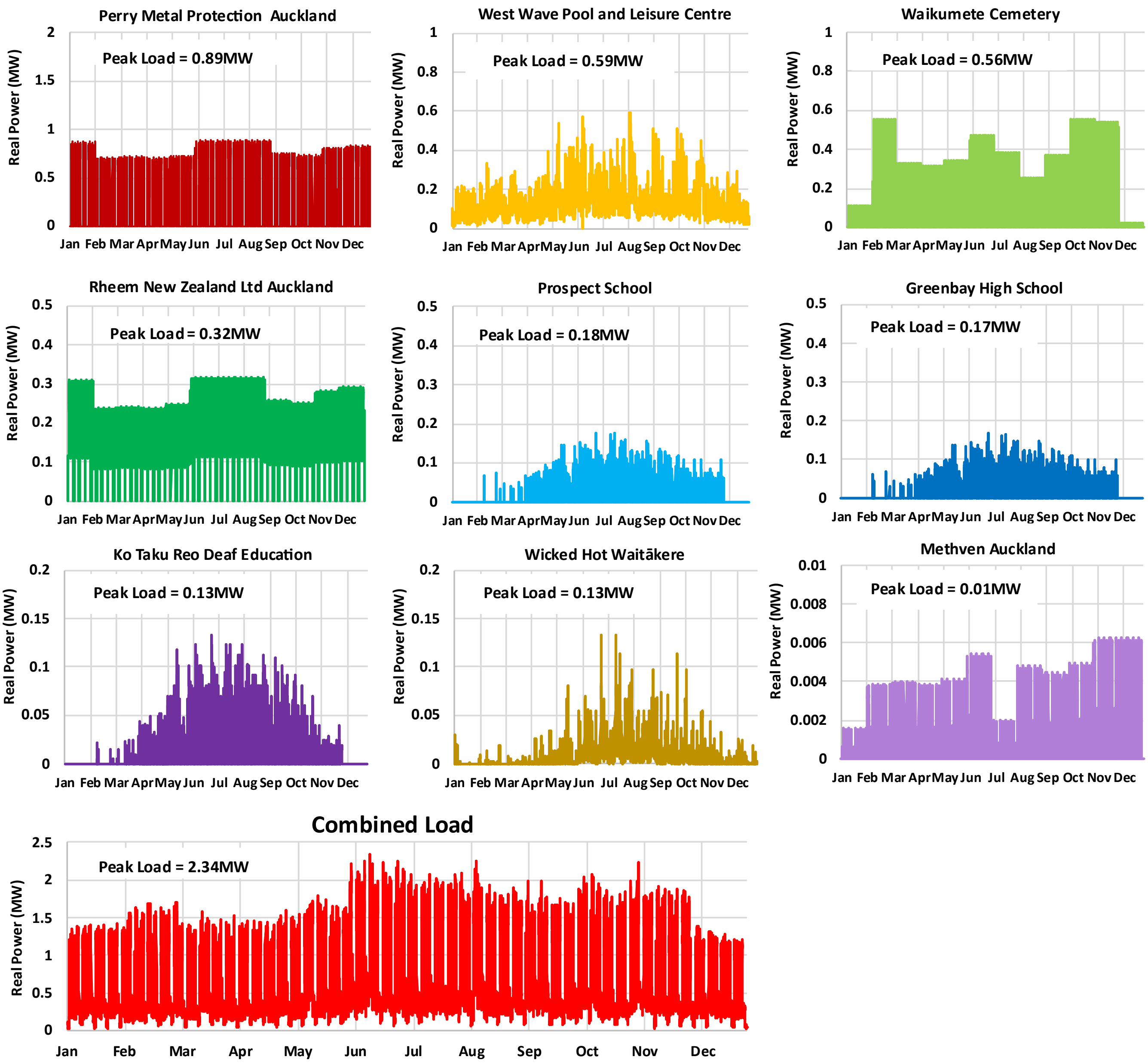


Figure 75. Loading Profiles: Hepburn Road 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.9.12 Effect of all Load Sites Connecting to Hepburn Road GXP

The following Figure 76 illustrates the Hepburn Road 33 kV GXP load profile together with the load profiles of all the Load Sites within the Hepburn Road 33 kV GXP region. Also shown in Figure 76 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Hepburn Road 33 kV GXP would increase to 132.8 MW, an increase of 6.5 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 137.3 MW, there is a diversity factor of 0.97 between the loads.
- Based on Ergo's analysis, the Hepburn Road 33 kV GXP's (N-1) limit is not expected to be exceeded.

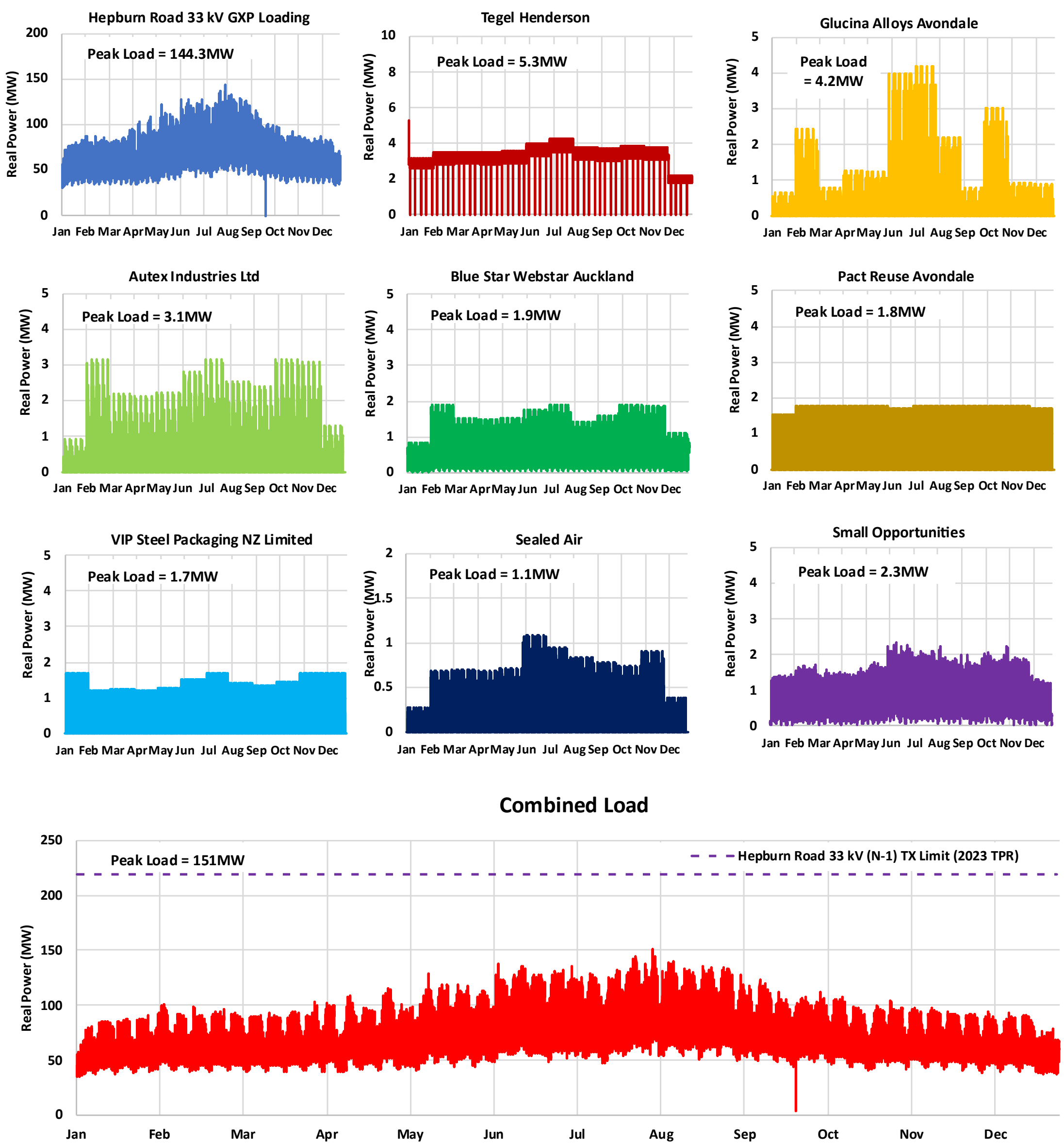


Figure 76. Loading Profiles: Hepburn Road 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.10 Māngere 110 kV GXP

The "Large" EECA load site connecting to the Māngere 110 kV GXP is:

- Blue Scope Pacific Steel (9.90 MW)

No "small" Load Sites are connecting to the Māngere 110 kV GXP.

The geographic location of the Load Site is shown on the following map, in relation to the local transmission and distribution substations.

Figure 77. Māngere 110 kV GXP: EECA Load Sites vs local substations

8.10.1 Māngere 110 kV GXP Upgrade

Māngere 110 kV GXP presently has 24 MVA of spare (N-1) capacity, and 94 MVA of spare (N) capacity. The single Load Site connecting is smaller than this, so the capacity of the GXP is not expected to be exceeded, and no further upgrades are expected at Māngere 110 kV GXP.

8.10.2 Blue Scope Pacific Steel

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	9.90	Māngere 110 kV

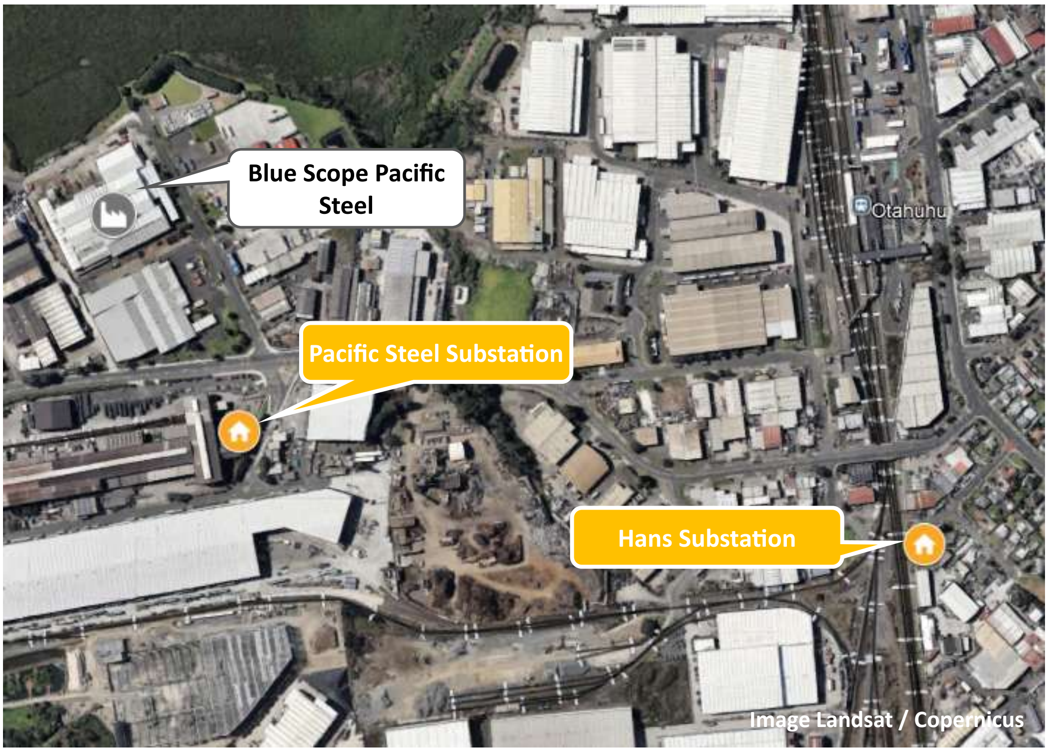


Figure 78. Blue Scope Pacific Steel geographic location in relation to the surrounding zone substations

8.10.2.1 Existing Electrical Supply to the Plant

Blue Scope Pacific Steel (PAC Steel) is presently supplied via a dedicated customer substation (Pacific Steel Substation), which is supplied by Māngere 110 kV GXP via 110 kV subtransmission circuits each rated to ~48.58 MVA. The site presently takes supply from Vector at 33 kV.

The site is located adjacent to the Pacific Steel zone substation. The zone substation is located in turn approximately 1.6 km from Māngere 110 kV GXP.

There is currently a maximum loading of 16.1 MVA on Pacific Steel zone substation, with 93.9 MVA of spare (N) capacity and 19.9 MVA of spare (N-1) capacity. Māngere 110 kV GXP presently has 24 MVA of spare (N-1) capacity, and 94 MVA of spare (N) capacity.

The subtransmission circuits presently suppling the Pacific Steel substation have ~32.48 MVA of spare (N-1) capacity, and ~81.06 MVA of spare (N) capacity.

8.10.2.2 Supply Option(s) for New Load

The substation, GXP, and subtransmission lines all have sufficient (N) and (N-1) capacity for this load.

For costing purposes, Ergo has included the cost of a 33/11 kV transformer appropriate for this load, which may be required at the Load Site. Ergo have not accounted for any 11 kV reticulation around the site, assuming, similar to the existing connection, that 11 kV reticulation would be owned by the Load Site.

8.10.2.3 Capital Cost Estimate

Table 43. Blue Scope Pacific Steel: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Small supply transformer (ZSS)	1.00	$1.50
		TOTAL	**$1.50**

8.10.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) or (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.10.3 Effect of all Load Sites Connecting to Māngere 110 kV GXP

The following Figure 79 illustrates the Māngere 110 kV GXP load profile together with the load profiles of all the Load Sites within the Māngere 110 kV GXP region. Also shown in Figure 79 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Māngere 110 kV GXP would increase to 25.9 MW, an increase of 9.85 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 26.0 MW, there is a diversity factor of 0.99 between the loads.
- Based on Ergo's analysis, the Māngere 110 kV GXP's (N-1) limit is not expected to be exceeded.

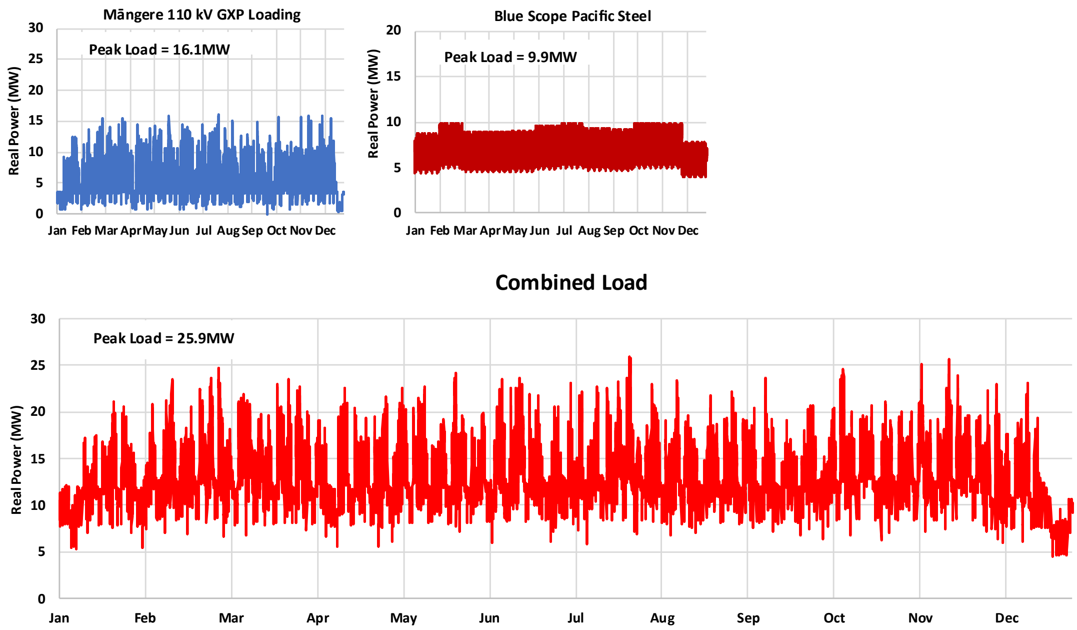


Figure 79. Loading Profiles: Māngere 110 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.11 Māngere 33 kV GXP

The "Large" EECA load sites connecting to the Māngere 33 kV GXP include:

- Coca Cola Amatil Keri Juice (3.05 MW)
- Hubbards Foods (2.77 MW)
- Health New Zealand Middlemore Hospital (2.76 MW)
- Oji Fibre Solutions Packaging Northern (1.98 MW)
- George Weston Foods Ōtāhuhu (1.72 MW)
- Auckland Airport (1.63 MW)
- Supreme Steel Products Ltd (1.48 MW)
- Air New Zealand Manukau (1.15 MW)

The "Small" EECA load sites connecting to the Māngere 33 kV GXP include (refer to Sections 8.11.10 and 8.11.12):

- Jack Link's Māngere (0.69 MW)
- International Waste Ltd (0.59 MW)
- Auckland Council Manukau Memorial Gardens (0.56 MW)
- Holiday Inn Auckland Airport Hotel (0.31 MW)
- Arxada (Arch Wood Protection) (0.18 MW)
- Green Harvest Pacific Ltd. (0.18 MW)
- Auckland Council Moana Nui A Kiwa - Māngere Pool (0.18 MW)
- Ministry of Education Aorere College (0.14 MW)
- LSG Sky Chefs Auckland Airport (0.12 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

Figure 80. Māngere 33 kV GXP: EECA Load Sites vs local substations. Ergo notes that while Pacific Steel Substation and Blue Scope Pacific Steel are shown on this map, they connect to the 110 kV GXP, not the 33 kV.

8.11.1 Māngere 33 kV GXP Upgrade

The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings. Based on the analysis in Section 8.11.13, the (N-1) rating of the GXP is not expected to be exceeded. However, Ergo notes that the GXP is experiencing growth, and as such, Transpower is discussing long term plans for the GXP with Vector, with some options being to upgrade the existing transformers or install a third 110/33 kV supply transformer at the GXP. An estimated cost for a third transformer is $4.5M.

8.11.2 Coca Cola Amatil Keri Juice

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	3.05	Māngere 33 kV

Figure 81. Coca Cola Amatil Keri Juice geographic location in relation to the surrounding zone substations

8.11.2.1 Existing Electrical Supply to the Plant

Coca Cola Amatil Keri Juice is presently supplied by Vector's Māngere Central zone substation. The site is supplied by two 11 kV feeders which are fully underground. The Māngere Central zone substation connects to the Māngere GXP through three 33 kV subtransmission circuits which are fully underground, rated to 20.23 MVA each.

The site is located approximately 2.1 km away from Māngere Central zone substation. The zone substation is located in turn approximately 2.4 km from Māngere 33 kV GXP.

There is currently a maximum loading of 36.3 MVA on Māngere Central zone substation, with 23.7 MVA of spare (N) capacity and 3.7 MVA of spare (N-1) capacity. The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission circuits presently supplying Māngere Central have approximately ~4.16 MVA of spare (N-1) capacity, and ~24.39 MVA of spare (N) capacity.

8.11.2.2 Supply Option(s) for New Load

The GXP and subtransmission circuits supplying the zone substation, and the zone substation all have adequate (N) and (N-1) capacity for this load.

Ergo notes that Vector have identified an upcoming constraint on the 11 kV feeder capacity of Māngere Central around the Airport Park industrial area (where this site is located). Vector are planning to mitigate these issues by installing a new substation at Māngere South, at an estimated cost of $1.2M for the new substation site, and $19.5M to build the new substation. Ergo has assumed that these upgrade projects would be required to supply this Load Site, due to its location. These costs have been included against this Load Site, as it may impact them.

The existing 11 kV feeders near the site are constrained, so Ergo has assumed that a new feeder would be required for this load. The new feeder is assumed to be underground, due to the urban/industrial topography, and would be ~3.4 km long.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.11.2.3 Capital Cost Estimate

Table 44. Coca Cola Amatil Keri Juice: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Māngere South secure site for new ZSS	1.00	$1.20
Subtransmission	Māngere South 33 kV switchroom	1.00	$7.20
Subtransmission	Māngere South Transformer and 11 kV switchroom	1.00	$12.30
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	3.40	$2.72
		TOTAL	**$23.62**

8.11.2.4 Expected Timeframe

It is estimated to take 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.11.3 Hubbards Foods

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	2.77	Māngere 33 kV

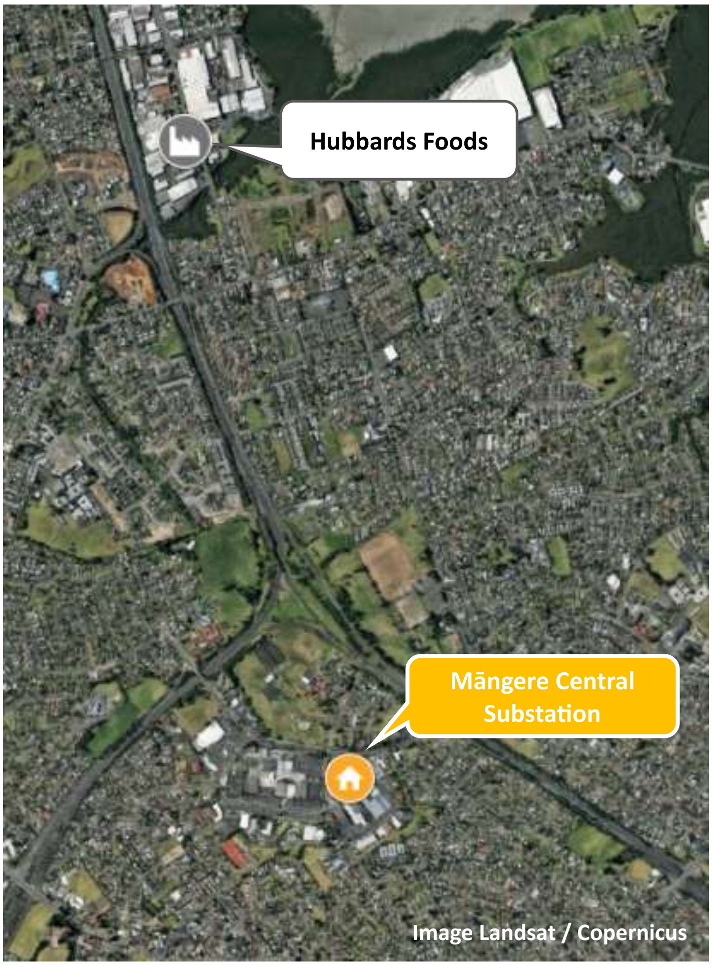


Figure 82. Hubbards Foods geographic location in relation to the surrounding zone substations

8.11.3.1 Existing Electrical Supply to the Plant

Hubbards Foods is presently supplied by Vector's Māngere Central zone substation. The site is supplied by an 11 kV feeder which is fully underground. The Māngere Central zone substation connects to the Māngere GXP through three 33 kV subtransmission circuits which are fully underground, rated to 20.23 MVA each.

The site is located approximately 2.5 km away from Māngere Central zone substation. The zone substation is located in turn approximately 2.4 km from Māngere GXP.

There is currently a maximum loading of 36.3 MVA on Māngere Central zone substation, with 23.7 MVA of spare (N) capacity and 3.7 MVA of spare (N-1) capacity. The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission circuits presently supplying Māngere Central have approximately ~4.16 MVA of spare (N-1) capacity, and ~24.39 MVA of spare (N) capacity.

8.11.3.2 Supply Option(s) for New Load

The GXP and subtransmission circuits supplying the zone substation, and the zone substation all have adequate (N) and (N-1) capacity for this load.

The existing 11 kV feeder has approximately 4.4 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.11.3.3 Capital Cost Estimate

Indicatively, it is expected that a distribution transformer to supply this load would cost approximately $500k.
Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.11.3.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.11.4 Health New Zealand Middlemore Hospital

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	2.76	Māngere 33 kV

Figure 83. Health New Zealand Middlemore Hospital geographic location in relation to the surrounding zone substations

8.11.4.1 Existing Electrical Supply to the Plant

Health New Zealand Middlemore Hospital is presently supplied by Vector's Hans zone substation. The site is supplied by an 11 kV feeder which is fully underground. The Hans zone substation connects to the Māngere GXP through two 33 kV subtransmission circuits which are fully underground, rated at 21.72 MVA each.

The site is located approximately 1.5 km away from Hans zone substation. The zone substation is located in turn approximately 1.5 km from Māngere GXP.

There is currently a maximum loading of 25.2 MVA on Hans zone substation, with 14.8 MVA of spare (N) capacity and no spare (N-1) capacity. The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission cables supplying Hans substation have ~-3.48 MVA of spare (N-1) capacity, and ~18.24 MVA of spare (N) capacity.

8.11.4.2 Supply Option(s) for New Load

The GXP has adequate spare (N) capacity and (N-1) capacity for this load. The zone substation, and the subtransmission circuits supplying the zone substation, lack (N-1) capacity.

Ergo understands that Vector have a project planned to install cooling fans on the transformers at Hans to increase their capacity, but it is unlikely that the installation of fans will be sufficient to provide for (N-1) security to the Load Site. Therefore, it is expected that the transformers at Hans zone substation may need to be replaced, for an (N-1) supply.

Additionally, for an (N-1) supply, it is expected that upgrades of the subtransmission circuits supplying the zone substation would be required. Ergo has assumed that a third subtransmission circuit would be installed, alongside the two existing, to relieve this constraint. The new subtransmission circuit is assumed to be underground cabling, due to the urban topography, and would be ~2.03 km long, matching the existing circuits.

The existing 11 kV feeder has approximately 3.4 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.11.4.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 45. Health New Zealand Middlemore Hospital: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Single underground 33kV cable	2.03	$4.06
Subtransmission	33kV circuit breaker (ZSS)	2.00	$0.60
Distribution	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$9.26**

8.11.4.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.11.5 Oji Fibre Solutions Packaging Northern

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.98	Māngere 33 kV

Figure 84. Oji Fibre Solutions Packaging Northern geographic location in relation to the surrounding zone substations

8.11.5.1 Existing Electrical Supply to the Plant

Oji Fibre Solutions Packaging Northern is presently supplied by Vector's Māngere Central zone substation. The site is supplied by an 11 kV feeder which is fully underground. The Māngere Central zone substation connects to the Māngere GXP through three 33 kV subtransmission circuits which are fully underground, rated to 20.23 MVA each.

The site is located approximately 2.8 km away from Māngere Central zone substation. The zone substation is located in turn approximately 2.4 km from Māngere GXP.

There is currently a maximum loading of 36.3 MVA on Māngere Central zone substation, with 23.7 MVA of spare (N) capacity and 3.7 MVA of spare (N-1) capacity. The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission circuits presently supplying Māngere Central have approximately ~4.16 MVA of spare (N-1) capacity, and ~24.39 MVA of spare (N) capacity.

8.11.5.2 Supply Option(s) for New Load

The GXP and subtransmission circuits supplying the zone substation, and the zone substation all have adequate (N) and (N-1) capacity for this load.

The existing 11 kV feeder has approximately 4.4 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.11.5.3 Capital Cost Estimate

Indicatively, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.11.5.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) security connection or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.11.6 George Weston Foods Ōtāhuhu

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.72	Māngere 33 kV

Figure 85. George Weston Foods Ōtāhuhu geographic location in relation to the surrounding zone substations

8.11.6.1 Existing Electrical Supply to the Plant

George Weston Foods Ōtāhuhu is presently supplied by Vector's Hans zone substation. The site is supplied by an 11 kV feeder which is fully underground. The Hans zone substation connects to the Māngere GXP through two 33 kV subtransmission circuits which are fully underground, rated at 21.72 MVA each.

The site is located approximately 1.7 km away from Hans zone substation. The zone substation is located in turn approximately 1.5 km from Māngere GXP.

There is currently a maximum loading of 25.2 MVA on Hans zone substation, with 14.8 MVA of spare (N) capacity and no spare (N-1) capacity. The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission cables supplying Hans substation have ~-3.48 MVA of spare (N-1) capacity, and ~18.24 MVA of spare (N) capacity.

8.11.6.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity. However, the zone substation and the subtransmission circuits supplying it lack spare (N-1) capacity.

Ergo understands that Vector have a project planned to install cooling fans on the transformers at Hans to increase their capacity, but it is unlikely that the installation of fans will be sufficient to provide for (N-1) security to the Load Site. Therefore, it is expected that the transformers at Hans zone substation may need to be replaced, for an (N-1) supply.

Additionally, for an (N-1) supply, it is expected that upgrades of the subtransmission circuits supplying the zone substation would be required. Ergo has assumed that a third subtransmission circuit would be installed, alongside the two existing, to relieve this constraint. The new subtransmission circuit is assumed to be underground cabling, due to the urban topography, and would be ~2.03 km long, matching the existing circuits.

The existing 11 kV feeder has approximately 3.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.11.6.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 46. George Weston Foods Ōtāhuhu: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Single underground 33kV cable	2.03	$4.06
Subtransmission	33kV circuit breaker (ZSS)	2.00	$0.60
Distribution	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$9.26**

8.11.6.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.11.7 Auckland Airport

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	1.63	Māngere 33 kV

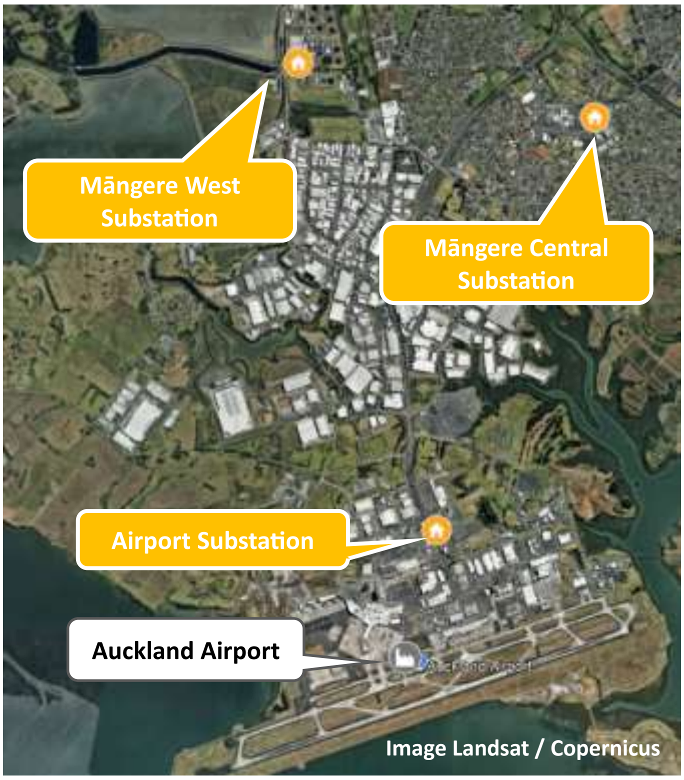


Figure 86. Auckland Airport geographic location in relation to the surrounding zone substations

8.11.7.1 Existing Electrical Supply to the Plant

Auckland Airport is presently supplied by Vector's Airport zone substation. Ergo understands that the Airport substation provides a direct supply to the private network within the Airport at 11 kV. The Airport substation is supplied at 33 kV by two 33 kV subtransmission circuit, each rated to 32.98 MVA.

The site is located approximately 1.0 km away from Airport zone substation. The zone substation is located in turn approximately 5.4 km from Māngere GXP.

There is currently a maximum loading of 14.3 MVA on Airport zone substation, with 35.7 MVA of spare (N) capacity and 10.7 MVA of spare (N-1) capacity. The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission cables supplying the Airport substation have ~18.68 MVA of spare (N-1) capacity, and ~51.66 MVA of spare (N) capacity.

8.11.7.2 Supply Option(s) for New Load

The GXP and subtransmission circuits supplying the zone substation, and the zone substation all have adequate (N) and (N-1) capacity for this load.

As the Airport takes supply at 11 kV from the Airport substation, the reticulation around the Airport site and therefore existing 11 kV feeder configuration and loading are unknown to Ergo. Ergo has allowed for a new circuit breaker at the Airport substation, and ~1.4 km of underground 11 kV cabling for this load.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.11.7.3 Capital Cost Estimate

Table 47. Auckland Airport: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.40	$1.12
		TOTAL	**$1.32**

8.11.7.4 Expected Timeframe

It is estimated to take 12-18 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.11.8 Supreme Steel Products Ltd

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.48	Māngere 33 kV

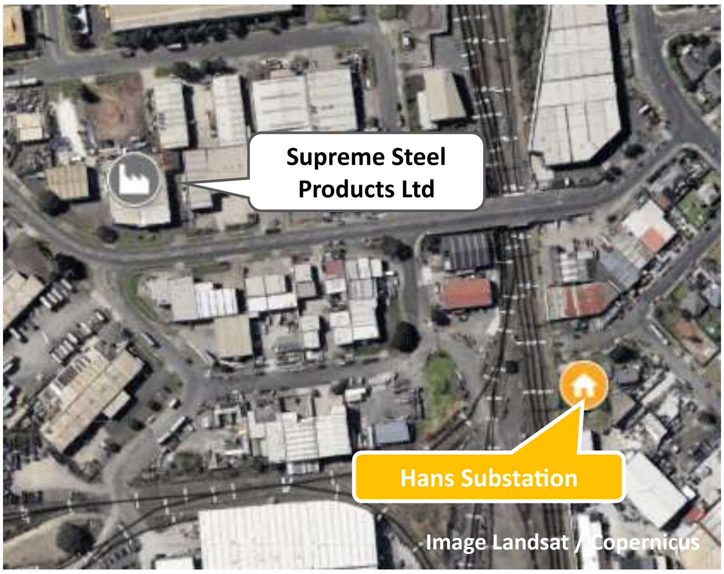


Figure 87. Supreme Steel Products Ltd geographic location in relation to the surrounding zone substations

8.11.8.1 Existing Electrical Supply to the Plant

Supreme Steel Products Ltd is presently supplied by Vector's Hans zone substation. The site is supplied by an 11 kV feeder which is fully underground. The Hans zone substation connects to the Māngere GXP through two 33 kV subtransmission circuits which are fully underground, rated at 21.72 MVA each.

The site is located approximately 0.3 km away from Hans zone substation. The zone substation is located in turn approximately 1.5 km from Māngere GXP.

There is currently a maximum loading of 25.2 MVA on Hans zone substation, with 14.8 MVA of spare (N) capacity and no of spare (N-1) capacity. The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings.

8.11.8.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity. However, the zone substation and the subtransmission circuits supplying it lack spare (N-1) capacity.

Ergo understands that Vector have a project planned to install cooling fans on the transformers at Hans to increase their capacity, but it is unlikely that the installation of fans will be sufficient to provide for (N-1) security to the Load Site. Therefore, it is expected that the transformers at Hans zone substation may need to be replaced, for an (N-1) supply.

Additionally, for an (N-1) supply, it is expected that upgrades of the subtransmission circuits supplying the zone substation would be required. Ergo has assumed that a third subtransmission circuit would be installed, alongside the two existing, to relieve this constraint. The new subtransmission circuit is assumed to be underground cabling, due to the urban topography, and would be ~2.03 km long, matching the existing circuits.

The existing 11 kV feeder has approximately 4.9 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.11.8.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 48. Supreme Steel Products Ltd: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Single underground 33kV cable	2.03	$4.06
Subtransmission	33kV circuit breaker (ZSS)	2.00	$0.60
Distribution	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$9.26**

8.11.8.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.11.9 Air New Zealand Manukau

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.15	Māngere 33 kV

Figure 88. Air New Zealand Manukau geographic location in relation to the surrounding zone substations

8.11.9.1 Existing Electrical Supply to the Plant

Air New Zealand Manukau is presently supplied by Vector's Airport zone substation. Ergo understands that the Airport substation provides a direct supply to the private network within the Airport at 11 kV. The Airport substation is supplied at 33 kV by two 33 kV subtransmission circuit, each rated to 32.98 MVA.

The site is located approximately 0.9 km away from Airport zone substation. The zone substation is located in turn approximately 5.4 km from Māngere GXP.

There is currently a maximum loading of 14.3 MVA on Airport zone substation, with 35.7 MVA of spare (N) capacity and 10.7 MVA of spare (N-1) capacity. The Māngere 33 kV GXP presently has 16 MVA of spare (N-1) capacity and 114 MVA of spare (N) capacity, based on the transformer ratings.

The subtransmission cables supplying the Airport substation have ~18.68 MVA of spare (N-1) capacity, and ~51.66 MVA of spare (N) capacity.

8.11.9.2 Supply Option(s) for New Load

The GXP and subtransmission circuits supplying the zone substation, and the zone substation all have adequate (N) and (N-1) capacity for this load.

As the Airport takes supply at 11 kV from the Airport substation, the reticulation around the Airport site and therefore existing 11 kV feeder configuration and loading are unknown to Ergo. Ergo has allowed for a new circuit breaker at the Airport substation, and ~1.5 km of underground 11 kV cabling for this load.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.11.9.3 Capital Cost Estimate

Table 49. Air New Zealand Manukau: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.50	$1.20
		TOTAL	**$1.40**

8.11.9.4 Expected Timeframe

It is estimated to take 12-18 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.11.10 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 50. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Jack Link's Māngere	Māngere West	5.6	35.6	3.3	0.69	200
International Waste Ltd	Māngere Central	3.7	23.7	1.4	0.59	200
Auckland Council Manukau Memorial Gardens	Māngere East	0.0	7.5	1.8	0.56	200
Holiday Inn Auckland Airport Hotel	Māngere Central	3.7	23.7	4.1	0.31	130
Arxada (Arch Wood Protection)	Hans	0.0	14.8	4.9	0.18	80
Green Harvest Pacific Ltd.	Māngere Central	3.7	23.7	3.5	0.18	80
Auckland Council Moana Nui A Kiwa - Māngere Pool	Māngere Central	3.7	23.7	5.3	0.18	80
Ministry of Education Aorere College	Māngere East	0.0	7.5	2.4	0.14	80
LSG Sky Chefs Auckland Airport	Airport	3.7	23.7	6.6	0.12	80

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.11.11 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.11.11.1 Hans

Four of the loads on Māngere 33 kV GXP are expected to connect to Hans zone substation. The loads are Health New Zealand Middlemore Hospital, George Weston Foods Ōtāhuhu, Supreme Steel Products Ltd, and Arxada (Arch Wood Protection). The sum of peaks of these loads is 7.01 MW, which the zone substation does not have (N-1) capacity for.

However, each of the large Load Sites connecting requires upgrades of the transformers and of the subtransmission to the substation to connect. If one or more of the large Load Sites connect, then the upgrades required for those sites would be expected to be sufficient for both sites. Therefore, no further upgrades are expected at Hans.

8.11.11.2 Māngere Central

Seven of the loads on Māngere 33 kV GXP are expected to connect to Māngere Central zone substation. These loads are Coca Cola Amatil Keri Juice, Hubbards Foods, Oji Fibre Solutions Packaging Northern, International Waste Ltd, Holiday Inn Auckland Airport Hotel, Green Harvest Pacific Ltd, and Auckland Council Moana Nui A Kiwa – Māngere Pool. The sum of peaks of these loads is 9.06 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that Vector plans to relieve some capacity constraints at Māngere Central (particularly those in the Airport area) by constructing the new Māngere South substation, which will offload some load on the substation. The anticipated total cost of the project is $20.7M, to acquire land, and construct the new substation including 33 kV and 11 kV switchrooms and transformers. While these costs have been included against the one large Load Site which is in the Airport zone, it is taken that these upgrades would be sufficient to offload the Māngere Central substation to support all of the connecting loads with (N-1) security.

No further upgrades are anticipated at Māngere Central substation.

8.11.11.3 Māngere Central 11 kV feeders

Two of the loads on the Māngere Central substation are expected to connect to the same 11 kV feeder. These loads are Hubbards Foods and Oji Fibre Solutions Packaging Northern. The sum of the peaks of these two loads is 4.75 MVA, which the existing 11 kV feeder does not have capacity for. Therefore, if both Load Sites connect, a new 11 kV feeder may be required. Ergo notes that costs may be shared between the two loads.

The new feeder is expected to be ~3.8 km long, and would likely be underground, due to the urban topography. An estimated cost for this feeder is $3.94M.

8.11.11.4 Māngere East

Two of the loads on Māngere 33 kV GXP are expected to connect to Māngere East zone substation. These loads are Auckland Council Manukau Memorial Gardens and Ministry of Education Aorere College. The sum of peaks of these loads is 0.69 MW, which the zone substation does not have (N-1) capacity for. However, both of these loads are "small" and are not expected to have a material impact on the network. Therefore, no further upgrades are expected at Māngere East, however, Ergo notes that Vector has a project planned to install a third transformer and new 33 kV cabling at Māngere East (expected cost $9.4M, to be commissioned in 2026), which we expect would mean that the substation will have (N-1) capacity in the future.

8.11.11.5 Airport

Three of the loads on Māngere 33 kV GXP are expected to connect to Airport zone substation. These loads are Auckland Airport, Air New Zealand Manukau, and LSG Sky Chefs Auckland Airport. The sum of peaks of these loads is 2.90 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at the Airport substation.

8.11.12 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Māngere 33 kV GXP gives a combined load of 2.52 MW. When the load shapes are combined, they result in the following load shape (Figure 89), with a maximum load of 2.03 MW, with a diversity factor of 0.81.

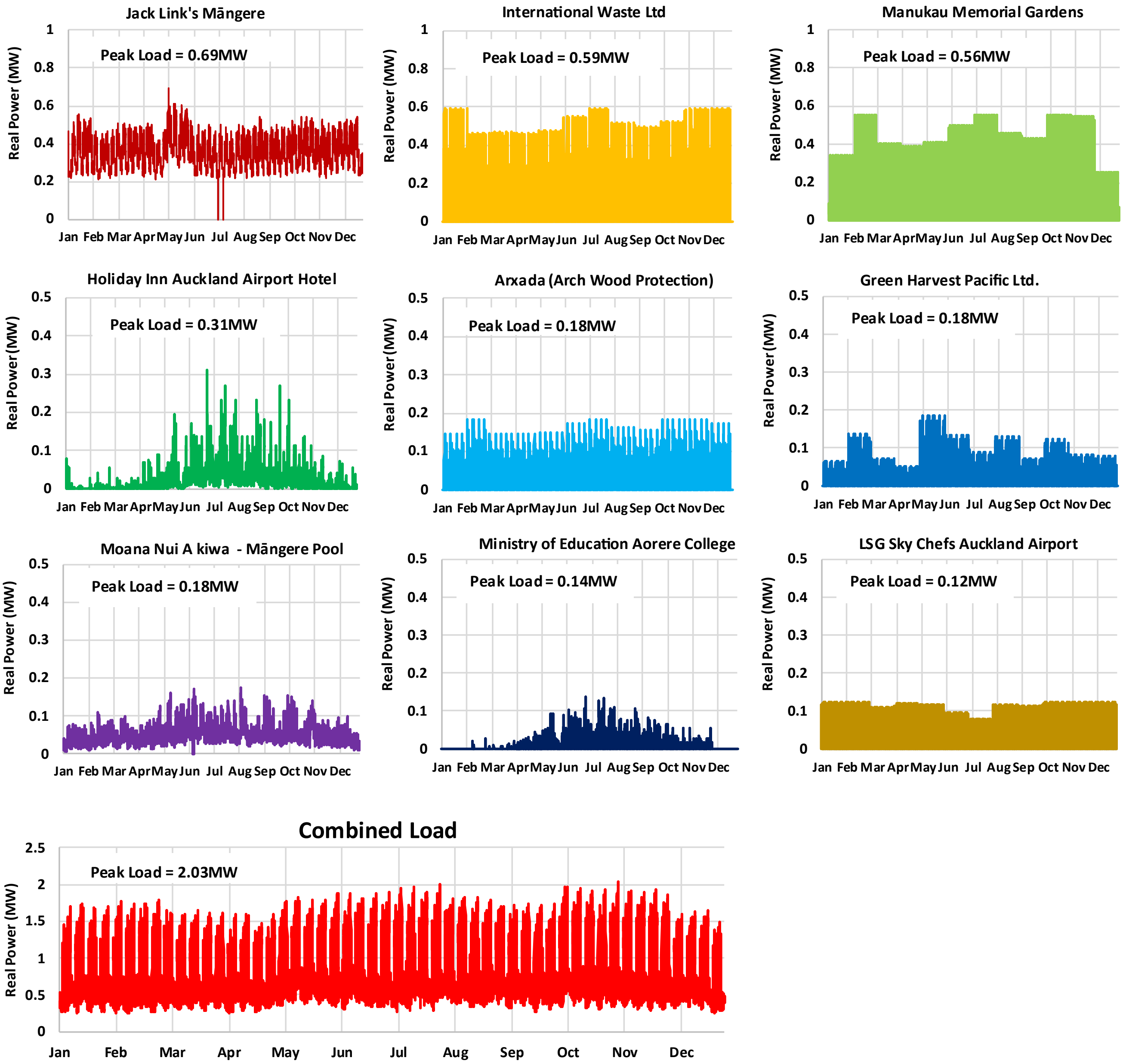


Figure 89. Loading Profiles: Māngere 33 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.11.13 Effect of all Load Sites Connecting to Māngere 33 kV GXP

The following Figure 90 illustrates the Māngere 33 kV GXP load profile together with the load profiles of all the Load Sites within the Māngere 33 kV GXP region. Also shown in Figure 90 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Māngere 33 kV GXP would increase to 123.4 MW, an increase of 9.5 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 132.5 MW, there is a diversity factor of 0.93 between the loads.
- Based on Ergo's analysis, the Māngere 33 kV GXP's (N-1) limit is not expected to be exceeded.

