North West Area Strategic Plan
System Capacity Planning Project
Aurora Energy

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5	20 May 2010	Final Issue	NJG	JLB/BK	MSH	MSH

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Executive summary

The long term plan for North West recommends the continuation of the existing philosophy of 110 kV transmission network with 110/22 kV terminal stations. A staged conversion of the Burnie CBD 11 kV network (supplied from Emu Bay) to 22 kV has been recommended based on the closure of the Burnie paper mill in 2010. Emu Bay will be converted to a 110/22 kV substation and new substations will be established at Wynyard and Penguin.

The ten year plan for North West recommends that the bus at Emu Bay be split to provide a 22 kV source of supply to relieve Burnie substation until Wynyard is established in 2014. Alternate supplies for the 11 kV network in the Burnie CBD will be established as part of the staged conversion of Emu Bay. Transformer replacements due to predicted age and capacity limitations have been recommended at Burnie and Port Latta terminal substations.

The five year plan for North West outlines the distribution works associated with the Emu Bay bus split, the new Wynyard substation and a major feeder reconfiguration in Burnie including the alternate CBD backup supplies and transfers to relieve Ulverstone.

This report is part of a series covering the eleven planning areas in the state of Tasmania. References are made in this report to others in the series which cover adjacent planning areas. An overarching summary document was compiled to highlight the important outcomes and recommendations from each area in the study.

Report Reference	Planning Area
0	System capacity planning project summary
1	Tamar area strategic plan
2	North Coast area strategic plan
3	**North West area strategic plan**
4	Hobart West area strategic plan
5	Hobart East area strategic plan
6	South area strategic plan
7	Sorell area strategic plan
8	East Coast area strategic plan
9	North East area strategic plan
10	Central area strategic plan
11	West Coast area strategic plan

1. Introduction

Aurora Energy (Aurora) engaged Aurecon (formerly Connell Wagner) to undertake a network system capacity planning study covering the eleven planning areas in the state of Tasmania. A report will be produced for each of the eleven planning areas and will include a long term strategic plan, a ten year plan and a five year plan.

Each area report contains a summary of the planning area, describing the geographical region encompassed, the existing electrical infrastructure and the local council plans as well as Aurora and Transend's committed and proposed works for the area. A load forecast is then presented, with a discussion of the magnitude and location of expected load growth, followed by a discussion of the resulting limitations at each substation. The long term strategic plan, ten year plan and five year plan are then presented.

1.1 Background

Aurora is the distribution network service provider of mainland Tasmania, supplying more than 1 GW peak load through its high voltage network in 2008. Transend is the transmission network service provider of Tasmania.

The Aurora HV distribution system consists mainly of 22 and 11 kV feeders, with the connection point generally on the load side of the feeder circuit breakers at Transend's terminal substations. Aurora also owns several 33/11 kV zone substations and 33 kV feeders, which are supplied by Transend's 110/33 kV substations.

This report has been prepared for Aurora and its intent is to review Aurora's short and long term network requirements, however it is understood that Transend is impacted by the recommendations contained within. Therefore all efforts have been made to perform the study in consultation with Transend, and consideration has been given to Transend's future vision and network security standards.

1.2 Methodology

The methodology used to carry out the planning study is outlined below.

To begin with, data was reviewed for each of the planning areas including:

- Annual planning reports from Transend and Aurora
- Known developments and constraints
- The existing network configuration (using Webmap)
- Load models and load transfer capacity
- Transformer refurbishment program (Aurora)
- Schematics of Aurora and Transend substations
- Joint planning studies and regulatory test reports
- Council plans and residential strategies for all of the Tasmanian councils (where available)

The load model for each planning area was then refined into smaller growth areas, with each area allocated medium or high growth based on land availability, council plans for the area and information from Aurora on growth hot spots and point loads. This process resulted in a load forecast for each planning area which fell between the medium and high growth forecasts provided by Aurora, with load growth biased towards those areas (and hence substations) where high growth is expected. This forecast is considered the high growth forecast for this study, with the medium and low forecasts being those provided by Aurora.

For the purposes of the long term strategic plan and ten year plan it was decided to use the high growth forecast to determine the timing of limitations. This conservative approach was taken to ensure that Aurora is prepared should a higher than expected forecast eventuate. The five year plan is intended to be used by Aurora for its short-term planning, including regulatory submission for relevant projects, and therefore needs to be as accurate as possible. As a result, the five year plan uses the medium growth forecast to determine the timing of limitations.

The long term strategic plan was produced by projecting the high growth load forecast out to the year 2050 and performing a high level review of the resulting limitations. Substation capacity and condition were the primary limitations considered at this stage, as distribution network limitations are difficult to forecast and can largely be addressed independently of major substation projects. The introduction of new voltage levels and phasing out of non-standard voltage levels were examined at this time. The recommendations considered to address the resulting limitations included load transfers, transformer refurbishment or replacement to increase capacity, installation of additional transformers and switchgear and the establishment of new substations.

The recommended projects which fell within the period from 2012 to 2022 were then examined in greater detail in the ten year plan. An options analysis was undertaken by comparing the technical and financial implications of the recommended option against several other feasible options. The project drivers were also examined in greater detail, with distribution network limitations such as feeder loading and reliability considered at this stage.

The five year plan focused on the distribution works required within the period from 2012 to 2017. An analysis of each of the existing and new substations was completed to determine feeder limitations in the five year period. The medium growth substation forecast provided by Aurora was combined with historical feeder loading data from 2009 to produce a five year forecast for all distribution feeders in the Aurora network. A number of projects were proposed which included works as part of the substation projects identified in the ten year plan and new projects based on the analysis of feeder loading. A brief justification for the new feeder projects has been included and DINIS studies were completed as applicable. A section has been included to discuss the ultimate configuration of the substation areas and the impact on the ultimate plan by any works completed in the five year period.

For each area, a report was compiled including the long term strategic plan, ten year plan and five year plan. An overarching summary document was compiled to highlight the important outcomes and recommendations from each area in the study.

1.3 Assumptions

A list of some of the general assumptions made for the study is outlined below.

- Direct connected customers were not included in the original load models. However, where the direct connected load affects the substation, an estimated block load has been incorporated into the substation load to determine the capacity limitation.
- The UES 2008 forecast has been used for all load models. The high and medium growth rates for smaller areas in the substation supply areas have been assumed based on existing feeder configuration, land availability, council plans for the area and information from Aurora on growth hot spots and point loads.
- Draft historical feeder loadings were used for the long term strategic and ten year plans. Revised feeder loadings were provided prior to the commencement of the five year plan and the new figures were incorporated to ensure feeder limitations were accurately determined.
- All committed proposed projects up to 2012 are assumed to be completed for this study
- The assumed substation limitation is load above firm capacity
- Transformer asset life as advised by Aurora is 40 years for zone substations and 45 years for terminal substations. For the purpose of this report, it is assumed that actual transformer life is extended by approximately five years due to the regular condition assessments and transformer loading under normal conditions.

- The four-hour emergency ratings for transformers is based on 1.2 x normal capacity. It has been assumed that remote switching can be completed within four hours.
- Substation general arrangements were not available during the study and it has been assumed that there is space for the proposed upgrades outlined in the long term strategic plan
- The long term strategy does not take into account individual distribution feeder capacity or voltage drop. This has been further reviewed in the five year plan.
- ESI regulations have been taken into consideration where applicable
- Basic costing was provided by Aurora and Transend and any additional assumptions made are shown in Appendix A
- An NPV analysis has been completed for each of the ten year proposed projects. It should be noted that a cost benefit analysis has not been undertaken
- Demand side initiatives have not been considered in this study. Any feasible demand side initiatives that are identified as part of a separate review will in some cases defer or alleviate identified capital expenditure. The focus of this review is to identify network constraints and determine appropriate network solutions.

2. Area background

The North West covers an area along the north western coastline from Smithton to Ulverstone.

Figure 2-1 North West study area

The area has strong rural and tourism industries and moderate residential and commercial developments along the coast line, particularly in the central business district of the one major city, Burnie. There is a high penetration of alternative gas energy source with a number of major customers implementing co-generation.

The Circular Head and Waratah-Wynyard areas are supported by a number of different industries including dairy production, agriculture, vegetables, commercial fishing and aquaculture, forestry, timber production and tourism.

There is moderate to strong load growth in the CBD of Burnie. The CBD is supplied at 11 kV from Emu Bay terminal substation, compared to 22 kV distribution in the rest of the North West area. There is no existing inter-connectability between the 11kV & 22kV feeders in Burnie CBD. The four 22 kV feeders supplying the Burnie suburban area south of the CBD are susceptible to airborne salt contamination for overhead lines close to the coast.

2.1 Existing infrastructure

There are five Transend terminal substations in the North West area.

Table 2-1 North West terminal substations

Terminal substation	Number of transformers	Rating of each transformer	Transformer primary voltage	Secondary voltage	Number of distribution feeders
Burnie	2	60 MVA	110 kV	22 kV	11
Emu Bay	2	38 MVA	110 kV	11 kV	4
Port Latta	2	22.5 MVA	110 kV	22 kV	2
Smithton	2	35 MVA	110 kV	22 kV	5
Ulverstone	2	45 MVA	110 kV	22 kV	8

2.2 Council areas and restrictions

The North West area covers four council areas; Circular Head, Waratah-Wynyard, Burnie and Central Coast. Each council has its own planning schemes and strategic plans for their area.

Circular Head

The Circular Head Council has a strategic plan document for 2009-2014. This document outlines a regional snapshot of the area, the vision, core values and mission for the area and the strategic planning framework. The priorities of the Circular Head council include development of the tourism sector, sustainable management of the natural resources in the area, development in the best interest of the community and running a well managed council.

The Circular Head Council planning scheme was originally published in 1995 and was updated in 2006. The planning scheme outlines a number of different zones and the development that is allowed in each zone. These intents will be taken into account in the development of the strategic plan for the North West.

Waratah-Wynyard

The Waratah-Wynyard Council has a strategic plan document for 2009-2014. This document outlines a municipal snapshot of the area, the vision, core values and mission for the area and the strategic planning framework. The priorities of the Waratah-Wynyard council include economic prosperity, community focus, sustainable management of the environment and a well managed council.

The Waratah-Wynyard Council planning scheme was originally published in 2000 and the most recent amendment was in 2008. The planning scheme outlines a number of different zones and the development that is allowed in each zone. These intents will be taken into account in the development of the strategic plan for the North West.

Burnie

The Burnie Council has a ‘Settlement and Investment Strategy for Burnie to 2026’. This document was published in May 2007 and outlines an approach to future land use planning and urban development. The scheme discusses local settlement patterns and strategy directions.

- Residential – the residential growth development areas include Malonga Heights, Mooreville and Singline estate in the south west, Brickport Road, Cooee, Shepton Park and Camdale in the west and Heybridge to the east.
- Retail – CBD preferred location, dining and entertainment to be encouraged towards the waterfront, new retail like supermarkets to be local close to new housing developments
- Commercial – promotion of efficient use of existing buildings balanced with new offices to attract new businesses, small commercial zones outside CBD to be considered in Upper Burnie and Cooee
- Industrial – growth will be encouraged at Heybridge, South Burnie and a residential area at Wivenhoe will be converted to a new industrial zone
- Community – No observed existing service gaps, changing age demographic require more health services and aged care facilities
- Tourism - lack of accommodation and tourism product, view to develop accommodation in the CBD and along the Waterfront

The Burnie Council planning scheme was originally published in 1989 and incorporates amendments up to September 2008. The planning scheme outlines a number of different zones and the development that is allowed in each zone. These intents will be taken into account in the development of the strategic plan for the North West.

Central Coast

The Central Coast Council has a strategic plan document for 2009-2014. This document outlines the strategic directions for the area including the shape of the place, a connected central coast, community capacity and creativity, environment and sustainable infrastructure and council sustainability and governance.

The Central Coast Council planning scheme was originally published in 2005 and incorporates amendments up to June 2008. The planning scheme outlines a number of different zones and the development that is allowed in each zone. The council also has a number of plans for specific areas within the council. This includes land use planning within each area. These intents and plans will be taken into account in the development of the strategic plan for the North West.

2.3 Approved and proposed works

The North West area has a number of existing system constraints. The proposed projects to be completed by December 2012 are outlined below:

Alternative 11 kV supply for Burnie CBD

Aurora has considered providing an alternate 11 kV connection point for Burnie CBD by 2012/13. This has been further reviewed in this study in Sections 7.1.2 and 8.5.2.

3. Load forecast

Due to the rural industrial nature of the load in the Smithton and Port Latta areas, significant growth above the medium rate is considered unlikely. As a result, for the purposes of the long term strategic study, medium growth has been applied at the Smithton and Port Latta terminal substations. It is expected that the growth in these areas will be dependent upon applications for new point load installations, particularly for industrial development.

The resulting 38 year load forecast and firm ratings for the Smithton and Port Latta terminal substations are provided below.

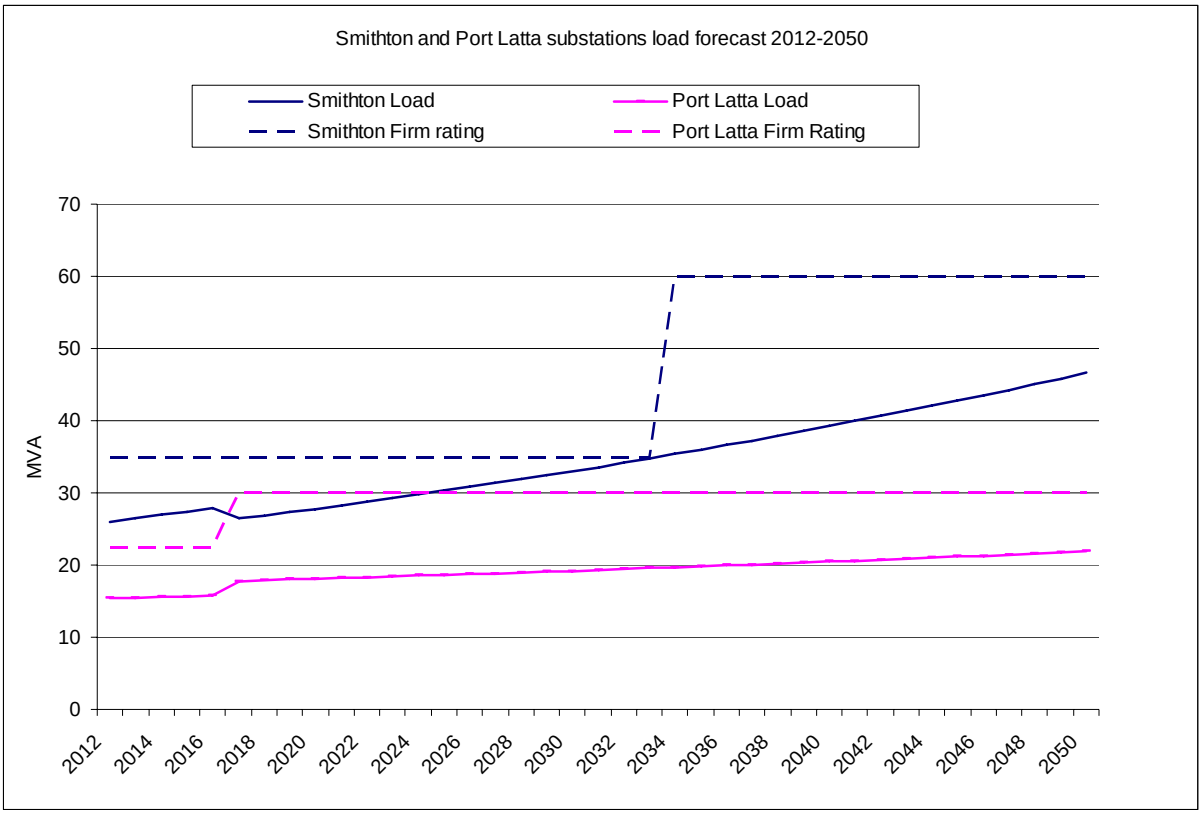

Figure 3-1 Substation load forecasts for Smithton and Port Latta

Figure 3-2 provides a geographic view of the resulting load distribution in 2012 and 2050.

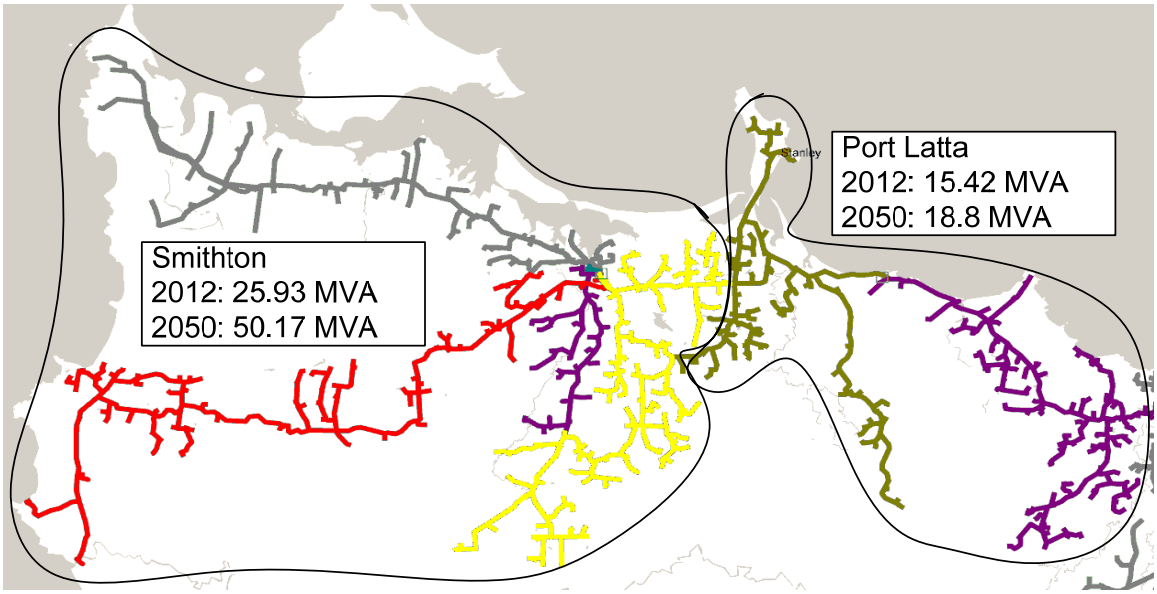

Figure 3-2 Forecast load distribution for Smithton and Port Latta

The resulting 38 year load forecast and firm ratings for the Burnie, Emu Bay (22 kV) and Ulverstone terminal substations are provided below. This forecast includes the initial partial conversion of Emu Bay to provide 22 kV supply in 2012 to deload Burnie and Ulverstone.

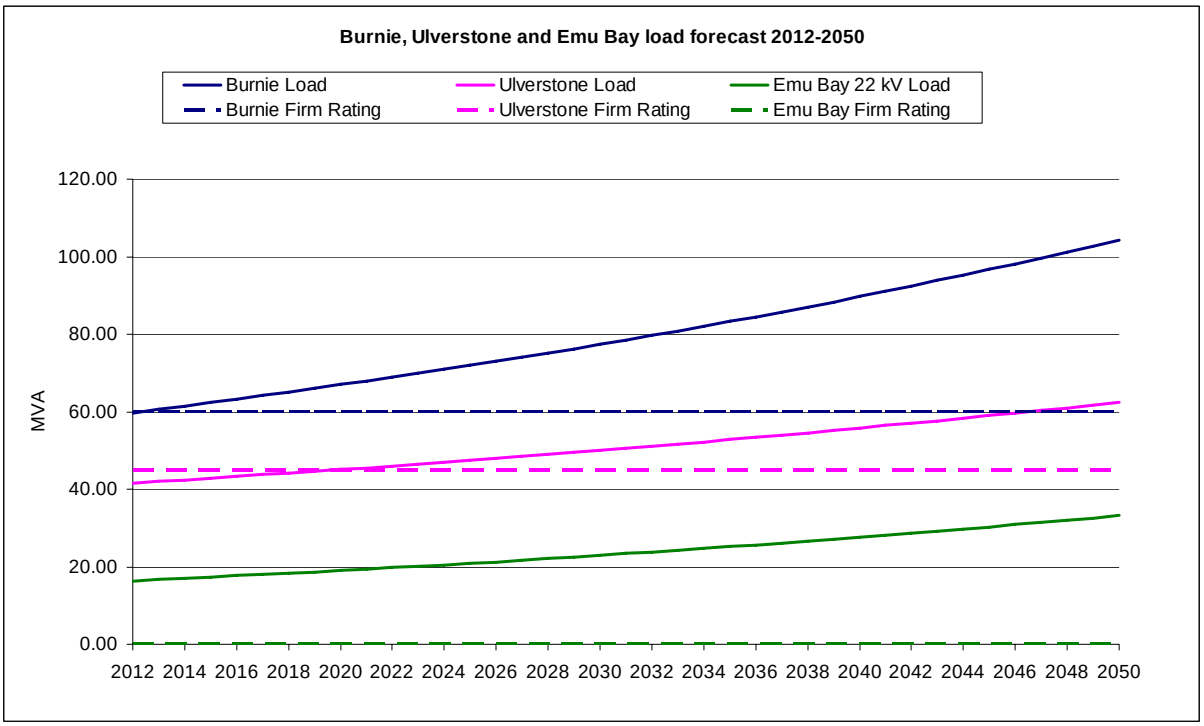

Figure 3-3 Substation load forecasts for Burnie, Ulverstone and Emu Bay

The growth in the areas around Burnie, Emu Bay and Ulverstone terminal substations vary between medium and high growth development. For the purposes of the long term strategic study, the assumed high growth areas include Wynyard, South Burnie and surrounds, Burnie CBD (supplied by Emu Bay), Wivenhoe, Shorewell Park, Heybridge and Penguin. The assumed medium growth areas include south west of Burnie past Mooreville, developed areas adjacent to the Burnie CBD, Ulverstone CBD and south east of Ulverstone.

