Wellington

Spare Capacity and Load Characteristics Report

EECA

24136 | 24136-RPT-001

Rev C | 29 SEP 25

Document History & Status

Revision	Date	Author	Reviewed by	Approved by	Status
A	20-12-2024	Caitlin Bergervoet			Draft
B	31-07-2025	Ellie Wright	Willem Rawlins	Kane Morison	Approved
C	29-09-2025	Ellie Wright		Kane Morison	Draft

Revision	Details
A	Stage 1 Draft for client review/comment
B	Stage 2 Draft
C	Updated following review from Wellington Electricity

Table of Contents

1. Executive Summary

Transpower maintains/manages the transmission network in New Zealand and supplies the Wellington region (as described in this report) via fifteen GXP's (supplying Electra, Powerco, and Wellington Electricity).

The three Electrical Distribution Businesses (EDBs), Electra, Powerco, and Wellington Electricity, 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 program that is called Regional Energy Transition Accelerator (RETA)[1]. The program is targeted at large energy-using businesses and public sector organisations that are committed to reducing carbon emissions and seeks to identify the barriers involved and opportunities available.

As part of the RETA program, EECA has developed a set of Load Sites for the Wellington region. The Load Sites involve existing consumers/plant that use fossil fuel, 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 Wellington 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.
- A capital cost estimate to supply electricity to each of the Load Sites.

The purpose of the Load Site cost analysis is to provide options for investment that will provide significant reduction in the use of fossil fuels.

1.1 Network Spare Capacity

Figure 1 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Wellington 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/

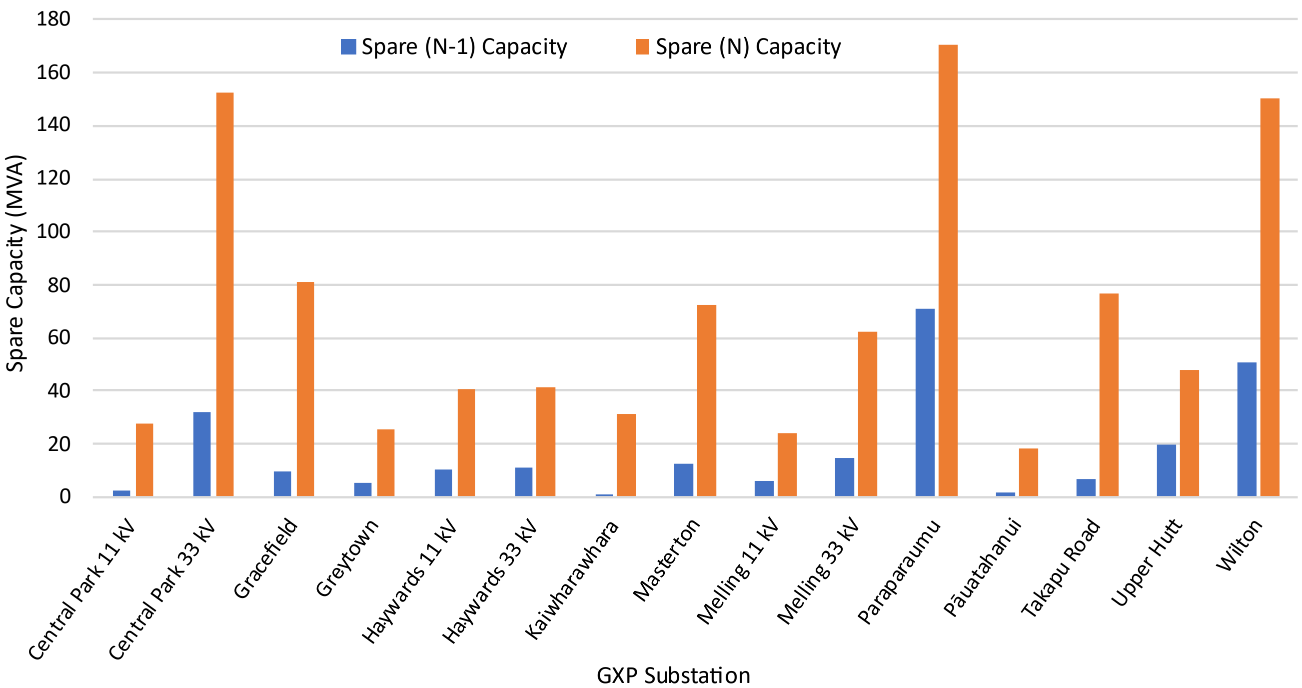


Figure 1. Summary: Approximate N and N-1 spare capacity at GXP substations.

Figure 2 and Figure 3 illustrate the (N) and (N-1) spare capacity at the three EDB's (Electra, Powerco, and Wellington Electricity) zone substations in the Wellington region. These figures are based on the maximum loadings and the EDBs' 2023-2025 disclosures. Negative numbers for (N-1) capacity indicate zone substations where the load has exceeded the (N-1) capacity in the past.

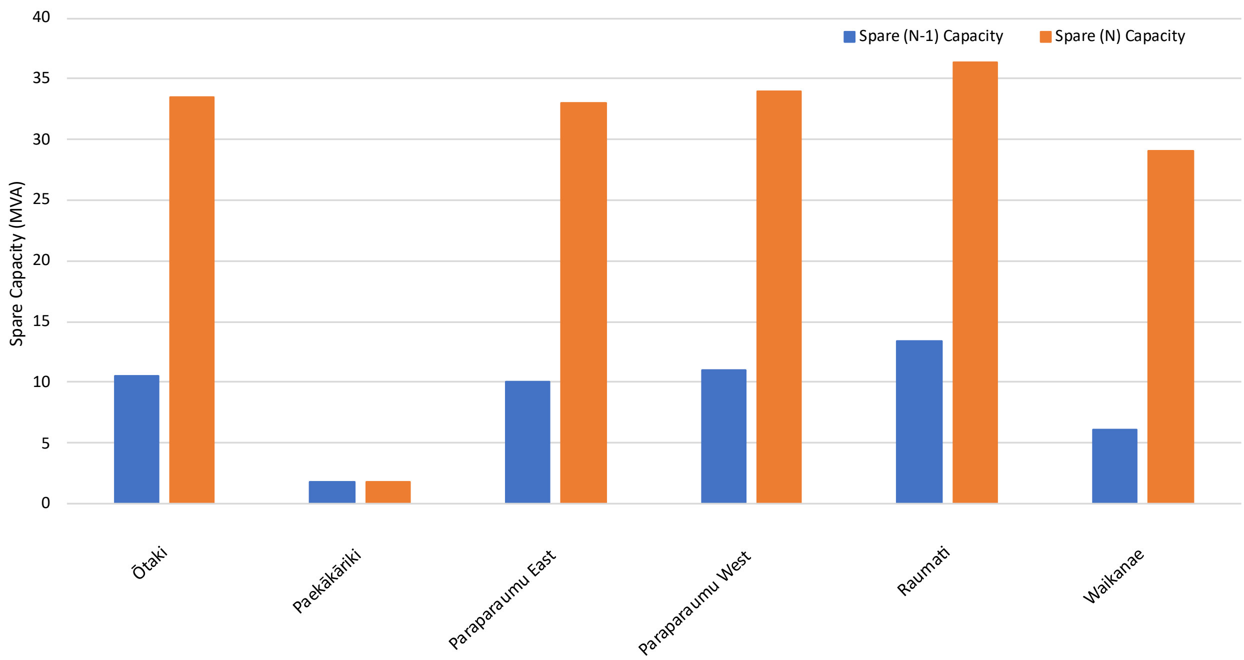


Figure 2. Summary: Approximate (N) and (N-1) spare capacity at Electra's zone substations.

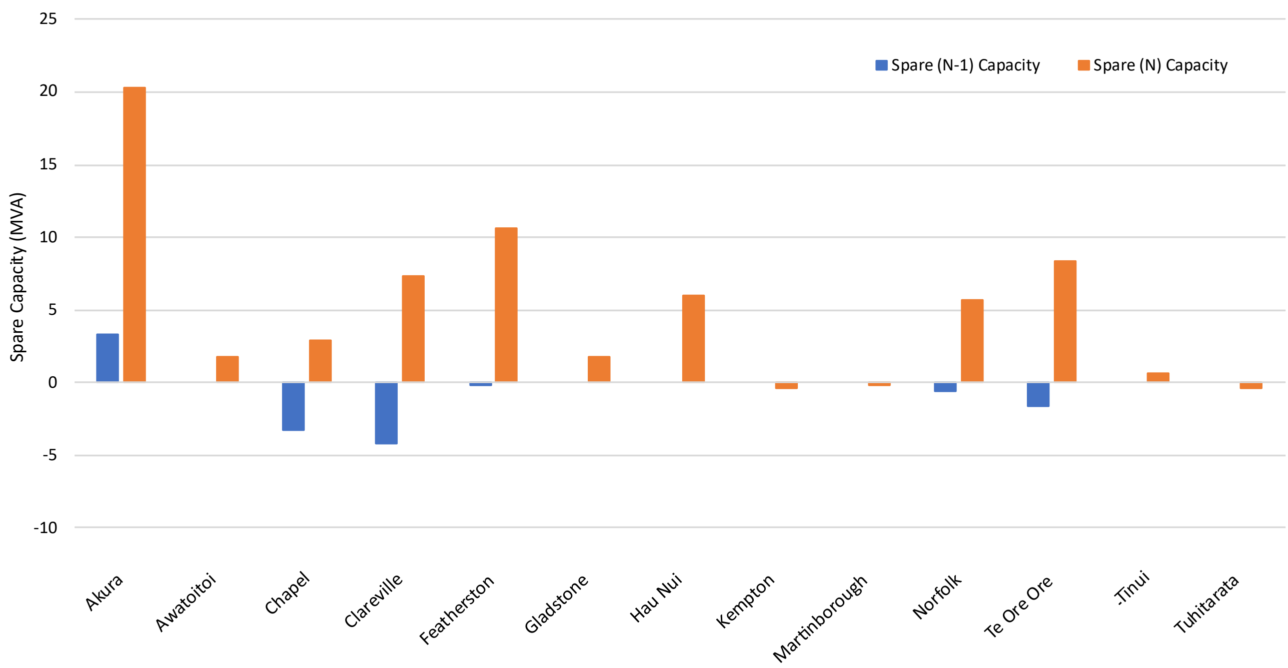


Figure 3. Summary: Approximate (N) and (N-1) spare capacity at Powerco's zone substations.

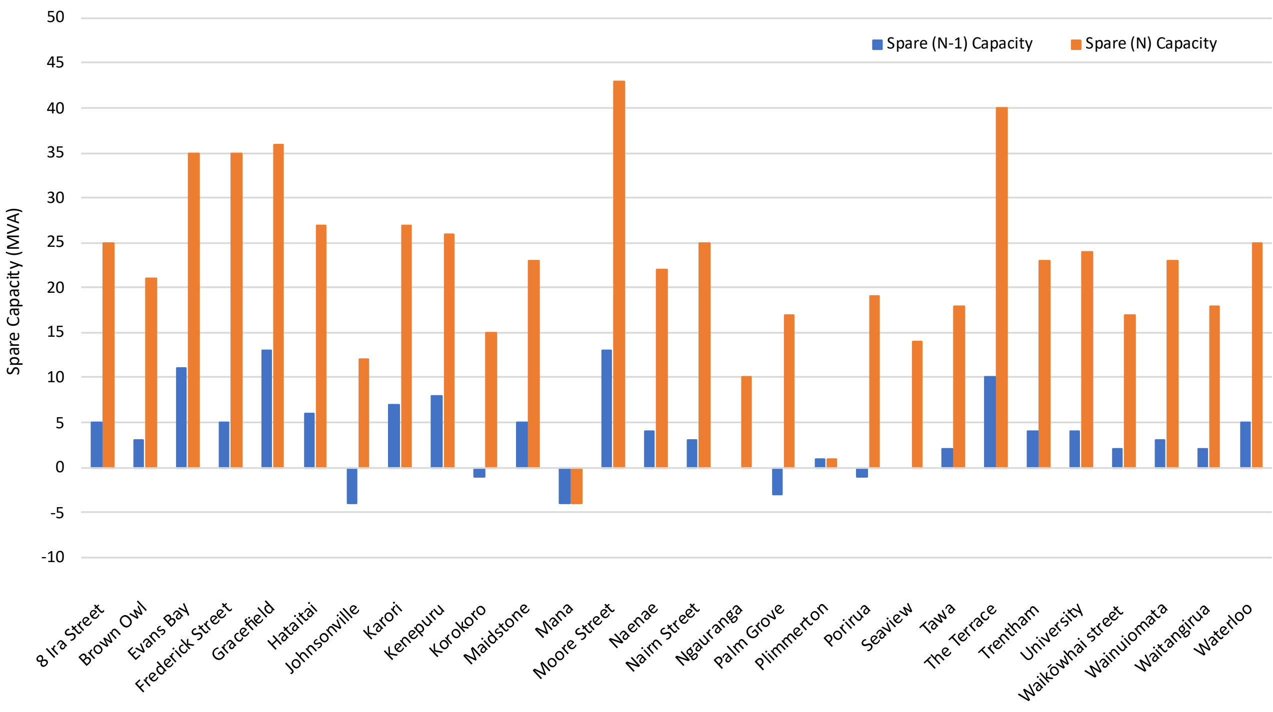


Figure 4. Summary: Approximate (N) and (N-1) spare capacity at Wellington Electricity's zone substations.

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-002) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Central Park 11 kV and 33 kV GXPs* – Supply a portion of Wellington, including most of Wellington Central and the eastern parts of the city. Loads are a mix of industrial, commercial, and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Gracefield GXP* – Supplies Petone and the industrial area at Seaview, as well as the suburb of Wainuiomata, with a mix of industrial, commercial, and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Greytown GXP* – Supplies Greytown, Featherston, and Martinborough towns and the surrounding rural areas, with loads associated with forestry, cropping, agriculture, and vineyards/wineries, as well as some commercial residential loads centred in the towns. Load is peaky throughout the year, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Haywards 11 kV and 33 kV GXPs* – Along with Upper Hutt GXP, supplies the load of Upper Hutt, with a mix of typically residential and commercial loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Kaiwharawhara GXP* – Supplies the load in Thorndon at the north of the Wellington CBD, with some load in the Ngaio Gorge and Khandallah areas. Mixture of mostly commercial and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period. The impact of the CBD loads is clear in the load profile as the load is much lower throughout the day during the weekends.
- *Masterton GXP* – Supplies Masterton town, and some surrounding rural areas. The load of the town dominates with residential and commercial loads, with loads associated with forestry, cropping, agriculture, and vineyards/wineries in the rural areas. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Melling 11 kV and 33 kV GXPs* – Supplies Lower Hutt, with a mix of industrial, commercial, and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Paraparaumu GXP* – Supplies several towns, including Paraparaumu, Waikanae, Ōtaki, and Paekākāriki, and the surrounding rural areas. There is a range of loads from commercial/residential through to agricultural loads. Notably in this region, many people commute into Wellington for work, so the daytime load is much lower than the morning and evening peaks. Load is winter peaking.
- *Pāuatahanui GXP* – Supplies Plimmerton. Load is a mix of mostly commercial and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Takapu Road GXP* – Supplies Porirua, Tawa, and Johnsonville. Loads are a mix of industrial, commercial, and residential. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.

- *Upper Hutt GXP* – Along with Haywards GXP, supplies Upper Hutt, with a mix of typically residential and commercial loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Wilton GXP* – Supplies urban and industrial areas around the north of Wellington city, including the industrial area around the interisland ferry terminal and the neighbouring port facilities. Load is a mix of industrial, commercial, and residential customers. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period. The impact of the CBD/city loads is clear in the load profile as the load is much lower throughout the day during the weekends.

Zone Substations:

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

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[2], which is only suitable for concept screening. (Refer to the assumptions outlined in Appendix 3 for more details)

Table 1. Summary of Load Sites and estimated capital costs

			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**
WL6	Fulton Hogan Wellington Asphalt Plant	7.92	Haywards 11 kV	$0.20	Haywards	$2.96	**$3.16**	**$0.40**	Major	1, 2
WL3	Downer Ngauranga Asphalt Plant	6.65	Kaiwharawhara	$9.00	Kaiwharawhara	$2.54	**$11.54**	**$1.74**	Major	1, 2
WL30	Wellington Hospital	4.51	Central Park 33 kV	$0.00	Palm Grove	$16.82	**$16.82**	**$3.73**	Moderate	1, 2
WL12	Taylor Preston Limited	3.84	Kaiwharawhara	$9.00	Ngauranga	$0.00	**$9.00**	**$2.34**	Major	1, 2
WL51	Higgins Concrete Wairarapa	3.65	Masterton	$0.00	Norfolk	$5.28	**$5.28**	**$1.45**	Moderate	1, 2
WL29	Wellington Water Seaview Wastewater Treatment Pla	2.33	Gracefield	$0.00	Seaview	$8.20	**$8.20**	**$3.52**	Moderate	1, 2
WL21	Hutt Hospital	1.85	Melling 11 kV	$0.20	Melling	$0.64	**$0.84**	**$0.45**	Minor	1
WL33	Victoria University of Wellington Kelburn Campus	1.74	Central Park 33 kV	$0.00	University	$0.35	**$0.35**	**$0.20**	Minor	1
WL76	Executive Laundry Group Limited Petone	1.63	Gracefield	$0.00	Korokoro	$17.92	**$17.92**	**$10.97**	Moderate	1, 2
WL4	Farrah's Breads Upper Hutt	0.25	Haywards 33 kV	$0.00	Trentham	$0.13	**$0.13**	**$0.53**	Minor	1
WL20	New Zealand Defence Force Trentham	1.41	Haywards 33 kV	$0.00	Trentham	$0.53	**$0.53**	**$0.38**	Moderate	1, 2
WL22	Callaghan Innovation Gracefield	1.15	Gracefield	$0.00	Gracefield	$0.35	**$0.35**	**$0.30**	Minor	1
WL36	Museum of New Zealand Te Papa Tongarewa Cable Str	1.18	Central Park 33 kV	$0.00	Frederick Street	$0.88	**$0.88**	**$0.75**	Minor	1
WL31	Kenepuru Hospital	1.06	Takapu Road	$0.00	Kenepuru	$0.35	**$0.35**	**$0.33**	Minor	1
WL5	Firth Dricon Waikanae	0.99	Paraparaumu	$0.00	Waikanae	$0.26	**$0.26**	**$0.26**	Minor	1
WL9	Breadcraft Wairarapa	0.99	Masterton	$0.00	Akura	$0.26	**$0.26**	**$0.26**	Minor	1
WL11	Sealed Air Porirua	0.99	Takapu Road	$0.00	Kenepuru	$0.26	**$0.26**	**$0.26**	Minor	1
WL8	Goodman Fielder Quality Bakers Wellington	0.95	Gracefield	$0.00	Seaview	$0.26	**$0.26**	**$0.27**	Minor	1
WL7	Godfrey Hirst Lower Hutt	0.93	Gracefield	$0.00	Gracefield	$0.26	**$0.26**	**$0.28**	Minor	1
WL2	DB Breweries Tuatara	0.91	Upper Hutt	$0.00	Maidstone	$0.26	**$0.26**	**$0.29**	Minor	1
WL41	Department of Corrections Rimutaka Prison	0.82	Haywards 33 kV	$0.00	Trentham	$0.26	**$0.26**	**$0.32**	Minor	1
WL55	Precinct Properties Aon Centre	0.63	Central Park 33 kV	$0.00	The Terrace	$0.20	**$0.20**	**$0.32**	Minor	1
WL28	ESR Kenepuru	0.45	Takapu Road	$0.00	Kenepuru	$0.20	**$0.20**	**$0.44**	Minor	1
WL1	Bostik Wellington	0.49	Melling 33 kV	$0.00	Naenae	$0.13	**$0.13**	**$0.26**	Minor	1
WL10	Mexicano Corn Chips Lower Hutt	0.49	Melling 33 kV	$0.00	Naenae	$0.13	**$0.13**	**$0.26**	Minor	1
WL59	Reserve Bank of New Zealand - Te Pūtea Matua	0.48	Wilton	$0.00	Moore Street	$0.13	**$0.13**	**$0.27**	Minor	1
WL32	Massey University Wellington Campus	0.46	Central Park 11 kV	$0.00	Nairn Street	$0.13	**$0.13**	**$0.28**	Minor	1
WL77	NZ Campus of Innovation and Sport (NZCIS)	0.39	Haywards 33 kV	$0.00	Trentham	$0.13	**$0.13**	**$0.33**	Minor	1
WL42	Wakefield Hospital	0.32	Central Park 33 kV	$0.00	Palm Grove	$0.13	**$0.13**	**$0.41**	Minor	1
WL37	Museum of New Zealand Te Papa Tongarewa Tory Stre	0.35	Central Park 11 kV	$0.00	Nairn Street	$0.13	**$0.13**	**$0.37**	Minor	1
WL14	Upper Hutt City Council H2O Xtream	0.35	Upper Hutt	$0.00	Maidstone	$0.13	**$0.13**	**$0.37**	Minor	1
WL27	Wellington Airport	0.33	Central Park 33 kV	$0.00	8 Ira Street	$0.13	**$0.13**	**$0.40**	Minor	1
WL58	Precinct Properties Treasury Building	0.33	Wilton	$0.00	Moore Street	$0.13	**$0.13**	**$0.40**	Minor	1
WL23	Wellington City Council Wellington Regional Aquatic (	0.32	Central Park 33 kV	$0.00	Evans Bay	$0.13	**$0.13**	**$0.40**	Minor	1
WL69	Victoria University of Wellington Rutherford House	0.32	Wilton	$0.00	Moore Street	$0.13	**$0.13**	**$0.41**	Minor	1
WL16	Hutt City Council Huia Pool	0.32	Gracefield	$0.00	Gracefield	$0.13	**$0.13**	**$0.41**	Minor	1
WL46	Hutt Valley High School	0.31	Gracefield	$0.00	Gracefield	$0.13	**$0.13**	**$0.42**	Minor	1

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

No.	Load Site Name	Load (MW)	Transmission Details: GXP/Transmission Substation	Transmission Details: Upgrade Costs ($M)	Distribution: Zone Substation	Distribution: Upgrade Costs ($M)	TOTAL Upgrade Costs ($M)	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
WL52	Rātonga-Rua-O-Porirua Campus	0.30	Takapu Road	$0.00	Kenepuru	$0.13	$0.13	$0.43	Minor	1
WL40	Argosy Property Ltd TSB Bank Building	0.30	Wilton	$0.00	Moore Street	$0.13	$0.13	$0.44	Minor	1
WL26	Te Pukenga Weltec & Whitireia Porirua Campus	0.29	Takapu Road	$0.00	Porirua	$0.13	$0.13	$0.45	Minor	1
WL67	Southern Cross Wellington Hospital	0.25	Central Park 33 kV	$0.00	Palm Grove	$0.13	$0.13	$0.51	Minor	1
WL57	Precinct Properties NTT Tower	0.26	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.31	Minor	1
WL39	Argosy Property Ltd MBIE Building	0.25	Wilton	$0.00	Moore Street	$0.13	$0.13	$0.52	Minor	1
WL49	Ōtaki College	0.24	Paraparaumu	$0.00	Ōtaki	$0.13	$0.13	$0.53	Minor	1
WL73	Wellington City Council Michael Fowler Centre	0.23	Central Park 33 kV	$0.00	The Terrace	$0.13	$0.13	$0.55	Minor	1
WL70	Victoria University of Wellington Te Aro	0.23	Central Park 33 kV	$0.00	Hataitai	$0.13	$0.13	$0.57	Minor	1
WL13	Whittaker's Porirua	0.20	Takapu Road	$0.00	Porirua	$0.08	$0.08	$0.40	Minor	1
WL47	Mahinawa Specialist School and Resource Centre	0.20	Takapu Road	$0.00	Titahi Bay	$0.08	$0.08	$0.40	Minor	1
WL15	Hutt City Council Wainuiomata Summer Pool	0.20	Gracefield	$0.00	Wainuiomata	$0.08	$0.08	$0.40	Minor	1
WL34	GNS Avalon	0.20	Melling 11 kV	$0.00	Melling	$0.08	$0.08	$0.40	Minor	1
WL50	Paraparaumu College	0.20	Paraparaumu	$0.00	Paraparaumu West	$0.08	$0.08	$0.41	Minor	1
WL54	Porirua City Council Te Rauparaha Arena and Aquatic	0.18	Takapu Road	$0.00	Porirua	$0.08	$0.08	$0.45	Minor	1
WL64	RJ Holdings Lambton House	0.17	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.46	Minor	1
WL66	RJ Holdings Solnet House	0.17	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.46	Minor	1
WL65	RJ Holdings Midlands Chambers	0.17	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.48	Minor	1
WL72	Wellington City Council Keith Spry Pool	0.17	Takapu Road	$0.00	Johnsonville	$0.08	$0.08	$0.48	Minor	1
WL38	Argosy Property Ltd 7 Waterloo Quay	0.15	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.53	Minor	1
WL61	RJ Holdings Bayleys Building	0.15	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.53	Minor	1
WL74	Wellington City Council Tawa Pool	0.14	Takapu Road	$0.00	Tawa	$0.08	$0.08	$0.56	Minor	1
WL25	Wellington City Council Freyberg Pool & Fitness Centr	0.14	Central Park 33 kV	$0.00	Frederick Street	$0.08	$0.08	$0.56	Minor	1
WL53	Oceania Healthcare Elderslea Village	0.14	Upper Hutt	$0.00	Maidstone	$0.08	$0.08	$0.59	Minor	1
WL48	Newlands College	0.13	Takapu Road	$0.00	Johnsonville	$0.08	$0.08	$0.60	Minor	1
WL62	RJ Holdings Harbour Tower	0.13	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.61	Minor	1
WL68	Victoria University of Wellington Old Government Bui	0.13	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.63	Minor	1
WL56	Precinct Properties Mayfair House	0.12	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.67	Minor	1
WL63	RJ Holdings Lambton Centre	0.11	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.70	Minor	1
WL35	GNS Lower Hutt	0.11	Gracefield	$0.00	Gracefield	$0.08	$0.08	$0.72	Minor	1
WL60	RJ Holdings Centrepoint Building	0.11	Central Park 33 kV	$0.00	The Terrace	$0.08	$0.08	$0.72	Minor	1
WL43	Kapiti Coast District Council Ōtaki Pool	0.11	Paraparaumu	$0.00	Ōtaki	$0.08	$0.08	$0.73	Minor	1
WL71	Wellington City Council City Gallery	0.10	Central Park 33 kV	$0.00	Frederick Street	$0.05	$0.05	$0.50	Minor	1
WL17	Hutt City Council McKenzie Summer Baths	0.10	Gracefield	$0.00	Petone	$0.05	$0.05	$0.51	Minor	1
WL18	Hutt City Council Stokes Valley Pool	0.10	Haywards 11 kV	$0.00	Haywards	$0.05	$0.05	$0.51	Minor	1
WL19	Hutt City Council The Dowse Art Museum	0.10	Gracefield	$0.00	Gracefield	$0.05	$0.05	$0.53	Minor	1
WL24	Wellington City Council Karori Pool	0.07	Wilton	$0.00	Karori	$0.05	$0.05	$0.67	Minor	1
WL44	Kapiti Coast District Council Waikanae Pool	0.07	Paraparaumu	$0.00	Waikanae	$0.05	$0.05	$0.76	Minor	1
WL75	Wellington City Council Thorndon Pool	0.04	Kaiwharawhara	$0.00	Kaiwharawhara	$0.05	$0.05	$1.16	Minor	1
WL45	Hampton Hill School	0.02	Takapu Road	$0.00	Tawa	$0.05	$0.05	$2.25	Minor	1
	TOTAL =>	58.59	TOTAL =>	$18.40	TOTAL =>	$64.35	$82.75			

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

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes in order to connect the respective Load Sites.

2. Introduction

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

- Electra – 6 zone substations
- Powerco (Wairarapa area only) – 13 zone substations
- Wellington Electricity (WE*) – 33 zone substations

The regional areas of the EDBs are shown in Figure 5 for the three EDBs respectively.

The Energy Efficiency & Conservation Authority (EECA) is running a flagship program that is called Regional Energy Transition Accelerator (RETA)[3]. The program is targeted at large energy-using businesses and public sector organisations that are committed to reducing carbon emissions and seeks to identify the barriers involved and opportunities available.

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

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

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

Figure 5. EDB regional areas[4]

[4] 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 Wellington region. This included reviewing both the GXP's and local distribution zone substations along with their associated lines/cables within the Wellington region.

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

- Transpower's *Transmission Planning Report 2023*.
- Electra's 2025 regulatory information disclosures and 2025 AMP[5].
- Powerco's 2023 regulatory information disclosures and 2023 AMP and 2025 AMP update[6].
- Wellington Electricity (WE*) 2025 regulatory information disclosures and 2025 AMP[7].
- SCADA substation loading data provided by Electra, Powerco, and WE*.
- GXP metering data extracted from the Electricity Authority's website[8].
- Network diagrams provided by Electra, Powerco, and WE*.
- Geographic Information System (GIS) asset and location data provided by Electra, Powerco, and WE*.
- Powerco's Demand Capacity Map[9].

[5] https://electra.co.nz/our-company/disclosures/

[6] https://www.Powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures

[7] https://www.welectricity.co.nz/disclosures/asset-management-plan/

[8] https://www.emi.ea.govt.nz/Wholesale/Datasets

[9] https://experience.arcgis.com/experience/3e5c53d1cc6c4ab0955675bdb0df408e

4. Wellington 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 Electra, Powerco, and WE*, are referred to as the Wellington region.

4.1 Transmission/GXP Substations

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

- Electra:
  - Paraparaumu GXP (Southern network).
- Powerco:
  - Greytown GXP ("Wairarapa" network).
  - Masterton GXP ("Wairarapa" network).
- WE*:
  - Central Park GXP (Southern Area).
  - Gracefield GXP (Northeast Area).
  - Haywards GXP (Northeast Area).
  - Kaiwharawhara GXP (Southern Area).
  - Melling GXP (Northeast Area).
  - Pāuatahanui GXP (Northwest Area).
  - Takapu GXP (Northwest Area).
  - Upper Hutt GXP (Northeast Area).
  - Wilton GXP (Southern Area).

The Wellington 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 some large wind farms, as well as some smaller landfill generators and a hydroelectric generation scheme. The generation plants in the region include:

- Southern Landfill (Landfill/Biogas generation) (1 MW) and Wellington Hospital (gas/oil cogeneration) (8 MW)[10] – connects at Central Park GXP.
- Hau Nui (wind generation) (9 MW) – connects at Greytown GXP.
- Silverstream (Landfill/biogas generation) (3 MW) – connects at Haywards GXP.
- Kourarau A and B (hydroelectric generation) (1 MW) – connects at Masterton GXP.
- Mill Creek (wind generation) (60 MW) – connects at Wilton GXP.
- West Wind (wind generation) (143 MW) – connects at West Wind GIP.

The transmission network in the Wellington region is also shown schematically in Figure 7. Generally, generation capacity in the Wellington region is lower than its maximum demand, with the deficit

[10] Note that the Wellington Hospital generation is standby generation only.

imported from the National Grid, either via the High Voltage DC (HVDC) link to Benmore (South Island) or from the Central North Island.

The region is reasonably interconnected with the National Grid, with connections to the Canterbury (via the HVDC) and the Whanganui-Manawatū regions. Four 220 kV circuits and one 110 kV circuit run north to the Central North Island (220 kV to Bunnythorpe and 110 kV to Mangamaire) from Haywards (220 kV) and Masterton (110 kV) respectively. The HVDC inter-island link runs south across the Cook Strait to Benmore Dam in the Canterbury region. Three 220/110 kV interconnecting transformers are located at Haywards, with another one located in Wilton.

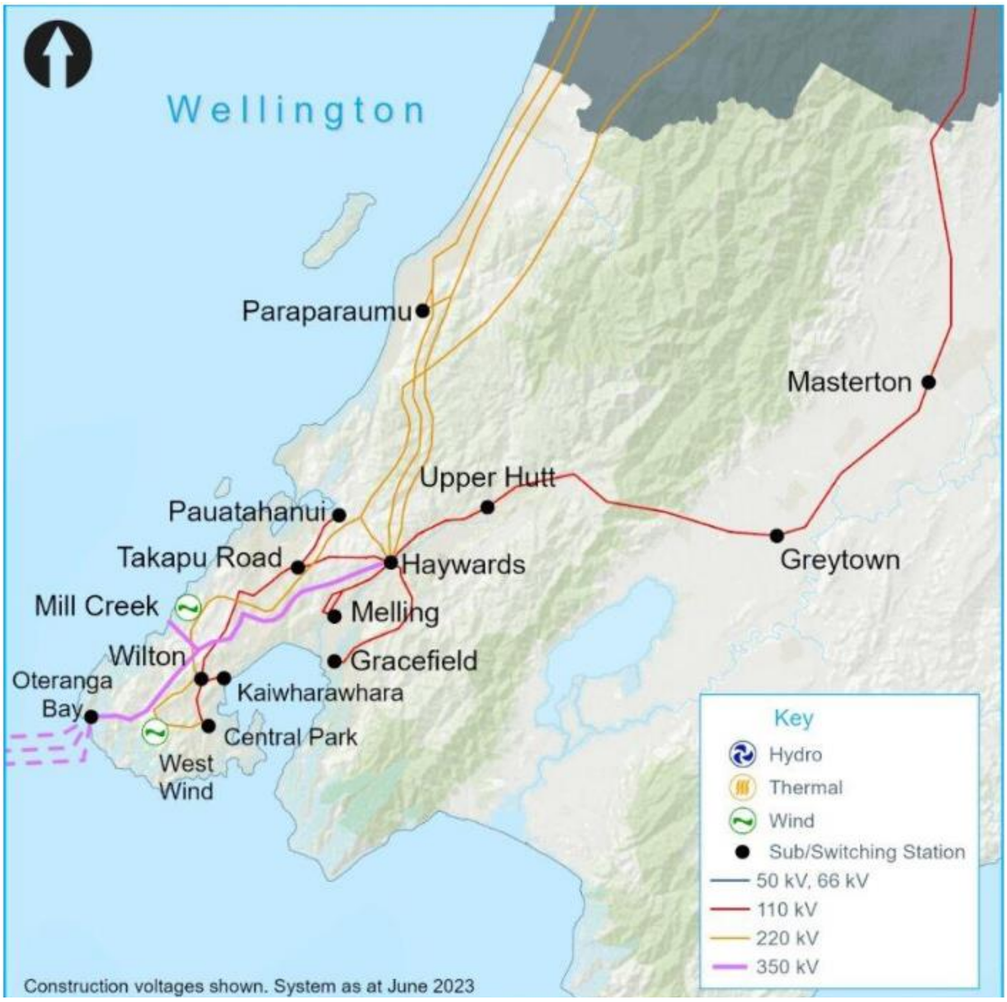


Figure 6. Transmission/GXP substations[11]

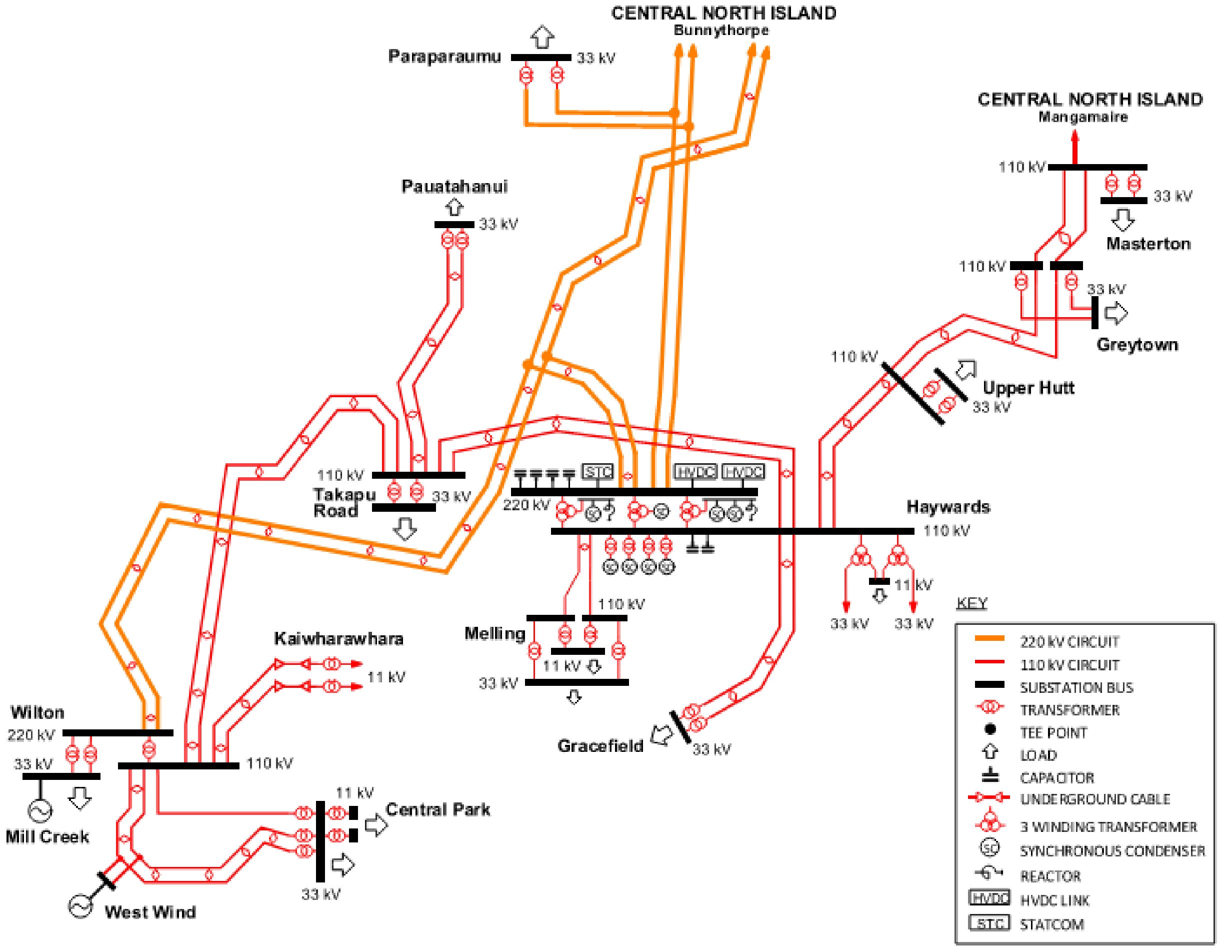


Figure 7. Existing transmission/GXP substations[11]

[11] *Transmission Planning Report 2023*.

4.2 Zone Substations

Zone substations are categorised by the EDB that owns and operates the network. As mentioned earlier, in the Wellington area there are three relevant EDB's – Electra, Powerco, and WE*. 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
Electra (Southern network)	6	1
Powerco (Wairarapa area)	13	2
Wellington Electricity (WE*)	33	12

4.2.1 Electra

Figure 8 shows the sub-transmission network, zone substations, and GXPs for Electra's region. The substations include:

- Paraparaumu GXP ("Southern" Network):
    - Ōtaki 33/11 kV zone substation
    - Waikanae 33/11 kV zone substation
    - Paraparaumu West 33/11 kV zone substation
    - Paraparaumu East 33/11 kV zone substation
    - Raumati 33/11 kV zone substation
    - Paekākāriki 33/11 kV zone substation

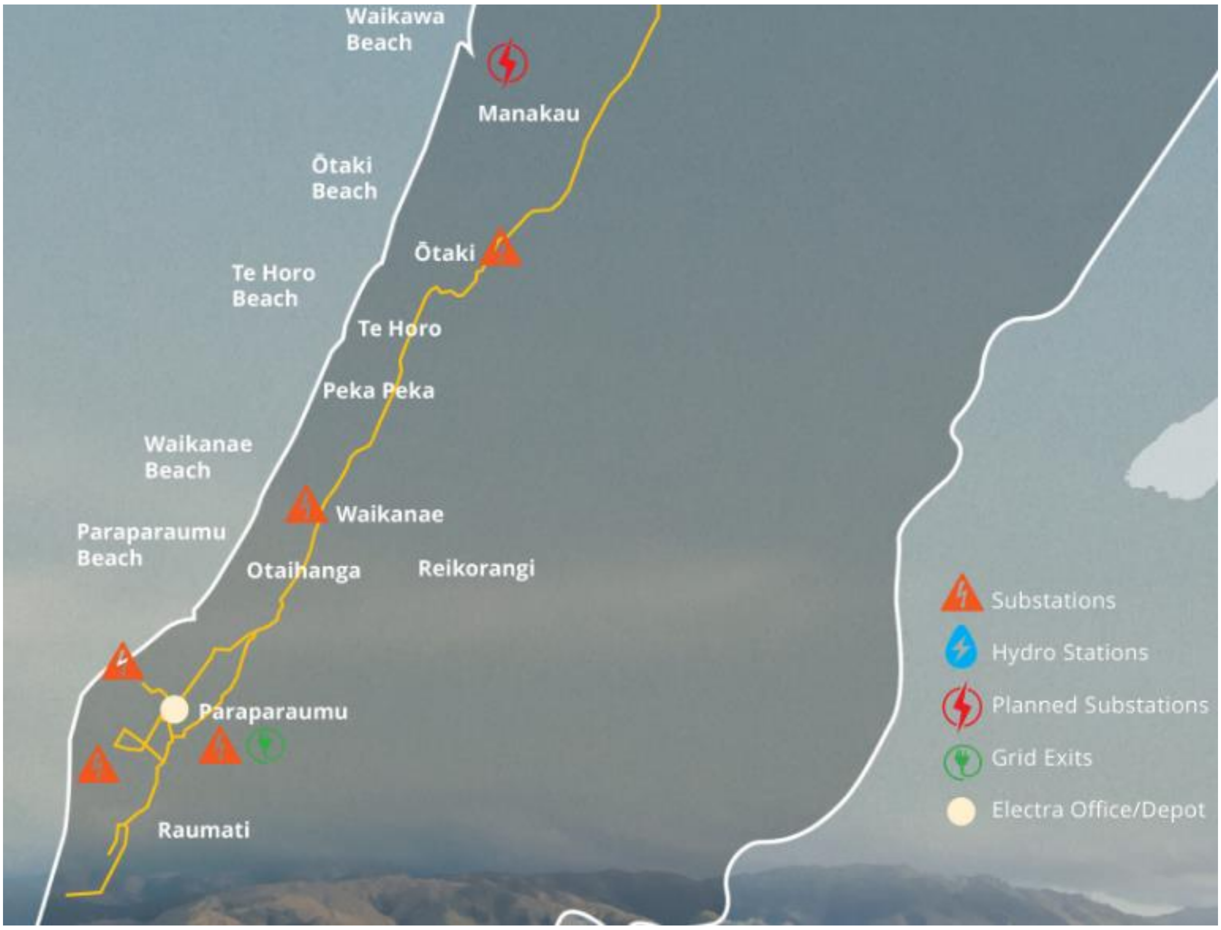


Figure 8. Electra zone substations and interconnecting sub-transmission circuits [12]

4.2.2 Powerco

Figure 9 shows the sub-transmission network, zone substations, and GXPs for Powerco's Wairarapa region. The substations include:

- Masterton GXP:
  - Akura 33/11 kV zone substation
  - Awatoitoi 33/11 kV zone substation
  - Chapel 33/11 kV zone substation
  - Clareville 33/11 kV zone substation
  - Gladstone 33/11 kV zone substation
  - Norfolk 33/11 kV zone substation
  - Te Ore Ore 33/11 kV zone substation
  - Tīnui 33/11 kV zone substation
- Greytown GXP:
  - Featherston 33/11 kV zone substation
  - Hau Nui 33/11 kV zone substation
  - Kempton 33/11 kV zone substation

[12] Electra's 2025 Asset Management Plan found here: https://electra.co.nz/our-company/disclosures/

- Martinborough 33/11 kV zone substation
- Tuhitarata 33/11 kV zone substation

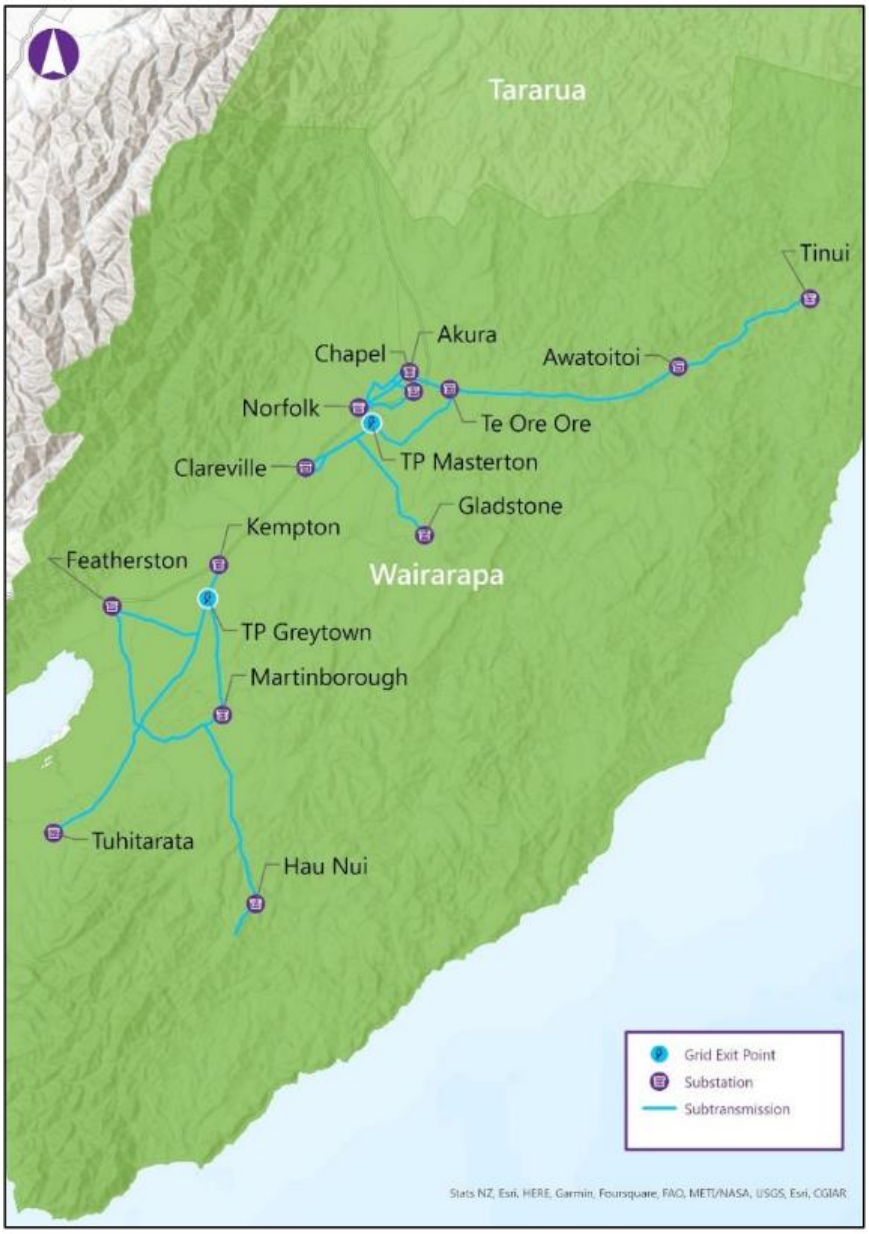


Figure 9. Powerco's Wairarapa region zone substations and interconnecting sub-transmission circuits [13]

[13] Powerco's 2023 Asset Management Plan found here: https://www.Powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures

4.2.3 Wellington Electricity (WE*)

Figure 10, Figure 11, and Figure 12 show the sub-transmission network, zone substations, and GXPs for the WE* region. The substations include:

- Central Park 11 kV and 33 kV GXPs:
  - 8 Ira Street 33/11 kV zone substation
  - Evans Bay 33/11 kV zone substation
  - Frederick Street 33/11 kV zone substation
  - Hataitai 33/11 kV zone substation
  - Nairn Street 33/11 kV zone substation
  - Palm Grove 33/11 kV zone substation
  - The Terrace 33/11 kV zone substation
  - University 33/11 kV zone substation
- Gracefield GXP:
  - Gracefield 33/11 kV zone substation
  - Korokoro 33/11 kV zone substation
  - Seaview 33/11 kV zone substation
  - Wainuiomata 33/11 kV zone substation
  - Petone 11 kV switching station
- Haywards 11 kV and 33 kV GXPs:
  - Haywards 11 kV zone substation
  - Trentham 33/11 kV zone substation
- Kaiwharawhara GXP:
  - Kaiwharawhara 11 kV zone substation
- Melling 11 kV and 33 kV GXPs:
  - Melling 11 kV zone substation
  - Naenae 33/11 kV zone substation
  - Waterloo 33/11 kV zone substation
- Pāuatahanui GXP:
  - Mana 33/11 kV zone substation
  - Plimmerton 33/11 kV zone substation
- Takapu Road GXP:
  - Johnsonville 33/11 kV zone substation
  - Kenepuru 33/11 kV zone substation
  - Ngauranga 33/11 kV zone substation
  - Porirua 33/11 kV zone substation
  - Tawa 33/11 kV zone substation
  - Waitangirua 33/11 kV zone substation
  - Tītahi Bay 11 kV switching station
- Upper Hutt GXP:
  - Maidstone 33/11 kV zone substation
  - Brown Owl 33/11 kV zone substation
- Wilton GXP:
  - Karori 33/11 kV zone substation
  - Moore Street 33/11 kV zone substation

- Waikowhai Street 33/11 kV zone substation

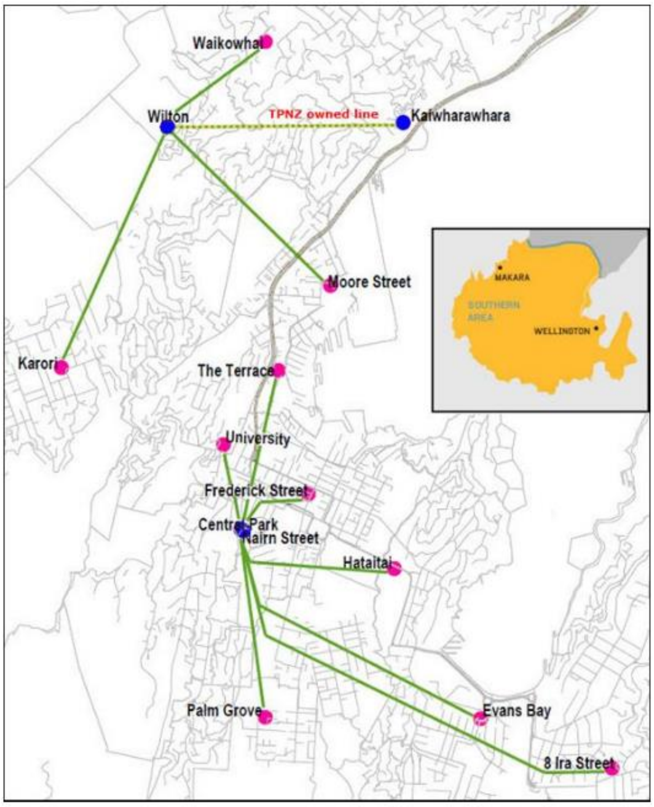


Figure 10. WE*'s Southern area zone substations and interconnecting sub-transmission circuits[14]

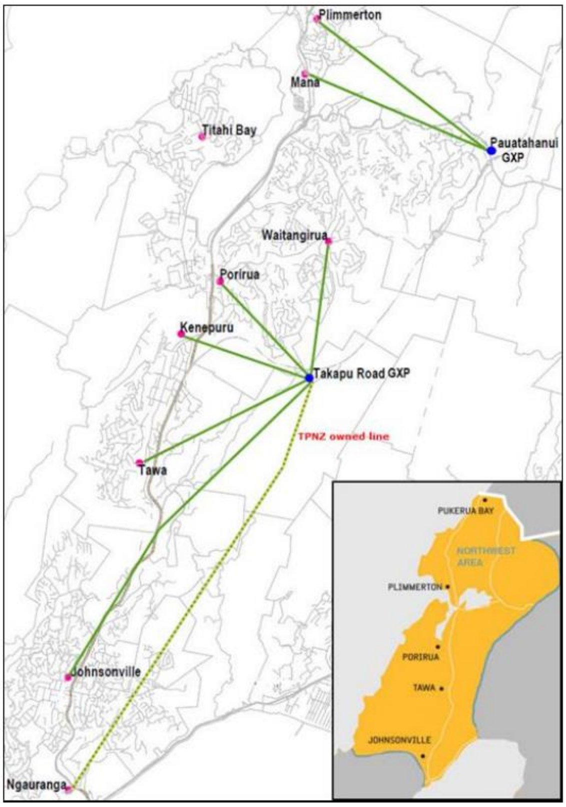


Figure 11. WE*s Northeast area zone substations and interconnecting sub-transmission circuits[14]

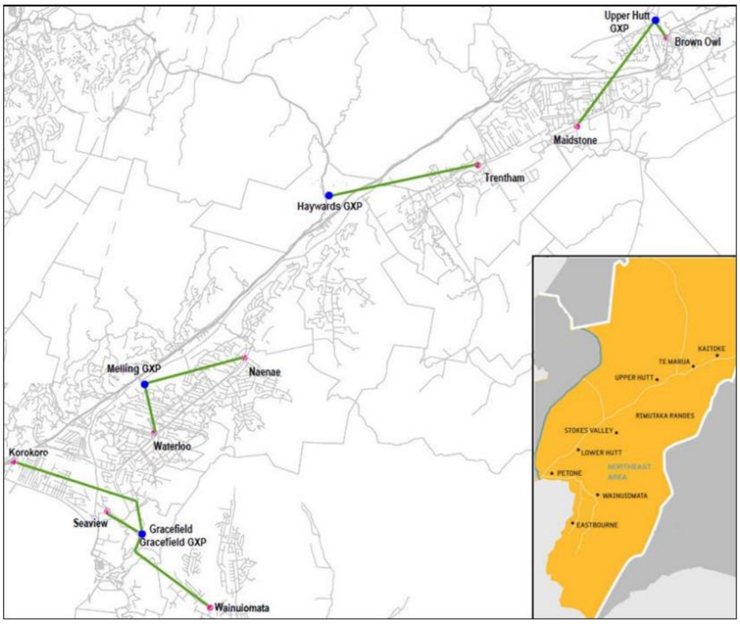


Figure 12. WE*'s Northwest area zone substations and interconnecting sub-transmission circuits [14]

[14] WE* 2025 Asset Management Plan found here: https://www.welectricity.co.nz/disclosures/asset-management-plan

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

Both Transpower and the EDB's 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)[15]. 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., Electra, Powerco, or WE*). 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.

