Powerco CPP – Portfolio Overview Document

Portfolio Name	Sanson – Bulls Project
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))*	$0.0	$0.2	$0.0	$0.0	$2.3	$3.4	$0.0	$5.9	$5.9
Post-Internal Cost Capitalisation and Efficiency Adjustments *(2016 Constant NZ$(M))*	$0.0	$0.2	$0.0	$0.0	$2.4	$3.4	$0.0	$6.0	$6.0

Description

Project need overview	The subtransmission network supplying Fielding, Sanson and Bulls townships, including RNZAF Ohakea air base, does not meet desired security of supply standards due to capacity constraints of the existing circuits and the lack of alternative supply feeds. Sanson substation is loaded beyond firm capacity, as is Transpower's Bunnythorpe GXP.

Proposed solution

Project solution overview	Powerco is proposing to establish a 33kV sub-transmission link between the Sanson substation and the Bulls substation. The project would involve the construction of a new ≈4km, 33kV line/cable from Bulls to Ohakea to link with an existing ≈3.5km, 33kV, underground cable[4] that runs between Sanson and Ohakea. A new 33/11kV zone substation would be installed at Ohakea to supply the Ohakea airbase and

[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.
[4] This underground cable is presently operated as an 11kV feeder out of the Sanson substation and supplies the Ohakea airbase.

	surrounding load.

Needs Identification

Background	The northern region of Powerco's Manawatu Area is supplied via the Bunnythorpe GXP. Powerco's sub-transmission network consists of a 33kV network of lines/cables that supply three zone substations (Feilding, Sanson and Kimbolton) (refer to Figure 1 & Figure 4). The 33kV sub-transmission network is not connected to the adjacent Powerco Rangitikei Area. The individual consumer loads in the region are relatively small and dominated by agriculture, sheep/dairy farming and light industrial consumers. The area has experienced a steady increase in irrigation load to support the agricultural sector and this is projected to continue. There is not a significant difference between the summer and winter peak demand due to the fact that as winter peaking loads are starting to drop they are replaced by agricultural/dairy loads that ramp up in spring and are maintained well into summer. The largest individual consumers are: • Bulls Substation: Canterbury Meatpackers (≈1MW) & Riverlands Manawatu Ltd. • Fielding; AFFCO NZ Ltd (≈2MW). • Sanson: NZDF –RNZAF Base Ohakea (≈2MW).
Drivers and Investment Triggers	The northern region of Powerco's Manawatu Area has a number of constraints which include the following: 1. The combined 2016 peak demand on the Feilding, Kimbolton & Sanson substations was ≈32MVA. During a contingent event on one of the 33kV lines between Bunnythorpe and Feilding the remaining 33kV line would be overloaded by ≈30% during peak network loading conditions. The existing supply network to the three substations does not meet the requirements of Powerco's Security-of-Supply Standard, which recommends a (N-1), no break supply network, security class AAA[5] for the combined load of Feilding/Kimbolton/Sanson. 2. The 2016 peak demand on the Sanson substation was ≈9MVA. The substation is supplied by a single, ≈15km, 33kV, overhead line from the Feilding substation. During extended 33kV line faults the Sanson load can be partially restored (≈4MVA) via switching on the 11kV network, but a significant portion of the consumers would not be restored until the 33kV line fault was repaired. The existing supply network to the Sanson substation does not meet the requirements of Powerco's Security-of-Supply Standard, which recommends a security class AA+[6]. 3. The 2016 peak demand on the Bulls substation was ≈6MVA. The substation is supplied by a single 33kV overhead line from

[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).

[6] AA+ Supply may be lost in the event of the outage of one major element of the sub-transmission network. Supply is restored automatically within 15 seconds by automatic switching at the sub-transmission or distribution level.

	the Marton GXP. During extended 33kV line faults the Bulls load can be partially restored (≈4MVA) via switching on the 11kV network, but a portion of the consumers would not be restored until the 33kV line fault was repaired. The existing supply network to the Bulls substation does not meet the requirements of Powerco's Security-of-Supply Standard, which recommends a security class AA [7]. 4. The Sanson substation is equipped with 2 x 7.5MVA, 33/11kV transformers. In the event of a transformer fault during peak network loading (2016 peak demand of ≈9MVA) consumer load would need to be shed. As per constraint 2 above, the Sanson substation does not meet Powerco's recommended security class of AA+[6]. 5. In 2016 peak the demand on the Bunnythorpe GXP was marginally over 100MVA and exceeded the substation's (N-1) transformer rating. Whilst the Bunnythorpe GXP is not owned by Powerco it does not meet Powerco's security of supply standards that would require the substation to have a security class of AAA[5]. Transpower's 2014 Annual Planning Report (APR) indicates the need to upgrade the transformers to 2 x 120MVA units or transfer demand to the adjacent GXPs (via Powerco's sub-transmission network). In addition to the above network constraints, the following other issues exist in relation to the region: • The Feilding-Sanson overhead line is relatively long (≈15km) and exposes the Sanson consumers (including the RNZAF airbase) to the heightened risk associated with longer overhead line length. • Maintenance activities on the existing Feilding-Sanson 33kV line are becoming increasingly difficult. Planned outages on the line are presently undertaken during light loading conditions and with the use of 11kV backup. As load increases the "network loading window" during which maintenance can occur will shrink and eventually close. • The Royal New Zealand Air Force (RNZAF) Ohakea air base is a key site that employs in excess of 1,000 people. The base's key roles are training, logistics, search & rescue and as such the security of electrical supply to the site is important. Presently, the Air Base is supplied by one single 11kV spur cable feeder from the Sanson substation.
Timing of the need	The majority of the constraints/issues outlined above already exist. During FY2018 and FY2019, Powerco intend to consult with the RZNAF and the relevant landowners/councils in order to secure the necessary consents/agreements. Project design and construction will commence in FY2022 to avoid resourcing constraints

[7] AA Supply may be lost in the event of the outage of one major element of the sub-transmission network. Supply can be restored within 45 minutes by switching at the sub-transmission or distribution level.