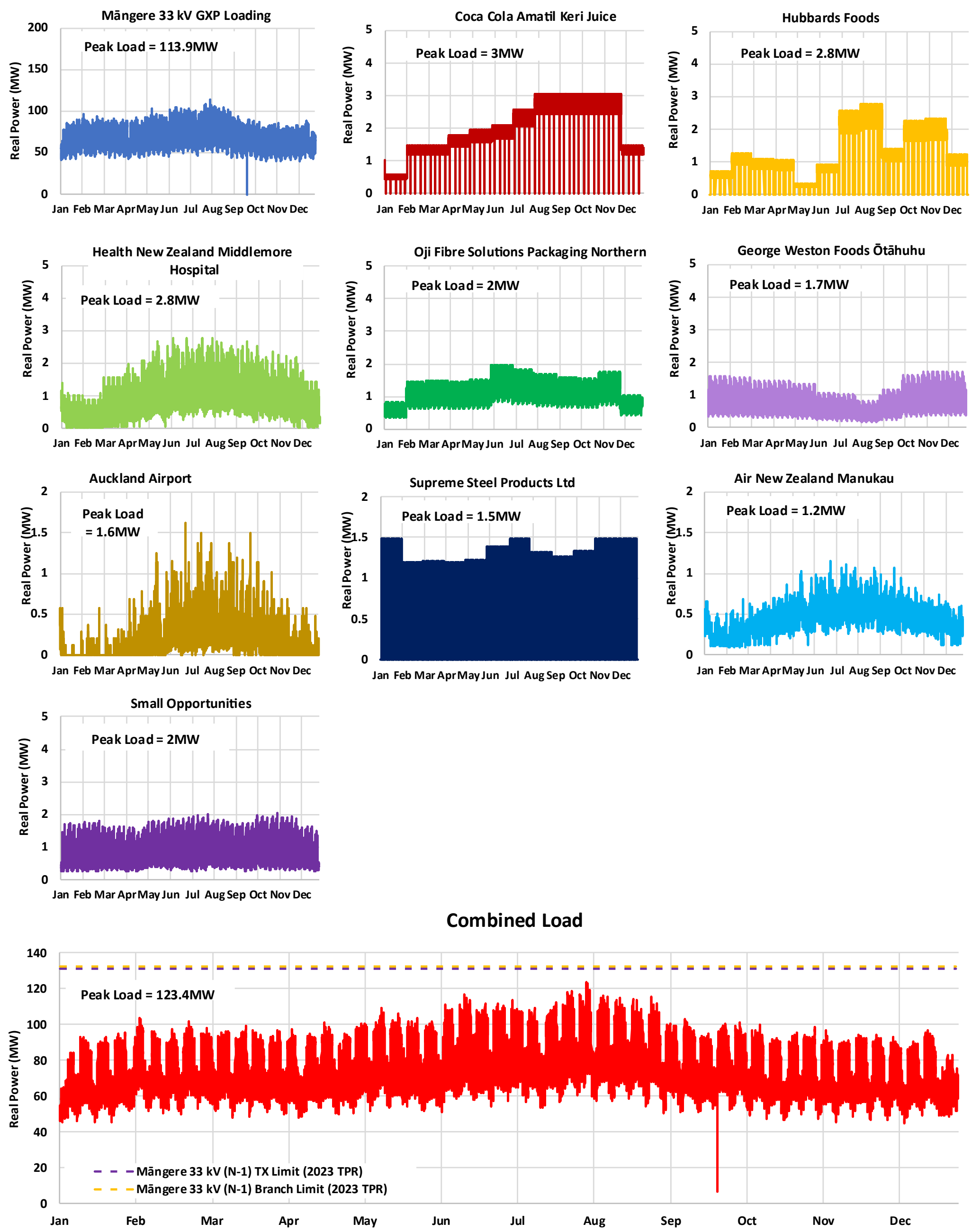


Figure 90. Loading Profiles: Māngere 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.12 Ōtāhuhu 22 kV GXP

The "Large" EECA load sites connecting to the Ōtāhuhu 22 kV GXP include:

- Altus NZ Ltd Auckland (5.48 MW)
- DB Breweries Limited Waitematā (5.23 MW)
- Goodman Fielder Quality Bakers Auckland (5.05 MW)
- Lion The Pride (3.81 MW)
- Huhtamaki NZ Ltd Moulder Fibre (3.27 MW)
- NZ Panels East Tāmaki (1.15 MW)

The "Small" EECA load sites connecting to the Ōtāhuhu 22 kV GXP include (refer to Sections 8.12.8 and 8.12.10):

- East Tāmaki Galvanising (0.54 MW)
- Bell Tea & Coffee Company Ltd Auckland (0.49 MW)
- Heinz Watties Limited La Bonne Cuisine (0.35 MW)
- Ministry of Education Sir Edmund Hillary Collegiate (0.22 MW)
- Auckland Council Ōtara Pool & Leisure Centre (0.17 MW)
- Auckland Council Papatoetoe Centennial Pool & Leisure Centre (0.11 MW)
- Ministry of Education Fairburn School (0.07 MW)

The geographic locations of the Load Sites are shown on the following map in relation to the local transmission and distribution substations.

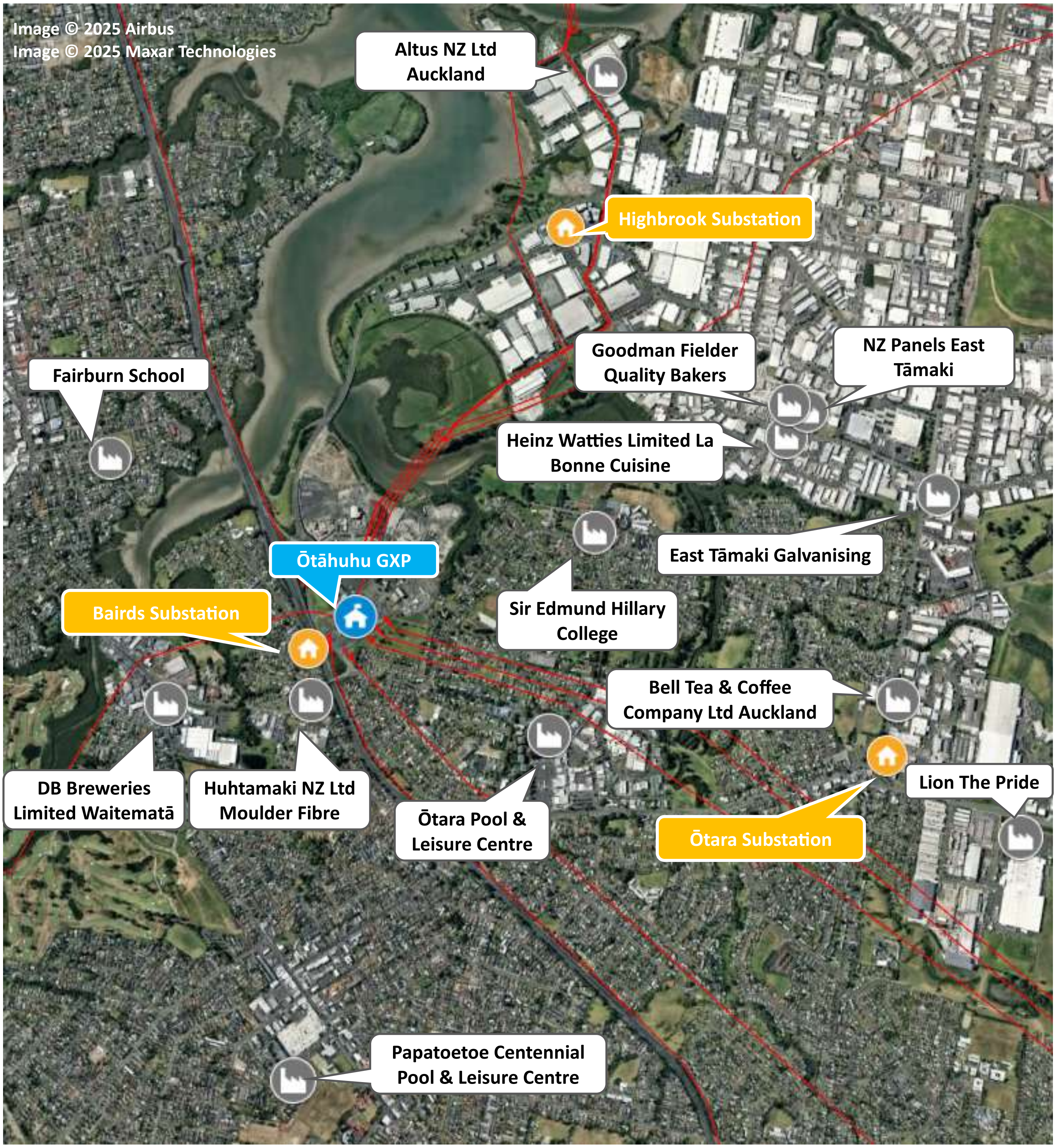


Figure 91. Ōtāhuhu 22 kV GXP: EECA Load Sites vs local substations.

8.12.1 Ōtāhuhu 22 kV GXP upgrade

Ōtāhuhu 22 kV GXP presently has 29 MVA of spare (N-1) capacity and 100 MVA of spare (N) capacity, based on the transformer ratings. The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.9.12). Therefore, no further upgrades are expected at Ōtāhuhu 22 kV GXP.

8.12.2 Altus NZ Ltd Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	5.48	Ōtāhuhu 22 kV

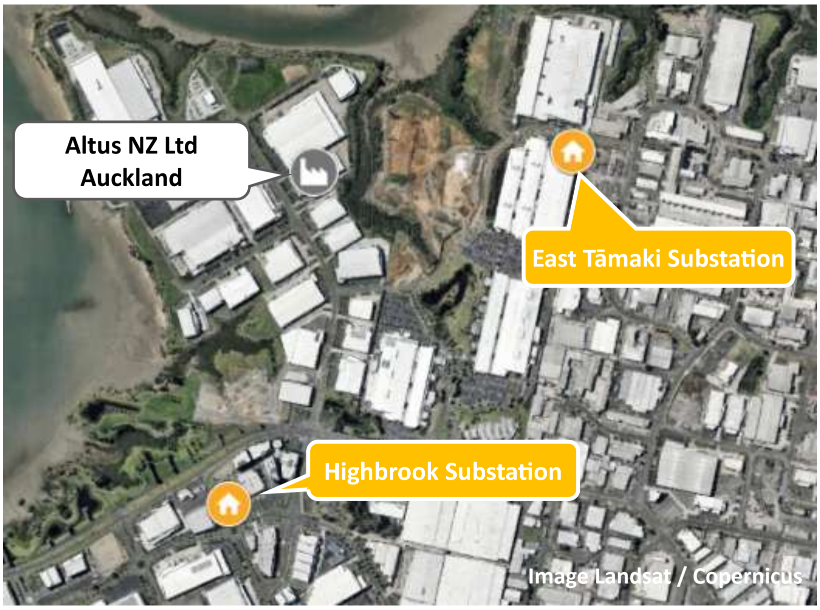


Figure 92. Altus NZ Ltd Auckland geographic location in relation to the surrounding zone substations.

8.12.2.1 Existing electrical supply to the Plant

Altus NZ Ltd Auckland is presently supplied by Vector's Highbrook zone substation. The site is supplied by a single 22 kV feeder which is fully underground. The zone substation connects to Ōtāhuhu GXP through two subtransmission circuits at 22 kV which are fully underground, rated at 20.92 MVA each.

The site is located approximately 0.8 km away from Highbrook zone substation. The zone substation is located in turn approximately 2 km from Ōtāhuhu GXP.

There is currently a maximum loading of 10 MVA on Highbrook zone substation, with 11 MVA of spare (N) capacity and 11 MVA of spare (N-1) capacity. Ōtāhuhu 22 kV GXP presently has 29 MVA of spare (N-1) capacity and 100 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Highbrook substation have ~10.92 MVA of spare (N-1) capacity, and ~31.84 MVA of spare (N) capacity.

8.12.2.2 Supply Option(s) for New Load

The GXP, zone substation, and subtransmission circuits supplying the zone substation have spare (N) and (N-1) capacity.

The existing 22 kV feeder has approximately 15.8 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 22 kV feeder.

For costing purposes, Ergo has included the cost of a 22/11 kV transformer appropriate for this load, which may be required at the Load Site.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.12.2.3 Capital Cost Estimate

Table 51. Altus NZ Ltd Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Small supply transformer (ZSS)	1.00	$1.50
		TOTAL	**$1.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.12.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.12.3 DB Breweries Limited Waitematā

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	5.23	Ōtāhuhu 22 kV

Figure 93. DB Breweries Limited Waitematā geographic location in relation to the surrounding zone substations

8.12.3.1 Existing Electrical Supply to the Plant

DB Breweries Limited Waitematā is presently supplied by Vector's Bairds zone substation. The site is supplied by an underground 11 kV feeder. Bairds zone substation connects directly to the GXP through two subtransmission circuits at 22 kV which are fully underground, rated at 35.06 MVA each.

The site is located approximately 0.7 km away from Bairds zone substation. The zone substation is located in turn approximately 0.3 km from Ōtāhuhu GXP.

There is currently a maximum loading of 28.6 MVA on Bairds zone substation, with 11.4 MVA of spare (N) capacity and no spare (N-1) capacity. Ōtāhuhu 22 kV GXP presently has 29 MVA of spare (N-1) capacity and 100 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Bairds substation have ~6.46 MVA of spare (N-1) capacity, and ~41.52 MVA of spare (N) capacity.

8.12.3.2 Supply Option(s) for New Load

The subtransmission circuits supplying the zone substation and the GXP have adequate spare (N-1) and (N) capacity. The zone substation has adequate (N) capacity, but lacks (N-1) capacity.

For an (N-1) security supply, it is expected that the transformers at Bairds zone substation may need to be replaced.

Due to the size of the load, it is expected that a new 11 kV feeder and associated circuit breaker would be required between the zone substation and the site. This feeder would likely be underground, due to the urban topography, and would be ~1.0 km long.

8.12.3.3 Capital Cost Estimate

Table 52. DB Breweries Limited Waitematā: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.00	$0.80
		TOTAL	**$1.00**

Table 53. DB Breweries Limited Waitematā: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.00	$0.80
		TOTAL	**$5.60**

8.12.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.12.4 Goodman Fielder Quality Bakers Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	5.05	Ōtāhuhu 22 kV

Figure 94. Goodman Fielder Quality Bakers Auckland geographic location in relation to the surrounding zone substations.

8.12.4.1 Existing electrical supply to the Plant

Goodman Fielder Quality Bakers Auckland is presently supplied by Vector's Ōtara zone substation. The site is supplied by a single 11 kV feeder which is fully underground. Ōtara zone substation connects directly to the GXP through three subtransmission circuits at 22 kV which are fully underground, rated at 14.48 MVA each.

The site is located approximately 1.7 km away from Ōtara zone substation. The zone substation is located in turn approximately 2.4 km from Ōtāhuhu GXP.

There is currently a maximum loading of 29.2 MVA on Ōtara zone substation, with 20.8 MVA of spare (N) capacity and 0.8 MVA of spare (N-1) capacity. Ōtāhuhu 22 kV GXP presently has 29 MVA of spare (N-1) capacity and 100 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Ōtara substation have ~-0.24 MVA of spare (N-1) capacity, and ~14.24 MVA of spare (N) capacity.

8.12.4.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity.

For an (N-1) security supply, it is expected that the two smaller transformers at Ōtara zone substation may need to be replaced. Additionally, a fourth 22 kV circuit may be required between the GXP and zone substation – matching the existing circuits, this circuit would be underground, and ~3.1 km in length.

Ergo notes that Vector is planning to install a new 11 kV feeder to reduce the load on the feeder OTAR K15, which this site connects to. The expected cost is $2.6M and is expected to occur 2026-27. However, due to the size of the load, 1x new dedicated 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 1.03 km.

8.12.4.3 Capital Cost Estimate

Table 54. Goodman Fielder Quality Bakers Auckland: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable (CBD)	1.03	$0.82
		TOTAL	**$1.02**

Table 55. Goodman Fielder Quality Bakers Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Medium supply transformer (ZSS)	2.00	$3.80
Subtransmission	22kV circuit breaker (ZSS)	2.00	$0.40
Subtransmission	Single underground 22kV cable	3.00	$2.10
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.03	$0.82
		TOTAL	**$7.32**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.12.4.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.12.5 Lion The Pride

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	3.81	Ōtāhuhu 22 kV

Figure 95. Lion The Pride geographic location in relation to the surrounding zone substations.

8.12.5.1 Existing electrical supply to the Plant

Lion The Pride is presently supplied by Vector's Ōtara zone substation. The site is supplied with a single 11 kV feeder which is fully underground. Ōtara zone substation connects directly to the GXP through three subtransmission circuits at 22 kV which are fully underground, rated at 14.48 MVA each.

The site is located approximately 0.7 km away from Ōtara zone substation. The zone substation is located in turn approximately 2.4 km from Ōtāhuhu GXP.

There is currently a maximum loading of 29.2 MVA on Ōtara zone substation, with 20.8 MVA of spare (N) capacity and 0.8 MVA of spare (N-1) capacity. Ōtāhuhu 22 kV GXP presently has 29 MVA of spare (N-1) capacity and 100 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Ōtara substation have ~-0.24 MVA of spare (N-1) capacity, and ~14.24 MVA of spare (N) capacity.

8.12.5.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity.

For an (N-1) security supply, it is expected that the two smaller transformers at Ōtara zone substation may need to be replaced. Additionally, a fourth 22 kV circuit may be required between the GXP and zone substation – matching the existing circuits, this circuit would be underground, and ~3.1 km in length.

The existing 11 kV feeder has approximately 5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.12.5.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 56. Lion The Pride: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	**Subtransmission => (N-1)**	**Distribution => (N)**	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Medium supply transformer (ZSS)	2.00	$3.80
Subtransmission	22kV circuit breaker (ZSS)	2.00	$0.40
Subtransmission	Single underground 22kV cable	3.00	$2.10
		TOTAL	**$6.30**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.12.5.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.12.6 Huhtamaki NZ Ltd Moulder Fibre

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	3.27	Ōtāhuhu 22 kV

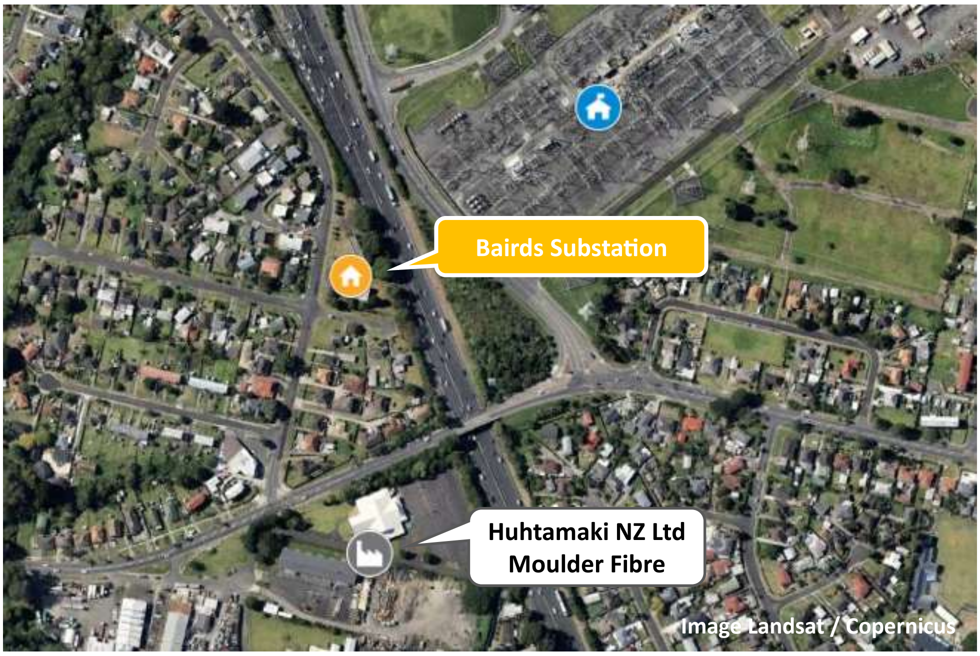


Figure 96. Huhtamaki NZ Ltd Moulder Fibre geographic location in relation to the surrounding zone substations.

8.12.6.1 Existing electrical supply to the Plant

Huhtamaki NZ Ltd Moulder Fibre is presently supplied by Vector's Bairds zone substation. The site is supplied with a single 11 kV feeder which is fully underground. Bairds zone substation connects directly to the GXP through two subtransmission circuits at 22 kV which are fully underground, rated at 35.06 MVA each.

The site is located approximately 0.2 km away from Bairds zone substation. The zone substation is located in turn approximately 0.3 km from Ōtāhuhu GXP.

There is currently a maximum loading of 28.6 MVA on Bairds zone substation, with 11.4 MVA of spare (N) capacity and no spare (N-1) capacity. Ōtāhuhu 22 kV GXP presently has 29 MVA of spare (N-1) capacity and 100 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Bairds substation have ~6.46 MVA of spare (N-1) capacity, and ~41.52 MVA of spare (N) capacity.

8.12.6.2 Supply Option(s) for New Load

The subtransmission circuits supplying the zone substation and the GXP have adequate spare (N-1) and (N) capacity. The zone substation has adequate (N) capacity, but lacks (N-1) capacity.

For an (N-1) security supply, it is expected that the transformers at Bairds zone substation may need to be replaced.

The existing 11 kV feeder has approximately 5.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.12.6.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 57. Huhtamaki NZ Ltd Moulder Fibre: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	**Subtransmission => (N-1)**		**Distribution => (N)**
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$4.60**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.12.6.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.12.7 NZ Panels East Tāmaki

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.15	Ōtāhuhu 22 kV

Figure 97. NZ Panels East Tāmaki geographic location in relation to the surrounding zone substations.

8.12.7.1 Existing electrical supply to the Plant

NZ Panels East Tāmaki is presently supplied by Vector's Ōtara zone substation. The site is supplied with a single 11 kV feeder which is fully underground. Ōtara zone substation connects directly to the GXP through three subtransmission circuits at 22 kV which are fully underground, rated at 14.48 MVA each.

The site is located approximately 1.6 km away from Ōtara zone substation. The zone substation is located in turn approximately 2.4 km from Ōtāhuhu GXP.

There is currently a maximum loading of 29.2 MVA on Ōtara zone substation, with 20.8 MVA of spare (N) capacity and 0.8 MVA of spare (N-1) capacity. Ōtāhuhu 22 kV GXP presently has 29 MVA of spare (N-1) capacity and 100 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Ōtara substation have ~-0.24 MVA of spare (N-1) capacity, and ~14.24 MVA of spare (N) capacity.

8.12.7.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity.

For an (N-1) security supply, it is expected that the two smaller transformers at Ōtara zone substation may need to be replaced. Additionally, a fourth 22 kV circuit may be required between the GXP and zone substation – matching the existing circuits, this circuit would be underground, and ~3.1 km in length.

The existing 11 kV feeder has approximately 3.6 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.12.7.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 58. NZ Panels East Tāmaki: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Medium supply transformer (ZSS)	2.00	$3.80
Subtransmission	22kV circuit breaker (ZSS)	2.00	$0.40
Subtransmission	Single underground 22kV cable	3.00	$2.10
		TOTAL	**$6.30**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.12.7.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.12.8 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 59. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
East Tāmaki Galvanising	Ōtara	0.8	20.8	3.6	0.54	200
Bell Tea & Coffee Company Ltd Auckland	Ōtara	0.8	20.8	6	0.50	130
Heinz Watties Limited La Bonne Cuisine	Ōtara	0.8	20.8	3.6	0.35	130
Ministry of Education Sir Edmund Hillary Collegiate	Bairds	0.0	11.4	4.7	0.22	130
Auckland Council Ōtara Pool & Leisure Centre	Bairds	0.0	11.4	4.7	0.17	80
Auckland Council Papatoetoe Centennial Pool & Leisure Centre	Bairds	0.0	11.4	1.4	0.11	80
Ministry of Education Fairburn School	Bairds	0.0	11.4	1.9	0.07	50

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.12.9 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.12.9.1 Bairds

Six of the loads on Ōtāhuhu 22 kV GXP are expected to connect to Bairds zone substation. These loads are DB Breweries Limited Waitematā, Huhtamaki NZ Ltd Moulder Fibre, Ministry of Education Sir Edmund Hillary Collegiate, Auckland Council Ōtara Pool & Leisure Centre, Auckland Council Papatoetoe Centennial Pool & Leisure Centre, Ministry of Education Fairburn School. The sum of peaks of these loads is 9.06 MW, which the zone substation does not have (N-1) capacity for.

However, the upgrades specified for the individual Load Sites are expected to be adequate for all the loads connecting, and should multiple of the loads connect, there may be an opportunity to share the costs of the upgrades.

8.12.9.2 Ōtara

Six of the loads on Ōtāhuhu GXP are expected to connect to Ōtara zone substation. These loads are Goodman Fielder Quality Bakers Auckland, Lion The Pride, NZ Panels East Tāmaki, East Tāmaki Galvanising, Bell Tea & Coffee Company Ltd Auckland, and Heinz Watties Limited La Bonne Cuisine. The sum of peaks of these loads is 11.40 MW, which the zone substation does not have (N-1) capacity for.

However, the upgrades specified for the individual Load Sites are expected to be adequate for all the loads connecting, and should multiple of the loads connect, there may be an opportunity to share the costs of the upgrades.

8.12.10 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Ōtāhuhu 22 kV GXP gives a combined load of 1.89 MW. When the load shapes are combined, they result in the following load shape (Figure 98), with a maximum load of 1.38 MW, with a diversity factor of 0.73.

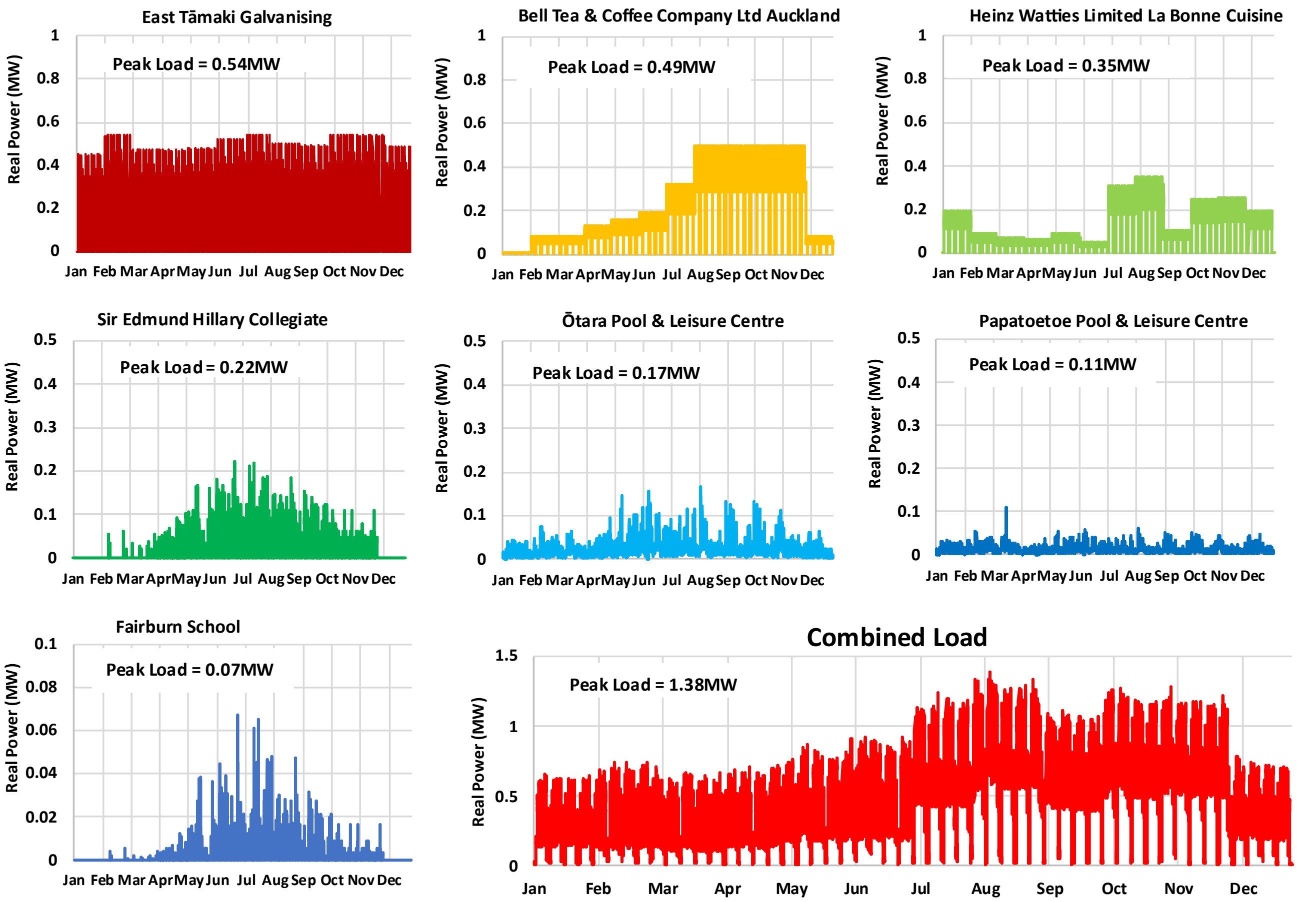


Figure 98. Loading Profiles: Ōtāhuhu 22 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.12.11 Effect of all Load Sites Connecting to Ōtāhuhu 22 kV GXP

The following Figure 99 illustrates the Ōtāhuhu 22 kV GXP load profile together with the load profiles of all the Load Sites within the Ōtāhuhu 22 kV GXP region. Also shown in Figure 99 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Ōtāhuhu 22 kV GXP would increase to 75.2 MW, an increase of 15.5 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 85.1 MW, there is a diversity factor of 0.93 between the loads.
- Based on Ergo's analysis, the Ōtāhuhu 22 kV GXP's (N-1) limit is not expected to be exceeded.

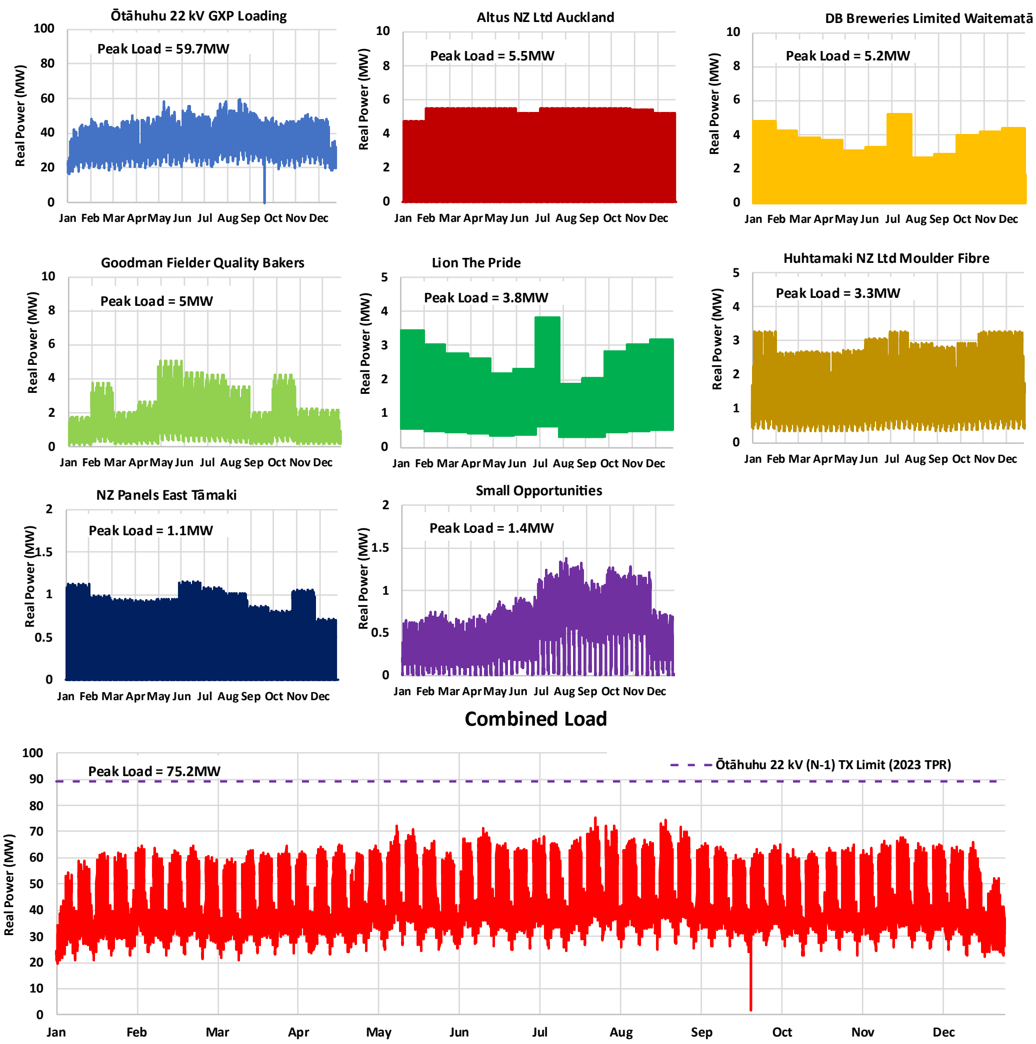


Figure 99. Loading Profiles: Ōtāhuhu 22 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.13 Pakuranga 33 kV GXP

The "Large" EECA load sites connecting to the Pakuranga 33 kV GXP include:

- Grain Corp NZ Ltd Meadow Lea Foods (10.89 MW)
- Higgins East Tāmaki (9.60 MW)
- Mr Chips Ltd (5.38 MW)

The "Small" EECA load sites connecting to the Pakuranga 33 kV GXP include (refer to Sections 8.13.5 and 8.13.7):

- Waste Management Technical Services East Tāmaki (0.42 MW)
- Auckland Council Lloyd Elsmore Park Pool & Leisure Centre (0.33 MW)
- Ministry of Education Botany Downs Secondary College (0.21 MW)
- Much Moore Icecream East Tāmaki (0.17 MW)
- Henkel NZ Ltd. East Tāmaki (0.17 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

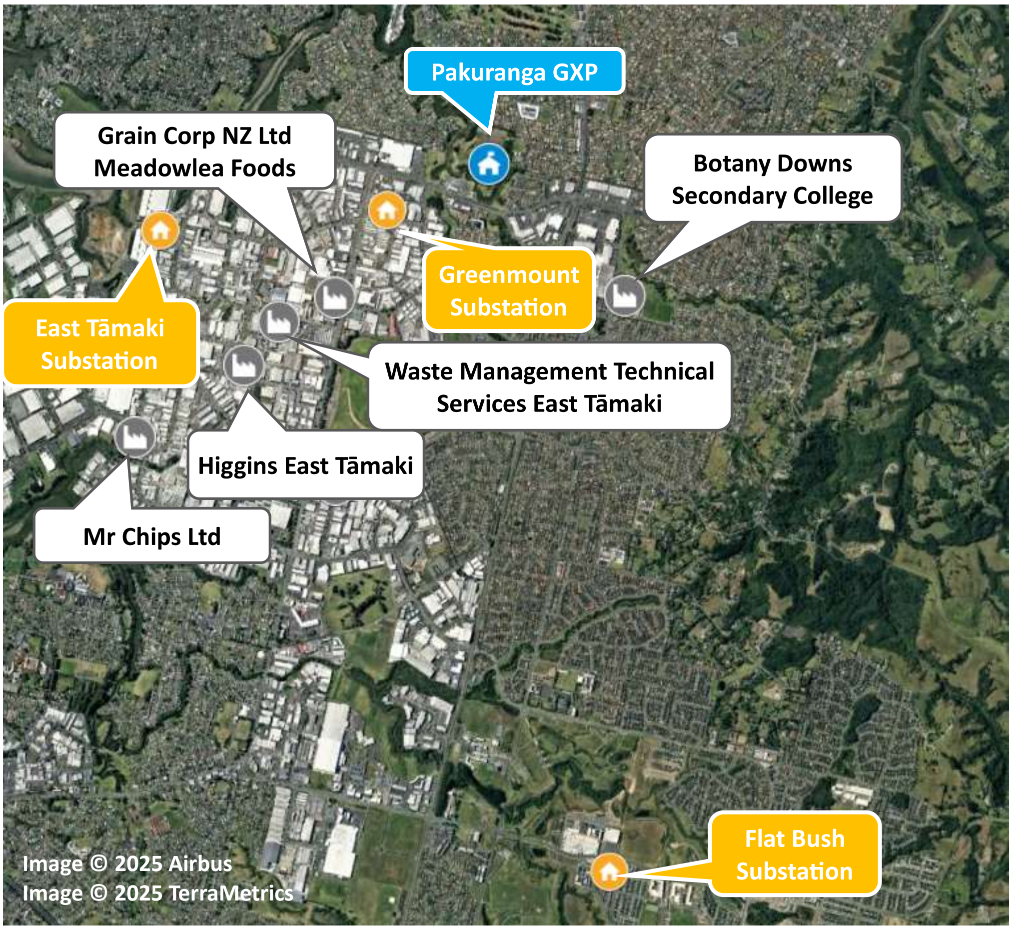


Figure 100. Pakuranga 33 kV GXP: EECA Load Sites vs local substations (southern snippet)

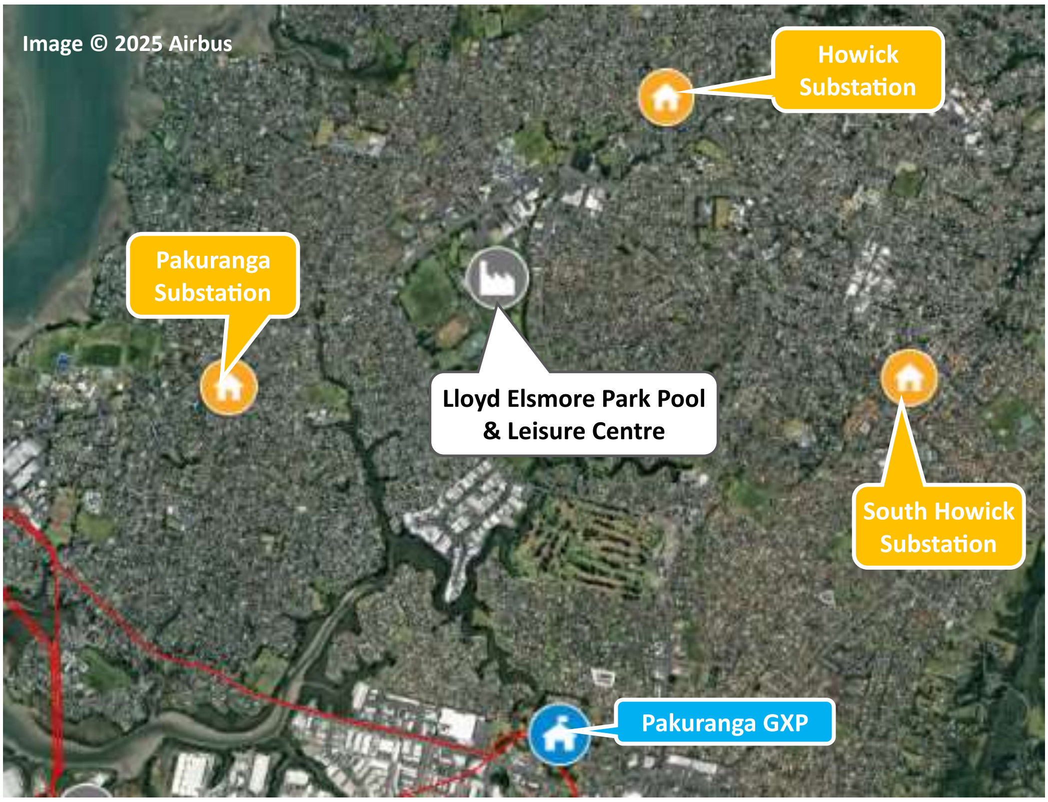


Figure 101. Pakuranga 33 kV GXP: EECA Load Sites vs local substations (northern snippet)

8.13.1 Pakuranga 33 kV GXP upgrade

Pakuranga 33 kV GXP presently has 116 MVA of spare (N-1) capacity and 206 MVA of spare (N) capacity, according to the transformer ratings. The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.13.8). Therefore, no further upgrades are expected at Pakuranga 33 kV GXP.

8.13.2 Grain Corp NZ Ltd Meadow Lea Foods

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	10.89	Pakuranga 33 kV

Figure 102. Grain Corp NZ Ltd Meadow Lea Foods geographic location in relation to the surrounding zone substations.

8.13.2.1 Existing electrical supply to the Plant

Grain Corp NZ Ltd Meadow Lea Foods is presently supplied by Vector's Greenmount zone substation. The site is supplied by a single 11 kV feeder which is fully underground. Greenmount zone substation connects directly to the GXP through three subtransmission circuits at 33 kV which are fully underground, rated at 24.75 MVA each.

The site is located approximately 0.6 km from Greenmount zone substation. The zone substation is located approximately 0.7 km from Pakuranga 33 kV GXP.

There is currently a maximum loading of 41 MVA on Greenmount zone substation, with 19 MVA of spare (N) capacity and no spare (N-1) capacity. Pakuranga 33 kV GXP presently has 116 MVA of spare (N-1) capacity and 206 MVA of spare (N) capacity, according to the transformer ratings.

The subtransmission circuits presently supplying the Greenmount substation have ~8.50 MVA of spare (N-1) capacity, and ~33.25 MVA of spare (N) capacity.

8.13.2.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) spare capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity for this load.

For an (N-1) security supply, a fourth 33 kV subtransmission circuit may be required between the GXP and the zone substation. This circuit would be underground, and ~1.38 km long, matching the existing circuits.

Due to the size of the load, it is expected that the Load Site would be supplied at 33 kV. This would require installation of 1x new 33 kV feeder and an associated circuit breaker at the Greenmount zone substation. Due to the urban/industrial topography of the area, this would likely be underground cabling, at a length of 0.8 km.

8.13.2.3 Capital Cost Estimate

Table 60. Grain Corp NZ Ltd Meadow Lea Foods: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	33kV circuit breaker (ZSS)	1.00	$0.30
Distribution	Single underground 33kV cable	0.80	$1.60
		TOTAL	**$1.90**

Table 61. Grain Corp NZ Ltd Meadow Lea Foods: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Large supply transformer (ZSS)	3.00	$6.90
Subtransmission	Single underground 33kV cable	1.38	$2.76
Distribution	33kV circuit breaker (ZSS)	3.00	$0.90
Distribution	Single underground 33kV cable	0.80	$1.60
		TOTAL	**$12.16**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.13.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.13.3 Higgins East Tāmaki

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	9.60	Pakuranga 33 kV

Figure 103. Higgins East Tāmaki geographic location in relation to the surrounding zone substations.

8.13.3.1 Existing electrical supply to the Plant

Higgins East Tāmaki is presently supplied by Vector's Greenmount zone substation. The site is supplied by a single 11 kV feeder which is fully underground. Greenmount zone substation connects directly to the GXP through three subtransmission circuits at 33 kV which are fully underground, rated at 24.75 MVA each.

The site is located approximately 1.3 km away from Greenmount zone substation. The zone substation is located in turn approximately 0.7 km from Pakuranga 33 kV GXP.

There is currently a maximum loading of 41 MVA on Greenmount zone substation, with 19 MVA of spare (N) capacity and no spare (N-1) capacity. Pakuranga 33 kV GXP presently has 116 MVA of spare (N-1) capacity and 206 MVA of spare (N) capacity, according to the transformer ratings.

