New Ripley North Zone Substation

Business Case
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energex
Part of Energy Queensland

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DOCUMENT VERSION

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1.0	Reviewed	08/12/2023	Principal Planning Engineer
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1 SUMMARY

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<tr><td>DNSP</td><td>Energex</td></tr>
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☐ Reliability ☐ CECV ☐ Safety ☐ Environment ☐ Financial
☐ Other

The identified need is to ensure supply in the area around the Ripley area remains compliant with Safety Net requirements, which is a regulatory obligation as outlined in the Distribution Authority.

This investment is driven by safety net non-compliance as there is excessive load at risk following a N-1 contingency at Cooneana zone substation (SSCNA).</td></tr>
<tr><td>Summary of preferred option</td><td>The proposed option is to establish a new 33/11kV Ripley North (SSRLN) substation to address the load at risk.</td></tr>
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<tr><td>$m, direct 2022-23</td><td>$0.834m</td><td>$1.676m</td><td>$4.198m</td><td>$4.206m</td><td>$5.900m</td><td>$16.814m</td></tr>
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<tr><td>Benefits</td><td>This project is compliance driven expenditure under our Safety Net obligations. As such, it is a lowest cost option assessment.</td></tr>
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2 BACKGROUND

2.1 Network Arrangement

The Queensland Government declared the Ripley Valley as a Priority Development Area in 2010. The Ripley Valley Priority Development Area is located in one of the largest urban growth areas in Australia, it covers an area of 4,680 hectares and is located approximately five kilometres south east of the Ipswich CBD and south of the Cunningham Highway. It will potentially develop into 48,750 dwellings to house a population of 131,000 people.

The Ripley Valley Priority Development Area is currently supplied by multiple zone substations under the Raceview bulk supply area and Goodna bulk supply area.

Raceview bulk supply 110/33kV substation (SSRVW) has seven 33kV feeders supplying seven zone substations including Ipswich South (SSIPS), Yamanto (SSYMT), Flinders (SSFDS), Kalbar (SSKBR), Boonah (SSBNH), Roderick St (SSRST), and Booval (SSBVL). SSRVW provides electricity supply to predominantly residential customers in the Yamanto, West Ipswich, Churchill, Flinders View, Ripley, Purga, Coolman, Peak Crossing, Harrisville, Wilsons Plain, Milora, Milbong, Kalbar, Boonah, Moogerah and Carneys Creek areas.

The relevant zone substations customers and loads are summarised below:

- **Ipswich South zone substation (SSIPS)** – is a 33/11kV zone substation supplying approximately 8,158 predominantly residential customers. SSIPS maximum demand recorded as 22.18 MVA in summer 2022/23.
- **Yamanto zone substation (SSYMT)** – is a 33/11kV zone substation supplying approximately 3,253 predominantly residential customers. SSYMT maximum demand recorded as 11.56 MVA in summer 2022/23.

Goodna bulk supply 110/33kV substation (SSH38) has nine 33kV feeders supplying seven zone substations, namely, Goodna (SSGNA), Carole Park (SSCPK), Carole Park Central (SSCPC), Redbank (SSRBK), Springfield (SSSPF), Springfield Central (SSSFC) and Cooneana (SSCNA). SSH38 provides electricity supply to a mix of residential and industrial customers in the Goodna, Carole Park, Carole Park Central, Cooneana, Redbank, Springfield, Swanbank and Ripley areas.

The relevant zone substations customers and loads are summarised below:

- **Cooneana zone substation (SSCNA)** - is a 33/11kV zone substation supplying approximately 2,135 predominantly residential customers. SSCNA maximum demand recorded as 10.51 MVA in summer 2022/23.

SSCNA zone substation is normally supplied by Goodna (SSH38) bulk supply substation and SSCNA zone substation can also be supplied by SSRVW via normally open two 33kV feeders.

Currently, Ripley Valley Development area is mainly supplied from SSCNA via two 11kV feeders and small area of this development is also supplied from SSYMT and SSIPS. One of the 11kV feeders suppling this development is longer than 18km and several 11kV protection devices installed for back-up protection purpose. The proposed Ripley North (SSRLN) is situated at the load centre of the development area and planned to supply via two 33kV feeders from SSRVW bulk supply substation. It is possible to lower the distribution losses and improve customer reliability once SSRLN is established.

Figure 1 shows the network arrangement and Figure 2 shows the geographic layout of the Raceview area.