[15] 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 must make security of supply decisions on behalf of their consumers. These decisions are based on the EDB's disclosed network security criteria/standards, that have been approved 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. 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[16] 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) capacity, 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.

[16] Demand side participation | Transpower

6. Spare Capacity – Transmission Substations (GXPs)

The following sections document the spare capacity that is available at the GXP's that supply the Wellington region.

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

- There are no line circuit breakers at Greytown, so an outage on a Greytown-Upper Hutt circuit will remove the corresponding Greytown-Masterton circuit, and vice-versa.
- During an outage of either Masterton-Greytown-Upper Hutt circuit, the Greytown-Upper Hutt section of the remaining circuit may exceed its summer rating for:
    - Periods of high HVDC north transfer coupled with high wind generation in the Wellington region; or
    - Periods where an operational split at Mangamaire is used to manage system conditions in the Central North Island.
- During periods of high HVDC north transfer and low wind generation in the Wairarapa region, an outage on either of the Haywards-Upper Hutt circuits may result in overloading on the remaining Haywards-Upper Hutt circuit.
- During periods of high HVDC north transfer, low wind generation in the Wellington region, and high Wellington loads, the online 220/110 kV interconnecting transformers at Haywards can overload for an outage of either the Wilton interconnecting transformer, or one of the Wellington interconnecting transformers. This issue is expected to arise in the next 5-10 years. Long-term, Transpower plans to install a second interconnecting transformer at Wilton, to manage this issue, at a cost of approximately $12 M.

Figure 13 below illustrates Transpower's view of a possible 2038 configuration for the Wellington region's transmission network. It includes:

- Scheduled replacement of the 110 kV Haywards-Upper Hutt lines.
- Scheduled replacement of the 220 kV Wilton-Haywards Tee lines.
- Scheduled replacement of the 33 kV bus at Greytown, Melling, and Pāuatahanui GXPs.
- Scheduled replacement of the 110/33 kV transformers at Upper Hutt, Pāuatahanui, Melling, and Gracefield GXPs.
- Installation of a 33 kV split bus at Central Park GXP.
- Installation of a new 220/33 kV transformer at Wilton GXP.
- Installation of a new 110/33 kV transformer at Takapu Road GXP.
- Upgrade the 110/11 kV transformers at Kaiwharawhara and Melling GXPs.

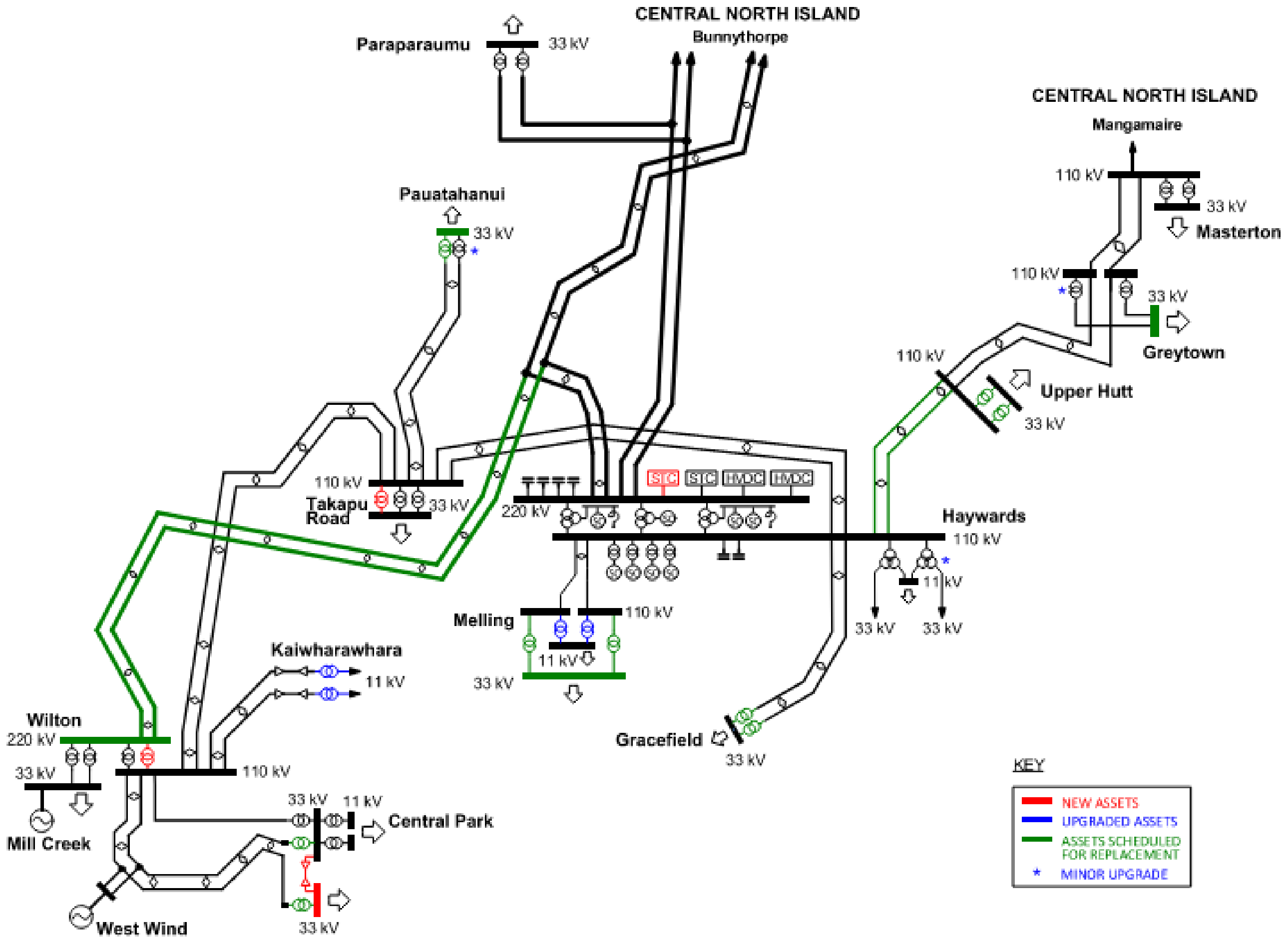


Figure 13. Existing transmission/GXP substations together with future possible upgraded/new assets[17]

[17] Transmission Planning Report 2023

6.1 Demand Forecast

Table 3 illustrates Transpower's forecast demand at the transmission substations in the Wellington region from its annual *Transmission Planning Report 2023*[18]. The forecast predicts the demand growing at an average of 1.7% per annum over the next fifteen years which is less than the national average of 2.0%.

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

GXP	Power factor	Peak demand (MW)											
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2038
Central Park 11 kV	1.00	24	24	25	25	25	26	26	26	27	27	27	28
Central Park 33 kV[1, 2]	0.99	161	166	173	176	180	183	186	189	190	191	193	195
Gracefield[6]	0.99	69	70	74	66	67	68	69	70	71	72	73	77
Greytown	0.99	17	17	17	18	18	18	18	19	19	19	19	19
Haywards 11 kV	1.00	21	25	26	26	27	27	28	28	29	29	29	31
Haywards 33 kV[1, 4]	0.99	22	26	26	26	27	27	27	26	26	26	27	27
Kaiwharawhara[1, 2]	0.99	34	46	47	48	48	49	50	50	51	52	52	54
Masterton[5]	0.99	50	53	56	57	58	59	60	60	61	61	62	62
Melling 11 kV	0.99	28	28	29	29	30	30	30	30	31	31	32	33
Melling 33 kV[1, 4]	1.00	40	44	44	55	55	57	57	58	59	59	60	62
Paraparaumu	1.00	72	74	75	76	78	79	81	82	83	84	86	88
Pāuatahanui[1, 3]	0.99	23	27	28	29	31	32	34	35	36	36	37	39
Takapu Road[1, 3]	1.00	110	119	122	126	129	132	135	137	139	140	142	147
Upper Hutt[1, 4]	1.00	36	39	40	40	42	44	46	48	48	49	49	50
Wilton	1.00	56	57	57	58	58	59	60	60	61	61	62	62

Notes:

1. Forecasts include step increases in demand as advised by Wellington Electricity.
2. Central Park and Kaiwharawhara growth from expected public transport electrification upgrades and several new buildings planned, step load increase of 8 MW expected in 2024.
3. Takapu Road and Pāuatahanui growth from public transport electrification and significant residential developments north of Porirua.
4. Haywards, Upper Hutt, Melling – public transport electrification and residential developments in Upper Hutt, Wallaceville, Manor Park, Naenae, Waterloo, and Wainuiomata.
5. Masterton – new development with step load increase in 2025 and 2026.
6. Gracefield – forecast decreases in 2026 due to load shift to Melling.

[18] Transmission Planning Report 2023

6.1.1 Central Park 11 kV and 33 kV GXPs

Transpower's demand forecast indicates that the Central Park 33 kV GXP was expected to have a 2023 peak demand of 161 MW at 0.99 power factor (~162.6 MVA). This value compares to the historical SCADA data that indicates the Central Park 33 kV GXP recorded a peak load of 145.1 MVA during the 2023 year (a difference of ~11%). The value aligns well with the historical SCADA data, when the loading of the 11 kV GXP is summed with that of the 33 kV GXP, at a peak load of 167.6 MVA.

Transpower's demand forecast indicates that the Central Park 11 kV GXP was expected to have a 2023 peak demand of 24 MW at 1.00 power factor (24 MVA). This value aligns with the historical SCADA data that indicates the Central Park 11 kV GXP recorded a peak load of 22.5 MVA during the 2023 year.

The Central Park 33 kV GXP is equipped with three 110/33 kV transformers (one rated at 120 MVA, and the other two at 100 MVA) providing:

- (N) capacity of 320 MVA and
- (N-1) capacity of 200 MVA.

Ergo notes that the 110/33 kV transformers supply both the 33 kV and the 11 kV bus (via the 33/11 kV transformers), so loading of the 110/33 kV transformers is best assessed when both the 33 kV and 11 kV GXP loads are considered.

The Central Park 11 kV GXP is equipped with two 33/11 kV transformers providing:

- (N) capacity of 50 MVA and
- (N-1) capacity of 25 MVA.

The 11 kV GXP is normally operated with its 11 kV bus split.

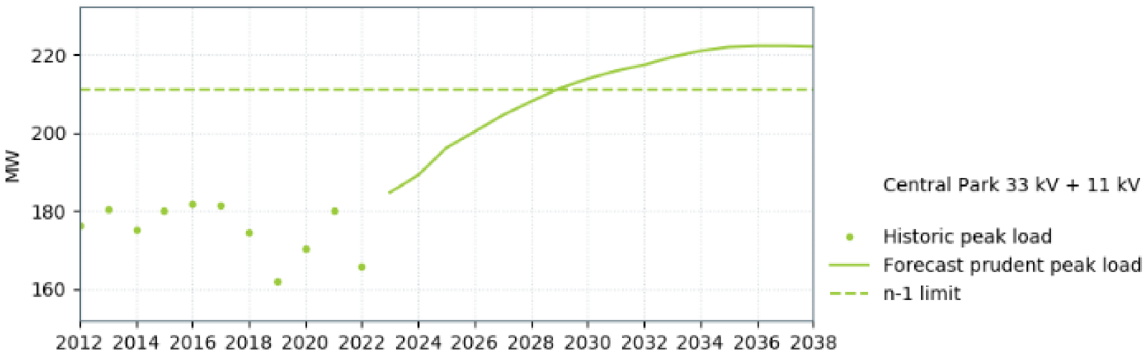
Central Park GXP is supplied at 110 kV by three circuits from Wilton:

- Two of which also tee off to the West Wind GIP, and are rated at 192/234 MVA (summer/winter) from the tee to Central Park and 214/238 MVA (summer/winter) from the tee to Wilton, and
- The third is rated at 190/207 MVA (summer/winter).

Peak load at Central Park is expected to exceed the (N-1) capacity of the 110/33 kV supply transformers from 2029. Transpower has identified that two of the three 110/33 kV transformers are due for risk-based condition replacement within the next 15 years, with the first replacement expected in 2025-2027. Transpower indicates in the *Transmission Planning Report 2023* that they are intending to discuss the size of the replacement transformers with Wellington Electricity. In the short term, Wellington Electricity has some capability to transfer load from Central Park GXP to Wilton GXP if required.

The following graph[19] compares Central Park 33 kV GXP's supply capacity with the historical loading and Transpower's demand forecast (including both the 33 kV and 11 kV GXPs).

[19] 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 14 illustrates Central Park 33 kV GXP's 2023 loading in comparison to its substation capacity (including both the 33 kV and 11 kV GXPs).

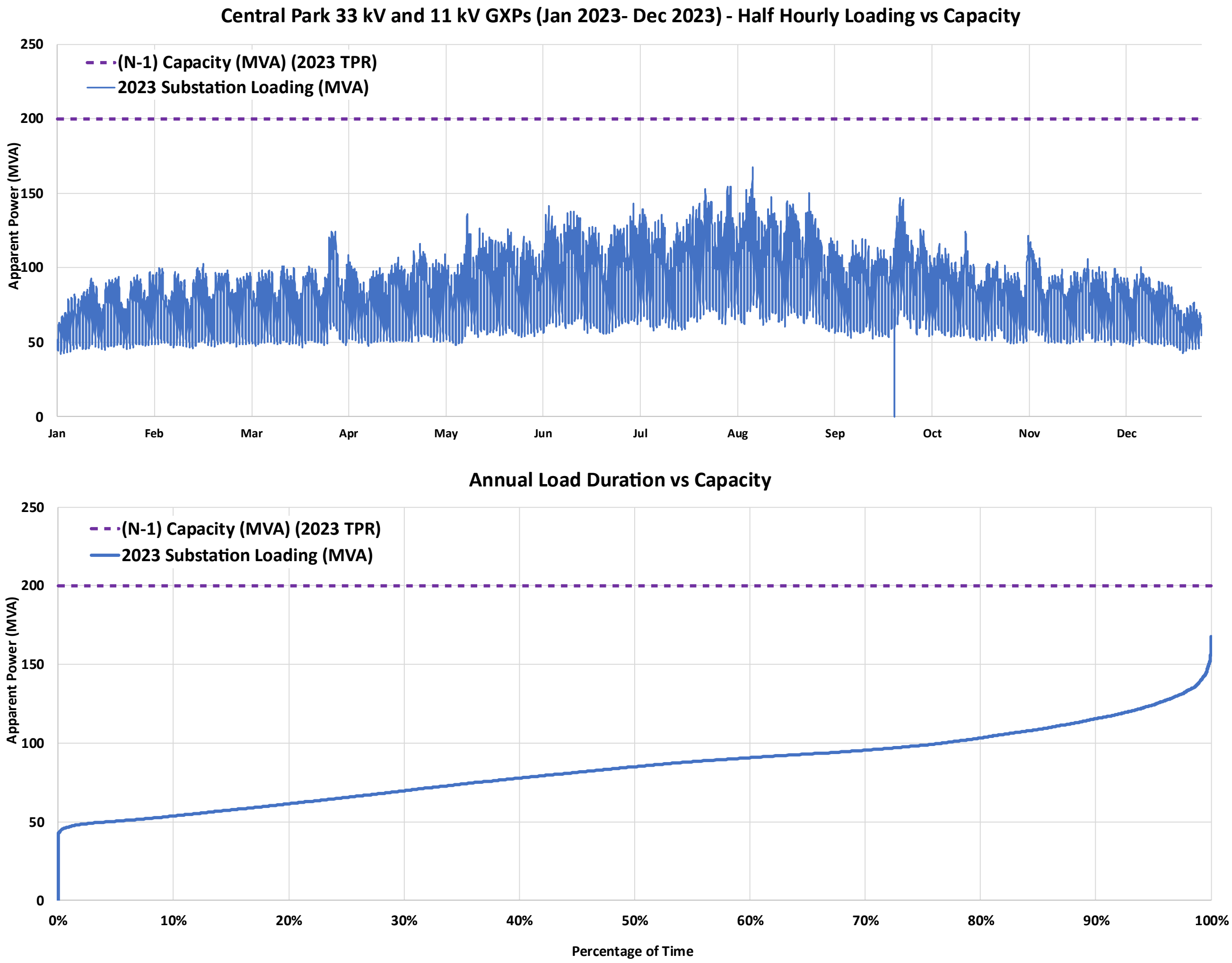
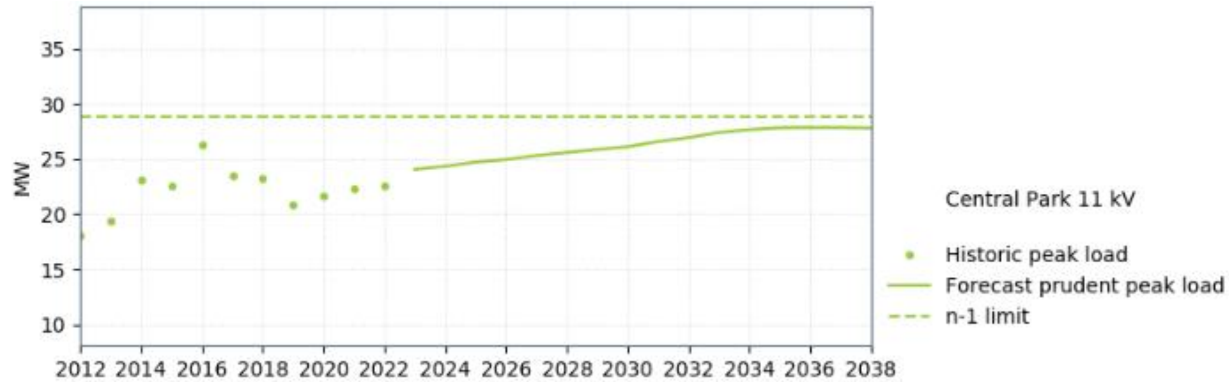


Figure 14. Central Park 33 kV GXP: 2023 Loading: Substation capacity.

The following graph[20] shows Central Park 11 kV GXP's 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 15 illustrates Central Park 11 kV's 2023 loading in comparison to its substation capacity.

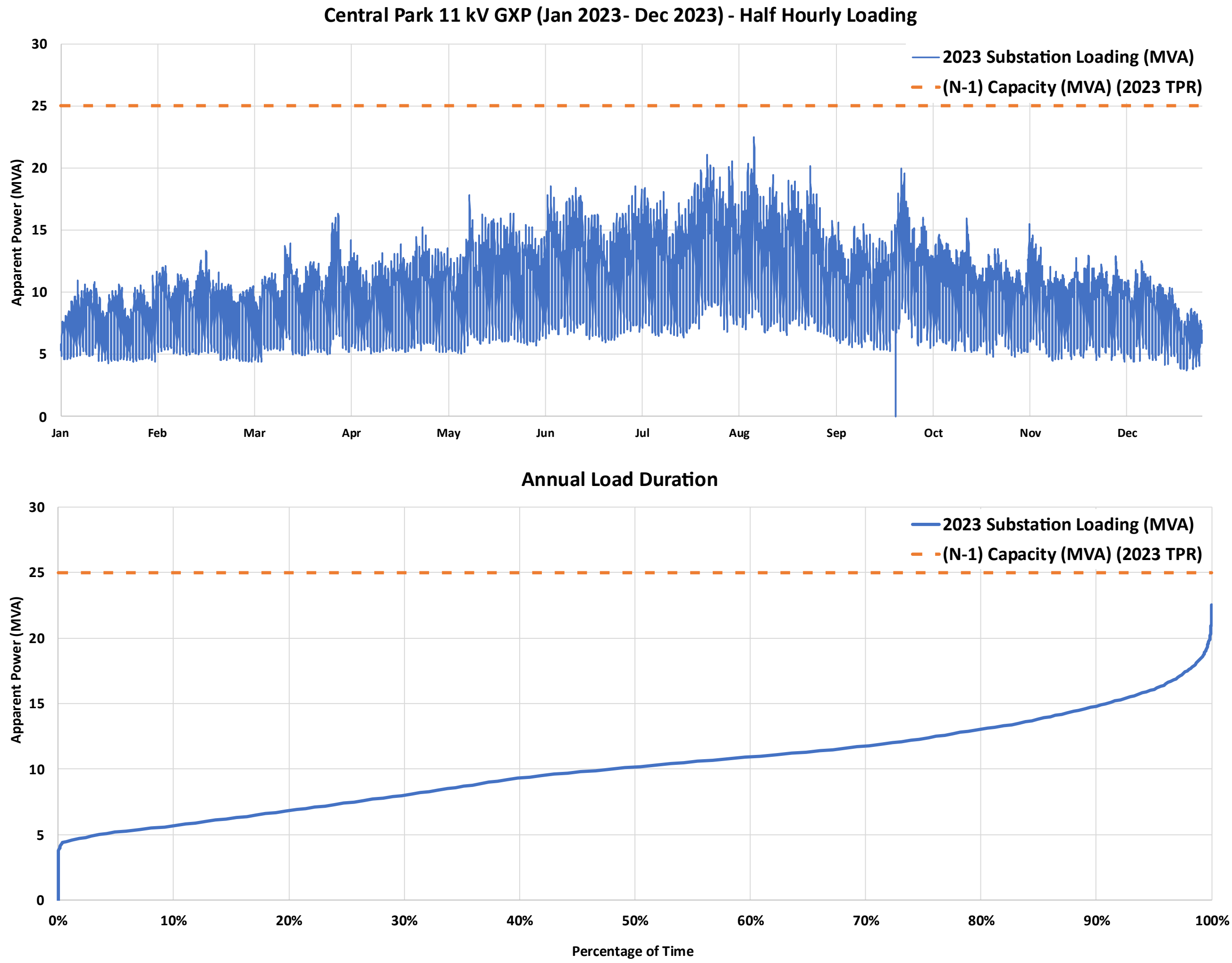


Figure 15. Central Park 11 kV GXP: 2023 Loading: Substation capacity.

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

6.1.2 Gracefield GXP

Transpower's demand forecast indicates that the Gracefield GXP was expected to have a 2023 peak demand of 69 MW at 0.99 power factor (~69.7 MVA). This compares with the historical SCADA data that indicates that during 2023 the Gracefield GXP experienced a peak load of 63.6 MVA (~9% difference to forecast).

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

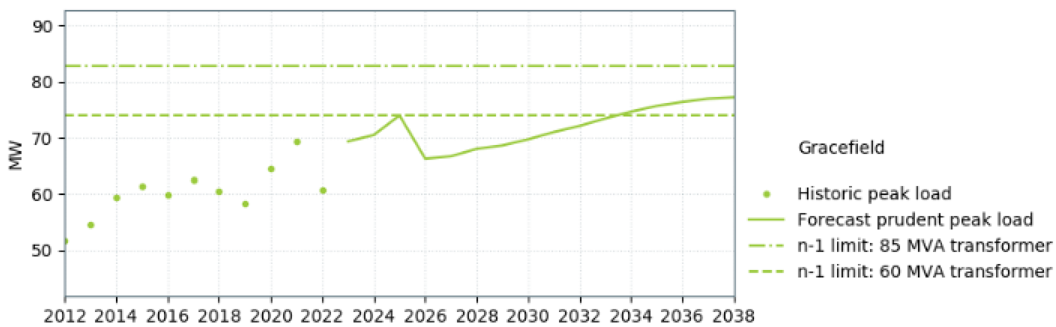
- (N) capacity of 145 MVA and
- (N-1) capacity of 73 MVA (estimated from the graph below).

The transformer capacity is limited by the strategic spare transformer.

Gracefield is supplied by two 110/33 kV circuits, each rated at 108/112 MVA (summer/winter). Each of the two 110 kV circuits is connected directly to one of the transformers at the GXP (i.e. there is no 110 kV bus at Gracefield).

Peak load at Gracefield is forecast to exceed the (N-1) capacity of the transformers from winter of 2034. Transpower is planning to carry out a replacement of the strategic spare transformer (the smaller of the two transformers) in 2024-2026. The other transformer at the site is scheduled for risk-based condition replacement nearer the end of the forecast period, at which point an appropriate rating for the new transformer will be discussed with Wellington Electricity.

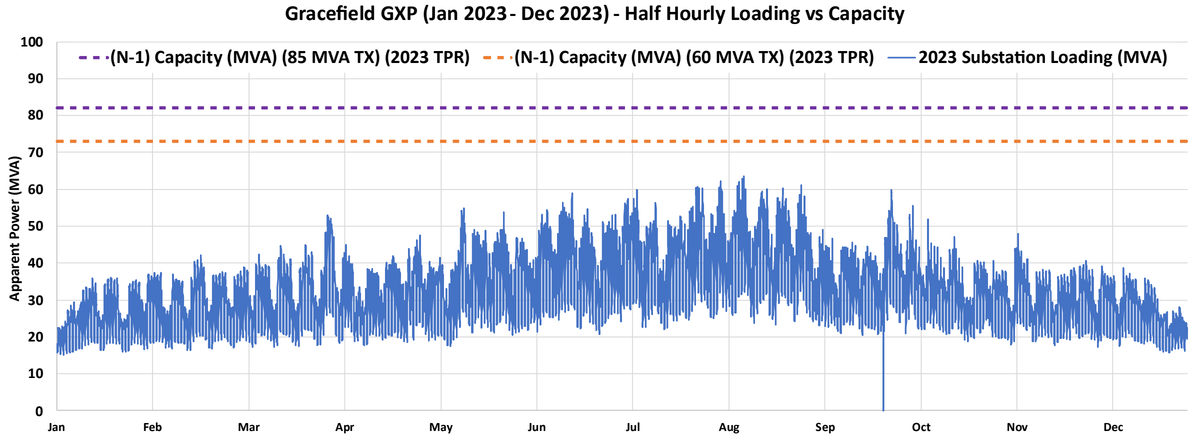
The following graph[21] compares Gracefield GXP's supply capacity with the historical loading and Transpower's demand forecast.



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 16 illustrates Gracefield's 2023 loading in comparison to its substation capacity.

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



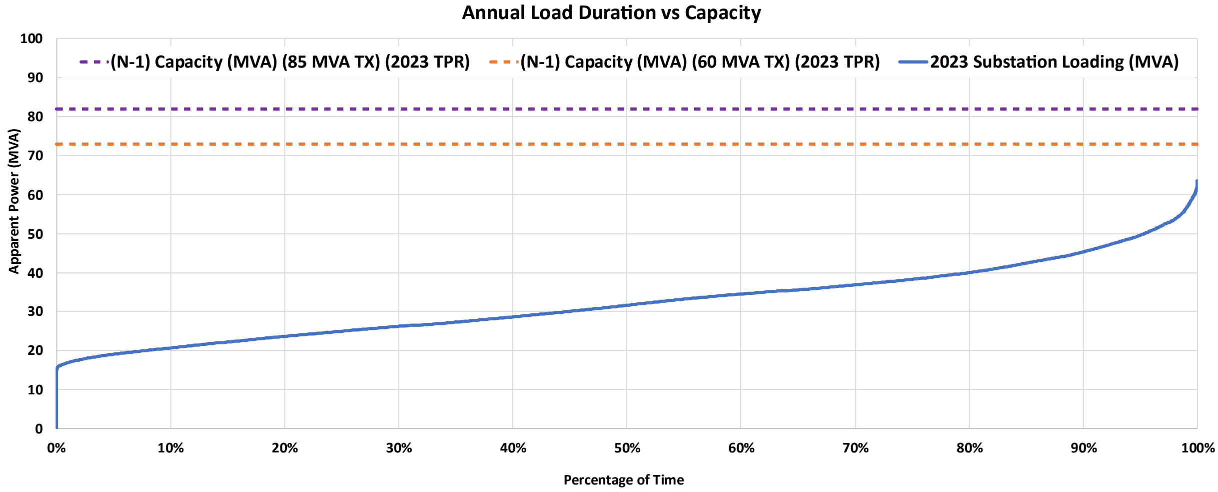


Figure 16. Gracefield GXP: 2023 Loading: Substation capacity

6.1.3 Greytown GXP

Transpower's demand forecast indicates that the Greytown GXP was expected to have a 2023 peak demand of 17 MW at 0.99 power factor (~17.2 MVA). This compares with the historical SCADA data that indicates that during 2023 the Greytown GXP experienced a peak load of 14.5 MVA.

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

- (N) capacity of 40 MVA and
- (N-1) capacity of 20 MVA.

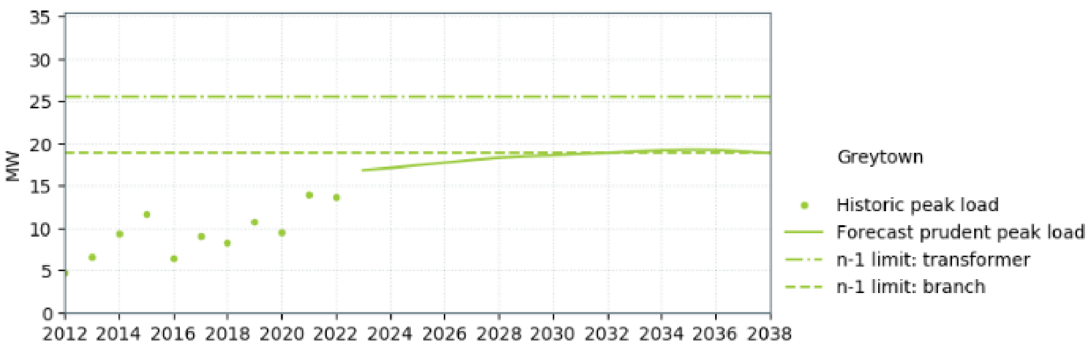
The transformer capacity is limited by a metering limit.

Greytown is supplied via the two 110 kV Masterton-Greytown-Upper Hutt circuits, both of which are rated to 88/97 MVA (summer/winter) for the Greytown to Masterton section, and 63/77 MVA (summer/winter) for the Greytown to Upper Hutt section.

As discussed earlier, there are no line circuit breakers for the two Masterton-Greytown-Upper Hutt circuits at Greytown. Therefore, a fault on any section of one Masterton-Greytown-Upper Hutt circuit will disconnect the entire circuit, thereby also disconnecting the associated 110/33 kV transformer at Greytown.

Peak load at Greytown is expected to exceed the transformer (N-1) capacity from winter of 2033. Transpower expects that removing the metering limit (at a cost of $100 k) will resolve the capacity issue at Greytown for the planning period.

The following graph[22] compares Greytown 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 Greytown's 2023 loading in comparison to its substation capacity.

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

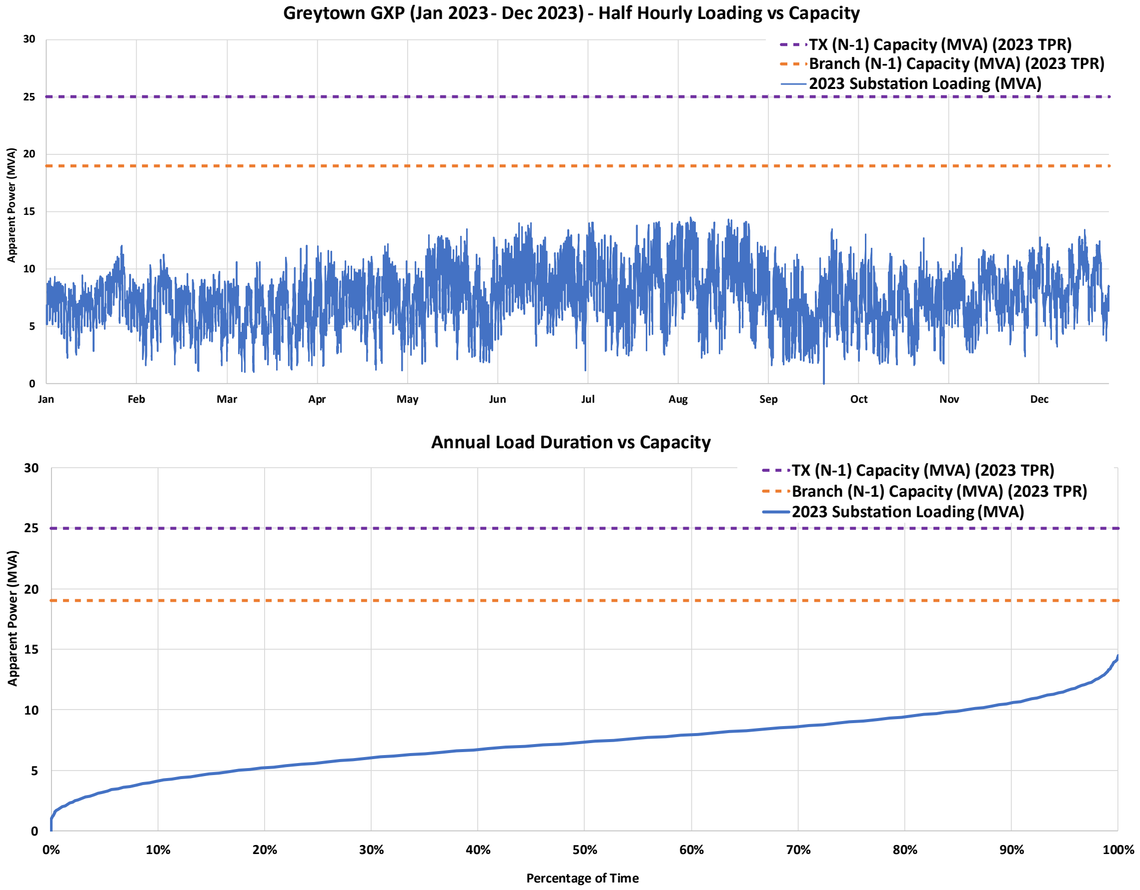


Figure 17. Greytown GXP: 2023 Loading: Substation capacity

6.1.4 Haywards 11 kV and 33 kV GXPs

Transpower's demand forecast indicates that the Haywards 11 kV GXP was expected to have a 2023 peak demand of 21 MW at 1.00 power factor (21 MVA). This aligns with the historical SCADA data that indicates that during 2023, the Haywards 11 kV GXP experienced a peak load of 19.3 MVA.

Transpower's demand forecast indicates that the Haywards 33 kV GXP was expected to have a 2023 peak demand of 22 MW at 0.99 power factor (~22.2 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Haywards 33 kV GXP experienced a peak load of 18.7 MVA.

When the loads of the Haywards 11 kV and 33 kV GXPs are combined, the 2023 peak is 38 MVA. Given this is approximately equal to the sum of the peaks of the two loads, there is little diversity between the two loads at present.

Haywards is equipped with two 110/33/11 kV transformers providing the 33 kV and 11 kV GXPs:

- (N) secure capacity of 60 MVA and
- (N-1) capacity of 30 MVA.

The transformer's 33 kV capacity is limited by a protection limit.

Ergo notes that the transformers are shared between the 11 kV and 33 kV GXPs, and while each transformer is rated to 60 MVA, this corresponds to 30 MVA capacity on the 33 kV bus and 30 MVA capacity on the 11 kV bus, per transformer.

Haywards is the main interconnecting point in the Wellington region, with four 220 kV circuits (all of which connect to Bunnythorpe), and eight 110 kV circuits. Two of the 220 kV circuits tee to Wilton and are rated to 694/762 MVA (summer/winter); the other two tee off to Paraparaumu and are rated at 354/390 MVA (summer/winter). Of the 110 kV circuits:

- Two connect to Takapu Road, and are rated at 411/431 MVA (summer/winter),
- Two connect to Upper Hutt, and are rated at 104/108 MVA (summer/winter),
- Two connect to Gracefield, and are rated at 107/111 MVA (summer/winter), and
- Two connect to Melling and are rated at 95/101 MVA (summer/winter).

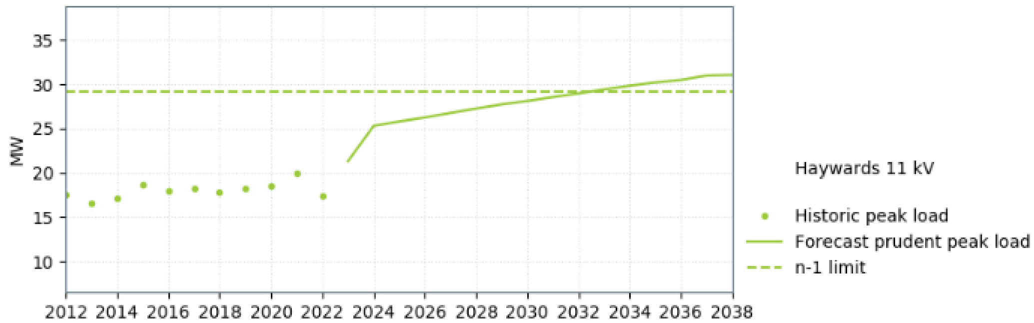
Haywards is also the connection point of the inter-island HVDC link, which can transfer up to 1200 MW north from the South Island, or 850 MW south from the North Island.

Haywards is the location of a significant amount of grid support assets, including a number of synchronous condensers, reactors, capacitors, and a STATCOM. Three of the four 220/110 kV interconnecting transformers are located at Haywards, each rated at 200 MVA; the fourth is located at Wilton and is rated at 250 MVA.

Peak load at Haywards 11 kV is forecast to exceed the (N-1) capacity of the transformers by winter of 2033. Similarly, peak load at Haywards 33 kV was forecast to exceed the (N-1) capacity of the transformers from winter of 2024. The 33 kV GXP capacity issue is expected to be resolved by removing the protection limit, which is expected to cost $100 k.

The combined peak load at Haywards 33 kV and 11 kV is expected to be within the (N-1) capacity of the supply transformers (Ergo assumes this is relating to the rating of the 110 kV winding of the transformers) for the planning period.

The following graph[23] compares Haywards 11 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 18 illustrates Haywards 11 kV GXP's 2023 loading in comparison to its substation capacity.

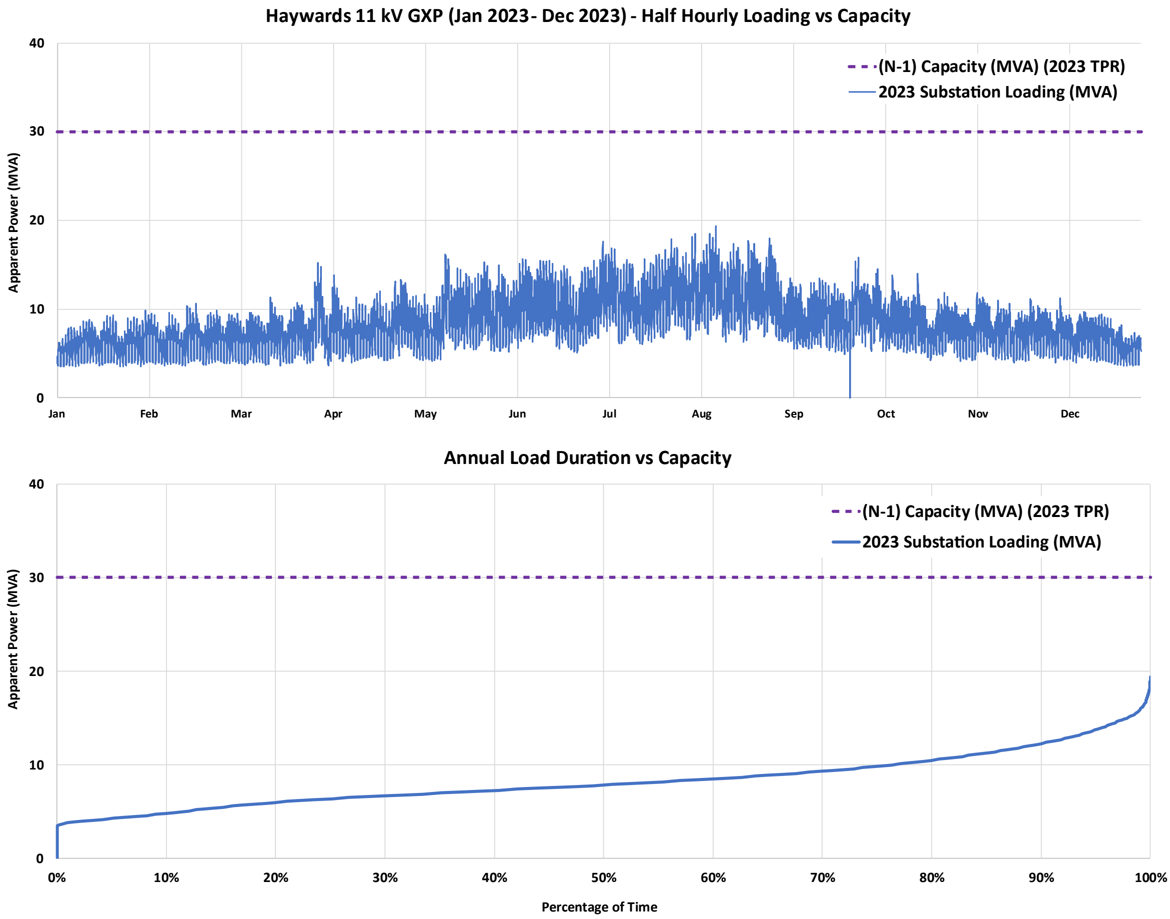
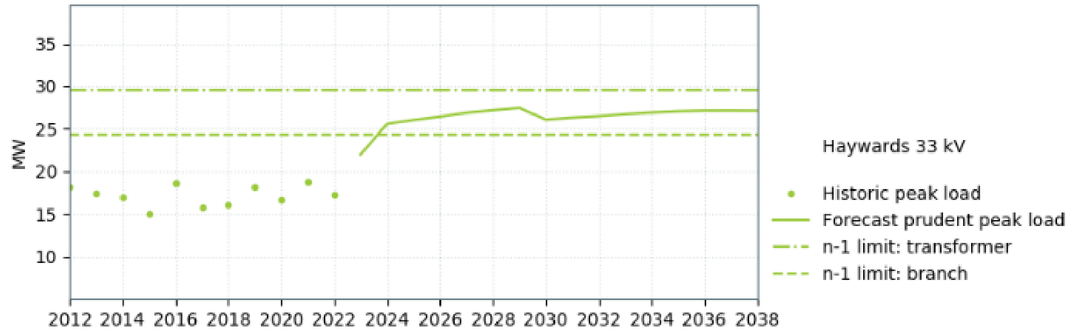


Figure 18. Haywards 11 kV GXP: 2023 Loading: Substation capacity

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

The following graph[24] compares Haywards 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 18 illustrates Haywards 33 kV GXP's 2023 loading in comparison to its substation capacity.

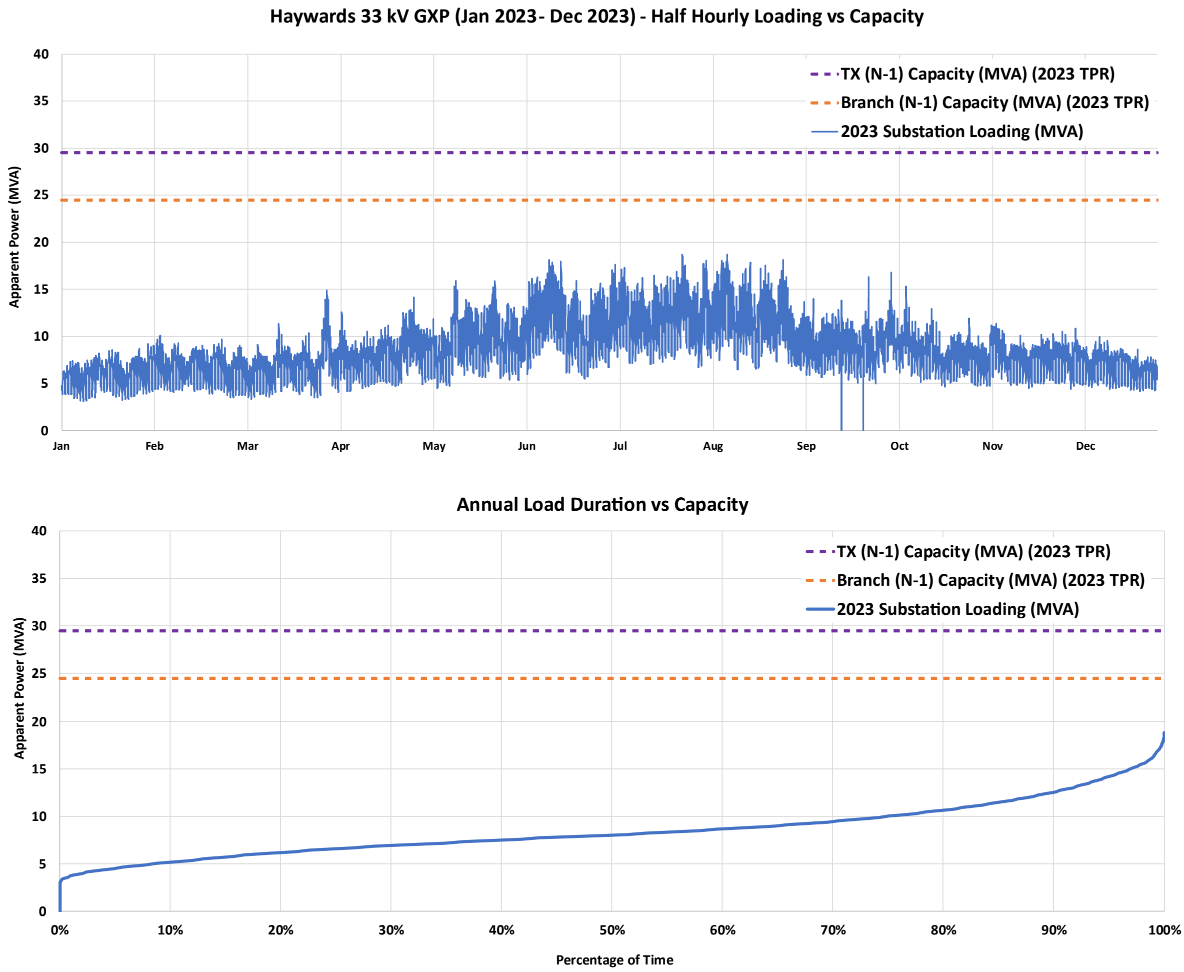
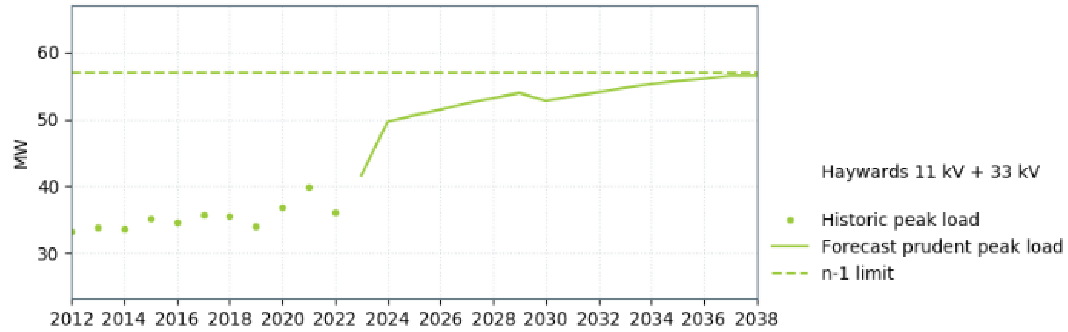


Figure 19. Haywards 33 kV GXP: 2023 Loading: Substation capacity

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

The following graph[25] compares Haywards 33 kV and 11 kV GXPs' combined 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 18 illustrates Haywards 33 kV and 11 kV GXPs' combined 2023 loading in comparison to the substation capacity.