The subtransmission circuits presently supplying the Greenmount substation have ~8.50 MVA of spare (N-1) capacity, and ~33.25 MVA of spare (N) capacity.

8.13.3.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) spare capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity for this load.

For an (N-1) security supply, a fourth 33 kV subtransmission circuit may be required between the GXP and the zone substation. This circuit would be underground, and ~1.38 km long, matching the existing circuits.

Due to the size of the load, it is expected that the Load Site would be supplied at 33 kV. This would require installation of 1x new 33 kV feeder and an associated circuit breaker at the Greenmount zone substation. Due to the urban/industrial topography of the area, this would likely be underground cabling, at a length of 2.0 km.

8.13.3.3 Capital Cost Estimate

Table 62. Higgins East Tāmaki: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	33kV circuit breaker (ZSS)	1.00	$0.30
Distribution	Single underground 33kV cable	2.00	$4.00
		TOTAL	**$4.30**

Table 63. Higgins East Tāmaki: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Large supply transformer (ZSS)	3.00	$6.90
Subtransmission	Single underground 33kV cable	1.38	$2.76
Distribution	33kV circuit breaker (ZSS)	3.00	$0.90
Distribution	Single underground 33kV cable	2.00	$4.00
		TOTAL	**$14.56**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.13.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.13.4 Mr Chips Ltd

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	5.38	Pakuranga 33 kV

Figure 104. Mr Chips Ltd geographic location in relation to the surrounding zone substations.

8.13.4.1 Existing electrical supply to the Plant

Mr Chips Ltd is presently supplied by Vector's East Tāmaki zone substation. The site is supplied with a single 11 kV feeder which is fully underground. East Tamaki zone substation connects directly to the GXP through two subtransmission circuits at 33 kV which are fully underground, rated at 30.47 MVA each.

The site is located approximately 1.3 km away from East Tāmaki zone substation. The zone substation is located in turn approximately 2.1 km from Pakuranga 33 kV GXP.

There is currently a maximum loading of 22.1 MVA on East Tāmaki zone substation, with 17.9 MVA of spare (N) capacity and no spare (N-1) capacity. Pakuranga 33 kV GXP presently has 116 MVA of spare (N-1) capacity and 206 MVA of spare (N) capacity, according to the transformer ratings.

The subtransmission circuits presently supplying the East Tāmaki substation have ~8.46 MVA of spare (N-1) capacity, and ~38.93 MVA of spare (N) capacity.

8.13.4.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying East Tāmaki substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

For an (N-1) security supply, it is expected that the transformers at East Tāmaki zone substation may need to be replaced.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of ~2.0 km.

8.13.4.3 Capital Cost Estimate

Table 64. Mr Chips Ltd: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	2.00	$1.60
		TOTAL	**$1.80**

Table 65. Mr Chips Ltd: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	2.00	$1.60
		TOTAL	**$6.40**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.13.4.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.13.5 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 66. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Waste Management Technical Services East Tāmaki	Greenmount	0.0	19	3.8	0.4165	130
Auckland Council Lloyd Elsmore Park Pool & Leisure Centre	Howick	0.0	19.2	2.3	0.33	130
Ministry of Education Botany Downs Secondary College	Greenmount	0.0	19	2.7	0.211375	130
Much Moore Icecream East Tāmaki	Greenmount	0.0	19	0.8	0.1715	80
Henkel NZ Ltd. East Tāmaki	Greenmount	0.0	19	0.8	0.16905	80

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.13.6 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.13.6.1 Greenmount

Six of the loads on Pakuranga 33 kV GXP are expected to connect to Greenmount zone substation. The loads are Grain Corp NZ Ltd MeadowLea Foods (connecting at 33 kV), Higgins East Tāmaki (connecting at 33 kV), Waste Management Technical Services East Tāmaki, Ministry of Education Botany Downs Secondary College, Much Moore Icecream East Tāmaki, and Henkel NZ Ltd. East Tāmaki. The sum of peaks of these loads is 21.45 MW (20.48 MW of this is on the 33 kV bus), which the zone substation does not have (N-1) capacity for.

However, the upgrades specified for the individual Load Sites are expected to be adequate for all the loads connecting, and should multiple of the loads connect, there may be an opportunity to share the costs of the upgrades.

8.13.7 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on the Pakuranga 33 kV GXP gives a combined load of 1.29 MW. When the load shapes are combined, they result in the following load shape (Figure 105), with a maximum load of 0.87 MW, with a diversity factor of 0.67.

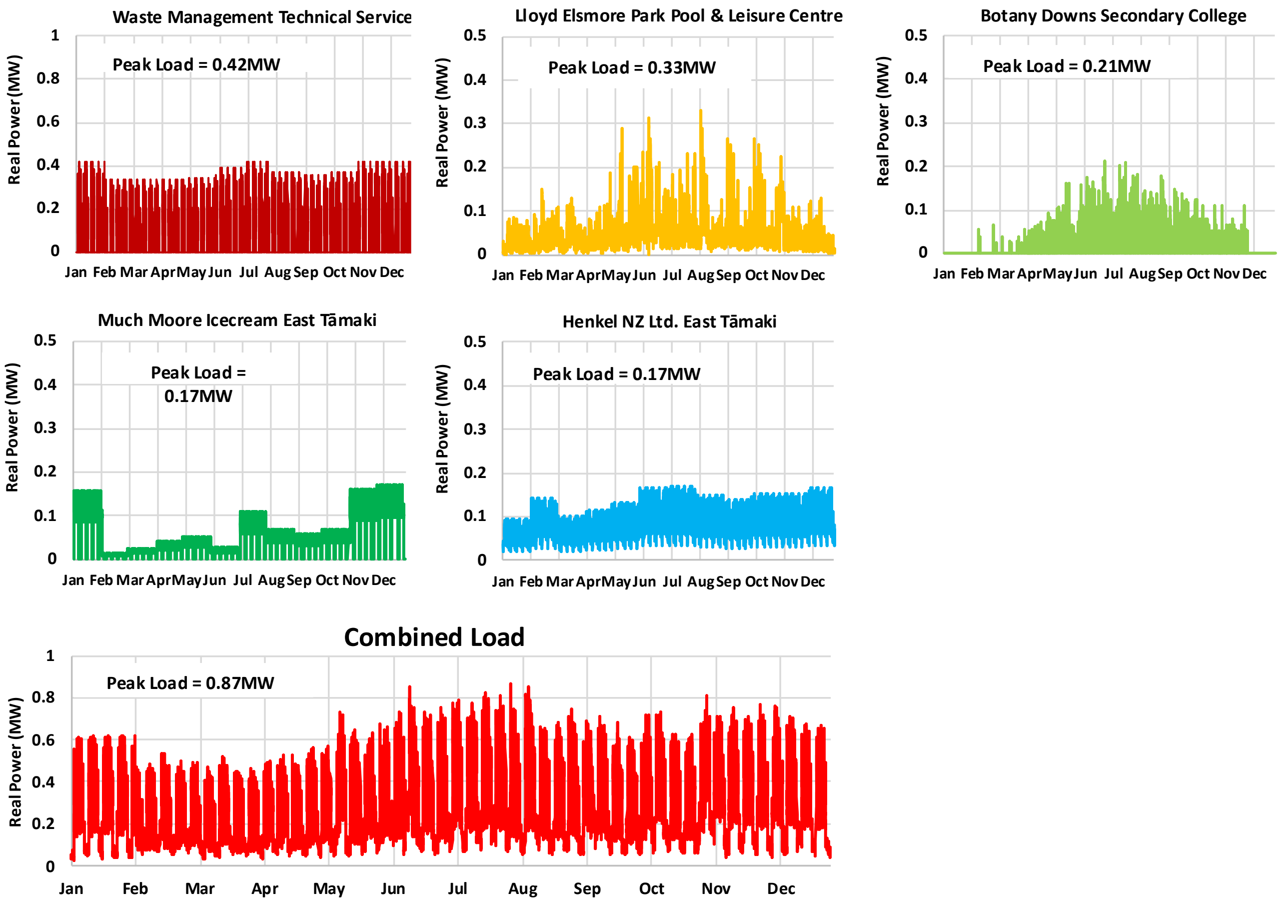


Figure 105. Loading Profiles: Pakuranga 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.13.8 Effect of all Load Sites Connecting to Pakuranga 33 kV GXP

The following Figure 106 illustrates the Pakuranga 33 kV GXP load profile together with the load profiles of all the Load Sites within the Pakuranga 33 kV GXP region. Also shown in Figure 106 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Pakuranga 33 kV GXP would increase to 164.2 MW, an increase of 10.5 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 180.4 MW, there is a diversity factor of 0.91 between the loads.
- Based on Ergo's analysis, the Pakuranga 33 kV GXP's (N-1) limit is not expected to be exceeded.

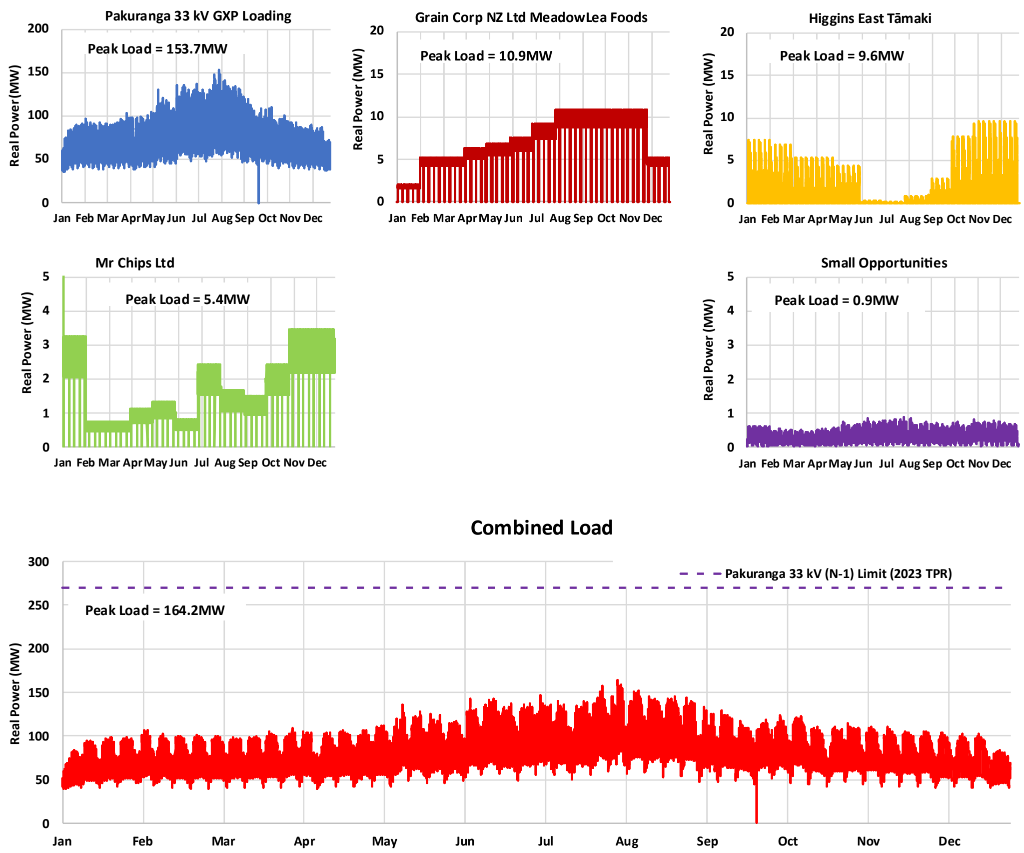


Figure 106. Loading Profiles: Pakuranga 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.14 Penrose 33 kV GXP

The "Large" EECA load sites connecting to the Penrose 33 kV GXP include:

- Visy Glass Auckland (30.31 MW)
- Fulton Hogan Limited Reliable Way (21.37 MW)
- Downer New Zealand Limited Auckland Asphalt (11.47 MW)
- Hayes Metal Refinery (5.44 MW)
- New Zealand Starch Auckland (4.73 MW)
- Gerard Roofs Auckland (4.06 MW)
- Expol Ltd Auckland (2.77 MW)
- Purewa Cemetery Auckland (1.92 MW)
- Coca Cola Amatil The Oasis (1.83 MW)
- Health New Zealand Greenlane Clinical Centre (1.81 MW)
- Envirowaste ltd Chemwaste (1.68 MW)
- Mercy Hospital (1.07 MW)

The "Small" EECA load sites connecting to the Penrose 33 kV GXP include (refer to Sections 8.14.14 and 8.14.16):

- Cemix Ltd (0.99 MW)
- Valmont Coatings Auckland FKA CSP Galvanizing (0.99 MW)
- Pets @ Rest (0.92 MW)
- Delmaine Fine Foods Auckland (0.57 MW)
- University of Auckland Newmarket (0.35 MW)
- Mt. Smart Stadium (0.35 MW)
- Smart Foods Ltd. (0.30 MW)
- Tip Top Auckland (0.25 MW)
- Auckland Showgrounds (0.22 MW)
- Ministry of Education Epsom Girls Grammar School (0.21 MW)
- Ministry of Education Stanhope Road School (0.19 MW)
- Auckland Council Lagoon Pools (0.18 MW)
- Southern Cross Healthcare Gillies Hospital (0.16 MW)
- Auckland Council Glen Innes Pool and Leisure Centre (0.17 MW)
- Van den Brink Poultry Limited (Brinks Chicken) St Johns (0.09 MW)
- Oceania Healthcare Meadowbank (0.06 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

Figure 107. Penrose 33 kV GXP: EECA Load Sites vs local substations.

8.14.1 Penrose 33 kV GXP upgrade

Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity, according to the transformer ratings. The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.14.17). Therefore, no further upgrades are expected at Penrose 33 kV GXP.

8.14.2 Visy Glass Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	30.31	Penrose 33 kV

Figure 108. Visy Glass Auckland geographic location in relation to the surrounding zone substations.

8.14.2.1 Existing electrical supply to the Plant

Visy Glass Auckland is presently supplied by Vector's McNab zone substation. There are four underground 11 kV feeders supplying two 11/0.4 kV transformers on site: K01, K14, K16, and K26. McNab zone substation connects directly to the Penrose 33 kV GXP through three underground subtransmission circuits at 33 kV, rated at 24.41 MVA each.

The site is located approximately 0.2 km away from McNab zone substation. The zone substation is located approximately 0.2 km from Penrose 33 kV GXP.

There is currently a maximum loading of 50.7 MVA on McNab zone substation, with 9.3 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the McNab substation have ~-1.88 MVA of spare (N-1) capacity, and ~22.53 MVA of spare (N) capacity.

8.14.2.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. However, the zone substation, and the subtransmission circuits supplying it, lack (N) and (N-1) capacity.

Due to the size of this load, it is expected that the new load would be supplied at 33 kV. Ergo has assumed, due to the proximity of the load to the GXP, that the new load could connect directly to the GXP.

For an (N) security solution, Ergo has assumed that 1x new 33 kV circuit would be installed between the GXP and the site. Ergo has also allowed for a medium substation at the site, including a medium switchroom and single large 33/11 kV transformer.

For an (N-1) security solution, Ergo has assumed that 2x new 33 kV circuits would be installed between the GXP and the site. Ergo has also allowed for a medium substation at the site, including a medium switchroom and 2x large 33/11 kV transformers.

The new 33 kV subtransmission circuits to the site would be underground (matching the existing circuits) and be ~0.5 km long. Cables would have to cross under a motorway, which Ergo has included an additional 1 km of cabling in the costs to account for.

8.14.2.3 Capital Cost Estimate

Table 67. Visy Glass Auckland: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission =>	(N)	Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Single underground 33kV cable	1.50	$3.00
Subtransmission	Large supply transformer (ZSS)	1.00	$2.30
Subtransmission	Medium switchroom (ZSS)	1.00	$3.00
Subtransmission	33kV circuit breaker (ZSS)	3.00	$0.90
Subtransmission	11kV circuit breaker (ZSS)	8.00	$1.60
		TOTAL	**$10.80**

Table 68. Visy Glass Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission =>	(N-1)	Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Double underground 33kV cable	1.50	$4.50
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Subtransmission	Medium switchroom (ZSS)	1.00	$3.00
Subtransmission	33kV circuit breaker (ZSS)	5.00	$1.50
Subtransmission	11kV circuit breaker (ZSS)	9.00	$1.80
		TOTAL	**$15.40**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.2.4 Expected Timeframe

It is estimated to take 24-36 months for either an (N) or an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.3 Fulton Hogan Limited Reliable Way

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	21.37	Penrose 33 kV

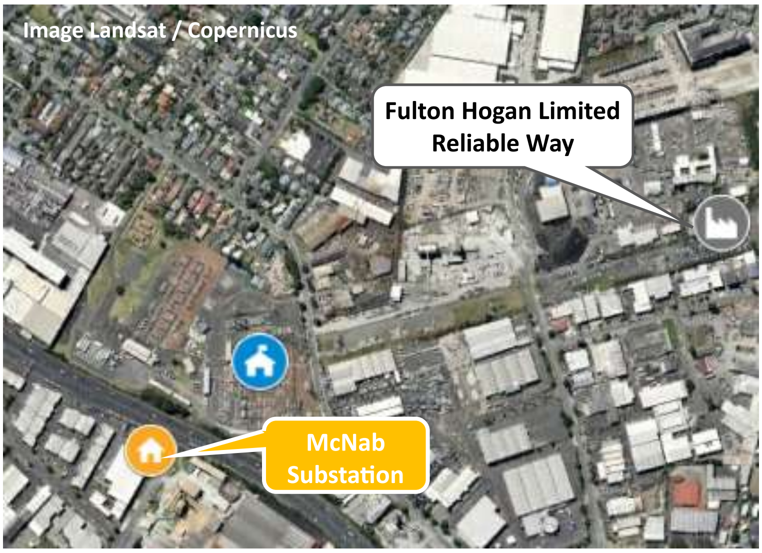


Figure 109. Fulton Hogan Limited Reliable Way geographic location in relation to the surrounding zone substations.

8.14.3.1 Existing electrical supply to the Plant

Fulton Hogan Limited Reliable Way is presently supplied by Vector's McNab zone substation. The site is supplied by a single 11 kV feeder that consists of two parallel cables up until the site entrance at Reliable Way. McNab zone substation connects directly to the Penrose 33 kV GXP through three underground subtransmission circuits at 33 kV, rated at 24.41 MVA each.

The site is located approximately 0.9 km from McNab zone substation. The zone substation is located approximately 0.2 km from Penrose 33 kV GXP.

There is currently a maximum loading of 50.7 MVA on McNab zone substation, with 9.3 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the McNab substation have ~-1.88 MVA of spare (N-1) capacity, and ~22.53 MVA of spare (N) capacity.

8.14.3.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. However, the zone substation, and the subtransmission circuits supplying it, lack (N) and (N-1) capacity.

Due to the size of this load, it is expected that the new load would be supplied at 33 kV. Ergo has assumed, due to the proximity of the load to the GXP, that the new load could connect directly to the GXP.

For an (N) security solution, Ergo has assumed that 1x new 33 kV circuit would be installed between the GXP and the site. Ergo has also allowed for a medium substation at the site, including a medium switchroom and single large 33/11 kV transformer.

For an (N-1) security solution, Ergo has assumed that 2x new 33 kV circuits would be installed between the GXP and the site. Ergo has also allowed for a medium substation at the site, including a medium switchroom and 2x large 33/11 kV transformers.

The new 33 kV subtransmission circuits to the site would be underground (matching the existing circuits to the zone substation) and be ~1.0 km long.

8.14.3.3 Capital Cost Estimate

Table 69. Fulton Hogan Limited Reliable Way: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission =>	(N)	Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Single underground 33kV cable	1.00	$2.00
Subtransmission	Large supply transformer (ZSS)	1.00	$2.30
Subtransmission	Medium switchroom (ZSS)	0.20	$0.60
Subtransmission	33kV circuit breaker (ZSS)	3.00	$0.90
Subtransmission	11kV circuit breaker (ZSS)	8.00	$1.60
		TOTAL	**$7.40**

Table 70. Fulton Hogan Limited Reliable Way: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission =>	(N-1)	Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Double underground 33kV cable	1.00	$3.00
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Subtransmission	Medium switchroom (ZSS)	0.20	$0.60
Subtransmission	33kV circuit breaker (ZSS)	5.00	$1.50
Subtransmission	11kV circuit breaker (ZSS)	9.00	$1.80
		TOTAL	**$11.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.3.4 Expected Timeframe

It is estimated to take 24-36 months for either an (N) or an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.4 Downer New Zealand Limited Auckland Asphalt

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	11.47	Penrose 22 kV (to be Penrose 33 kV)

Figure 110. Downer New Zealand Limited Auckland Asphalt geographic location in relation to the surrounding zone substations.

8.14.4.1 Existing electrical supply to the Plant

Downer New Zealand Limited Auckland Asphalt is presently supplied by Vector's Westfield zone substation. The site is presently supplied by a 11 kV feeder which is fully underground. Westfield zone substation connects to the Penrose 22 kV GXP via three subtransmission circuits at 22 kV, rated at 19.66 MVA each.

The site is located approximately 1.8 km from Westfield zone substation. The zone substation is located approximately 2.8 km from Penrose 22 kV GXP.

There is currently a maximum loading of 28.4 MVA on Westfield zone substation, with 11.6 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 22 kV GXP presently has 52 MVA of spare (N-1) capacity and 97 MVA of spare (N) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Westfield substation have ~10.92 MVA of spare (N-1) capacity, and ~30.58 MVA of spare (N) capacity.

8.14.4.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load, at both 22 kV and 33 kV. However, the zone substation, and the subtransmission circuits supplying it, lack (N) and (N-1) capacity.

Due to the size of this load, it is expected that the new load would be supplied at 33 kV or 22 kV (costing has considered a 33 kV connection). Ergo has assumed, due to the proximity of the load to the GXP, that the new load could connect directly to the Penrose 33 kV GXP.

For an (N) security solution, Ergo has assumed that 1x new 33 kV circuit would be installed between the GXP and the site. Ergo has also allowed for a medium substation at the site, including a medium switchroom and single large 33/11 kV transformer.

For an (N-1) security solution, Ergo has assumed that 2x new 33 kV circuits would be installed between the GXP and the site. Ergo has also allowed for a medium substation at the site, including a medium switchroom and 2x large 33/11 kV transformers.

The new 33 kV subtransmission circuits to the site would be underground (matching the existing circuits) and be ~1.4 km long. Cables would have to cross under a motorway, which Ergo has included an additional 1 km of cabling in the costs to account for.

8.14.4.3 Capital Cost Estimate

Table 71. Downer New Zealand Limited Auckland Asphalt: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission =>	(N)	Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Single underground 33kV cable	2.40	$4.80
Subtransmission	Large supply transformer (ZSS)	1.00	$2.30
Subtransmission	Medium switchroom (ZSS)	0.20	$0.60
Subtransmission	33kV circuit breaker (ZSS)	3.00	$0.90
Subtransmission	11kV circuit breaker (ZSS)	8.00	$1.60
		TOTAL	**$10.20**

Table 72. Downer New Zealand Limited Auckland Asphalt: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission =>	(N-1)	Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Double underground 33kV cable	2.40	$7.20
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Subtransmission	Medium switchroom (ZSS)	0.20	$0.60
Subtransmission	33kV circuit breaker (ZSS)	5.00	$1.50
Subtransmission	11kV circuit breaker (ZSS)	9.00	$1.80
		TOTAL	**$15.70**

The above costs do not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.4.4 Expected Timeframe

It is estimated to take 24-36 months for either an (N) or an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.5 Hayes Metal Refinery

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	5.44	Penrose 33 kV

Figure 111. Hayes Metal Refinery geographic location in relation to the surrounding zone substations.

8.14.5.1 Existing electrical supply to the Plant

Hayes Metal Refinery is presently supplied by Vector's Te Papapa zone substation. It is supplied by an 11 kV feeder which consists of a mixture of underground cables and overhead lines. Te Papapa zone substation connects directly to the Penrose 33 kV GXP through two underground subtransmission circuits at 33 kV, rated to 25.72 MVA each.

The site is located approximately 0.7 km away from Te Papapa zone substation. The zone substation is located in turn approximately 2.2 km from Penrose 33 kV GXP.

There is currently a maximum loading of 21.7 MVA on Te Papapa zone substation, with 18.3 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Te Papapa substation have ~4.02 MVA of spare (N-1) capacity, and ~29.74 MVA of spare (N) capacity.

8.14.5.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) spare capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity for this load.

Ergo understands that Vector is planning to acquire land for a Southdown zone substation which will allow the industrial sites around Te Papapa to operate with (N-1) security, rather than upgrade the transformers at the existing zone substation. While a project to install some cable ducts at the Southdown site as future-proofing (including an allowance for new cabling between Southdown and Te Papapa) is planned for ~2026 (cost ~$8M), the new Southdown substation is not planned for installation until past the end of the present planning period (i.e. after 2034). Ergo expects that this Load Site may impact this plan, and so the cost of a large zone substation, and of the future-proofing cable ducts are included in Ergo's costings for an (N-1) supply for this site.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 0.90 km.

8.14.5.3 Capital Cost Estimate

Table 73. Hayes Metal Refinery: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	0.90	$0.72
		TOTAL	**$0.92**

Table 74. Hayes Metal Refinery: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Southdown future-proofing cable ducts	1.00	$8.00
Subtransmission	Large zone substation	1.00	$11.50
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	0.90	$0.72
		TOTAL	**$20.42**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.5.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.6 New Zealand Starch Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high-temperature heat pumps	4.73	Penrose 33 kV

Figure 112. New Zealand Starch Auckland geographic location in relation to the surrounding zone substations.

8.14.6.1 Existing electrical supply to the Plant

New Zealand Starch Auckland is presently supplied by Vector's Te Papapa zone substation. It is supplied by an 11 kV feeder which consists of underground cables. Te Papapa zone substation connects directly to the Penrose 33 kV GXP through two underground subtransmission circuits at 33 kV, rated to 25.72 MVA each.

The site is located approximately 0.4 km away from Te Papapa zone substation. The zone substation is located in turn approximately 2.2 km from Penrose 33 kV GXP.

There is currently a maximum loading of 21.7 MVA on Te Papapa zone substation, with 18.3 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Te Papapa substation have ~4.02 MVA of spare (N-1) capacity, and ~29.74 MVA of spare (N) capacity.

8.14.6.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) spare capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity for this load.

Ergo understands that Vector is planning to acquire land for a Southdown zone substation which will allow the industrial sites around Te Papapa to operate with (N-1) security, rather than upgrade the transformers at the existing zone substation. While a project to install some cable ducts at the Southdown site as future-proofing (including an allowance for new cabling between Southdown and Te Papapa) is planned for ~2026 (cost ~$8M), the new Southdown substation is not planned for installation until past the end of the present planning period (i.e. after 2034). Ergo expects that this Load Site may impact this plan, and so the cost of a large zone substation, and of the future-proofing cable ducts are included in Ergo's costings for an (N-1) supply for this site.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 0.50 km.

8.14.6.3 Capital Cost Estimate

Table 75. New Zealand Starch Auckland: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	0.50	$0.40
		TOTAL	**$0.60**

Table 76. New Zealand Starch Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Southdown future-proofing cable ducts	1.00	$8.00
Subtransmission	Large zone substation	1.00	$11.50
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	0.50	$0.40
		TOTAL	**$20.10**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.6.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.7 Gerard Roofs Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	4.06	Penrose 33 kV

Figure 113. Gerard Roofs Auckland geographic location in relation to the surrounding zone substations.

8.14.7.1 Existing electrical supply to the Plant

Gerard Roofs Auckland is presently supplied by Vector's St Johns zone substation. The site is supplied by an 11 kV feeder which consists of underground cables. St. Johns zone substation connects directly to the Penrose 33 kV GXP through three underground subtransmission circuits at 33 kV, rated at 30.47 MVA each. The Ōrākei and St Heliers substations are both supplied off the St. Johns zone substation, via 2x 33 kV circuits each.

The site is located approximately 1.0 km away from St Johns zone substation. The zone substation is located in turn approximately 3.6 km from Penrose 33 kV GXP.

There is currently a maximum loading of 19.3 MVA on St Johns zone substation, with 20.7 MVA of spare (N) capacity and 0.7 MVA of spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

With a present loading on the Ōrākei and St Heliers substations of 23.9 MVA and 21.9 MVA, respectively, the subtransmission circuits presently supplying the St. Johns substation have ~-4.16 MVA of spare (N-1) capacity, and ~26.31 MVA of spare (N) capacity.

8.14.7.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) spare capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity for this load.

Ergo understands that due to load growth in the St Johns area, Vector plans to construct a new Tāmaki zone substation. This is expected to cost $14M and is planned to occur 2035-36. Additionally, there is a future-proofing cable ducts project planned for the new substation site, which is expected to cost $3.8M and planned for construction in 2032. Ergo expects that this Load Site may impact this plan, and so the cost of the substation, and of the future-proofing cable ducts are included in Ergo’s costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 4.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.14.7.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 77. Gerard Roofs Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	**Subtransmission => (N-1)**		**Distribution => (N)**
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Tāmaki new ZSS (St. Johns constraint)	1.00	$14.00
Subtransmission	Tāmaki future-proofing cable ducts	1.00	$3.80
		TOTAL	**$17.80**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.7.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.8 Expol Ltd Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	2.77	Penrose 33 kV

Figure 114. Expol Ltd Auckland geographic location in relation to the surrounding zone substations.

8.14.8.1 Existing electrical supply to the Plant

Expol Ltd Auckland is presently supplied by Vector's Te Papapa zone substation. It is supplied by an 11 kV feeder which consists of underground cables. Te Papapa zone substation connects directly to the Penrose 33 kV GXP through two underground subtransmission circuits at 33 kV, rated to 25.72 MVA each.

The site is located approximately 0.6 km away from Te Papapa zone substation. The zone substation is located in turn approximately 2.2 km from Penrose 33 kV GXP.

There is currently a maximum loading of 21.7 MVA on Te Papapa zone substation, with 18.3 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Te Papapa substation have ~4.02 MVA of spare (N-1) capacity, and ~29.74 MVA of spare (N) capacity.

8.14.8.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

Ergo understands that Vector is planning to acquire land for a Southdown zone substation which will allow the industrial sites around Te Papapa to operate with (N-1) security, rather than upgrade the transformers at the existing zone substation. While a project to install some cable ducts at the Southdown site as future-proofing (including an allowance for new cabling between Southdown and Te Papapa) is planned for ~2026 (cost ~$8M), the new Southdown substation is not planned for installation until past the end of the present planning period (i.e. after 2034). Ergo expects that this Load Site may impact this plan, and so the cost of a large zone substation, and of the future-proofing cable ducts are included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 3.6 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.14.8.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 78. Expol Ltd Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution =>	(N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Southdown future-proofing cable ducts	1.00	$8.00
Subtransmission	Large zone substation	1.00	$11.50
		TOTAL	**$19.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.8.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.9 Purewa Cemetery Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.92	Penrose 33 kV

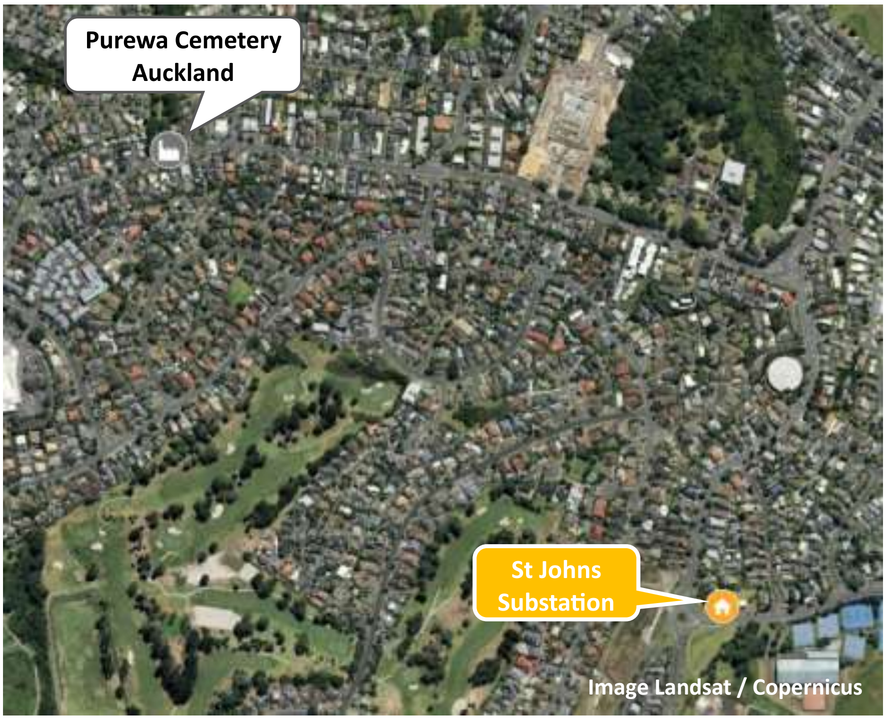


Figure 115. Purewa Cemetery Auckland geographic location in relation to the surrounding zone substations.

8.14.9.1 Existing electrical supply to the Plant

Purewa Cemetery Auckland is presently supplied by Vector's St Johns zone substation. The site is supplied by an 11 kV feeder which consists of underground cables. St. Johns zone substation connects directly to the Penrose 33 kV GXP through three underground subtransmission circuits at 33 kV, rated at 30.47 MVA each. The Ōrākei and St Heliers substations are both supplied off the St. Johns zone substation, via 2x 33 kV circuits each.

The site is located approximately 1.1 km away from St Johns zone substation. The zone substation is located in turn approximately 3.6 km from Penrose 33 kV GXP.

There is currently a maximum loading of 19.3 MVA on St Johns zone substation, with 20.7 MVA of spare (N) capacity and 0.7 MVA of spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

With a present loading on the Ōrākei and St Heliers substations of 23.9 MVA and 21.9 MVA, respectively, the subtransmission circuits presently supplying the St. Johns substation have ~-4.16 MVA of spare (N-1) capacity, and ~26.31 MVA of spare (N) capacity.

8.14.9.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) spare capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity for this load.

Ergo understands that due to load growth in the St Johns area, Vector plans to construct a new Tāmaki zone substation. This is expected to cost $14M and is planned to occur 2035-36. Additionally, there is a future-proofing cable ducts project planned for the new substation site, which is expected to cost $3.8M and planned for construction in 2032. Ergo expects that this Load Site may impact this plan, and so the cost of the substation, and of the future-proofing cable ducts are included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 5.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.14.9.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 79. Purewa Cemetery Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	**Subtransmission => (N-1)**	**Distribution => (N)**	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Tāmaki new ZSS (St. Johns constraint)	1.00	$14.00
Subtransmission	Tāmaki future-proofing cable ducts	1.00	$3.80
		TOTAL	**$17.80**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.9.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.10 Coca Cola Amatil The Oasis

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.83	Penrose 33 kV

Figure 116. Coca Cola Amatil The Oasis geographic location in relation to the surrounding zone substations.

8.14.10.1 Existing electrical supply to the Plant

Coca Cola Amatil The Oasis is presently supplied by Vector's Sylvia Park zone substation. The site is supplied by an 11 kV feeder which consists of underground cables. Sylvia Park zone substation connects directly to the Penrose 33 kV GXP through two underground subtransmission circuits at 33 kV, rated to 27.78 MVA each.

The site is located approximately 0.2 km away from Sylvia Park zone substation. The zone substation is located in turn approximately 2.3 km from Penrose 33 kV GXP.

There is currently a maximum loading of 17.1 MVA on Sylvia Park zone substation, with 22.9 MVA of spare (N) capacity and 2.9 MVA of spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Sylvia Park substation have ~10.68 MVA of spare (N-1) capacity, and ~38.46 MVA of spare (N) capacity.

8.14.10.2 Supply Option(s) for New Load

The GXP and the zone substation, and the subtransmission circuits supplying the zone substation all have adequate spare (N) and (N-1) capacity for this load.

The existing 11 kV feeder has approximately 5.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.14.10.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.10.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) or an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.11 Health New Zealand Greenlane Clinical Centre

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.81	Penrose 33 kV

Figure 117. Health New Zealand Greenlane Clinical Centre geographic location in relation to the surrounding zone substations.

8.14.11.1 Existing electrical supply to the Plant

Health New Zealand Greenlane Clinical Centre is presently supplied by Vector's Drive zone substation. It is supplied by an 11 kV feeder which consists of a mixture of underground cables and overhead lines. Drive zone substation connects directly to the Penrose 33 kV GXP through two underground subtransmission circuits at 33 kV, rated to 23.32 MVA each.

The site is located approximately 0.7 km away from Drive zone substation. The zone substation is located in turn approximately 4.4 km from Penrose 33 kV GXP.

There is currently a maximum loading of 28.7 MVA on Drive zone substation, with 11.3 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Drive substation have ~-5.38 MVA of spare (N-1) capacity, and ~17.94 MVA of spare (N) capacity.

8.14.11.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) spare capacity for this load. The zone substation and the circuits supplying the zone substation have adequate (N) but not (N-1) capacity for this load.

For an (N-1) security supply, it is expected that the transformers at Drive zone substation may need to be replaced. Ergo understands that the Drive transformers are due for condition-based replacement in the near future, and could be upgraded to a larger size at the same time.

Additionally, for an (N-1) supply, an additional 33 kV subtransmission circuit would need to be installed between Penrose GXP and Drive zone substation, which would be underground cabling, and a length of ~5.7 km, matching the existing circuits.

The existing 11 kV feeder has approximately 3.7 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.14.11.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 80. Health New Zealand Greenlane Clinical Centre: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	33kV circuit breaker bay	2.00	$1.00
Subtransmission	Single underground 33kV cable	5.70	$11.40
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$17.00**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.11.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.12 Envirowaste Ltd Chemwaste

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.68	Penrose 33 kV

Figure 118. Envirowaste Ltd Chemwaste geographic location in relation to the surrounding zone substations.

8.14.12.1 Existing electrical supply to the Plant

Envirowaste ltd Chemwaste is presently supplied by Vector's Te Papapa zone substation. It is supplied by an 11 kV feeder which consists of a mixture of underground cables and overhead lines. Te Papapa zone substation connects directly to the Penrose 33 kV GXP through two underground subtransmission circuits at 33 kV, rated to 25.72 MVA each.

The site is located approximately 1 km away from Te Papapa zone substation. The zone substation is located in turn approximately 2.2 km from Penrose 33 kV GXP.

There is currently a maximum loading of 21.7 MVA on Te Papapa zone substation, with 18.3 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 93 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Te Papapa substation have ~4.02 MVA of spare (N-1) capacity, and ~29.74 MVA of spare (N) capacity.

8.14.12.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

Ergo understands that Vector is planning to acquire land for a Southdown zone substation which will allow the industrial sites around Te Papapa to operate with (N-1) security, rather than upgrade the transformers at the existing zone substation. While a project to install some cable ducts at the Southdown site as future-proofing (including an allowance for new cabling between Southdown and Te Papapa) is planned for ~2026 (cost ~$8M), the new Southdown substation is not planned for installation until past the end of the present planning period (i.e. after 2034). Ergo expects that this Load Site may impact this plan, and so the cost of a large zone substation, and of the future-proofing cable ducts are included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 2.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.14.12.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 81. Envirowaste Ltd Chemwaste: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Southdown future-proofing cable ducts	1.00	$8.00
Subtransmission	Large zone substation	1.00	$11.50
		TOTAL	**$19.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.12.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.13 Mercy Hospital

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.07	Penrose 33 kV

Figure 119. Mercy Hospital geographic location in relation to the surrounding zone substations.

8.14.13.1 Existing electrical supply to the Plant

Mercy Hospital is presently supplied by Vector's Newmarket zone substation. It is supplied by an 11 kV feeder which is fully underground. Newmarket zone substation is in turn supplied by three 33 kV subtransmission underground circuits directly from the GXP, rated at 27.55 MVA each.

The site is located approximately 0.6 km away from Newmarket zone substation. The zone substation is located in turn approximately 5.5 km from Penrose 33 kV GXP.

There is currently a maximum loading of 38.1 MVA on Newmarket zone substation, with 21.9 MVA of spare (N) capacity and 1.9 MVA of spare (N-1) capacity. Penrose 33 kV GXP presently has 60 MVA of spare (N-1) capacity and 260 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Newmarket substation have ~17.00 MVA of spare (N-1) capacity, and ~44.55 MVA of spare (N) capacity.

8.14.13.2 Supply Option(s) for New Load

The GXP and the zone substation, and the subtransmission circuits supplying the zone substation all have adequate spare (N) and (N-1) capacity for this load.

The existing 11 kV feeder has approximately 6.1 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

As the zone substation, subtransmission circuits, and GXP all have adequate (N-1) capacity, an (N) capacity supply is not considered.

8.14.13.3 Capital Cost Estimate

Indicatively, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.14.13.4 Expected Timeframe

It is estimated to take 12-18 months for either an (N) or an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.14.14 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 82. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Cemix Ltd	Te Papapa	0.0	18.3	3.6	0.99	260
Valmont Coatings Auckland FKA CSP Galvanizing	McNab	0.0	9.3	5.4	0.99	260
Pets @ Rest	Te Papapa	0.0	18.3	2.7	0.92	260
Delmaine Fine Foods Auckland	McNab	0.0	9.3	3.1	0.57	200
University of Auckland Newmarket	Newmarket	1.9	21.9	1.4	0.35	130
Mt. Smart Stadium	Te Papapa	0.0	18.3	4.4	0.35	130
Smart Foods Ltd.	Sylvia Park	2.9	22.9	6.1	0.30	130
Tip Top Auckland	Carbine	7.4	27.4	6.6	0.25	130
Auckland Showgrounds	Drive	0.0	11.3	3.4	0.22	130
Ministry of Education Epsom Girls Grammar School	Newmarket	1.9	21.9	5.7	0.21	130
Ministry of Education Stanhope Road School	McNab	0.0	9.3	4.1	0.19	80
Auckland Council Lagoon Pools	Mt Wellington	4	24	2.6	0.18	80
Southern Cross Healthcare Gillies Hospital	Drive	0.0	11.3	3.3	0.17	80
Auckland Council Glen Innes Pool and Leisure Centre	Mt Wellington	4	24	2.6	0.17	80
Van den Brink Poultry Limited (Brinks Chicken) St Johns	Glen Innes	9.1	29.1	5.8	0.09	50

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Oceania Healthcare Meadowbank	Ōrākei	0.0	12.1	0.2	0.06	50

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.14.15 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.14.15.1 Drive

Three of the loads on Penrose 33 kV GXP are expected to connect to Drive zone substation. These loads are Health New Zealand Greenlane Clinical Centre, Auckland Showgrounds, and Southern Cross Healthcare Gillies Hospital. The sum of peaks of these loads is 2.20 MW, which the zone substation does not have (N-1) capacity for.

However, two of the connecting sites are small loads and expected to have a minimal impact on the network. If Health NZ Greenlane Clinical centre connects, then the upgrades required for that site would be expected to be sufficient for all the connecting sites. Therefore, no further upgrades are expected at Drive.

8.14.15.2 McNab

Three of the loads on Penrose 33 kV GXP are expected to connect to McNab zone substation. These loads are Valmont Coatings Auckland FKA CSP Galvanizing, Delmaine Fine Foods Auckland, and Ministry of Education Stanhope Road School. The sum of peaks of these loads is 1.76 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that this substation is already operating under (N) security during peak loading.

The connecting sites are small loads and expected to have a minimal impact on the network. Therefore, no further upgrades are expected at McNab.

8.14.15.3 Mt Wellington

Two of the loads on Penrose 33 kV GXP are expected to connect to Mt Wellington zone substation. These loads are Auckland Council Lagoon Pools and Auckland Council Glen Innes Pool and Leisure Centre. The sum of peaks of these loads is 0.34 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Mt Wellington zone substation.

8.14.15.4 Newmarket

Three of the loads on Penrose 33 kV GXP are expected to connect to Newmarket zone substation. These loads are Mercy Hospital, University of Auckland Newmarket, and Ministry of Education Epsom Girls Grammar School. The sum of peaks of these loads is 1.92 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that Vector has an existing project planned to increase the capacity of the Newmarket substation by establishing a new substation at the Newmarket site. It is expected that the installation of this project would provide all of the connecting loads with (N-1) security. This project is planned for commissioning in 2035, and is expected to cost $11.3M (more costs to come in future planning periods, which are unknown to Ergo).

