

Powerco CPP – Portfolio Overview Document

Portfolio Name	Papamoa Region Reinforcement
Expenditure Class	Capex
Expenditure Category	Growth & Security
As at Date	12 June 2017

Expenditure Forecast ^{1,2}	Pre CPP	FY19	FY20	FY21	FY22	FY23	Post CPP	CPP Period Total	Project Total
Pre-Internal Cost Capitalisation and Efficiency Adjustments ³ (2016 Constant NZ\$(M))	\$17.1	\$0.2	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.2	\$17.3
Post-Internal Cost Capitalisation and Efficiency Adjustments (2016 Constant NZ\$(M))	\$18.3	\$0.2	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.2	\$18.5

Description

Project Need Overview	Subtransmission circuits supplying the existing Papamoa area are loaded beyond firm capacity. Rapid greenfield residential growth in the area is increasing this risk. The new load growth is overloading feeders and has breached class capacity at Papamoa substation. Transpower’s transmission capacity to the area will breach security standards in the near future.
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Proposed Solution

Project Solution Overview	This project proposes to off-load Mt Maunganui GXP by transferring the existing Papamoa load onto Te Matai GXP by installing new subtransmission out of Te Matai GXP to Papamoa. A new zone substation will be constructed at Wairakei to partially off-load Papamoa substation and cater for the new growth. A new 33kV switchboard will be constructed at Te Matai to connect the new load.
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¹ Forecast expenditure is based on Powerco’s financial year (i.e. FY18 is for the period April 2017 through March 2018). Expenditures do not consider general price level changes over time (i.e. are in real or constant terms).

² Only includes Growth & Security Expenditure. Some projects discuss and rely on the replacement of assets that are at “end of life”. However, the replacement cost for these assets is accounted for in the Replacement Expenditure category.

³ All other forecast expenditure / cost estimates in this POD are pre-internal cost capitalisation and efficiency adjustments, consistent with this forecast.

Need Identification	
Background	<p>The Mt Maunganui /Papamoa/Maketu coastal area of Powerco’s network takes supply from two 110/33kV Transpower owned GXPs (Mount Maunganui and Te Matai). Over the past two decades this coastal area has experienced significant land development, particularly to the south east of Papamoa. Powerco’s existing regional sub-transmission network is illustrated geographically and structurally in Figure 1 and Figure 4 respectively. In order to supply consumers as land has developed along the coast Powerco has installed a dual 33kV cable spur from the Mt Maunganui GXP to the Te Maunga and Papamoa 33/11kV zone substations. Following this Powerco has installed 2 x 33kV underground cables to the south-east of Papamoa with the objective of supplying a future Wairakei 33/11kV substation. These 2 x 33kV cables are presently energized at 11kV and are operated as express 11kV feeders from the Papamoa substation.</p> <p>The 2014 ADMD on the Te Maunga/Papamoa cable-spur was ≈28MVA (including network losses). There is ≈6MVA of potential 11kV backfeed (from Te Maunga to Omanu & Matapihi), which is limited by the urban development that is taking place along the coastline.</p> <p>The area to the south east of Papamoa is expected to experience continued growth in demand due to subdivision expansion that has been identified in the Bay of Plenty’s (BoP) Smart-Growth strategy.</p> <p>The following constraints/issues exist:</p>
Underlying Drivers and Investment Triggers	<ul style="list-style-type: none"> • The combined ADMD peak demand of the Te Maunga/Papamoa substations exceeded the (N-1) capacity of the existing cable-spur during 2014 (MTM-TMA-A/MTM-TMA-B rated to 27.3MVA/29.7MVA respectively). The present supply network will not meet the requirements of Powerco’s Security-of-Supply Standard, which recommends that the combined load of the two substations should be afforded a (N-1), no break supply network with a security class of AA⁴. • The peak loading level on the Papamoa substation has significantly exceeded the existing (N-1) capacity and the 11kV feeders are highly loaded and need to be off-loaded. The Papamoa substation does not meet the requirements of Powerco’s Security-of-Supply Standard, which recommends that the substation should be afforded a (N-1), no break supply network with a security class of AAA⁵. • In 2014 the peak load on the Mt Maunganui GXP was 61.5 MVA and in 2025 is expected to exceed the existing network’s (N-1) transmission capacity of approximately 75 MVA (winter circuit rating of 77MVA at 1.0 p.u. voltage). The upgrade of

⁴ AA - Supply may be lost in the event of the outage of one major element of the sub-transmission network. Supply can be resorted within 45 minutes by switching at sub-transmission or distribution level (Powerco - Standard 310S001 – Security of Supply Classification – Zone Substations).

⁵ AAA - Supply is uninterrupted in the event of the outage of one major element of the sub-transmission network. Load can be transferred to other substations without interruption by switching on the network if necessary to avoid exceeding ratings (Powerco - Standard 310S001 – Security of Supply Classification – Zone Substations).



	<p>the existing overhead transmission lines are expected to be a significant challenge due to public and land owner opposition. Transpower have indicated that the existing 2 x 75MVA, 110/33kV transformers at Mt Maunganui have an (N-1) capacity of 87MVA/87MVA (summer/winter).</p> <ul style="list-style-type: none"> • In 2028 the peak demand on the 33kV cables supplying the Papamoa substation is projected to be 27.7MVA, which will exceed the (N-1) rating of the 33kV supply cables.
<p>Timing</p>	<p>The Te Maunga/Papamoa cable-spur and the Papamoa substation need to be off-loaded as soon as possible. Particularly given that demand in the region has continued to increase and the supply is via relatively long underground cables that typically take a long time to repair.</p> <p>The resolution of the constraints has taken longer than expected due to public/landowner opposition. Given this fact Powerco has modified its original proposal and is continuing to secure the consents/easements for the preferred option.</p>