Figure 1 – Existing network diagram of the Raceview area

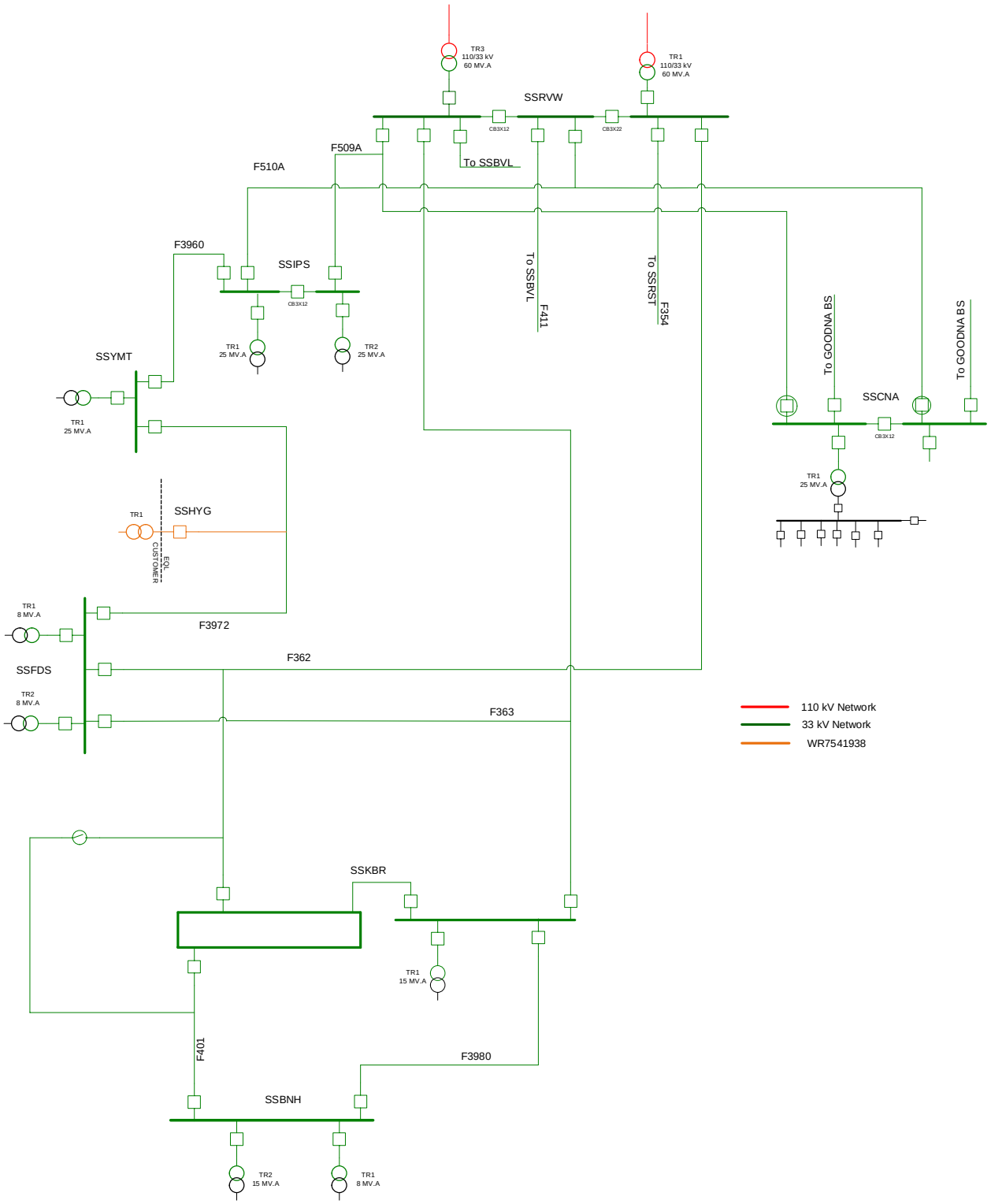
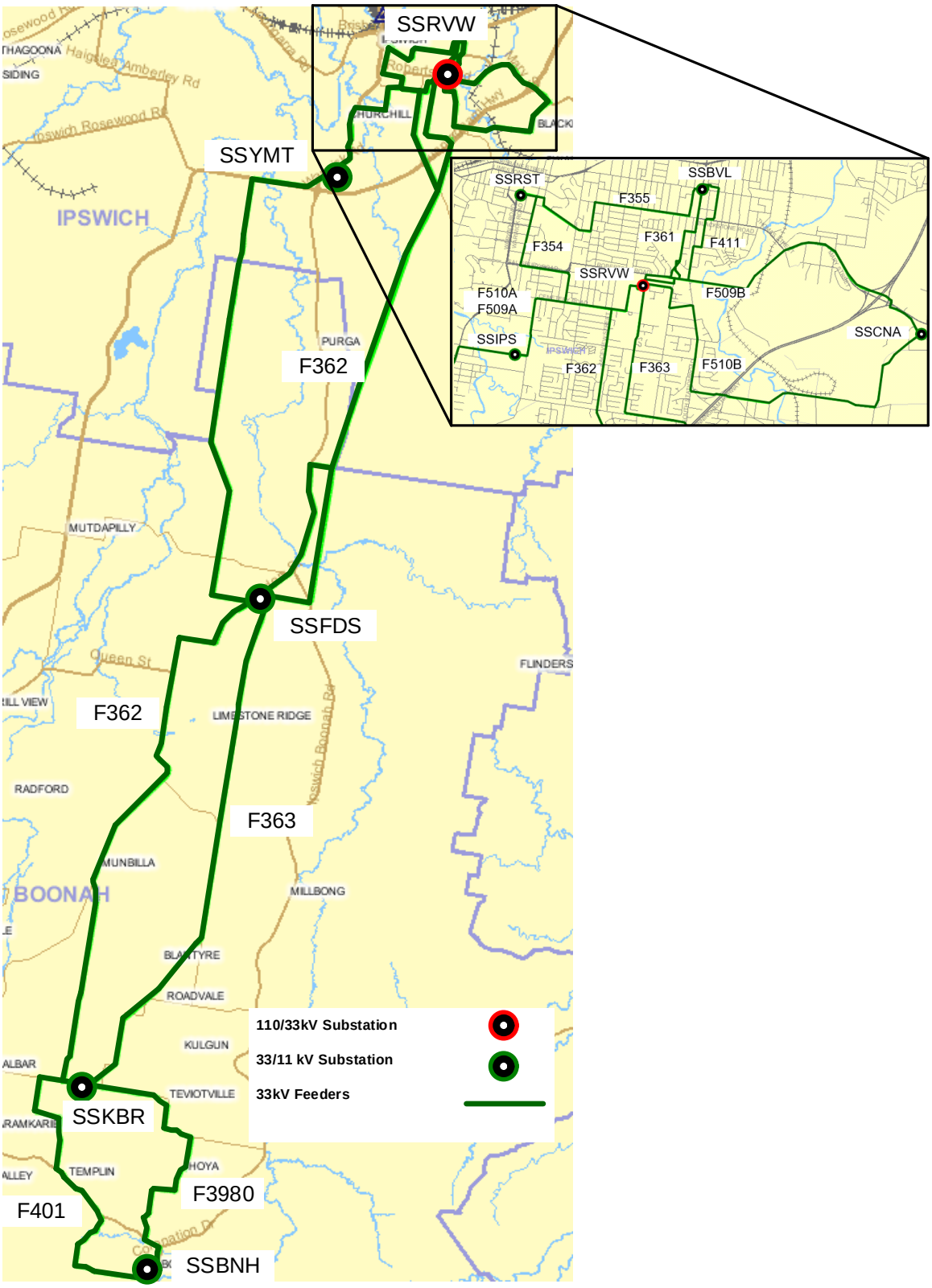