The following figure provides a geographic view of the resulting load distribution in 2012 and 2050. The red circles denote areas with a proposed high growth forecast.

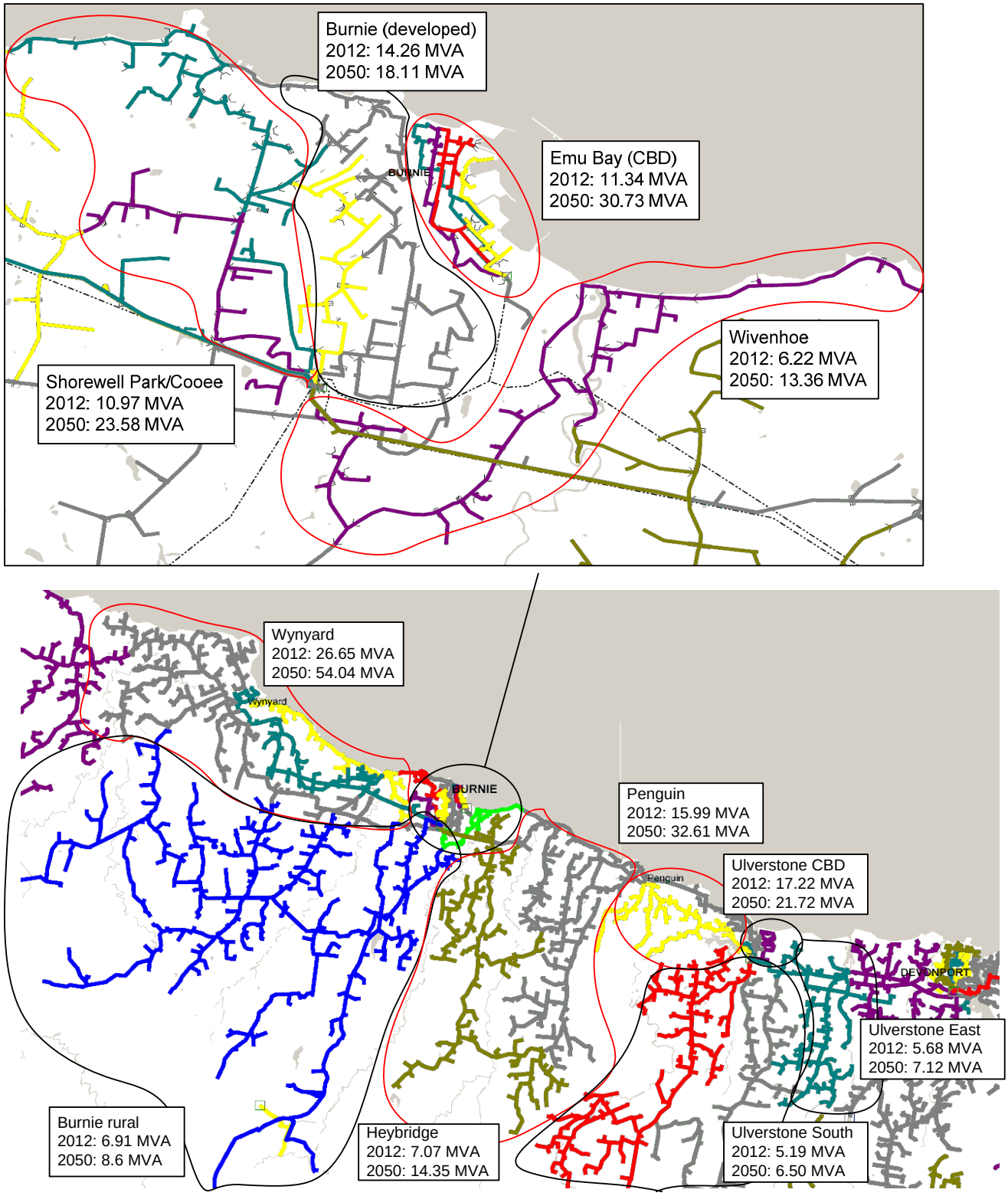

Figure 3-4 Substation load distribution for Burnie, Ulverstone and Emu Bay

4. Limitations

4.1 Port Latta

There are two 22.5 MVA 110/22 kV transformers at Port Latta terminal substation. This substation experiences a higher peak summer demand and supplies a direct connected customer, Goldamere, via two 22 kV feeders. Using the feeder load reporting system (FLRS), the average daily load for Goldamere is 10.4 MVA. The forecast 22 kV distribution load for 2009 is 4.8 MVA and a load of 8.4 MVA is predicted in 2050 using the medium growth forecast. The firm capacity at the Port Latta terminal substation will not be exceeded in the time frame. The 22 kV distribution feeders will both be within their ratings.

The Tasmanian government is encouraging industrial growth in the Port Latta area which will mean the load growth will be based on point loads from individual connection requests. Increases in mining activities in the West Coast area will also influence the load growth at Port Latta. The nominal rating of the feeders and/or the terminal substation firm capacity may be exceeded depending upon the applications for new point load installations in the area, particularly for industrial development.

The two 22 kV distribution feeders are long and have small transfer capability with adjacent networks.

The majority of the area supplied by Port Latta substation is low density rural with sections of high density rural near Smithton and the tourist area of Stanley.

The two 110/22-11 kV 22.5 MVA transformers were installed at Port Latta in 1967. Assuming an asset life of 50 years, the transformers are predicted to be due for replacement around 2017.

4.2 Smithton

There are two 35 MVA 110/22 kV transformers at Smithton terminal substation. The forecast load in 2009 is 24.7 MVA and using the medium growth forecast, the firm capacity will be exceeded in 2030. However, there are a number of industrial point loads and a low generic growth which will mean that the firm capacity may be exceeded sooner. There are a number of industrial point loads in the area and growth on the terminal substation will mainly be based upon applications for new point loads. The ratings of the distribution feeders and the terminal substation may be exceeded dependent on the point load increases.

The majority of the area supplied by Smithton terminal substation is low density rural with sections of high density rural surrounding an urban area in Smithton township.

There are a number of irrigation pumps in the area which affects the voltage on the long distribution feeders.

The two 110/22 kV 35 MVA transformers were installed at Smithton in 2003. These transformers are not predicted to be due for age replacement during the forecast timeframe.

4.3 Burnie

There are two 60 MVA 110/22-11 kV transformers at Burnie and eleven 22 kV distribution feeders. The forecast substation load in 2009 was 70 MVA which exceeds the firm rating of the terminal substation. Two distribution feeders from the Burnie terminal substation exceeded their nominal rating of 10 MVA in 2009.

Burnie terminal substation covers a number of reliability communities including urban, high density rural and low density rural.

The Wynyard area is supplied from Burnie on feeders 91004, 91005, 91006 and ultimately 91009 when it is used to split 91004 or 91006 in the next two years. The three existing feeders are running close to maximum demand. Burnie terminal substation is running over firm capacity and there are no spare circuit breakers on the existing 22 kV bus. Further growth is predicted in the Wynyard area and the council has just created a new industrial subdivision adjacent to the Burnie airport, which is located in Wynyard. This area is classified as urban for reliability purposes.

There are a number of ravines that form natural barriers along the North West Coast and make it difficult when installing new 22 kV distribution feeders.

The 110/22-11 kV 60 MVA transformers at Burnie terminal substation were installed in 1971. Assuming an asset life of 50 years, it is predicted that the transformers will be due for replacement around 2021.

4.4 Emu Bay

There are two 38 MVA 110/22-11 kV transformers at Emu Bay terminal substation operating at a secondary voltage of 11 kV to supply Burnie's CBD. The Aurora forecast distribution load in 2009 is 10.4 MVA and the average direct connected load for Tasmanian Paper is 15 MVA. This results in a total forecast load of 25.4 MVA in 2009. However, Tasmanian paper is due to cease operation in June 2010 and the 11 kV load on Emu Bay will reduce accordingly.

The Burnie CBD is supplied at 11 kV from the Emu Bay substation. There is currently no alternative 11 kV supply to the CBD. Emu Bay substation covers an area that is mainly high density commercial and high density industrial. The current supply arrangement does not satisfy reliability requirements for a high density commercial area.

The 110/22-11 kV 38 MVA transformers at Emu Bay were installed in 1973. Assuming an asset life of 50 years, it is predicted that the transformers will be due for replacement around 2023.

4.5 Ulverstone

There are two 45 MVA 110/22-11 kV transformers at Ulverstone terminal substation. The forecast load in 2009 is 42.73 MVA. The firm capacity is forecast to be exceeded in 2014. The load on one of the feeders in the Penguin area exceeded its nominal 10 MVA rating in 2009.

The Ulverstone township is classed as urban for reliability purposes and the surrounding areas are high density rural.

There are a number of ravines that form natural barriers along the North West Coast and make it difficult when installing new 22 kV distribution network between the main centres.

The two 110/22-11 kV 45 MVA transformers at Ulverstone were each installed in 1978 and 1983. Assuming an asset life of 50 years, it is predicted that the transformers will be due for replacement around 2030.

5. Planning philosophy

The existing philosophy of 110 kV transmission network with 110/22 kV terminal stations will be continued in the Burnie area. This includes the installation of a new substation at Wynyard, the staging of the conversion of Emu Bay to a 110/22 kV connection point and a new substation at Penguin.

A staged conversion of the Burnie CBD 11 kV network (supplied from Emu Bay) to 22 kV will be completed over a ten year period from 2012 to 2022. This will align with the replacement of the transformers at Emu Bay due to capacity and predicted age limitations around 2022.

A conduit plan for the Burnie substation is required to allow for future feeders out of the substation. This will include the installation of banks of conduits on the main routes from the substation, particularly towards the CBD. This is further outlined in Section 8.3.2.

6. Long term strategy

6.1 Proposed projects

The proposed projects in the long term strategy are discussed in more detail below.

It should be noted that the projects proposed in this section will require further detailed analysis to confirm their economic and technical feasibility. A regulatory investment test will also be required for those projects where the augmentation component exceeds $1 million (RIT-D) or $5 million (RIT-T).

6.1.1 CBD network study

It is recommended that a study be completed on the 11 kV network in the Burnie CBD to determine a detailed cost for a proposed upgrade to 22 kV. It is proposed that the network is converted over a ten year period to 2022 to align with the replacement of the transformers at Emu Bay due to capacity and predicted age limitations around 2022.

6.1.2 Emu Bay 22 kV supply

The requirement for 11 kV supply at Emu Bay substation will be greatly reduced in 2010 when the paper mill is no longer in operation. It is recommended that the existing 110/22-11 kV transformers be reconfigured to run at two separate secondary voltage levels by 2012. The Burnie CBD will still be supplied at 11 kV and the second transformer will operate at 22 kV and take load from Burnie to address firm capacity limitations. The new 22 kV feeders from Emu Bay will also deload the heavily loaded feeder from Ulverstone to the Penguin area.

A new section of 22 kV switchgear will be required at Emu Bay substation as Transend has advised that the existing switchgear is not suitable for operation at 22 kV. Backup supply for the 11 kV network will be provided from Burnie and is outlined further in the following section and Sections 7.1.2 and Section 8.5.2.

6.1.3 Alternate 11 kV supply to Burnie CBD

Aurora has considered providing an alternate 11 kV connection point for Burnie CBD by 2012. It is recommended that this be completed in conjunction with the initial stage of the Emu Bay substation conversion. The alternate supplies will operate from 22 kV distribution feeders from Burnie substation which will be deloaded by the new 22 kV supply at Emu Bay. More information on the alternate supply to the Burnie CBD is available in the ten and five year plans in Sections 7.1.2 and 8.5.2.

6.1.4 Wynyard 110/22 kV terminal substation

It is recommended that a new terminal substation with two 110/22 kV 60 MVA transformers be installed at Wynyard in 2014 to deload the Burnie terminal substation and provide a reliable supply to the Wynyard area. The new terminal substation will take approximately 28 MVA off the Burnie terminal substation which includes load from feeders 91004, 91005, 91006, 91009 and 91012.

More information on the Wynyard substation installation is available in the ten and five year plans in Sections 7.1.3and 8.6.

6.1.5 Port Latta transformer replacement

Due to the age of the transformers at Port Latta terminal substation (1967) and the government push for industrial development in the Port Latta area, it is recommended that these transformers be replaced with two 110/22 kV 30 MVA transformers around 2017. The firm capacity of Smithton substation is predicted to be exceeded in 2030. If the forecast follows closer to the high growth forecast (due to large point load installations), the transformers at Smithton substation may reach firm capacity in 2021. The increased firm capacity at Port Latta substation can be used to deload Smithton substation as required. Depending on the location of new point load installations and the load transfer to Port Latta, new feeders to split the existing feeders may be required.

6.1.6 Burnie transformer replacement

Burnie terminal substation has two 110/22 kV 60 MVA transformers that were installed in 1971. It is recommended that a like for like replacement is completed. Assuming an asset life of 50 years, it is predicted that these transformers will need replacement around 2021. This timing can be refined further by completing regular testing on the transformers as they approach the 50 year mark.

6.1.7 Emu Bay transformer replacement

Emu Bay terminal substation has two 110/22/11 kV 30 MVA transformers that were installed in 1973. It is recommended that two 110/22 kV 60 MVA transformers be installed at the substation. Assuming an asset life of 50 years, these transformers are predicted to need replacement around 2022 and the firm capacity of the substation will be exceeded around the same time based on the transfer of the converted CBD network to 22 kV. The existing alternate supplies can be utilised as feeder ties and the 22/11 kV autotransformers redeployed elsewhere.

6.1.8 Ulverstone transformer replacement

Ulverstone terminal substation has two 110/22 kV 45 MVA transformers that were each installed in 1978 and 1983. Assuming an asset life of 50 years, it is predicted that these transformers will need replacement around 2030. A firm capacity limitation is reached at Ulverstone in the years prior to the nominated transformer replacement year. Monitoring of both the transformer condition and the load will be required to finalise the replacement year.

6.1.9 Smithton transformer replacement or third transformer

The firm capacity of Smithton substation is predicted to be exceeded in 2030. The Port Latta transformer replacement project will deload the substation around 2017 which will alter the timing of the limitation at Smithton. It is recommended that the transformers be replaced with two 110/22 kV 60 MVA units around 2034. The load at the substation should be monitored and the timing of the project adjusted accordingly. The existing transformers were installed in 2003 and can be recovered for use at another site.

Transend has advised that the replacement of the existing transformers will be a complex and expensive project because of physical site limitations. The option of installing a third transformer should be considered as another possible solution.

6.1.10 Penguin 110/22 kV terminal substation

Emu Bay and Ulverstone substations will both be exceeding firm capacity in 2046. It is recommended that a new terminal substation with two 110/22 kV 60 MVA transformers be installed at Penguin in 2046 to deload the substations and provide a reliable supply to the Penguin area.

6.2 Summary of proposed works

The proposed works from 2012 to 2050 in the North West planning area are listed below.

Table 6-1 North West project summary

Year	Proposed Project	Proposed Outcomes
2012	Emu Bay 22 kV supply	Addresses firm capacity limitations at Burnie and Ulverstone
2012	Alternate supply to Burnie CBD	Provide backup supply to Burnie's high commercial area
2014	Wynyard terminal substation	Address firm capacity issues at Burnie substation, improved reliability of supply to Wynyard area
2017	Port Latta transformer replacements	Addresses age limitation at Port Latta, increase in firm capacity for Port Latta and Smithton areas
2021	Burnie transformer age replacements	Addresses age limitations at Burnie substation
2022	Emu Bay transformer age replacements	Addresses age limitations at Emu Bay substation, prevention of predicted future overload in 2039
2028	Ulverstone transformer age replacements	Addresses age limitations at Ulverstone, prevention of predicted future overload in 2036, addresses firm capacity issues at Burnie
2034	Smithton transformer replacements	Addresses age limitation at Smithton, increase in firm capacity for Smithton and Port Latta areas
2046	Penguin terminal substation	Address firm capacity issues at Burnie and Ulverstone substations, improved reliability of supply to Penguin area

The proposed projects have been incorporated and the resulting 38 year load forecast and firm ratings for the North West substations are shown below.

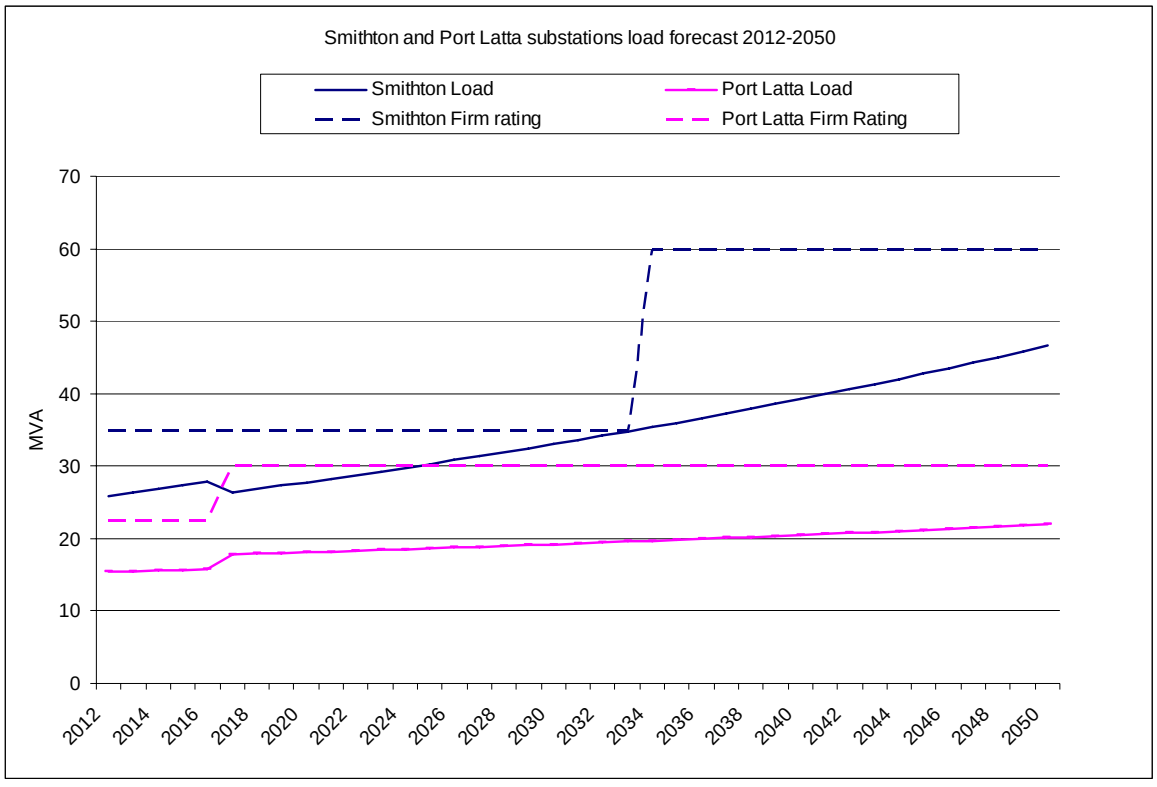

Figure 6-1 Substation load forecast with updated firm ratings

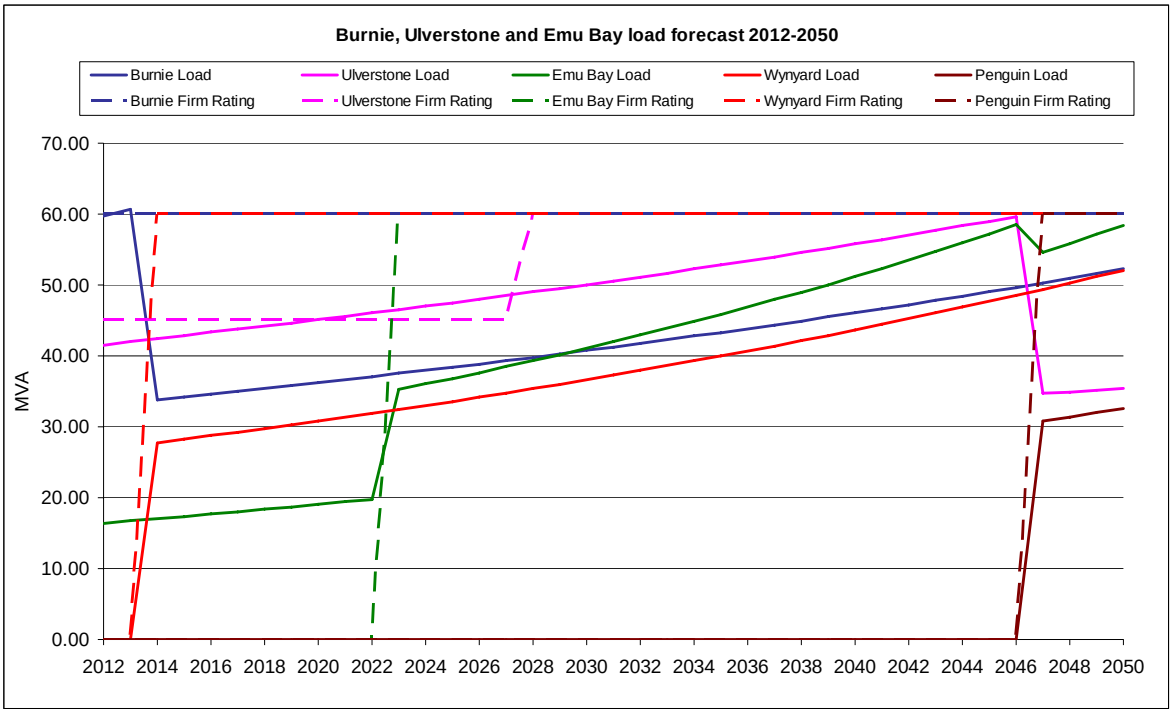

Figure 6-2 Substation load forecast with updated firm ratings

The proposed new supply area for each of the substations in the Burnie area in 2050 is outlined in Figure 6-3 below.