8.14.15.5 St Johns

Two of the loads on Penrose 33 kV GXP are expected to connect to St Johns zone substation. These loads are Gerard Roofs Auckland and Purewa Cemetery Auckland. The sum of peaks of these loads is 5.98 MW, which the zone substation does not have (N-1) capacity for.

However, the already planned upgrades, which were included in the costings in the earlier sections for the individual load sites, are considered adequate to supply both of the connecting loads with (N-1) security. The upgrades relate to the establishment of the new Tāmaki substation, which will offload St Johns.

8.14.15.6 Sylvia Park

Two of the loads on Penrose 33 kV GXP are expected to connect to Sylvia Park zone substation. These loads are Coca Cola Amatil The Oasis and Smart Foods Ltd. The sum of peaks of these loads is 2.12 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Sylvia Park zone substation.

8.14.15.7 Te Papapa

Seven of the loads on Penrose 33 kV GXP are expected to connect to Te Papapa zone substation. These loads are Hayes Metal Refinery, New Zealand Starch Auckland, Expol Ltd Auckland, Envirowaste ltd Chemwaste, Cemix Ltd, Pets @ Rest, and Mt. Smart Stadium. The sum of peaks of these loads is 16.88 MW, which the zone substation does not have (N-1) capacity for.

However, the already planned upgrades, which were included in the costings in the earlier sections for the individual load sites, are considered adequate to supply all the connecting loads with (N-1) security. The upgrades relate to the establishment of the new Southdown substation, which will offload Te Papapa.

8.14.16 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Penrose 33 kV GXP gives a combined load of 5.98 MW. When the load shapes are combined, they result in the following load shape (see Figure 120 and Figure 121), with a maximum load of 4.61 MW, with a diversity factor of 0.77.

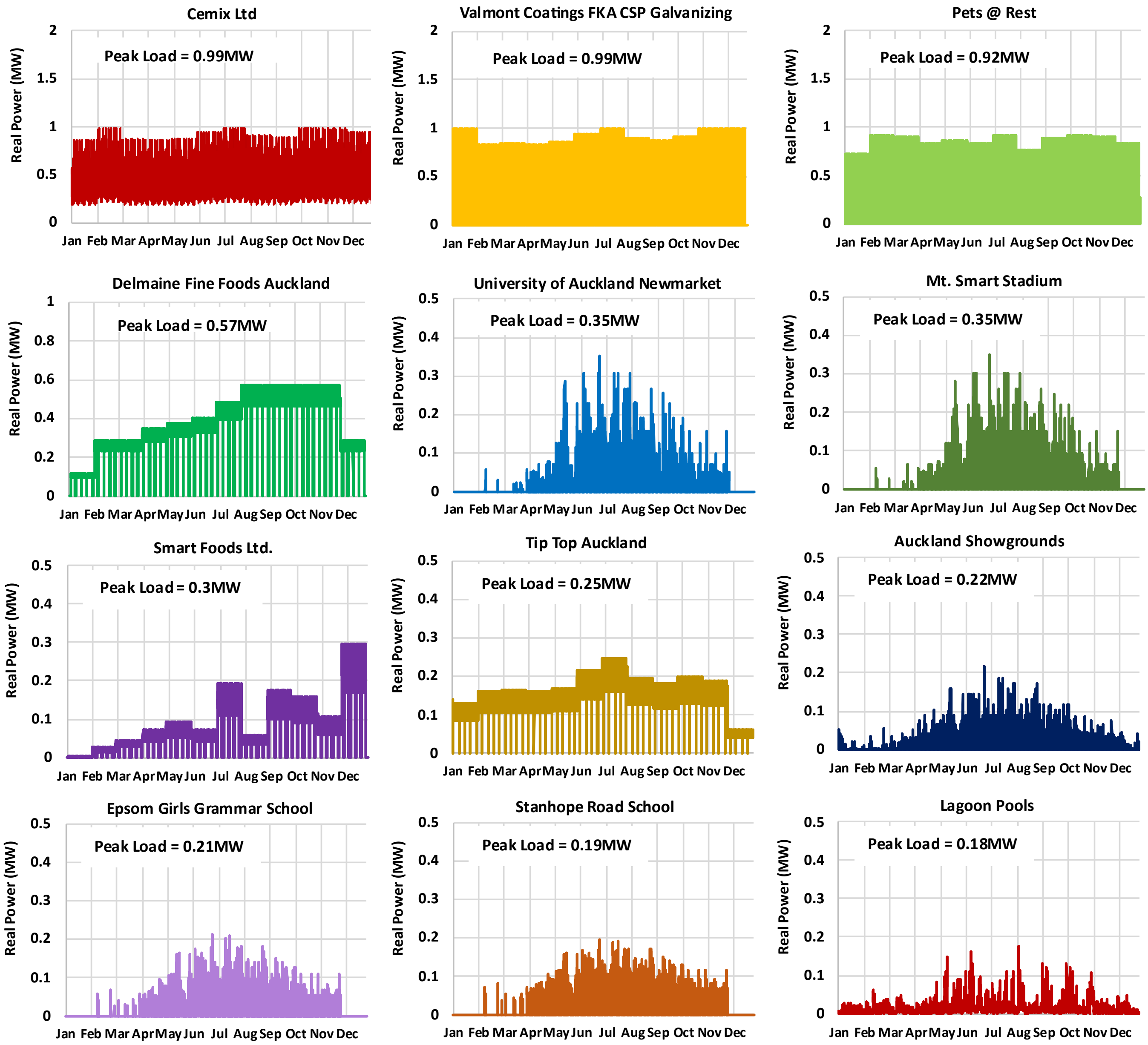


Figure 120. Loading Profiles: Penrose 33 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles) (part 1)

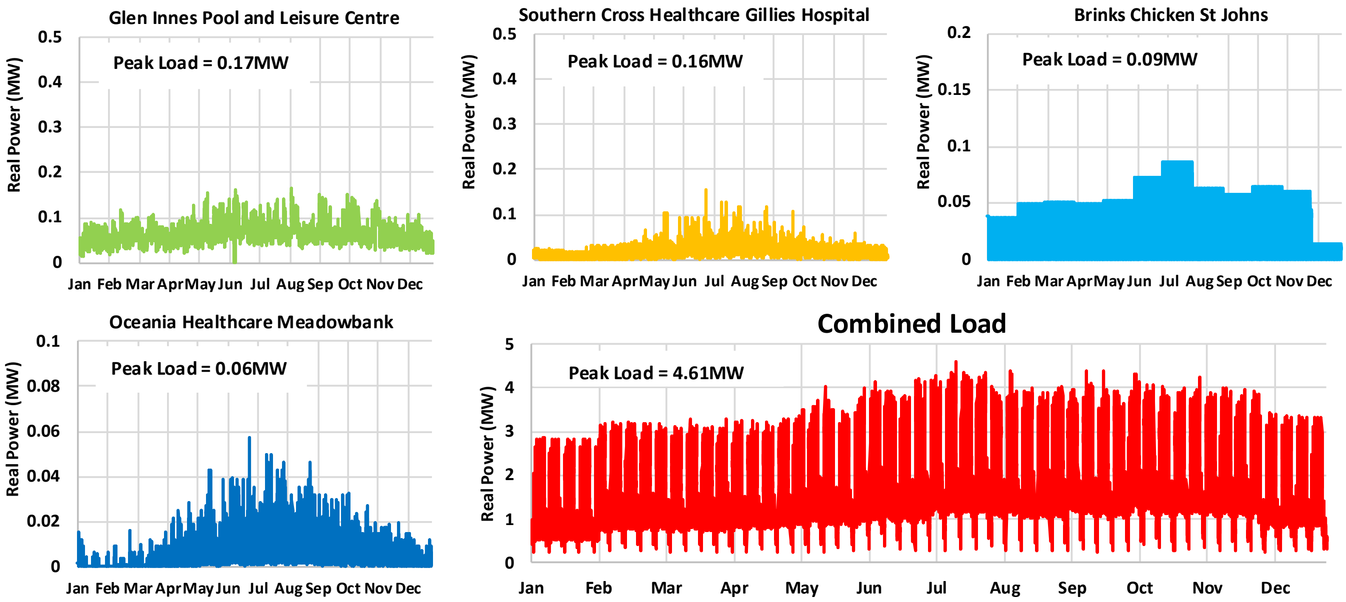


Figure 121. Loading Profiles: Penrose 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles) (part 2)

8.14.17 Effect of all Load Sites Connecting to Penrose 33 kV GXP

The following Figure 122 and Figure 123 illustrate the Penrose 33 kV GXP load profile together with the load profiles of all the Load Sites within the Penrose 33 kV GXP region. Also shown in Figure 122 and Figure 123 are:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Penrose 33 kV GXP would increase to 350.7 MW, an increase of 52.2 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 391.6 MW, there is a diversity factor of 0.90 between the loads.
- Ergo notes that as the Penrose 22 kV GXP is supplied off the Penrose 33 kV bus, the Load Sites connecting to the Penrose 22 kV GXP are included as a lump sum in the calculations for Penrose 33 kV GXP, as shown below.
- Based on Ergo's analysis, the Penrose 33 kV GXP's (N-1) limit is not expected to be exceeded.

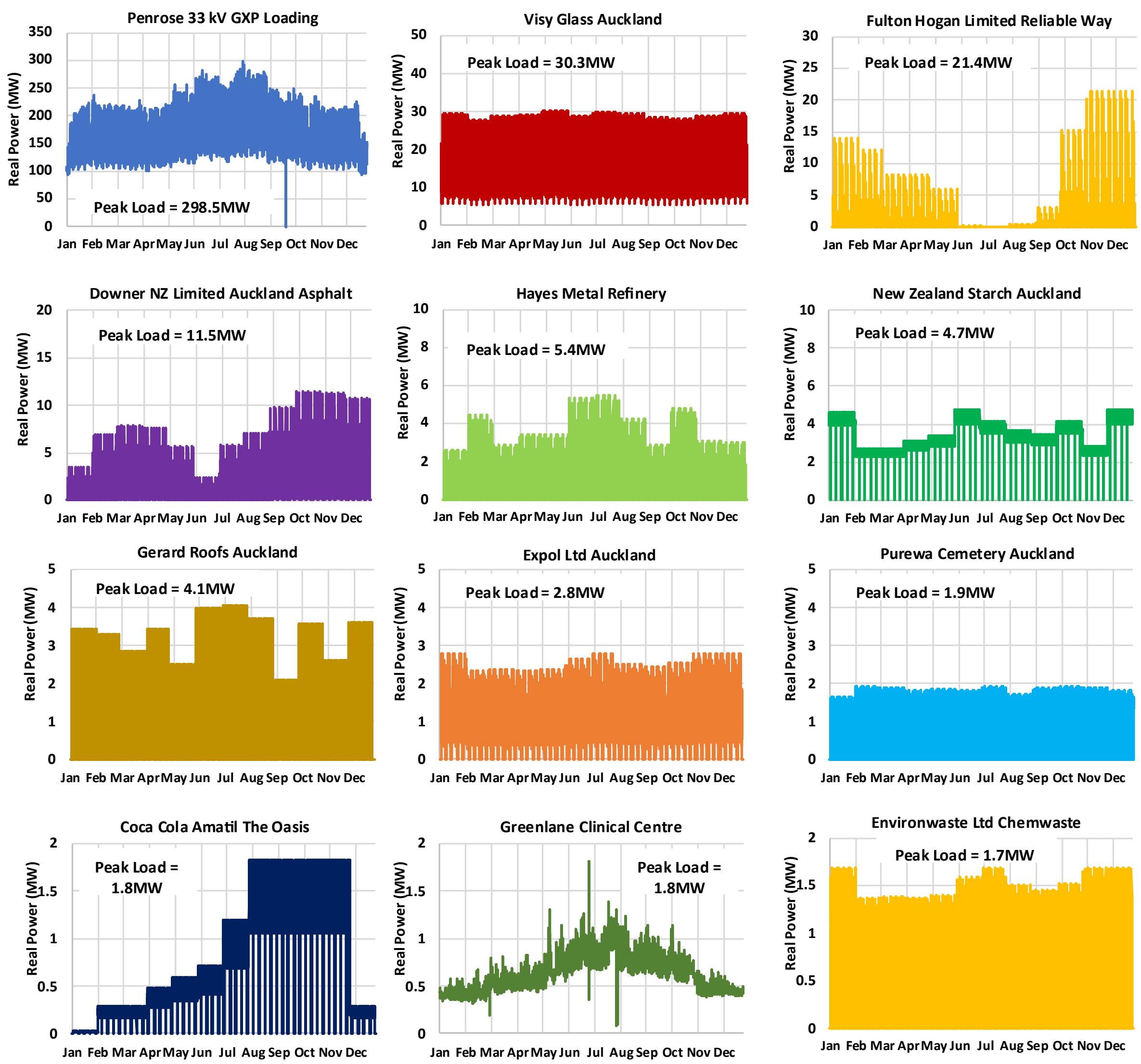


Figure 122. Loading Profiles: Penrose 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles) (part 1)

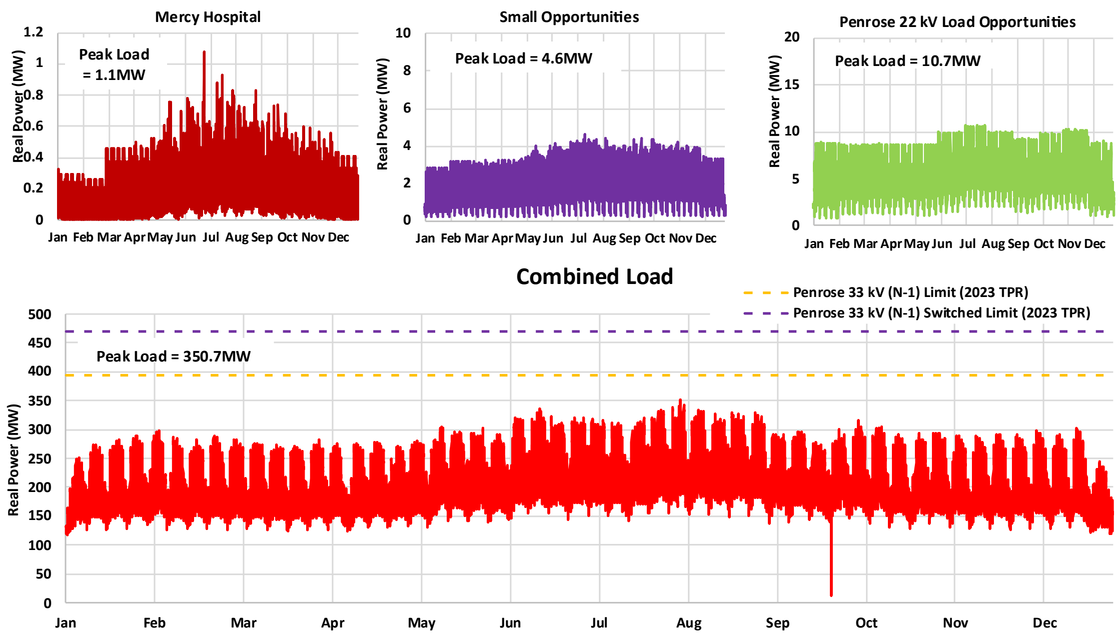


Figure 123. Loading Profiles: Penrose 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles) (part 2)

8.15 Penrose 22 kV GXP

The "Large" EECA load sites connecting to the Penrose 22 kV GXP include:

- Fletcher Steel Ltd Pacific Coil Coaters (2.97 MW)
- Huntsman Chemical Company Ltd Barnes Plastics (1.88 MW)
- NZ Comfort Group (1.78 MW)
- Auckland Meat Processors Auckland (1.48 MW)
- Mauri NZ Auckland (1.33 MW)
- Kerry Group Kerry Ingredients (1.19 MW)

The "Small" EECA load sites connecting to the Penrose 22 kV GXP include (refer to Sections 8.15.8 and 8.15.10):

- NZ Nail Industries (0.69 MW)
- Steel Masters Auckland Ltd (0.49 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

Figure 124. Penrose 22 kV GXP: EECA Load Sites vs local substations.

8.15.1 Penrose 22 kV GXP upgrade

Penrose 33 kV GXP presently has 52 MVA of spare (N-1) capacity and 97 MVA of spare (N) capacity, according to the transformer ratings. The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.15.11). Therefore, no further upgrades are expected at Penrose 22 kV GXP.

8.15.2 Fletcher Steel Ltd Pacific Coil Coaters

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	2.97	Penrose 22 kV

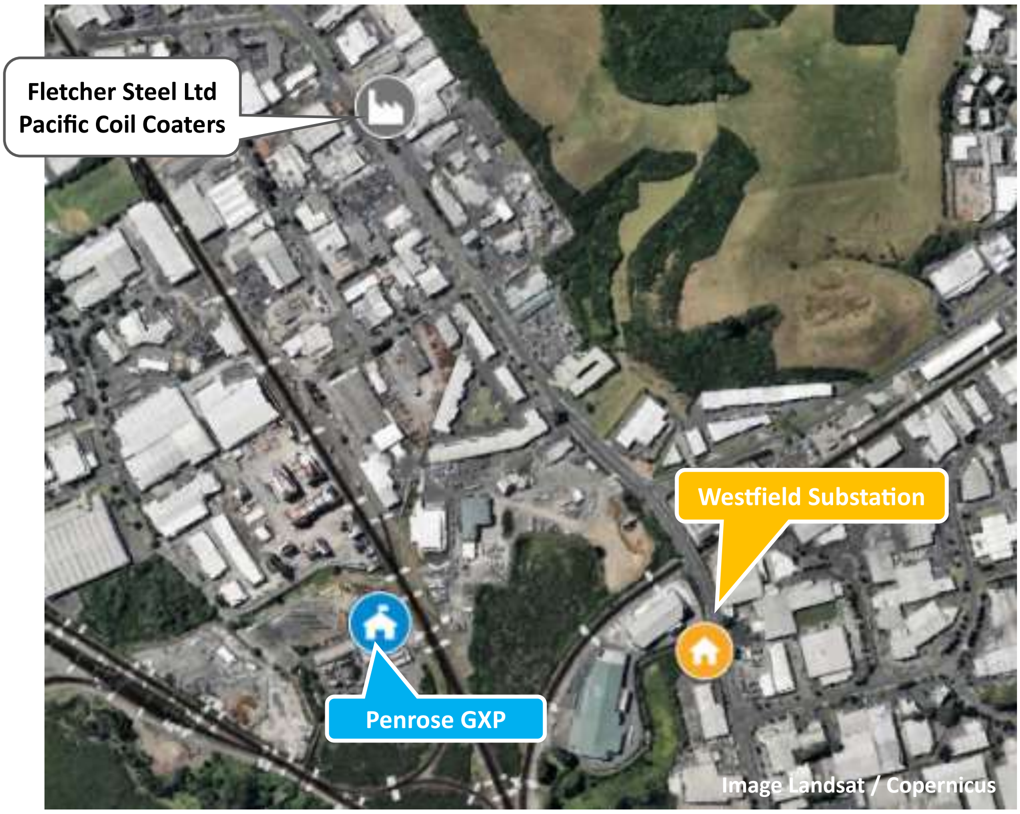


Figure 125. Fletcher Steel Ltd Pacific Coil Coaters geographic location in relation to the surrounding zone substations.

8.15.2.1 Existing electrical supply to the Plant

Fletcher Steel Ltd Pacific Coil Coaters is presently supplied by Vector's Westfield zone substation. The site is presently supplied with an 11 kV feeder which is fully underground. Westfield zone substation connects to the Penrose 22 kV GXP via three subtransmission circuits at 22 kV, rated at 19.66 MVA each.

The site is located approximately 0.9 km away from Westfield zone substation. The zone substation is located in turn approximately 2.8 km from Penrose 22 kV GXP.

There is currently a maximum loading of 28.4 MVA on Westfield zone substation, with 11.6 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 52 MVA of spare (N-1) capacity and 97 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Westfield substation have ~10.92 MVA of spare (N-1) capacity, and ~30.58 MVA of spare (N) capacity.

8.15.2.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

Ergo notes that Vector presently has plans to install a third transformer at Westfield zone substation, with estimated cost $3.0M and commissioning during 2034-35. Ergo expects that this Load Site may impact this plan, and so the cost of the third transformer is included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 5.9 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.15.2.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 83. Fletcher Steel Ltd Pacific Coil Coaters: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Westfield 3rd transformer	1.00	$3.00
		TOTAL	**$3.00**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.15.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded

8.15.3 Huntsman Chemical Company Ltd Barnes Plastics

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.88	Penrose 22 kV

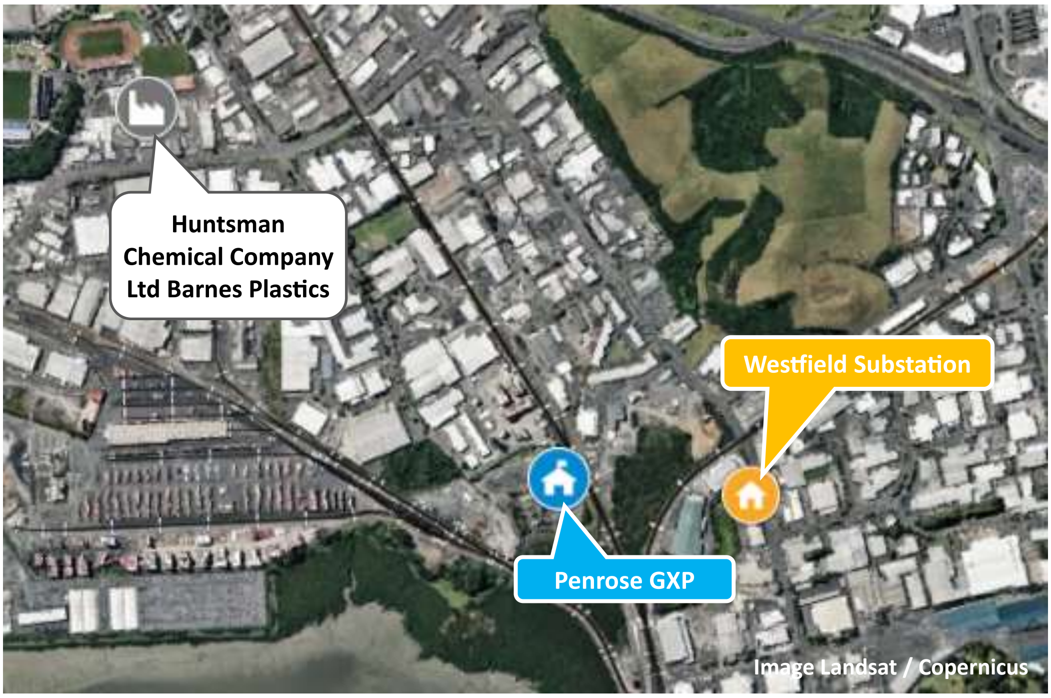


Figure 126. Huntsman Chemical Company Ltd Barnes Plastics geographic location in relation to the surrounding zone substations.

8.15.3.1 Existing electrical supply to the Plant

Huntsman Chemical Company Ltd Barnes Plastics is presently supplied by Vector's Westfield zone substation. The site is presently supplied by an 11 kV feeder which is fully underground. Westfield zone substation connects to the Penrose 22 kV GXP via three subtransmission circuits at 22 kV, rated at 19.66 MVA each.

The site is located approximately 1.8 km away from Westfield zone substation The zone substation is located in turn approximately 2.8 km from Penrose 22 kV GXP.

There is currently a maximum loading of 28.4 MVA on Westfield zone substation, with 11.6 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 52 MVA of spare (N-1) capacity and 97 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Westfield substation have ~10.92 MVA of spare (N-1) capacity, and ~30.58 MVA of spare (N) capacity.

8.15.3.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

Ergo notes that Vector presently has plans to install a third transformer at Westfield zone substation, with estimated cost $3.0M and commissioning during 2034-35. Ergo expects that this Load Site may impact this plan, and so the cost of the third transformer is included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 3.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.15.3.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 84. Huntsman Chemical Company Ltd Barnes Plastics: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Westfield 3rd transformer	1.00	$3.00
		TOTAL	$3.00

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.15.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded

8.15.4 NZ Comfort Group

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.78	Penrose 22 kV

Figure 127. NZ Comfort Group geographic location in relation to the surrounding zone substations.

8.15.4.1 Existing electrical supply to the Plant

NZ Comfort Group is presently supplied by Vector's Westfield zone substation. The site is presently supplied by an 11 kV feeder which is fully underground. Westfield zone substation connects to the Penrose 22 kV GXP via three subtransmission circuits at 22 kV, rated at 19.66 MVA each.

The site is located approximately 1.2 km away from Westfield zone substation. The zone substation is located in turn approximately 2.8 km from Penrose 22 kV GXP.

There is currently a maximum loading of 28.4 MVA on Westfield zone substation, with 11.6 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 52 MVA of spare (N-1) capacity and 97 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Westfield substation have ~10.92 MVA of spare (N-1) capacity, and ~30.58 MVA of spare (N) capacity.

8.15.4.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

Ergo notes that Vector presently has plans to install a third transformer at Westfield zone substation, with estimated cost $3.0M and commissioning during 2034-35. Ergo expects that this Load Site may impact this plan, and so the cost of the third transformer is included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 3.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.15.4.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 85. NZ Comfort Group: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Westfield 3rd transformer	1.00	$3.00
		TOTAL	**$3.00**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.15.4.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.15.5 Auckland Meat Processors Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	1.48	Penrose 22 kV

Figure 128. Auckland Meat Processors Auckland geographic location in relation to the surrounding zone substations.

8.15.5.1 Existing electrical supply to the Plant

Auckland Meat Processors Auckland is presently supplied by Vector's Westfield zone substation. The site is presently supplied by an 11 kV feeder which is fully underground. Westfield zone substation connects to the Penrose 22 kV GXP via three subtransmission circuits at 22 kV, rated at 19.66 MVA each.

The site is located approximately 0.7 km away from Westfield zone substation. The zone substation is located in turn approximately 2.8 km from Penrose 22 kV GXP.

There is currently a maximum loading of 28.4 MVA on Westfield zone substation, with 11.6 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 52 MVA of spare (N-1) capacity and 97 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Westfield substation have ~10.92 MVA of spare (N-1) capacity, and ~30.58 MVA of spare (N) capacity.

8.15.5.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

Ergo notes that Vector presently has plans to install a third transformer at Westfield zone substation, with estimated cost $3.0M and commissioning during 2034-35. Ergo expects that this Load Site may impact this plan, and so the cost of the third transformer is included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 5.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.15.5.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 86. Auckland Meat Processors Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Westfield 3rd transformer	1.00	$3.00
		TOTAL	**$3.00**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.15.5.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded

8.15.6 Mauri NZ Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.33	Penrose 22 kV

Figure 129. Mauri NZ Auckland geographic location in relation to the surrounding zone substations.

8.15.6.1 Existing electrical supply to the Plant

Mauri NZ Auckland is presently supplied by Vector's Westfield zone substation. The site is presently supplied by an 11 kV feeder which is fully underground. Westfield zone substation connects to the Penrose 22 kV GXP via three subtransmission circuits at 22 kV, rated at 19.66 MVA each.

The site is located approximately 1.3 km away from Westfield zone substation. The zone substation is located in turn approximately 2.8 km from Penrose 22 kV GXP.

There is currently a maximum loading of 28.4 MVA on Westfield zone substation, with 11.6 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 52 MVA of spare (N-1) capacity and 97 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Westfield substation have ~10.92 MVA of spare (N-1) capacity, and ~30.58 MVA of spare (N) capacity.

8.15.6.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

Ergo notes that Vector presently has plans to install a third transformer at Westfield zone substation, with estimated cost $3.0M and commissioning during 2034-35. Ergo expects that this Load Site may impact this plan, and so the cost of the third transformer is included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 4.4 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.15.6.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 87. Mauri NZ Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	**Subtransmission => (N-1)**		**Distribution => (N)**
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Westfield 3rd transformer	1.00	$3.00
		TOTAL	**$3.00**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.15.6.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded

8.15.7 Kerry Group Kerry Ingredients

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.19	Penrose 22 kV

Figure 130. Kerry Group Kerry Ingredients geographic location in relation to the surrounding zone substations.

8.15.7.1 Existing electrical supply to the Plant

Kerry Group Kerry Ingredients is presently supplied by Vector's Westfield zone substation. The site is presently supplied by an 11 kV feeder which is fully underground. Westfield zone substation connects to the Penrose 22 kV GXP via three subtransmission circuits at 22 kV, rated at 19.66 MVA each.

The site is located approximately 0.4 km away from Westfield zone substation. The zone substation is located in turn approximately 2.8 km from Penrose 22 kV GXP.

There is currently a maximum loading of 28.4 MVA on Westfield zone substation, with 11.6 MVA of spare (N) capacity and no spare (N-1) capacity. Penrose 33 kV GXP presently has 52 MVA of spare (N-1) capacity and 97 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Westfield substation have ~10.92 MVA of spare (N-1) capacity, and ~30.58 MVA of spare (N) capacity.

8.15.7.2 Supply Option(s) for New Load

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

Ergo notes that Vector presently has plans to install a third transformer at Westfield zone substation, with estimated cost $3.0M and commissioning during 2034-35. Ergo expects that this Load Site may impact this plan, and so the cost of the third transformer is included in Ergo's costings for an (N-1) supply for this site.

The existing 11 kV feeder has approximately 4.4 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.15.7.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 88. Kerry Group Kerry Ingredients: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Westfield 3rd transformer	1.00	$3.00
		TOTAL	**$3.00**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.15.7.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded

8.15.8 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 89. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
NZ Nail Industries	Westfield	0.0	11.6	3.3	0.693	200
Steel Masters Auckland Ltd*	Westfield	0.0	11.6	-2.9	0.495	130

*Ergo has checked the existing feeder of this site against the Vector capacity map, which indicated that the feeder has sufficient capacity for the additional load, contrary to the data shown above. Ergo has assumed that the data in the map is accurate.

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.15.9 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.15.9.1 Westfield

All eight of the loads on Penrose 22 kV GXP are expected to connect to Westfield zone substation. The sum of peaks of these loads is 11.82 MW, which the zone substation does not have (N-1) capacity for.

However, the already planned upgrades, which were included in the costings in the earlier sections for the individual load sites, are considered adequate to supply all the connecting loads with (N-1) security. The upgrades relate to the installation of a third transformer at Westfield substation.

8.15.10 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Penrose 22 kV GXP gives a combined load of 1.19 MW. When the load shapes are combined, they result in the following load shape (Figure 131), with a maximum load of 1.17 MW, with a diversity factor of 0.99.

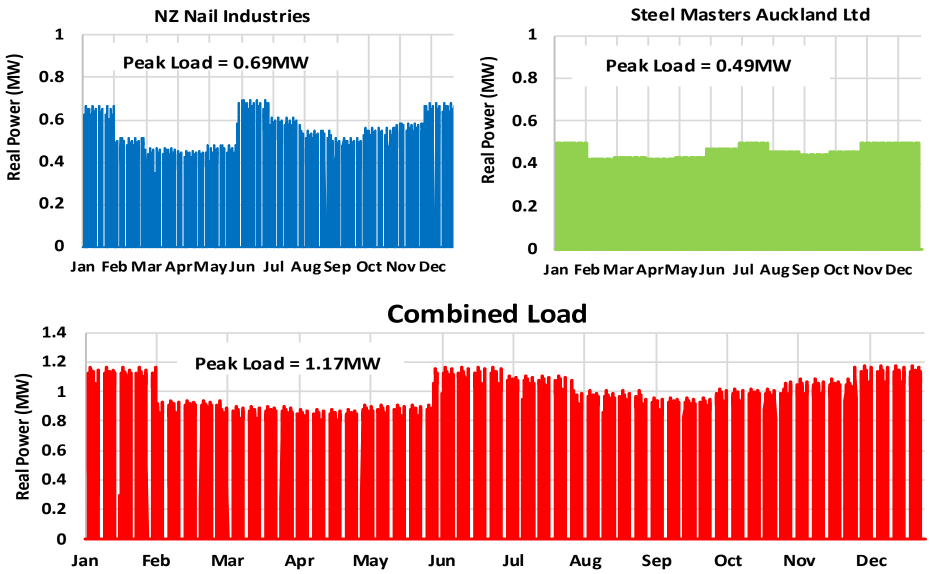


Figure 131. Loading Profiles: Penrose 22 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.15.11 Effect of all Load Sites Connecting to Penrose 22 kV GXP

The following Figure 132 illustrates the Penrose 22 kV GXP load profile together with the load profiles of all the Load Sites within the Penrose 22 kV GXP region. Also shown in Figure 132 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Penrose 22 kV GXP would increase to 47.0 MW, an increase of 9.81 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 49.0 MW, there is a diversity factor of 0.96 between the loads.
- Based on Ergo's analysis, the Penrose 22 kV GXP's (N-1) limit is not expected to be exceeded.

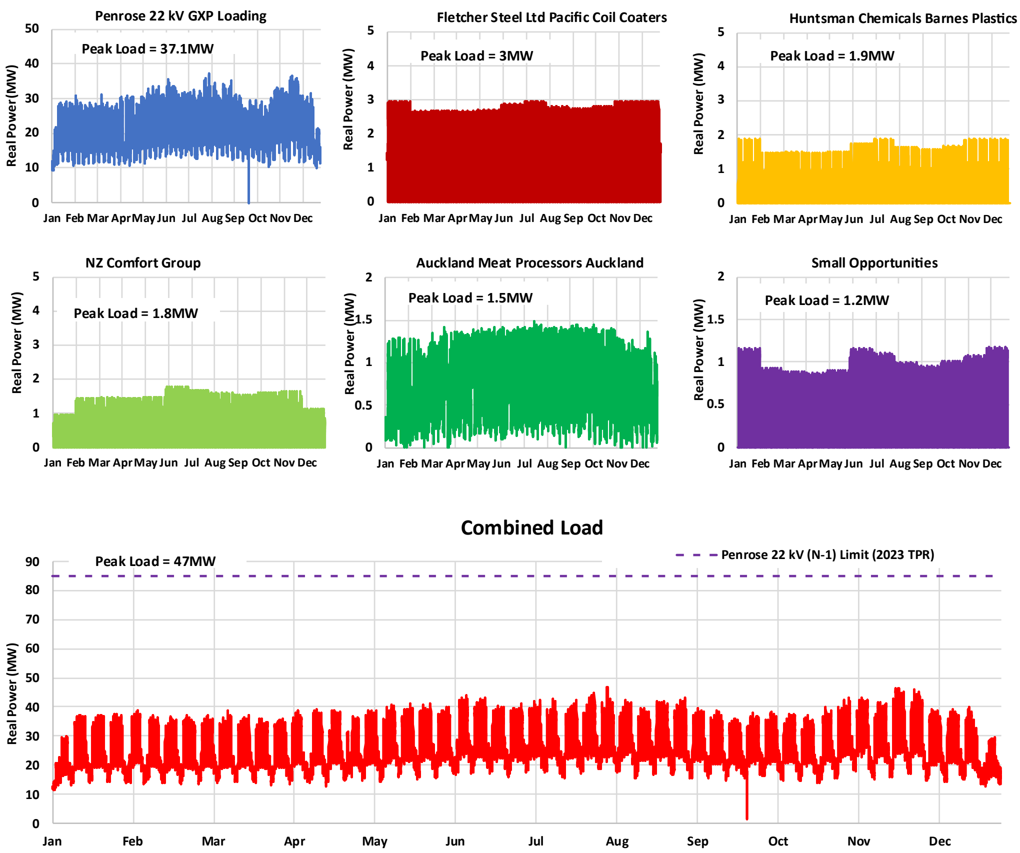


Figure 132. Loading Profiles: Penrose 22 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.16 Mt Roskill 110 kV GXP

The "Large" EECA load site connecting to the Mt Roskill 110 kV GXP includes:

- Alsco NZ Auckland (2.2 MW)

The "Small" EECA load sites connecting to the Mt Roskill 110 kV GXP include (refer to Sections 8.16.3 and 8.16.5):

- Health New Zealand Mason Clinic (0.24 MW)
- Ministry of Education Western Springs College (0.13 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

Figure 133. Mt Roskill 110 kV GXP: EECA Load Sites vs local substations.

8.16.1 Mt Roskill 110 kV GXP Upgrade

Mt Roskill 110 kV GXP presently has 1 MVA of spare (N-1) capacity and 61 MVA of spare (N) capacity, based on the transformer ratings of the 110/22 kV transformers at Kingsland 110/22 kV substation, which is the only 110 kV load at the GXP.

Given there is only a single large load connecting to the Mt Roskill 110 kV GXP, an outline of expected upgrades to the GXP can be found in Section 8.16.2. Upgrades for this Load Site are considered adequate for all of the connecting Load Sites. Ergo does not anticipate upgrades to the GXP for the "small" Load Sites.

8.16.2 Alsco NZ Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	2.2	Mt Roskill 110 kV

Figure 134. Alsco NZ Auckland geographic location in relation to the surrounding zone substations.

8.16.2.1 Existing Electrical Supply

Alsco NZ Auckland is presently supplied by Vector's Kingsland zone substation. The site is supplied via an 11 kV underground feeder. Kingsland 110 kV zone substation is in turn supplied from Mt Roskill 110 kV GXP by two underground 110 kV subtransmission circuits direct from the GXP, rated at 74 MVA each. Kingsland substation is supplied by 2x 110/22 kV transformers, each rated to 60 MVA, which also supply the nearby Pt Chevalier and Ponsonby substations (these transformers are considered in the GXP (N) and (N-1) capacities). Kingland substation's 11 kV bus is supplies by 2x 22/11 kV transformers, each rated to 20 MVA.

This site is located approximately 0.5 km from Kingsland zone substation. In turn, Kingsland zone substation is approximately 7.1 km from Mt Roskill 110 kV GXP.

There is currently a maximum loading of 24.8 MVA on Kingsland zone substation, with 15.2 MVA of spare (N) capacity and no spare (N-1) capacity. Mt Roskill 110 kV GXP presently has 1 MVA of spare (N-1) capacity and 61 MVA of spare (N) capacity.

The 110 kV subtransmission circuits presently supplying the Kingsland substation have ~14.61 MVA of spare (N-1) capacity, and ~88.61 MVA of spare (N) capacity.

8.16.2.2 Supply Option(s)

Both the zone substation and the GXP have adequate spare (N) capacity to supply the load. However, the zone substation and GXP both lack adequate spare (N-1) capacity. The 110 kV subtransmission circuits supplying the substation have adequate (N) and (N-1) capacity for this load.

Ergo notes that Vector has a project planned to install a new substation at Mt Eden, to increase the spare (N-1) capacity available at Kingsland 11 kV (price unknown to Ergo, commissioning ~2031). Additionally, Vector have a project planned to upgrade the subtransmission capacity of the Mt Roskill 110 kV-Kingsland 22 kV circuits (estimated cost $9.4M, commissioning in 2034, with more cost anticipated after the present planning period). It is expected that these upgrades would be sufficient to supply the Load Site with (N-1) transmission and subtransmission security. Ergo expects that this Load Site may impact these plans, and so the costs for them are included in the costings for an (N-1) solution for this site. As a cost is unknown for the new Mt Eden substation project, a large substation price is included in the costing instead of a specific price.

The existing 11 kV feeder has approximately 4.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.16.2.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 90. Alsco NZ Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Kingsland substation 110/22 kV reinforcement	1.00	$9.40
Subtransmission	Large zone substation	1.00	$11.50
		TOTAL	**$20.90**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.16.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 24-36 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded

8.16.3 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 91. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Expected Feeder Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Health New Zealand Mason Clinic	Chevalier	0.0	19	5.9	0.24	130
Ministry of Education Western Spring College	Chevalier	0.0	19	5.0	0.13	80

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.16.4 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.16.4.1 Chevalier

Two of the loads on Mt Roskill 110 kV GXP are expected to connect to Chevalier zone substation. These loads are Health New Zealand Mason Clinic and Ministry of Education Western Springs College. The sum of peaks of these loads is 0.37 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that this substation is already operating under (N) security during peak loading.

The connecting sites are small loads and expected to have a minimal impact on the network. Therefore, no further upgrades are expected at Chevalier.

8.16.5 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on Mt Roskill 110 kV GXP gives a combined load of 0.37 MW. When the load shapes are combined, they result in the following load shape (Figure 135), with a maximum load of 0.30 MW, with a diversity factor of 0.80.

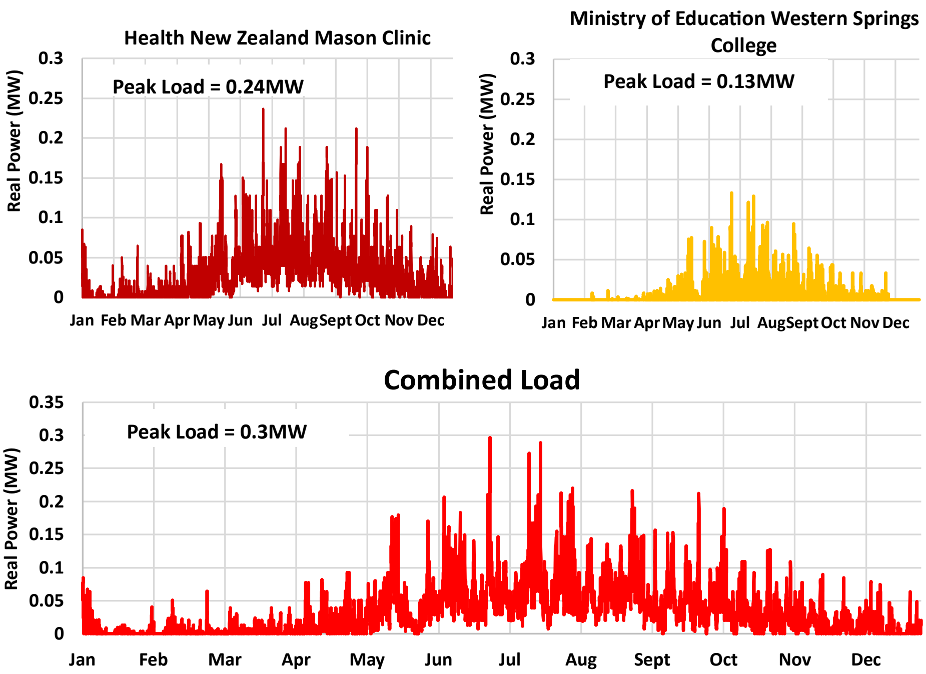


Figure 135. Loading Profiles: Mt Roskill 110 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.16.6 Effect of all Load Sites Connecting to Mt Roskill 110 kV GXP

Figure 136 illustrates the Mt Roskill 110 kV GXP load profile together with the load profiles of all the Load Sites within the Mt Roskill 110 kV GXP region. Also shown in Figure 136 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Mt Roskill 110 kV GXP would not increase. Given that the independent sum of the individual load peaks is 61.4 MW there is a diversity factor of 0.96 between the loads.