Figure 2 – Geographic of the Raceview network



3 IDENTIFIED NEED

The identified need is to ensure supply in the area around Ripley remains compliant with Safety Net requirements, which is a regulatory obligation as outlined in the Distribution Authority.

This investment is driven by safety net non-compliance as detailed in the sections below:

- Specifically, there is load at risk following a N-1 contingency at SSCNA.

3.1 Compliance

3.1.1 Sub-transmission Network

Under its Distribution Authority, Energex must adhere to the Safety Net which identifies the principles that apply to the operation of network assets under network contingency conditions. System contingency related capability is assessed against available load transfers, emergency cyclic capacity (ECC) ratings, non-network response, mobile plant, mobile generators, and short-term ratings of plant and equipment where available, using a 50% probability of exceedance (PoE) load forecast.

SSCNA zone substation is classified as Urban, and as such, the following Safety Net criteria apply:

Urban – following an N-1 event:

- No greater than 40MVA (16,000 customers) is without supply for more than 30 minutes
- No greater than 12MVA (5,000 customers) is without supply for more than 3 hours
- No greater than 4MVA (1,600 customers) is without supply for more than 8 hours.

Further to an assessment against its Safety Net obligations, in accord with industry practice Energex also undertakes an analysis of system capacity under normal conditions such that no sub-transmission network asset should be operated above its normal cyclic capacity for a 10% probability of exceedance (PoE) load forecast.

3.1.2 Distribution network

To meet Safety Net obligations Energex needs to maintain adequate automated, remote and manual transfer capability via its 11kV feeders without exceeding their rated capacities.

3.2 Sub-transmission Network Limitations

The network limitation that the proposed investment aims to address is the inability to supply all load at the Ripley area following the loss of a transformer at SSCNA.

3.2.1 Cooneana (SSCNA) Substation Limitations

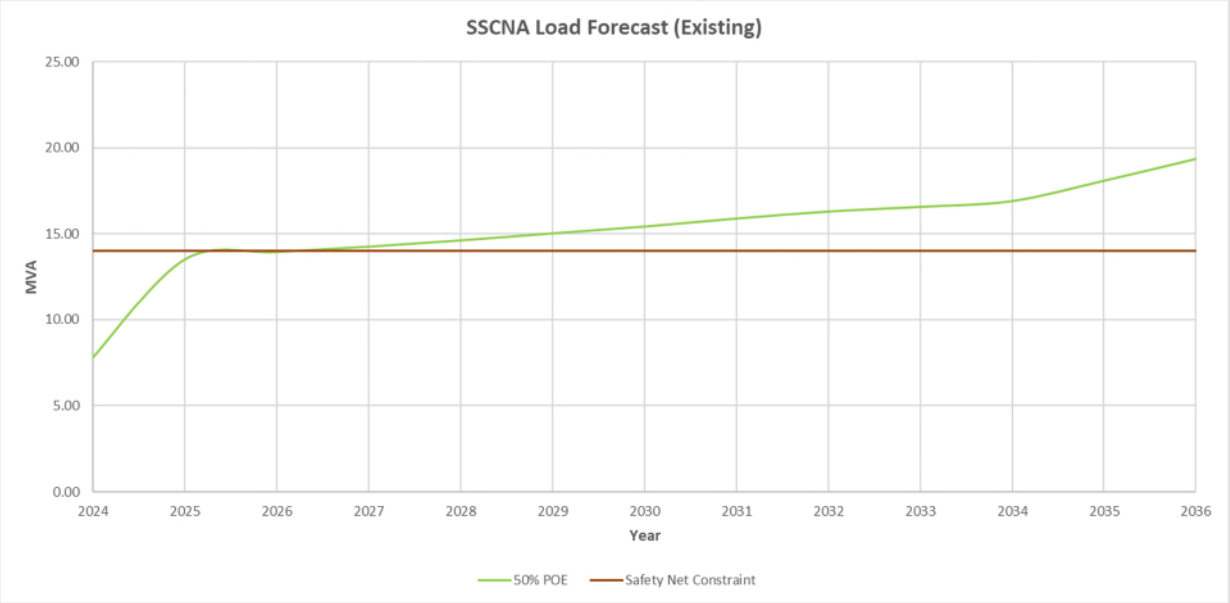
SSCNA is equipped with one 25MVA 33/11kV transformer. The substation capacity is limited by the 33/11kV transformer and NCC, ECC and 2HEC as below:

- Normal Cyclic Capacity (NCC) – 26.0 MVA
- Emergency Cyclic Capacity (ECC) – 0.0 MVA
- 2 Hour Emergency Capacity (2HEC) – 0.0 MVA
- Safety Net Constraint – 14.0 MVA

The Safety Net Constraint includes all capabilities that can be made available within the required restoration timeframe for Urban category, following the loss of the transformer at SSCNA. Specifically, this comprises 4 MVA of manual transfer, 6 MVA of demand reduction and 4 MVA of mobile generation.

Figure 3 shows the 50% POE load forecast and Safety Net constraint for SSCNA.

Figure 3 – SSCNA Load Forecast



As shown in the above figure, based on the amount of 50%POE load forecast there will be a breach of the Safety Net at SSCNA from 2026/27, the substation Load at Risk (LAR) under N-1 conditions will increase to 1.0 MVA in 2028/29.

4 OPTIONS ANALYSIS

In determining the most cost-effective solution to address the identified network limitations, Energex has sought to identify a range of technically feasible, alternative options that could satisfy the network requirements in a timely and efficient manner.

4.1 Option 1 Establish a new SSRLN 33/11kV zone substation with two 25 MVA Transformers

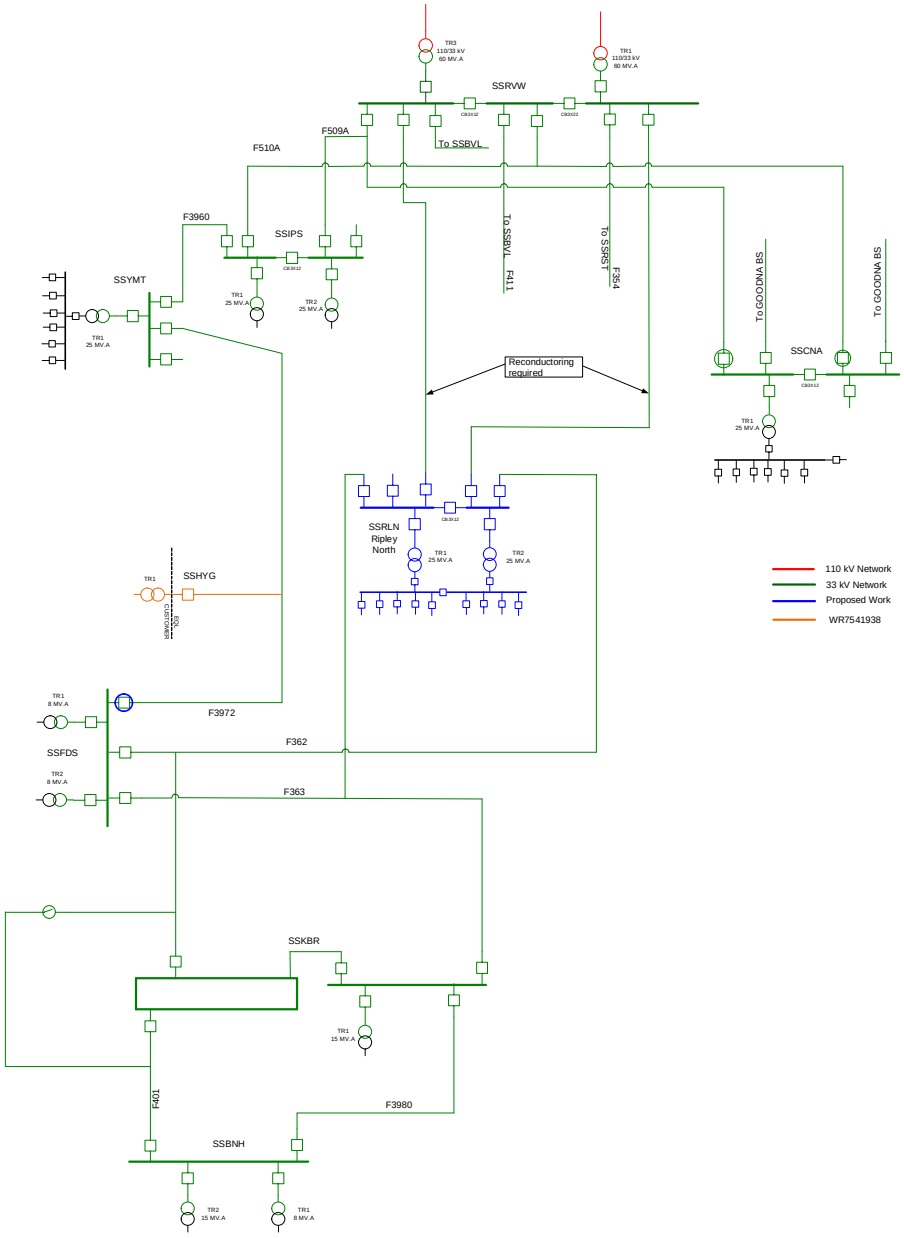
Currently, Ripley Valley Development area is mainly supplied from SSCNA via two 11kV feeders. This option solves N-1 limitation at SSCNA transferring the Ripley load to the proposed SSRLN substation. In addition, proposed SSRLN is located at centre of Ripley development area. Hence, distribution feeder losses will be minimised and reliability of the supply to Ripley area will be improved after establishment of SSRLN.