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Demand Forecast | Rangitikei & Manawatu Areas

RANGITIKEI AREA SUBSTATIONS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	CLASS CAPACITY	GROWTH	2016	2017	2018	2019	2020	2025	2030
Arahina	2.9	0.2%	8.9	8.9	9.0	9.0	9.0	9.1	9.2
Bulls	4.0	0.1%	5.7	5.7	5.7	5.7	5.7	5.7	5.8
Pukepapa	3.4	0.3%	9.0	9.0	9.1	9.1	9.1	9.2	9.4
Rata	0.7	0.0%	2.3	2.3	2.3	2.3	2.3	2.3	2.3

MANAWATU AREA SUBSTATIONS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	CLASS CAPACITY	GROWTH	2016	2017	2018	2019	2020	2025	2030
Feilding	23.7	1.0%	22.0	22.2	22.4	22.6	22.8	23.9	24.9
Keith St	21.9	0.5%	19.1	19.2	19.3	19.4	19.5	19.9	20.3
Kelvin Grove	17.2	2.2%	18.9	19.4	19.8	20.2	20.6	22.7	24.8
Kimbolton	0.6	0.2%	3.1	3.1	3.1	3.1	3.1	3.1	3.2
Main St	17.0	0.5%	29.4	29.5	29.7	29.8	30.0	30.7	31.4
Milson	18.1	1.5%	18.9	19.2	19.5	19.8	20.1	21.4	22.8
Sanson	0.0	1.0%	8.9	9.0	9.1	9.2	9.2	9.7	10.2

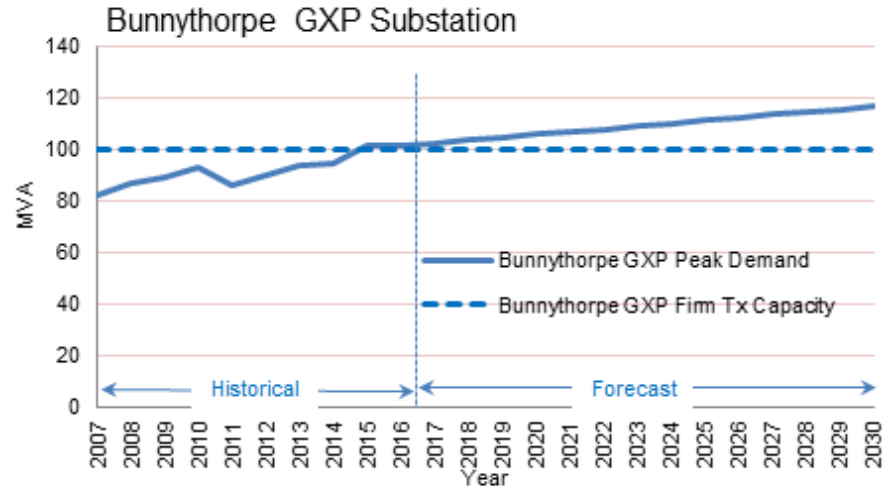
*Note that a major upgrade programme is planned for the Palmerston North CBD. This will reduce demand on the CBD substations to within class capacity. The project is described in a separate POD.

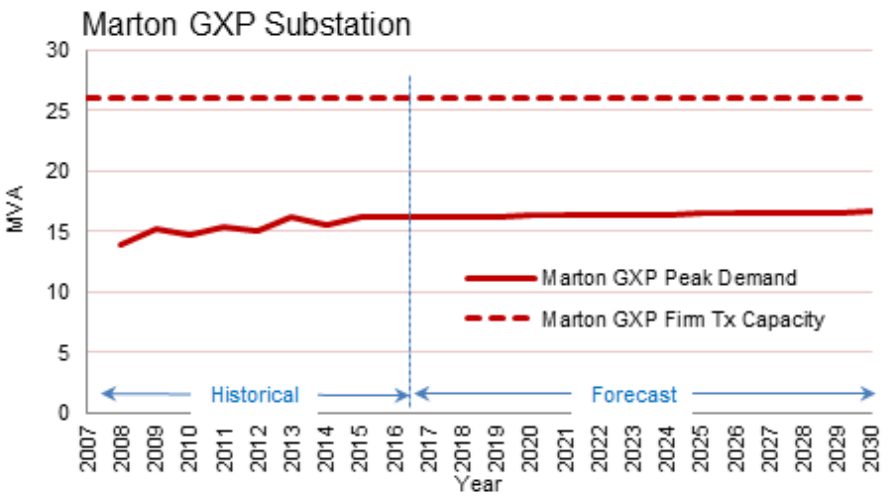
RANGITIKEI & MANAWATU AREA GXPS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	FIRM TX CAPACITY	GROWTH	2016	2017	2018	2019	2020	2025	2030
Marton GXP	26[8].0	0.2%	16.2	16.2	16.2	16.3	16.3	16.5	16.6
Bunnythorpe GXP	100.0	1.1%	101.4	102.5	103.6	104.6	105.7	111.2	116.6

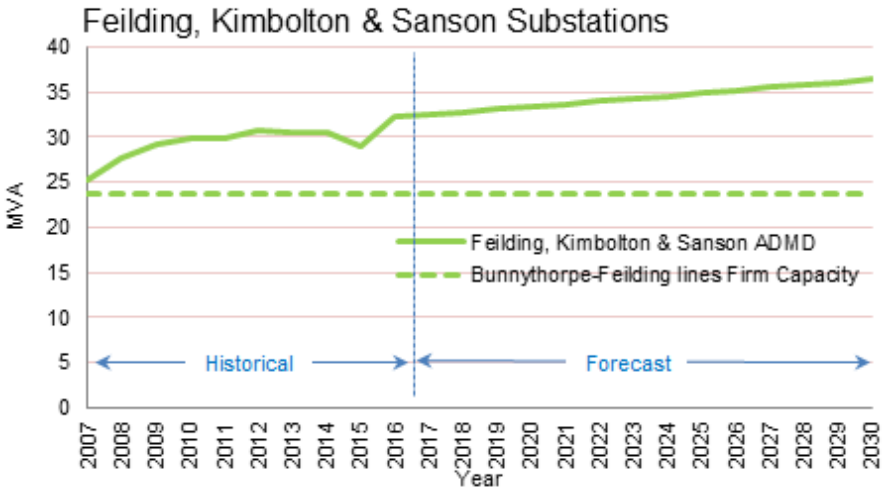
Notes:

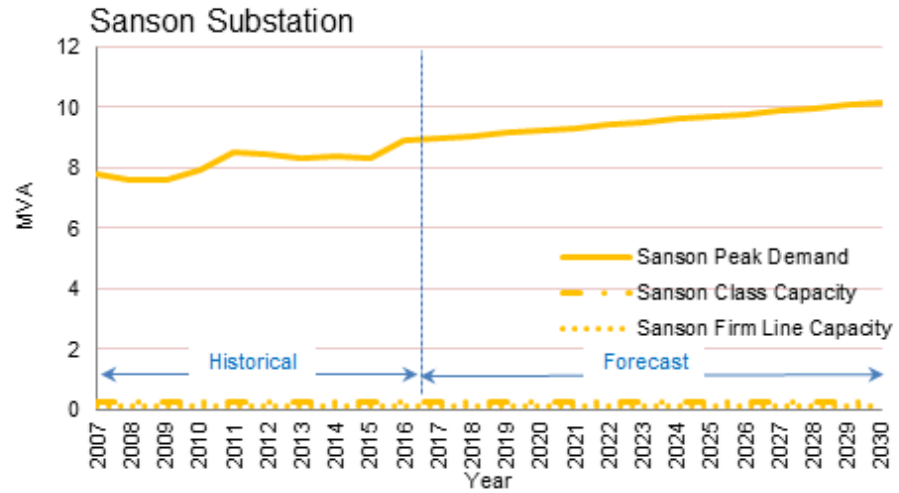
1. Class capacity is similar to Firm Capacity in that it represents the capacity that can be delivered following the first outage of any major equipment. Unlike Firm Capacity it considers the long term deliverable capacity after allowing for switching and network reconfiguration (11kV & 33kV) post-fault 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 Marton GXP is equipped with two transformer units (20 MVA & 30 MVA).