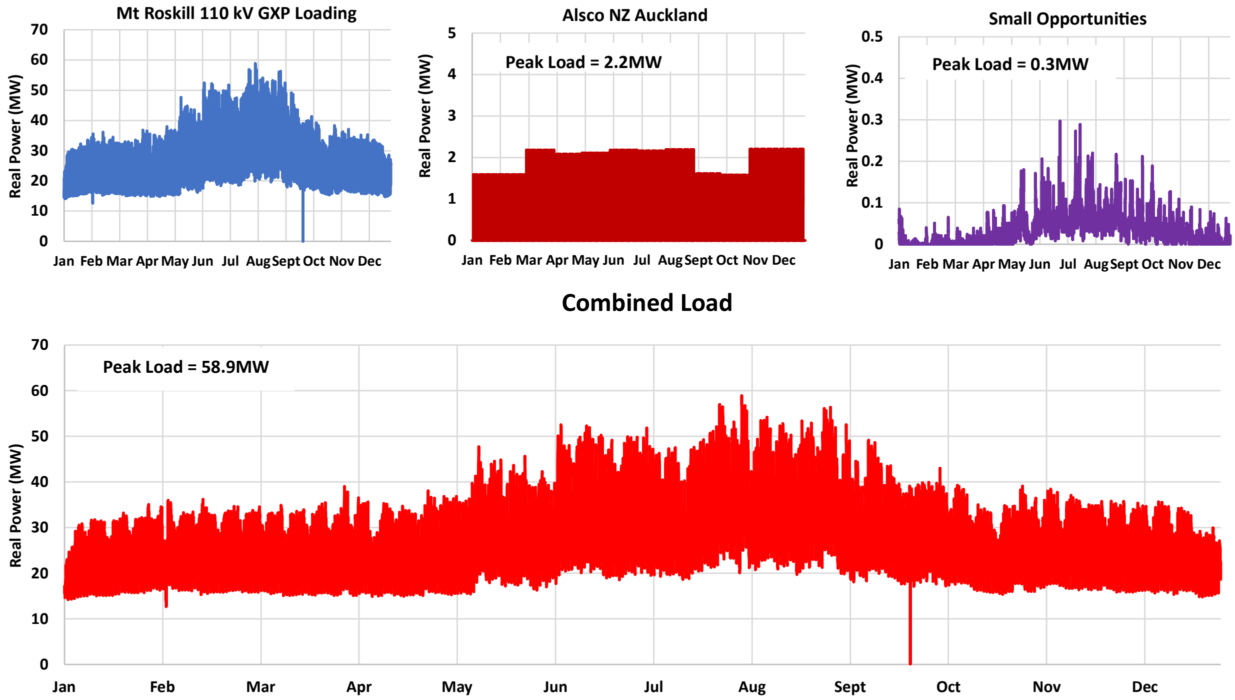


Figure 136. Loading Profiles: Mt Roskill 110 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.17 Mt Roskill 22 kV GXP

The "Large" EECA load site connecting to the Mt Roskill 22 kV GXP includes:

- Sanitarium Auckland (1.63 MW)

The "Small" EECA load sites connecting to the Mt Roskill 22 kV GXP include (refer to Sections 8.17.3 and 8.17.5):

- Davis Funeral Services Limited Auckland (0.96 MW)
- Ministry of Education Lynfield College (0.37 MW)
- Lexham Gardens Rest Home (0.27 MW)
- Everil Orr Care Centre (0.27 MW)
- Mount Albert Aquatic Centre (0.26 MW)
- Plant & Food Research Mt Albert (0.25 MW)
- Tai Poutini Polytechnic Auckland Campus (0.22 MW)
- Epicurean Dairy Co Auckland (0.18 MW)
- ESR (Institute of Environmental Science and Research) Auckland (0.14 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

Figure 137. Mt Roskill 22 kV GXP: EECA Load Sites vs local substations.

8.17.1 Mt Roskill 22 kV GXP Upgrade

Mt Roskill 22 kV GXP presently has 45 MVA of spare (N-1) capacity and 95 MVA of spare (N) capacity, based on the transformer ratings.

The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.17.6). Therefore, no further upgrades are expected at Mt Roskill 22 kV GXP.

8.17.2 Sanitarium Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.63	Mt Roskill 22 kV

Figure 138. Sanitarium Auckland geographic location in relation to the surrounding zone substations.

8.17.2.1 Existing Electrical Supply

Sanitarium Auckland is presently supplied by Vector's Hillsborough zone substation. The site is supplied via an 11 kV feeder consisting of a combination of underground cable and overhead line. Hillsborough zone substation is in turn supplied from Mt Roskill 22 kV GXP by two underground 33 kV subtransmission circuits direct from the GXP, which are rated to 26.33 MVA and 39.5 MVA.

This site is located approximately 1.1 km from Hillsborough zone substation. In turn, Hillsborough zone substation is approximately 2.9 km from Mt Roskill 22 kV GXP.

There is currently a maximum loading of 21.6 MVA on Hillsborough zone substation, with 18.4 MVA of spare (N) capacity and no spare (N-1) capacity. Mt Roskill 22 kV GXP presently has 45 MVA of spare (N-1) capacity and 95 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Hillsborough substation have ~4.73 MVA of spare (N-1) capacity, and ~44.23 MVA of spare (N) capacity.

8.17.2.2 Supply Option(s)

The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load. The zone substation has adequate (N) but not (N-1) capacity for this load.

For an (N-1) security supply, it is expected that the transformers at Hillsborough zone substation may need to be replaced.

The existing 11 kV feeder has approximately 1.6 MVA of spare capacity. Therefore, due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 1.4 km.

8.17.2.3 Capital Cost Estimate

Table 92. Sanitarium Auckland: Indicative capital cost to supply the Load Site with (N) sub-transmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.40	$1.12
		TOTAL	**$1.32**

Table 93. Sanitarium Auckland: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.40	$1.12
		TOTAL	**$5.92**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.17.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 24-36 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.17.3 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 94. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Expected Feeder Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Davis Funeral Services Limited Auckland	Balmoral	5.9	25.9	1.3	0.96	260
Ministry of Education Lynfield College	White Swan	0.0	16.5	3.6	0.37	130
Lexham Gardens Rest Home	Balmoral	5.9	25.9	6.7	0.27	130
Everil Orr Care Centre	Avondale	0.0	10.2	3.5	0.27	130
Mount Albert Aquatic Centre	Sandringham	0.0	19.3	3.8	0.26	130
Plant & Food Research Mt Albert	Sandringham	0.0	19.3	3.8	0.25	130
Tai Poutini Polytechnic Auckland Campus	Mt Albert	N/A	11.3	5.2	0.22	130
Epicurean Dairy Co Auckland	Avondale	0.0	10.2	2.6	0.18	80
ESR (Institute of Environmental Science and Research) Auckland	Sandringham	0.0	19.3	3.8	0.14	80

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.17.4 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.17.4.1 Avondale

Two of the loads on Mt Roskill 22 kV GXP are expected to connect to Avondale zone substation. These loads are Everil Orr Care Centre and Epicurean Dairy Co Auckland. The sum of peaks of these loads is 0.45 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that this substation is already operating under (N) security during peak loading.

The connecting sites are small loads and expected to have a minimal impact on the network. Therefore, no further upgrades are expected at Chevalier.

8.17.4.2 Balmoral

Two of the loads on Mt Roskill 22 kV GXP are expected to connect to Balmoral zone substation. These loads are Davis Funeral Services Limited Auckland and Lexham Gardens Rest Home. The sum of peaks of these loads is 1.23 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Balmoral zone substation.

8.17.4.3 Sandringham

Three of the loads on Mt Roskill 22 kV GXP are expected to connect to Sandringham zone substation. These loads are Mount Albert Aquatic Centre, Plant & Food Research Mt Albert, and ESR (Institute of Environmental Science and Research) Auckland. The sum of peaks of these loads is 0.65 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that this substation is already operating under (N) security during peak loading.

The connecting sites are small loads and expected to have a minimal impact on the network. Therefore, no further upgrades are expected at Chevalier.

8.17.5 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Mt Roskill 22 kV GXP gives a combined load of 3.00 MW. When the load shapes are combined, they result in the following load shape (Figure 139), with a maximum load of 2.21 MW, with a diversity factor of 0.74.

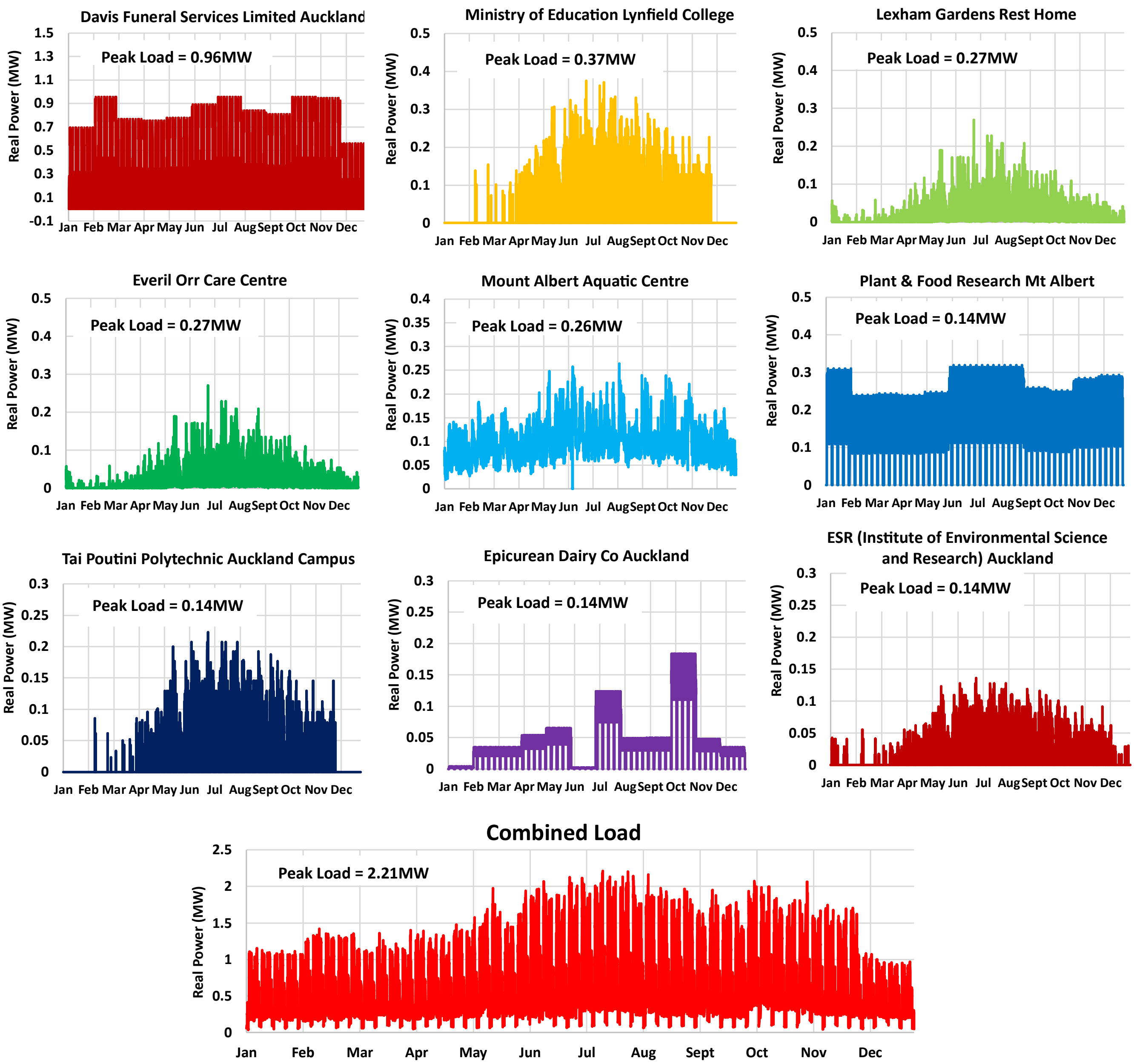


Figure 139. Loading Profiles: Mt Roskill 22 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.17.6 Effect of all Load Sites Connecting to Mt Roskill 22 kV GXP

The following Figure 140 illustrates the Mt Roskill 22 kV GXP load profile together with the load profiles of all the Load Sites within the Mt Roskill 22 kV GXP region. Also shown in Figure 140 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Mt Roskill 22 kV GXP would increase to 118.3 MW, an increase of 2.5 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 119.7 MW there is a diversity factor of 0.99 between the loads.
- Based on Ergo's analysis, the Mt Roskill 22 kV GXP's (N-1) limit is not expected to be exceeded.

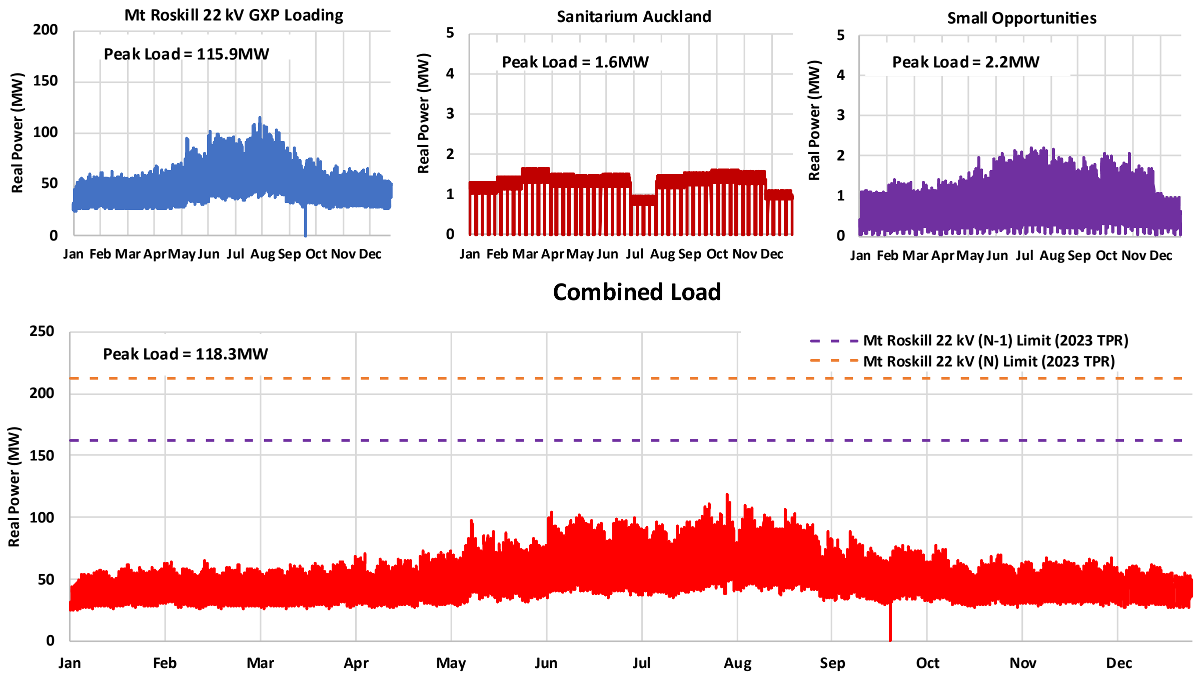


Figure 140. Loading Profiles: Mt Roskill 22 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.18 Silverdale 33 kV GXP

The “Large” EECA Load Sites connecting to the Silverdale 33 kV GXP are:

- Fulton Hogan Limited North Harbour (7.71 MW)
- Higgins Silverdale (7.27 MW)
- NZ Gourmet Gourmet Paprika (2.55 MW)

The “Small” EECA Load Sites connecting to the Silverdale 33 kV GXP are (refer to Sections 8.18.5 and 8.18.7):

- George Weston Foods Silverdale (0.59 MW)
- Massimo's Italian Cheeses (0.49 MW)
- Superb Herb Helensville (0.21 MW)
- Ministry of Education Ōrewa College (0.10 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

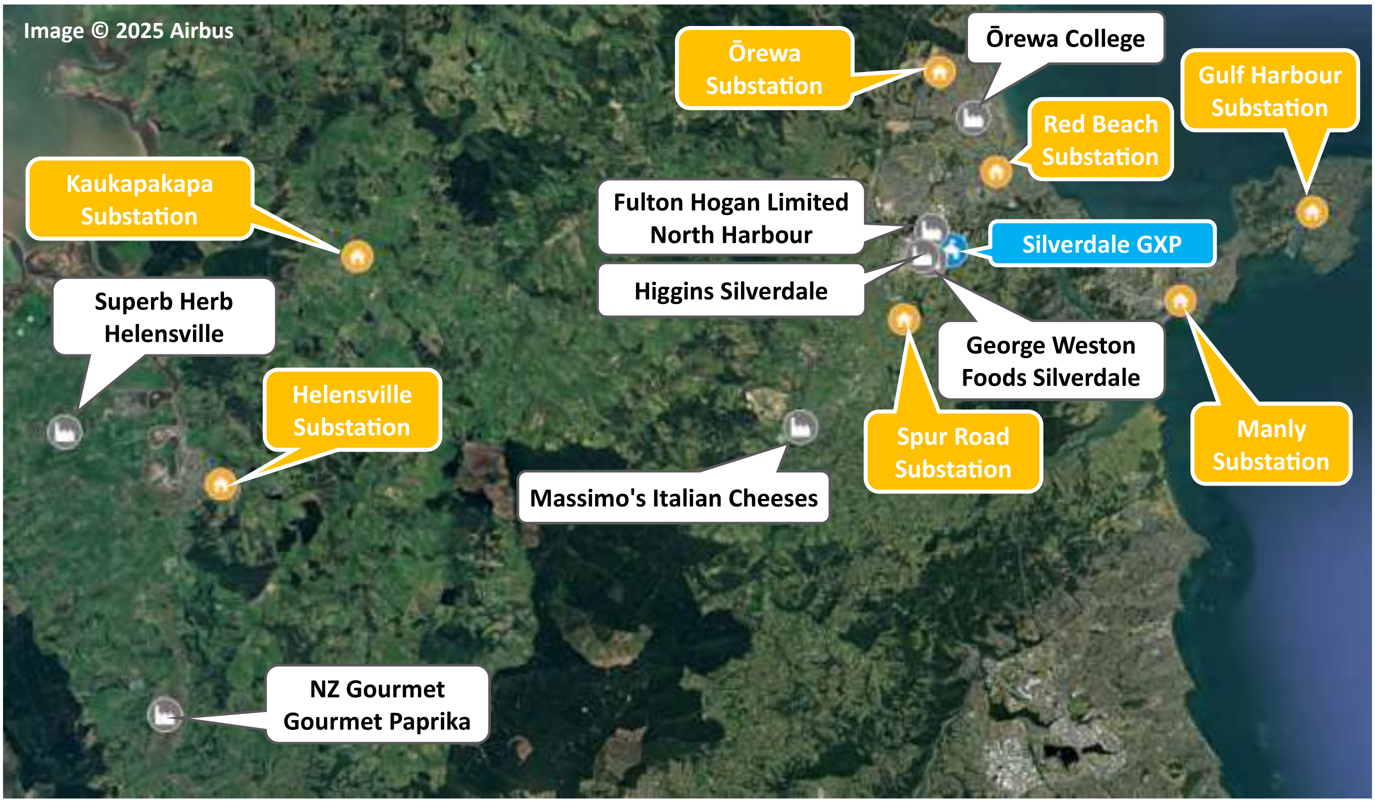


Figure 141. Silverdale 33 kV GXP: EECA Load Sites vs local substations.

8.18.1 Silverdale 33 kV GXP Upgrade

Silverdale 33 kV GXP presently has 23 MVA of spare (N-1) capacity and 113 MVA of spare (N) capacity, based on the transformer ratings.

The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.18.8). Therefore, no further upgrades are expected at Silverdale 33 kV GXP.

8.18.2 Fulton Hogan Limited North Harbour

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	7.71	Silverdale 33 kV

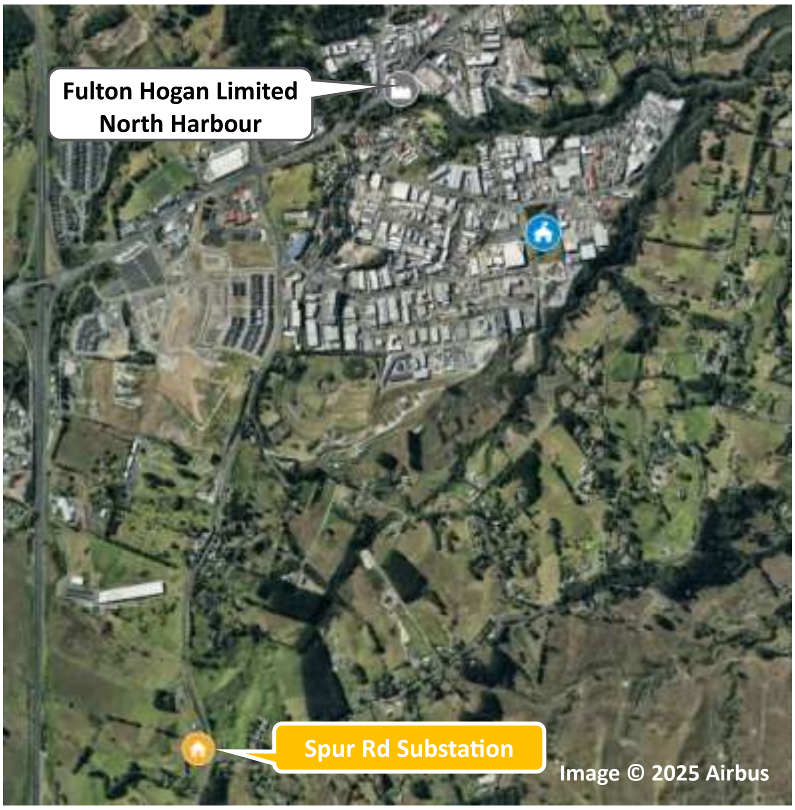


Figure 142. Fulton Hogan Limited North Harbour geographic location in relation to the surrounding zone substations.

8.18.2.1 Existing Electrical Supply

Fulton Hogan Limited North Harbour is presently supplied by Vector's Spur Road zone substation. The site is supplied by an 11 kV feeder that consists of a mixture of overhead lines and underground cables. The zone substation is supplied directly from the Silverdale GXP through two 33 kV subtransmission circuits consisting of predominantly overhead lines, each rated to 35.32 MVA. A single Spur Rd-Horseshoe Bush-Helensville-Kaukapakapa-Silverdale circuit completes a 33 kV ring, the majority of which is rated to 26.65 MVA, though the Helensville-Kaukapakapa section is rated to 32.75 MVA (Ergo notes that while this circuit is routed via Horseshoe Bush substation, it does not presently supply the Horseshoe Bush substation load.).

The site is located approximately 2.5 km away from Spur Road zone substation. The zone substation is located in turn approximately 2.3 km from Silverdale GXP.

There is currently a maximum loading of 15 MVA on Spur Road zone substation, with 25 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Silverdale 33 kV GXP presently has 23 MVA of spare (N-1) capacity and 113 MVA of spare (N) capacity.

With present maximum loadings on Helensville and Kaukapakapa of 11.8 MVA and 6.2 MVA, respectively, the 33 kV Spur Rd-Helensville-Kaukapakapa subtransmission ring has ~28 MVA of spare (N-1) capacity, and ~64.29 MVA of spare (N) capacity. Ergo notes that as this is a ring (meshed) network, there will be inaccuracies in this calculation, as full load flow calculations are required to determine the load sharing between each of the subtransmission circuits and therefore their spare capacity.

8.18.2.2 Supply Option(s)

The zone substation has adequate spare (N) capacity for this load, but lacks adequate spare (N-1) capacity. The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load.

Ergo understands that Vector are planning to install a new substation at Dairy Flat, to reduce the strain on Spur Road and Coatesville substations. It is expected that this would allow the Spur Road substation to provide the Load Site with (N-1) security. Ergo expects that this Load Site may impact this plan, and so the costs for it are included in the costings for an (N-1) solution for this site. As a cost is unknown for the new Dairy Flat substation project, a large substation price is included in the costing, instead of a specific price.

The existing 11 kV feeder has approximately 1.1 MVA of spare capacity. Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. As the area around the load and the substation are increasingly urbanised, it is assumed that the new feeder would be underground cables, at a length of ~2.9 km.

8.18.2.3 Capital Cost Estimate

Table 95. Fulton Hogan Limited North Harbour: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable	2.90	$1.74
		TOTAL	**$1.94**

Table 96. Fulton Hogan Limited North Harbour: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Large zone substation	1.00	$11.50
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable	2.90	$1.74
		TOTAL	**$13.44**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.18.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 24-36 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.18.3 Higgins Silverdale

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	7.27	Silverdale 33 kV

Figure 143. Higgins Silverdale geographic location in relation to the surrounding zone substations.

8.18.3.1 Existing Electrical Supply

Higgins Silverdale is presently supplied by Vector's Spur Road zone substation. The site is supplied by an 11 kV feeder that consists of a mixture of overhead lines and underground cables. The zone substation is supplied directly from the Silverdale GXP through two 33 kV subtransmission circuits consisting of predominantly overhead lines, each rated to 35.32 MVA. A single Spur Rd-Horseshoe Bush-Helensville-Kaukapakapa-Silverdale circuit completes a 33 kV ring, the majority of which is rated to 26.65 MVA, though the Helensville-Kaukapakapa section is rated to 32.75 MVA (Ergo notes that while this circuit is routed via Horseshoe Bush substation, it does not presently supply the Horseshoe Bush substation load.).

The site is located approximately 1.8 km away from Spur Road zone substation. The zone substation is located in turn approximately 2.3 km from Silverdale GXP.

There is currently a maximum loading of 15 MVA on Spur Road zone substation, with 25 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Silverdale 33 kV GXP presently has 23 MVA of spare (N-1) capacity and 113 MVA of spare (N) capacity.

With present maximum loadings on Helensville and Kaukapakapa of 11.8 MVA and 6.2 MVA, respectively, the 33 kV Spur Rd-Helensville-Kaukapakapa subtransmission ring has ~28 MVA of spare (N-1) capacity, and ~64.29 MVA of spare (N) capacity. Ergo notes that as this is a ring (meshed) network, there will be inaccuracies in this calculation, as full load flow calculations are required to determine the load sharing between each of the subtransmission circuits and therefore their spare capacity.

8.18.3.2 Supply Option(s)

The zone substation has adequate spare (N) capacity for this load, but lacks adequate spare (N-1) capacity. The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load.

Ergo understands that Vector are planning to install a new substation at Dairy Flat, to reduce the strain on Spur Road and Coatesville substations. It is expected that this would allow the Spur Road substation to provide the Load Site with (N-1) security. Ergo expects that this Load Site may impact this plan, and so the costs for it are included in the costings for an (N-1) solution for this site. As a cost is unknown for the new Dairy Flat substation project, a large substation price is included in the costing, instead of a specific price.

The existing 11 kV feeder has approximately 1.1 MVA of spare capacity. Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. As the area around the load and the substation are increasingly urbanised, it is assumed that the new feeder would be underground cables, at a length of ~2.0 km.

8.18.3.3 Capital Cost Estimate

Table 97. Higgins Silverdale: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable	2.00	$1.20
		TOTAL	**$1.40**

Table 98. Higgins Silverdale: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Large zone substation	1.00	$11.50
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable	2.00	$1.20
		TOTAL	**$12.90**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.18.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 24-36 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.18.4 NZ Gourmet Gourmet Paprika

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	2.55	Silverdale 33 kV

Figure 144. NZ Gourmet Gourmet Paprika geographic location in relation to the surrounding zone substations.

8.18.4.1 Existing Electrical Supply

NZ Gourmet Gourmet Paprika is presently supplied by Vector's Helensville zone substation. The site is supplied by an 11 kV feeder that consists of predominantly overhead lines. The zone substation is supplied by the Spur Rd-Horseshoe Bush-Helensville-Kaukapakapa-Silverdale ring, including two 33 kV subtransmission circuits between Silverdale and Spur Road, consisting of predominantly overhead lines, each rated to 35.32 MVA; and a single Spur Rd-Horseshoe Bush-Helensville-Kaukapakapa-Silverdale circuit, the majority of which is rated to 26.65 MVA, though the Helensville-Kaukapakapa section is rated to 32.75 MVA (Ergo notes that while this circuit is routed via Horseshoe Bush substation, it does not presently supply the Horseshoe Bush substation load.).

The site is located approximately 6.4 km away from Helensville zone substation. The zone substation is located in turn approximately 20.8 km from Silverdale GXP.

There is currently a maximum loading of 11.8 MVA on Helensville zone substation, with 3.2 MVA of spare (N) capacity and no spare (N-1) capacity. Silverdale 33 kV GXP presently has 23 MVA of spare (N-1) capacity and 113 MVA of spare (N) capacity.

With present maximum loadings on Spur Rd and Kaukapakapa of 15 MVA and 6.2 MVA, respectively, the 33 kV Spur Rd-Helensville-Kaukapakapa subtransmission ring has ~28 MVA of spare (N-1) capacity, and ~64.29 MVA of spare (N) capacity. Ergo notes that as this is a ring (meshed) network, there will be inaccuracies in this calculation, as full load flow calculations are required to determine the load sharing between each of the subtransmission circuits and therefore their spare capacity.

8.18.4.2 Supply Option(s)

The zone substation has adequate spare (N) capacity for this load, but lacks adequate spare (N-1) capacity. The GXP and the subtransmission circuits supplying the zone substation have adequate (N) and (N-1) spare capacity for this load.

The existing 11 kV feeder has approximately 0.8 MVA of spare capacity. Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. As the area around the load and the substation are increasingly urbanised, it is assumed that the new feeder would be underground cables for ~2.7 km as it exits Helensville town, and then overhead lines for the remaining rural area of the route, ~7.6 km.

8.18.4.3 Capital Cost Estimate

Table 99. NZ Gourmet Gourmet Paprika: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable	2.70	$1.62
Distribution	Single overhead 11kV line	7.60	$3.80
		TOTAL	**$5.62**

Table 100. NZ Gourmet Gourmet Paprika: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	Medium supply transformer (ZSS)	2.00	$3.80
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable	2.70	$1.62
Distribution	Single overhead 11kV line	7.60	$3.80
		TOTAL	**$9.42**

8.18.4.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 24-36 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.18.5 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 101. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Expected Feeder Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
George Weston Foods Silverdale	Spur Road	5	25	1.1	0.59	200
Massimo's Italian Cheeses	Spur Road	5	25	0.7	0.49	130
Superb Herb Helensville	Helensville	0.0	3.2	-2.2	0.21	130
Ministry of Education Ōrewa College	Ōrewa	0.0	17.3	2.9	0.10	80

*Ergo has checked the existing feeder of this site against the Vector capacity map, which indicated that the feeder has sufficient capacity for the additional load, contrary to the data shown above. Ergo has assumed that the data in the map is accurate.

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.18.6 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.18.6.1 Spur Road

Four of the loads on Silverdale GXP are expected to connect to Spur Road zone substation. These loads are Fulton Hogan Limited North Harbour, Higgins Silverdale, George Weston Foods Silverdale, and Massimo's Italian Cheeses. The sum of peaks of these loads is 16.07 MW, which the zone substation does not have (N-1) capacity for.

If only one of the two large sites were to connect (Fulton Hogan or Higgins), then no further upgrades would be expected, other than those required for the Load Site itself. However, if both large sites connect, then transformer upgrades may be required at Spur Road substation, which Ergo estimates could cost $4.6M.

8.18.6.2 Helensville

Two of the loads on Silverdale GXP are expected to connect to Helensville zone substation. These loads are NZ Gourmet Paprika and Superb Herb Helensville. The sum of peaks of these loads is 2.76 MW, which the zone substation does not have (N-1) capacity for.

The upgrades required for the connecting large load site, NZ Gourmet Paprika, are considered adequate to supply all the connecting loads with (N-1) security. The upgrades relate to transformer replacements at Helensville substation.

The other connecting site is a “small” load and is expected to have a minimal impact on the network. Therefore, no further upgrades are expected at Helensville.

8.18.7 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on Silverdale 33 kV GXP gives a combined load of 1.39 MW. When the load shapes are combined, they result in the following load shape (Figure 145), with a maximum load of 1.04 MW, with a diversity factor of 0.75.

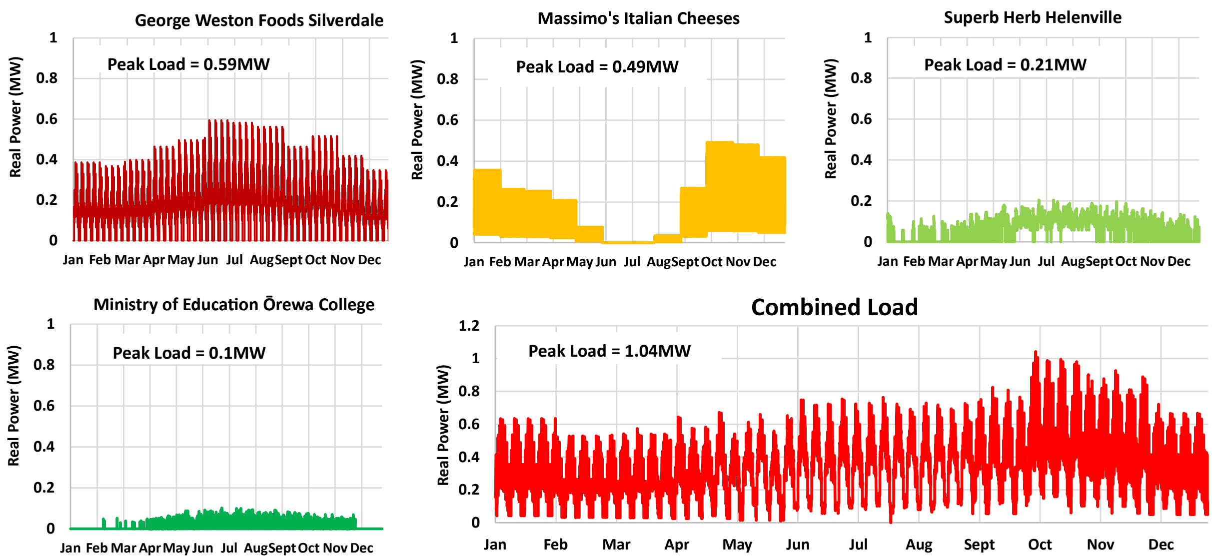


Figure 145. Loading Profiles: Silverdale 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.18.8 Effect of all Load Sites Connecting to Silverdale 33 kV GXP

The following Figure 146 illustrates the Silverdale 33 kV GXP load profile together with the load profiles of all the Load Sites within the Silverdale 33 kV GXP region. Also shown in Figure 146 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Silverdale 33 kV GXP would increase to 108.2 MW, an increase of 1.3 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 125.5 MW there is a diversity factor of 0.86 between the loads.
- Based on Ergo's analysis, the Silverdale 33 kV GXP's (N-1) limit is not expected to be exceeded.

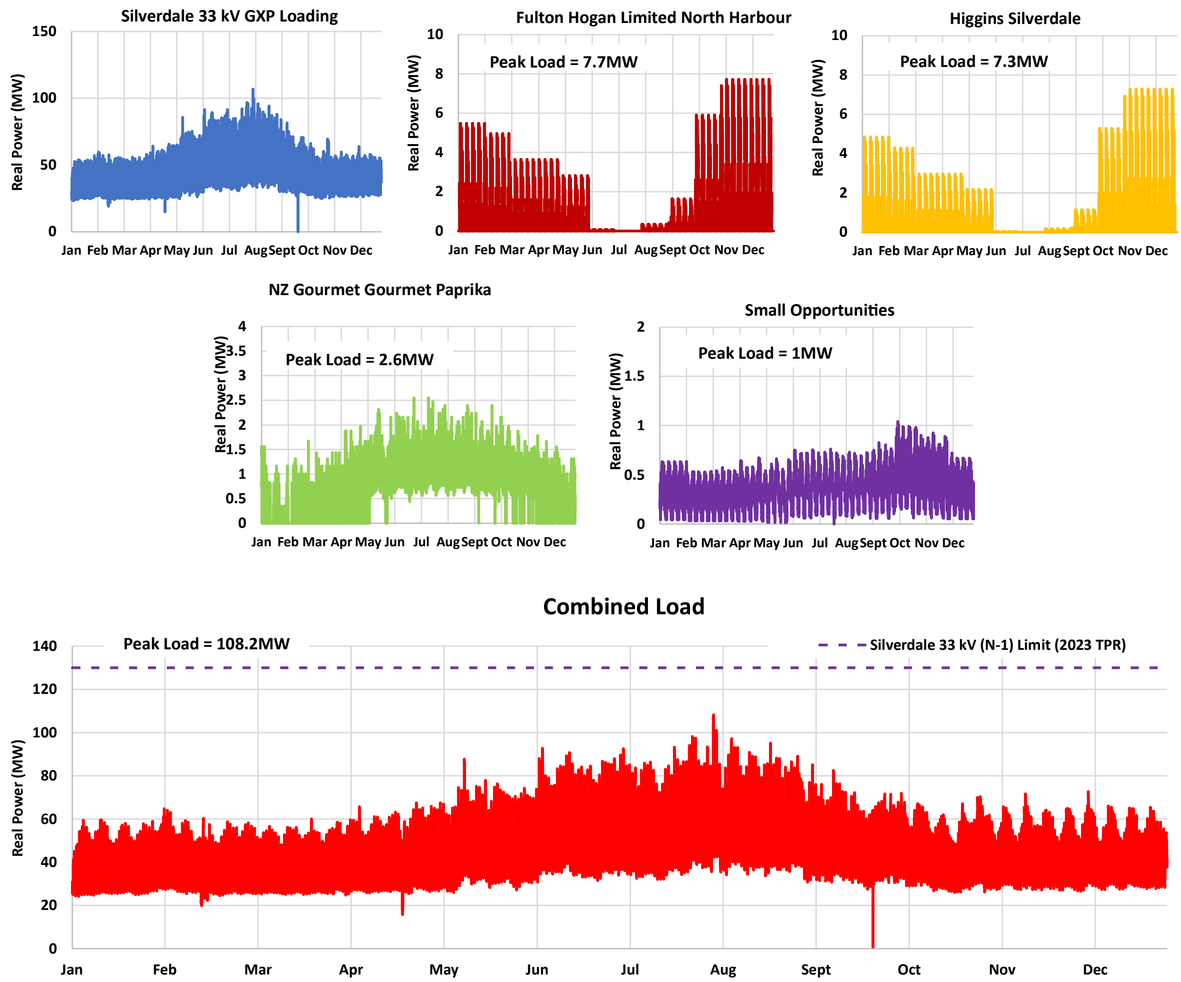


Figure 146. Loading Profiles: Silverdale 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.19 Takanini 33 kV GXP

The "Large" EECA Load Sites connecting to the Takanini 33 kV GXP are:

- Fonterra Brands Limited Takanini (7.05 MW)
- Griffins Papakura (3.28 MW)
- Mainfeeds Ltd Manurewa (1.98 MW)
- Ottogi NZ Ltd Takanini (1.83 MW)
- CORE Timber Services Papakura (1.21 MW)

The "Small" EECA Load Sites connecting to the Takanini 33 kV GXP are (refer to Sections 8.19.7 and 8.19.9):

- Tegel Takanini Feedmill (0.93 MW)
- Health New Zealand Manukau Super Clinic (0.42 MW)
- Auckland Council Manurewa Pool and Leisure Centre (0.26 MW)
- Clevedon Valley Buffalo Company (0.25 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

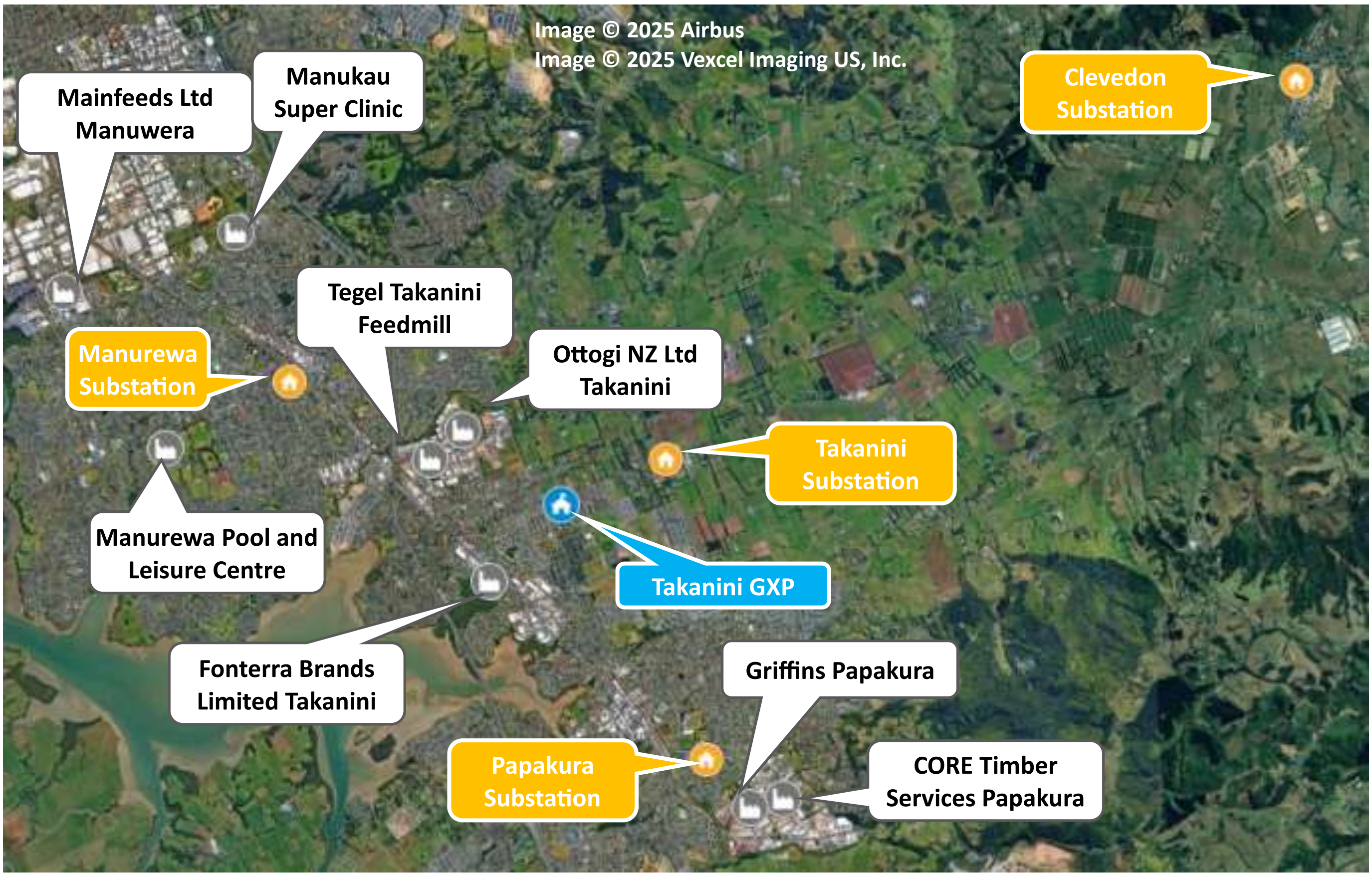


Figure 147. Takanini 33 kV GXP: EECA Load Sites vs local substations (southern snippet).

Figure 148. Takanini 33 kV GXP: EECA Load Sites vs local substations (northern snippet).

8.19.1 Takanini 33 kV GXP upgrade

Takanini 33 kV GXP presently has 48 MVA of spare (N-1) capacity and 168 MVA of spare (N) capacity, according to the transformer ratings. The connecting load sites are not expected to exceed the spare (N-1) capacity of the GXP (see Section 8.19.10). Therefore, no further upgrades are expected at Takanini 33 kV GXP.

8.19.2 Fonterra Brands Limited Takanini

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	7.05	Takanini 33 kV

Figure 149. Fonterra Brands Limited Takanini geographic location in relation to the surrounding zone substations.

8.19.2.1 Existing electrical supply to the Plant

Fonterra Brands Limited Takanini is presently supplied by Vector's Papakura zone substation. The site is supplied by a 11 kV feeder which is fully underground cables. The zone substation connects directly to the GXP through two subtransmission circuits at 33 kV, rated to 21.78 MVA each.

The site is located approximately 3.4 km away from Papakura zone substation. The zone substation is located in turn approximately 3.7 km from Takanini GXP.

There is currently a maximum loading of 30 MVA on Papakura zone substation, with 10 MVA of spare (N) capacity and no spare (N-1) capacity. Takanini 33 kV GXP presently has 48 MVA of spare (N-1) capacity and 168 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Papakura substation have ~-8.22 MVA of spare (N-1) capacity, and ~13.56 MVA of spare (N) capacity.

8.19.2.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation and the subtransmission circuits which supply it have adequate (N) but not (N-1) capacity.

For an (N-1) security supply, it is expected that the transformers at Papakura zone substation may need to be replaced. Additionally, a third 33 kV subtransmission circuit may be required between Papakura and Takanini GXP. The new circuit would likely be underground, and ~4.4 km long, matching the existing circuits.

Ergo notes that Vector has a project on-hold which was to install 2x 11 kV feeders to the Fonterra Takanini site. Ergo has assumed that this additional load would bring this project off-hold. No price is given in the AMP for this project, so Ergo has assumed that the project would include 2x 11 kV circuit breakers, and 2x underground cabling circuits (due to the urban/industrial topography), each ~4 km long. Included in this route would be a crossing over a train line, for which Ergo has allowed an additional 1 km of cabling in the costings.