This option involves following major items:

- Establish a double modular zone substation (or equivalent) at Ripley North (SSRLN) consisting of 5 x 33kV feeder CBs, 2 x 33kV transformer CBs, 1 x 33kV bus tie/bus section CB, 10 x 11kV feeder CBs, 2 x 11kV transformer CBs, 1 x 11kV bus tie/bus section CB.
- Install two 33/11kV, 25 MVA transformers at SSRLN.

- Install DCCT 33kV feeder (40 MVA) from P2142323/P70155-C to SSRLN. Install DCCT 33kV feeder (40 MVA) from P24081-C/P70165-B to SSRLN. Cut in/out F362 and F363 at SSRLN.
- Upgrade 33kV feeders F362/F363 to obtain a NC rating of 40 MVA & 2Hr emergency rating of 45 MVA between SSRVW and SSRLN.
- Modify/upgrade protection for 33kV feeders F362/F363 (SSRVW – SSRLN) at SSRVW.
- Establish/cut over 11kV feeders (CNA9A, CNA8A, IPS2B, YMT6A and any other relevant 11kV feeder at the time of establishment of SSRLN) to new 11kV switchboard at SSRLN.
- Make 33kV circuit breaker CB39722 Normally Open at SSFDS.

Figure 5 – Option 1 network diagram



4.1.1 Costs

Option 1 has an estimated initial direct cost of $19.5m for the regulatory period, which has been factored into the NPV as a cost in 2029. OPEX for Option 1 is $25.4k / annum.

4.2 Option 2 Establish a new SSRLN 33/11kV zone substation with one 25 MVA Transformer

Currently, Ripley Valley Development area is mainly supplied from SSCNA via two 11kV feeders. This option solves N-1 limitation at SSCNA by cutting over the two 11kV feeders to proposed SSRLN. In addition, proposed SSRLN is located at centre of Ripley development area. Hence, distribution feeder losses will be minimised and reliability of the supply to Ripley area will be improved after establishment of SSRLN.

However, installation of second transformer and second 11kV bus will be required in 2035 as per forecast load growth in Ripley development area.

This option involves following major items:

- Establish zone substation (or equivalent) at SSRLN consist of 5 x 33kV feeder CBs, 2 x 33kV transformer CBs, 1 x 33kV bus tie/bus section CB, 6 x 11kV feeder CBs, 1 x 11kV transformer CB, 1 x 11kV bus tie/bus section CB.
- Install a new 33/11kV, 25 MVA transformer with NEX at SSRLN.
- Install DCCT 33kV feeder (40 MVA) from P2142323/P70155-C to SSRLN. Install DCCT 33kV feeder (40 MVA) from P24081-C/P70165-B to SSRLN. Cut in/out F362 and F363 at SSRLN.
- Upgrade 33kV feeders F362/F363 to obtain a NC rating of 40 MVA & 2Hr emergency rating of 45 MVA between SSRVW and SSRLN
- Modify/upgrade protection for 33kV feeders F362/F363 (SSRVW – SSRLN) at SSRVW.
- Establish/cut over 11kV feeders (CNA9A, CNA8A, IPS2B, YMT6A and any other relevant 11kV feeder at the time of establishment of SSRPN) to new 11kV switchboard at SSRLN.
- Make 33kV circuit breaker CB39722 Normally Open at SSFDS.
- Install mobile substation connection point and mobile substation parking pad.