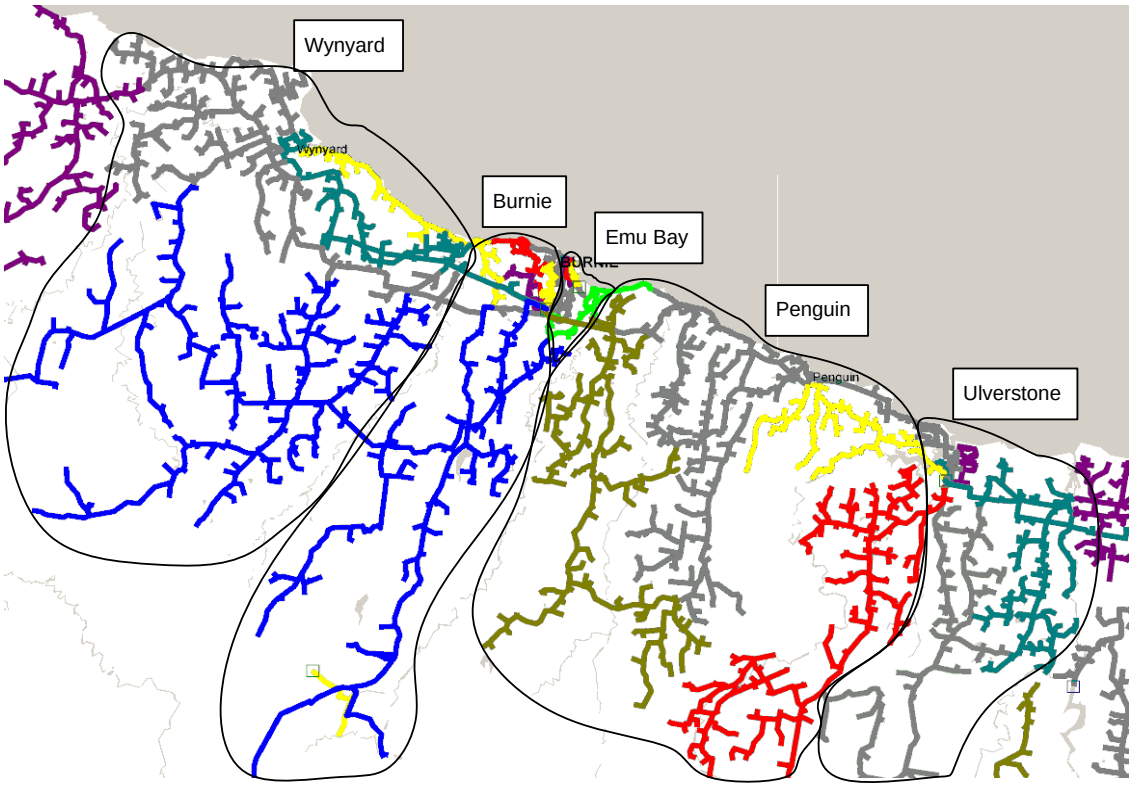

Figure 6-3 Proposed supply areas in 2050

7. Ten year plan

7.1 Proposed projects

The proposed projects for the ten year plan are outlined below.

It should be noted that while each proposed project has undergone a thorough high level analysis, these projects will require further detailed analysis to confirm their economic and technical feasibility. A regulatory investment test will also be required for those projects where the augmentation component exceeds $1 M (RIT-D) or $5 M (RIT-T).

7.1.1 Emu Bay 22 kV supply

The Burnie CBD is supplied by an 11 kV network from Emu Bay substation located south east of the city. The requirement for 11 kV supply at Emu Bay substation will be greatly reduced in 2010 when the paper mill is no longer in operation.

Limitations

There are two 60 MVA 110/22-11 kV transformers at Burnie and eleven 22 kV distribution feeders. The forecast substation load in 2012 is 73.4 MVA which exceeds the firm rating of the terminal substation. There are no spare circuit breakers available on the 22 kV bus.

Option 1 – Emu Bay 22 kV supply

It is recommended that the existing 110/22-11 kV transformers at Emu Bay be reconfigured to run at two separate secondary voltage levels by 2012. The Burnie CBD will still be supplied at 11 kV and the second transformer will operate at 22 kV and take load from Burnie to address the firm capacity limitations. The new 22 kV feeders from Emu Bay will also deload the heavily loaded feeder from Ulverstone to the Penguin area.

A new section of 22 kV switchgear will be required at Emu Bay substation as Transend has advised that the existing switchgear is not suitable for operation at 22 kV.

Option 2 – Natural gas co-generation (non-network option)

There are potential natural gas co-generation sites around the Burnie area that may be available to import into the distribution network. This will be a temporary measure to address peak loading in the distribution network.

Option 3 – Do nothing option

The do nothing option is not considered a feasible option as the firm capacity at Burnie substation has already been exceeded.

Recommended development

It is recommended that the existing 110/22-11 kV transformers at Emu Bay be reconfigured to run at two separate secondary voltage levels by 2012. This will defer the Wynyard project as Burnie substation will be deloaded to just below firm capacity. An alternate supply to the CBD will be required to provide a backup to the 11 kV network. Further information on this project is outlined in the following section.

7.1.2 Alternate 11 kV supply to Burnie CBD

The Burnie CBD is supplied by an 11 kV network from Emu Bay substation located south east of the city.

Limitations

The distribution network surrounding the Burnie CBD operates at 22 kV and there is no transfer capability with the 11 kV network supplying the CBD.

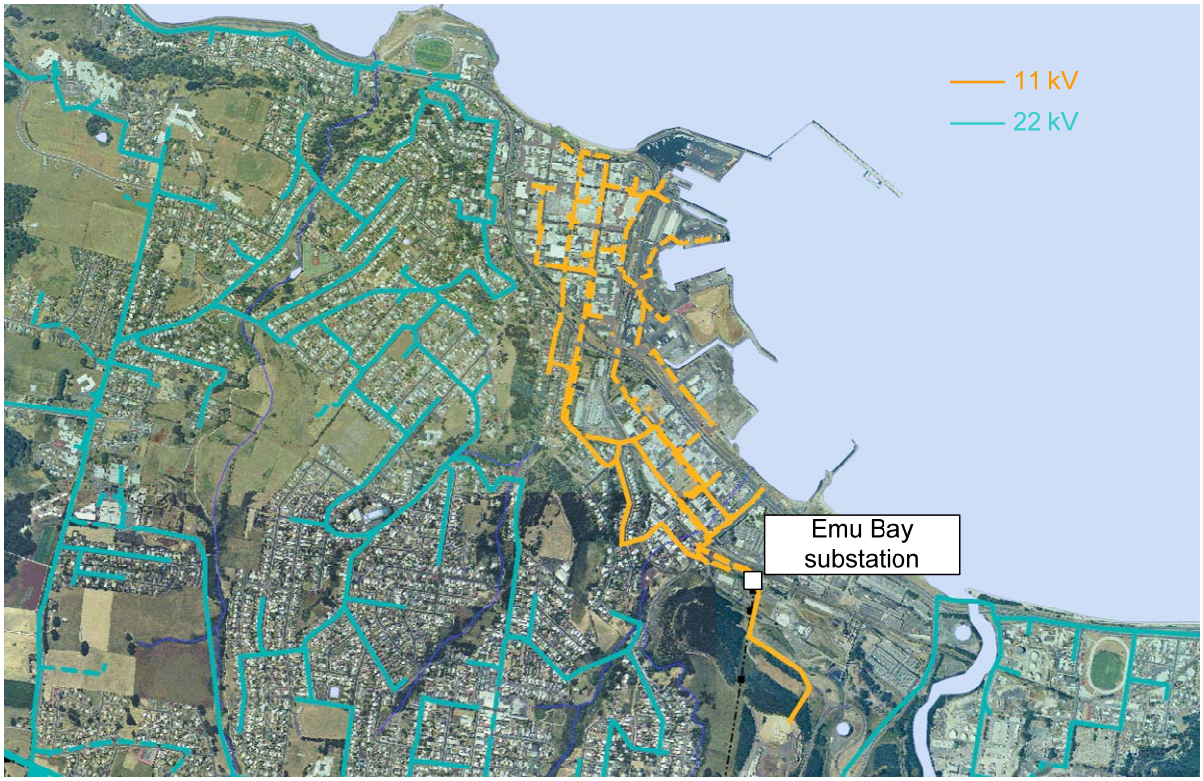

Figure 7-1 Emu Bay 11 kV supply area

At this point, it is unknown how many of the feeders in the CBD have 22 kV sections of cable and how many distribution transformers need to be replaced in preparation for a proposed change in the CBD to 22 kV supply. This will be established by the study recommended in the long term plan.

Recommended development

The options for the establishment of an alternate supply on an existing feeder from Burnie are further analysed in the five year plan in Section 8.5.2. Two alternate supplies from Burnie will be required to provide firm capacity for the 11 kV network.

7.1.3 Establish a new connection point at Wynyard

Burnie substation supplies the surrounding suburbs of Burnie, west to Wynyard, east to Heybridge and a large rural area to the south.

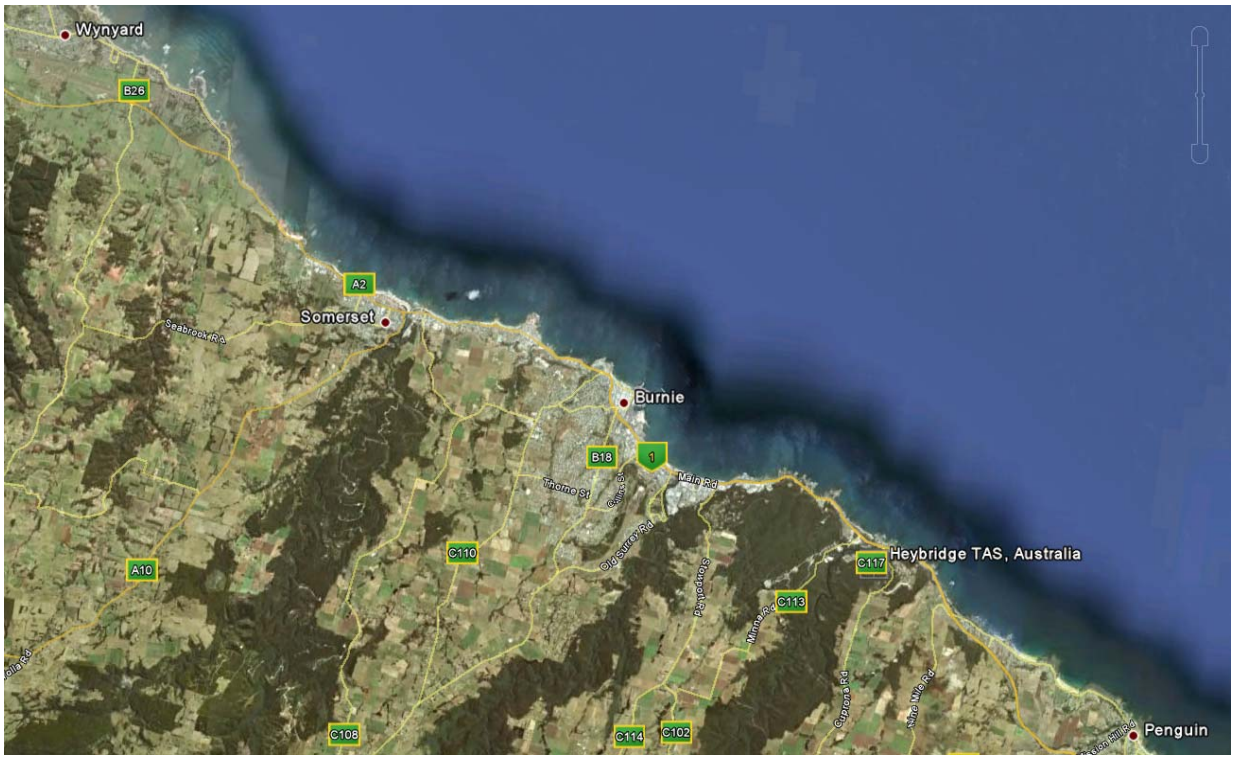

Figure 7-2 Burnie supply area

Limitations

There are two 60 MVA 110/22-11 kV transformers at Burnie and eleven 22 kV distribution feeders. The forecast substation load in 2012 was 73.4 MVA which exceeds the firm rating of the terminal substation. The installation of a 22 kV connection at Emu Bay will reduce the load at Burnie to just below firm capacity in 2012. There are no spare circuit breakers available on the 22 kV bus.

The Wynyard area is supplied from Burnie on feeders 91004, 91005, 91006 and 91009. The feeders are running close to maximum demand. Further growth is predicted in the Wynyard area and the council has just created a new industrial subdivision adjacent to the Burnie airport, which is located in Wynyard. This area is classified as urban for reliability purposes.

There are a number of ravines that form natural barriers along the North West Coast and make it difficult when installing new 22 kV distribution feeders between the main centres.

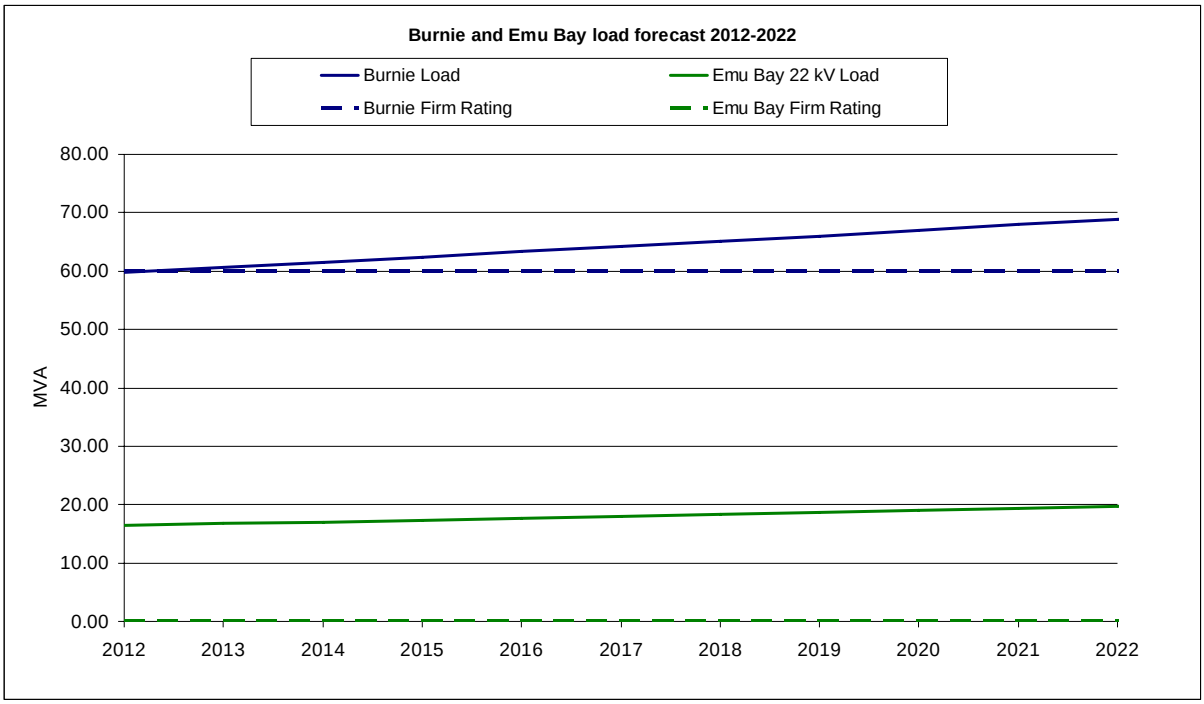

Figure 7-3 Substation load forecast for Burnie and Emu Bay

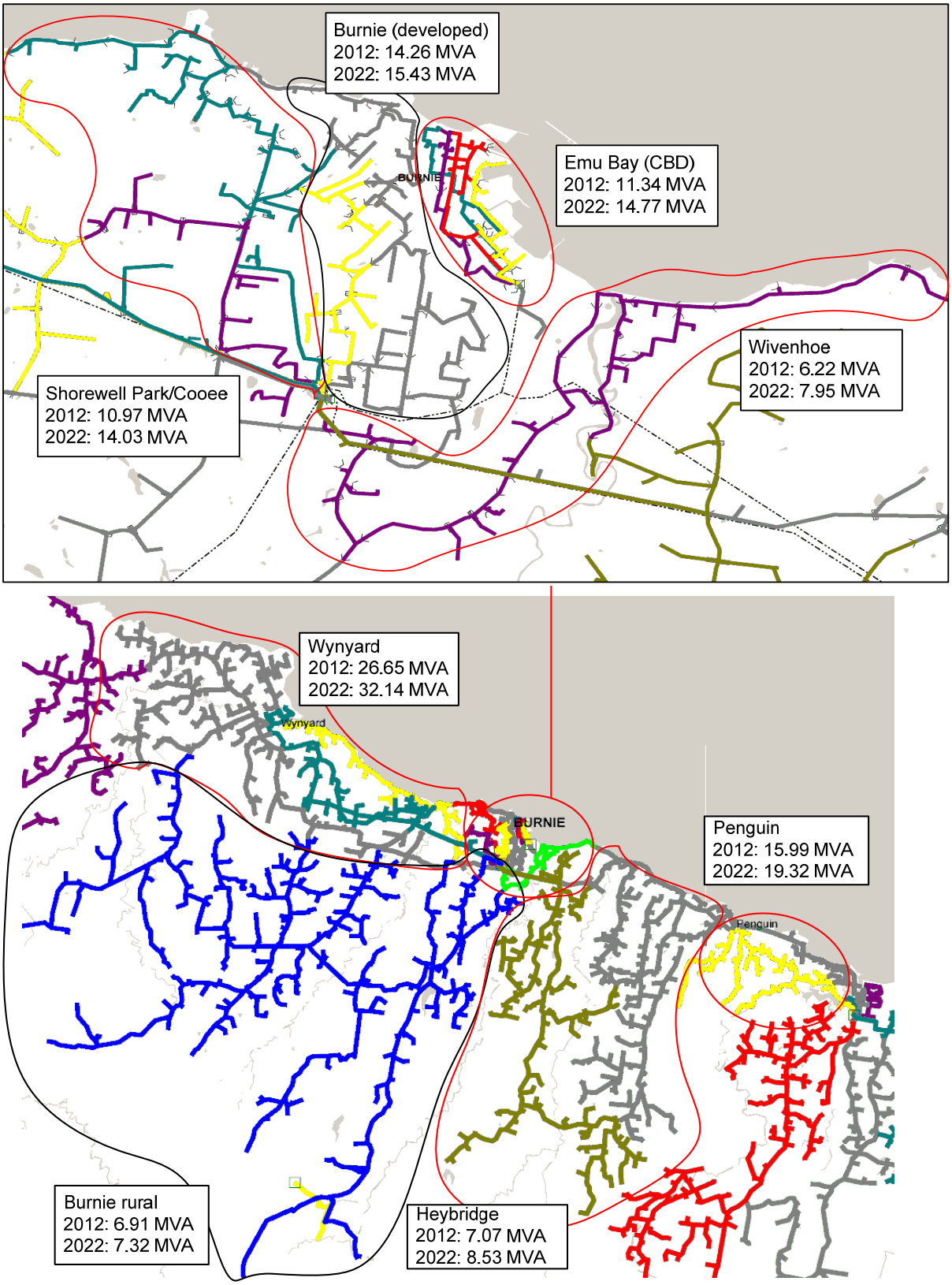

Figure 7-4 Substation load distribution for Burnie and Emu Bay

Option 1 – Establish a new connection point at Wynyard

It is recommended that a new terminal substation with two 110/22 kV 60 MVA transformers be installed at Wynyard in 2014 to deload the Burnie terminal substation and provide a reliable supply to the Wynyard area. The new terminal substation will take approximately 28 MVA off the Burnie terminal substation which includes load off feeders 91004, 91005, 91006, 91009 and 91012. This will align with the planning philosophy to remove load from the Burnie substation so that it can supply the closer surrounding areas.