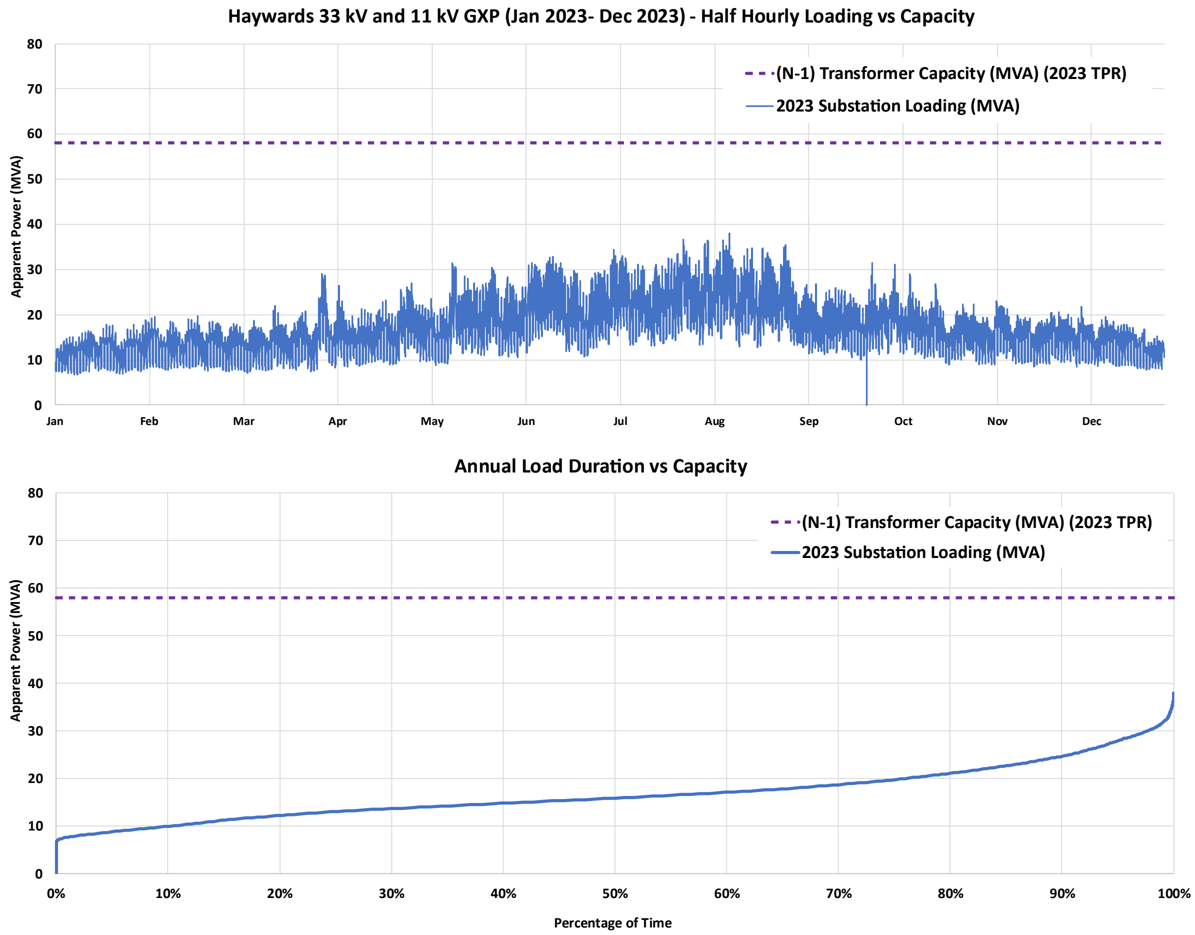


Figure 20. Haywards 33 kV and 11 kV GXPs combined: 2023 Loading: Substation capacity

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

6.1.5 Kaiwharawhara GXP

Transpower's demand forecast indicates that the Kaiwharawhara GXP was expected to have a 2023 peak demand of 34 MW at 0.99 power factor (~34.3 MVA). This contrasts with the historical SCADA data that indicates that, during 2023, the Kaiwharawhara GXP experienced a peak load of 28.6 MVA (17% lower than forecast).

The Kaiwharawhara GXP is equipped with two 110/11 kV transformers providing:

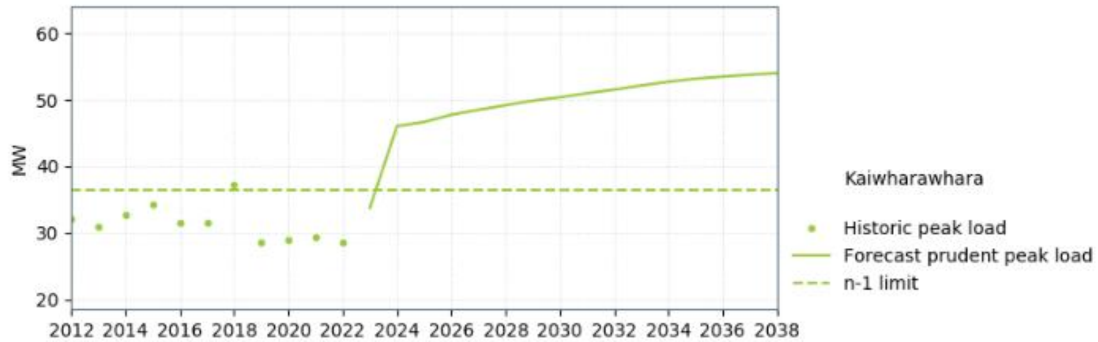
- (N) secure capacity of 60 MVA and
- (N-1) capacity of 30 MVA.

The transformer capacity is limited by the rating of the Wellington Electricity-owned 11 kV circuit breakers.

Kaiwharawhara is supplied by two 110 kV circuits from Wilton which are rated to 57/66 MVA (summer/winter). The capacity of the 110 kV circuits is limited by a cable section. Each 110 kV circuit is connected directly to one of the 110/11 kV transformers (i.e. there is no 110 kV bus), so a loss of either of the 110 kV circuit also results in a loss of the associated transformer.

The Kaiwharawhara peak load was forecast to exceed the (N-1) capacity of the transformers from winter of 2024. Transpower plans to discuss longer term options to resolve this issue, with one option being to replace the existing Kaiwharawhara transformers with larger units.

The following graph[26] compares Kaiwharawhara 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 Kaiwharawhara's 2023 loading in comparison to its substation capacity.

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

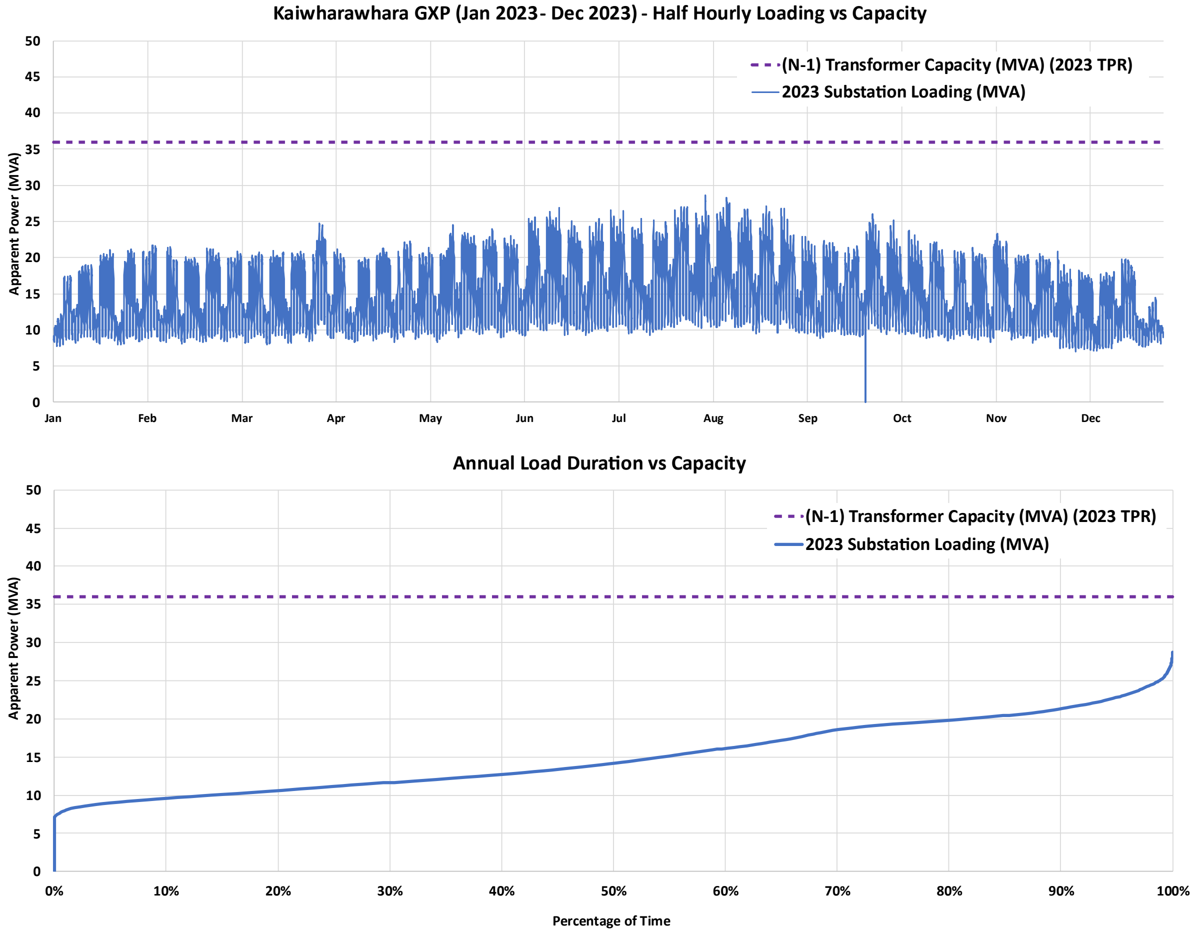


Figure 21. Kaiwharawhara GXP: 2023 Loading: Substation capacity

6.1.6 Masterton GXP

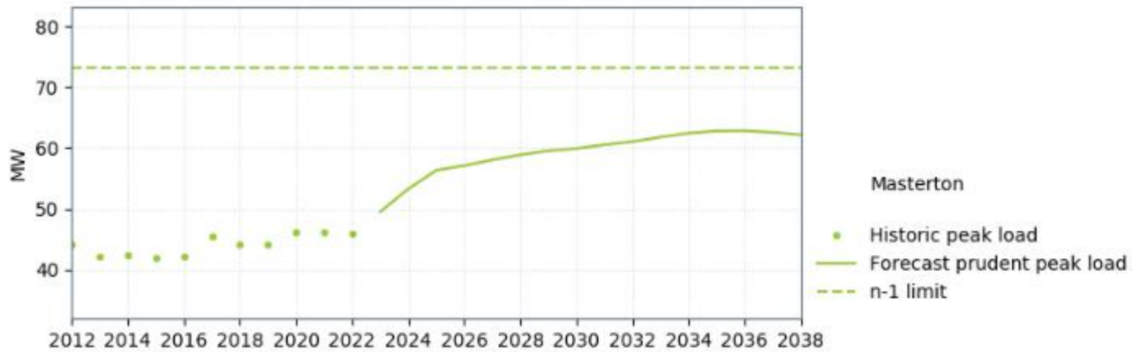
Transpower's demand forecast indicates that the Masterton GXP was expected to have a 2023 peak demand of 50 MW at 0.99 power factor (~50.5 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Marton GXP experienced a peak load of 47.2 MVA.

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

- (N) secure capacity of 120 MVA and
- (N-1) capacity of 60 MVA.

Masterton is supplied via the two 110 kV Masterton-Greytown-Upper Hutt circuits, both of which are rated to 88/97 MVA (summer/winter) for the Greytown to Masterton section, and 63/77 MVA (summer/winter) for the Greytown to Upper Hutt section.

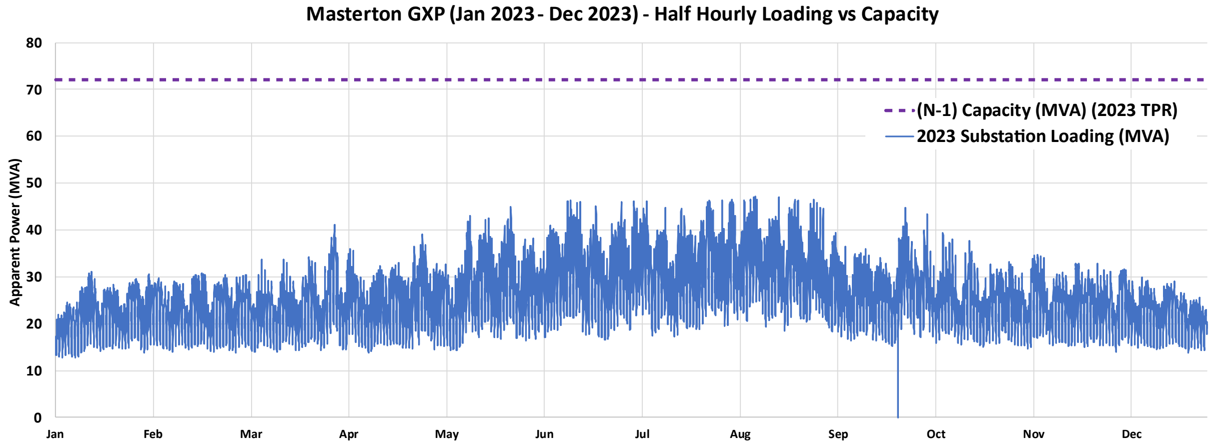
The following graph[27] compares Masterton GXP's supply capacity with the historical loading and Transpower's demand forecast.



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 Masterton's 2023 loading in comparison to its substation capacity.

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



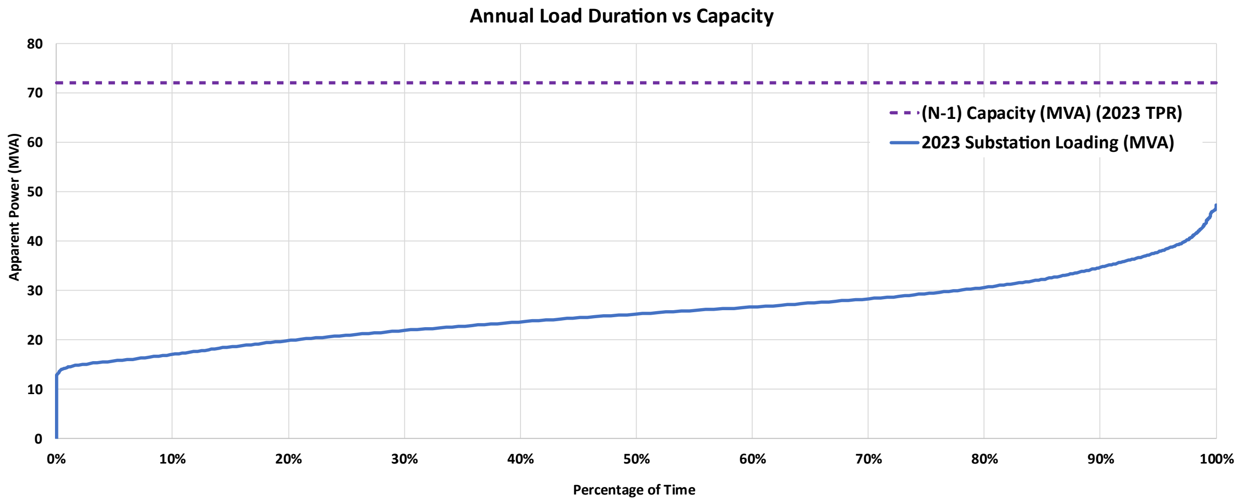


Figure 22. Masterton GXP: 2023 Loading: Substation capacity

6.1.7 Melling 11 kV and 33 kV GXPs

Transpower's demand forecast indicates that the Melling 11 kV GXP was expected to have a 2023 peak demand of 28 MW at 0.99 power factor (~28.3 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Melling 11 kV GXP experienced a peak load of 26.1 MVA.

Transpower's demand forecast indicates that the Melling 33 kV GXP was expected to have a 2023 peak demand of 40 MW at 1.00 power factor (40 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Melling 33 kV GXP experienced a peak load of 37.3 MVA.

The Melling 11 kV GXP is equipped with two 110/11 kV transformers providing:

- (N) secure capacity of 50 MVA and
- (N-1) capacity of 32 MVA.

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

- (N) secure capacity of 100 MVA and
- (N-1) capacity of 50 MVA.

The 110/33 kV transformer's winter capacity is limited by the 33 kV current transformers (CTs).

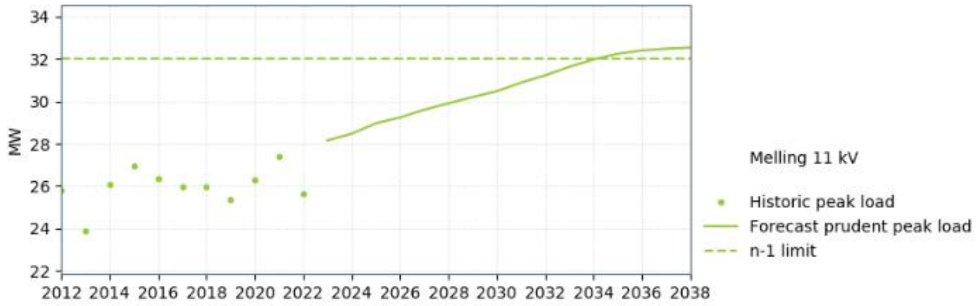
Melling takes supply at 110 kV via two 110 kV circuits from Haywards. The two circuits are rated at 95/101 MVA (summer/winter). An outage of either 110 kV circuit also takes the associated 110/33 kV and 110/11 kV transformer out of service.

The 11 kV peak load is expected to exceed the (N-1) capacity of the supply transformers from winter of 2035. This may be resolved in the future by replacing the 110/11 kV transformers with larger units, at an expected cost of $8 M.

Peak load on the 33 kV GXP is expected to exceed the (N-1) capacity of the supply transformers from winter of 2038. However, for an outage of one of the 110 kV circuits, peak load at the 33 kV GXP is expected to result in a low 33 kV bus voltage from winter of 2035. This issue can be managed by changing the tap position of the 110/33 kV transformers as the load grows.

The following graph[28] shows Melling 11 kV GXP's historical loading and Transpower's demand forecast.

[28] 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 23 illustrates Melling 11 kV GXP's 2023 loading.

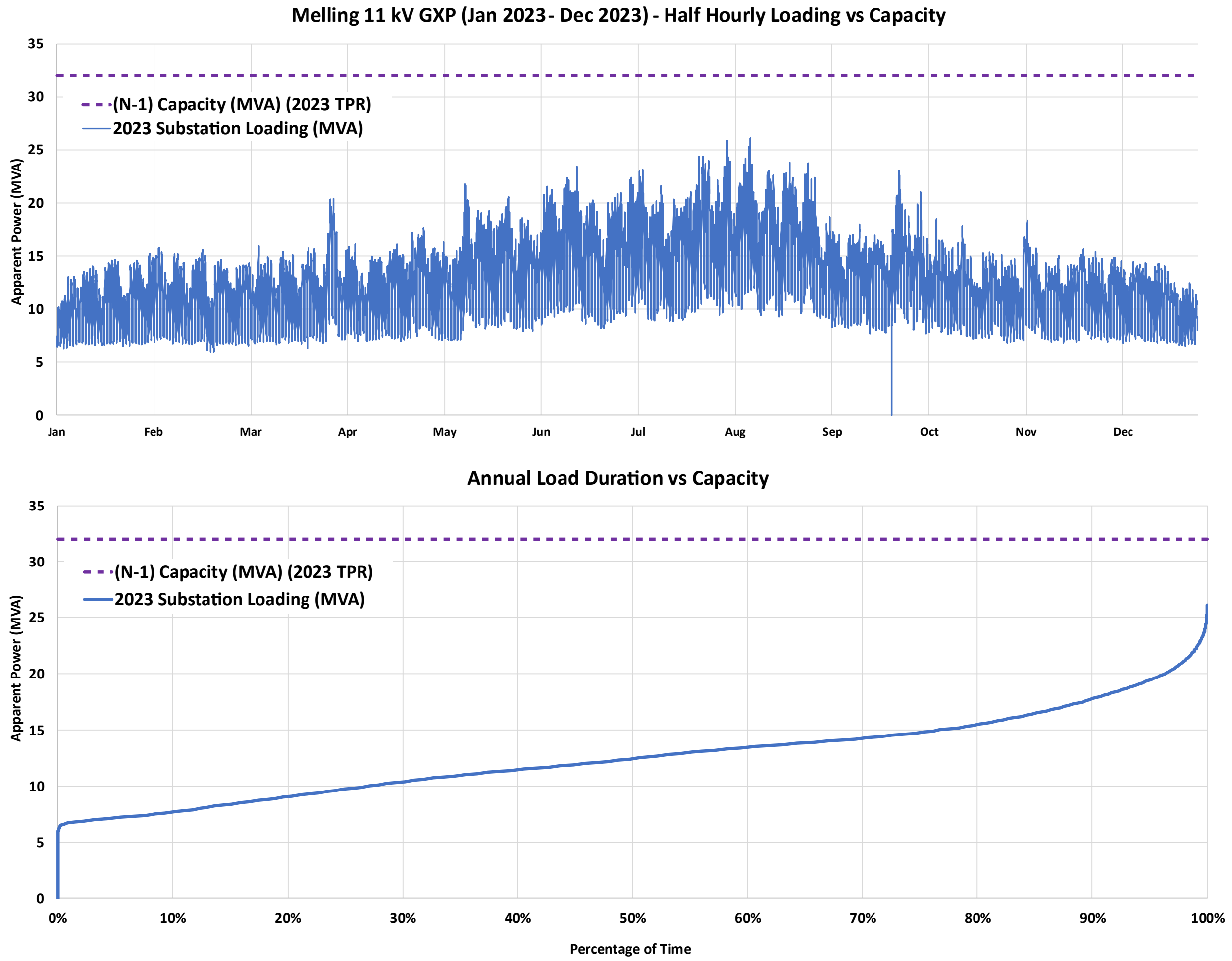
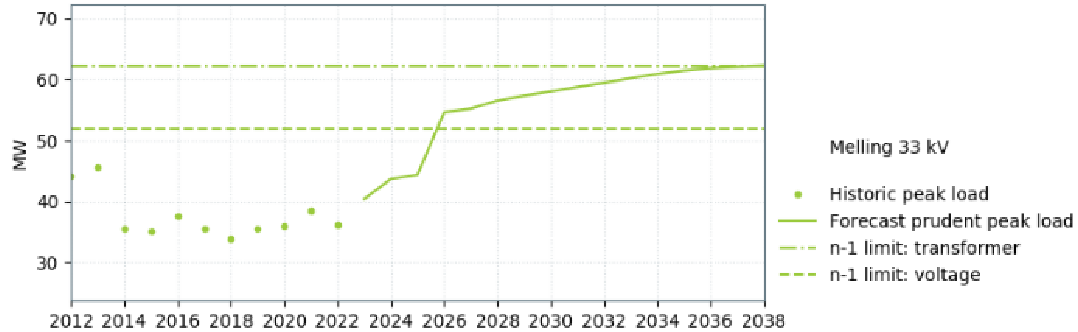


Figure 23. Melling 11 kV GXP: 2023 Loading: Substation capacity

The following graph[29] shows Melling 33 kV GXP's 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 24 illustrates Melling 33 kV GXP's 2023 loading.

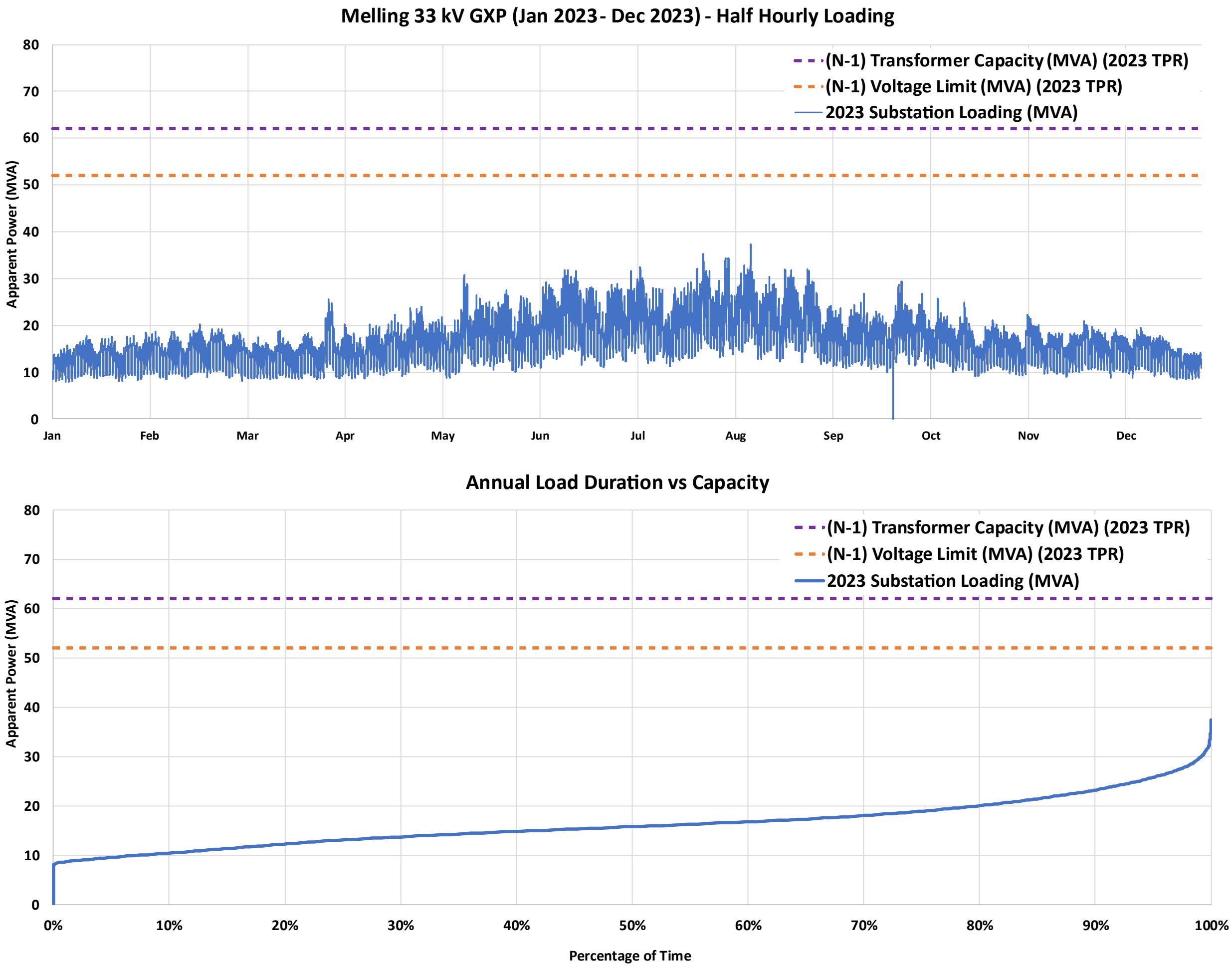


Figure 24. Melling 33 kV GXP: 2023 Loading: Substation capacity

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

6.1.8 Paraparaumu GXP

Transpower's demand forecast indicates that the Paraparaumu GXP was expected to have a 2023 peak demand of 72 MW at 1.00 power factor (72 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Paraparaumu GXP experienced a peak load of 69.1 MVA.

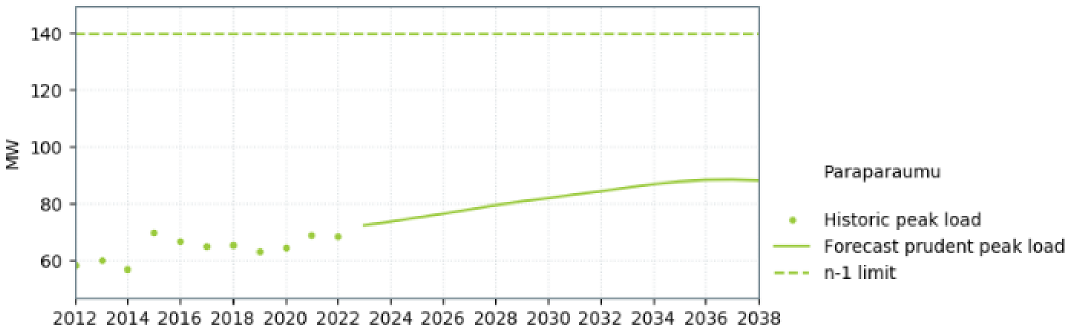
The Paraparaumu GXP is equipped with two 220/33 kV transformers providing:

- (N) secure capacity of 240 MVA and
- (N-1) capacity of 140 MVA.

The transformer's capacity is limited by the 33 kV circuit breakers.

Paraparaumu tees off two of the Haywards-Bunnythorpe circuits. The circuits between Paraparaumu and the tee are rated to 253/291 MVA (summer/winter), and from the tee to Haywards are rated to 354/390 MVA (summer/winter).

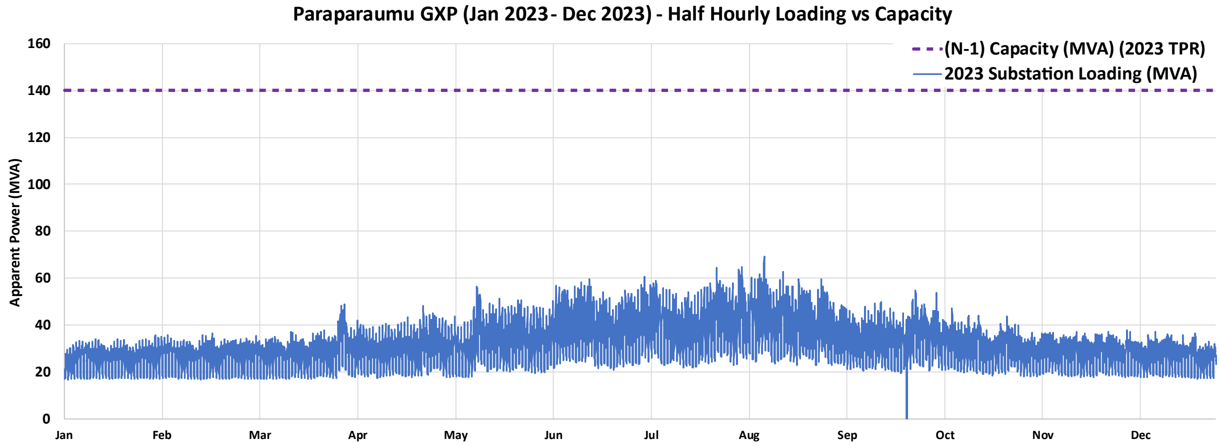
The following graph[30] compares Paraparaumu GXP's supply capacity with the historical loading and Transpower's demand forecast.



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 Paraparaumu GXP's 2023 loading in comparison to its substation capacity.

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



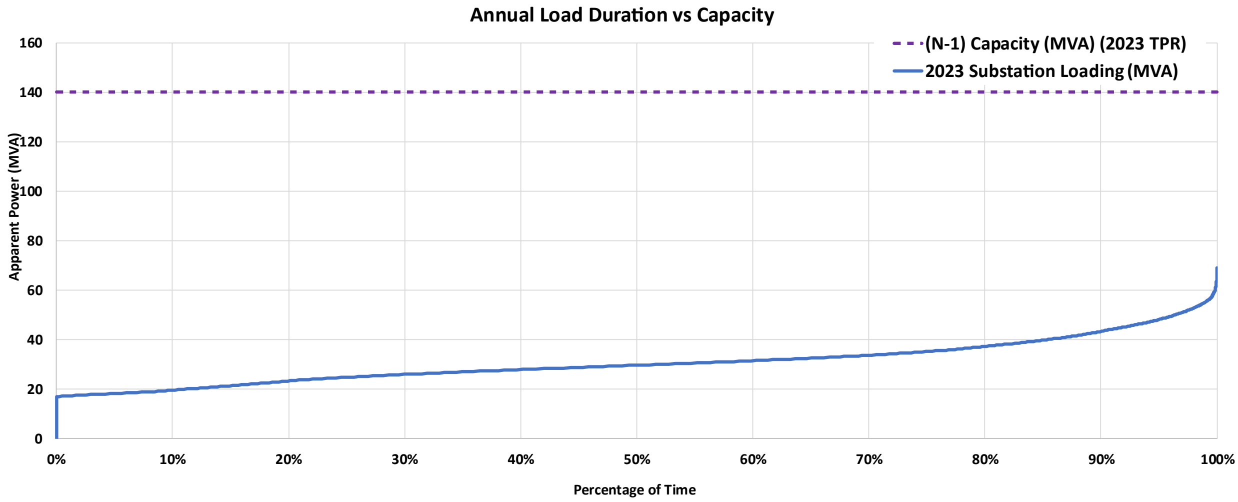


Figure 25. Paraparaumu GXP: 2023 Loading: Substation capacity

6.1.9 Pāuatahanui GXP

Transpower's demand forecast indicates that the Pāuatahanui GXP was expected to have a 2023 peak demand of 23 MW at 0.99 power factor (~23.2 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Pāuatahanui GXP experienced a peak load of 21.4 MVA.

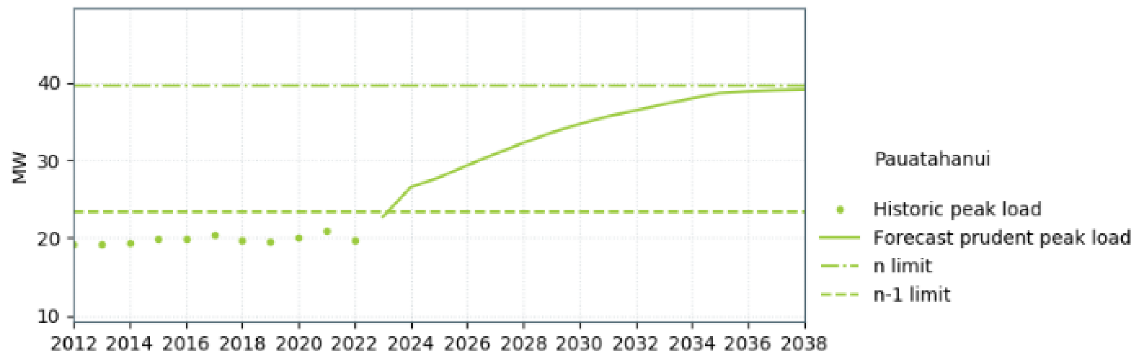
The Pāuatahanui GXP is equipped with two 110/33 kV transformers providing:

- (N) secure capacity of 40 MVA and
- (N-1) capacity of 23 MVA.

Pāuatahanui is supplied by two 110 kV circuits from Takapu Road, each rated at 78/78 MVA (summer/winter). Each of the two 110 kV circuits connect directly to one of the 110/33 kV transformers, meaning that an outage of one of the 110 kV circuits also remove the associated transformer from service.

Peak load was expected to exceed the (N-1) capacity of the supply transformers from winter of 2024. Transpower plans to discuss this issue with Wellington Electricity.

The following graph[31] compares Pāuatahanui 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 Pāuatahanui GXP's 2023 loading in comparison to its substation capacity.

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

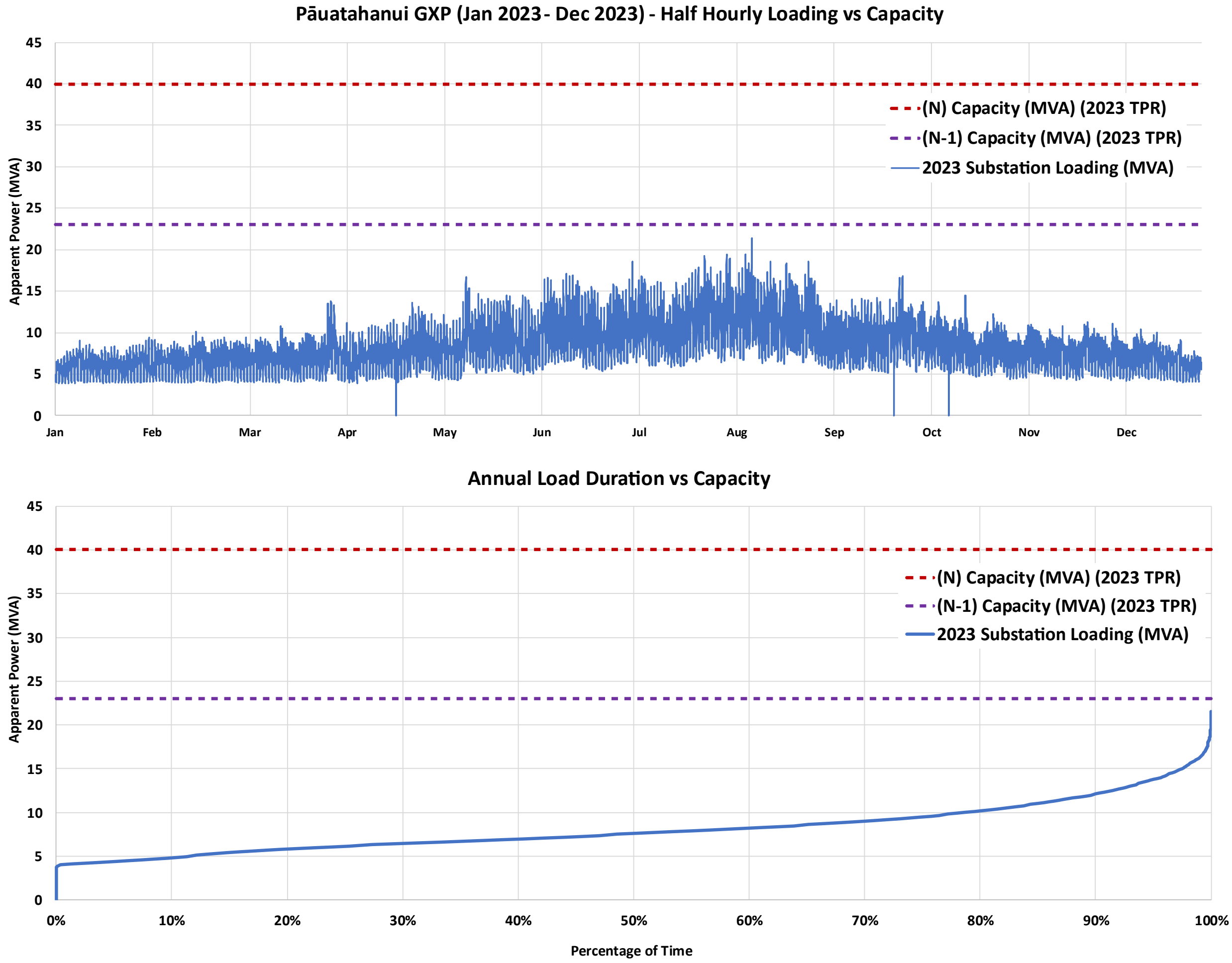


Figure 26. Pāuatahanui GXP: 2023 Loading: Substation capacity

6.1.10 Takapu Road GXP

Transpower's demand forecast indicates that the Takapu Road GXP was expected to have a 2023 peak demand of 110 MW at 1.00 power factor (110 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Takapu Road GXP experienced a peak load of 103.4 MVA.

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

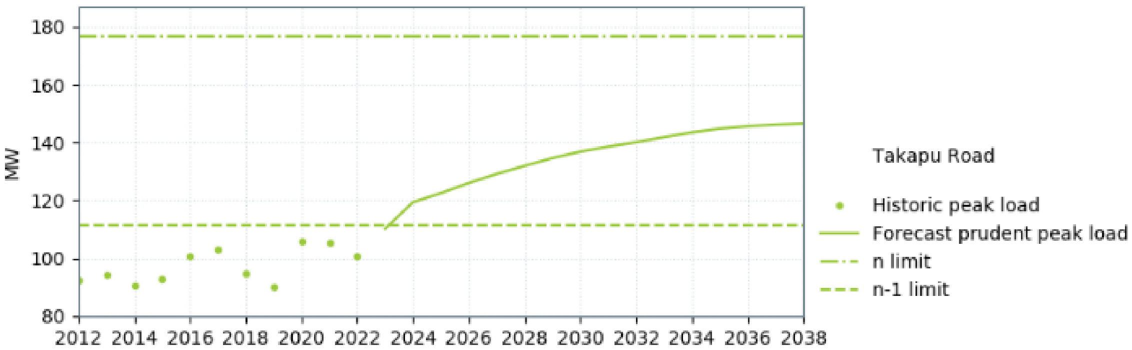
- (N) secure capacity of 180 MVA and
- (N-1) capacity of 110 MVA.

Takapu Road GXP has six 110 kV lines connected to it:

- Two supply Pāuatahanui, each rated at 78/78 MVA (summer/winter),
- Two connect to Wilton, each rated at 281/312 MVA (summer/winter), and
- Two connect to Haywards, each rated at 411/431 MVA (summer/winter).

Peak load at Takapu Road was forecast to exceed the (N-1) capacity of the transformers from winter of 2024. Transpower indicates in the planning report that overloads can be managed by transferring load between Pāuatahanui and Takapu Road, within Wellington Electricity's distribution network.

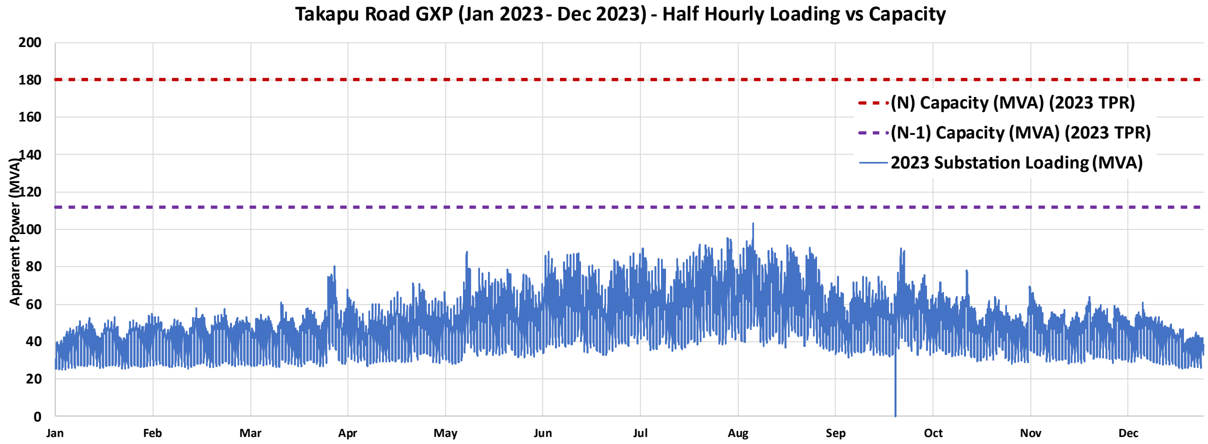
The following graph[32] compares Takapu Road GXP's supply capacity with the historical loading and Transpower's demand forecast.



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 Takapu Road GXP's 2023 loading in comparison to its substation capacity.

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



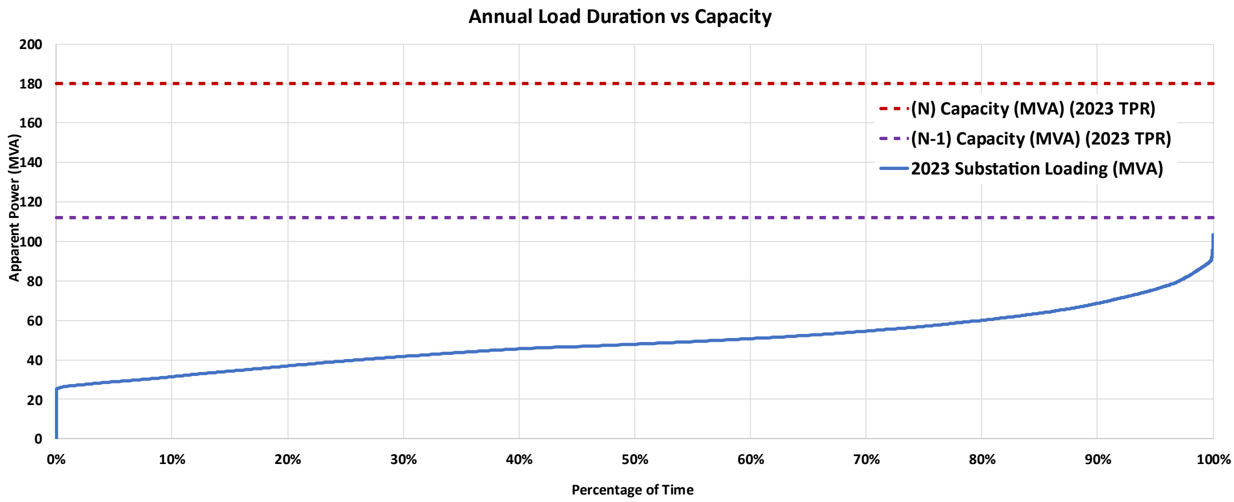


Figure 27. Takapu Road GXP: 2023 Loading: Substation capacity

6.1.11 Upper Hutt GXP

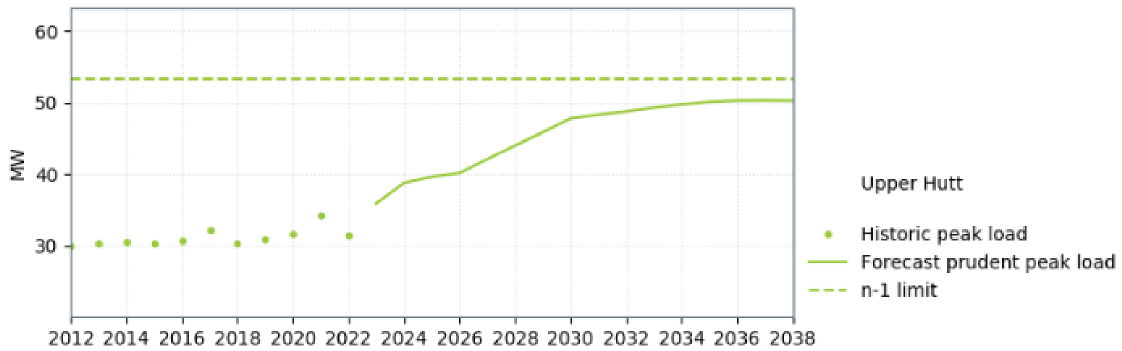
Transpower's demand forecast indicates that the Upper Hutt GXP was expected to have a 2023 peak demand of 36 MW at 1.00 power factor (36 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Upper Hutt GXP experienced a peak load of 32.4 MVA.

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

- (N) secure capacity of 80 MVA and
- (N-1) capacity of 52 MVA.

Upper Hutt is supplied by two 110 kV circuits from Haywards, which are rated at 104/108 MVA (summer/winter). A further two 110 kV circuits connect Upper Hutt to Greytown and Masterton, both of which are rated to 88/97 MVA (summer/winter) for the Greytown to Masterton section, and 63/77 MVA (summer/winter) for the Greytown to Upper Hutt section.

The following graph[33] compares Upper Hutt 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 28 illustrates Upper Hutt GXP's 2023 loading in comparison to its substation capacity.

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

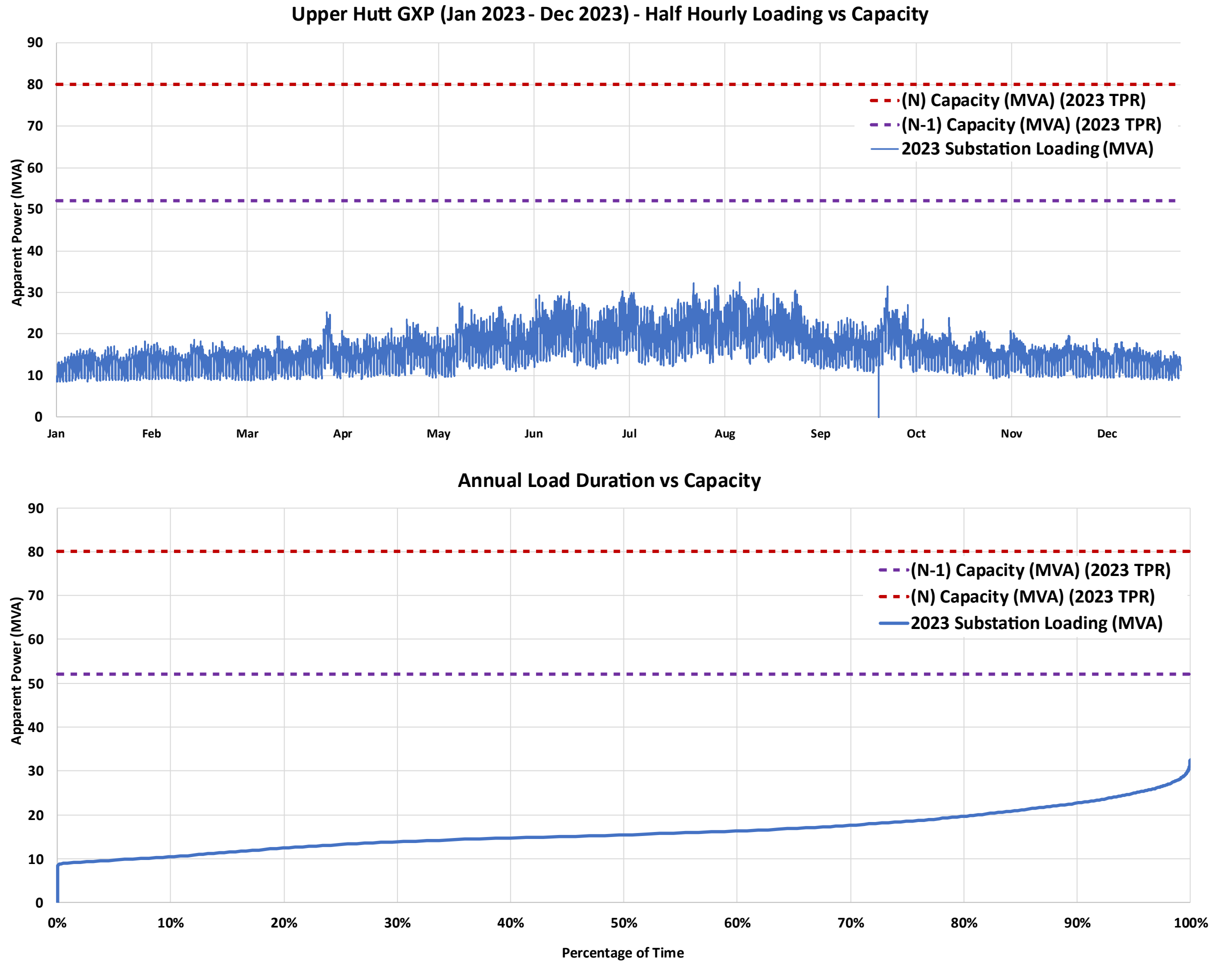


Figure 28. Upper Hutt GXP: 2023 Loading: Substation capacity

6.1.12 Wilton GXP

Transpower's demand forecast indicates that the Wilton GXP was expected to have a 2023 peak demand of 56 MW at 1.00 power factor (56 MVA). This compares with the historical SCADA data that indicates that, during 2023, the Wilton GXP experienced a peak load of 49.5 MVA (~12% lower than forecast), when the local wind farm generation is excluded.

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

- (N) secure capacity of 200 MVA and
- (N-1) capacity of 100 MVA.

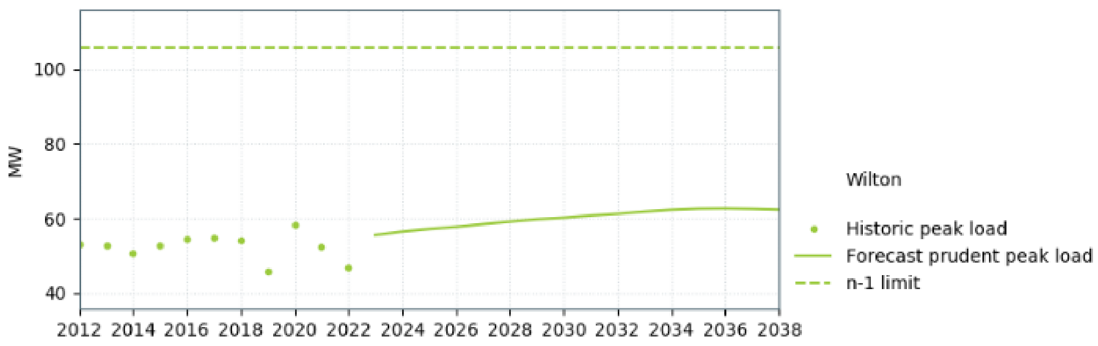
The transformer capacity is limited by the connected 33 kV cables.