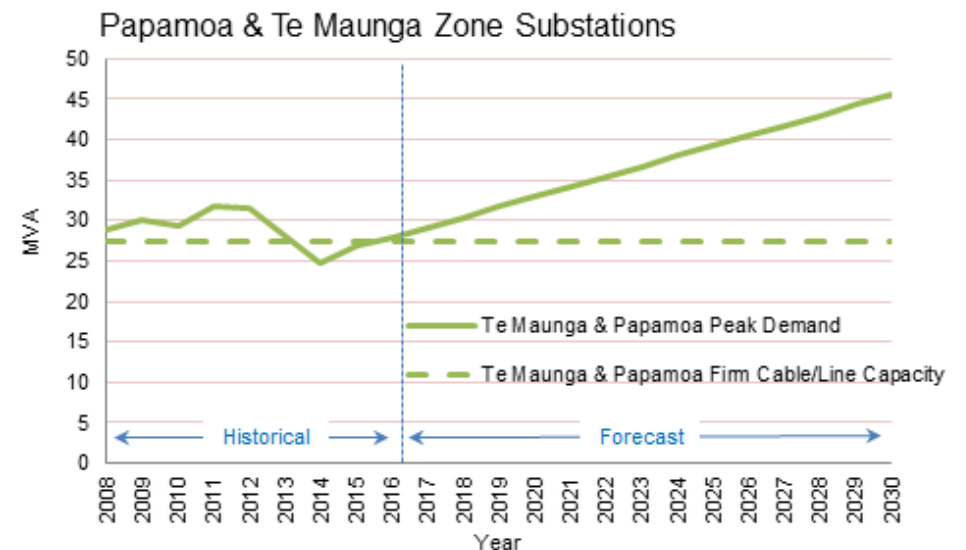
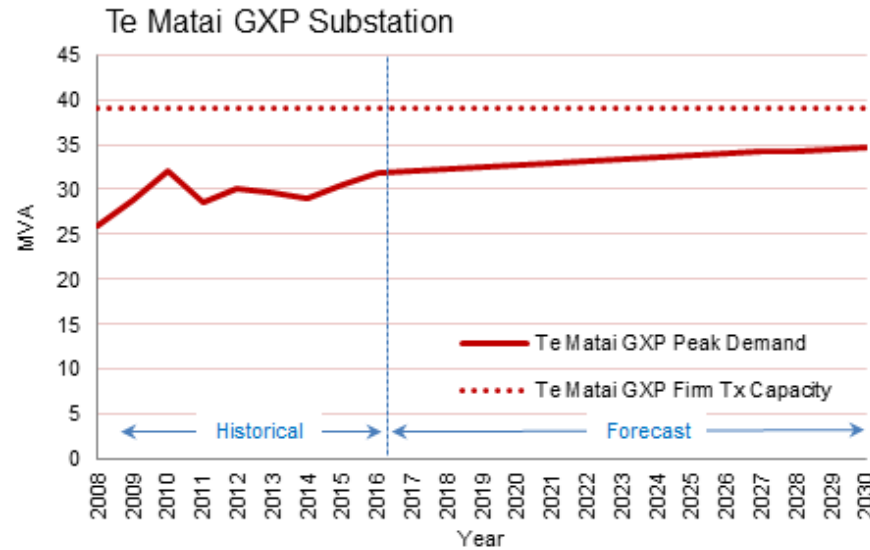
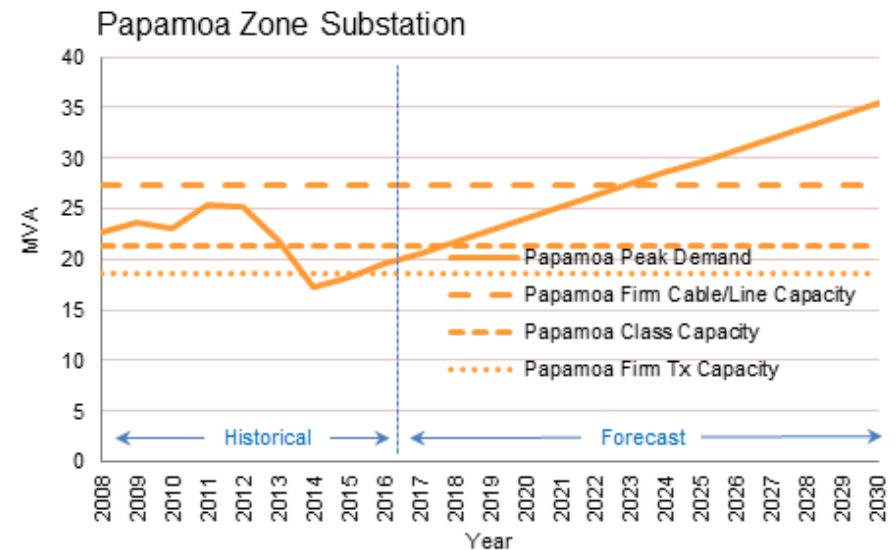
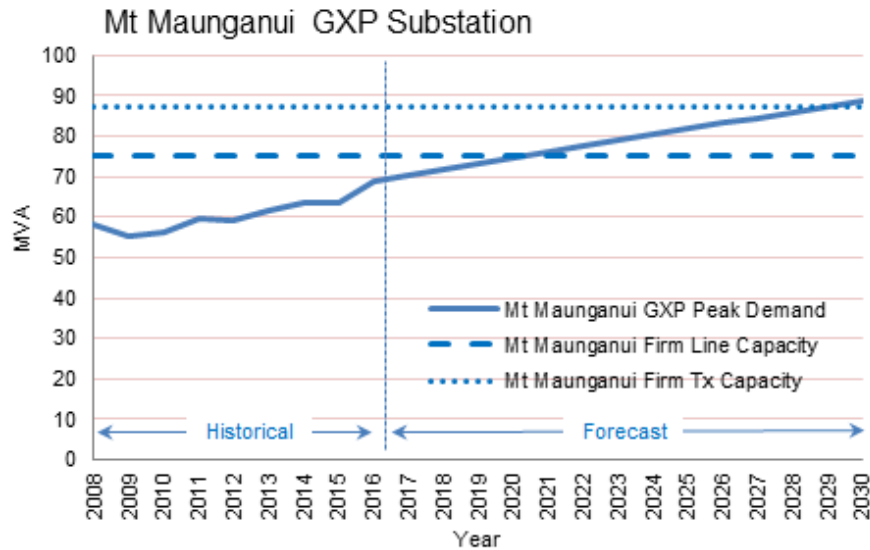
Demand Forecast | Mt Maunganui Area

MOUNT MAUNGANUI AREA SUBSTATIONS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	CLASS CAPACITY	GROWTH	2016	2017	2018	2019	2020	2025	2030
Atuaroa Ave	0.0	0.8%	8.1	8.1	8.2	8.3	8.3	8.7	9.0
Matapihi	24.1	0.9%	14.4	14.5	14.6	14.8	14.9	15.6	16.3
Omanu	24.3	0.6%	15.6	15.7	15.7	15.8	15.9	16.3	16.8
Paengaroa	2.3	0.1%	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Papamoa	21.3	5.8%	19.5	20.6	21.8	22.9	24.1	29.8	35.4
Pongakawa	2.1	0.5%	7.4	7.4	7.4	7.5	7.5	7.7	7.8
Te Maunga	9.1	1.5%	8.4	8.5	8.6	8.7	8.8	9.5	10.1
Te Puke	22.9	0.6%	20.4	20.5	20.6	20.8	20.9	21.5	22.2
Triton	21.3	0.8%	21.4	21.6	21.8	21.9	22.1	23.0	23.9

MOUNT MAUNGANUI AREA GXPS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	TX CAPACITY	GROWTH	2016	2017	2018	2019	2020	2025	2030
Mt Maunganui GXP	90.0	2.1%	68.9	70.3	71.7	73.2	74.6	81.7	88.8
Te Matai GXP	39.0	0.6%	31.9	32.1	32.3	32.5	32.7	33.7	34.8

Notes:

1. Class capacity is similar to Firm Capacity and represents the capacity that can be delivered following the first outage of any major equipment. Unlike Firm Capacity it considers the deliverable capacity in the context of switching and network reconfiguration (11kV & 33kV) post-fault conditions.
2. All maximum demand values are in MVA.
3. Purple shaded cells indicate that the substation’s Class Capacity has been exceeded and network enhancements should be considered.
4. The after diversity maximum demand (ADMD) on the Te Maunga/Papamoa spur is close to sum of the peak demands on the two substations (i.e. there is little diversity)
5. The Mt Maunganui substation is supplied via two 110kV overhead transmission circuits that have a (N-1) winter rating of 77MVA at 1.0 p.u. voltage. This is a significant constraint.