Option 2 – Install a third transformer at Burnie substation

It is recommended that a third transformer and 22 kV switchgear be installed at Burnie in 2014 to deload the two existing transformers. This will provide additional firm capacity and spare circuit breakers for new feeders. One new feeder will need to be installed towards the Wynyard area and one to the north of the substation. An increase in 22 kV fault levels will need to be taken into account.

Option 3 – Natural gas co-generation (non-network option)

There are potential natural gas co-generation sites around the Burnie area that may be available to export into the distribution network. This will be a temporary measure to address peak loading in the distribution network.

Option 4 – Do nothing option

The do nothing option is not considered a feasible option as the firm capacity at Burnie substation has already been exceeded.

Technical comparison

Table 7-1 Technical comparison of options

Option	Description	Advantages	Disadvantages
1	Establish a new connection point at Wynyard	• Addresses firm capacity issue at Burnie • Will free up at least two breakers for use in supplying the Burnie area • Improves reliability in the Wynyard area • Higher operational flexibility • Utilises existing 22 kV feeders that run past the site • Aligns with the strategic plan • Does not increase feeder congestion around Burnie substation	• Requires a new site and a new 110 kV overhead DCCT transmission line

Option	Description	Advantages	Disadvantages
2	Install a third transformer at Burnie substation	• Addresses firm capacity issue at Burnie • Provides additional circuit breakers at Burnie substation • Utilises existing site	• Feeder congestion around Burnie substation • New long feeder routes required towards Wynyard • Does not align with plan to decrease the geographical size of Burnie's supply area

Cost comparison

Table 7-2 Cost comparison of options

Option	Initial Capital Cost ($M)	Total Capital Cost ($M)	Net Present Value ($M)
1	24.2	31.2	19.7
2	11.0	43.2	23.0

The above cost comparison of options indicates that option 1 provides the lowest cost solution. Details of the NPV analysis are given in Appendix B.

Recommended development

Based on the technical and cost comparison, option 1 is considered the preferred option to address the forecast limitations.

The scope of works for Transend includes:

- Establishment of a new site in the Wynyard area
- Cut in of the new site to the 110 kV network
- Installation of 2 x 60 MVA 110/22 kV transformers
- Installation of a new switchgear and control building with two buses of 22 kV switchgear

The scope of works for Aurora includes:

- Installation of 22 kV feeder tails to cut into the existing feeders to Wynyard, Somerset and south of Burnie. Further details will be provided in the five year plan in Section 8.6.

There will be spare breakers available at Burnie when load is transferred onto the new Wynyard substation and there are three spare bays available (without circuit breakers) that can also be utilised if required.

The resulting forecast, proposed location and schematic diagrams for the Wynyard project are outlined below.

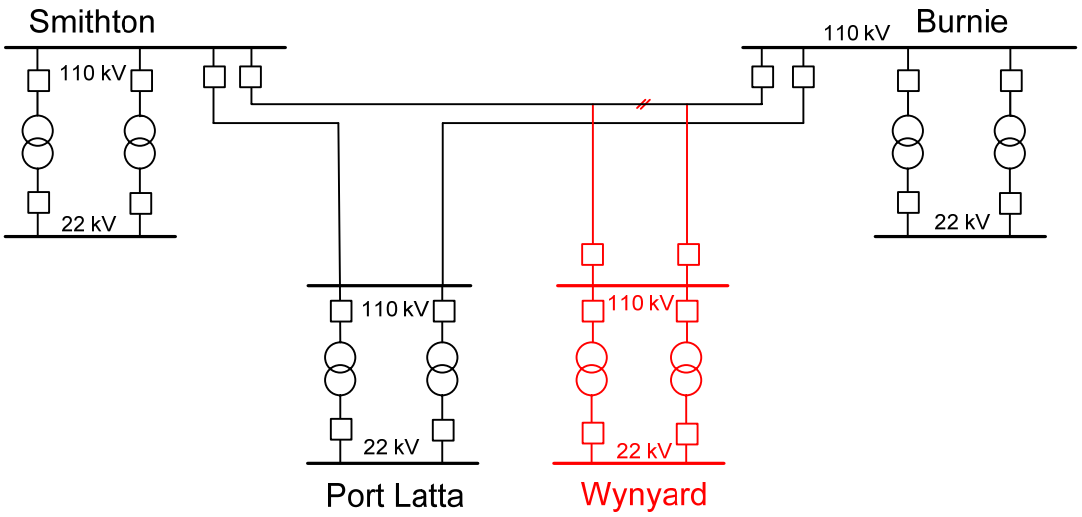

Figure 7-5 Proposed schematic for Wynyard project

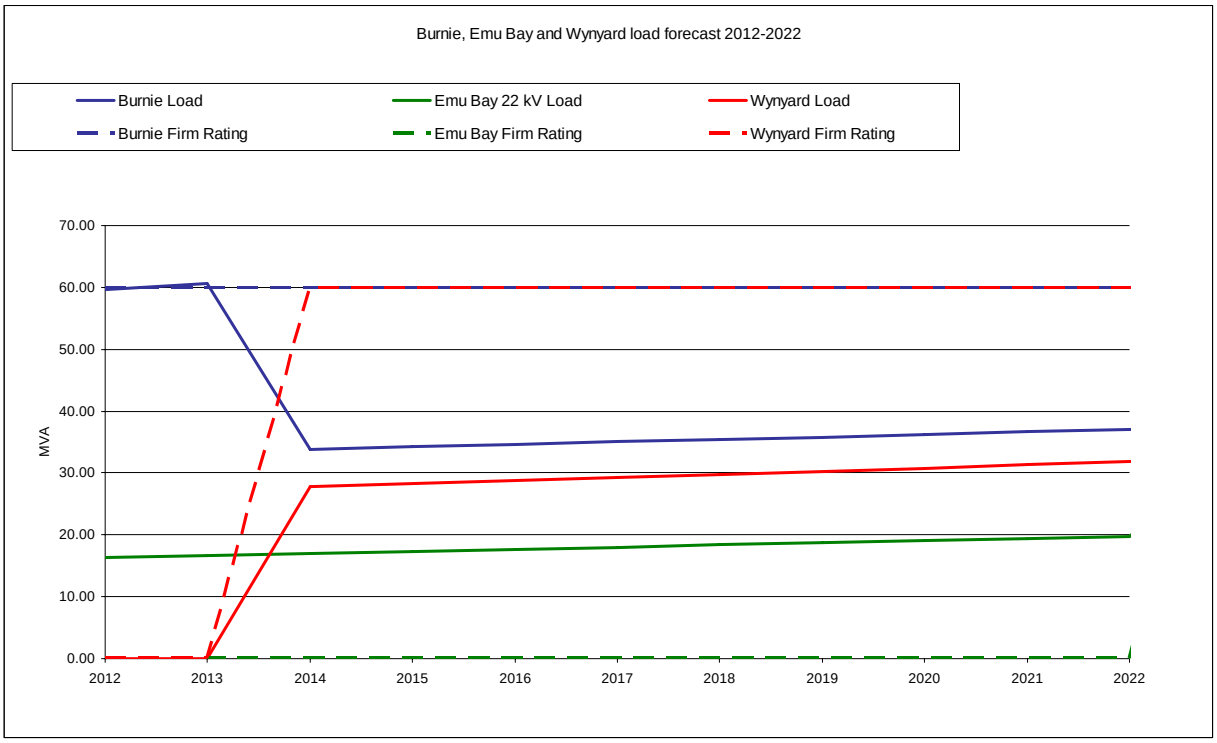

Figure 7-6 Proposed forecast for Wynyard project

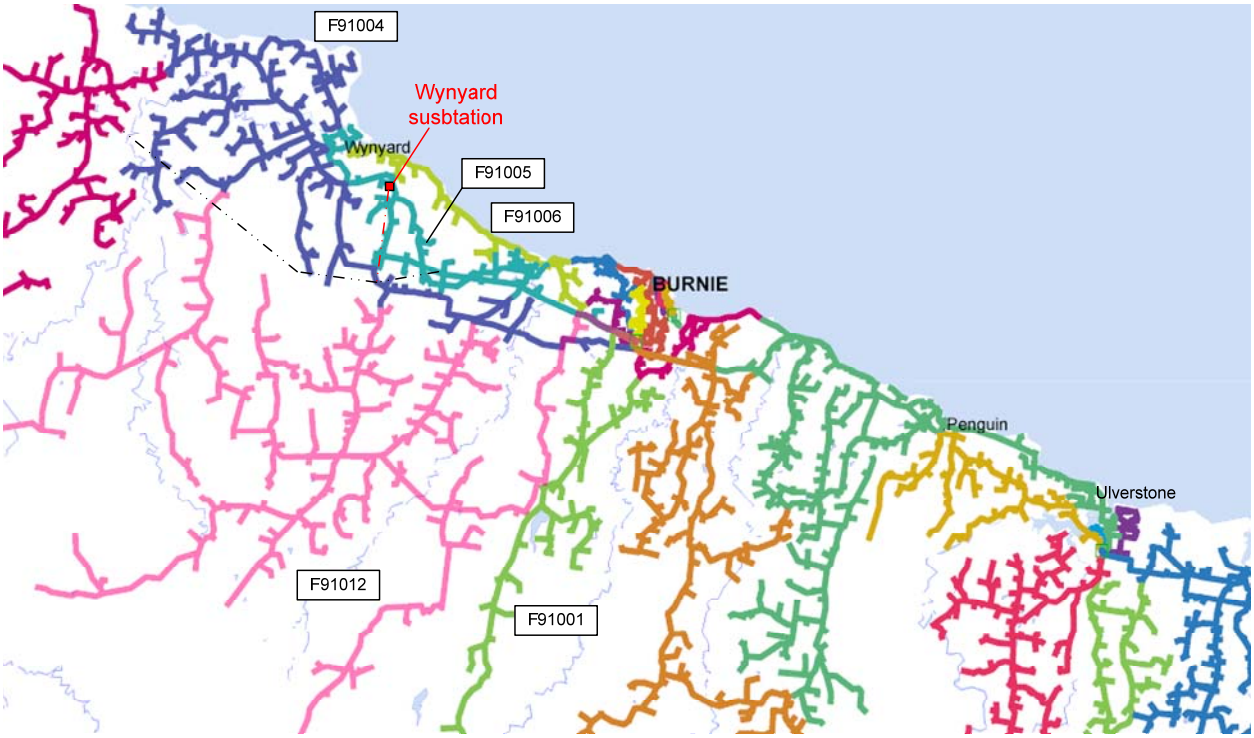

Figure 7-7 Proposed location of Wynyard substation

7.1.4 Port Latta transformer replacement

Port Latta substation supplies the industrial and low density rural areas around Port Latta and the tourism town of Stanley.

Limitations

The transformers at Port Latta terminal substation were installed in 1967. Assuming an asset life of 50 years, it is predicted that the transformers will need replacement around 2017. The distribution load is very small and will not influence the replacement of the transformers. The Transend direct connected 22 kV customer, Goldamere, had an average load of 10.4 MVA in 2009. An expansion at Goldamere may cause the substation load to exceed the firm rating of the transformers.

The firm capacity of Smithton substation is predicted to be exceeded in 2030. If the forecast follows closer to the high growth forecast (due to large point load installations), the transformers at Smithton substation may reach firm capacity in 2021.

There are also no spare 22 kV circuit breakers at the Port Latta substation.

Option 1 – Replace the transformers at Port Latta substation

The first option is to replace the two existing 110/22 kV 22.5 MVA transformers with two 110/22 kV 30 MVA transformers and install 22 kV switchgear. This will address the predicted age limitation of the existing transformers and the lack of spare circuit breakers. The timing of the transformer replacement will be dependent on either a request for increased supply from Goldamere or the predicted age replacement year of around 2017.

Option 2 – Non-network option

No non-network alternatives have been considered.

Option 3 – Do nothing option

The do nothing option is not considered a feasible option as the Port Latta transformers are predicted to reach an age limitation around 2017 and there are no spare circuit breakers at the substation.

Recommended development

The scope of works for Transend includes:

- Replacement of the existing transformers with two 110/22 kV 30 MVA transformers
- Installation of two buses of 22 kV switchgear

The scope of works for Aurora includes:

- Load transfers to Port Latta to deload Smithton

The estimated cost for the upgrade is $15 million.

7.1.5 Burnie transformer replacement

Burnie substation supplies the surrounding suburbs of Burnie, west to Wynyard, east to Heybridge and a large rural area to the south.

Limitations

The transformers at Burnie terminal substation were installed in 1971. Assuming an asset life of 50 years, it is predicted that the transformers will need replacement around 2021.

Option 1 – Replace the ageing transformers at Burnie substation

The first option is to replace the two existing 110/22 kV 60 MVA transformers with two new 110/22 kV 60 MVA transformers around 2021. This will address the predicted age limitation of the existing transformers.

Option 2 – Non-network option

No non-network alternatives have been considered.

Option 3 – Do nothing option

The do nothing option is not considered a feasible option as the Burnie transformers are predicted to reach an age limitation around 2021.

Recommended development

The scope of works for Transend includes:

- Replacement of the existing transformers with two 110/22 kV 60 MVA transformers

The scope of works for Aurora includes:

- Nil

The estimated cost of the upgrade is $6 million.

7.2 Summary of proposed works

The proposed works from 2012 to 2022 in the North West planning area are listed in Table 7-3.

Table 7-3 North West project summary

Year	Proposed Project	Proposed Outcomes
2012	Emu Bay 22 kV supply	Address firm capacity issues at Burnie and Ulverstone substations
2012	Alternate supply to Burnie CBD	Maintain backup to Burnie's high commercial area
2014	Wynyard terminal substation	Address firm capacity issues at Burnie and Ulverstone substations, improved supply to Wynyard area
2017	Port Latta transformer replacement	Addresses age limitation at Port Latta, increase in firm capacity for Port Latta and Smithton areas
2021	Burnie transformer age replacement	Addresses age limitations at Burnie substation

8. Five year plan

A five year plan for each of the substations (including proposed new substations) in the North West area is outlined below.

It should be noted that while each proposed project has undergone a thorough high level analysis, these projects will require further detailed analysis to confirm their economic and technical feasibility. A regulatory investment test will also be required for those projects where the augmentation component exceeds $1 million (RIT-D) or $5 million (RIT-T).

8.1 Port Latta substation

Port Latta terminal substation supplies a large rural area including the tourism town of Stanley in the west and east towards the Wynyard.

8.1.1 Limitations

Using the medium growth forecast, the Port Latta terminal substation load in 2012 is forecast to be 15.42 MVA and it is forecast to grow to 15.80 MVA in 2017. A 5 MVAr capacitor bank was recently installed at Port Latta and this will slightly reduce the peak load.

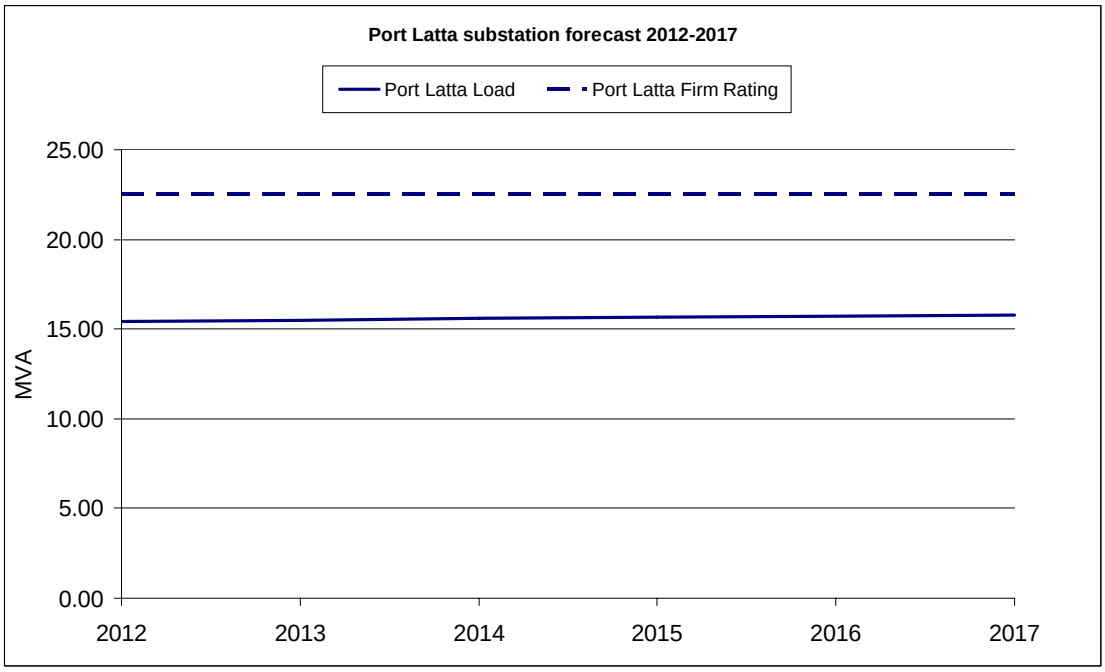

Figure 8-1 Substation five year medium growth forecast

The existing 22 kV network consists of two 22 kV feeders and there are no spare 22 kV circuit breakers. The Port Latta 22 kV supply area and individual 22 kV feeders are shown in the following figures.

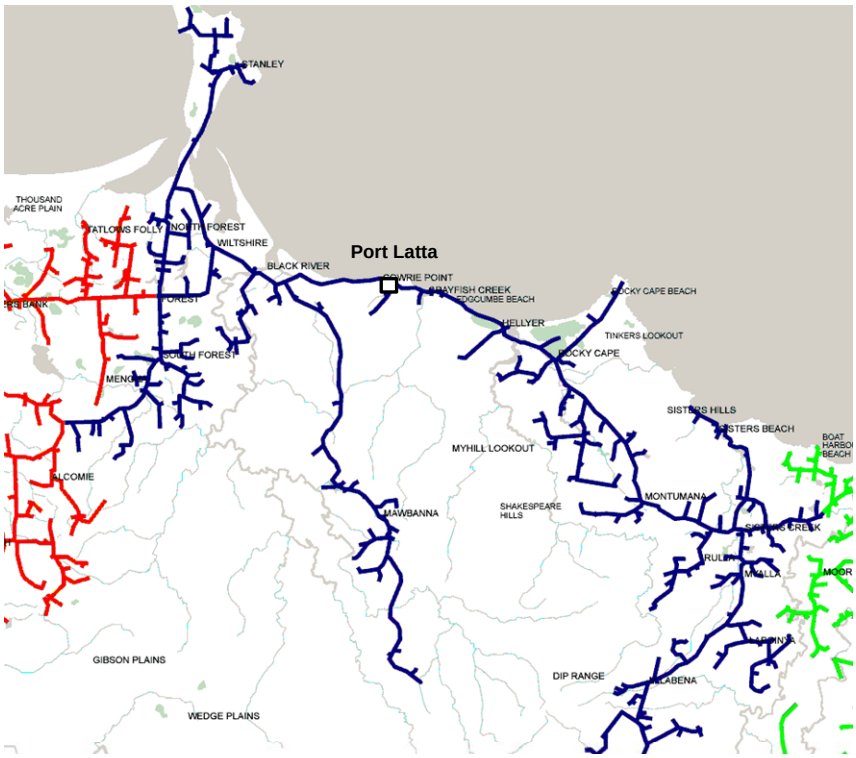

Figure 8-2 Port Latta 22 kV supply area

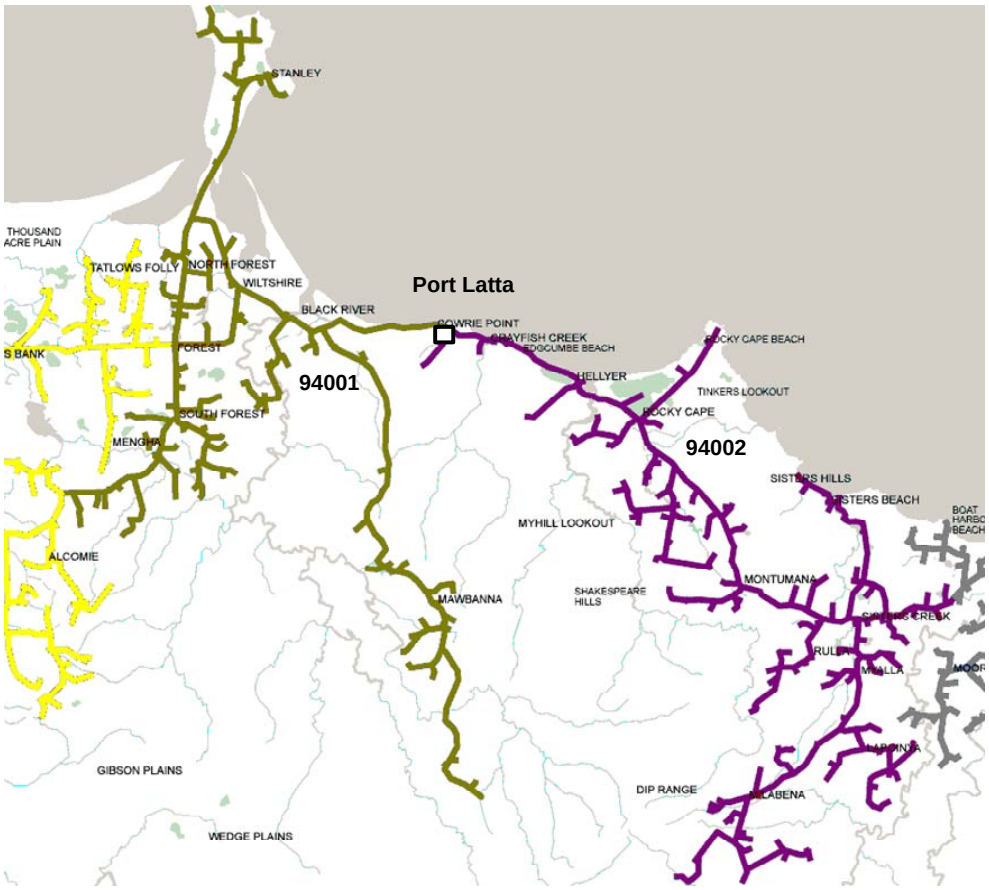

Figure 8-3 Port Latta 22 kV individual feeders

A five year feeder forecast has been developed using the actual peak feeder loads from 2009 and the forecast medium substation growth. The forecast for each feeder is outlined in the following table.