Wilton is supplied at 220 kV by Haywards, on tees off two of the Haywards-Bunnythorpe circuits, both of which are rated to 526/565 MVA (summer/winter) for the Wilton to tee section, and 694/762 MVA (summer/winter) for the tee to Haywards section.

Seven 110 kV circuits connect to Wilton:

- Two connect to Takapu Road, each rated at 281/312 MVA (summer/winter),
- Two connect to Kaiwharawhara, each rated at 57/66 MVA (summer/winter),
- Two of which also tee off to the West Wind GIP, and are rated at 192/234 MVA (summer/winter) from the tee to Central Park and 214/238 MVA (summer/winter) from the tee to Wilton, and
- One connects directly to Central Park and is rated to 190/207 MVA (summer/winter).

The following graph[34] compares Wilton 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 29 illustrates Wilton's 2023 loading in comparison to its substation capacity.

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

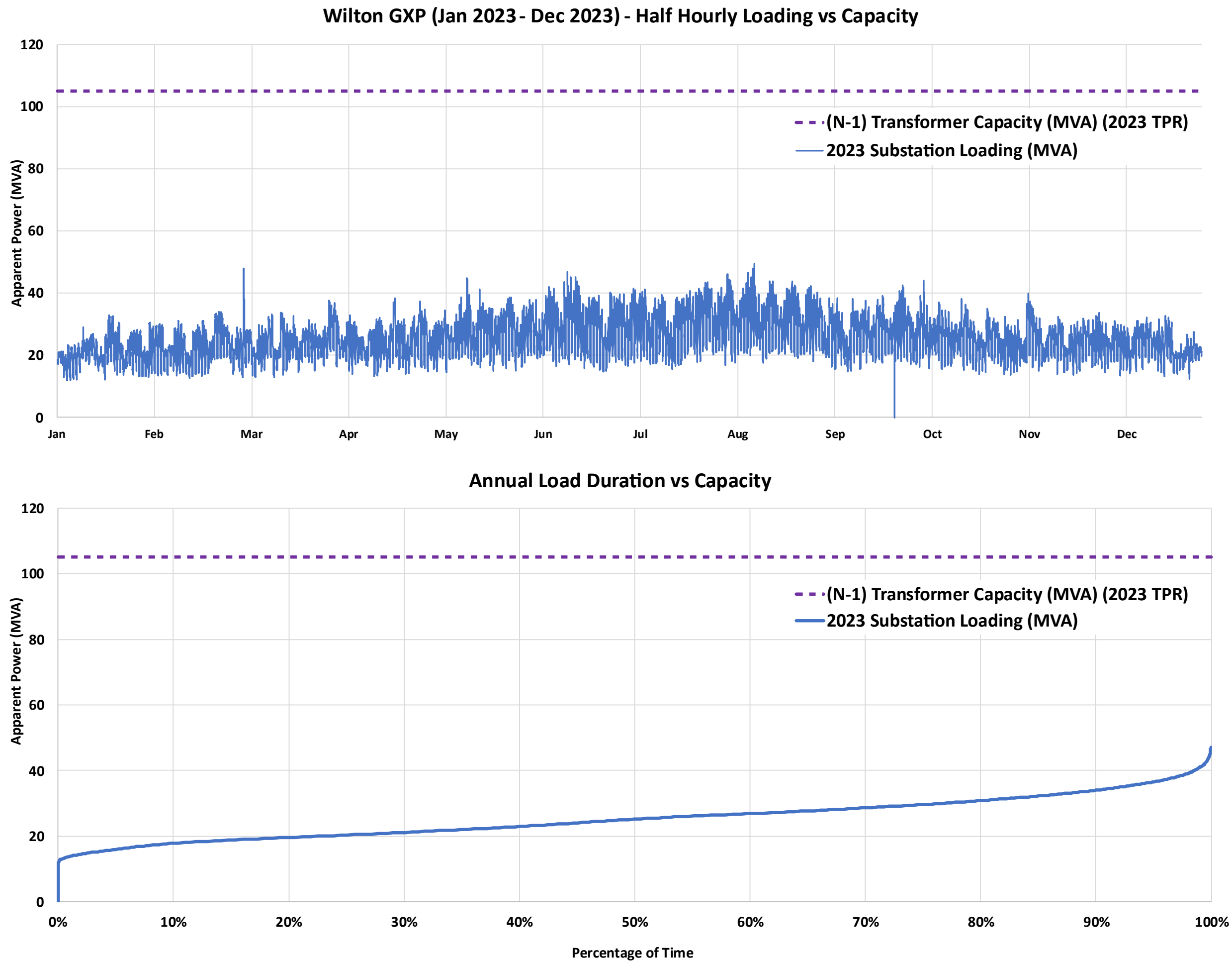


Figure 29. Wilton GXP: 2023 Loading: Substation capacity

6.2 Spare Capacity based on Transpower's 2023 Forecast

Figure 30 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 2023,2024, and 2025 Electra, Powerco, and Wellington Electricity *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.

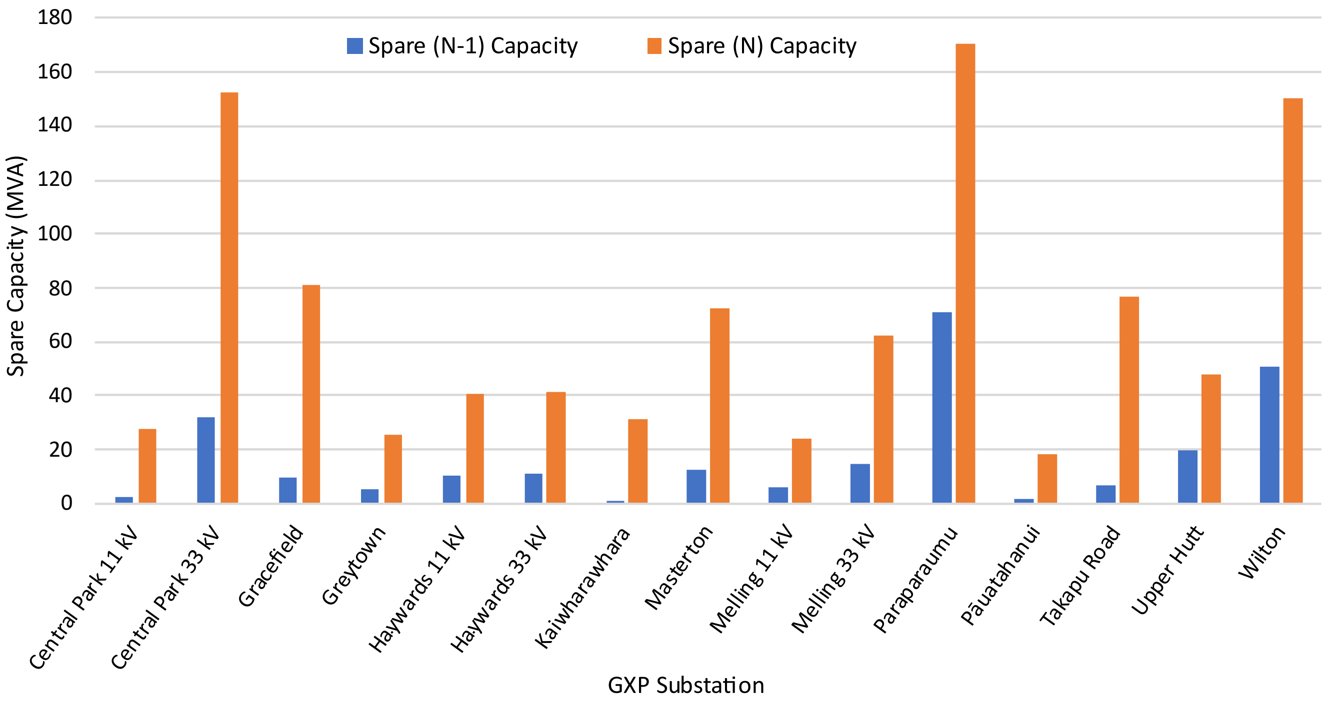


Figure 30. Summary: GXP Spare Capacity based on GXP 2023 EMI loading data.

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 the zone substation, Ergo reviewed the EDBs' 2023, 2024 and 2025 disclosure data and the historical substation loading data for 2023. Actual historical loading data was provided by Electra, Powerco, and Wellington Electricity, and all data is shown in Table 4, Table 5, and Table 6 respectively.

7.1 Electra

Table 4. Electra: 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	Ōtaki	33.5	33.0	10.5	10.0
2	Paekākāriki	1.8	-0.7	1.8	-0.7
3	Paraparaumu East	33.0	32.6	10.0	9.6
4	Paraparaumu West	34.0	33.3	11.0	10.3
5	Raumati	36.4	34.6	13.4	11.6
6	Waikanae	29.1	29.4	6.1	6.4

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

7.2 Powerco

Table 5. Powerco: 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	Akura	20.30	Unknown	3.3	Unknown
2	Awatoitoi	1.80	Unknown	N/A	Unknown
3	Chapel	2.90	Unknown	-3.3	Unknown
4	Clareville	7.30	Unknown	-4.2	Unknown
5	Featherston	10.60	Unknown	-0.2	Unknown
6	Gladstone	1.80	Unknown	N/A	Unknown
7	Hau Nui	5.95	Unknown	N/A	Unknown
8	Kempton	-0.35	Unknown	N/A	Unknown
9	Martinborough	-0.15	Unknown	N/A	Unknown
10	Norfolk	5.70	Unknown	-0.6	Unknown
11	Te Ore Ore	8.35	Unknown	-1.7	Unknown
12	Tinui	0.60	Unknown	N/A	Unknown
13	Tuhitarata	-0.40	Unknown	N/A	Unknown

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 Wellington Electricity

Table 6. Wellington Electricity: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N-1) Capacity (MVA)	
		Disclosure Data	Historical Data
1	8 Ira Street	5.0	Unknown
2	Brown Owl	3.0	Unknown
3	Evans Bay	11.0	Unknown
4	Frederick Street	5.0	Unknown
5	Gracefield	13.0	Unknown
6	Hataitai	6.0	Unknown
7	Johnsonville	-4.0	Unknown
8	Karori	7.0	Unknown
9	Kenepuru	8.0	Unknown
10	Korokoro	-1.0	Unknown
11	Maidstone	5.0	Unknown
12	Mana	-4.0	Unknown
13	Moore Street	13.0	Unknown
14	Naenae	4.0	Unknown
15	Nairn Street	3.0	Unknown
16	Ngauranga	0.0	Unknown
17	Palm Grove	-3.0	Unknown

No.	Substation Name	Spare (N-1) Capacity (MVA)	
		Disclosure Data	Historical Data
18	Plimmerton	1.0	Unknown
19	Porirua	-1.0	Unknown
20	Seaview	0.0	Unknown
21	Tawa	2.0	Unknown
22	The Terrace	10.0	Unknown
23	Trentham	4.0	Unknown
24	University	4.0	Unknown
25	Waikowhai Street	2.0	Unknown
26	Wainuiomata	3.0	Unknown
27	Waitangirua	2.0	Unknown

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

7.4 Summary

7.4.1 Electra

(N-1) Capacity Summary

Figure 31 illustrates the approximate (N-1) spare capacities at Electra'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 Electra.

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.

The negative (N-1) ratings represent a zone substation where the (N-1) rating is already exceeded at times throughout the year. This means there is no spare (N-1) capacity left, and the red graph indicates the extent that the (N-1) secure capacity has been exceeded in the past. Zone substations with (N) security have been omitted from this graph. This means that all of Electra's six zone substations have (N-1) security with respect to the supply transformers. The load at each of the six zone substations did not exceed the (N-1) supply capacity in 2023.

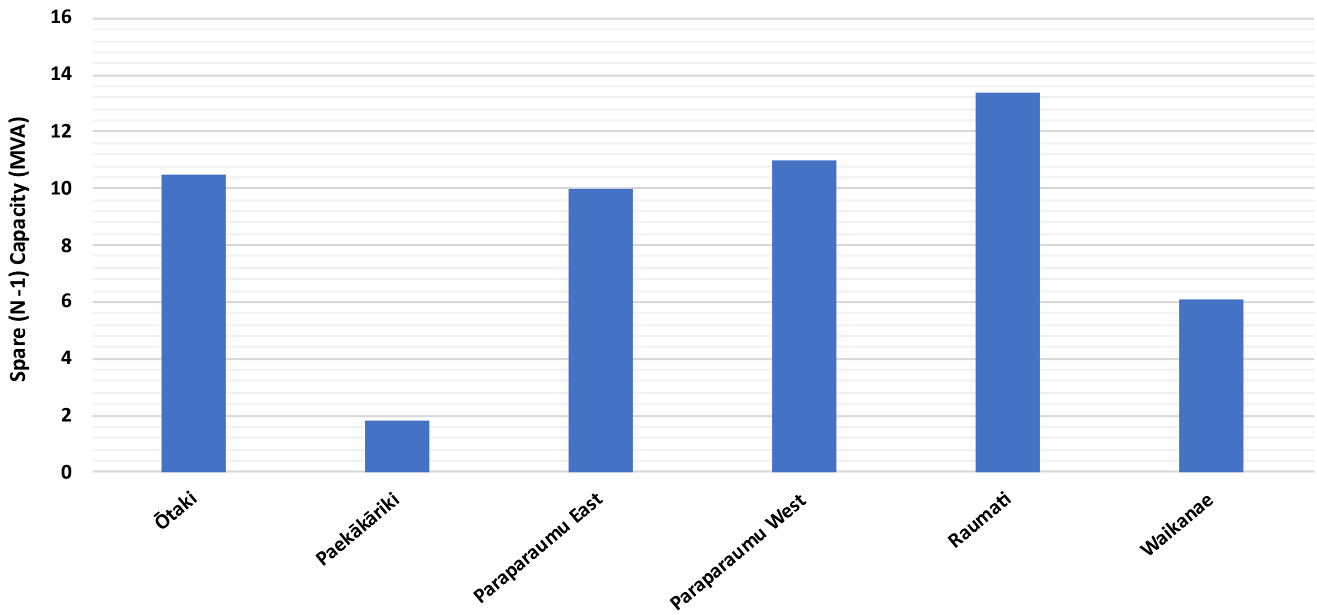


Figure 31. Summary: Approximate (N-1) spare capacity at Electra's zone substations in 2025

The zone substations with spare (N-1) capacity remaining vary from 27% (for Waikanae) to 58% (for Raumati).

(N) Capacity Summary

Figure 32 illustrates the approximate (N) spare capacities at Electra's zone substations, for the disclosed peak demand estimates[35]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Electra.

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 32 indicates that there is a moderate volume of spare (N) capacity at Electra's substations, with spare capacity ranging from 36% (for Paekākāriki) to 79% (for Raumati) available although we note that these may be in locations where (N-1) security of supply would be a standard requirement.

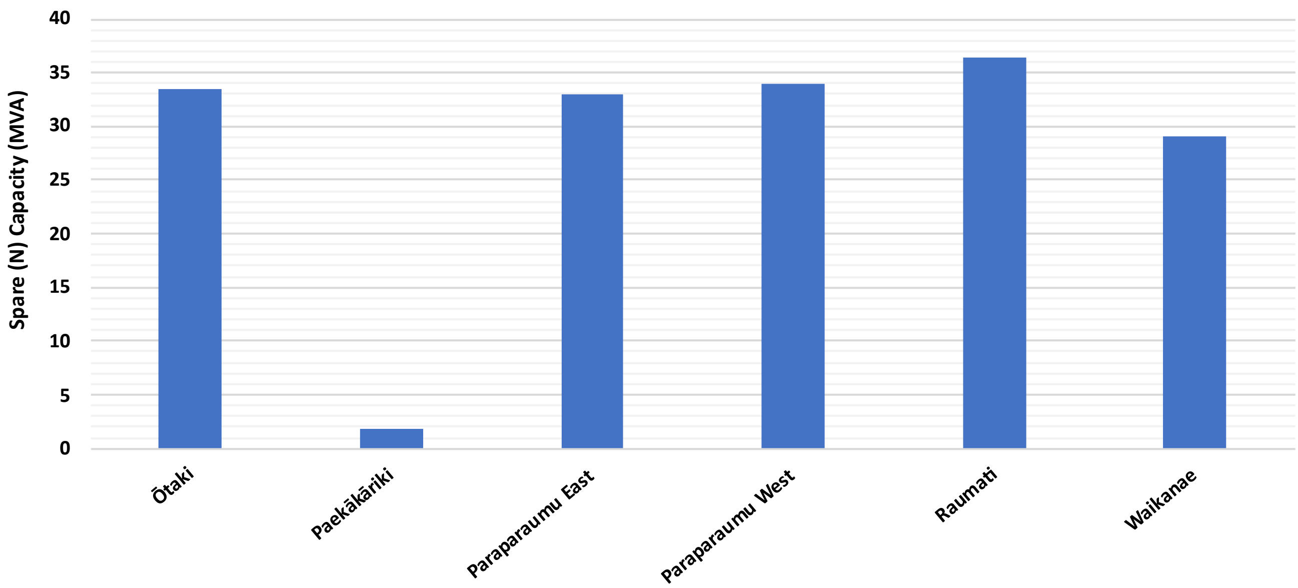


Figure 32. Summary: Approximate (N) spare capacity at Electra's zone substations in 2025

7.4.2 Powerco

(N-1) Capacity Summary

Figure 33 illustrates the approximate (N-1) spare capacities at Powerco'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 Powerco.

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.

[35] Electra' 2025 AMP available here: https://electra.co.nz/our-company/disclosures/

The negative (N-1) ratings represent a zone substation where the (N-1) rating is already exceeded at times throughout the year. This means there is no spare (N-1) capacity remaining and the red graph indicates the extent that the (N-1) secure capacity has been exceeded in the past. Zone substations with (N) security have been omitted from this graph. This means that twelve of the thirteen zone substations do not have (N-1) security with respect to the supply transformers. At five of the zone substations, the (N-1) supply capacity has been met or exceeded in 2025.

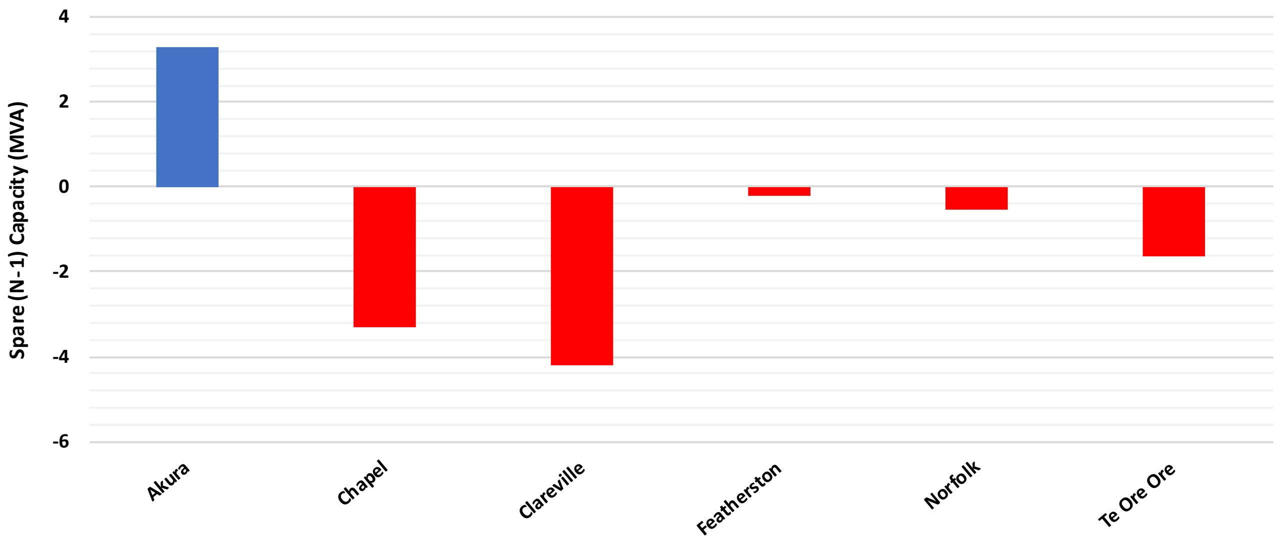


Figure 33. Summary: Approximate (N-1) spare capacity at Powerco's zone substations

(N) Capacity Summary

Figure 34 illustrates the approximate (N) spare capacities at Powerco's zone substations, for the disclosed peak demand estimates[36]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Powerco.

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 34 indicates that there is a wide range of spare (N) capacity, with spare (N) capacity ranging from -6% to 95% (ignoring Hau Nui, which connects some generation to the network). We note that where substations have spare (N) capacity may be in locations where (N-1) security of supply would be a standard requirement. [37].

[36] Powerco's 2025 AMP available here: https://www.Powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures

[37] Negative spare capacity occurs when 2025 maximum load exceeds transformer capacity. Network backfeed occurring at these sites.

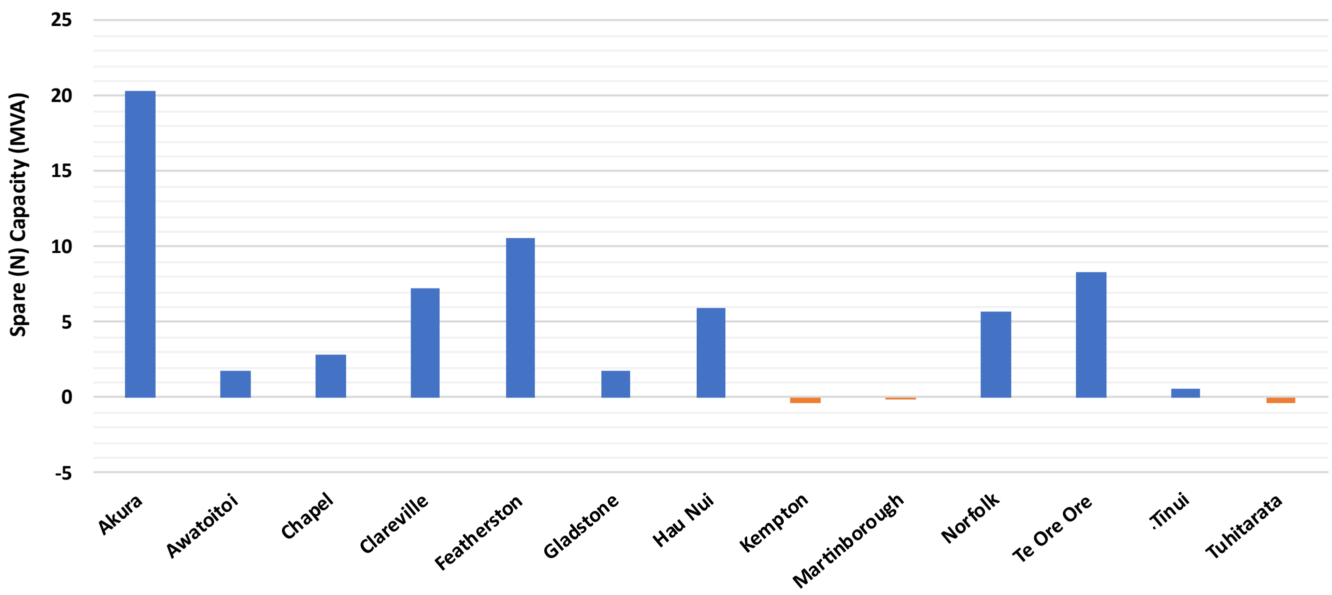


Figure 34. Summary: Approximate (N) spare capacity at Powerco's zone substations

7.4.3 Wellington Electricity

(N-1) Capacity Summary

Figure 35 illustrates the approximate (N-1) spare capacities at Wellington Electricity'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 Wellington Electricity.

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.

The negative (N-1) ratings represent a zone substation where the (N-1) rating is already exceeded at times throughout the year. This means there is no spare (N-1) capacity remaining and the red graph indicates the extent that the (N-1) secure capacity has been exceeded in the past. At seven of the zone substations, the (N-1) supply capacity has been met or exceeded in 2025.

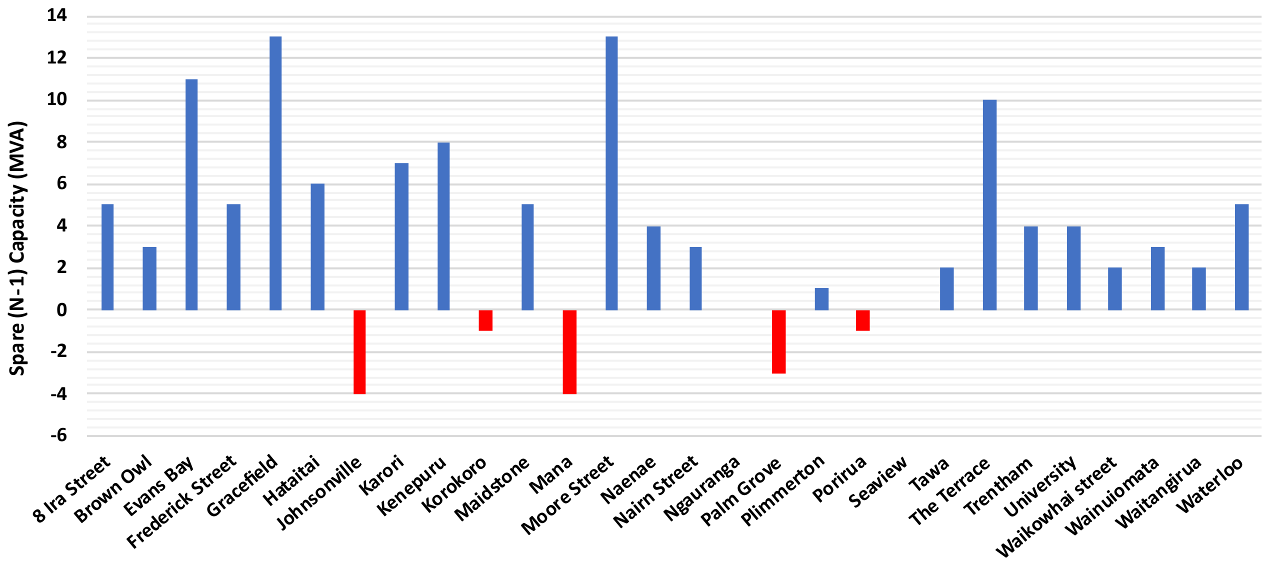


Figure 35. Summary: Approximate (N-1) spare capacity at Wellington Electricity's zone substations

The zone substations with spare (N-1) capacity remaining vary from 13% (for Tawa) to 52% (for Gracefield).

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 the Load Site's 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 required, 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 Sites 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 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.

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 (instead of the 2022 loading data provided by Transpower, Electra, Powerco, and Wellington Electricity). 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 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 and 11 kV feeders are capable of supplying up to 12 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[38] 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, as a general rule, 110 kV and 220 kV lines cannot be installed in road reserve 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).

---

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

- There is space available in zone substation 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.
- 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.
- The load data and maximum demand was accurate at the time it was sourced, but may not reflect the future available network capacity at the time the Load Site converts to using electricity. Therefore, the scope and cost required to connect may differ significantly from that presented in the report.

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes in order to connect the respective Load Sites. For the larger Load Sites Ergo recommend proceeding with a Concept Design Report (CDR) to improve the accuracy of the respective cost estimate.

8.3 Central Park 11 kV GXP

The "Small" EECA load sites connecting to the Central Park 11 kV GXP include:

- Massey University Wellington Campus (0.46 MW) (also connected to Central Park 33 kV, section 8.4)
- Museum of New Zealand Te Papa Tongarewa Tory Street (0.35 MW)

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

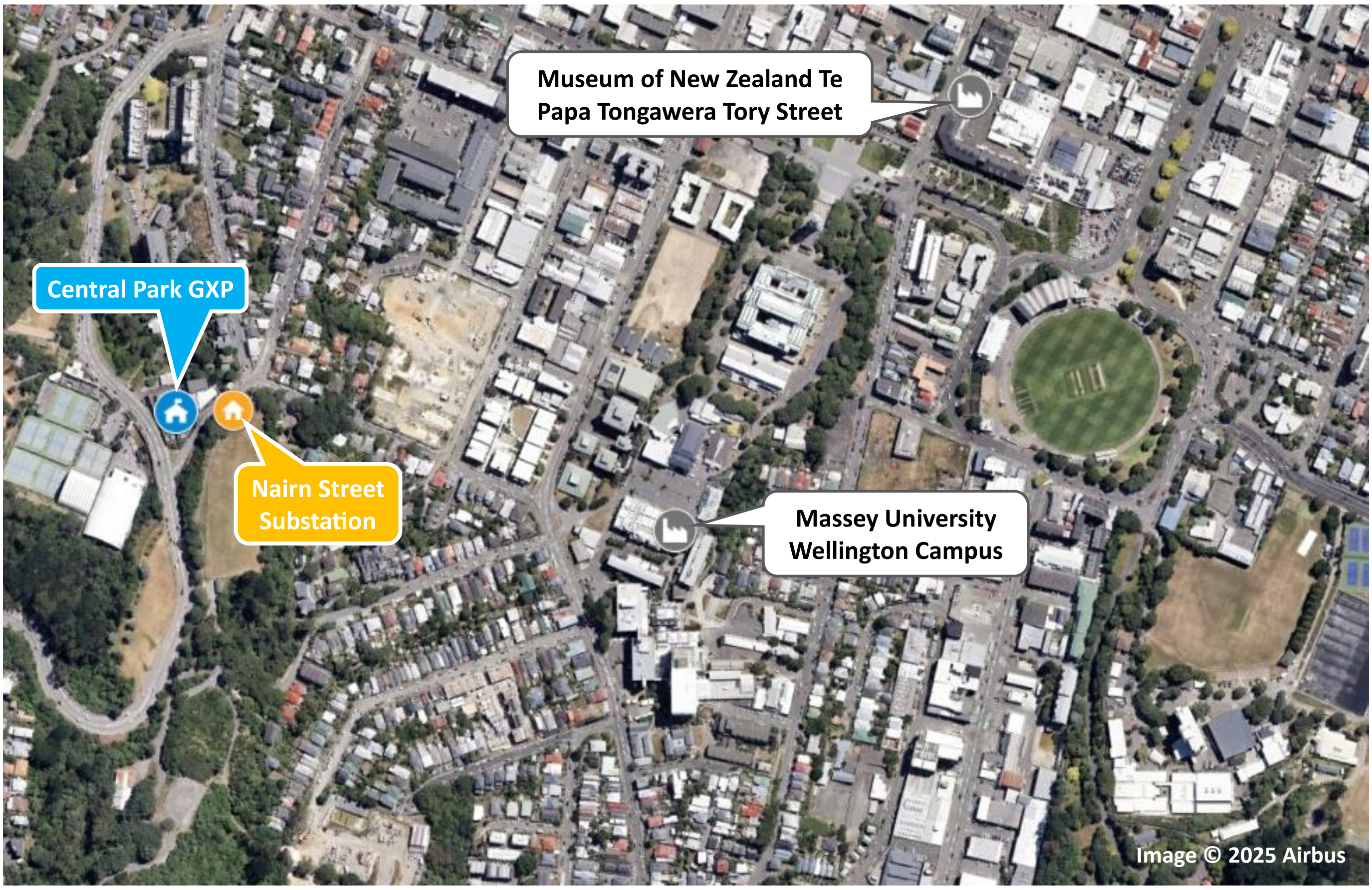


Figure 36. Central Park 11 kV GXP: EECA Load Sites vs local substations

8.3.1 Central Park 11 kV GXP upgrade

The Central Park 11 kV GXP presently has 2.5 MVA of spare (N-1) capacity and 27.5 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 8.3.2). Therefore, no further upgrades are expected at Central Park 11 kV GXP.

8.3.2 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 7. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Massey University Wellington Campus	Nairn Street	3	2.73	0.46	160-200
Museum of New Zealand Te Papa Tongarewa Tory Street	Nairn Street	3	2.73	0.35	160-200

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.

8.3.3 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.

8.3.3.1 Nairn Street

Four of the loads on Central Park 11 kV GXP are expected to connect to Nairn Street zone substation. These loads are Massey University Wellington Campus and Museum of New Zealand Te Papa Tongarewa Tory Street. The sum of peaks of these loads is 0.81 MW, which the zone substation has (N-1) capacity for. Therefore, no further upgrades are expected at Nairn Street.

8.3.4 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Central Park 11 kV GXP gives a combined load of 0.81 MW. When the load shapes are combined, they result in the following load shape (Figure 37), with a maximum load of 0.81 MW, with a diversity factor of 1. Both load sites peaked at the same time.

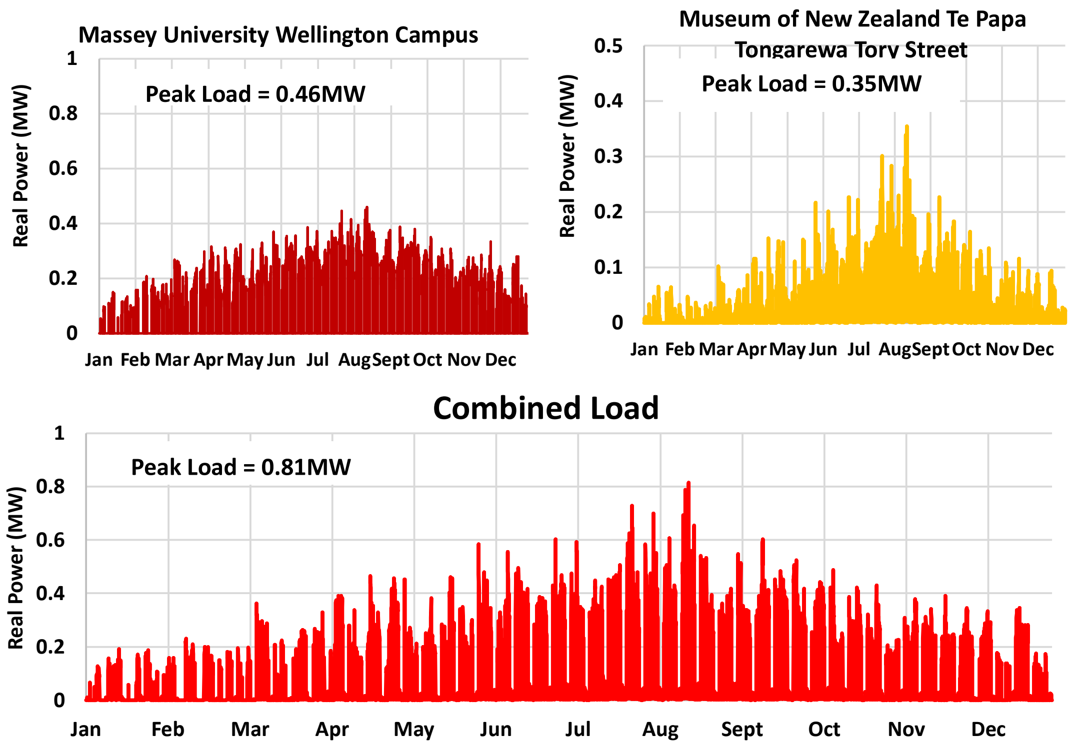


Figure 37. Loading Profiles: Central Park 11 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.3.5 Effect of all Load Sites Connecting to Central Park 11 kV GXP

Figure 38 illustrates the Central Park 11 kV GXP load profile together with the load profiles of all the Load Sites within the Central Park 11 kV GXP region.

Also shown in Figure 38 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Central Park 11 kV GXP would increase to 22.9 MW, an increase of 0.39 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 23.3 MW, there is a diversity factor of 0.98 between the loads.
- Based on Ergo's analysis, the Central Park 11 kV GXP's (N-1) limit is not expected to be exceeded.

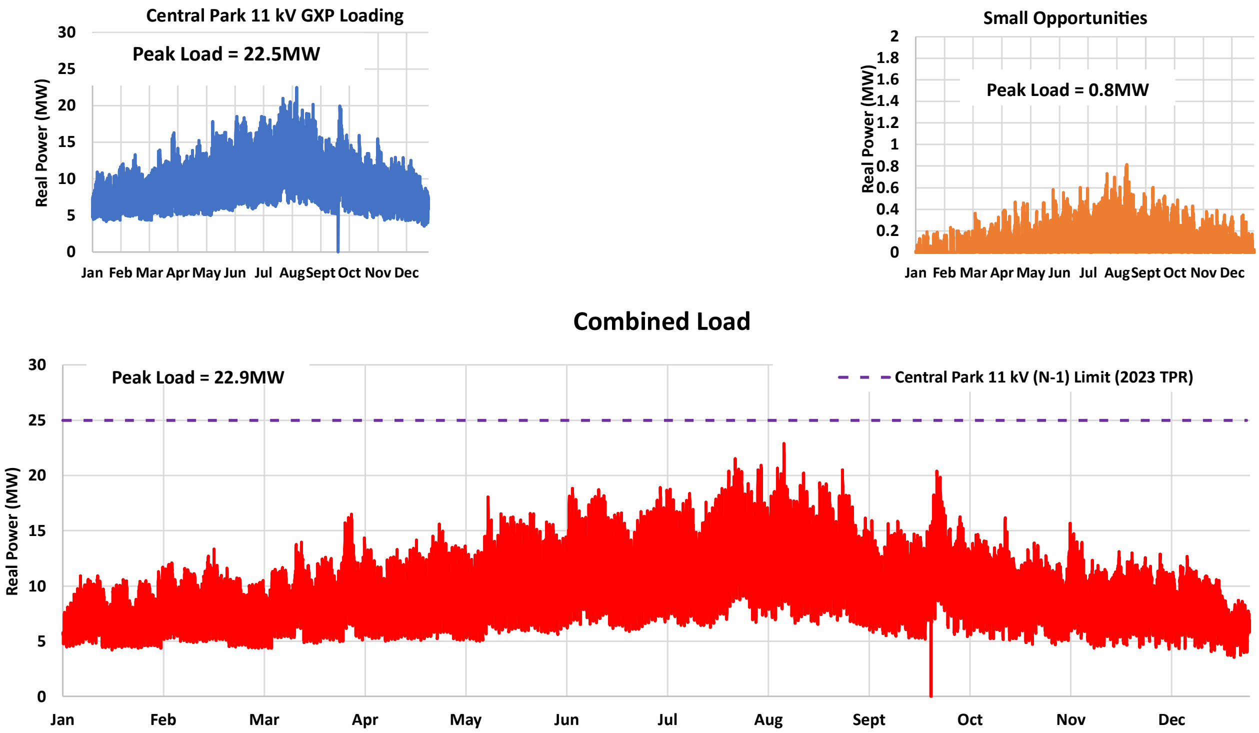


Figure 38. Loading Profiles: Central Park 11 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.4 Central Park 33 kV GXP

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

- Wellington Hospital (4.51 MW)
- Victoria University of Wellington Kelburn Campus (1.74 MW)
- Museum of New Zealand Te Papa Tongarewa Cable Street (1.18 MW)

The "Small" EECA load sites connecting to the Central Park 33 kV GXP include:

- Precinct Properties Aon Centre (0.63 MW)
- Massey University Wellington Campus (0.46 MW) (also connected to Central Park 11 kV, section 8.3)
- Wakefield Hospital (0.32 MW)
- Wellington Airport (0.33 MW)
- Wellington City Council Wellington Regional Aquatic Centre (0.32 MW)
- Southern Cross Wellington Hospital (0.25 MW)
- Wellington City Council Michael Fowler Centre (0.23 MW)
- Victoria University of Wellington Te Aro (0.23 MW)
- Wellington City Council Freyberg Pool & Fitness Centre (0.14 MW)
- RJ Holdings Centrepoint Building (0.11 MW)
- Wellington City Council City Gallery (0.1 MW)

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

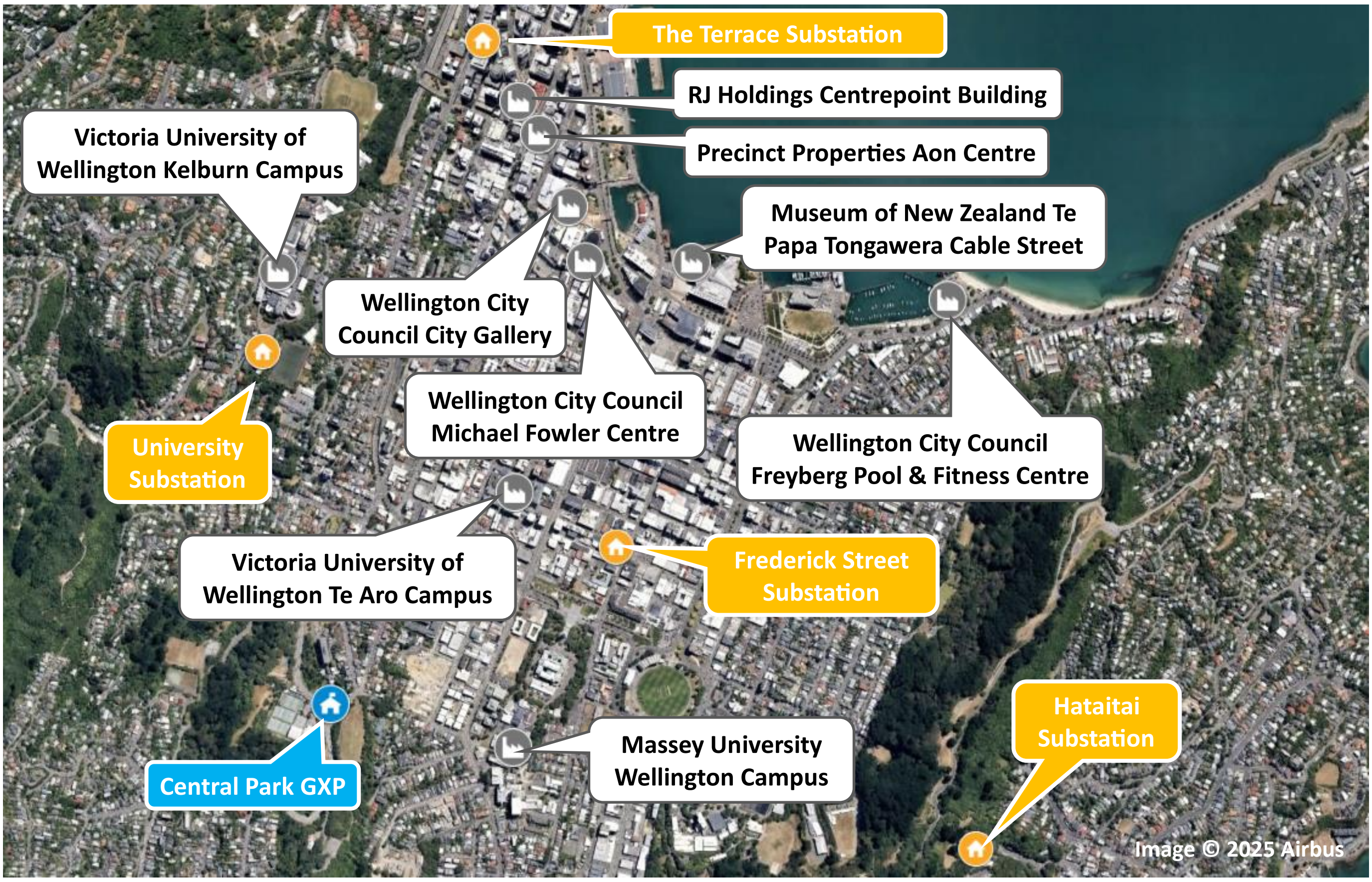


Figure 39. Central Park 33 kV GXP: EECA Load Sites vs local substations (northern snippet)

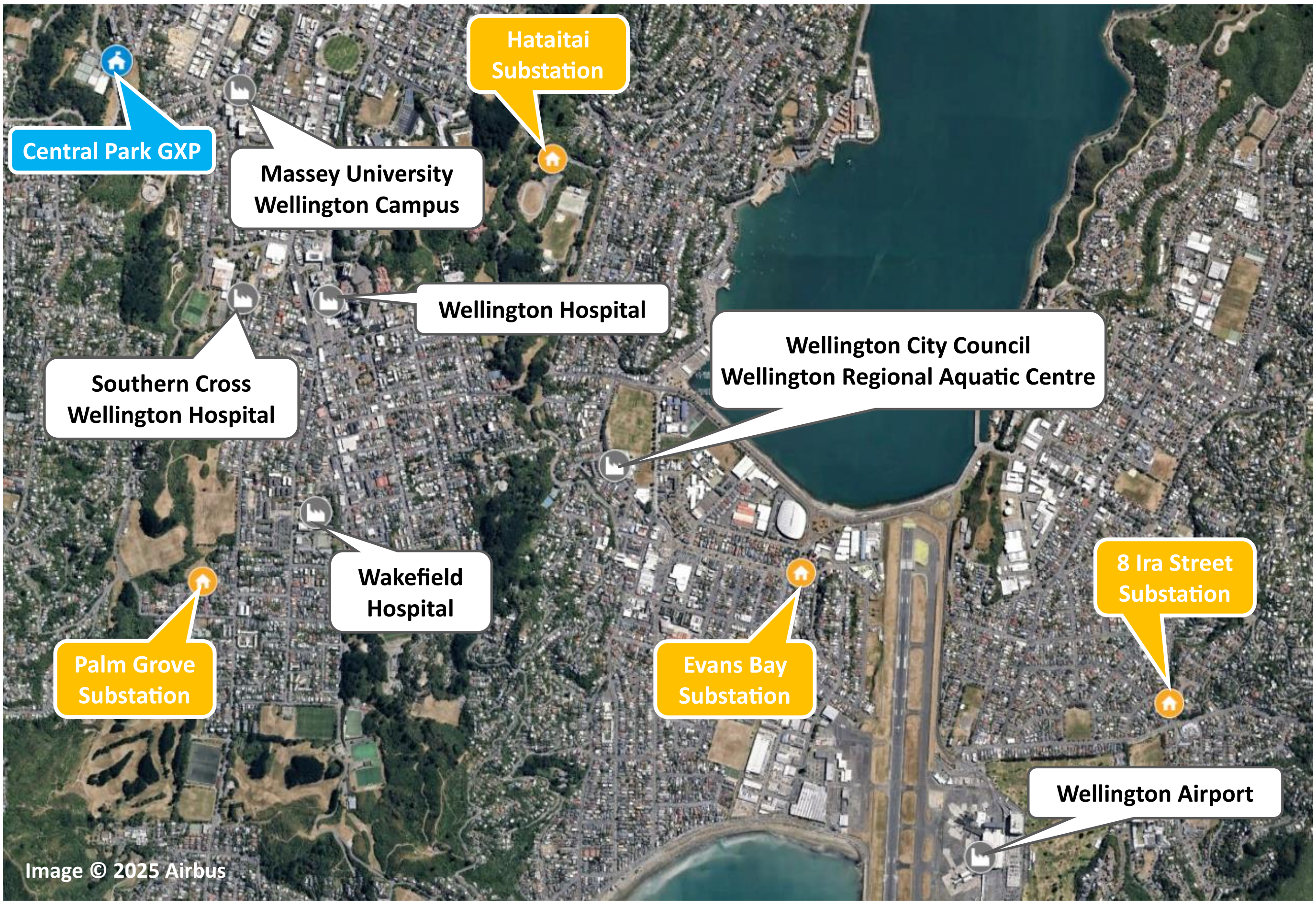


Figure 40. Central Park 33 kV GXP: EECA Load Sites vs local substations (southern snippet)

8.4.1 Central Park 33 kV GXP upgrade

The Central Park 33 kV GXP presently has 32.4 MVA of spare (N-1) capacity and 152.4 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 8.4.8). Therefore, no further upgrades are expected at Central Park 33 kV GXP.

8.4.2 Wellington Hospital

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	4.51	Central Park 33 kV GXP

Figure 41. Wellington Hospital geographic location in relation to the surrounding zone substations.

8.4.2.1 Existing electrical supply to the Plant

Wellington Hospital is presently supplied by Wellington Electricity's Palm Grove zone substation. The site is supplied by an 11 kV feeder which consists entirely of underground cabling. Palm Grove connects directly to the Central Park 33 kV GXP via two 33 kV sub-transmission circuits rated to ~20 MVA each.

The site is located approximately 1.2 km away from Palm Grove zone substation. The zone substation is located approximately 2.1 km from Central Park 33 kV GXP.

There is currently a maximum loading of 23 MVA on Palm Grove zone substation, with -3 MVA of spare (N-1) capacity. The Central Park 33 kV GXP presently has 32.4 MVA of spare (N-1) capacity and 152.4 MVA of spare (N) capacity, based on the transformer ratings.

8.4.2.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation and sub-transmission circuits has insufficient (N-1) capacity for this load.

Ergo understands that Wellington Electricity is proposing a new zone substation in the Newtown area due to a major customer development, which would offload Palm Grove substation. However, due to shifting customer intentions, the project proceeding is unclear.

The existing 11 kV feeder has approximately -0.51 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 topography of the area, this would likely be an underground cable, at a length of 1.4 km.

8.4.2.3 Capital Cost Estimate

Table 8. Wellington Hospital: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Double underground 33kV cable	2.50	$7.50
Distribution	Medium zone substation	1.00	$8.00
Distribution	11kV circuit breaker (ZSS) [39]	1.00	$0.20
Distribution	Single underground 11kV cable	1.40	$1.12
		TOTAL	**$16.82**

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 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.

[39] Provided there is sufficient space in the switchroom to extend the switchboard.

8.4.3 Victoria University of Wellington Kelburn Campus

Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	1.74	Central Park 33 kV GXP

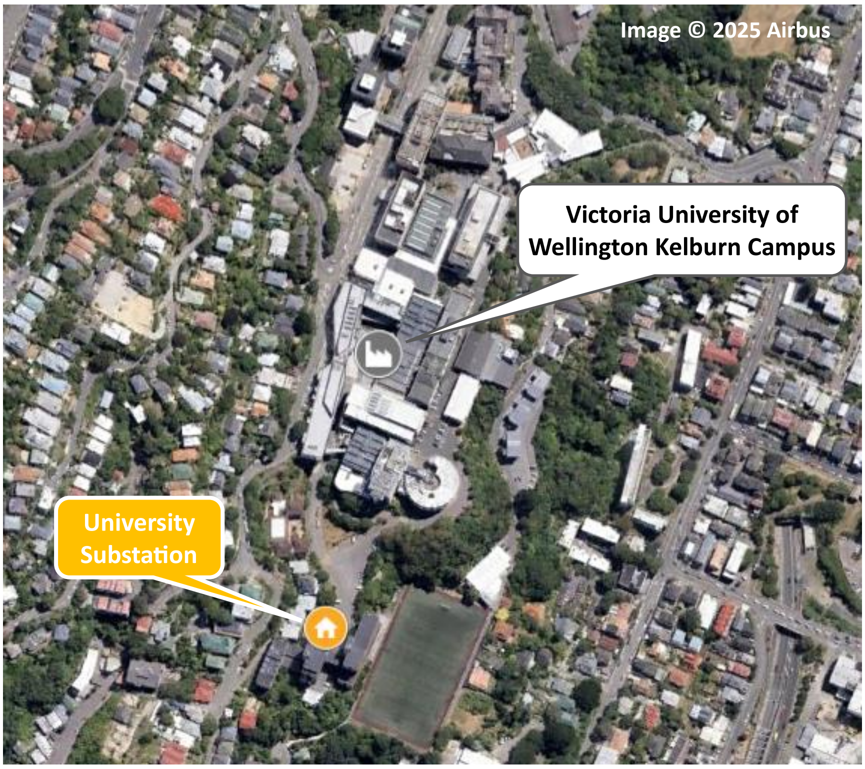


Figure 42. Victoria University of Wellington Kelburn Campus geographic location in relation to the surrounding zone substations.