Options Analysis Long List of Project Options High Level Assessment	
Assessment Process	<p>A wide range of potential options are available for the resolution of electrical network constraints. However, depending on local conditions some of the options can have fatal flaws. On this basis a two tier Options Analysis is followed. In the first instance all potential options are considered against a set of high level criteria. Those options that are identified as having significant challenges and not favourable are not considered further. As a result of the process a short list of viable options is identified for further analysis.</p>
Long List of Options	<p>The following table contains a list of the high level project options that are potentially available to resolve the electrical supply issues in the Papamoa east area. Option 1 involves maintaining the status quo and allowing the risks associated with consumer non-supply to increase over time. Adoption of this option is possible, but as a prudent network operator Powerco is of the view that following this path would not be appropriate, given the supply network does not meet with Powerco’s Security-of-Supply Standard. Another significant factor is that the Te Maunga /Papamoa spur consists of underground cables that share a common trench. Underground cable faults can take a significant amount of time to locate and repair, during which there would be significant number of consumers without power. Option 1 is thus not short-listed.</p> <p>The three non-network options (Options 2, 3 and 4) are not shortlisted on the following basis:</p> <ul style="list-style-type: none"> • Renewable generation sources are often not viable due to their intermittent nature and cost. Viable renewable generation options are also limited by the fact that the load on the Te Maunga/ Papamoa cable-spur is winter peaking. Fossil fuelled generation is technically viable but not shortlisted due to cost, environmental and consenting and issues. • Fuel switching and demand side response (DSR) are considered to be deferment strategies and their viability is uncertain. Powerco presently uses a mains borne ripple control system to control significant amounts of hot water cylinder load on the Te Maunga / Papamoa cable-spur. No significant/additional winter peaking consumer loads have been identified for control and given the nature & rate of the developing load DSR is not considered to be viable. <p>Options 5 and 6 involve the establishment of a new 110/33/11kV GXP substation at Papamoa east. The substation would be supplied (respectively) via a double circuit 110kV overhead line or a dual set of 110kV cables. Option 5 was discounted due to significant public and landowner opposition to overhead lines. Option 6, involving a 110kV cable supply, was shortlisted on the basis that it is achievable and has significant merits in spite of the significant costs.</p> <p>Options 9 and 10 involve the reinforcement of the Papamoa east area using 33kV lines/cables from the Mt Maunganui GXP coupled with, in the long term, the upgrade of the 110kV transmission supply into the Mt Maunganui GXP. Both of these options have been discounted on the basis that the existing overhead 110kV lines into Mt Maunganui traverse through densely populated urban environments and Transpower has indicated that the upgrade of lines would be met with significant public/landowner opposition. The alternative would involve the installation of a third 110kV underground cable (from</p>

Kaitimako to Mt Maunganui) at significant cost.

Options 7 and 8 involve the installation of 33kV supply circuits from the Te Matai GXP to a new 33/11kV substation located in Papamoa east, which in turn would be connected to the existing 33kV cables (operating at 11kV) that run south east of the 33/11kV Papamoa substation. Option 7 was discounted on the basis that there would be significant public opposition to the installation of overhead 33kV lines. Option 8 was shortlisted on the basis that it is achievable and has significant benefits given that it creates 33kV ring between the Mt Maunganui and Te Matai GXPs.

Option 11 involves a hybrid project that proposes the installation of 110kV cables that are initially operating at 33kV to supply the Wairakei 33/11kV substation. This option defers costs associated with constructing a 110/33kV GXP substation at Wairakei. Option 12 involves the installation of a third 33kV cable between Matapihi and Te Maunga, coupled with the installation of the Wairakei 33/11kV substation (supplied via 2 x 33kV cables from Papamoa). Whilst Option 12 is viable it was not shortlisted on the basis that it does not resolve the long term security issues associated with the Mt Maunganui GXP and does not provide the supply diversity that is achieved by many of the other options (linking Mt Maunganui GXP with Te Matai). Furthermore, Option 12 would only defer the need to increase the network capacity from Te Matai to supply the emerging consumer load to the south-west of Tauranga/Papamoa.

Long List of Options | High Level Assessment

Papamoa East Region		Long list of projects and high level assessment			Assessment Criteria					
PROJECT FOCUS	No.	PROJECT	Safety	Fit	Feasible	Practical	GEIP	Security	Cost	Short-list
Do Nothing	1	Allow the electrical demand & risk of consumer non-supply to increase	✓	✗	✓	✓	✓	✗	✓	✗
Non-network:	2	Distributed Generation (DG) including peak lopping generation	✓	✗	✓	✗	✓	✓	✗	✗
	3	Fuel switching to reduce electrical demand	✓	✓	✗	✗	✓	✓	✗	✗
	4	Demand Side Response (DSR)	✓	✓	✗	✗	✓	✓	✗	✗
	5	New Papamoa GXP & 110kV O/H line from Te Matai	✓	✓	✓	✓	✓	✓	✗	✓
Network Reinforcement	6	New Papamoa GXP & 110kV U/G cable from Te Mataia	✓	✓	✗	✗	✓	✓	✗	✗
	7	Upgrade Te Matai GXP & 33kV O/H lines to Wairakei Substation	✓	✓	✗	✗	✓	✓	✓	✗
	8	Upgrade Te Matai GXP & 33kV U/G Cables to Wairakei Substation	✓	✓	✓	✓	✓	✓	✓	✓
	9	Upgrade Mt Maunganui GXP & 33kV O/H lines to Wairakei Substation	✓	✓	✗	✗	✓	✓	✗	✗
	10	Upgrade Mt Maunganui GXP & 33kV U/G Cables to Wairakei Substation	✓	✓	✗	✗	✓	✓	✗	✗
	11	110kV U/G cable from Te Mataia - Initially operated at 33kV	✓	✓	✓	✓	✓	✓	✗	✓
	12	Install 3rd 33kV cable between Matapihi and Te Maunga Substations	✓	✓	✓	✓	✓	✓	✓	✗

Key:

- Safety Health and Safety: Any significant implications in terms of Safety or Health - new products or compounds or practices, or requires difficult live line access etc.
- Fit Fit for Purpose: Does the option address the need appropriately and does it fit with other developments in the vicinity.
- Feasible Technically Feasible: Consider the complexity, future adaptability, and whether it aligns with company standards, strategies and policies.
- Practicality Practical to Implement: Are there potential environmental or property issues which may be insurmountable. Can it be achieved in the required time frame.
- GEIP Good Electricity Industry Practice (GEIP): Good practice (technically and environmentally) and in terms of AM practice (capacity, age, technological)
- Security Security and Reliability: Does the option provide adequate levels of security and appropriate reliability considering the demand, load type and future growth.
- Cost Some options will intuitively be known to be far more expensive than other options, and this may preclude them.