Table 8-1 Forecast feeder growth

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Port Latta	94001	4.60	4.62	4.64	4.66	4.68	4.71
	94002	4.33	4.35	4.38	4.40	4.42	4.44

The forecast feeder loads have been assessed against a maximum feeder rating of 10 MVA for overhead and underground feeders. From the table above, it appears that there are no capacity limitations on the Port Latta feeders.

Port Latta substation has existing transfer capability with Smithton. The following figures are from the load transfer models provided by Aurora.

Table 8-2 Forecast transfer capability

Substation	Feeder	2012 transfer (MVA)	2013 transfer (MVA)	2014 transfer (MVA)	2015 transfer (MVA)	2016 transfer (MVA)	2017 transfer (MVA)
Port Latta - Smithton	93001	2.7	2.6	2.5	2.3	2.2	2.0
Total transfers	-	2.7	2.6	2.5	2.3	2.2	2.0

8.1.2 Proposed projects

Port Latta transformer replacement and feeder upgrade

It is recommended that the two existing 110/22 kV 22.5 MVA transformers be replaced with two 110/22 kV 30 MVA transformers and new 22 kV switchgear around 2017. This will address the predicted age limitation of the existing transformers and the lack of spare circuit breakers at the substation.

There is reasonable load transfer capacity available between Smithton feeder 93001 and the Port Latta feeder 94001. This connection can be utilised to complete a permanent load transfer from Smithton onto Port Latta to deload Smithton substation.

8.1.3 Ultimate configuration

Substation

Port Latta is expected to remain a two transformer substation up to 2050. The two existing transformers will be replaced with 30 MVA units when the predicted age limitation is reached around 2017.

Feeders

The installation of switchgear with the new transformers will allow new feeders to be run from Port Latta substation. Additional conduits should be installed on the main routes from the substation to allow for future feeders.

8.2 Smithton substation

Smithton terminal substation supplies a large rural area and a number of industrial point loads in the Smithton area.

8.2.1 Limitations

Using the medium growth forecast, the Smithton terminal substation load in 2012 is forecast to be 25.93 MVA and it is forecast to grow to 28.41 MVA in 2017.

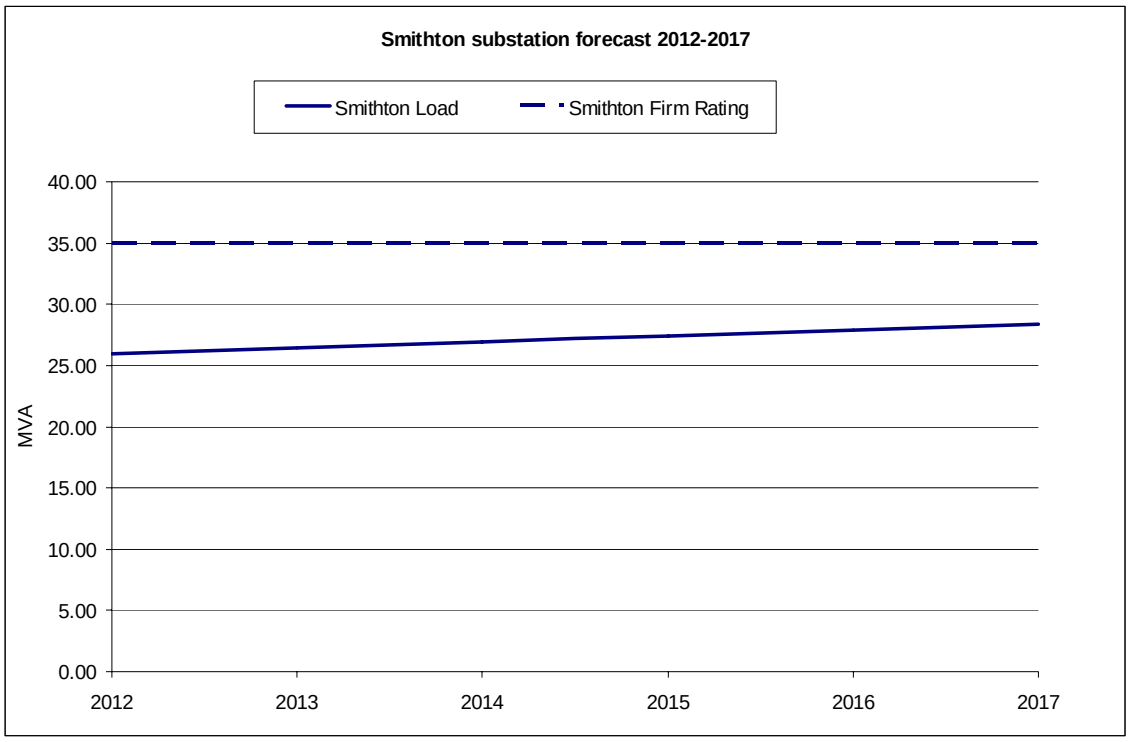

Figure 8-4 Substation five year medium growth forecast

The existing 22 kV network consists of five 22 kV feeders and there is one spare 22 kV circuit breaker. The Smithton 22 kV supply area and individual 22 kV feeders are shown in the following figures.

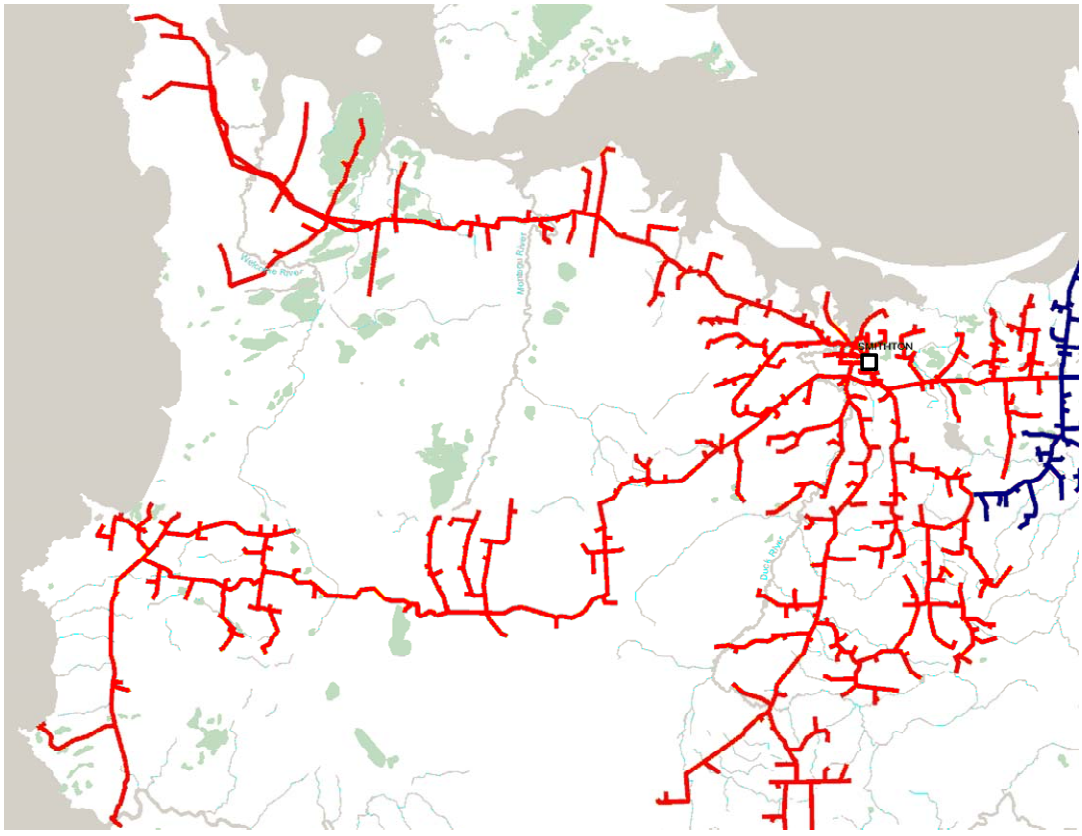

Figure 8-5 Smithton 22 kV supply area

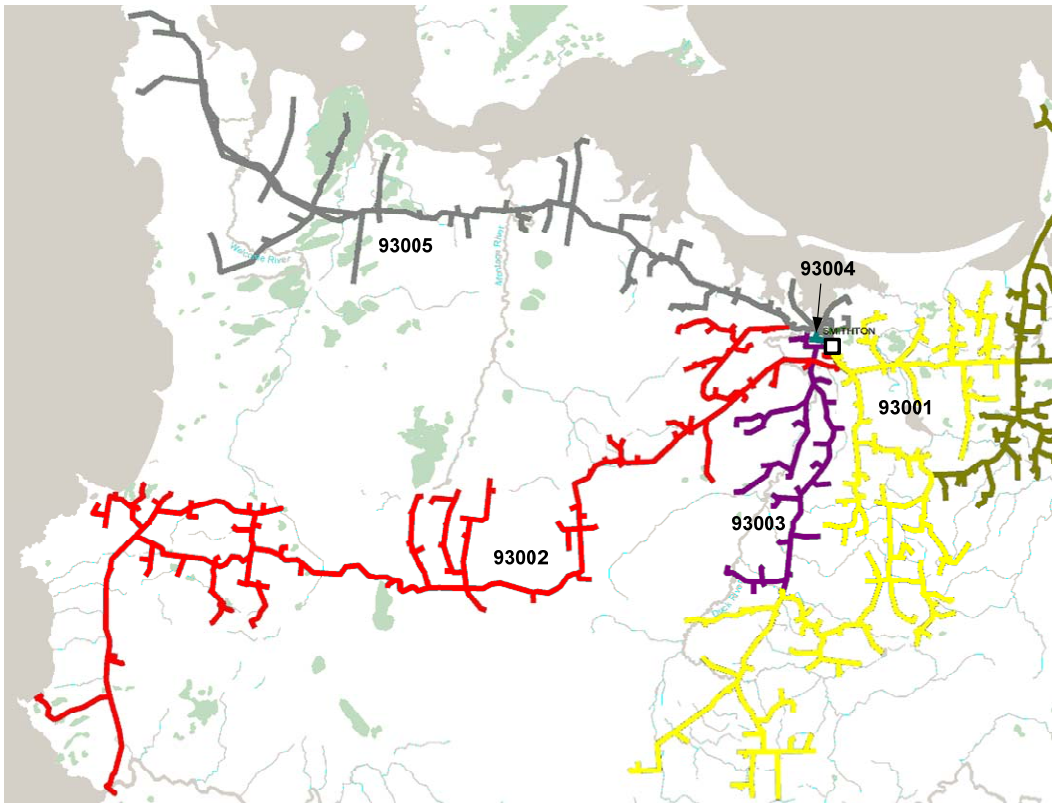

Figure 8-6 Smithton 22 kV individual feeders

A five year feeder forecast has been developed using the actual peak feeder loads from 2009 and the forecast medium substation growth. The forecast for each feeder is outlined in the following table.

Table 8-3 Forecast feeder growth

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Smithton	93001	6.36	6.48	6.61	6.73	6.85	6.97
	93002	7.08	7.22	7.36	7.49	7.63	7.76
	93003	6.45	6.58	6.70	6.83	6.95	7.07
	93004	7.18	7.32	7.46	7.60	7.74	7.87
	93005	5.32	5.42	5.52	5.62	5.73	5.82

The forecast feeder loads have been assessed against a maximum feeder rating of 10 MVA for overhead and underground feeders. From the table above, it appears that there are no capacity limitations on the Smithton feeders.

Smithton substation has existing transfer capability with Port Latta. The following figures are from the load transfer models provided by Aurora.

Table 8-4 Forecast transfer capability

Substation	Feeder	2012 transfer (MVA)	2013 transfer (MVA)	2014 transfer (MVA)	2015 transfer (MVA)	2016 transfer (MVA)	2017 transfer (MVA)
Smithton - Port Latta	94001	6.1	6.0	5.9	5.8	5.8	5.7
Total transfers	-	6.1	6.0	5.9	5.8	5.8	5.7

8.2.2 Proposed projects

There are no substation or feeder projects for the Smithton substation in the five year plan.

8.2.3 Ultimate configuration

Substation

Smithton is expected to remain a two transformer substation up to 2050. The two existing transformers will be replaced when the age limitation is reached.

Feeders

The majority of the load in the Smithton area is comprised of industrial point loads so the need for new feeders will be driven by individual customer applications. There is only one spare breaker available at the substation so obtaining a high utilisation on the existing feeders will be important.

8.3 Burnie substation

Burnie terminal substation supplies a large area including suburbs north of the substation, west towards Wynyard, south to a large rural area and east towards Penguin.

8.3.1 Limitations

Using the medium growth forecast, the Burnie terminal substation load in 2012 is forecast to be 70.8 MVA and it is forecast to grow to 73.04 MVA in 2017. This forecast does not include the new 22 kV supply from Emu Bay in 2012.

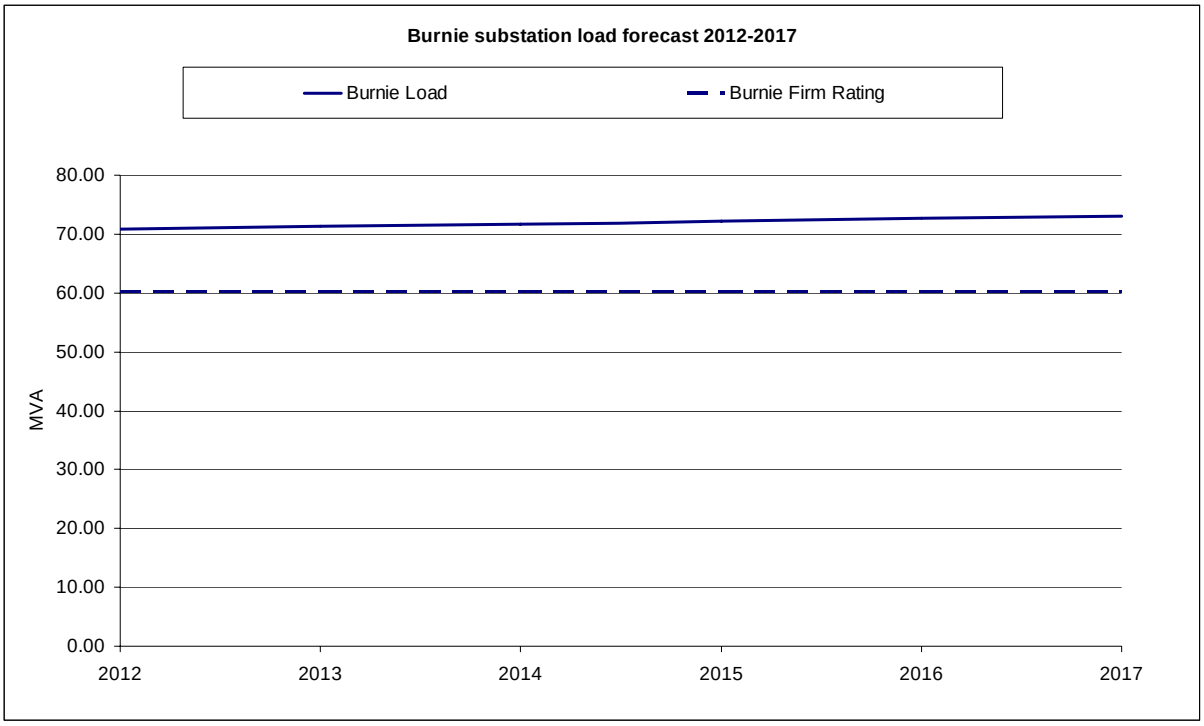

Figure 8-7 Substation five year medium growth forecast

The existing 22 kV network consists of twelve 22 kV feeders and there are two spare 22 kV circuit breakers. The Burnie 22 kV supply area and individual 22 kV feeders are shown in the following figures.

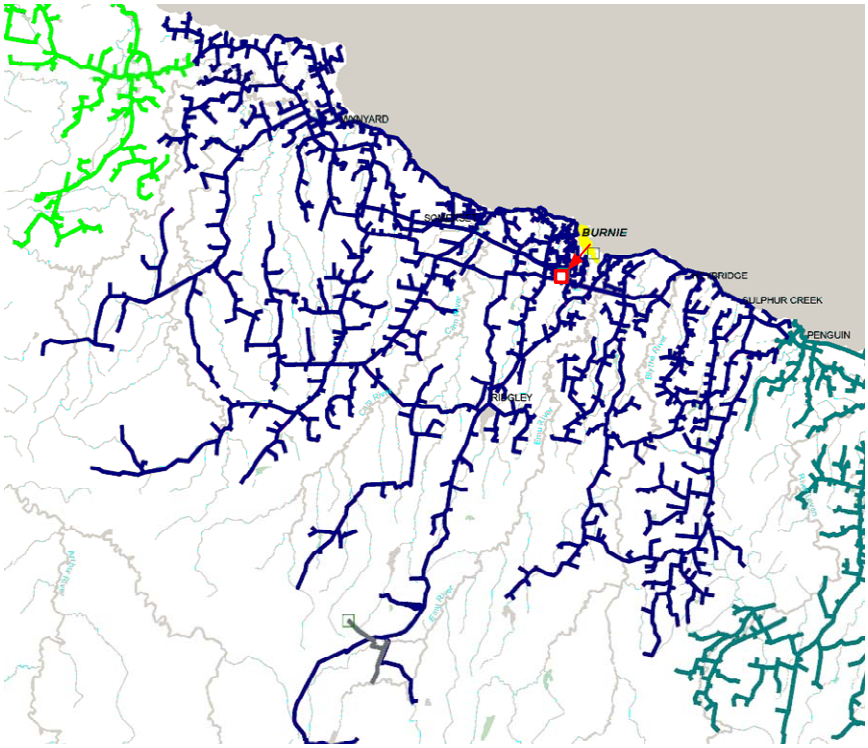

Figure 8-8 Burnie 22 kV supply area

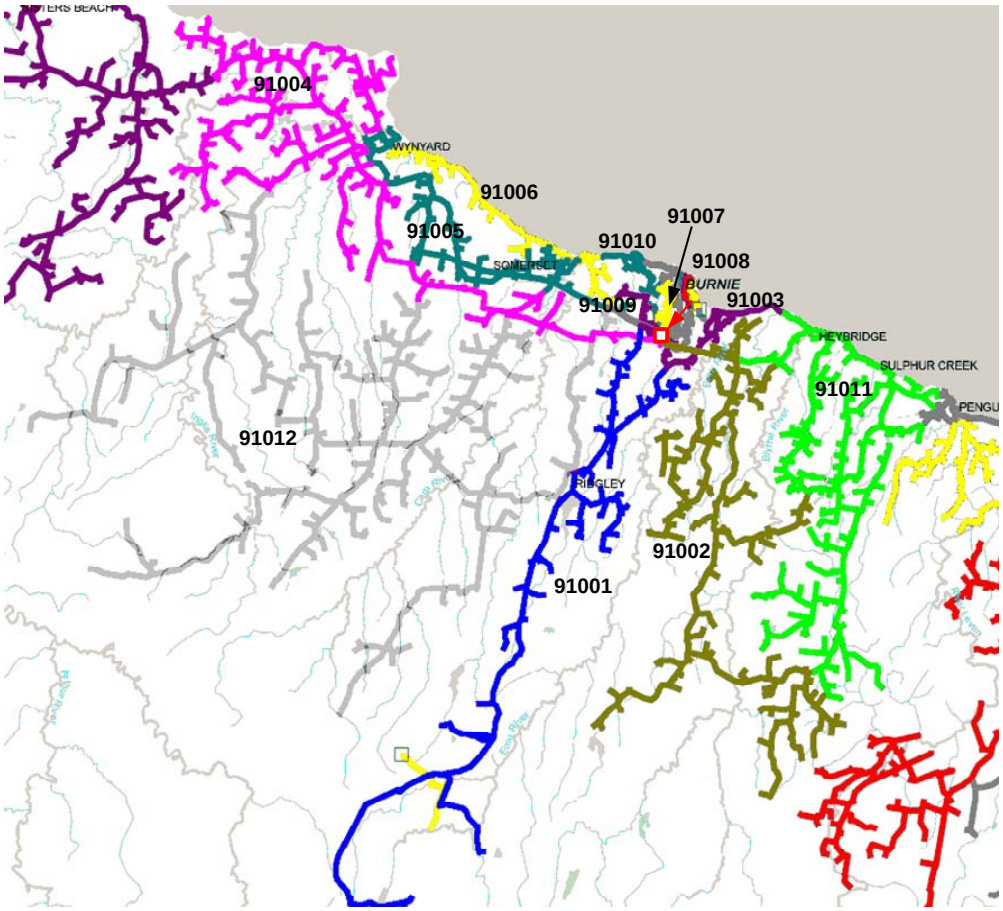

Figure 8-9 Burnie 22 kV individual feeders

A five year feeder forecast has been developed using the actual peak feeder loads from 2009 and the forecast medium substation growth. The forecast for each feeder is outlined in the following table.