[8] Transpower Planning Report 2014 states: "The transformers' capacity is limited by metering equipment (20 MVA), followed by an LV bushing limit (24 MVA) and a protection limit (25 MVA); with these resolved, the N-1 capacity will be 26/27 MVA (summer/winter)."


Bunnythorpe GXP Substation
MVA
Year
Bunnythorpe GXP Peak Demand
Bunnythorpe GXP Firm Tx Capacity
Historical
Forecast


Marton GXP Substation
MVA
Year
Marton GXP Peak Demand
Marton GXP Firm Tx Capacity
Historical
Forecast


Feilding, Kimbolton & Sanson Substations
MVA
Year
Feilding, Kimbolton & Sanson ADMD
Bunnythorpe-Feilding lines Firm Capacity
Historical
Forecast


Sanson Substation
MVA
Year
Sanson Peak Demand
Sanson Class Capacity
Sanson Firm Line Capacity
Historical
Forecast

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Options Analysis | Long List of Project Options | High Level Assessment	
Assessment Process	A wide range of potential options are available for the resolution of electrical network constraints. However, depending on local conditions many of the options may not be suitable. On this basis a two tier Options Analysis process 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. A significant issue that Powerco often faces is the reality of trying to secure landowner easements and or public support for projects that the local community or landowners are opposed to. For this reason the costs associated with easements/consents are often difficult to estimate and the consenting/land-acquisition stage of a project can take a significant period. Given this fact Powerco assesses the risk / likelihood of securing development rights for individual projects (within a realistic timeframe) during the high level assessment stage.
Long List of Options	The following table contains a list of the high level project options that are potentially available to resolve the electrical supply issues within the northern-west of the Palmerston North Area. The four non-network options (Nos. 1, 2, 3, 4 & 5) are not shortlisted on the following basis: • Fossil fuelled generation (i.e. diesel generation) is technically viable but not shortlisted due to the cost and environmental/consenting challenges. In addition the costs are expected to be high. For example, in the event of an outage on the Fielding-Sanson line as much as 9MW[9] would need to be supplied by stand-by generation. The capital cost of a 9MW[9] standby diesel generation plant is estimated to range from $14M to $18M[10,11]. • Powerco has not identified any viable renewable generation options that would provide the required security of supply[12]. • Fuel switching and demand side response (DSR) are not viable options because these options would not resolve the major constraint (i.e. the loss of the Fielding-Sanson line). • Powerco currently uses a mains-borne ripple control system to manage significant amounts of hot water cylinder load on its network. During peak loading periods most hot water cylinders are turned off. The demand reduction however is not sufficient to resolve the major network constraint (i.e. the loss of the Fielding-Sanson Line) • Energy storage solutions could be technically feasible, but are not economically viable at the size required to provide viable back-up for extended periods. For example, an emerging technology that could be employed is storage batteries installed in domestic premises. However, the capital costs associated with 9MW[9] of domestic batteries with two hours capacity are estimated to be >$29M[13]. Alternatively, a grid-scale battery solution providing 9MW for two hours would, at current rates, cost >$25M. While many outages

[9] This is the present Sanson substation peak demand and this amount is predicted to increase in the future.
[10] Excludes the ongoing maintenance and operational costs.
[11] Diesel generation plant is estimated to range from $1,500/kW to $2,000/kW, depending on whether it is high, medium or low speed plant.
[12] Typical plant might involve wind turbines or photovoltaic arrays. Both of these generators have an intermittent output which cannot be relied upon unless there is significant penetration and diversity.
[13] The installed costs of domestic battery storage systems are currently around $10k - $12k for a 7kWh unit.

	would be addressed within two hours and peak demand periods are rarely sustained for several hours, storage solutions at this size would not provide sufficient back-up for extended outages.. Two network reinforcement options were shortlisted (Nos. 6 & 7) on the basis that they address many of the constraints identified in the section titled "Needs Identification" section above.

Long List of Options | High Level Assessment

Sanson-Bulls Project		*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 in	✓	✗	✗	✗	✗	✗	✓	✗
Non-network	2	Distributed Generation (DG) including peak lopping generation	✓	✗	✓	✓	✓	✓	✗	✗
	3	Fuel switching to reduce electrical demand	✓	✓	✗	✗	✓	✓	✗	✗
	4	Demand Side Response (DSR)	✓	✓	✗	✗	✓	✓	✗	✗
	5	Energy storage	✓	✓	✓	✓	✗	✓	✗	✗
Network Reinforcement	6	New Feilding-Sanson Line	✓	✗	✓	✓	✓	✗	✓	✓
	7	New Sanson-Bulls circuit & Ohakea Substation	✓	✓	✓	✓	✓	✓	✓	✓

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, safety)
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	**Cost (NZ$M)** [14]	**Description**

Option 6:
 	
New Feilding-Sanson Line
	$9.1M	This option involves the installation of a new 33kV circuit between the Feilding and Sanson substations (refer to Figure 2 & Figure 5). The new circuit would follow a route south-east from Sanson along SH3 for ≈8km (overhead line), turn left into Stewart Road for 4km (overhead line) and then follow the urban streets of Feilding to arrive at the Feilding substation (underground cable). The following substation and additional works would be undertaken:
		• A single indoor 33kV line circuit breaker at the Fielding substation[15].
		• A new indoor 33kV switchboard (2 x line circuit breakers, 2 x incomer circuit breakers & 1 x bus-coupler) at Sanson and associated switchroom. The existing substation is only equipped with a single outdoor 33kV line circuit breaker and the transformers are fed via ABS (not circuit breakers). The existing substation site would need to be extended. There is sufficient Powerco owned land to accommodate the extension.
		• To improve the 11kV backup to the Bulls substation (and network restoration times) two of the relevant feeders would have the following equipment installed:
		  ○ Remote controlled 11kV switches to enable quick restoration of consumer loads.
		  ○ Voltage regulators to provide voltage support.
		• Both of the existing Bunnythorpe-Feilding ≈10km, 33kV, overhead lines would be upgraded. These lines are presently equipped with a Butterfly conductor designed to operate at 50°C and would be re-tensioned to operate at 70°C.