Options Analysis Short List of Options		
Option	Capital Cost ⁶	Description
<p>Option 6:</p> <p><i>New Papamoa GXP & 110kV U/G cable from Te Matai Figure 2 & Figure 5</i></p>	\$27.5M	<p>The following network enhancements are proposed:</p> <ul style="list-style-type: none"> • Construction of a double circuit, ≈12km, 110kV, underground cable with a rating of 2 x 75MVA between the Te Matai GXP and a new Papamoa East 110/33kV substation. Where possible the cable would be installed in the road reserve and would need to cross the Kaituna River at the following two most suitable locations: <ul style="list-style-type: none"> ○ At an existing SH2 bridge adjacent to Rangiuru Rd. ○ At a new bridge associated with the new Eastern Link motorway just south of Bell Road. • Construction of a new 110/33kV Papamoa East substation equipped with 2 x 75MVA transformers. • Construction of a new 33/11kV Wairakei zone substation equipped with 1 x 24MVA transformer. • Land and easements for the above equipment/assets. • 2 x 110kV circuit breaker bays at the Te Matai GXP. These would be installed by Transpower and the costs are not included in this PoD.
<p>Option 8:</p> <p><i>Upgrade Te Matai GXP & 33kV U/G Cables to Wairakei Substation Figure 3 & Figure 6</i></p>	\$17.3M	<p>The following network enhancements are proposed:</p> <ul style="list-style-type: none"> • Construction of a new 33/11kV Wairakei zone substation equipped with 1 x 24MVA transformer. • Land and easements for the above equipment/assets. • Construction of two 33kV cables between Te Matai GXP and Wairakei substation (12kms) • Construction of an 8 x 33kV circuit breaker indoor switchboard and associated control building at the Te Matai GXP. In the long term the costs associated with expanding the existing outdoor 33kV switchyard are considered to be less economic than progressing with an indoor solution, particularly given that the Powerco’s future plans include a number of additional 33kV feeders for other zone substations (cost not included in this PoD). Transpower have indicated that an outdoor to indoor 33kV conversion is their preferred solution and Powerco expects to own the future 33kV switchboard and building at Te Matai. • The upgrade of the existing 2 x 110/33kV transformers at the Te Matai GXP. This activity would be undertaken by Transpower and would be required in ≈2020. Transpower have indicated that the existing 30MVA and 40MVA, 110/33kV transformers at Te Matai have an (N-1) capacity of 36MVA/39MVA (summer/winter).

⁶ The total capital cost of each project. The costs do not consider the time value of money and do not include the economic value of other factors (i.e. network losses and consumer outage costs).



<p>Option 11:</p> <p><i>110kV U/G cable from Te Matai Operated at 33kV</i></p>	<p>\$26.0M</p>	<p>This option effectively involves a staged version of Option 5 whereby the 110kV underground cables are installed but initially operated at 33kV. The following network enhancements are initially proposed:</p> <ul style="list-style-type: none"> • Construction of a double circuit, ≈12km, 110kV, underground cable with a rating of 2 x 75MVA between the Te Matai GXP and a new Papamoa East 110/33kV substation. Where possible the cable would be installed in the road reserve and would need to cross the Kaituna River at the following two most suitable locations: <ul style="list-style-type: none"> ○ At an existing SH2 bridge adjacent to Rangiuru Rd. ○ At a new bridge associated with the new Eastern Link motorway just south of Bell Road. • 2 x 33kV circuit breaker bays at the Te Matai GXP to supply the 110kV cables (operating at 33kV). These would be installed by Transpower. • Construction of a new 33/11kV Wairakei zone substation equipped with 1 x 24MVA transformer, an 11kV switchboard and a 33kV switchboard. This substation would connect to the Te Matai GXP via the 110kV cables and to the Papamoa zone substation via the existing 33kV cables. • Land and easements for the above equipment/assets. <p>The above network enhancements would be followed, at a later stage, by:</p> <ul style="list-style-type: none"> • Construction of a new 110/33kV Papamoa East substation equipped with 2 x 75MVA, 110/33kV transformers. • 2 x 110kV circuit breaker bays at the Te Matai GXP. These would be installed by Transpower. • The above mentioned 2 x 110kV cables would be re-energised at 110kV and the 33kV supply to the Wairakei 33/11kV substation transferred from Te Matai to the new Wairakei GXP.
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Option Analysis | Advantages vs Disadvantages

The following sections summarise the advantages/disadvantages associated with the short listed options. The intention being to also capture project risks and inter-dependencies.

Option	Advantages	Disadvantages
<p>Option 6: <i>New Papamoa GXP & 110kV U/G cable from Te Matai</i> <i>Figure 2 & Figure 5</i></p>	<ul style="list-style-type: none"> • Injects a robust, high capacity 110kV supply into the Papamoa east region, which is available for the connection of future 33/11kV zone substations. • Defers the need to replace the Te Matai 33kV switchyard with an indoor switchboard. • Establishes a third 110/33kV GXP (Papamoa GXP) in the Tauranga Area. This should deliver the most secure and reliable network (in comparison to other options). • Delivers flexibility to cut into the 33kV cables and establish another zone substation (should it be required). 	<ul style="list-style-type: none"> • Involves significant capital expenditure at the front end of the project (both 2 x 110kV cables and 110/33kV substation) • If the land development in the Papamoa east region is delayed (low growth scenario) there would be no need for a new 110/33kV substation.
<p>Option 8: <i>Upgrade Te Matai GXP & 33kV U/G Cables to Wairakei Substation</i> <i>Figure 3 & Figure 6</i></p>	<ul style="list-style-type: none"> • Relatively low capital expenditure, particularly at the front end of the project. • Significantly defers the need to progress and install a costly Papamoa GXP (Option 5). 	<ul style="list-style-type: none"> • Involves the early retirement of the existing outdoor 33kV switchyard at the Te Matai GXP. • In the long term the 110/33kV transformers at the Te Matai GXP will need to be upgraded.
<p>Option 11: <i>110kV U/G cable from Te Matai Operated at 33kV</i></p>	<ul style="list-style-type: none"> • Provides a long term upgrade path that would facilitate, in the long term, the installation of a third 110/33kV GXP (Papamoa GXP) in the Tauranga Area. • Lowest electrical losses. 	<ul style="list-style-type: none"> • Involves significant capital expenditure at the front end of the project (2 x 110kV cables).
<p>Shared Features</p>	<ul style="list-style-type: none"> • Avoids the need to upgrade the Mt Maunganui GXP. • Network reliability is expected to be good due to the installation of the indoor switchboards, underground cables supply and robust/unit protection systems. 	<ul style="list-style-type: none"> • Involves the installation of significant runs of underground cable at higher cost than the overhead equivalent.

	<ul style="list-style-type: none"> • Practical and achievable in terms of consenting and routes. • Utilises known technology and proven designs. • Avoids the construction of overhead lines that are not generally favoured by the public. • Delivers simple & reliable protection system. • Delivers a transmission link between the Mt Maunganui GXP and the Te Matai GXP, which provides diversity of supply. The financial benefits associated with network diversity are often difficult to financially justify. However, the lack of network diversity can result in significant consumer outages. For example, the 2014 Penrose outage that involved the failure of multiple 33kV cables in a common trench (cable fire). 	
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Recommendation	
Preferred Option	The preference is to proceed with Option 8 that involves the upgrade of the Te Matai GXP and the installation of 2 x 33kV underground cables to a new Wairakei Substation. The proposed 2 x 33kV underground cables would also be installed between Papamoa and Wairakei.
Reasons for choosing Option	<p>Powerco has spent a significant amount of effort attempting to progress Option 6. This option involved the construction of overhead 110kV lines, from Te Matai to Papamoa east, and was met by significant opposition by both the public and landowners. As a result of this fact Powerco have progressed to examine the available underground cable supply options. The preferred solution is Option 8 for the following reasons:</p> <ul style="list-style-type: none"> • It has the lowest overall capital cost. • It improves the supply diversity to all substations, due to the fact that the Mt Maunganui and the Te Matai GXPs will be linked at 33kV and all the relevant zone substations (Te Maunga, Papamoa & Wairakei) would be supplied via two independent routes. • It is practical and achievable.