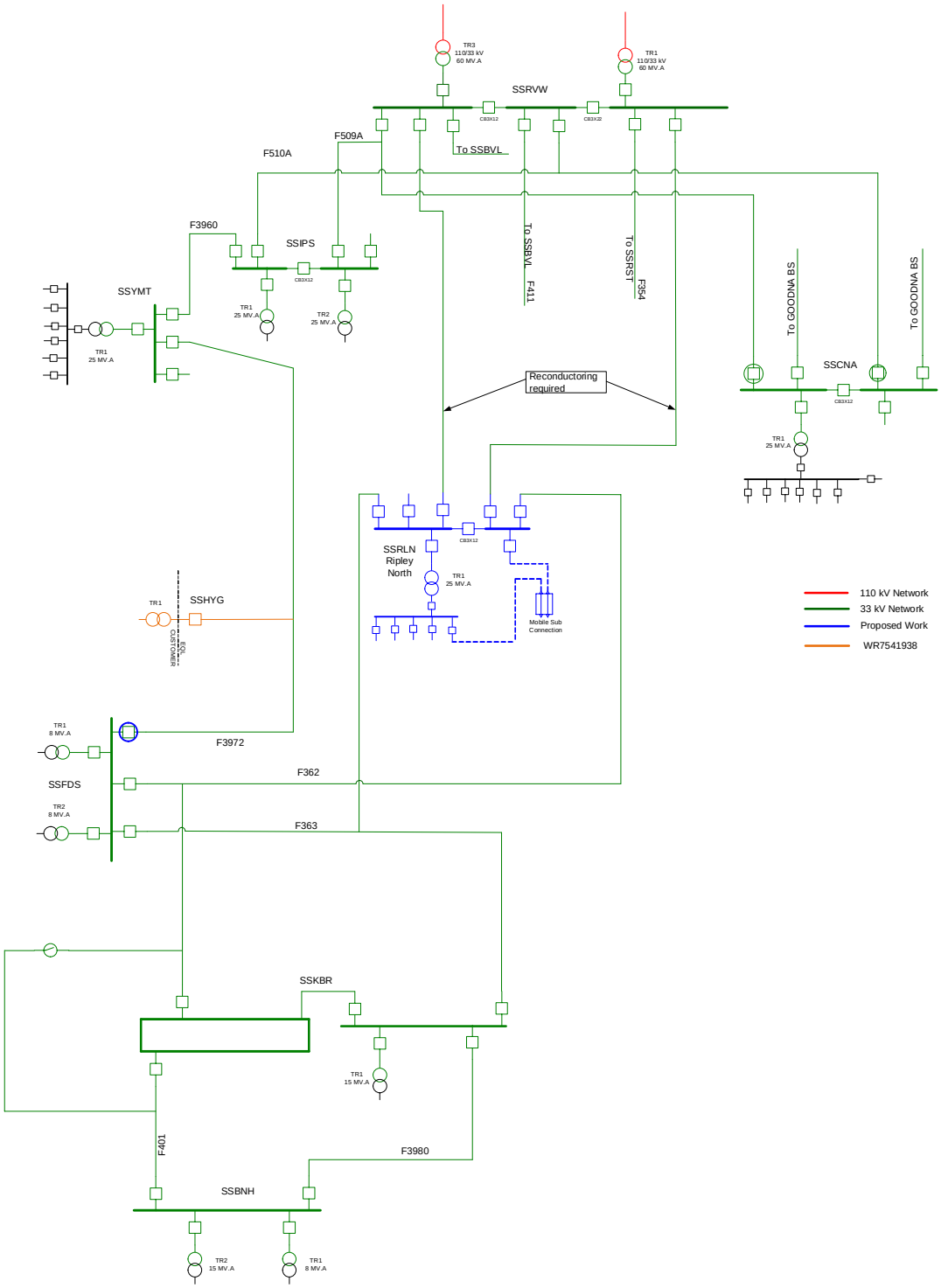
4.2.1 Future Stages

According to the load growth in Ripley development area, the single 33/11kV transformer option will meet N-1 limitation in 2035.

2035:

- Install 2nd 33/11kV, 25 MVA transformer at SSRLN
- Install 2nd 11kV bus including 5 x 11kV feeder CBs and 1 x 11kV transformer CB at SSRLN
- Cutover relevant 11kV feeders to the new 11kV bus

Figure 6 – Option 2 network diagram



4.2.2 Costs

Option 2 has an estimated initial direct cost of $17.4m in this regulatory period, which has been factored into the NPV as a cost in 2029. The direct cost of second stage for Option 2 is estimated as $4.3m. OPEX for this option is $22.7k / annum.

According to the population growth in Ripley area, it is required to install the second 33/11kV transformer and second 11kV bus at SSRLN by 2035 to meet Safety Net requirements. It should be noted that installation of second transformer and second 11kV bus in a separate project will be more expensive. In addition, installation of mobile substation connection point and mobile substation parking pad will be required in the first stage of the project.

4.3 Option 3 Install Second 33/11kV, 25 MVA transformer and Second 11kV bus at SSCNA

This option addresses the N-1 limitation at SSCNA by installing second 33/11kV transformer and second 11kV bus. However, Ripley development area is approximately 8 km away from SSCNA. Therefore, it will be necessary to install multiple long 11kV feeders to meet the demand in Ripley development resulting higher distribution losses and lower reliability.