Option 7: ***New Sanson-Bulls Circuit & Ohakea Substation***	$5.9M	This option involves the installation of a new 33kV circuit between the Sanson and Bulls substations and a new 33/11kV substation adjacent to the Ohakea air base (refer to Figure 3 & Figure 6). The new circuit would follow a 3.5km route (existing underground cable[5]) from the Sanson substation to the new substation adjacent to SH1, 2km along SH1 to the Rangitikei River (overhead line) and finally 2.5km across the river through the Bulls township (underground cable). Once the new Sanson-Bulls circuit is commissioned the Sanson and Ohakea zone substations would be supplied (system normal) from the Marton GXP as opposed to the Bunnythorpe GXP, which it is currently is supplied from. As a consequence the peak demand on the Bunnythorpe-Feilding lines and the Bunnythorpe GXP would reduce by ≈9MVA. The following substation and additional works would also be undertaken: • A new indoor 33kV switchboard (2 x line circuit breakers, 2 x incomer circuit breakers & 1 x bus-coupler) at Sanson and associated

[14] Project capital costs in 2016 NZ Dollars. The values are not economic costs and do not factor in the "time value of money" or consider the costs of electrical loss reduction, reliability improvement, cost-of-non-supply or any other relevant factors. These other issues are considered in Powerco's options analysis.

[15] The Feilding substation presently has an outdoor 33kV switchyard that is close to end-of-life. Powerco has plans to replace the switchgear with a new indoor 33kV switchboard (6 x line circuit breakers and 1 x bus-coupler) with associated switchroom building. The costs associated with replacing Feilding's outdoor 33kV switchgear would be included in Powerco's Replacement Expenditure category. In the event that Option 6 is chosen an additional 7th 33kV line breaker would be included and the costs included in Powerco's Growth & Security Expenditure category.

		switchroom. This switchboard would be equipped with an automated changeover to restore supply to the Sanson substation in the event of a fault on the Marton-Bulls-Ohakea-Sanson 33kV supply. The existing substation site would need to be extended. There is sufficient Powerco owned land to accommodate the extension. • A new indoor 33kV switchboard (2 x line circuit breakers & 1 incomer) at Bulls and an associated switchroom building. The existing substation site would need to be extended. There is sufficient Powerco owned land to accommodate the extension. • A new zone substation adjacent to the Ohakea air base[16], equipped with 1 x 5MVA, 33/11kV transformer and a control room to house an indoor 33kV switchboard (2 x line circuit breakers & 1 incomer) and an indoor 11kV switchboard (3 x feeder circuit breakers and an incoming circuit breaker). An easement over RNZAF land would need to be secured to build the substation. • Installation of a fibre cable between Bulls and Sanson to provide protection system communications (length approximately 8.5km). • Upgrade of a 1.7km section of overhead 33kV line between Marton and Bulls (the line section is presently equipped with a Dog conductor designed to operate at 50°C and would be re-tensioned to operate at 70°C).

[16] Note that Option 6 uses the present 11kV supply to the Ohakea air base and options for reinstating the supply include installing a new 33/11kV substation or a new 11kV feeder from Sanson to Ohakea.

Option Analysis | Advantages vs Disadvantages and Cost Breakdown

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
Option 6: ***New Feilding-Sanson Line***	• Delivers an (N-1), no-break, sub-transmission supply[17] to the Sanson substation.	• Higher capital expenditure cost • The solution does not address the security constraints at Bulls • The project involves the construction of ≈12km of 33kV overhead line, which may face significant public/council/landowner opposition. There is a risk that the line cannot be installed in the road reserve and easements need to secured across private land or alternatively the entire circuit has to be installed underground (i.e. cable) at significant cost. • The Bunnythorpe-Feilding 33kV lines traverse across significant tranches of private land and the upgrade of the lines may face significant landowner opposition.
Option 7: ***New Sanson-Bulls Circuit & Ohakea Substation***	• Delivers an (N-1), with-break, sub-transmission supply[18] to Sanson that is equipped with a quick restoration scheme. • Delivers an (N-1), with-break, sub-transmission supply[19] to the new Ohakea substation. • Provides an (N-1), with-break, sub-transmission supply[18] to the Bulls zone substation. • Reduces the demand on the Bunnythorpe-Feilding lines and defers the need to upgrade the lines. • Shifts load off the Sanson substation (onto the new Ohakea substation) and defers the need to upgrade the transformer capacity at Sanson. • Shifts Sanson load to Marton GXP, which defers the need to upgrade the Bunnythorpe GXP[20].	• The project involves the construction of ≈2km of 33kV overhead line along SH1, which may face significant public/council/landowner opposition. There is a risk (albeit less than for the longer line in option 6) that the line cannot be installed in the road reserve and easements over private land need to be secured or alternatively the entire circuit has to be installed underground (i.e. cable) at a higher cost. • The proposed 33kV cable/line crossing of the Rangitikei River will be challenging and is a risk. • Consent/compensation is expected to be required from landowners adjacent to the Rangitikei River to install the 33kV cable. Their agreement has yet to be secured.

[17] 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).
[18] AA+ Supply may be lost in the event of the outage of one major element of the sub-transmission network. Supply is restored within 15 seconds by automatic switching at the sub-transmission or distribution level.
[19] AA Supply may be lost in the event of the outage of one major element of the sub-transmission network. Supply can be restored within 45 minutes by switching at the sub-transmission or distribution level.

	• Provides diversity of supply to a number of zone substations and to the Bunnythorpe and Marton GXPs. In times of significant network stress and/or major disasters diversity of supply is of significant benefit.	

Recommendation	
Preferred Option	The preference is to proceed with Option 7 : New Sanson-Bulls Circuit & Ohakea Substation
Reasons for choosing Option	Option 7 has the lowest capital cost and delivers a number of benefits that Option 6 does not. These include: • Provides increased network diversity. • Significant saving in Capital Expenditure cost. • Reduces loading on the Bunnythorpe GXP and supply lines to Feilding substation. • Provides secure 33kV supply to Bulls and Ohakea

[20] Powerco is progressing a separate project that involves reinforcing the supply network to the Palmerston North CBD and which will also transfer load away from the Bunnythorpe GXP (to the Linton GXP). Further details may be found in a separate Powerco PoD titled "PoD02 Palmerston North CBD Reinforcement".