Option 8 | Detailed Costs

Item	Description	Actual Cost	Projected Cost
A	Property & Consent Costs		
A.1	Wairakei Zone Substation Land	\$614,095	-
A.2	Easements and consenting (future)		\$291,181
B	Investigation and Reporting Costs		
B.1	Consultants/Investigations/Preliminary Designs	\$1,750,043	
C	Substation Costs		
C.1	Wairakei Zone Substation		\$3,542,230
C.2	Te Matai 33kV Switchboard/room		\$2,008,854
D	Line and Cable Costs		
D.1	Te Matai to Wairakei 33kV cables (14km)		\$9,105,591
E	Committed/Historical Costs (A+B+C+D)	\$2,364,139	
F	Future Projected Costs (A+B+C+D)		\$14,947,856
G	Anticipated Final Cost (E+F)		\$17,311,995

Option 8 Implementation Plan				
Project or Action	Start Year ¹	End Year ¹	NZ \$'000 ¹	Details / Comments
Project costs to date	-	FY14	\$2,364	Costs that have already occurred.
Easements/land/consents	FY16	FY19	\$291	Easement costs across 3 private landowners and Transpower land.
Wairakei Zone Substation	FY17	FY19	\$3,542	1 x 24MVA substation, 33kV switchboard and 11kV switchboard.
Te Matai 33kV Switchboard/room	FY17	FY17	\$2,009	33kV switchboard and building and associated 33kV cabling
Te Matai to Wairakei 33kV Cables	FY17	FY19	\$9,106	14.0km double cct 33kV cable from Te Matai to Wairakei
Total Project Costs →	FY15	FY19	\$17,312	Only Includes Growth & Security Expenditure.

Supporting Documents and Models	
<p><i>Planning documents</i> <i>Standards Policies</i> <i>Reviews and Consultant reports</i> <i>Concept Designs Estimates</i></p>	<ol style="list-style-type: none"> 1. Area Plans: Tauranga & Te Puke Areas. 2. Papamoa East Options Analysis. 3. "Project Papamoa Update", Powerco Board Memo 1067, 16th Dec 2013. 4. "Tauranga Eastern Link (TEL) Cables", Powerco Board Memo, 1068, 16th Dec 2013. 5. "Te Matai to Wairakei 33kV Cable Circuits – Conceptual Design", AECOM report, Dec 2014. 6. "Wairakei Zone Substation Concept Design Report (CDR)", Edison report, Oct 2014. 7. Powerco's Demand Forecast. 8. Powerco's 2013 Asset Management Plan (AMP). 9. Powerco's Annual Planning Report (APR). 10. "310S001 Security-of-Supply Classifications – Zone Substations", Powerco Standard. 11. "393S041 Zone Substation Transformer Ratings", Powerco Standard. 12. "393S035 Electrical Network Conductor Rating Standard", Powerco Standard. 13. "Annual Planning Report – March 2014", Transpower APR document.

Notes/Assumptions	
<i>Generic Assumptions in relation</i>	<ul style="list-style-type: none"> • Costs are expressed in 2016 (real) dollars.



<p><i>to Options Costs</i></p>	<ul style="list-style-type: none"> • The costs quoted are to construct the network and do not include economic factors (i.e. costs of non-supply) • The capital costs fall within the Growth and Security expenditure categories only. • The capital costs only include Powerco’s capital expenditure (not Transpower or other parties). • The costs include all costs associated with the proposed projects (or alternate options) regardless of whether those costs fall within the CPP period or not, although they do not include any sunk costs (committed already).
<p><i>Specific Assumptions in Relation to Options Costs</i></p>	<ul style="list-style-type: none"> • Cost estimation for the options has initially been achieved via a desktop study using Powerco’s standard building block unit costs. The costs have then been refined by further investigations. • Property and consenting costs are usually a high risk area involving considerable uncertainty. Due to the urban/lifestyle-block nature of area underground cable is used and where possible installed in road reserve.