8.19.2.3 Capital Cost Estimate

Table 102. Fonterra Brands Limited Takanini: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	2.00	$0.40
Distribution	Double underground 11kV cable (CBD)	5.00	$7.00
		TOTAL	**$7.40**

Table 103. Fonterra Brands Limited Takanini: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	33kV circuit breaker (ZSS)	2.00	$0.60
Subtransmission	Single underground 33kV cable	4.40	$8.80
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS)	2.00	$0.20
Distribution	Double underground 11kV cable (CBD)	5.00	$7.00
		TOTAL	**$21.40**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.19.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 24-36 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.19.3 Griffins Papakura

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	3.28	Takanini 33 kV

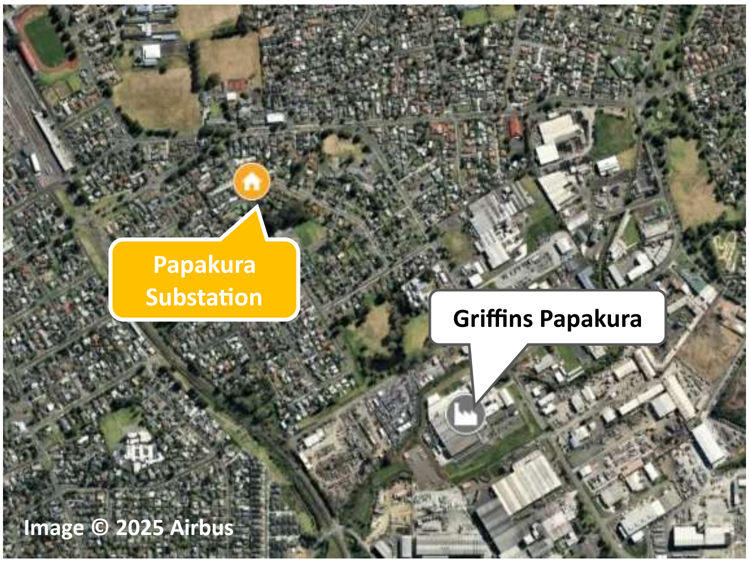


Figure 150. Griffins Papakura geographic location in relation to the surrounding zone substations.

8.19.3.1 Existing electrical supply to the Plant

Griffins Papakura is presently supplied by Vector's Papakura zone substation. The site is supplied by a 11 kV feeder which consists of a mixture of overhead lines and underground cables. The zone substation connects directly to the GXP through two subtransmission circuits at 33 kV, rated to 21.78 MVA each.

The site is located approximately 0.8 km away from Papakura zone substation. The zone substation is located in turn approximately 3.7 km from Takanini GXP.

There is currently a maximum loading of 30 MVA on Papakura zone substation, with 10 MVA of spare (N) capacity and no spare (N-1) capacity. Takanini 33 kV GXP presently has 48 MVA of spare (N-1) capacity and 168 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Papakura substation have ~-8.22 MVA of spare (N-1) capacity, and ~13.56 MVA of spare (N) capacity.

8.19.3.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation and the subtransmission circuits which supply it have adequate (N) but not (N-1) capacity.

For an (N-1) security supply, it is expected that the transformers at Papakura zone substation may need to be replaced. Additionally, a third 33 kV subtransmission circuit may be required between Papakura and Takanini GXP. The new circuit would likely be underground, and ~4.4 km long, matching the existing circuits.

The existing 11 kV feeder has approximately 2.8 MVA of spare capacity. Therefore, due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 1.1 km.

8.19.3.3 Capital Cost Estimate

Table 104. Griffins Papakura: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.10	$0.88
		TOTAL	**$1.08**

Table 105. Griffins Papakura: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	33kV circuit breaker (ZSS)	1.00	$0.30
Subtransmission	Single underground 33kV cable	4.43	$8.86
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.10	$0.88
		TOTAL	**$14.84**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.19.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 24-36 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.19.4 Mainfeeds Ltd Manurewa

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.98	Takanini 33 kV

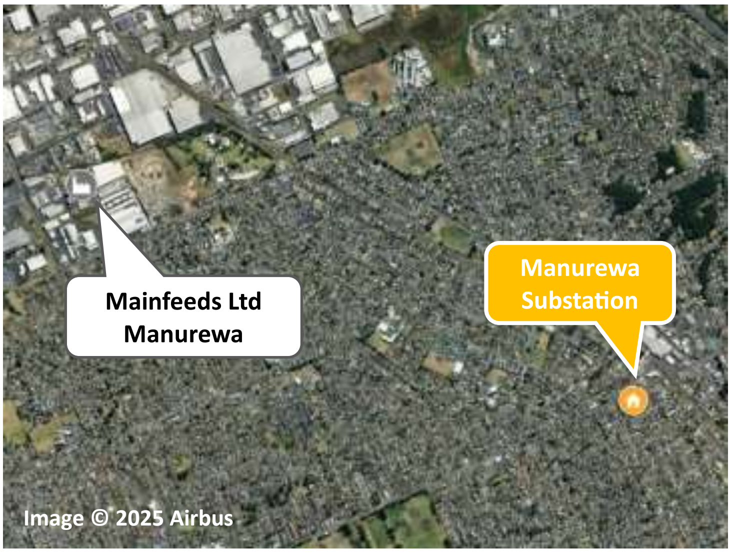


Figure 151. Mainfeeds Ltd Manurewa geographic location in relation to the surrounding zone substations.

8.19.4.1 Existing electrical supply to the Plant

Mainfeeds Ltd Manurewa is presently supplied by Vector's Manurewa zone substation. The site is supplied by a 11 kV feeder which is fully underground cable. The zone substation connects directly to the GXP through three subtransmission circuits at 33 kV, rated to 22.06 MVA each.

The site is located approximately 3.1 km away from Manurewa zone substation. The zone substation is located in turn approximately 3.7 km from Takanini GXP.

There is currently a maximum loading of 60.8 MVA on Manurewa zone substation, with -0.8 MVA of spare (N) capacity and no spare (N-1) capacity. Takanini 33 kV GXP presently has 48 MVA of spare (N-1) capacity and 168 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Manurewa substation have ~-16.68 MVA of spare (N-1) capacity, and ~5.38 MVA of spare (N) capacity.

8.19.4.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. However, the zone substation lacks (N) or (N-1) capacity. The subtransmission circuits which supply the zone substation have adequate (N) but not (N-1) capacity.

Ergo notes that Vector has an existing plan to install a new 11 kV feeder at Clendon, to relieve some loading on Manurewa substation. Given the high present loading of Manurewa, Ergo has considered that upgrades would still be required at Manurewa to provide the Load Site with an (N) or (N-1) security supply.

For an (N) security supply, it is expected that two of the existing transformers at Manurewa would need to be replaced. Similarly, it is taken that two of the existing subtransmission circuits between Manurewa substation and the GXP would be required. The replacement subtransmission circuits would be underground, and ~4.8 km long, matching the existing circuits.

For an (N-1) security supply, it is expected that all three transformers at Manurewa zone substation may need to be replaced, along with all three of the existing subtransmission circuits between Manurewa and the GXP. The replacement subtransmission circuits would be underground, and ~4.8 km long, matching the existing circuits.

The existing 11 kV feeder has approximately 3.9 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.19.4.3 Capital Cost Estimate

Table 106. Mainfeeds Ltd Manurewa: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Double underground 33kV cable	4.80	$6.72
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$19.00**

Table 107. Mainfeeds Ltd Manurewa: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Subtransmission	Triple underground 33 kV cable	4.80	$19.20
Subtransmission	Large supply transformer (ZSS)	3.00	$6.90
		TOTAL	**$26.10**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.19.4.4 Expected Timeframe

It is estimated to take 24-36 months for either an (N) or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.19.5 Ottogi NZ Ltd Takanini

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.83	Takanini 33 kV

Figure 152. Ottogi NZ Ltd Takanini geographic location in relation to the surrounding zone substations.

8.19.5.1 Existing electrical supply to the Plant

Ottogi NZ Ltd Takanini (may be known as Otoki) is presently supplied by Vector's Takanini zone substation. The site is supplied by a 11 kV feeder which consists of a mixture of overhead lines and underground cables. The zone substation connects directly to the GXP through two subtransmission circuits at 33 kV, rated to 26.86 MVA each.

The site is located approximately 2.6 km away from Takanini zone substation. The zone substation is located in turn approximately 1.4 km from Takanini GXP.

There is currently a maximum loading of 31.5 MVA on Takanini zone substation, with -1.5 MVA of spare (N) capacity and no spare (N-1) capacity. Takanini 33 kV GXP presently has 48 MVA of spare (N-1) capacity and 168 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Takanini substation have ~-4.64 MVA of spare (N-1) capacity, and ~22.22 MVA of spare (N) capacity.

8.19.5.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. However, the zone substation lacks (N) or (N-1) capacity. The subtransmission circuits which supply the zone substation have adequate (N) but not (N-1) capacity.

Ergo understands that Vector plan to upgrade the Takanini zone substation, by adding an additional transformer at the site, and accompanying subtransmission circuit. The planned upgrades have an estimated cost of $10.9M, and are planned to commission in 2026 (project has already commenced).

Ergo expects that this project would provide the substation with adequate (N) capacity, but potentially not (N-1), for this load; and that it would provide the existing subtransmission circuits with adequate (N-1) capacity for this load. Ergo expects that this Load Site may impact this plan, and so the costs for it are included in the costings for an (N) solution for this site.

For an (N-1) security supply, it is expected that the existing two transformers at Takanini zone substation may need to be replaced.

The existing 11 kV feeder has approximately -0.2 MVA of spare capacity. Therefore, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 3.4 km.

8.19.5.3 Capital Cost Estimate

Table 108. Ottogi NZ Ltd Takanini: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Takanini new TX and subtransmission circuit	1.00	$10.90
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	3.40	$2.72
		TOTAL	**$13.82**

Table 109. Ottogi NZ Ltd Takanini: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Takanini new TX and subtransmission circuit	1.00	$10.90
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	3.40	$2.72
		TOTAL	**$18.42**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.19.5.4 Expected Timeframe

It is estimated to take 24-36 months for either an (N) or an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.19.6 CORE Timber Services Papakura

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.21	Takanini 33 kV GXP

Figure 153. CORE Timber Services Papakura geographic location in relation to the surrounding zone substations

8.19.6.1 Existing electrical supply to the Plant

CORE Timber Services Papakura is presently supplied by Vector's Papakura zone substation. The site is currently supplied by an 11 kV feeder which is a mixture of underground cables and overhead lines. The zone substation connects directly to the GXP through two subtransmission circuits at 33 kV, rated to 21.78 MVA each.

The site is located approximately 1.1 km away from Papakura zone substation. The zone substation is located in turn approximately 3.7 km from Takanini 33 kV GXP.

There is currently a maximum loading of 30 MVA on Papakura zone substation, with 10 MVA of spare (N) capacity and no spare (N-1) capacity. Takanini 33 kV GXP presently has 48 MVA of spare (N-1) capacity and 168 MVA of spare (N) capacity.

The subtransmission circuits presently supplying the Papakura substation have ~-8.22 MVA of spare (N-1) capacity, and ~13.56 MVA of spare (N) capacity.

8.19.6.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation and the subtransmission circuits which supply it have adequate (N) but not (N-1) capacity.

For an (N-1) security supply, it is expected that the transformers at Papakura zone substation may need to be replaced. Additionally, a third 33 kV subtransmission circuit may be required between Papakura and Takanini GXP. The new circuit would likely be underground, and ~4.4 km long, matching the existing circuits.

The existing 11 kV feeder has approximately 7.7 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.19.6.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 110. CORE Timber Services Papakura: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	33kV circuit breaker (ZSS)	1.00	$0.30
Subtransmission	Single underground 33kV cable	4.43	$8.86
Subtransmission	Large supply transformer (ZSS)	2.00	$4.60
		TOTAL	**$13.76**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.19.6.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 24-36 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.19.7 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 111. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Expected Feeder Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Tegel Takanini Feedmill	Takanini	0.0	-1.5	-0.2	0.890909091	260
Health New Zealand Manukau Super Clinic	Manurewa	0.0	-0.8	1.1	0.423642424	130
Auckland Council Manurewa Pool and Leisure Centre	Manurewa	0.0	-0.8	2	0.264	130
Clevedon Valley Buffalo Company	Maraetai	4.2	19.2	6	0.245	130

*Ergo has checked the existing feeder of this site against the Vector capacity map, which indicated that the feeder has sufficient capacity for the additional load, contrary to the data shown above. Ergo has assumed that the data in the map is accurate.

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.19.8 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.19.8.1 Manurewa

Three of the loads on Takanini GXP are expected to connect to Manurewa zone substation. These loads are Mainfeeds Ltd Manurewa, Health New Zealand Manukau Super Clinic, and Auckland Council Manurewa Pool and Leisure Centre. The sum of peaks of these loads is 2.67 MW, which the zone substation does not have (N-1) capacity for.

However, two of the connecting sites are small loads and expected to have a minimal impact on the network. If Mainfeeds Ltd Manurewa connects, then the upgrades required for that site would be expected to be sufficient for all the connecting sites. Therefore, no further upgrades are expected at Manurewa.

8.19.8.2 Papakura

Three of the loads on Takanini GXP are expected to connect to Papakura zone substation. These loads are Fonterra Brands Limited Takanini, Griffins Papakura, and CORE Timber Services Papakura. The sum of peaks of these loads is 11.54 MW, which the zone substation does not have (N-1) capacity for.

However, one of the connecting sites is a small load and is expected to have a minimal impact on the network. If any of the large Load Sites connects, then the upgrades required for that site would be expected to be sufficient for all the connecting sites. Therefore, no further upgrades are expected at Papakura.

8.19.8.3 Takanini

Two of the loads on Takanini GXP are expected to connect to Takanini zone substation. These loads are Ottogi NZ Ltd Takanini and Tegel Takanini Feedmill. The sum of peaks of these loads is 2.72 MW, which the zone substation does not have (N-1) capacity for.

However, one of the connecting sites is a small load and is expected to have a minimal impact on the network. If Ottogi NZ Ltd Takanini connects, then the upgrades required for that site would be expected to be sufficient for all the connecting sites. Therefore, no further upgrades are expected at Takanini.

8.19.9 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Takanini 33 kV GXP gives a combined load of 2.03 MW. When the load shapes are combined, they result in the following load shape (Figure 154), with a maximum load of 1.44 MW, with a diversity factor of 0.71.

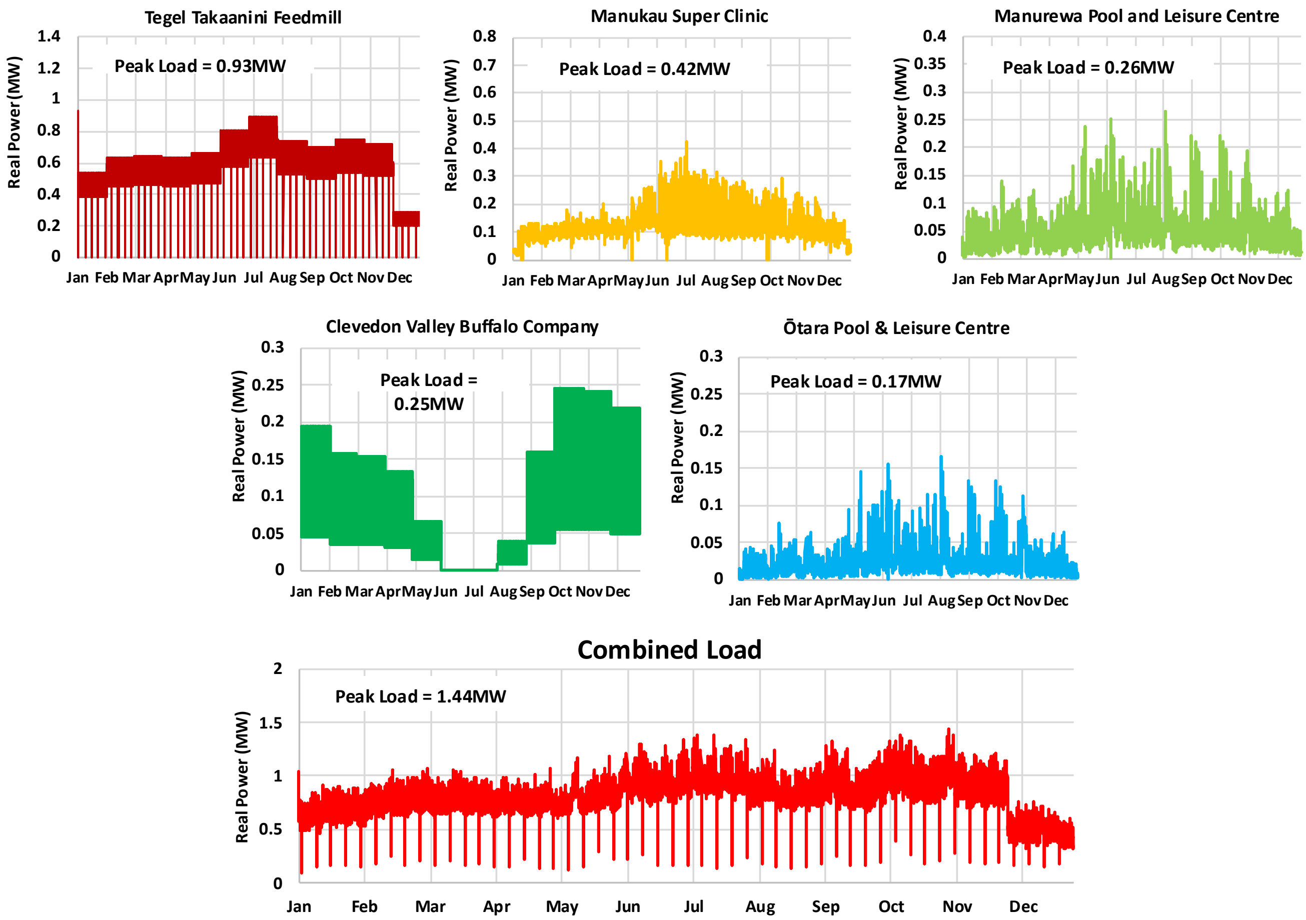


Figure 154. Loading Profiles: Takanini 33 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.19.10 Effect of all Load Sites Connecting to Takanini GXP

The following Figure 155 illustrates the Takanini 33 kV GXP load profile together with the load profiles of all the Load Sites within the Takanini 33 kV GXP region. Also shown in Figure 155 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Takanini 33 kV GXP would increase to 139.6 MW, an increase of 8.0 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 148.4 MW there is a diversity factor of 0.94 between the loads.
- Based on Ergo's analysis, the Takanini 33 kV GXP's (N-1) limit is not expected to be exceeded.

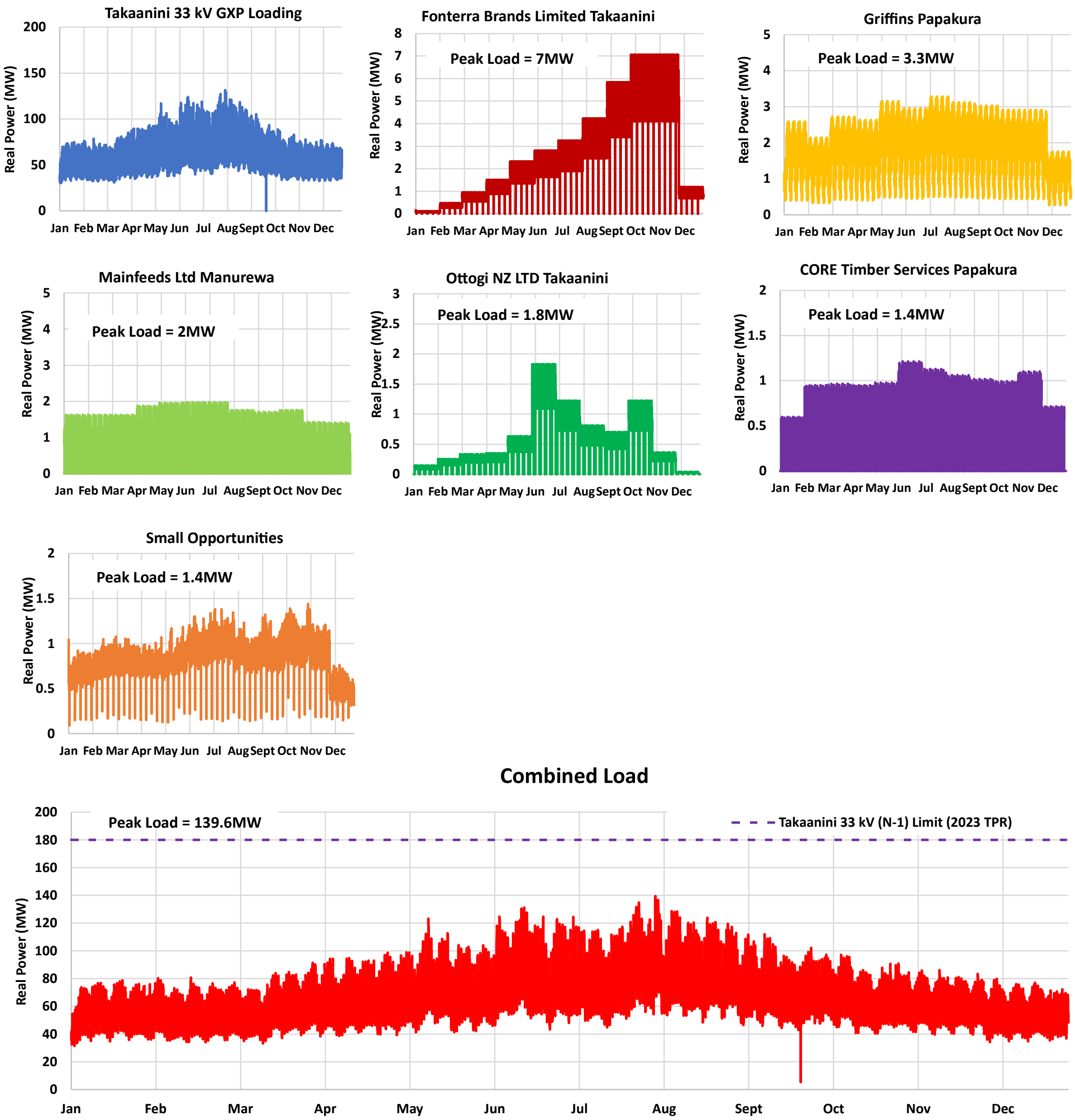


Figure 155. Loading Profiles: Takanini 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.20 Wairau Road 33 kV/Albany 110 kV GXP

The "Large" EECA Load Sites connecting to the Wairau Road 33 kV/Albany 110 kV GXP are:

- New Zealand Sugar Company Limited Auckland (12.49 MW)
- Health New Zealand North Shore Hospital (1.3 MW)

The "Small" EECA Load Sites connecting to the Wairau Road 33 kV/Albany 110 kV GXP are (refer to Sections 8.20.3.1 and 8.20.6):

- NZ Defence Force Devonport (0.85 MW)
- Auckland University of Technology North Campus (0.39 MW)
- Ministry of Education Northcote College (0.38 MW)
- Ministry of Education Birkenhead College (0.28 MW)
- Auckland Council Birkenhead Pool and Leisure Centre (0.22 MW)
- Auckland Council Takapuna Pool and Leisure Centre (0.11 MW)

The geographic locations of the Load Sites are shown on the following maps in relation to the local transmission and distribution substations.

Figure 156. Wairau Road 33 kV/Albany 110 kV GXP: EECA Load Sites vs local substations.

8.20.1 Wairau Road 33 kV/Albany 110 kV GXP Upgrade

Wairau Road 33 kV/Albany 110 kV GXP presently has -4 MVA of spare (N-1) capacity and 167 MVA of spare (N) capacity, based on the transformer ratings.

Ergo understands that Vector and Transpower are discussing options to improve the supply capacity at the Wairau/Albany GXP. The preferred option at present is to install another transformer at the Wairau Road site, with an expected cost of $7.5M from Transpower, and $0.6M of enabling works required from Vector. Ergo has included these costs in the individual Load Site assessments below.

8.20.2 New Zealand Sugar Company Limited Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	12.49	Wairau Road 33 kV/Albany 110 kV

Figure 157. New Zealand Sugar Company Limited Auckland geographic location in relation to the surrounding zone substations.

8.20.2.1 Existing Electrical Supply to the Plant

New Zealand Sugar Company Limited Auckland is presently supplied by Vector's Highbury zone substation. The site is supplied by an 11 kV feeder that consists of a mixture of overhead lines and underground cables. Highbury substation is supplied by a tee off a 33 kV ring consisting of Birkdale and Highbury substations. Birkdale substation also supplies Balmain Rd substation via a 33 kV circuit. The ring includes 2x 33 kV circuits between Birkdale and the GXP (rated at 34.07 MVA and 38.07 MVA), 1x 33 kV circuit between Birkdale and the tee point (rated at 26.64 MVA), and 1x 33 kV circuit between the tee point and the GXP (rated at 33.38 MVA). The 1x circuit from the tee point to Highbury is rated to 29.15 MVA.

The site is located approximately 1.12 km away from Highbury zone substation. The zone substation is located in turn approximately 4 km from Wairau Road 33 kV/Albany 110 kV GXP.

There is currently a maximum loading of 12.7 MVA on Highbury zone substation, with -0.2 MVA of spare (N) capacity and no spare (N-1) capacity (the site is a single transformer site at present). Wairau Road 33 kV/Albany 110 kV GXP presently has -4 MVA of spare (N-1) capacity and 167 MVA of spare (N) capacity.

With present loadings on Birkdale and Balmain Rd of 22.4 MVA and 9.5 MVA, respectively, the 33 kV subtransmission ring has ~16.74 MVA of spare (N-1) capacity, and ~55.44 MVA of spare (N) capacity. Ergo notes that as this is a ring (meshed) network, there will be inaccuracies in this calculation, as full load flow calculations are required to determine the load sharing between each of the subtransmission circuits and therefore their spare capacity.

The single subtransmission circuit between the tee and the zone substation has ~16.45 MVA of spare (N) capacity, and no (N-1) capacity, as it is a single circuit.

8.20.2.2 Supply Option(s) for New Load

EECA requested that Ergo carry out analysis for this load in two stages – the first stage being 6.00 MW, the second being 6.49 MW, for a total of 12.49 MW. Analysis assumes that the development of the project continues along either the (N) or (N-1) path, and does not mix the two.

For both stages of the load, the GXP has adequate (N) capacity, but insufficient (N-1) capacity for the new load. The zone substation does not have adequate spare (N) or (N-1) capacity. The subtransmission ring supplying the zone substation has sufficient (N) and (N-1) capacity. The subtransmission circuit from the ring (tee) to the zone substation has sufficient (N) capacity, but no (N-1) capacity.

<u>Stage 1 – 6.00 MW</u>

Ergo understands that Vector and Transpower are discussing options to improve the supply capacity at the Wairau/Albany GXP. The preferred option at present is to install another transformer at the Wairau Road site, with an expected cost of $7.5M from Transpower, and $1.1M of enabling works required from Vector. Ergo expects that this Load Site may impact this plan, and so the costs for it are included in the costings for an (N-1) solution for this site.

Ergo understands that Vector is planning to upgrade the Highbury zone substation by adding a second transformer and second 33 kV subtransmission cable. The upgrades are expected to occur in 2025-26 and cost $6.1M. Ergo expects that this Load Site may impact this plan, and so the costs for it are included in the costings for an (N-1) solution for this site.

For either an (N) or an (N-1) solution, it is assumed that the existing transformer at Highbury would need to be replaced.

For either an (N) or an (N-1) solution, it is expected that 1x new 11 kV feeder would be installed, between the zone substation and the Load Site. This new feeder would be rated to 33 kV (as future-proofing for stage 2), but operated at 11 kV at this stage. Due to the urban topography of the area, this would likely be underground cabling, at a length of ~2.0 km.

<u>Stage 2 – 6.49 MW</u>

The addition of the Stage 2 load brings the total additional load to 12.49 MW.

For either an (N) or an (N-1) solution, the 11 kV feeder installed in Stage 1 would be upgraded to 33 kV, with the site now taking supply at 33 kV.

For an (N-1) solution, a second 33 kV feeder from the zone substation to the Load Site would be required. This feeder would be identical to the one installed during Stage 1.

8.20.2.3 Capital Cost Estimate

Table 112. New Zealand Sugar Company Limited Auckland: Indicative capital cost to supply the Load Site with (N) subtransmission supply security (stage 1).

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Medium supply transformer (ZSS)	1.00	$1.90
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 33kV cable	2.00	$4.00
		TOTAL	**$6.10**

Table 113. New Zealand Sugar Company Limited Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security (stage 1).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Wairau Road GXP 2nd transformer	1.00	$7.50
Subtransmission	Wairau Road GXP 2nd transformer enabling works	1.00	$1.10
Subtransmission	Medium supply transformer (ZSS)	1.00	$1.90
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 33kV cable	2.00	$4.00
		TOTAL	**$14.70**

Table 114. New Zealand Sugar Company Limited Auckland: Indicative capital cost to supply the Load Site with (N) subtransmission supply security (stage 2).

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	33kV circuit breaker (ZSS)	1.00	$0.30
		TOTAL	**$0.30**

Table 115. New Zealand Sugar Company Limited Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security (stage 1).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N-1)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Single underground 33kV cable	2.00	$4.00
Distribution	33kV circuit breaker (ZSS)	2.00	$0.60
		TOTAL	**$4.60**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.20.2.4 Expected Timeframe

The following timeframes are expected to plan, design, procure, construct, and commission the works.

- For an (N) security solution:
    - Stage 1: 24-36 months
    - Stage 2: 12-24 months
- For an (N-1) security solution:
    - Stage 1: 36-48 months
    - Stage 2: 12-24 months

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.20.3 Health New Zealand North Shore Hospital

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.30	Wairau Road 33 kV/Albany 110 kV

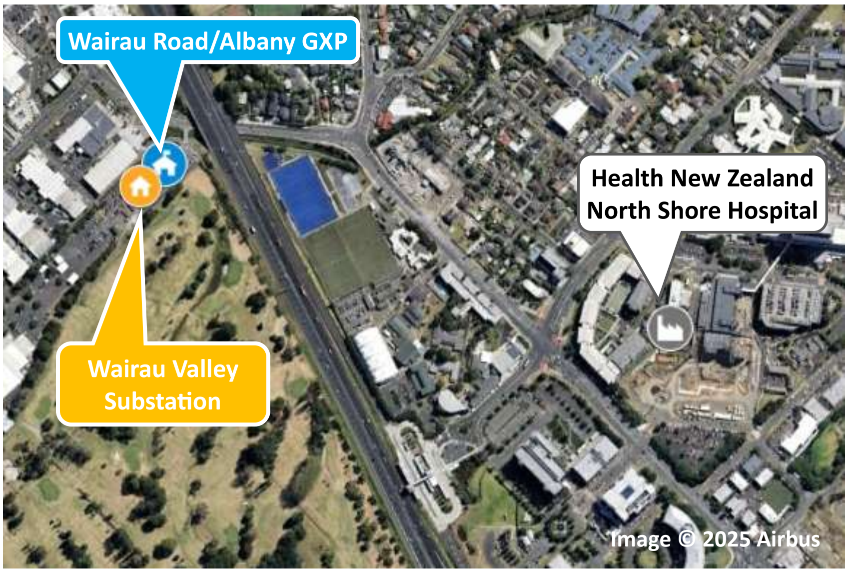


Figure 158. Health New Zealand North Shore Hospital geographic location in relation to the surrounding zone substations.

8.20.3.1 Existing Electrical Supply to the Plant

Health New Zealand North Shore Hospital is presently supplied by Vector's Wairau Valley zone substation. The site is supplied by two 11 kV feeders that are fully underground. Wairau Valley zone substation is adjacent to the GXP.

The site is located approximately 0.9 km away from Wairau Valley zone substation. The zone substation is located adjacent to Wairau Road 33 kV/Albany 110 kV GXP.

There is currently a maximum loading of 18.5 MVA on Wairau Valley zone substation, with 6.5 MVA of spare (N) capacity and no spare (N-1) capacity. Wairau Road 33 kV/Albany 110 kV GXP presently has -4 MVA of spare (N-1) capacity and 167 MVA of spare (N) capacity.

8.20.3.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity. However, they both lack adequate spare (N-1) capacity. As the zone substation is adjacent to the GXP, it is assumed that any subtransmission circuits between the GXP and the zone substation have adequate spare (N) and (N-1) capacity.

Ergo understands that Vector and Transpower are discussing options to improve the supply capacity at the Wairau/Albany GXP. The preferred option at present is to install another transformer at the Wairau Road site, with an expected cost of $7.5M from Transpower, and $1.1M of enabling works required from

Vector. Ergo expects that this Load Site may impact this plan, and so the costs for it are included in the costings for an (N-1) solution for this site.

Vector is also planning to upgrade both transformers at the Wairau Road zone substation, which has an expected cost of $6.5M. Ergo expects that this Load Site may impact this plan, and so the costs for it are included in the costings for an (N-1) solution for this site.

The existing 11 kV feeder has approximately 4.2 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.20.3.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 116. Health New Zealand North Shore Hospital: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Wairau Road GXP 2nd transformer	1.00	$7.50
Subtransmission	Wairau Road GXP 2nd transformer enabling works	1.00	$1.10
Distribution	Wairau 33/11kV TX upgrade T1+T2	1.00	$6.50
		TOTAL	**$15.10**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.20.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection, or 36-48 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.20.4 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 117. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
NZ Defence Force Devonport	Ngātaringa Bay	N/A	3.1	0.1	0.8455	260
Auckland University of Technology North Campus	Hillcrest	0.0	1.9	4.8	0.3882375	130
Ministry of Education Northcote College*	Highbury	0.0	-0.2	-0.3	0.37825	130
Ministry of Education Birkenhead College*	Birkdale	0.0	17.6	-2.9	0.278125	130
Auckland Council Birkenhead Pool and Leisure Centre	Highbury	0.0	-0.2	3.4	0.22	130
Auckland Council Takapuna Pool and Leisure Centre	Hillcrest	0.0	1.9	2.3	0.11	80

*Ergo has checked the existing feeders of these sites against the Vector capacity map, which indicated that the feeders have sufficient capacity for the additional load, contrary to the data shown above. Ergo has assumed that the data in the map is accurate.

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.20.5 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.20.5.1 Highbury

Three of the loads on Wairau Road GXP are expected to connect to Highbury zone substation. These loads are New Zealand Sugar Company Limited Auckland, Ministry of Education Northcote College, and Auckland Council Birkenhead Pool and Leisure Centre. The sum of peaks of these loads is 13.09 MW, which the zone substation does not have (N-1) capacity for.

However, two of the connecting sites are small loads and expected to have a minimal impact on the network. If New Zealand Sugar Company Limited Auckland connects, then the upgrades required for that site would be expected to be sufficient for all the connecting sites. Therefore, no further upgrades are expected at Highbury.

8.20.5.2 Hillcrest

Two of the loads on Wairau Road GXP are expected to connect to Hillcrest zone substation. These loads are Auckland University of Technology North Campus are Auckland Council Takapuna Pool and Leisure Centre. The sum of peaks of these loads is 0.5 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that this substation is already operating under (N) security during peak loading.

The connecting sites are small loads and expected to have a minimal impact on the network. Therefore, no further upgrades are expected at Hillcrest.

8.20.6 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Takanini 33 kV GXP gives a combined load of 2.11 MW. When the load shapes are combined, they result in the following load shape (Figure 159), with a maximum load of 1.77 MW, with a diversity factor of 0.84.

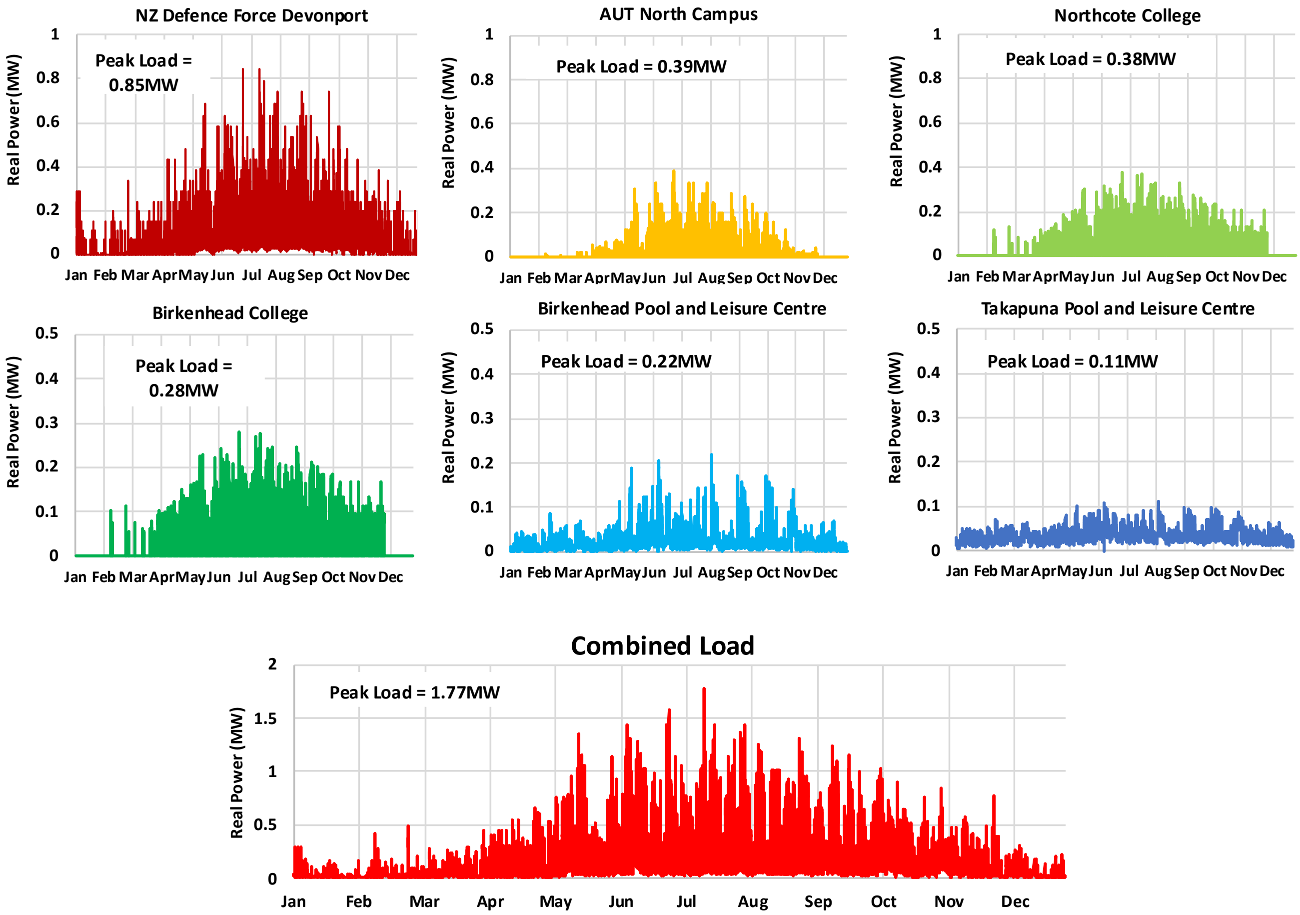


Figure 159. Loading Profiles: Wairau Road 33 kV/Albany 110 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.20.7 Effect of all Load Sites Connecting to Wairau Road 33 kV/Albany 110 kV GXP

The following Figure 160 illustrates the Wairau Road 33 kV/Albany 110 kV GXP load profile together with the load profiles of all the Load Sites within the Wairau Road 33 kV/Albany 110 kV GXP region. Also shown in Figure 160 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Wairau Road 33 kV/Albany 110 kV GXP would increase to 139.6 MW, an increase of 8.0 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 147.2 MW there is a diversity factor of 0.95 between the loads.
- Based on Ergo's analysis, the Wairau Road 33 kV/Albany 110 kV GXP's (N-1) limit is expected to be exceeded. Mitigations for this are discussed in Section 8.20.1.

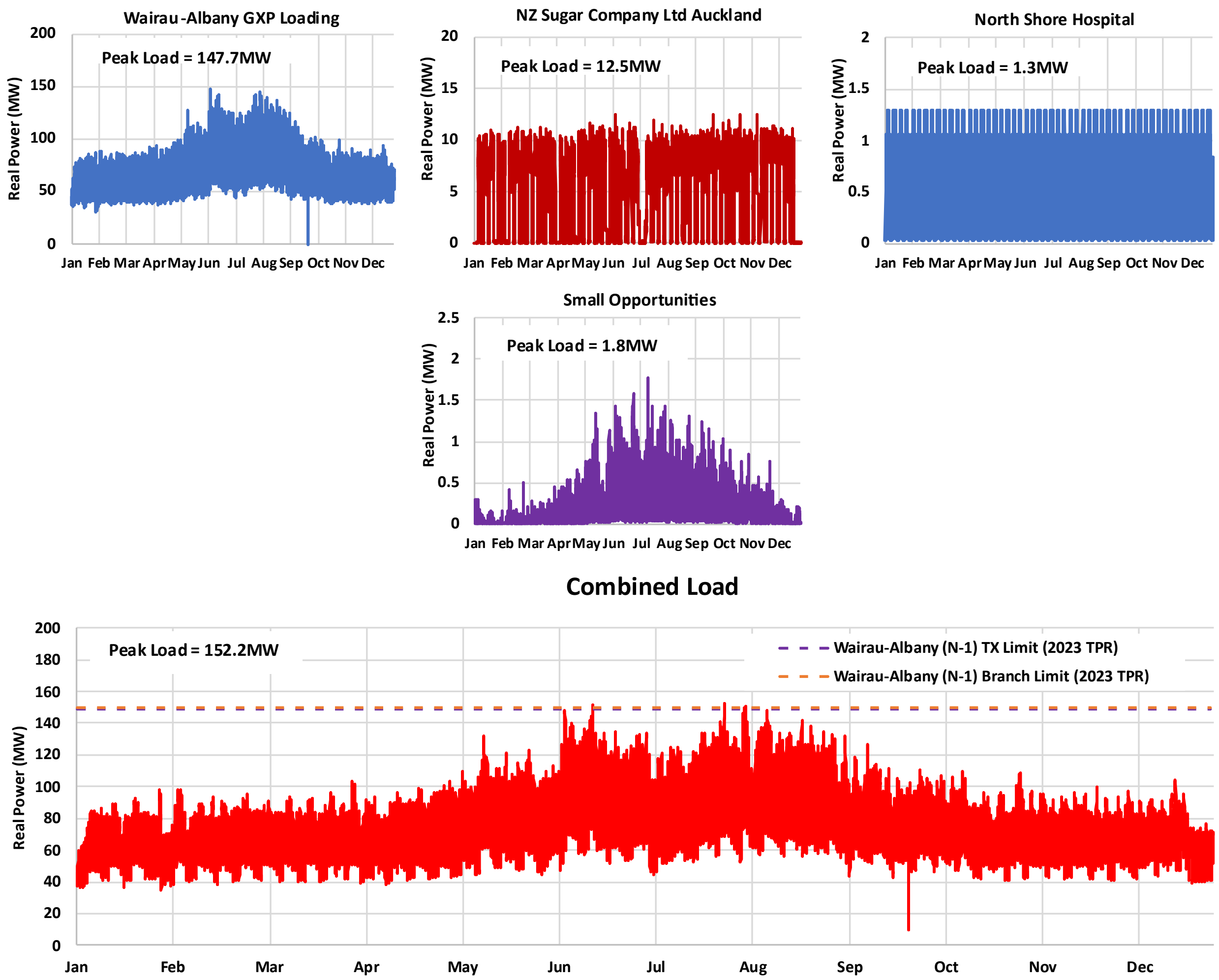


Figure 160. Loading Profiles: Wairau Road 33 kV/Albany 110 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.21 Wellsford 33 kV GXP

The "Large" EECA Load Site connecting to the Wellsford GXP is:

- Southern Paprika Limited Warkworth (4.30 MW)

No "small" Load Sites are connecting to the Wellsford 33 kV GXP.

The geographic location of the Load Site is shown on the following map in relation to the local transmission and distribution substations.

Figure 161. Wellsford 33 kV GXP: EECA Load Sites vs local substations.

8.21.1 Wellsford GXP Upgrade

Given there is only a single load connected to the Wellsford GXP, an outline of expected upgrades to the GXP can be found in Section 8.21.2.

8.21.2 Southern Paprika Limited Warkworth

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	4.30	Wellsford 33 kV

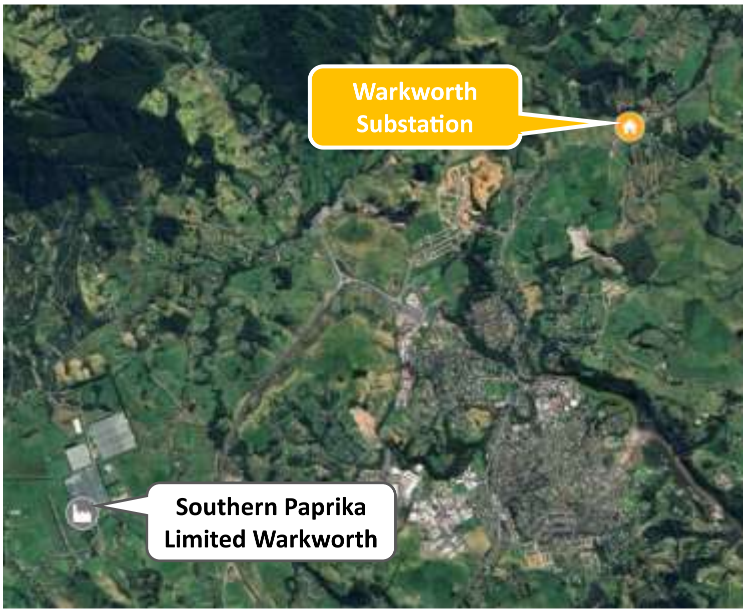


Figure 162. Southern Paprika Limited Warkworth geographic location in relation to the surrounding zone substations.