8.4.3.1 Existing electrical supply to the Plant

Victoria University of Wellington Kelburn Campus is presently supplied by Wellington Electricity's University zone substation. The site is supplied by three 11 kV feeders at multiple distribution transformers which consists entirely of underground cabling. University substation connects directly to the Central Park 33 kV GXP via two 33 kV sub-transmission circuits rated to ~20 MVA each.

The main site is located approximately 0.2 km away from University zone substation. The zone substation is located approximately 1 km from Central Park 33 kV GXP.

There is currently a maximum loading of 16 MVA on University zone substation, with 4 MVA of spare (N-1) capacity. The Central Park 33 kV GXP presently has 32.4 MVA of spare (N-1) capacity and 152.4 MVA of spare (N) capacity, based on the transformer ratings.

8.4.3.2 Supply Option(s) for New Load

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

One of the existing 11 kV feeders has approximately 2.55 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeders.

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

8.4.3.3 Capital Cost Estimate

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

8.4.3.4 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.

8.4.4 Museum of New Zealand Te Papa Tongarewa Cable Street

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.18	Central Park 33 kV GXP

Figure 43. Victoria University of Wellington Kelburn Campus geographic location in relation to the surrounding zone substations.

8.4.4.1 Existing electrical supply to the Plant

Museum of New Zealand Te Papa Tongarewa Cable Street is presently supplied by Wellington Electricity's Frederick Street zone substation. The site is supplied by an 11 kV feeder which consists entirely of underground cabling. Frederick Street connects directly to the Central Park 33 kV GXP via two 33 kV sub-transmission circuits rated to ~30 MVA each.

The site is located approximately 0.8 km away from Frederick Street zone substation. The zone substation is located approximately 0.9 km from Central Park 33 kV GXP.

There is currently a maximum loading of 25 MVA on Frederick Street zone substation, with 5 MVA of spare (N-1) capacity. The Central Park 33 kV GXP presently has 32.4 MVA of spare (N-1) capacity and 152.4 MVA of spare (N) capacity, based on the transformer ratings.

8.4.4.2 Supply Option(s) for New Load

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

The existing 11 kV feeder has approximately 0.07 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 topography of the area, this would likely be an underground cable, at a length of 0.85 km.

8.4.4.3 Capital Cost Estimate

Indicatively, it is expected that a distribution transformer to supply this load would cost approximately $350 k.

Table 9. Museum of New Zealand Te Papa Tongarewa Cable Street: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS) [40]	1.00	$0.20
Distribution	Single underground 11kV cable	0.85	$0.68
		TOTAL	**$0.88**

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

8.4.4.4 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.

[40] Provided there is sufficient space in the switchroom to extend the switchboard.

8.4.5 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 10. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Precinct Properties Aon Centre	The Terrace	10	6.88	0.63	200
Massey University Wellington Campus[41]	Frederick Street	5	-0.27	0.46	160-200
Wakefield Hospital[42]	Palm Grove	-3	-0.51	0.37	160-200
Wellington Airport	8 Ira Street	5	0.12	0.33	160-200
Wellington City Council Wellington Regional Aquatic Centre	Evans Bay	11	Unknown	0.32	160-200
Southern Cross Wellington Hospital	Palm Grove	-3	-0.51	0.29	160-200
Wellington City Council Michael Fowler Centre	The Terrace	10	6.88	0.23	160-200
Victoria University of Wellington Te Aro	Hataitai	7	1.36	0.23	160-200
Wellington City Council Freyberg Pool & Fitness Centre	Frederick Street	5	0.07	0.14	80
RJ Holdings Centrepoint Building	The Terrace	10	2.28	0.11	80
Wellington City Council City Gallery	Frederick Street	5	0.07	0.10	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.

[41] Ergo has assumed that if this load were to connect, it would connect onto its other feeder from Nairn Street, which does have spare capacity.

[42] See Section 8.4.6.2 for details on Palm Grove planned upgrade.

8.4.6 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.

8.4.6.1 Frederick Street

Four of the loads on Central Park 33 kV GXP are expected to connect to Frederick Street zone substation. These loads are Museum of New Zealand Te Papa Tongarewa Cable Street, Massey University Wellington Campus, Wellington City Council Freyberg Pool & Fitness Centre, and Wellington City Council City Gallery. The sum of peaks of these loads is 1.88 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Frederick Street.

8.4.6.2 Palm Grove

Three of the loads on Central Park 33 kV GXP are expected to connect to Palm Grove zone substation. These loads are Wellington Hospital, Wakefield Hospital, and Southern Cross Wellington Hospital. The sum of peaks of these loads is 5.08 MW, which the zone substation does not have (N-1) capacity for.

Ergo notes that Wellington Electricity is planning to add a new zone substation in Newtown as part of a customer-initiated decarbonisation project. If the project proceeds, it is expected to resolve the security constraint at Palm Grove. Wellington Electricity also proposes to upgrade the 33/11 kV transformers at Palm Grove as an alternative solution.

8.4.6.3 The Terrace

Three of the loads on Central Park 33 kV GXP are expected to connect to The Terrace zone substation. These loads are Precinct Properties Aon Centre, Wellington City Council Michael Fowler Centre, and RJ Holdings Centrepoint Building. The sum of peaks of these loads is 0.98 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at The Terrace zone substation.

8.4.7 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on the Central Park 33 kV GXP gives a combined load of 3.13 MW. When the load shapes are combined, they result in the following load shape (Figure 44), with a maximum load of 2.72 MW, with a diversity factor of 0.87.

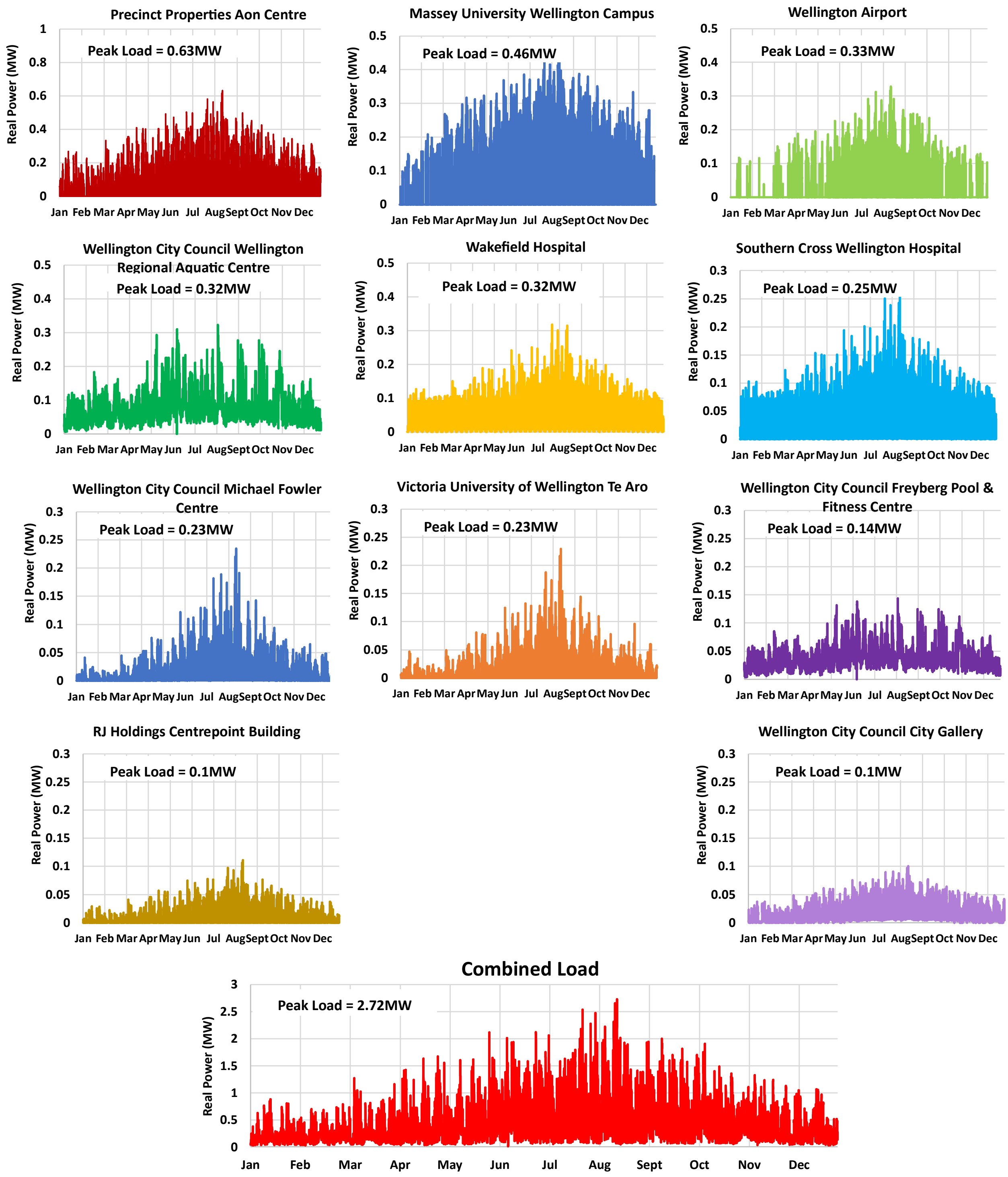


Figure 44. Loading Profiles: Central Park 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.4.8 Effect of all Load Sites Connecting to Central Park 33 kV GXP

Figure 45 illustrates the Central Park 33 kV GXP load profile together with the load profiles of all the Load Sites within the Central Park 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 Central Park 33 kV GXP would increase to 148.6 MW, an increase of 3.77 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 155 MW, there is a diversity factor of 0.96 between the loads.
- Based on Ergo's analysis, the Central Park 33 kV GXP's (N-1) limit is not expected to be exceeded.

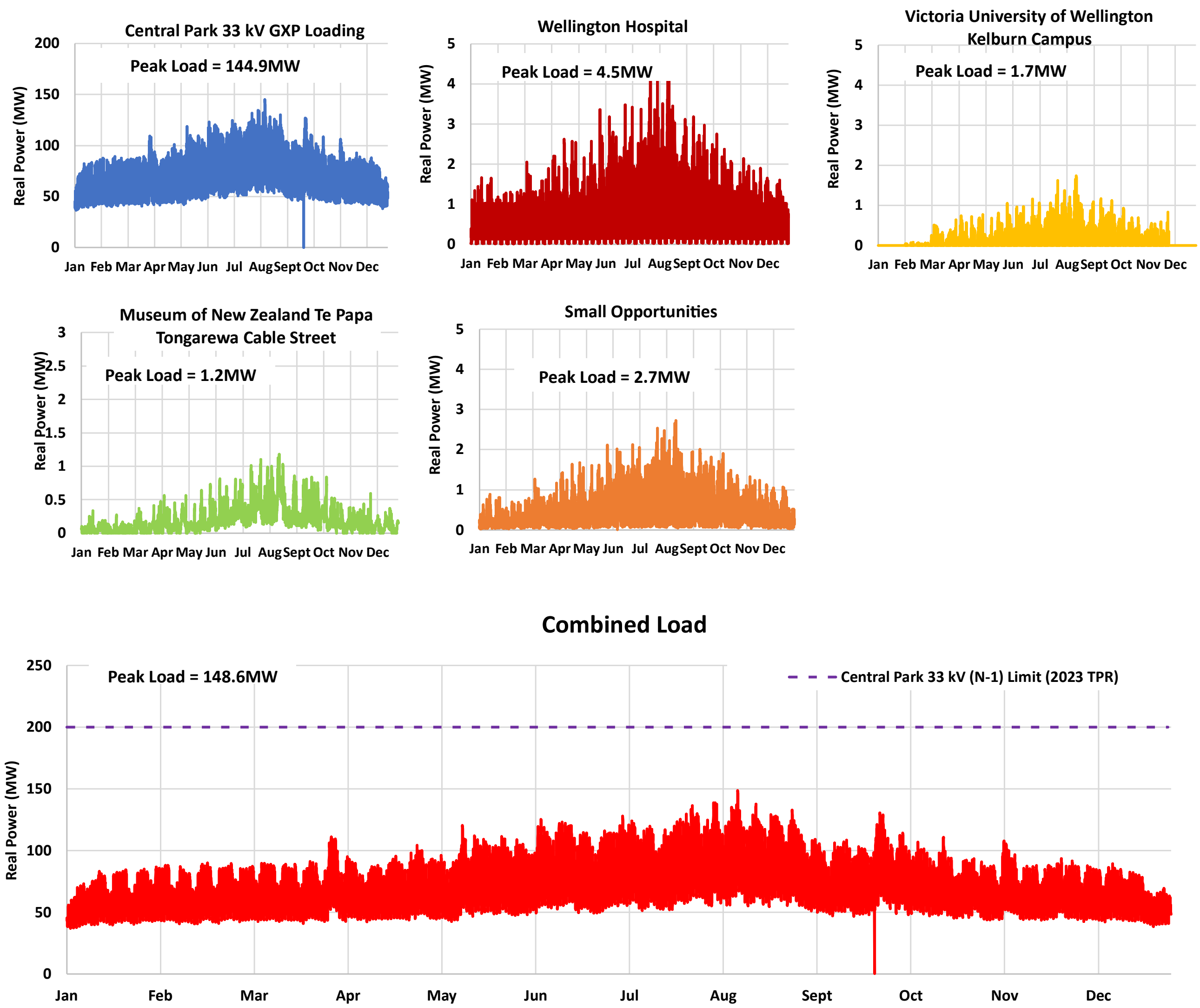


Figure 45. Loading Profiles: Central Park 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.5 Gracefield 33 kV GXP

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

- Wellington Water Seaview Wastewater Treatment Plant (2.33 MW)
- Executive Laundry Group Limited Petone (1.63 MW)
- Callaghan Innovation Gracefield (1.15 MW)

The “Small” EECA load sites connecting to the Gracefield 33 kV GXP include:

- Goodman Fielder Quality Bakers Wellington (0.95 MW)
- Godfrey Hirst Lower Hutt (0.93 MW)
- Hutt City Council Huia Pool (0.32 MW)
- Hutt Valley High School (0.31 MW)
- Hutt City Council Wainuiomata Summer Pool (0.2 MW)
- GNS Lower Hutt (0.11 MW)
- Hutt City Council McKenzie Summer Baths (0.1 MW)
- Hutt City Council The Dowse Art Museum (0.1 MW)

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

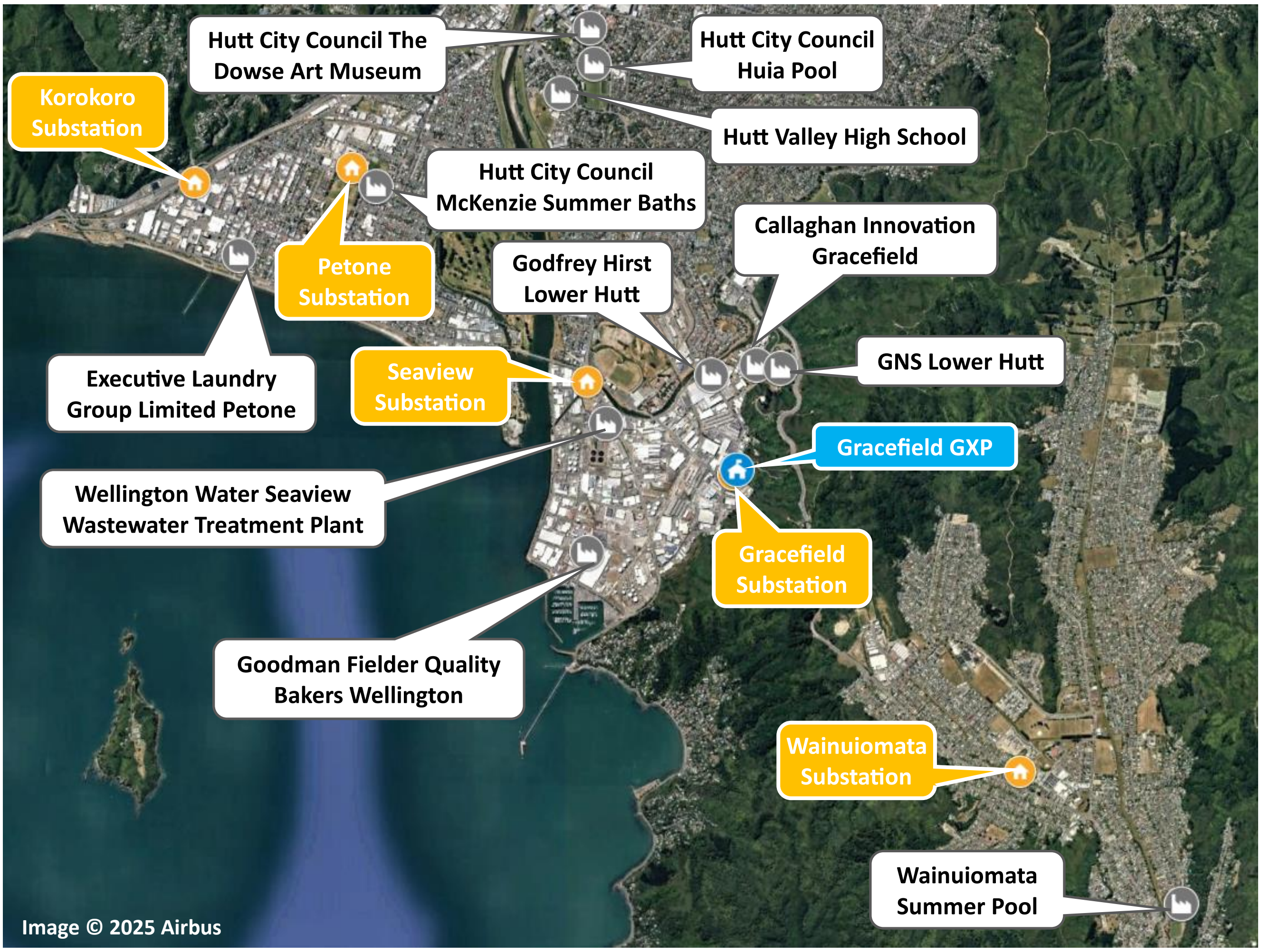


Figure 46. Gracefield 33 kV GXP: EECA Load Sites vs local substations

8.5.1 Gracefield 33 kV GXP upgrade

The Gracefield 33 kV GXP presently has 9.4 MVA of spare (N-1) capacity and 81.4 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 8.5.8). Therefore, no further upgrades are expected at Gracefield 33 kV GXP.

8.5.2 Wellington Water Seaview Wastewater Treatment Plant

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	2.33	Gracefield 33 kV GXP

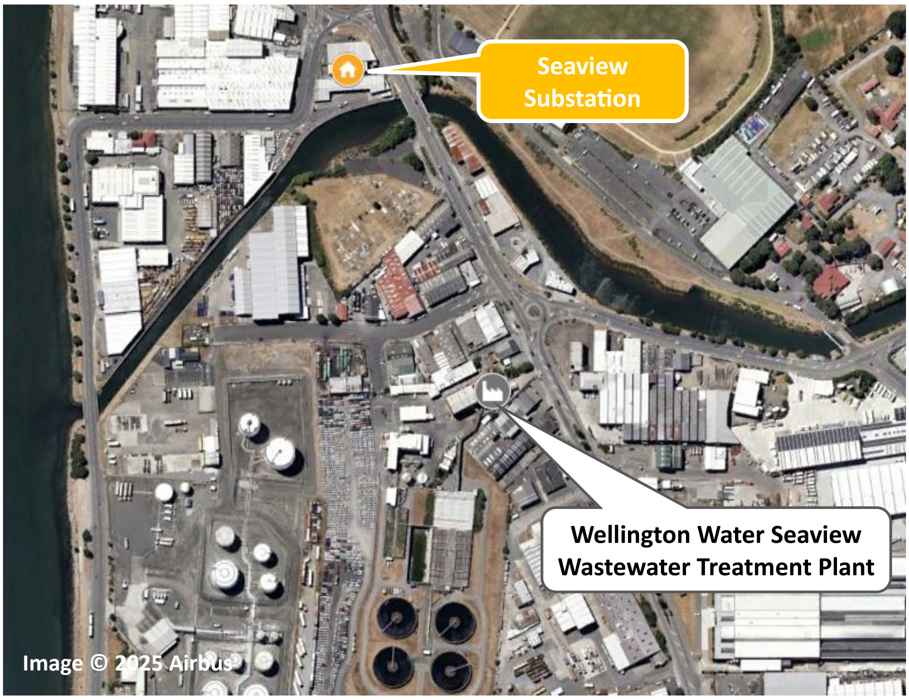


Figure 47. Wellington Water Seaview Wastewater Treatment Plant geographic location in relation to the surrounding zone substations.

8.5.2.1 Existing electrical supply to the Plant

Wellington Water Seaview Wastewater Treatment Plant is presently supplied by Wellington Electricity's Seaview zone substation. The site is supplied by an 11 kV feeder which consists entirely of underground cabling. Seaview connects directly to the Gracefield GXP via two 33 kV sub-transmission circuits rated to ~10.6 MVA each.

The site is located approximately 0.4 km away from Seaview zone substation. The zone substation is approximately 1.3 km from Gracefield GXP.

There is currently a maximum loading of 14 MVA on Seaview zone substation, with 0 MVA of spare (N-1) capacity. The Gracefield GXP presently has 9.4 MVA of spare (N-1) capacity and 81.4 MVA of spare (N) capacity, based on the transformer ratings.

8.5.2.2 Supply Option(s) for New Load

The GXP has adequate spare (N) and (N-1) capacity for this load. The zone substation does not have adequate (N-1) spare capacity for the new load. The sub-transmission circuit supplying Seaview substation has insufficient (N-1) capacity.

To provide the site with an (N-1) security supply, a transformer upgrade was included in the cost at Seaview zone substation, as well as an upgraded sub-transmission supply from Gracefield GXP of an underground cable of 1.4 km in length.

The existing 11 kV feeder has approximately 1.49 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 0.5 km. The price has been increased due to stream crossings.

8.5.2.3 Capital Cost Estimate

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

Table 11. Wellington Water Seaview Wastewater Treatment Plant: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	**Sub-transmission => (N-1)**		**Distribution => (N)**
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Sub-transmission	Single underground 33kV cable[43]	1.40	$2.80
Distribution	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS) [44]	1.00	$0.20
Distribution	Single underground 11kV cable	0.50	$0.60
		TOTAL	**$8.20**

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

8.5.2.4 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.

[43] Single circuit only assuming two existing circuits are run in parallel for increased capacity, alternatively two new cable circuits would be required.
[44] Provided there is sufficient space in the switchroom to extend the switchboard.

8.5.3 Executive Laundry Group Limited Petone

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.63	Gracefield 33 kV GXP

Figure 48. Executive Laundry Group Limited Petone geographic location in relation to the surrounding zone substations.

8.5.3.1 Existing electrical supply to the Plant

Executive Laundry Group Limited Petone is presently supplied by Wellington Electricity's Korokoro zone substation. The site is supplied by an 11 kV feeder which consists entirely of underground cabling. Korokoro connects directly to the Gracefield GXP via two 33 kV sub-transmission circuits rated to ~13.3 MVA each.

The site is located approximately 0.6 km away from Korokoro zone substation. The zone substation is located approximately 4.4 km from Gracefield GXP.

There is currently a maximum loading of 17 MVA on Korokoro zone substation, with -1 MVA of spare (N-1) capacity. The Gracefield GXP presently has 9.4 MVA of spare (N-1) capacity and 81.4 MVA of spare (N) capacity, based on the transformer ratings.

8.5.3.2 Supply Option(s) for New Load

The GXP has adequate (N) and (N-1) capacity to supply the new load. The sub-transmission circuit supplying Korokoro substation, as well as the transformers, have insufficient (N-1) capacity.

Ergo understands that Wellington Electricity is considering resolving the constraint on the Korokoro 33 kV sub-transmission cables, according to their 2025 AMP. The options proposed include relocating 11 kV cables from the sub-transmission cables to remove a thermal pinch point, redeveloping Petone zone substation, and replacing the 33 kV cables altogether. Due to the declining trend in load for Korokoro zone substation, a full cable replacement was priced here. The total cable length is approximately 5.2 km, plus an extra 1 km for a required river crossing.

The existing 11 kV feeder has approximately 0.84 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 0.87 km.

8.5.3.3 Capital Cost Estimate

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

Table 12. Executive Laundry Group Limited Petone: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission =>	(N-1)	Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Sub-transmission	Single underground 33kV cable[45]	6.30	$12.60
Distribution	Large supply transformer (ZSS)	2.00	$4.60
Distribution	11kV circuit breaker (ZSS)[46]	1.00	$0.20
Distribution	Single underground 11kV cable	0.87	$0.52
		TOTAL	**$17.92**

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

8.5.3.4 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.

[45] Single circuit only assuming two existing circuits are run in parallel for increased capacity, alternatively two new cable circuits would be required.
[46] Provided there is sufficient space in the switchroom to extend the switchboard.

8.5.4 Callaghan Innovation Gracefield

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.15	Gracefield 33 kV GXP

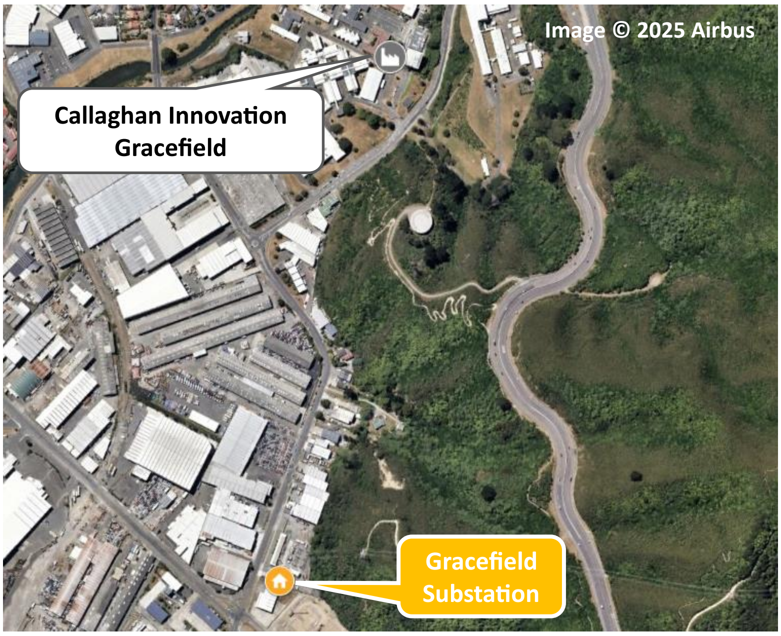


Figure 49. Callaghan Innovation Gracefield geographic location in relation to the surrounding zone substations.

8.5.4.1 Existing electrical supply to the Plant

Callaghan Innovation Gracefield is presently supplied by Wellington Electricity's Gracefield zone substation. The site is supplied by an 11 kV feeder which consists entirely of underground cabling. Gracefield zone substation connects to the Gracefield GXP by two sub-transmission circuits rated to ~76 MVA each.

The site is located approximately 0.8 km away from Gracefield zone substation. The zone substation is located around 40 m adjacent to Gracefield GXP.

There is currently a maximum loading of 10 MVA on Gracefield zone substation, with 13 MVA of spare (N-1) capacity. The Gracefield GXP presently has 9.4 MVA of spare (N-1) capacity and 81.4 MVA of spare (N) capacity, based on the transformer ratings.

8.5.4.2 Supply Option(s) for New Load

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

The existing 11 kV feeder has approximately 1.65 MVA of spare capacity. Therefore, Ergo has assumed that the new load could connect onto its existing 11 kV feeder.

8.5.4.3 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. switchgear and cables) on the plant site.

8.5.4.4 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.

8.5.5 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 13. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Goodman Fielder Quality Bakers Wellington	Seaview	0	1.53	0.95	260
Godfrey Hirst Lower Hutt	Gracefield	13	2.16	0.93	260
Hutt City Council Huia Pool	Gracefield	13	0.97	0.32	130
Hutt Valley High School	Gracefield	13	0.97	0.31	130
Hutt City Council Wainuiomata Summer Pool	Wainuiomata	3	1.46	0.20	80
GNS Lower Hutt	Gracefield	13	1.65	0.11	80
Hutt City Council McKenzie Summer Baths[47]	Petone	-1	2.37	0.10	50
Hutt City Council The Dowse Art Museum	Gracefield	13	0.97	0.10	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.

[47] Ergo estimates that since this is a summer peak load, it will not have a material effect on the security of Petone, which is winter peaking.

8.5.6 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.

8.5.6.1 Gracefield

Six of the loads on Gracefield 33 kV GXP are expected to connect to Gracefield zone substation. These loads are Callaghan Innovation Gracefield, Godfrey Hirst Lower Hutt, Hutt City Council Huia Pool, Hutt Valley High School, GNS Lower Hutt, and Hutt City Council's The Dowse Art Museum. The sum of peaks of these loads is 2.93 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Gracefield.

8.5.6.2 Seaview

Two of the loads on Gracefield 33 kV GXP are expected to connect to Seaview zone substation. These loads are Wellington Water Seaview Wastewater Treatment Plant and Goodman Fielder Quality Bakers Wellington. The sum of peaks of these loads is 3.27 MW, which the zone substation does not have (N-1) capacity for.

Wellington Electricity states that due to a declining trend in peak demand, the security of supply can be maintained by shifting load to other zone substations. Ergo assumes that the upgrade to Seaview if Wellington Water Seaview Wastewater Treatment Plant connects would be sufficient for both sites connecting. This is because Goodman Fielder Quality Bakers Wellington is a small load and expected to have a minimal effect on the network. Therefore, no further upgrades are expected at Seaview.

8.5.7 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on the Gracefield 33 kV GXP gives a combined load of 2.72 MW. When the load shapes are combined, they result in the following load shape (Figure 50), with a maximum load of 1.77 MW, with a diversity factor of 0.65.

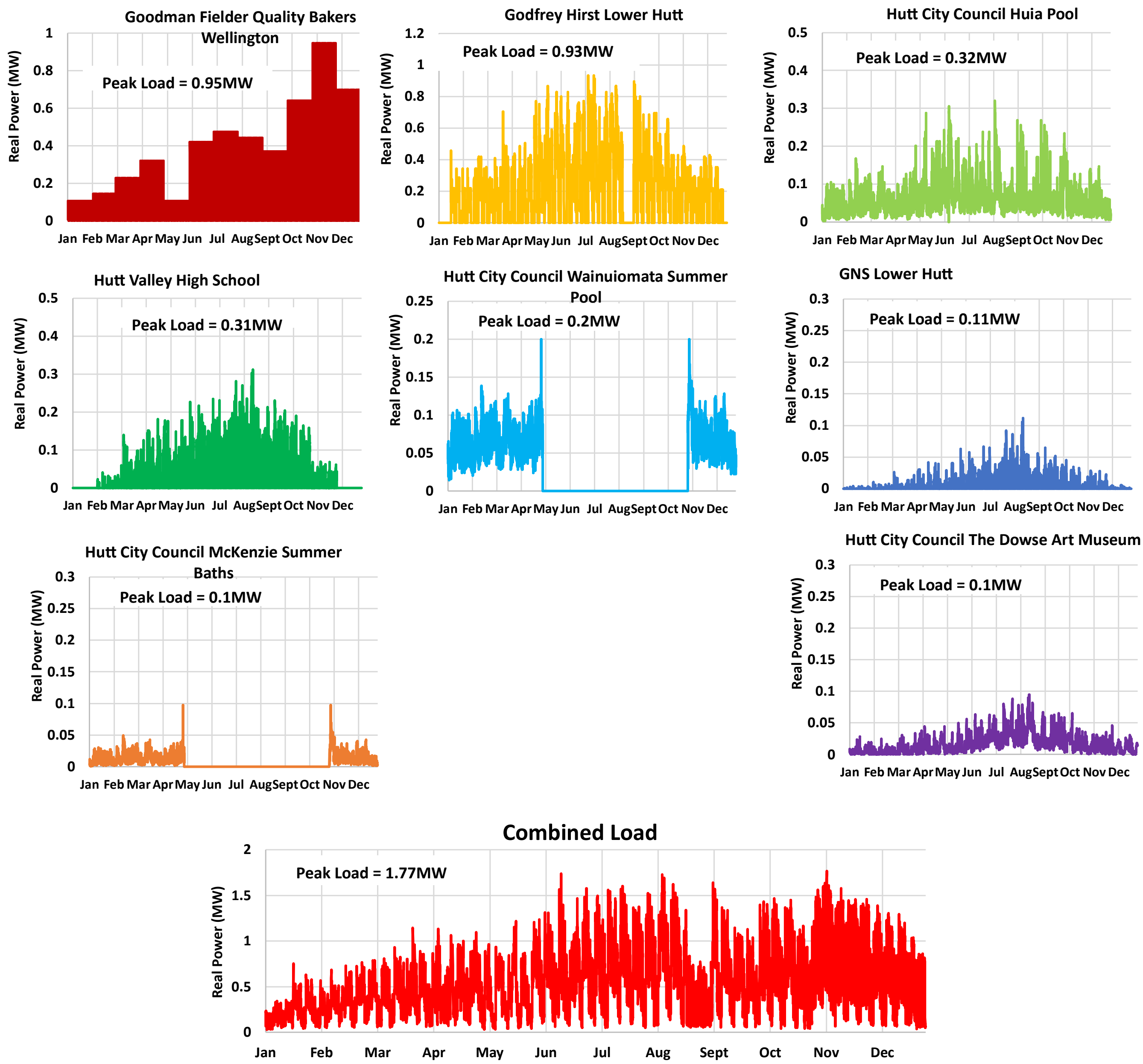


Figure 50. Loading Profiles: Gracefield 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.5.8 Effect of all Load Sites Connecting to Gracefield 33 kV GXP

Figure 51 illustrates the Gracefield 33 kV GXP load profile together with the load profiles of all the Load Sites within the Gracefield 33 kV GXP region.

Also shown in Figure 51 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Gracefield 33 kV GXP would increase to 67.9 MW, an increase of 4.46 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 70.4 MW, there is a diversity factor of 0.97 between the loads.
- Based on Ergo's analysis, the Gracefield 33 kV GXP's (N-1) limit is not expected to be exceeded.

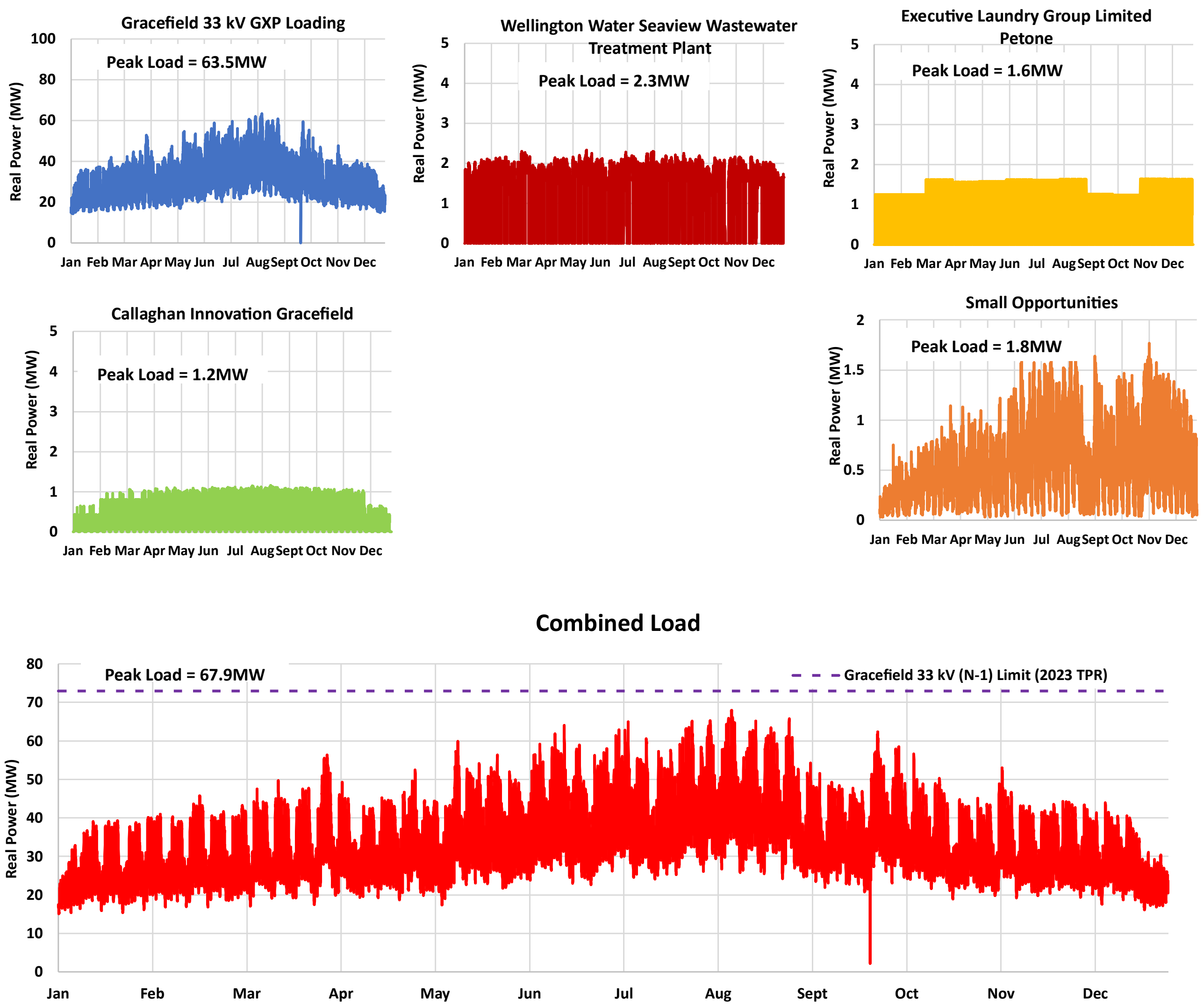


Figure 51. Loading Profiles: Gracefield 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.6 Greytown 33 kV GXP

The geographic locations of the local transmission and distribution substations are shown on the following maps.

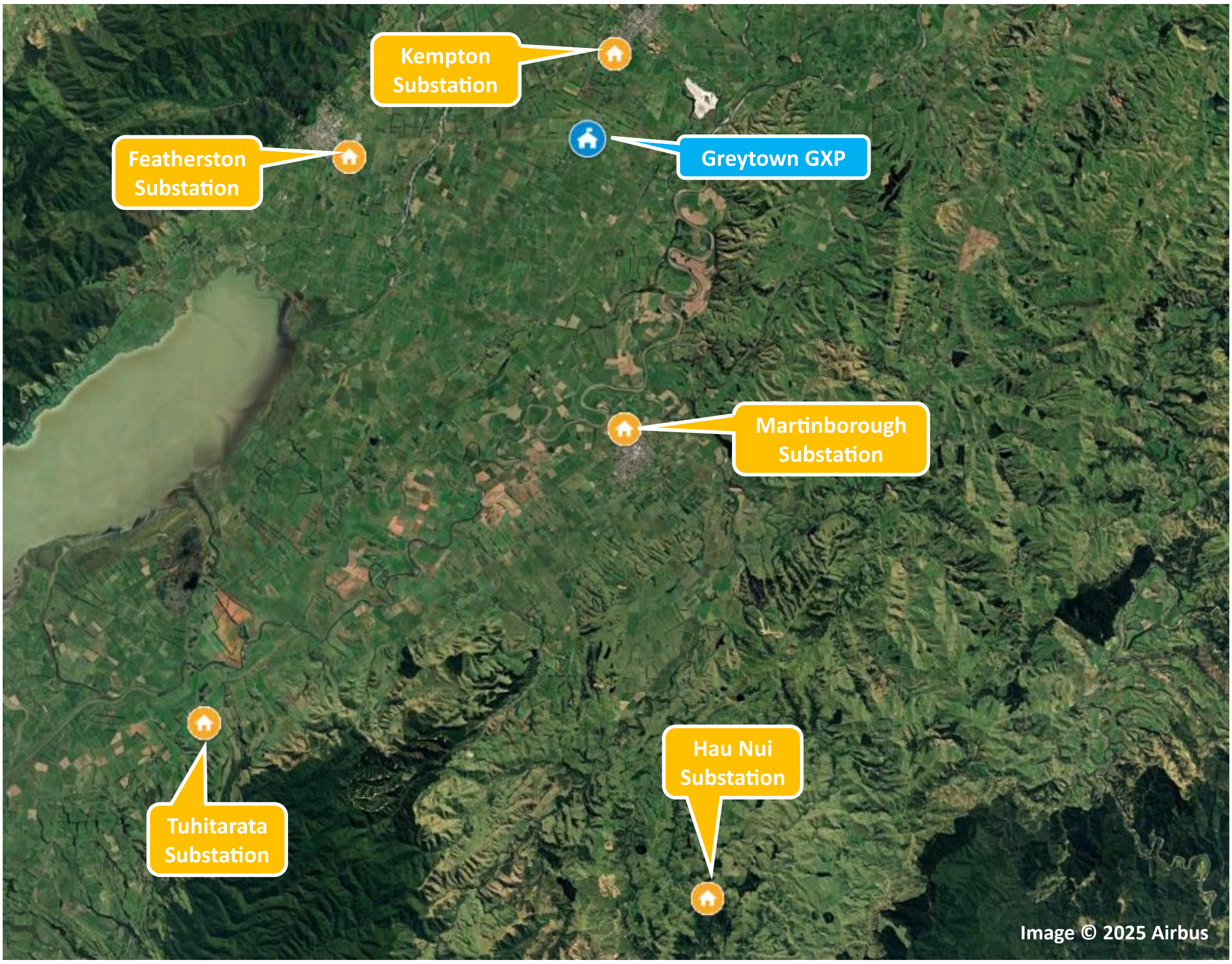


Figure 52. Greytown 33 kV GXP: EECA Load Sites vs local substations

8.6.1 Greytown 33 kV GXP upgrade

The Greytown 33 kV GXP presently has 5.51 MVA of spare (N-1) capacity and 25.51 MVA of spare (N) capacity, based on the transformer ratings. There are no connecting EECA load sites at the GXP. Therefore, no further upgrades are expected at Greytown 33 kV GXP.

8.7 Haywards 11 kV GXP

The "Large" EECA load sites connecting to the Haywards 11 kV GXP include:

- Fulton Hogan Wellington Asphalt Plant (7.92 MW)

The "Small" EECA load sites connecting to the Haywards 11 kV GXP include:

- Farrah's Breads Upper Hutt (0.25 MW) (also connected to Haywards 33 kV GXP, section 8.8)
- Hutt City Council Stokes Valley Pool (0.1 MW)

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

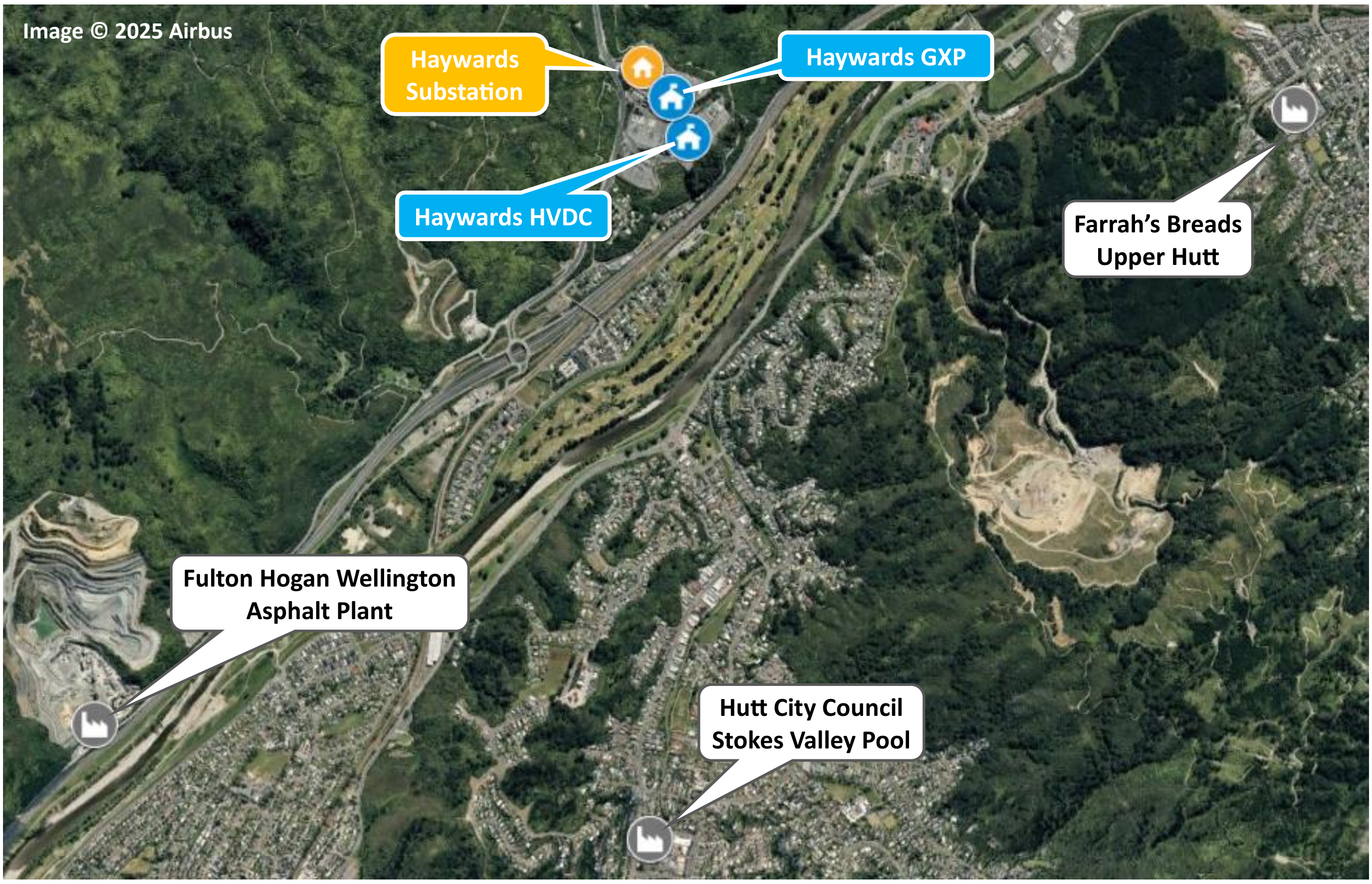


Figure 53. Haywards 11 kV GXP: EECA Load Sites vs local substations.

8.7.1 Haywards 11 kV GXP upgrade

The Haywards 11 kV GXP presently has 10.7 MVA of spare (N-1) capacity and 40.7 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 8.7.6). Therefore, no further upgrades are expected at Haywards 11 kV GXP.

8.7.2 Fulton Hogan Wellington Asphalt Plant

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	7.92	Haywards 11 kV GXP

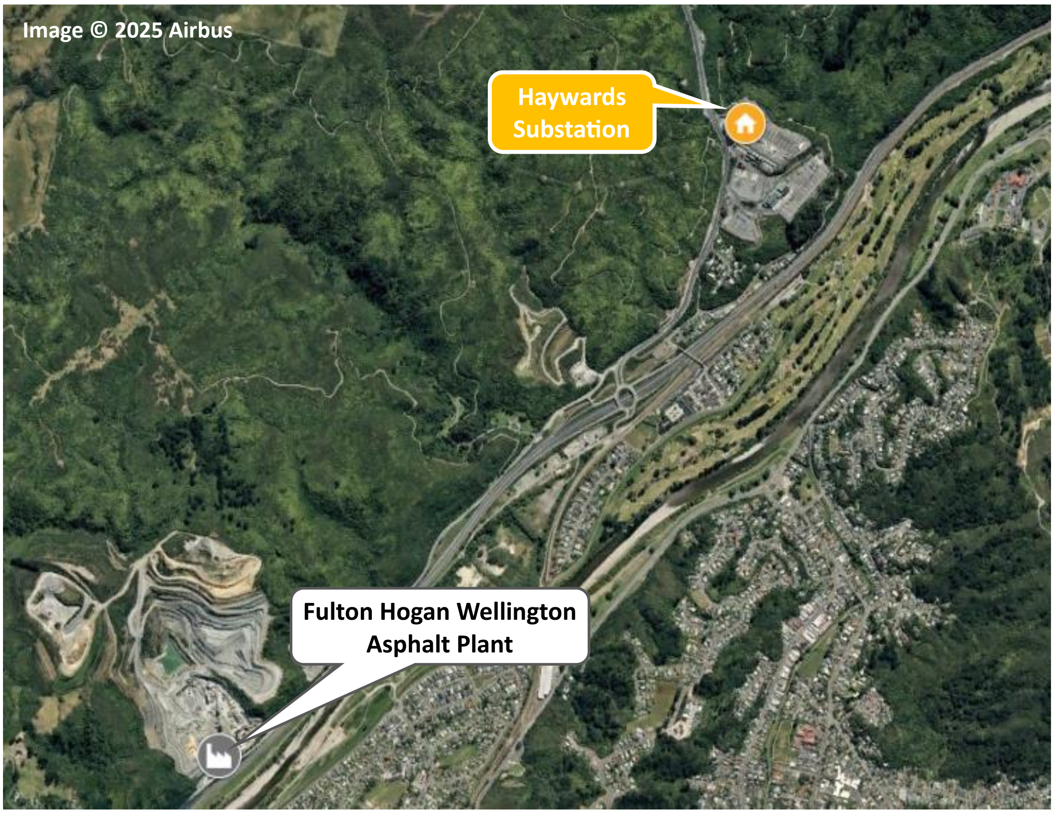


Figure 54. Fulton Hogan Wellington Asphalt Plant geographic location in relation to the surrounding zone substations.

8.7.2.1 Existing electrical supply to the Plant

Fulton Hogan Wellington Asphalt Plant is presently supplied by Wellington Electricity's Haywards zone substation. The site is supplied by an 11 kV feeder which is a mixture of overhead lines and underground cables. Haywards connects directly to the Haywards 11 kV GXP via an 11 kV switchboard at the site.

The site is located approximately 3.3 km away from Haywards zone substation and GXP.

The Haywards 11 kV GXP presently has 40.7 MVA of spare (N) capacity, based on the transformer ratings.

8.7.2.2 Supply Option(s) for New Load

The GXP, and therefore zone substation, has adequate spare (N-1) capacity for this load. Therefore, no further upgrades are expected at this level.

The existing 11 kV feeder has approximately 0.88 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 loading of the new connection, this would likely be an overhead line, at a length of 3.7 km. The costs have been increased for this cable run due to a motorway crossing requirement.

8.7.2.3 Capital Cost Estimate

Table 14. Fulton Hogan Wellington Asphalt Plant: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	11kV circuit breaker (ZSS) [48]	1.00	$0.20
Distribution	Single underground 11kV cable	3.70	$2.96
		TOTAL	**$3.16**

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

8.7.2.4 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.

[48] Provided there is sufficient space in the switchroom to extend the switchboard.

8.7.3 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 15. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Farrah's Breads Upper Hutt[49]	Haywards	N/A	-0.3	0.25	130
Hutt City Council Stokes Valley Pool	Haywards	N/A	1.68	0.10	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.

[49] Ergo has assumed that if this load were to connect, it would connect onto its other feeder from Trentham, which does have spare capacity.

8.7.4 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.