Option 7 | Detailed Costs

Item	Description	Actual Cost	Projected Cost
A	Property & Consent Costs		
A.1	Easements, consenting & compensation - future	-	$215,000
B	Investigation and Reporting Costs		
B.1	None	-	-
C	Substation Costs		
C.1	Ohakea 33/11kV, 5MVA substation	-	$2,317,970
C.2	Sanson substation 33kV indoor switchboard & building	-	$902,325
C.3	Bulls substation 33kV indoor switchboard & building	-	$798,347
D	Line and Cable Costs		
D.1	Marton-Bulls Overhead Line Upgrade	-	$282,601
D.2	Bulls to Ohakea 33kV line/cable	-	$1,395,465

E	Committed/Historical Costs (A+B+C+D)	$0	
F	Future Projected Costs (A+B+C+D)		$5,911,708
G	Anticipated Final Cost (E+F)		**$5,911,708**

Option 7 | Implementation Plan				
Project or Action	**Start Year[1]**	**End Year[1]**	**NZ $'000[1]**	**Details / Comments**
Project costs to date	-	FY14	$0	Costs that have already occurred.
Future land/easements/compensation/legal	FY19	FY19	$215	Costs associated with easements, compensation, designations etc. to secure the cable/line corridor and the substation land.
Ohakea 33/11kV, 5MVA substation	FY22	FY22	$2,318	Costs associated with design, tendering, procurement & construction of a 33/11kV, 5MVA substation, including an indoor 33kV switchboard, 11kV switchboard & associated building.
Sanson substation 33kV indoor switchboard & building	FY23	FY23	$902	Costs associated with a new 33kV switchboard (2 line CBs, 2 incomers and 1 bus section breaker).
Bulls substation 33kV indoor switchboard & building	FY23	FY23	$798	Costs associated with a new 33kV switchboard (2 line CBs & 1 incomer CB).
Marton-Bulls 33kV Line Upgrade	FY23	FY23	$283	Cost to upgrade a 1.7km section of the Martons-Bulls existing line. The upgrade would re-tension the line to operate at 70°C.
Bulls to Ohakea 33kV line/cable	FY23	FY23	$1,395	Costs associated with the construction of ≈2km of single circuit, neon conductor, 33kV overhead line and ≈2.5km of single circuit, 33kV, underground cable.
Total Project Costs ➔	**FY19**	**FY21**	**$5,912**	Growth & Security Expenditure.

Supporting Documents and Models	
Planning documents ***Standards | Policies*** ***Reviews and Consultant reports*** ***Concept Designs | Estimates***	1. Sanson-Bulls 33kV Line – Options Analysis Report, September 2016. 2. Sub-transmission Network Upgrade Bulls/Ohakea/Sanson/Fielding – Concept Cost Estimate, Jacobs report dated June 2015. 3. Powerco's Demand Forecast. 4. Powerco's 2016 Asset Management Plan (AMP). 5. Area Plan Summary 6. "*310S001 Security-of-Supply Classifications – Zone Substations*", Powerco Standard. 7. "*393S041 Zone Substation Transformer Ratings*", Powerco Standard. 8. "*393S035 Electrical Network Conductor Rating Standard*", Powerco Standard. 9. Annual Planning Report – March 2014", Transpower APR document.

Notes/Assumptions	
Generic assumptions in relation to Options Costs	• Costs are expressed in 2016 (real) dollars. • The costs quoted are to construct the network • 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).
Specific assumptions in relation to Options Costs	• 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 the area underground cable is used and where possible installed in road reserve.

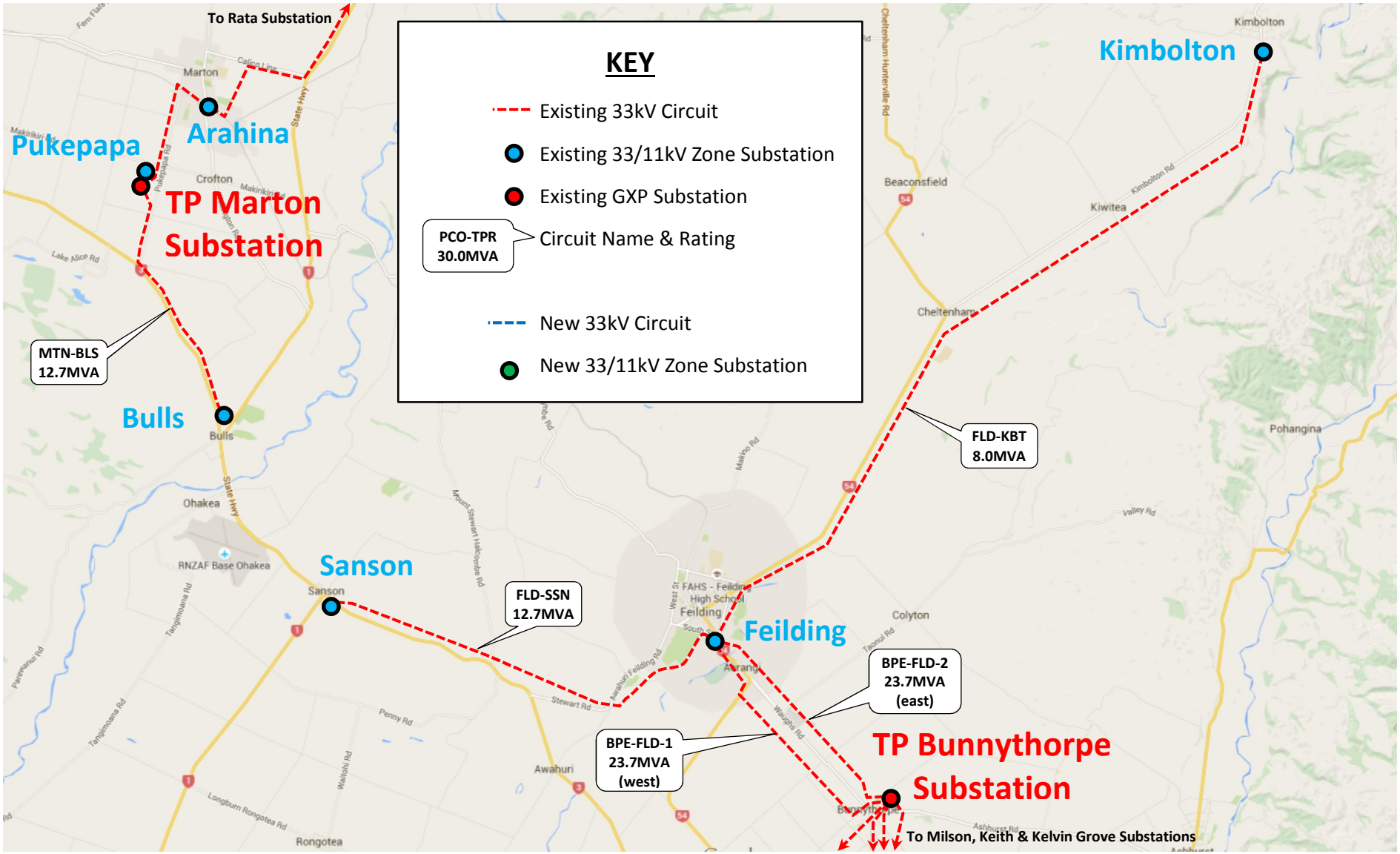

Figure 1 Existing Marton & Bunnythorpe GXP Sub-transmission Networks: Geographic Diagram