Table 8-5 Forecast feeder growth

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
South west rural	91001*	3.68	3.70	3.72	3.74	3.77	3.79
	91012*	3.68	3.70	3.72	3.74	3.77	3.79
Heybridge	91002	3.51	3.53	3.56	3.58	3.60	3.62
	91011	3.84	3.86	3.89	3.91	3.93	3.96
Wynyard	91004	8.00	8.05	8.10	8.16	8.20	8.25
	91005	8.39	8.44	8.50	8.55	8.60	8.65
	91006	7.96	8.01	8.06	8.11	8.16	8.21
Wivenhoe	91003	6.53	6.57	6.62	6.66	6.70	6.74
Shorewell Park	91009	2.22	2.24	2.25	2.27	2.28	2.29
	91010	9.07	9.13	9.19	9.25	9.30	9.36
Burnie developed	91007	4.17	4.20	4.23	4.25	4.28	4.30

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
	91008	9.81	9.88	9.94	10.01	10.07	10.12

** 91001 split by 91012 – assumed approximate load split of 50/50*

The forecast feeder loads have been assessed against a maximum feeder rating of 10 MVA for overhead and underground feeders. From the table above, it appears that there is a limitation on 91008.The adjacent feeder 91007 has available capacity therefore a new tie may be required between the feeders to balance the load. These feeders will also be affected by the alternate CBD supply project. This is further outlined in Section 8.3.2 and 8.5.2 under the Emu Bay substation.

Burnie substation does not have existing transfer capability with any substations. The feeders at Ulverstone that are adjacent to Burnie feeders are heavily loaded and the distance between Port Latta and Burnie is too far for transfers. The Wynyard project and works at Ulverstone will provide much needed transfer capability for Burnie substation.

8.3.2 Proposed projects

Emu Bay 22 kV supply

The new 22 kV feeders from Emu Bay will deload Burnie substation by supplying feeders 91002, 91011 and 91003 from two new feeders. The area to be supplied is shown below. Feeder 91003 will be redirected to deload F91008 and supply one of the new alternate supplies to the CBD. The proposed reconfiguration of F91003 is shown graphically in Figure 8-12.

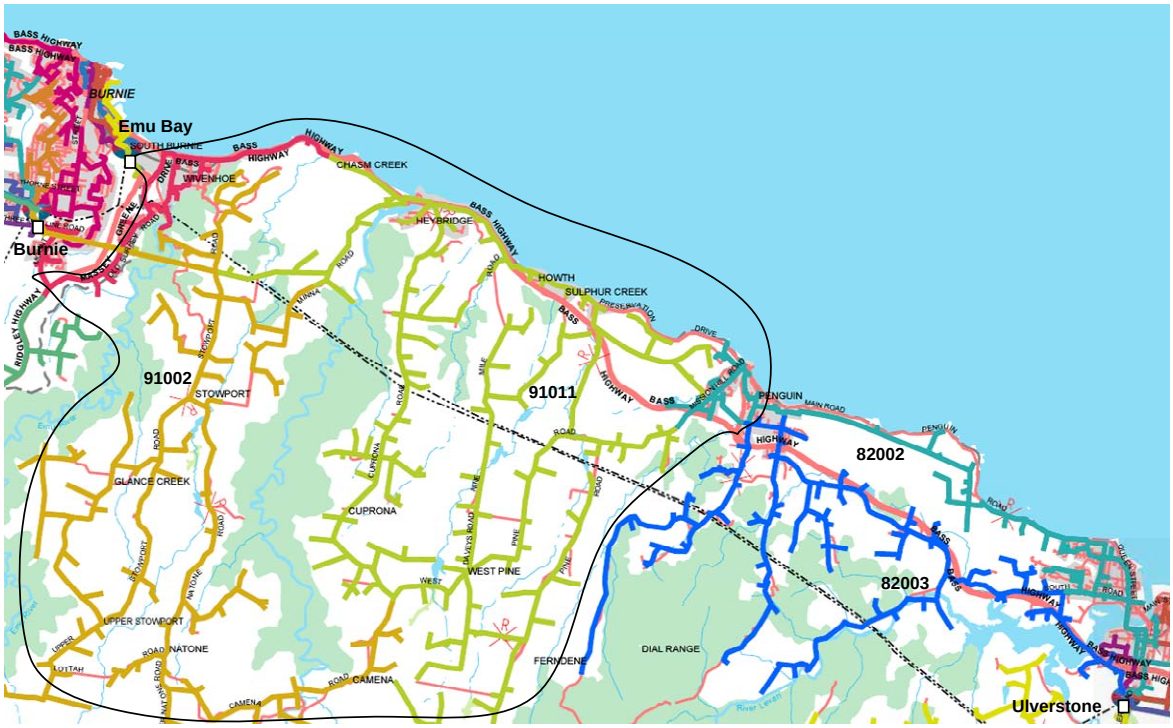

Figure 8-10 Load transfer to deload Burnie

Table 8-6 Forecast feeder growth after transfer project

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Burnie	91002	0.00	0.00	0.00	0.00	0.00	0.00
	91003	0.50	0.50	0.51	0.51	0.51	0.52
	91011	0.11	0.11	0.11	0.11	0.11	0.11

Wynyard substation

It is recommended that a new terminal substation with two 110/22 kV 60 MVA transformers be installed at Wynyard in 2014 to deload the Burnie terminal substation and provide a reliable supply to the Wynyard area. For information on the options analysis for this project, please refer to ten year plan in Section 6.1.4. For information on the scope of work under the five year plan please refer to Section 8.6.

The resulting Burnie five year forecast is shown in the following figure.

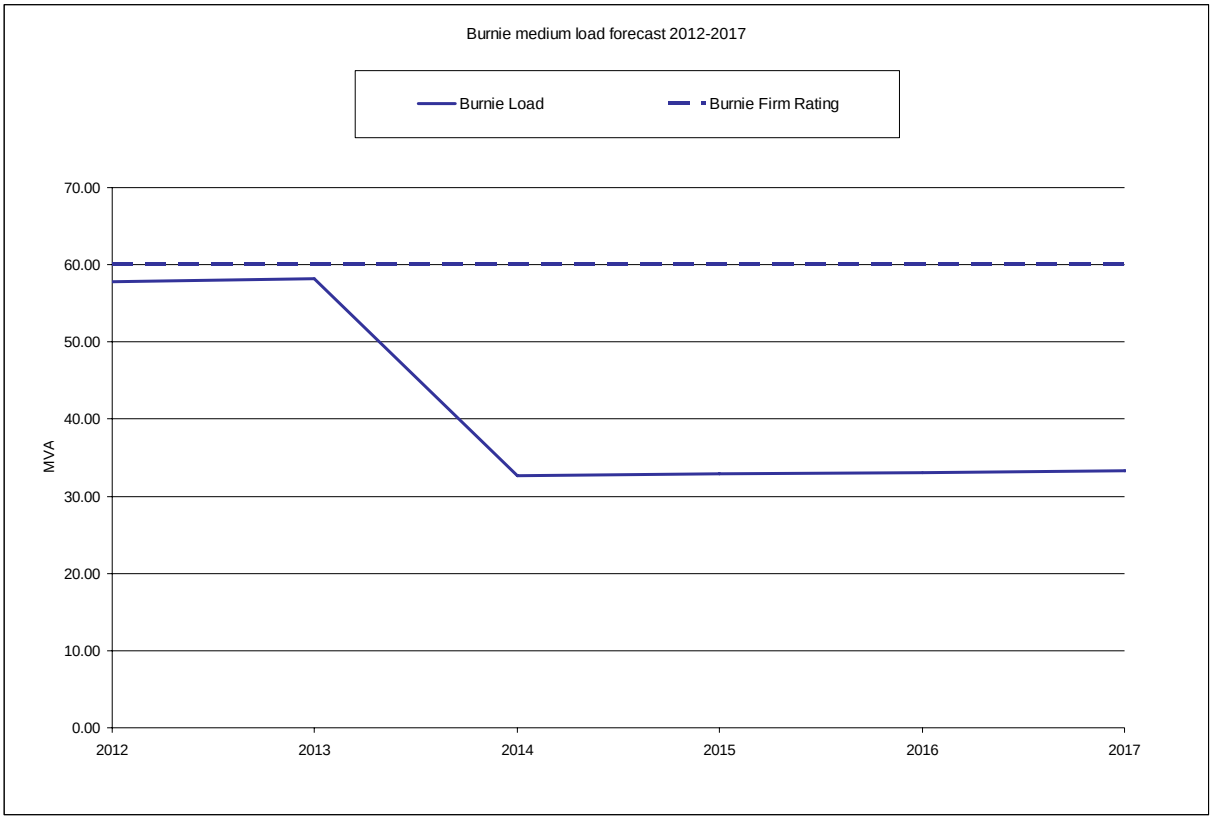

Figure 8-11 Burnie forecast with Wynyard substation installation

As outlined above, Burnie load is reduced below firm capacity in 2014.

The resulting Burnie feeder loads are shown in the following table.

Table 8-7 Burnie substation proposed feeder forecast

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Burnie	91004	8.00	8.05	0.32	0.32	0.33	0.33
	91005	8.39	8.44	0.09	0.09	0.09	0.09
	91006	7.96	8.01	2.01	2.03	2.04	2.05
	91012	3.68	3.70	0.69	0.70	0.70	0.71

As outlined above, feeders 91004, 91005, 91006 and 91012 will be deloaded by the installation of the Wynyard substation. The loads on these figures will be changed under the Burnie feeder reconfiguration as outlined in the following section.

Burnie feeder reconfiguration

A reconfiguration of the Burnie feeders is required after the installation of the Wynyard substation. This will include the balancing of the load across the existing feeders and the creation of new feeders using the tails freed up by the installation of Wynyard substation. Part of the Burnie feeder reconfiguration will be completed in 2012 under the Emu Bay 22 kV supply and alternative supply projects.

The scope of works on each feeder is outlined in the table below and shown graphically in the following figure.

Table 8-8 Burnie feeder reconfiguration works

Feeder	Works	Load transfers	Comments
91001	• No works required	• Load transferred from F91004	• Maintain as rural feeder
91002	• No works required	• No transfers required	• Deloaded under Emu Bay project in 2012 – maintain as spare feeder tail
91003	• No works required	• No transfers required	• Deloaded and utilised under Emu Bay project to deload F91008 and for use as an alternate supply to the CBD
91004	• No works required	• Load transferred to feeder 91001	• Maintain as spare feeder tail
91005	• No works required	• No transfers required	• This feeder will supply a small load and be maintained as a backup supply to Wynyard. The tail can be redirected into Shorewell Park in the future if required.
91006	• No works required	• Load will be transferred from feeder 91010	• Addresses firm capacity limitations on feeder 91010
91007	• No works required	• No transfers required	• Load transferred from F91008 under Emu Bay project in 2012

Feeder	Works	Load transfers	Comments
91008	• No works required	• No transfers required	• Deloaded under Emu Bay project in 2012 by reconfigured F91003 and F91007 and has an alternate supply connection to the CBD
91009	• No works required	• No transfers required	• Available to supply load growth in the Shorewell Park area
91010	• No works required	• Load will be transferred onto 91006 and 91007	• Addresses firm capacity limitation on feeder 91010
91011	• No works required	• No transfers required	• Deloaded under Emu Bay project in 2012 – maintain as spare feeder tail
91012	• No works required	• No transfers required	• Maintain as spare feeder tail

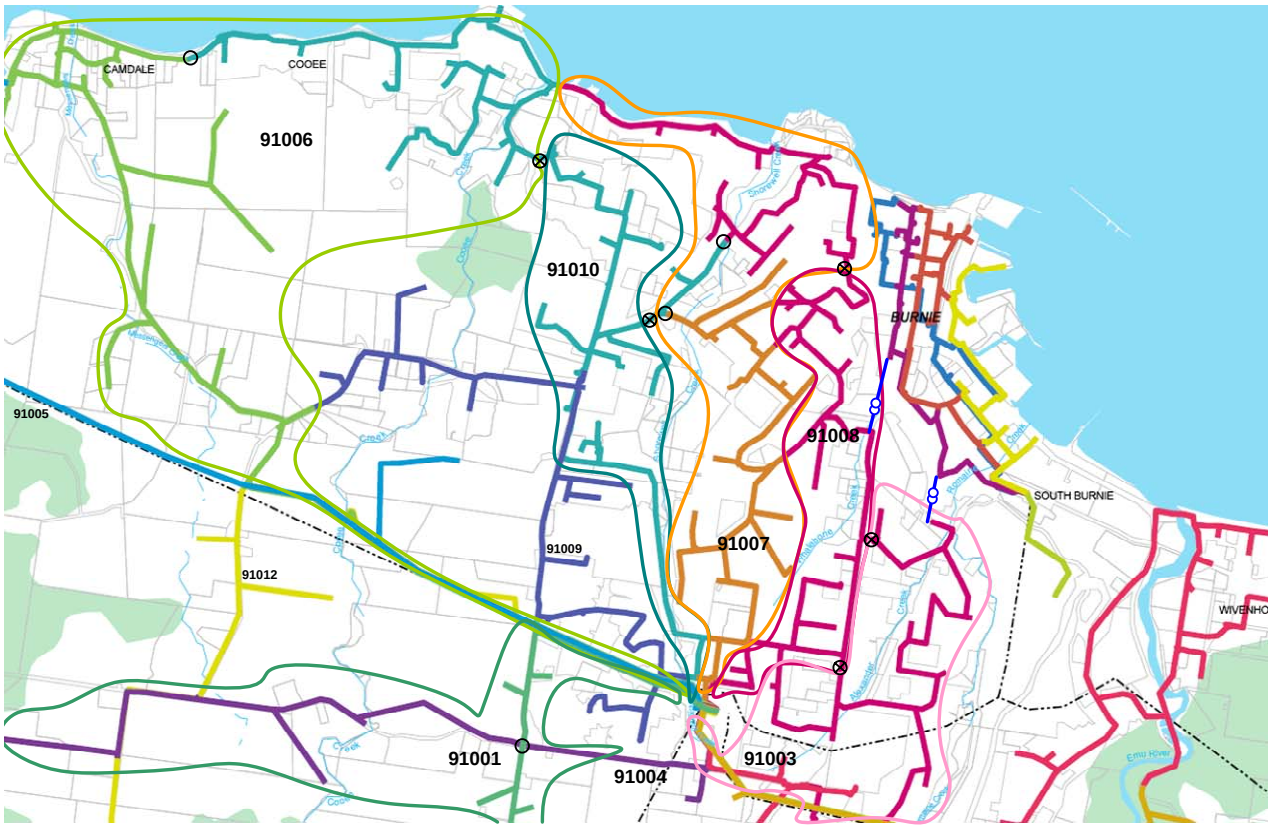

Figure 8-12 Burnie feeder reconfiguration

The following table outlines the new Burnie feeder loads after the reconfiguration.

Table 8-9 Burnie substation feeder forecast with reconfiguration works

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Burnie	91001	3.68	3.70	4.00	4.02	4.05	4.07
	91002	0.00	0.00	0.00	0.00	0.00	0.00
	91003	3.00	3.00	3.02	3.04	3.06	3.07
	91004	8.00	8.05	0.00	0.00	0.00	0.00
	91005	8.39	8.44	0.09	0.09	0.09	0.09
	91006	7.96	8.01	5.40	5.43	5.46	5.49
	91007	6.90	6.94	6.99	7.03	7.07	7.11
	91008	4.32	4.35	4.38	4.41	4.43	4.46
	91009	2.22	2.25	2.26	2.28	2.29	2.31
	91010	9.07	9.13	5.32	5.36	5.39	5.42
	91011	0.11	0.11	0.11	0.11	0.11	0.11
	91012	3.68	3.70	0.69	0.70	0.70	0.71

8.3.3 Ultimate configuration

Substation

Burnie is expected to remain a two transformer substation up to 2050. The two existing transformers will be replaced like for like when the age limitation is reached. The new Wynyard substation and works at Emu Bay and Penguin will provide additional firm capacity in the North West area. A third transformer at Burnie substation is not considered a suitable solution to firm capacity issues due to predicted feeder congestion.

Feeders

The installation of the 22 kV supply at Emu Bay and the new Wynyard substation will deload some of the existing Burnie feeders. These feeders can then be redirected to the high growth areas as required. Additional conduits should be installed on the main routes north from the substation to allow for future feeders.

8.4 Ulverstone substation

Ulverstone terminal substation supplies the town of Ulverstone, west to Penguin and a large rural area to the south and south east.

8.4.1 Limitations

Using the medium growth forecast, the Ulverstone terminal substation load in 2012 is forecast to be 43.41 MVA and it is forecast to grow to 44.83 MVA in 2017. A 5 MVAr capacitor bank has recently been installed at Ulverstone substation and this will slightly reduce the peak load on the substation. This forecast does not include the proposed load transfer in 2012 to the new Emu Bay 22 kV supply.

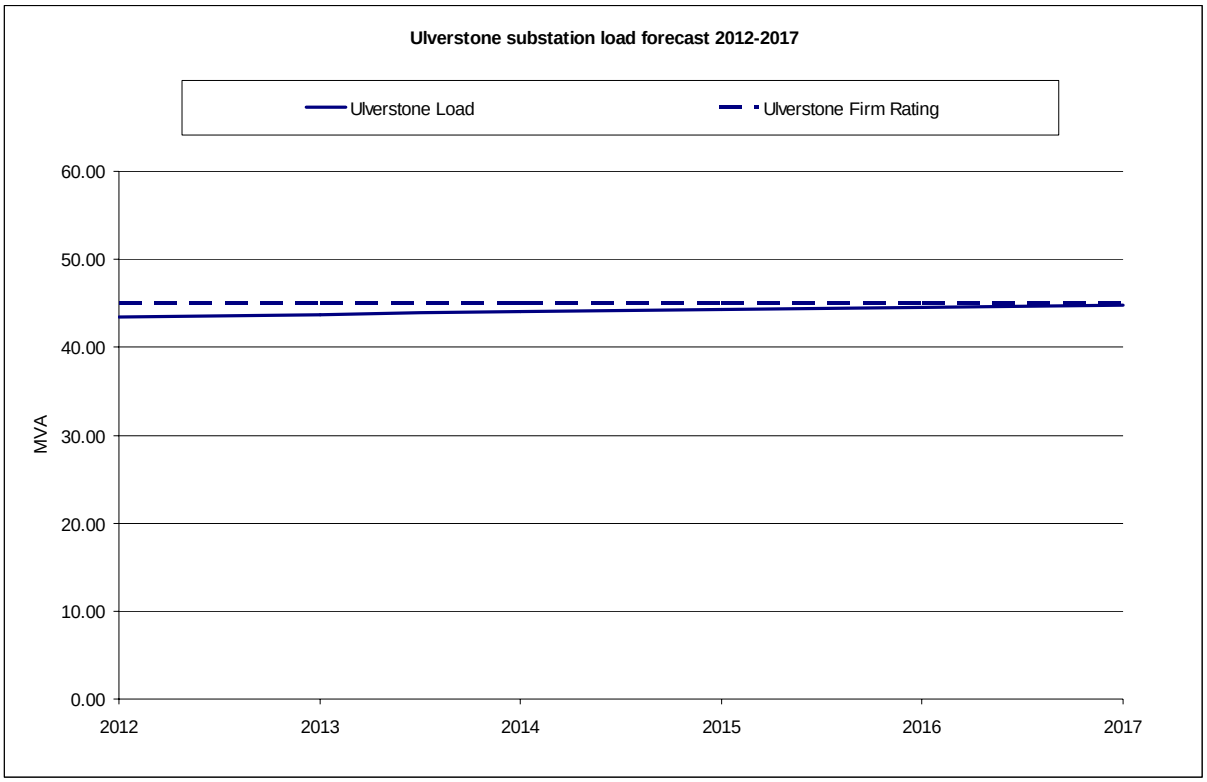

Figure 8-13 Substation five year medium growth forecast

The existing 22 kV network consists of eight 22 kV feeders and there are no spare 22 kV circuit breakers. The Ulverstone 22 kV supply area and individual 22 kV feeders are shown in the following figures.