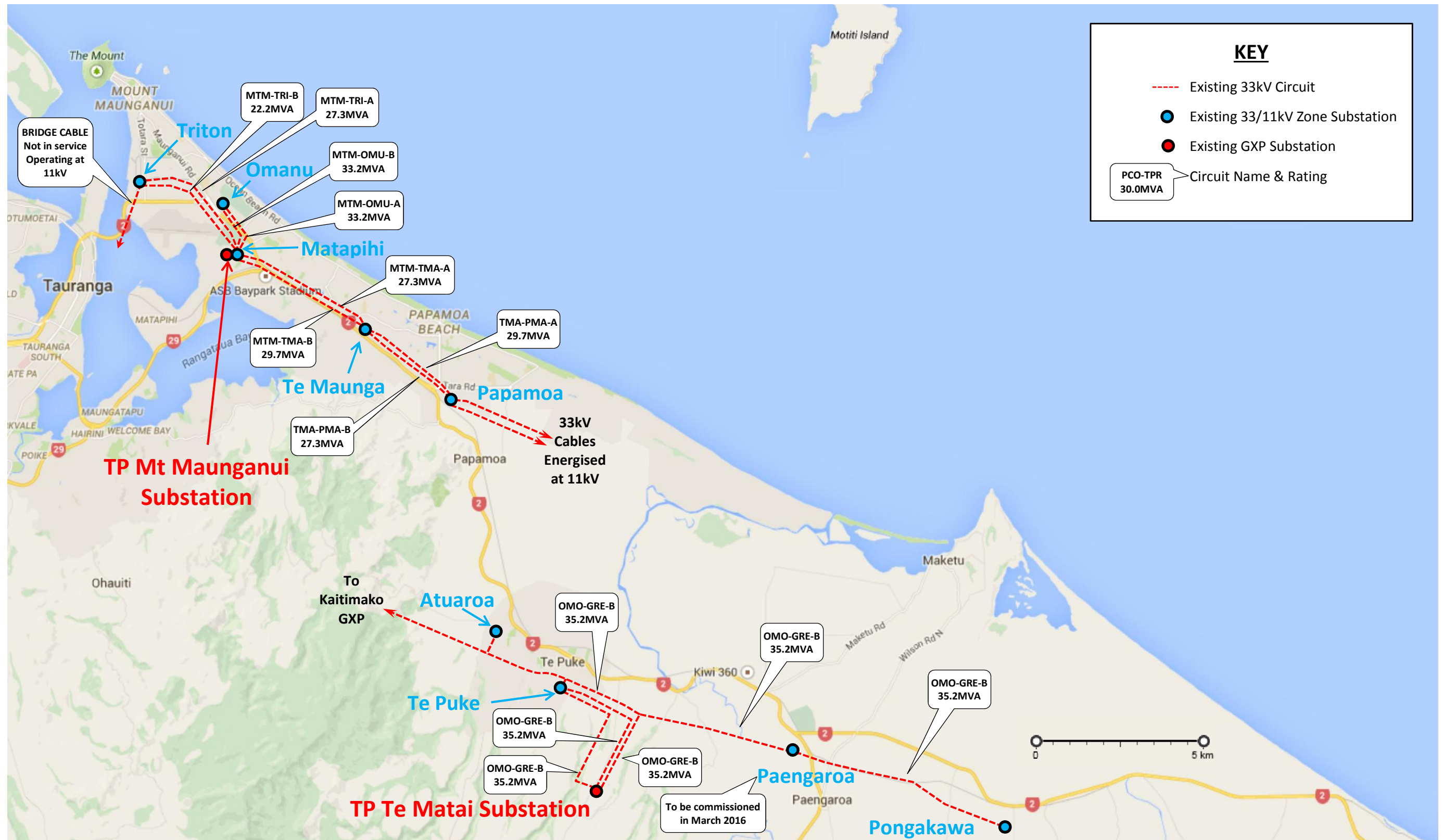


Figure 1 Existing Papamoa East Sub-transmission Network: Geographic Diagram

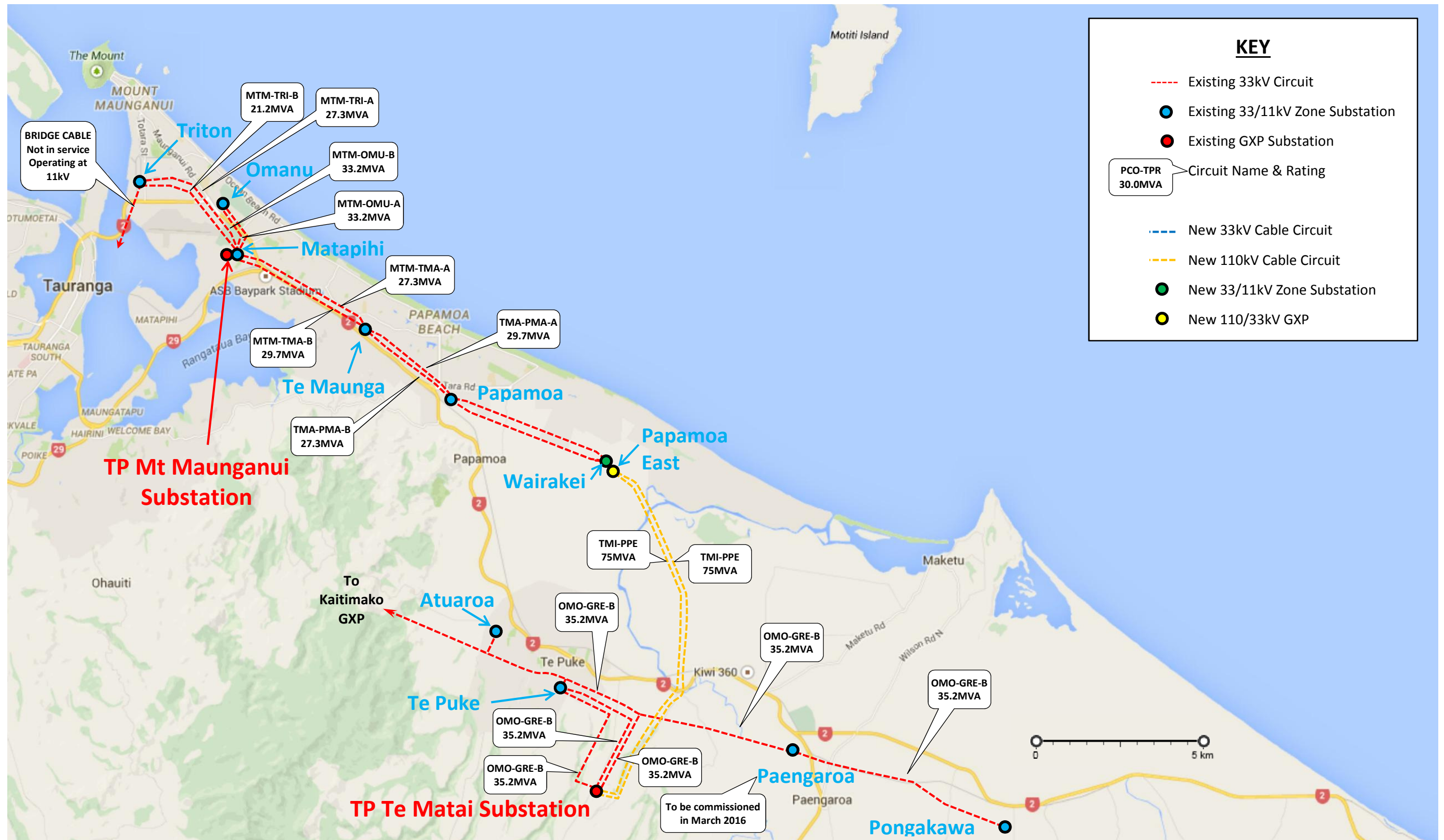


Figure 2 Option 5: New Papamoa GXP – 110kV U/G cable from Te Matai: Geographic Diagram