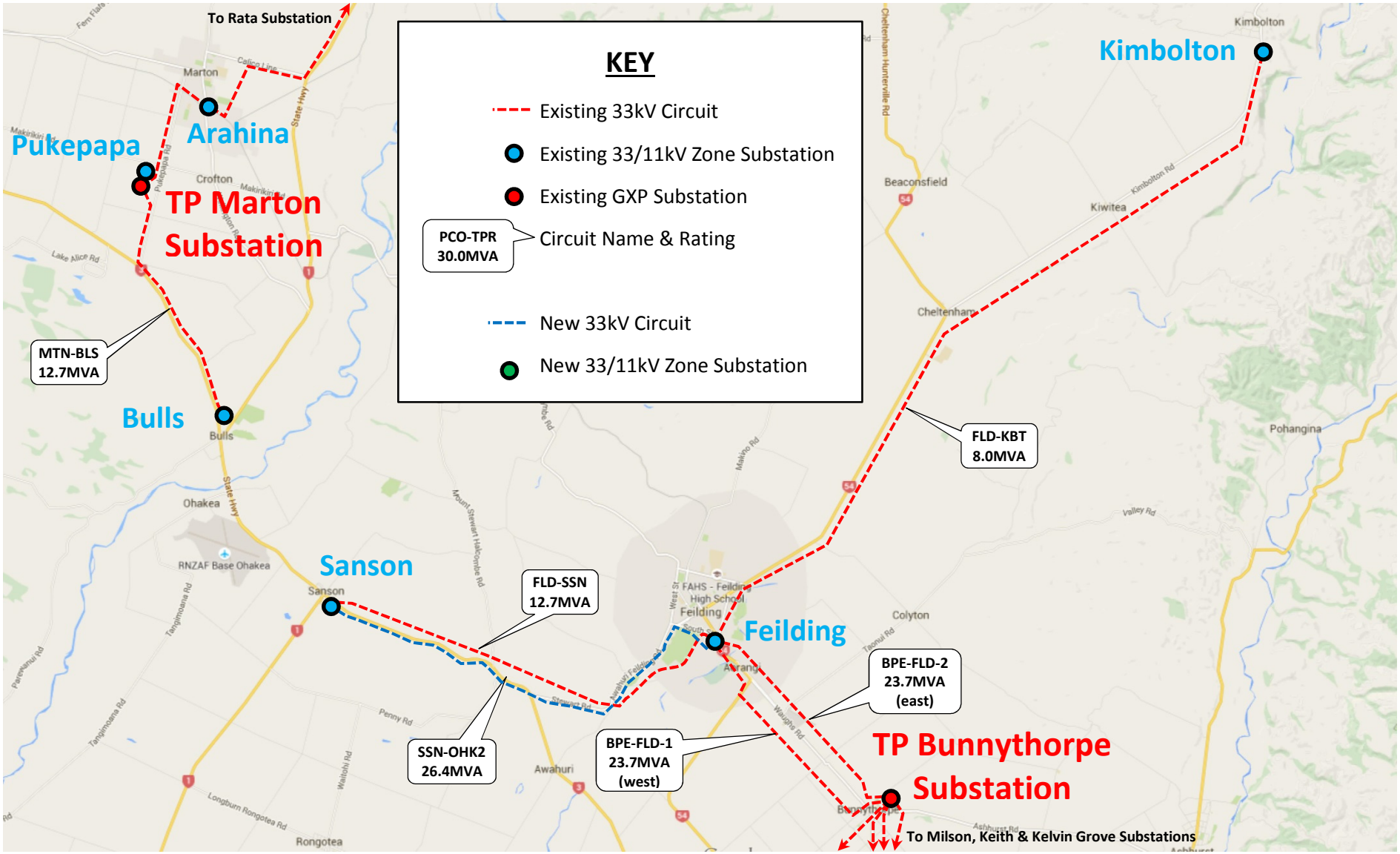

Figure 2 Option 6 – New Feilding-Sanson Line: Geographic Diagram

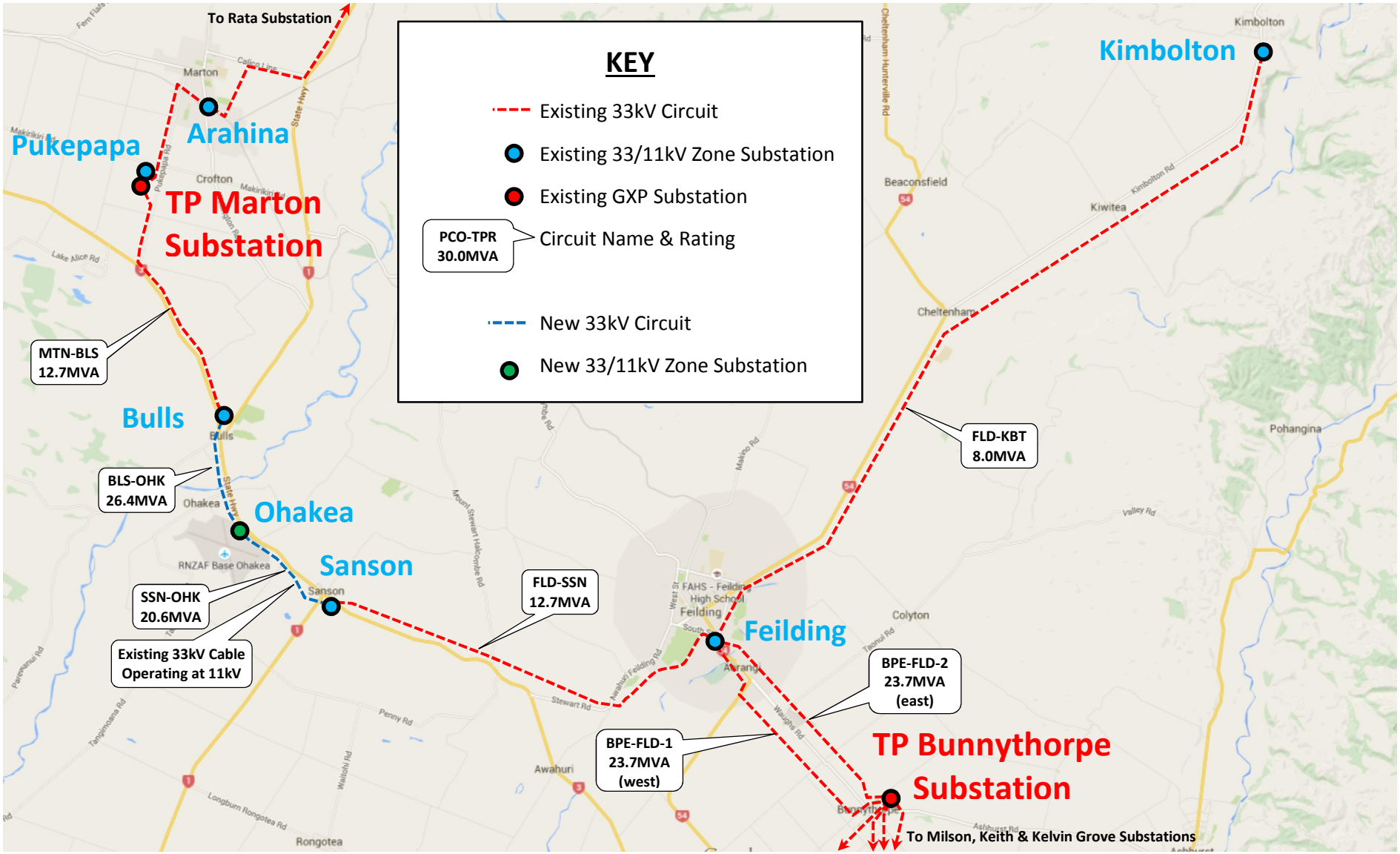

Figure 3 Option 7 - Sanson-Bulls