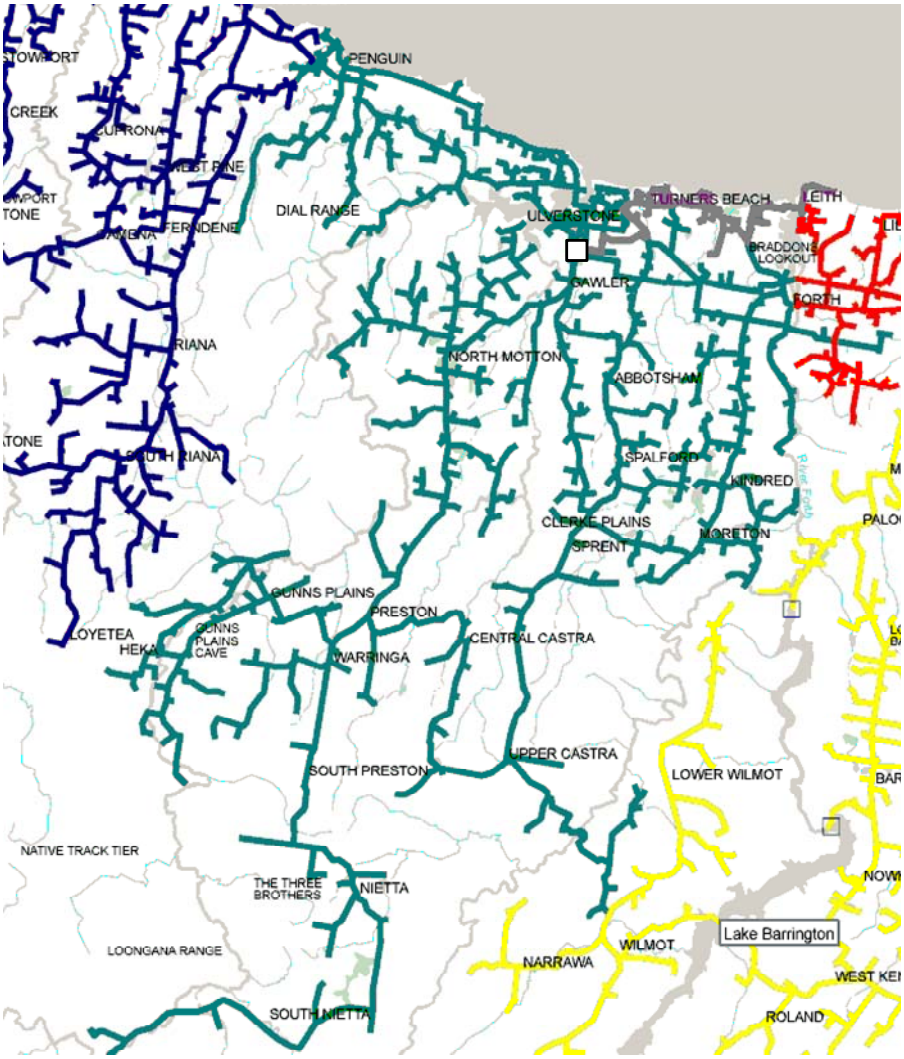

Figure 8-14 Ulverstone 22 kV supply area

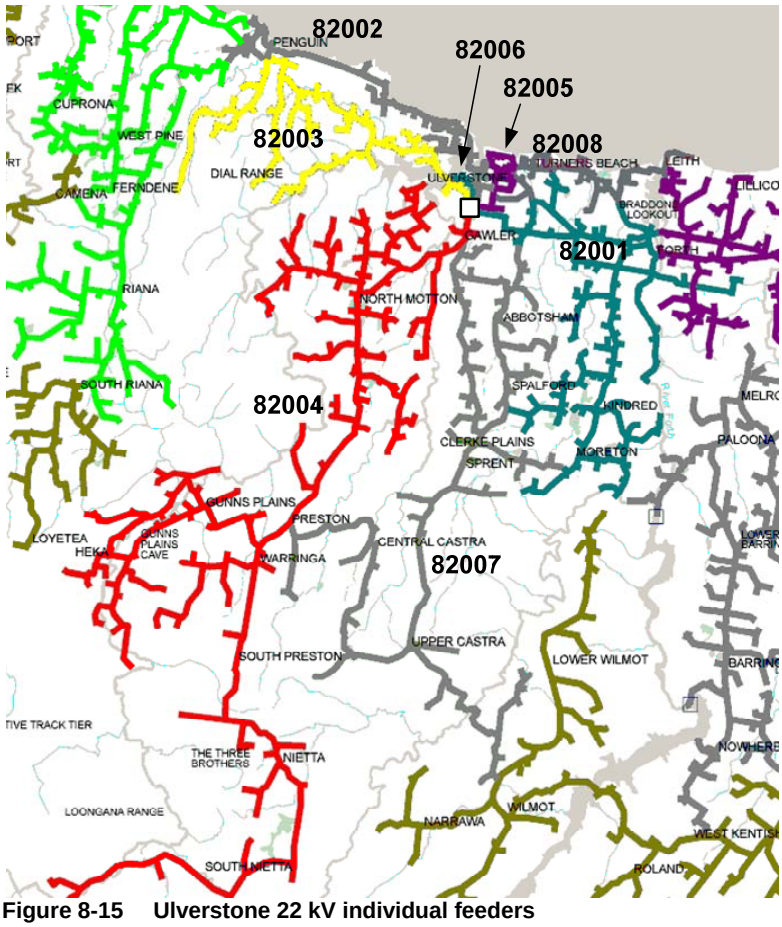

Figure 8-15 Ulverstone 22 kV individual feeders

A five year feeder forecast has been developed using the actual peak feeder loads from 2009 and the forecast medium substation growth. The forecast for each feeder is outlined in the following table.

Table 8-10 Forecast feeder growth

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Penguin and west	82002	10.35	10.42	10.49	10.56	10.62	10.69
	82003	3.90	3.93	3.95	3.98	4.00	4.03
Ulverstone south	82004	2.52	2.54	2.56	2.57	2.59	2.60
	82007	1.03	1.04	1.04	1.05	1.06	1.06
Ulverstone east	82001	2.10	2.12	2.13	2.14	2.16	2.17
	82008	6.32	6.36	6.40	6.44	6.49	6.52
Ulverstone urban	92005	4.51	4.54	4.57	4.60	4.63	4.66
	92006	9.14	9.21	9.27	9.33	9.39	9.44

The forecast feeder loads have been assessed against a maximum feeder rating of 10 MVA for overhead and underground feeders. From the table above, it appears that there is a limitation present on feeder 82002 to Penguin. This is further discussed in Section 8.4.2.

Ulverstone substation has existing transfer capability with Devonport and Burnie. The following figures are from the load transfer models provided by Aurora.

Table 8-11 Forecast transfer capability

Substation	Feeder	2012 transfer (MVA)	2013 transfer (MVA)	2014 transfer (MVA)	2015 transfer (MVA)	2016 transfer (MVA)	2017 transfer (MVA)
Ulverstone - Devonport	80006	7.4	7.4	7.3	7.2	7.1	7.0
Ulverstone - Burnie	91011	1.9	1.8	1.8	1.8	1.8	1.7
Total transfers	-	9.3	9.2	9.1	9	8.9	8.7

8.4.2 Proposed projects

Load transfer to Emu Bay

The main feeder supplying Penguin is heavily loaded and while limited support is available from the adjacent feeder, the Ulverstone substation is also heavily loaded and needs to be deloaded. It is recommended that load be transferred from Ulverstone feeder 82002 to the new Emu Bay feeder in 2012 after the installation of the 22 kV supply at Emu Bay. This transfer can be reversed when the Ulverstone substation transformers are upgraded due to age limitations and additional capacity is available. The load transfer is outlined in the figure below.

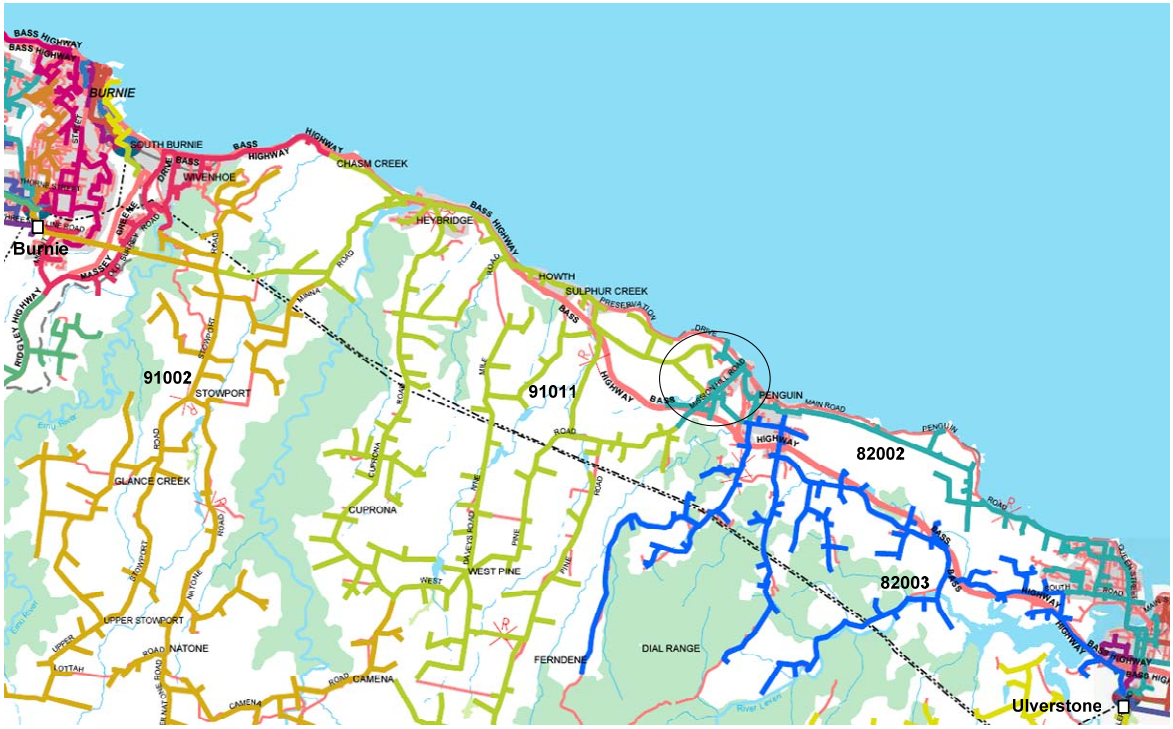

Figure 8-16 Load transfer to deload Ulverstone

Table 8-12 Forecast feeder growth after transfer project

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Penguin	82002	8.07	8.13	8.18	8.23	8.29	8.33

The overloaded feeder will be deloaded for the remainder of the five year period under this project.

8.4.3 Ultimate configuration

Substation

Ulverstone is expected to remain a two transformer substation up to 2050. The two existing transformers will be replaced with 60 MVA units around 2030 to increase capacity and address the predicted age limitation of the transformers. Additional switchgear will be required with the new transformers to allow new feeders to be constructed from Ulverstone.

Feeders

The installation of switchgear with the replacement transformers will allow new feeders to be run from Ulverstone. There are no spare breakers at Ulverstone so support will be required from Burnie and Emu Bay until the transformers are replaced.

8.5 Emu Bay substation

Emu Bay terminal substation supplies the CBD of Burnie at 11 kV. The mill will cease operation in June 2010 which will impact on the requirement for 11 kV in the area.

8.5.1 Limitations

Using the medium growth forecast, the Emu Bay 11 kV terminal substation load in 2012 is forecast to be 10.78 MVA and it is forecast to grow to 11.57 MVA in 2017. The firm capacity of the substation will be affected by the initial project at Emu Bay in 2012. This is discussed further in the proposed projects.

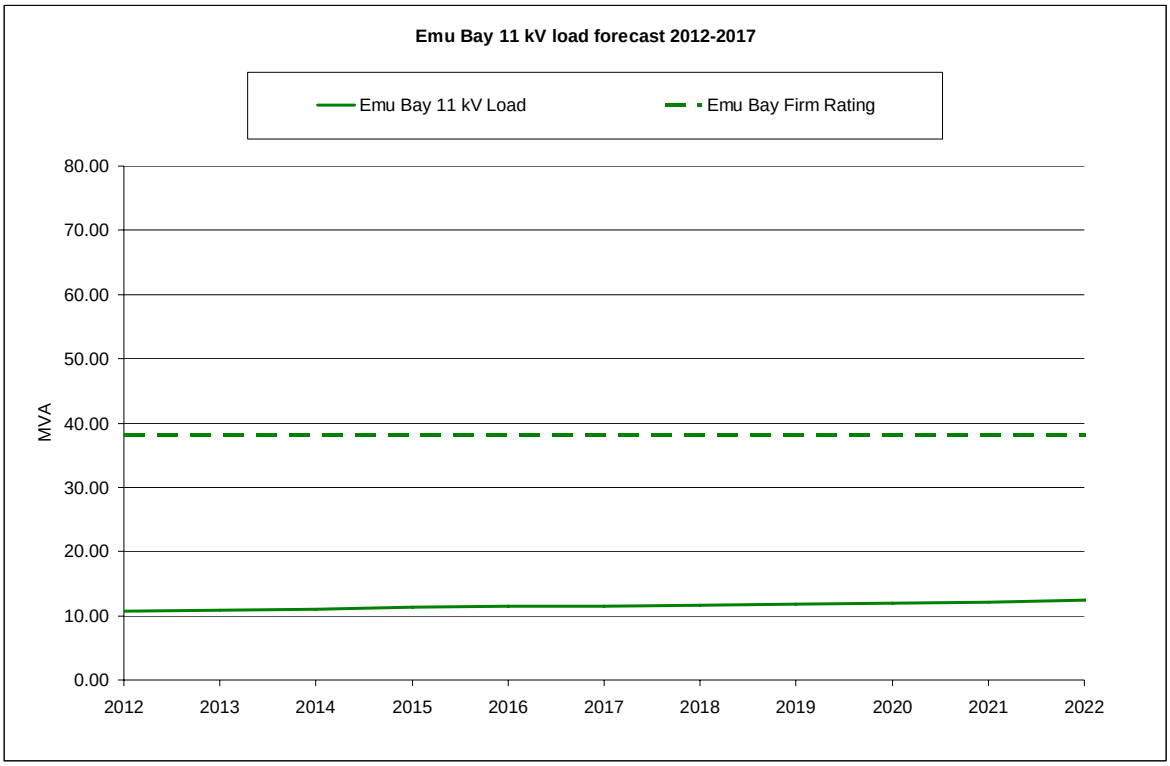

Figure 8-17 Substation five year medium growth forecast

The existing 11 kV network consists of four 11 kV feeders and there are currently no spare 11 kV circuit breakers. When the mill ceases operation, there will be spare circuit breakers available at the substation. The Emu Bay 11 kV supply area and individual 11 kV feeders are shown in the following figures.

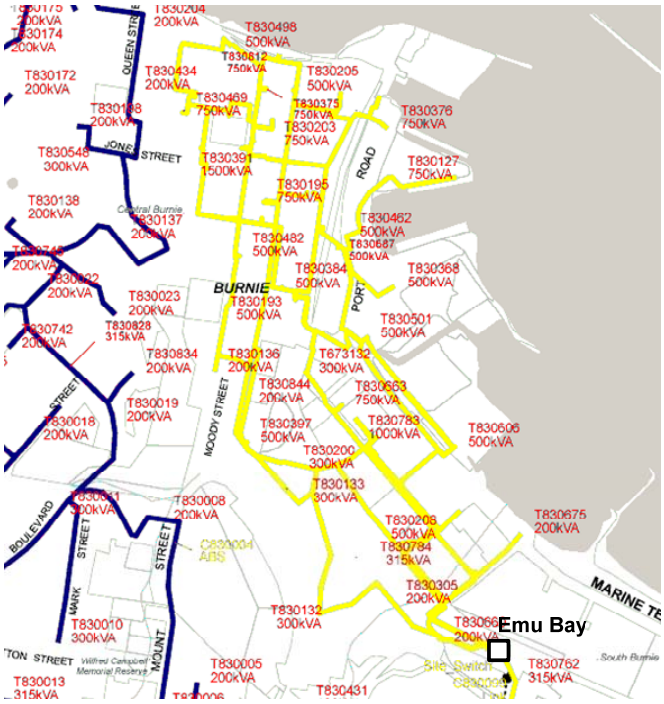

Figure 8-18 Emu Bay 11 kV supply area

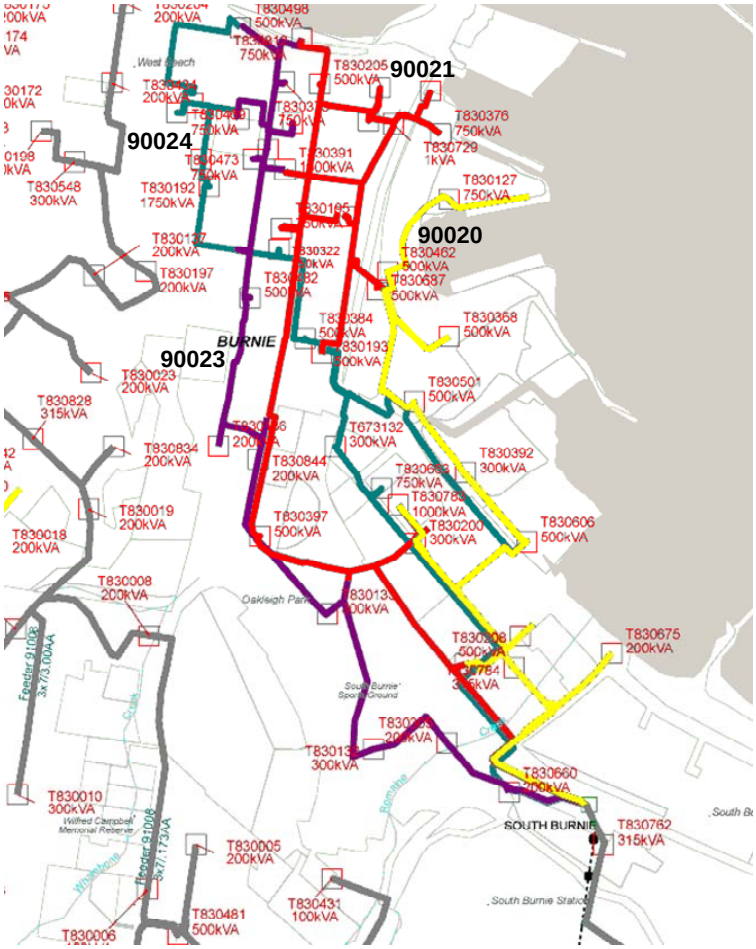

Figure 8-19 Emu Bay 11 kV individual feeders

A five year feeder forecast has been developed using the actual peak feeder loads from 2009 and the forecast medium substation growth. The forecast for each feeder is outlined in the following table.

Table 8-13 Forecast feeder growth

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Emu Bay	90020	2.43	2.47	2.50	2.54	2.58	2.61
	90021	2.77	2.81	2.85	2.89	2.93	2.97
	90023	3.34	3.39	3.44	3.49	3.54	3.58
	90024	3.55	3.61	3.66	3.71	3.76	3.81

The forecast feeder loads have been assessed against a maximum feeder rating of 5 MVA for overhead and underground feeders. From the table above, it appears that there are no limitations on the Emu Bay feeders.

Emu Bay substation does not have any existing transfer capability as the 11 kV network is surrounded by the 22 kV network from Burnie substation.

8.5.2 Proposed projects

Emu Bay 22 kV supply

It is recommended that the existing 110/22-11 kV transformers at Emu Bay be reconfigured to run at two separate secondary voltage levels in 2012. The Burnie CBD will still be supplied at 11 kV and the second transformer will operate at 22 kV and take load from Burnie to address the firm capacity limitations. The new 22 kV feeders from Emu Bay will also deload the heavily loaded feeder from Ulverstone to the Penguin area. The new load to be supplied at 22 kV from Emu Bay is shown in the following figure.

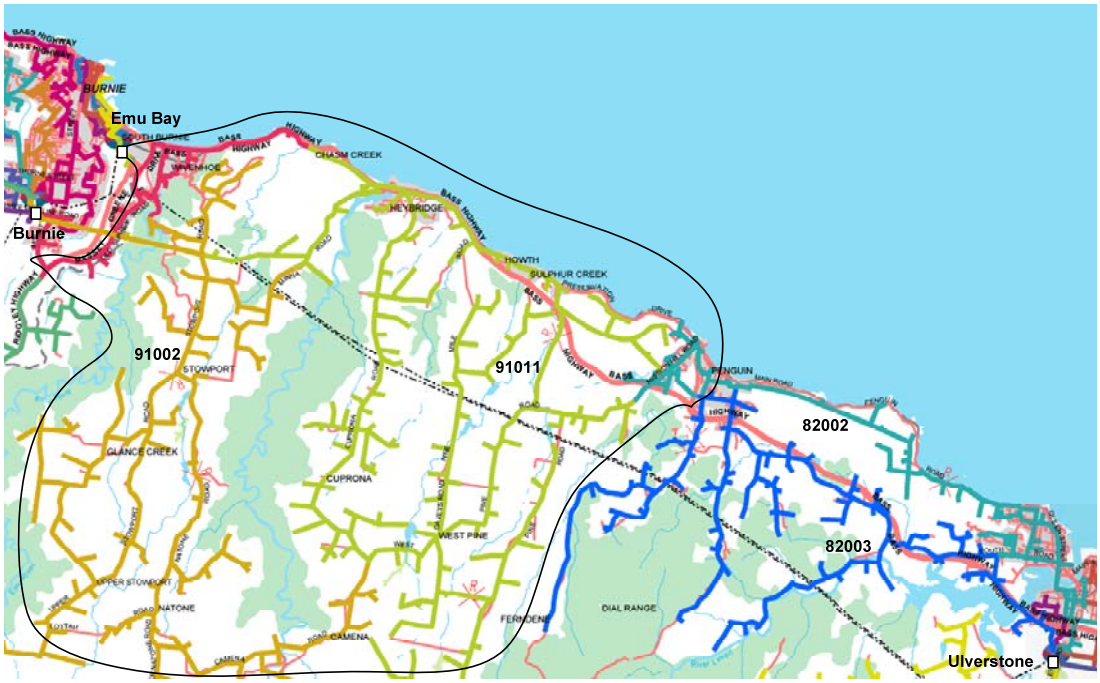

Figure 8-20 Load transfer to deload Ulverstone

Table 8-14 Forecast feeder growth after transfer project

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Emu Bay	New 1	7.38	7.43	7.48	7.52	7.57	7.61
	New 2	8.13	8.18	8.24	8.29	8.34	8.39

Alternative supply to the CBD

It is recommended that two alternate 11 kV connection points be installed in 2012 to enable transfer between the 11 kV and 22 kV networks in Burnie.