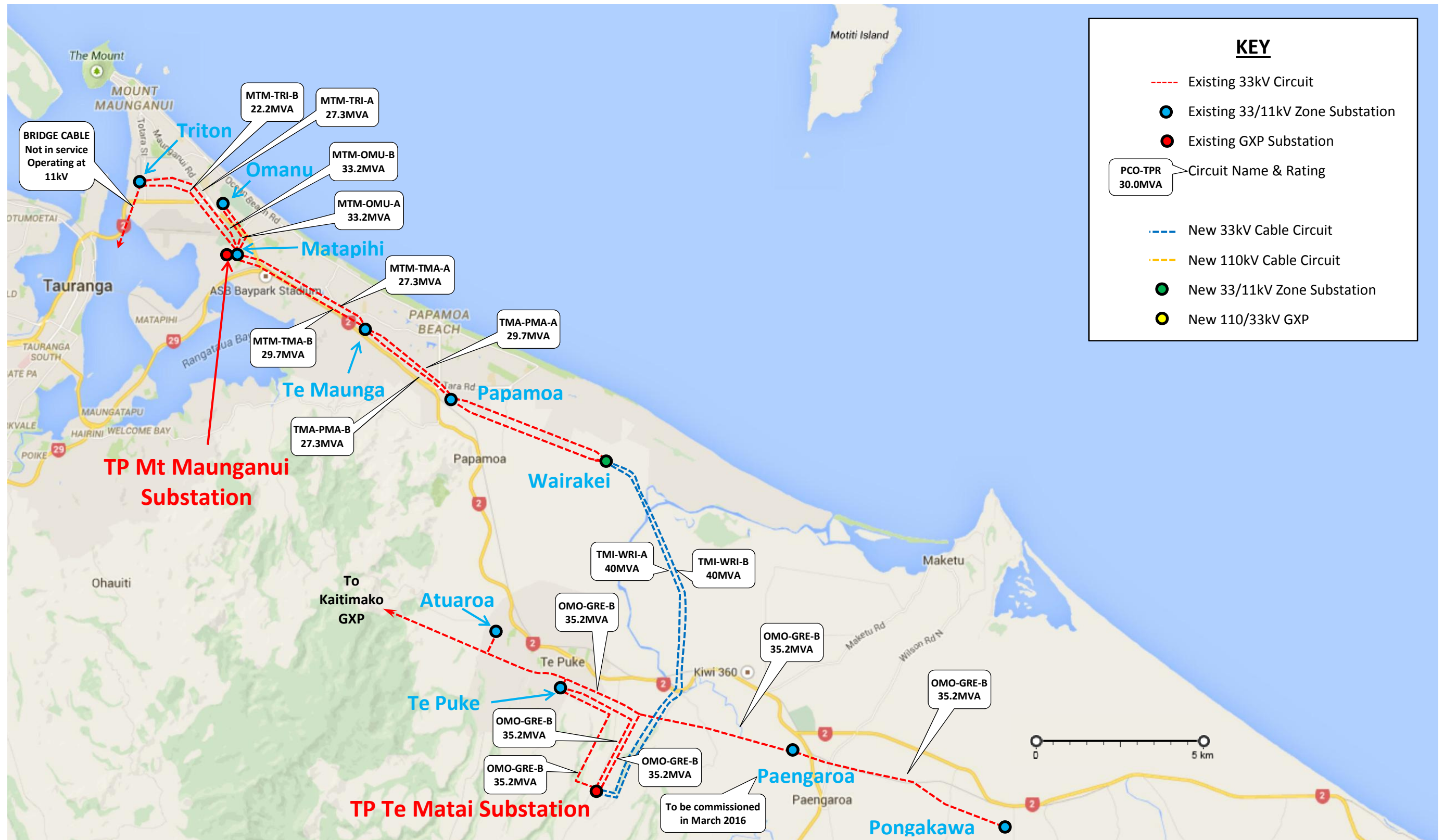


Figure 3 Option 8: Upgrade Te Matai GXP - 33kV U/G Cables to Wairakei Substation: Geographic Diagram

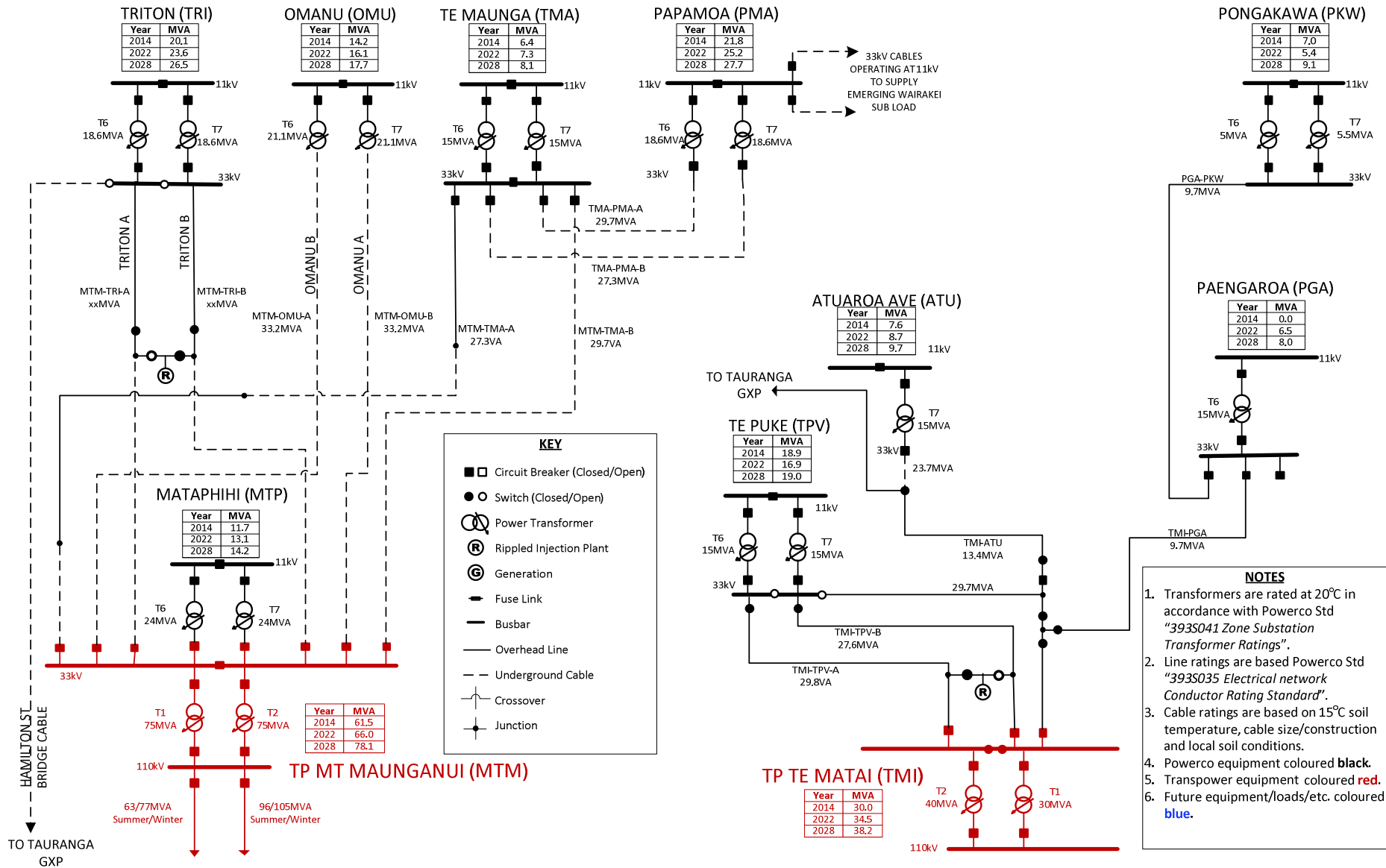
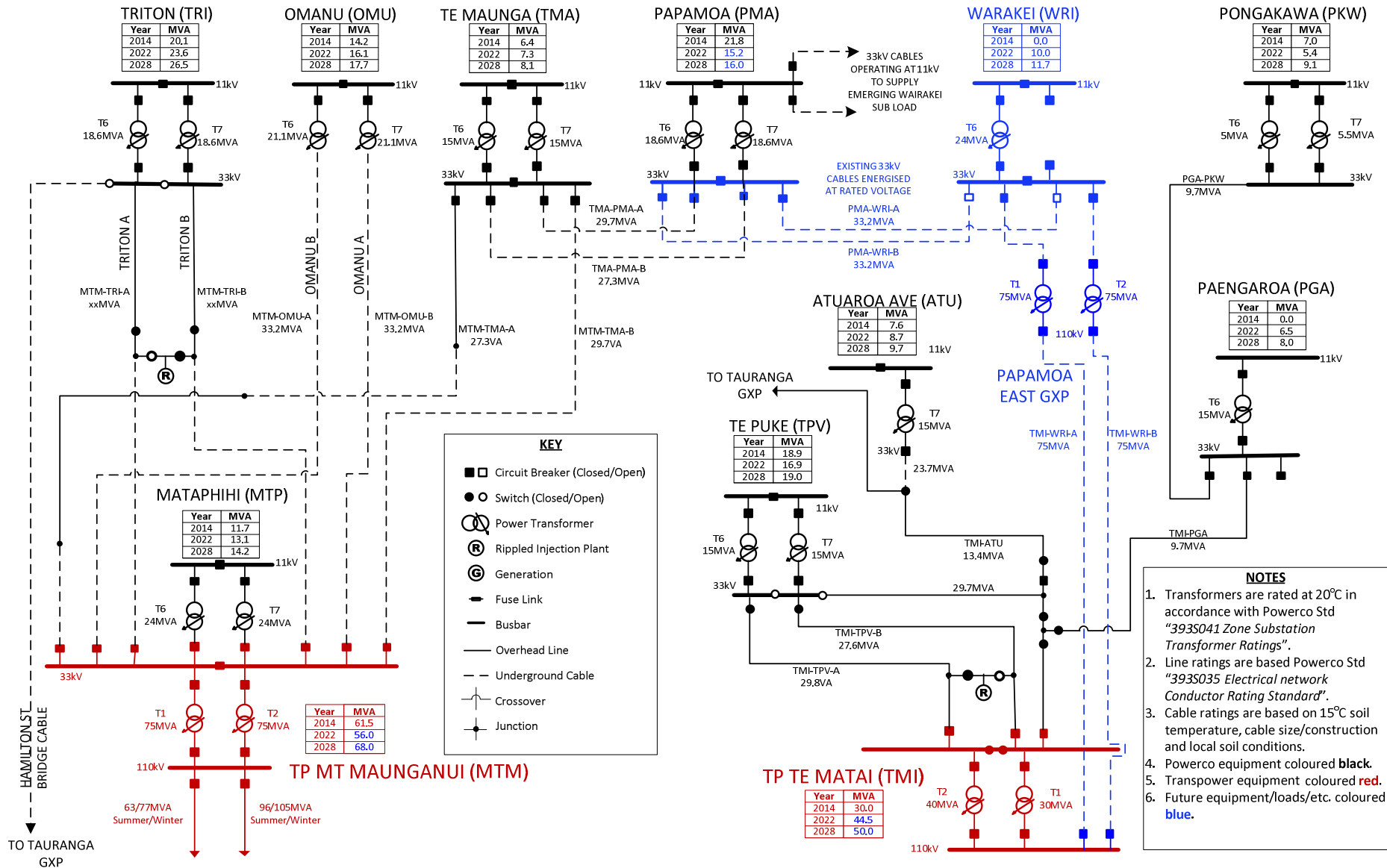