8.7.4.1 Haywards

All four loads on Haywards 11 kV GXP are expected to connect to Haywards zone substation. These loads are Farrah's Breads Upper Hutt, Fulton Hogan Wellington Asphalt Plant, and Hutt City Council Stokes Valley Pool. The sum of peaks of these loads is 8.26 MW, which the GXP/zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Haywards.

8.7.5 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Haywards 11 kV GXP gives a combined load of 0.34 MW. When the load shapes are combined, they result in the following load shape (Figure 55), with a maximum load of 0.30 MW, with a diversity factor of 0.88.

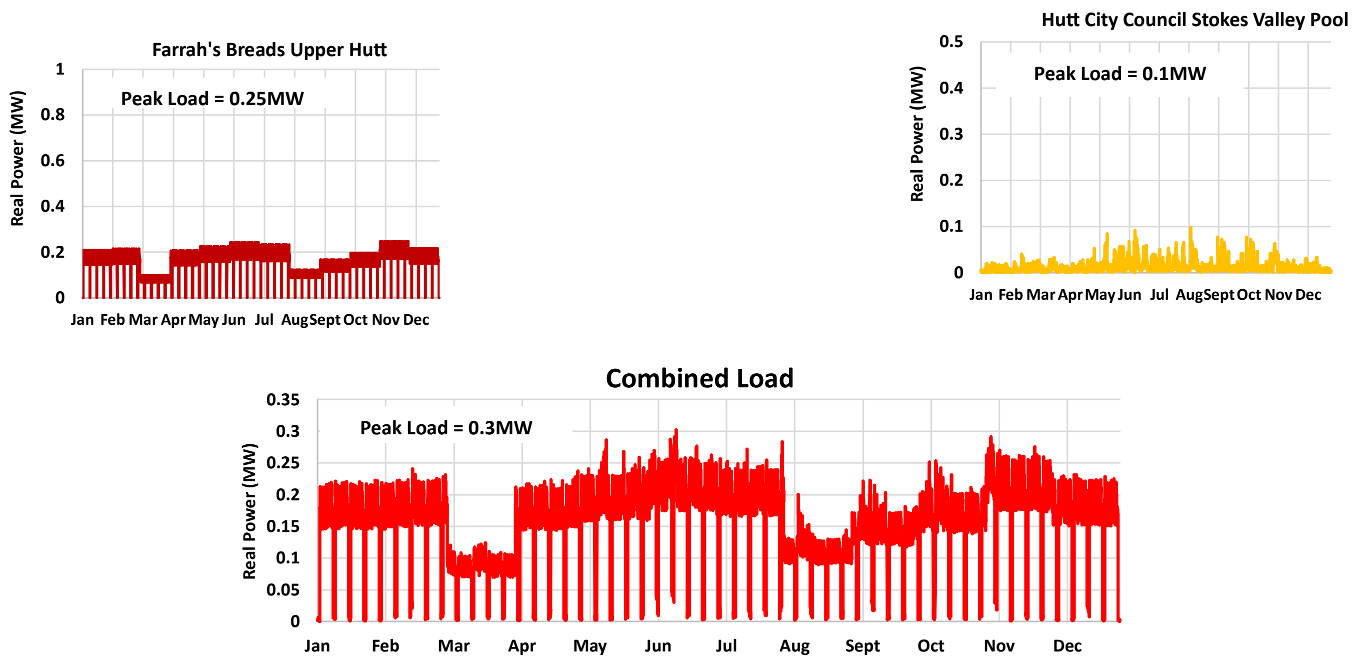


Figure 55. Loading Profiles: Haywards 11 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.7.6 Effect of all Load Sites Connecting to Haywards 11 kV GXP

Figure 56 illustrates the Haywards 11 kV GXP load profile together with the load profiles of all the Load Sites within the Haywards 11 kV GXP region.

Also shown in Figure 56 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Haywards 11 kV GXP would increase to 19.4 MW, an increase of 0.11 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 27.5 MW, there is a diversity factor of 0.97 between the loads.
- Based on Ergo's analysis, the Haywards 11 kV GXP's (N-1) limit is not expected to be exceeded.

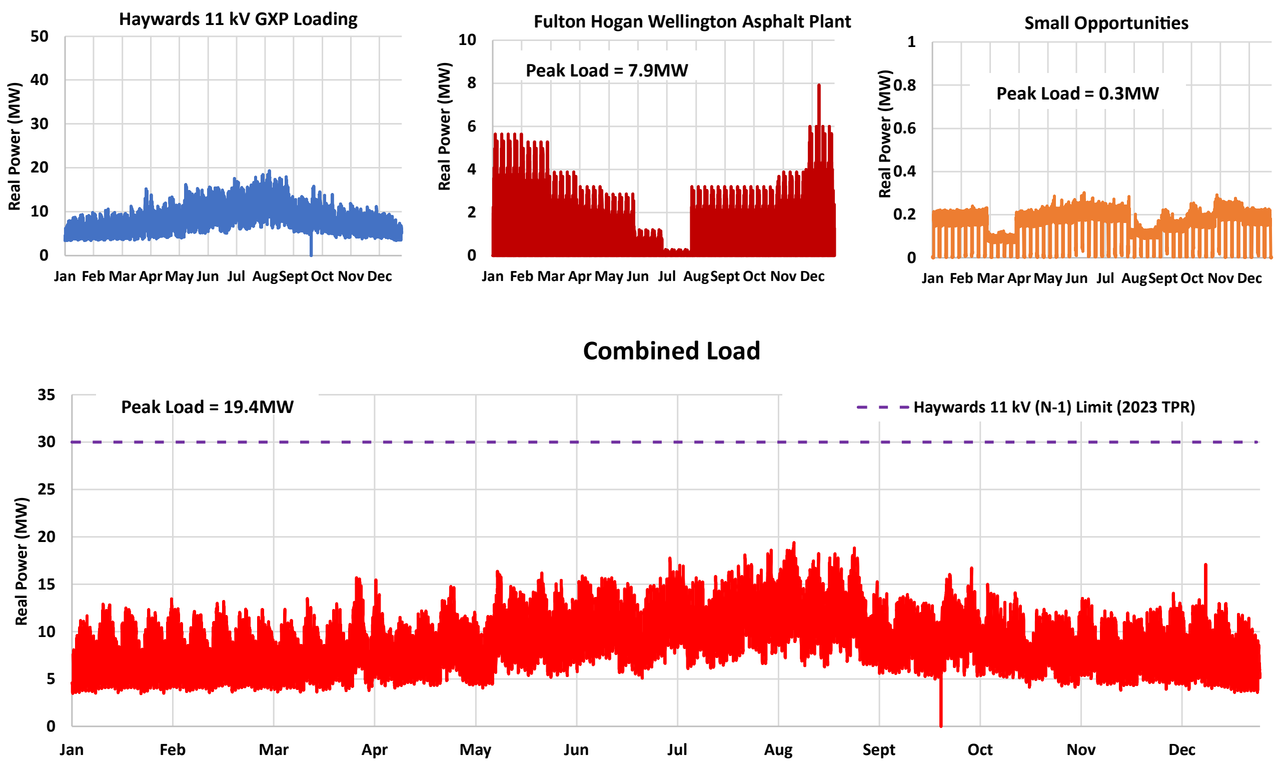


Figure 56. Loading Profiles: Haywards 11 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.8 Haywards 33 kV GXP

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

- New Zealand Defence Force Trentham (1.41 MW)

The "Small" EECA load sites connecting to the Haywards 33 kV GXP include:

- Farrah's Breads Upper Hutt (0.25 MW) (also connected to Haywards 11 kV GXP, section 8.6.1)
- Department of Corrections Rimutaka Prison (0.82 MW)
- NZ Campus of Innovation and Sport (NZCIS) (0.39 MW)

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

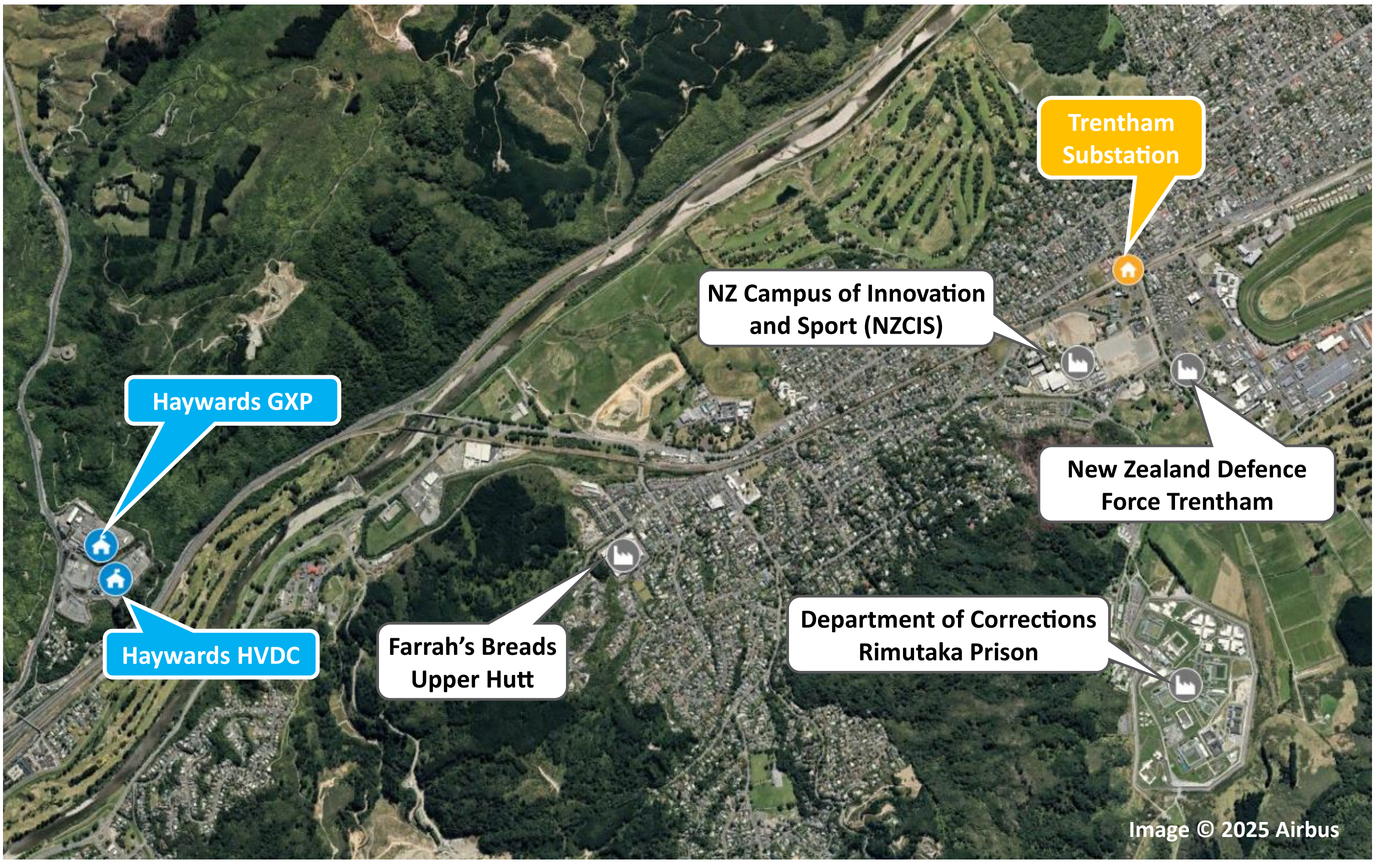


Figure 57. Haywards 33 kV GXP: EECA Load Sites vs local substations.

8.8.1 Haywards 33 kV GXP upgrade

The Haywards 33 kV GXP presently has 11.3 MVA of spare (N-1) capacity and 41.3 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 8.8.6). Therefore, no further upgrades are expected at Haywards 33 kV GXP.

8.8.2 New Zealand Defence Force Trentham

Load Site Description	Electrical Demand (MW)	Transpower GXP
High temperature heat pumps	1.41	Haywards 33 kV GXP

Figure 58. New Zealand Defence Force Trentham geographic location in relation to the surrounding zone substations.

8.8.2.1 Existing electrical supply to the Plant

New Zealand Defence Force Trentham is presently supplied by Wellington Electricity's Trentham zone substation. The site is supplied by an 11 kV feeder which consists entirely of underground cabling. Trentham connects directly to the Haywards 33 kV GXP via two 33 kV sub-transmission circuits rated to ~14.7 MVA each.

The site is located approximately 0.5 km away from Trentham zone substation. The zone substation is located approximately 4.5 km from Haywards 33 kV GXP.

There is currently a maximum loading of 15 MVA on Trentham zone substation, with 4 MVA of spare (N-1) capacity. The Haywards 33 kV GXP presently has 11.3 MVA of spare (N-1) capacity and 41.3 MVA of spare (N) capacity, based on the transformer ratings.

8.8.2.2 Supply Option(s) for New Load

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

For an (N-1) security supply, it is expected that the sub-transmission circuit at Trentham zone substation may need to be replaced. Ergo understands that Wellington Electricity plans to replace both Trentham 33 kV sub-transmission cables from Haywards GXP. The project is expected to complete in 2027 and cost approximately $4.3 M. The costs have not been included in Ergo's capital cost estimate for the site.

The existing 11 kV feeder has approximately 0.52 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 0.55 km.

8.8.2.3 Capital Cost Estimate

Indicatively, for an (N-1) security solution, it is expected that a distribution transformer to supply this load would cost approximately $350 k.

Table 16. New Zealand Defence Force Trentham: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Sub-transmission	Trentham 33 kV cable replacement		
Distribution	11kV circuit breaker (ZSS)[48]	1.00	$0.20
Distribution	Single underground 11kV cable	0.55	$0.33
		TOTAL	**$0.53**

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

8.8.2.4 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.

8.8.3 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 17. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Department of Corrections Rimutaka Prison	Trentham	4	0.52	0.82	260
NZ Campus of Innovation and Sport (NZCIS)	Trentham	4	1.88	0.39	130
Farrah's Breads Upper Hutt	Trentham	4	0.55	0.25	130

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.

8.8.4 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.

8.8.4.1 Trentham

Three of the loads on Haywards 33 kV GXP are expected to connect to Trentham zone substation. These loads are Farrah's Breads Upper Hutt, New Zealand Defence Force Trentham, Department of Corrections Rimutaka Prison, and NZ Campus of Innovation and Sport (NZCIS). The sum of peaks of these loads is 2.87 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Trentham.

8.8.5 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Haywards 33 kV GXP gives a combined load of 1.46 MW. When the load shapes are combined, they result in the following load shape (Figure 59), with a maximum load of 1.37 MW, with a diversity factor of 0.94.

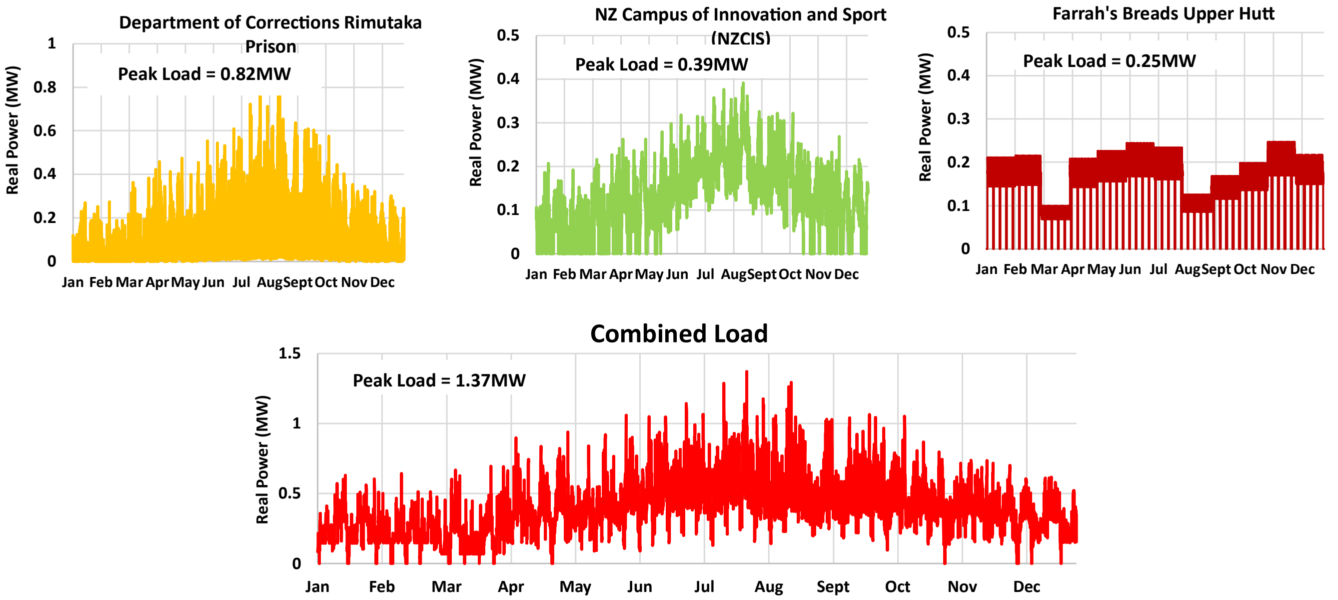


Figure 59. Loading Profiles: Haywards 33 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.8.6 Effect of all Load Sites Connecting to Haywards 33 kV GXP

Figure 60 illustrates the Haywards 33 kV GXP load profile together with the load profiles of all the Load Sites within the Haywards 33 kV GXP region.

Also shown in Figure 60 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Haywards 33 kV GXP would increase to 19.9 MW, an increase of 1.28 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 21.4 MW, there is a diversity factor of 0.93 between the loads.
- Based on Ergo's analysis, the Haywards 33 kV GXP's (N-1) limit is not expected to be exceeded.

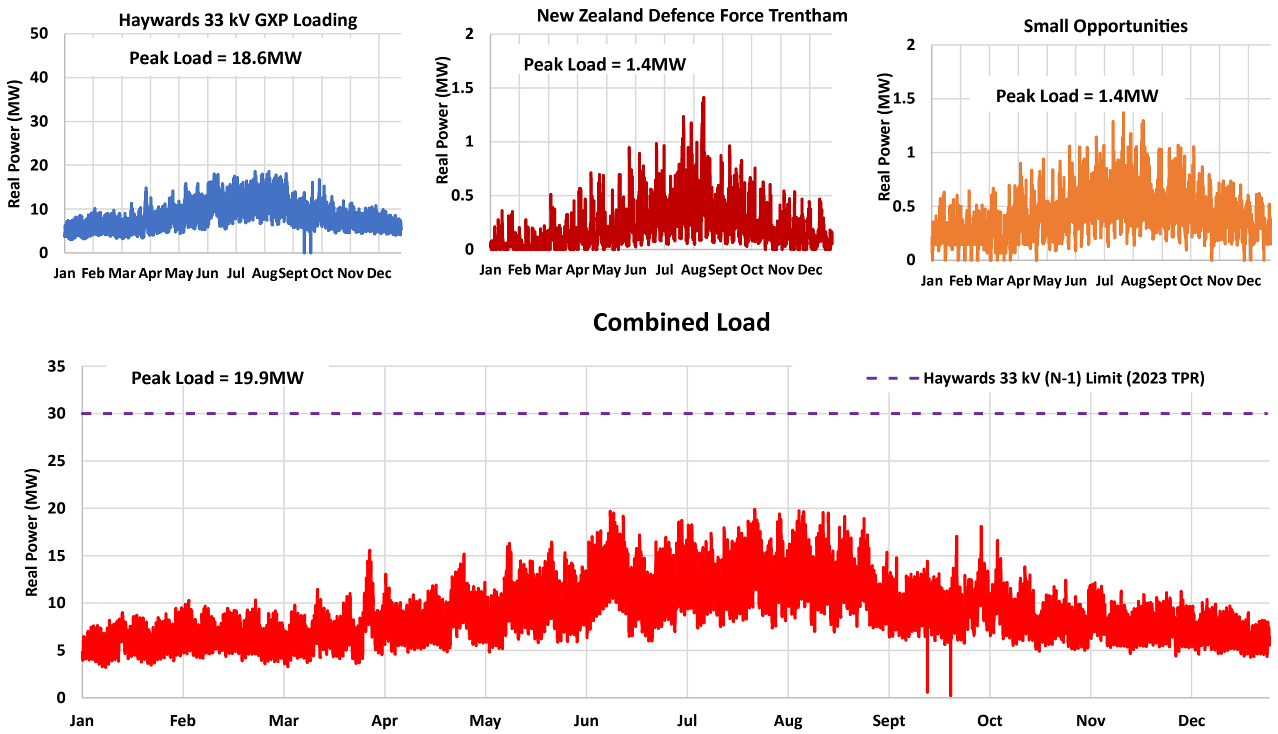


Figure 60. Loading Profiles: Haywards 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.9 Kaiwharawhara 11 kV GXP

The "Large" EECA load sites connecting to the Kaiwharawhara 11 kV GXP include:

- Downer Ngauranga Asphalt Plant (6.65 MW)
- Taylor Preston Limited (3.84 MW) (also connected to Takapu Road GXP, section 8.15)

The "Small" EECA load sites connecting to the Kaiwharawhara 11 kV GXP include:

- Precinct Properties NTT Tower (0.26 MW) (also connected to Wilton 33 kV GXP, section 8.17)
- RJ Holdings Lambton House (0.17 MW)
- RJ Holdings Solnet House (0.17 MW)
- RJ Holdings Midlands Chambers (0.17 MW)
- RJ Holdings Harbour Tower (0.13 MW)
- Precinct Properties Mayfair House (0.12 MW)
- Wellington City Council Thorndon Pool (0.04 MW)

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

Figure 61. Kaiwharawhara 11 kV GXP: EECA Load Sites vs local substations (northern snippet).

Figure 62. Kaiwharawhara 11 kV GXP: EECA Load Sites vs local substations (southern snippet).

8.9.1 Kaiwharawhara 11 kV GXP upgrade

The Kaiwharawhara 33 kV GXP presently has 1.4 MVA of spare (N-1) capacity and 31.4 MVA of spare (N) capacity, based on the transformer ratings. As discussed in Section 8.9.7, if all Load Sites connect to the GXP, then it is expected that the GXP's branch rating would be exceeded.

Ergo understands that Transpower is considering replacing the 110/11 kV transformers at the Kaiwharawhara GXP with larger units. This shall be initiated by Wellington Electricity when necessary. This upgrade was shared between the two large load sites connecting to the GXP: Downer Ngauranga New Zealand and Taylor Preston Limited. It is assumed that these upgrades would be sufficient to connect all remaining load sites. Therefore, no additional further upgrades at Kaiwharawhara are expected.

8.9.2 Downer Ngauranga Asphalt Plant

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	6.65	Kaiwharawhara 11 kV GXP

Figure 63. Downer Ngauranga Asphalt Plant geographic location in relation to the surrounding zone substations.

8.9.2.1 Existing electrical supply to the Plant

Downer Ngauranga Asphalt Plant is presently supplied by Wellington Electricity's Kaiwharawhara zone substation. The site is supplied by an 11 kV feeder which is a mixture of overhead lines and underground cables. Kaiwharawhara connects directly to the Kaiwharawhara GXP via an 11 kV switchboard at the site.

The site is located approximately 2.7 km away from Kaiwharawhara GXP.

The Kaiwharawhara GXP presently has 1.4 MVA of spare (N-1) capacity and 31.4 MVA of spare (N) capacity, based on the transformer ratings.

8.9.2.2 Supply Option(s) for New Load

The GXP has adequate (N), but not (N-1) capacity to supply the new load. Therefore, a transformer upgrade is required at the GXP for an (N-1) connection. There are no upgrades planned for Kaiwharawhara, although the Transpower *Transmission Planning Report 2023* states that Transpower will engage with Wellington Electricity to upgrade the switchgear/transformers.

The existing 11 kV feeder has approximately 4.42 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 3.9 km from Kaiwharawhara substation and 1.0 km from Ngauranga substation. Ergo understands that Downer Ngauranga Asphalt Plant and Taylor Preston Limited are connected to the same feeder, so some upgrades could be shared between feeders. The Wellington Electricity upgrades to this feeder are detailed further in the Taylor Preston Limited section (Section 8.9.3). However, considering this load is larger, a more conservative estimate will be priced.

8.9.2.3 Capital Cost Estimate

Table 18. Downer Ngauranga Asphalt Plant: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Large supply transformer (GXP)[50]	2.00	$9.00
Distribution	11kV circuit breaker (ZSS)[51]	1.00	$0.20
Distribution	Single underground 11kV cable	3.90	$2.34
		TOTAL	**$11.54**

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

8.9.2.4 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.

[50] Provided there is sufficient space in the existing transformer enclosures.
[51] Provided there is sufficient space in the switchroom to extend the switchboard.

8.9.3 Taylor Preston Limited

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	3.84	Kaiwharawhara 11 kV GXP Takapu Road 33 kV GXP

Figure 64. Taylor Preston Limited geographic location in relation to the surrounding zone substations.

8.9.3.1 Existing electrical supply to the Plant

Taylor Preston Limited is presently supplied by Transpower's Kaiwharawhara GXP and Wellington Electricity's Ngauranga zone substation. Different areas of the site are supplied by one of two 11 kV feeders from these two substations which consists entirely of underground cabling. Kaiwharawhara GXP supplies the zone via two Transpower-owned 110/11 kV transformers. Ngauranga zone substation connects to the Takapu Road GXP via two 33 kV sub-transmission cables rated to ~10 MVA each.

Taylor Preston Limited is located approximately 2.5 km away from Kaiwharawhara GXP. The site is located approximately 0.6 km away from Ngauranga zone substation. The zone substation is located approximately 10.7 km from Takapu Road GXP.

The Kaiwharawhara GXP presently has 1.4 MVA of spare (N-1) capacity and 31.4 MVA of spare (N) capacity, based on the transformer ratings. There is currently a maximum loading of 10 MVA on Ngauranga zone substation, with 0 MVA of spare (N-1) capacity. The Takapu Road GXP presently has 6.6 MVA of spare (N-1) capacity and 76.6 MVA of spare (N) capacity, based on the transformer ratings.

8.9.3.2 Supply Option(s) for New Load

The Kaiwharawhara GXP has inadequate (N-1) spare capacity. The Ngauranga zone substation has inadequate spare (N-1) capacity for the new load. The Takapu Road GXP security is (N-1). Therefore, a transformer upgrade is expected at Ngauranga zone substation as well as Kaiwharawhara. Ergo notes that Wellington Electricity has planned upgrades for the Ngauranga transformers. The project is expected to complete in 2028 at a cost of $9.0 M. These costs are part of a standard asset replacement plan; therefore, the costs have not been included against the customer. There are no upgrades planned for Kaiwharawhara, although the Transpower Transmission Planning Report states that Transpower will engage with Wellington Electricity to upgrade the switchgear/transformers.

Ergo understands that Wellington Electricity has numerous upgrades planned to upgrade the Load Site electricity infrastructure. In 2026, Wellington Electricity plans to upgrade short sections of cable along the Abattoirs Kaiwharawhara feeder. The project is expected to cost $0.8 M and targeted to complete in 2026.

The existing 11 kV feeder from Ngauranga has 0.39 MVA of spare capacity. Wellington Electricity is planning to install new 11 kV feeders from Ngauranga to the Abattoirs customer-owned substations on site. The new feeder is expected to alleviate the constraint on the Kaiwharawhara feeder. The project is expected to complete in 2029 at a cost of $8.1 M. In line with advice from WE*, as this is an already-planned project, Ergo has not included the costs for it against this Load Site.

8.9.3.3 Capital Cost Estimate

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

Table 19. Taylor Preston Limited: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Distribution	Abattoirs 11kV feeder upgrade		
Distribution	New Ngauranga feeder		
		TOTAL	**$9.00**

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

8.9.3.4 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.

8.9.4 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 20. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Precinct Properties NTT Tower	Kaiwharawhara	N/A	3.3	0.26	80
RJ Holdings Lambton House	Kaiwharawhara	N/A	3.3	0.17	80
RJ Holdings Solnet House	Kaiwharawhara	N/A	4.09	0.17	80
RJ Holdings Midlands Chambers	Kaiwharawhara	N/A	3.82	0.17	80
RJ Holdings Harbour Tower	Kaiwharawhara	N/A	3.82	0.13	80
Precinct Properties Mayfair House	Kaiwharawhara	N/A	3.82	0.12	80
Wellington City Council Thorndon Pool	Kaiwharawhara	N/A	8.61	0.04	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.

8.9.5 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.

8.9.5.1 Kaiwharawhara

All nine of the loads on Kaiwharawhara 11 kV GXP are expected to connect together. These loads are Downer Ngauranga Asphalt Plant, Taylor Preston Limited, Precinct Properties NTT Tower, RJ Holdings Lambton House, RJ Holdings Solnet House, RJ Holdings Midlands Chambers, RJ Holdings Harbour Tower, Precinct Properties Mayfair House, and Wellington City Council Thorndon Pool. The sum of peaks of these loads is 11.56 MW, which the zone substation does not have (N-1) capacity for. The upgrades to Kaiwharawhara are discussed in section 8.9.1.

8.9.6 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on the Kaiwharawhara 11 kV GXP gives a combined load of 1.07 MW. When the load shapes are combined, they result in the following load shape (Figure 65), with a maximum load of 1.03 MW, with a diversity factor of 0.96.

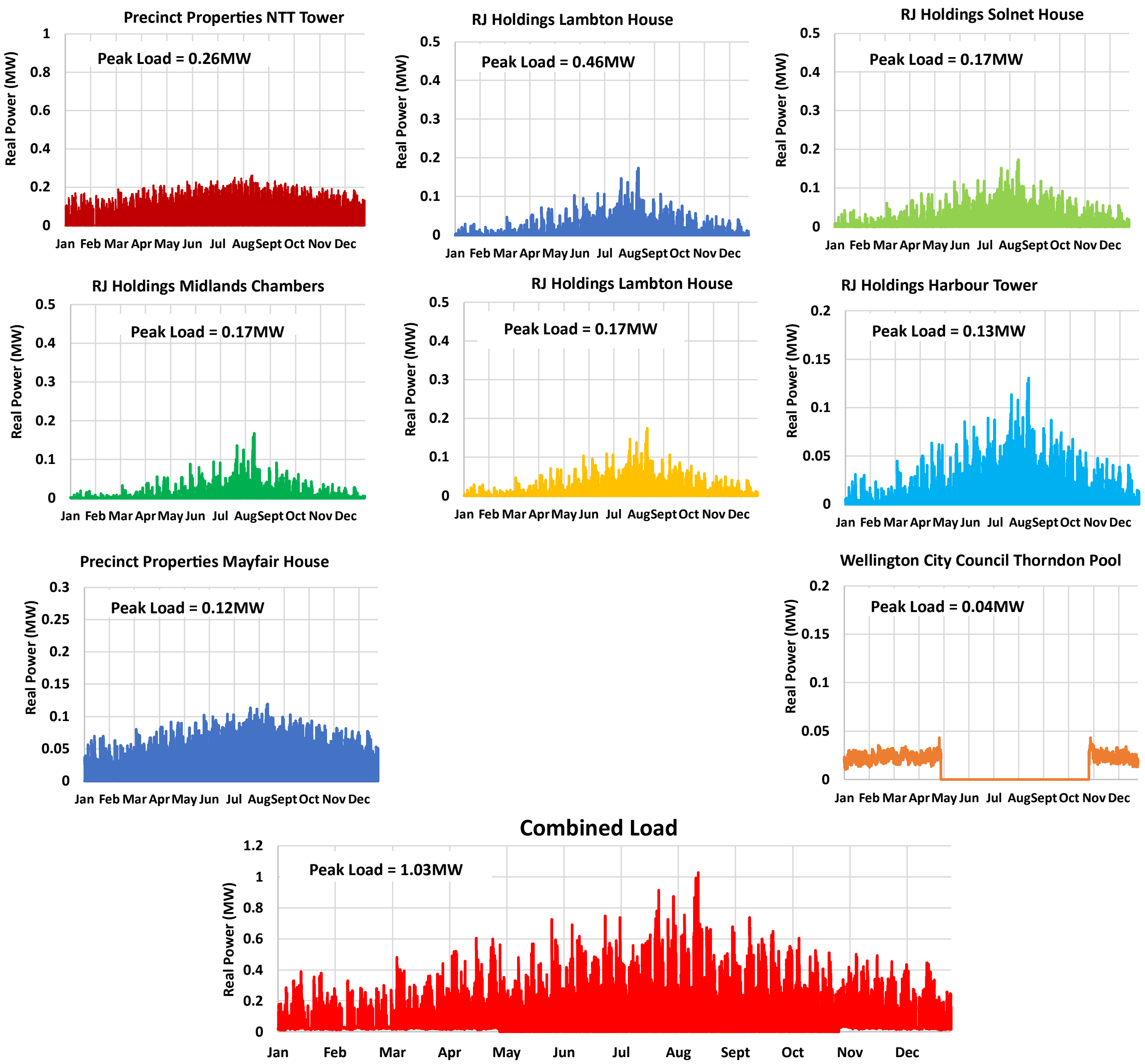


Figure 65. Loading Profiles: Kaiwharawhara 11 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.9.7 Effect of all Load Sites Connecting to Kaiwharawhara 11 kV GXP

Figure 66 illustrates the Kaiwharawhara 11 kV GXP load profile together with the load profiles of all the Load Sites within the Kaiwharawhara 11 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 Kaiwharawhara 11 kV GXP would increase to 33.2 MW, an increase of 4.61 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 40.1 MW, there is a diversity factor of 0.83 between the loads.
- Based on Ergo's analysis, the Kaiwharawhara 11 kV GXP's (N-1) limit is expected to be exceeded.

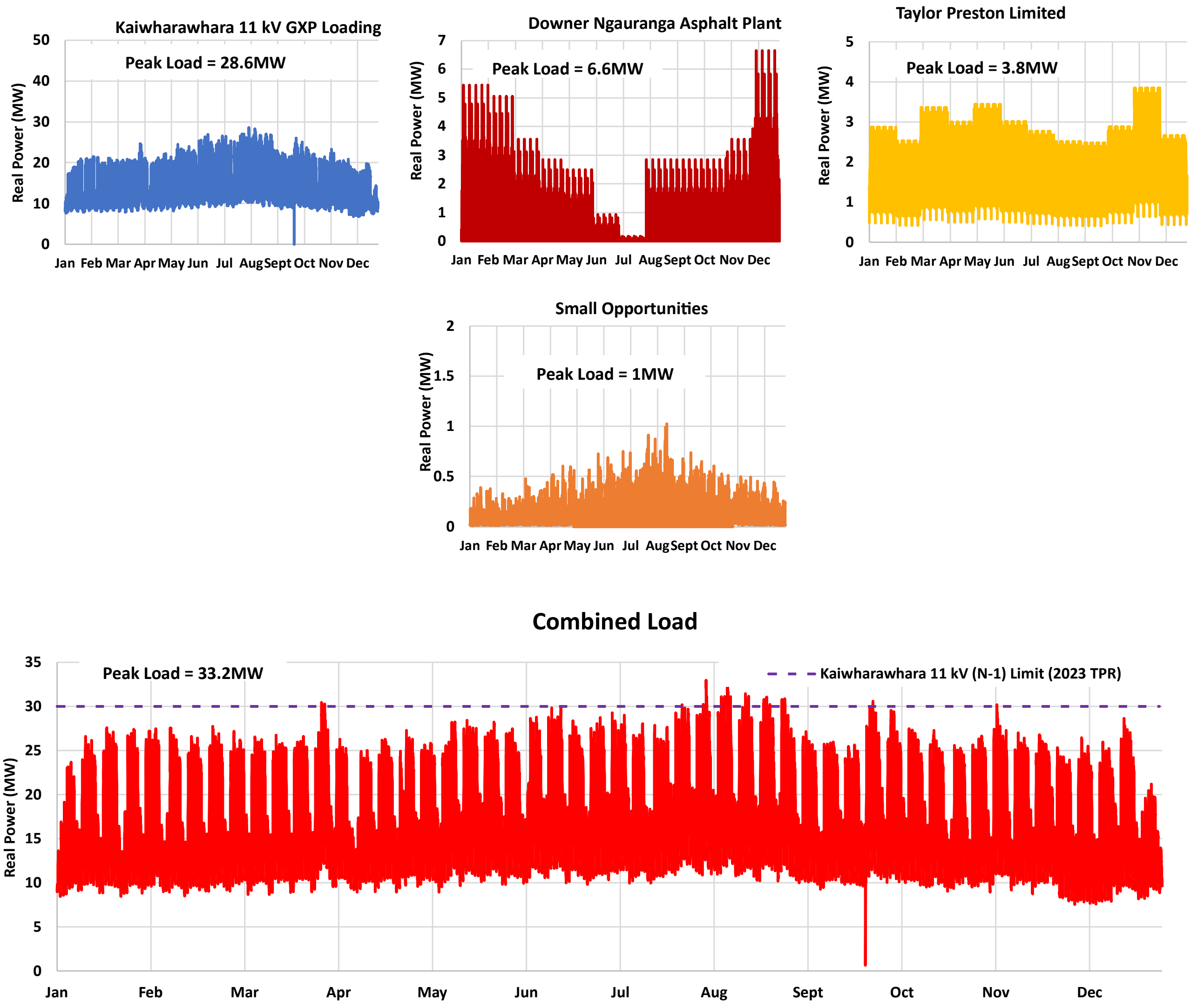


Figure 66. Loading Profiles: Kaiwharawhara 11 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.10 Masterton 33 kV GXP

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

- Higgins Concrete Wairarapa (3.65 MW)

The “Small” EECA load sites connecting to the Masterton 33 kV GXP include:

- Breadcraft Wairarapa (0.99 MW)

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

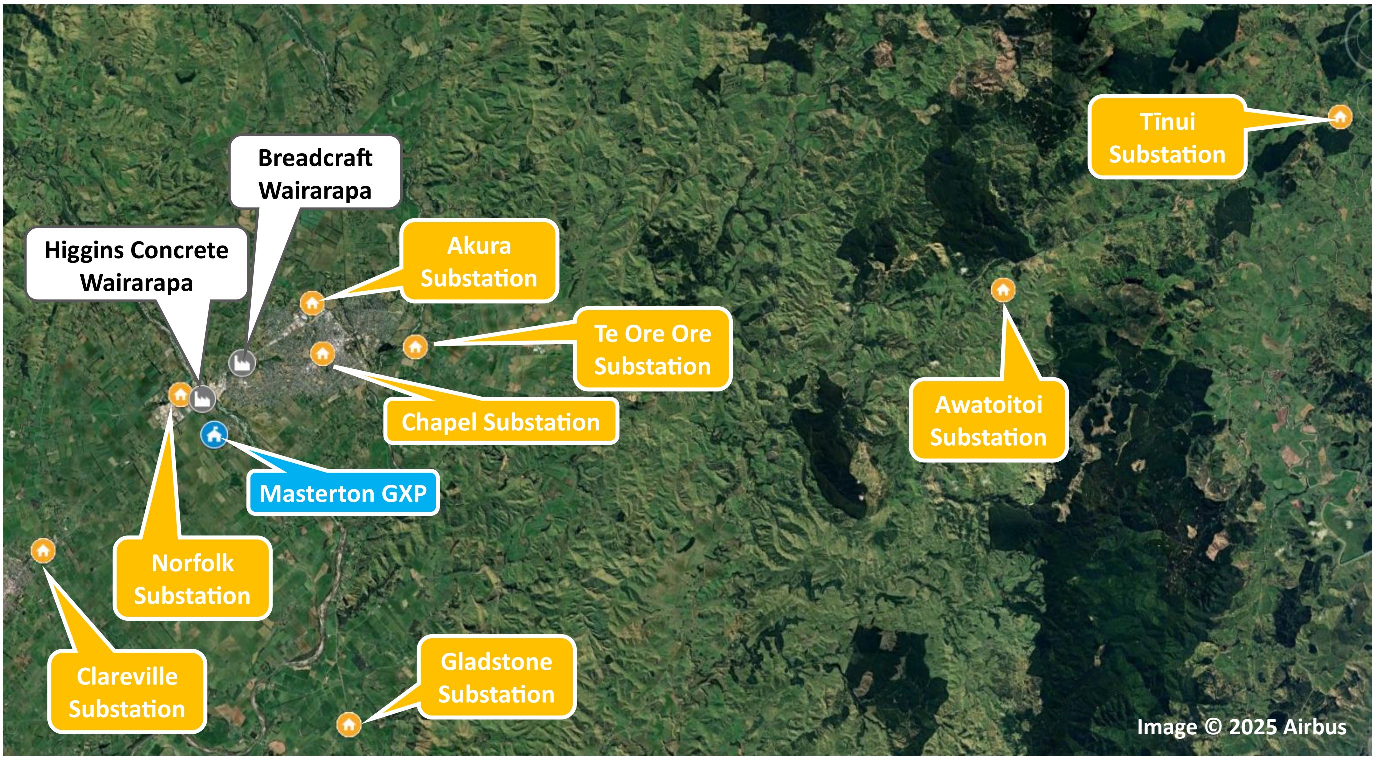


Figure 67. Masterton 33 kV GXP: EECA Load Sites vs local substations.

8.10.1 Masterton 33 kV GXP upgrade

The Masterton 33 kV GXP presently has 12.8 MVA of spare (N-1) capacity and 72.8 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 8.10.4). Therefore, no further upgrades are expected at Masterton 33 kV GXP.

8.10.2 Higgins Concrete Wairarapa

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	3.65	Masterton 33 kV GXP

Figure 68. Higgins Concrete Wairarapa geographic location in relation to the surrounding zone substations.

8.10.2.1 Existing electrical supply to the Plant

Higgins Concrete Wairarapa is presently supplied by Powerco's Norfolk zone substation. The site is supplied by an 11 kV feeder which is a mixture of overhead lines and underground cables. Norfolk connects directly to the Masterton GXP via a 33 kV sub-transmission ring circuit with 5.9 MVA spare capacity.

The site is located approximately 0.8 km away from Norfolk zone substation. The zone substation is located approximately 1.8 km from Masterton GXP.

There is currently a maximum loading of 6.8 MVA on Norfolk zone substation, with 5.7 MVA of spare (N) capacity and -0.55 MVA of spare (N-1) capacity. The Masterton GXP presently has 12.8 MVA of spare (N-1) capacity and 72.8 MVA of spare (N) capacity, based on the transformer ratings.

8.10.2.2 Supply Option(s) for New Load

The GXP and zone substation both have spare (N) but not adequate spare (N-1) capacity. Ergo understands that Powerco is planning to convert 600 m of overhead line to underground cable and re-tension a further 1.1 km of line in the Akura-Norfolk sub-transmission ring to increase spare capacity. This is understood to occur between 2024-2027 at a cost of $0.681 M, according to their 2023 AMP. These costs have been included in the pricing of the site upgrades. Powerco is also planning a possible future development to increase the capacity of Norfolk substation transformers.

The existing 11 kV feeder has approximately 2 MW 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 rural topography of the area, this would likely be an overhead line, at a length of 1.2 km.

8.10.2.3 Capital Cost Estimate

Indicatively, for an (N) security solution, it is expected that a distribution transformer to supply this load would cost approximately $500 k.

Table 21. Higgins Concrete Wairarapa: Indicative capital cost to supply the Load Site with (N) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZSS) [52]	1.00	$0.20
Distribution	Single overhead 11kV line	1.20	$0.60
		TOTAL	**$0.80**

Table 22. Higgins Concrete Wairarapa: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Sub-transmission	Norfolk sub-transmission upgrades		$0.68
Distribution	Medium supply transformer (ZSS)	2.00	$3.80
Distribution	11kV circuit breaker (ZSS)	1.00	$0.20
Distribution	Single overhead 11kV line	1.20	$0.60
		TOTAL	**$5.28**

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

[52] Provided there is sufficient space in the switchroom to extend the switchboard.

8.10.3 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 23. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Breadcraft Wairarapa	Akura	4	0.5	0.99	260

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.

8.10.4 Effect of all Load Sites Connecting to Masterton 33 kV GXP

Figure 69 illustrates the Masterton 33 kV GXP load profile together with the load profiles of all the Load Sites within the Masterton 33 kV GXP region.

Also shown in Figure 70 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Masterton 33 kV GXP would increase to 50.8 MW, an increase of 3.68 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 52.6 MW, there is a diversity factor of 0.97 between the loads.
- Based on Ergo's analysis, the Masterton 33 kV GXP's (N-1) limit is not expected to be exceeded.

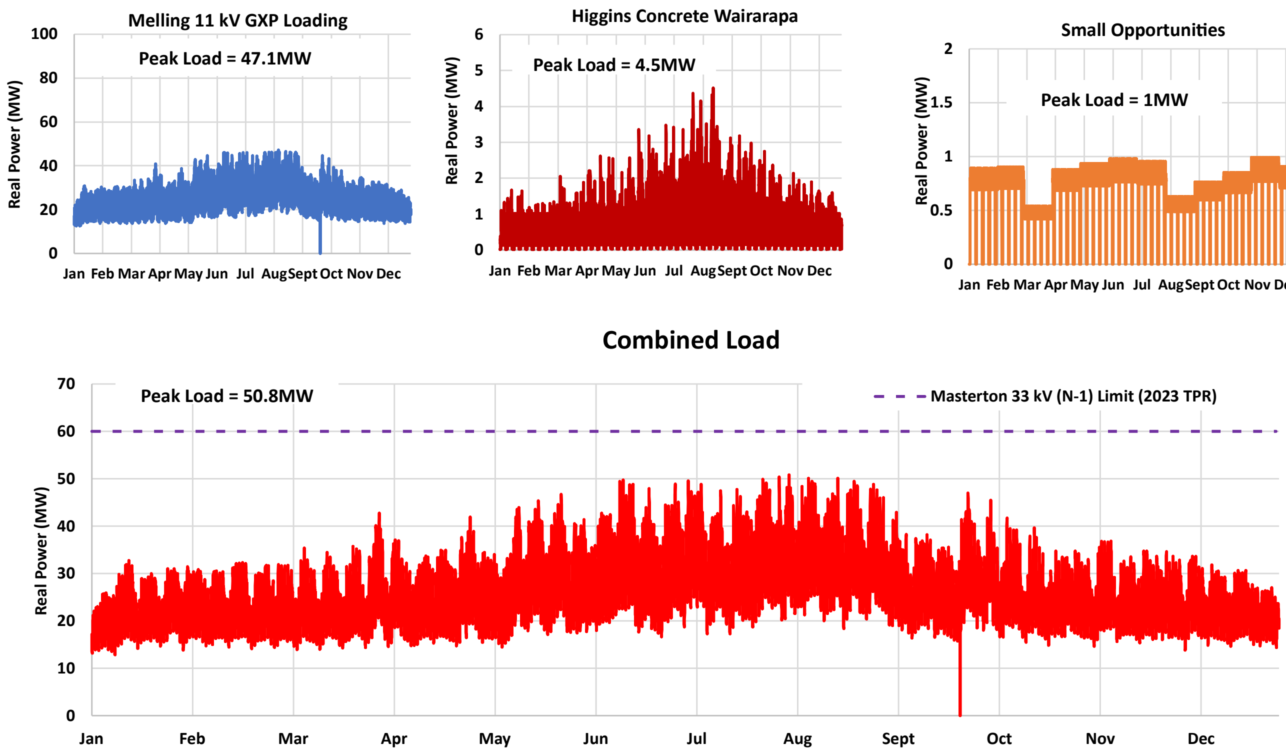


Figure 69. Loading Profiles: Masterton 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.11 Melling 11 kV GXP

The "Large" EECA load sites connecting to the Melling 11 kV GXP include:

- Hutt Hospital (1.85 MW)

The "Small" EECA load sites connecting to the Melling 11 kV GXP include:

- GNS Avalon (0.2 MW)

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

Figure 70. Melling 11 kV GXP: EECA Load Sites vs local substations.

8.11.1 Melling 11 kV GXP upgrade

The Melling 11 kV GXP presently has 5.9 MVA of spare (N-1) capacity and 23.9 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 8.11.5). Therefore, no further upgrades are expected at Melling 11 kV GXP.

8.11.2 Hutt Hospital

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.85	Melling 11 kV GXP

Figure 71. Hutt Hospital geographic location in relation to the surrounding zone substations.

8.11.2.1 Existing electrical supply to the Plant

Hutt Hospital is presently supplied by Wellington Electricity's Melling zone substation. The site is supplied by an 11 kV feeder which consists entirely of underground cabling. Melling connects directly to the Melling 11 kV GXP via an 11 kV switchboard at the site.

The site is located approximately 0.8 km away from Melling GXP.

The Melling 11 kV GXP presently has 5.9 MVA of spare (N-1) capacity and 23.9 MVA of spare (N) capacity, based on the transformer ratings.

8.11.2.2 Supply Option(s) for New Load

The GXP has spare (N) and (N-1) capacity to supply the new load. Therefore, no further upgrades are expected at Melling.

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 an associated circuit breaker are assumed to be required. Due to the urban topography of the area, this would likely be an underground cable, at a length of 1.07 km.

8.11.2.3 Capital Cost Estimate

Indicatively, it is expected that a distribution transformer to supply this load would cost approximately $350 k.

Table 24. Hutt Hospital: Indicative capital cost to supply the Load Site with (N-1) sub-transmission supply security.

Transmission => (N-1)	Sub-transmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	11kV circuit breaker (ZSS) [53]	1.00	$0.20
Distribution	Single underground 11kV cable	1.07	$0.64
		TOTAL	**$0.84**

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

8.11.2.4 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.

[53] Provided there is sufficient space in the switchroom to extend the switchboard.

8.11.3 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 25. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
GNS Avalon	Melling	N/A	2.18	0.20	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.

8.11.4 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.

8.11.4.1 Melling

All two of the loads on Melling 11 kV GXP are expected to connect to Melling zone substation. These loads are Hutt Hospital and GNS Avalon. The sum of peaks of these loads is 2.05 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are required at Melling zone substation.

8.11.5 Effect of all Load Sites Connecting to Melling 11 kV GXP

Figure 72 illustrates the Melling 11 kV GXP load profile together with the load profiles of all the Load Sites within the Melling 11 kV GXP region.

Also shown in Figure 72 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Melling 11 kV GXP would increase to 27.0 MW, an increase of 0.91 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 28.1 MW, there is a diversity factor of 0.96 between the loads.
- Based on Ergo's analysis, the Melling 11 kV GXP's (N-1) limit is not expected to be exceeded.