The first connection will be made by overbuilding 22 kV overhead conductor from P144018 (91008 Mount St) to an appropriate site on Mount Street for a 5 MVA 22/11 kV ground mounted (possibly cubicle type) auto-transformer. The 11 kV connection will be created by the installation of 22 kV conductor along Mount St and connecting to 90023 on P148679. The eight low voltage poles may need to be replaced depending on their suitability for overbuilding the high voltage conductor. Pole mounted reclosers will be required to make the connection normally open for normal operation. Load will be transferred from feeder 91008 to feeder 91007 and the reconfigured feeder 91003 through existing connection points to provide spare capacity on F91008.

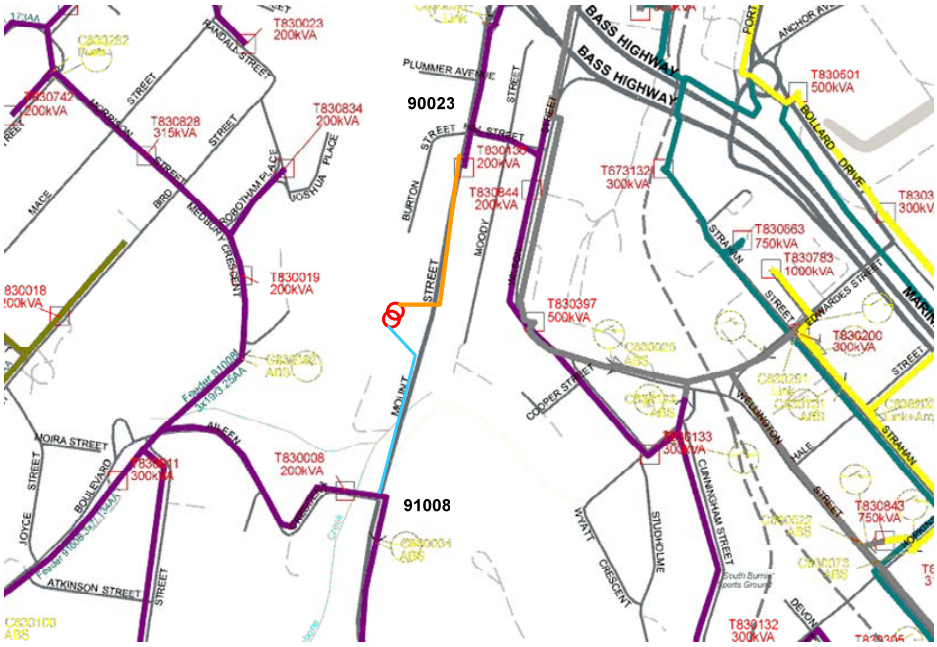

Figure 8-21 Emu Bay 11 kV alternate supply

The second connection will be made by installing a short section of 22 kV cable from reconfigured feeder 91003 (previously 91008) to an appropriate site on Young Street for a 22/11 kV 5 MVA ground mounted auto-transformer. The 11 kV connection will be created by installing of an 22 kV section of cable from the transformer along Studholme Street to Emu Bay feeder 90023 on Cunningham Street.

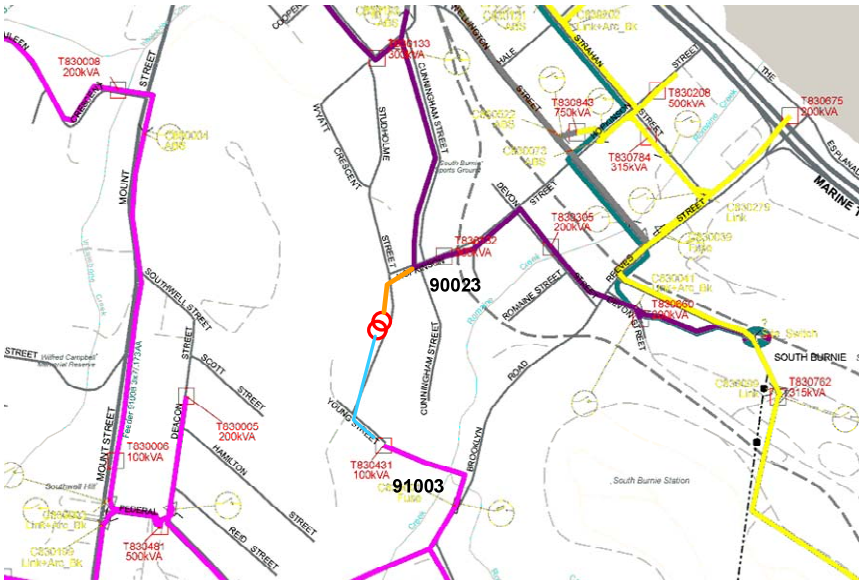

Figure 8-22 Emu Bay 11 kV alternate supply

8.5.3 Ultimate configuration

Substation

Emu Bay will be converted to a 110/22 kV connection point around 2022. Emu Bay is expected to remain a two transformer substation up to 2050.

Feeders

There will be spare 11 kV breakers (due to the shutdown of the paper mill) at Emu Bay substation that can be utilised until the network is converted to 22 kV. New switchgear will be installed under the Emu Bay 22 kV supply project. Transfer capacity will be established between Burnie and Emu Bay when the conversion to 22 kV is complete.

8.6 Wynyard substation

The Wynyard substation is proposed to be installed in 2014 to relieve the firm capacity limitations at Burnie and improve reliability in the 22 kV network to the Wynyard area. For information on the options analysis for this project, please refer to the ten year plan in Section 7.1.3. This section of the report will focus on the scope of work for Aurora under the five year plan. These feeder routes are suggestions and will need further analysis based on the chosen site location.

Assuming a site location, the scope of works for this project includes:

- Installation of a 2.5 km 22 kV tail to cut into Burnie feeder 91004 on Reservoir Drive. This feeder will pick up load from Burnie feeder 91004.
- Installation of an 800 m 22 kV tail to cut into Burnie feeder 91006 on the Bass Highway. This feeder will pick up load from Burnie feeder 91006 and 91005.
- Installation of a 400 m 22 kV tail to cut into Burnie feeder 91005 on Coopers Lane. This feeder will pick up load from Burnie feeder 91005 and 91006.
- Installation of a 100 m 22 kV tail to cut into Burnie feeder 91005 on Mount Hicks Road. This feeder will pick up load from Burnie feeder 91005.
- Installation of a 100 m 22 kV tail to cut into Burnie feeder 91005 on Mount Hicks Road. This feeder will pick up load from Burnie feeder 91005 and 91012.

The proposed works and the feeder supply areas are shown in the following figures. A natural barrier of the Cam River has been used as an approximate boundary between the Wynyard and Burnie supply areas.

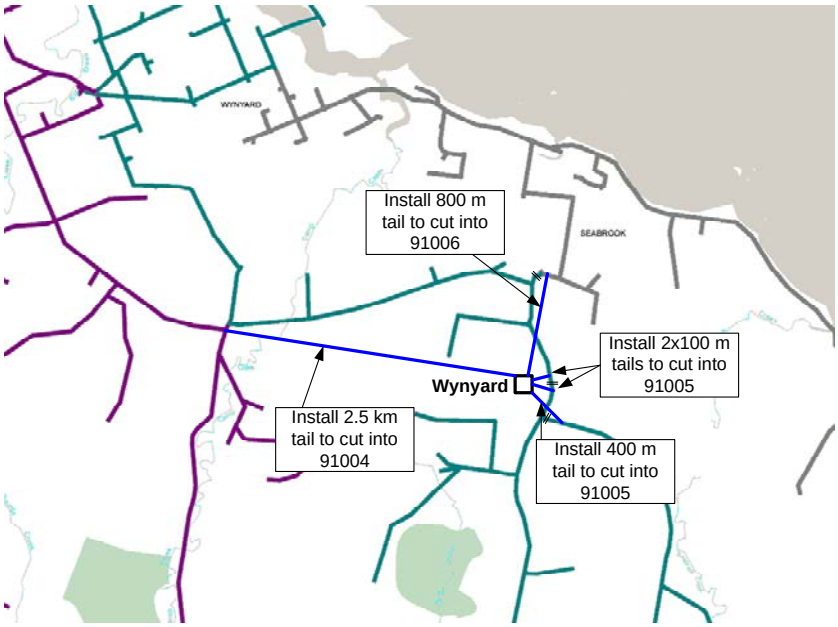

Figure 8-23 Wynyard substation 22 kV feeder works

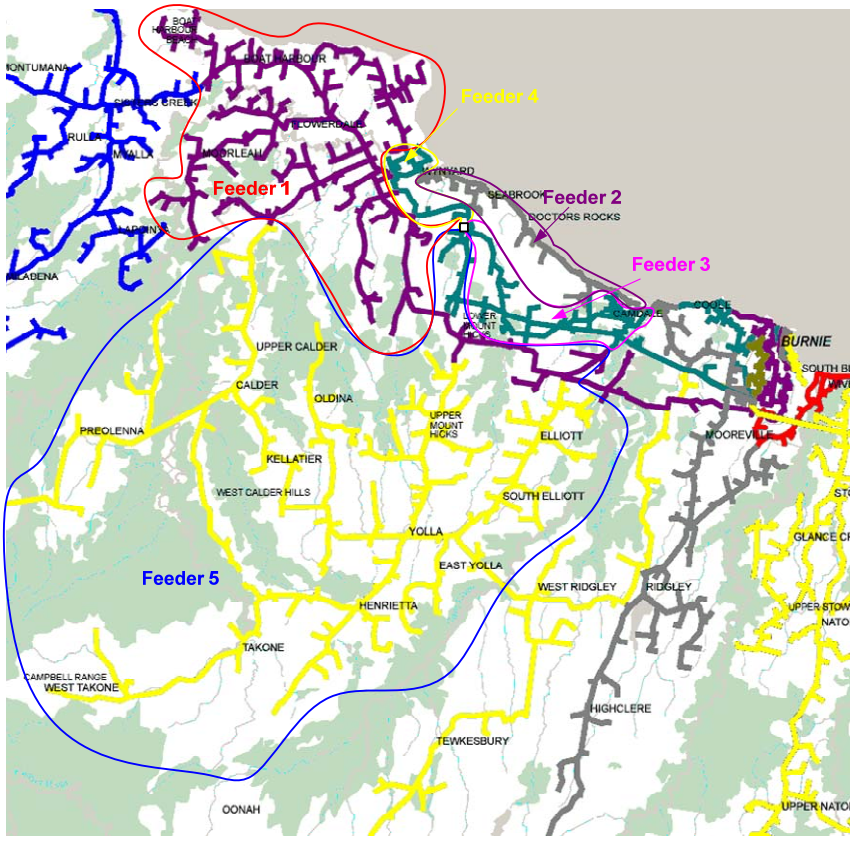

Figure 8-24 Wynyard substation new approximate 22 kV feeder supply areas

DINIS has been used to calculate approximate feeder loads for the new feeders from the Wynyard substation. The loads have been projected based on the substation growth from which the feeder was originally connected. Further analysis will be required on the final 22 kV configuration based on the chosen substation site location.

Table 8-15 Proposed new feeder growth

Area	Feeder/s	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)	2018 load (MVA)	2019 load (MVA)
Wynyard	1	6.74	6.79	6.83	6.87	6.90	6.93
	2	5.74	5.77	5.81	5.84	5.87	5.90
	3	2.99	3.01	3.03	3.04	3.06	3.08
	4	4.83	4.86	4.89	4.92	4.95	4.98
	5	3.42	3.44	3.46	3.48	3.50	3.52

As outlined above there are no forecast feeder limitations in the five years following the establishment of Wynyard substation, based on the feeder planning rating of 10 MVA.

8.6.1 Proposed projects

The Wynyard substation is to be established in the third year of the five year plan period so there are no further projects required for this substation supply area.

8.6.2 Ultimate configuration

Substation

Wynyard is expected to remain a two transformer substation up to 2050. This substation maintains a similar supply area over the long term strategic plan period.

Feeders

The requirement for future feeders will be dependent on the development of land in the area. Additional conduits should be installed on the major routes from the substation to allow for future feeders in any direction.

Appendix A
Estimating data

Appendix A

The following tables list the standard feeder and substation costs used for this report.

Voltage	Feeder Type	Cost ($k/km)			Source
		Rural	Urban	High density Urban	
110 kV	Overhead single circuit	450	-	-	Transend (advised $400-500k)
110 kV	Over head single circuit (double circuit construction)	500	-	-	Transend (advised $400-500)
110 kV	Overhead double circuit	550	-	-	Transend (advised $500-600k)
66 kV	Overhead single circuit	250	-	-	Aurora
66 kV	Overhead double circuit	330	-	-	Aurecon assumption
66 kV	Overbuild of existing 22 kV	180	290	360	Aurecon assumption
33 kV	Underground single circuit	250	300	500	Aurora
33 kV	Underground double circuit	420	500	750	Aurora
33 kV	Overhead single circuit	150	200	300	Aurora
22 kV	Overhead single circuit	100	150	200	Aurora
22 kV	Underground single circuit	220	270	470	Aurora
22 kV	Underground double circuit	360	440	690	Aurora
11 kV	Overhead single circuit	100	150	200	Aurora
11 kV	Underground single circuit	220	270	470	Aurora
11 kV	Underground double circuit	360	440	690	Aurora

Component	Cost ($k)	Source
110/22/11 kV terminal substation	17,500	Transend (advised $15-20M)
110/22/11 kV terminal substation (single 25 MVA transformer)	9,000	Transend (advised $8-10M)
Install 3rd 110/22/11 kV transformer at existing site	7,000	Transend (advised $6-8M)
Install 3rd 33/11 kV transformer at existing site	3,000	Aurecon assumption
Replace 2 x 110/22/11 kV 60 MVA transformers	6,000	Aurecon assumption based Transend projects in APR
Replace 2 x 110/22/11 kV 25 MVA transformers	5,000	Aurecon assumption based Transend projects in APR
Establish 110/33 kV substation at existing site	13,500	Transend (advised $12-15M)
Establish 110/66 kV substation at existing site	14,000	Aurecon assumption
66/22 kV zone substation	9,000	Aurora
33/11 kV zone substation	7,000	Aurora
33 kV switchboard (5 CBs in existing building)	500	Aurecon assumption
11 kV switchboard (8 CBs in existing building)	300	Aurecon assumption

Appendix B
NPV analysis

Appendix B

The following table lists the NPV analyses attached in this section of the report.

NPV	Project	Section reference
1	Wynyard substation	7.1.3

Wynyard NPV analysis (North West area)

Base Year

2010

OPTION 1

Establish Wynyard substation

Development Year			System Limitation	Description of Works	Cost $k	Medium Growth Net Present Value in $ M			High Growth Net Present Value in $ M			Low Growth Net Present Value in $ M		
Medium	High	Low				5.64%	6.64%	7.64%	5.64%	6.64%	7.64%	5.64%	6.64%	7.64%
2014	2013	2015	Burnie system capacity exceeded	Establish 110/22 kV substation at Wynyard: - 110 kV cut in - 3 x 110 kV CBs - 2 x 60 MVA 110/22 kV transformers - 16 x 22 kV CBs and 22 kV feeders	$24,200	$19.43	$18.71	$18.03	$20.53	$19.96	$19.40	$18.39	$17.55	$16.75
2040	2039	2041	Burnie system capacity exceeded	Install a third transformer at Burnie: - 1 x 110 kV CB - 1 x 60 MVA 110/22 kV transformer - 8 x 22 kV CBs	$7,000	$1.35	$1.02	$0.77	$1.43	$1.08	$0.83	$1.28	$0.95	$0.71
					Total	**$20.78**	**$19.73**	**$18.80**	**$21.95**	**$21.04**	**$20.23**	**$19.67**	**$18.50**	**$17.46**

OPTION 2

Install a third transformer at Burnie

Development Year			System Limitation	Description of Works	Cost $k	Medium Growth Net Present Value in $ M			High Growth Net Present Value in $ M			Low Growth Net Present Value in $ M		
Medium	High	Low				5.64%	6.64%	7.64%	5.64%	6.64%	7.64%	5.64%	6.64%	7.64%
2014	2013	2015	Burnie system capacity exceeded	Install a third transformer at Burnie: - 1 x 110 kV CB - 1 x 60 MVA 110/22 kV transformer - 8 x 22 kV CBs	$11,000	$8.83	$8.51	$8.19	$9.33	$9.07	$8.82	$8.36	$7.98	$7.61
2015	2014	2016	Wynyard 22 kV feeder capacity and reliability	Install feeders to Wynyard	$8,000	$6.08	$5.80	$5.54	$6.42	$6.19	$5.96	$5.76	$5.44	$5.14
2026	2025	2027	Burnie optimal feeder capacity exceeded	Establish 110/22 kV substation at Wynyard: - 110 kV cut in - 3 x 110 kV CBs - 2 x 60 MVA 110/22 kV transformers - 16 x 22 kV CBs and 22 kV feeders	$24,200	$10.06	$8.65	$7.45	$10.63	$9.23	$8.02	$9.52	$8.11	$6.92
					Total	**$24.97**	**$22.96**	**$21.18**	**$26.38**	**$24.48**	**$22.80**	**$23.64**	**$21.53**	**$19.68**

Appendix C
Glossary

Appendix C – Glossary of terms

AAC – All Aluminium Conductor

AAAC – All Aluminium Alloy Conductor

ACO – Auto Change-Over

APR – Annual Planning Report

AVR – Automatic Voltage Regulation

CB – Circuit Breaker

CBD – Central Business District

DCCT – Double Circuit

DINIS – Power systems software package used by Aurora for load flow studies.

ESI regulations – Electricity Supply Industry regulations, transmission network performance standards specified by the Tasmanian Department of Energy

ECC – Emergency Cyclic Capacity

FLRS – Feeder Load Reporting System, Aurora database of historical distribution feeder loading.

HV – High Voltage

NCC – Normal Cyclic Capacity

NPV – Net Present Value

PMR – Pole-Mounted Recloser

RIT – Regulatory Investment Test

RMU – Ring Main Unit

SCCT – Single Circuit

TRIP – Targeted Reliability Improvement Project

WACC – Weighted Average Cost of Capital

Webmap – Software package used by Aurora to maintain geographical information about installed assets.

XLPE – Cross Linked Poly Ethylene

Adelaide 61 8 8237 9777
Auckland 64 9 520 6019
Bangkok 66 2 260 4560
Blenheim 64 3 520 6060
Brisbane 61 7 3173 8000
Cairns 61 7 4051 6266
Canberra 61 2 6112 0100
Christchurch 64 3 366 0821
Darwin 61 8 8919 9777
Geraldton 61 8 9964 2764
Gladstone 61 7 4962 0600
Gold Coast 61 7 5591 7775
Hamilton 64 7 834 1565
Hanoi 84 4976 1282
Ho Chi Minh City 84 8 3910 0288
Hong Kong 852 3664 6888
Jakarta 62 21 5140 2470
Karratha 61 8 9185 6344
Kuala Lumpur 60 3 2164 7301
Lithgow 61 2 6351 3750
Mackay 61 7 4951 3500
Maroochydore 61 7 5443 4055
Melbourne 61 3 8683 1333
Mildura 61 3 5022 2766
Morwell 61 3 5116 7205
Nelson 64 3 539 0190
Newcastle 61 2 4941 5415
Paraparaumu 64 4 296 1240
Parramatta 61 2 9890 4100
Perth 61 8 9223 1500
Phnom Penh 855 12 923 248
Port Augusta 61 8 8642 3197
Queenstown 64 3 441 0346
Rangiora 64 3 313 8776
Shanghai 86 21 3313 4750
Singapore 65 6256 6188
Sydney 61 2 9465 5599
Tauranga 64 7 578 6183
Toowoomba 61 7 4632 6249
Townsville 61 7 4772 2858
Traralgon 61 3 5176 0113
Wellington 64 4 472 9589
Whyalla 61 8 8645 5755
Wollongong 61 2 4224 7274

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