Figure 4 Existing Papamoa Sub-transmission Network: One-Line Diagram

Papamoa Region Reinforcement



- NOTES**
- Transformers are rated at 20°C in accordance with Powerco Std "393S041 Zone Substation Transformer Ratings".
 - Line ratings are based Powerco Std "393S035 Electrical network Conductor Rating Standard".
 - Cable ratings are based on 15°C soil temperature, cable size/construction and local soil conditions.
 - Powerco equipment coloured **black**.
 - Transpower equipment coloured **red**.
 - Future equipment/loads/etc. coloured **blue**.

Figure 5 Option 5: New Papamoa GXP – 110kV U/G cable from Te Matai: One-Line Diagram

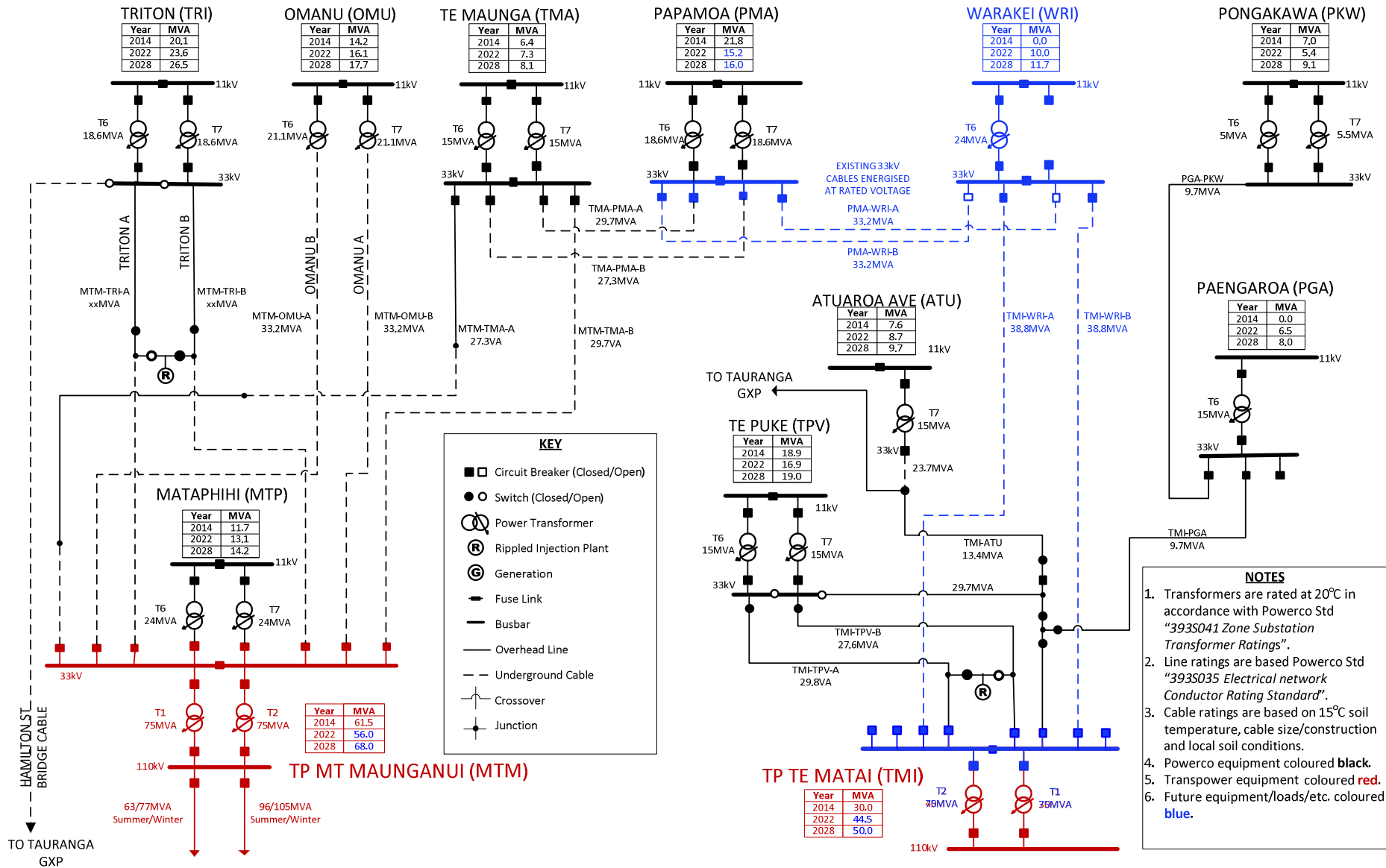


Figure 6 Option 8: Upgrade Te Matai GXP - 33kV U/G Cables to Wairakei Substation: One-Line Diagram