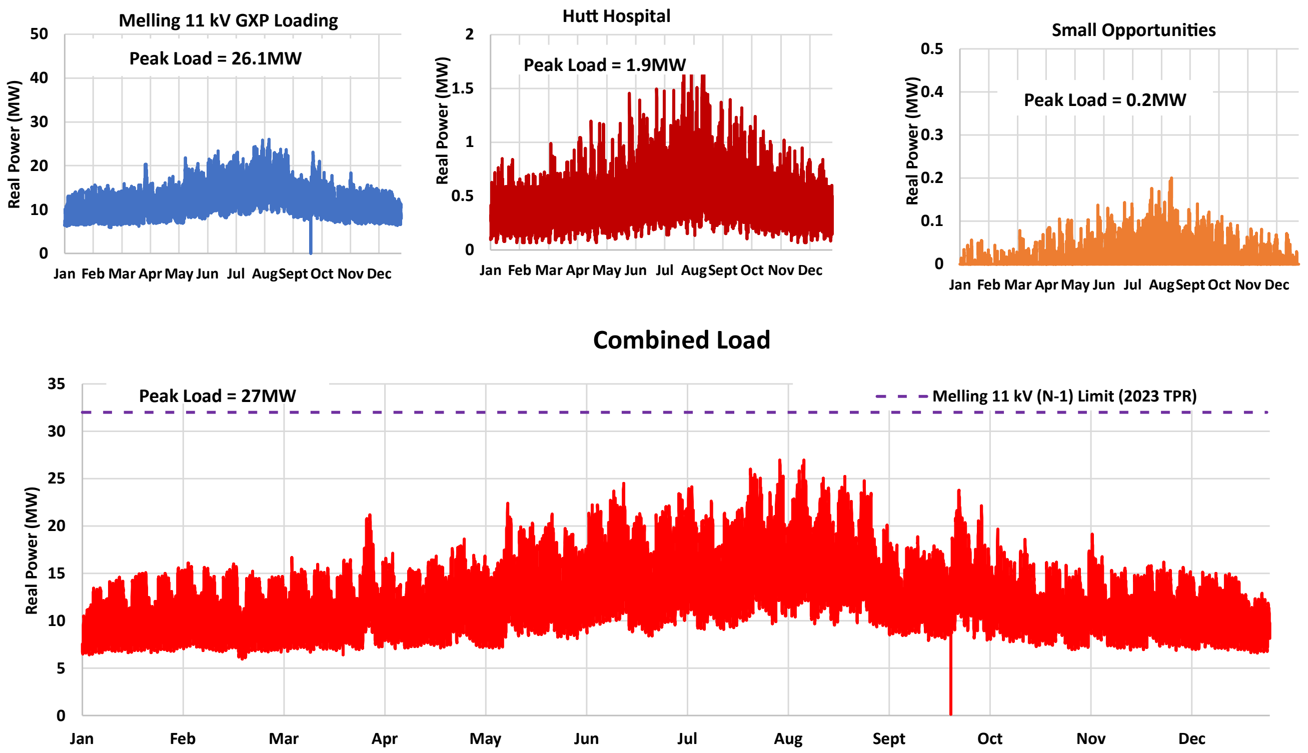


Figure 72. Loading Profiles: Melling 11 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.12 Melling 33 kV GXP

The "Small" EECA load sites connecting to the Melling 33 kV GXP include:

- Bostik Wellington (0.49 MW)
- Mexicano Corn Chips Lower Hutt (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.

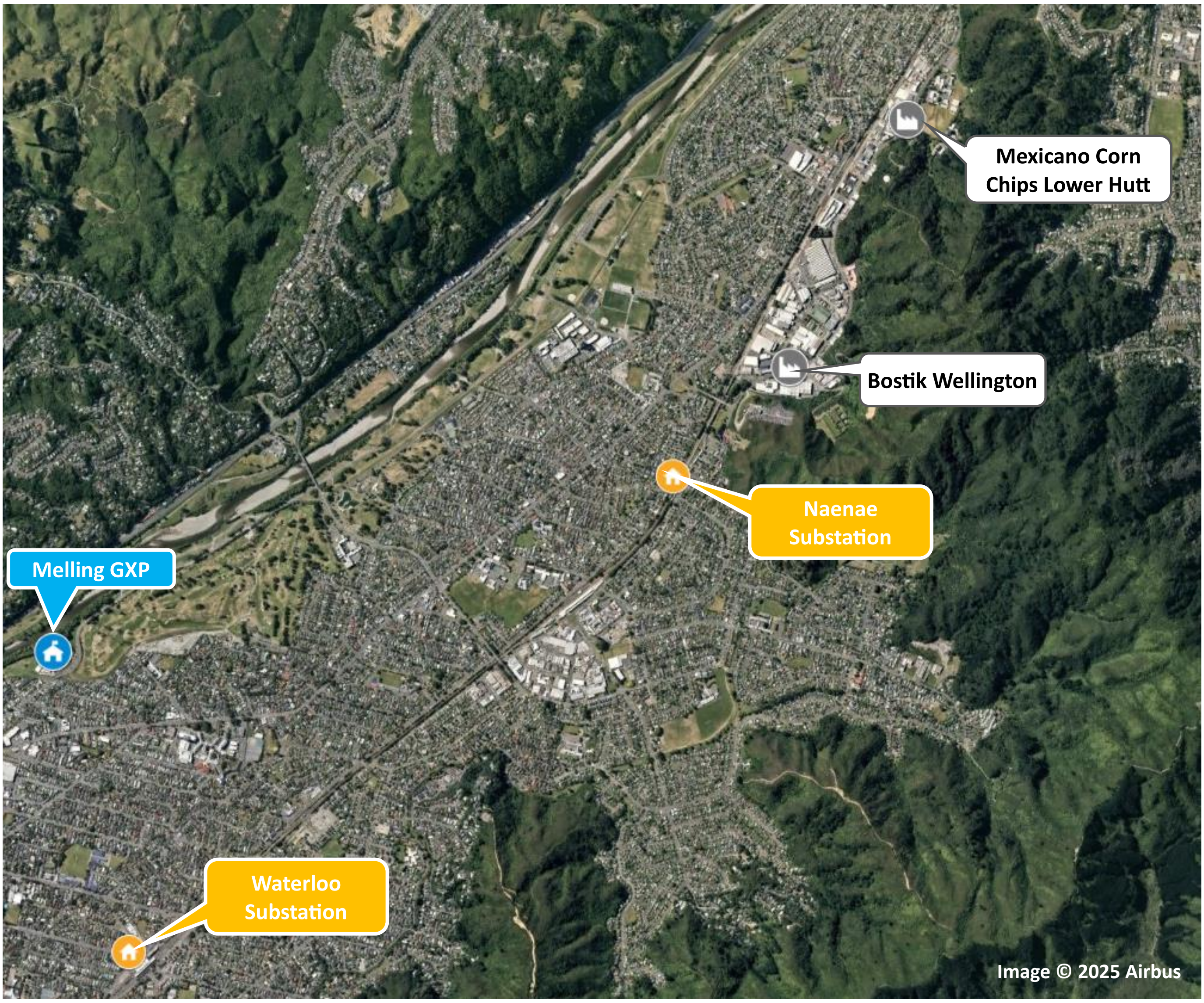


Figure 73. Melling 33 kV GXP: EECA Load Sites vs local substations.

8.12.1 Melling 33 kV GXP upgrade

The Melling 33 kV GXP presently has 14.69 MVA of spare (N-1) capacity and 62.7 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 8.12.5). Therefore, no further upgrades are expected at Melling 33 kV GXP.

8.12.2 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 26. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Bostik Wellington	Naenae	4	2.52	0.49	130
Mexicano Corn Chips Lower Hutt	Naenae	4	0.9	0.49	130

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.

8.12.3 Combined Load on Zone Substations

8.12.3.1 Naenae

Two of the loads on Melling 33 kV GXP are expected to connect to Melling zone substation. These loads are Bostik Wellington and Mexicano Corn Chips Lower Hutt. The sum of peaks of these loads is 0.99 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are required at Naenae zone substation.

8.12.4 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Melling 33 kV GXP gives a combined load of 0.99 MW. When the load shapes are combined, they result in the following load shape (Figure 74), with a maximum load of 0.81 MW, with a diversity factor of 0.81.

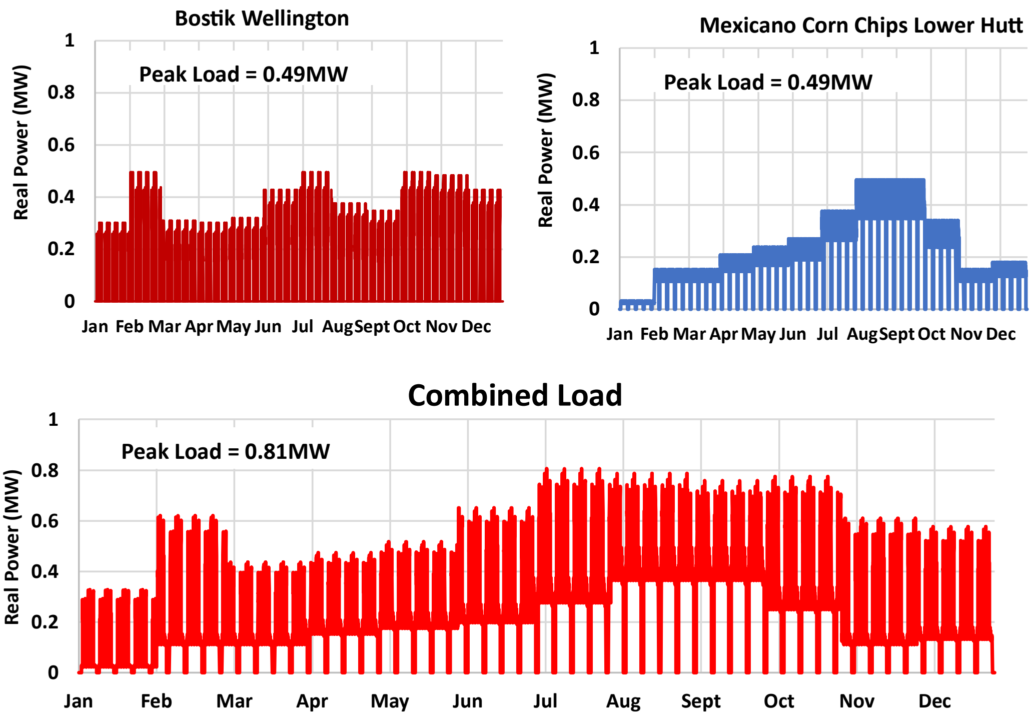


Figure 74. Loading Profiles: Melling 33 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.12.5 Effect of all Load Sites Connecting to Melling 33 kV GXP

Figure 75 illustrates the Melling 33 kV GXP load profile together with the load profiles of all the Load Sites within the Melling 33 kV GXP region.

Also shown in Figure 75 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Melling 33 kV GXP would increase to 37.7 MW, an increase of 0.37 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 38.1 MW, there is a diversity factor of 0.99 between the loads.
- Based on Ergo's analysis, the Melling 33 kV GXP's (N-1) limit is not expected to be exceeded.

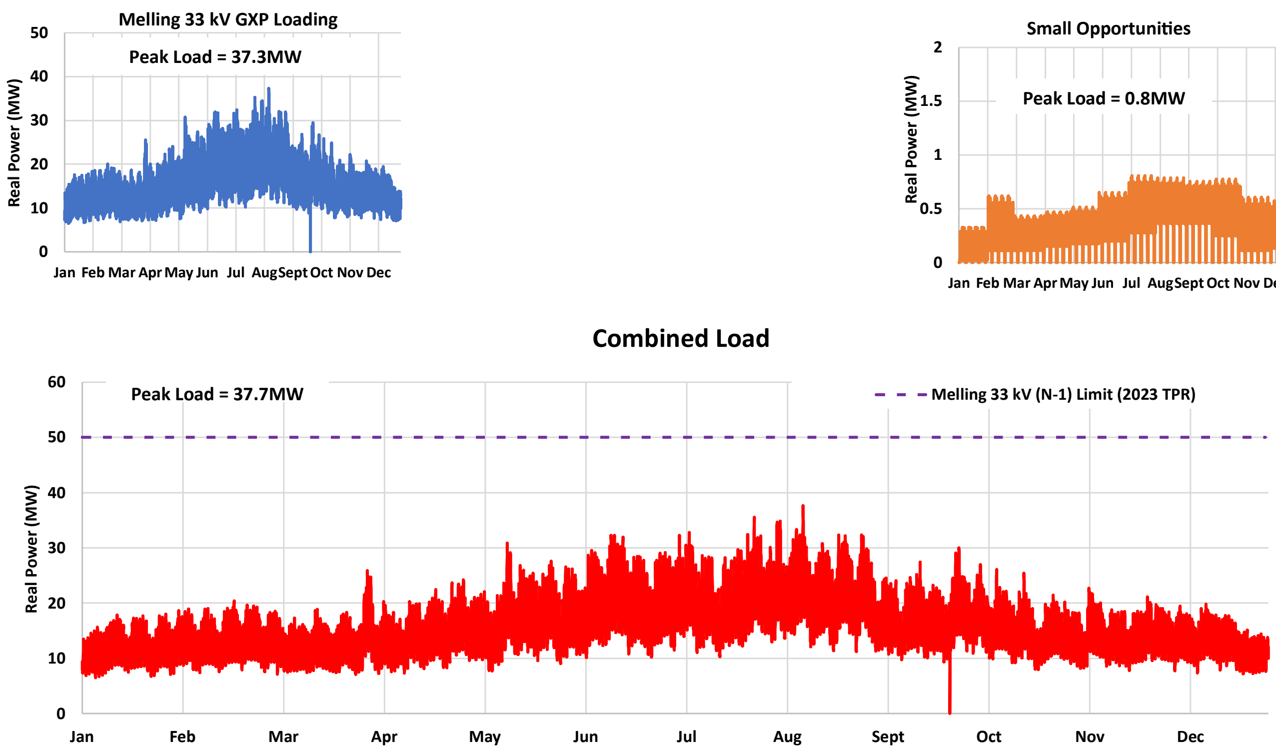


Figure 75. Loading Profiles: Melling 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.13 Paraparaumu 33 kV GXP

The “Small” EECA load sites connecting to the Paraparaumu 33 kV GXP include:

- Firth Dricon Waikanae (0.99 MW)
- Ōtaki College (0.24 MW)
- Paraparaumu College (0.2 MW)
- Kapiti Coast District Council Ōtaki Pool (0.11 MW)
- Kapiti Coast District Council Waikanae Pool (0.07 MW)

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

Figure 76. Paraparaumu 33 kV GXP: EECA Load Sites vs local substations.

8.13.1 Paraparaumu 33 kV GXP upgrade

The Paraparaumu 33 kV GXP presently has 70.9 MVA of spare (N-1) capacity and 170.9 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 8.13.5). Therefore, no further upgrades are expected at Paraparaumu 33 kV GXP.

8.13.2 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 27. 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)	Expected Feeder Spare Capacity (MW)[54]	Opportunity Load (MW)	Estimate cost ($k)
Firth Dricon Waikanae	Waikanae	6.1	2.19	0.99	260
Ōtaki College	Ōtaki	10.5	-6.77	0.24	130
Paraparaumu College	Paraparaumu West	11	-3.66	0.20	80
Kapiti Coast District Council Ōtaki Pool	Ōtaki	10.5	-6.16	0.11	80
Kapiti Coast District Council Waikanae Pool	Waikanae	6.1	-0.88	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.

[54] No feeder maximum capacity was provided to Ergo for Electra feeders. Results shown here are based on a maximum capacity of 6 MVA per feeder.

8.13.3 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.

8.13.3.1 Ōtaki

Two of the loads on Paraparaumu 33 kV GXP are expected to connect to Ōtaki zone substation. These loads are Ōtaki College and Kapiti Coast District Council Ōtaki Pool. The sum of peaks of these loads is 0.35 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are required at Ōtaki zone substation.

8.13.3.2 Waikanae

Two of the loads on Paraparaumu 33 kV GXP are expected to connect to Waikanae zone substation. These loads are Firth Dricon Waikanae and Kapiti Coast District Council Waikanae Pool. The sum of peaks of these loads is 1.06 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are required at Waikanae zone substation.

8.13.4 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on the Paraparaumu 33 kV GXP gives a combined load of 1.61 MW. When the load shapes are combined, they result in the following load shape (Figure 77), with a maximum load of 1.32 MW, with a diversity factor of 0.82.

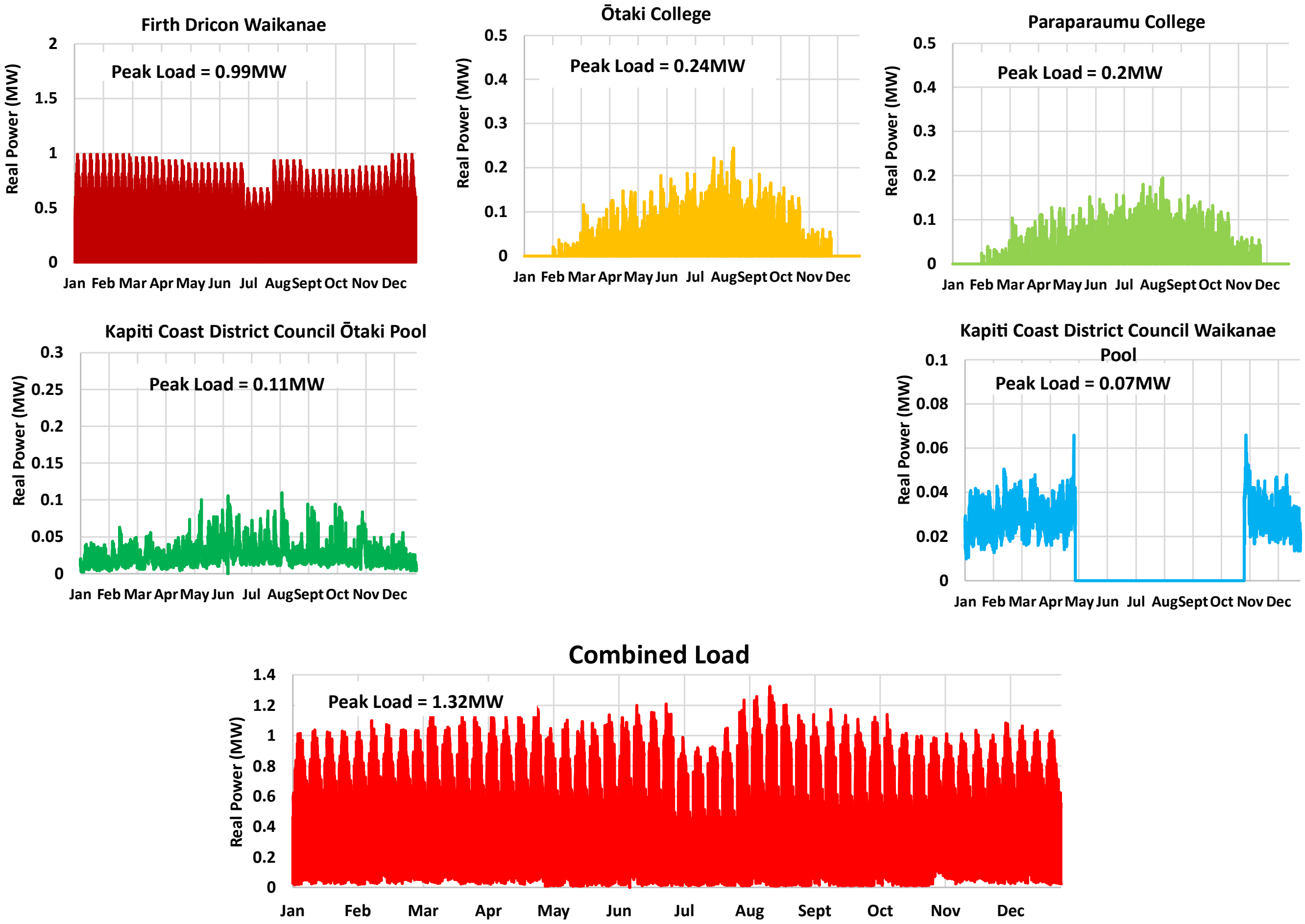


Figure 77. Loading Profiles: Paraparaumu 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.13.5 Effect of all Load Sites Connecting to Paraparaumu 33 kV GXP

Figure 78 illustrates the Paraparaumu 33 kV GXP load profile together with the load profiles of all the Load Sites within the Paraparaumu 33 kV GXP region.

Also shown in Figure 78 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Paraparaumu 33 kV GXP would increase to 69.9 MW, an increase of 0.80 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 70.4 MW, there is a diversity factor of 0.99 between the loads.
- Based on Ergo's analysis, the Paraparaumu 33 kV GXP's (N-1) limit is not expected to be exceeded.

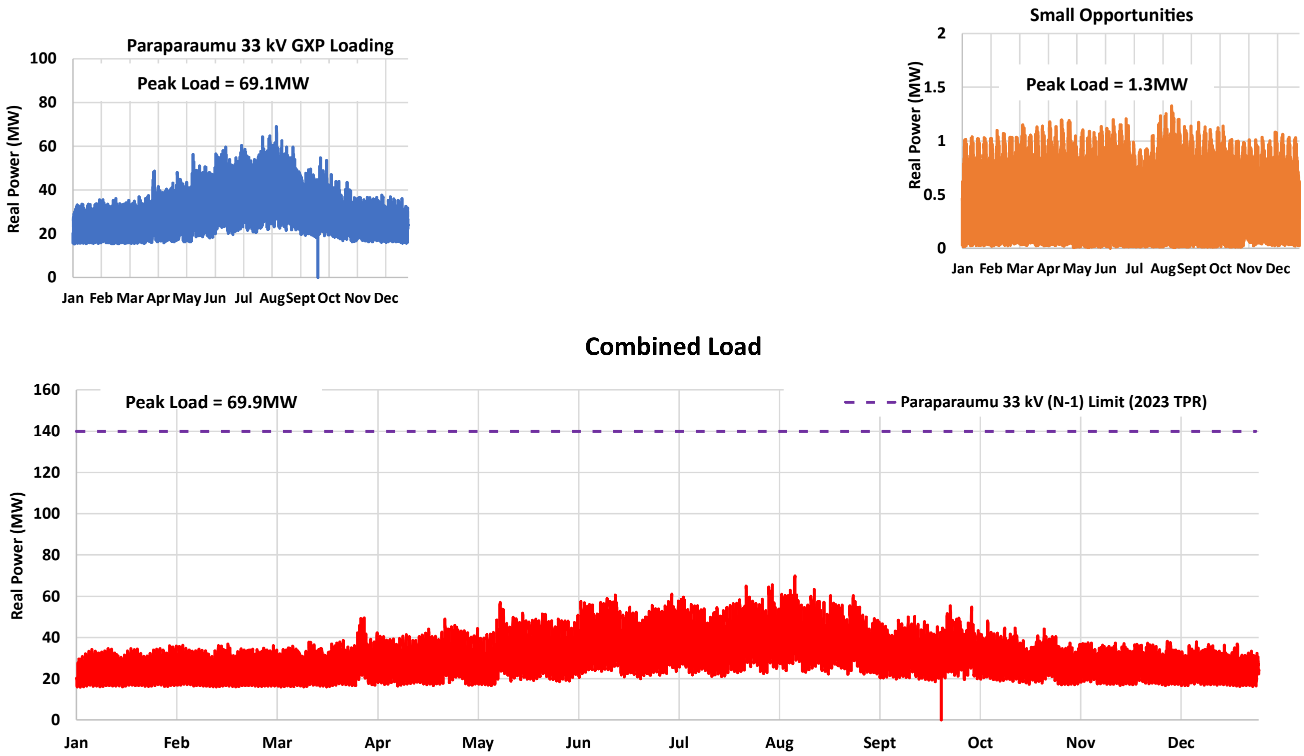


Figure 78. Loading Profiles: Paraparaumu 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.14 Pāuatahanui 33 kV GXP

The geographic locations of the local transmission and distribution substations are shown on the following maps.

Figure 79. Pāuatahanui 33 kV GXP: EECA Load Sites vs local substations.

8.14.1 Pāuatahanui 33 kV GXP upgrade

The Pāuatahanui 33 kV GXP presently has 1.6 MVA of spare (N-1) capacity and 18.6 MVA of spare (N) capacity, based on the transformer ratings. There are no connecting load sites to the GXP. Therefore, no further upgrades are expected at Pāuatahanui 33 kV GXP.

Ergo notes that due to the low (N-1) capacity, Transpower was planning to install a transformer overload protection scheme at Pāuatahanui in 2024. The indicative cost of this project is expected to cost $0.5 M.

8.15 Takapu Road 33 kV GXP

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

- Taylor Preston Limited (3.84 MW) (also connected to Kaiwharawhara 11 kV GXP, section 8.9)
- Kenepuru Hospital (1.06 MW)

The “Small” EECA load sites connecting to the Takapu Road 33 kV GXP include:

- Sealed Air Porirua (0.99 MW)
- ESR Kenepuru (0.45 MW)
- Rātonga-Rua-O-Porirua Campus (0.3 MW)
- Te Pukenga Weltec & Whitireia Porirua Campus (0.29 MW)
- Whittaker's Porirua (0.2 MW)
- Mahinawa Specialist School and Resource Centre (0.2 MW)
- Porirua City Council Te Rauparaha Arena and Aquatic Centre (0.18 MW)
- Wellington City Council Keith Spry Pool (0.17 MW)
- Wellington City Council Tawa Pool (0.14 MW)
- Newlands College (0.13 MW)
- Hampton Hill School (0.02 MW)

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

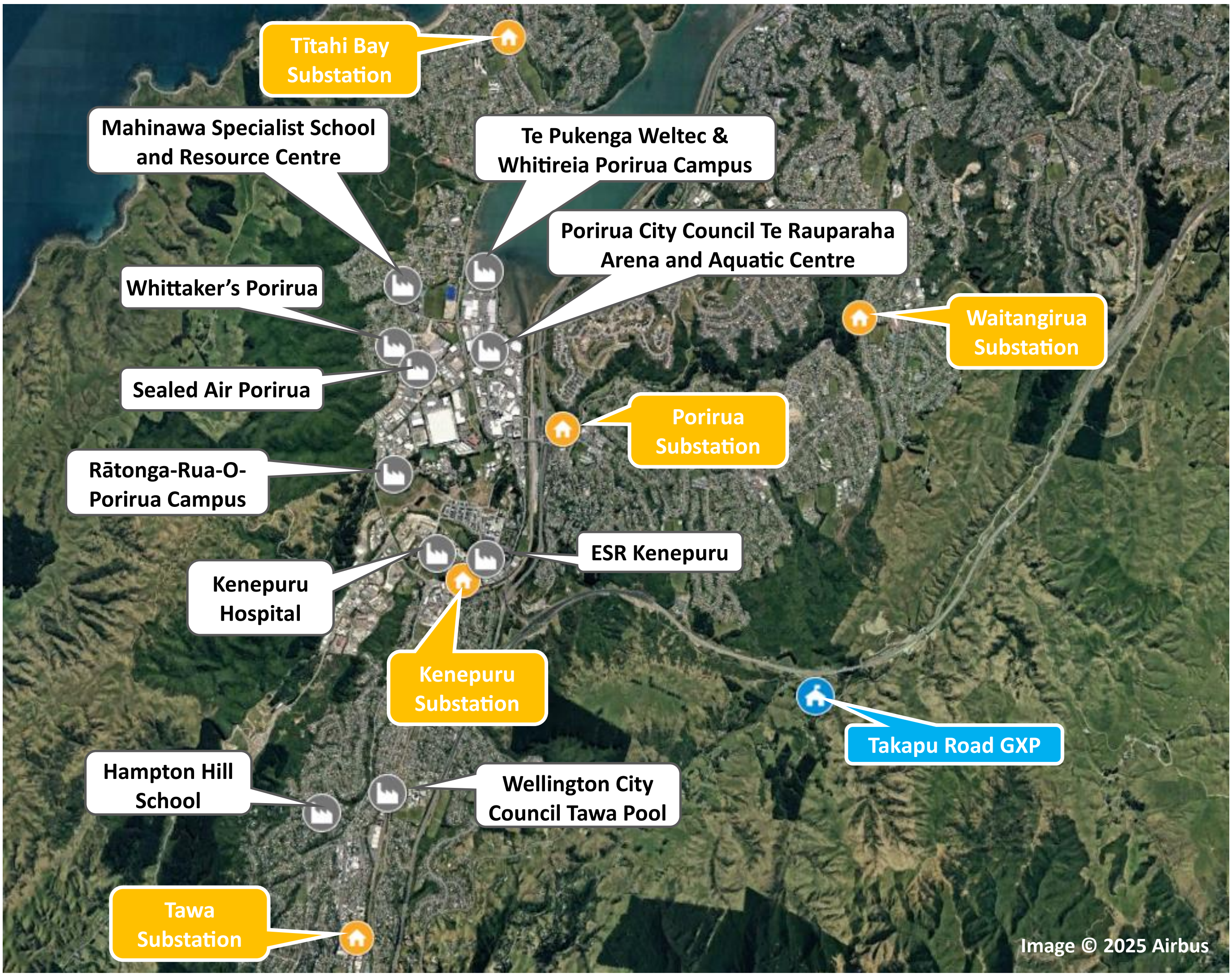


Figure 80. Takapu Road 33 kV GXP: EECA Load Sites vs local substations (northern snippet)

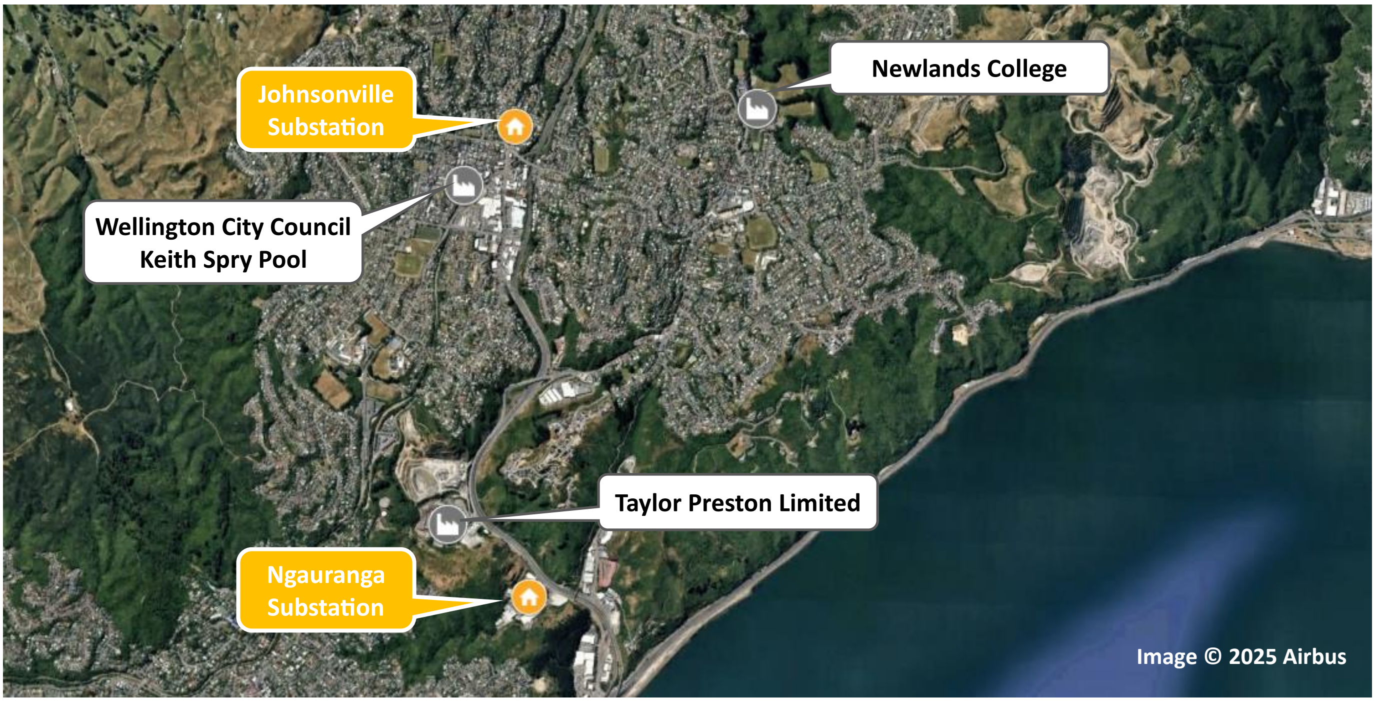


Figure 81. Takapu Road 33 kV GXP: EECA Load Sites vs local substations (southern snippet).

8.15.1 Takapu Road 33 kV GXP upgrade

The Takapu Road 33 kV GXP presently has 6.6 MVA of spare (N-1) capacity and 76.6 MVA of spare (N) capacity, based on the transformer ratings. As discussed in Section 8.15.6, if all Load Sites connect to the GXP, then it is expected that the GXP's branch rating may be exceeded.

Ergo understands that Transpower is exploring options to increase the supply capacity in the Pāuatahanui and Takapu Road GXP areas. In the short term this can be done by installing a special protection scheme at the Pāuatahanui GXP. For the longer term, Transpower discusses the possibility of installing a new 110/33 kV transformer at the Takapu Road GXP, at an indicative cost of $10 M.

8.15.2 Kenepuru Hospital

Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	1.12	Takapu Road 33 kV GXP

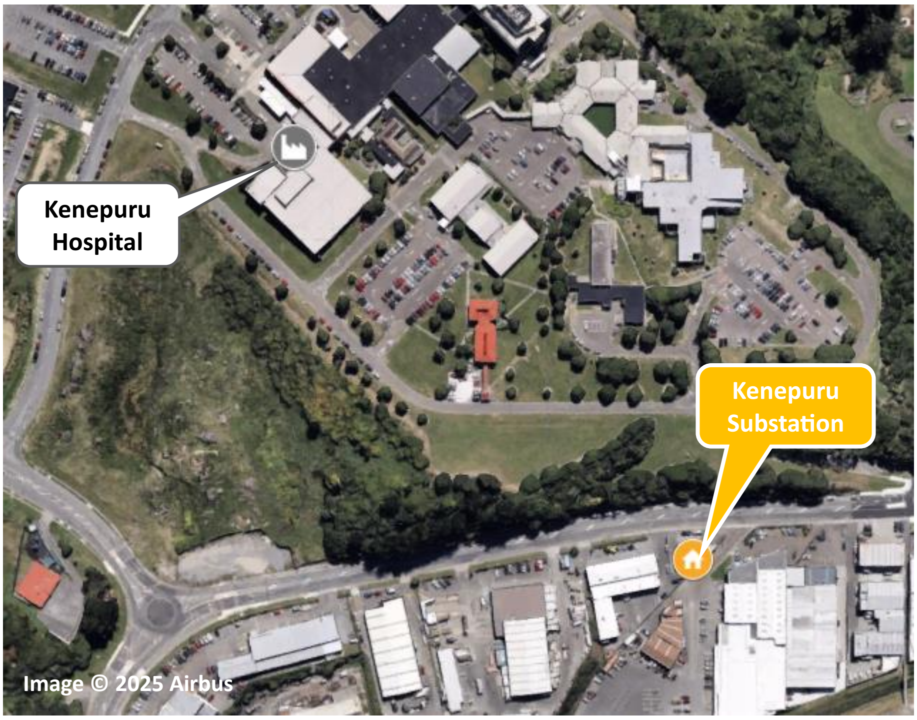


Figure 82. Kenepuru Hospital geographic location in relation to the surrounding zone substations.

8.15.2.1 Existing electrical supply to the Plant

Kenepuru Hospital is presently supplied by Wellington Electricity's Kenepuru zone substation. The site is supplied by an 11 kV feeder which consists entirely of underground cabling. Kenepuru connects directly to the Takapu Road GXP via two 33 kV sub-transmission circuits rated to ~13.7 MVA each.

The site is located approximately 0.3 km away from Kenepuru zone substation. The zone substation is located approximately 3 km from Takapu Road GXP.

There is currently a maximum loading of 10 MVA on Kenepuru zone substation, with -1 MVA of spare (N-1) capacity. The Takapu Road GXP presently has 6.6 MVA of spare (N-1) capacity and 76.6 MVA of spare (N) capacity, based on the transformer ratings.

8.15.2.2 Supply Option(s) for New Load

The GXP and sub-transmission lines can supply (N-1) security to the new load. The zone substation has spare (N-1) capacity.

The existing 11 kV feeder has approximately 2.43 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, it is expected that a distribution transformer to supply this load would cost approximately $350 k.

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 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 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Sealed Air Porirua	Kenepuru	8	1.11	0.99	260
ESR Kenepuru	Kenepuru	8	2.43	0.51	200
Rātonga-Rua-O-Porirua Campus	Kenepuru	8	3.31	0.30	130
Te Pukenga Weltec & Whitireia Porirua Campus[55]	Porirua	-1	0.34	0.29	130
Whittaker's Porirua	Porirua	-1	0.51	0.20	80
Mahinawa Specialist School and Resource Centre	Titahi Bay	N/A	0.14	0.20	80
Porirua City Council Te Rauparaha Arena and Aquatic Centre	Porirua	-1	0.34	0.18	80
Wellington City Council Keith Spry Pool	Johnsonville	-4	-0.05	0.17	80
Wellington City Council Tawa Pool	Tawa	2	1.25	0.14	80
Newlands College[56]	Johnsonville	-4	-1.54	0.13	80
Hampton Hill School	Tawa	2	0.48	0.02	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.

[55] See Section 8.15.4.3 for details on Porirua planned upgrade.
[56] See Section 8.15.4.1 for details on Johnsonville planned upgrade.

8.15.4 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.

8.15.4.1 Johnsonville

Two of the loads on Takapu Road 33 kV GXP are expected to connect to Johnsonville zone substation. These loads are Wellington City Council Keith Spry Pool and Newlands College. The sum of peaks of these loads is 0.30 MW, which the zone substation does not have (N-1) capacity for.

Wellington Electricity plans to construct a new zone substation in Grenada to offload Johnsonville and Ngauranga. The zone substation is expected to complete Stage 1 construction in 2028, at a cost of $6.5 M. Wellington Electricity also proposes the alternative solution to replace the 33 kV sub-transmission cables and transformers, however, this will likely occur later. Both solutions will likely be sufficient for the Load Sites to connect.

8.15.4.2 Kenepuru

Four of the loads on Takapu Road 33 kV GXP are expected to connect to Kenepuru zone substation. These loads are Kenepuru Hospital, Sealed Air Porirua, ESR Kenepuru, and Rātonga-Rua-O-Porirua Campus. The sum of peaks of these loads is 2.81 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Kenepuru zone substation.

8.15.4.3 Porirua

Three of the loads on Takapu Road 33 kV GXP are expected to connect to Porirua zone substation. These loads are Te Pukenga Weltec & Whitireia Porirua Campus, Whittaker's Porirua, and Porirua City Council Te Rauparaha Arena and Aquatic Centre. The sum of peaks of these loads is 0.67 MW, which the zone substation does not have (N-1) capacity for.

Wellington Electricity plans to upgrade the Porirua zone substation, including the 33 kV cables, transformers, and 11 kV switchboard. The upgrades are expected to complete in 2031 at a total cost of $23.1 M, according to the Wellington Electricity 2025 AMP. In the meantime, Wellington Electricity plan to run two new Kenepuru 11 kV feeders to Mohuia Crescent (supplying Whittaker's Porirua) to offload Porirua zone substation. The project is scheduled to complete in 2026 at a cost of $12.7 M. As the additional connecting load is small, the stated upgrades should be sufficient for the sites to connect.

8.15.4.4 Tawa

Two of the loads on Takapu Road 33 kV GXP are expected to connect to Tawa zone substation. These loads are Wellington City Council Tawa Pool and Hampton Hill School. The sum of peaks of these loads is 0.17 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are required at Tawa zone substation.

8.15.5 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Takapu Road 33 kV GXP gives a combined load of 3.07 MW. When the load shapes are combined, they result in the following load shape (Figure 83), with a maximum load of 2.26 MW, with a diversity factor of 0.74.

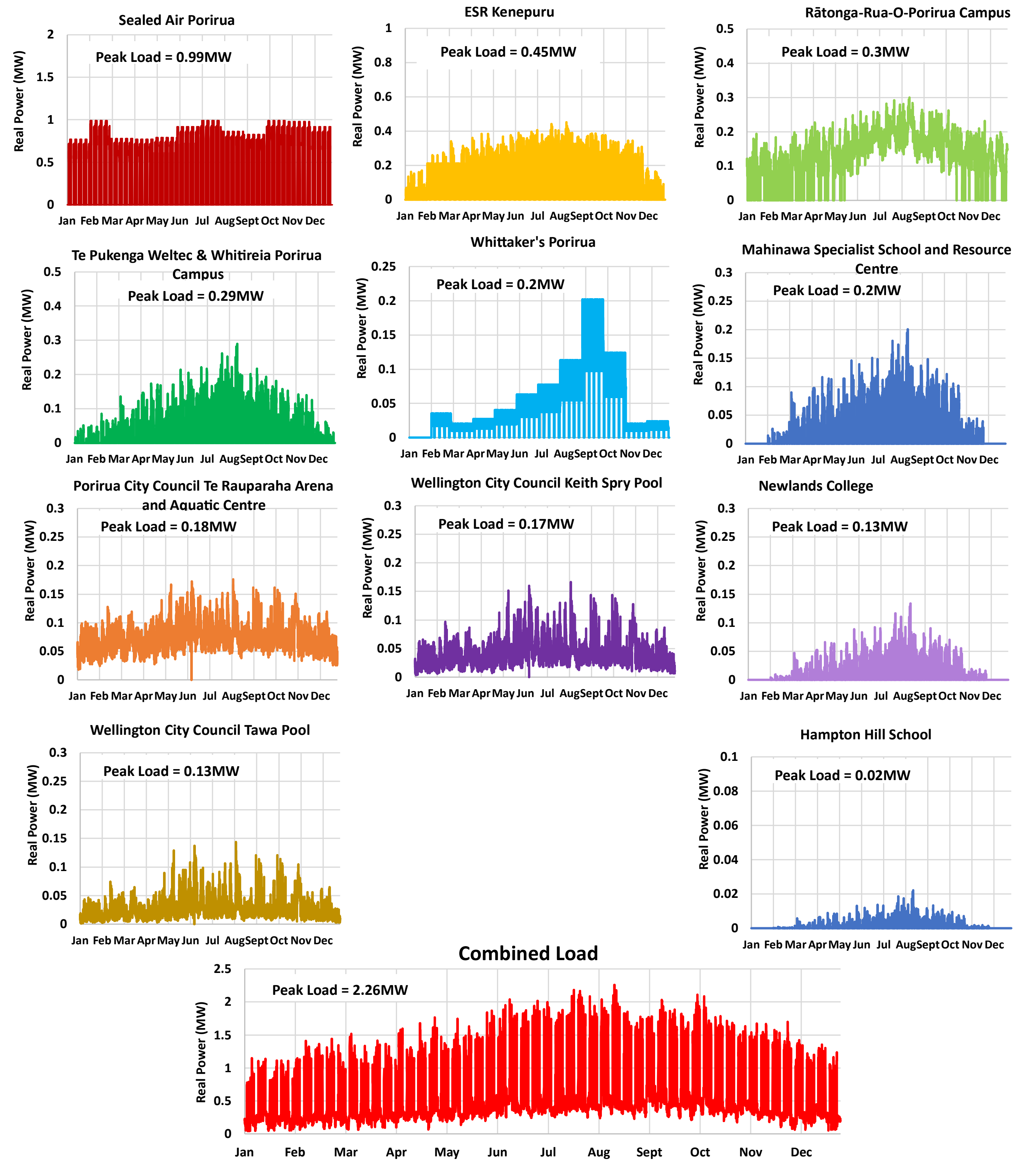


Figure 83. Loading Profiles: Takapu Road 33 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.15.6 Effect of all Load Sites Connecting to Takapu Road 33 kV GXP

Figure 84 illustrates the Takapu Road 33 kV GXP load profile together with the load profiles of all the Load Sites within the Takapu Road 33 kV GXP region.

Also shown in Figure 84 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Takapu Road 33 kV GXP would increase to 106.3 MW, an increase of 2.97 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 111.8 MW, there is a diversity factor of 0.97 between the loads.
- Based on Ergo's analysis, the Takapu Road 33 kV GXP's (N-1) limit may be exceeded, although the maximum load is below the (N-1) limit.

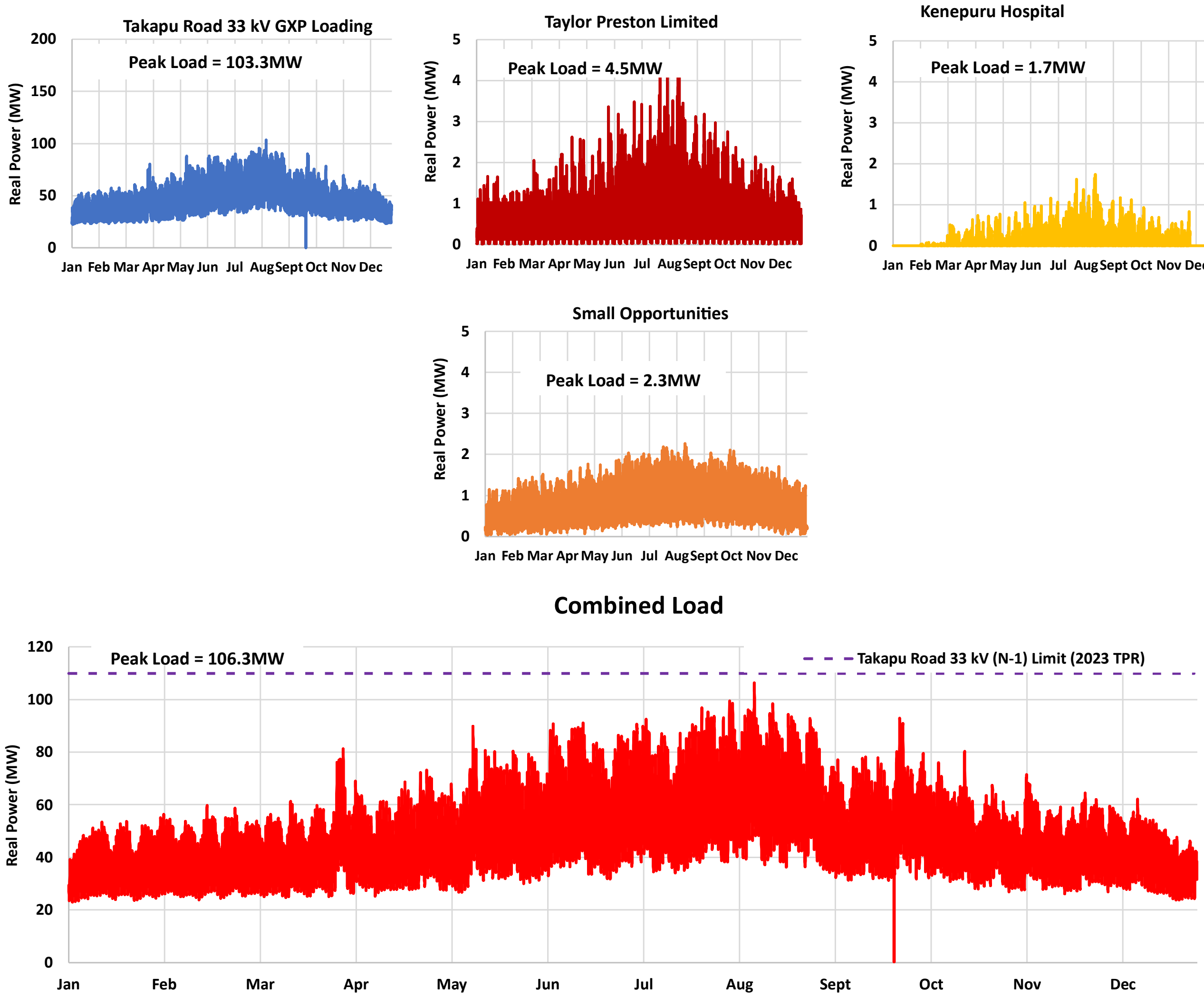


Figure 84. Loading Profiles: Takapu Road 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.16 Upper Hutt 33 kV GXP

The "Small" EECA load sites connecting to the Upper Hutt 33 kV GXP include:

- DB Breweries Tuatara (0.91 MW)
- Upper Hutt City Council H2O Xtream (0.35 MW)
- Oceania Healthcare Elderslea Village (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.

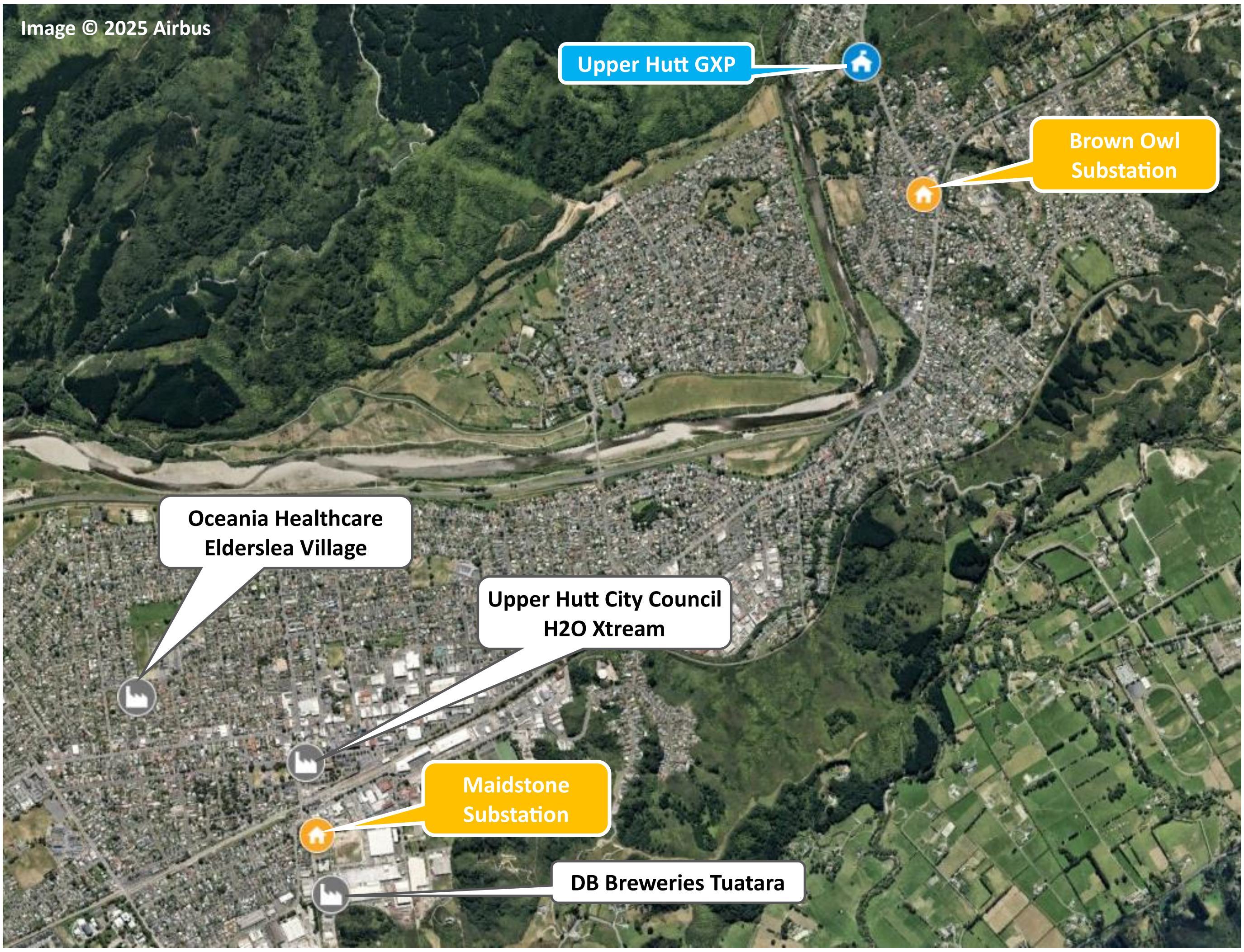


Figure 85. Upper Hutt 33 kV GXP: EECA Load Sites vs local substations.

8.16.1 Upper Hutt 33 kV GXP upgrade

The Upper Hutt 33 kV GXP presently has 19.6 MVA of spare (N-1) capacity and 170.9 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 8.16.5). Therefore, no further upgrades are expected at Upper Hutt 33 kV GXP.

8.16.2 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 29. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
DB Breweries Tuatara	Maidstone	5	Unknown	0.91	260
Upper Hutt City Council H2O Xtream	Maidstone	5	1.1	0.35	130
Oceania Healthcare Elderslea Village	Maidstone	5	2.3	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.