8.21.2.1 Existing Electrical Supply to the Plant

Southern Paprika Limited Warkworth is presently supplied by Vector's Warkworth zone substation. The site is currently supplied by a 11 kV feeder which consists of a mixture of underground cable and overhead line. Warkworth substation is supplied from Wellsford GXP by 2x 33 kV subtransmission circuits (one of which is routed via Wellsford substation, but does not supply the load of Wellsford substation), rated to 32.75 MVA and 41.41 MVA respectively. Warkworth substation also supplies the downstream Snells Beach and Big Ōmaha substations via a single 33 kV circuit to each.

The site is located approximately 6.3 km from Warkworth zone substation. The zone substation is located approximately 17.5 km from Wellsford GXP.

There is currently a maximum loading of 15.8 MVA on Warkworth zone substation, with 6.7 MVA of spare (N) capacity and no spare (N-1) capacity. Wellsford 33 kV GXP presently has -1 MVA of spare (N-1) capacity and -1 MVA of spare (N) capacity.

With maximum loadings on Snells Beach and Big Ōmaha substations of 7.1 MVA and 7.5 MVA, respectively, the subtransmission circuits supplying Warkworth have ~2.35 MVA of spare (N-1) capacity, and ~43.76 MVA of spare (N) capacity.

8.21.2.2 Supply Option(s) for New Load

The zone substation and the subtransmission circuits suppling the zone substation all have adequate (N) but not (N-1) capacity for this load. The GXP does not have adequate (N) or (N-1) capacity for this load.

Ergo understands that Vector has formally engaged with Transpower to investigate increasing the supply capacity at the GXP. For an (N) solution, it is assumed that a special protection scheme (SPS) would be installed on the GXP transformers, to avoid overloading one unit when the other is offline (indicative cost $0.5M). For an (N-1) solution, replacements of the GXP transformers are required (indicative cost $14M).

Ergo understands that Vector have recently completed work to improve the subtransmission circuit capacity to Warkworth, and plan to reduce the loading on the Warkworth transformers by installing new substations at Sandspit and Warkworth South, at costs of $15M (completion in 2025) and $15.7M (completion in 2029), respectively. It is taken that these upgrades would collectively be sufficient to provide this Load Site with (N-1) subtransmission security, however, the Load Site connecting may influence the upgrades, so the upgrade costs are included in the costings for this site, for an (N-1) security supply.

Due to the size of the load, for either an (N) or an (N-1) secure supply, it is assumed that a new 11 kV feeder would be installed to the site from Warkworth substation. Ergo has assumed that the feeder would be cabled from the substation through to the Warkworth town (~5.6 km), and then overhead lines through the rural area nearer the load (~2.7 km). Ergo notes that the feeder would require a crossing of a motorway/state highway, for which Ergo has allowed an additional 1 km of cabling in the costings.

8.21.2.3 Capital Cost Estimate

Table 118. Southern Paprika Limited Warkworth: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single overhead 11kV line	2.70	$1.35
Distribution	Single underground 11kV cable	6.60	$3.96
		TOTAL	**$6.01**

Table 119. Southern Paprika Limited Warkworth: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Wellsford GXP TX replacements	1.00	$14.00
Subtransmission	New Sandspit Zone Substation	1.00	$15.00
Subtransmission	New Warkworth South Zone Substation	1.00	$15.70
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single overhead 11kV line	2.70	$1.35
Distribution	Single underground 11kV cable	6.60	$3.96
		TOTAL	**$50.21**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.21.2.4 Expected Timeframe

It is estimated to take 24-36 months for an (N) security connection, or 36-48 months for an (N-1) security connection, to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.21.3 Effect of all Load Sites Connecting to Wellsford 33 kV GXP

The following Figure 163 illustrates the Wellsford 33 kV GXP load profile together with the load profiles of all the Load Sites within the Wellsford 33 kV GXP region. Also shown in Figure 163 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Wellsford 33 kV GXP would increase to 42.1 MW, an increase of 2.90 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 43.5 MW there is a diversity factor of 0.97 between the loads.
- Based on Ergo's analysis, the Wellsford 33 kV GXP's (N-1) limit is expected to be exceeded. Mitigations for this are discussed in Section 8.21.2.

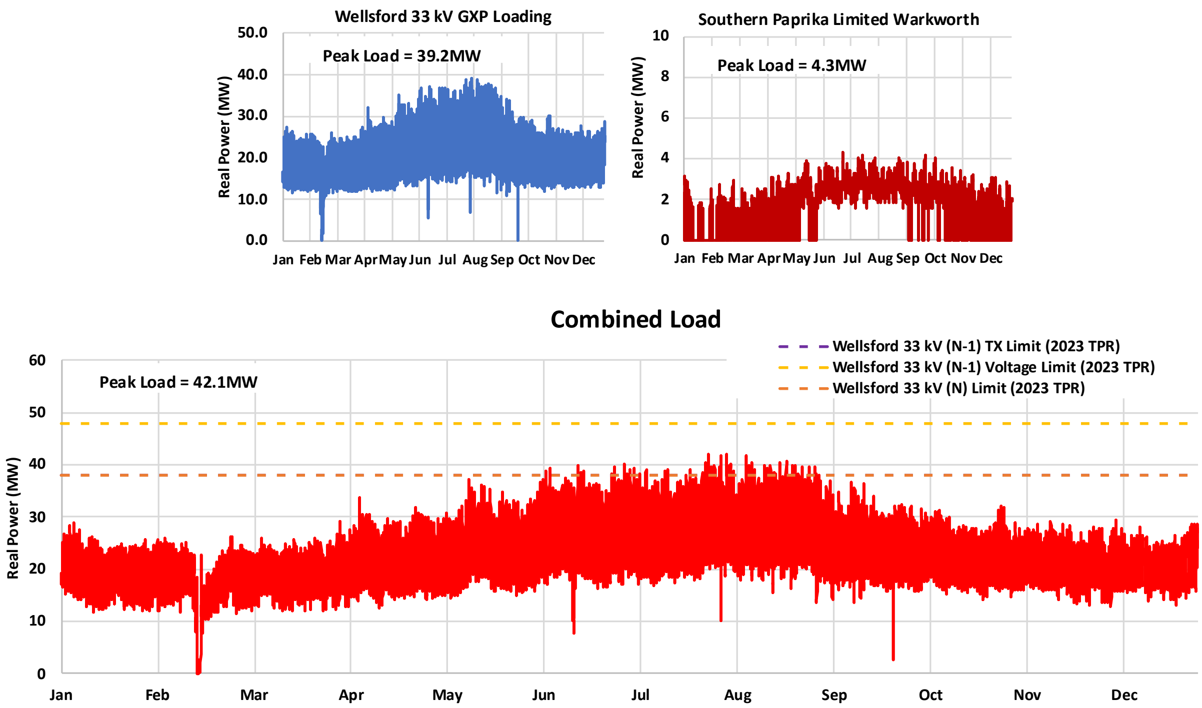


Figure 163. Loading Profiles: Wellsford 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.22 Wiri 33 kV GXP

The “Large” EECA Load Sites connecting to the Wiri 33 kV GXP include:

- Griffins Wiri (13.12 MW)
- Bluebird Foods (10.10 MW)
- COLAS Limited (previously known as ASCO Asphalt) (7.52 MW)
- Frucor Suntory New Zealand Limited Plunket Avenue (1.00-5.00 MW)
- Visy Board (2.76 MW)
- Frucor Suntory New Zealand Limited Orb Avenue (2.44 MW)
- Bremworth Auckland (1.90 MW)
- Visy Beverage Can (1.73 MW)
- Salters Cartage Ltd (1.68 MW)
- Nestle Cambria Park (1.63 MW)
- Godfrey Hirst NZ Limited Auckland (1.48 MW)
- Ann Funeral Home & Onsite Cremations Auckland (1.15 MW)
- George Weston Foods Wiri (1.09 MW)

The “Small” Load Sites connecting to the Wiri 33 kV GXP include (refer to Sections 8.22.15 and 8.22.17):

- Koppers Performance Chemicals NZ Wiri (0.84 MW)
- Department of Corrections Auckland Regional Women's Correctional Facility (0.69 MW)
- Hellers Ltd Auckland (0.54 MW)
- Westfield Manukau City (0.33 MW)
- AFFCO New Zealand Limited Wiri (0.16 MW)

The geographic locations of the Load Sites are shown on the following map in relation to the local transmission and distribution substations.

Figure 164. Wiri 33 kV GXP: EECA Load Sites vs local substations.

8.22.1 Wiri 33 kV GXP Upgrade

Wiri GXP presently has 14 MVA of spare (N-1) capacity and 14 MVA of spare (N) capacity, according to the transformer ratings.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service. As such, for all load sites, it is assumed that the GXP has (N) capacity only (but not (N-1) capacity).

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. The costs associated with this have been included against each of the large Load Sites assessed below. Should more than one Load Site connect, there could be an opportunity for cost sharing regarding the required GXP upgrades for an (N-1) supply.

8.22.2 Griffins Wiri

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	13.12	Wiri 33 kV

Figure 165. Griffins Wiri geographic location in relation to the surrounding zone substations

8.22.2.1 Existing Electrical Supply

Griffins Wiri is presently supplied by Vector's Wiri zone substation. The site is supplied via a 11 kV underground feeder. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits rated to 23.55 MVA each.

This site is located approximately 0.86 km from Wiri zone substation. Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.2.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity to supply the load. However, the zone substation and GXP both lack adequate spare (N-1) capacity.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N-1) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

For an (N-1) connection, addition of a fourth subtransmission circuit between Wiri GXP and Wiri substation would be required. The circuit is assumed to be underground, due to the urban topography, and would be ~2.4 km, matching the existing circuits.

Due to the size of the load, it is expected that the Load Site would be supplied at 33 kV. This would require installation of 1x new 33 kV feeder and an associated circuit breaker at the Wiri substation. Due to the urban/industrial topography of the area, this would likely be underground cabling, at a length of 0.9 km. Given the likely route of the new feeder, it is possible the cost could be shared between Griffins Wiri and Bluebird Foods.

8.22.2.3 Capital Cost Estimate

Table 120. Griffins Wiri: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	33kV circuit breaker (ZSS)	1.00	$0.30
Distribution	Single underground 33kV cable	0.90	$1.80
		TOTAL	$2.10

Table 121. Griffins Wiri: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Subtransmission	Single underground 33kV cable	2.40	$4.80
Subtransmission	33kV circuit breaker (ZSS)	2.00	$0.60
Distribution	33kV circuit breaker (ZSS)	1.00	$0.30
Distribution	Single underground 33kV cable	0.90	$1.80
		TOTAL	$15.00

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.2.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.3 Bluebird Foods

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	10.10	Wiri 33 kV

Figure 166. Bluebird Foods geographic location in relation to the surrounding zone substations

8.22.3.1 Existing Electrical Supply

Bluebird Foods is presently supplied by Vector's Wiri zone substation. The site is supplied via a 11 kV underground feeder. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 0.2 km from Wiri zone substation. In turn, Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.3.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity to supply the load. However, the zone substation and GXP both lack adequate spare (N-1) capacity.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

For an (N-1) connection, an additional fourth subtransmission circuit between Wiri GXP and Wiri substation would be required. The circuit is assumed to be underground, due to the urban topography, and would be ~2.4 km, matching the existing circuits.

Due to the size of the load, it is expected that the Load Site would be supplied at 33 kV. This would require installation of 1x new 33 kV feeder and an associated circuit breaker at the Wiri substation. Due to the urban/industrial topography of the area, this would likely be underground cabling, at a length of 0.2 km. Given the likely route of the new feeder, it is possible the cost could be shared between Bluebird Foods and Griffins Wiri.

8.22.3.3 Capital Cost Estimate

Table 122. Bluebird Foods: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	33kV circuit breaker (ZSS)	1.00	$0.30
Distribution	Single underground 33kV cable	0.10	$0.20
		TOTAL	**$0.50**

Table 123. Bluebird Foods: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Subtransmission	Single underground 33kV cable	2.40	$4.80
Subtransmission	33kV circuit breaker (ZSS)	2.00	$0.60
Distribution	33kV circuit breaker (ZSS)	1.00	$0.30
Distribution	Single underground 33kV cable	0.10	$0.20
		TOTAL	**$13.40**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.3.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.4 COLAS Limited

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	7.52	Wiri 33 kV

Figure 167. COLAS Limited geographic location in relation to the surrounding zone substations

8.22.4.1 Existing Electrical Supply

COLAS Limited is presently supplied by Vector's Wiri zone substation. The site is supplied via an 11 kV underground feeder. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 2.1 km from Wiri zone substation. In turn, Wiri zone substation is approximately 3.6 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.4.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity. However, the zone substation and GXP lack adequate spare (N-1) capacity.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

Due to the location of this substation, it is assumed that the load could connect to the new West Wiri substation, rather than the Wiri substation. As the West Wiri substation is new, it is assumed that it, and the circuits supplying it, have (N-1) capacity for this load.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 2.1 km.

8.22.4.3 Capital Cost Estimate

Table 124. COLAS Limited: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment		Number and Capital Cost ($M)
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	2.00	$1.60
		TOTAL	**$1.80**

Table 125. COLAS Limited: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment		Number and Capital Cost ($M)
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Distribution	11kV circuit breaker (ZSS)	1.00	$0.10
Distribution	Single underground 11kV cable (CBD)	2.00	$1.60
		TOTAL	**$9.20**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.4.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.5 Frucor Suntory New Zealand Limited Plunket Avenue

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.0-5.0	Wiri 33 kV

Figure 168. Frucor Suntory New Zealand Limited Plunket Avenue geographic location in relation to the surrounding zone substations

8.22.5.1 Existing Electrical Supply

Frucor Suntory New Zealand Limited Plunket Avenue is presently supplied by Vector's Wiri zone substation. The site is supplied via an 11kV feeder which is an underground cable. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 1.0 km from Wiri zone substation. In turn, Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.5.2 Supply Option(s) for New Load

Frucor Suntory New Zealand has advised EECA that the site is undergoing regarding the scale of decarbonisation of the site's heat pumps and steam boiler system. As such, the analysis has been divided into investment stages between the load sizes of 1.0 and 5.0 MVA. Each stage is considered separately rather than sequentially.

Option 1: 1-2 MW (Ergo assumed 1.5 MW)

The first option would provide the site with heat pumps only.

The GXP, zone substation, and subtransmission circuits supplying the zone substation all have sufficient (N-1) capacity for this load.

The existing 11 kV feeder has approximately 4.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

Options 2 and 3: 3-5 or 4-5 MW

The second and third options would provide this site with an electric boiler, or supply both this site and the Orb Avenue Frucor site with electric boilers, respectively.

Ergo has taken a view that the upgrades required for both of these options would be the same.

The subtransmission circuits supplying the site have adequate (N) and (N-1) capacity for this load. The GXP and zone substation both have adequate (N), but not (N-1) capacity.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

While Ergo understands that the installation of the new West Wiri substation may have made more (N-1) capacity available at Wiri substation, Ergo has conservatively assumed that the transformers at Wiri substation would require replacements.

The existing 11 kV feeder has approximately 4.3 MVA of spare capacity. However, due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 1.0 km.

8.22.5.3 Capital Cost Estimate

Indicatively, for Option 1, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 126. Frucor Suntory New Zealand Limited Plunket Avenue (Option 2 or 3): Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.00	$0.80
		TOTAL	$1.00

Table 127. Frucor Suntory New Zealand Limited Plunket Avenue (Option 2 or 3): Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Subtransmission	Large supply transformer (ZSS)	3.00	$6.90
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.00	$0.80
		TOTAL	$15.40

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.5.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.6 Visy Board

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	2.76	Wiri 33 kV

Figure 169. Visy Board geographic location in relation to the surrounding zone substations

8.22.6.1 Existing Electrical Supply

Visy Board is presently supplied by Vector's Clendon zone substation. The site is supplied via an 11 kV underground feeder. Clendon Substation is in turn supplied from Wiri GXP by two underground 33 kV subtransmission circuits direct from the GXP, each rated to 29.27 MVA.

This site is located approximately 1.8 km from Clendon zone substation. In turn, Clendon zone substation is approximately 6.9 km from Wiri GXP.

There is currently a maximum loading of 20.6 MVA on Clendon zone substation, with 19.4 MVA of spare (N) capacity and no spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Clendon substation have ~8.67 MVA of spare (N-1) capacity, and ~37.94 MVA of spare (N) capacity.

8.22.6.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity, but lack (N-1) capacity. The subtransmission circuits have adequate spare (N) and (N-1) capacity for this load.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

Due to the location of this substation, it is assumed that the load could connect to the new West Wiri substation, rather than the Clendon substation. As the West Wiri substation is new, it is assumed that it, and the circuits supplying it, have (N-1) capacity for this load.

Due to the size of the load, 1x new 11 kV feeder and associated circuit breaker are assumed to be required. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 1.8 km.

Visy Board and Salters Cartage are located near each other, and both require new feeders to West Wiri. There may be an opportunity for cost sharing if the Load Sites were to share an 11 kV feeder.

8.22.6.3 Capital Cost Estimate

Table 128. Visy Board: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.80	$1.44
		TOTAL	$1.64

Table 129. Visy Board: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	1.80	$1.44
		TOTAL	**$9.14**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.6.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.7 Frucor Suntory New Zealand Limited Orb Avenue

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	2.44	Wiri 33 kV

Figure 170. Frucor Suntory New Zealand Limited Orb Avenue geographic location in relation to the surrounding zone substations

8.22.7.1 Existing Electrical Supply

Frucor Suntory New Zealand Limited Orb Avenue is presently supplied by Vector's Wiri zone substation. The site is supplied via an 11kV feeder which is an underground cable. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 1.0 km from Wiri zone substation. In turn, Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.7.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity, but lack (N-1) capacity. The subtransmission circuits suppling the zone substation have adequate (N) and (N-1) spare capacity for this load.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

While Ergo understands that the installation of the new West Wiri substation may have made more (N-1) capacity available at Wiri substation, Ergo has conservatively assumed that the transformers at Wiri substation would require replacements.

The existing 11 kV feeder has approximately 4.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.22.7.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500k.

Table 130. Frucor Suntory New Zealand Limited Orb Avenue: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	**Subtransmission => (N-1)**	**Distribution => (N)**	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Subtransmission	Large supply transformer (ZSS)	3.00	$6.90
		TOTAL	**$14.40**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.7.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.8 Bremworth Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.90	Wiri 33 kV

Figure 171. Bremworth Auckland geographic location in relation to the surrounding zone substations

8.22.8.1 Existing Electrical Supply

Bremworth Auckland is presently supplied by Vector's Manukau zone substation. The site is supplied via an 11 kV feeder consisting of a combination of overhead lines and underground cables. Manukau zone substation is in turn supplied from Wiri 33 kV GXP by three underground 33 kV subtransmission circuits direct from the GXP, each rated at 33.15 MVA.

This site is located approximately 2.2 km from Manukau zone substation. In turn, Manukau zone substation is approximately 0.1 km from Wiri GXP.

There is currently a maximum loading of 54.7 MVA on Manukau zone substation, with 21.5 MVA of spare (N) capacity and 7.3 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Manukau substation have ~11.6 MVA of spare (N-1) capacity, and ~44.75 MVA of spare (N) capacity.

8.22.8.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) and (N-1) capacity.

The zone substation and the subtransmission circuits supplying it have adequate (N) and (N-1) capacity for this load. The GXP has adequate (N) capacity, but not (N-1).

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

The existing 11 kV feeder has approximately 0.7 MVA of spare capacity. Due to the size of the load, the overhead line component of the feeder may need to be uprated. Due to the urban/industrial topography of the area, this would likely be an underground cable, at a length of 0.7 km.

8.22.8.3 Capital Cost Estimate

Table 131. Bremworth Auckland: Indicative capital cost to supply the Load Site with (N) subtransmission supply security.

Transmission => (N)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Single underground 11kV cable (CBD)	0.70	$0.56
		TOTAL	**$0.56**

Table 132. Bremworth Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Distribution	Single underground 11kV cable (CBD)	0.70	$0.56
		TOTAL	**$8.06**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.8.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.9 Visy Beverage Can

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.73	Wiri 33 kV

Figure 172. Visy Beverage Can geographic location in relation to the surrounding zone substations

8.22.9.1 Existing Electrical Supply

Visy Beverage Can is presently supplied by Vector's Wiri zone substation. The site is supplied via an 11 kV underground feeder. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 1.4 km from Wiri zone substation. In turn, Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.9.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity, but lack (N-1) capacity. The subtransmission circuits supplying the zone substation have adequate (N) and (N-1) capacity for the new load.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

While Ergo understands that the installation of the new West Wiri substation may have made more (N-1) capacity available at Wiri substation, Ergo has conservatively assumed that the transformers at Wiri substation would require replacements.

The existing 11 kV feeder has approximately 3.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.22.9.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 133. Visy Beverage Can: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	**Subtransmission => (N-1)**	**Distribution =>**	**(N)**
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Subtransmission	Large supply transformer (ZSS)	3.00	$6.90
		TOTAL	**$14.40**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.9.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.10 Salters Cartage Ltd

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.68	Wiri 33 kV

Figure 173. Salters Cartage Ltd geographic location in relation to the surrounding zone substations

8.22.10.1 Existing Electrical Supply

Salters Cartage Ltd is presently supplied by Vector's Wiri zone substation. The site is supplied via an 11 kV feeder which is an underground cable. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 2.0 km from Wiri zone substation. In turn, Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.10.2 Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N) capacity, but lack (N-1) capacity. The subtransmission circuits supplying the zone substation have adequate (N) and (N-1) capacity for the new load.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

Due to the location of this substation, it is assumed that the load could connect to the new West Wiri substation, rather than the Wiri substation. As the West Wiri substation is new, it is assumed that it, and the circuits supplying it, have (N-1) capacity for this load.

Ergo has assumed that a new 11 kV feeder may be installed from West Wiri substation to supply this load, which would be underground, due to the urban/industrial topography, and would be ~2.0 km long.

Visy Board and Salters Cartage are located near each other, and both require new feeders to West Wiri. There may be an opportunity for cost sharing if the Load Sites were to share an 11 kV feeder.

8.22.10.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 134. Salters Cartage Ltd: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single underground 11kV cable (CBD)	2.00	$1.60
		TOTAL	**$9.30**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.10.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.11 Nestle Cambria Park

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.63	Wiri 33 kV

Figure 174. Nestle Cambria Park geographic location in relation to the surrounding zone substations

8.22.11.1 Existing Electrical Supply

Nestle Cambria Park is presently supplied by Vector's West Wiri zone substation. The site is supplied via an 11 kV feeder which is an underground cable. West Wiri Zone Substation is in turn supplied from Wiri GXP by the two underground 33 kV subtransmission circuits which also supply Clendon substation.

This site is located approximately 0.46 km from West Wiri zone substation. In turn, West Wiri zone substation is approximately 3.2 km from Wiri GXP.

Ergo does not have visibility at present on the existing loading or capacity of West Wiri substation, but it is assumed that as it is a new site, that it has (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

With an existing loading on Clendon substation of 20.6 MVA, and assuming no loading on the West Wiri substation, the subtransmission circuits supplying Clendon and West Wiri substations have ~8.67 MVA of spare (N-1) capacity, and ~37.94 MVA of spare (N) capacity.

8.22.11.2 Supply Option(s) for New Load

The GXP has adequate spare (N) but not (N-1) capacity for this load. The zone substation and the circuits supplying it are assumed to have adequate (N) and (N-1) capacity for this load.

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

As the 11 kV feeder to the site is new (as is the zone substation), it is assumed that it has capacity for the new load. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.22.11.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 135. Nestle Cambria Park: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
		TOTAL	**$7.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.11.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.12 Godfrey Hirst NZ Limited Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.48	Wiri 33 kV

Figure 175. Godfrey Hirst NZ Limited Auckland geographic location in relation to the surrounding zone substations

8.22.12.1 Existing Electrical Supply

Godfrey Hirst NZ Limited Auckland is presently supplied by Vector's Wiri zone substation. The site is supplied via an 11kV feeder which is an underground cable. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 1.3 km from Wiri zone substation. In turn, Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.12.2 Supply Option(s) for New Load

The zone substation and the circuits supplying it have adequate (N) and (N-1) capacity for this load. The GXP has adequate (N) capacity, but not (N-1).

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

The existing 11 kV feeder has approximately 2.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.22.12.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 136. Godfrey Hirst NZ Limited Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
		TOTAL	**$7.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.12.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.13 Ann Funeral Home & Onsite Cremations Auckland

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.2	Wiri 33 kV

Figure 176. Ann Funeral Home & Onsite Cremations Auckland geographic location in relation to the surrounding zone substations

8.22.13.1 Existing Electrical Supply

Ann Funeral Home & Onsite Cremations Auckland is presently supplied by Vector's Wiri zone substation. The site is supplied via an 11kV feeder which is an underground cable. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 1.9 km from Wiri zone substation. In turn, Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.13.2 Supply Option(s) for New Load

The zone substation and the circuits supplying it have adequate (N) and (N-1) capacity for this load. The GXP has adequate (N) capacity, but not (N-1).

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

The existing 11 kV feeder has approximately 3.5 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.22.13.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 137. Ann Funeral Home & Onsite Cremations Auckland: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
		TOTAL	**$7.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.13.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.14 George Weston Foods Wiri

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	1.1	Wiri 33 kV

Figure 177. George Weston Foods Wiri geographic location in relation to the surrounding zone substations

8.22.14.1 Existing Electrical Supply

George Weston Foods Wiri is presently supplied by Vector's Wiri zone substation. The site is supplied via an 11kV feeder which is an underground cable. Wiri zone substation is in turn supplied from Wiri GXP by three underground 33 kV subtransmission circuits direct from the GXP, rated to 23.55 MVA each.

This site is located approximately 1.0 km from Wiri zone substation. In turn, Wiri zone substation is approximately 2.3 km from Wiri GXP.

There is currently a maximum loading of 38.5 MVA on Wiri zone substation, with 21.5 MVA of spare (N) capacity and 1.5 MVA of spare (N-1) capacity. As discussed in Section 8.22.1, it is assumed that Wiri GXP presently has no spare (N-1) capacity and 14 MVA of spare (N) capacity.

The subtransmission circuits supplying Wiri substation have ~8.6 MVA of spare (N-1) capacity, and ~32.15 MVA of spare (N) capacity.

8.22.14.2 Supply Option(s) for New Load

The zone substation and the circuits supplying it have adequate (N) and (N-1) capacity for this load. The GXP has adequate (N) capacity, but not (N-1).

Ergo notes that, according to the Transpower *Transmission Planning Report 2023*, a special protection scheme was required for the transformers at the Wiri GXP from 2023 – thus, it is assumed that a special protection scheme is already in place at Wiri GXP, which will manage loading under (N) conditions, should one transformer be out of service.

For an (N-1) security supply, upgrades are required at Wiri GXP. Ergo understands that Transpower is investigating the addition of a 110 kV bus at the GXP, and third transformer. These upgrades are assumed to be sufficient to provide the Load Site with (N-1) security.

The existing 11 kV feeder has approximately 1.3 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.22.14.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350k.

Table 138. George Weston Foods Wiri: Indicative capital cost to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
Transmission	110kV circuit breaker bay	5.00	$3.00
		TOTAL	**$7.50**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

8.22.14.4 Expected Timeframe

It is estimated to take 12-18 months for an (N) security connection or 36-48 months for an (N-1) security connection to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.22.15 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 139. Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network.

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Expected Feeder Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Koopers Performance Chemicals NZ Wiri	Wiri	1.5	21.5	3.5	0.84	260
Department of Corrections Auckland Regional Woman’s Correctional Facility	Clendon	0.0	19.4	2.8	0.66	200
Hellers Ltd Auckland	Wiri	1.5	21.5	2.8	0.54	200
Westfield Manukau City	Manukau	7.3	27.3	4.7	0.33	130
AFFCO New Zealand Limited Wiri	Wiri	1.5	21.5	5.3	0.16	80

Each Load Site is estimated to take 3-6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.22.16 Combined Load on Zone Substations

While individual Load Site assessments in the sections above focus on upgrades required if only one Load Site were to connect, this section details where multiple Load Sites are proposed to connect to the same zone substation and whether the proposed upgrades in the sections above are sufficient or if further upgrades are required.

It is noted that any costs provided in this section would be additional to those stated in the preceding sections assessing individual Load Sites.

8.22.16.1 Manukau

Two of the loads on Wiri 33 kV GXP are expected to connect to Manukau zone substation. The loads are Bremworth Auckland, and Westfield Manukau City. The sum of peaks of these loads is 2.23 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Manukau substation.

8.22.16.2 West Wiri

Four of the loads on Wiri 33 kV GXP are expected to connect to West Wiri zone substation. The loads are COLAS Limited, Visy Board, Salters Cartage Limited, and Nestle Cambria Park. The sum of peaks of these loads is 13.6 MW. Ergo has assumed that the substation, being new, has capacity for these loads.

8.22.16.3 Wiri

Eleven of the loads on Wiri 33 kV GXP are expected to connect to Wiri zone substation. The loads are Griffins Wiri (connecting at 33 kV), Bluebird Foods (connecting at 33 kV), Frucor Plunket Avenue, Frucor Orb Avenue, Visy Beverage Can, Godfrey Hirst, Ann Funeral Home, George Weston Foods, Koppers Performance Chemicals, Hellers Ltd Auckland, and AFFCO New Zealand Limited Wiri. The sum of peaks of these loads is 35.5 MW (23.22 MW of this would connect to the 33 kV bus), which the zone substation does not have (N-1) capacity for.

However, the upgrades specified for the individual Load Sites are expected to be adequate for all the loads connecting, and should multiple of the loads connect, there may be an opportunity to share the costs of the upgrades. The upgrades are the installation of a fourth subtransmission circuit between Wiri substation and Wiri 33 kV GXP, and replacement of the three existing transformers at Wiri with larger units.

8.22.17 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on Wiri 33 kV GXP gives a combined load of 2.55 MW. When the load shapes are combined, they result in the following load shape (Figure 178), with a maximum load of 1.54 MW, with a diversity factor of 0.61.

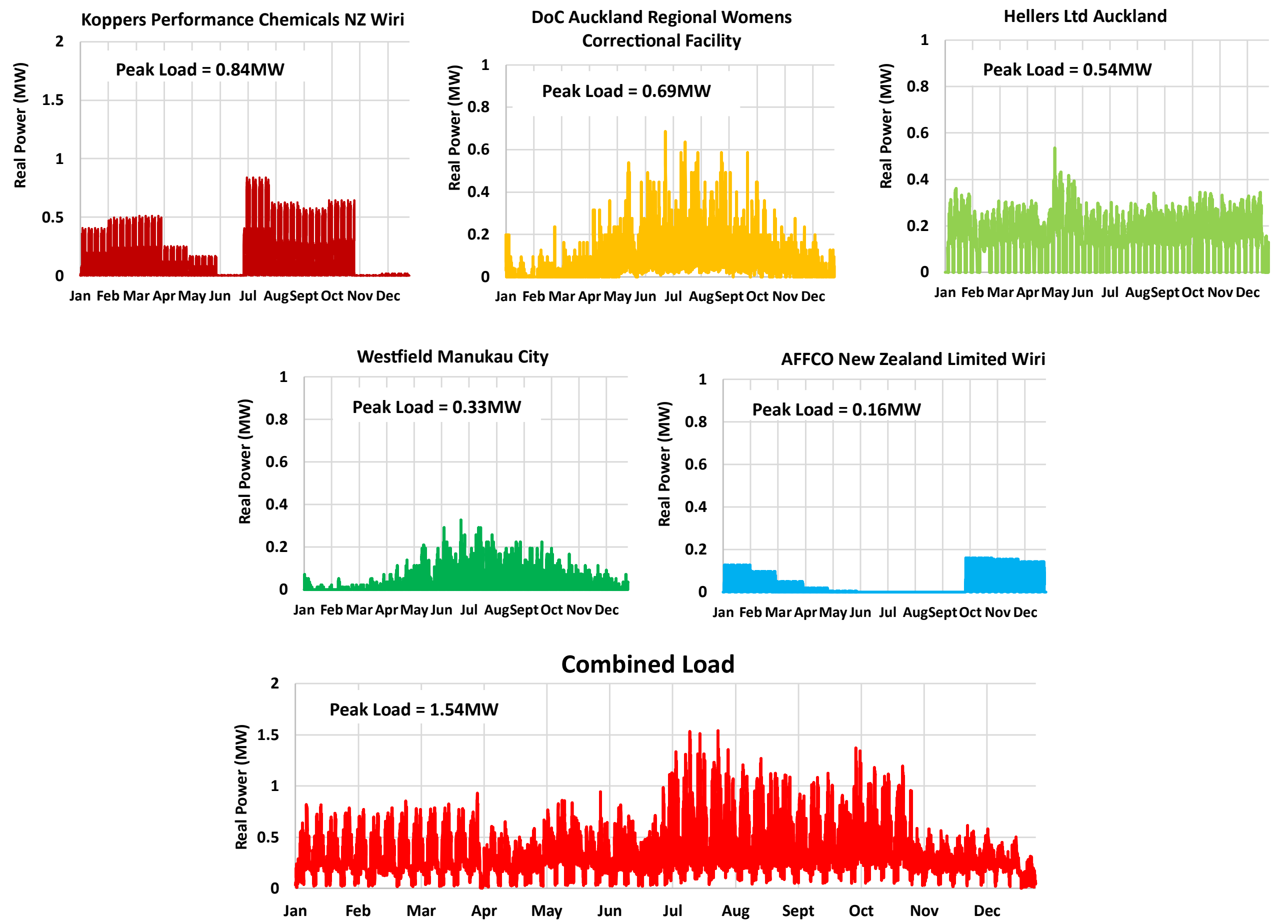


Figure 178. Loading Profiles: Wiri 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.22.18 Effect of all Load Sites Connecting to Wiri 33 kV GXP

The following Figure 179 illustrates the Wiri 33 kV GXP load profile together with the load profiles of all the Load Sites within the Wiri 33 kV GXP region. Also shown in Figure 179 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Wiri 33 kV GXP would increase to 118.7 MW, an increase of 26.65 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 143.0 MW there is a diversity factor of 0.83 between the loads.
- Based on Ergo's analysis, the Wiri 33 kV GXP's (N-1) limit is expected to be exceeded. Ergo has discussed mitigations for this in Section 8.22.1.

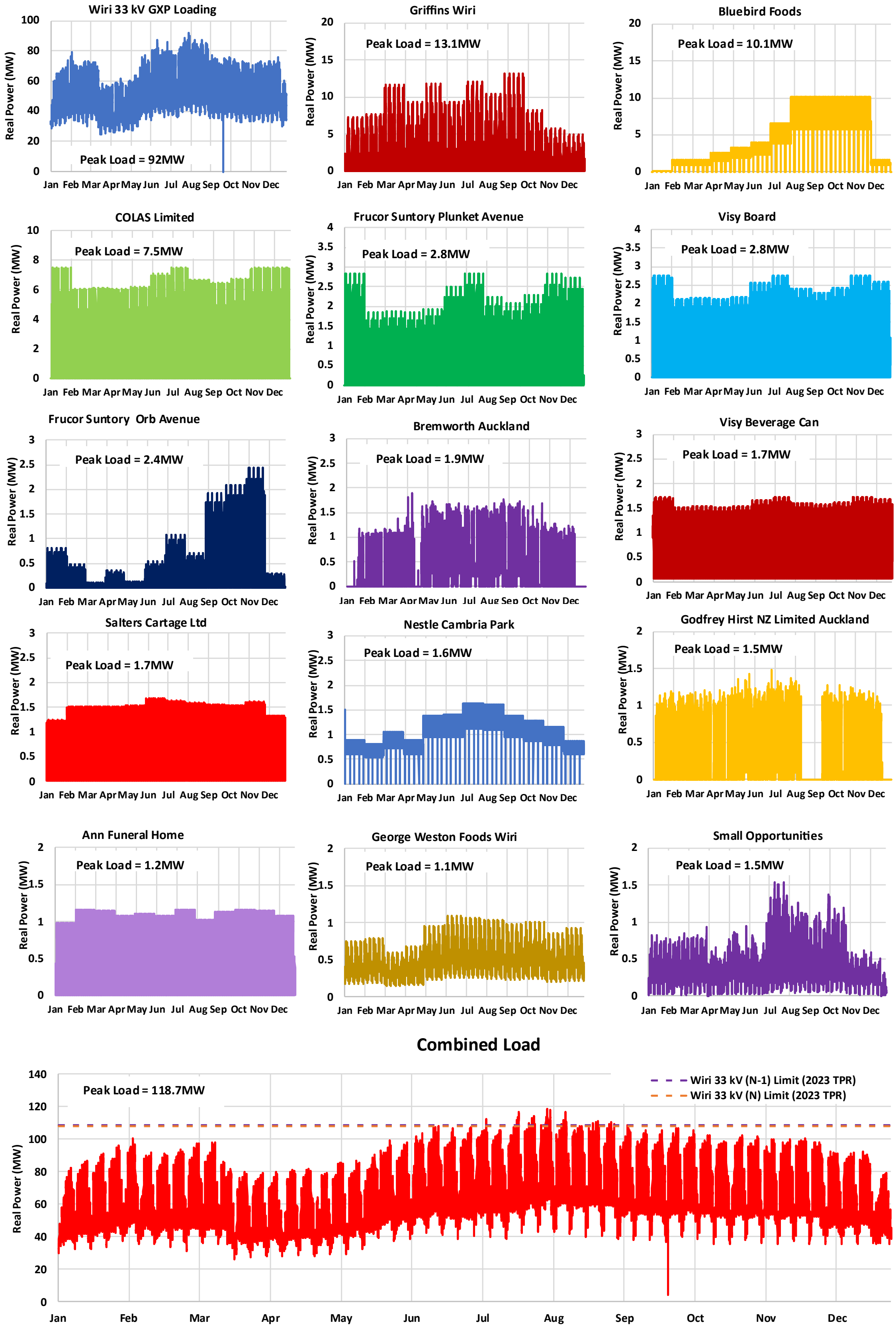


Figure 179. Loading Profiles: Wiri 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

9. Conclusions

9.1 Network Spare Capacity

The following Figure 180 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Auckland region. This figure is based on historical maximum loadings and Transpower's *Transmission Planning Report 2023* and does not incorporate any future load growth. It is important to note that these spare capacities do not include any voltage constraints or upstream transmission constraints (which would have to be confirmed by Transpower or the relevant EDB). As such, it is highly likely that those constraints would prevent all the spare capacity shown below being utilised.

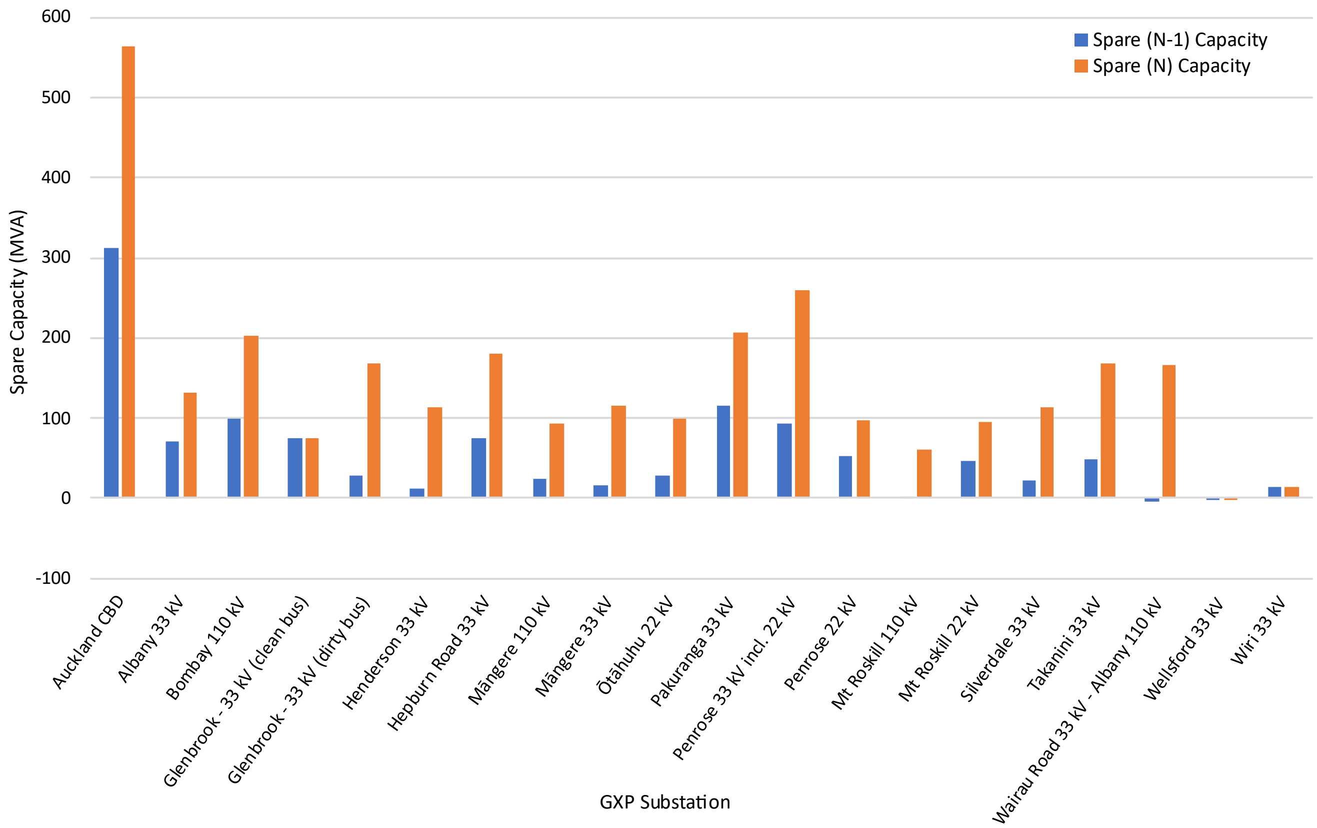


Figure 180. Summary: Approximate (N) and (N-1) spare capacity at GXP substations (not including the two Kiwirail supply GXPs, Penrose and Southdown 25 kV GXPs).

Figure 181 and Figure 182 illustrate the (N) and (N-1) spare capacity at the two EDB's (Counties Energy and Vector) zone substations in the Auckland region. These figures are based on the maximum loadings and the EDB 2023-2024 disclosures. Negative numbers for (N-1) capacity indicate zone substations where the load has exceeded the (N-1) capacity in the past.