This option involves following major items:

- Install second 33/11kV, 25 MVA transformer at SSCNA.
- Install second 11kV bus with 6 x 11kV feeder CBs and 1 x 11kV transformer CBs at SSCNA.
- Install an 11kV joggle chamber to new 11kV bus if required at SSCNA.
- Install second station service transformer (SST) and LV boards at SSCNA.
- Install a AFLC coupling cell at SSCNA.
- Install 11kV RMU to connect SST and AFLC coupling cell at SSCNA.
- Install a protection panel for new 33/11kV, 25 MVA transformer at SSCNA.
- Install battery bank and battery charger if required at SSCNA.
- Cutover 11kV feeders to new 11kV switchboard as required at SSCNA.
- Install two new 11kV feeders from SSCNA to Ripley development area.

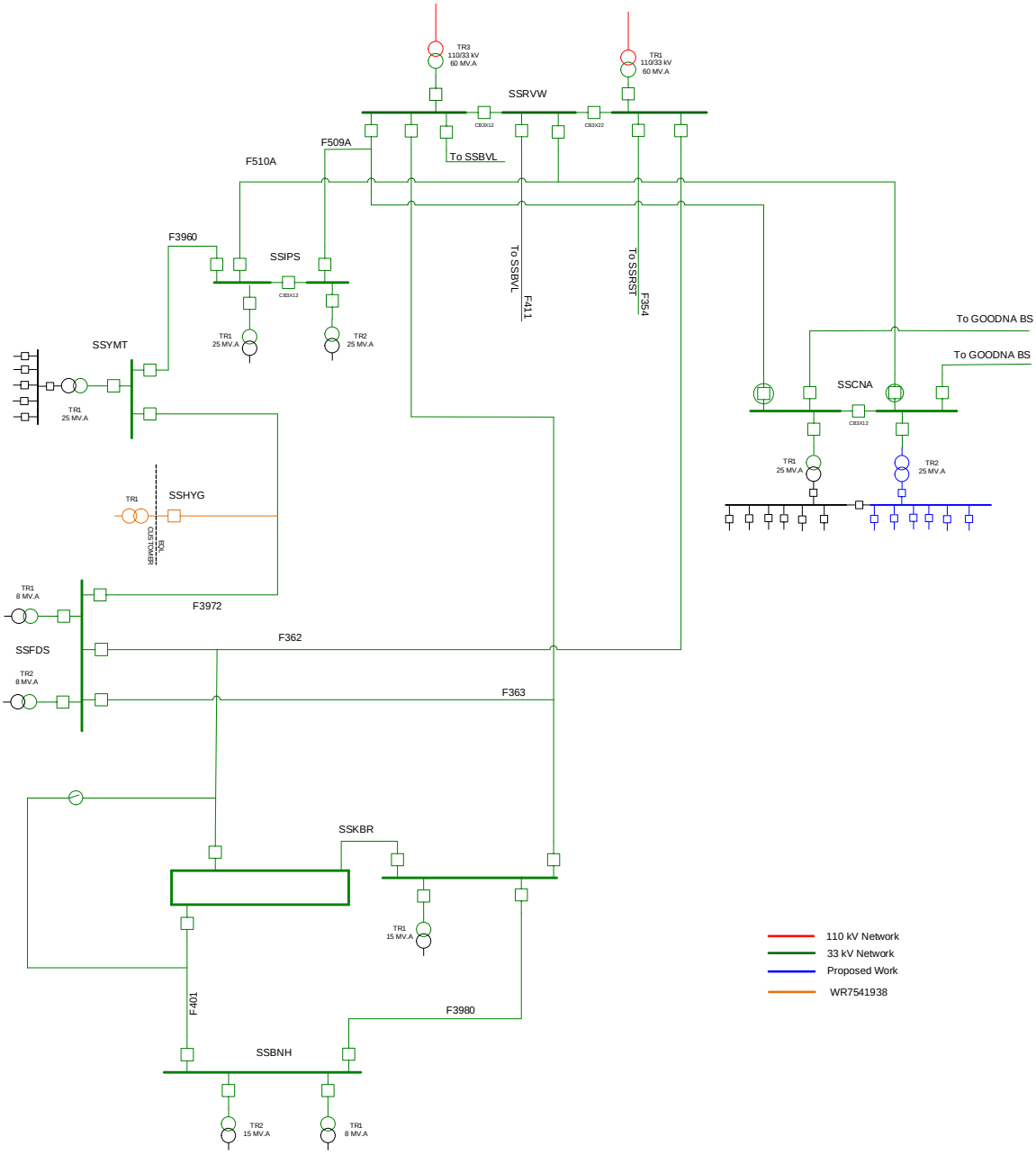
4.3.1 Future Stages:

New 11kV feeders are required to install every two to three years according to load growth in Ripley development area.

2031 onwards:

- Install 11kV feeders from SSCNA to Ripley development area every two years according to load growth.

Figure 7 – Option 3 network diagram



4.3.2 Costs

Option 3 has an estimated initial direct cost of $12.1m for this regulatory period, which has been factored into the NPV as a cost in 2029. It is estimated that installation of an 11kV feeder in future stages is $3.2m. OPEX for this option is $100.5k / annum.