8.16.3 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.

8.16.3.1 Maidstone

Three of the loads on Upper Hutt 33 kV GXP are expected to connect to Maidstone zone substation. These loads are DB Breweries Tuatara, Upper Hutt City Council H2O Xtream, and Oceania Healthcare Elderslea Village. The sum of peaks of these loads is 1.39 MW, which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are expected at Maidstone zone substation.

The sub-transmission circuits supplying Maidstone zone substation currently have -2.8 MVA of spare (N-1) spare capacity. Ergo understands that Wellington Electricity is planning to replace sections of the two sub-transmission circuits for asset health in 2030. This is expected to cost $16.8 M in total. In the short term, the zone substations load will be shifted to Trentham through inter-ties.

8.16.4 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on the Upper Hutt 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 86), with a maximum load of 1.26 MW, with a diversity factor of 0.90.

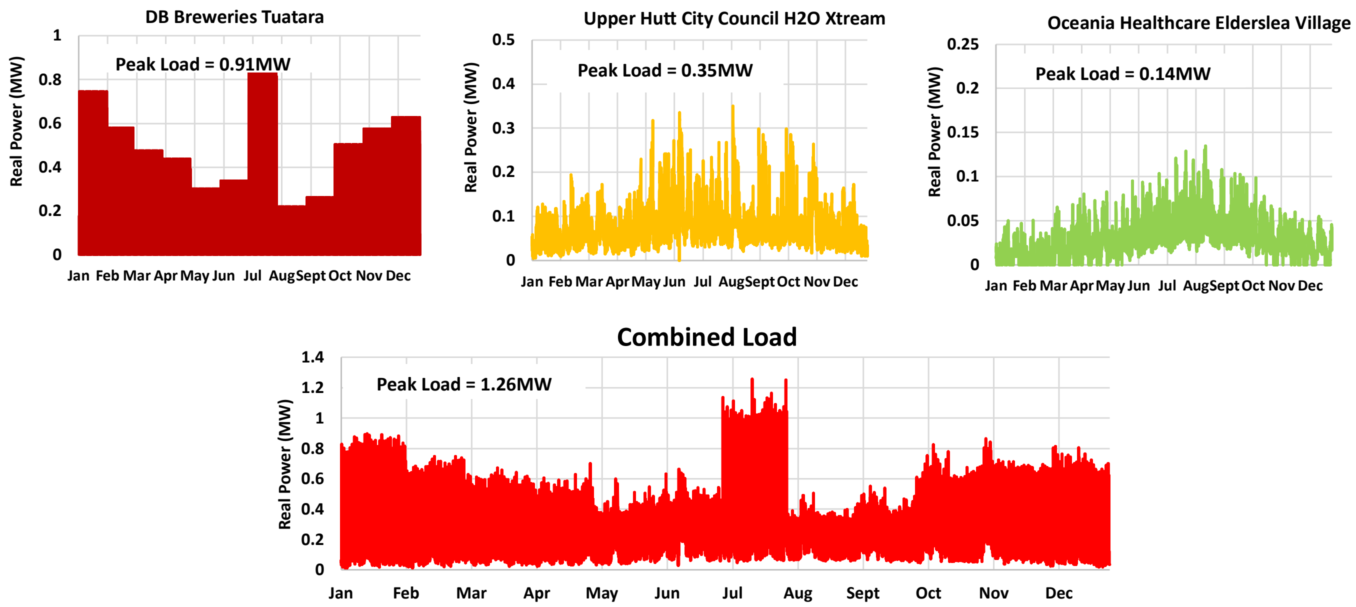


Figure 86. Loading Profiles: Upper Hutt 33 kV GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.16.5 Effect of all Load Sites Connecting to Upper Hutt 33 kV GXP

Figure 87 illustrates the Upper Hutt 33 kV GXP load profile together with the load profiles of all the Load Sites within the Upper Hutt 33 kV GXP region.

Also shown in Figure 87 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Upper Hutt 33 kV GXP would increase to 32.7 MW, an increase of 0.25 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 33.7 MW, there is a diversity factor of 0.97 between the loads.
- Based on Ergo's analysis, the Upper Hutt 33 kV GXP's (N-1) limit is not expected to be exceeded.

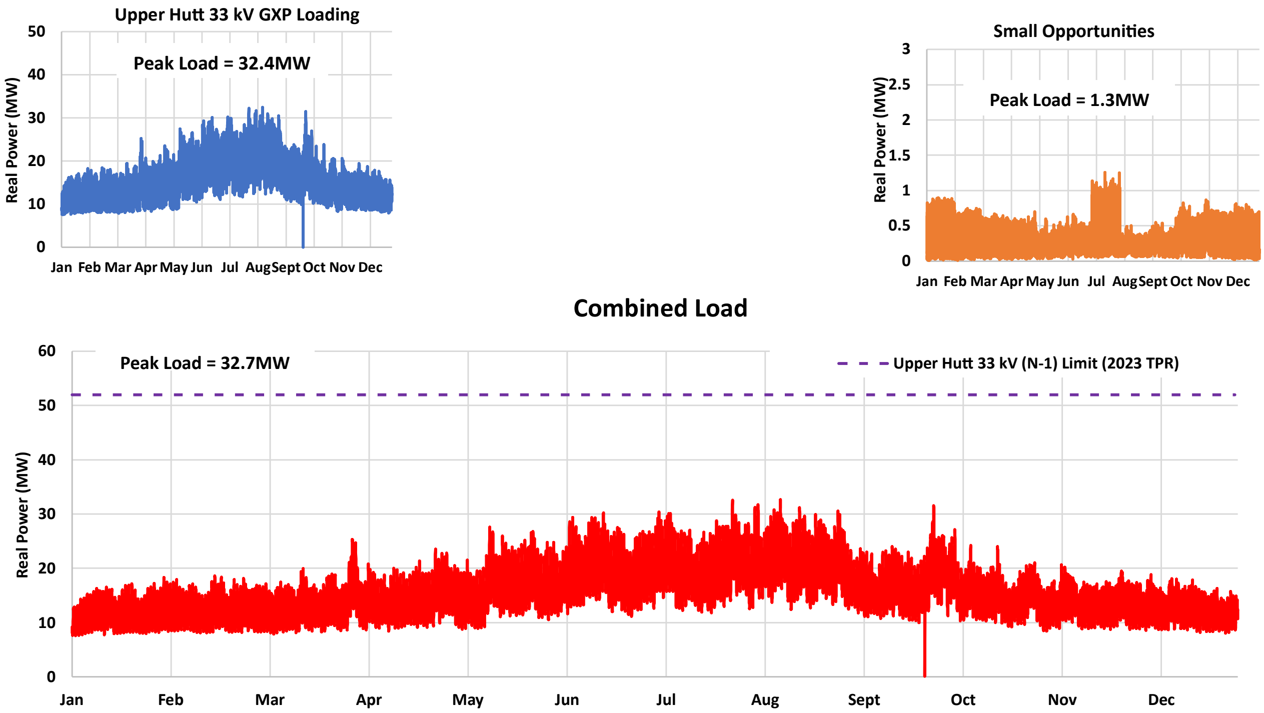


Figure 87. Loading Profiles: Upper Hutt 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.17 Wilton 33 kV GXP

The "Small" EECA load sites connecting to the Wilton 33 kV GXP include:

- Reserve Bank of New Zealand - Te Pūtea Matua (0.48 MW)
- Precinct Properties Treasury Building (0.33 MW)
- Victoria University of Wellington Rutherford House (0.32 MW)
- Argosy Property Ltd TSB Bank Building (0.3 MW)
- Precinct Properties NTT Tower (0.26 MW) (also connected to Kaiwharawhara 11 kV GXP, section 8.9)
- Argosy Property Ltd MBIE Building (0.25 MW)
- Argosy Property Ltd 7 Waterloo Quay (0.15 MW)
- RJ Holdings Bayleys Building (0.15 MW)
- Victoria University of Wellington Old Government Buildings (0.13 MW)
- RJ Holdings Lambton Centre (0.11 MW)
- Wellington City Council Karori Pool (0.07 MW)

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

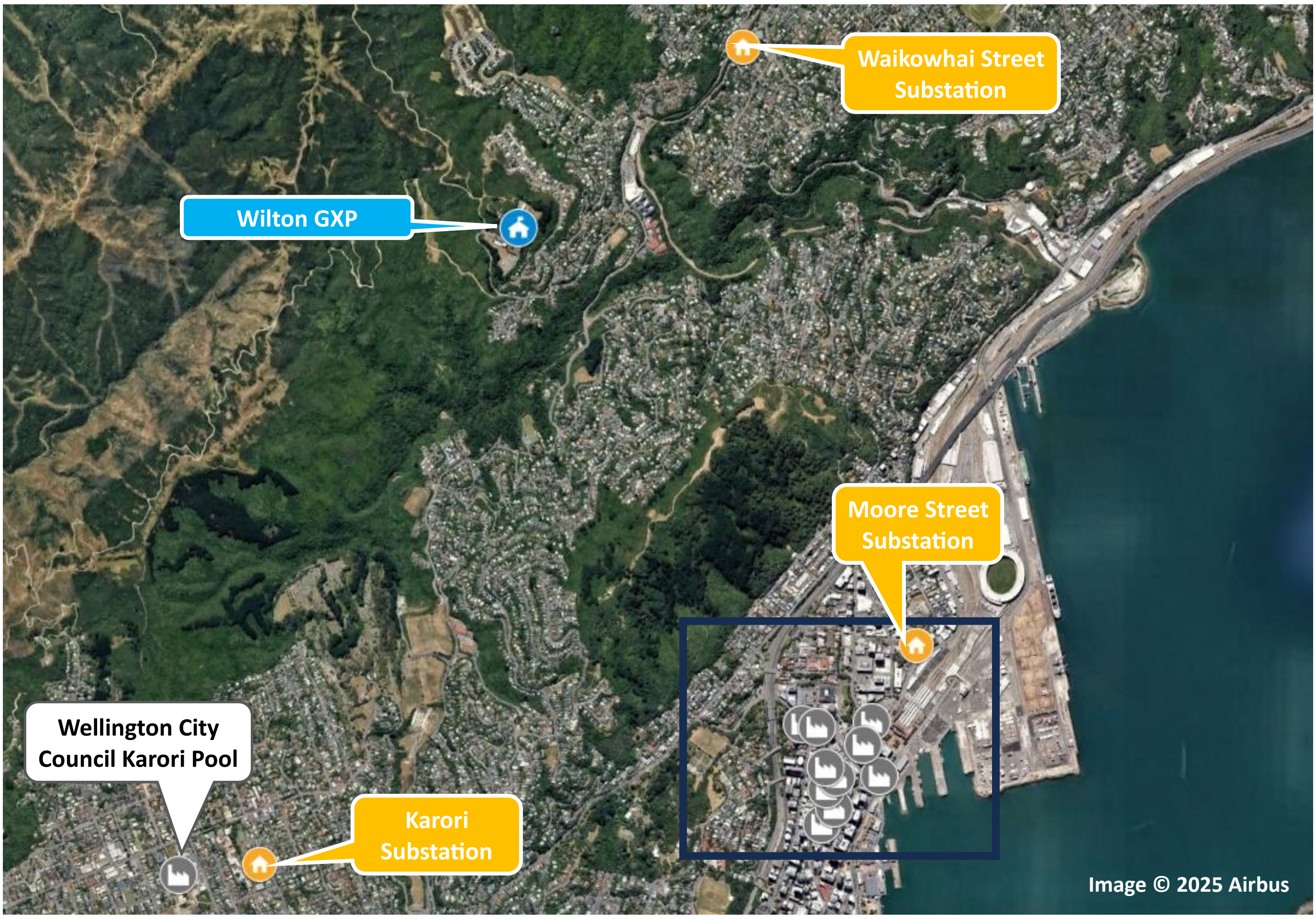


Figure 88. Wilton 33 kV GXP: EECA Load Sites vs local substations.

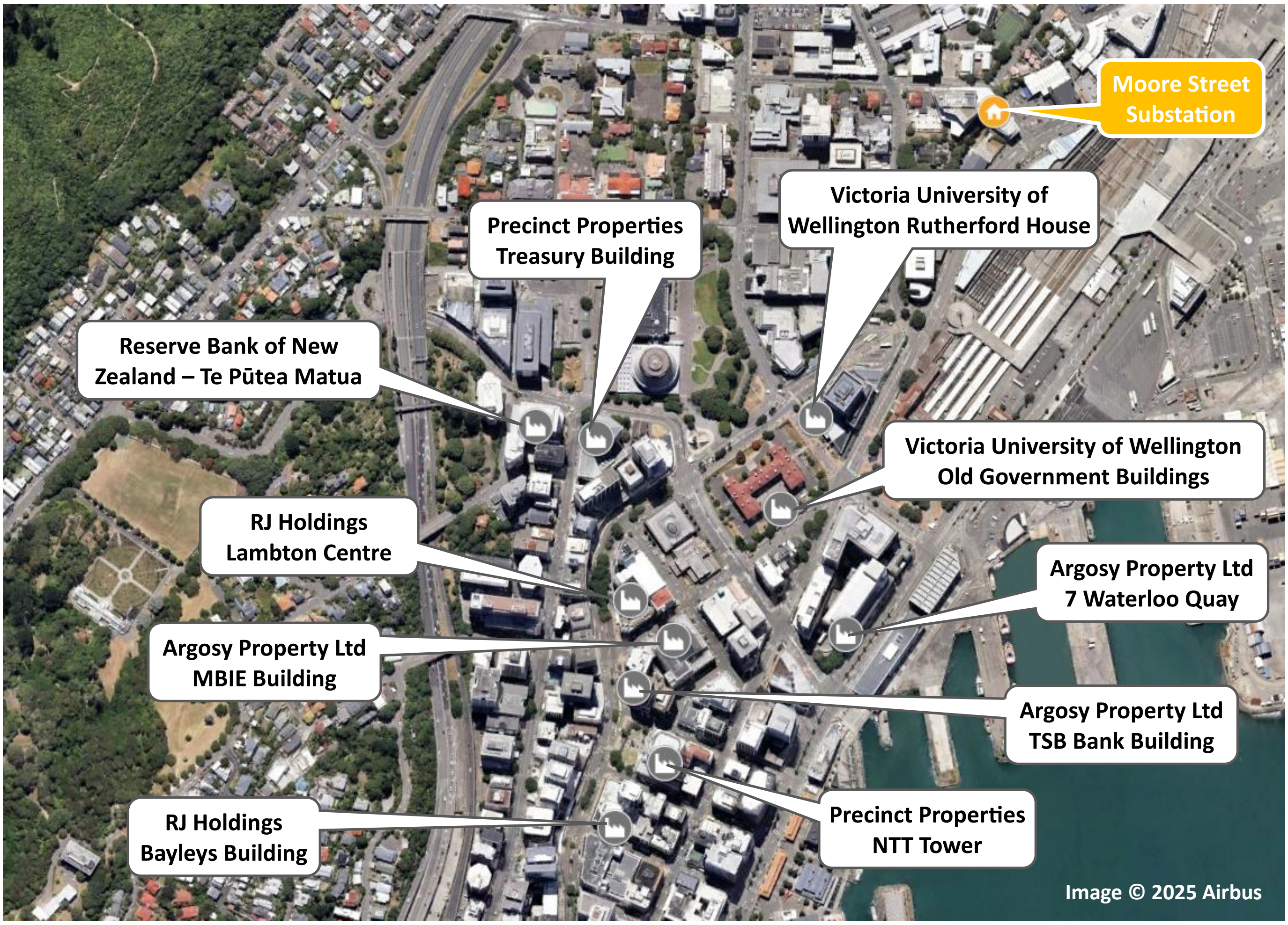


Figure 89. Wilton 33 kV GXP: EECA Load Sites vs local substations (Moore Street network).

8.17.1 Wilton 33 kV GXP upgrade

The Wilton 33 kV GXP presently has 50.5 MVA of spare (N-1) capacity and 150.5 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 8.17.5). Therefore, no further upgrades are expected at Wilton 33 kV GXP.

8.17.2 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. The spare capacity columns provide an indication of the overall capacity of the network separate from the cost.

Table 30. 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)	Expected Feeder Spare Capacity (MW)	Opportunity Load (MW)	Estimate cost ($k)
Reserve Bank of New Zealand - Te Pūtea Matua	Moore Street	13	6.3	0.48	160-200
Precinct Properties Treasury Building	Moore Street	13	6.3	0.33	160-200
Victoria University of Wellington Rutherford House	Moore Street	13	3.17	0.32	160-200
Argosy Property Ltd TSB Bank Building	Moore Street	13	3.17	0.30	160-200
Precinct Properties NTT Tower	Moore Street	13	1.76	0.26	130
Argosy Property Ltd MBIE Building	Moore Street	13	2.18	0.25	130
Argosy Property Ltd 7 Waterloo Quay	Moore Street	13	1.94	0.15	80
RJ Holdings Bayleys Building	Moore Street	13	1.76	0.15	80
Victoria University of Wellington Old Government Buildings	Moore Street	13	2.18	0.13	80
RJ Holdings Lambton Centre	Moore Street	13	3.62	0.11	80
Wellington City Council Karori Pool	Karori	7	4.87	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.

8.17.3 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.

8.17.3.1 Moore Street

Ten of the loads on Wilton 33 kV GXP are expected to connect to Moore Street zone substation. These loads are Reserve Bank of New Zealand - Te Pūtea Matua, Precinct Properties Treasury Building, Victoria University of Wellington Rutherford House, Argosy Property Ltd TSB Bank Building, Precinct Properties NTT Tower, Argosy Property Ltd MBIE Building, Argosy Property Ltd 7 Waterloo Quay, RJ Holdings Bayleys Building, Victoria University of Wellington Old Government Buildings, and RJ Holdings Lambton Centre. The sum of peaks of these loads is 2.48 MW which the zone substation does have (N-1) capacity for. Therefore, no further upgrades are required at Moore Street zone substation.

8.17.4 Combined Load of Small Opportunities

Summing the maximum values of the “small” loads on the Wilton 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 90), with a maximum load of 2.46 MW, with a diversity factor of 0.97.

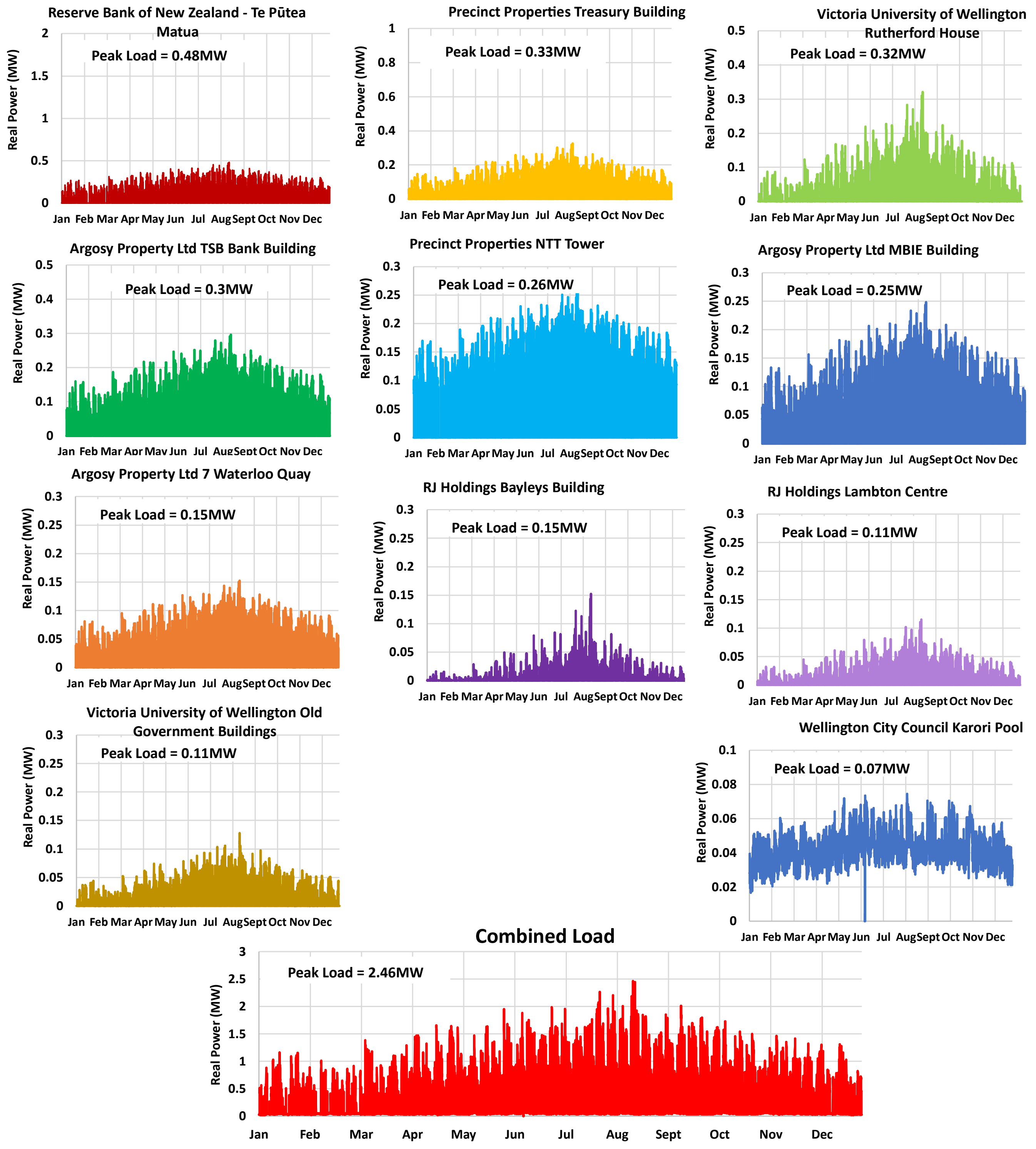


Figure 90. Loading Profiles: Wilton 33 kV GXP “small” Load Site Profiles: Combined Load (sum of all profiles)

8.17.5 Effect of all Load Sites Connecting to Wilton 33 kV GXP

Figure 91 illustrates the Wilton 33 kV GXP load profile together with the load profiles of all the Load Sites within the Wilton 33 kV GXP region.

Also shown in Figure 91 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Wilton 33 kV GXP would increase to 45.6 MW, an increase of 1.82 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 46.3 MW, there is a diversity factor of 0.99 between the loads.
- Based on Ergo's analysis, the Wilton 33 kV GXP's (N-1) limit is not expected to be exceeded.

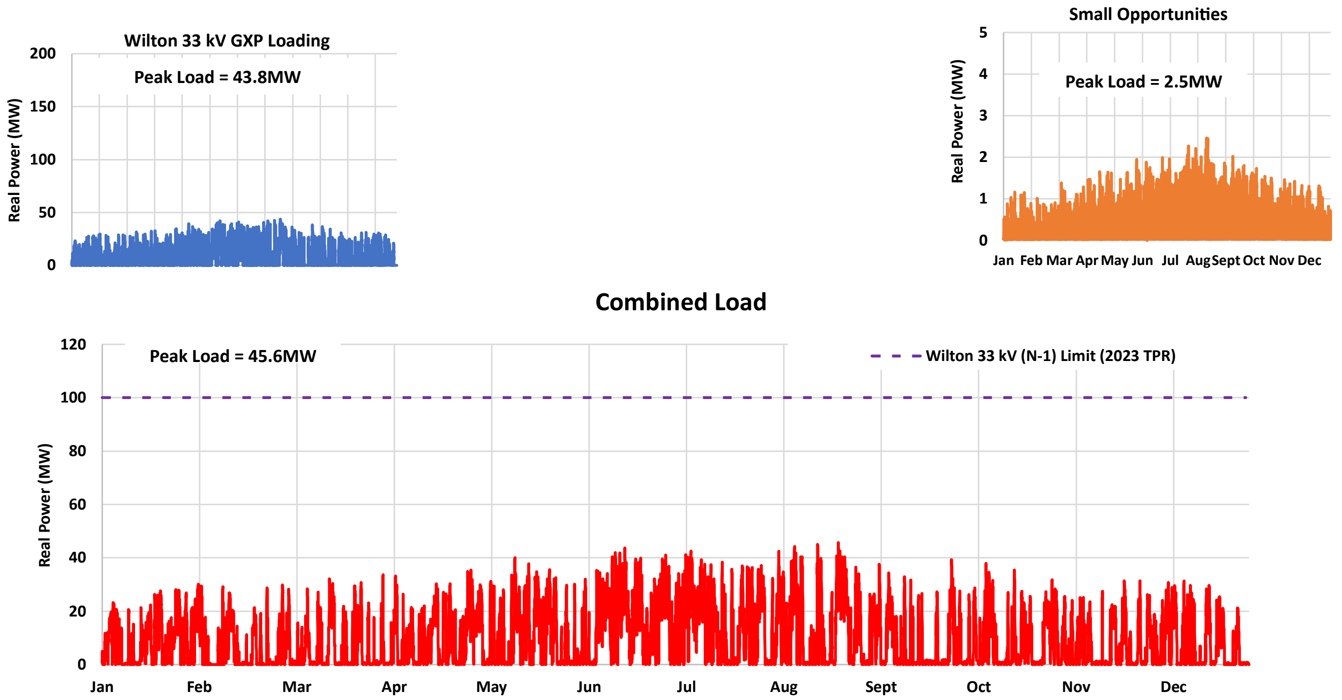


Figure 91. Loading Profiles: Wilton 33 kV GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

9. Conclusions

9.1 Network Spare Capacity

Figure 1 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Wellington 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.

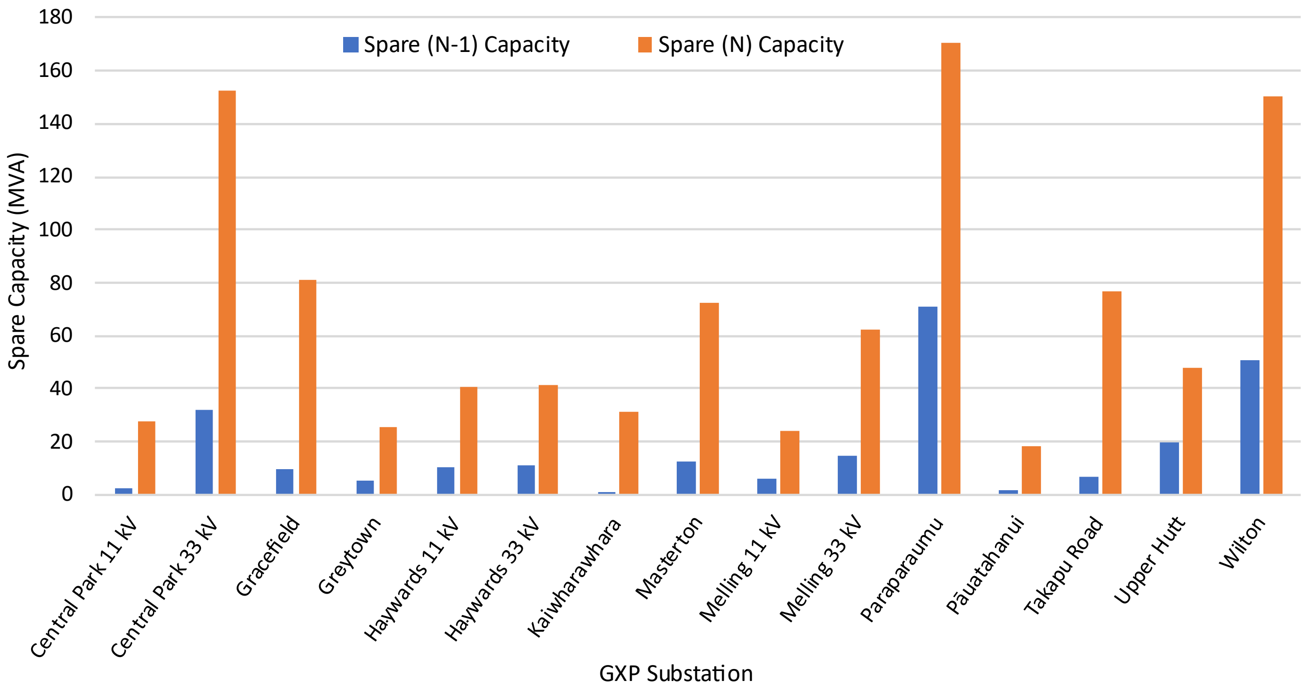


Figure 92. Summary: Approximate N and N-1 spare capacity at GXP substations.

Figure 93, Figure 94, and Figure 95 illustrate the (N) and (N-1) spare capacity at the three EDB's (Electra, Powerco, and Wellington Electricity) zone substations in the Wellington region. These figures are based on the maximum loadings and the EDB 2023-2025 disclosures. Negative numbers for (N-1) capacity indicate zone substations where the load has exceeded the (N-1) capacity in the past.

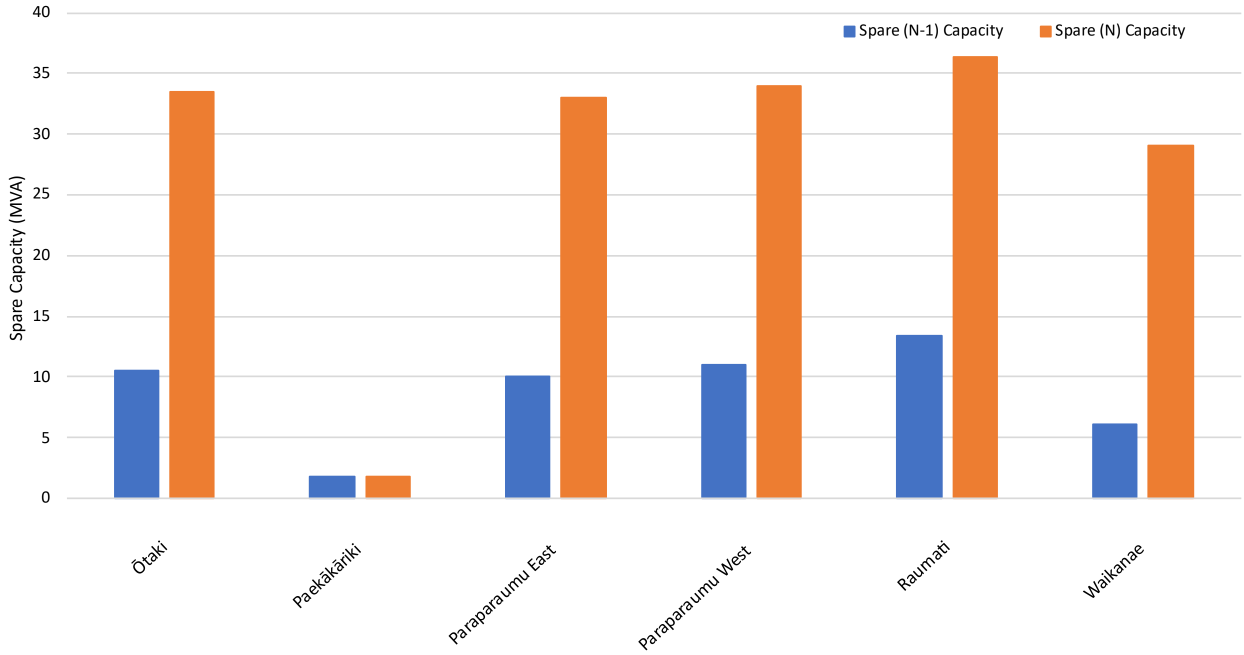


Figure 93. Summary: Approximate (N) and (N-1) spare capacity at Electra's zone substations.

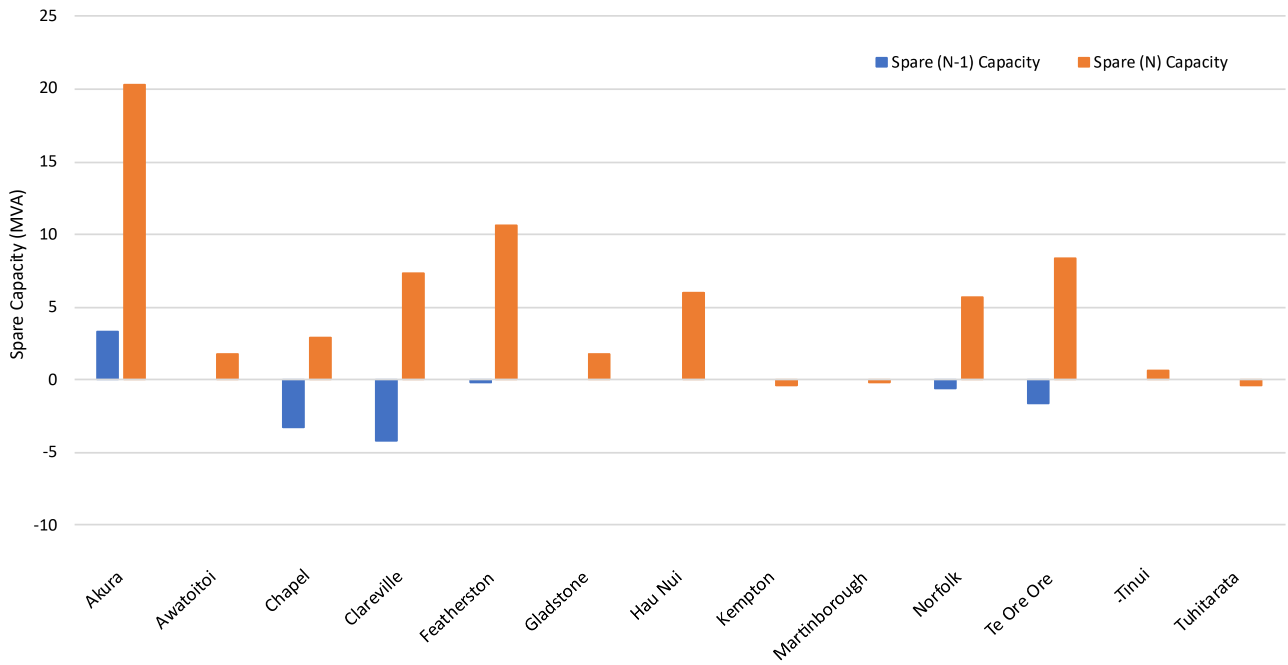


Figure 94. Summary: Approximate (N) and (N-1) spare capacity at Powerco's zone substations.

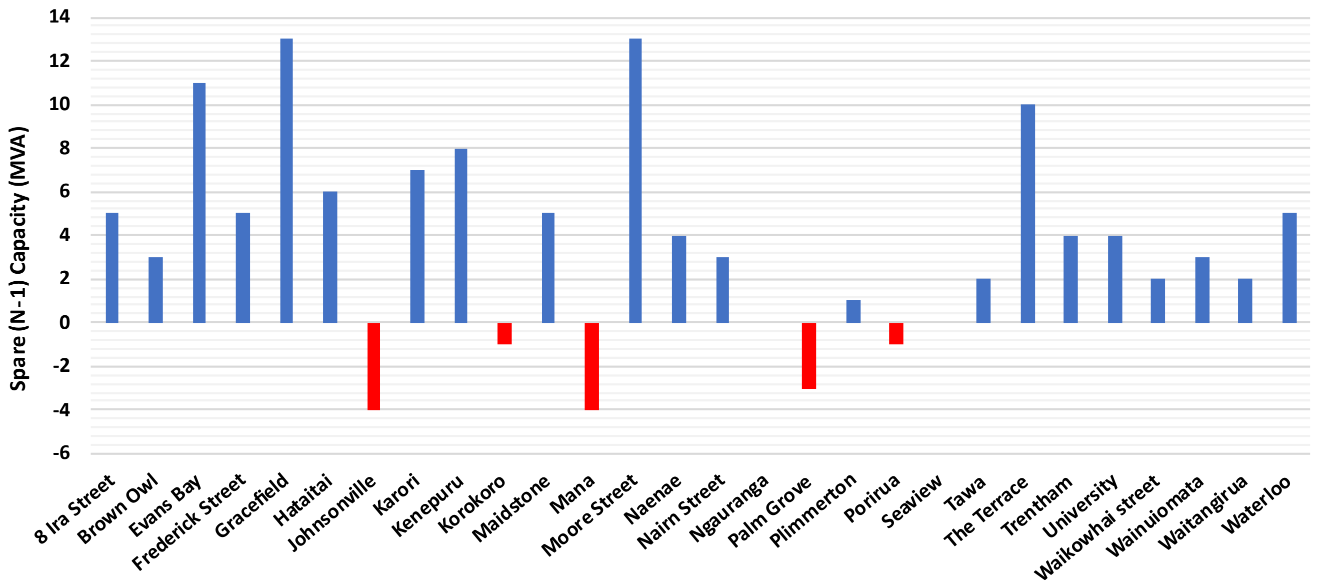


Figure 95. Summary: Approximate (N-1) spare capacity at Wellington Electricity's zone substations.

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-002) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Central Park 11 kV and 33 kV GXPs* – Supply a portion of Wellington, including most of Wellington Central and the eastern parts of the city. Loads are a mix of industrial, commercial, and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Gracefield GXP* – Supplies Petone and the industrial area at Seaview, as well as the suburb of Wainuiomata, with a mix of industrial, commercial, and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Greytown GXP* – Supplies Greytown, Featherston, and Martinborough towns and the surrounding rural areas, with loads associated with forestry, cropping, agriculture, and vineyards/wineries, as well as some commercial residential loads centred in the towns. Load is peaky throughout the year, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Haywards 11 kV and 33 kV GXPs* – Along with Upper Hutt GXP, supplies the load of Upper Hutt, with a mix of typically residential and commercial loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Kaiwharawhara GXP* – Supplies the load in Thorndon at the north of the Wellington CBD, with some load in the Ngaio Gorge and Khandallah areas. Mixture of mostly commercial and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period. The impact of the CBD loads is clear in the load profile as the load is much lower throughout the day during the weekends.
- *Masterton GXP* – Supplies Masterton town, and some surrounding rural areas. The load of the town dominates with residential and commercial loads, with loads associated with forestry, cropping, agriculture, and vineyards/wineries in the rural areas. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Melling 11 kV and 33 kV GXPs* – Supplies Lower Hutt, with a mix of industrial, commercial, and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Paraparaumu GXP* – Supplies several towns, including Paraparaumu, Waikanae, Ōtaki, and Paekākāriki, and the surrounding rural areas. There is a range of loads from commercial/residential through to agricultural loads. Notably in this region, many people commute into Wellington for work, so the daytime load is much lower than the morning and evening peaks. Load is winter peaking.
- *Pāuatahanui GXP* – Supplies Plimmerton. Load is a mix of mostly commercial and residential loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Takapu Road GXP* – Supplies Porirua, Tawa, and Johnsonville. Loads are a mix of industrial, commercial, and residential. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.

- *Upper Hutt GXP* – Along with Haywards GXP, supplies Upper Hutt, with a mix of typically residential and commercial loads. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period.
- *Wilton GXP* – Supplies urban and industrial areas around the north of Wellington city, including the industrial area around the interisland ferry terminal and the neighbouring port facilities. Load is a mix of industrial, commercial, and residential customers. Load is winter peaking, with typical daily morning and evening peaks, though load throughout the day is flatter in the summer period. The impact of the CBD/city loads is clear in the load profile as the load is much lower throughout the day during the weekends.

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[57], which is only suitable for concept screening. (Refer to the assumptions outlined in Section Appendix 3 for more details)

Table 31. Summary of Load Sites and estimated 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)			
WL6	Fulton Hogan Wellington Asphalt Plant	7.92	Haywards 11 kV	$0.20	Haywards	$2.96	**$3.16**	**$0.40**	Major	1, 2
WL3	Downer Ngauranga Asphalt Plant	6.65	Kaiwharawhara	$9.00	Kaiwharawhara	$2.54	**$11.54**	**$1.74**	Major	1, 2
WL30	Wellington Hospital	4.51	Central Park 33 kV	$0.00	Palm Grove	$16.82	**$16.82**	**$3.73**	Moderate	1, 2
WL12	Taylor Preston Limited	3.84	Kaiwharawhara	$9.00	Ngauranga	$0.00	**$9.00**	**$2.34**	Major	1, 2
WL51	Higgins Concrete Wairarapa	3.65	Masterton	$0.00	Norfolk	$5.28	**$5.28**	**$1.45**	Moderate	1, 2
WL29	Wellington Water Seaview Wastewater Treatment Plar	2.33	Gracefield	$0.00	Seaview	$8.20	**$8.20**	**$3.52**	Moderate	1, 2
WL21	Hutt Hospital	1.85	Melling 11 kV	$0.20	Melling	$0.64	**$0.84**	**$0.45**	Minor	1
WL33	Victoria University of Wellington Kelburn Campus	1.74	Central Park 33 kV	$0.00	University	$0.35	**$0.35**	**$0.20**	Minor	1
WL76	Executive Laundry Group Limited Petone	1.63	Gracefield	$0.00	Korokoro	$17.92	**$17.92**	**$10.97**	Moderate	1, 2
WL4	Farrah's Breads Upper Hutt	0.25	Haywards 33 kV	$0.00	Trentham	$0.13	**$0.13**	**$0.53**	Minor	1
WL20	New Zealand Defence Force Trentham	1.41	Haywards 33 kV	$0.00	Trentham	$0.53	**$0.53**	**$0.38**	Moderate	1, 2
WL22	Callaghan Innovation Gracefield	1.15	Gracefield	$0.00	Gracefield	$0.35	**$0.35**	**$0.30**	Minor	1
WL36	Museum of New Zealand Te Papa Tongarewa Cable Str	1.18	Central Park 33 kV	$0.00	Frederick Street	$0.88	**$0.88**	**$0.75**	Minor	1
WL31	Kenepuru Hospital	1.06	Takapu Road	$0.00	Kenepuru	$0.35	**$0.35**	**$0.33**	Minor	1
WL5	Firth Dricon Waikanae	0.99	Paraparaumu	$0.00	Waikanae	$0.26	**$0.26**	**$0.26**	Minor	1
WL9	Breadcraft Wairarapa	0.99	Masterton	$0.00	Akura	$0.26	**$0.26**	**$0.26**	Minor	1
WL11	Sealed Air Porirua	0.99	Takapu Road	$0.00	Kenepuru	$0.26	**$0.26**	**$0.26**	Minor	1
WL8	Goodman Fielder Quality Bakers Wellington	0.95	Gracefield	$0.00	Seaview	$0.26	**$0.26**	**$0.27**	Minor	1
WL7	Godfrey Hirst Lower Hutt	0.93	Gracefield	$0.00	Gracefield	$0.26	**$0.26**	**$0.28**	Minor	1
WL2	DB Breweries Tuatara	0.91	Upper Hutt	$0.00	Maidstone	$0.26	**$0.26**	**$0.29**	Minor	1
WL41	Department of Corrections Rimutaka Prison	0.82	Haywards 33 kV	$0.00	Trentham	$0.26	**$0.26**	**$0.32**	Minor	1
WL55	Precinct Properties Aon Centre	0.63	Central Park 33 kV	$0.00	The Terrace	$0.20	**$0.20**	**$0.32**	Minor	1
WL28	ESR Kenepuru	0.45	Takapu Road	$0.00	Kenepuru	$0.20	**$0.20**	**$0.44**	Minor	1
WL1	Bostik Wellington	0.49	Melling 33 kV	$0.00	Naenae	$0.13	**$0.13**	**$0.26**	Minor	1
WL10	Mexicano Corn Chips Lower Hutt	0.49	Melling 33 kV	$0.00	Naenae	$0.13	**$0.13**	**$0.26**	Minor	1
WL59	Reserve Bank of New Zealand - Te Pūtea Matua	0.48	Wilton	$0.00	Moore Street	$0.13	**$0.13**	**$0.27**	Minor	1
WL32	Massey University Wellington Campus	0.46	Central Park 11 kV	$0.00	Nairn Street	$0.13	**$0.13**	**$0.28**	Minor	1
WL77	NZ Campus of Innovation and Sport (NZCIS)	0.39	Haywards 33 kV	$0.00	Trentham	$0.13	**$0.13**	**$0.33**	Minor	1
WL42	Wakefield Hospital	0.32	Central Park 33 kV	$0.00	Palm Grove	$0.13	**$0.13**	**$0.41**	Minor	1
WL37	Museum of New Zealand Te Papa Tongarewa Tory Stre	0.35	Central Park 11 kV	$0.00	Nairn Street	$0.13	**$0.13**	**$0.37**	Minor	1
WL14	Upper Hutt City Council H2O Xtream	0.35	Upper Hutt	$0.00	Maidstone	$0.13	**$0.13**	**$0.37**	Minor	1
WL27	Wellington Airport	0.33	Central Park 33 kV	$0.00	8 Ira Street	$0.13	**$0.13**	**$0.40**	Minor	1
WL58	Precinct Properties Treasury Building	0.33	Wilton	$0.00	Moore Street	$0.13	**$0.13**	**$0.40**	Minor	1
WL23	Wellington City Council Wellington Regional Aquatic (	0.32	Central Park 33 kV	$0.00	Evans Bay	$0.13	**$0.13**	**$0.40**	Minor	1
WL69	Victoria University of Wellington Rutherford House	0.32	Wilton	$0.00	Moore Street	$0.13	**$0.13**	**$0.41**	Minor	1
WL16	Hutt City Council Huia Pool	0.32	Gracefield	$0.00	Gracefield	$0.13	**$0.13**	**$0.41**	Minor	1
WL46	Hutt Valley High School	0.31	Gracefield	$0.00	Gracefield	$0.13	**$0.13**	**$0.42**	Minor	1

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

No.	Load Site Name	Load (MW)	Transmission Details: GXP/Transmission Substation	Transmission Details: Upgrade Costs ($M)	Distribution: Zone Substation	Distribution: Upgrade Costs ($M)	TOTAL Upgrade Costs ($M)	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
WL52	Rātonga-Rua-O-Porirua Campus	0.30	Takapu Road	$0.00	Kenepuru	$0.13	$0.13	$0.43	Minor	1
WL40	Argosy Property Ltd TSB Bank Building	0.30	Wilton	$0.00	Moore Street	$0.13	$0.13	$0.44	Minor	1
WL26	Te Pukenga Weltec & Whitireia Porirua Campus	0.29	Takapu Road	$0.00	Porirua	$0.13	$0.13	$0.45	Minor	1
WL67	Southern Cross Wellington Hospital	0.25	Central Park 33 kV	$0.00	Palm Grove	$0.13	$0.13	$0.51	Minor	1
WL57	Precinct Properties NTT Tower	0.26	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.31	Minor	1
WL39	Argosy Property Ltd MBIE Building	0.25	Wilton	$0.00	Moore Street	$0.13	$0.13	$0.52	Minor	1
WL49	Ōtaki College	0.24	Paraparaumu	$0.00	Ōtaki	$0.13	$0.13	$0.53	Minor	1
WL73	Wellington City Council Michael Fowler Centre	0.23	Central Park 33 kV	$0.00	The Terrace	$0.13	$0.13	$0.55	Minor	1
WL70	Victoria University of Wellington Te Aro	0.23	Central Park 33 kV	$0.00	Hataitai	$0.13	$0.13	$0.57	Minor	1
WL13	Whittaker's Porirua	0.20	Takapu Road	$0.00	Porirua	$0.08	$0.08	$0.40	Minor	1
WL47	Mahinawa Specialist School and Resource Centre	0.20	Takapu Road	$0.00	Titahi Bay	$0.08	$0.08	$0.40	Minor	1
WL15	Hutt City Council Wainuiomata Summer Pool	0.20	Gracefield	$0.00	Wainuiomata	$0.08	$0.08	$0.40	Minor	1
WL34	GNS Avalon	0.20	Melling 11 kV	$0.00	Melling	$0.08	$0.08	$0.40	Minor	1
WL50	Paraparaumu College	0.20	Paraparaumu	$0.00	Paraparaumu West	$0.08	$0.08	$0.41	Minor	1
WL54	Porirua City Council Te Rauparaha Arena and Aquatic	0.18	Takapu Road	$0.00	Porirua	$0.08	$0.08	$0.45	Minor	1
WL64	RJ Holdings Lambton House	0.17	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.46	Minor	1
WL66	RJ Holdings Solnet House	0.17	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.46	Minor	1
WL65	RJ Holdings Midlands Chambers	0.17	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.48	Minor	1
WL72	Wellington City Council Keith Spry Pool	0.17	Takapu Road	$0.00	Johnsonville	$0.08	$0.08	$0.48	Minor	1
WL38	Argosy Property Ltd 7 Waterloo Quay	0.15	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.53	Minor	1
WL61	RJ Holdings Bayleys Building	0.15	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.53	Minor	1
WL74	Wellington City Council Tawa Pool	0.14	Takapu Road	$0.00	Tawa	$0.08	$0.08	$0.56	Minor	1
WL25	Wellington City Council Freyberg Pool & Fitness Centr	0.14	Central Park 33 kV	$0.00	Frederick Street	$0.08	$0.08	$0.56	Minor	1
WL53	Oceania Healthcare Elderslea Village	0.14	Upper Hutt	$0.00	Maidstone	$0.08	$0.08	$0.59	Minor	1
WL48	Newlands College	0.13	Takapu Road	$0.00	Johnsonville	$0.08	$0.08	$0.60	Minor	1
WL62	RJ Holdings Harbour Tower	0.13	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.61	Minor	1
WL68	Victoria University of Wellington Old Government Bui	0.13	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.63	Minor	1
WL56	Precinct Properties Mayfair House	0.12	Kaiwharawhara	$0.00	Kaiwharawhara	$0.08	$0.08	$0.67	Minor	1
WL63	RJ Holdings Lambton Centre	0.11	Wilton	$0.00	Moore Street	$0.08	$0.08	$0.70	Minor	1
WL35	GNS Lower Hutt	0.11	Gracefield	$0.00	Gracefield	$0.08	$0.08	$0.72	Minor	1
WL60	RJ Holdings Centrepoint Building	0.11	Central Park 33 kV	$0.00	The Terrace	$0.08	$0.08	$0.72	Minor	1
WL43	Kapiti Coast District Council Ōtaki Pool	0.11	Paraparaumu	$0.00	Ōtaki	$0.08	$0.08	$0.73	Minor	1
WL71	Wellington City Council City Gallery	0.10	Central Park 33 kV	$0.00	Frederick Street	$0.05	$0.05	$0.50	Minor	1
WL17	Hutt City Council McKenzie Summer Baths	0.10	Gracefield	$0.00	Petone	$0.05	$0.05	$0.51	Minor	1
WL18	Hutt City Council Stokes Valley Pool	0.10	Haywards 11 kV	$0.00	Haywards	$0.05	$0.05	$0.51	Minor	1
WL19	Hutt City Council The Dowse Art Museum	0.10	Gracefield	$0.00	Gracefield	$0.05	$0.05	$0.53	Minor	1
WL24	Wellington City Council Karori Pool	0.07	Wilton	$0.00	Karori	$0.05	$0.05	$0.67	Minor	1
WL44	Kapiti Coast District Council Waikanae Pool	0.07	Paraparaumu	$0.00	Waikanae	$0.05	$0.05	$0.76	Minor	1
WL75	Wellington City Council Thorndon Pool	0.04	Kaiwharawhara	$0.00	Kaiwharawhara	$0.05	$0.05	$1.16	Minor	1
WL45	Hampton Hill School	0.02	Takapu Road	$0.00	Tawa	$0.05	$0.05	$2.25	Minor	1
	TOTAL =>	58.59	TOTAL =>	$18.40	TOTAL =>	$64.35	$82.75			

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

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes in order to connect the respective Load Sites.

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 a capital cost estimate 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 32. Cost estimate classification matrix[58]

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.

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