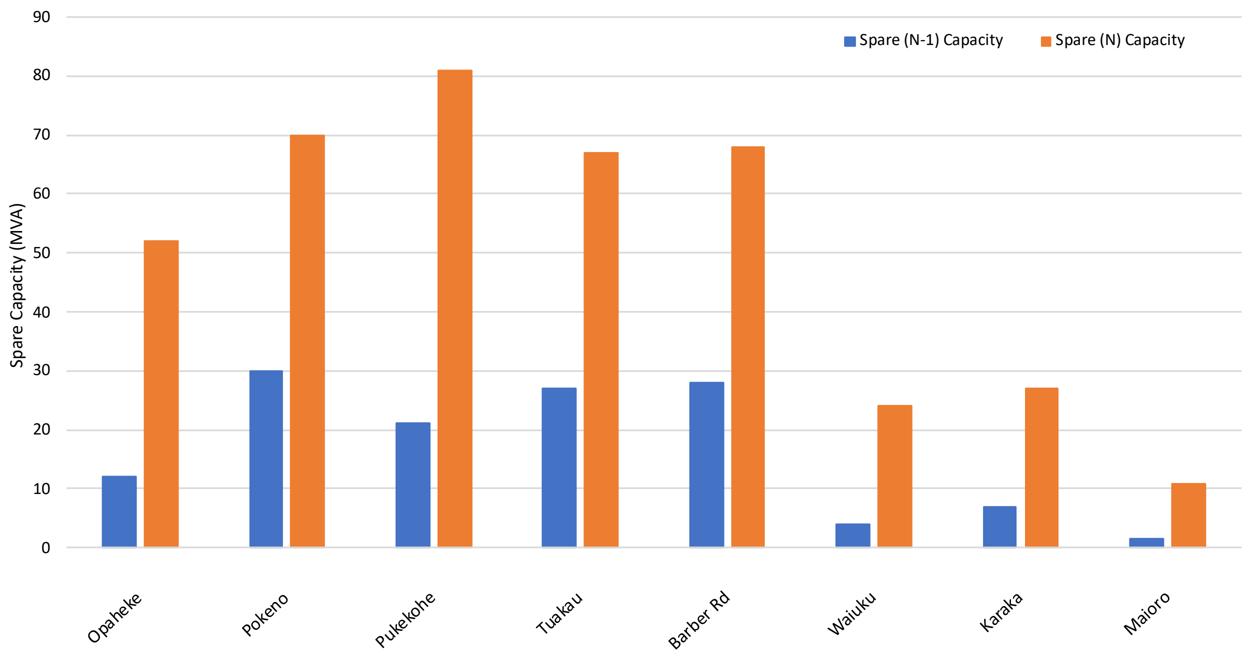


Figure 181. Summary: Approximate (N) and (N-1) spare capacity at Counties Energy's zone substations.

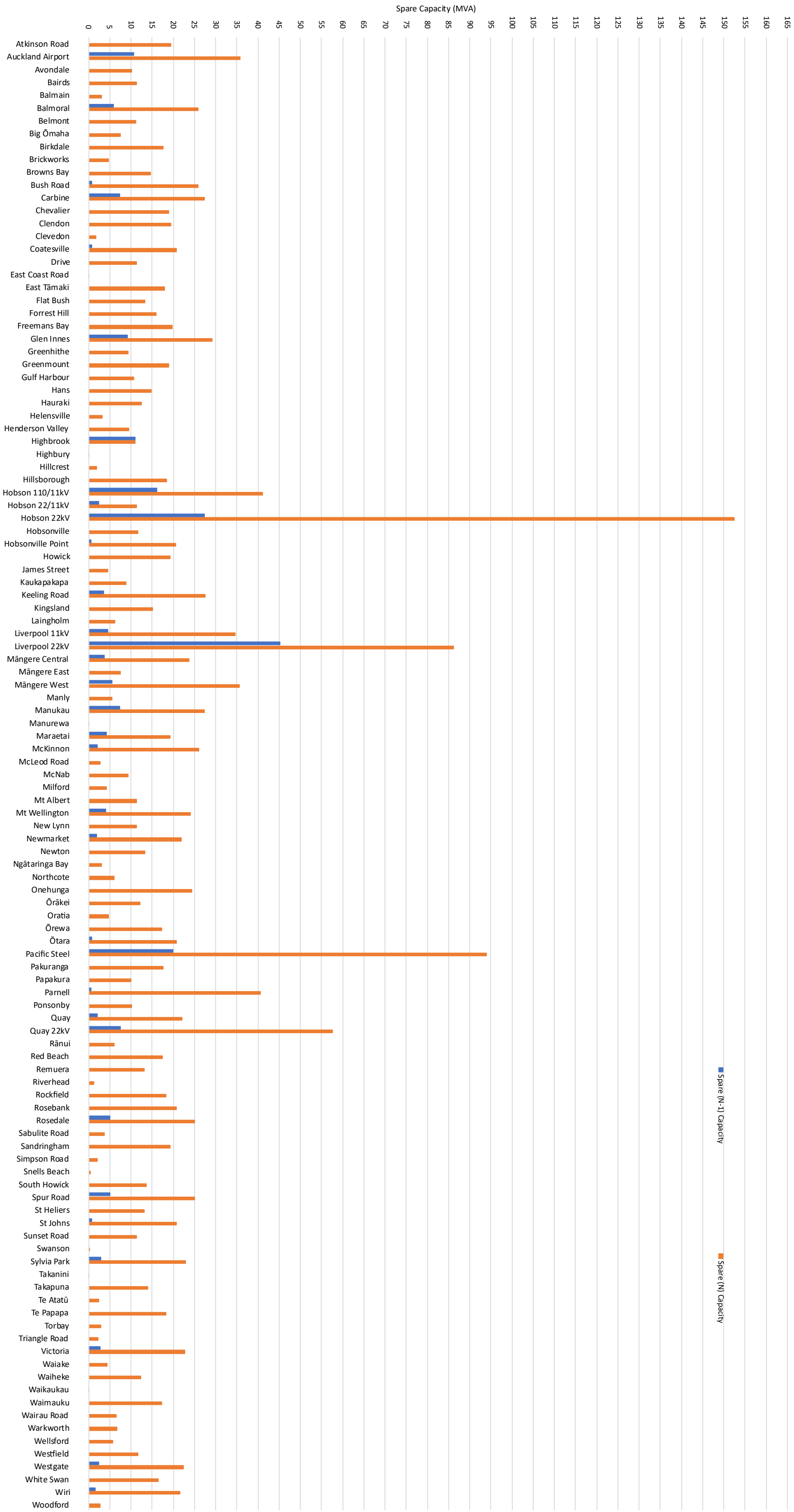


Figure 182. Summary: Approximate (N) and (N-1) spare capacity at Vector's zone substations.

9.2 Load Characteristics

The substation load characteristics are documented in detail in the main body of the report (and the supplementary document 24136-RPT-004) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Auckland CDB (Penrose 110 kV GXP and Hobson St 110 kV GXP)* – Supplies Auckland's CBD area. Load is predominantly commercial, with some residential. Load is reasonably flat throughout the year, with a slight winter peak, with typical daily morning and evening peaks, with load significantly dropping during weekends.
- *Albany 33 kV GXP* – Supplies a portion of Auckland's North Shore, including Albany North Harbour, Rosedale, Forrest Hill, Browns Bay, Torbay, and Greenhithe. Load is predominantly residential and commercial, with extensive growth occurring in both of these groups. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Bombay 110 kV GXP* – Supplies the eastern area of Counties' network, including Mangatāwhiri, Bombay, Pukekohe, and Tuakau. Load is predominantly residential with some industrial (dairy plants). Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Glenbrook 33 kV GXP (clean bus)* – Supplies the western area of Counties' network, including Glenbrook, Karaka, and Waiuku; as well as supplying a portion of the Glenbrook Steel Mill's load. Load is a mixture of residential, commercial, and industrial, with some agricultural. Load is peaky and relatively even through the year, appearing to be largely dominated by the Steel Mill load.
- *Glenbrook 33 kV GXP (dirty bus)* – Supplies the portion of the Glenbrook Steel Mill's load which has a lower power quality (this bus is kept separate from the clean bus to avoid exposing other loads to this power quality). Load is entirely industrial and is peaky and relatively even throughout the year.
- *Henderson 33 kV GXP* – Supplies a section of West Auckland, including Rānui, Swanson, Woodford, Hobsonville, Westgate, Te Atatu, Riverhead, and Simpson Rd. Load is predominantly residential and commercial, with extensive growth occurring in both of these groups. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Hepburn Rd 33 kV GXP* – Supplies a section of West Auckland, including Rosebank, Green Bay, Rānui, Oratia, Glendene, New Lynn, Titirangi, and Laingholm. Load is predominantly residential, with some commercial and industrial. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Māngere 110 kV GXP* – Supplies the PAC Steel industrial area, including some other industrial customers. Load is entirely industrial. Load is peaky throughout the year.
- *Māngere 33 kV GXP* – Supplies Māngere township and the surrounding areas, including the area around the Auckland Airport. Load is a mixture of residential and commercial with some industrial. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Ōtāhuhu 22 kV GXP* – Supplies Ōtāhuhu and surrounding areas such as the Highbrook commercial and industrial areas, as well as Ōtara and Bairds. Load is predominantly industrial with some

residential. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.

- *Pakuranga 33 kV GXP* – Supplies East Tāmaki, Pakuranga, Howick, and Flat Bush. Load is predominantly residential, with some industrial customers. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Penrose 33 kV and 22 kV GXPs* –Supply areas in central Auckland, including Onehunga, Westfield, Glen Innes, Mt Wellington, Newmarket, Ōrākei, Remuera, and Sylvia Park. Load is a mixture of residential, commercial, and industrial (including some of Vector's largest industrial customers). Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Mt Roskill 110 kV and 22 kV GXPs* – Supply the areas around Mt Roskill including Chevalier, Kingsland, Ponsonby, Avondale, Hillsborough, Mt Albert, Sandringham, Balmoral, and White Swan. Load is predominantly residential, with some industrial and commercial loads. Residential demand is rapidly increasing. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Mt Roskill 22 kV GXP –Silverdale 33 kV GXP* – Supplies some of the northern area of Vector's network, including Ōrewa, Silverdale, Millwater, Whangaparāoa, Stillwater, Red Beach, Manly, and Tindalls Beach. Load is predominantly residential, with an increasing commercial demand. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Takanini 33 kV GXP* – Supplies areas of Manurewa, Takanini, and Papakura, as well as some smaller townships and rural areas such as Clevedon, Maraetai, Beachlands, and Waiheke Island. Load is predominantly residential, with some commercial and industrial. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Wairau Rd 33 kV/Albany 110 kV GXP* – Supplies a portion of Auckland's North Shore, including the Wairau Valley, Glenfield, Devonport, Bayswater, Takapuna, Northcote, Birkenhead, and Beach Haven. Load is predominantly residential and commercial, with extensive growth occurring in both of these groups. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Wellsford 33 kV GXP* – Supplies the northernmost area of Vector's network, including Wellsford, Warkworth, Matakana, Sandspit, Ōmaha, Snells Beach, Leigh, and Tapora. Load is predominantly residential, with some commercial and agricultural demand. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Wiri 33 kV GXP* – supplies Manukau and the surrounding areas such as the Wiri commercial area and residential Clendon. Load is a mixture of residential, commercial, and industrial. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.

Zone Substations:

- The load characteristics of the zone substations vary widely depending on the connected consumers/generators.

9.3 EECA Load Sites

The following table shows EECA's Load Sites together with:

- The peak electrical power requirements of the Load Site.
- The distribution zone substation to which the Load Site would connect.
- The transmission substation/GXP which supplies the relevant zone substation.
- Ergo's estimate of the capital cost to increase the capacity of the relevant transmission assets (lines and substations).
- Ergo's estimate of the capital cost to install the necessary distribution assets to supply the Load Site.
- The cost efficiency associated with the Load Site in terms of $M/MW.
- The 'complexity of connection' based on the level of upgrades required.

The costs are preliminary and Ergo is of the view that they have an accuracy of Class 5[41], which is only suitable for concept screening (refer to the assumptions outlined in Appendix 3 for more details).

Ergo notes that, additional to any costs outlined in this report, Vector requires a development contribution cost to be paid by connecting Load Sites. This development contribution varies depending on the complexity of installing and connecting the new load, and would be determined by Vector when a connection application request is made by the customer. More information on this contribution is available on the Vector website.

[41] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

Table 140. Summary of Load Sites and indicative high-level capital costs

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
AKL71	Health New Zealand Auckland City Hospital	5.81	ACBD	$0.00	Liverpool 22kV	$6.19	**$6.19**	**$1.07**	Moderate	1, 2
AKL162	University of Auckland City	4.69	ACBD	$0.00	Liverpool 22kV	$1.50	**$1.50**	**$0.32**	Minor	1, 2
AKL163	University of Auckland Grafton	1.59	ACBD	$0.00	Liverpool 11kV	$0.00	**$0.00**	**$0.00**	Minor	1
AKL149	Sky City Auckland	0.98	ACBD	$0.00	Victoria	$0.00	**$0.00**	**$0.00**	Minor	1
AKL30	Auckland University of Technology City Campus	0.93	ACBD	$0.00	Liverpool 11kV	$0.00	**$0.00**	**$0.00**	Minor	1
AKL46	Department of Corrections Mt. Eden Prison & Aucklan	0.52	ACBD	$0.00	Newton	$0.00	**$0.00**	**$0.00**	Minor	1
AKL184	Grand Millennium Hotel	0.41	ACBD	$0.00	Liverpool 22kV	$0.00	**$0.00**	**$0.00**	Minor	1
AKL19	Auckland Council Tepid Baths	0.26	ACBD	$0.00	Hobson 22/11kV	$0.00	**$0.00**	**$0.00**	Minor	1
AKL13	Auckland Council Parnell Baths	0.18	ACBD	$0.00	Quay	$0.00	**$0.00**	**$0.00**	Minor	1
AKL160	The Olympic Pools & Fitness Centre Newmarket	0.17	ACBD	$0.00	Parnell	$0.00	**$0.00**	**$0.00**	Minor	1
AKL6	Amcor Cartons Albany	5.94	ALB33	$0.00	Bush Road	$11.06	**$11.06**	**$1.86**	Moderate	1, 2
AKL48	Department of Corrections Auckland Prison	0.84	ALB33	$0.00	Coatesville	$0.00	**$0.00**	**$0.00**	Minor	1
AKL102	Ministry of Education Long Bay College	0.42	ALB33	$0.00	Torbay	$0.00	**$0.00**	**$0.00**	Minor	1
AKL14	Auckland Council Albany Stadium Pool	0.40	ALB33	$0.00	McKinnon	$0.00	**$0.00**	**$0.00**	Minor	1
AKL98	Massey University Auckland	0.36	ALB33	$0.00	McKinnon	$0.00	**$0.00**	**$0.00**	Minor	1
AKL18	Auckland Council Glenfield Pool and Leisure Centre	0.18	ALB33	$0.00	James Street	$0.00	**$0.00**	**$0.00**	Minor	1
AKL177	Boundary Road Brewery	5.18	BOB110	$0.00	Ōpaheke	$1.50	**$1.50**	**$0.29**	Minor	1, 2
AKL190	NIG Nutritionals Pukekohe	4.76	BOB110	$0.00	Pukekohe	$0.00	**$0.00**	**$0.00**	Minor	1
AKL126	NZ Hothouse Karaka	2.37	BOB110	$0.00	Ōpaheke	$0.05	**$0.05**	**$0.02**	Minor	1
AKL127	NZ Hothouse Bombay	1.98	BOB110	$0.00	Pukekohe	$1.19	**$1.19**	**$0.60**	Minor	1
AKL180	Gellerts Auckland	1.56	BOB110	$0.00	Pukekohe	$0.00	**$0.00**	**$0.00**	Minor	1
AKL188	KJ Flowers Drury	0.51	BOB110	$0.00	Ōpaheke	$0.00	**$0.00**	**$0.00**	Minor	1
AKL183	Rainbow Park Nurseries Ltd Drury	0.50	BOB110	$0.00	Pukekohe	$0.00	**$0.00**	**$0.00**	Minor	1
AKL192	Bokay Flower Farms	0.37	BOB110	$0.00	Barber Rd	$0.00	**$0.00**	**$0.00**	Minor	1
AKL167	Van den Brink Poultry Limited (Brinks Chicken) Karaka	0.29	BOB110	$0.00	Ōpaheke	$0.00	**$0.00**	**$0.00**	Minor	1
AKL189	Ministry of Education Pukekohe High School	0.22	BOB110	$0.00	Pukekohe	$0.00	**$0.00**	**$0.00**	Minor	1
AKL91	Karaka Park Produce Ltd Pukekohe	0.14	BOB110	$0.00	Ōpaheke	$0.00	**$0.00**	**$0.00**	Minor	1
AKL130	NZ Steel Glenbrook Steel Mill - Stage 1	26.20	GLN33-clean	$0.00	N/A	$7.00	**$7.00**	**$0.27**	Moderate	1, 2
AKL130	NZ Steel Glenbrook Steel Mill - Stage 2	25.67	GLN33-clean	$0.00	N/A	$3.70	**$3.70**	**$0.14**	Moderate	1, 2
AKL191	NZ Gourmet Waiuku	1.44	GLN33-clean	$0.00	Waiuku	$2.71	**$2.71**	**$1.89**	Minor	1, 2
AKL185	Dhindsa Farm Limited	0.39	GLN33-clean	$0.00	Waiuku	$0.00	**$0.00**	**$0.00**	Minor	1
AKL33	Ayyildiz Ltd Rose's Halloumi Cheese	0.25	GLN33-clean	$0.00	Karaka	$0.00	**$0.00**	**$0.00**	Minor	1
AKL194	Wing Shing Farms Karaka	0.15	GLN33-clean	$0.00	Karaka	$0.00	**$0.00**	**$0.00**	Minor	1
AKL138	PALM McCallum Industries	4.49	HEN33	$0.00	Rānui	$20.48	**$20.48**	**$4.57**	Moderate	1, 2
AKL88	Industrial Processors Limited	1.98	HEN33	$0.00	Swanson	$10.80	**$10.80**	**$5.46**	Moderate	1, 2
AKL175	William Morrison Funeral Directors Auckland	1.91	HEN33	$0.00	Te Atatū	$6.60	**$6.60**	**$3.45**	Moderate	1, 2
AKL181	Tasti Auckland	0.76	HEN33	$0.00	Te Atatū	$0.00	**$0.00**	**$0.00**	Minor	1
AKL84	Homestead Produce Ltd	0.62	HEN33	$0.00	Riverhead	$0.00	**$0.00**	**$0.00**	Minor	1
AKL74	Health New Zealand Waitākere Hospital	0.47	HEN33	$0.00	Woodford	$0.00	**$0.00**	**$0.00**	Minor	1
AKL131	Sunrise Healthcare West Harbour	0.27	HEN33	$0.00	Hobsonville Point	$0.00	**$0.00**	**$0.00**	Minor	1
AKL168	Van Lier Riverhead	0.25	HEN33	$0.00	Riverhead	$0.00	**$0.00**	**$0.00**	Minor	1
AKL108	Ministry of Education Waitākere College	0.21	HEN33	$0.00	Woodford	$0.00	**$0.00**	**$0.00**	Minor	1
AKL187	Heirloomacy Waimauku	0.21	HEN33	$0.00	Waimauku	$0.00	**$0.00**	**$0.00**	Minor	1
AKL117	Ministry of Education Edmonton Primary School	0.11	HEN33	$0.00	Te Atatū	$0.00	**$0.00**	**$0.00**	Minor	1
AKL145	Riverland Roses Riverland Nursery	0.09	HEN33	$0.00	Hobsonville Point	$0.00	**$0.00**	**$0.00**	Minor	1
AKL158	Tegel Henderson	5.28	HEP33	$0.00	Henderson Valley	$31.86	**$31.86**	**$6.03**	Moderate	1, 2
AKL63	Glucina Alloys Avondale	4.19	HEP33	$0.00	Rosebank	$17.20	**$17.20**	**$4.11**	Moderate	1, 2
AKL32	Autex Industries Ltd	3.15	HEP33	$0.00	Rosebank	$17.20	**$17.20**	**$5.46**	Moderate	1, 2
AKL37	Blue Star Group (New Zealand) Ltd Webstar Auckland	1.88	HEP33	$0.00	Keeling Road	$22.86	**$22.86**	**$12.15**	Moderate	1, 2
AKL10	Pact Reuse Avondale	1.78	HEP33	$0.00	Rosebank	$17.20	**$17.20**	**$9.65**	Moderate	1, 2
AKL169	VIP Steel Packaging NZ Limited	1.68	HEP33	$0.00	Rosebank	$17.20	**$17.20**	**$10.22**	Moderate	1, 2
AKL148	Sealed Air	1.09	HEP33	$0.00	McLeod Road	$9.00	**$9.00**	**$8.27**	Moderate	1, 2
AKL140	Perry Metal Protection Auckland	0.89	HEP33	$0.00	Rosebank	$0.00	**$0.00**	**$0.00**	Minor	1
AKL12	Auckland Council West Wave Pool and Leisure Centre	0.59	HEP33	$0.00	McLeod Road	$0.00	**$0.00**	**$0.00**	Minor	1
AKL26	Auckland Council Waikumete Cemetery	0.56	HEP33	$0.00	Sabulite Road	$0.00	**$0.00**	**$0.00**	Minor	1
AKL144	Rheem New Zealand Ltd Auckland	0.32	HEP33	$0.00	Rosebank	$0.00	**$0.00**	**$0.00**	Minor	1
AKL109	Ministry of Education Prospect School	0.18	HEP33	$0.00	Waikaukau	$0.00	**$0.00**	**$0.00**	Minor	1
AKL113	Ministry of Education Greenbay High School	0.17	HEP33	$0.00	Atkinson Road	$0.00	**$0.00**	**$0.00**	Minor	1
AKL93	Ko Taku Reo Deaf Education, Auckland	0.13	HEP33	$0.00	Sabulite Road	$0.00	**$0.00**	**$0.00**	Minor	1
AKL186	Wicked Hot Waitākere	0.13	HEP33	$0.00	Henderson Valley	$0.00	**$0.00**	**$0.00**	Minor	1
AKL101	Methven Auckland	0.01	HEP33	$0.00	Rosebank	$0.00	**$0.00**	**$0.00**	Minor	1
AKL36	Blue Scope Pacific Steel	9.90	MNG110	$0.00	Pacific Steel	$1.50	**$1.50**	**$0.15**	Minor	1, 2

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary, based on data gathered at one point in time, and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes. For the larger Load Sites Ergo recommend proceeding with a Concept Design Report (CDR) to improve the accuracy of the respective cost estimate. It is additionally encouraged that Load Sites engage with their respective EDB at the earliest opportunity during upgrade planning in order to confirm the most up-to-date information.

			Transmission Details		Distribution		TOTAL			
No.	Load Site Name	Load (MW)	GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
AKL195	Coca Cola Amatil Keri Juice	3.05	MNG33	$0.00	Māngere Central	$23.62	$23.62	$7.75	Moderate	1, 2
AKL85	Hubbards Foods	2.77	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL75	Health New Zealand Middlemore Hospital	2.76	MNG33	$0.00	Hans	$9.26	$9.26	$3.35	Moderate	1, 2
AKL136	Oji Fibre Solutions Packaging Northern	1.98	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL59	George Weston Foods Ōtāhuhu	1.72	MNG33	$0.00	Hans	$9.26	$9.26	$5.39	Moderate	1, 2
AKL11	Auckland Airport	1.63	MNG33	$0.00	Airport	$1.32	$1.32	$0.81	Minor	1, 2
AKL154	Supreme Steel Products Ltd	1.48	MNG33	$0.00	Hans	$9.26	$9.26	$6.24	Moderate	1, 2
AKL2	Air New Zealand Manukau	1.15	MNG33	$0.00	Airport	$1.40	$1.40	$1.21	Minor	1, 2
AKL90	Jack Link's Māngere	0.69	MNG33	$0.00	Māngere West	$0.00	$0.00	$0.00	Minor	1
AKL89	International Waste Ltd	0.59	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL23	Auckland Council Manukau Memorial Gardens	0.56	MNG33	$0.00	Māngere East	$0.00	$0.00	$0.00	Minor	1
AKL83	Holiday Inn Auckland Airport Hotel	0.31	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL8	Arxada (Arch Wood Protection)	0.18	MNG33	$0.00	Hans	$0.00	$0.00	$0.00	Minor	1
AKL67	Green Harvest Pacific Ltd.	0.18	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL20	Auckland Council Moana Nui A kiwa - Māngere Pool	0.18	MNG33	$0.00	Māngere Central	$0.00	$0.00	$0.00	Minor	1
AKL114	Ministry of Education Aorere College	0.14	MNG33	$0.00	Māngere East	$0.00	$0.00	$0.00	Minor	1
AKL96	LSG Sky Chefs Auckland Airport	0.12	MNG33	$0.00	Airport	$0.00	$0.00	$0.00	Minor	1
AKL5	Altus NZ Ltd Auckland	5.48	OTA22	$0.00	Highbrook	$1.50	$1.50	$0.27	Minor	1, 2
AKL45	DB Breweries Limited Waitematā	5.23	OTA22	$0.00	Bairds	$5.60	$5.60	$1.07	Moderate	1, 2
AKL65	Goodman Fielder Quality Bakers Auckland	5.05	OTA22	$0.00	Ōtara	$7.32	$7.32	$1.45	Moderate	1, 2
AKL95	Lion The Pride	3.81	OTA22	$0.00	Ōtara	$6.30	$6.30	$1.65	Moderate	1, 2
AKL86	Huhtamaki NZ Ltd Moulder Fibre	3.27	OTA22	$0.00	Bairds	$4.60	$4.60	$1.41	Moderate	1, 2
AKL129	NZ Panels East Tāmaki	1.15	OTA22	$0.00	Ōtara	$6.30	$6.30	$5.49	Moderate	1, 2
AKL50	East Tāmaki Galvanising	0.54	OTA22	$0.00	Ōtara	$0.00	$0.00	$0.00	Minor	1
AKL35	Bell Tea & Coffee Company Ltd Auckland	0.49	OTA22	$0.00	Ōtara	$0.00	$0.00	$0.00	Minor	1
AKL78	Heinz Watties Limited La Bonne Cuisine	0.35	OTA22	$0.00	Ōtara	$0.00	$0.00	$0.00	Minor	1
AKL106	Ministry of Education Sir Edmund Hillary Collegiate	0.22	OTA22	$0.00	Bairds	$0.00	$0.00	$0.00	Minor	1
AKL24	Auckland Council Ōtara Pool & Leisure Centre	0.17	OTA22	$0.00	Bairds	$0.00	$0.00	$0.00	Minor	1
AKL27	Auckland Council Papatoetoe Centennial Pool & Leisu	0.11	OTA22	$0.00	Bairds	$0.00	$0.00	$0.00	Minor	1
AKL115	Ministry of Education Fairburn School	0.07	OTA22	$0.00	Bairds	$0.00	$0.00	$0.00	Minor	1
AKL66	Grain Corp NZ Ltd MeadowLea Foods	10.89	PAK33	$0.00	Greenmount	$12.16	$12.16	$1.12	Moderate	1, 2
AKL81	Higgins East Tāmaki	9.60	PAK33	$0.00	Greenmount	$14.56	$14.56	$1.52	Moderate	1, 2
AKL118	Mr Chips Ltd	5.38	PAK33	$0.00	East Tāmaki	$6.40	$6.40	$1.19	Moderate	1, 2
AKL173	Waste Management Technical Services East Tāmaki	0.42	PAK33	$0.00	Greenmount	$0.00	$0.00	$0.00	Minor	1
AKL15	Auckland Council Lloyd Elsmore Park Pool & Leisure C	0.33	PAK33	$0.00	Howick	$0.00	$0.00	$0.00	Minor	1
AKL112	Ministry of Education Botany Downs Secondary Colleg	0.21	PAK33	$0.00	Greenmount	$0.00	$0.00	$0.00	Minor	1
AKL119	Much Moore Icecream East Tāmaki	0.17	PAK33	$0.00	Greenmount	$0.00	$0.00	$0.00	Minor	1
AKL80	Henkel NZ Ltd. East Tāmaki	0.17	PAK33	$0.00	Greenmount	$0.00	$0.00	$0.00	Minor	1
AKL170	Visy Glass Auckland	30.31	PEN33	$0.00	N/A	$15.40	$15.40	$0.51	Moderate	1, 2
AKL57	Fulton Hogan Limited Reliable Way	21.37	PEN33	$0.00	N/A	$11.50	$11.50	$0.54	Moderate	1, 2
AKL49	Downer New Zealand Limited Auckland Asphalt	11.47	PEN33	$0.00	N/A	$15.70	$15.70	$1.37	Moderate	1, 2
AKL70	Hayes Metal Refinery	5.44	PEN33	$0.00	Te Papapa	$20.42	$20.42	$3.75	Moderate	1, 2
AKL121	New Zealand Starch Auckland	4.73	PEN33	$0.00	Te Papapa	$20.10	$20.10	$4.25	Moderate	1, 2
AKL62	Gerard Roofs Auckland	4.06	PEN33	$0.00	St Johns	$17.80	$17.80	$4.39	Moderate	1, 2
AKL178	Expol Ltd Auckland	2.77	PEN33	$0.00	Te Papapa	$19.50	$19.50	$7.04	Moderate	1, 2
AKL143	Purewa Cemetery Auckland	1.92	PEN33	$0.00	St Johns	$17.80	$17.80	$9.27	Moderate	1, 2
AKL42	Coca Cola Amatil The Oasis	1.83	PEN33	$0.00	Sylvia Park	$0.00	$0.00	$0.00	Minor	1
AKL73	Health New Zealand Greenlane Clinical Centre	1.81	PEN33	$0.00	Drive	$17.00	$17.00	$9.37	Moderate	1, 2
AKL51	Environwaste ltd Chemwaste	1.68	PEN33	$0.00	Te Papapa	$19.50	$19.50	$11.59	Moderate	1, 2
AKL100	Mercy Hospital	1.07	PEN33	$0.00	Newmarket	$0.00	$0.00	$0.00	Minor	1
AKL40	Cemix Ltd	0.99	PEN33	$0.00	Te Papapa	$0.00	$0.00	$0.00	Minor	1
AKL165	Valmont Coatings Auckland FKA CSP Galvanizing	0.99	PEN33	$0.00	McNab	$0.00	$0.00	$0.00	Minor	1
AKL141	Pets @ Rest	0.92	PEN33	$0.00	Te Papapa	$0.00	$0.00	$0.00	Minor	1
AKL193	Delmaine Fine Foods Auckland	0.57	PEN33	$0.00	McNab	$0.00	$0.00	$0.00	Minor	1
AKL164	University of Auckland Newmarket	0.35	PEN33	$0.00	Newmarket	$0.00	$0.00	$0.00	Minor	1
AKL156	Mt. Smart Stadium	0.35	PEN33	$0.00	Te Papapa	$0.00	$0.00	$0.00	Minor	1
AKL150	Smart Foods Ltd.	0.30	PEN33	$0.00	Sylvia Park	$0.00	$0.00	$0.00	Minor	1
AKL161	Tip Top Auckland	0.25	PEN33	$0.00	Carbine	$0.00	$0.00	$0.00	Minor	1
AKL43	Auckland Showgrounds	0.22	PEN33	$0.00	Drive	$0.00	$0.00	$0.00	Minor	1
AKL107	Ministry of Education Epsom Girls Grammar School	0.21	PEN33	$0.00	Newmarket	$0.00	$0.00	$0.00	Minor	1
AKL111	Ministry of Education Stanhope Road School	0.19	PEN33	$0.00	McNab	$0.00	$0.00	$0.00	Minor	1
AKL28	Auckland Council Lagoon Pools	0.18	PEN33	$0.00	Mt Wellington	$0.00	$0.00	$0.00	Minor	1
AKL151	Southern Cross Healthcare Gillies Hospital	0.16	PEN33	$0.00	Drive	$0.00	$0.00	$0.00	Minor	1
AKL22	Auckland Council Glen Innes Pool and Leisure Centre	0.17	PEN33	$0.00	Mt Wellington	$0.00	$0.00	$0.00	Minor	1
AKL166	Van den Brink Poultry Limited (Brinks Chicken) St John	0.09	PEN33	$0.00	Glen Innes	$0.00	$0.00	$0.00	Minor	1
AKL132	Oceania Healthcare Meadowbank	0.06	PEN33	$0.00	Ōrākei	$0.00	$0.00	$0.00	Minor	1

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No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
AKL53	Fletcher Steel Ltd Pacific Coil Coaters	2.97	PEN22	$0.00	Westfield	$3.00	**$3.00**	**$1.01**	Moderate	1, 2
AKL87	Huntsman Chemical Company Ltd Barnes Plastics	1.88	PEN22	$0.00	Westfield	$3.00	**$3.00**	**$1.60**	Moderate	1, 2
AKL123	NZ Comfort Group	1.78	PEN22	$0.00	Westfield	$3.00	**$3.00**	**$1.68**	Moderate	1, 2
AKL29	Auckland Meat Processors Auckland	1.48	PEN22	$0.00	Westfield	$3.00	**$3.00**	**$2.03**	Moderate	1, 2
AKL182	Mauri NZ Auckland	1.33	PEN22	$0.00	Westfield	$3.00	**$3.00**	**$2.25**	Moderate	1, 2
AKL92	Kerry Group Kerry Ingredients	1.19	PEN22	$0.00	Westfield	$3.00	**$3.00**	**$2.53**	Moderate	1, 2
AKL128	NZ Nail Industries	0.69	PEN22	$0.00	Westfield	$0.00	**$0.00**	**$0.00**	Minor	1
AKL153	Steel Masters Auckland Ltd	0.49	PEN22	$0.00	Westfield	$0.00	**$0.00**	**$0.00**	Minor	1
AKL4	Alsco NZ Auckland	2.20	ROS110	$0.00	Kingsland	$20.90	**$20.90**	**$9.50**	Moderate	1, 2
AKL76	Health New Zealand Mason Clinic	0.24	ROS110	$0.00	Chevalier	$0.00	**$0.00**	**$0.00**	Minor	1
AKL116	Ministry of Education Western Springs College	0.13	ROS110	$0.00	Chevalier	$0.00	**$0.00**	**$0.00**	Minor	1
AKL147	Sanitarium Auckland	1.63	ROS22	$0.00	Hillsborough	$5.92	**$5.92**	**$3.63**	Moderate	1, 2
AKL44	Davis Funeral Services Limited Auckland	0.96	ROS22	$0.00	Balmoral	$0.00	**$0.00**	**$0.00**	Minor	1
AKL103	Ministry of Education Lynfield College	0.37	ROS22	$0.00	White Swan	$0.00	**$0.00**	**$0.00**	Minor	1
AKL133	Lexham Gardens Rest Home	0.27	ROS22	$0.00	Balmoral	$0.00	**$0.00**	**$0.00**	Minor	1
AKL134	Everil Orr Care Centre	0.27	ROS22	$0.00	Avondale	$0.00	**$0.00**	**$0.00**	Minor	1
AKL34	Mount Albert Aquatic Centre	0.26	ROS22	$0.00	Sandringham	$0.00	**$0.00**	**$0.00**	Minor	1
AKL142	Plant & Food Research Mt Albert	0.25	ROS22	$0.00	Sandringham	$0.00	**$0.00**	**$0.00**	Minor	1
AKL155	Tai Poutini Polytechnic Auckland Campus	0.22	ROS22	$0.00	Mt Albert	$0.00	**$0.00**	**$0.00**	Minor	1
AKL196	Epicurean Dairy Co Auckland	0.18	ROS22	$0.00	Avondale	$0.00	**$0.00**	**$0.00**	Minor	1
AKL52	ESR (Institute of Environmental Science and Research)	0.14	ROS22	$0.00	Sandringham	$0.00	**$0.00**	**$0.00**	Minor	1
AKL58	Fulton Hogan Limited North Harbour	7.71	SVL33	$0.00	Spur Road	$13.44	**$13.44**	**$1.74**	Moderate	1, 2
AKL82	Higgins Silverdale	7.27	SVL33	$0.00	Spur Road	$12.90	**$12.90**	**$1.77**	Moderate	1, 2
AKL125	NZ Gourmet Gourmet Paprika	2.55	SVL33	$0.00	Helensville	$9.42	**$9.42**	**$3.69**	Moderate	1, 2
AKL61	George Weston Foods Silverdale	0.59	SVL33	$0.00	Spur Road	$0.00	**$0.00**	**$0.00**	Minor	1
AKL99	Massimo's Italian Cheeses	0.49	SVL33	$0.00	Spur Road	$0.00	**$0.00**	**$0.00**	Minor	1
AKL179	Superb Herb Helenville	0.21	SVL33	$0.00	Helensville	$0.00	**$0.00**	**$0.00**	Minor	1
AKL110	Ministry of Education Ōrewa College	0.10	SVL33	$0.00	Ōrewa	$0.00	**$0.00**	**$0.00**	Minor	1
AKL54	Fonterra Brands Limited Takanini	7.05	TAK33	$0.00	Papakura	$21.40	**$21.40**	**$3.04**	Moderate	1, 2
AKL69	Griffins Papakura	3.28	TAK33	$0.00	Papakura	$14.84	**$14.84**	**$4.53**	Moderate	1, 2
AKL97	Mainfeeds Ltd Manurewa	1.98	TAK33	$0.00	Manurewa	$26.10	**$26.10**	**$13.18**	Moderate	1, 2
AKL137	Ottogi NZ Ltd Takanini	1.83	TAK33	$0.00	Takanini	$18.42	**$18.42**	**$10.06**	Moderate	1, 2
AKL139	CORE Timber Services Papakura	1.21	TAK33	$0.00	Papakura	$13.76	**$13.76**	**$11.35**	Moderate	1, 2
AKL157	Tegel Takanini Feedmill	0.93	TAK33	$0.00	Takanini	$0.00	**$0.00**	**$0.00**	Minor	1
AKL77	Health New Zealand Manukau Super Clinic	0.42	TAK33	$0.00	Manurewa	$0.00	**$0.00**	**$0.00**	Minor	1
AKL17	Auckland Council Manurewa Pool and Leisure Centre	0.26	TAK33	$0.00	Manurewa	$0.00	**$0.00**	**$0.00**	Minor	1
AKL41	Clevedon Valley Buffalo Company	0.25	TAK33	$0.00	Maraetai	$0.00	**$0.00**	**$0.00**	Minor	1
AKL122	New Zealand Sugar Company Limited Auckland - Stage	6.00	WRD33	$7.50	Highbury	$7.20	**$14.70**	**$2.45**	Major	1, 2
AKL122	New Zealand Sugar Company Limited Auckland - Stage	6.49	WRD33	$0.00	Highbury	$4.60	**$4.60**	**$0.71**	Moderate	1, 2
AKL72	Health New Zealand North Shore Hospital	1.30	WRD33	$7.50	Wairau Road	$7.60	**$15.10**	**$11.61**	Major	1, 2
AKL124	NZ Defence Force Devonport	0.85	WRD33	$0.00	Ngātaringa Bay	$0.00	**$0.00**	**$0.00**	Minor	1
AKL31	Auckland University of Technology North Campus	0.39	WRD33	$0.00	Hillcrest	$0.00	**$0.00**	**$0.00**	Minor	1
AKL104	Ministry of Education Northcote College	0.38	WRD33	$0.00	Highbury	$0.00	**$0.00**	**$0.00**	Minor	1
AKL105	Ministry of Education Birkenhead College	0.28	WRD33	$0.00	Birkdale	$0.00	**$0.00**	**$0.00**	Minor	1
AKL25	Auckland Council Birkenhead Pool and Leisure Centre	0.22	WRD33	$0.00	Highbury	$0.00	**$0.00**	**$0.00**	Minor	1
AKL21	Auckland Council Takapuna Pool and Leisure Centre	0.11	WRD33	$0.00	Hillcrest	$0.00	**$0.00**	**$0.00**	Minor	1
AKL152	Southern Paprika Limited Warkworth	4.30	WEL33	$14.00	Warkworth	$36.21	**$50.21**	**$11.68**	Major	1, 2
AKL68	Griffins Wiri	13.12	WIR33	$7.50	Wiri	$7.50	**$15.00**	**$1.14**	Major	1, 2
AKL38	Bluebird Foods	10.10	WIR33	$7.50	Wiri	$5.90	**$13.40**	**$1.33**	Major	1, 2
AKL9	COLAS Limited (ASCO Asphalt)	7.52	WIR33	$7.50	West Wiri	$1.70	**$9.20**	**$1.22**	Major	1, 2
AKL55	Frucor Suntory New Zealand Limited Plunket Avenue	5.00	WIR33	$7.50	Wiri	$7.90	**$15.40**	**$3.08**	Major	1, 2
AKL171	Visy Board	2.76	WIR33	$7.50	West Wiri	$1.64	**$9.14**	**$3.31**	Major	1, 2
AKL56	Frucor Suntory New Zealand Limited Orb Avenue	2.44	WIR33	$7.50	Wiri	$6.90	**$14.40**	**$5.91**	Major	1, 2
AKL39	Bremworth Auckland	1.90	WIR33	$7.50	Manukau	$0.56	**$8.06**	**$4.24**	Major	1, 2
AKL172	Visy Beverage Can	1.73	WIR33	$7.50	Wiri	$6.90	**$14.40**	**$8.33**	Major	1, 2
AKL146	Salters Cartage Ltd	1.68	WIR33	$7.50	West Wiri	$1.80	**$9.30**	**$5.53**	Major	1, 2
AKL120	Nestle Cambria Park	1.63	WIR33	$7.50	West Wiri	$0.00	**$7.50**	**$4.59**	Major	1, 2
AKL64	Godfrey Hirst NZ Limited Auckland	1.48	WIR33	$7.50	Wiri	$0.00	**$7.50**	**$5.08**	Major	1, 2
AKL7	Ann Funeral Home & Onsite Cremations Auckland	1.15	WIR33	$7.50	Wiri	$0.00	**$7.50**	**$6.51**	Major	1, 2
AKL60	George Weston Foods Wiri	1.09	WIR33	$7.50	Wiri	$0.00	**$7.50**	**$6.89**	Major	1, 2
AKL94	Koppers Performance Chemicals NZ Wiri	0.84	WIR33	$0.00	Wiri	$0.00	**$0.00**	**$0.00**	Minor	1
AKL47	Department of Corrections Auckland Regional Women	0.69	WIR33	$0.00	Clendon	$0.00	**$0.00**	**$0.00**	Minor	1
AKL79	Hellers Ltd Auckland	0.54	WIR33	$0.00	Wiri	$0.00	**$0.00**	**$0.00**	Minor	1
AKL174	Westfield Manukau City	0.33	WIR33	$0.00	Manukau	$0.00	**$0.00**	**$0.00**	Minor	1
AKL1	AFFCO New Zealand Limited Wiri	0.16	WIR33	$0.00	Wiri	$0.00	**$0.00**	**$0.00**	Minor	1
	TOTAL =>	**435.57**	**TOTAL =>**	**$126.50**	**TOTAL =>**	**$771.89**	**$898.39**			

Notes

1 Doesn't include distribution transformer or switchgear costs for Load Sites (details provided in body of report). Estimated between $50k - $350k depending on size.

2 (N-1) scenario cost shown

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Appendices

Appendix 1 Lists of Tables and Figures

Appendix 2 Glossary

CT	Current transformer
DG	Distributed generator
EDB	Electrical Distribution Business
EIPC	Electricity Industry Participation Code
ENA	Electricity Network Association
ESA	Electricity Supply Authority
GIP	Grid injection point
GXP	Grid exit point substation
kV	Kilovolts
MW	Megawatts
MVAr	Mega volt amps reactive
MVA	Mega volt amps
ONAN	Oil natural air natural (the methods used to cool the windings and body of the transformer)
ONAF	Oil natural air forced (the methods used to cool the windings and body of the transformer)
SCADA	Supervisory control and data acquisition
SPS	Special protection system
TOPS	Transformer overload protection scheme
ZSS	Zone substation

Appendix 3 Accuracy of Cost Estimates and Assumptions

The amount of time available and effort expended to prepare an indicative capital cost has a significant bearing on the expected accuracy range. Accordingly the accuracy of capital cost estimates should be based on the amount and quality of information available at the time the estimate is developed. The Association for the Advancement of Cost Engineering (AACE) has developed a framework for the accuracy of cost estimates as a project progresses, which is illustrated below.

Table 141 Cost estimate classification matrix[42]

ESTIMATE CLASS	*Primary Characteristics*	*Secondary Characteristic*		
	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges at an 80% confidence level
Class 5 (Order of Magnitude)	***0% to 2%***	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	**L: -20% to -50%** **H: +30% to +100%**
Class 4 (Preliminary)	***1% to 15%***	Study or Feasibility	Equipment Factored or Parametric Models	**L: -15% to -30%** **H: +20% to +50%**
Class 3 (Early Budget)	***10% to 40%***	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	**L: -10% to -20%** **H: +10% to +30%**
Class 2 (Budget/Control)	***30% to 70%***	Control or Bid / Tender	Detailed Unit Cost With Forced Detailed Take-off	**L: -5% to -15%** **H: +5% to +20%**
Class 1 (Definitive/Construction)	***50% to 100%***	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	**L: -3% to -10%** **H: +3% to +15%**

Assumptions

Ergo is of the view that the capital cost estimates developed in this report are Class 5 and we note the following:

- Costs exclude land and/or land easements.
- Costs exclude planning/consenting.
- It is assumed there is sufficient space/land in switchrooms/switchyards to accommodate the new equipment.
- The estimates are based on the connection of Load Sites and do not consider the connection of multiple Load Sites.

It is further noted that Vector does not endorse the cost estimates in this report and recommends any customer wanting to find out about the cost of connecting to contact Vector directly.

42 Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.