4.4 Option 4 Install Stand Alone Power System (Generators and Batteries)

Installation of Stand Alone Power Systems such as generators and batteries will required considerable amount area of land. Therefore, this option is assessed as not feasible due to limited area available at existing the SSCNA site.

4.5 Economic Analysis

4.5.1 Cost summary 2025-30

Option 1 to establish a new SSRLN 33/11kV zone substation with two 33/11kV, 25 MVA transformers is the preferred option and has been estimated as $19.5m. The forecast expenditure would span over 6 years, the expenditure across the 2025-30 regulatory period is shown in Table 1.

Table 1 – Cost summary 2025-30

Option	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Establish a new SSRLN 33/11kV zone substation with two 25 MVA Transformers	$0.834m	$1.676m	$4.198m	$4.206m	$5.900m	$16.814m

4.5.2 NPV analysis

From the table below, Option 1 is the lowest cost option. The NPV under the base case is -$22.405m, with the Capex, Opex and Benefits NPV shown in Table 2.

Table 3 shows the results having changed various inputs into the financial model.

Table 2 – Base Case NPV analysis

Option	Rank	Net NPV	Capex NPV	Opex NPV
Establish a new SSRLN 33/11kV zone substation with two 25 MVA Transformers	1	-$18.032m	-$17.000m	-$1.032m
Establish a new SSRLN 33/11kV zone substation with one 25 MVA Transformers	2	-$19.486m	-$18.466m	-$1.020m
Install Second 33/11kV, 25 MVA transformer and Second 11kV bus at SSCNA	3	-$23.095m	-$17.868m	-$5.226m

Table 3 – NPV Sensitivity Analysis

Option	Discount rate	
	2.5%	4.5%
Establish a new SSRLN 33/11kV zone substation with two 25 MVA Transformers	-$19.308m	-$16.860m
Establish a new SSRLN 33/11kV zone substation with one 25 MVA Transformers	-$21.021m	-$18.078m
Install Second 33/11kV, 25 MVA transformer and Second 11kV bus at SSCNA	-$25.995m	-$20.683m

4.6 Optimal Timing

This is a Safety Net requirement and the optimum timing for this project is in 2029.

5 RECOMMENDATION

It is recommended to establish a new SSRLN 33/11kV zone substation with two 33/11kV, 25 MVA transformers to address the network security standard load at risk. Table 4 summarises the option under consideration.

Table 4 Options Analysis Scorecard

Criteria	Option 1 - Establish a new SSRLN 33/11kV zone substation with two 25 MVA Transformers	Option 2 – Establish a new SSRLN 33/11kV zone substation with one 25 MVA Transformers	Option 3 - Install Second 33/11kV, 25 MVA transformer and Second 11kV bus at SSCNA
Net Present Value	-$22.405m	-$27.874m	-$28.996m
Investment cost	$19.5m	$17.4m	$12.1m
Investment Risk	Medium	Medium	Medium
Delivery time	6 years	6 years	6 years
Detailed analysis – Risks	This option may present risk during upgrading two 33kV feeders as these two feeders are supplying SSFDS, SSKBR and SSBNH loads	This option may present risk during upgrading two 33kV feeders as these two feeders are supplying SSFDS, SSKBR and SSBNH loads.	This option may present risk of installing second 11kV bus as the existing 11kV circuit breakers are not in the current period contract. New 11kV circuit breakers need to match with existing circuit breakers or it may need a new building for new switchgear.
Detailed analysis - Advantages	Close to the Ripley development area	Close to the Ripley development area	No obvious advantages.

Appendix 1: Alignment with the National Electricity Rules

Table 5 Recommended Option's Alignment with the National Electricity Rules

NER capital expenditure objectives	Rationale
A building block proposal must include the total forecast capital expenditure which the DNSP considers is required in order to achieve each of the following (the capital expenditure objectives):	
6.5.7 (a) (1) meet or manage the expected demand for standard control services over that period	Section 3, Section 4.1
6.5.7 (a) (2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;	Section 3, Section 4.1
6.5.7 (a) (3) to the extent that there is no applicable regulatory obligation or requirement in relation to: (i) the quality, reliability or security of supply of standard control services; or (ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent: (iii) maintain the quality, reliability and security of supply of standard control services; and (iv) maintain the reliability and security of the distribution system through the supply of standard control services	Section 3, Section 4.1
6.5.7 (a) (4) maintain the safety of the distribution system through the supply of standard control services.	Section 3, Section 4.1
NER capital expenditure criteria	**Rationale**
The AER must be satisfied that the forecast capital expenditure reflects each of the following:	
6.5.7 (c) (1) (i) the efficient costs of achieving the capital expenditure objectives	Section 4.5
6.5.7 (c) (1) (ii) the costs that a prudent operator would require to achieve the capital expenditure objectives	Section 4.5
6.5.7 (c) (1) (iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives	Section 3.2, 4.5

Appendix 2: Reconciliation Table

Table 6 Reconciliation

Expenditure	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
Expenditure in business case $m, direct 2022-23	$0.834m	$1.676m	$4.198m	$4.206m	$5.900m	$16.814m