Circuit & Ohakea Substation: Geographic Diagram

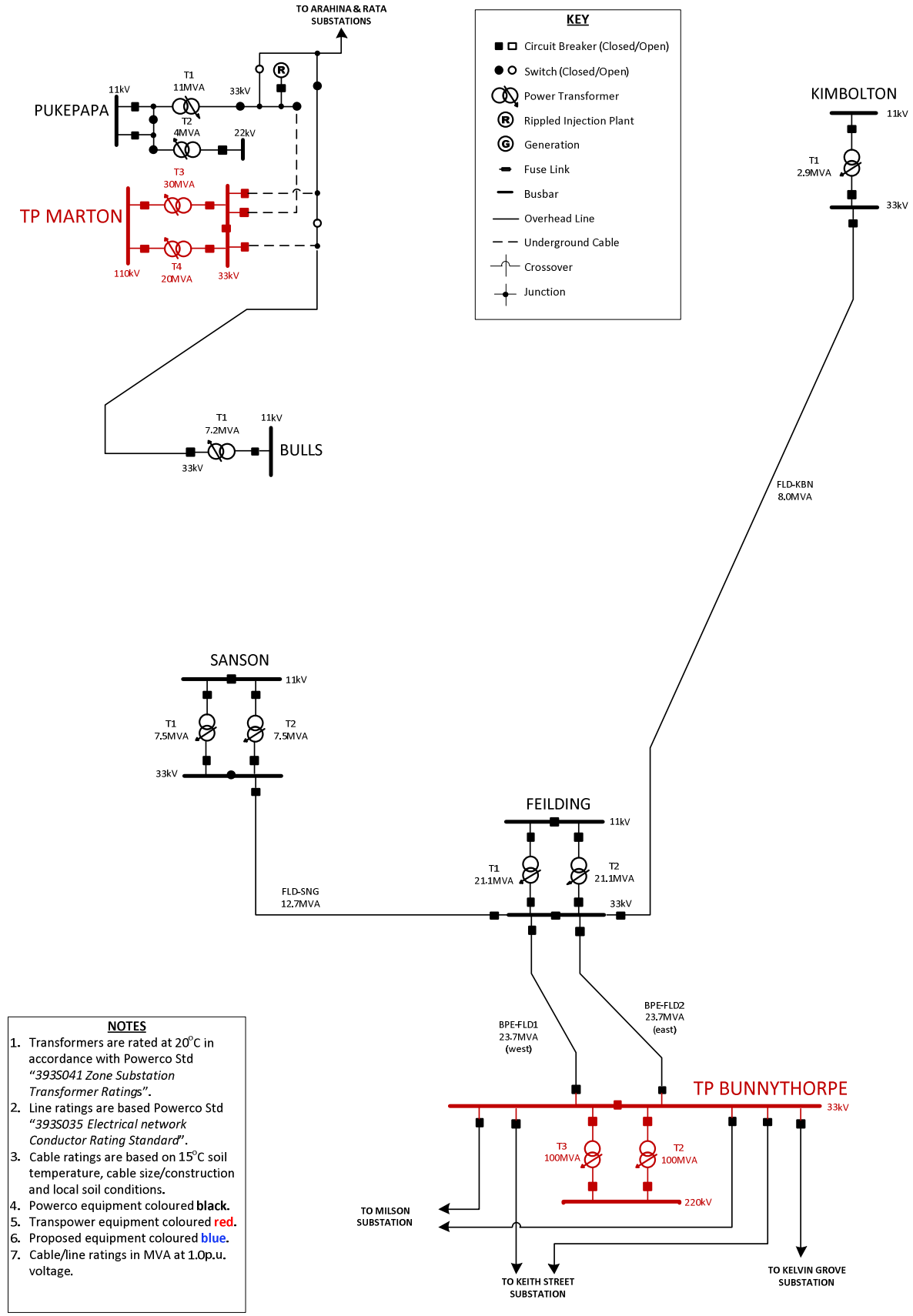

Figure 4: Existing Marton & Bunnythorpe GXP Sub-transmission Networks, Single Line Diagram

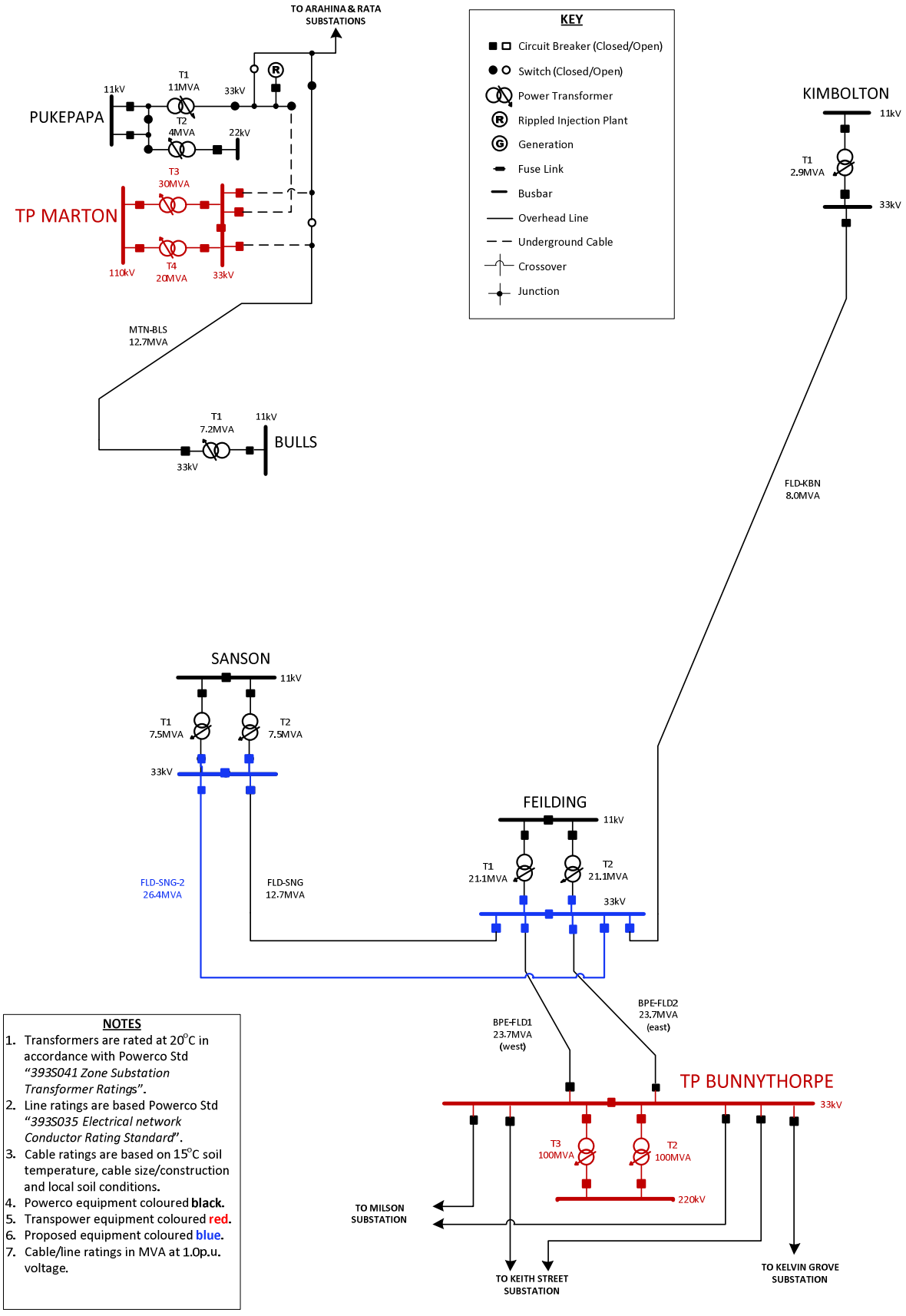

Figure 5: Option 6 – New Feilding-Sanson Line, Single Line Diagram

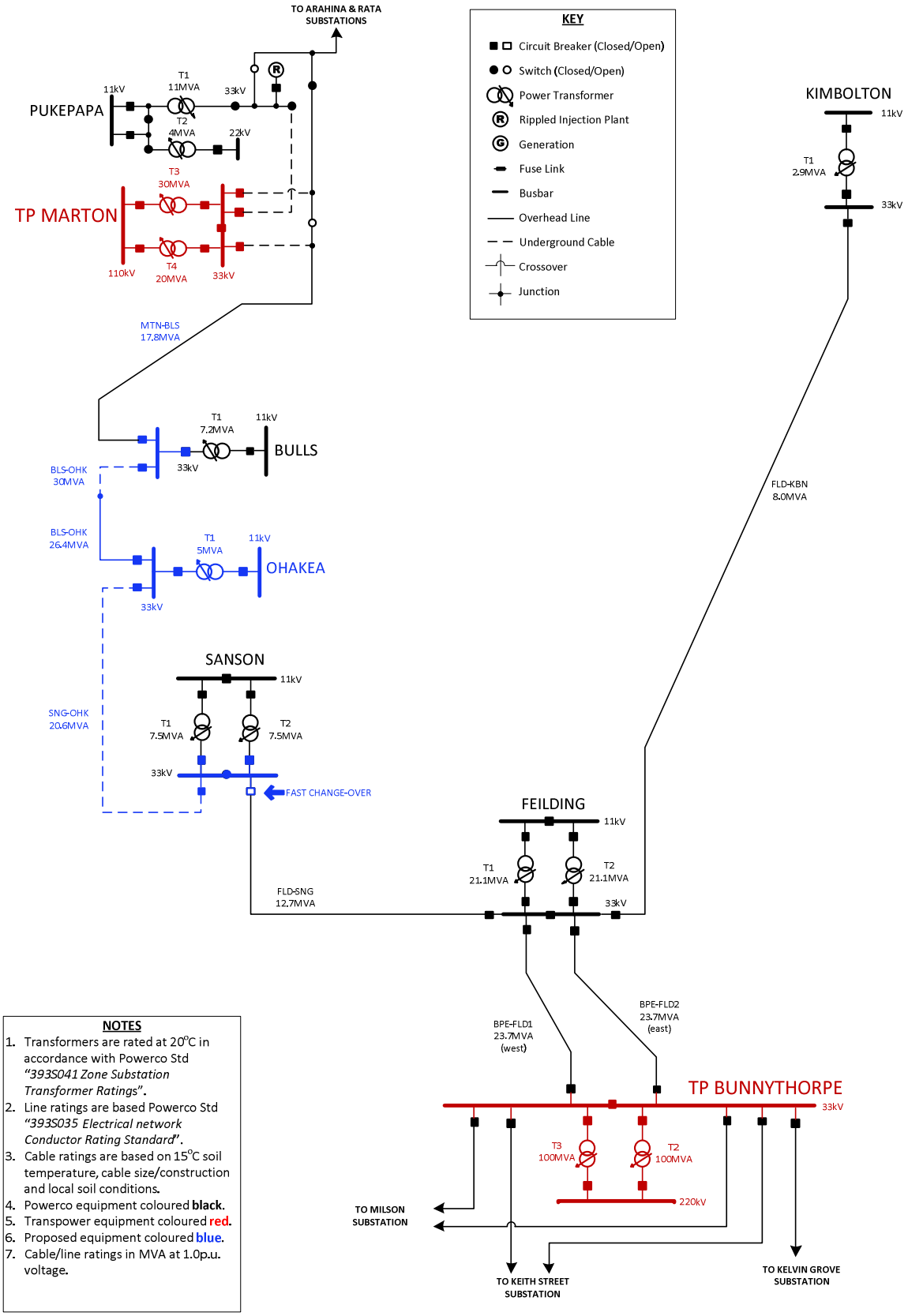

Figure 6: Option 7 – Sanson-Bulls Circuit & Ohakea Substation, Single Line Diagram